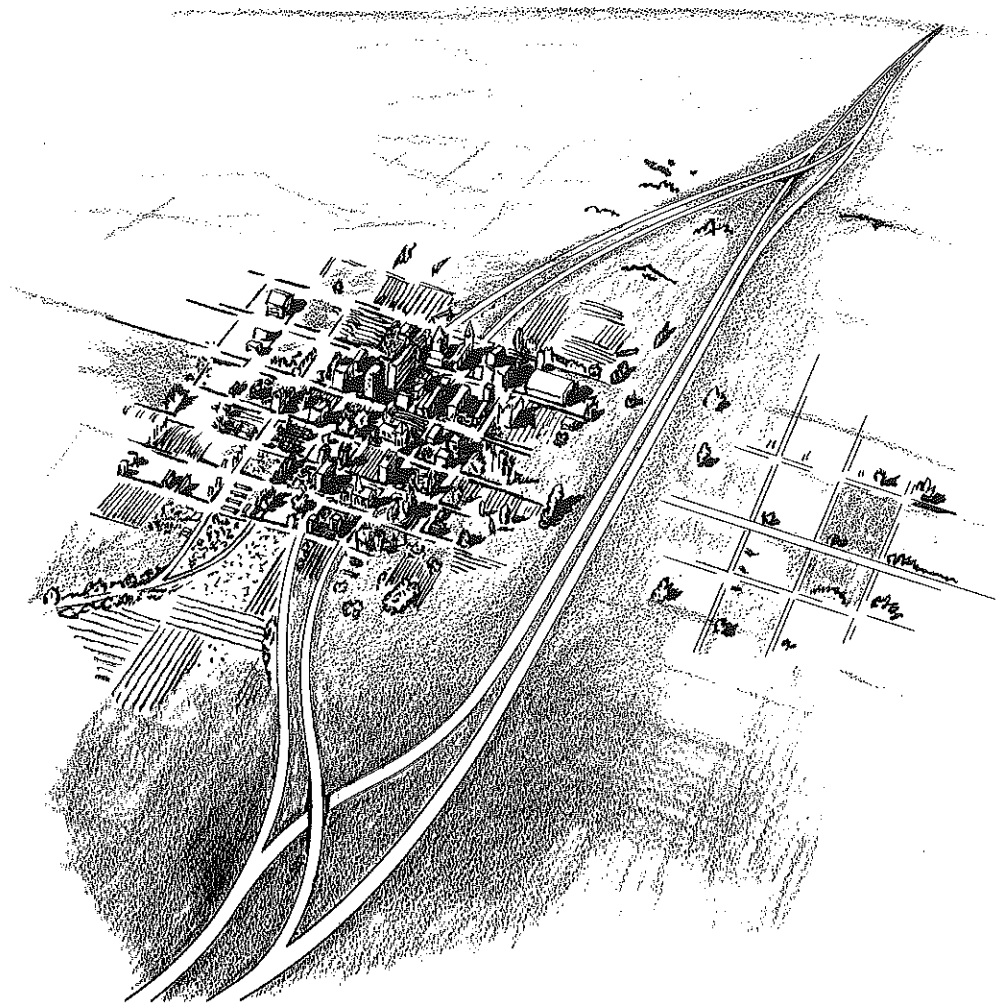
Lowell S. Doyle

A POLICY ON URBAN CONNECTIONS TO INTERSTATE AND ARTERIAL ROUTES



MICHIGAN STATE HIGHWAY DEPARTMENT

JOHN C. MACKIE, COMMISSIONER

A POLICY ON
URBAN CONNECTIONS TO
INTERSTATE AND ARTERIAL ROUTES

MICHIGAN
STATE HIGHWAY DEPARTMENT
John C. Mackie, Commissioner

Prepared by
OFFICE OF PLANNING
Planning Division

December 1958

FOREWORD

THE intent of this Policy is to bring consistency of planning, design and operation into a major area of transportation service; that is, the urban connections to the Interstate and Arterial Systems. This can best be achieved by developing and stating sound principles and criteria for:

1. Traffic and land-use services consistent with the size and economic importance of the urban area to be served.
2. Roadway design consistent with the requirements of urban area traffic.
3. Interchange design consistent with the relationships between through and urban traffic, and between major and minor turning movements.

The first requires the determination, by factual and acceptable indices, of the traffic and economic importance of the urban area to be served. These indices are provided by Highway Classification.

The second requires the determination of probable traffic usage, and also the extent to which existing business and commercial developments are to be protected. This is a matter of location, geometric design and access control.

The third requires a logical and consistent approach to the interchange problem, based on the recognition that the facilities provided for each traffic movement should bear a definite relationship to the magnitude and importance of that movement.

Urban connections presuppose urban trunkline systems, and consistency in the one requires consistency in the other. For this reason it becomes impossible to discuss urban connections without at the same time discussing urban trunklines. Therefore, urban trunklines are discussed in this policy, but only to the extent of providing essential background for the statement of principles governing selection, location and design of urban connections.

John C Mackie

STATE HIGHWAY COMMISSIONER

A POLICY ON URBAN CONNECTIONS TO INTERSTATE AND ARTERIAL ROUTES

THE Interstate and Arterial Highway Systems, as established by Federal and State legislation,[1] are intended to give Michigan a complete and modern automotive transportation network. A complete transportation system must be one which serves the needs of the full economy of the State and its regions; above all, it will need to interconnect and to serve those metropolitan and urban centers where human activity is concentrated. In the words of Mr. Edward A. Ackerman, Director of the Water Resources Program, Resources for the Future, Incorporated:[2]

> "Cities are the creatures of transportation, and the works which make transportation possible . . . Any major change either in the techniques of transportation or in the location and direction of transportation arteries must have some urban effects . . . The planned new National System of Interstate and Defense Highways is such a major transportation change for the United States. It cannot fail to have a lasting and profound impact upon the form, size and character of many American cities."

It is a fact that Michigan (at least as far north as Townline 12) is becoming an urbanized State within one of the most-rapidly urbanizing regions of the United States. Even in 1957, five-sixths of all the Nation's employment was in pursuits generally located in urban areas,[3] and the Northern Urban Region (which includes Michigan), had 43 per cent of the resident population of the Nation and 68 per cent of the manufacturing employment, with only eight per cent of the total land area.[4]

The highway planner no longer can ignore the implications of this urban growth in relation to the service demands upon an interregional transportation system. In the

Foreword to the Urban Land Institute's publication "The New Highways: Challenge to the Metropolitan Region", this same idea is given rather graphic expression in these terms:

> "As of November 1957 A. D. we are on the threshold of outer space travel. This comes at a time when we have not yet approached satisfactory solutions to moving humanity and materials on the planet, Earth.
>
> "Without attempting a learned dissertation on why this paradox exists, it seems evident that one basic reason is our uncanny ability to approach problems, urban growth among them, in a series of technical vacuums . . .
>
> "The fact remains that only recently have those charged with the building of our facilities for moving people and goods become aware that the implications of what they do extend far beyond the strips of concrete they locate and lay down for the wheels of transport; implications which involve the very roots of our national economy and urban environment."

The need for recognition, by highway planners, of urban growth phenomena and their impact on transportation problems cannot be questioned. The determination of factual and acceptable bases for the planning and development of highway transportation in urban areas cannot be postponed.

The need for a definitive policy, relating form to function, for urban connections to the Interstate System and the State Trunkline Arterial System, is evidenced by the wide diversity of designs currently in the planning or construction stage. At present there is no uniformity of design; there are no accepted service criteria. In many instances there has been established no clear correlation between the size and importance of the urban area, the potential traffic generation, and the type of interchange and connection proposed. This vital relationship between transportation and the urban functions can be paraphrased from the article by Mr. Ackerman, previously referred to, in these words:

"By 1975 the population growth of the Nation will be concentrated regionally; forty-five per cent will be in fifteen per cent of the land area (which will include Michigan). If public programs are to be related to people's anticipated needs, and needs are in some part a function of numbers of people, then these facts would seem to be an elemental part of superhighway planning."

As far back as 1941, the National Inter-Regional Highway Committee formulated certain basic principles for the selection of Interstate routes, in accordance with these premises:

1. That the system must connect as many of the larger cities (50,000 and over) as its limited mileage would permit.

2. That the system must incorporate adequate routes leading directly into the larger cities; and that it should also include service to as many cities as possible of 10,000 and over.

3. That urban service should be provided by an integrated system of inter-connecting highways between major cities, augmented by circumferential and distributor routes.

It will be noticed that the Committee laid particular stress on the concept of connecting major cities and providing adequate routes between major cities. The circumferentials (bypasses) and distributors were envisioned as adjuncts, augmenting the basic interconnecting system. This concept is based on the fact that inhabited places are the source, as well as the destination, of all traffic movements. The progressive increase in traffic volume as one approaches an urban center is a well-known phenomenon. It has been demonstrated many times that trip frequency and trip length are inversely proportional; in other words, exceedingly long "through trips" will form but a minor percentage of the total travel volume even on the projected Interstate System. Most of the traffic will be generated or attracted by the urban concentrations along the system, because of these economic and sociological truths:

1. "Cities do not grow of themselves. Country-sides set them up to do tasks that must be performed in central places."[5]

2. "The pattern of urban characteristics thus far depicted for the United States is one of increasingly urban residence and occupation, in which cities tend more and more toward multi-functional activities."[6]

3. Traffic is generated by people pursuing their daily tasks. Most people must be on the job for five or even six days of every week, and for at least fifty weeks in the year. This does not leave much time for the generation of huge volumes of long-distance travel; even the range of week-end trips is limited by the fact that the office, the store, the factory or the truck must be back in operation Monday morning.

4. The attractive effect of the city is precisely analogous to the force of gravitation, in that it varies directly with the economic mass and inversely with the travel distance. The more important a city is in the general economy, the greater is its power and radius of traffic attraction.[7]

The Federal Aid Highway Act of 1944 prescribed that: "There shall be designated within the continental United States a National System of Interstate Highways . . . so located as to connect, by routes as direct as practicable, the principal cities, metropolitan areas and industrial centers . . . "

The intent of both the Committee and the Congress in establishing an Interstate System quite evidently was that cities of major importance along the Interstate routes were to be served by adequate facilities with direct connections to the system. From a planning standpoint, the only logical applications within the meaning and intent of directive and legislation must be based on these axioms:

1. "Adequate" means sufficient in capacity; it also means modern cross-section and control of access. In short, it means the provision of traffic services commensurate with the character, importance and traffic attractive power of the urban area to be served.

2. "Direct" means directional, grade-separated interchanges;

it means new diagonal routes rather than the conversion of existing but circuitous facilities. It means that full trunkline loop service shall be provided to those places of sufficient trunkline importance and traffic attraction, and that the use of stub connections shall be limited to places at definitely lesser levels of importance.

3. "Connections" means interstate routes connecting, or serving, the major cities of the State. It means that bypasses will function principally as adjuncts to the system. It means that the cities are the chief generators and the chief attractors of trunkline and interstate traffic.

If this philosophy is acceptable, [8] it becomes the basis for a statement of policy regarding major urban connections to the Interstate System and to the State Trunkline Arterial System, which is being planned to commensurate standards.

MAJOR URBAN TRUNKLINE CONNECTIONS

The means of connecting or interchanging the major urban service routes with the Interstate or Arterial Systems should provide for easy, directional flow at approximately the prevailing travel speeds of traffic. There are three basic methods of accomplishing this, with several modifications, as follows:

I. A grade-separated "wye" where the roadways are spread sufficiently to allow the urban route to take off from the inside and cross the opposing roadway by a minimum structure, i.e., one roadway over and one roadway under. This is the cheapest, most direct and most logical method of accomplishing an urban connection.

Ia. A modification of the above method, where the major route has been constructed, consists of taking off from the outside with adequate curvature[10] and crossing both major roadways with a more expensive structure; i.e., one roadway over and two under, or vice versa. Obviously this method is more expensive and less direct, and therefore less desirable.

II. A basic clover-leaf with directional roadways[10] substituted in the major quadrant (or even in two quadrants) in place of the clockwise loops which are adequate only for low-speed, low-volume minor traffic movements.

III. A tri-level interchange[10/] where traffic desires indicate two major traffic movements. The tri-level arrangement is very versatile, lending itself to the possibilities of future "dual-dual" facilities, if and when required by traffic growth.

IIIa. In special cases combinations of designs can be used effectively; particularly combinations of tri-levels with reversal of roadway direction. It is possible to solve complex interchange problems at reasonable structure cost by using tri-levels, while at the same time providing direct connections for all major traffic flows.

The general geometrics for these design possibilities are illustrated diagrammatically at the end of this report, together with other sketches exploring the "dual-dual" idea for major trunklines. There doubtless are other designs of merit, which could be adopted if found acceptable from the viewpoint of both planning and engineering.

CONTROL OF ACCESS ON URBAN ROUTES

The principles of limited access should be applied to major urban area connections on new locations, from their interchange with the Interstate or Arterial route up to the urban limits, or to the beginnings of urbanized development, for these reasons:

1. To preserve the expressway characteristics of the major trunkline route, as implied in the Inter-Regional Highway Committee directive and in the Federal Aid legislation.

2. To prevent the development of mushroom and ribbon commercial enterprises, to the detriment of traffic operation and in direct competition with established local businesses.

3. To counteract the notion, prevalent with the public and with the Press, that the new highways will tend to attract custom from established motorist-service businesses, by making it easier to avoid the cities than to drive through them.

4. To place the point of transition from control of access to free access, at a sufficient distance from the major trunkline

route so that any possible build-up of congestion will not affect major route traffic.

TERMINALS AND DISTRIBUTION IN THE URBAN AREA

With the exception of urban expressways in the very large cities, all urban connections reach a point geographically where their function changes; this point should be coincident with the point where the complete control of access is discontinued. The reason for this is to be found in the reasons for the existence of the cities themselves; it is given pointed expression by Mr. Boyd T. Barnard, Chairman of the Central Business District Council, Urban Land Institute, in these words:

> "The changing functions of the highway from a linear movement facility to a collector and distributor as it enters a point of population concentration must be recognized.
>
> "Failure to do so will inevitably have an adverse effect on the economic functioning of the concentrated area."

Where the urban connector enters the actual urban or urbanized area the type of design will of necessity depend largely upon the size of the city and upon local conditions and street patterns, but the essential function will, in all cases, be precisely the same; that is, to distribute the inbound traffic toward its ultimate terminals in the most efficient manner, and to collect the outbound traffic from the local street system and blend it into a common traffic-stream in a natural, safe and efficient way.

There are several practical methods of accomplishing these objectives, some good and some indifferent; some suited only to the larger cities and others universally applicable. The best methods, in descending order of operational merit and of urban concentration, are:

1. Plaza-Distributor

This term is used for want of a more precisely descriptive one. The urban route is connected to two or more pairs of one-way streets at the point where control of access is modified, by means of either grade-separated or channelized cross-overs, as dictated by traffic load. This method is extremely flexible, in that it can at first consist of one pair of one-way streets, and the second or even the third pair can be connected into the system at such future time as the traffic increases require.

2. One-Way Streets

A modification of the above, suited to smaller cities where the street pattern permits and where it is unlikely that more capacity will be required within the foreseeable future. This (and Method 1) are the only truly functional methods of distributing and collecting trunkline traffic within the urbanized areas without the operational difficulties of left turns and inefficient signallization.

3. Odd-Lane Design

Specifically applicable on the urban approaches where speeds are controlled, this method incorporates the virtues of the wide median and eliminates the faults of the narrow median. The center lane, restricted to "left turns only" by adequate overhead signing, provides a refuge outside of the travelled lanes not only for cross-road traffic, but for between-intersection driveway access. It eliminates the rear-end collision hazard inherent in the narrow-median design, and it eliminates the restrictions on left turns into driveways imposed by the wide-median design with left-turn slots only at intersections.

4. Wide-Median Design

The wide-median design with left-turn slots, provides adequately for through traffic and offers reasonable facilities for left turns at intersections. However, if the median is curbed it hinders local access, and if uncurbed it becomes a mud-hole from local usage.

5. Narrow-Median Design

This design offers little of operational merit except the separation of opposing traffic-streams. Even this advantage is more illusory than real because a mountable median is only a warning and not a barrier, while a curbed median is not only a barrier but a traffic hazard of itself. There is no room for left-turn slots and so all left turns must be made from the inside travelled lane, creating a rear-end collision potential.

The above tabulation just about exhausts the design possibilities for urban distributors or penetrators, with the exception of the conventional four-lane and two-lane streets, of which nothing needs to be said except that they are of the lowest order of traffic facilities.

With regard to the so-called "plaza-distributor", there has been some question as to whether this design would be eligible for any Interstate moneys if incorporated as part of an Interstate urban route.

Any unit of the Interstate System must be constructed to the design standards as adopted by the A. A. S. H. O. and the Bureau of Public Roads, July 17, 1957; as applied to Michigan and all other States east of the Mississippi, this has been interpreted as meaning full limited-access throughout.

However, highway planning personnel in Michigan, at both State and City levels, have come to the conclusion that in many cases traffic needs would be better served if the above requirements were revised to admit of the use of plaza-distributors for certain urban situations. Within the concentrated areas of urban activity, the concepts of traffic distribution and of limited access are incompatible. It is a demonstrable fact that a plaza-distributor, built with regular Federal Aid funds if necessary, would, in most cases, actually result in less dollar cost to the State, and less financial outlay 'in toto', than a limited-access facility built with Interstate funds. This can be accomplished within the letter of the existing regulations by establishing two Interstate urban stubs, each terminating at the limits of urban concentration; these two stubs are then connected by a Federal Aid Primary route. Although this arrangement would not be eligible for Interstate moneys throughout, and although it could not be designated as Federal Aid Interstate, it could carry the Interstate Route

markers as established by the A. A. S. H. O. Committee, thus creating a continuous marked route as far as the travelling public is concerned.

LEVELS OF TRUNKLINE URBAN SERVICE

A final policy statement undoubtedly should concern the levels of trunkline service to be provided for all places which will be bypassed by the new Interstate and Arterial routes.

It might be inferred from previously-quoted statements that all cities of over 50,000 population should have direct connections, and that all cities in the 10,000 - 50,000 group should have trunkline "service" at a lesser level.

This is only a broad generalization. It is not literally applicable in Michigan, with its diverse socio-economic organization as reflected in the concentration of the larger cities in the lower part of the State, and the distribution of many smaller, -- but regionally even more important, -- cities in the northern portion. 9/

Some of these places will, of course, be large cities or urban areas of first importance to the State and its regions; they will need to be served by direct trunkline loops of the highest capacity and geometric design, as delineated in the preceding sections of this policy. Other places will be of considerable regional or local importance, but smaller in size and therefore of less power as generators of traffic volume-wise; these may well be served by trunkline loops of somewhat lesser capacity and geometry.

Still other places on the existing trunkline may be small local communties of economic or recreational importance for which a trunkline "stub" connection may suffice. At the bottom of the scale are those very small communities which are served by the existing trunkline through the incidence of location, and not because they are of "trunkline classification". These may well continue to be served

adequately by the existing highway after its reversion to county road status, without any direct access to the new route.

It is not possible at this time to set up a rational formula for these determinations. Such a formula would need to take into account the economic importance of the locality, as well as its absolute generative power in terms of traffic volumes; both of these factors in turn would need to be modified for future growth and industrial development, area and seasonal influences of tourist and recreational traffic, and other imponderables.

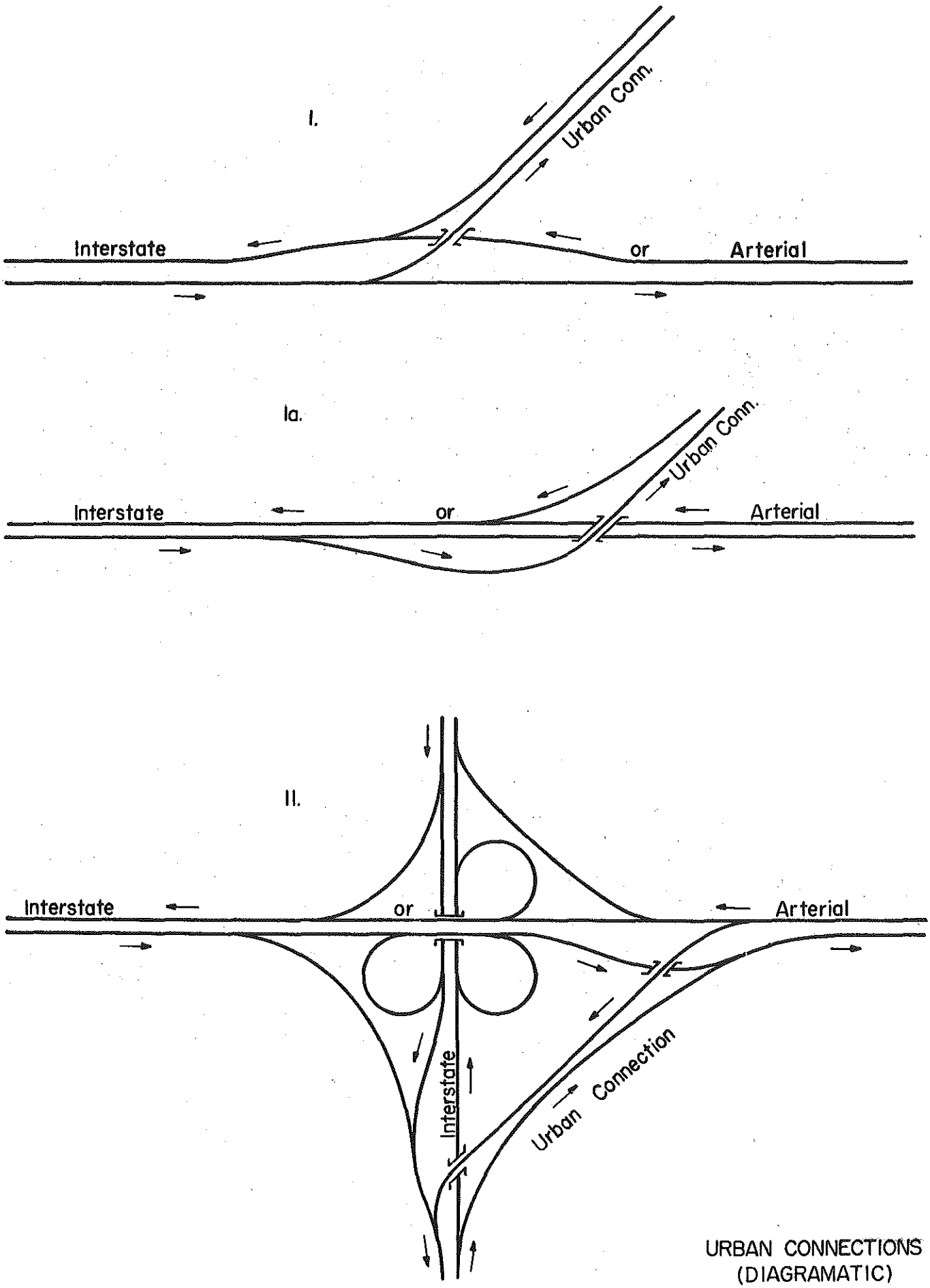
Cities in the metropolitan classification should, of course, have the highest possible type of urban connections. The plaza-distributor is indicated if at all compatible with topography and general street arrangement.

The cities classified as Regional Centers are all located in the northern half of the Lower Peninsula and in the Upper Peninsula. They qualify for direct loop connections with distribution by one-way or odd-lane streets, where feasible.

Cities classed as District Centers, however, show a great variation both geographically and population-wise. Those in the south half of the Lower Peninsula mostly exceed 30,000 in population; they should have direct trunkline-loop connections and usually either plaza-type or one-way street distributors. The remaining cities in this group vary in both size and character, and their requirements as to trunkline service will also vary. Some of the smaller places, due to their importance as the centers of recreational areas, will require a higher type of service than their actual populations would seem to indicate.

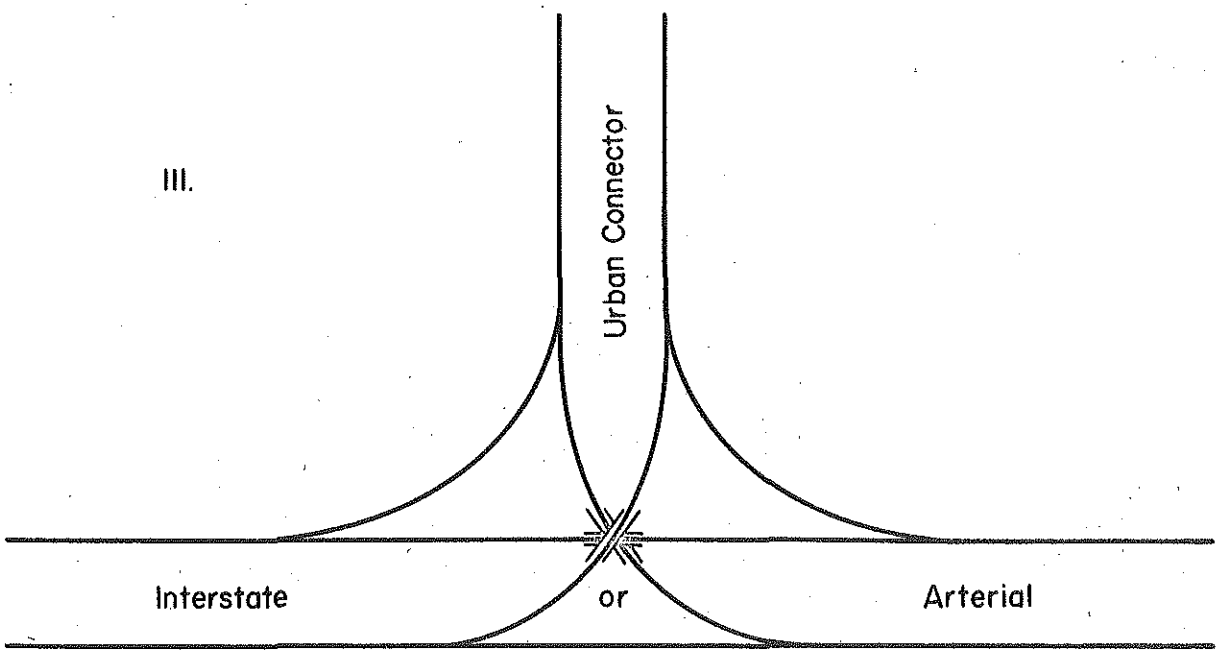
The greatest variations in population are found in those places classified as Complete Market Centers and Intermediate Market Centers; it is not practical to set up even general specifications as to the types of trunkline service for these two categories on any generalized basis.

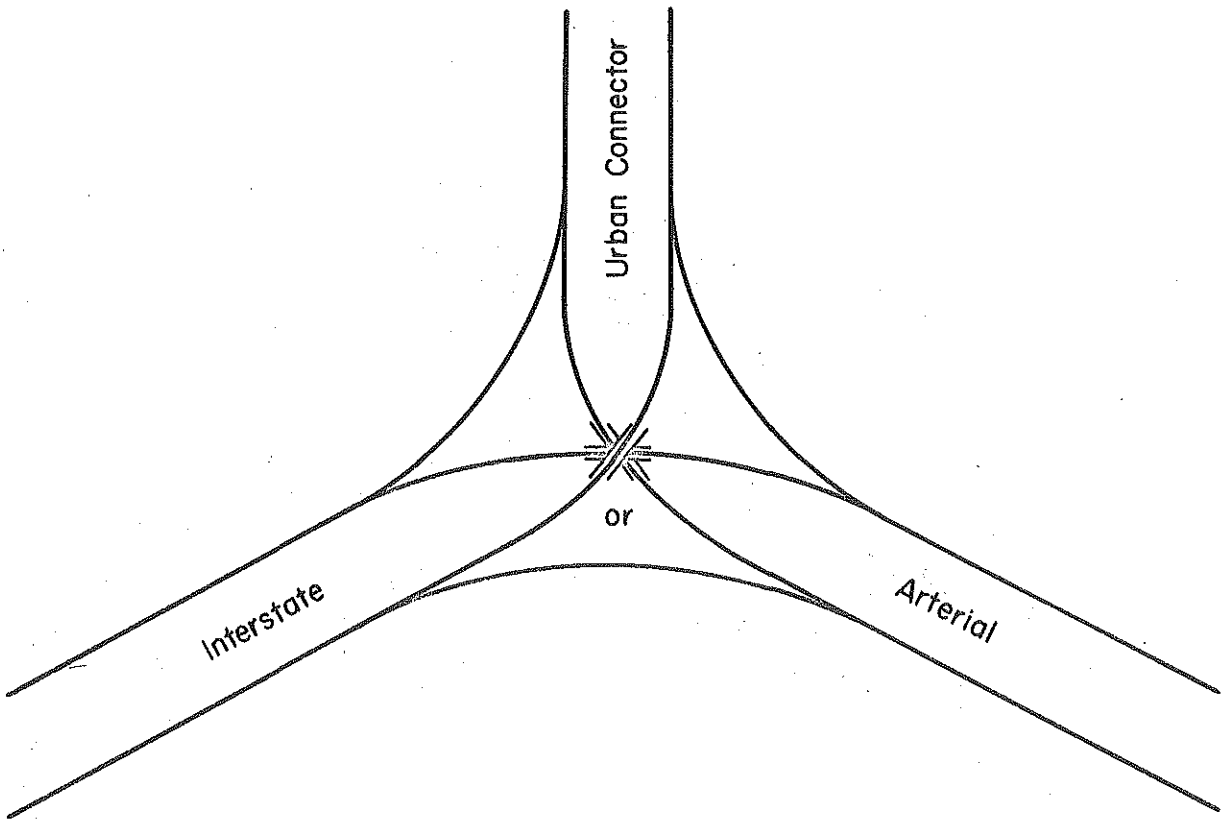
However, it should be possible within the limits of present knowledge, and with the invaluable help of the Highway Classification Study, to outline certain broad criteria which will serve as a guide in determining the level of trunkline service for all places of trunkline importance, subject, of course, to modifications in specific cases and in the light of more advanced planning knowledge and investigation. These general criteria will be made the subject of a supplemental study and report.



URBAN CONNECTIONS
(DIAGRAMATIC)

III.





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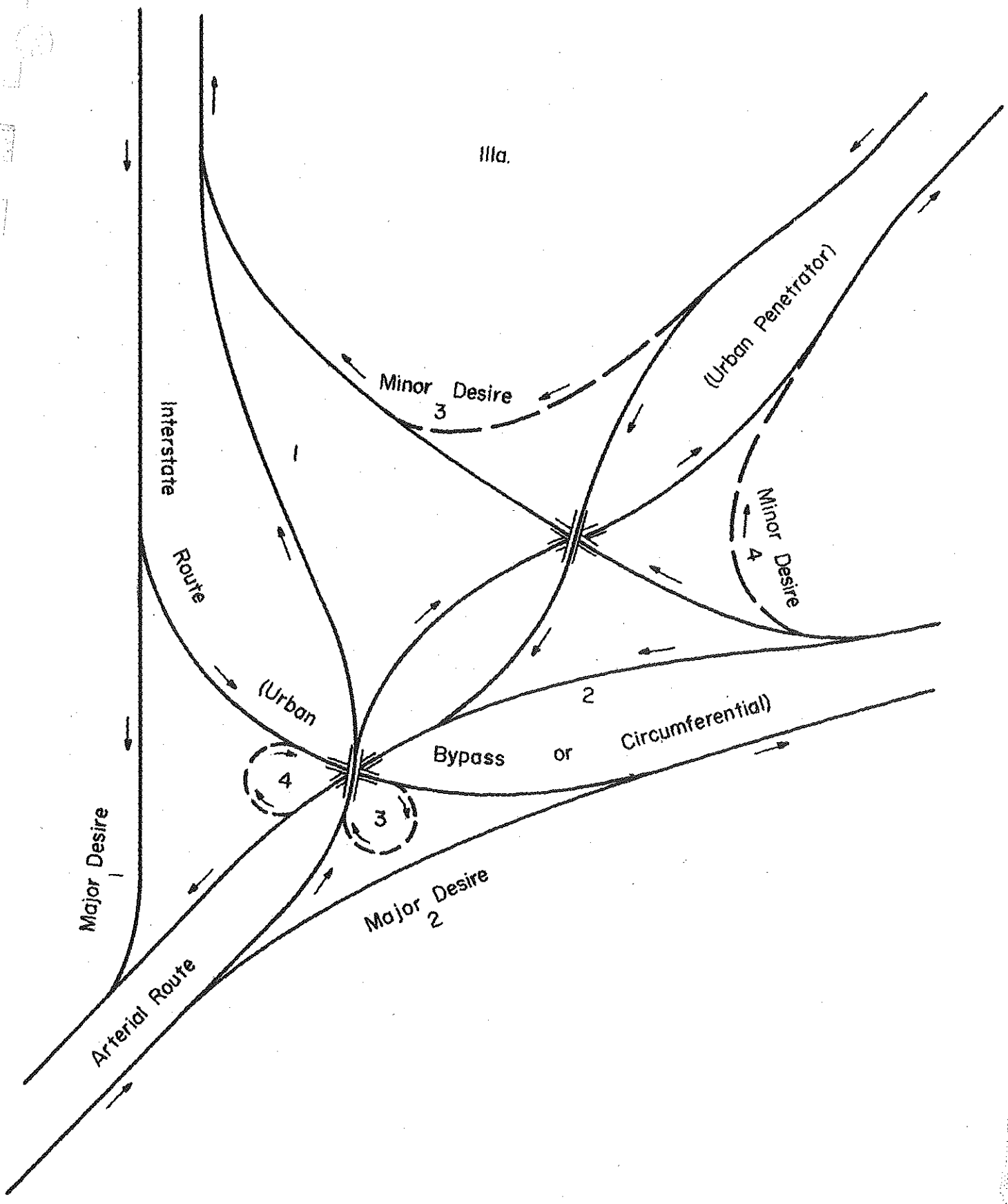
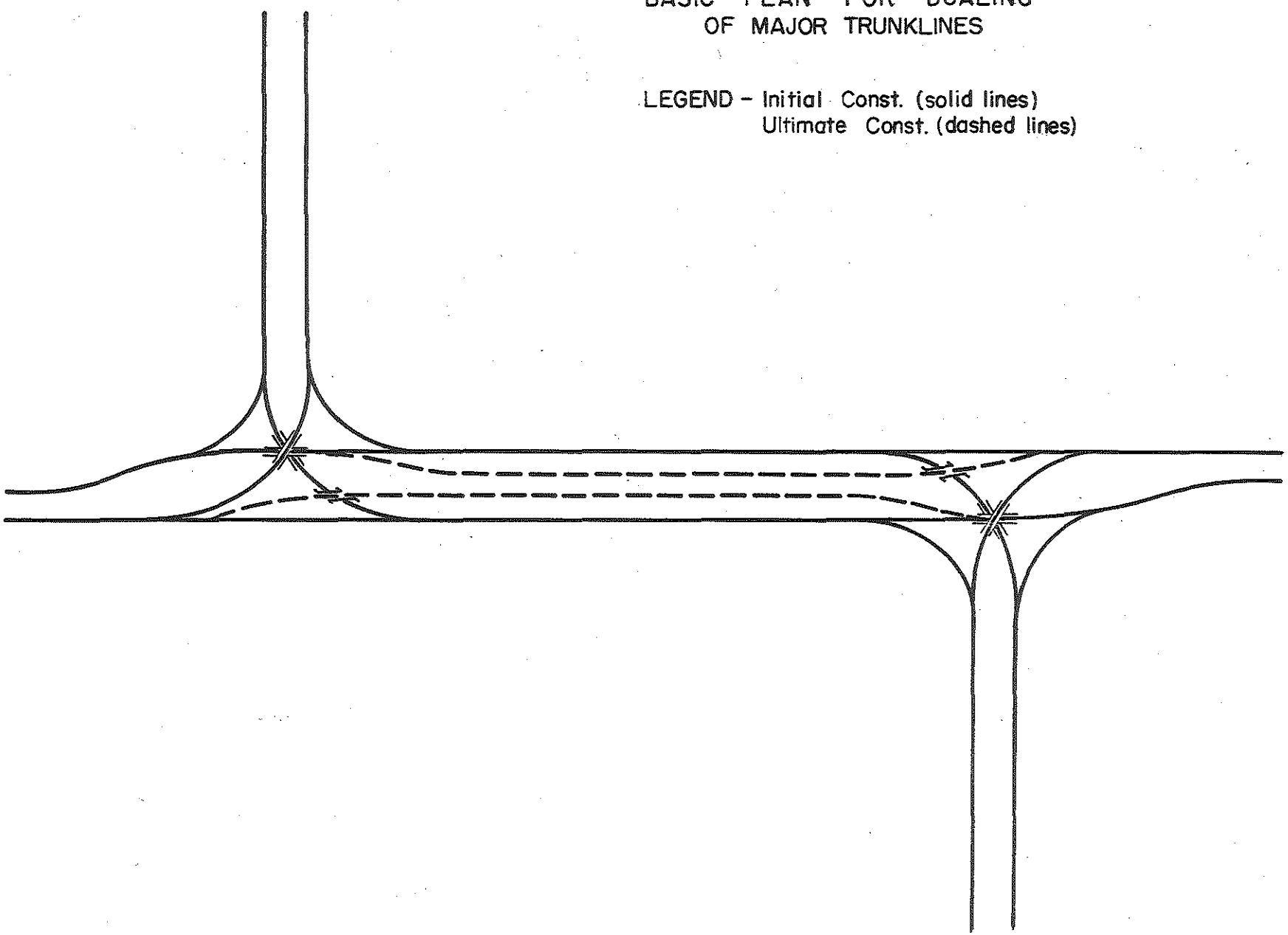


URBAN CONNECTIONS
(DIAGRAMATIC)

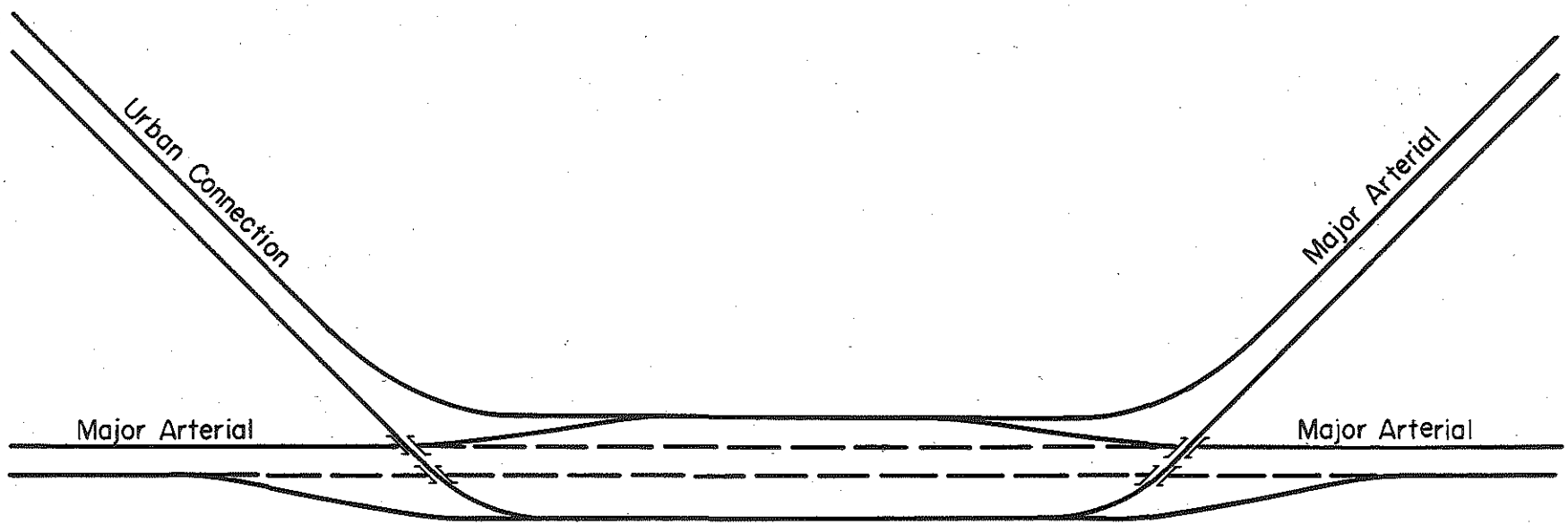
BASIC PLAN FOR DUALING
OF MAJOR TRUNKLINES

LEGEND – Initial Const. (solid lines)
Ultimate Const. (dashed lines)



BASIC PLAN FOR DUALING OF MAJOR TRUNKLINES PLUS URBAN CONNECTION

LEGEND - Initial Const. (solid lines)
Ultimate Const. (dashed lines)



BASIC PLAN FOR DUALING OF MAJOR TRUNKLINES PLUS URBAN CONNECTION

LEGEND – Initial Const. (solid lines)
Ultimate Const. (dashed lines)
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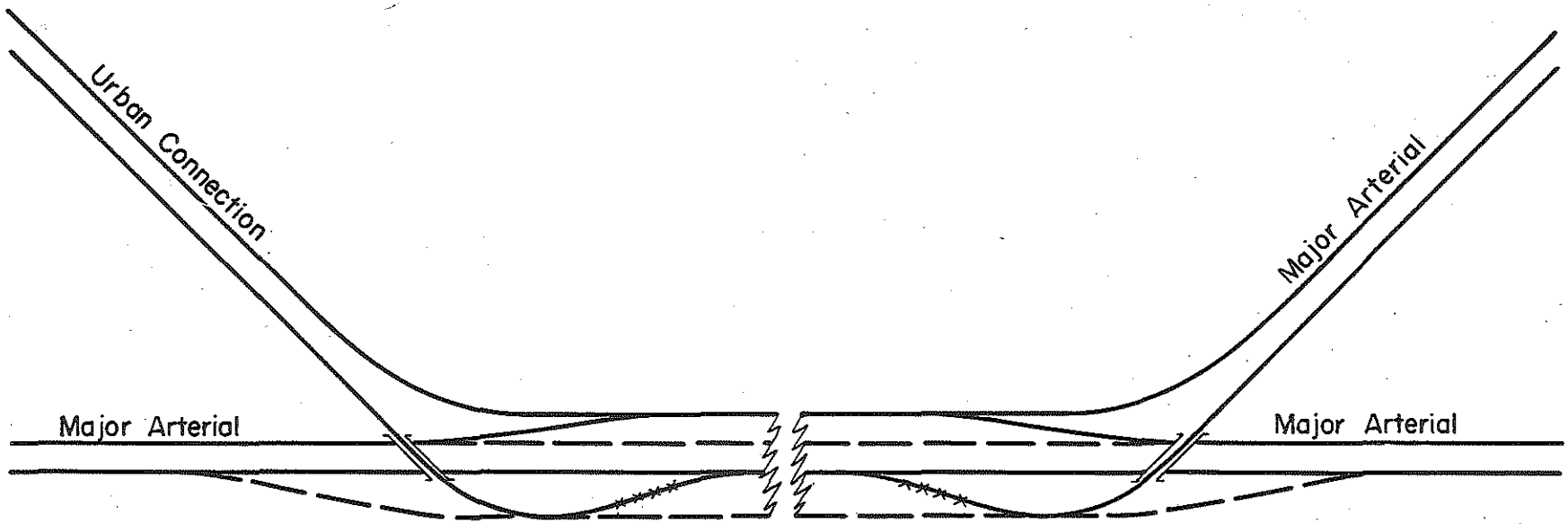

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1. See Appendix: Trunkline Arterial Highways.

2. Urban Land Institute: Technical Bulletin 31.

3. United States News and World Report: July 19, 1957.

4. Urban Land Institute: Technical Bulletin 31.

5. Mark Jefferson: Distribution of the World's City Folks.

6. Edward Ackerman: The National Environment of Urban Growth and Highway Construction.

7. Consider the Eastern Seaboard "Interurbia"; the sheer size and propinquity of Boston, New York, Philadelphia, Baltimore and Washington insure a traffic inter-attraction which is equalled nowhere else in the world.

8. See Appendix: Planning.

9. See Appendix: Highway Classification.

10. Maximum curvature of 4^{o} 30' is suggested, in accordance with recent verbal agreement between the Office of Planning and the Office of Engineering.

APPENDIX

APPENDIX A

TRANSPORTATION PLANNING: A BASIC PHILOSOPHY

With transportation as a premise, the planning philosophy becomes a very simple one. It is this, and no more. Our economy functions by and through transportation, automotive or otherwise; without transportation it would cease to function. Therefore, transportation comes first, and always first; the other elements and features of our physical environment and our social needs must be adjusted to the basic transportation plan.

Just as there is but one philosophy for planning, there is but one touchstone for testing plans. IF THEY ARE GOOD TRANSPORTATION, THEY ARE GOOD PLANS.

Apply the test as you will, it always works. Test the neighborhood concept, the greenbelt concept; test one-way streets and plaza-distributors; test city entrance routes and bypasses; test channelization and signallization; test parking, shopping centers, downtown malls, rural industrialization; test subdivision regulations and zoning.

If it is good transportation, it is good planning. And not otherwise.

TRUNKLINE ARTERIAL HIGHWAYS

The Michigan Legislature, by Act 87 (P.A. 1955) established a system of arterial highways totalling somewhat less than 2,000 miles; to consist of multi-lane divided highways and to include the Federal Aid System of Interstate and Defense Highways. Federal Legislation and Administrative rulings specify that the Interstate routes shall be constructed on a limited-access basis; the Michigan Statutes permit, -- but do not require, -- limited access on the balance of the arterial system.

This legislation was a step in the right direction, but only a step. Preliminary planning studies and forecasts have indicated that by 1975 Michigan will need something more on the order of 4,000 miles of arterial highways. The current revision of the Highway Needs Study will establish this latter figure with more precision, and is expected to show geographically the extensions and additions required to complete the ultimate system.

Comprehensive planning and programming require the establishment of a firm policy on arterial highways, which will specify:

1. The extent and location of an ultimate arterial system as of 1975.

2. The degree of access control on the system, by routes and sections of routes.

3. The types of urban connections to the system, by place classification and geometric design.

HIGHWAY CLASSIFICATION

The report "A Method of Rural Road Classification", published by the Department in 1950, contained a register of 1,300 places whose relative traffic attraction had been determined. They were grouped into classes representing marked differences in their level of importance as attractors of traffic. Five of these classes, comprising 138 places, were found to have traffic attraction of statewide significance; these places were designated as being of "trunkline importance".

This method of classifying inhabited places, valuable though it has proved in system selection and for overall planning purposes, still has a weakness when it is applied to the determination of the level of trunkline service to be provided for places bypassed by the new arterial routes. This is because of the fact that the method reflects the socio-economic importance of the places in relation to the State and the local regions which they serve, rather than their absolute traffic-generative power. For instance, places of relatively small population may be rated properly in a high category of statewide importance, but the fact remains that they do not attract or generate sufficient traffic, in terms of absolute volume, to warrant a high-type or high-capacity urban connection.

Many of the Class V places (Intermediate Market Centers) range in population from 350 to 1,000 and obviously do not require elaborate trunkline traffic facilities although they may truthfully be of trunkline importance. Other Class V places have populations as high as 6,000 and, therefore, will generate enough traffic to require facilities of a different order. This is equally true of Classes IV, III and

II; only the Class I places (Metropolitan Centers) show a consistent relationship between size and economic importance.

The reason for this phenomenon is apparent in the economy of the State. The regional centers (Class II) in the northern part of the State are more important to that economy than are the district centers (Class III) to the economy of the lower part, although the concentrations of population and industry insure that the latter will in general be considerably larger.

This means that the criteria used for selecting the type of trunkline service to any of these places must, of necessity, reflect both the absolute size and the relative traffic importance of that place. Within the present areas of planning knowledge, the attempt to strike such a balance will admittedly be somewhat empirical, and therefore subject to review, discussion and revision before being advanced as a firm policy. Even an empirical method, however, should be developed with these ends in mind:

1. It will strike some kind of balance between the economic importance and the traffic generative power of each community.

2. It will show up places of a borderline nature, which will need further evaluation in the light of local modifying factors.

3. It will eliminate the need for individual evaluations of all places served or bypassed by a new route, a method expensive in man-hours at the technical level.

4. It will provide a method of justifying to local authorities, on a uniform basis, the types of trunkline service proposed.