

ment may also be poured into a grid, having metallic crossbars which would act as reflectors. Metallic reflectors would have the advantages of high reflectivity, great strength and low maintenance charges; cement would cost less but would require painting to secure high reflectivity.

3. The idea is put forward that roads can be built which will insure high visibility at selected points. One of these points, which constitute the "gleam points," is situated several hundred feet ahead of the driver, where he should first note danger. A second gleam point should be much nearer at the left of the driver at the center line. The light for the gleams is obtained through the suppression and utilization of glare. Other gleams may be used to make the edges of the highway more strikingly visible.

4. Studies have already been made in an echelon formation of reflectors in order to enhance the anti-skidding characteristics of the

highways. This naturally complements the researches already made by the rubber companies on how best to roughen the tire treads in order to secure the best grip to the road and to avoid noise and vibration. Some preliminary results of these studies are reported.

5. The reflectors may be arranged in patterns representing letters or road signs so that they can be easily read by the driver while the car is moving without shifting the eyes from the road.

6. In carrying out the use of signs on the surface of the pavement, it is suggested that good psychology should be used in imparting road information to drivers and passengers as well. The driver needs his information long enough before the appropriate action so that he can consider it in his mind and there will be no indecision when the time for action arrives.

7. Special treatments are briefly considered for crossings, curves, center lines.

REPORT OF COMMITTEE ON ROADSIDE DEVELOPMENT

By H. J. NEALE, *Chairman, Landscape Engineer, Virginia Department of Highways*

SYNOPSIS

We must keep in sight the true objectives of complete highway design. The roadbed and the roadside are inter-dependent factors in a single problem. Streamlined grading, adequate drainage, positive slope protection, and provision for waysides, safety turn-outs, and other essential driver services, must be combined with safe and effective traffic services and structures.

A separate report on War Memorials is sponsored by the Committee as a guide in selection of sites and in design of appropriate memorials on highways and roadside areas. Lasting beauty, traffic service, and easy maintenance must be combined in a good memorial.

The value of aerial photographs for "complete highway" development is also covered in a special report on "Aerial Surveys for New Highways and Road-sides."

Those landscape items considered most essential for complete highway service are listed for inclusion in post-war construction.

The process of developing turf on stabilized soils on airfields in Florida is briefly described. Field tests for establishment of turf on a stabilized base of granular materials on highway shoulders in Indiana are also cited. Such treatment of soil areas has possibilities for widespread use on airfields, flight strips, and road shoulders and other areas subject to occasional traffic use and emergency parking of vehicles.

A "Clearing House" of timely information on roadside development was initiated in 1943. Among others, the need for more efficient equipment for distributing and anchoring mulches to control dust and erosion is pointed out.

Experiments in the use of standard spray equipment to apply fertilizer in liquid form are reported by the Connecticut State Highway Department. The cost of spraying fertilizer on high-cut slopes was found to be about one-half the cost of spreading an equivalent application of dry fertilizer by hand.

The need for the employment of professionally trained landscape engineers in all State highway departments is stressed in order that streamlined grading, adequate drainage, and positive slope protection may be combined with effective traffic service.

The extent to which roadside development is incorporated in highway projects has a direct relation to savings in maintenance costs, to the protection of the highway investment, to traffic safety and driver services, and to adjacent land values. The reports of the Committee on Roadside Development for over a decade have emphasized these basic relationships and the report on Interregional Highways, in referring to roadside development, summarizes it ably in the following excerpt.¹

"Highway design, in the broadest sense, rests upon landscape principles as well as upon the more commonly recognized engineering principles of alignment, profile, grade cross section, roadway and right-of-way width, drainage, and structural strength and durability. A balanced agreement with the two sets of principles characterizes the best design.

"Flattened slopes of excavation and embankment and a well-rounded cross-sectional contour are essential to prevent soil erosion and to minimize the risks of injury and damage when vehicles accidently or unavoidably leave the roadway. They are needful also to mold the highway into the terrain and to make it a harmonious feature of the natural landscape.

"Consideration of landscaping desiderata should pervade all stages of the location, design, and construction of rural sections of the interregional system, and a proper regard for landscape principles in the design will simplify and increase the effectiveness of maintenance processes and lower the cost of adequate upkeep."

These are component factors of the "complete highway" as outlined in our report for 1943. During 1944 the Committee has made intensive studies of some of the more essential

or vital problems that should be of value to all States in preparing postwar highway plans.

War Memorials

Most highway departments will be faced with the problem of selecting appropriate sites for war memorials and then having to construct and perpetually maintain them. In order that the recognized mistakes or errors in judgment that have prevailed in so many instances following previous wars may not be repeated, a thorough study has been made of many different types of memorials now in existence. A separate brochure on this subject has been prepared by a member of the Committee which should serve as a guide in the selection of general types of memorials that are adaptable to roadsides. This special report emphasizes the need for specialized technical supervision of details of design, setting and construction. Such memorials can range in size from a simple setting of a boulder and bronze tablet, or a small grove of trees on the roadside, to a more pretentious wayside or a memorial highway. The more useful the memorial is from a traffic standpoint the more justification there will be to maintain it with highway funds. They should be developed in a dual capacity, to perpetuate most appropriately the memory of those who have so valorously served their country and at the same time they should be contributory to the inalienable rights of pursuit of happiness for future generations. It is hoped that this brochure will help engineers and officials to select the most fitting and appropriate memorials with respect to site location, lay-out and design, usefulness to traffic, and perpetual maintenance cost.

Aerial photographs and surveys

The value of aerial photographs for "complete highway" and roadside design together with a history of aerial photography, with respect to highway location, is covered in a special report prepared by a member of the Committee. One of the main causes of

¹ Page 89, House Document No. 379, January 12, 1944, message from the President of the United States transmitting a Report of the National Interregional Highway Committee Outlining and Recommending a National System of Interregional Highways.

inadequate highway design, including piecemeal and unsatisfactory roadside development, has been the lack of complete topographic data on proposed highway locations with their relation to adjoining lands and land uses. Specific recommendations are made for the use of aerial photographs to obtain the best highway and roadside design from the standpoint of conservation of existing landscape values, economy in grading, adequate drainage, prevention of erosion, and the incorporation of essential traffic and driver services.

Post-war roadside development

A decade of experience gained through the operation of the one per cent roadside development demonstration allotments has proven conclusively that fundamental landscape items involving streamlined grading, drainage, and erosion prevention are indispensable to the protection of the highway investment, to traffic safety, and to the reduction of maintenance costs. Comprehensive roadside development, including safety and scenic turn-outs, waysides or roadside parks, tree planting and related work, is essential for adequate driver services and good highway appearance.

Some States have recognized these values and have made them component parts of highway construction projects. There are some State and highway engineers, however, that still do not consider roadside work as essential construction but more in the light of an acceptable "extra" which may be given consideration if and when funds are available.

In view of the foregoing and of the emphasis given these items in the interregional highway report, it is recommended that all roadside development items involving streamlined grading, drainage, and erosion prevention be made an integral part of highway construction plans, specifications, and estimates and that these items be made a mandatory part of all Federal-aid highway projects. It is further recommended that adequate provision be made in all Federal-aid highway programs for comprehensive roadside development, including items of roadside tree planting, safety and scenic turn-outs, waysides, roadside parks, etc., wherever they are practical and useful for traffic safety and driver service. It is felt that the public appreciates the

practical value of roadside trees and driver services at the present time and in the future they will demand a broader use of them.

The Committee further recommends that the following items should be considered as a part of and paid for as regular construction.

- (1) Salvaging of topsoil, sod, weathered stone, and other landscape materials wherever economically available on a project.
- (2) Salvaging or otherwise protecting or conserving trees and other plant material. This item will include the construction of tree wells and root protection, etc.
- (3) Streamlined earth cross sections and adequate surface and subsurface drainage:
 - (a) Flat cut and fill slopes and transitions
 - (b) Properly rounded slope intersections and end-warpings
 - (c) Adequate design of drainage-ways and gutters
 - (d) Intercepting channels above cut slopes
 - (e) Protection of drainage-ways against erosion at ends of cut slopes, on fills, and at inlets and outlets of pipe, culvert and bridge drains
 - (f) Drop inlets, catch basins, or other special drainage structures
 - (g) Berms or dikes or shoulders of fills
 - (h) Paved roadside gutters, etc., and related treatment.
- (4) Subsurface drainage on shoulders, gutters, and slopes where obviously needed.
- (5) Basic construction such as grading, retaining walls, etc. for safety and scenic turn-outs, waysides or other roadside development.
- (6) Obliteration of abandoned roadways, borrow pits, and structures.

The following items should be included in the original Plans, Specifications and Estimates assembly and preferably performed as part of the initial contract. They should be paid for as a part of normal construction but the work may be done by supplemental contract or by force account immediately

following the initial contract as the State may elect.

- (a) Establishment of turf or other ground cover for dust and erosion control including topsoiling, mulching, fertilizing, seeding, sprigging or sodding
- (b) Planting of vines, shrubs and trees for erosion prevention, traffic control, screen and snowbreak planting, etc.

force account as the State may desire. Such work may include:

1. Selective clearing, roadside clean-up, tree pruning, etc.
2. Development of views and vistas.
3. Final landscape development of safety and scenic turn-outs, waysides, roadside parks, etc.

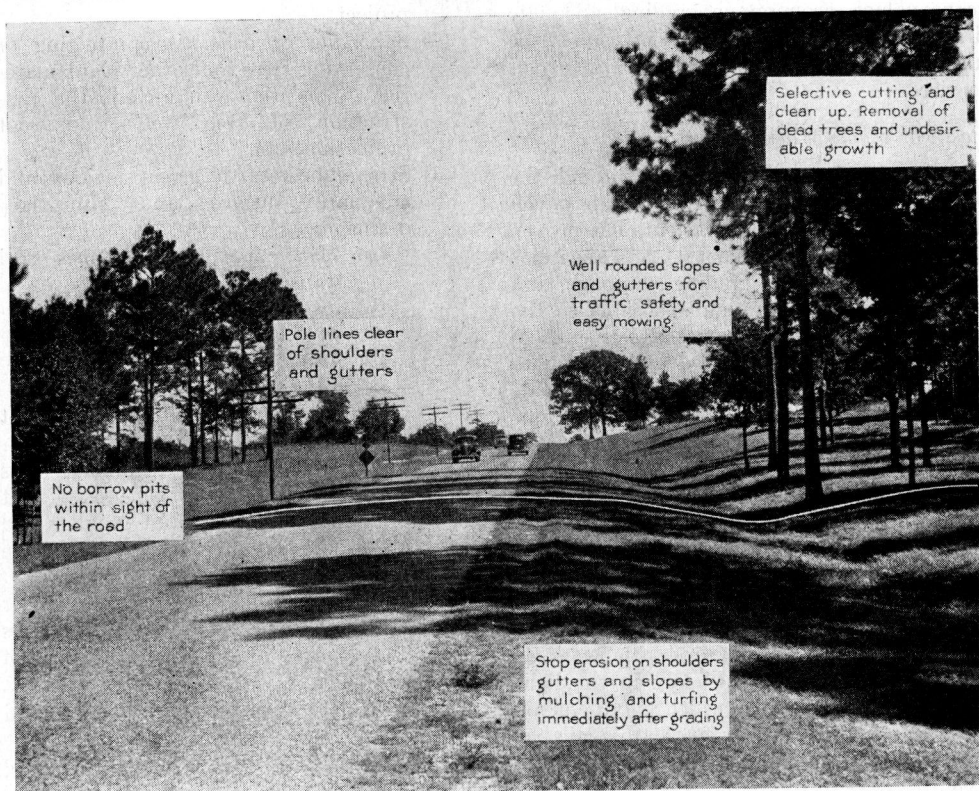


Figure 1. Make adjustments in location to protect, during grading and construction, natural and developed features like stream and lake shores, groves of trees, sites for safety and scenic turnouts, etc.

- (c) Additional landscape work to conserve property and highway values and as may be necessitated by special agreement in the purchase of right-of-way or in damage to private property.

Local conditions may justify other landscape items as being essential to a complete highway development. Funds for these items should be allotted in the original PS&E assembly although the work itself may be done by initial contract, supplemental contract or

4. Planting of shade and flowering trees, etc.
5. Footwalks, paths, and other incidental structures.

TURF CULTURE

The turfing program developed in the Army for the prevention of dust and erosion and for airplane use has further emphasized the need for careful planning and for determination of requirements before construction

operations begin. By far the most costly item in extensive turfing operations is topsoiling. The actual needs for topsoil or any other treatment of the soil on the site should be given careful consideration in view of the end product desired and the availability and costs of local materials needed. In too many instances topsoil is carefully stripped and stockpiled with considerable expenditure of funds and labor before those who are

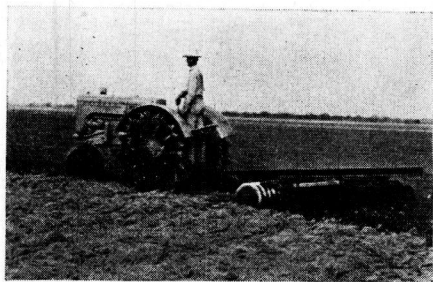


Figure 2. Tillage Prior to Mulching. Offset disc harrows are found to be very satisfactory for most tillage operations.

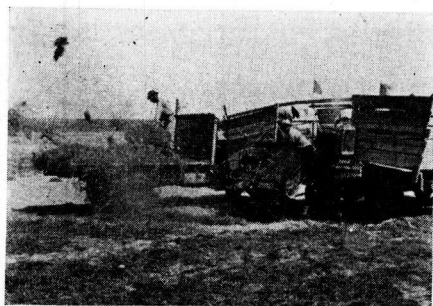


Figure 3. Mulch Distributor in Action. Bunches of hay must be redistributed by pitchfork.

responsible for turfing programs have determined the topsoil needs. There are many instances where topsoil is essential and every effort should be made to save all that can be salvaged from the site. On the other hand there are many instances where excellent stands of turf have been established on subsoil. In some cases the stands of turf on subsoil have been far superior to those that have been produced on topsoil on the same site. There have been cases where good turf has been produced on gravel or poor sand and on stabilized soils without an application of top soil.

The most extensive use of turf on stabilized soil on airfields has been by the Army engineers in the Jacksonville district. The loose sand of Florida is incapable of sustaining traffic especially in dry seasons. Necessary bearing capacity of shoulders and end zones for occasional traffic was provided by admixture of local soil binders with the sand. It was originally planned to treat these stabilized areas with asphalt emulsion or some other chemical dust palliative but after making some tests it was decided to use turf.



Figure 4. View showing dust control affected by mulch in foreground as compared to continued dust on unmulched area in background.

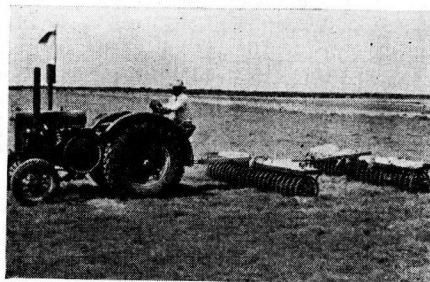


Figure 5. V-type Wheel Land Packer for Anchoring Mulch. Packers are usually pulled singly.

The process of developing these areas was briefly as follows: Limerock (or in a few instances clay or shell) was spread over the graded sand to a uniform depth, usually about 4 in., as determined by tests. This stabilizing agent was thoroughly mixed with the surface sand by a disk harrow with depth control wheels which limit the processing to a minimum depth of 6 in. Sufficient water was added to provide optimum moisture for maximum density. The surface was again graded and the area sprigged with Bermuda-grass, fertilized, and overseeded with a cover

crop such as Sudangrass. Following these operations the area was again watered as needed and then compacted by rubber-tired rollers until the desired compaction was attained. The area was again bladed to remove uneven sections, and then seeded with Bermudagrass seed, followed by a final smooth rolling.

The growth of grass on this stabilized soil was slow at first. After repeated heavy applications of nitrogenous fertilizers a good cover of Bermudagrass was obtained. Other species of grass and weeds generally appear to be discouraged by the stabilization process or materials with the result that the cover is often almost a pure stand of Bermudagrass. The cover of grass produced on these areas

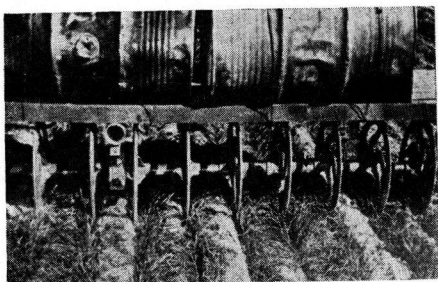


Figure 6. Close-up of V-type Wheel Land Packer Showing Depth of Penetration. Good tillage is essential for satisfactory anchoring.

has proven to be satisfactory for the intended purpose and is produced and maintained at much lower costs than would be required for chemical dust palliatives.

Heavy bombers which have run off pavements onto the areas stabilized and turfed as above have caused little if any rutting of the surface. Fighter planes have used these areas successfully for regular landings and take-offs. Where such use has been excessive the turf, of course, has been injured and in some instances destroyed in limited areas. This treatment of shoulders appears to have possibilities for more extensive use on airfields, flight strips, road shoulders and other areas exposed to occasional traffic by heavy vehicles.

Mulching for immediate control of dust and erosion and as an aid to the establishment of turf has been extensively used on Army installations as it has been used along highways in the past. The extensive acreages involved on airfields as well as the shortage of available

labor have emphasized the need for more efficient equipment for distributing and anchoring mulches.

The method of specifying seed requirements in terms of pure live seed on a basis that permits of more flexibility to seedsmen as developed for Army specifications shown on pages 22 to 25 in the 1943 report by the Committee² has been used extensively during

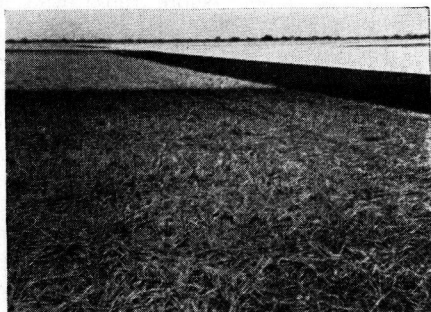


Figure 7. Runway Shoulder Mulched with Mature Rhodesgrass Hay. Note rows of anchored hay.



Figure 8. View Showing Dense Bermuda Grass Turf Clipped Approximately 4 in. High Effectively Controlling Dust and Erosion. Planes can land in formation and taxi on turfed areas like this.

the past year. Except for the usual minor misunderstandings when the change was first made, no difficulty has been reported in the use of the new method of specifying seed requirements and the advantage of the method has become more apparent.

Erosion Prevention and Control

A shortage of personnel in the State highway organizations, coupled with other wartime

² *Roadside Development*, Highway Research Board, 1943.

conditions caused postponement of experimental erosion control work contemplated by the Committee at the beginning of the past year. Some progress has been reported, however, which may be of interest.

Now is the ideal time to examine the results of the highway erosion prevention and control work of past years. We should be thinking now of how to improve old practices and develop new methods to provide information that can be put to use in the post-war highway construction program, with emphasis on mulching practices. For example, the possibility of developing a mechanical means of spreading mulch more easily on steep slopes than by slow hand methods should be investigated as soon as new types of agricultural equipment are available. Since trial operations in Connecticut were reported in the 1942 Committee Report (pp. 23-27)³, the assembled mud jack equipment used for seeding of steep slopes by spraying fluid mixture in one operation at lower cost than conventional separate operations of topsoiling, liming, fertilizing, and sowing of seed has been improved. The outlet hose and nozzle have been reduced to 1½ in. in diameter. Extensive slope seeding was done with this equipment during 1943 and 1944, following mulching by hand methods.

Indiana is following through field tests on highway shoulders aimed to establish turf on a stable all-weather base of granular material. Observations during 1944 indicate that turf will grow on compacted aggregates mixed with clay binder to which liberal quantities of fertilizer have been added. Thorough mixing of aggregate, soil and fertilizer is essential to encourage deep penetration of the grass roots.

The 1939-1943 Report of the Ohio Department of Highways (pp. 26-27) describes modification of "regular" roadside seeding with an improved operation known as "Seeding and Protecting Roadside Areas" which consists of seeding and mulching all of the bare areas along the roadsides and within the right-of-way.

Fertilizer applied in liquid form

In the course of roadside maintenance, it is generally the vegetation on steep slopes

that needs fertilizing the most, and yet on these areas distribution of fertilizer must be by expensive hand methods.

The Connecticut State Highway Department has experimented with the spraying of a solution of Ammonium Nitrate on 2:1 slopes of an average height of 40 ft. A high power sprayer was used with a constant pressure of 250 lb. at the nozzle, and the cost of the spray application was approximately one-half of the cost of hand application of dry fertilizer on adjacent plots at the same time and at the same rates of application. Further trials are contemplated with complete fertilizers in liquid form.

The fertilizer solution caused rather heavy corrosion of the brass parts of the nozzle but the use of plastics may solve this problem. The method is worth further trial.

It is urged that further experiments and field trials be carried on along the described lines.

EDUCATION OF PERSONNEL

One of our greatest needs is improvement in the educational preparation of young landscape architects and engineers for work with the various highway departments.

During 1944 the Committee has continued its investigations into civil engineering and landscape architectural education, with the goal of coordinating the education of students in these two parallel professions to better fit them for roadside development assignments in public works organizations.

This is a period of change and the Committee has found educational institutions in a receptive mood as regards curriculum revision.

The Committee is continuing the study of suggestions from highway departments and colleges along these lines, and will in the near future present definite suggestions regarding revisions of, and additions to, the curricula of institutions offering degrees in civil engineering and landscape architecture.

Following its progressive studies regarding landscape architects in public service, the Committee plans to prepare lists of professional classifications and grades, together with proposed typical qualifications, duties and responsibilities for each grade. These charts may be useful for distribution to State highway departments and Civil Service

³ *Roadside Development*, Highway Research Board, 1942.

Commissions, and should be of value in setting up a landscape design organization in any public agency to carry out highway, roadside, or park landscape development.

"CLEARING HOUSE" INDEX

In order to have a medium of exchange of ideas and discussion of field operations, the Committee started in August 1943 a "Clearing House" of information on roadside development. Four distributions of information were made in 1943 and five distributions were made during 1944.

It is informal in character, and no attempt is made to edit or condense contributions. To eliminate an extensive amount of reproduction, each participant is requested to furnish sufficient copies of his information for the entire mailing list. Most of the material can be mimeographed, so it is no hardship for the contributor to supply sufficient copies. Periodically, contributions of this information on roadside development are assembled and mailed to all on the mailing list, now totaling about 70 names.

An index of the "clearing house" contribution distributed in 1943 and 1944, prepared by Frank H. Brant, Landscape Engineer, North Carolina State Highway and Public Works Commission, follows:

Roadside Development—General

- Roadside Development under Wartime Conditions. (Reports from Texas, Maryland, California, Vermont, South Dakota, Kentucky, Illinois, West Virginia, Rhode Island) (10-5-43)
- Notes on Various Items of Roadside Development (California). (10-5-43)
- Excerpts from "Precautionary Camouflage." (U. S. OCD Publ. 2019, Sept. 1943) (4-25-44)
- Roadside Improvement (Ohio). (1943 report on major roadside improvement operations) (4-25-44)
- Maintenance Manual (Chapter IX—Roadside Development) (Massachusetts) (6-28-44)
- Specifications for Roadside Development (Massachusetts). (Extracts from Standard Specifications) (Loam or Topsoil, Peat Borrow, Seeding, Sodding, General Planting, Transplanting of Trees, Mulching) (6-28-44)
- Report of Meeting of Roadside Improvement Personnel (Ohio). (General notes; papers on Mulching, Sodding, Stream Bank Protection, Roadside Park Design, Office Records and Cost Accounting, Visual Reports, Reporting Office Routine, and Visual Education) (8-21-44)
- Roadside Shelterbelts. (U. S. Forest Service) (10-26-44)
- War Memorials Adaptable to Highway Road-sides (Ohio). (10-26-44)
- Roadside Planting, from *Surveyor and Municipal and County Engineer* (Great Britain). (10-26-44)
- The Beauty of the Road, from *Highways, Bridges and Aerodromes* (Great Britain). (10-26-44)
- Erosion Control (Seeding, Sodding, Mulching, Etc.)*
- Experimental Seeding of Slopes in Connecticut by Pump Method. (8-2-43)
- Soil Paint. (A report on the use of a special asphalt used over seedings as a temporary erosion retardant) (9-1-43)
- Notes on Erosion Control and Roadside Parks (Ohio). (9-1-43)
- Supplemental Specification No. E-305 (Seeding and Protecting Roadway Areas). (Ohio) (9-1-43)
- Hay Spread Along Maryland Road is Declared "unfit for Feed." (Article from *Washington Post*, September 12, 1943) (10-5-43)
- Notes on Various Items of Roadside Development (California). (10-5-43)
- Cooperative Turf Establishment Tests in Connecticut. (10-5-43)
- Grass and Ground Cover Test Plots in Missouri. (10-5-43)
- Slope Erosion Control Treatment (Maryland). (Cross-sectional diagram showing various types of erosion control treatment) (10-5-43)
- Asphalt Mulch for Soil Erosion Control. (Further report on Missouri experiments) (11-10-43)
- Notes on Trial Seedings of *Lespedeza latissima* (North Carolina) (11-10-43)
- Experimental Seeding of Slopes in Connecticut by Pump Method. (Revised and additional report) (3-10-44)
- Excerpts from reply made to a radio commentator in answer to criticisms relative to seeding and mulching programs (Ohio). (3-10-44)
- Wartime Aerodrome Construction in South Africa—The Importance of Turf Grasses. (Abstract of magazine article) (4-25-44)
- Excerpts from "The Effect of Sawdust on Plant Growth." (Michigan Agricultural Experiment Station Bulletin, Aug. 1943.) (4-25-44)

Notes on Roadside Development (Colorado). (Dealing principally with erosion control and mowing.) (4-25-44)

Experimental Application of Liquid Fertilizer (Connecticut). (6-28-44)

Notes on Materials and Practices (Illinois). (Nitrogen-Fixing Bacteria and Legumes; Application of Lime; application of Fertilizer; application of Mulch Material) (6-28-44)

Specifications for Roadside Development (Massachusetts). (Extracts from Standard Specifications) (Loam or Topsoil, Peat Borrow, Seeding, Sodding, General Planting, Transplanting of Trees, Mulching) (6-28-44)

Experiments on Sawdust in Connection with Seeding (North Carolina). (8-21-44)

Report of Meeting of Roadside Improvement Personnel (Ohio). (Including papers on Mulching, Sodding, Stream Bank Protection) (8-21-44)

Seeding Experiments (Missouri). (10-26-44)

Grading Standards

Virginia Adopts New Right-of-Way Widths and Standards for Grading. (Including Standard Sheets CS-6 and CS-7, entitled "Typical Methods of Grading Side Slopes") (9-1-43)

Outdoor Advertising

The Regulation of Outdoor Advertising (Virginia). (Instructions and interpretations in connection with State laws regulating outdoor advertising) (8-2-43)

Right of Way and Easements

Virginia Adopts New Right of Way Widths and Standards for Grading. (Including Standard Sheets CS-6 and CS-7, entitled "Typical Methods of Grading Side Slopes") (10-5-43)

Special Easements for Roadside Improvement (Indiana). (10-26-44)

Special Slope Easements (Ohio). (10-26-44)

Roadside Maintenance

Mowing Operations, and Right-of Way Clean-up (North Carolina). (Instructions and suggestions governing these maintenance operations) (8-2-43)

Roadside Maintenance (Minnesota). (Instructions governing roadside maintenance under wartime restrictions) (9-1-43)

Borax for Weed Control in Missouri. (9-1-43)

Roadside Development Under Wartime Conditions. (Reports from Texas, Maryland,

California, Vermont, South Dakota, Kentucky, Illinois, West Virginia, Rhode Island) (10-5-43)

Notes on Wartime Roadside Maintenance (Missouri). (10-5-43)

Mowing Operations (Maryland). (Memorandum of instructions) (10-5-43)

Description and Illustration of Heavy Duty Brush Cutter (Heavy Mowing Machine). (U. S. Forest Service) (11-10-43)

Berm Drag and Roller (Ohio). (Detail drawings and illustration of a combination drag and roller) (3-10-44)

Maintenance of High Shoulders (Ohio) (3-10-44)

Notes on Roadside Development (Colorado). (Dealing principally with erosion control and mowing) (4-25-44)

Stock Poisoning by Wild Cherry. (Kentucky experience) (4-25-44)

Wartime Roadside Maintenance. (A compilation of information from a large number of states) (4-25-44)

Experimental Application of Liquid Fertilizer (Connecticut). (6-28-44)

Maintenance Manual (Chapter IX—Roadside Development) (Massachusetts) (6-28-44)

Roadside Parks

Notes on Erosion Control and Roadside Parks (Ohio). (9-1-43)

Roadside Parks (Ohio) (Map of locations, attendance record, maintenance costs, and register sheet) (4-25-44)

Report of Meeting of Roadside Improvement Personnel (Ohio). (General notes, including paper on Roadside Park Design) (8-21-44)

War Memorials Adaptable to Highway Road-sides (Ohio). (10-26-44)

Seed Purchase Specifications

Grass Seed Specifications (Virginia). (February 25, 1944) (4-25-44)

Method of Seed Purchase (North Carolina). (6-28-44)

Discussion of Seed Purchase Specifications. (8-21-44)

a—Basis of purity and germination percentages

b—Basis of pure live seed percentage

c—Specifications (Indiana)

d—Specifications (Ohio)

e—Comment from a seed dealer

Seed Purchase Specifications (Iowa). (10-26-44)

Utility Regulation

- Regulating Tree Trimming (Pennsylvania). (Regulations governing trimming and removal of trees on or along state highways) (Including copy of permit form) (11-10-43)
- Regulations Governing Clearing for Construction or Maintenance of Utility Lines Along State Highways in North Carolina. (Adopted by N. C. Utilities Coordinating

Committee) (Also suggestions for clearing practices on utility rights-of-way) (3-10-44)

- Control of Utilities along Highways (Indiana). (Includes copy of law and copies of tree trimming and tree removal permit forms) (4-25-44)

- Regulation of Tree Trimming by Utilities (Kansas). (Including laws and permit forms) (6-28-44)

AERIAL SURVEYS FOR NEW HIGHWAYS AND ROADSIDES

BY WILBUR H. SIMONSON, *Public Roads Administration, Chairman, Subcommittee on Design, Right-of-Way and Border Control Committee on Roadside Development*

SYNOPSIS

The paper outlines use of aerial photographs and maps in locating and designing highway and roadside areas to fit the terrain and to conserve natural and developed features. Tables are included to give a record of progress in highway use of aerial photographic surveys and to show the relationship of map-scales, contour intervals, topography, and land-use in preliminary and final stages of highway location and design. Advantages of aerial survey methods for obtaining complete topographic information on a belt or zone of land are summarized. A list of recent photogrammetric references is included.

In his book, "American Highway Practice," Dr. L. I. Hewes states two principles that may well be kept in mind by locators and designers of every post-war highway. These are first that "the reconnaissance should cover a belt of country rather than a line"¹ and, second, that "better designs result if the line is first studied carefully on paper and the mistakes rectified there."²

The best of possible engineering aids toward carrying out these principles in practice are aerial photographs and aerial survey methods. By combined use of aerial and ground survey methods, complete topographic information on a wide belt of terrain can be obtained at relatively low cost in time and money. Only when complete and accurate topographic information is available, can errors in location be prevented and mistakes that may otherwise be made in design and construction be avoided or rectified in the preliminary stages of highway development. And in the long run, only

when complete topographic information is at hand can highway locators and landscape architects work out simultaneously the highway design requirements for traffic and driver services. Mapped topography is needed to fit new highway locations into the terrain and to design roadway cross sections and roadside areas to conserve natural and developed features in that terrain.

Early beginning of aerial survey methods

The use of aerial highway surveys probably began when a location engineer first flew in an airplane over a proposed route and was quickly able to find control points such as gaps in mountain ranges or edges of bad ground indicating where the best highway location lay. Oblique or vertical photographs taken on these flights recorded such control points so that ground survey crews could be directed to them without loss of time.

Aerial mosaics were next obtained by assembly of two or more overlapping vertical photographs to serve as a map on which to

¹ See Volume 1, page 30.

² See Volume 1, page 39.