Percival

IOWA STATE HIGHWAY COMMISSION

Highway Needs Studies

May 1, 1968

Since the beginning of organized road and street construction in Iowa, the question upermost in the minds of administrators, planners, legislators, and many segments of the general public has been: What is the job ahead of us and what resources do we have to accomplish these goals? Numerous studies have been conducted by individual jurisdictions and interested groups and on occasion a joint effort has been made by all jurisdictions to obtain an answer to these complex questions.

All studies in the past that dealt with this phase of planning have produced answers that were satisfactory for only one point in time but provided no means for updating the results. In October, 1957, the Iowa State Highway Commission in cooperation with the Bureau of Public Roads released the results of the "Section 210" Study. This study set out the dollar needs as determined at that time for all the road and street systems in the state. By 1959, the feeling prevailed that the 210 Study had become outdated and did not contain the detail necessary to make an accurate determination of the proper distribution of the Iowa Road Use Tax Fund among the various jurisdictions involved. The 58th General Assembly of Iowa in House Joint Resolution 12 directed that a complete review should be made of the construction, maintenance, and administration needs on Iowa's roads and streets. This resolution created the eleven-member Iowa Highway Study Committee, and required it to make recommendations to the 59th General Assembly on matters of management, financing, safety, construction, and maintenance of Iowa's highway systems. Agreements were entered into with the Automotive Safety Foundation of Washington, D.C., to direct the necessary engineering studies required to determine highway needs, and the Public Administration Service of Chicago, Illinois, to direct the necessary fiscal studies. These studies were completed in 1960 and resulted in two reports, a needs study and financial analysis, to the Highway Study Committee.

By 1966, it became apparent that the dynamic situation of change that had been experienced on Iowa's roads and streets during the preceeding six years had materially affected the 1960 analyses. The Iowa State Highway Commission upon the recommendation of the staff made the decision in early 1966 to proceed with an updating of the 1960 studies and the development of a method of maintaining an up-to-date needs and financial analysis for use in subsequent years. The feeling was, that this type of information has become so important as a management tool in this age of complex transportation problems, the expenditure of Highway Commission planning funds would be justified in establishing such a system. As a result of this decision, the Highway Commission retained Roy Jorgensen Associates, Incorporated, to perform a two part contract:

Part I - July 1966-December 1966--Update the 1960 Needs and Finance Studies to provide needs information during the interim period while a continuing needs study system was being developed.

Part II - January 1967-December 1967--Develop a system for maintaining up-to-date Needs and Finance Data

Part I of this study resulted in a report to the Iowa State Highway Commission titled "Iowa Needs and Finances, 1967-1987".

In order to develop and maintain a continually up-to-date needs study for all highways, roads and streets in Iowa, the Needs Study Unit was organized in July, 1966, under the Division of Planning. Throughout the year, 1967, Roy Jorgensen Associates, Incorporated, provided guidance and assistance to the Commission staff in establishing methods and procedures and production of necessary manuals for the successful operation of the Needs Study Unit.

A staff of four professional engineer-planners and four sub-professionals has been provided to perform the necessary activities and maintain the required records for this continuing study. The staff is headed by the Needs Study Engineer. The other three engineers are each responsible for an individual system of roads or streets: the Rural Primary System, city streets and municipal extensions of the Primary System, and county roads.

Over 112,000 miles of Iowa's roads and streets have been classified according to the function each individual facility performs. These classifications have been incorporated into the records systems maintained by the Needs Study Unit. Provision has been made for appropriate revisions to these classifications resulting from annual reviews conducted by the needs study staff.

Design guides have been developed by the needs study staff with the advice and counsel of three technical advisory committees. The committees were comprised of Commission, municipal, and county engineers. The guides are used in the determination of needs and assignment of improvements on each system of highways, roads, and streets.

Field inventories have been conducted by the needs study staff to supplement data available from existing Commission records. These inventories are performed by personnel from the Commission's district offices or temporary employees of the Needs Study Section. All inventory crews are thoroughly trained by the needs study staff to insure uniformity in reporting throughout the state.

The section-by-section appraisal of all inventoried roads and streets is accomplished by: (1) assigning numerical field rating to each section based on the present physical condition, (2) evaluating the geometric and physical characteristics through data processing methods, and (3) determining the ability of the section to carry traffic volumes at desirable operating speeds. Road and street sections that are determined to be deficient are "assigned" appropriate improvements by a computer program. Forecasts of future deficiencies on these improved sections, and on sections that are not now deficient, are made by simulating conditions on each section annually through a future 20-year period. The traffic volume on each section is expanded year-by-year, and the condition rating is depreciated year-by-year until the computer analysis determines that the section has become inadequate.

Average construction costs applied to the identified improvements through a computer cost assignment program are based on historical construction costs experienced in Iowa. Appropriate maintenance costs are also applied annually to each section throughout the 20-year study period.

Compatible records have been established for the regular updating of needs and finances. Taking advantage of data processing methods, computer tape records have been developed for all systems of roads and streets.

These records will be continually updated by the needs study staff from data furnished by county engineers, municipal officials, and the Commission staff when changes occur on the existing systems. Data from future inventories, traffic counts, cost analyses and reclassification will also be reflected in the up-to-date records.

An important part of future studies performed by the Needs Study Section will be the financial analyses relating to needs determinations. Estimating the amount of revenues that will be available and the determination of an equitable distribution between user and non-user responsibilities will be accomplished by the needs study staff.

The information derived from these needs and finance analysis studies will be invaluable to the members of the various governmental units that deal with roads and streets. One of the more important uses for this information would be in the development of future construction programs and the establishment of project priorities. Within these study results information would be readily available to answer the many requests received annually from the Bureau of Public Roads, Iowa Legislature, American Association of State Highway Officials, and many other groups and governmental units. The resulting dollar needs determined by these processes provide management with the amount of expenditure needed during a future period of time to overcome the deficiencies in their transportation systems. The financial analysis would show the amount of this future need that could be overcome with the finances available and the amount of needs that would remain due to the lack of financial resources.

Municipal Street Needs Study Evaluation

During the past year and five months, many miles of municipal streets and their necessary structures have been inventoried for use in the determination of needs. The inventory of municipal streets began in the early part of June, 1967, and was completed prior to September 15, 1967. This was not a 100% inventory due to the great volume of miles involved, however the schedule envisions a complete inventory of all municipal streets and structures within a four or five year period. The mileage inventoried in this initial period involved approximately 4952 miles. This included a 100% inventory of the Primary Road Extensions in all size communities and a 100% inventory of other arterials in all municipalities with 2500 population and greater. A 25% sample of arterial mileage was inventoried in communities with less than 2500 population. In addition, a 20% sample of the total local street mileage for all cities and towns was inventoried. As future inventories are completed they will include the balance of the miles not previously inventoried as well as a re-sampling of previously inventoried miles to determine depreciation factors.

The inventory record to be used for needs is being built from existing information when possible plus additional informational items collected in the field by inventory crews. This includes condition ratings in addition to geometric informational items.

The information gathered in the field is returned to the office where it is reviewed and checked for accuracy and ultimately is placed on the data tape record in the form shown on page 1 for road data and page 4 for structural data as illustrated in the accompanying appendix.

The first 38 spaces on page 1 deal with identification of any one roadway section. The items from this point on through tape position 161 show the existing geometric and condition items as well as the needs rating applied to each section of street. The spaces from this point through the balance of the tape record provide locations for recording information relating to future improvements required on any given street section. Space has been provided for the possibility of four future improvements plus maintenance and administration costs and the anticipated terminal condition of the street section at the completion of the 20-year study period.

The first 38 spaces on page 4 provide for the identification of structures and tape positions 39 through 93 are locations for geometric, condition, and needs rating information. Tape positions 94 through the balance of the tape record provide space for the possibility of two improvements during the study period.

100% Primary
100% Trunk
50% Feeder
20% Other
} Physical Inventory

Pages 2 and 3 and page 5 are illustrations of the code sheets used to update the tape records for roadway and structures, respectively. The tape record can be updated at any time construction is performed or some other significant change takes place on the roadway or structures.

To assist in the evaluation of each section of street a point rating system similar to sufficiency rating has been developed for city streets. The maximum possible points that can be assigned to any given section of street are shown on page 6 of the appendix. Geometric and capacity items comprise 65 points of this rating system and condition 35 points for a possible total of 100 points.

Over 2500 - 100% Arterial
Under 2500 - 100% Random Sample 22% Arterial 11½% local

Each of the geometric items on any one section of street is evaluated against a desirable design guide applicable to that particular street. If a given item meets the design guide criteria it is given the maximum points allowable. If this item fails to meet the design guides, it receives something less than the maximum. The geometric and capacity ratings are applied by a computer program, whereas the condition ratings applied to each street section are determined by field inventory crews.

If a street rates less than 70 points total, the computer program will propose an improvement to bring the rating of this street back to a level above the 70 point cut off. Street sections are also examined for individual deficiencies even though the total point rating may be above 70. This could occur in the case of unacceptable surface type, traffic carrying capacity, or other individual items. The computer program looks at each section of street for each year of the 20 year study period. As each subsequent year is examined the traffic on the road is expanded and the condition rating is depreciated until the end of the study period is reached.

? How is Traffic Coordinated

Page 7 and 8 of the appendix contains the tables used for the assignment of geometric points on any given section of road. Page 9 through page 23 of the appendix contains the capacity analysis performed on each section of street for each year of the 20 year study period. Pages 24 and 25 contain the design guides developed for needs evaluation.

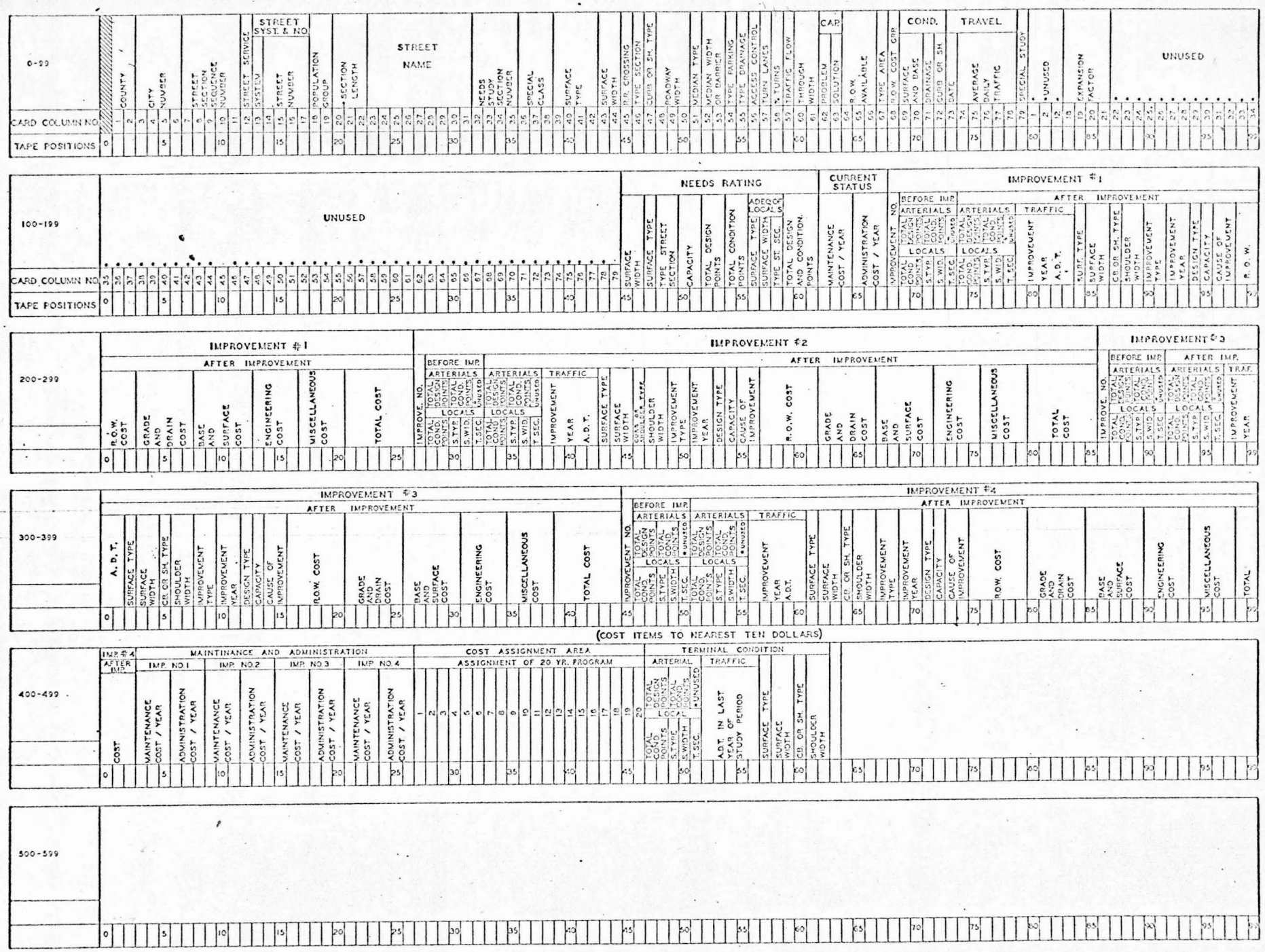
We are desirous that all municipal officials review the attached data for informational purposes. We would also welcome any suggestions that might improve our evaluation of municipal streets and structures for needs purposes. It is planned that a report will be prepared for release in the latter part of 1968 showing the needs on all road and street systems in the state of Iowa. It is our wish to review the findings of this report with the League of Iowa Municipalities in September before the final printing is completed.

APPENDIX

Municipal Street Appraisal

CITY ARTERIAL AND LOCAL STREET DATA TAPE FORMAT

PROGRAM AND PLANNING DEPARTMENT
OCTOBER 1967



ARTERIAL AND LOCAL STREETS

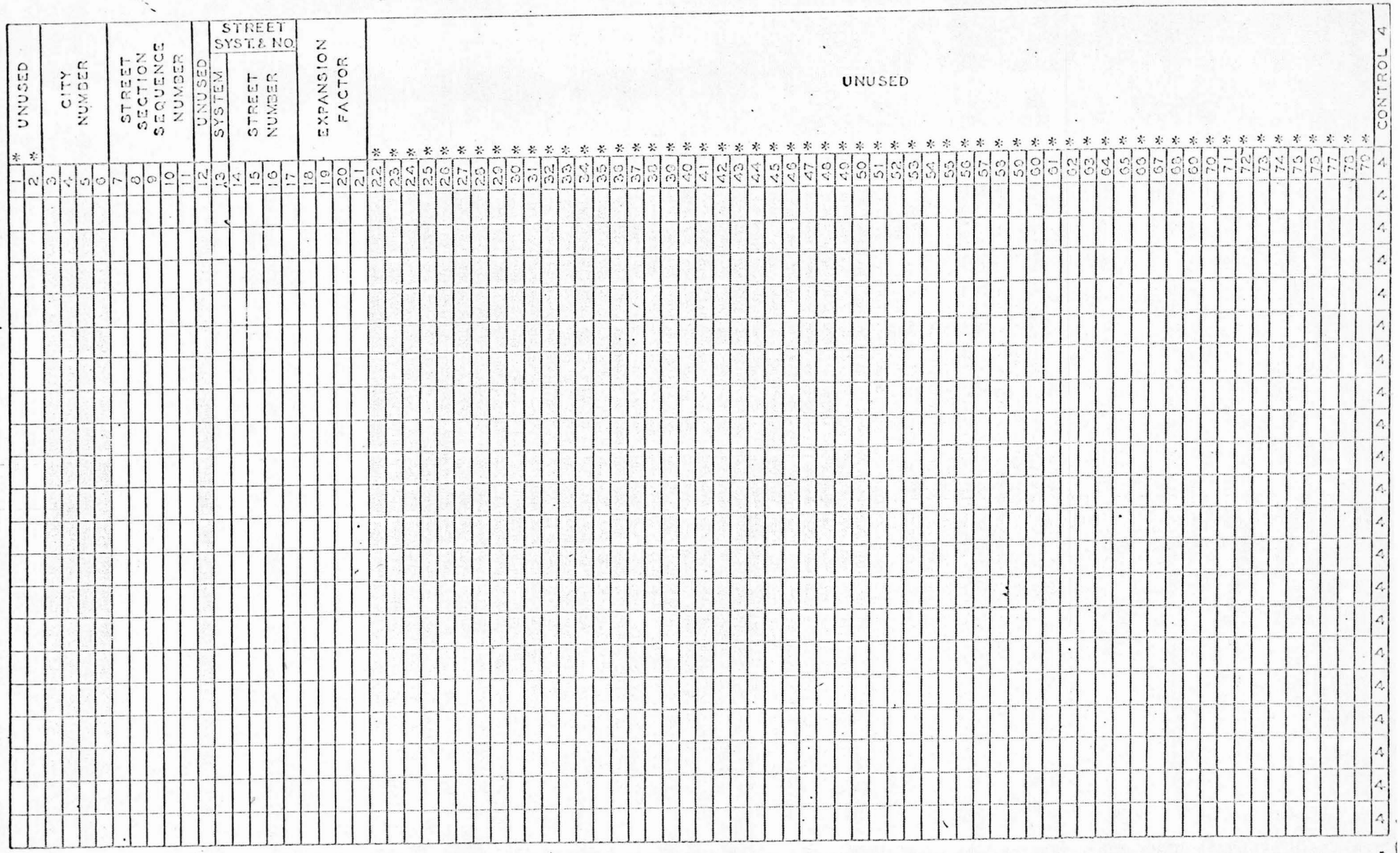
COLUMN 80 = 1—CHANGE, 2—DELETE, 3 ADD

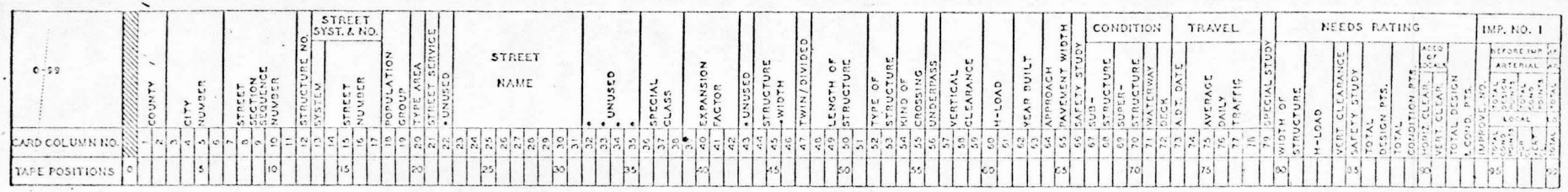
1	COUNTY NUMBER	
2		
3	CITY NUMBER	
4		
5		
6		
7	STREET SECTION SEQUENCE NUMBER	SEQU.
8		
9		
10		
11		
12	STREET SERVICE	
13	SYSTEM	STREET SYST. NO.
14	STREET NUMBER	
15		
16		
17		
18	POPULATION GROUP	
19		
20	SECTION LENGTH	
21		
22		
23	STREET NAME	
24		
25		
26		
27		
28		
29		
30		
31		
32	NEEDS STUDY SECTION NUMBER	
33		
34		
35		
36	SPECIAL CLASS	
37		
38		
39	SURFACE TYPE	
40		
41		
42		
43	SURFACE WIDTH	
44		
45	R.R. CROSSING	
46	TYPE SECTION	
47	CURB/SHLD. TYPE	
48	ROADWAY WIDTH	
49		
50		
51	MEDIAN TYPE	
52	MEDIAN WIDTH OR BARRIER	
53		
54	TYPE PARKING	
55	TYPE DRAINAGE	
56	ACCESS CONTROL	
57	TURN LANES	
58	% TURNS	
59	TRAFFIC FLOW	
60	THROUGH WIDTH	
61		
62	PROBLEM	CAP.
63	SOLUTION	
64	R.O.W. AVAILABLE	
65		
66		
67	TYPE AREA	
68	R.O.W. COST GP.	
69	SURFACE AND BASE	COND.
70		
71	DRAINAGE	
72	SHOLD/CURB	
73	A.D.T. DATE	TRAVEL
74	AVERAGE DAILY TRAFFIC	
75		
76		
77		
78		
79	SPECIAL STUDY	
80	CONTROL	

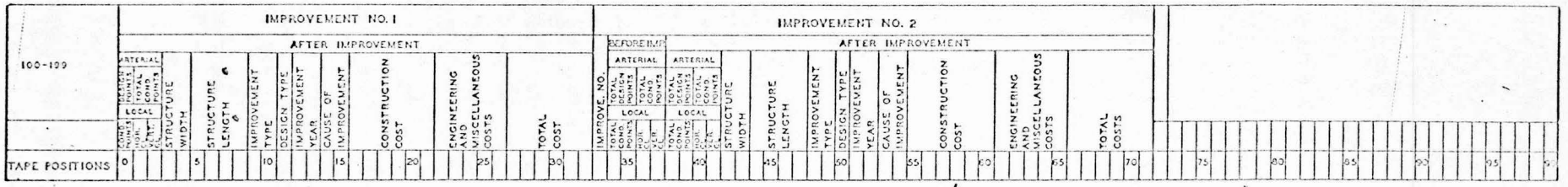
page 2

ARTERIAL AND LOCAL STREETS

COLUMN 80 = CONTROL 4 (CHANGE)







(COST ITEMS TO NEAREST TEN DOLLARS)

200-299

300-399

400-499

500-599

MUNICIPAL NEEDS DATA UPDATE FORMAT

ARTERIAL AND LOCAL STRUCTURES

COLUMN 80 = 1—CHANGE, 2—DELETE, 3 ADD

1	COUNTY NUMBER		
2			
3	CITY NUMBER		
4			
5			
6			
7	STREET SECTION SEQUENCE NUMBER		
8			
9			
10			
11			
12	STRUCT. NO.		
13	SYSTEM	STREET SYST. NO.	
14	STREET NUMBER		
15			
16			
17			
18	POPULATION GROUP		
19			
20	TYPE AREA		
21	STREET SERVICE		
22	* UNUSED		
23	STREET NAME		
24			
25			
26			
27			
28			
29			
30			
31			
32	* UNUSED		
33	*		
34	*		
35	*		
36	SPECIAL CLASS		
37			
38			
39	EXPANSION FACTOR		
40			
41			
42			
43	* UNUSED		
44	STRUCTURE WIDTH		
45			
46			
47	TWIN/DIVIDED		
48	LENGTH OF STRUCTURE		
49			
50			
51			
52	TYPE STRUCTURE		
53			
54	KIND OF CROSSING		
55			
56	UNDERPASS		
57	VERTICAL CLEARANCE		
58			
59			
60	H LOAD		
61			
62	YEAR BUILT		
63			
64	APPROACH WIDTH		
65			
66	SAFETY STUDY		
67	SUB-STRUCT.	CONDITION	
68			
69	SUPER STRUCT.		
70			
71	WATERWAY		
72	DECK		
73	ADT. DATE	TRAVEL	
74	AVERAGE DAILY TRAFFIC		
75			
76			
77			
78			
79	SPECIAL STUDY		
80	CONTROL		

MUNICIPAL STREETS

POINT RATING

Surface Type	5	
Type Street Section	10	65
Capacity	35	
Surface Width	15	
Condition:		
Surface and Base	25	
Drainage	5	35
Curb or Shoulder	5	
TOTAL	100	

SURFACE TYPE RATING -- 5 Points

Standard Calls For	Existing Surface Type is				
	High	Intermediate	Low	Gravel	Dirt
High	5	4	1	0	0
Intermediate	5	5	3	0	0
Low	5	5	5	0	0
Gravel	5	5	5	5	0

TYPE STREET SECTION -- 10 Points

Col. 47 (Curb or shoulder type) code	Standard Calls for Curbs	Shoulders
0	0	0
1	10	10
2	4	6
3	0	2
4	8	8
5	0	4
6	6	6
7	0	2
8	0	0
9	10	10

CAPACITY RATING -- 35 Points

1. Read 10% of ADT volume
2. Select capacity from appropriate capacity table
3. Divide (1) by (2) to get volume/capacity ratio, to 00.00 value
4. Assign rating points as follows

Volume/Capacity Ratio	Rating Points
00.00 - 00.59	35
00.60 - 00.64	33
00.65 - 00.69	30
00.70 - 00.74	27
00.75 - 00.79	25
00.80 - 00.84	20
00.85 - 00.89	15
00.89 - 00.95	10
00.95 - 00.99	5
≥ 1.00	0

Cities - "C" Level

SURFACE WIDTH RATING

No Shoulders*

tandard oadbed idth (ft)	Existing Surface Width (feet)										
	72+	67 to 71	66 to 62	61 to 57	56 to 52	51 to 47	46 to 42	41 to 37	36 to 32	31 to 27	26 to 24	24
112	15	9	6	0	0	0	0	0	0	0	0	
88	15	15	15	15	15	15	6	0	0	0	0	
73	15	12	9	5	0	0	0	0	0	0	0	
69	15	15	12	9	6	6	3	0	0	0	0	
67	15	15	13	12	9	6	3	0	0	0	0	
45	15	15	15	15	15	15	15	12	9	3	3	
43	15	15	15	15	15	15	15	12	11	6	3	

With Shoulders*

112	15	12	9	0	0	0	0	0	0	0	0	0
88	15	15	15	15	15	15	9	0	0	0	0	0
73	15	15	12	9	0	0	0	0	0	0	0	0
69	15	15	15	15	15	15	12	0	0	0	0	0
67	15	15	15	15	15	15	12	3	0	0	0	0
45	15	15	15	15	15	15	15	15	15	15	6	0
43	15	15	15	15	15	15	15	15	15	15	15	0

*Shoulders must be on both sides and 8' wide or better. Shoulder surface type must be gravel or better, stable year round.

CAPACITY - ARTERIAL STREETS

Capacity can be defined as the maximum number of vehicles that has a reasonable expectation of passing over a given section of road in a given time period under prevailing roadway and traffic conditions. One of the more important elements limiting, and often interrupting, the flow of traffic is an intersection. Street width between intersections is, of course, important. It is obvious that a street 100 feet wide could carry far more traffic than a street 24 feet wide, but other items of traffic control also influence the number of vehicles that a given width of street can serve. A 48 foot wide expressway can carry many more vehicles in an hour than a 48 foot wide undivided city street. The main reason for this difference in capacity is the effect of intersections (crossing traffic and turning traffic) on a normal city street and the absence of these intersections on an expressway.

A series of traffic volume tables have been prepared as a basis for determining where capacity problems exist, or are likely to occur in the future. These tables are for different size cities, different areas of the city, and for arterial streets on and off the State Primary System.

Table 6, on the following pages, gives hourly traffic volumes through street intersections of various widths and with different turning movements. Table 6a and 6b are for streets without intersections. Table 6a is for divided streets and table 6b for undivided streets.

MUNICIPAL ARTERIAL STREETS

Capacity Codes

Volume / Capacity	Capacity Code
0.00	0
0.01-0.49	1
0.50-0.89	2
0.90-1.09	3
1.10-1.19	4
1.20-1.29	5
1.30-1.49	6
1.50-1.69	7
1.70-1.99	8
$\geq$ 2.00	9

PROCEDURE FOR DETERMINING CAPACITY

1. Select Basic Capacity Value from following table:

Through Width	Basic Capacity
≤23	1300
24-27	1700
28-31	2000
32-35	2300
36-39	2600
40-43	2900
44-47	3300
48-51	3600
52-61	4000
62-72	4600
>72	5000

2. If population group is under 10,000 multiply by 0.70
   If population group is 10,000 - 49,999 multiply by 0.80
   If population group is ≥50,000 multiply by 0.96

3. If type area is Central Business District multiply by 1.00
   If type area is not Central Business District multiply by 1.25

4. If primary extension multiply by 0.95
   If not primary extension multiply by 1.00

5. Multiply by 0.50 for 50% Green Time

6. The value arrived at after performing steps 1-5 is referred to as T in the following equations. To fine the appropriate equation check % turns, turning lanes provided and through width.

I. FOR THROUGH WIDTHS $\leq 27'$

A. High % Turns

a. No Turn Lane

$$X = T(.90)(.85)$$
(.765)

b. Left Turn Lane

$$X = T(1.3)(.90)(0.8) + 0.20(x)$$
(.936)

$0.20(x)$ not greater than 240

c. Right Turn Lane

$$X = T(1.2)(.85) + 0.20(x)$$
(1.020)

$0.20(x)$ not greater than 600

d. Left & Right Turn Lane

$$X = T(1.3)(1.2)(0.8) + 0.03(x)$$
(1.020)

$0.30(x)$ not greater than 840

The above equations are based on 40% Green Time for through traffic and 15% Green Time for left turns.

B. Average % Turns

a. No Turn Lane

$X = T$

b. Left Turn Lane

$$X = T(1.3)(0.9) + 0.10(x)$$
(1.170)

$0.10(x)$ not greater than 160

c. Right Turn Lane

$X = T(1.2) + 0.10(x)$ $0.10(x)$ not greater than 600

d. Left & Right Turn Lane

$$X = T(1.3)(1.2)(0.9) + 0.15(x)$$
(1.404)

$0.15(x)$ not greater than 760

The above equations are based on 45% Green Time for through traffic and 10% green time for left turns.

C. Low % Turns

a. No Turn Lanes

$$X = T(1.16)(1.24)^{(1.438)}$$

b. Left Turn Lane

$$X = T(1.16)(1.30)^{(1.508)}$$

c. Right Turn Lane

$$X = T(1.20)(1.24)^{(1.488)} + 0.02(x)$$

$0.02(x)$ not greater than 600

d. Left & Right Turn Lanes

$$X = T(1.20)(1.30)^{(1.560)} + 0.02(x)$$

$0.02(x)$ not greater than 600

The above equations are based on 50% green time for through traffic and no separate phase for left turns.

II. FOR THROUGH WIDTHS 28' - 31'

A. High % Turns

a. No Turn Lane

$$X = T(.925)(.875)^{(.809)}$$

b. Left Turn Lane

$$X = T(1.20)(.925)(0.8)^{(0.880)} + 0.20(x)$$

$0.20(x)$ not greater than 240

c. Right Turn Lane

$$X = T(1.125)(.875)^{(0.984)} + 0.20(x)$$

$0.20(x)$ not greater than 600

d. Left & Right Turn Lanes

$$X = T(1.125)(1.20)(0.80)^{(1.080)} + 0.30(x)$$

$0.30(x)$ not greater than 840

The above equations are based on 40% green time for through traffic and 15% green time for left turns.

B. Average % Turns

a. No Turn Lane

$X = T$

b. Left Turn Lane

$$X = T(1.20)(0.9) + \overset{(1.080)}{0.10(x)}$$

$0.10(x)$ not greater than 160

c. Right Turn Lane

$X = T(1.125) + 0.10(x)$ $0.10(x)$ not greater than 600

d. Left & Right Turn Lane

$$X = T(1.20)(1.125)(0.9) + \overset{(1.215)}{0.15(x)}$$

$0.15(x)$ not greater than 760

The above equations are based on 45% green time for through traffic and 10% green time for left turns.

C. Low % Turns

a. No Turn Lanes

$$X = T\overset{(1.276)}{(1.10)(1.16)}$$

b. Left Turn Lanes

$$X = T\overset{(1.320)}{(1.10)(1.20)}$$

c. Right Turn Lanes

$$X = T\overset{(1.305)}{(1.125)(1.16)} + 0.02(x)$$

$0.02(x)$ not greater than 600

d. Left & Right Turn Lanes

$$X = T\overset{(1.350)}{(1.125)(1.20)} + 0.02(x)$$

$0.02(x)$ not greater than 600

The above equations are based on 50% green time for through traffic and no separate phase for left turns

III. FOR THROUGH WIDTHS 32' - 35'

A. High % Turns

a. No Turn Lane

$$X = T(.938)(.888)^{(.833)}$$

b. Left Turn Lanes

$$X = T(1.15)(.938)(0.8)^{(0.863)} + 0.20(x)$$

$0.20(x)$ not greater than 240

c. Right Turn Lanes

$$X = T(1.088)(0.888)^{(0.966)} + 0.20(x)$$

$0.20(x)$ not greater than 600

d. Left & Right Turn Lanes

$$X = T(1.15)(1.088)(0.8)^{(1.001)} + 0.30(x)$$

$0.30(x)$ not greater than 840

The above equations are based on 40% green time for through traffic and 15% green time for left turns.

B. Average % Turns

a. No Turn Lane

$X = T$

b. Left Turn Lanes

$$X = T(1.15)(0.9)^{(1.035)} + 0.10(x)$$

$0.10(x)$ not greater than 160

c. Right Turn Lanes

$X = T(1.088) + 0.10(x)$ $0.10(x)$ not greater than 600

d. Left & Right Turn Lanes

$$X = T(1.088)(1.15)(0.9)^{(1.126)} + 0.15(x)$$

$0.15(x)$ not greater than 760

The above equations are based on 45% green time for through traffic and 10% green time for left turns.

C. Low % Turns

a. No Turn Lanes

$$X = T(1.07)(1.12)^{(1.198)}$$

b. Left Turn Lanes

$$X = T(1.15)(1.07)^{(1.231)}$$

c. Right Turn Lanes

$$X = T(1.088)(1.12)^{(1.219)} + 0.02(x)$$

$0.02(x)$ not greater than 600

d. Left & Right Turn Lanes

$$X = T(1.088)(1.15)^{(1.251)} + 0.02(x)$$

$0.02(x)$ not greater than 600

The above equations are based on 50% green time for through traffic and no separate phase for left turns.

IV. THROUGH WIDTHS 36' - 51'

A. High % Turns

a. No Turn Lanes

$$X = T(.95)(.90)^{(.855)}$$

b. Left Turn Lanes

$$X = T(1.10)(.95)(0.8)^{(0.836)} + 0.20(x)$$

$0.20(x)$ not greater than 240

c. Right Turn Lanes

$$X = T(1.05)(0.90)^{(0.945)} + 0.20(x)$$

$0.20(x)$ not greater than 600

d. Left & Right Turn Lanes

$$X = T(1.05)(1.10)(0.8)^{(0.924)} + 0.30(x)$$

$0.30(x)$ not greater than 840

The above equations are based on 40% green time for through traffic and 15% green time for left turns.

B. Average % Turns

a. No Turn Lanes
$X = T$

b. Left Turn Lanes
$$X = \underset{(0.990)}{T(1.10)(0.9)} + 0.10(x)$$
$0.10(x)$ not greater than 160

c. Right Turn Lanes
$X = T(1.05) + 0.10(x)$ $0.10(x)$ not greater than 600

d. Left & Right Turn Lanes
$$X = \underset{(1.040)}{T(1.10)(1.05)(0.9)} + 0.15(x)$$
$0.15(x)$ not greater than 760

The above equations are based on 45% green time for through traffic and 10% green time for left turns.

C. Low % Turns

a. No Turn Lanes
$$X = \underset{(1.123)}{T(1.04)(1.08)}$$

b. Left Turn Lanes
$$X = \underset{(1.144)}{T(1.10)(1.04)}$$

c. Right Turn Lanes
$$X = \underset{(1.134)}{T(1.05)(1.08)} + 0.02(x)$$
$0.02(x)$ not greater than 600

d. Left & Right Turn Lanes
$$X = \underset{(1.155)}{T(1.05)(1.10)} + 0.02(x)$$
$0.02(x)$ not greater than 600

The above equations are based on 50% green time for through traffic and no separate phase for left turns.

V. FOR THROUGH WIDTHS >51'

A. High % Turns

a. No Turn Lanes

$$X = T(.975)(.950)^{(0.926)}$$

b. Left Turn Lanes

$$X = T(1.05)(.975)(0.86)^{(0.880)} + 0.20(x)$$

$0.20(x)$ not greater than 192

c. Right Turn Lanes

$$X = T(1.02)(.950)^{(0.974)} + 0.20(x)$$

$0.20(x)$ not greater than 600

d. Left & Right Turn Lanes

$$X = T(1.025)(1.050)(0.86)^{(0.926)} + 0.30(x)$$

$0.30(x)$ not greater than 792

The above equations are based on 43% green time for through traffic and 12% green time for left turns.

B. Average % Turns

a. No Turn Lanes

$X = T$

b. Left Turn Lanes

$$X = T(1.05)(0.975)(0.9)^{(0.921)} + 0.10(x)$$

$0.10(x)$ not greater than 160

c. Right Turn Lanes

$X = T(1.025) + 0.10(x)$ $0.10(x)$ not greater than 600

d. Left & Right Turn Lanes

$$X = T(1.025)(1.050)(0.9)^{(0.969)} + 0.15(x)$$

$0.15(x)$ not greater than 760

The above equations are based on 45% green time for through traffic and 10% green time for left turns.

C. Low % Turns

a. No Turn Lanes

$$X = T(1.02)(1.04)^{(1.061)}$$

b. Left Turn Lanes

$$X = T(1.05)(1.02)^{(1.071)}$$

c. Right Turn Lanes

$$X = T(1.025)(1.04)^{(1.066)} + 0.02(x)$$

$0.02(x)$ not greater than 600

d. Left & Right Turn Lanes

$$X = T(1.025)(1.050)^{(1.076)} + 0.02(x)$$

$0.02(x)$ not greater than 600

The above equations are based on 50% green time for through traffic and no separate phase for left turns.

POPULATION GROUP OVER 50,000 (0.96)

PRIMARY EXTENSION (10% trucks)

Table 6

THROUGH TRAFFIC WIDTH (ft)	20-23	24-27	28-31	32-35	36-39	40-43	44-47	48-51	52-61	62-72	≥72
Central Business District											
High % Turns (20%)											
No Turn Lane	456	596	702	902	1020	1138	1294	1412	1696	1950	2120
Left Turn Lane	661	864	1018	1083	1219	1352	1482	1596	1796	2037	2197
Right Turn Lane	741	969	1141	1240	1397	1559	1773	1941	2226	2560	2782
Lt & Rt Turn Lane	985	1284	1522	1561	1540	1718	1954	2130	2407	2729	2998
Average % Turns (10%)											
No Turn Lane	592	776	912	1048	1186	1322	1504	1642	1824	2098	2260
Left Turn Lane	770	1009	1186	1183	1305	1454	1649	1786	1884	2143	2315
Right Turn Lane	789	1034	1216	1222	1388	1547	1760	1916	2078	2389	2596
Rt & Rt Turn Lane	978	1282	1357	1392	1447	1613	1855	2008	2079	2391	2598
Low % Turns (2%)											
No Turn Lane	854	1116	1145	1174	1328	1482	1686	1838	1934	2236	2416
Left Turn Lane	905	1183	1190	1197	1355	1512	1720	1875	1953	2256	2440
Right Turn Lane	906	1185	1198	1210	1368	1526	1737	1894	1984	2283	2477
Lt & Rt Turn Lane	960	1255	1288	1341	1394	1556	1770	1933	2003	2303	2502
Residential & Fringe Area											
High % Turns (20%)											
No Turn Lane	570	746	878	1128	1274	1422	1618	1764	2120	2438	2650
Left Turn Lane	826	1061	1256	1323	1463	1605	1793	1933	2198	2498	2699
Right Turn Lane	926	1213	1426	1551	1751	1955	2225	2425	2782	3160	3303
Lt & Rt Turn Lane	1228	1628	1664	1701	1921	2145	2441	2661	2898	3214	3424
Average % Turns (10%)											
No Turn Lane	772	970	1140	1312	1482	1654	1882	2052	2280	2622	2850
Left Turn Lane	1003	1261	1382	1443	1627	1797	2023	2191	2515	2638	2853
Right Turn Lane	1029	1293	1520	1551	1728	1930	2195	2394	2596	2986	3245
Lt & Rt Turn Lane	1275	1602	1672	1742	1811	2022	2301	2509	2597	2988	3248
Low % Turns (2%)											
No Turn Lane	1112	1396	1432	1468	1660	1852	2106	2298	2416	2780	3022
Left Turn Lane	1179	1480	1488	1497	1693	1889	2146	2344	2440	2808	3052
Right Turn Lane	1179	1481	1497	1513	1711	1908	2170	2368	2477	2851	3098
Lt & Rt Turn Lane	1251	1570	1628	1686	1744	1946	2214	2415	2502	2879	3129

POPULATION GROUP OVER 50,000 (0.96)

Non-Primary Extension (5% trucks)

Table 6

THROUGH TRAFFIC WIDTH (ft)	20-23	24-27	28-31	32-35	36-39	40-43	44-47	48-51	52-61	62-72	≥72
Central Business District											
High % Turns (20%)											
No Turn Lane	480	628	740	950	1074	1198	1362	1486	1786	2054	2232
Left Turn Lane	696	910	1073	1140	1271	1390	1548	1667	1882	2135	2303
Right Turn Lane	780	1020	1203	1306	1476	1647	1872	2043	2343	2696	2930
Lt & Rt Turn Lane	1034	1353	1392	1432	1620	1807	2054	2241	2534	2832	3009
Average % Turns (10%)											
No Turn Lane	624	816	960	1104	1248	1392	1584	1728	1920	2208	2400
Left Turn Lane	811	1061	1137	1214	1373	1531	1728	1871	1974	2247	2428
Right Turn Lane	832	1088	1280	1287	1455	1624	1847	2015	2186	2514	2733
Rt & Rt Turn Lane	1030	1348	1407	1466	1525	1702	1937	2112	2188	2516	2735
Low % Turns (2%)											
No Turn Lane	898	1176	1206	1236	1396	1560	1774	1936	2036	2340	2544
Left Turn Lane	952	1247	1254	1261	1426	1591	1809	1975	2056	2363	2569
Right Turn Lane	953	1247	1260	1273	1440	1608	1828	1994	2087	2400	2609
Lt & Rt Turn Lane	1010	1322	1356	1412	1469	1639	1865	2034	2109	2423	2634
Residential & Fringe Area											
High % Turns (20%)											
No Turn Lane	600	786	924	1186	1342	1496	1702	1858	2232	2566	2790
Left Turn Lane	870	1140	1312	1379	1528	1676	1874	2024	2303	2619	2831
Right Turn Lane	975	1277	1501	1631	1845	2057	2340	2555	2930	3294	3530
Lt & Rt Turn Lane	1295	1692	1740	1788	2024	2257	2567	2802	3009	3341	3563
Average % Turns (10%)											
No Turn Lane	780	1020	1200	1380	1560	1740	1980	2160	2400	2760	3000
Left Turn Lane	1014	1325	1421	1517	1704	1883	2120	2298	2428	2768	3089
Right Turn Lane	1040	1360	1600	1610	1820	2030	2310	2520	2733	3143	3414
Lt & Rt Turn Lane	1288	1684	1739	1854	1908	2128	2421	2641	2735	3144	3418
Low % Turns (2%)											
No Turn Lane	1124	1468	1507	1546	1748	1948	2216	2420	2544	2926	3180
Left Turn Lane	1191	1556	1566	1577	1783	1987	2262	2462	2569	2955	3212
Right Turn Lane	1192	1558	1575	1592	1801	2007	2285	2493	2609	3001	3261
Lt & Rt Turn Lane	1264	1651	1694	1766	1837	2047	2331	2543	2634	3030	3293

POPULATION GROUP 10,000 - 50,000 (0.80)

Primary Extension (10% trucks)

Table 6

THROUGH TRAFFIC WIDTH (ft)	20-23	24-27	28-31	32-35	36-39	40-43	44-47	48-51	52-61	62-72	>72
Central Business District											
High % Turns (20%)											
No Turn Lane	380	498	586	752	850	948	1078	1176	1414	1626	1768
Left Turn Lane	550	722	850	901	1020	1137	1274	1368	1521	1720	1853
Right Turn Lane	617	808	951	1033	1168	1302	1481	1616	1855	2133	2320
Lt & Rt Turn Lane	814	1067	1097	1127	1274	1421	1615	1762	1998	2298	2500
Average % Turns (10%)											
No Turn Lane	494	646	760	874	988	1102	1254	1368	1520	1748	1900
Left Turn Lane	641	838	900	961	1086	1211	1378	1504	1666	1803	1946
Right Turn Lane	657	861	940	1018	1152	1285	1462	1595	1731	1990	2163
Rt & Rt Turn Lane	812	1063	1065	1066	1208	1348	1534	1672	1734	1994	2168
Low % Turns (2%)											
No Turn Lane	712	930	954	978	1106	1234	1404	1532	1612	1852	2014
Left Turn Lane	754	985	992	997	1128	1258	1432	1562	1628	1870	2034
Right Turn Lane	755	986	1012	1017	1151	1283	1461	1593	1653	1898	2065
Lt & Rt Turn Lane	798	1043	1070	1116	1162	1296	1475	1609	1669	1917	2085
Residential & Fringe Area											
High % Turns (20%)											
No Turn Lane	476	622	732	940	1062	1184	1348	1470	1768	2032	2208
Left Turn Lane	690	901	1061	1127	1259	1376	1534	1691	1853	2102	2267
Right Turn Lane	772	1010	1188	1292	1460	1627	1852	2121	2320	2666	2897
Lt & Rt Turn Lane	1020	1332	1371	1410	1592	1775	2021	2204	2500	2872	3121
Average % Turns (10%)											
No Turn Lane	618	808	950	1092	1236	1378	1568	1710	1900	2186	2376
Left Turn Lane	803	1050	1126	1201	1358	1515	1712	1852	1946	2214	2393
Right Turn Lane	823	1076	1266	1273	1441	1606	1828	1994	2163	2488	2705
Lt & Rt Turn Lane	1017	1330	1333	1335	1511	1685	1917	2091	2168	2494	2710
Low % Turns (2%)											
No Turn Lane	888	1162	1193	1224	1384	1542	1756	1916	2014	2316	2518
Left Turn Lane	941	1231	1240	1248	1411	1572	1791	1954	2034	2339	2543
Right Turn Lane	941	1232	1265	1273	1439	1604	1807	1974	2065	2374	2581
Lt & Rt Turn Lane	995	1304	1338	1396	1454	1620	1844	2013	2085	2397	2607

POPULATION GROUP 10,000 - 50,000 (0.80)

Non-Primary Extension (5% trucks)

Table 6

THROUGH TRAFFIC WIDTH (ft)	20-23	24-27	28-31	32-35	36-39	40-43	44-47	48-51	52-61	62-72	>72
Central Business District											
High % Turns (20%)											
No Turn Lane	400	524	616	792	894	998	1136	1238	1488	1712	1860
Left Turn Lane	580	760	892	950	1072	1197	1330	1428	1590	1801	1940
Right Turn Lane	650	851	1000	1088	1228	1371	1561	1701	1952	2246	2441
Lt & Rt Turn Lane	857	1122	1154	1187	1340	1495	1702	1855	2104	2420	2630
Average % Turns (10%)											
No Turn Lane	520	680	800	920	1040	1160	1320	1440	1600	1840	2000
Left Turn Lane	675	883	947	1011	1143	1275	1451	1583	1664	1889	2040
Right Turn Lane	693	906	1066	1073	1213	1353	1540	1680	1822	2095	2277
Rt & Rt Turn Lane	856	1120	1122	1124	1271	1418	1614	1761	1825	2098	2282
Low % Turns (2%)											
No Turn Lane	748	980	1005	1030	1164	1300	1478	1612	1696	1950	2120
Left Turn Lane	792	1038	1044	1050	1187	1326	1507	1644	1712	1969	2141
Right Turn Lane	792	1039	1050	1061	1198	1339	1522	1661	1730	1998	2173
Lt & Rt Turn Lane	838	1100	1127	1174	1222	1366	1553	1693	1756	2019	2195
Residential & Fringe Area											
High % Turns (20%)											
No Turn Lane	500	654	770	990	1118	1248	1420	1548	1860	2140	2326
Left Turn Lane	725	947	1116	1187	1313	1438	1603	1726	1940	2203	2378
Right Turn Lane	812	1062	1251	1361	1536	1715	1952	2127	2441	2808	3052
Lt & Rt Turn Lane	1071	1401	1442	1484	1675	1871	2130	2321	2630	2910	3094
Average % Turns (10%)											
No Turn Lane	650	850	1000	1150	1300	1450	1650	1800	2000	2300	2500
Left Turn Lane	844	1104	1184	1264	1430	1594	1793	1942	2040	2322	2510
Right Turn Lane	866	1133	1333	1341	1516	1691	1924	2100	2277	2618	2846
Lt & Rt Turn Lane	1070	1400	1403	1407	1590	1774	2018	2202	2282	2624	2935
Low % Turns (2%)											
No Turn Lane	936	1224	1256	1288	1456	1624	1848	2016	2120	2438	2650
Left Turn Lane	992	1297	1305	1313	1485	1656	1884	2046	2141	2462	2676
Right Turn Lane	992	1297	1312	1326	1500	1673	1904	2077	2173	2500	2717
Lt & Rt Turn Lane	1050	1373	1409	1469	1529	1706	1941	2118	2195	2524	2743

POPULATION GROUP UNDER 10,000 (0.70)

Primary Extension (10% trucks)

Table 6.

THROUGH TRAFFIC WIDTH (ft)	20-23	24-27	28-31	32-35	36-39	40-43	44-47	48-51	52-61	62-72	>72
Central Business District											
High % Turns (20%)											
No Turn Lane	334	436	512	658	744	830	944	1030	1236	1422	1546
Left Turn Lane	483	631	741	788	892	995	1132	1228	1481	1537	1654
Right Turn Lane	542	707	831	903	1022	1141	1297	1416	1621	1866	2028
Lt & Rt Turn Lane	715	934	962	991	1121	1251	1422	1552	1752	2017	2192
Average % Turns (10%)											
No Turn Lane	432	566	666	764	864	964	1098	1198	1330	1530	1662
Left Turn Lane	561	735	788	840	950	1060	1207	1317	1395	1605	1730
Right Turn Lane	575	754	887	891	1007	1124	1280	1396	1514	1742	1892
Rt & Rt Turn Lane	710	931	952	934	1056	1178	1342	1464	1517	1745	1898
Low % Turns (2%)											
No Turn Lane	622	814	835	856	968	1080	1228	1340	1410	1622	1762
Left Turn Lane	659	862	867	873	987	1101	1252	1366	1424	1638	1779
Right Turn Lane	659	863	872	881	996	1112	1265	1380	1445	1665	1806
Lt & Rt Turn Lane	698	915	938	978	1017	1134	1289	1408	1460	1679	1824
Residential & Fringe Area											
High % Turns (20%)											
No Turn Lane	416	544	640	822	930	1036	1180	1286	1546	1778	1932
Left Turn Lane	602	788	927	986	1115	1234	1372	1474	1654	1873	2019
Right Turn Lane	675	883	1040	1130	1278	1423	1622	1767	2028	2332	2535
Lt & Rt Turn Lane	891	1165	1202	1240	1402	1562	1780	1940	2192	2522	2711
Average % Turns (10%)											
No Turn Lane	540	706	832	956	1080	1206	1372	1496	1662	1912	2078
Left Turn Lane	701	917	984	1051	1167	1325	1508	1641	1730	1966	2123
Right Turn Lane	720	941	1108	1114	1260	1406	1600	1744	1892	2176	2365
Lt & Rt Turn Lane	889	1162	1165	1168	1320	1474	1677	1829	1896	2191	2370
Low % Turns (2%)											
No Turn Lane	778	1018	1044	1070	1210	1350	1536	1676	1762	2026	2202
Left Turn Lane	824	1079	1085	1091	1234	1377	1566	1709	1779	2046	2224
Right Turn Lane	825	1079	1085	1102	1246	1390	1582	1726	1806	2077	2258
Lt & Rt Turn Lane	874	1144	1173	1222	1271	1418	1614	1761	1824	2097	2280

POPULATION GROUP UNDER 10,000 (0.70)

Non-Primary Extension (5% trucks)

Table 6

THROUGH TRAFFIC WIDTH (ft)	20-23	24-27	28-31	32-35	36-39	40-43	44-47	48-51	52-61	62-72	>72
Central Business District											
High % Turns (20%)											
No Turn Lane	350	458	540	692	782	872	994	1084	1302	1498	1628
Left Turn Lane	507	663	782	830	937	1046	1132	1280	1423	1609	1732
Right Turn Lane	568	743	877	951	1075	1198	1297	1490	1708	1965	2130
Lt & Rt Turn Lane	750	977	1010	1042	1170	1314	1422	1634	1860	2124	2310
Average % Turns (10%)											
No Turn Lane	456	596	700	804	910	1016	1156	1260	1400	1610	1750
Left Turn Lane	592	774	910	883	1000	1116	1271	1385	1470	1681	1815
Right Turn Lane	607	794	933	937	1061	1184	1347	1470	1594	1833	1992
Rt & Rt Turn Lane	750	981	1024	1067	1111	1242	1412	1540	1597	1836	1996
Low % Turns (2%)											
No Turn Lane	656	856	879	902	1020	1136	1294	1412	1484	1706	1856
Left Turn Lane	695	907	931	920	1040	1158	1319	1440	1498	1723	1874
Right Turn Lane	695	908	932	929	1051	1170	1332	1455	1521	1748	1903
Lt & Rt Turn Lane	737	962	988	1002	1071	1195	1359	1483	1536	1766	1921
Residential & Fringe Area											
High % Turns (20%)											
No Turn Lane	438	572	674	866	978	1092	1242	1354	1628	1872	2034
Left Turn Lane	635	828	976	1038	1172	1288	1432	1539	1732	1962	2116
Right Turn Lane	711	926	1095	1190	1343	1501	1707	1861	2136	2456	2667
Lt & Rt Turn Lane	938	1225	1265	1305	1474	1647	1872	2041	2310	2651	2812
Average % Turns (10%)											
No Turn Lane	568	744	876	1006	1138	1268	1444	1576	1750	2012	2188
Left Turn Lane	737	966	1137	1105	1251	1394	1587	1720	1813	2061	2227
Right Turn Lane	756	991	1167	1173	1326	1478	1684	1837	1992	2291	2491
Lt & Rt Turn Lane	935	1224	1226	1229	1390	1550	1765	1927	1996	2295	2496
Low % Turns (2%)											
No Turn Lane	820	1072	1100	1128	1274	1422	1618	1764	1856	2134	2318
Left Turn Lane	869	1136	1164	1150	1299	1450	1650	1799	1874	2155	2341
Right Turn Lane	869	1136	1167	1162	1312	1465	1667	1817	1903	2187	2376
Lt & Rt Turn Lane	921	1205	1236	1287	1338	1493	1700	1853	1921	2210	2400

Table 6A

Thru Width	≤ 60	5000 V.P.H.
	> 60	8000 V.P.H.

Table 6B

Thru Width	< 40	1700 V.P.H.
	40 - 60	2800 V.P.H.
	> 60	4500 V.P.H.

IOWA HIGHWAY NEEDS STUDY
DESIGN GUIDES FOR CITY ARTERIALS

DATE 2-1-68

	TYPE FACILITY	FREEWAY & EXPRESSWAY		MAJOR STREETS								
	TYPE AREA	ALL AREAS		CENTRAL BUSINESS DIST.			FRINGE & OUTLYING BUS.			RESIDENTIAL & RURAL		
	DESIGN CLASS CODE	4	5	1	2	3	1	2	3	1	2	3
ROADWAY	DESIGN YEAR TRAFFIC (D.H.V.)	OVER 5000	5000 & UNDER	OVER 1500	700-1500	0-699	OVER 1900	900-1900	0-899	OVER 1900	900-1000	0-899
	NO. OF TRAVEL LANES	6	4	6	4	2	6	4	2	6	4	2
	TRAVEL LANE WIDTH	12	12	12	12	12	12	12	12	12	12	12
	TOTAL TRAVEL WIDTH	72	48	72	48	24	72	48	24	72	48	24
	PARKING LANES	NONE		NONE 1/	2 AT 10'	2 AT 10'	NONE 1/	2 AT 10'	2 AT 10'	NONE 1/	2 AT 9'	2 AT 9'
	MEDIAN WIDTH	20	20	MINIMUM 4'		N/A	MINIMUM 4'		N/A	MINIMUM 4'		N/A
	TOTAL ROADWAY WIDTH	112	88	73 2/	69 2/	45 2/	73 2/	69 2/	45 2/	73 2/	67 2/	43 2/
	MINIMUM R.O.W. WIDTH	140	110	98	94	65	98	94	65	98	92	63
	TYPE STREET SECTION	PAVED SHO. 6' LT.-10' RT.		CURBS			CURBS			CURBS		
	SURFACE TYPE	HIGH		HIGH			HIGH			HIGH		
	ACCESS CONTROL	FULL 3/		NONE			NONE			NONE		
BRIDGES	DESIGN LOADING	HS-20		HS-20			HS-20			HS-20		
	ROADWAY WIDTH	TWIN BRIDGES 52' WIDE SINGLE BRIDGES 92' PLUS MEDIAN	TWIN BRIDGES 40' WIDE SINGLE BRIDGES 68' PLUS MEDIAN	APPROACH SURFACE WIDTH PLUS 6 FEET AND SIDEWALKS								
	VERTICAL CLEARANCE	16'		16'			16'			16'		
	UNDERPASS HORZ. CLEAR.	4/		6 FEET BEHIND CURB								

1/ PARKING PERMITTED IN OFF-PEAK HOURS

2/ BACK OF CURB TO BACK OF CURB

3/ SOME AT GRADE CROSSINGS ALLOWED ON EXPRESSWAY

4/ EDGE OF PAVEMENT + 30' OR SHOULDER LINE + 4' WITH GUARDRAIL ON R.R. UNDERPASSES

IOWA HIGHWAY NEEDS STUDY
DESIGN GUIDES FOR LOCAL CITY STREETS

POPULATION GROUPS			10000 & OVER			2500 - 10000		UNDER 2500	
TYPE OF AREA			CENTRAL BUSINESS DISTRICT	FRINGE AND OUTLYING BUSINESS	RESIDENTIAL AND RURAL	ALL BUSINESS AREAS	RESIDENTIAL AND RURAL	ALL BUSINESS AREAS	RESIDENTIAL AND RURAL
DESIGN CLASS CODE			1	2	3	4	5	6	7
ROADWAY	NUMBER OF TRAVEL LANES	DESIRABLE	2	2	2	2	2	2	2
		TOLERABLE	2	2	2	2	2	2	2
	NUMBER OF PARKING LANES	DESIRABLE	2	2	1	2	1	2	1
		TOLERABLE	1	1	1	1	1	1	SHOULDER
	SURFACE WIDTH	DESIRABLE	52	44	31	44	31	44	31
		TOLERABLE	40	30	24	30	24	30	18
	TYPE STREET SECTION	DESIRABLE	CURBS			CURBS		CURBS	CURBS
		TOLERABLE							GRAVEL SHOULDERS
	SURFACE TYPE 1/	DESIRABLE	HIGH	HIGH	INTER.	HIGH	INTER.	HIGH	INTER.
		TOLERABLE	HIGH	INTER	LOW	INTER	LOW	INTER	GRAVEL
BRIDGES	DESIGN LOADING		HS-20	HS-20	H-15	HS-20	H-15	HS-20	H-15
	STRUCTURE WIDTH	DESIRABLE	APPROACH SURFACE WIDTH PLUS 4 FEET AND SIDEWALK						
		TOLERABLE	APPROACH SURFACE WIDTH						

1/ HIGH SURFACE: PORTLAND CEMENT CONCRETE 7 INCHES OR MORE IN THICKNESS ON A BASE SUITABLE TO CARRY FREQUENT HEAVY AXLE LOADS; OR ASPHALTIC CONCRETE 4 INCHES OR MORE IN THICKNESS ON A BASE SUITABLE TO CARRY FREQUENT HEAVY AXLE LOADS; OR ASPHALTIC CONCRETE OVERLAYS WHICH PRODUCE A TOTAL SURFACE THICKNESS GREATER THAN 4 INCHES; OR EXISTING BRICK OR BLOCK.

INTERMEDIATE SURFACE: PORTLAND CEMENT CONCRETE LESS THAN 7 INCHES IN THICKNESS ON A NON-PREPARED BASE SUITABLE TO CARRY A MODERATE FREQUENCY OF HEAVY AXLE LOADS; OR AT LEAST 1 INCH BUT LESS THAN 4 INCHS OF BITUMINOUS SURFACE ON A PREPARED BASE SUITABLE TO CARRY A MODERATE FREQUENCY OF HEAVY AXLE LOADS.

LOW SURFACE: A BITUMINOUS SURFACE LESS THAN 1 INCH IN THICKNESS ON A BASE SUITABLE TO CARRY OCCASIONAL HEAVY AXLE LOADS.

PERCIVAL

MUNICIPAL STREETS

INVENTORY PRINT-OUT

General: The print-out contains the inventory information which was gathered for the 1968-1988 Needs Study. It includes information on all arterial streets as well as information on 20% of the local streets chosen at random. The attached instructions explain each item in the same order in which they appear on the print-out, and are the same as the instructions that the inventory crews used when they gathered the information in the field.

MUNICIPAL STREET

Instructions for Inventory Code Sheets

Columns

1-2	COUNTY NUMBER - Code the county number.
CO NR	Precede single digit county numbers with 0. Example 01.
3-6	CITY NUMBER - Always use four digit code.
CITY NR	Precede numbers less than 1000 by 0's. Example 0080. Highway Commission System.
7-11	Sequencing of City Streets other Than Interstate and Primary Extensions. The major sequence, minor sequence and subsection sequence digits will be used as a five digit number in sequencing these streets. These streets will be sequenced from south to north, and west to east by an increase of five in each succeeding number. The first number used at the corporation line will always be 00500. An example of the sequence numbers in columns 7-8-9-10-11 would be 00500, 00505, 00510, 00515, etc.
SEQUE NUMBR	

Columns

12 PREDOMINANT ROADWAY SERVICE

ST SERVICE

Code

(1) Freeway - a facility devoted entirely to the movement of traffic which performs no land service function. This type of facility will always be a multi-lane, divided roadway with full control of access and no crossings at grade.

(2) Expressway - A facility devoted to the movement of traffic which performs little land service function. This type of facility will be a multi-lane, divided roadway with partial control of access and few crossings at grade.

(3) Ramp - A roadway connection between a freeway or expressway facility and a surface street or highway; also a connection between a freeway or expressway and another freeway or expressway. It will have full control of access and no crossings at grade.

(4) Arterial - A roadway which primarily serves through traffic on a continuous route. It may also act as a feeder route for freeway and expressway facilities Although an arterial is primarily intended to move traffic, it may provide a secondary land service function.

(5) Collector - A street which serves the dual function of serving international traffic movements within a specific area and movements from that area to an arterial route.

(6) Local - A street which primarily provides access to adjacent residential, commercial, industrial or recreational properties.

Columns

13-17 STREET OR HIGHWAY NUMBER

ST NUM Code

Column 13

1. U.S. Numbered Primary Route
2. Iowa Numbered Primary Route
3. Interstate
4. F.A.S. Extension
5. Other City Streets

Column 14-15-16-17

In the case of Primary or Interstate Routes use columns to show the assigned route number. Example: 0218, 0063.

On all city street systems other than Primary or Interstate routes, each street will be assigned a four digit number. Streets traversing a city or town in a predominately east-west direction will be assigned numbers from 0000 through 4999. Streets crossing in a north-south direction will be assigned numbers from 5000 through 9999. In metropolitan areas use continuous numbers across the entire area.

To allow for future expansion of the city corporate limits the first east-west street on the south corporation line should be assigned the number 1000. The first north-south street on the west corporation line should be designated 6000. The numbers assigned to succeeding streets should be done by assigning numbers by tens and reserving the other numbers for new streets that may be built in the future. An example of the numbers assigned would be 1010, 1020, 1030, etc., and 6010, 6020, 6030, etc. Where large open areas are encountered it would be necessary to skip large blocks of numbers to provide for many additional streets in the future

Columns

18-19 POPULATION GROUP - Precoded manually in office

P
O
P

Code:

01	100,000 and Above
02	50,000 through 99,999
03	25,000 through 49,999
04	10,000 through 24,999
05	5,000 through 9,999
06	2,500 through 4,999
17	2,000 through 2,499
27	1,000 through 1,999
37	500 through 999
47	Less than 500

20-22 SECTION LENGTH - (precoded on Primary Roads from Inventory columns 55-57).

SECT
LGTH

Note -- Code length of the section to the nearest 0.01 mile. For divided sections, the coded length will be the lane length of the South or East Lane.

23-38 STREET NAME - Record in columns 23-31 the name of the street or avenue as shown on the street systems map. Be sure to record whether it is identified as street, avenue, place, etc.

Columns

23-38 Continued.

Columns 32-35
Needs Study section number and typical section number

Columns 36-38
Special Class

Col. 36 - code:

1. Freeway (non-primary)
2. Local
3. Collector
4. City Arterial
5. Primary Arterial
6. Primary Expressway
7. Primary Freeway
8. Interstate
9. Expressway (non-primary)

Col. 37 - code:

1. To be abandoned
2. Transferred to city from primary
3. Transferred to city from county
4. Transferred to state from city
5.
6.
7.
8.
9.
0. No change

Col. 38 - code:

0. Outside Urban Boundary
1. Inside Corporation Line
2. Inside Urban Boundary - outside corporation line.

All cities with 1960 population of 5,000 and above have Urban Area Boundaries.

Columns

39-42 SURFACE TYPE - Primary Extensions and interstate routes will have a precoded four-digit number indicating the surface type.

The surface type on all other city street systems should be indicated as follows:

Code:

0000	Non existing streets
1000	Unimproved streets
2000	Gravel or stone streets
3000	Oil surface on non-prepared base
5000	Bituminous surface on prepared base
6200	Asphaltic concrete on prepared base
6700	Asphaltic concrete resurfacing on portland cement concrete, brick, or block
7000	Portland cement concrete
8000	Brick or block

43-44 SURFACE WIDTH - Record surface width in feet to nearest foot. Measure this distance from face to face of curbs or from edge of pavement to edge of pavement if there are no curbs. Measure edge to edge of pavement on mountable curb sections. Measure outer edge of shoulder to outer edge of shoulder on gravel streets.

Columns

45 RAILROAD CROSSING - Code as follows:

RR CROSS

0. No Crossing
1. Single track with gates
2. Single track with automatic signals
3. Single track with watchman
4. Single track with crossbucks
5. Multiple tracks with gates
6. Multiple tracks with automatic signals
7. Multiple tracks with watchman
8. Multiple tracks with crossbucks
9. Other

46 TYPE SECTION - Code as follows:

T Y P

Not Divided:		Divided:	
Normal Section	0	Normal Section	1
Climb Lane w/median	2	Climb Lane	6
Climb Lane w/o median	3	Intersection	7
Intersection w/median	4	One-way street	9
Intersection w/o median	5		
Dual Surface	8		

47 CURB OR SHOULDER TYPE - Code as follows:

C R B

0 None
1 Paved Shoulders 8' wide and over
2 Paved shoulders 4' wide to 8' wide
3 Paved shoulders less than 4' wide
4 Stabilized gravel shoulder 8' wide and over
5 Stabilized gravel less than 8' wide
6 Gravel shoulder 8' wide and over
7 Gravel shoulder under 8' wide
8 Earth or Sod shoulder
9 Curbs

48-50 ROADWAY WIDTH - Primary road extensions precoded from Primary Road Inventory columns 45-47. Code surface width plus one foot on curb sections or from outer edge of shoulder to outer edge of shoulder if there are no curbs. Code width from outer edge of shoulder to outer edge of shoulder on mountable curb sections. For gravel surfaces use same width as surface width. Code 000 on non-existent streets. Sections which are bridges between adjoining states will be identified by coding a "B" in the first digit of the roadway width column 48.

Columns

51 — MEDIAN TYPE - Code as follows:

M
Y
T

0 - None of the following

Curbed
1 - Hard surfaced, refuged island
2 - Hard surfaced, no refuge
3 - Grass, refuge island
4 - Grass, no refuge

Not Curbed
5 - Hard surfaced, refuged island
6 - Hard surfaced, no refuge
7 - Grass, refuge island
8 - Grass, no refuge

9 - Legal center parking permitted

Medians greater than 6 feet in width are considered refuge islands

52-53 — MEDIAN WIDTH OR BARRIER - Record width in feet to nearest foot between edges of traffic lanes. Record average width if width varies. If a barrier exists, code "9" in first column and width of median in feet in second column. If median exceeds 9 feet, neglect any barriers and code median width.

MD
WD

Barrier types are: barrier guard rail, concrete barrier, cable, fence, trees and shrubs.

54 — TYPE PARKING - Code as follows:

P
R
K

0 No Restrictions
1 No parking
2 Allowed only in off-peak hours
3 Parallel parking on one side
4 Parallel parking on both sides
5 Angle parking on one side
6 Angle parking on both sides
7 Combination of angle and parallel

Columns

55 — TYPE DRAINAGE - Record existing drainage.

D
R
N

1 Curb and gutter
2 Open ditches
3 None

56 — ACCESS CONTROL - Code as follows:

A
C
C

1 Interstate system or other fully controlled access highway

2 Expressway system, a four-laned divided highway with interchanges or separation at major intersections and grade crossings at designated minor public road intersections. Expressway controlled access highway.

3 Planned controlled access highways on which through traffic is given primary consideration.

4 Planned controlled access highways on which through traffic and land service traffic are given equal consideration.

5 None

57 — TURNING LANES - Code the turning lane provisions at the most critical intersection in each road section.

TURN LANES

Code:

1 left turn lane provided
2 right turn lane provided
3 left and right turn lanes provided
0 None

58 — NUMBER OF TURNS - Code the volume of turns at each critical intersection as follows:

TURNS

1 High - with signals
2 Average - with signals
3 Low - with signals
4 High - stop sign on arterial
5 Average - stop sign on arterial
6 Low - stop sign on arterial
7 High - no signals or stop signs
8 Average - no signals or stop signs
9 Low - no signals or stop signs
0 No intersections on street section

Low 2% Average 10% High 20%

Columns

59

T
R
F

TRAFFIC FLOW - Code as follows:

1 One Way - south
2 One Way - north
3 One Way - east
4 One Way - west
5 Two Way - north-south
6 Two Way - east-west

60-61

APP WIDTH

THROUGH TRAFFIC WIDTH - Code the width of the driving surface available to through traffic. Do not include the width of lanes reserved for turning movements.

62

CAP PROB

CAPACITY PROBLEM - This item will be determined from capacity tables which will be furnished to the field crews, and included in the computer evaluation.

Code as follows:

0 No apparent capacity problem

1 Existing capacity problem

2 Probable future capacity problem

63

CAP SOLU

CAPACITY SOLUTION - Code as follows:

0 No apparent solution

1 Select another parallel street to replace this arterial

2 Select another parallel street to function with this street as a one-way couplet

3 Widen this street

4 Provide additional turning lanes or other wise improve a critical intersection

Columns

64-66

ROW
AVAL

RIGHT OF WAY FOR STREET WIDENING - Record in feet. This entry will allow an office evaluation of whether a street or road can be widened. Determining what is excessive cost is a judgemental consideration but generally will include the necessity of acquiring major buildings or groups of buildings, or other expensive man-made facilities. Also consider damages which would result from widening.

In highly developed business areas, this width will be the distance from the face of the business buildings on one side of the street to the face of the buildings on the opposite side.

In areas of individual homes, record the distance from a point 25 feet in front of the homes on one side of the street to a point 25 feet in front of the homes on the opposite side.

In both of the above areas there will be occasions when some few buildings or homes are closer to the street than the majority. In these cases disregard these structures unless they appear to be of such value that they might encure an extremely high cost to secure.

In open areas record a width which appears to be consistant with the surrounding built up areas.

olumns

67 TYPE OF AREA

TY
AREA

Code

1 Central Business District

2 Fringe Area

3 Outlying Business District

4 Residential Area

5 Rural

These areas are defined as follows:

1. Central Business District - That portion of a municipality in which the dominant land use is for intense business activity. This district is characterized by large numbers of pedestrians, commercial vehicle loadings of goods and people, a heavy demand for parking space and high parking turnover.

2. Fringe area - That portion of a municipality immdeiately outside the central business district in which there is a wide range in type of business activity generally including small businesses, light industry, warehousing, automobile service activities and intermediate strip development, as well as some concentrated residential areas. Most of the traffic in this area involved trips that do not have an origin or a destination within the area. This area is characterized by moderate pedestrian traffic and a lower parking turnover than is found in the central business district, but it may include large parking areas serving that district.

Columns

67 Continued: Type of Area

3. Outlying Business District - That portion of a municipality or an area within the infulence of a municipality, normally separated goegraphically by some distance from the Central Business District and its Fringe area, in which the principal land use is for business activity. This district has its own local traffic circulation superimposed on through movements to and from the Central Business District, a relatively high parking demand and turnover, and moderate pedestrian traffic. Compact off-street shopping developments entirely on one side of the street are not included in the scope of this definition.

4. Residential Area - That portion of a municipality, or an area within the influence of a municipality, in which the dominant land use is residential development, but where small business areas may be included. This area is characterized by few pedestrians and a low parking turnover.

5. Rural - Roadway serves a sparsely developed area primarily devoted to agriculture or conservation usage.

Columns

68 ROW COST GROUP

ROW COST GR

Code

1	Central Business District	-- Low Cost
2	Central Business District	-- Average Cost
3	Central Business District	-- High Cost
4	Fringe Area or Outlying Business District	-- Low Cost
5	Fringe Area or Outlying Business District	-- Average Cost
6	Fringe Area or Outlying Business District	-- High Cost
7	Residential	-- Low Cost
8	Residential	-- Average Cost
9	Residential	-- High Cost
0	Rural	

When two different type areas occur along the same street, code the lower numbered area. Example -- central business district on one side of the street and residential on the other side, code central business district.

Note -- For cities and towns in the Des Moines metropolitan area the Central Iowa Regional Planning Commission will furnish a map showing the areas and cost groups needed to code this entry.

Columns

69-70

SURF COND

SURFACE AND BASE CONDITION - The rater should remember that he is rating the condition of both the surface and the base in this item. When the condition of the surface reflects a poor and unstable base condition, the item should be rated downward accordingly.

In some cases, a newly laid surface may be observed to be in excellend condition. However, in those cases where it can be determined that poor base or no base underlies the surface, the rating may be penalized 15 to 20 points.

Indicate pavement condition by numerical rating.

Code	
24-25	Excellent - New or near-new condition
16-23	Good - Minor cracking or spalling or irregularities. Minor roughness causing little discomfort in riding.
8-15	Fair - Moderate cracking and failures - extensive patching required. Good gravel streets are also in this category.
1-7	Poor - Very heavy cracking, deep failures, obvious instability. Very unsatisfactory riding surface.
0	Very Poor - Completely broken up

Columns

71 ADEQUACY OF DRAINAGE - The condition of existing drainage facilities is based on their physical condition and ability to provide adequate removal of runnoff and minimize flooding. This condition rating is determined by visual inspection of storm sewer systems, and appurtences, ditches, culverts, pipes, side drains, etc. Inquiry among local residents as to the extent and frequency of flooding is also helpful in determining the condition of the overall system. Separate criteria are used for curbed sections and non-curbed sections as follows:

		Curbed Section	Open Section
5	Excellent	Inlets and pipes observed to be in like-new condition.	Ditches and structures clean and in like-new condition.
4	Good	Inlets and pipes observed to be in good condition. Possibly some minor cleaning or repair required.	Ditches and structures generally in good condition. Some minor repair, regrading or cleaning needed.
3	Fair	Inlets and pipes observed to be in fair condition. Some moderate cleaning and repair required.	Ditches and structures generally in fair condition. Some moderate cleaning and repair required.
2-1	Poor	Inlets and pipes observed to be in poor condition. Very extensive repairs required.	Ditches and structures generally in poor condition. Very extensive repairs required.
0	Very poor	Cannot be corrected by extensive repairs. Replacement required.	Inadequate ditches, etc. Structures in such poor condition that replacement is required.

Columns

72 CURB OR SHOULDER CONDITION - The physical condition of the curbs or shoulder will be rated as follows:

	CURB SECTION	OPEN SECTION	
		Surfaced Shoulders	Sod Shoulders
Excellent	New or like-new condition.	New or near-new condition.	Shoulders are rated on their regularity, uniformity of width, and uniformity of cross slope. Shoulders varying in width, not wel defined or varyin in cross slope should be rated down. Shoulders with cross slopes steeper than 1" per foot, should be rated down. The shoulder must be a distinct part of the roadway surface or the ditch front slope. Consideration should also be given to the amount of additional roadway width the shoulde affords the drive
Good	Minor cracking or spalling. Normal maintenance will correct.	Light cracking or spalling.	
Fair	Moderate cracking and failures. Requires special repairs.	Moderate cracking and failures. Patching required.	
Poor	Very heavy cracking Extensive repairs or rebuilding required.	Heavy cracking, deep failures, obvious instability.	
Very Poor	Completely broken up. Rebuilding required.	Completely broken up.	

Columns

73 D A T	ADT DATE - Precoded in office. Record the date of the ADT count by entering the last number of the year the count was made. For estimated ADT enter 9 in this column.
74-78 ADT	ADT - Precoded in office Enter the actual ADT count for each section of road inventoried.
79 S S	SPECIAL STUDY - This column is being reserved for office use to denote unusual situations
80 C T	CARD TYPE - For office use 4 Change Card 2 5 Change Card 3

PERCIVAL

MUNICIPAL STREETS

DEFICIENCIES AND IMPROVEMENT PRINT-OUT

General: The Deficiencies and Improvement Print Out shows the results of a computer program which analyzes each section of street and determines if and when improvements are needed.

To assist in the evaluation of each section of street a point rating system similar to sufficiency rating has been developed for city arterial streets. The maximum possible points that can be assigned to any given section of street are shown on page 6 of the appendix. Geometric and capacity items comprise 65 points of this rating system and condition 35 points for a possible total of 100 points, and distributed as shown in Table 1.

Each of the geometric items on any one section of street is evaluated against a desirable design guide applicable to that particular street. If a given item meets the design guide criteria, it is given the maximum points allowable. If this item fails to meet the design guides, it receives something less than the maximum. The geometric and capacity ratings are applied by a computer program, whereas the condition ratings applied to each street section are determined by field inventory crews.

If a street rates less than 70 points total, the computer program will propose an improvement to bring the rating of this street back to a level above the 70 point cut off. Street sections are also examined for individual deficiencies even though the total point rating may be above 70. This could occur in the case of unacceptable surface type, traffic carrying capacity, or other individual items. The computer program looks at each section of street for each year of the 20 year study period. As each subsequent year is examined, the traffic on the road is expanded and the condition rating is depreciated until the end of the study period is reached.

The first line of the print out shows the condition of the road as it presently exists. The last line of the print out for each section of street shows the condition and physical properties of the street in 1987, if all the proposed improvements are made. All print lines between the present and terminal contain information concerning the improvements called for. The condition ratings and physical features are those expected to exist just prior to construction of the improvement. Upon completion of the proposed

improvement, the physical features are adjusted to reflect design guide requirements and the condition ratings adjusted to reflect that of the new improvement.

Each item listed on the D & I Print Out is identified by a title at the top of each page. A description of each of these items follows:

Columns	
1-2 CO NR	County Number - Numbered in alphabetical order according to county name.
5-8 NEED STDY SECT NUMB	Need Study Section Number - The first three digits of this number are used to combine small street sections that have the same general characteristics into logical needs sections for the purpose of analysis. The first needs study section on a street will be numbered 010, the second section 020, etc. These numbers will be assigned on streets from west to east and south to north beginning at the west or south urban boundary line or corporation line if there is no urban boundary line. One section within each needs study section must be selected as the typical section and is so designated by a "One" in the fourth digit of the needs study number. All other sections within that needs study section will have a zero coded in the fourth digit.
11-15 SEQUENCE 1 ST	First Sequence - This number is the first sequence number of a needs study section. Each street is sequenced using a five-digit number. The streets will be sequenced from south to north or from west to east by an increase of five in each succeeding number. The first number used at the corporation line will be 00500.
18-22 SEQUENCE 2 ND	Second Sequence - This number is the last sequence number of a needs study section.

Columns

25-28

CITY

NUMB

City Number The incorporated cities and towns are numbered in alphabetical order using a four-digit number beginning with 0010, followed by 0020, etc.

30

S
E
R

Street Service - Coded according to the service it provides from the following list.

1. Freeway
2. Expressway
3. Ramp
4. Arterial
5. Collector
6. Local

32

S
Y
S

System - Coded from the following list.

1. U. S. numbered primary route
2. Iowa numbered primary route
3. Interstate
4. F.A.S. Extension
5. Other City Streets

35-38

ST

NUMB

Street Number - On all city street systems other than Primary or Interstate Routes, each street will be assigned a four-digit number. Streets traversing a city or town in a predominantly east-west direction will be assigned numbers from 0000 through 4999. Streets crossing in a north-south direction will be assigned numbers from 5000 through 9999. In metropolitan areas, use continuous numbers across the entire area.

To allow for future expansion of the city corporate limits the first east-west street on the south corporation line should be assigned the number 1000. The first north-south street on the west corporation line should be designated 6000. The numbers assigned to successive streets should be done by assigning numbers by tens and reserving the other numbers for

Columns

35-38 (cont'd) ST NUMB — new streets that may be built in the future. An example of the numbers assigned would be 1010, 1020, 1030, etc., and 6010, 6020, 6030, etc. Where large open areas are encountered, it would be necessary to skip large blocks of numbers to provide for many additional streets in the future.

40-43 NEED SECT LGTH — Section Length - The length of the section is shown to the nearest 0.01 mile, for divided sections the length will be the lane length of the south or east lane.

46 SURF TYP — Surface Type - The surface type on all city street systems will be indicated as follows:

- 0 - Non existing streets
- 7 - Unimproved streets
- 6 - Gravel or stone streets
- 5 - Oil surface on non-prepared base
- 4 - Bituminous surface on prepared base
- 3 - Asphaltic concrete on prepared base
- 3 - Asphaltic concrete resurfacing on Portland cement concrete, brick or block
- 1 - Portland cement concrete, brick or block

48-49 SURF WD — Surface Width - The surface width is recorded in feet to the nearest foot. The distance is measured from face to face of curbs or from edge of pavement to edge of pavement, if there are no curbs. The distance was measured from edge to edge of pavement on mountable curb sections and from outer edge of shoulder to outer edge of shoulder on gravel streets.

Columns

51

C/S

Curb or Shoulder Type - Coded as follows:

0 - None
1 - Paved shoulders 8' wide and over
2 - Paved shoulders 4' to 8' wide
3 - Paved shoulders less than 4' wide
4 - Stabilized gravel shoulder 8' wide and over
5 - Stabilized gravel less than 8' wide
6 - Gravel shoulder 8' wide and over
7 - Gravel shoulder under 8' wide
8 - Earth or sod shoulder
9 - Curbs

53-55

RDY WD

Roadway Width - Measured from back to back of curbs on curb sections or from outer edge of shoulder to outer edge of shoulder if there are no curbs, or if there are mountable curbs.

57

MED T Y P

Median Type - Coded as follows:

0 - None of the following

Curbed

1 - Hard surfaced, refuge island
2 - Hard surfaced, no refuge
3 - Grass, refuge island
4 - Grass, no refuge

Not Curbed

5 - Hard surfaced, refuge island
6 - Hard surfaced, no refuge
7 - Grass, refuge island
8 - Grass, no refuge
9 - Legal center parking permitted

Medians greater than 6 feet in width are considered refuge islands.

Columns

59-60

MED
W
D

Median Width or Barrier - The width is recorded in feet to the nearest foot between edges of traffic lanes. It shows average width if width varies. If a barrier exists, a "9" is coded in first column and width of barrier in feet in second column. If median exceeds 9 feet, any barriers are neglected and the median width is coded.

Barrier types are: Barrier guard rail, concrete barrier, cable, fence, trees and shrubs.

62

D
R
A

Type of Drainage - Coded as follows:

1 - Curb and Gutter
2 - Open ditches
3 - None

64-65

TH
WD

Through Traffic Width - Shows the width of the driving surface available to through traffic. It does not include the width of lanes reserved for turning movements. Will be blank on local streets.

67-69

ROW
AVL

Right-of-Way for Street Widening - Recorded in feet. This entry will allow an office evaluation of whether a street or road can be widened. Determining what is excessive cost is a judgmental consideration but generally will include the necessity of acquiring major buildings or groups of buildings, or other expensive man-made facilities. Also consider damages which would result from widening.

In highly developed business areas, this width will be the distance from the face of the business buildings on one side of the street to the face of the buildings on the opposite side.

In areas of individual homes, the distance is recorded from a point 25 feet in front of the homes on one side of the street to a point 25 feet in front of the homes on the opposite side.

In both of the above areas there will be occasions when some few buildings or homes are closer to the

Columns

67-69 (cont'd)

ROW AVL

street than the majority. In these cases these structures are disregarded unless they appear to be of such value that they might incur an extremely high cost to secure.

In open areas width which appears to be consistent with the surrounding built-up areas is recorded. Will be blank on local streets.

71

A R A

Type of Area

Code:

1 - Central business district
2 - Fringe area
3 - Outlying business district
4 - Residential area
5 - Rural

A description of each is given in the instructions for the municipal street inventory listing. Will be blank on local streets.

73

R C G

Row Cost Group

Code:

1	Central Business District	-- Low Cost
2	Central Business District	--Average Cost
3	Central Business District	-- High Cost
4	Fringe Area or Outlying Business District	-- Low Cost
5	Fringe Area or Outlying Business District	-- Average Cost
6	Fringe Area or Outlying Business District	-- High Cost

Columns

73 (cont'd)

R
C
G

7	Residential	-- Low Cost
8	Residential	-- Average Cost
9	Residential	-- High Cost
0	Rural	

When two different type areas occur along the same street, code the lower numbered area. Example -- central business district on one side of the street and residential on the other side, code central business district.

77-78

BS
SF

Base and Surface Condition - Indicates pavement condition by numerical rating.

Code

24-25	Excellent	- New or near-new condition
16-23	Good	- Minor cracking or spalling or irregularities. Minor roughness causing little discomfort in riding.
8-15	Fair	- Moderate cracking and failures -- extensive patching required. Good gravel streets are also in this category.
1- 7	Poor	- Very heavy cracking, deep failures, obvious instability Very unsatisfactory riding surface.
0	Very Poor	- Completely broken up.

80

D
R

Adequacy of Drainage - The condition of existing drainage facilities is based on their physical condition and ability to provide adequate removal of runoff and minimize flooding. This condition rating is determined by visual inspection of storm sewer systems, and appurtences, ditches, culverts, pipes, side drains, etc. Inquiry among local residents as to the extent and frequency of flooding is also helpful in determining the condition of the overall system.

Columns

80 (cont'd)

D R

Separate criteria are used for curbed sections and non-curbed sections as follows:

		Curbed Section	Open Section
5	Excellent	Inlets and pipes observed to be in like-new condition.	Ditches and structures clean and in like-new condition.
4	Good	Inlets and pipes observed to be in good condition. Possibly some minor cleaning or repair required.	Ditches and structures generally in good condition. Some minor repair, regrading or cleaning needed.
3	Fair	Inlets and pipes observed to be in fair condition. Some moderate cleaning and repair required.	Ditches and structures generally in fair condition Some moderate cleaning and repair required.
2-1	Poor	Inlets and pipes observed to be in poor condition. Very extensive repairs required.	Ditches and structures generally in poor condition. Very extensive repairs required.
0	Very Poor	Cannot be corrected by extensive repairs. Replacement required.	Inadequate ditches, etc. Structures in such poor condition that replacement is required.

82

C/S

Curb Or Shoulder Condition - The physical condition of the curbs or shoulder will be rated as follows:

		Curb Section	Open Section	
			Surface Shoulders	Sod Shoulders
5	Excellent	New or like-new condition	New or near-new condition	Shoulders are rated on their

Columns

82 (cont'd)

C/S		Curb Section	Open Section	
			Surface Shoulders	Sod Shoulders
4	Good	Minor cracking or spalling, Normal maintenance will correct.	Light cracking or spalling.	regularity, uniformity of width, and uniformity of cross slope. Shoulders varying in width, not well-defined or varying in cross slope should be rated down. Shoulders with cross slopes steeper than 1" per foot, should be rated down. The shoulder must be a distinct part of the roadway surface or the ditch front slope. Consideration should also be given to the amount of additional roadway width the shoulder affords the driver.
3	Fair	Moderate cracking and failures. Requires special repairs.	Moderate cracking and failures. Patching required.	
1-2	Poor	Very heavy cracking. Extensive repairs or rebuilding required.	Heavy cracking, deep failures, obvious instability.	
0	Very Poor	Completely broken up. Rebuilding required.	Completely broken up.	

87 Surface Width Design Points

SF WD Arterial - Points are assigned for surface width from Table 5. This indicates how the existing width compares to that called for on the design guides, with a maximum of 15 Points.

Columns

87 (cont'd) Local - The surface width is checked against the design guides and rated as follows:

SF
WD

2 - Desirable
1 - Tolerable
0 - Intolerable

89 Surface Type Design Points -

S
U
R

Arterial - Points are assigned for surface type from Table 2. This has a maximum of 5 points.

Local - The existing surface type is checked against the design guides and rated as follows:

2 - Desirable
1 - Tolerable
0 - Intolerable

91-92 Design Points for Type of Street Section -

T
Y
P

Arterial - Points are assigned for type of street section from Table 3. The maximum for this is 10 Points.

Local - The type of street section is checked against the design guides and rated as follows:

2 - Desirable
1 - Tolerable
0 - Intolerable

94-95 Design Points for Capacity

C
A
P

Arterial - Points are assigned from Table 4. Using the Volume/Capacity Ratio, with a maximum of 35 points.

Locals - No special consideration is given to capacity on local streets and will be left blank.

98-99 Total Condition Points

C
O
N

Columns

101-102

D
E
S

Total Design Points

104-106

TOT

Total Points - Sum of the Design and Condition points.

108

Design Class Code - This number is determined from the design guides using average daily traffic for arterial streets, and population and type of area for local streets.

110

C
A
P

Capacity Code - This is a one-digit taken from Table 6. A capacity code of 3 or greater indicates a capacity problem. This column will be blank on local streets.

113-114

D
A
T
E

ADT Date - Shows the year of the estimated ADT.

116-120

-ADT-

Average Daily Traffic - The estimated average daily traffic for the year shown.

122-123

T
Y
P

Improvement Type - The first digit is the backlog-Future Code. It indicates whether the the road was deficient in 1968 (Backlog) or whether it became deficient at some future year in the study period, and is coded as follows:

1. Backlog
2. Future

The second digit indicates the type of improvement called for using the following codes:

Columns

122-123 (contd)
T
Y
P

1. New Construction
2. Reconstruction
3. Widen & Resurface
4. Base & Surface
5. Resurface

125-126
YR

Improvement Year - Shows the year the improvement is called for.

129-130
C
S
E

Cause of Improvement - A two-digit code showing the cause of improvement from Table 7.

132
N
R

Improvement Number - The possible codes are:

1 Improvement No. 1
2 Improvement No. 2
3 Improvement No. 3
4 Improvement No. 4

IOWA HIGHWAY NEEDS STUDY
DESIGN GUIDES FOR LOCAL CITY STREETS

POPULATION GROUPS			10000 & OVER			2500 - 10000		UNDER 2500	
TYPE OF AREA			CENTRAL BUSINESS DISTRICT	FRINGE AND OUTLYING BUSINESS	RESIDENTIAL AND RURAL	ALL BUSINESS AREAS	RESIDENTIAL AND RURAL	ALL BUSINESS AREAS	RESIDENTIAL AND RURAL
DESIGN CLASS CODE			1	2	3	4	5	6	7
ROADWAY	NUMBER OF TRAVEL LANES	DESIRABLE	2	2	2	2	2	2	2
		TOLERABLE	2	2	2	2	2	2	2
	NUMBER OF PARKING LANES	DESIRABLE	2	2	1	2	1	2	1
		TOLERABLE	1	1	1	1	1	1	SHOULDER
	SURFACE WIDTH	DESIRABLE	52	44	31	44	31	44	31
		TOLERABLE	40	30	24	30	24	30	18
	TYPE STREET SECTION	DESIRABLE	CURBS			CURBS		CURBS	CURBS
		TOLERABLE							GRAVEL SHOULDERS
	SURFACE TYPE [1]	DESIRABLE	HIGH	HIGH	INTER.	HIGH	INTER.	HIGH	INTER.
		TOLERABLE	HIGH	INTER	LOW	INTER	LOW	INTER	GRAVEL
BRIDGES	DESIGN LOADING		HS-20	HS-20	H-15	HS-20	H-15	HS-20	H-15
	STRUCTURE WIDTH	DESIRABLE	APPROACH SURFACE WIDTH PLUS 4 FEET AND SIDEWALK						
		TOLERABLE	APPROACH SURFACE WIDTH						

[1] HIGH SURFACE: PORTLAND CEMENT CONCRETE 7 INCHES OR MORE IN THICKNESS ON A BASE SUITABLE TO CARRY FREQUENT HEAVY AXLE LOADS; OR ASPHALTIC CONCRETE 4 INCHES OR MORE IN THICKNESS ON A BASE SUITABLE TO CARRY FREQUENT HEAVY AXLE LOADS; OR ASPHALTIC CONCRETE OVERLAYS WHICH PRODUCE A TOTAL SURFACE THICKNESS GREATER THAN 4 INCHES; OR EXISTING BRICK OR BLOCK.

INTERMEDIATE SURFACE: PORTLAND CEMENT CONCRETE LESS THAN 7 INCHES IN THICKNESS ON A NON-PREPARED BASE SUITABLE TO CARRY A MODERATE FREQUENCY OF HEAVY AXLE LOADS; OR AT LEAST 1 INCH BUT LESS THAN 4 INCHS OF BITUMINOUS SURFACE ON A PREPARED BASE SUITABLE TO CARRY A MODERATE FREQUENCY OF HEAVY AXLE LOADS.

LOW SURFACE: A BITUMINOUS SURFACE LESS THAN 1 INCH IN THICKNESS ON A BASE SUITABLE TO CARRY OCCASIONAL HEAVY AXLE LOADS.

IOWA HIGHWAY NEEDS STUDY
DESIGN GUIDES FOR CITY ARTERIALS

DATE 2-1-68

	TYPE FACILITY	FREEWAY & EXPRESSWAY		MAJOR STREETS								
	TYPE AREA	ALL AREAS		CENTRAL BUSINESS DIST.			FRINGE & OUTLYING BUS.			RESIDENTIAL & RURAL		
	DESIGN CLASS CODE	4	5	1	2	3	1	2	3	1	2	3
ROADWAY	DESIGN YEAR TRAFFIC (D.H.V.)	OVER 5000	5000 & UNDER	OVER 1500	700-1500	0-899	OVER 1900	900-1900	0-899	OVER 1900	900-1900	0-899
ROADWAY	NO. OF TRAVEL LANES	6	4	6	4	2	6	4	2	6	4	2
ROADWAY	TRAVEL LANE WIDTH	12	12	12	12	12	12	12	12	12	12	12
ROADWAY	TOTAL TRAVEL WIDTH	72	48	72	48	24	72	48	24	72	48	24
ROADWAY	PARKING LANES	NONE		NONE 1/	2 AT 10'	2 AT 10'	NONE 1/	2 AT 10'	2 AT 10'	NONE 1/	2 AT 9'	2 AT 9'
ROADWAY	MEDIAN WIDTH	20	20	MINIMUM 4'		N/A	MINIMUM 4'		N/A	MINIMUM 4'		N/A
ROADWAY	TOTAL ROADWAY WIDTH	112	88	73 2/	69 2/	45 2/	73 2/	69 2/	45 2/	73 2/	67 2/	43 2/
ROADWAY	MINIMUM R.O.W. WIDTH	140	110	98	94	65	98	94	65	98	92	63
ROADWAY	TYPE STREET SECTION	PAVED SHO. 6' LT.-10' RT.		CURBS			CURBS			CURBS		
ROADWAY	SURFACE TYPE	HIGH		HIGH			HIGH			HIGH		
ROADWAY	ACCESS CONTROL	FULL 3/		NONE			NONE			NONE		
BRIDGES	DESIGN LOADING	HS-20		HS-20			HS-20			HS-20		
BRIDGES	ROADWAY WIDTH	TWIN BRIDGES 52' WIDE SINGLE BRIDGES 92' PLUS MEDIAN	TWIN BRIDGES 40' WIDE SINGLE BRIDGES 68' PLUS MEDIAN	APPROACH SURFACE WIDTH PLUS 6 FEET AND SIDEWALKS								
BRIDGES	VERTICAL CLEARANCE	16'		16'			16'			16'		
BRIDGES	UNDERPASS HORZ. CLEAR.	4/		6 FEET BEHIND CURB								

1/ PARKING PERMITTED IN OFF-PEAK HOURS

2/ BACK OF CURB TO BACK OF CURB

3/ SOME AT GRADE CROSSINGS ALLOWED ON EXPRESSWAY

4/ EDGE OF PAVEMENT + 30' OR SHOULDER LINE + 4' WITH GUARDRAIL ON R.R. UNDERPASSES

TABLE 1

MUNICIPAL STREETS

POINT RATING

Surface Type	5	
Type Street Section	10	65
Capacity	35	
Surface Width	15	
Condition:		
Surface and Base	25	
Drainage	5	35
Curb or Shoulder	5	
TOTAL	100	

TABLE 2

SURFACE TYPE RATING -- 5 Points

Standard Calls For	Existing Surface Type is				
	High	Intermediate	Low	Gravel	Dirt
High	5	4	1	0	0
Intermediate	5	5	3	0	0
Low	5	5	5	0	0
Gravel	5	5	5	5	0

TABLE 3

TYPE STREET SECTION -- 10 Points

Col. 47 (Curb or shoulder type) code	Standard Calls for Curbs	Shoulders
0	0	0
1	10	10
2	4	6
3	0	2
4	8	8
5	0	4
6	6	6
7	0	2
8	0	0
9	10	10

TABLE 4

CAPACITY RATING -- 35 Points

1. Read 10% of ADT volume
2. Select capacity from appropriate capacity table
3. Divide (1) by (2) to get volume/capacity ratio, to 00.00 value
4. Assign rating points as follows

Volume/Capacity Ratio	Rating Points
00.00 - 00.59	35
00.60 - 00.64	33
00.65 - 00.69	30
00.70 - 00.74	27
00.75 - 00.79	25
00.80 - 00.84	20
00.85 - 00.89	15
00.89 - 00.95	10
00.95 - 00.99	5
≥ 1.00	0

TABLE 5

SURFACE WIDTH RATING

No Shoulders*

Standard Roadbed Width (ft)	Existing Surface Width (feet)										
	72+	67 to 71	66 to 62	61 to 57	56 to 52	51 to 47	46 to 42	41 to 37	36 to 32	31 to 27	26 to 24	24
112	15	9	6	0	0	0	0	0	0	0	0	
88	15	15	15	15	15	15	6	0	0	0	0	
73	15	12	9	5	0	0	0	0	0	0	0	
69	15	15	12	9	6	6	3	0	0	0	0	
67	15	15	13	12	9	6	3	0	0	0	0	
45	15	15	15	15	15	15	15	12	9	3	3	
43	15	15	15	15	15	15	15	12	11	6	3	

With Shoulders*

112	15	12	9	0	0	0	0	0	0	0	0	0
88	15	15	15	15	15	15	9	0	0	0	0	0
73	15	15	12	9	0	0	0	0	0	0	0	0
69	15	15	15	15	15	15	12	0	0	0	0	0
67	15	15	15	15	15	15	12	3	0	0	0	0
45	15	15	15	15	15	15	15	15	15	15	6	0
43	15	15	15	15	15	15	15	15	15	15	15	0

*Shoulders must be on both sides and 8' wide or better. Shoulder surface type must be gravel or better, stable year round.

TABLE 6

MUNICIPAL ARTERIAL STREETS

Capacity Codes

Volume / Capacity	Capacity Code
0.00	0
0.01-0.49	1
0.50-0.89	2
0.90-1.09	3
1.10-1.19	4
1.20-1.29	5
1.30-1.49	6
1.50-1.69	7
1.70-1.99	8
$\geq$ 2.00	9

TABLE 7

CAUSE OF IMPROVEMENT CODES

Municipal Deficiencies and Improvements Program

Arterial

Page	Code	Cause of Improvement	Improvement
28	01	Surface Width Points <3 Surface Type Points <4	Reconstruction
28	02	Surface Width Points <3	Widen and Resurface
28	03	Surface Type Points <1 Surface Width Points <15	Reconstruction
28	04	Surface Condition Points ≤ 15 Surface Width Points ≤ 12	Widen and Resurface
28	05	Surface Condition Points ≤ 15 Surface Width Points ≤ 12 Surface Type Points <4	Reconstruction
28	06	Surface Condition Points <8	Base and Surface
36,28	07	Surface Condition Points ≤ 15	Resurface
36	08	Surface Condition Points ≤ 15 Improvement Number >2	Reconstruction
36	09	Surface Condition Points ≤ 15 Below Standard Surface Type Surface Width Points <15	Reconstruction
36	10	Surface Condition Points ≤ 15 Below Standard Surface Type	Base and Surface

TABLE 7

Page	Code	Cause of Improvement	Improvement
29	11	Total Needs Rating Points <70 Capacity Points <25	Reconstruction
29	12	Total Needs Rating Points <70 Surface Condition Rating <8	Reconstruction
29	13	Total Needs Rating Points <70 Type Section Rating <4 Type Area Not Rural	Reconstruction
29	14	Total Needs Rating Points <70 Width Rating <9 Type Area Not Rural	Reconstruction
29	15	Total Needs Rating Points <70 Width Rating <12 Total Condition Rating <20	Reconstruction
29	16	Total Needs Rating Points <70 Curb & Drainage Cond. Points <6 And either surface condition <12 or surface type rating <4	Reconstruction
29	17	Total Needs Rating Points <70 Surface Width Rating <12 And either surface cond. <12 or surface type rating <4	Reconstruction
29	18	Total Needs Rating Points <70 Surface Width rating <12	Widen and Resurface
29	19	Total Needs Rating Points <70	Resurface
29	20	Total Needs Rating points <70 And either surf. condition <12 or surface type rating <4	Base and Surface
29	21	Total Needs Rating Points <70 Curb & Drainage Cond. Points <6	Reconstruction

TABLE 7

Page	Code	Cause of Improvement	Improvement
40	22	Total Needs Rating Points <70 but ≥65 Type section rating <4 Type Area Rural	Reconstruction
40	23	Total Needs Rating Points <70 but ≥65 Surface Width Rating <9 Type Area Rural	Reconstruction
32	24	Change in Design Class Code	Reconstruction
		Locals	
38	31	Surface Width not tolerable Surface Type not Standard	Reconstruction
38	32	Surface Width not tolerable	Widen and Resurface
38	33	Surface Type not tolerable	Base and Surface
16	34	Surface Condition points ≤15 Improvement number >2	Base and Surface
16,13	35	Surface Condition Points ≤15	Resurface if ≥8 Base and Surf. if <8
38	36	Surface Condition Points <8 (gravel)	Resurface with gravel
38	37	Surface type not tolerable Type section not tolerable	Reconstruction
13	38	Surface Condition Points <8 Type Street section not tolerable	Reconstruction
38	39	Type street section not tolerable Surface Type Class 6	Reconstruction

PERCIVAL

MUNICIPAL STREETS

Cost Program Print-Out Interpretation

General: The cost program assigns costs to each individual street section that was analyzed in the municipal streets deficiencies and improvements program. The costs are taken from tables of estimated costs developed by the Needs Study Unit for this purpose. The computer examines each record and collects the information necessary to assign costs for each improvement from the proper cost table. Estimated maintenance and administration costs are assigned to each street section also at this time. As each record is processed, the cost information assigned from the cost tables is written on the computer tape and summarized by needs section on the computer print-out sheets.

Municipal Street Cost Assignment Print-Out

For each needs section studied, there will be at least one line of print. If improvements have been called for in the deficiencies and improvements program, each improvement will be shown on a separate line with the estimated costs associated with that improvement. The information on the left side of the print-out is identical to that found on the Municipal Streets Deficiencies and Improvements print-out. Other information to be found on the print-out is as follows:

Print-Out Identification	
MAINT COST	Maintenance Cost - The cost figure shown is summed by year as well as by needs section. This was done to eliminate the necessity of showing 20 lines of print for each needs section to show maintenance costs. Example: If the improvement year for the first improvement is 1975, then the maintenance cost shown on the line with the first improvement, will be the estimated maintenance cost for all the years, beginning with 1968, up to and including the year 1975. On the line with the second improvement the maintenance cost shown will be for the years beginning with 1976, up to and including the year of the second improvement. If there is no second improvement, the cost shown will be the maintenance cost for the remaining years in the study period including 1987.

Print-Out Identification

ROW COST

GRADE DRAIN

BASE SUR

ENG COST

MISC COST

These costs are estimated costs of making the type of improvement indicated on the line with the cost figures.

Example: If the grade and drain cost is $75,000 per mile for new construction (improvement type 1) and the needs section length is 2.00 miles then the Grade and Drain Cost shown on the line when Improvement Type 1 is indicated for this needs section will be 2.00 x $75,000 = $150,000

ROW, Base and Surface, Engineering, and Miscellaneous Costs are determined in the same manner.

ADMIN COST

Administration Cost

TOTAL COST

Total Cost - Gives the total of all costs shown on the corresponding line.

At the end of each City there is a City Total which gives the sum of the totals for the City Arterials and Locals.

IOWA HIGHWAY NEEDS STUDY
DESIGN GUIDES FOR CITY ARTERIALS

DATE 2-1-68

	TYPE FACILITY	FREEWAY & EXPRESSWAY		MAJOR STREETS								
	TYPE AREA	ALL AREAS		CENTRAL BUSINESS DIST.			FRINGE & OUTLYING BUS.			RESIDENTIAL & RURAL		
	DESIGN CLASS CODE	4	5	1	2	3	1	2	3	1	2	3
ROADWAY	DESIGN YEAR TRAFFIC (D.H.V.)	OVER 5000	5000 & UNDER	OVER 1500	700-1500	0-699	OVER 1900	900-1900	0-899	OVER 1900	900-1900	0-899
ROADWAY	NO. OF TRAVEL LANES	6	4	6	4	2	6	4	2	6	4	2
ROADWAY	TRAVEL LANE WIDTH	12	12	12	12	12	12	12	12	12	12	12
ROADWAY	TOTAL TRAVEL WIDTH	72	48	72	48	24	72	48	24	72	48	24
ROADWAY	PARKING LANES	NONE		NONE 1/	2 AT 10'	2 AT 10'	NONE 1/	2 AT 10'	2 AT 10'	NONE 1/	2 AT 9'	2 AT 9'
ROADWAY	MEDIAN WIDTH	20	20	MINIMUM 4'		N/A	MINIMUM 4'		N/A	MINIMUM 4'		N/A
ROADWAY	TOTAL ROADWAY WIDTH	112	88	73 2/	69 2/	45 2/	73 2/	69 2/	45 2/	73 2/	67 2/	43 2/
ROADWAY	MINIMUM R.O.W. WIDTH	140	110	98	94	65	98	94	65	98	92	63
ROADWAY	TYPE STREET SECTION	PAVED SHO. 6' LT.-10' RT.		CURBS			CURBS			CURBS		
ROADWAY	SURFACE TYPE	HIGH		HIGH			HIGH			HIGH		
ROADWAY	ACCESS CONTROL	FULL 3/		NONE			NONE			NONE		
BRIDGES	DESIGN LOADING	HS-20		HS-20			HS-20			HS-20		
BRIDGES	ROADWAY WIDTH	TWIN BRIDGES 52' WIDE SINGLE BRIDGES 92' PLUS MEDIAN	TWIN BRIDGES 40' WIDE SINGLE BRIDGES 68' PLUS MEDIAN	APPROACH SURFACE WIDTH PLUS 6 FEET AND SIDEWALKS								
BRIDGES	VERTICAL CLEARANCE	16'		16'			16'			16'		
BRIDGES	UNDERPASS HORZ. CLEAR.	4/		6 FEET BEHIND CURB								

1/ PARKING PERMITTED IN OFF-PEAK HOURS

2/ BACK OF CURB TO BACK OF CURB

3/ SOME AT GRADE CROSSINGS ALLOWED ON EXPRESSWAY

4/ EDGE OF PAVEMENT + 30' OR SHOULDER LINE + 4' WITH GUARDRAIL ON R.R. UNDERPASSES

IOWA HIGHWAY NEEDS STUDY
DESIGN GUIDES FOR LOCAL CITY STREETS

POPULATION GROUPS			10000 & OVER			2500 - 10000		UNDER 2500	
TYPE OF AREA			CENTRAL BUSINESS DISTRICT	FRINGE AND OUTLYING BUSINESS	RESIDENTIAL AND RURAL	ALL BUSINESS AREAS	RESIDENTIAL AND RURAL	ALL BUSINESS AREAS	RESIDENTIAL AND RURAL
DESIGN CLASS CODE			1	2	3	4	5	6	7
ROADWAY	NUMBER OF TRAVEL LANES	DESIRABLE	2	2	2	2	2	2	2
		TOLERABLE	2	2	2	2	2	2	2
	NUMBER OF PARKING LANES	DESIRABLE	2	2	1	2	1	2	1
		TOLERABLE	1	1	1	1	1	1	SHOULDER
	SURFACE WIDTH	DESIRABLE	52	44	31	44	31	44	31
		TOLERABLE	40	30	24	30	24	30	18
	TYPE STREET SECTION	DESIRABLE	CURBS			CURBS		CURBS	CURBS
		TOLERABLE							GRAVEL SHOULDERS
	SURFACE TYPE 1/	DESIRABLE	HIGH	HIGH	INTER.	HIGH	INTER.	HIGH	INTER.
		TOLERABLE	HIGH	INTER	LOW	INTER	LOW	INTER	GRAVEL
BRIDGES	DESIGN LOADING		HS-20	HS-20	H-15	HS-20	H-15	HS-20	H-15
	STRUCTURE WIDTH	DESIRABLE	APPROACH SURFACE WIDTH PLUS 4 FEET AND SIDEWALK						
		TOLERABLE	APPROACH SURFACE WIDTH						

1/ HIGH SURFACE: PORTLAND CEMENT CONCRETE 7 INCHES OR MORE IN THICKNESS ON A BASE SUITABLE TO CARRY FREQUENT HEAVY AXLE LOADS; OR ASPHALTIC CONCRETE 4 INCHES OR MORE IN THICKNESS ON A BASE SUITABLE TO CARRY FREQUENT HEAVY AXLE LOADS; OR ASPHALTIC CONCRETE OVERLAYS WHICH PRODUCE A TOTAL SURFACE THICKNESS GREATER THAN 4 INCHES; OR EXISTING BRICK OR BLOCK.

INTERMEDIATE SURFACE: PORTLAND CEMENT CONCRETE LESS THAN 7 INCHES IN THICKNESS ON A NON-PREPARED BASE SUITABLE TO CARRY A MODERATE FREQUENCY OF HEAVY AXLE LOADS; OR AT LEAST 1 INCH BUT LESS THAN 4 INCHS OF BITUMINOUS SURFACE ON A PREPARED BASE SUITABLE TO CARRY A MODERATE FREQUENCY OF HEAVY AXLE LOADS.

LOW SURFACE: A BITUMINOUS SURFACE LESS THAN 1 INCH IN THICKNESS ON A BASE SUITABLE TO CARRY OCCASIONAL HEAVY AXLE LOADS.

TABLE 3-M
Arterial Streets
Construction Cost Per Mile

Design Type 1

Type Improvement	ROW & Util. Adj.	Grade & Drain	Base & Surface	Misc.	Engr.	Total
New Construction	$ 74,390	235,118	377,731	7,709	86,878	781,826
Reconstruction	74,390	181,157	346,896	11,563	75,546	689,552
Widen & Resurface	22,356	181,157	346,896	11,563	75,546	637,518
Base & Surface			370,022	50,107	58,818	478,947
Design Type 2	Type area 1, 2, or 3					
New Construction	70,314	222,235	357,034	7,286	82,118	738,987
Reconstruction	70,314	171,230	327,888	10,930	71,407	651,769
Widen & Resurface	21,131	171,230	327,888	10,930	71,407	602,586
Base & Surface			349,747	47,362	55,595	452,704
Design Type 2	Type Area 4 or 5					
New Construction	68,276	215,794	346,685	7,075	79,738	717,568
Reconstruction	68,276	166,267	318,384	10,613	69,337	632,877
Widen & Resurface	20,518	166,267	318,384	10,613	69,337	585,119
Base & Surface			339,609	45,989	53,984	439,582
Design Type 3	Type Area 1					
New Construction	45,857	144,936	232,848	4,752	53,555	481,948
Reconstruction	45,857	111,672	213,840	7,128	46,570	425,067
Widen & Resurface	13,781	111,672	213,840	7,128	46,570	392,991
Base & Surface			228,096	30,888	36,258	295,242
Design Type 3	Type Area 2 or 3					
New Construction	20,000	99,792	161,568	4,752	29,272	315,384
Reconstruction	20,000	66,528	161,568	2,376	25,352	275,824
Widen & Resurface	7,000	15,137	91,979	3,131	12,127	129,374
Base & Surface			161,568	26,136	20,647	208,351
Design Type 3	Type Area 4 or 5					
New Construction	20,000	95,357	154,387	4,541	27,971	302,256
Reconstruction	20,000	63,571	154,387	2,270	24,225	264,453
Widen & Resurface	7,000	14,832	90,128	3,068	11,883	126,911
Base & Surface			154,387	24,974	19,730	199,091

Table 3-M (continued)

Local Streets

Design Type 1

Type Improvement	ROW & Util. Adj.	Grade & Drain	Base & Surface	Misc.	Engr.	Total
New Construction		95,146	151,114	2,798	27,396	276,454
Reconstruction		61,565	151,114	2,798	23,699	239,176
Widen & Resurface		14,615	88,807	3,023	11,709	118,154
Base & Surface			151,114	30,782	20,009	201,905

Design Types 2, 4, 6

New Construction		80,784	128,304	2,376	23,261	234,725
Reconstruction		52,272	128,304	2,376	20,125	203,077
Widen & Resurface		13,397	81,406	2,771	10,733	108,307
Base & Surface			128,304	26,136	17,043	171,483

Design Types 3, 5, & 7

New Construction		35,839	67,279	3,274	11,703	118,095
Reconstruction		21,815	67,279	2,567	10,083	101,744
Widen & Resurface			46,568	4,437	5,611	56,616
Base & Surface			67,279	13,094	8,841	89,214

TABLE 4-M

Estimated Maintenance Costs For Arterial and Local Streets

Arterial Streets

High Type Pavement

Surface Width	Cost Per mile
$\geq$ 40'	$3170
< 40'	1770

Intermediate Type Pavement All Surface Widths	1520
Low Type Pavement All Surface Widths	1380

LOCAL STREETS

Paved (High and Intermediate)	1638
Non-paved (gravel)	1390
Dirt	500

PERCIVAL

MUNICIPAL STRUCTURES
DEFICIENCIES AND IMPROVEMENTS
PRINT-OUT INTERPRETATION

General: The purpose of the municipal structures deficiencies and improvement program is to determine the present adequacy of structures on the municipal system and to project structure needs for the system over the same 20-year period used in the municipal streets deficiencies and improvements program. For purposes of the study, each structure on the system is identified with a sequence number. This number matches the sequence number of the street section on which the structure exists. This makes it possible to use the structures program in conjunction with the results of the municipal streets program in determining what improvements should be made and when they should be made.

The basic unit analyzed by the deficiencies and improvements program is a single structure. The analysis is made in the following way:

1. The existing structure is rated on a point rating basis with 100 points being the maximum possible rating for structures on arterial streets. The rating is divided between a rating for design considerations (60 pts. possible), and a condition rating (40 pts. possible). For structures on local streets the condition was rated the same as on arterials, and an adequacy rating was used for structure width and vertical clearance instead of assigning design points.

2. The structure is then analyzed, through the computer program, and using the point ratings and other criteria, it is determined if the structure is deficient now.

3. If the structure is deficient now, an improvement type is set based on the type of deficiency. Next, a check is made to see if an improvement is called for on the street section. If so, the improvement year for the structure improvement will be set as the same year as the street improvement, except when a critical situation exists which calls for the structure to be improved immediately. If there is no street improvement called for, the improvement year will be set depending upon the severity of the deficiency.

If the structure is not deficient now, a check is made to see if a major street improvement is being called for which would make a structure improvement necessary to bring it up to design standard.

If an improvement is found to be necessary in the future, an improvement type is set, and the improvement year will be set by calling for the improvement to be made at the same time as the major street improvement, or if there is none, the improvement will be called for in the year that the structure theoretically becomes deficient.

It is possible to have two improvements called for in the 20-year study period. When this occurs the first improvement will always be a waterway opening improvement, or a deck repair improvement. The second improvement will always be a widening improvement, or a reconstruction improvement.

The procedure outlined above is used on each structure, and during each structure analysis, needed information is printed on the computer print-out sheets.

Deficiencies and Improvements Print-Out

For each structure processed in the program, there will always be at least one line of print. There will be two lines if one improvement is called for and three lines if two improvements are called for. The first line will always show the present condition. The second and third lines, if any, will show the condition after each improvement.

Columns

1-2
CO
NO

COUNTY NUMBER - Numbered in alphabetical order according to county name. Example: Adair - 01

5-8
CITY
NUMB

CITY NUMBER - Numbered in alphabetical order according to city name. Example: Ackley - 0010

11-15
SEQ
NUMB

SEQUENCE NUMBER - Same as Sequence Number of the street section on which the structure is located.

18
STREET
S
Y
S

STREET SYSTEM - The same as that coded for the street section on which the structure exists.

20-23
STREET
NUMB

STREET NUMBER - The same as the street number of the street where the structure is located.

26-28
SP
CLS

SPECIAL CLASS - The existing classifications are coded as follows:

Col. 26

1 - Freeway (non-primary)
2 - Local
3 - Collector
4 - City Arterial
5 - Primary Arterial
6 - Primary Expressway
7 - Primary Freeway
8 - Interstate
9 - Expressway (non-primary)

Col. 27
Proposed future Classification

1 - To be abandoned
2 - Transferred to city from primary
3 - Transferred to city from county
4 - Transferred to state from city

Columns

26-28
SP
CLS

SPECIAL CLASS
(cont'd)

Col. 27 (cont'd)
Proposed future Classification

5 -
6 -
7 -
8 -
9 -
0 - No Change

Col. 28
Existing Location

0 - Outside Urban Boundary
1 - Inside corporation line
2 - Inside urban boundary line - outside corporation line

All cities with 1960 populations of 5,000 and above have urban area boundaries.

30
N
U
M

STRUCTURE NUMBER - The structures that are located on each street section will be numbered in consecutive order from south to north and west to east by the use of this digit. The first structure on a street section will be number 1, the second number 2, etc. Always start over with 1 on each new street section.

32-33
T S
Y T
P R

TYPE STRUCTURE - Coded as follows:

Wood Trestle.....	00
Pony Truss	01
High Truss	02
Steel Beam or Girder	03
Reinforced Concrete Girder.....	04
Reinforced Concrete Slab	05

Columns

32-33
TS
YT
PR

TYPE STRUCTURE (cont'd)

Steel or RC Arch	06
Prestressed or Prestressed-Pretensioned Bridge	07
Cantilever	08
Box Culvert	09
Aluminum	10

35
T
/
D

TWIN/DIVIDED - Coded as follows:

0 - Not twin or divided
1 - Twin
2 - Divided

37-38
KC
NR
DS

KIND OF CROSSING - Coded as follows:

Ford	01	Above Stream, RR & another road	14
Ferry	02	Tunnel	15
Railroad at Grade	03	Foot Passage above road	16
Above Drainage	04	Over Interstate	20
Above Railroad	05	Under Interstate	21
Above RR & Stream	06	Over Primary	30
Under RR (simple)	07	Under Primary	31
Under RR combined	08	Over Arterial	40
Above other public road	09*	Under Arterial	41
Under other public road	10*	Over Collector	50
Above Private road	11	Under Collector	51
Under Private road	12	Over Local	60
Above stream & other road	13	Under Local	61

NOTE - Code 09 and 10 should not be used as an entry for this item.

42-43
STR
LENG

LENGTH OF STRUCTURE - Total traveled length of structure is coded using four-digit code to nearest foot.

Columns

45-48
STR
WID

STRUCTURE WIDTH - The horizontal clearance in feet and tenths of feet. This is usually face of curb to face of curb. If this is a divided structure, the narrowest width is shown. For twin structure, each structure will be recorded as a separate entry.

50-53
VER
CLR

VERTICAL CLEARANCE - The minimum vertical clearance in feet and tenths of feet. Unlimited vertical clearance is blank.

55-56
A W
P I
P D

APPROACH WIDTH - The approach pavenemt width in feet at the south or west end of the structure.

58-59
H
LD

H-LOAD - Coded as follows:

	Code		Code
H-20	20	H-10	10
H-15	15	H- 8	08
H-12	12	H- 6	06

62
S
A
F

SAFETY STUDY - Indicates an obstruction or condition that poses a threat to safe driving and cannot easily be removed at low cost. When a safety study is coded on this form, the roadway form should also indicate that a safety study exists on the appropriate roadway section. Enter the appropriate code.

Code:

0 - No safety study exists
1 - The location, geometrics, or condition of the structure poses a threat to safe driving.

64-65
D
A
T

A.D.T. DATE - Shows the year of the estimated A.D.T.

67-71
-ADT-

AVERAGE DAILY TRAFFIC - The estimated average daily traffic for the year shown.

Columns

73-74
)ESIGN POINTS
SW
TD

STRUCTURE WIDTH DESIGN POINTS - Points are assigned according to how the existing width compares to that shown on the design guides. The number of points to be assigned is found on municipal structure Tables 4, 5, 7, and 8, with a maximum of 30 points.

76-77
H
LD

H-LOAD DESIGN POINTS - Points are assigned from municipal structure Table No. 9 with a maximum of 20 points.

80
VC
EL
RR

VERTICAL CLEARANCE DESIGN POINTS - Points are assigned from vertical clearance ratings Table No. 10 with a maximum of 5 points.

82
S
A
F

SAFETY STUDY DESIGN POINTS - Points are assigned from Table No. 11 with a maximum of 5 points.

86-87
SS
UT
BR

SUB-STRUCTURE CONDITION - For this evaluation all structural components normally considered as part of the sub-structure will be rated. This includes any part of the structure beneath the beams or girders (i.e. footings, piers, columns, caps, abutments, etc.). Concrete should be examined for cracking, spalling, scouring or other deterioration and rated down accordingly, particularly if reinforcing steel is exposed. Steel sub-structures should be examined for rust or other chemical deterioration severe enough to affect the structure's strength. Damage to steel and timber members caused by ice floe, driftwood or traffic should also be considered and rated down if the structure is weakened.

Enter Code Ratings as follows:

Adequacy Rating	
15	New or like new condition
10-14	Minor deterioration easily remedied by routine maintenance
5- 9	Major deterioration of some

Columns

86-87 (cont'd)
S S
U T
B R

Adequacy Rating

5-9 (cont'd)	structural members that can be replaced individually.
1-4	One or more entire bents need replacing or major repairs (i.e. abutments and first interior bents may be sound, but other interior bents damaged).
0	Very poor condition throughout. Should be replaced.

89-90
S S
U T
P R

SUPER-STRUCTURE CONDITION - For this evaluation all structural components normally considered as part of the super-structure will be rated. This includes any part of the structure above the bearings seats, (i.e. beams or girders, trusses, stringers, rail, etc.) exclusive of the actual deck. Components of the super-structure showing wear or deterioration should be noted and this item rated down according to the severity of the structural deficiency. Damage to the super-structure by traffic or other external causes should be examined and taken into consideration on the overall evaluation. Enter code ratings as follows:

Adequacy Rating

15	New or like new condition
10-14	Minor deterioration easily remedied by routine maintenance
5-9	Major deterioration of some structural members or damaged members that can be replaced individually
1 -4	One or more entire spans need replacing or major repairs (i.e. approach spans may be sound but main span should be replaced.
0	Very poor condition throughout. Should be replaced.

Columns

92 W W O — WATERWAY OPENING CONDITION - This item is to evaluate the condition of the opening beneath the bridge or underpass as it affects the structure or roadway being rated. Condition of the banks or slopes under the structure and adjacent to the structure are important considerations as well as the stream bed. This item should be rated down when there is evidence of flooding, erosion, or excessive maintenance on approaches and abutments at stream crossings. Other crossings should be rated down where sloughing or eroding of steep slopes is evident or where insufficient horizontal clearance is provided. Rate this item as follows:

Code	
5	Satisfactory. No adverse conditions evident.
4-3-2-1	Conditions varying in degree from satisfactory to very poor.
0	Very poor condition.

94 D E C — DECK CONDITION - The evaluation of the deck contion takes into consideration the riding surface or that portion of the structure actually in contact with traffic. Cracking and spalling of concrete surfaces, raveling and irregularity of bituminous overlays, and wear and deterioration of wooden decks are conditions which will lower this rating. Enter code rating as follows:

Adequacy Rating	
5	New or like new condition
3-4	Minor maintenance required. Isolated spots need repair.
1-2	Partial reconstruction required. Large sections need to be replaced or repaired.
0	Very poor. Complete new deck needed.

Columns

97-98
TOT
PTS

TOTAL POINTS - Sum of the design and the condition points.

103
D T
E Y
S P

DESIGN CLASS CODE - Determined from the design guides the same as the street section.

106-107
I Y
M R
P

IMPROVEMENT YEAR - The year the improvement is called for.

110-111
I T
M Y
P P

IMPROVEMENT TYPE - The first digit is called the backlog or future code, depending on whether the structure was found deficient in 1968 (Backlog) or in a future year during the study period (future).

Code

1 - Backlog
2 - Future

The second digit indicates the improvement type. Improvement types are:

2 Reconstruction
3 Widening
8 Deck Repair Improvement
9 Waterway Opening Improvement

114-115
I C
M S
P E

CAUSE OF IMPROVEMENT - Indicates what deficiency caused the improvement to be needed. A list of these are found in Table 16.

119
I N
M B
P R

IMPROVEMENT NUMBER - Possible codes are:

Code
1 - Improvement Number 1
2 - Improvement Number 2

MUNICIPAL STRUCTURES

POINT RATING

*Structure Width	30
*Vertical Clearance	5
*H-Loading	20
*Safety Study	5
Superstructure	15
Substructure	15
Deck	5
Waterway Opening	5
TOTAL	100

*Arterials Only

Table 4

Municipal Structures

Clear Roadway Width Rating
For Expressway and Freeway
(Maximum 30 Points)

Twin		Divided	
Existing Struc. Width	Rating Col. 1	Existing Struc. Width	Rating Col. 2
40'	30	36'	30
35'	25	34'	28
30'	20	32'	26
28'	12	30'	20
26'	6	27'	15
24'	0	25'	5
		24'	0

Table 5

Municipal Structures

Clear Roadway Width Rating
For Expressway and Freeway Structures

Underpasses

(Maximum 30 Points)

Existing Structure Width	6 - Lane Col. 1	Existing Structure Width	4 - Lane Col. 2
58'	30	46'	30
56'	25	44'	25
54'	15	42'	20
52'	0	40'	15
		38'	10
		36'	0

Table 7

MUNICIPAL STRUCTURES

Clear Roadway Width Rating
(Maximum 30 Points)

Existing Structure Width	ADT Central Business District >15,000		7,000 - 15,000		<7,000
	Residential And Fringe Area >19,000		9,000 - 19,000		<9,000
	Design Structure Width				
	Non-Div 78' Col. 1	Div-Twin 42'* Col. 2	Non-Div 54' Col. 3	Div-Twin 30' Col. 4	30' Col. 5
78'	30				
76'	29				
74'	27				
72'	25				
70'	20				
78'	18				
66'	15				
64'	12				
62'	8				
60'	5				
58'	0				
56'					
54'			30		
52'			28		
50'			26		
48'			24		
46'			22		
44'			15		
42'		30	8		
40'		28	5		
38'		25	0		
36'		21			
34'		18			
32'		15			
30'		8		30	30
28'		4		28	28
26'		0		25	25
24'				20	20
22'				14	14
20'				6	6
18'				2	2
16'				0	0

* one-half of Design Standard Wdth.

Table 8

MUNICIPAL STRUCTURES

Clear Roadway Width Ratings for Underpasses
(Maximum 30 Points)

Existing Structure Width	ADT: Central Business District >15,000	Central Business District 7,000 - 15,000	Central Business District <7,000	Residential and Fringe Areas >19,000	Residential and Fringe Areas 9,000 - 19,000	Residential and Fringe Areas <9,000
	Design Structure Width					
	Non-Div 84' Col.1	Div 48'* Col.2	Non-Div 60' Col.3	Div 36' Col.4	36' Col. 5	
84'	30					
82'	28					
80'	27					
78'	25					
76'	23					
74'	20					
72'	18					
70'	14					
68'	9					
66'	6					
64'	2					
62'	1					
60'	0		30			
58'			28			
56'			25			
54'			21			
52'			18			
50'			12			
48'		30	8			
46'		28	5			
44'		25	3			
42'		20	1			
40'		15	0			
38'		10				
36'		5		30	30	
34'		3		28	28	
32'		1		26	26	
30'		0		22	22	
28'				18	18	
26'				13	13	
24'				10	10	
22'				5	5	
20'				1	1	
18'				0	0	

* one-half of Design Standard Width

EFFECTIVE DATE	PAGE	SECTION
JANUARY 1, 1968		

Table 9

MUNICIPAL STRUCTURES
Load Limitation Ratings
(Maximum 20 Points)

Present H-Loading	Design Standard HS-20	H-15
20	20	20
15	18	20
12	13	18
10	5	13
5	0	5
<5	0	0

Note -- Assign 20 points to all underpasses

Table 9A

Load Limitation Ratings
(No Present H-Loading)

Superstructure & Substructure Condition Points	Rating
27-30	20
24-26	18
21-23	16
18-20	14
15-17	12
12-14	10
9-11	8
6-8	6
3-5	4
0-2	2

Table 10

Vertical Clearance Ratings
(Maximum 5 Points)

Existing Vertical Clearance	Points
Unlimited -- 16.0'	5
15.0 - 15.9'	4
14.0 - 14.9'	3
13.0 - 13.9	2
12.0 - 13.0'	1
0 - 11.9'	0

Table 11

Safety Study Ratings
(Maximum 5 Points)

Code	Points
0	5
1	0

DEFICIENCIES AND IMPROVEMENT INFORMATION FOR MUNICIPAL STRUCTURES

Cause for Improvement Codes

Arterial Structures

1. Total Design & Condition Points less than 40
2. Structure Width less than Approach Width
3. Vertical Clearance Less than 10'
4. Superstructure rating less than 5
5. Substructure rating less than 5
6. Deck Rating less than 3
7. Waterway opening less than 3
8. Total Design & Condition Points less than 70
9. Structure Width less than Design Width
10. Vertical Clearance less than 16.0 feet
11. Deck Rating 0

Local Structures

12. Structure Width less than Approach Width
13. Vertical Clearance less than 10 feet
14. Substructure condition less than 5
15. Superstructure condition less than 5
16. Sum of substructure and superstructure condition less than 16
17. Deck condition less than 3
18. Waterway opening condition less than 3
19. Structure Width less than Design Width

Improvement Types Used

2. Reconstruction
3. Widening
8. Redecking
9. Waterway Opening

Backlog Codes Used

1. Backlog
2. Future

PERCIVAL

MUNICIPAL STRUCTURES

Cost Assignment Program Print-Out Interpretation

General: The purpose of the cost assignment program is to assign costs to structure improvements called for in the structures deficiencies and improvement program. The main steps in the program are:

1. Each structure record is examined to determine if an improvement has been called for.

2. If a reconstruction, widening, or deck repair improvement is called for, the area of the structure is calculated by multiplying length times width.

3. The costs are determined by multiplying the costs per square foot found in the cost table by the area.

If a waterway opening improvement has been called for, the cost is taken directly from the cost table as a cost per project.

As the records are being processed in the program, the cost information is written on the computer tape, and printed on the computer print-out.

Municipal Structures Cost Print-Out

For each structure analyzed in the deficiencies and improvements program, except for the underpasses, there will be at least one line of print on the print-out. The information on the left side of the print-out is identical to that found on the deficiencies and improvements print-out. Other information found on the print-out is as follows:

Print-Out Identification	
STRUC WIDTH	Structure Width - This is the design width or width that the structure would have after the improvement was made. Width in feet.

Print-Out Identification	
STRUC LENG	Structure Length - This is the length of the structure, in feet, before the improvement, and for purposes of the study, it is used as the length after the improvement. No attempt was made to predict what the new length of a structure would be when an improvement was called for.
CONST COST	Construction and Engineering Cost - These are the costs that were determined by the procedure mentioned in the program explanation (step 3).
ENG COST	
ADM COST	Administration Cost
TOTAL COST	Total Cost - Total of all costs on the corresponding line.
IMP YEAR	Improvement Year - Year improvement was called for, except when it is the last line of a record and shows only a maintenance cost, then an 87 will appear to indicate the last year of the study period.

MUNICIPAL STRUCTURES COST TABLE

Cost Per Square Foot (dollars)

Improvement Type	Construction	Engineering	Total
1,2,3 - New Construction, Reconstruction, Widening	15.20	2.15	17.35
8 - Redecking	1.93	.27	2.10
9 - Waterway Opening Improvement	21,000*	3,000	24,000

*Cost per project