REPORT OF SUBCOMMITTEE ON ROADSIDE DESIGN

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SYNOPSIS

In the master plan of a city or region, the highway system forming the network of traffic arteries, ties all the other parts of the plan together. Just as the highway system must be complete to adequately serve the region or city, so should each highway be complete in order to provide complete traffic and driver service along its route.

Factors which control the location and design of every highway include the character, density, and speed of traffic; topography; soil character, local land-use, etc. Topography is the most important factor in location To fit the highway to the topography, it is essential that two or three or more alternative routes be studied, preferably by air survey and photogrammetric methods By no other means can the designer obtain accurate topographic information in so short a time

The streamlined cross-section is a necessary part of complete highway design. It improves appearance, and increases both safety and traffic service The streamlined section also facilitates the growth of vegetation, and lowers costs of machine mowing and snow removal

Plans for the *complete highway* will consider the requirements of both route and region as regards air, rail, and water transportation, terminal and roadside parking, prevailing land-use, and wayside development in general

Horizontal rather than vertical expansion of our cities is anticipated following the War The planning and design of the complete highway must provide these broader elements of space for the anticipated spread of cities The Sub-Committee on Roadside Design recognizes an increasing trend toward these broader elements of space in the planning program This principle will show itself in the need for more highways of the well-located, well-designed freeway type A brief comparison is presented of the advantages of the *complete highway* over an ordinary highway.

HIGHWAY LANDSCAPE DESIGN A COORDINATING PART OF THE MASTER PLAN DESIGN

The Subcommittee on Roadside Design has given continual emphasis to the fact that effective roadside development is an integral part of the complete highway As such, it must be designed as part of the total and not something applied as decorative or non-essential to the utilitarian design If the highway is to be what we shall call a *complete highway* not only will its parts be well designed, but the design will carefully fit together the surfaced road bed, shoulders, gutters, slopes, bridges, culverts and other structures on and off the right of way The design of the *complete highway* will consider both traffic and land use problems. For example, in the urban section the highway design must carefully balance traffic needs with the necessity for access and egress to and from residential, commercial and recreational areas, whereas in the rural section similar coordination of traffic with land use is essential to make a complete highway. The design must give due consideration to such land use details as to make provision for stock underpasses where it becomes necessary for the alignment to cut farm areas Springs, wells and water supply in general must be carefully considered in highway location and construction Fine river or lake shores, and groves of trees will be conserved for the future generations who will travel the road and live by it The complete highway will provide service for housing, industry, business and shopping districts, major park areas as well as neighborhood parks and play grounds within the metropolitan areas and will make suitable service connections with the smaller communities, agricultural areas and regional recreational and scenic developments

No one part of the master plan of the city or of the highway can be considered alone Highway landscape design has as its objective. the development of the highway as a whole complete unit planned as a part of the country landscape or of the urban improvements.

DESIGN OF THE COMPLETE HIGHWAY

Topography a major control

There are many factors which control the location and design of every highway. These include the character, density, and speed of traffic, the topography, soil character; local industry, land use; etc Of these factors, topography is one of the most important The form of the surface of the land, the locations of rivers and the tops of ridges, the location of urban features such as industrial plants, freight depots, air fields, etc , are all inter-dependent factors to which roads must be fitted

It is essential that the highway be adequately designed for traffic capacity, speed, volume, safety, etc It is equally essential that the highway fit "the lay of the land" Otherwise, construction scars will be costly to heal; ditches and gutters will need continual cleaning because of erosion, snow removal, mowing and other maintenance will be costly and unsatisfactory With the *complete highway* as an objective, its relation to the land as created by nature is fundamental Topography is, therefore, the key The more nearly the location, alignment and profile adheres to the natural topography, the greater the conservation of existing trees, the greater the degree of safety and the greater the naturalness of the blending from construction into the countryside Consideration of these factors in the design may result in the introduction of flat curvature in place of long tangents and the variation in profile within certain governing limitations meeting engineering requirements.

Air Surveys as an aid in basic considerations

Aerial photography and aerial surveys have more and more become a valuable aid in the design studies of the complete highway

The development of the science of photogrammetry has made it possible to obtain accurate topographic maps from air surveys. Army air forces are developing new photographic and mapping equipment which have already rendered ground preliminary survey and reconnaissance methods of a decade ago obsolete In a day of clear weather, a whole highway route over a strip a half mile or more wide and several miles long can be pictured The results obtained are comparable in many respects to a ground contour survey requiring weeks or months of field work by crews of transit or planetable men.

Highway engineers making reconnaissance and development studies will have available much new equipment after the war.

Even the old uncompensated mosaic air maps of the 1930's had the following advantages

1. To the highway administrator with his limited time for technical details, the air surveys reveal the broad picture of the area involved and gives him cognizance of the problem as a whole without the necessity of consideration of details

2 To the location construction engineer a more thorough investigation of location is possible by means of the aerial surveys. The physical conditions are revealed sufficiently to enable him to study the general line desired to serve the traffic direction with minimum cost.

3. To the design engineer, the air maps provide a foundation picture upon which may be drawn to scale the general alignment of the proposed highway. It also makes possible the sketching of alternate routes and the making of reasonable cost comparisons.

4 To the landscape engineer, air surveys and photogrammetric maps reveal existing waterways, timber growth, and outstanding viewpoints to be conserved during construction, together with sites for waysides, turnouts, flight strips and other desirable development which would properly be integrated with original highway construction

5 To the right-of-way engineer airmaps will mean a great saving of time in his preliminary work because of the facility with which proposed acquisition can be related to the character of land, its use, and the structures thereon. Right-of-way maps can in many cases be prepared without crossing or setting stakes on lands to be acquired.

LOCATION ITS RELATION TO LANDSCAPE OBJECTIVES

The importance and the use of air surveys in the preliminary stage of design of location having thus been recognized, it is advantageous to consider what landscape objectives are sought with respect to the determination of a good centre line location There should be coupled with the essential engineering requirements a location fulfilling the following landscape objectives

1. Avoidance of excessive cuts and fills where possible, thus reducing the cost of landscape treatment and of annual highway maintenance.

2. Utilization of sites suitable for wayside parks, airfields, scenic outlooks and proper access to these and other recreational areas.

3. The conservation of existing vegetation and trees, shorelines, and other landscape features to the extent consistent with the engineering requirements.

4. The taking of full advantage of the natural lay of the land and of existing scenery within its range.

The use of the *complete highway* is essentially both utilitarian and for pleasure. The location must therefore give both of these functions in due consideration. It is probable that the use of the highways for pleasure will greatly increase in the post-war period and in normal peace times.

All these landscape objectives involve careful coordination of work of the engineer and the landscape architect during preliminary reconnaissance, in order that the most practical general route may be determined, taking advantage of the specific scenic factors that would enhance the ultimate solution. The utilitarian objectives might logically influence the design to determine a route somewhat shorter in distance or possibly of less difficult construction. However, the landscape objective might justify a somewhat longer route or a more difficult construction, if the scenic values seemed to the engineer and the landscape architect to offset the financial difference. This objective dictates a careful study of such opportunities as locating the route so a commanding view would make a lasting impression upon the traveling public (Figs. 1 and 2).

DESIGN OF THE CROSS SECTION

In the design of the cross section of a given highway, the conditions governing widths of pavement lanes and width of shoulder have caused an overall increase in the lateral distance needed for these elements Recognition of the desirability of flatter fill slopes and flatter backslopes has similarly resulted in greater width needed in the general grading operations

Unfortunately, recognition of this need for greater width in pavements, shoulders and slopes has not always been considered as synonymous with the need for greater width in right of way. The result has been that slopes have not been flattened as much as seems desirable and the purpose of blending construction into natural topography has been defeated.

The general principles applying to the cross section as formulated in the 1941 Report of the Committee on Roadside Development are a most valuable guide to the desirable cut and fill slopes in relation to various classes of topography. These diagrams indicate the desirability of 4:1 slopes where the height of cut or fill is 5 ft. or less and preferably up to 10 ft.; 2:1 from 10 ft. to 20 or 30 ft. and 1½:1 only where it is necessary to have a cut or fill exceeding 30 ft.

The streamlined section with the flatter slopes has proven its value for the following reasons.

1. Greater ease in establishing vegetation and thus:

2. Reducing the extent of soil erosion.

3. Reduction of snow drifting as evidenced where angular breaks in slopes are avoided.

4. Greater safety at high speeds of travel.

5 Reduction in cost of maintenance, since the streamlined section and flat slopes can be maintained by machine, whereas the steeper slopes require much hand work and cause gutter clogging

All of these factors point to the one conclusion that for ample space for traffic movement coupled with desirable shoulder width and streamlined section giving safety and economy of maintenance as well as improved appearance, a liberal width of right of way is essential.

We recommend the continuance of this emphasis upon the necessity of liberal right of way. More latitude in this direction will make possible better design and better highway service at lower annual cost

DESIGN OF GRADING PLANS AND DETAILS

As an inheritance from the practice of railway engineering, most highway departments rely upon typical cross sections in the design of grading adjacent to highway construction operations. This method has facilitated the calculation of end areas and of volume between stations, but has resulted in a mechanical uniformity in fill slopes and backslopes that is definitely artificial in appearance. A partial remedy to this uniformity of backslope has been accomplished where the slope has been flattened and warped as the depth of cut decreases at each end of the cut area.

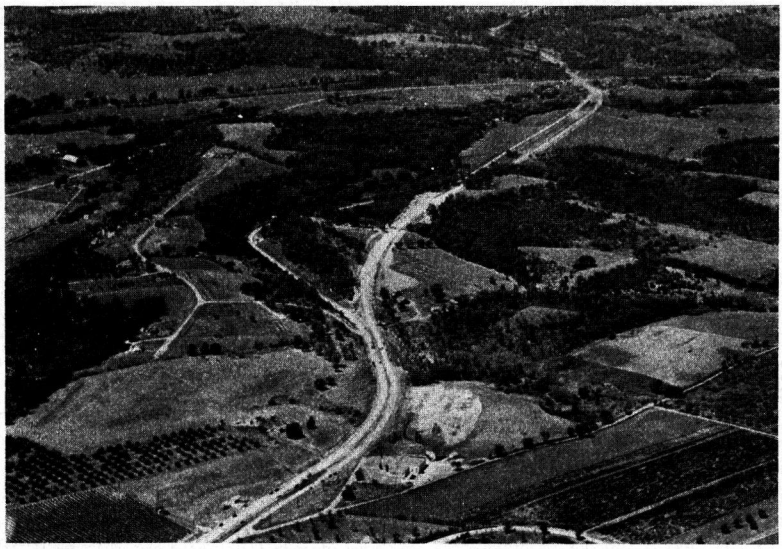

Figure 1. Aerial photographic surveys reveal areas of timber growth, types of land-use, and topographic features governing the location of alternative routes, together with sites for waysides, safety-turnouts, flight strips, and other developments to be integrated with original construction of a complete highway.

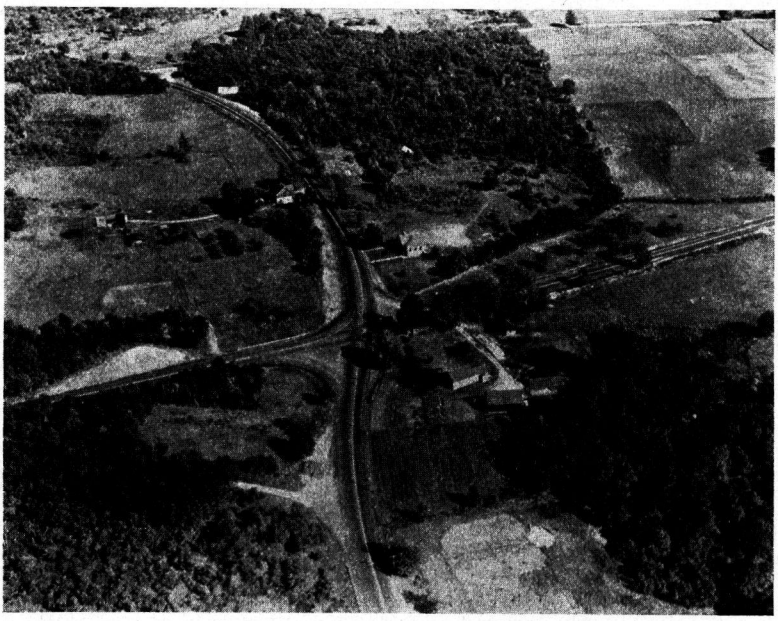

Figure 2. Aerial photographs indicate the character of land and the location of structures on it in relation to proposed acquisition of highway right-of-way.

Although not now commonly practiced, the Subcommittee on Roadside Design believes that the preparation of detail grading plans based upon contour maps of the area involved, should be prepared for all major structures and their adjacent ground surfaces. Such grading

plans, indicating the relation of proposed contours to existing contours, would make possible a more pleasing blending of construction into the natural terrain and would avoid the tendency now predominant toward mechanical uniformity.

Grading design of this nature is particularly important at special areas of development, as at grade separations, bridges, safety turnouts, parking spaces, terminal developments, etc. Complete plan information of this kind is insurance that the finished product of construction will be of adequate quality and of public satisfaction

The desirability of cross sections for calculations and field purposes would continue to apply to the normal highway construction. The preparation of grading plans as described would be particularly applicable to the special areas referred to, and would be a forward step in the attainment of the *complete highway*.

DESIGN OF COMPLETE HIGHWAY AN INTEGRAL PART OF METROPOLITAN AND REGIONAL PLAN

The design of the *complete highway* must take into consideration all the ramifications of the many types of rural and urban land-use which form the background of the regional or metropolitan master plan Local roads, express highways and freeways, and their satellite parking facilities, waysides, flight strips, etc , are all to be given a place in the designing of a system of *complete highways*

The development of Air transportation will be a major factor in *complete highway* design after the war. Mr Stanton, Administrator of the Civil Aeronautics Administration, predicts the establishment of an airport in every community of 1,000 population or over and a system of airports for the metropolitan areas These airports must be served from the heart of the cities, which brings an important element into the highway planning program Suitable routes between airport and downtown terminals become a part of the general arterial pattern of the complete highway

The location of terminals and off-street parking developments is another important factor in the complete highway design. Mr. Wilbur H. Simonson, Senior Landscape Architect, Public Roads Administration, in his paper presented at the Citizens Conference on Planning, gives emphasis to this broad interchange of planning objectives. He states "Off street parking and terminal developments and interconnections to airports and railroads will need to be integrated with post-war highway construction Metropolitan highways and arterial street net works will also need to be modernized and coordinated with large scale post-war housing developments The effective realization of these needs in cities calls for closer working relations between highway engineers and city and town planners in order to fit the traffic requirements into the pattern of urban growth planned for each municipality."

Housing and civic planning of the so called downtown areas are other factors closely related to the design of the *complete highway*. Decentralization and the establishment of the neighborhood units automatically effects the highway pattern and should result from a carefully analyzed development plan There will always be necessary the central downtown business and shopping district with the grouping of public and semi-public buildings. The relation of this development, however, to space whether that space be designated as park or parking is fundamental in its benefit or harm to the economic and functional use of the land.

There is a strong belief that in the postwar era, horizontal expansion of the city is to replace the tendency toward vertical expansion With respect to the so called "sky-scrapers," Mr. Herbert Nelson, Vice President of the National Association of Real Estate Boards, states "High buildings do not pay. You may be surprised to know that there are only about 500 buildings in the United States of 20 stories or more in height and these 500 buildings make a story of complete financial disaster "

If this statement is correct, our planning and design of the *complete highway* must provide these broader elements of space for the anticipated spread of the development and provision for areas needed for parks, parking, air and light

SUMMARY

The Subcommittee on Roadside Design recognizes an increasing trend toward broader elements of space in the planning program This principle will show itself in the necessity for more highways of the well located, well

designed freeway type. It would be well, therefore, to summarize the advantages of such a freeway

1. The *freeway* has adequate right of way thus providing for all the elements of space required in safe movement of traffic.

2 The freeway, or other complete highway, includes adequate border control.

3 The freeway, or other complete highway, includes in the design so called streamlined slopes and gutters, thus facilitating maintenance at low cost and improved appearance.

4. The freeway, or other complete highway, is designed so that its treatment is in harmonious relation to adjoining land use.

5. The freeway, or other complete highway, in its location and design makes provision for easy access to recreational and scenic areas.

All these factors and the trend toward horizontal expansion in the physical development of cities demand scientific planning for the anticipated traffic growth and involves the providing of broad approaches to the cities, the establishment of express highways through the cities, and the construction of belt lines for the distribution of traffic around the more congested areas.

Advance designs meeting the requirements of the Defense Highway Act of 1941 make possible plans for post-war construction which will logically have this objective of a complete highway meeting the ultimate traffic needs with due consideration being given to the basic qualities defined in the Committee Report, namely utility, economy, safety and beauty

There is little doubt in the minds of those concerned with the future welfare of our country, that once the war is won, an essential step in winning the peace and avoiding the mistakes of the past, will be the reconstruction of our cities and the scientific planning and re-construction of the transportation system serving these centers.

Congestion, obsolescence and decay must give way to light, air, orderliness and adequate environments This can be accomplished only by scientific planning and scientific planning can only result where the research necessary for master plan development broadens to the complete city and the regional area served by a complete transportation system.

The design of the *complete highway* is thus far reaching and involves coordination of traffic needs with scenic and aesthetic values Completeness is only resultant from design and design must aim to fulfill not only utilitarian needs but to incorporate beauty in its structure.