# IOWA

# *Manual Of*

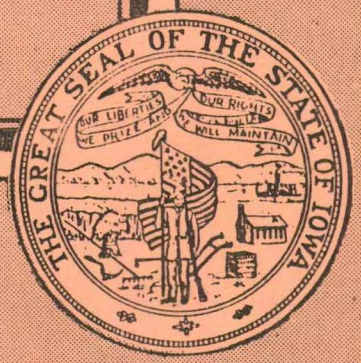
# *Engineering*

# *Procedures*

**FOR**

**DETERMINING**

**ARTERIAL STREET NEEDS**




**IOWA HIGHWAY STUDY COMMITTEE**

**AMES IOWA**

**1959**

# IOWA HIGHWAY STUDY COMMITTEE

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The Iowa Highway Study Committee was created under provisions of House Joint Resolution 12, adopted and passed by the 58th General Assembly.

Engineering Offices
IOWA HIGHWAY STUDY COMMITTEE

# MANUAL OF ENGINEERING PROCEDURES
## For Determining Improvements Needed on Arterial City Streets


Prepared by the Engineering Staff of the
AUTOMOTIVE SAFETY FOUNDATION

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With the Advice and Counsel of the
CITY ENGINEERING ADVISORY COMMITTEE

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DECEMBER 1959

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## SECTION 1

## INTRODUCTION

The 58th General Assembly of the State of Iowa passed and adopted House Joint Resolution 12 effective July 4, 1959, creating an Iowa Highway Study Committee. This Study Committee is to make a fiscal, administrative and engineering survey of Iowa's entire network of highways, roads and streets.

The Study Committee acting through the Iowa State Highway Commission entered into an agreement on July 29, 1959 with the Automotive Safety Foundation of Washington, D. C. to conduct an engineering study of highway needs and prepare a long-range plan for improvement of the physical condition of all highways, roads and streets in the State.

The Committee's agreement with the Automotive Safety Foundation calls for:

1. An analysis of the fundamental economic factors affecting highway transportation in Iowa and of the services rendered by highways for agriculture, industry, commerce and for all other purposes within the state.

2. An analysis of the use of Iowa road and street systems in terms of traffic volumes, travel habits, traffic patterns, composition of the traffic stream and related factors.

3. Forecasts of future highway use, based upon projections of trends in population, motor vehicle registration and travel.

4. An examination of the existing legal and administrative classification of roads and streets to determine the extent to which regrouping of present systems is required in the interest of economy, improved services to the public and more efficient management. This study shall also include the possibility of eliminating portions of road mileage from the systems.

5. Determination of tolerable physical standards for existing highways, roads and streets and of appropriate standards for future construction.

6. Measurement of existing and future deficiencies in the highway plant on the basis of as complete a physical inventory as possible. Comprehensive and uniform data will be compiled, detailing the physical characteristics and condition of roads and structures and the ability of these facilities to carry the traffic desiring to use them. Where present or future deficiencies are found, needed inprovements will be determined and costs estimated on the basis of appropriate standards established for each class of road and street.

7. Determination of annual replacements and costs required as roads and streets wear out during the period while deficiencies are being overcome. This will be based on road life experience in Iowa and elsewhere.

8. Determination of annual maintenance requirements from an analysis of maintenance cost records, taking into account the effects of recommended physical improvements in the highway plant and in maintenance procedures and standards.

9. Formulation of several alternative long-range plans for road and street construction, replacement and maintenance, based on systematic and coordinated programs for improvement by state, county and municipal highway agencies.

10. Analysis of highway management at all levels of government, with a view to possible recommendations for improvement of administrative machinery to permit more efficient management and the most prudent expenditure of public funds.

11. The Foundation's Laws Division will evaluate those sections of the present highway statutes that pertain to this study and will suggest such amendments as will be necessary to implement the recommendations.

12. Analysis of highway safety problems insofar as they relate to design standards, maintenance practices and traffic engineering. This phase of the study will not cover such subjects as strength of the highway patrol or motor vehicle registration and regulation problems.

The preceding items apply to all classes of roads and streets. However, the approach in evaluation of each class of roads and streets will necessarily be somewhat different in order to meet the particular characteristics of service performance. Specific procedures have been developed for each class of facility, so designed that they reflect a balanced appraisal of the entire highway and street network within the state.

In addition, the Study Committee on October 15, 1959, secured the services of the Public Administration Service, a non-profit organization located in Chicago, to conduct a separate but concurrent study of road and street finance. The report of the Public Administration Service to the Study Committee will in part be based on the engineering study of road and street needs.

The cooperation of the Iowa League of Municipalities and the Iowa Chapter of the American Public Works Association has been solicited and obtained through their respective governing officials.

The appraisal of streets in Iowa cities and towns can best be made by Iowa engineers familiar with local conditions. To insure that the procedures and standards for appraisal of city and town street needs would be on a sound, conservative basis, geared to the economy of the state, an Engineering Advisory Committee composed of City Engineers and City Managers who are professional engineers, was selected by the Engineering Staff of the Study Committee and their services made available to the Study Committee by their respective mayors to aid in their preparation. Similarly a State Engineering Advisory Committee and a County Engineering Advisory Committee were designated to aid in preparation of procedures and standards for appraisal of State highways and county roads respectively.

## GENERAL PROCEDURES

The purpose of this manual is to establish a uniform procedure for reporting the needs for an adequate and efficient urban transportation system. The following steps will be taken in this analysis for "Arterial" and for "Business and Industrial Access" streets.

1. Inventory of street usage and traffic control.
2. Classification of streets into logical systems.
3. Study of existing conditions.
4. Determination of present and future deficiencies.
5. Determination of remedial measures.
6. Estimate costs of remedial measures.
7. Prepare a report of street maintenance costs.

## ASSIGNMENT OF RESPONSIBILITY

The gathering of inventory and traffic information will be the responsibility of the Director of Public Works or City Engineer for all city streets except the urban extensions of state highways. The Highway Commission will be responsible for furnishing inventory and traffic information for urban extensions of state highways, and will assist city officials to the extent of supplying whatever further information the Commission has available on other city streets.

City officials, the Highway Commission, County Engineers (where there are urban extensions of county roads) and the Engineering Office of the Study Committee are jointly responsible for appraising city street needs in accordance with procedures established by this manual. This will be done through the "conference" method where the above people sit down together and work out the needed improvements jointly.

The Automotive Safety Foundation will be responsible for the direction of the Study and for all engineering procedures, standards, methods of analysis, review of interpretations, conclusions, recommendations and contents of the final report, except finance studies and reports.

Directors of Public Works or City Engineers will be responsible for initial pricing of improvement projects and for developing maintenance cost information. Maintenance cost information will be reviewed and analyzed by the City Engineering Advisory Committee.

## JUDGMENT REQUIRED

The procedures to be used have been prepared as carefully as possible with consideration being given to all information available. The procedures must be considered in the nature of guides, however, since the determination of deficiencies and needs is not a mechanical process. The manual covers the more common situations known to exist. There will be exceptional situations and borderline cases where the standards and guides will not apply. In such instances it is important that the engineer use his best judgment and when conditions require deviation from the manual, sufficient explanation should be given to justify such deviation.

## RESIDENTIAL STREETS

The type of service rendered and the characteristics of residential streets are sufficiently different from arterial city streets so that the procedures and standards described in this manual do not apply. The method for determining needs of residential access streets is described in the Manual of Engineering Procedures for Determining the Needs of Residential Streets.

SECTION 2

STREET SYSTEM CLASSIFICATION

## INVENTORY OF STREET USAGE AND TRAFFIC CONTROL

This work (which has already been completed) involved preparation of two maps; one showing existing street usage, and the other showing traffic control measures on arterial streets. Preliminary instructions were mailed on September 10 to all cities over 5,000 population explaining the preparation of these maps.

The information on these maps was used in preparing a pre-classification of city streets into logical systems. Street system classification is further described on the following pages.

## CLASSIFICATION OF STREETS

Street classification is the orderly grouping together into systems of streets providing similar services to the public. It is the framework around which street responsibilities can be established, realistic improvement programs formulated, a sound financial plan devised and organization and management requirements defined. Classification benefits city street administration by establishing:

1. The function and use of streets;
2. The extent of community-wide interest as distinguished from the interest of adjacent property owners;
3. The physical requirements of street construction and the need for traffic control measures;
4. A logical basis for an equitable distribution of cost between government, user and property owner.

Streets are generally divided into two systems according to the character of use they perform.

### Arterial Streets

Arterial streets are those which connect the focal points of traffic interest within a city, or streets which provide connections with outlying areas and other cities. State highways and county roads within cities are examples of arterial streets.

Arterials may extend into or through business areas. However, only those streets in business areas which perform the services of arterial streets should be included in the arterial system.

The classification of arterial streets will be further subdivided into the following.

1. Interstate highways and other freeways.
2. Urban extensions of other State highways.
3. Urban extensions of major county roads.
4. Other arterial streets.

### Access Streets

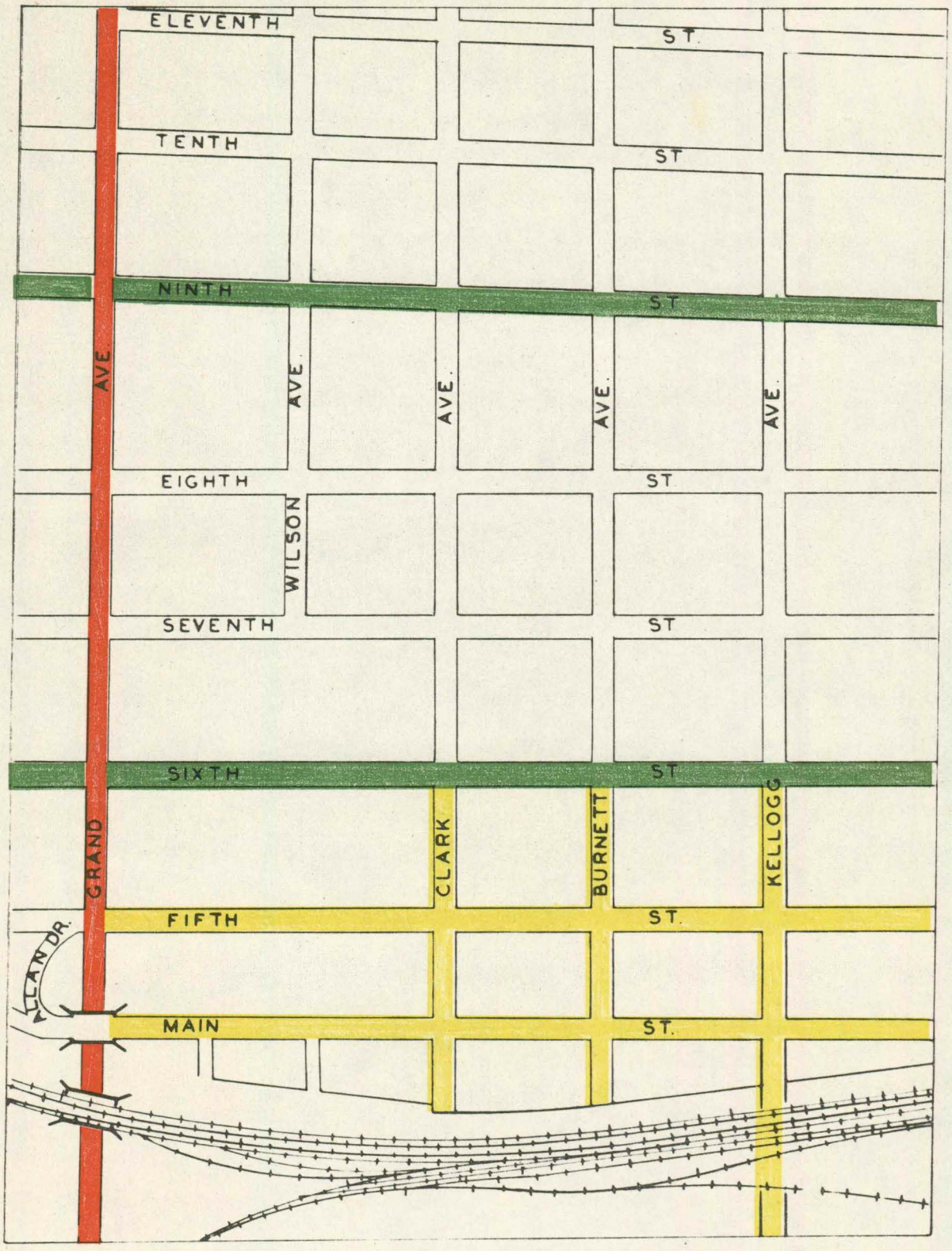
Access streets are those streets primarily providing access to abutting property. They serve as tributaries to arterial streets and discourage through traffic. In general, the uninterrupted flow of traffic on access streets is not of first importance. Access streets are of two general types, business and industrial or residential.

Business and industrial access streets are those, other than arterials in business areas, where more than one-half of the street frontage is used for business or industrial purposes. In larger cities they are those streets in the "central business district" not meeting the definition for arterial streets. In smaller places, most of the business area may be built along arterial streets and there may be no business access streets.

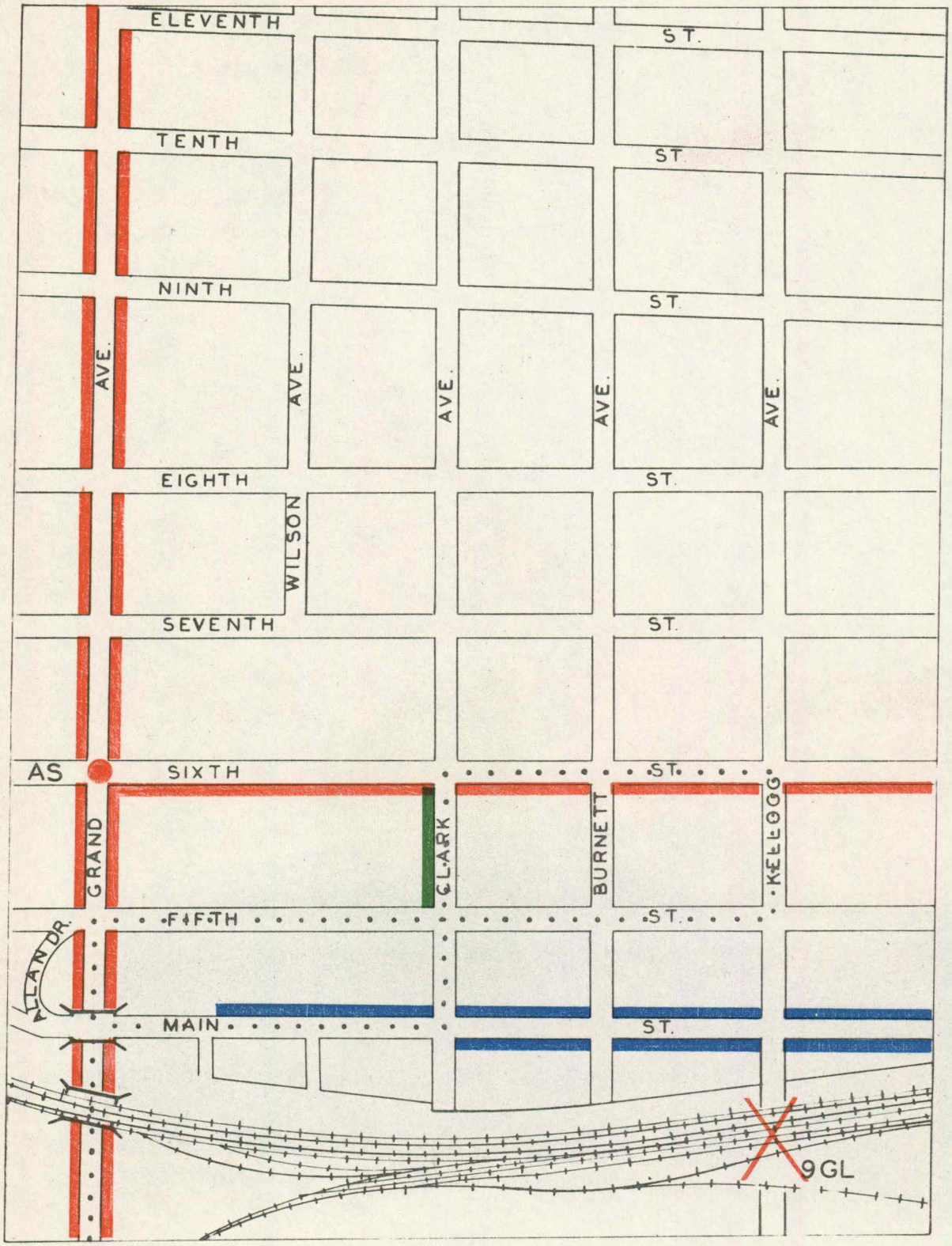
Residential access streets are those serving principally to give access to homes and other dwelling units such as apartments.

**********
* CLASSIFICATION OF CITY STREETS INTO SYSTEMS IS FOR STUDY PURPOSES ONLY. IN NO WAY DOES *
* THIS CLASSIFICATION ALTER OR OTHERWISE AFFECT THE LEGAL STATUS OF PRESENT CITY STREETS. *
* THE STUDY CLASSIFICATION WILL SERVE AS ONE BASIS FOR TABULATION AND ANALYSIS OF NEEDS *
* OF CITY STREETS BASED ON THE SERVICES THEY PERFORM. *
**********

# MAP NO. 1.
# STREET CLASSIFICATION MAP



# MAP NO. 2
# STREET USAGES AND TRAFFIC CONTROL



## PRE-CLASSIFICATION

Using the maps prepared in response to our letter of September 10, traffic information and other information available to the Engineering Office of the Study Committee, a tentative classification of city streets has been made for each city over 5,000 population. This pre-classification is shown on two copies of map 3 enclosed with this manual of procedure.

The streets included in the pre-classification system are indicated on the map by the following legend.

1. Interstate highways and freeways by a BLUE line.
2. State highways by a RED line.
3. Urban extension of county roads by a DASHED BLACK line.
4. Other arterial streets by a GREEN line.
5. Business and industrial access streets by a YELLOW line.
6. Residential access streets by NO COLOR.

This pre-classification provides a reasonable, inter-connected network of city streets selected on the basis of the best information available to the staff. However, analysis alone is no substitute for the first-hand knowledge and judgment of those most closely associated with the responsibility of providing street transportation service within each city. Therefore, a review of the pre-classification plan in each city is necessary.

## REVIEW OF PRE-CLASSIFICATION

The Director of Public Works or City Engineer together with other city officials (mayor, city planner, traffic engineer, others) are requested to review the pre-classification plan for conformity with the definitions stated above. If it is determined that a state highway urban extension or other arterial street or a business and industrial access street should be added, extended or deleted from the pre-classification plan it should be done as follows:

### Additions

1. State highway urban extensions. This situation may be encountered in establishing one-way streets, alternate routes around central business district, etc. Indicate the proposed location by a wide, dashed line in RED along the street line.

2. Other arterial streets. Indicate street location to be added by a wide, dashed GREEN line.

3. Business and industrial access. Indicate street location by a wide, dashed YELLOW line.

### Deletions

1. State highway urban extensions. This situation may be encountered as a correlary to the establishment of one-way streets or by-passes of central business districts. With the rerouting of State extensions the present street will change to another class of street. If the street changes to an urban extension of a county road, indicate by a bold dashed BLACK line along the street shown in red. If the street changes to an "other arterial", indicate by a bold, dashed GREEN line along the street shown in red. If the street changes to a business and industrial access, indicate by a bold, dashed YELLOW line along the street marked in red. If the street changes to a residential access, indicate by short diagonal lines in BLACK across the street in red.

2. County road extensions, other arterial streets, business and industrial access streets. Indicate locations to be deleted by short, diagonal BLACK lines.

It is requested that one copy of this pre-classification map, with or without changes, signed by the Director of Public Works, City Engineer, or City Planner be returned as soon as possible to the:

Engineering Offices
Iowa Highway Study Committee
Bldg. 6, Iowa State Highway Commission
Ames, Iowa

Pending final review by the Automotive Safety Foundation of Street Systems on Map 3, each city shall collect and record complete inventory and traffic data for all arterial streets shown on Map 3 - including proposed additions and deletions.

## ARTERIAL STREET SYSTEMS IN CITIES UNDER 5,000 POPULATION

Organization of streets into logical systems in cities or towns of less than 5,000 population can in most instances be done by an inspection of traffic flow characteristics and street pattern. The extensions of state highways and main county roads into or through these cities are arterial in character. Such highways or roads generally carry the largest volumes of traffic within these cities. Connections to business and industrial establishments from these highways and roads are provided on business and industrial access streets, and to dwellings by means of residential access streets.

For study purposes, the municipal extensions of state highways and major county roads will comprise the arterial street systems in all incorporated cities or towns having a 1950 population less than 5,000.

## SECTION 3

## STUDY OF EXISTING CONDITIONS

The third step in the study process is to record on a map and on arterial street project work sheets the inventory of existing conditions on the main arteries including interstate highways, state highway urban extensions, urban extensions of county roads, city arterials and business and industrial access streets. (The inventory of residential streets will not be recorded on maps.) This information will be recorded on map 4 in accordance with a code which will reflect the following data:

### STREETS

#### Surface Type Definitions

For this study the various street surface types are grouped into five categories. Indicate surface type by letter code according to the following definitions.

TYPE A. HIGH TYPE PAVEMENT. May be any of the following: A portland cement concrete pavement or a brick or block surface on a rigid or flexible base with a total thickness of 8 inches or more. An asphaltic concrete or similar surface 3 inches or more in thickness on a rigid or flexible base with a total thickness or 8 inches or more.

TYPE B. INTERMEDIATE TYPE PAVEMENT. May be any of the following: A portland cement concrete pavement or a brick or block surface on a rigid or flexible base with a total thickness of less than 8 inches. An asphaltic concrete or similar surface 3 inches or less in thickness on a rigid or flexible base, the total thickness of both being less than 8 inches.

TYPE C. SURFACE TREATED. A light flexible base or stabilized earth road to which has been added by any process a bituminous surface course less than 1 inch in thickness. This includes double-shot bituminous penetration surfaces on a flexible base or stabilized earth base.

TYPE D. LOW TYPE. A road surfaced with sand-clay, crushed stone, gravel or similar granular material. This surface may or may not be stabilized with a bituminous, chemical or portland cement admixture or given light penetrations of oil to serve as a dust palliative.

TYPE E. EARTH. Includes unimproved roads and graded and drained roads having an earth surface.

#### SURFACE WIDTH

Shall be the width to the nearest foot of the paved surface as measured from edge to edge or from curb to curb, as the case may be. Where the edge of the surface is irregular, report the average width. If the section has curbs, add the letter "C" after the surface width, thus: "30C".

#### Right-of-Way Width

Record to the nearest foot.

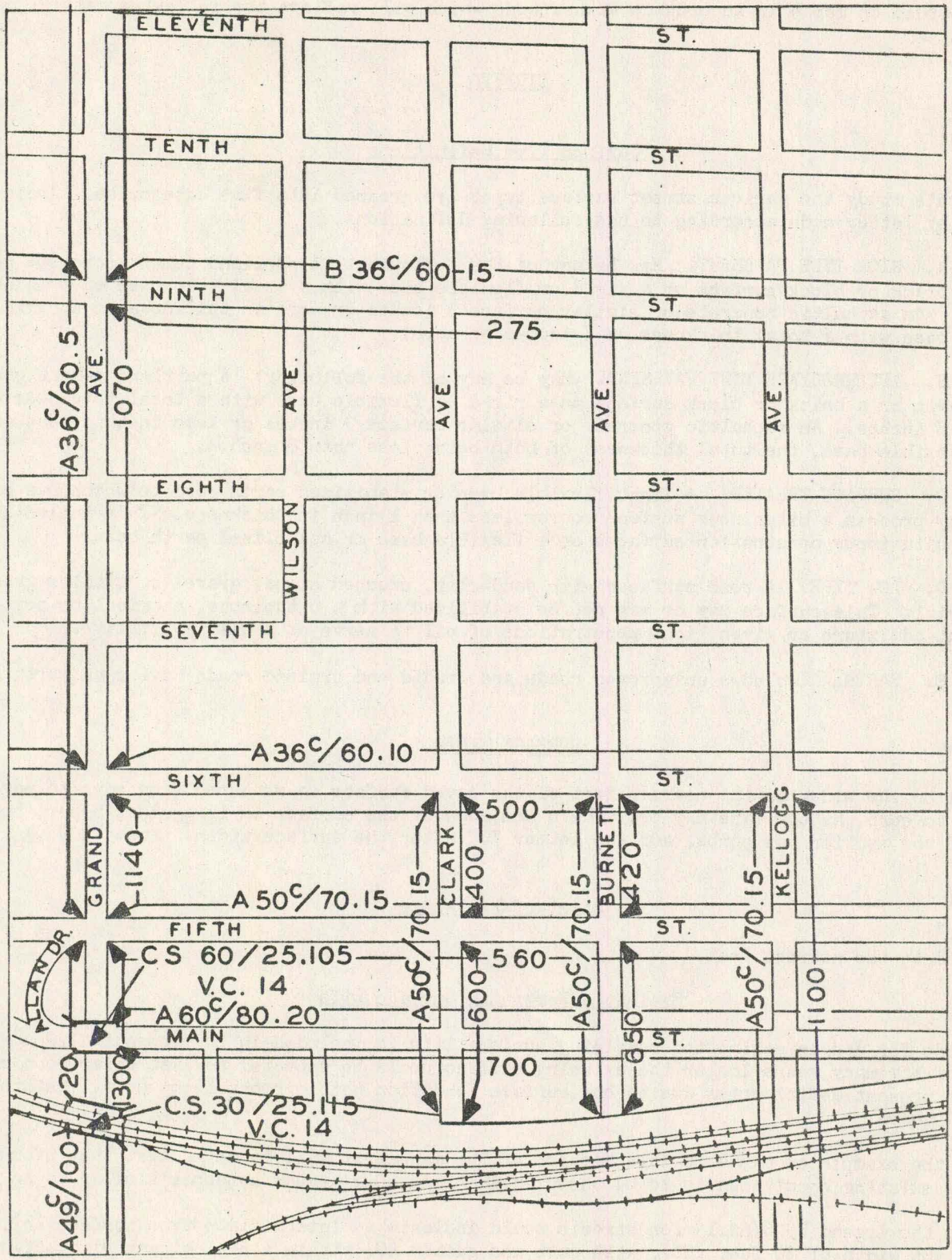
#### Estimated Remaining Surface Life

A guide for use in estimating remaining surface life is included in the appendix. Report your estimate of how many years longer the existing surface could be expected to last under good maintenance. For present deficiencies due to bad surface condition not correctable by normal maintenance, record "0" years.

From the example on map 4 in this section of the manual it will be noted that the information concerning existing conditions is to be shown in the form of a legend somewhat similar to an equation.

Thus, the legend B30C/60.15 for streets would indicate an intermediate type surface (B), having a predominant width of 30 feet (30), with curb and gutter (C) within a predominant right-of-way 60 feet wide (60) and having an estimated life expectancy of 15 years (15). Arrows will define the limits of street length within which these conditions are similar. Since these data should stand out on the map, it is requested that they be shown by fairly large symbols and in ink or colored crayon.

# MAP NO. 4
# EXISTING CONDITIONS



## STRUCTURES

The same procedure will be followed for all structures and railroad grade crossing protection. For purposes of this study, structures will be assumed to include bridges of over 20-feet clear distance between faces of end supports, measured along the center line of the street, all railroad grade separations of any length, all street grade separations, all railroad grade crossings and tunnels. If the structure is not on the map, it should be sketched on the map and a condensed description inserted. The method used for describing structures is as follows:

### Bridge Type

| Material | Legend |
|---|---|
| Concrete or Masonry | C |
| Precast concrete | PC |
| Prestressed concrete beams | PCB |
| Steel | S |
| Timber | T |
| Combination CS, CT, ST, PCT, PCBT, or CPCB | |

### Clear Bridge Width

Shall be the width from curb to curb or wheel guard to wheel guard.

### Estimated Age

The age calculated from the date of construction or the estimated age if records of construction are not available. Bear in mind the procedure for estimating the present age of structures is different from the procedure for roadway surfaces for which the estimated remaining life is desired.

### Length of Structure

Over-all length in feet will be shown as measured between back of abutments and along the centerline of the street.

### Minimum Vertical Clearance

If the structure has an overhead restriction such as a steel truss bridge portal or a structure under a railroad, show the minimum height from street surface to lowest member over the street to the nearest foot.

These data are also to be shown in the form of a legend as previously described, and would indicate for the legend ST48/25.130, a structure with predominating materials of steel and timber (ST), having a clear bridge width of 48 feet (48), with an estimated age of 25 years (25), and being 130 feet in length (130). Show minimum vertical clearance thus: v.c. 11.5

## METHODS FOR OBTAINING TRAFFIC VOLUMES

In order to further evaluate street needs it is requested that, where available, each city show in black figures the design hour volume counts for all arterial streets. These counts should be shown as illustrated on map 4. These counts should be located on the opposite side of the street band from the street condition legend described previously and should be defined as to limits of street length by arrows.

The City Engineer will also need to report design hour volumes on his project work sheets. The relation between annual average daily traffic on a street and the traffic in the "design hour" varies depending on (1) type of traffic, (2) type of development in the area (downtown, intermediate, outlying) and (3) nature or extent of cross traffic. For the usual urban condition the highest hourly flow is found during the afternoon work-to-home peaks. The highest of these afternoon peaks for each week are usually averaged for the year to represent the hourly volume for design. This approach generally yields a design-hour volume which approximates the 30th highest hourly volume for the year.

Traffic data for major city streets show that in general the volume (both directions) during the 30th highest hour varies from 7 to 18 percent of the ADT, with the average about 11 percent.

On existing arterial streets with some congestion design hour volumes are usually found in the range of 8 to 10 percent of ADT. Where there is no congestion this value would be 10 to 12 percent.

On new arterial streets where freedom of operation by traffic is substantial, design hour volumes can be expected to vary between 12 to 14 percent of ADT.

On circumferential routes around the downtown area design hour volumes can be expected to range from 10 to 12 percent of ADT, and for outlying circumferentials about 13 to 15 percent of ADT.

## Special Instructions for Taking Short Traffic Counts

For the average city there will be no great difficulty in obtaining satisfactory traffic volume information from short counts taken through the peak hour.

Procedure:

1. A Friday not preceded or followed by a holiday or snow storm will give a count which can be seasonally adjusted to approximate the design hour volume.

2. Pick out a location along the street between intersections where the traffic volume appears to be greatest.

3. Counts should continue for at least two hours and cover the traffic peak (usually 4 PM to 6 PM). Longer counts will relieve doubt as to the high traffic hour and 12-hour or 24-hour counts will be helpful.

4. The 15-minute counts should be arranged chronologically. The greatest sum of any consecutive four 15-minute periods will give the desired count.

5. If abnormal variations in directional flow are apparent, counts may be necessary in the morning and afternoon to determine the high hour.

6. Counts made during the winter season should be increased by 1.05 to yield the approximate design hour volume.

## SPECIAL TRAFFIC STUDIES

While many of Iowa's smaller cities are experiencing traffic congestion problems, the amount of congestion and size of traffic volumes generally lend themselves to solutions within the framework of available factual information. The problem in cities of over 50,000 is more complex and generally the factual information gathered to date is not sufficient to arrive at solutions which do not involve considerable personal judgment.

Accordingly, arrangements were made at the outset of the engineering study to conduct cooperative origin and destination traffic surveys in the seven larger cities of Iowa. The results of these surveys will be used in determining the location and type of facilities needed to provide fully adequate street transportation in these cities.

* * * * * * * * * * * * * * * * * * * * * * *

If your city has been engaged in the continuing program of urban transportation planning as recommended by the National Committee on Urban Transportation, most of the data requested in this "Study of Existing Conditions" section will then already be available in your records. For example, the procedure described in the NCUT Manual on Street Inventory would satisfy the requirements of this study.

SECTION 4

## BASIC PRINCIPLES FOR STUDY OF DEFICIENCIES AND NEEDS

Conferences with each city over 5,000 population will be arranged by the Engineering Office of the Study Committee. These conferences are to be attended by the Director of Public Works, City Engineer, City Traffic Engineer (if any), City Planner (if any), a representative of the Urban Department of the State Highway Commission, a representative of the District Office of the State Highway Commission, and the County Engineer. At this conference existing deficiencies and needed improvements will be determined. Following the conference each City Engineer will estimate the cost of needed improvements and forward the originals of all project work sheets and appropriate maps to the Engineering office of the Study Committee in Ames for review and consolidation with other city needs.

The objective is to determine the most economical long-range solution of the traffic problem over a 20-year period for all arterial streets. The analysis recognizes that:

1. State highways are usually the main arteries of local, as well as state-wide travel. State highways must be considered in relation to the total traffic movement on the entire street system.

2. Generally, there are several streets available and alternative solutions to traffic problems are possible.

3. Reasonable freedom from delay should be provided, varying in amount in each community, depending on time losses.

4. Terrain and existing urban development may severely restrict the location and type of facility which can be provided with reasonable economy.

5. Central business districts are established and in most cases, little widening or other physial improvement within such areas is possible to aid traffic circulation. By-passes of such areas are justified wherever there is heavy, through traffic.

6. Current engineering practices should be followed in new designs. Widening of existing streets should produce at least one added traffic lane, and resurfacing or reconstruction of pavements will be needed in accordance with estimated pavement life expectancy.

7. Traffic control measures are required to the maximum extent to keep the existing street system at top efficiency but, in most cases, they cannot be expected to solve the basic problem.

8. The solution should anticipate the probable direction and extent of population, industry, business and traffic growth. The plan, however, is not a fixed commitment in its details. It should be divided into stages of work according to the degree of urgency and practicability.

### DETERMINATION OF DEFICIENCIES AND NEEDS

Each city street and structure is to be appraised following the methods and procedures hereinafter described to determine it's adequacy to handle today's traffic. Street deficiencies are in two broad categories, (1) structural and (2) the capacity to move traffic. A deficiency in either or both may exist now, or may develop within the next 20 years - the period covered by this study.

Work proposed should be indicated as "Needed Now", or needed in one of the four, future 5-year periods. By comparing existing conditions (including design-hour traffic volumes) with minimum conditions of adequacy as described in the appendix, present adequacy can reasonably be determined. Care must also be exercised in evaluating other adjacent streets which may become deficient within the 20-year study period.

Before a street is declared deficient for capacity reasons, all reasonable relief measures should be exhausted before resorting to major construction projects. The following relief measures should be considered:

#### Removal of Street Parking

Removal of street parking at peak periods or at all times may gain sufficient capacity to satisfy the demand. It should be born in mind that some provision must be made for this loss of parking. No construction project will be considered where diagonal parking is maintained within the street boundaries.

## One-way Streets

Conversions from two-way street operation to one-way streets operating in pairs will increase capacity. This is particularly effective in relieving congestion on narrow streets.

## Traffic Signals

A study of traffic flow as compared with signal timing may be helpful in increasing capacity. On arterial streets it is desirable to have traffic signals interconnected so as to provide progressive movement for traffic. Retiming of traffic signals to allow more green time for congested streets may give some relief. Where cross traffic volume is light, traffic actuated signals may be helpful.

## Lane Lines

Pavement markings of all kinds and especially lane markings are valuable in keeping traffic organized. This promotes higher capacity.

## Restriction of Turning Movements

Prohibition of turns, particularly left turns, generally provides for a better flow of traffic and thereby increases capacity. Caution must be exercised that prohibition of turns at one location will not create an undesirable situation at another.

## Truck Routes

Reduction of the number of large trucks (dual-tired vehicles) increases passenger car traffic capacity. However, it is not reasonable to impose too much penalty in distance or time and, accordingly, the route selected for truck traffic should be reasonably direct and suitable for such traffic or must be made so.

## Channelizing Islands

Channelizing islands are devices superimposed on the roadway surface to control the directional movement of vehicles waiting to turn or cross, and reduce the area in which the vehicles are exposed to conflict. Channelizing islands tend to place vehicles one behind the other in orderly fashion and allow them to move through congested areas with a minimum of conflict. This type of treatment is expecially adaptable to complex intersections involving more than four approaches, or where the angles of approach are acute. In many cases proper channelization will eliminate signalized intersections and increase efficiency.

* * * * * * * * * * * * * * * * * * * * * * * * * * * *

The Hourly Capacity Tables in the appendix will assist in judging the present capacity of the street under existing conditions and the amount of relief certain remedial measures may afford. Thus, the installation of one-way traffic, elimination of left turns, elimination of parking during peak hours, or re-routing of commercial vehicles may give adequate capacity for present or anticipated future traffic.

It will also be necessary to estimate future traffic to determine the design standards of new improvements and to determine when presently adequate streets become deficient in traffic capacity.

There is no set formula for forecasting future traffic volumes, but it has been found that the statewide increase in travel by 1980 on all highways, roads and streets in Iowa is expected to be 70 percent. However, this is an average figure. The City Engineer should check with the City Traffic Engineer (if one is available) before entering his estimate on project work sheets. Traffic on many major streets can be expected to increase by more than the average amount. Community growth in each city will have its own individual characteristics and, therefore, items such as local economy, industrial growth, etc., should be given due consideration before future traffic projections are made. Where deviation from the average appears reasonable, the City Engineer should show his reasons on the project work sheet under remarks.

## TOLERABLE CONDITIONS

Guides have been established for use in determining the present adequacy of existing arterial streets. These guides include criteria similar to those used in the table of design standards but

are not as exacting. They represent a level of arterial street adequacy which may be described as barely tolerable to the user, and are called "minimum conditions considered tolerable for present traffic."

The determination of whether an existing street is tolerable is not a strictly mechanical process. This manual and the table of "minimum conditions" are guides to assist the engineer, based on the more common situations known to exist. There will be special cases and borderline situations which are not covered here. One or two minor deficiencies would not be enough reason to declare a street intolerable. However, one major deficiency such as lack of traffic volume capacity or a number of minor deficiencies would.

## USE OF MAPS AND FORMS

The location and number of all proposed projects for which costs are estimated on arterial streets or business and industrial access streets will be shown on map 5. Contracts let to construction prior to January 1, 1960 should be treated as though completed, and the characteristics of the street following completion reported on form ASF-M2. Project limits will be indicated by arrows to the ends of the projects. Assign a project number to each proposed improvement and show this number between the arrows defining the limits. Circle the number. For structures included in a street project, indicate location by a circled project number with a single arrow drawn to the location of the proposed structure. Just above the circled project numbers for either a street or structure, indicate the year-period in which construction is proposed. If the work is "Needed Now", indicate by placing the letter "N" just above the circled project number. If the work is needed in the first five-year construction period, indicate by placing "0-5" just above the circled project number. Follow the same procedure for the year periods "5-10", "10-15" and "15-20".

If no work is needed in the next 20 years, the limits of the adequate street will be defined by arrows and instead of a circled project number, the figures "O.K.20+" will be shown to indicate the section is adequate.

Form ASF-M2 will be used for recording existing inventory, deficiencies, the corrective measures decided upon and for developing the project cost estimate for roadways. Proposed work on structures and railroad protection forming a part of a street project, will be included on form ASF-SRP with a form ASF-SRP completed for each structure or railroad protection for which work is proposed and attached to form ASF-M2. For a separate structure not a part of a street project, but for which work is proposed, a form ASF-M2 and a form ASF-SRP will each be completed and submitted together.

Project numbers of form ASF-M2 and form ASF-SRP will conform with the location and project numbers shown on map 5.

The hourly capacity tables and the tables of new construction standards will be of assistance in determining street needs in each locality. A table listing the approximate costs to be applied to various street needs and all other tables and samples of the forms to be used are to be found in the appendix. The Engineering Office of the Study Committee feels that it will be more expedient and present a more realistic cost estimate if these prices are applied by engineers in each city before review by the Automotive Safety Foundation. Use your own estimates if you have more specific data.

Complete forms ASF-M2 and ASF-SRP for all deficient streets, structures and railroad grade crossings and submit together with all maps to the:

Engineering Offices
Iowa Highway Study Committee
Bldg. 6, Iowa State Highway Commission
Ames, Iowa

In case of any uncertainity at any point in the work program, information should be requested at the above address without delay. If necessary telephone Ames, CE (Cedar) 2-7251, Extension 292 or come to the office.

## RURAL STANDARDS

There may be instances where it would be manifestly improper to measure deficiencies and recommend improvements using criteria for city streets. The character of land use inside some incorporated cities and towns is rural in nature and may continue to remain so for the next 20 years. In such cases rural cross-sections may already exist.

Keep in mind, however, that where a municipal street section now exists, or where more than 50 percent of the area adjacent to the street is already developed (houses, stores, etc.), or where the

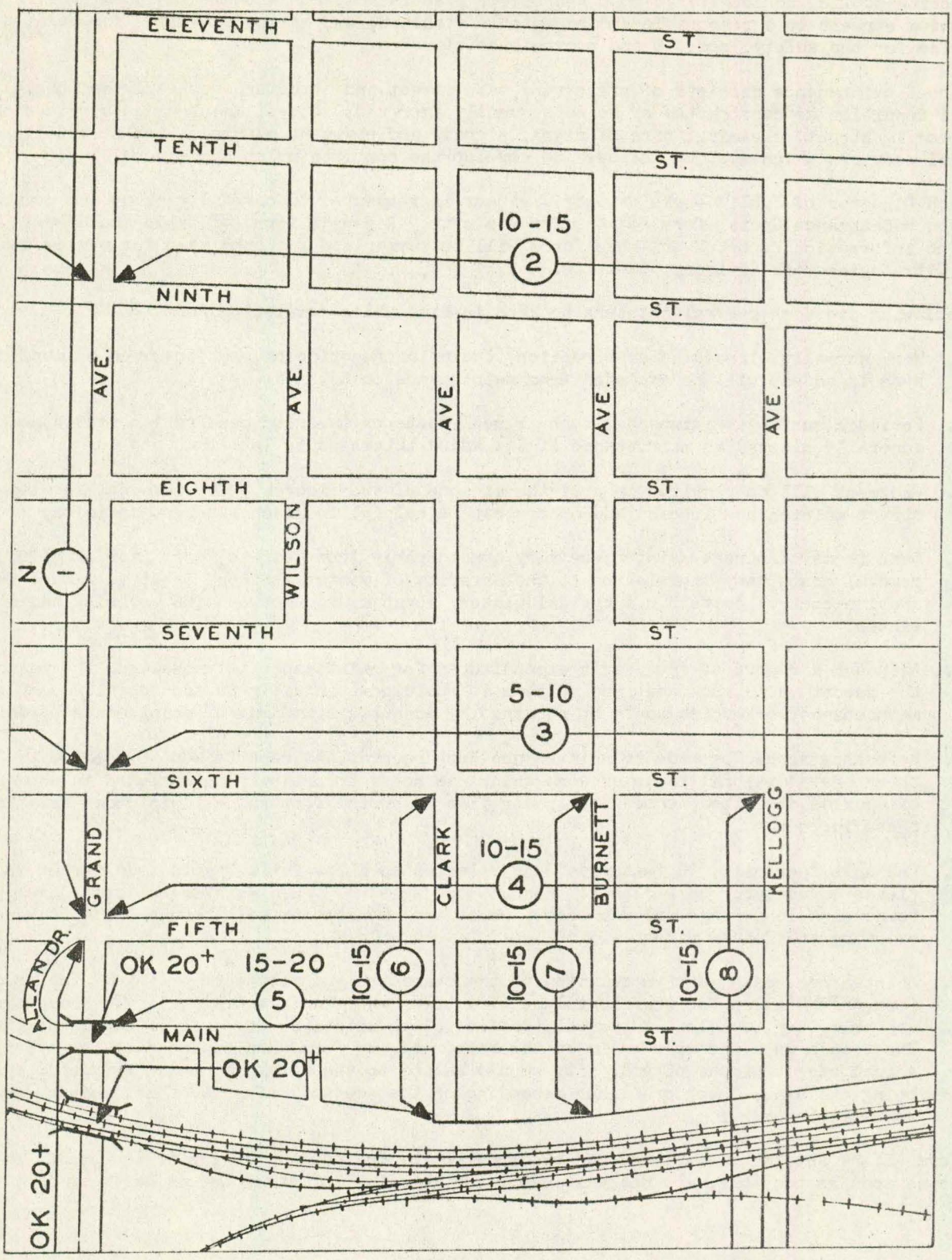
area adjacent to the street is expected to become at least 50 percent developed in the next 20 years, or if the street connects two nearby developed areas both of which already have municipal street cross-sections - in all the above cases it is appropriate to use municipal standards and report the needs on form ASF-M2.

Where rural cross-sections exist or would be appropriate, use Highway Project Work Sheets, form ASF-S1 for urban extension of state highways and County Project Work Sheets, form ASF-C1 for urban extension of county roads instead of form ASF-M2. A copy of the State Manual of Engineering Procedures for determining state highway needs and a copy of the County Manual of Engineering Procedures for determining county road needs will be furnished each Director of Public Works or City Engineer for this purpose. A supply of highway project work sheets will also be furnished.

* * * * * * * * * * * * * * * * * * * * *

Having gathered the information necessary for the needs study as set out in this manual it will be comparatively simple and well worth-while for each city to set up a procedure for keeping this information continuously up to date as recommended in the Guide and Manual of the National Committee on Urban Transportation.

# MAP NO. 5
## STREET AND STRUCTURE NEEDS
(REFER ALSO TO MAP NO. 1, PAGE 5)



## SECTION 5

## REPORT OF STREET MAINTENANCE COSTS

Inasmuch as adequate street maintenance is essential to providing good transportation service to the motoring public, no long-range road and street plan is complete without including the cost of maintaining streets to a reasonable and acceptable standard, and making provision for related services to provide for the safety, comfort and convenience of users.

Street maintenance consists of preserving each street and structure as nearly as possible in its original condition as constructed or as subsequently improved. Street maintenance services such as snow removal, street cleaning, care of signs, signals and pavement markings, and street lighting are essential services which must be included to develop the complete maintenance work load.

Each Director of Public Works or City Engineer is requested to carefully study and complete the report on Maintenance Costs, form ASF-M4, for his city. A sample form ASF-M4 is included in the appendix. The information reported on these forms will be summarized and submitted for review and analysis by the City Engineering Advisory Committee.

Following are some general pointers to keep in mind while completing form ASF-M4.

1. Work normally classed as construction, including resurfacing when one inch or more of thickness is added, will be excluded from maintenance costs.

2. Periodic surface maintenance, such as seal coats or inverted penetration retreatments, are generally classed as maintenance if the added thickness is less than one inch.

3. Judgment will be required in arriving at some of the figures. The personal knowledge of street maintenance foremen and others may be helpful to reach the best decision.

4. Some items of street maintenance very considerably from year to year. For example, snow removal costs vary in relation to the severity of winter weather. What is wanted is snow and ice control costs for a typical winter, about midway between the severist and mildest winter.

5. Although a report of one year's expenditures for maintenance is requested, the balance of the report is to show what you believe it would cost annually to successfully complete the maintenance work which would be required by adequate standards of maintenance performance.

6. Reference should be made to maintenance cost records and reports kept by each city. If there are additional items of work which can not appropriately be included in any of the categories described, enter them under item 10 on the form and explain under remarks what these include.

7. The unit "per mile, 30 feet wide" was selected to allow for variations in street widths. Please adjust your cost data to this unit of measure. When maintenance costs are applied to develop long-range program costs, necessary adjustments will then be made to agree with existing and future street widths.

8. Maintenance costs vary in relation to the character and volume of traffic. The headings on form ASF-M4 allow for traffic volume variations only in a general way. To the extent you are able, try to select a typical traffic volume situation for each of the conditions shown. The totals on a per mile basis at the bottom of the form when expanded to the mileage and actual street widths of your city should relate to the total maintenance expenditure reported, being the same, lower or higher depending on the adequacy of present maintenance performance and efficiency.

Form ASF-M4 should be completed and returned to the Engineering Office of the Study Committee in Ames as soon as possible. Do not wait until the appraisal of street needs has been completed.

# APPENDIX

TABLE I

MINIMUM CONDITIONS CONSIDERED TOLERABLE FOR PRESENT TRAFFIC

| DESIGN FEATURE | CRITERIA |
|---|---|
| SURFACE TYPE | Existing streets having a dustless surface (type C or better) shall be considered tolerable for present traffic. |
| SURFACE CONDITION | The condition of a surface (type C or better) is considered tolerable for present traffic provided there is no indication of imminent failure. Excessive cracking, pot holes, rutting, extensive joint failures and longitudinal unevenness are indications of surface failure (or base or subgrade conditions causing the surface to fail). If these conditions cannot be corrected by normal maintenance the surface condition is considered intolerable. |
| RIDEABILITY | Poor riding qualities most often occur on older pavements and can be present even though failure of the surface is not imminent. Qualities considered below minimum conditions include excessive crown, poor intersection contour which cause vehicles to "lope", surface roughness, bumps and severe longitudinal unevenness. If these qualities can only be corrected by reconstruction, rideability is below minimum conditions. |
| TRAFFIC CONTROL | Where congestion exists and available traffic control measures have not been implemented, then existing traffic control measures are inadequate. Absence of any of the following measures which would eliminate or reduce congestion, will result in "traffic control" being declared below minimum conditions considered tolerable.<br>1. Prohibition of street parking during peak hours or at all times.<br>2. Establishment of one-way streets operating in pairs, if feasible.<br>3. Interconnection of traffic signals to provide progressive movement of traffic.<br>4. Provision of lane lines and other pavement markings.<br>5. Prohibition of turning movements.<br>6. Establishment of truck routes, if necessary.<br>7. Channelization of complicated intersections, or intersections where turning movements are frequent. |
| CONTINUITY OF DESIGN | Normally, traffic movement is facilitated and driving made easier when geometric features of an arterial street are uniform and continuous throughout its length. Such features as offset street intersections (causing sharp changes in horizontal alinement), frequent changes in street width (a narrow street surface for several blocks), noticeable changes in surface type (from a smooth asphaltic concrete to rough granite block), and infrequent, abrupt vertical curves (crests or valleys) are considered intolerable. |
| DRAINAGE | Existing drainage facilities shall be considered tolerable providing they remove surface water without damage to the street and without causing an impediment or hazard to the free movement of vehicles. Standing water on a significant portion of the street surface after a rainfall is not tolerable. Open ditches adjacent to the roadway are not considered acceptable in areas where more than 50 percent of the contiguous area has been developed. |
| EXCESSIVE MAINTENANCE | Maintenance costs normally vary with the age of the street and volume of traffic. For example, surface maintenance costs on arterial streets carrying about 10,000 vehicles per day will range from a low to a high cost depending primarily on the age of the pavement. Where such costs are unusually high (twice the normal cost) they are regarded as excessive and below minimum conditions. However, the maintenance cost on a street carrying 18,000 vehicles per day may be about the same as a 10,000 VPD street considered intolerable and yet the 18,000 VPD street may be considered acceptable - for that larger volume of traffic. Accordingly, each arterial street must be considered in relation to others in the same traffic volume bracket to determine whether its maintenance cost is excessive. Whenever maintenance costs exceed twice the normal costs |

| DESIGN FEATURE | CRITERIA |
|---|---|
| Cont. EXCESSIVE MAINTENANCE | for a particular traffic volume group they are considered intolerable. |
| ACCIDENT FREQUENCY | Where motor vehicle accident information is available the number of accidents on the street section in one recent year should be divided by the length of section to determine the average number of accidents per mile for that year. If there has been more than five reported accidents per mile (fatal, injury or property damage) during the year the accident frequency is too high and is below minimum conditions. |
| TRAFFIC CAPACITY | Traffic capacity shall be considered tolerable if the 1959 design hour volume traffic count does not exceed the calculated practical capacity. |
| STREET LIGHTING | Illumination shall be considered tolerable if each intersection along an arterial street is well lighted. |
| STRUCTURES | Structures should be as wide as approach streets, have vertical clearance for vehicular traffic of at least 13 feet, load rating of H-15, deck surfaces in good condtion with sidewalks adequate for the pedestrian traffic, if any. |
| RAILROAD GRADE SEPARATION OR CROSSING PROTECTION | Main line railroad crossings on arterial streets carrying heavy traffic sometimes warrant grade separations. However, due to the complications involved in many urban grade separation projects each location presents a separate problem not susceptible to a generalized solution or statement as to minimum conditions for which separation of grades is warranted. Each case must be evaluated on the basis of engineering judgment of all factors involved. A general guide as to the need for grade separation of main line railway crossings is to multiply the average daily train traffic by the average daily street traffic. This product is called the exposure factor. Where the product is in excess of 25,000 there is warrant for separation.<br><br>Where the exposure factor (average number of trains per day times average annual daily traffic) is above 25,000 and no grade separation exists, the condition will be considered tolerable if the crossing is protected by flashing lights and automatic gates with automatic flood lights included if there are switching operations conducted at night at the crossing.<br><br>Where the exposure factor is above 3,000 flashing lights alone are considered tolerable.<br><br>Where the exposure factor is under 3,000, reflectorized signs with advance warning signs are considered tolerable.<br><br>At any railroad grade crossing where there is frequent, excessive delay (over 10 minutes at a time) to traffic caused by switching of trains, the condition should be regarded as below minimum conditions. |

TABLE II

DESIGN STANDARDS FOR NEW CONSTRUCTION

ON ARTERIAL CITY STREETS

| Design Features | Freeways | | Arterial Streets | | | | |
|---|---|---|---|---|---|---|---|
| | | | Cities Over 5000 Population | | | Cities Under 5000 Pop. | |
| | | | Down Town Areas | Intermediate Areas | Outlying Areas | Down Town Areas | Outlying Areas |
| | 1 | 2 | 4 | 5 | 6 | 7 | 8 |
| 1980 Design Hour Volume | 4000 To 6000 | 750 To 4000 | See Remarks Under Surface Width | | | | |
| Lane Width | 12' | 12' | 11' | 11' | 11' | 11' | 11' |
| Number of Lanes | 6 | 4 | 4 or More | 4 or More | 2 or More | 4 or More | 2 or More |
| Surface Width | 72 | 48 | Width to be governed by 1980 traffic volume and operating conditions. Refer to Hourly capacity tables in appendix. | | | | |
| Surface Type /1 | A | A | A | A or B | A, B or C | A | A, B or C |
| Curbs and Sidewalks /2 | Not Required | | Yes | Yes | As Required | Yes | As Required |
| Shoulder Width /2 | 10' | 10' | None | None | 8' If Not Curbed | None | 8' If Not Curbed |
| Median Width | Normally 16' Minimum 4' Barrier Type | | Desirable | | | | |
| Parking | Not Permitted | | Permitted only when hourly capacity tables show there will be sufficient traffic capacity if parallel parking is permitted. | | | | |
| Illumination | Continuous | | Continuous | | Intersections | Continuous | Intersections |
| Traffic Control At Intersections | No Intersections at Grade | | Progressive traffic signal system, or fixed time traffic signals at intersections where cross traffic is more than 10% of the arterial under consideration thru stop sign control elsewhere. | | | | |
| Structure Roadway Width | Less than 150' long-full roadway width (incl. sho.) over 150' long-surface width plus 6' | | Street surface width plus 4 feet plus sidewalks (if required) or 18" safety walk. | | | | |
| Vertical Clearance | 15' | | 15' | 15' | 15' | 15' | 15' |
| Design loading | H20-S16 | | H20-S16 | | | | |
| Railroad Separation Structures | Required for all R.R. Crossings | | Where practical and feasible, separation structures on all mainline R.R. crossings and on other R.R. lines where exposure factor is 25,000 or above. | | | | |
| Grade Crossing Protection | Not Applicable | | Automatic gates and flashing lites where exposure factor exceeds 3000; flashing lites only where exposure factor is 1500 to 3000; reflectorized warning signs where exposure factor is less than 1500 | | | | |

/1 Where more than one surface type is shown, the selection should be based on character and amount of traffic

/2 Decision whether to use shoulders or curbs should depend on extent of urban development. Where the area adjacent to street is, or will become, more than 50% developed use curbs.

ENGINEERING OFFICES
IOWA HIGHWAY STUDY COMMITTEE
REPORT ON MAINTENANCE COSTS

City Name _____ Population Size: 5-10,000 ☐ 10-20,000 ☐ 20-40,000 ☐ OVER 40,000 ☐ Form ASF-M4

| Type of Maintenance Operation | Total Expenditure For the Year 19___ | Unit | Estimate of Average Annual Cost for Adequate Maintenance | | | | |
|---|---|---|---|---|---|---|---|
| | | | Arterial Streets | | | Residential Streets | |
| | | | St. Hwys | Types A&B Surfaces | Type C Surfaces | Types A, B, C Surfaces | Type D, E Surfaces |
| 1. Routine Surface Maintenance. patching, joint sealing, mud jacking, replacement of gravel surfacing, periodic grading | | per mile 30' wide | | | | | |
| 2. Special surface maintenance. seal coats, minor betterments, planing and resurfacing, when less than 1" of new material is added, etc. | | per mile 30' wide | | | | | |
| 3. Curbs, gutters, ditches, entrances, sidewalks, shoulders, culverts. Repairs and minor replacements | | per mile | | | | | |
| 4. Structures and Underpasses. Painting and repairs | | per lineal ft 30' wide | | | | | |
| 5. Roadside. Grass mowing, reseeding, replanting, trimming trees, collection of debris | | per mile | | | | | |
| 6. Snow and ice control. Plowing snow, snow removal, sanding salting, ice removal | | per mile 30' wide | | | | | |
| 7. Street cleaning. Sweeping, flushing, cleaning catch basins and storm sewers | | per mile 30' wide | | | | | |
| 8. Traffic Control. Repair and replacement of signs, repair of signals, power to operate signals, painting of pavement markings. | | per mile 30' wide | | | | | |
| 9. Street lighting. Repairs to and replacement of lights and poles, power for operation | | per mile | | | | | |
| 10. Other. Describe _____ _____ | | | | | | | |
| 11. Overhead and administration. office rental, heat and light, office supplies and equipment, salaries of overhead and superuisory personnel, engineering etc. | | per mile | | | | | |
| Totals | | | | | | | |

Remarks:

Prepared by: _____ Title: _____ Date: _____ 19___

GUIDE CONSTRUCTION COST DATA FOR ARTERIAL CITY STREETS

| Class of Work | Unit | Cost Range Low | Normal | High |
|---|---|---|---|---|
| 1. RIGHT OF WAY (exclusive of freeways) | sq ft | $0.35 | $0.75 | $4.00 |
| 2. EASEMENTS, DAMAGES | front foot | $0.50 | $1.50 | $15.00 |
| 3. UTILITIES - Move and adjust | mile | $2,000 | $8,000 | $12,000 |
| *4. STORM DRAINAGE (Including excavation and backfill for storm sewers only, inlets and manholes) | | | | |
| Downtown areas | mile | *$5,000 | *$12,500 | *$17,500 |
| Outlying areas | mile | *$4,000 | *$10,000 | *$12,000 |
| 5. GRADING | | | | |
| a. Reconstruction of an existing street including removal of old surface, base, curb, gutter, sidewalk and trees, excavation, hauling of excavated material, borrow, fine grading and related work. | 1'wide per mile | $300 | $600 | $900 |
| b. Street widening including removal of old curb, gutter and sidewalks, trees, excavation, hauling of excavated material, borrow, fine grading and related work. | 1'wide per mile | $200 | $500 | $900 |
| c. New streets where none exists now including clearing and grubbing, excavation, hauling excavated material, borrow, fine grading and related work. | 1'wide per mile | $200 | $400 | $700 |
| d. Freeways | 1'wide per mile | $6,200 | $20,800 | $27,800 |
| 6. SURFACE AND BASE | | | | |
| Low Type | | | | |
| a. A double-shot inverted penetration surface (3/4") on a gravel, stone or stabilized soil base of less than 8 inches thickness. | 1'wide per mile | $800 | $1,100 | $1,500 |
| Intermediate Type | | | | |
| b. A bituminous road mix 3 inches or more in thickness on a gravel, stone or stabilized soil base having a total surface (Cont'd.) | | | | |

* These costs represent only that portion of the total storm drainage cost which is applicable to the project to be estimated, (generally 10 percent).

| Class of Work | Unit | Cost Range Low | Normal | High |
|---|---|---|---|---|
| b. (Contd) and base thickness of less than 8 inches. | 1'wide per mile | $900 | $1,400 | $1,700 |
| c. A hot-mix asphaltic concrete surface 2 inches or less in thickness on a gravel, stone, stabilized soil or portland cement concrete base having a total surface and base thickness of less than 8 inches. | 1'wide per mile | $1,300 | $2,400 | $3,000 |
| d. A portland cement concrete surface six inches or less in thickness laid directly on a compacted and finished subgrade. | 1'wide per mile | $2,500 | $3,000 | $3,200 |
| High Type | | | | |
| e. A hot-mix asphaltic concrete surface three inches or more in thickness on a gravel, stone, stabilized soil or portland cement concrete base having a total surface and base thickness of more than 8 inches. | 1'wide per mile | $1,600 | $3,100 | $4,000 |
| f. A portland cement concrete surface 8 inches or more in thickness on a gravel, stone or stabilized soil base, or a portland cement concrete surface 10 inches or more in thickness laid directly on compacted and finished subgrade. | 1'wide per mile | $3,000 | $3,700 | $4,100 |
| Resurfacing (per inch thickness) | 1'wide per mile | $300 | $400 | $430 |
| 7. CURB AND GUTTER (one side only) | mile | $11,900 | $14,500 | $15,800 |
| 8. SIDEWALKS (4" thickness) | 1'wide per mile | $2,300 | $2,800 | $3,000 |
| 9. SOIL EROSION CONTROL (seeding, sodding, planting.) | mile | $8,000 | $9,500 | $10,500 |
| 10. STREET LIGHTING (including connections to service) | | | | |
| Per intersection | each | $300 | $1,000 | $1,200 |
| Continuous along street | mile | $10,000 | $25,000 | $40,000 |
| 11. TRAFFIC SIGNALS (4-way, 3 light) | | | | |
| Fixed time (per intersection) | each | $2,000 | $2,500 | $4,000 |

| Class of Work | Unit | Cost Range Low | Normal | High |
|---|---|---|---|---|
| Traffic actuated (per intersection) | each | $5,000 | $11,000 | $15,000 |
| Pedestrian actuated (per intersection) | each | $1,200 | $1,500 | $2,000 |
| Interconnected (per intersection) | each | $5,000 | $12,000 | $16,000 |
| Flashing light | each | $400 | $800 | $1,200 |
| 12. STRUCTURES | | | | |
| Steel I-beam, concrete deck | sq ft | $10.50 | $11.50 | $12.50 |
| Welded steel girder | sq ft | $12.50 | $13.75 | $15.00 |
| Prestressed concrete beam and deck | sq ft | $9.50 | $10.50 | $11.50 |
| Continuous concrete slab | sq ft | $10.00 | $11.00 | $12.00 |
| Precast concrete | sq ft | $9.50 | $10.25 | $11.00 |
| Treated timber | sq ft | $9.00 | $9.50 | $10.00 |
| 13. RAILROAD PROTECTION | | | | |
| Signs only | crossing | $95 | $105 | $125 |
| Flashing lights only | crossing | $6,000 | $10,000 | $17,000 |
| Flashing lights and gates | crossing | $12,000 | $15,000 | $30,000 |

GUIDES FOR ESTIMATING REMAINING SURFACE LIFE [1]

CITY STREETS

| Year Built or Last Resurfaced | Average Remaining Life | | | Year Built or Last Resurfaced | Average Remaining Life | | |
|---|---|---|---|---|---|---|---|
| | Type A Surfaces | Type B Surfaces | Type C Surfaces | | Type A Surfaces | Type B Surfaces | Type C Surfaces |
| 1960 | 35 Yrs | 25 Yrs | 10 Yrs | | | | |
| 59 | 34 | 24 | 9 | 1924 | 8 Yrs | 3 Yrs | |
| 58 | 33 | 23 | 8 | 23 | 8 | 2 | |
| 57 | 32 | 22 | 7 | 22 | 8 | 2 | |
| 56 | 31 | 21 | 6 | 21 | 7 | 2 | |
| 1955 | 30 | 20 | 6 | 1920 | 7 | 2 | |
| 54 | 29 | 19 | 5 | 19 | 7 | 2 | |
| 53 | 28 | 18 | 5 | 18 | 6 | 1 | |
| 52 | 27 | 17 | 4 | 17 | 6 | 1 | |
| 51 | 26 | 16 | 4 | 16 | 6 | 1 | |
| 1950 | 25 | 15 | 3 | 1915 | 5 | 1 | |
| 49 | 24 | 15 | 3 | 14 | 5 | 1 | |
| 48 | 23 | 14 | 2 | 13 | 5 | 1 | |
| 47 | 22 | 13 | 2 | 12 | 4 | 0 | |
| 46 | 22 | 12 | 2 | 11 | 4 | 0 | |
| 1945 | 21 | 12 | 1 | 1910 | 4 | 0 | |
| 44 | 20 | 11 | 1 | 9 | 4 | | |
| 43 | 19 | 10 | 1 | 8 | 3 | | |
| 42 | 18 | 10 | 1 | 7 | 3 | | |
| 41 | 18 | 9 | 0 | 6 | 3 | | |
| 1940 | 17 | 9 | 0 | 1905 | 3 | | |
| 39 | 16 | 8 | | 4 | 3 | | |
| 38 | 16 | 8 | | 3 | 2 | | |
| 37 | 15 | 7 | | 2 | 2 | | |
| 36 | 14 | 7 | | 1 | 2 | | |
| 1935 | 14 | 6 | | 1900 | 2 | | |
| 34 | 13 | 6 | | 1899 | 2 | | |
| 33 | 13 | 6 | | 98 | 2 | | |
| 32 | 12 | 5 | | 97 | 1 | | |
| 31 | 12 | 5 | | 96 | 1 | | |
| 1930 | 11 | 5 | | 1895 | 1 | | |
| 29 | 11 | 4 | | 94 | 1 | | |
| 28 | 10 | 4 | | 93 | 1 | | |
| 27 | 10 | 4 | | 92 | 0 | | |
| 26 | 9 | 3 | | 91 | 0 | | |
| 1925 | 9 | 3 | | 1890 | 0 | | |

[1] Using the age of the existing surface, enter the proper column for surface type and read the figure representing the average number of additional years of service which can be expected, for that type of surface. The above remaining lives are averages for the ages shown. For specific streets these values should be reduced if the pavement surface is in poor or very poor condition. The values may be increased if the pavement is in good

## HOURLY CAPACITY TABLES

Hourly capacity tables in the following pages are based on data described in the Highway Capacity Manual dated 1950 as published by the Highway Research Board. The data show hourly volume capacities at signalized intersections, which usually limit the amount of traffic which can flow on a street in a given period of time. Capacities are affected principally by:

1. Area of city; i.e., downtown, intermediate, outlying.
2. Distribution of two-way traffic by direction, assumed to be, in the peak hours:
   50-50 for downtown areas
   55-45 for intermediate areas
   60-40 for out-lying areas
3. Type of street operation; i.e., one-way or two-way.
4. Extent of parking.
5. Amount of green signal time available in the hour.
6. Width of street.
7. Other factors such as amount of truck and bus traffic, turning movements, etc. The tables following assume average conditions for all factors not specifically defined.

The tables should be used with judgment since conditions which are unusual will affect results. Tables are self-explanatory with these helps:

1. Description of Areas

   a. DOWNTOWN AREA. An area devoted mainly to business purposes, consisting of closely spaced development, 50% or more of which is devoted to business purposes.
   b. INTERMEDIATE AREA. Area generally surrounding the downtown area, consisting of closely spaced development, possibly with multi-unit dwellings and less than 50% devoted to business.
   c. OUT-LYING AREA. Mainly residential with more widely spaced single unit dwellings.

2. The controlling percentages of green signal time which may be used in estimating street capacity for major streets are 45%, 55% and 65%. If 45% of the green signal time is used in estimating the capacity of one of the intersecting streets, then 45% of the green signal time must be used in estimating the capacity of the other intersection street. If 55% of the green signal time is used for a major street, then 35% of the green signal time must be used for the minor intersecting street. The interlocking percentages are enclosed in parenthesis.

## EXAMPLE OF HOURLY STREET CAPACITY COMPUTATION

The example chosen is the signalized intersection of 1st Street and 2nd Avenue in the downtown area.

1st Street is a two-way street, 70' wide, with parking permitted on both sides. Design hour traffic volume on the north leg of the intersection is 2,455 and on the south leg is 2,399.

2nd Avenue is a one-way street, 40' wide with no parking permitted. Design hour traffic on both the east and west legs is 753.

Since 1st Street has about 75% of the total traffic volume of the intersection, it will be assumed that the signal at the intersection is timed for 65%-25% green with 65% of the green on 1st Street.

Then for 1st Street, the table for "Two-way Street, Downtown, Parking Permitted" will be used. In this table, enter the tabulation for (65-25). Follow down under 65 to the figure opposite 70 for total street width. This is 1,920 which is the average hourly capacity for this leg of the intersection.

Since the characteristics of South 1st Street are the same as for North 1st Street, it will have the same average hourly capacity which is 1,920.

East 2nd Avenue MUST be estimated on the 25% of green allowed in the table for (65-25). Again, entering the table for "One-way Street, Downtown, Parking Prohibited," the columns for (65-25) are entered and following down under 25 to the figure opposite 40 for total street width. This is 820 which is the average hourly capacity for this leg.

As West 2nd Avenue has the same characteristics as East 2nd Avenue, it will have the same average hourly capacity which is 820.

In the computation for 2nd Avenue, it will be noted that 25% green MUST be estimated, since 65% green was used for the other street forming the intersection. This totals 90% of the total cycle time. The other 10% is used for two cycles of yellow. No allowance should be made in computations for vehicles crossing on yellow as these vehicles were considered in the studies for capacity for the percentage of green given in the table.

## AVERAGE HOURLY CAPACITY

## TWO-WAY STREET, BOTH DIRECTIONS

| Total Street Width | Downtown—Parking Prohibited Percent Green | | | | | Downtown—Parking Permitted Percent Green | | | | |
|---|---|---|---|---|---|---|---|---|---|---|
| | 45 | (55 — 35) | | (65 — 25) | | 45 | (55 — 35) | | (65 — 25) | |
| 20 | 360 | 440 | 280 | 520 | 200 | --- | --- | --- | --- | --- |
| 22 | 450 | 550 | 350 | 650 | 250 | --- | --- | --- | --- | --- |
| 24 | 540 | 660 | 420 | 780 | 300 | --- | --- | --- | --- | --- |
| 26 | 630 | 770 | 490 | 910 | 350 | --- | --- | --- | --- | --- |
| 28 | 720 | 880 | 560 | 1040 | 400 | --- | --- | --- | --- | --- |
| 30 | 810 | 990 | 630 | 1170 | 450 | 450 | 550 | 350 | 650 | 250 |
| 32 | 900 | 1100 | 700 | 1300 | 500 | 495 | 600 | 390 | 720 | 270 |
| 34 | 990 | 1210 | 770 | 1430 | 550 | 540 | 660 | 420 | 780 | 300 |
| 36 | 1080 | 1320 | 840 | 1560 | 600 | 585 | 710 | 460 | 850 | 320 |
| 38 | 1170 | 1430 | 910 | 1690 | 650 | 650 | 800 | 500 | 940 | 360 |
| 40 | 1260 | 1540 | 980 | 1820 | 700 | 700 | 850 | 550 | 1010 | 390 |
| 42 | 1350 | 1650 | 1050 | 1950 | 750 | 740 | 910 | 570 | 1070 | 410 |
| 44 | 1440 | 1760 | 1120 | 2080 | 800 | 790 | 960 | 620 | 1140 | 440 |
| 46 | 1530 | 1860 | 1200 | 2210 | 850 | 830 | 1010 | 650 | 1200 | 460 |
| 48 | 1600 | 1950 | 1250 | 2310 | 890 | 880 | 1070 | 690 | 1270 | 490 |
| 50 | 1665 | 2030 | 1300 | 2400 | 930 | 920 | 1120 | 720 | 1330 | 510 |
| 52 | 1755 | 2140 | 1370 | 2540 | 970 | 970 | 1180 | 760 | 1400 | 540 |
| 54 | 1820 | 2220 | 1420 | 2620 | 1020 | 1010 | 1230 | 790 | 1460 | 560 |
| 56 | 1890 | 2300 | 1480 | 2730 | 1050 | 1060 | 1290 | 830 | 1530 | 590 |
| 58 | 1960 | 2390 | 1530 | 2830 | 1090 | 1100 | 1340 | 860 | 1590 | 610 |
| 60 | 2025 | 2470 | 1580 | 2930 | 1120 | 1150 | 1400 | 900 | 1660 | 640 |
| 62 | 2070 | 2530 | 1610 | 2990 | 1150 | 1170 | 1430 | 910 | 1690 | 650 |
| 64 | 2140 | 2610 | 1670 | 3090 | 1190 | 1215 | 1480 | 950 | 1760 | 670 |
| 66 | 2180 | 2660 | 1700 | 3150 | 1210 | 1260 | 1540 | 980 | 1820 | 700 |
| 68 | 2230 | 2720 | 1740 | 3220 | 1240 | 1280 | 1560 | 1000 | 1850 | 710 |
| 70 | 2300 | 2800 | 1800 | 3320 | 1280 | 1330 | 1620 | 1040 | 1920 | 740 |
| 72 | 2340 | 2850 | 1830 | 3380 | 1300 | 1350 | 1650 | 1050 | 1950 | 750 |

## AVERAGE HOURLY CAPACITY

## TWO-WAY STREET, BOTH DIRECTIONS

| Total Street Width | Intermediate—Parking Prohibited Percent Green | | | | | Intermediate—Parking Permitted Percent Green | | | | |
|---|---|---|---|---|---|---|---|---|---|---|
| | 45 | (55 — 35) | | (65 — 25) | | 45 | (55 — 35) | | (65 — 25) | |
| 20 | 325 | 400 | 250 | 470 | 180 | --- | --- | --- | --- | --- |
| 22 | 410 | 500 | 320 | 590 | 230 | --- | --- | --- | --- | --- |
| 24 | 490 | 600 | 380 | 710 | 270 | --- | --- | --- | --- | --- |
| 26 | 580 | 700 | 460 | 830 | 330 | --- | --- | --- | --- | --- |
| 28 | 660 | 800 | 520 | 950 | 370 | --- | --- | --- | --- | --- |
| 30 | 735 | 900 | 570 | 1060 | 410 | 450 | 540 | 360 | 650 | 250 |
| 32 | 820 | 1000 | 640 | 1180 | 460 | 490 | 590 | 390 | 710 | 270 |
| 34 | 900 | 1100 | 700 | 1300 | 500 | 550 | 670 | 430 | 800 | 300 |
| 36 | 980 | 1200 | 760 | 1420 | 540 | 590 | 720 | 460 | 850 | 330 |
| 38 | 1045 | 1270 | 820 | 1510 | 580 | 660 | 800 | 520 | 950 | 370 |
| 40 | 1100 | 1340 | 860 | 1590 | 610 | 700 | 850 | 550 | 1010 | 390 |
| 42 | 1165 | 1420 | 910 | 1680 | 650 | 735 | 890 | 580 | 1060 | 410 |
| 44 | 1230 | 1500 | 960 | 1770 | 690 | 800 | 970 | 630 | 1160 | 440 |
| 46 | 1270 | 1550 | 990 | 1830 | 710 | 840 | 1020 | 660 | 1210 | 470 |
| 48 | 1310 | 1600 | 1020 | 1890 | 730 | 900 | 1100 | 700 | 1300 | 500 |
| 50 | 1355 | 1650 | 1060 | 1950 | 760 | 945 | 1160 | 730 | 1370 | 520 |
| 52 | 1390 | 1700 | 1080 | 2000 | 780 | 980 | 1200 | 760 | 1420 | 540 |
| 54 | 1435 | 1740 | 1130 | 2070 | 800 | 1045 | 1270 | 820 | 1510 | 580 |
| 56 | 1470 | 1790 | 1150 | 2120 | 820 | 1090 | 1330 | 850 | 1570 | 610 |
| 58 | 1510 | 1840 | 1180 | 2180 | 840 | 1145 | 1400 | 890 | 1650 | 640 |
| 60 | 1535 | 1870 | 1200 | 2220 | 850 | 1185 | 1450 | 920 | 1710 | 660 |
| 62 | 1555 | 1890 | 1220 | 2240 | 870 | 1230 | 1500 | 960 | 1770 | 690 |
| 64 | 1595 | 1940 | 1250 | 2300 | 890 | 1270 | 1550 | 990 | 1830 | 710 |
| 66 | 1620 | 1970 | 1270 | 2330 | 910 | 1315 | 1600 | 1030 | 1890 | 740 |
| 68 | 1640 | 2000 | 1280 | 2360 | 920 | 1355 | 1650 | 1060 | 1950 | 760 |
| 70 | 1660 | 2020 | 1300 | 2390 | 930 | 1400 | 1700 | 1100 | 2020 | 780 |
| 72 | 1680 | 2050 | 1310 | 2420 | 940 | 1430 | 1740 | 1120 | 2070 | 790 |

## AVERAGE HOURLY CAPACITY

## TWO-WAY STREET, BOTH DIRECTIONS

| Total Street Width | Outlying or Rural Percent Green | | | | | | |
|---|---|---|---|---|---|---|---|
| | 45 | (55 — 35) | | (65 — 25) | | (75 — 16.7) | |
| 20 | 300 | 370 | 230 | 430 | 170 | 500 | 110 |
| 22 | 370 | 450 | 290 | 540 | 200 | 620 | 140 |
| 24 | 455 | 560 | 350 | 660 | 250 | 760 | 170 |
| 26 | 530 | 650 | 410 | 760 | 300 | 880 | 190 |
| 28 | 560 | 680 | 440 | 810 | 310 | 940 | 200 |
| 30 | 635 | 780 | 490 | 920 | 350 | 1070 | 230 |
| 32 | 715 | 880 | 550 | 1030 | 400 | 1190 | 260 |
| 34 | 785 | 960 | 610 | 1130 | 440 | 1320 | 290 |
| 36 | 840 | 1030 | 650 | 1210 | 470 | 1410 | 310 |
| 38 | 900 | 1100 | 700 | 1300 | 500 | 1500 | 330 |
| 40 | 960 | 1180 | 740 | 1380 | 540 | 1600 | 350 |
| 42 | 1015 | 1240 | 790 | 1460 | 570 | 1690 | 370 |
| 44 | 1070 | 1310 | 830 | 1540 | 600 | 1790 | 400 |
| 46 | 1110 | 1360 | 860 | 1600 | 620 | 1850 | 410 |
| 48 | 1160 | 1420 | 900 | 1670 | 650 | 1940 | 430 |
| 50 | 1200 | 1470 | 930 | 1730 | 670 | 2020 | 440 |
| 52 | 1235 | 1510 | 960 | 1780 | 690 | 2060 | 460 |
| 54 | 1270 | 1560 | 980 | 1830 | 710 | 2120 | 470 |
| 56 | 1315 | 1610 | 1020 | 1880 | 730 | 2200 | 480 |
| 58 | 1350 | 1660 | 1040 | 1940 | 760 | 2260 | 490 |
| 60 | 1370 | 1680 | 1060 | 1970 | 770 | 2290 | 500 |
| 62 | 1400 | 1710 | 1090 | 2020 | 780 | 2350 | 520 |
| 64 | 1430 | 1750 | 1110 | 2060 | 800 | 2380 | 520 |
| 66 | 1440 | 1760 | 1120 | 2070 | 810 | 2410 | 530 |
| 68 | 1460 | 1790 | 1130 | 2100 | 820 | 2450 | 540 |
| 70 | 1480 | 1810 | 1150 | 2130 | 830 | 2470 | 550 |
| 72 | 1500 | 1840 | 1160 | 2160 | 840 | 2510 | 550 |

## AVERAGE HOURLY CAPACITY

### ONE-WAY STREET

| Total Street Width | Downtown—Parking Both Sides | | | | | Intermediate—Parking Both Sides | | | | |
|---|---|---|---|---|---|---|---|---|---|---|
| | Percent Green | | | | | Percent Green | | | | |
| | 45 | (55 — 35) | | (65 — 25) | | 45 | (55 — 35) | | (65 — 25) | |
| 20 | ---- | ---- | ---- | ---- | --- | ---- | ---- | ---- | ---- | --- |
| 22 | ---- | ---- | ---- | ---- | --- | ---- | ---- | ---- | ---- | --- |
| 24 | ---- | ---- | ---- | ---- | --- | ---- | ---- | ---- | ---- | --- |
| 26 | ---- | ---- | ---- | ---- | --- | ---- | ---- | ---- | ---- | --- |
| 28 | ---- | ---- | ---- | ---- | --- | ---- | ---- | ---- | ---- | --- |
| 30 | ---- | ---- | ---- | ---- | --- | ---- | ---- | ---- | ---- | --- |
| 32 | ---- | ---- | ---- | ---- | --- | ---- | ---- | ---- | ---- | --- |
| 34 | ---- | ---- | ---- | ---- | --- | ---- | ---- | ---- | ---- | --- |
| 36 | ---- | ---- | ---- | ---- | --- | ---- | ---- | ---- | ---- | --- |
| 38 | ---- | ---- | ---- | ---- | --- | ---- | ---- | ---- | ---- | --- |
| 40 | 830 | 1020 | 640 | 1190 | 470 | 850 | 1040 | 660 | 1230 | 470 |
| 42 | 880 | 1080 | 680 | 1270 | 490 | 900 | 1100 | 700 | 1300 | 500 |
| 44 | 930 | 1140 | 720 | 1340 | 520 | 960 | 1170 | 750 | 1380 | 540 |
| 46 | 980 | 1200 | 760 | 1410 | 550 | 1010 | 1240 | 780 | 1460 | 560 |
| 48 | 1035 | 1260 | 810 | 1490 | 580 | 1060 | 1300 | 820 | 1530 | 590 |
| 50 | 1075 | 1310 | 840 | 1550 | 600 | 1110 | 1370 | 850 | 1610 | 610 |
| 52 | 1120 | 1370 | 870 | 1620 | 620 | 1165 | 1430 | 900 | 1680 | 650 |
| 54 | 1160 | 1420 | 900 | 1680 | 640 | 1225 | 1490 | 960 | 1770 | 680 |
| 56 | 1200 | 1470 | 930 | 1730 | 670 | 1280 | 1560 | 1000 | 1850 | 710 |
| 58 | 1240 | 1520 | 960 | 1790 | 690 | 1315 | 1610 | 1020 | 1900 | 730 |
| 60 | 1280 | 1570 | 990 | 1850 | 710 | 1365 | 1670 | 1060 | 1970 | 760 |
| 62 | 1320 | 1610 | 1030 | 1910 | 730 | 1410 | 1720 | 1100 | 2030 | 790 |
| 64 | 1370 | 1670 | 1070 | 1980 | 760 | 1455 | 1780 | 1130 | 2100 | 810 |
| 66 | 1390 | 1700 | 1080 | 2010 | 770 | 1490 | 1830 | 1150 | 2150 | 830 |
| 68 | 1420 | 1740 | 1100 | 2050 | 790 | 1535 | 1870 | 1200 | 2220 | 850 |
| 70 | 1450 | 1770 | 1130 | 2090 | 810 | 1585 | 1930 | 1240 | 2290 | 880 |
| 72 | ---- | ---- | ---- | ---- | --- | ---- | ---- | ---- | ---- | --- |

## AVERAGE HOURLY CAPACITY

### ONE-WAY STREET

| Total Street Width | Downtown—Parking One Side Percent Green | | | | | Intermediate—Parking One Side Percent Green | | | | |
|---|---|---|---|---|---|---|---|---|---|---|
| | 45 | (55 — 35) | | (65 — 25) | | 45 | (55 — 35) | | (65 — 25) | |
| 20 | ---- | ---- | ---- | ---- | --- | ---- | ---- | ---- | ---- | ---- |
| 22 | ---- | ---- | ---- | ---- | --- | ---- | ---- | ---- | ---- | ---- |
| 24 | ---- | ---- | ---- | ---- | --- | ---- | ---- | ---- | ---- | ---- |
| 26 | ---- | ---- | ---- | ---- | --- | ---- | ---- | ---- | ---- | ---- |
| 28 | ---- | ---- | ---- | ---- | --- | ---- | ---- | ---- | ---- | ---- |
| 30 | 700 | 850 | 550 | 1020 | 380 | 735 | 900 | 570 | 1070 | 400 |
| 32 | 760 | 930 | 590 | 1090 | 430 | 830 | 1020 | 640 | 1200 | 460 |
| 34 | 830 | 1010 | 650 | 1200 | 460 | 900 | 1100 | 700 | 1300 | 500 |
| 36 | 900 | 1100 | 700 | 1300 | 500 | 975 | 1190 | 760 | 1410 | 540 |
| 38 | 955 | 1170 | 740 | 1380 | 530 | 1030 | 1250 | 810 | 1480 | 580 |
| 40 | 1025 | 1250 | 800 | 1490 | 560 | 1090 | 1340 | 840 | 1580 | 600 |
| 42 | 1080 | 1320 | 840 | 1560 | 600 | 1155 | 1410 | 900 | 1670 | 640 |
| 44 | 1150 | 1400 | 900 | 1670 | 630 | 1210 | 1470 | 950 | 1740 | 680 |
| 46 | 1190 | 1450 | 930 | 1720 | 660 | 1260 | 1540 | 980 | 1820 | 700 |
| 48 | 1240 | 1520 | 960 | 1790 | 690 | 1310 | 1600 | 1020 | 1900 | 720 |
| 50 | 1295 | 1580 | 1010 | 1870 | 720 | 1365 | 1670 | 1060 | 1970 | 760 |
| 52 | 1350 | 1650 | 1050 | 1950 | 750 | 1420 | 1740 | 1100 | 2060 | 780 |
| 54 | 1390 | 1690 | 1090 | 2010 | 770 | 1460 | 1790 | 1130 | 2110 | 810 |
| 56 | 1440 | 1760 | 1120 | 2080 | 800 | 1510 | 1850 | 1160 | 2180 | 830 |
| 58 | 1490 | 1830 | 1150 | 2160 | 820 | 1555 | 1890 | 1220 | 2240 | 870 |
| 60 | 1530 | 1870 | 1190 | 2210 | 850 | 1610 | 1950 | 1270 | 2320 | 900 |
| 62 | 1580 | 1930 | 1230 | 2290 | 870 | 1640 | 1990 | 1290 | 2350 | 930 |
| 64 | 1620 | 1980 | 1260 | 2340 | 900 | 1680 | 2050 | 1310 | 2410 | 950 |
| 66 | 1660 | 2030 | 1290 | 2390 | 930 | 1730 | 2110 | 1350 | 2500 | 960 |
| 68 | 1710 | 2090 | 1330 | 2470 | 950 | 1785 | 2170 | 1400 | 2570 | 1000 |
| 70 | ---- | ---- | ---- | ---- | --- | ---- | ---- | ---- | ---- | ---- |
| 72 | ---- | ---- | ---- | ---- | --- | ---- | ---- | ---- | ---- | ---- |

## AVERAGE HOURLY CAPACITY

### ONE-WAY STREET

| Total Street Width | Downtown—Parking Prohibited Percent Green | | | | | Intermediate—Parking Prohibited Percent Green | | | | |
|---|---|---|---|---|---|---|---|---|---|---|
| | 45 | (55 — 35) | | (65 — 25) | | 45 | (55 — 35) | | (65 — 25) | |
| 20 | 555 | 680 | 430 | 810 | 300 | 555 | 680 | 430 | 810 | 300 |
| 22 | 665 | 810 | 520 | 960 | 370 | 660 | 810 | 510 | 970 | 350 |
| 24 | 775 | 950 | 600 | 1120 | 430 | 755 | 920 | 590 | 1090 | 420 |
| 26 | 880 | 1080 | 680 | 1280 | 480 | 840 | 1030 | 650 | 1220 | 460 |
| 28 | 970 | 1190 | 750 | 1400 | 540 | 920 | 1120 | 720 | 1320 | 520 |
| 30 | 1080 | 1320 | 840 | 1560 | 600 | 990 | 1210 | 770 | 1430 | 550 |
| 32 | 1170 | 1430 | 910 | 1690 | 650 | 1060 | 1300 | 820 | 1530 | 590 |
| 34 | 1240 | 1520 | 960 | 1800 | 680 | 1110 | 1360 | 860 | 1600 | 620 |
| 36 | 1330 | 1630 | 1030 | 1930 | 730 | 1185 | 1450 | 920 | 1710 | 660 |
| 38 | 1420 | 1740 | 1100 | 2050 | 790 | 1240 | 1510 | 970 | 1790 | 690 |
| 40 | 1490 | 1830 | 1150 | 2160 | 820 | 1290 | 1570 | 1010 | 1870 | 710 |
| 42 | 1580 | 1930 | 1230 | 2290 | 870 | 1350 | 1650 | 1050 | 1950 | 750 |
| 44 | 1660 | 2020 | 1300 | 2400 | 920 | 1420 | 1740 | 1100 | 2050 | 790 |
| 46 | 1730 | 2120 | 1340 | 2490 | 970 | 1470 | 1800 | 1140 | 2120 | 820 |
| 48 | 1820 | 2220 | 1420 | 2630 | 1010 | 1510 | 1850 | 1170 | 2180 | 840 |
| 50 | 1890 | 2310 | 1470 | 2730 | 1050 | 1565 | 1910 | 1220 | 2260 | 870 |
| 52 | 1960 | 2400 | 1520 | 2830 | 1090 | 1620 | 1980 | 1260 | 2340 | 900 |
| 54 | 2030 | 2480 | 1580 | 2930 | 1130 | 1670 | 2040 | 1300 | 2410 | 930 |
| 56 | 2110 | 2580 | 1640 | 3040 | 1180 | 1710 | 2090 | 1330 | 2470 | 950 |
| 58 | ---- | ---- | ---- | ---- | ---- | 1755 | 2140 | 1370 | 2530 | 980 |
| 60 | ---- | ---- | ---- | ---- | ---- | 1800 | 2200 | 1400 | 2600 | 1000 |
| 62 | ---- | ---- | ---- | ---- | ---- | ---- | ---- | ---- | ---- | ---- |
| 64 | ---- | ---- | ---- | ---- | ---- | ---- | ---- | ---- | ---- | ---- |
| 66 | ---- | ---- | ---- | ---- | ---- | ---- | ---- | ---- | ---- | ---- |
| 68 | ---- | ---- | ---- | ---- | ---- | ---- | ---- | ---- | ---- | ---- |
| 70 | ---- | ---- | ---- | ---- | ---- | ---- | ---- | ---- | ---- | ---- |
| 72 | ---- | ---- | ---- | ---- | ---- | ---- | ---- | ---- | ---- | ---- |

## DETAILED INSTRUCTIONS FOR COMPLETING FORM ASF-M2

| Item | Instructions |
|---|---|
| 1. | Enter the number of the State Highway Commission district in which your city is located (if known). |
| 2. | Enter the name of the county in which your city is located. |
| 3. | Enter the name of your city. |
| 4. | The U.S. or State route marker number may be shown on one of your city maps. If not, determine this number when you make your field check. Federal-aid secondary (FAS) route numbers are shown on "Official Farm to Market" road maps for each county. Check with the County Engineer in your county to get this information. FAS routes on county roads which extend into your city will connect with state highways or other FAS routes, or go on through your city or town. |
| 5. | Control section and study section number pertain to state highways only. For all other city arterials show the street section number which you entered on Map 5. |
| 6. | Check the appropriate box. |
| 7. | Enter length of street section to the nearest one-tenth of a mile. |
| 8. | Enter official street name or number and give a concise description of the beginning and ending points of the street section in item 5 above. |
| 9. | Check one of the boxes to indicate proper legal system. The only legal systems in cities which have been designated by action of the General Assembly are (1) urban extensions of the rural state primary system, (2) State park and institutional roads, and (3) urban extensions of the secondary (county) road system. Interstate highways are a part of the state primary system. If the arterial street described in item 5 and 8 above are neither of these, then the box "city street" should be checked. |
| 10. | Do not confuse with U.S. and state highway route marker numbers. Refer to a federal-aid system map for proper system determination. If none is available leave blank. This will be added later in the review by the Automotive Safety Foundation. |
| 11. | Refer to map 3 as finally approved by ASF to determine correct study system. Check proper box. |
| 12. | In order to get an accurate tabulation of existing street mileage in each city it is necessary to identify legal, platted streets which are not presently being used by traffic. Check proper box. |
| 13. | Refer to surface type definitions in Section 3 of the text and enter proper code identification. |
| 14. | Enter average or nominal width of street surfacing. In most cases this will be the curb to curb width. However, some streets are not surfaced full width. What is wanted here is the surfaced width only. |
| 15. | Enter the full width of the nominal travelled way whether surfaced or not. |
| 16. | Refer to your city plats giving right-of-way widths. If you do not have such a map, a copy can usually be obtained from one of the other city officials or from the county court house. |
| 17. | In order to provide information regarding the possibilities of street widening (where traffic conditions warrant it) it is necessary to know the nominal building set-back from the edge of the existing right-of-way line. Street widening projects involving removal of existing buildings are exorbitantly expensive. However, if widening can be done between the limits of existing buildings, the acquisition of additonal right-of-way may be economically justified. Enter nominal building set back to the nearest foot. |
| 18. | Where traffic counts are available enter the annual average daily volume for the street section. Where counts are not available, an estimate must be made. If your city has a traffic engineer or traffic officer with the city police department, have him prepare the estimate. Enter the count followed by "est." to distinguish estimated counts from those based on a field count. |

19. Refer to discussion of design hour volumes or short count instructions in Section 3 of text.

20. Refer to capacity tables elsewhere in this appendix. Use information showing (1) type of operation, (2) parking conditions, (3) percent of signal green time, (4) type of area, and (5) street width to determine practical capacity of the street.

21. If you do not have vehicle classification counts, estimate the percent of dual-tired commercial vehicles in the traffic stream. If estimated, show "est." after entry.

22. From records in the City Engineer's office determine when the street was paved or last resurfaced. Otherwise estimate the year.

23. Refer to the table elsewhere in this appendix showing "Guides for Estimating Remaining Surface Life" for aid in estimating the remaining useful life of the street surface.

24. As an aid in estimating the cost of improvement it is useful to know what utilities will be encountered. Check the appropriate box.

25. Check the appropriate box.

26. Check the appropriate box.

27. Check the appropriate box.

28. Check the appropriate box.

29. Check the appropriate box.

30. Check the appropriate box.

31. Check the appropriate box which most nearly indicates present condtions.

32. Check the appropriate boxes.

33. Check the appropriate box.

34. Check the appropriate box. Full control refers to freeway conditions where access to the street can only be gained by means of ramps at grade separation structures. Partial control refers to expressway standards where access to the street is generally at grade sometimes using channelization.

35. This information will be entered by the Engineering Office of the Study Committee based on a special study of delay on State highways in cities.

36.-46. Refer to "Minimum Conditions Considered Tolerable for Present Traffic" elsewhere in this appendix. Place a check mark in the box if the item does not meet minimum conditions. Otherwise leave blank.

47. Check one of the boxes. If the street section does not meet "minimum conditions considered tolerable" it is deficient now. One of the future five-year period boxes should be checked if the street section is tolerable now but will become deficient due to a future traffic capacity problem or if the street surface wears out at some future period. Refer to items 20 and 23 above. If both a future capacity and future structural deficiency are indicated, check the box which shows the earliest of these two deficiencies.

48. In most instances the box "no" will be checked. A special warrant for improvement may exist if any of the following conditions prevail.

a. The street should be constructed to rural standards instead of a city cross-section.
b. Existing condtions can not be fully explained on this form.
c. Unusual circumstances exist which might justify reconstruction of the street ever though the street is apparently serving traffic satisfactorily now.

49. Check the appropriate box. Refer to the table of "design standards for new construction" elsewhere in this appendix.

50. Enter length to the nearest one-tenth of a mile. This should be the same length entered in item 7 above unless the street is to be relocated, or a new street is to be built.

51. Refer to the table of "design standards for new construction" elsewhere in this appendix. Enter the proper number shown at the head of the columns.

52. Enter the traffic engineer's estimate. (See page 14 of this manual)

53. Refer to items 19 and 52. The figure entered here must relate in a logical way to the entries made in items 19 and 52.

54. Refer to the surface type definitions shown in Section 3 of the text.

55. Refer to the table of "design standards for new construction". Use the lane widths shown on this table and enter the width which can realistically be obtained in view of existing conditions.

56. Check the appropriate box.

57. Check the appropriate box.

58. Refer to the table of "design standards for new construction". These are minimum widths. If it is practicable to achieve wider medians for turning movements try to do so. Enter the width which can realistically be obtained in view of existing conditions.

59. Check the appropriate box.

60. Refer to the table of design standards. Check the appropriate box.

61. Refer to Guide Construction Cost Data, form ASF-M5, in this appendix and previous street contracts involving acquisition of right-of-way and control of access. Make your estimate as realistic as possible. Check with any other city official or others who may be in a position to firm up your estimate. Show your computations on the back side of the sheet. Show your cost to the nearest $1,000. Do not enter the last three digits.

62. Refer to the table elsewhere in this appendix showing "Guide Construction Prices" and to street contracts let during the past two years. Show your computations on the backside of this sheet. Show your cost to the nearest $1,000. Do not enter the last three digits.

63. See 62 above.

64. Enter here any necessary improvement costs not covered in items 61-63 above. Under remarks (item 67) give an explanation of the items included. Show your computations on the back side of this sheet. Show your cost to the nearest $1,000. Do not enter the last three digits.

65. Count the number of structures reported on form ASF-SRP and enter the number here.

66. Count the number of railroad grade crossing protection devices reported on form ASF-SRP and enter the number here.

67. Enter any further explanation which will help in reviewing the work sheet if the information entered above is not sufficient.

72. To be signed by the Director of Public Works or City Engineer, as the case may be. Please show the date.

ENGINEERING OFFICES
IOWA HIGHWAY STUDY COMMITTEE

# ARTERIAL STREET PROJECT WORK SHEET

## FOR DETERMINING THE NEEDS OF SELECTED ARTERIAL STREETS INCLUDING URBAN EXTENSIONS OF STATE HIGHWAYS AND MAJOR COUNTY ROADS

DO NOT USE THIS SPACE

FORM ASF-M2

ITEM | CARD CONTROL | COL. 3 | COL. 1

**IDENTIFICATION:**

1. Highway Commission District No. _____ 2. County Name _____ 3. City Name _____ — 1,2 — 2-4
4. U.S., State or FAS Route No. (If any) _____ 5. Control Section No. _____ & Study Section No. _____, or Street Section No. _____ — 3 — 5-7
6. Population Size: Unincorp. (Rural) ☐ Incorporated: Under 1000 ☐ 1000-2500 ☐ 2500-5000 ☐ 5000-10000 ☐ 10000-20000 ☐ 20000-40000 ☐ OVER 40000 ☐ (1950 Census) — 4 — 8-10
7. Length of Study Section _____ Mi. — 5 — 11-13
8. Street Name/Number _____ From _____ To _____ — 6,7 — 14-17

**CLASSIFICATION**

9. Existing System: — 9 — 18
   - STATE HIGHWAYS ☐
   - State Park and Institutional ☐
   - FARM TO MARKET ☐
   - COUNTY LOCAL ☐
   - CITY STREET ☐
10. Federal System: — 10 — 19
   - Interstate Hwy. System ☐
   - Fed.-Aid Primary ☐
   - Fed.-Aid Secondary ☐
   - Non-Federal ☐
11. Study System: — 11 — 20
   - State Trunkline ☐
   - Ext. of County Trunk ☐
   - Ext. of County Feeder ☐
   - Other City Arterial ☐
   - Business or Industrial Access ☐
   - Residential Access ☐

**EXISTING INVENTORY AND TRAFFIC DATA:**

12. Legal Platted Street But Not Open to Traffic: Yes ☐ No ☐ — 13 — 21
13. Surface Type _____ — 14 — 22-24
14. Surface Width _____ Ft. — 18 — 25-28
15. Width of Travelled Way (Incl Parking) _____ Ft. — 34 — 29
16. Right of Way Width _____ Ft. — 35 — 30-33
17. Building Setback (From Edge of R.O.W.) _____ Ft.
18. Est. 1959 Annual Ave. Daily Traffic _____ VPD
19. Est. 1959 Design Hour Volume _____ VPH
20. Practical Capacity _____ VPD
21. Percent Commercial (Dual-Tired) Vehicles _____ %
22. Year Paved or Last Resurfaced 19 ____
23. Estimated Remaining Surface Life _____ Yrs.
24. Fire Hydrants: None ☐ One Side ☐ Both Sides ☐
25. Utility Poles: None ☐ One Side ☐ Both Sides ☐
26. Storm Sewers: None ☐ In Place ☐
27. Street Lights: None ☐ Intersections ☐ Continuous ☐
28. Type of Street Lighting: Pedestal ☐ Mast Arm ☐
29. Curbs: None ☐ One Side ☐ Both Sides ☐
30. Ditches: None ☐ One Side ☐ Both Sides ☐
31. Sidewalks: None ☐ One Side ☐ Both Sides ☐
32. Parking: None ☐ One Side ☐ Both Sides ☐
    Type (If permitted): Parallel ☐ Diagonal ☐
    Restrictions: None ☐ Off-Peak Only ☐
33. Street Operation: One Way ☐ Two Way ☐
34. Type of Access Control None ☐ Partial ☐ Full ☐
35. Signalized Intersection Time Loss _____

**CHARACTER OF DEFICIENCIES:** (Check only those items found to be below minimum conditions considered tolerable)

36. Surface Type ☐ — 36,37 — 34-35
37. Surface and Base Condition ☐ — 38,39 — 36-37
38. Rideability ☐ — 40,41 — 38-39
39. Traffic Control ☐ — 42,43 — 40-41
40. Continuity of Design ☐ — 44,45 — 42-43
41. Special Warrant (Explain) ☐ — 46 — 44
42. Drainage ☐
43. Excessive Maintenance ☐
44. Structures Only ☐
45. Accident Frequency ☐
46. Traffic Capacity ☐

**WHEN IMPROVEMENT IS NEEDED:**

47. Deficient Now ☐ In 1-5 Yrs ☐ 6-10 Yrs ☐ 11-15 Yrs ☐ 16-20 Yrs ☐ Over 20 Yrs ☐ — 47,48 — 45-47
48. Special Warrant No ☐ Yes ☐ (Explain Under Remarks) — 49,50 — 48-51

**PROPOSED IMPROVEMENT:**

49. Type of Work Proposed — 54,55 — 52-54
   - Resurfacing ☐
   - Surface Widening ☐
   - Resurfacing & Widening ☐
   - Reconstruction (Same Location) ☐
   - New Construction (New Street) ☐
   - Other ☐

**DESIGN DATA:**

50. Length _____ Mi. — 60 — 55-56
51. Design Std. No. _____ — — — 57-60
52. Est. 1960 ADT _____ VPD
53. Est. 1980 DHV _____ VPH
54. Surface Type _____
55. Surface Width _____ Ft.
56. Curbed: Yes ☐ No ☐
57. Sidewalks Yes ☐ No ☐
58. Median Width (If any): _____ Ft.
59. Parking Permitted Yes ☐ No ☐
60. Access Control: None ☐ Partial ☐ Full ☐

**COST ESTIMATE:** (Thousand of Dollars)

61. Right of Way (Incl. Access Control $ _____
62. Grading and Drainage $ _____
63. Surface, Base, Curbs & Sidewalks $ _____
64. Other (Lighting, Traffic Control Etc.) $ _____

Do Not Write in This Space: _____

SPECIAL CASE — 61 — 61

65. No. of Attached Structure Sheets _____ — 61 — 62-64
66. No. of Attached R.R. Protection Sheets _____

67. REMARKS (Use back of this sheet if more space is needed) — 62 — 65-68; 63 — 69-72; 64 — 73-76

**PRIORITY INDICATORS:** (State Highways Only)

68. Dependability _____ 69. Facility of Movement _____ 70. Safety _____ 71. Cost Per Vehicle-Mile _____ — 68,69 — 77-78; 70,71 — 79-80

72. PREPARED BY: _____ TITLE: _____ DATE: _____ 1960

CO. | CITY | SEC.

## DETAILED INSTRUCTIONS FOR COMPLETING FORM ASF-SRP

| Item | Instructions |
|---|---|
| 1. | Enter the number of the State Highway Commission district in which your city is located (if known). |
| 2. | Enter the county name in which your city is located. |
| 3. | Enter the county number. |
| 4. | Enter the name of your city. |
| 5. | Enter the proper U.S., state or Federal-aid secondary route number if the street is located on one of these three systems, if not, show a "dash". This route number, if applicable, will be the same as for item 4 on appropriate form ASF-M2. |
| 6. | Control section and study section number pertain to state highways only. For all other city arterials show the street section number from apropriate form ASF-M2. |
| 7. | Repeat the description of street section termini given on the appropriate form ASF-M2 for the street section in 6 above. |
| 8. | Check the appropriate box. |
| 9. | Check the appropriate box. |
| 10. | Assign a structure number (ST-1, ST-2, etc.) or railroad protection number (RP-1, RP-2, etc.) and enter in space provided. A separate form ASF-SRP is required for each structure and each type of protection at railroad grade crossings. Start with ST-1 and RP-1 for each section of street. Show this number on Map 5 with a line to the structure or railroad protection. |
| 11. | For each structure reported enter its length measured along the centerline of the bridge roadway. If reporting railroad protection, enter a "dash". |
| 12,13 & 14. | Check the appropriate boxes. The box checked for each of these three items should agree with the boxes checked for items 9, 10 and 11 on appropriate form ASF-M2. |
| 15. | Check the appropriate box which most closely describes the type of service rendered by the structure. |
| 16. | Enter the proper number of spans. |
| 17. | Show the clear width of the travelled way to the nearest foot as measured between curbs or handrails, whichever is less. |
| 18. | Refer to forms ASF-M2, item 18, and enter the same traffic volume. |
| 19. | Enter to the nearest foot the measured distance from floor of bridge deck to lowest obstruction overhead. If there is no overhead obstruction enter the word "unlimited". |
| 20. | From records in the City Engineer's office show the safe load (H-20, S-16, etc.) or, if an old bridge the marked safe load (i.e., 15 tons, etc.) |
| 21. | Check one box in each column. |
| 22. | From records in the City Engineer's office determine the year built and enter here. Otherwise estimate the year built. |
| 23. | Enter average number of trains per day. |
| 24. | Enter number of tracks. |
| 25. | Check appropriate box. |
| 26-32. | Check the appropriate box after each item in line with the following guides. |

| | | Degree of Deficiency |
|---|---|---|
| 26. | Width of traveled way | |
| | 1. Meets design standards. | Good |
| | 2. Meets minimum conditions considered tolerable. | Fair |
| | 3. Roadway is narrower than approach street width but not over one foot per lane narrower. | Poor |
| | 4. Roadway is narrower than approach street width by more than one foot per lane. | Very Poor |
| 27. | Vertical clearance | |
| | 1. Meets design standards. | Good |
| | 2. Meets minimum conditions considered tolerable. | Fair |
| | 3. One foot less than minimum conditions. | Poor |
| | 4. Over one foot less than minimum conditions. | Very Poor |
| 28. | Load-carrying capacity. (Do not rate railroad overpasses.) | |
| | 1. Meets design standards. | Good |
| | 2. Meets minimum conditions considered tolerable. | Fair |
| | 3. Rated as an H-10 bridge. | Poor |
| | 4. Rated at less than H-10. | Very Poor |
| 29. | Approach alinement (include underpasses) | |
| | 1. Approaches at both ends are on tangent alinement and changes in vertical alinement are slight or non-existent. | Good |
| | 2. Horizontal or vertical alinement deficiencies exist at one approach which reduces the practical traffic capacity through or over the structure. | Fair |
| | 3. Horizontal or vertical alinement deficiencies exist at both ends of the structure which severely restrict traffic capacity. | Poor |
| | 4. Horizontal and vertical alinement deficiencies exist at both approaches which restrict traffic flow to less than 50 percent of practical capacity. | Very Poor |
| 30. | Physical condition | |
| | 1. Condition similar to a new or nearly new bridge. | Good |
| | 2. Handrails, curbs or other minor appurtenances showing deterioration, but deck and main members in sound condition. | Fair |
| | 3. Bridge deck deteriorated or weakened; or rust, spalling, cracking or rotting present on main members of superstructure or substructure without structural weakening. | Poor |
| | 4. Main members of superstructure or substructure weakened by rust, spalling, cracking or rotting. | Very Poor |
| 31. | Flooding (Rate only stream crossings) | |
| | 1. Waterway opening under bridge able to accommodate severest storm without flooding. | Good |
| | 2. Infrequent flooding, once every five years or less. | Fair |
| | 3. Occasional flooding, on an average of once a year. | Poor |
| | 4. Flooding which causes the street to be closed for more than 6 hours at a time, or flooding oftener than once a year. | Very Poor |
| 32. | Railroad grade crossing protection | |
| | 1. Meets design standards | Good |
| | 2. Meets minimum conditions considered tolerable | Fair |
| | 3. Where the exposure factor exceed 25,000 and no grade separation structure exists but no significant delay to traffic; or where the exposure factor is below 25,000 and flashing lights are provided without gates accompanied by frequent, excessive delay to traffic. | Poor |

4. Where the exposure factor exceeds 25,000 and no grade separation structure exists accompanied by frequent, excessive delay; or where the exposure factor is below 25,000 and there are warning signs only (no flashing lights or gates) and there is frequent, excessive delay to traffic.

Degree of Deficiency

Very Poor

33. Check the appropriate box. If the structure or R.R. protection does not meet "minimum conditions considered tolerable" it is deficient now. One of the future five-year period boxes should be checked if the structure or R.R. protection is tolerable now but will become structurally deficient at some future period. Refer to items 26 to 32 above. If more than one structural deficiency is indicated, check the box which shows the earliest of these deficiencies.

34. Special warrant should be checked "yes" only under the following conditions:

a. The street section of which this structure is a part has been checked as special warrant.
b. Traffic capacity is a problem.
c. The proposed improvement involves costs not normally a part of the structure cost.

35. Check appropriate box if this type of work only is required.

36. Check appropriate box if this type of work only is required.

37. Check appropriate box if this type of work only is required.

38. Check appropriate box if this type of work only is required.

39. Check appropriate box if this type of work only is required.

40. Check appropriate box if this type of work only is required.

41. Check appropriate box if this type of work only is required.

42. Check appropriate box if this type of work only is required.

If no work is required, leave all "cost range" boxes blank and check "no work"

43. Multiply length of bridge (measured along centerline of travelled way) times width to obtain deck area. If your normal practice is to include all or part of curbs, sidewalks and hand-rails to develop costs per square foot do so here.

44. Enter type of structure by the following code number.

| Type | Code |
|---|---|
| No structure or protection | 1 |
| Treated timber structure | 2 |
| Box culvert (over 20' span) | 3 |
| Precast concrete structure | 4 |
| Continuous concrete slab structure | 5 |
| Prestressed concrete beam structure | 6 |
| Steel I-beam, concrete deck structure | 7 |

45. Refer to the 1980 traffic shown on the street work sheet of which this structure or railroad protection is a part. Enter the same figure.

46. Refer to the design standards for new construction and enter the design loading here.

47. Refer to the design standards for new construction and enter the clear roadway width here.

48. Refer to guide construction cost data, form ASF-M5 and previous structure contracts involving acquisition of rights of way and control of access. Make your estimate as realistic as possible. Check with any other city official or others who may be in a position to firm up your estimate. Show your computations on the back side of the sheet. Show your cost to the nearest $1,000. Do not enter the last three digits.

49. Refer to the table elsewhere in the appendix showing "guide construction cost data" and to structure and railroad protection contracts let during the past two years. Show your computations on the back side of the sheet. Show your cost to the nearest $1,000. Do not enter the last three digits.

50. See 49 above.

51. Enter any further explanation which will help in reviewing the work sheet if the information above is not, sufficient.

52. To be signed by the Director of Public Works or City Engineer, as the case may be. Please show the date.

ENGINEERING OFFICES
IOWA HIGHWAY STUDY COMMITTEE

# STRUCTURE AND R.R. PROTECTION WORK SHEET

## FOR USE ON ALL ROAD AND STREET SYSTEMS

Form ASF-SRP

DO NOT USE THIS SPACE

| ITEMS | CARD CONTROL | COL. |
|---|---|---|
| | | 1 |
| 1,3 | | 2-4 |
| 4 | | 5-7 |
| 5 | | 8-10 |
| 6 | | 11-13 |
| 8,10 | | 14-15 |
| 11 | | 16-17 |
| | | |
| 12 | | 18 |
| 13 | | 19 |
| 14 | | 20 |
| | | |
| 15 | | 21 |
| 17 | | 22-24 |
| 18 | | 25-28 |
| 20 | | 29 |
| — | | |
| 26,27 | | 34-35 |
| 28,29 | | 36-37 |
| 30,31 | | 38-39 |
| 32 | | 40 |
| — | | 41-44 |
| 33,34 | | 45-47 |
| 35-42,43 | | 48-51 |
| 44,45 | | 52-54 |
| 46, COST RANGE | | 55-58 |
| SPECIAL CASE | | 59-61 |
| 48 | | 62-64 |
| 49 | | 65-68 |
| — | | 69-72 |
| — | | 73-76 |
| — | | 77-80 |

**IDENTIFICATION:**

1. District No: _____ 2. County Name: _____ 3. County No _____
4. City Name (If any) _____ 5. Route No. or FAS No. _____ (If any)
6. Control Section No. (If any) _____ Study Section No. _____ Or Road (Street) Section No. _____
7. Project (Road Section) Description: From _____ To _____
8. Rural-Urban Classification: Rural (Unincorporated) ☐ Pop. size if incorporated: Under 1000 ☐ 1000-2500 ☐ 2500-5000 ☐ 5,000-10,000 ☐ 10-20,000 ☐ 20-40,000 ☐ Over 40,000 ☐
9. Is there an existing structure or R.R. protection in place? Yes ☐ No ☐
10. Structure No: _____ or R.R. protection No: _____
11. Structure Length _____ (NEAREST FOOT)

**SYSTEM CLASSIFICATION:**

12. Existing System (If any)
- State Primary Highway ☐
- State Park, Institutional, Etc. ☐
- County Farm-To-Market Road ☐
- County Local Road ☐
- City Street ☐

13. Federal System
- Interstate ☐
- Federal-Aid Primary ☐
- Federal-Aid Secondary ☐
- Non-Federal ☐

14. Study System
- State Trunkline ☐
- County Trunk ☐
- County Feeder ☐
- County Local ☐
- City Arterial ☐
- Bus or Industrial Access ☐
- Residential Access St. ☐

**EXISTING INVENTORY AND TRAFFIC DATA:**

Structures Only:

15. Type of Service
- Stream Crossing ☐
- R.R. Under Hwy. ☐
- R.R. Over Hwy. ☐
- Hwy Separation ☐

16. No. Spans _____
17. Width of Travelled Way _____ Ft.
18. 1959 A.D.T. _____ VPD
19. Vertical Clearance _____ Ft.
20. Safe Loading: _____
21. Type of Material in Structure:

| | Subst. | Superst. |
|---|---|---|
| Steel | ☐ | ☐ |
| Concrete or Masonry | ☐ | ☐ |
| Timber | ☐ | ☐ |

22. Year Built 19____

Railroad Grade Crossing Protection Only:

23. No. Trains Per Day _____
24. No. Tracks _____
25. Type of Existing Protection:
- None ☐
- Cross-Arms (Signs) Only ☐
- Automatic Signals Only ☐
- Auto. Signals & Gates ☐

**CHARACTER OF DEFICIENCIES:**

| | Good | Fair | Poor | Very Poor |
|---|---|---|---|---|
| 26. Width of Travelled Way | ☐ | ☐ | ☐ | ☐ |
| 27. Vertical Clearance | ☐ | ☐ | ☐ | ☐ |
| 28. Load-Carrying Capacity | ☐ | ☐ | ☐ | ☐ |
| 29. Approach Alinement | ☐ | ☐ | ☐ | ☐ |

| | Good | Fair | Poor | Very Poor |
|---|---|---|---|---|
| 30. Physical Condition | ☐ | ☐ | ☐ | ☐ |
| 31. Flooding | ☐ | ☐ | ☐ | ☐ |
| 32. R.R. Gr. Cross Prot. | ☐ | ☐ | ☐ | ☐ |

**WHEN IMPROVEMENT IS NEEDED:**

33. Deficient Now ☐ In 1-5 Yrs ☐ 6-10 Yrs ☐ 11-15 Yrs ☐ 16-20 Yrs ☐ Over 20 Yrs ☐ or Adequate Now ☐
34. Special Warrant: No ☐ Yes ☐ Explain _____

**PROPOSED IMPROVEMENT:**

Type of Work Proposed:

| | COST RANGE L | M | H |
|---|---|---|---|
| 35. Reflloor or Resurface Travelled Way | ☐ | ☐ | ☐ |
| 36. Rebuild or Recondition | ☐ | ☐ | ☐ |
| 37. Widen | ☐ | ☐ | ☐ |
| 38. New Structure (Old Structure Abandoned or Torn Down) | ☐ | ☐ | ☐ |
| 39. New Structure (Does Not Replace an Existing Structure) | ☐ | ☐ | ☐ |
| 40. Move Existing Structure, Re-Erect | ☐ | ☐ | ☐ |
| 41. Automatic R.R. Crossing Signals Only | ☐ | ☐ | ☐ |
| 42. Automatic R.R. Crossing Signals & Gates | ☐ | ☐ | ☐ |

NO WORK ☐

43. Area of Bridge Deck _____ Sq. Ft.
44. Type of Structure _____
45. Estimated 1980 ADT _____ V.P.D.
46. Structure Design Loading _____
47. Proposed Clear Roadway Width _____ Ft.

**COST OF IMPROVEMENT:** (This space not to be completed by county engineers)

48. Right of way and Access Control $_____ (nearest 1,000)
49. Approach Road (If not part of Road Project) $_____
50. Structure $_____ or Grade Crossing Protection $ _____

51. Remarks: (Use back of sheet if more space is needed)

52. Signed: _____ Title: _____ Date: _____ 19

D CO. SEC.