

REPORT OF DIVISION I
ON
DESIGN, RIGHT-OF-WAY, AND BORDER CONTROL

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In the annual report by the Chairman of the Committee on Roadside Development, emphasis was placed on the need of harmonizing landscape and engineering principles to obtain advanced designs for COMPLETE HIGHWAYS. Through this medium the present values and future permanency of the public investment in highways may be essentially conserved and protected. To this end, the report of Division I aims to answer the assigned question:

"Is it necessary to start the integration of roadside principles with highway reconnaissance and location for the COMPLETE HIGHWAY? If so, how does this affect design, right-of-way, border control, and wayside development?"

Roadside Design. - In recognition of the fact that highway planning and construction is so directly tied-in with related land-planning questions, a digest of the printed report of the Subcommittee on Roadside Design¹ is presented to show how landscape design in highway development is a coordinate part of the master plan for city, town, or rural region. Bound into this is the growing question of wayside parking and off-road developments to serve as safe and convenient stopping points for traffic that desires to come to a halt. And most pressing of all is the question of adequate right-of-way and border-control protective measures, from the viewpoint of modern traffic and land-use needs.

Landscape Design in Highway Development. - The Master Plan for a city or region deals with the arrangement of land, and facilities and structures for housing, industry, recreation, transportation, and other phases of human life and progress. In making provision for every type of needed development, each in well-planned relation to the other, the circulatory or transport system with its planned network of roads, street, and highways, connects and draws together all the other parts of the city or regional plan. No one part, district, or section of a city or highway can be considered alone. Human needs and desires require both a complete city and a complete highway system designed with all the facilities necessary for the comfort, convenience, and health of the people.

Landscape design in the development of a COMPLETE HIGHWAY has as its objective more efficient and beautiful adaptation of land for human use. Efficiency and beauty are equally served by fitting together the roadbed, shoulders, gutters,

¹ - The complete report by A. R. Nichols, Chairman on Roadside Design, is published in the Proceedings of the Highway Research Board, Vol. 23, p. 258 (1943). Reprints are also available.

slopes, culverts, bridges, and other structures and facilities which make up the COMPLETE HIGHWAY as a whole, with the landscape which lies outside the borders of the highway improvement. This landscape may be man-made as in cities, or natural as in open country. Efficiency and beauty cannot be separated, they are inseparable factors in the design, the location, the construction, or any other phase of either a complete city or a COMPLETE HIGHWAY.

Design of the Complete Highway. - Effective design must be a successful compromise between several factors. The location and design of a COMPLETE HIGHWAY is influenced or controlled by the character, density, and speed of traffic; by topography and soil character; and by the kind of land-use and border development. Thus a well-designed highway must first meet the requirements of traffic. It must also as far as possible "fit the lay of the land", for the more nearly the location, alinement, and profile fit the topography of the route, the greater will be the conservation of trees and streams, the smaller the cost of construction and later maintenance, and the better the natural blending of the highway structure into the city or country surroundings.

Fitting the highway into the surroundings must be considered in original route selection and location. Accurate air survey maps are of the greatest aid in this first stage of complete highway development. Advances in air mapping techniques and equipment are being made by the Air Forces, and after the War air maps and surveys will be available to all highway organizations at a fraction of the time and cost once required to obtain corresponding requisite information regarding topography by ground survey methods. Photogrammetric air maps in the form of corrected mosaics, etc. will be useful for the following purposes:

1. To show a complete picture of the entire route traversed by a highway so that any layman can understand it. In cases of right-of-way and other legal negotiations, airmaps have been of great advantage to all concerned with working out these phases of the problem.
2. Airmaps make possible careful comparative studies and rough cost estimates of several alternate routes without separate ground surveys.
3. Natural features, existing materials, structures, etc., which should be preserved during construction are shown on the original airmap sometimes without the need for further ground reconnaissance.
4. In some cases, right-of-way maps have been prepared from the airmap without the need of crossing or setting stakes on private lands. (See (Canadian) ROADS AND BRIDGES, March, 1943, article by W. J. Fulton, "Three Stage Surveying Procedure for Post-War Road Projects.")
5. Sites for waysides, safety-turnouts, flight strips, and other desirable roadside areas can be selected and acquired in advance of highway location surveys for construction. Once construction begins, it is often too late to acquire necessary lands outside the travelled way at reasonable cost.

6. A study of soil, drainage, and geologic factors of the ground surface, and of existing vegetation, will often enable the location engineer to avoid drainage difficulties, and land slips and slides; and will indicate possible sources of salvage and borrow materials of value in later construction.

Landscape Objectives in Highway Location. - Landscape objectives to be considered in route selection and location of highways include:

1. Avoidance of excessive cut and fill, wherever possible, thereby reducing costs of subsequent landscape treatment and eventual annual maintenance costs of the highway.
2. Selection of sites for wayside development, scenic and safety turnouts, rest areas, flight strips, etc.
3. Conservation and preservation of fine trees, shorelines, streams, and other natural features of the route.
4. Fitting the highway to the 'lay of the land', and taking advantage of existing scenic assets of the route, thus providing not only an efficient highway but also a beautiful one.

All landscape objectives involve careful coordination of the field work of the locating and landscape engineers during reconnaissance and location. Alternate locations should be studied, each possessing certain engineering and landscape advantages. That line which combines the greatest number of the factors favoring both service and beauty will be the logical selection.

Design of the Cross-Section. - The need for flattened, well-rounded cut and fill slopes, as well as for wider traffic lane and shoulder widths, will in the future require greater over-all right-of-way widths than highway organizations heretofore have been willing or able to acquire. Proper cross-section design and adequate right-of-way cannot be separated. In fact, most of the bad cross-section design of past years has been attributable, not to lack of engineering design ability, but to simple lack of the necessary space in which to do good work.

As a rough minimum requirement, it may be said that adequate right-of-way should be obtained on future primary highways to permit the flattening and liberal rounding of slopes up to about 30 ft. in height to a slope ratio of 2:1, wherever topography permits, plus room for proper slope rounding beyond the slope stakes. Cuts and fills of 5 to 7 ft. normally, and preferably up to 10 ft. should be flattened to 4:1. For detailed information on the design of land widths to fit model highway sections, see page 6 of the 1941 and page 14 of the 1942 Report of the Committee.

The advantages of well-flattened and rounded slopes might be repeated here:

1. Greater ease and shorter time interval required for establishment of ground cover vegetation.

2. Reduction or control of erosion because of the reduction of the velocity of surface water flowing over slopes of flatter gradient.
3. Reduction of drifting snow on the travelled way because of streamline effect of flattening and rounding.
4. A safer road when traffic must leave the traffic lanes in an emergency.
5. Opportunity for increased use of machines for mowing, snow removal, and other maintenance in contrast to the hand labor methods required on steep slopes, in V-ditches, and around guard rails.

Adequate cross-section design depends in the final analysis upon ample right-of-way to meet the space requirements of design.

Descriptive data and plans entitled "Design for Transition of Road Slope" were presented by Thomas E. Carpenter, a member of this Committee. (See Appendix IV, page 64 for a digest of this preliminary report.) After general discussion at the meeting this problem of slope ratio control was referred to Division I for further study.

This outline of objectives should be a convenient reference for those interested in studying alternate methods as an aid in expanding the conception of roadside design out of the static of today's typical roadway sections to an appreciation of what may be called the flow of cross-section in its streamlined relationship to natural terrain. Discussion brought out the fundamental point that the only really effective cross-section grading is that which is incorporated in the original construction.

Design of Grading Plans. - The monotonous and rigid appearance of angular railroad-type cross-sections can be relieved to some extent by rounding and flattening slope intersections, and by warping ends of cuts and fills to present an appearance of ground slope surfaces as found in nature.

Detailed grading plans should be prepared for the ground surfaces near, and closely related to, major highway structures and facilities, and developed roadside areas. Both original and proposed new contours should be indicated on such grading plan sheets. Calculation of grading yardage from original and new contours is entirely practicable, and the grading plan method may be found of advantage over certain primary highways, as in the case of the Mount Vernon Memorial Highway, and a number of other outstanding highways in Metropolitan Areas. Complete plan information of this kind for major construction is insurance that the finished product of construction will be of adequate quality and of public satisfaction. It is a tremendous aid in avoiding resort to field change orders in the work of construction. Field work, once begun, is less likely to be interrupted by emergency change orders where advance grading plans are used as a check on the complete design before contract construction begins.

Design of Complete Highways as a Part of Regional Design. - The trend toward de-centralization of populations will continue to have an impact upon regional highway design, and location. Landscape design has its part to play in most of the aspects of highway development to be carried forward in harmony with the master plan of a city or region. Provision for development of space on highways, air-fields, parks and parking areas, will continue to require the joint application of landscape and engineering principles. The better these principles are integrated in the layout of land for human use, comfort, convenience, and health, the more efficient and pleasing will be the whole regional or city master plan, and the COMPLETE HIGHWAY as a part of that plan.

Chicago - A Leader in City Planning. - Two historic events of outstanding importance to highway and city planners responsible for the development of COMPLETE HIGHWAYS appeared to be significant at the jointly held Chicago meeting of the Highway Research Board and the American Association of State Highway Officials. The first comprehensive demonstration in the United States of a unified conception and execution of plan as a complete development dates back 50 years to the Chicago World's Fair of 1893. Following the World's Fair, particularly during the first decade of this century, several American cities had obtained the services of consultants to study the over-all problems of city growth, and had their city plans published. The most famous of these was the City Plan of Chicago, initiated by the Members of the Commerce Club and the Merchant's Association. Chicago has been a pioneer in creating the conception of city planning as we know it today.

With the growth in the scale of the planning concept from the city -- to the metropolitan -- to the regional area, and with the wartime demand for speed in the planning and execution of needed construction work, it was most fitting and opportune for the Highway Research Board to schedule on the general program the timely subject "Aerial Mapping Used in Regional Highway Planning".¹

In the Metropolitan Region of Chicago, unusual teamwork in planning practice has been established, especially in the highway transport field. Many public highway officials have collaborated in programming, planning, and scheduling highway and street construction work. The large number of municipalities which almost completely ring and radiate from the central City of Chicago, the 15 near-in counties (3 in Indiana, 3 in Wisconsin, and 9 in Illinois) and the 3 States themselves with Public Roads Administration aid have carried forward a well-integrated program for the past 13 years or more.

Well-ordered Roadside. - Past reports of this Committee have repeatedly emphasized the need for orderly development of the roadsides along public highways. It is of mutual importance to both public and private property development that roadside values be appreciated by beneficial development and not depreciated by pernicious exploitation. Planning, including zoning, furnishes an intelligent and effective method of regulating land-use and building development along the roadsides so as to prevent and reduce those uses which are detrimental to the

¹ - Proceedings, Highway Research Board, Volume 23, p. 555 (1943).

public welfare and safety. Planning and development of the COMPLETE HIGHWAY requires that roadside service facilities like filling stations, restaurants, etc., be placed in their proper locations as an integral part of the whole construction.

Roadside Service Development and Limited-Access Highways. - There is every indication that limited-access highways will be constructed in the vicinity of the larger cities of all regions after the war. Such highways carry heavy concentrations of traffic, and, under these conditions, the need for orderly development of roadside service facilities becomes acute. Too many of our finest highways in past years have been ruined as safe, effective traffic arteries, by haphazard private construction of hot-dog stands, gasoline stations, and temporary business establishments of all kinds.

Experience indicates that there are several solutions of the roadside service development problem:

1. On some limited-access highways, public authorities have erected gasoline stations and other roadside service structures to be leased to the highest bidder.
2. In other cases, oil companies, for example, have been allotted concessions at designed-turnout points where privately-owned service facilities have been erected.
3. A third solution lies in provision for access to land areas on service roads or on important roads crossing the main limited-access highway. Where the plans provide such access, private business interests are encouraged to take the initiative in the development of whatever roadside services appear to be needed on the designated area.

The Committee believes that research will be needed to determine the best principles governing roadside service problems. Authoritative standards for location and design of entrance and exit driveways are needed. Whether publicly or privately owned, roadside service developments and their approaches require the effective application of correct principles in order to produce a uniformly efficient and safe highway development. Certainly, bordering land development should be in harmony with other parts of the highway design. No interference with traffic safety, such as now occurs where ribbon development has taken place, can be tolerated. Politics must be kept out of the layout of access road space, or all the many advantages of limited-access may be lost. Even the development of roadside service buildings to produce revenue, to be applied to maintenance and other annual highway expense, must be critically analyzed by the designer. In any case, suitable control procedures must be mutually worked out from the administrative and legislative as well as the design standpoints. Traffic safety and convenience, and the protection of bordering land values must be considered paramount against all other conflicting factors.

Experience would appear to indicate that:

1. Commercial roadside facilities should not be needed on limited access highways passing through towns and cities where ample entrance and exit facilities

are provided to existing roadside services, or to service roads on which space is available for private development of such services. In the interests of safety and efficient operation, motorists will have every opportunity to leave the express routes and obtain gasoline, food, sleeping quarters, or any other commercial service from existing urban facilities, or from such added facilities private firms may feel can be profitably established outside the highway right-of-way on the local service roads provided.

2. Where long stretches of expressway go through rural areas not already provided with services, safely designed access roads will be required to serve gasoline stations, restaurants and overnight accommodations built by private owners on land outside of the publicly-controlled right-of-way. Every opportunity and encouragement should be given to private service companies, but if these are unwilling to take necessary financial risks under the above conditions, the public authority may be forced to establish its own gasoline, food, and overnight facilities. Such services as may be found essential to traffic needs will usually be operated by private concessionaires.

3. Highway officials should not be expected to build access roads and driveways across roadsides of limited-access highways wherever land owners desire to set up a hotel, a gas station, or other service. Such haphazard action leads straight to ribbon development. Instead, the needs of the tourist, the trucker, and the bus driver and passengers, must be met by an impartial and reasonable design policy with standards set up after careful deliberation and held to by highway authorities without fear or favor.

Unless such standards of design policy are established in advance of the coming era of "freeway" construction, unsound pressure from both private and public sources may thwart the whole purpose of the limited-access principle. This principle requires that the expressway development be worked out as a single COMPLETE HIGHWAY design problem of many parts, all fitted together in relation to surrounding land-use and traffic safety and service needs.

Comprehensive design of this over-all character calls for equally broad legislative authority for administrative action. Intensive research into all related phases of this pressing problem must find practical solutions so that the ability of the designer to meet traffic requirements will not be unduly restricted or prohibited. To meet the new problems that will have to be faced in postwar development and to make the designs of the COMPLETE HIGHWAY effective and long-lasting, special studies of major elements of limited-access legislation and administration are needed.

Right-of-Way and Border Control of Highways. - This note¹ will assume that road building will be a major enterprise after the war, that old roads will be widened

¹ - Report of Subcommittee on Right-of-Way and Border Control, by Flavel Shurtleff, Chairman.

and new roads built, and that for greater efficiency, safety and attractiveness, all roads in the state system of highways will need far more protection against wrong uses of bordering private lands. On new and widened roads, border control should be written into the plan of the improvement and should influence highway design and the acquisition of land for the right-of-way. On old roads, more effective border control methods should be worked out.

In the freeway or limited-access highway legislation passed in the last seven years in seventeen States,* there is much promise, but not a complete answer to the border control problem even if the ambiguities of the new laws are removed and improved bills are enacted into law.** Although the States secure wide rights-of-way (not less than 200 feet) for new principal routes, shut off quite generally access from private land, build and operate (or lease) a chain of structures adequate to serve highway travel practically monopolizing this type of business, there will still be uses of private property which should be guarded against. These are not limited to wrongly located outdoor advertising signs which need no access to the highway. They include a variety of business uses which are poor neighbors to the highway and which can be well-served by local roads.

Zoning of the State highway corridors has been much discussed as a desirable supplement to control through limited access on new roads, and as an essential on old roads where widening is out of the question because of expense. The merit of control by zoning is sufficiently demonstrated. To cite an outstanding example, the Merritt Parkway in Connecticut runs for thirty-five miles through land admirably suited for residential development which has been zoned for residence in each of the seven towns along the route. The only exception is a clearly indicated business area which is so zoned, and this is limited to a few hundred yards.

But the Merritt Parkway presents an unusual situation. Zoning along the route antedated by several years the construction of the road. Usually towns are asked to apply zoning to a long used and often intensively developed road, and either reject zoning completely or adopt an ordinance so burdened with compromises as to nullify its usefulness. A State highway route even in rural areas is looked upon as potential business frontage and is so zoned. The result is an ill-assorted development of unprofitable and temporary business structures. To avoid the spot-tiness which is inevitable when zoning is left to towns and cities several national organizations, notably the American Automobile Association, the American Association of State Highway Officials and the American Planning and Civic Association, recommend zoning of State highway corridors by a State agency. Apparently the Outdoor Advertising Association of America, Inc., joined in this recommendation. In a statement of policy adopted at its Forty-third Annual Meeting in Louisville in 1933 is the following paragraph:

* New York, Rhode Island, Connecticut, California, Maine, West Virginia, Maryland, Michigan, Ohio, Colorado, Virginia, Louisiana, New Hampshire, Florida, Texas, Massachusetts, Illinois.

** See model bill for limited-access highway legislation in General Administrative Memorandum 214 - March 19, 1943 of Federal Commissioner of Public Roads Administration.

"The application of the principle of zoning resulting from the study and analysis of land use and State planning by an over-all agency should result in the orderly and appropriate development of business and commerce with due regard for the convenience and general welfare of rural residents and the traveling public in rural areas, as well as the future growth and development of business and commerce throughout the State consistent with the conservation of the natural beauties of rural landscape."

For the last four legislative sessions there has been organized effort in several States to adopt State zoning of highways, but no matter how narrow the strip to be zoned, the opposition in the legislature has been solid to State interference with local rights of government.

Consequently while advocating State zoning as essential for all roads in the State system, this report would make a further recommendation for new routes, and raise a question as to the method of applying zoning on old routes.

The recommendation is that as soon as the right-of-way for new or widened routes is determined, a zoning plan should be adopted by the highway department for a protected highway area of necessarily varying width but averaging 1500 feet. This zoning plan should be an integral part of the general highway plan.

Instead of waiting for legislative approval of the highway zoning plan or for adoption of sections of it by the localities along the routes, the use of all private property in the protected area should be restricted in accordance with the zoning plan at the time that the land is acquired by the State for the highway routes and as a part of the land transaction. Each deed to the State would recite that the land left in private ownership within the protected area could be used only for agricultural or residential purposes except as the zoning plan permitted other uses. There is precedent for the purchase or taking of such rights in land in the practice of State highway and parkway departments. This practice has the advantage of permanence as against the too great flexibility of zoning ordinances and their administration.

The question is whether on old routes it is best to persevere in a campaign of education in the hope eventually of winning from the legislature a grant of complete power to the highway department to zone the highway corridors, or to win immediately a more limited right.

Some of the limitations suggested on the highway department's right to zone are:

1. The highway department may adopt a comprehensive zoning plan; but this plan shall not become binding in any community until locally approved.
2. The highway department zoning plan shall become binding on all localities which have not during a grace period of three years adopted their own zoning plan.

3. The highway department shall have jurisdiction in zoning only in non-urban localities, i.e., under 2500 in population.

All these suggestions have obvious defects and very likely any limitation on comprehensive zoning by the highway department which would be acceptable to the legislators who represent communities jealous of their local rights would be equally objectionable. Is it possible that experience in some States with a more limited zoning right may speed the full grant of power?

Resume of Discussion following presentation of Mr. Shurtleff's Report: All agree that some form of border control is essential to the protection of highway investments, but so far as we have been unable to find a means for such protection on a State-wide basis. Many of our present highway entrances into towns and cities will have to be abandoned because they have become too congested owing to business encroachments. If we are to safeguard our new entrances, then some form of highway protection must be provided in the beginning of the development.

Zoning of Highway Corridors. - One proposal was that a municipal contract provide that a zoning plan be adopted and submitted as part of a project agreement. In each of the alternate methods discussed, the question of stipulating a fixed width of corridor, or merely that the borders be zoned, seemed to resolve itself into being a practical problem of eliminating opposition to any protective plan in a given locality. Considering the fact that the city does not have the legal right to zone outside the limits of the municipality, zoning seems to lack the comprehensive qualities needed, especially on limited-access highways. Zoning does not compensate the property owner for any loss of land-use. Zoning to protect rural areas has been done in California Counties, and in Wisconsin.

The use of highway development rights offers some promise. For instance, the farmer would retain his right to use the land as he sees fit provided the use was agricultural, but he could not install permanent structures within a certain agreed distance necessary for future road widening. The economic advantage in this would be that when the highway needs such widening, no structures would be affected.

In cities, a somewhat similar building set-back procedure has been used successfully, as in the City of Washington in the 16th and K street widenings. In this case, however, the full width of highway land is owned by the District of Columbia, which gives the private property owners certain use of the roadside space reserved for future expansion of the highway. Such allowed use must be in conformity with the planned requirements set up by the city officials.

Municipal zoning in Chicago provides for set-back lines in streets. In 1935, counties were permitted to zone. All land-use is now zoned on a county-wide basis. Metropolitan Chicago Counties in Illinois, Indiana and Wisconsin, have the power to zone land within a stated-width of the center-lines of highways. Cities cannot zone outside municipal limits under the law as now existing. State-wide zoning has been proposed in Indiana, with the State Planning Commission to have power to administer, but this proposed legislation failed of passage.

The principle of highway development rights looks practicable under existing rights of eminent domain. Set-back regulations may also be legal under present zoning laws of five counties in the Chicago area. McHenry and Lake County laws are now coming up before legislatures. Because land-use controls such as zoning, stem from the police power of the State, they can never constitute a permanent, over-all solution to the problem of ribbon development. Intensive study of these questions of land-use regulation is needed to harmonize modern traffic requirements with roadside development.

Land acquisition policy and performance must facilitate land assembly at the minimum total cost, with a maximum of speed. Another significant field of investigation is the public control of highway access and adjacent areas.

In recognition of the many and complex problems involved in the right-of-way and border-control phases of COMPLETE HIGHWAY development, the Public Roads Administration in 1943 issued two timely bulletins comprehensive in scope:

**PUBLIC LAND ACQUISITION FOR HIGHWAY PURPOSES, and
PUBLIC CONTROL OF HIGHWAY ACCESS AND ROADSIDE DEVELOPMENT**

(For sale by the Superintendent of Documents, U. S. Government Printing Office, Washington, D. C. at 10 and 15 cents each respectively.)