COMMONWEALTH OF KENTUCKY
DEPARTMENT OF TRANSPORTATION
FRANKFORT, KENTUCKY 40601

ELIJAH M. HOGGE
SECRETARY

WENDELL H. FORD
GOVERNOR

BUREAU OF HIGHWAYS
JAMES E. GRAY
COMMISSIONER

September 14, 1973

MEMORANDUM TO: J. R. Harbison
State Highway Engineer
Chairman, Research Committee

SUBJECT: Research Report No. 373, "STOLVAC: A Traffic Data System;" KYP-72-37; HPR-1-(9), Part III.

This report presents a conceptual plan for storage and retrieval of statewide traffic data. Perhaps only certain users of traffic data will find the plan or the idea of creating the data file to be worthy or compelling. Research would be a principal user.

STOLVAC is an acronym coined by the author of the report; it contracts the words "speed," "turning," "origin," "loadometer," "volume," "accident" and "classification".

Respectfully submitted,

Jas. H. Havens
Director of Research

JHH:gd
Attachment
CC's: Research Committee

TECHNICAL REPORT STANDARD TITLE PAGE

1. Report No.	2. Government Accession No.	3. Recipient's Catalog No.
4. Title and Subtitle STOLVAC: A TRAFFIC DATA SYSTEM		5. Report Date September 1973 6. Performing Organization Code
7. Author(s) D. R. Herd		8. Performing Organization Report No. 373
9. Performing Organization Name and Address Division of Research Kentucky Bureau of Highways 533 South Limestone Lexington, Kentucky 40508		10. Work Unit No. 11. Contract or Grant No. KYP- 72-37 13. Type of Report and Period Covered Final
12. Sponsoring Agency Name and Address		14. Sponsoring Agency Code
15. Supplementary Notes Study Title: Traffic Inventory		

16. Abstract

The purpose of this study was to design a traffic data inventory system and to develop operating procedures for that system. This report outlines the general design of such a system that will be called STOLVAC (acronym for Speed, Turning movements, Origin-destination, Loadometer, Volume, Accident, and Classification data). The report also presents recommendations relating to the development and maintenance of STOLVAC. Staging of the system development is recommended.

17. Key Words	18. Distribution Statement
Speeds Turning Movements Origin-Destination Loadometer Volumes Accidents Classification Traffic Inventory Computer	

19. Security Classif. (of this report)	20. Security Classif. (of this page)	21. No. of Pages	22. Price
Unclassified	Unclassified		

Form DOT F 1700.7 (8-69)

Research Report
373

STOLVAC: A TRAFFIC DATA SYSTEM

KYP-72-37; HPR 1-(9), Part III

by

Donald R. Herd
Research Engineer Associate

Division of Research
Bureau of Highways
DEPARTMENT OF TRANSPORTATION
Commonwealth of Kentucky

September 1973

INTRODUCTION

Normal highway engineering functions require that various types of information relating to the highway be available to the engineer. Among these are quantifications of vehicular traffic on the highways, such as traffic volumes, vehicle characteristics, vehicle speeds and weights, origin-destination information, directional distribution, intersection turning movements, and accident concentration statistics. The engineer not only needs current values for these data but he frequently desires historical values in his planning, design, operations, research, and other functions. Current data can easily be obtained by observation; the past cannot be recaptured unless it has been preserved in some record. Often the engineer requires immediate access to large quantities of these data. The computer can provide a convenient mechanism for storing, sorting, retrieving, and analyzing bulk data of the type characteristic of highway traffic needs.

In 1968, Deacon and Lynch *(1)* developed a method of calculating equivalent axleloads (EAL's) and in the process created magnetic tape storage containing loadometer (truck weight information) and classification data collected within Kentucky from 1950 through 1966. In response to a need for updating these tapes, the basic structure of the files was reexamined. After careful consideration, it was apparent that the development of a computerized filing system containing not only current and historical loadometer and classification data but other information is desirable. An extensive study has thus been initiated intending to

1. develop a basic system for traffic data storage for the Department of Transportation,
2. develop a method by which one might query the system, and
3. enumerate techniques for keeping the system updated.

This presentation reports on the conceptual aspects of designing, creating, and maintaining the system (to be herein after called STOLVAC, acronym for Speeds, Turning movements, Origin-destination, Loadometer, Volume, Accidents, and Classification data).

THE SYSTEM

Structure

Structuring a computer data system requires knowledge of computer operation. The use of the computer involves both computer hardware and software. The hardware is the actual mechanical components of the computer system, namely

1. the memory unit,
2. central processing unit,
3. input/output unit, and
4. the control unit.

The software portion of the system provides an interface between the hardware and user needs by means of a series of system programs. STOLVAC will require input into the system, storage, analysis, and output. The storage of data, however, will have more impact on the STOLVAC system creation.

Storage may be achieved by numerous techniques, but three types -- punched cards, magnetic tape, and disks are most useful. Punched cards are the original storage device even though they are of limited value for long-term storage. Some problems with card storage are

1. cards are susceptible to warpage,
2. a limited number of items may be stored on each card record, and
3. the file becomes quite bulky if a card file is continually updated.

Magnetic tapes and disks provide beneficial long-term storage because they can accept larger record lengths, require less storage space, and are more durable. Data recorded on tape or disk may be more efficiently read and analyzed by the computer than that on cards. Tapes and disks are similar and have the same limitations, except problems may not be as severe with disks. Tapes are less expensive than disks, unless the stored information is required on a daily basis *(2)*. Disks are easier and quicker to work with than tapes because

1. individual records may be changed, while with tapes this cannot be done without rewriting the entire tape;
2. disks allow skipping for data in a file, while tapes are generally read from start to finish; and
3. tapes may require 4 minutes to achieve maximum head movement while disks take approximately one-fourth second.

Two types of storage are used within a computer system. Information may be online, meaning the data are loaded permanently within the computer. If data must be loaded onto the system each time it is used, then it is offline storage. STOLVAC will have both online and offline storage capabilities. The offline portion of the system will contain raw and basic data loaded on tapes while the online portion will be the derived and summarized data (these four data types are discussed in the next section).

Content

Primary decisions relate to the types of files to be created and maintained. There are four basic categories of data to be considered -- raw, basic, summary, and derived. The foundation of any data collection and assimilation process is the raw information, or data as collected in the field survey. Raw data may be simplified by such means as deleting less valuable information, thus becoming basic data which are as useable as the raw data. Regrouping and analyzing both raw and basic information yields summary data which are not as useable for general purposes as raw and basic data. Derived information is obtained by factoring and manipulating the other three data types. The latter information is the least diversified and usually may be used only for specific purposes. Usually, it is not practical to store raw data; basic and summary data together with derived parameters usually suffice. This is usually true because basic data may yield as much detailed information as the raw and yet not require as much storage.

Another important consideration is the particular kinds of files which the system should contain. A traffic data filing system should have the capability of cross-referencing information relating to various traffic parameters. What then are accepted measurements of these parameters? The Federal Highway Administration (FHWA), which sets standards for the conduction of traffic surveys, lists six important types *(3)* of traffic information as

1. traffic volumes,
2. vehicle classifications,
3. vehicle weights,
4. design-hour volumes,
5. directional distributions, and
6. origin-destination information.

FHWA also places importance on accident related information. If design-hour volumes are considered with traffic volumes and directional distribution can be included with classification and volume information, the FHWA list becomes essentially the same as that presently used by the Division of Planning *(4)*:

1. traffic volumes,
2. vehicle classifications,
3. vehicle dimensions and weights, and
4. origin-destination information.

Planning, the Bureau's chief data collector and user, indicates that it occasionally collects and uses other types of traffic data. In addition, the Division of Traffic uses three other information types:

1. spot-speeds,
2. intersection turning-movements, and
3. accidents.

Therefore, there are seven possibilities for inclusion as separate files of the STOLVAC system:

1. vehicle speeds (S),
2. intersection turning movements (T),
3. origin-destination information (O),
4. vehicle weights and dimensions (loadometer) (L),
5. traffic volumes (V),
6. accident records (A), and
7. vehicle classifications (C).

ELEMENTS OF THE INDIVIDUAL FILES

Although STOLVAC is to be a system interrelating the different data types, its design must respect the individuality of each data type. Thus, the system should allow for use of each information type both singly and in combination with the other types. Consequently, there must be within STOLVAC a method for cross-referencing the files so that correlation of the different data can be achieved. This can be handled in the design of the individual records of each file. Parameters should be contained in each record allowing for correlating all data types.

Control Elements

The control elements shown in Figure 1 illustrate the parameters required for cross-referencing STOLVAC files. The control elements will be a portion of each record of files, and coding instructions are presented in APPENDIX A, Section I. The general information contained in the control elements identifies

1. file or data type,
2. source and validity of the data,
3. date and time of collection,
4. location of data collection site, and
5. physical characteristics of the location.

The most significant of these for the purpose of cross-referencing is that of the location. The development of the referencing scheme used with STOLVAC is presented in APPENDIX B. Figure 2 illustrates a traffic characteristics record that is a part of Wisconsin's Highway Network Data and Information System (HNDI) *(5)*. This illustrates the use of a control key for relating the records similar to the control elements.

The upcoming sections discuss each data type that is a candidate for inclusion in STOLVAC. It is intended that each type of data be examined with regard to its use, techniques used in acquiring it, and availability of both current and past quantifications.

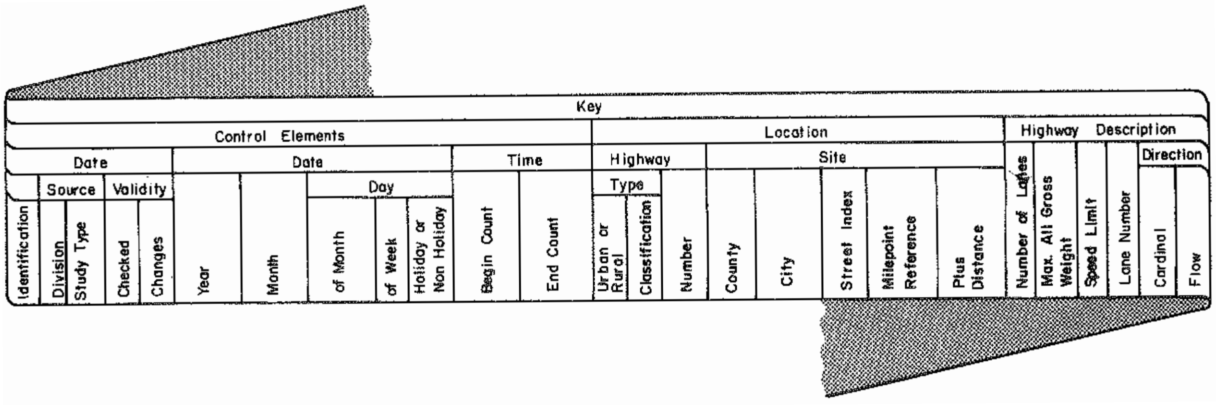


Figure 1. Format of Control Elements Data.

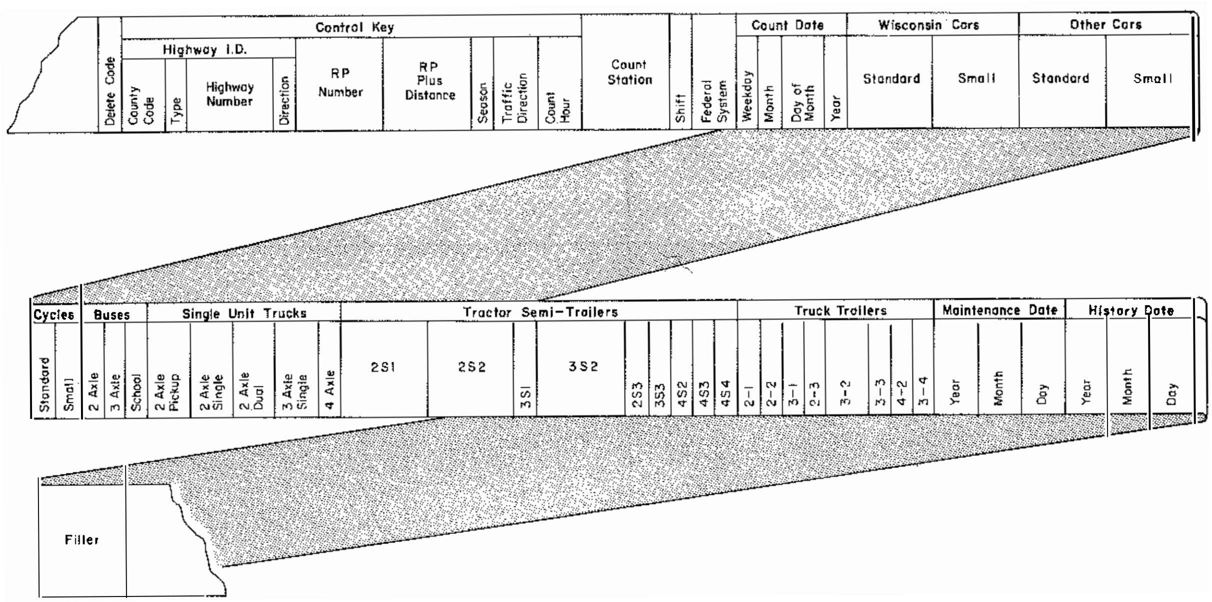


Figure 2. HNDI Characteristics File Format.

Vehicle Classification

Classification counts subdivide the traffic stream into types of vehicles and may be used for the following purposes:

1. pavement design -- traffic composition along with vehicle weight data are used to make computations of expected equivalent axleloads (EAL's),
2. capacity analysis -- percentages of trucks and buses (determined from classification counts) in the traffic stream affect capacity,
3. allocation of costs and revenues -- classifications provide an indication of which users derive the most benefit from highway facilities by indicating types of vehicles using the road and similarily indicate which highway function (construction, maintenance, operations, etc) need funds,
4. economic analysis -- composition of traffic is necessary for computing road user costs and benefits, and
5. research -- many specialized research studies involve the use of classification information.

Referring again to Figure 2, the method by which Wisconsin preserves classification data in the computer is illustrated by a single classification record format. Their file is basically current, though 2 years of historical information are available. Their breakdown of vehicles is self-explanatory and similar to FHWA recommendations. According to the Federal Highway Administration *(6)*, classification data should identify the following:

1. highway system,
2. station,
3. direction of travel,
4. date data were obtained,
5. hour of the day data were obtained,
6. automobiles classified as in-state or out-of-state and standard or small,
7. motor-powered cycles,
8. buses classified as commercial or school and non-revenue, and
9. classification of trucks by type.

Until 1968, most classification data taken in Kentucky were collected in conjunction with origin-destination and truck weight surveys, although a few special classification counts were conducted. Since that time, the Division of Planning has initiated a program of classification counts and has tied them to temporary traffic count stations located in each county. These counts have greatly increased the amount of classification data available. This data, as well as those of all other classification counts, are recorded on forms (Figure 3) and maintained on file in the Traffic Section of the Division of Planning. Raw data contained on these forms (Figure 3), identify location, time, and date of the counts. Further stratifications subdivide traffic into the following categories:

1. automobiles by local (in-state) or foreign (out-of-state),
2. trucks by three classes of single units and four classes of combinations, and
3. buses (school and other).

Figure 4 shows a conceptual format which, when combined with the Control Elements of Figure 1, will provide a complete classification record coded as instructed in APPENDIX A, Section II. This format places importance on:

1. automobiles -- classified either as local (in-state) or foreign (out-of-state). The classifications are in turn subdivided into standard and small size cars, even though techniques currently being used by the Division of Planning do not always permit the actual determination of vehicle size. Therefore, it is important to have the capability of recording all local and foreign automobiles as a single entity, whether they are also counted as standard or small sizes.
2. automobiles pulling trailers -- recorded as a single entity.
3. pickups -- space should be provided for pickups and pickups hauling trailers.
4. cycles -- all motor powered cycles will be recorded as a single type.
5. trucks -- due to surveying techniques of the Bureau, trucks will be divided into two broad classes of either single unit or combination vehicles. Also, combination vehicles are further subdivided into groups according to total number of axles. To clarify some of the terminology, it is appropriate to consider the example designations of 2S1 and 2-1. The "S" indicates the vehicle has a semi-trailer -- the 2 represents the number of axles on the tractor and the 1 represents the number of axles on the trailer. The 2-1 designation represents a two-axle truck pulling a one-axle trailer.
6. buses -- classified as school buses (which include all non-revenue buses) or commercial buses (subdivided according to number of axles).

HPS T-5

COUNTY Rowan

ROUTE NO. I-64

COMMONWEALTH OF KENTUCKY
DEPARTMENT OF TRANSPORTATION
BUREAU OF HIGHWAYS – DIVISION OF PLANNING
TRAFFIC DENSITY REPORT

STATION NUMBER L-58
DATE 1-13,14,15-71
DAY Wed-Thur-Fri

VEHICLES MOVING TOWARD Olive Hill, Ky. (East) 5

TIME PERIOD	Passenger Cars: Local	Passenger Cars: Foreign	Less than 1½ Tons	2 Axle Dual Tires	3 Axle	Tractor Truck & Semi Trailor: 3 Axle	4 Axle	5 Axle	6 Axle	Busses: School	Busses: Other	Total Vehicles: Pass	Coml.	Total
600 AM—700	17	1	4	2	–	–	–	–	–	–	–	18	6	24
700—800	17	–	6	5	–	–	–	2	–	–	–	17	13	30
800—900	31	1	10	11	1	–	–	3	1	–	–	32	26	58
900—1000	36	3	14	10	–	–	–	1	–	–	–	39	25	64
1000—1100	35	7	17	8	–	–	–	–	–	–	–	42	25	67
1100—1200	36	4	16	13	–	–	–	–	–	–	–	40	29	69
1200 PM—100	48	2	11	4	–	–	–	–	–	–	1	50	16	66
100—200	44	5	12	7	–	–	–	–	–	–	–	49	19	68
200—300	48	12	8	4	1	–	4	8	–	–	–	60	25	85
300—400	56	27	7	7	1	–	1	8	–	–	–	83	24	107
400—500	51	20	10	5	–	1	2	6	1	–	1	71	26	97
500—600	39	13	9	3	–	2	3	10	–	–	–	52	27	79
600—700	42	4	1	1	–	–	3	6	–	–	–	46	11	57
700—800	35	6	3	2	–	1	1	10	–	–	–	41	17	58
800—900	26	4	–	2	–	–	3	3	–	–	–	30	8	38
900—1000	19	7	1	1	–	2	2	8	–	–	–	26	14	40
1000—1100	13	4	1	2	–	–	1	3	–	–	–	17	7	24
1100—1200	10	10	1	1	–	1	2	12	–	–	–	20	17	37
1200 AM—100	9	6	–	–	–	–	1	6	–	–	–	15	7	22
100—200	7	3	–	–	–	–	1	8	–	–	–	10	9	19
200—300	4	6	–	1	–	2	3	10	–	–	–	10	16	26
300—400	2	3	–	–	–	–	2	4	–	–	–	5	6	11
400—500	4	2	3	2	–	–	1	6	–	–	–	6	12	18
500—600	3	4	1	2	3	–	3	4	–	–	–	7	13	20
	632	154	135	93	6	9	33	118	2	–	2	786	398	1184

VEHICLES MOVING TOWARD Morehead, Ky. (West) 7

TIME PERIOD	Passenger Cars: Local	Passenger Cars: Foreign	Less than 1½ Tons	2 Axle Dual Tires	3 Axle	Tractor Truck & Semi Trailor: 3 Axle	4 Axle	5 Axle	6 Axle	Busses: School	Busses: Other	Total Vehicles: Pass.	Coml.	Total	Total All Vehicles: Pass.	Coml.	Total
600 AM—700	16	1	8	1	–	–	–	–	–	–	–	17	9	26	35	15	50
700—800	35	–	10	1	–	–	–	1	–	–	–	35	12	47	52	25	77
800—900	58	2	10	9	1	–	–	1	–	–	–	60	21	81	92	47	139
900—1000	33	–	16	11	–	–	–	1	–	–	–	33	28	61	72	53	125
1000—1100	43	1	20	8	–	–	1	1	–	–	–	44	30	74	86	55	141
1100—1200	35	1	15	8	–	–	–	1	–	–	–	36	24	60	76	53	129
1200 PM—100	34	–	10	6	–	–	–	1	–	–	–	34	17	51	84	33	117
100—200	36	–	8	5	–	–	–	–	–	–	–	36	13	49	85	32	117
200—300	34	16	14	4	2	–	4	12	–	–	–	50	36	86	110	61	171
300—400	34	21	9	1	–	–	4	12	–	–	–	55	26	81	138	50	188
400—500	46	19	7	3	–	2	1	10	–	–	–	65	23	88	136	49	185
500—600	64	7	4	–	1	–	1	8	–	–	–	71	14	85	123	41	164
600—700	44	15	2	4	–	–	2	6	–	–	–	59	14	73	105	25	130
700—800	30	10	1	2	–	–	3	5	–	–	–	40	11	51	81	28	109
800—900	29	11	–	3	–	1	3	9	–	–	–	40	16	56	70	24	94
900—1000	25	4	–	1	–	2	3	4	–	–	–	29	10	39	55	24	79
1000—1100	16	4	–	2	–	2	3	11	–	–	–	20	18	38	37	25	62
1100—1200	14	2	–	2	–	–	2	6	–	–	–	16	10	26	36	27	63
1200 AM—100	10	4	1	1	–	1	3	10	–	–	–	14	16	30	29	23	52
100—200	6	6	–	–	–	–	1	3	–	–	–	12	4	16	22	13	35
200—300	2	7	–	1	–	2	3	6	–	–	–	9	12	21	19	28	47
300—400	3	2	–	–	–	1	2	10	–	–	–	5	13	18	10	19	29
400—500	1	1	–	2	–	2	1	3	–	–	–	2	8	10	8	20	28
500—600	11	2	4	1	3	1	2	6	–	–	–	13	17	30	20	30	50
	659	136	139	76	7	14	39	127	–	–	–	795	402	1197	1581	800	2381
	632	154	135	93	6	9	33	118	2	–	2	786	398	1184	526 ÷ 2381 = 22.09 % T		
	1291	290	274	169	13	23	72	245	2	–	2	1581	800	2381	1975 ÷ 526 = 3.755 Axles; 2381 x 1.07 x 1.27 = 3256 ADT		

Figure 3. Sample Classification Form.

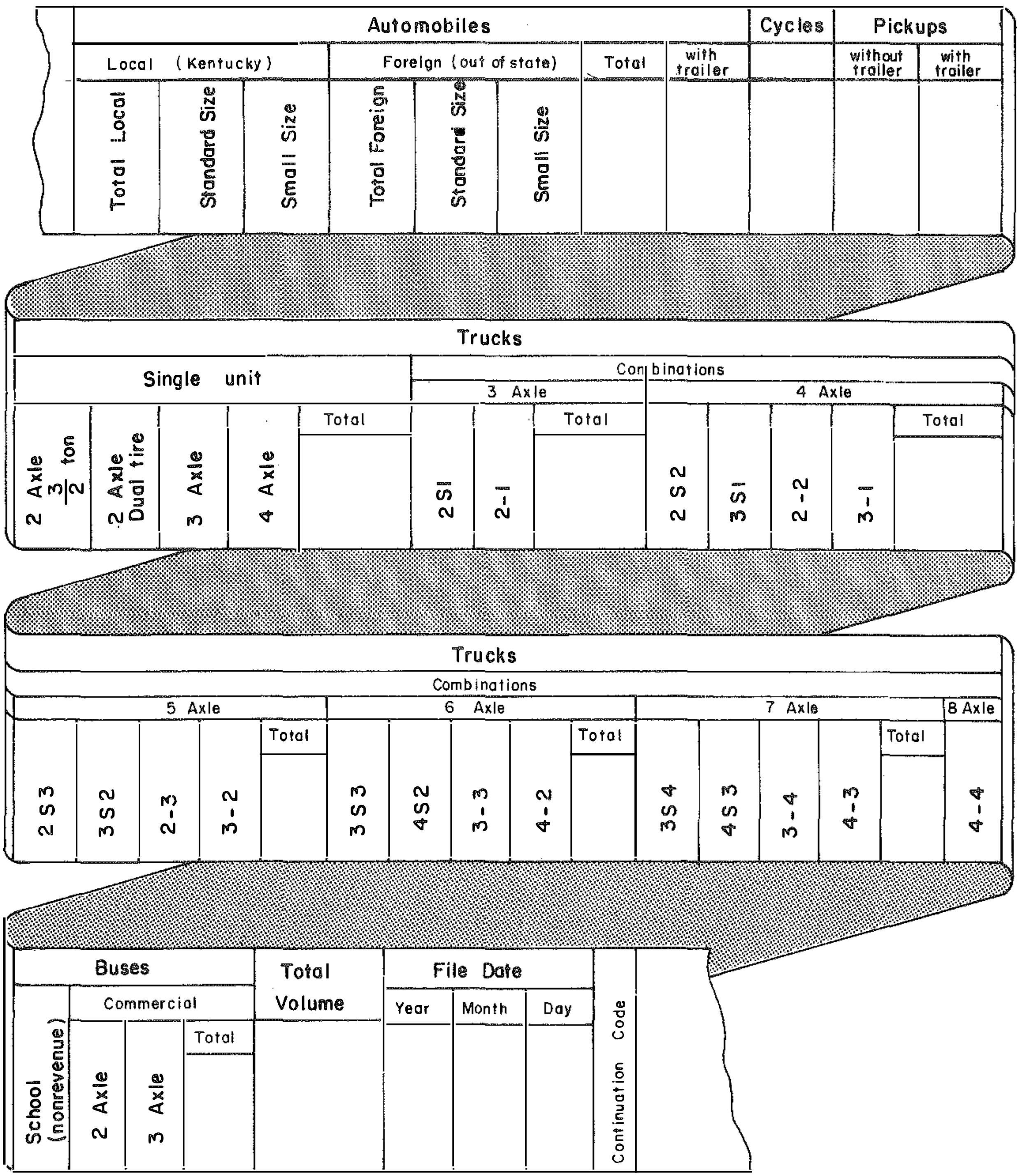


Figure 4. Classification File Format.

Loadometer Data

Uses of vehicle weight and size information (loadometer data) were illustrated by Buffington, Schafer, and Adkins *(7)* and are:

1. to determine requirements for highway pavements,
2. to aid in determination of geometric design requirements,
3. to help allocate highway costs among users,
4. to assist in allocation of highway revenues among various governmental agencies responsible for highway construction and operations,
5. to assist in establishing vehicle size and weight limits,
6. to assist governmental units in establishing sound transportation policy, and
7. to furnish basic data for continuing research.

The Federal Highway Administration requires states to conduct truck weight surveys according to procedures outlined in its truck weight manual *(6)*. It is apparent that inclusion of a loadometer file in the system is warranted. How then should a file be structured and what particular bits of information should it contain? Since such surveys are based on the individual vehicle rather than a group, the vehicle should be described by

1. type,
2. dimensions such as axle spacings, wheel base, height, length, and width, and
3. number and weights of axles.

It is also desirable to know if the vehicle is loaded or empty and the commodity being transported.

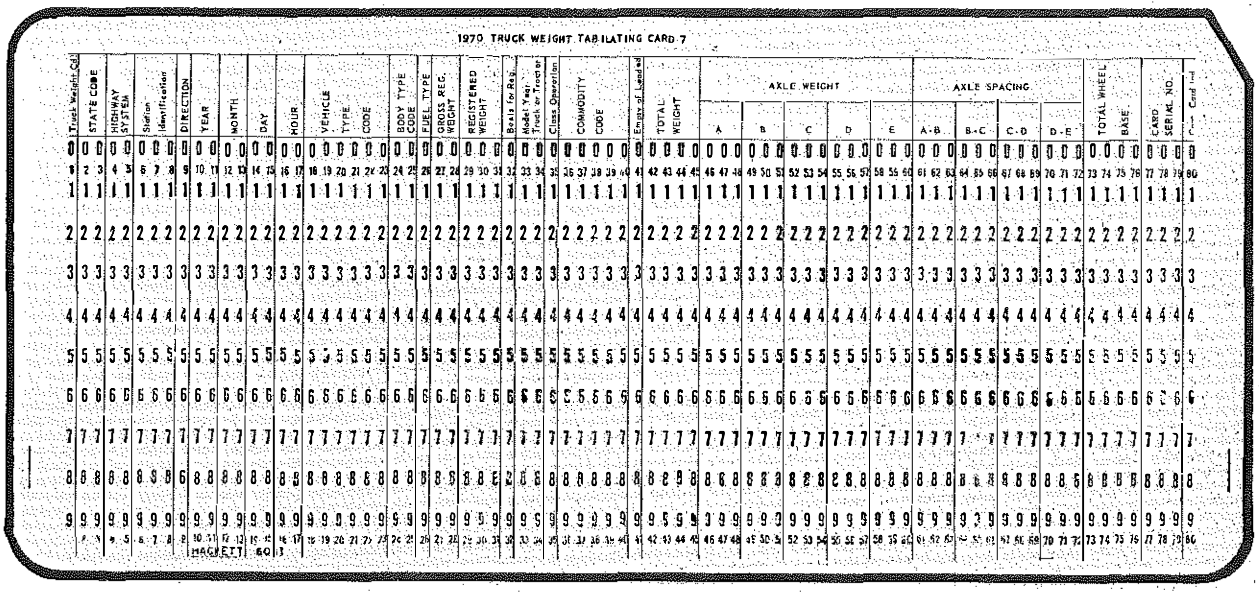
Each summer for approximately 4 to 5 weeks, the Division of Planning regularly conducts loadometer surveys in accordance with Federal Highway Administration standards. These studies, providing weight data for approximately 6,000 vehicles yearly, are taken at 11 permanent stations across the state. Raw data obtained for each vehicle are keypunched on regular 80-column computer cards and placed on file in the Division of Planning's Traffic Section. These data cards are formated according to FHWA standards, which have changed with time. Figure 5 shows a sample of these record cards for the years 1967 and 1968. This particular format contains fields for origin and destination data but the format for 1969 through 1971 does not. Figure 6 shows the desired basic loadometer file format; however, some problems were associated with selecting the appropriate format. For example, considering changing laws regulating the trucking industry, it is difficult to predict how many axles will be permitted on trucks and truck-trailer combinations in the future. Even though truck and full trailer combinations are not common in Kentucky and are restricted somewhat by law, it is not out of the realm of possibility to expect them to be used widely within the state in the future. The coding instructions for this file are given in APPENDIX A, Section III.

Traffic Volumes

Many people think only of traffic volumes with the mere mention of traffic data. There are a number of forms of traffic volumes; Annual Average Daily Traffic (AADT) and Design Hour Volume (30th highest hourly volume (DHV)) are of primary interest. AADT's and DHV's can be used in design, economic analyses, and as a data source for research studies. Design of highways is highly dependent on AADT and DHV because the determination of the type of facility to be built is based on these values. Pavement thickness design and geometric design features are controlled by these values. Economic analyses used in highway planning require a knowledge of traffic volumes for estimating road user costs and benefits. Since volumes are the basic type of traffic data, it is apparent they are important in varying highway research studies.

The Planning Division has 50 continuous, automatic traffic recorder (ATR) stations throughout the state. Temporary counting stations are periodically operated in each county to obtain short-term data. Each county is cross-sectionally covered during a 5-year period by these short-term counts. ATR information is used to derive factors enabling computation of AADT's for temporary stations and development of traffic flow maps. Results of these counts are maintained in tabulated form and by means of traffic flow maps.

Wisconsin's traffic counts file record format (Figure 7) may be compared to that chosen for STOLVAC's (Figure 8). The STOLVAC volume file, coded according to instructions in APPENDIX A, Section IV, provides data fields for each hourly volume taken at count stations. For example, a one-hour volume observed between 2 and 3 p.m. would be recorded for the 15th hour and designated in units of ten vehicles per hour. Also provided is space for the actual count for the day and the derived AADT.



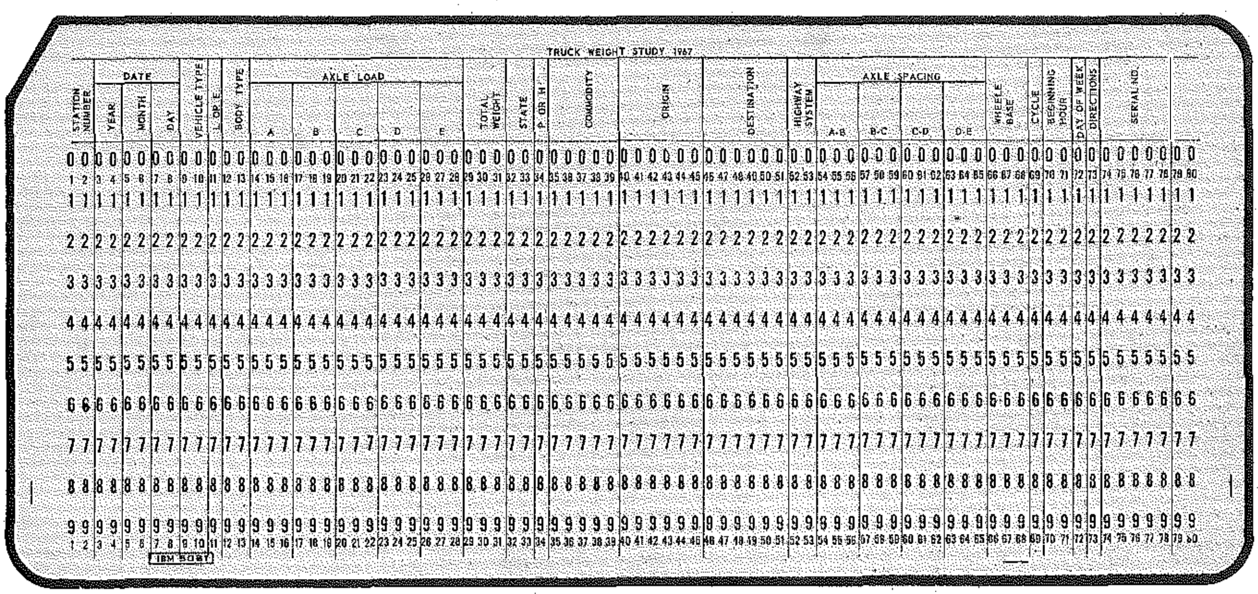


Figure 5. Sample Loadometer Data Cards.

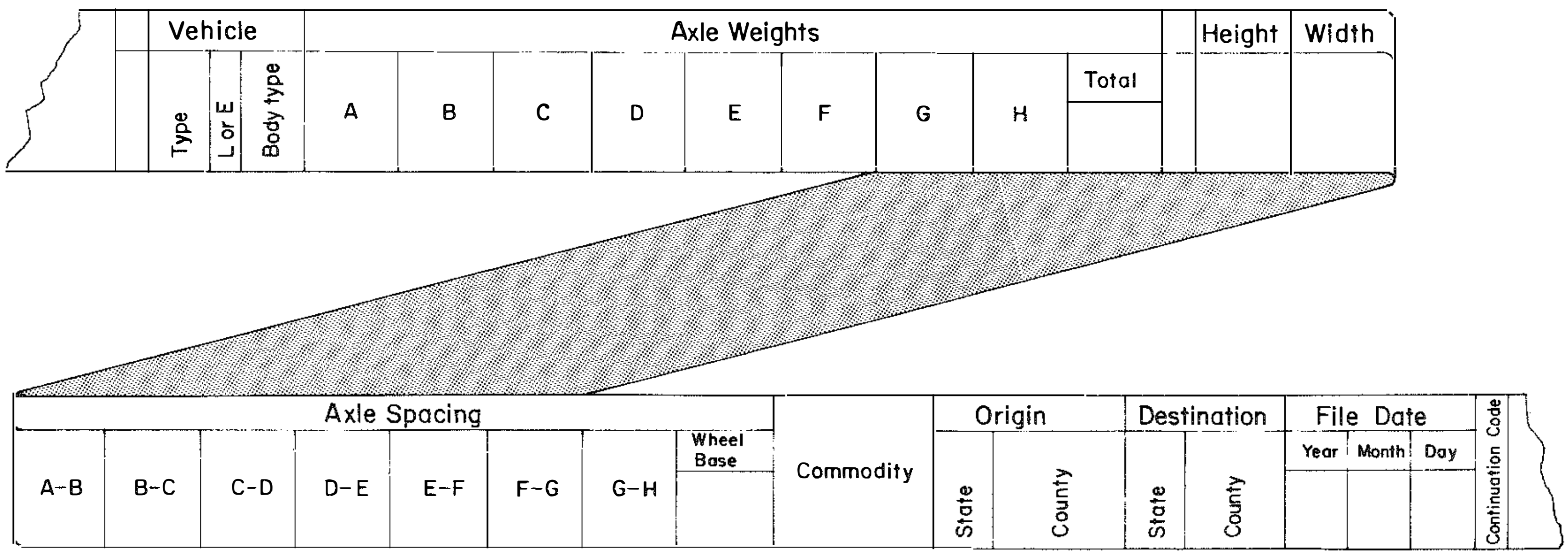


Figure 6. Loadometer File Format.

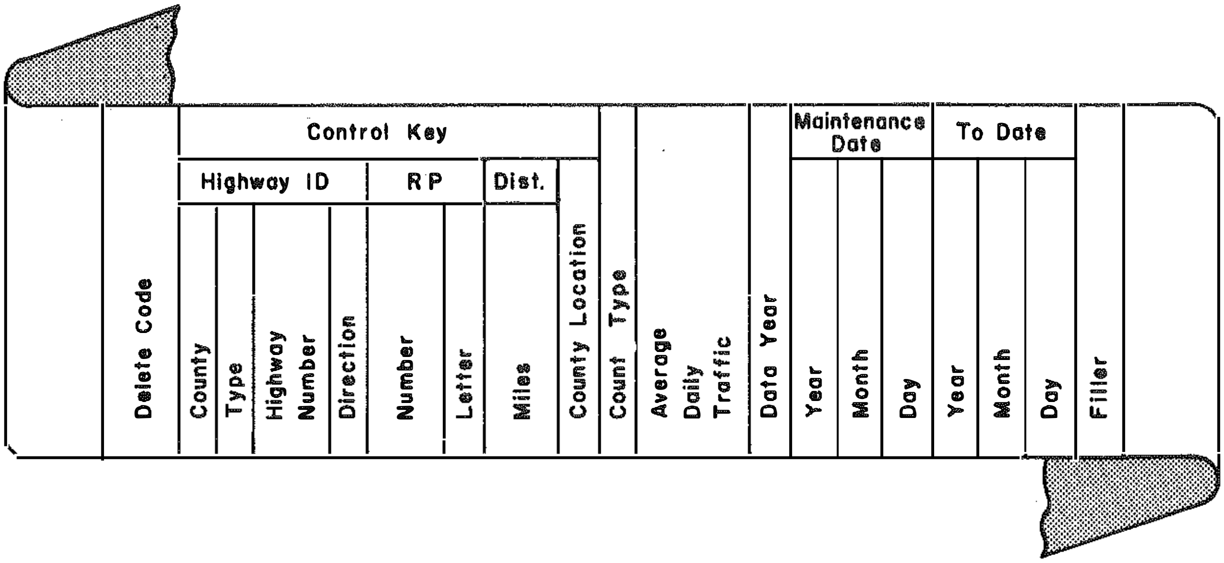


Figure 7. HNDI Traffic Counts File.

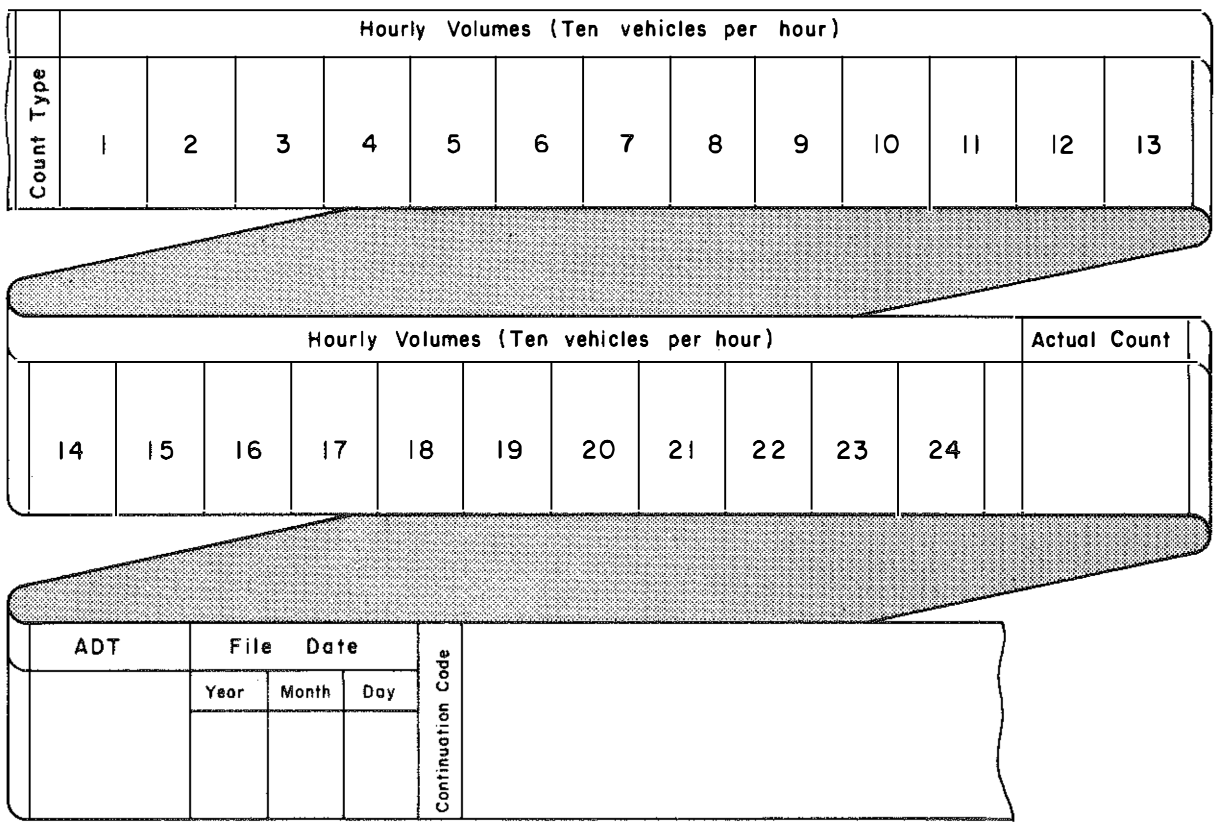


Figure 8. Volumes File Format.

Speeds

Highway safety is influenced by numerous characteristics of both the roadway and the traffic stream. Among these factors is speed, which may be discussed in terms of design speed and running speed. Average running speeds have been increasing; design speeds have also increased. Generally, policies or standards dictate the design speed, though maximum speed limits are governed by statute. After a speed limit is set on a section of road, local sentiments occasionally make it necessary to reassess that speed limit. Responsibility for this reevaluation rests with the Division of Traffic, who, upon receiving a request for speed limit reduction, will normally conduct a speed study. The purpose of the study is to determine if the speed limit reduction is warranted. If this study shows the 85th-percentile speed, which is the common engineering basis for speed limits, warrants a reduction, then the speed limit will be decreased. The speed limit aspect of highway engineering has been clouded recently by the imposition of the national maximum speed limit of 55 miles per hour (25 m/s) because no one knows how temporary that will be.

Speed studies involve the determination of the percentage of specific vehicle types (normally automobiles, trucks, and buses) operating in certain speed ranges. Often as part of normal research, the Division of Research will conduct speed studies; the Division of Planning does not routinely conduct them. Both the Traffic and Research Divisions monitor 100 cars and 30 trucks as a representative sample, though the Traffic Institute of Northwestern University recommends a sample size of 200. Figure 9 illustrates the data form used in these speed studies.

If a speeds file is to be included within STOLVAC, then it could conveniently be formated to conform with Figure 10. This format identifies the vehicle type and the number of each type operating within specified speed intervals. The vehicle type coding should be consistent with that defined within APPENDIX A, Section III.B. APPENDIX A, Section V gives additional coding instructions.

Origin-Destination Studies

Origin-destination (O & D) studies are normally conducted to determine travel characteristics such as trip origin, destination, and purpose. There are various types of O & D studies conducted in both urban and rural areas. They involve roadside interviews of drivers, home interviews, and license plate surveys. There are major differences in each study. In both the roadside and home interviews, personal contact is made and many specific questions may be asked while license plate surveys have no personal contact and only general travel patterns may be assessed by an observer.

The Division of Planning is the prime collector and user of O & D information. Each summer an extensive O & D program is carried out throughout the state at both urban and rural locations. Figure 11 is a sample of a form used in these O & D programs. This information is used in various planning functions, particularly in working with the Statewide Traffic Model. In addition to the Division of Planning, the Division of Research may conduct a limited number of O & D studies as elements of specific research studies. Results of most studies are maintained in a paper file by the Division of Planning. Some studies conducted by Research have been keypunched and loaded on tape.

Many O & D studies are conducted with specific objectives in mind. Thus, not all studies result in collection of the same information. From a basic point of view, O & D studies attempt

1. primarily to identify
    - a) approximate travel patterns,
    - b) trip origin and destination and
    - c) trip purpose, and
2. secondarily to identify
    - a) vehicle type,
    - b) vehicle occupancy,
    - c) commodity carried by trucks, and
    - d) intermediate stops.

A STOLVAC O & D file would be formated as Figure 12 and coded as discussed in APPENDIX A, Section VI.

Accidents

Recently, there has been considerable concern about highway safety. Consequently, there have been attempts to reduce the number and severity of traffic accidents. The highway engineering function has responsibilities for safer highways. Two basic steps may be taken by the Bureau to maximize highway safety. First, potential hazards may be eliminated by upgrading existing facilities. Second, all new construction may apply the latest standards in design and construction. It is unrealistic to think that all flaws in highways can be corrected or that new construction always results in safer highways. There is simply not enough money to correct all highway imperfections. Many suposedly safe design standards have proven hazardous with increased knowledge. Thus, there will always be hazardous locations in the highway network and attempts to minimize and correct those sites that meet certain criteria must be undertaken by determining where the accident situation is most critical.

HD 72-3
Rev. 11-65

COMMONWEALTH OF KENTUCKY
DEPARTMENT OF HIGHWAYS

MOTOR VEHICLE SPEED FIELD SHEET (RADAR)

COUNTY	ROUTE NO.	ZONE	MPH	DATE
TIME TO	DAY	WEATHER		N.S.E.W. BOUND

LOCATION

PAVEMENT CONDITIONS

REMARKS

SPEED	AUTOMOBILES	TOT.	CUMULATIVE TOTAL	CUMULATIVE PERCENT	SPEED	TRUCKS	BUSSES	CUMULATIVE TOTAL	CUMULATIVE PERCENT
100					100				
95					95				
90					90				
85					85				
80					80				
78					78				
76					76				
74					74				
72					72				
70					70				
68					68				
66					66				
64					64				
62					62				
60					60				
58					58				
56					56				
54					54				
52					52				
50					50				
48					48				
46					46				
44					44				
42					42				
40					40				
38					38				
36					36				
34					34				
32					32				
30					30				
28					28				
26					26				
24					24				
22					22				
20					20				
18					18				
16					16				
14					14				
12					12				
10					10				

OPERATOR ____________________

Figure 9. Sample Speed Check Data Sheet.

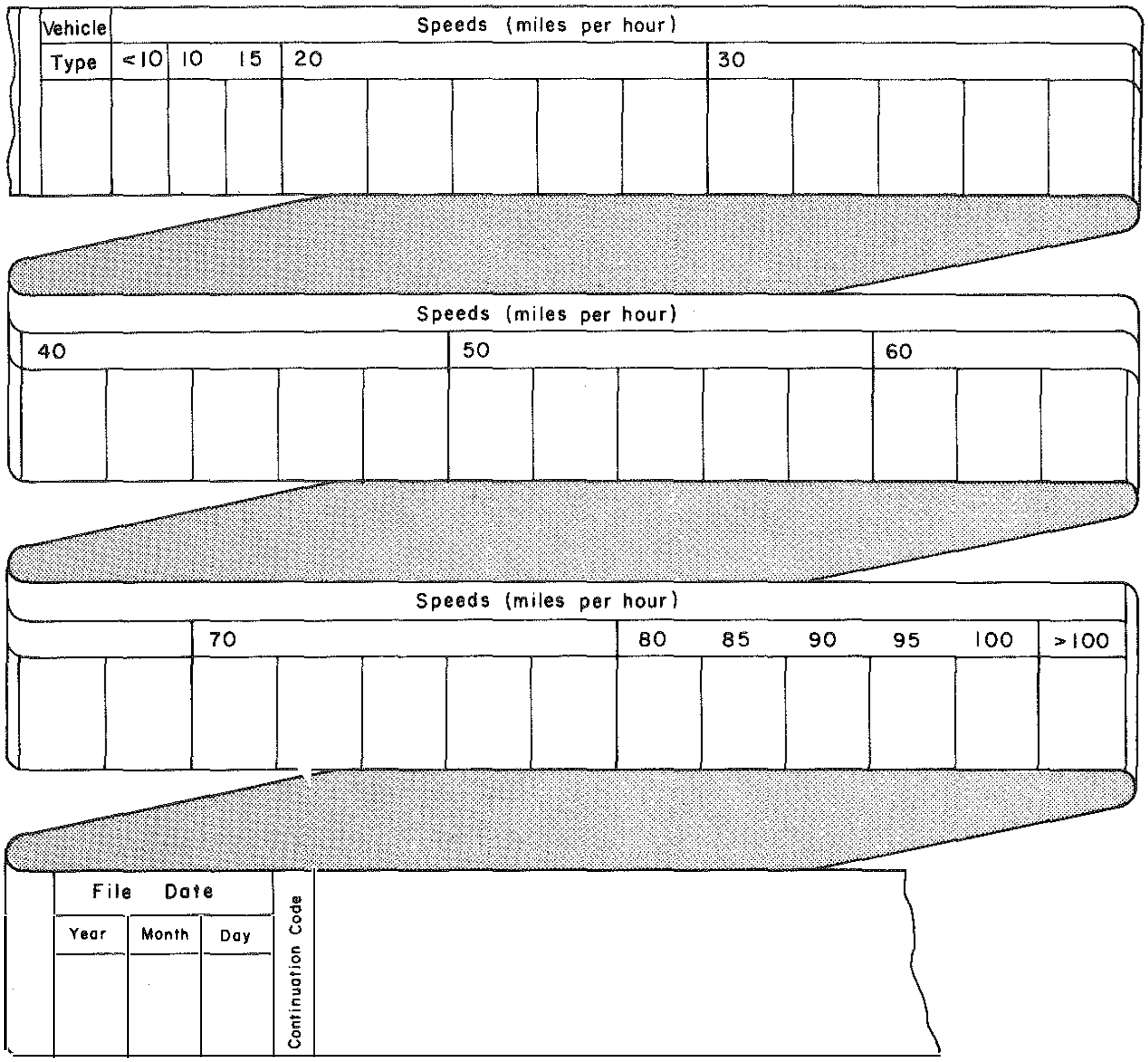


Figure 10. Speed File Format.

HD 52-200
7-66

County ____________ Station ______ Route ______ Interviewer ____________

KENTUCKY DEPARTMENT OF HIGHWAYS
DIVISION OF PLANNING
ORIGIN-DESTINATION
STUDY

Date ____________ Direction of Travel ____________ Beginning Hour ____________

Vehicle Type	Number In Vehicle	Where Did This Trip Begin?	Where Will This Trip End?	Trip Purpose	TRUCKS ONLY	Ask Of Thru Trips Only		
					COMMODITY	Route of Entrance	Intermediate Stop	
							Location	Purpose

Vehicle Type:
1. Passenger Car, Local
2. Passenger Car, Foreign
3. Pick-up or Panel
4. 2-Axle, Single Tire
5. 2-Axle, Dual Tire
6. 3-Axle, Single Unit
7. Combinations
8. Bus

Trip Purpose:
1. Work
2. Personal Business
3. School
4. Social
5. Recreational
6. Shopping

Commodity:
1. Farm
2. Comm.
3. Coal
4. Gravel

Intermediate Stop Purpose:
1. Work or Business
2. Shopping
3. Recreation
4. Eat Meal
5. Gas or Oil
6. Overnight

Figure 11. Sample Origin-Destination Form.

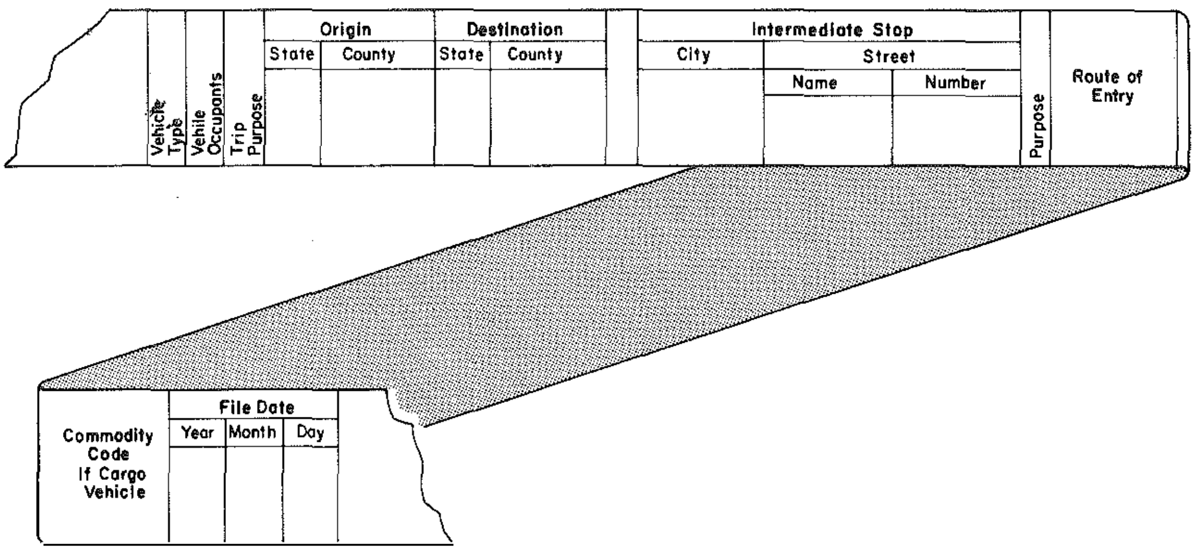


Figure 12. Origin-Destination File Format.

Presently, the Traffic Division identifies as hazardous sites those locations where three or more accidents have occurred within a 12-month period or where a fatality has occurred. Analysis of the sites involves both central office and district personnel. A determination is made as to whether the location is recognizably dangerous or if the unusually high number of accidents was a chance occurrence. Accident histories are the foundation for this program.

Traffic accidents investigated by the Kentucky State Police result in the filing of a written report with the Department of Justice. These reports (raw accident data) are then microfilmed, coded, and loaded on magnetic tape. Duplicates of those tapes are obtained by the Bureau and entered into a computer file. This file was created in conjunction with the Management Information System (MIS) and is an online disk file containing records of all state-police-reported accidents occurring in the last 24 months. In the near future, this file may be reduced to 12 months of record. Each record contains the following information for each reported accident:

1. case number,
2. accident type,
3. accident location (highway, county, milepost, city),
4. time of day,
5. date (day of week, month, day, year),
6. roadway conditions (character, defects, surface condition, lighting condition, type),
7. vehicle (type, action, defects, fatalities, injuries),
8. driver (residency, age, sex, violation),
9. pedestrian (injury, death), and
10. aid system.

This file is the Traffic Division's source for determining hazardous locations.

The Traffic Division's accident surveillance team believes that information contained in this file is adequate, but it could be improved. The Division of Traffic has expressed a desire for 3 years of accident histories to be contained online, and Jorgensen *(8)* recommends a 5-year retention period. Due to present storage techniques, no additional information can be included in the existing file. Kentucky compares favorably with the other states in information coded and stored, but there is room for reevaluation and perhaps restructuring the system. Table 1 compares Kentucky's format with Jordan and Wilson's *(9)* recommended minimum elements of an accident file and formats used by North Carolina and Connecticut.

An important aspect of accident surveillance is a collision diagram. To prepare these diagrams, it is necessary to know the direction in which the vehicles were traveling at the time of the accident. This information is not available from the computer printout and written reports must be laboriously examined to extract the information.

Also involved with accident statistics are the Divisions of Planning and Research. Planning plots accident concentrations on county maps. Research will always consider the accident situation with high priority. The Research Division has access to magnetic tapes containing the state-police-reported accidents on a yearly basis since 1967.

Figure 13 is the STOLVAC format for coding accident records. The length of each record must be flexible because of the varying number of vehicles involved in any particular accident. The first record is a description of the accident location and information pertaining to the accident in general. Additional records for each vehicle provide more specific information. There are differing opinions as to what should constitute the minimum information in the record. Items in Figure 13 may be regarded as minimum requirements for Kentucky, but it must be pointed out that an adequate analysis may be done with less information. However, the suggested format is desired since it would simplify accident surveillance procedures. Coding instructions are given in APPENDIX A, Section VII. Because records are to be of card length, the control elements have been modified to fit required information onto the identifying card.

Intersection Turning Movements

To determine the type of traffic control devices and signal timing which should be used in regulating traffic flow through intersections, it is necessary to quantify all traffic maneuvors in the intersection -- right turns, left turns, and through vehicles. The Traffic Division conducts a large number of these studies by simply counting the traffic entering and leaving the intersection. A file containing this type of information within this inventory system would be formated as shown in Figure 14. Only raw data would be coded as instructed in APPENDIX A, Section VIII.

TABLE 1

ELEMENTS OF TRAFFIC ACCIDENT RECORDS COMPARED

RECORD ITEM	JORDAN	KY.	N. C.	CONN.
Identification				
Accident Number	X	X	X	X
Driver	X	X	X	X
Vehicle	X	X	X	X
Location	X	X	X	X
Time and Date	X	X	X	X
Driver				
Age		X	X	X
Sex		X	X	X
Condition(s)	X			X
Alcohol and Drug Involvement	X			X
Violation	X	X	X	
Intent	X		X	
Residence		X		X
Pedestrians				
Age			X	X
Sex			X	X
Conditions	X			X
Alcohol and Drug Involvement	X			X
Violation	X	X	X	
Intent	X			X
Vehicle				
Defect	X	X		
Speed	X		X	
Maneuver	X	X	X	X
Point of impact	X			X
Damage severity	X	X		X
Object struck	X		X	X
Mileage-odometer	X			X
Accident Severity				
Property damage	X	X	X	X
Injury	X	X	X	X
Fatal	X	X	X	X
Victims (occupants-pedestrians)				
Injury	X	X		
Age	X	X	X	
Sex	X		X	
Condition(s)	X			
Position of seating	X			
Cause of death	X			
Blood alcohol	X			
Ejection	X			
Dates of death	X			
Extricator time	X			
Object struck (vehicle)	X			
Environment				
Light		X	X	X
Weather	X		X	X
Condition (roadway)	X	X	X	X
Maximum safe speed	X		X	
Road defects	X	X	X	X
Physical features	X	X		
Emergency Response				
Police notified (time)	X			X
Police arrived (time)	X			X
Emergency services notified (time)	X			
Emergency services arrived (time)	X			

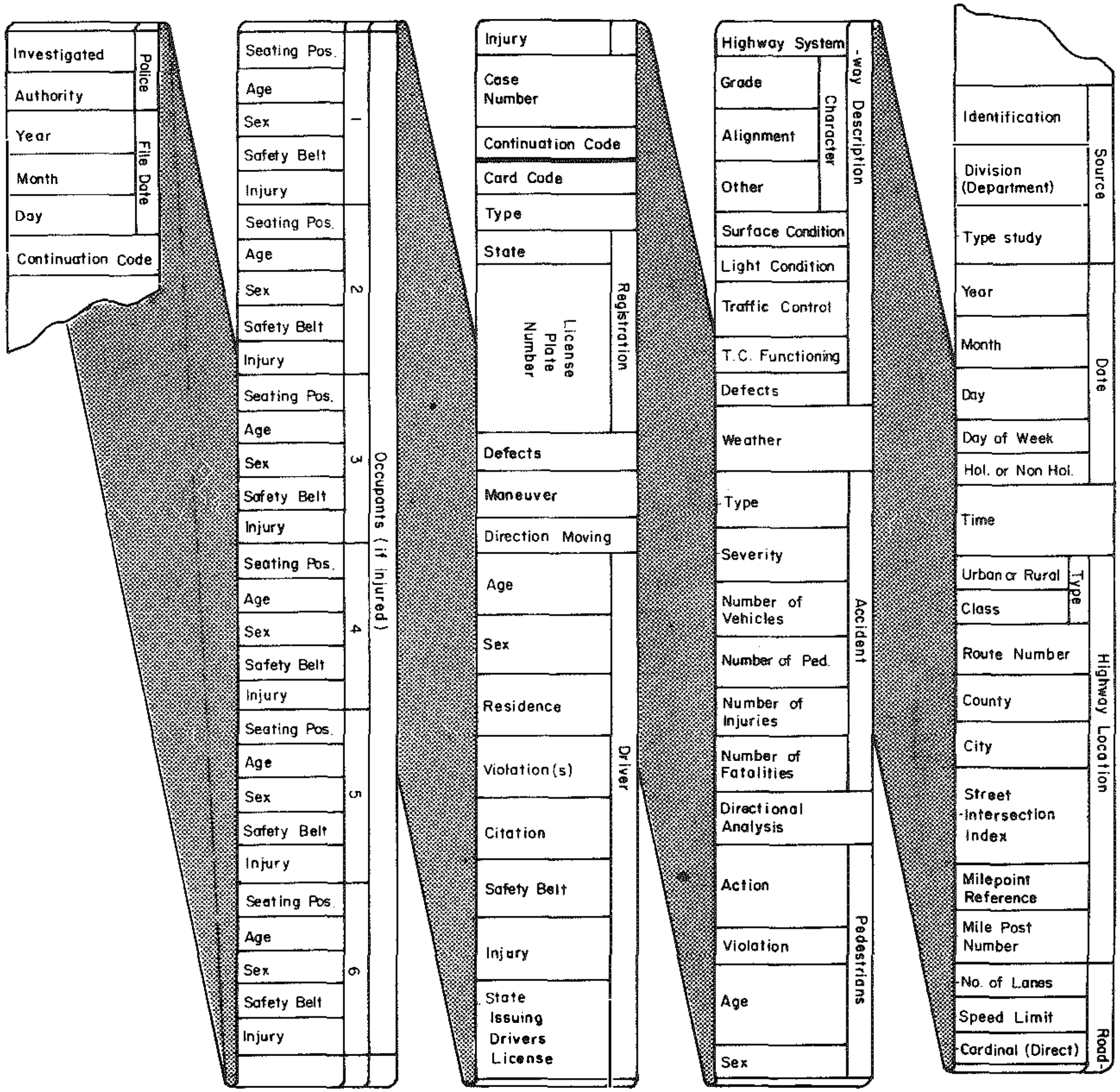


Figure 13. The Accident Record File Format.

Intersection Identification		Direction of Travel and Turning Movements					
North-South Route Number	East-West Route Number	From North			From South		
		Right	Thru.	Left	Right	Thru.	Left

Direction of Travel and Turning Movements					
From East			From West		
Right	Thru.	Left	Right	Thru.	Left

Figure 14. Turning Movements File Format.

SYSTEM IMPLEMENTATION

Thus far, discussion of STOLVAC has been conceptual in nature. The system must also be considered from the perspective of its creation and maintenance. It then is significant to enumerate techniques for accomplishing system implementation. These considerations, though, cannot be achieved until answers are provided to questions concerning the scope of the system. Kentucky is predominantly a rural state; therefore, traffic data collected will be overwhelmingly rural. However, urban information is collected and STOLVAC must be capable of accepting and distinguishing these data. The beginning date for information contained in the files must be established. Equally significant is the period of time information will be retained in the system.

Urban data could not be accepted by STOLVAC as the system was originally designed. Thus, the control elements were modified to allow for inclusion of urban information. The problem existed because there was no method for referencing survey sites in urban areas unless they were on a state aid system. A decision was made to include the city and nearest intersection as parameters of the control elements. The intersection will be identified by a code obtained from a street intersection index. This index does not presently exist nor was it devised in the course of this study. The Bureau should proceed to establish the index for all the Commonwealth's urban areas.

Primary interest was in the selection of the initiation date. Two of the purposes of this study was the creation and maintenance of historical files. The initiation date for the files should be as early as possible, allowing for the most complete historical file. However, manpower for loading bulk quantities of historical data of some types may prove excessive; it may be undesirable for all files to have the same initiation date.

The retention period for information in each file is another pertinent question. Again, the historical significance of the system indicates that data should be retained indefinitely. With offline files on magnetic tape, this can be achieved. Online files should not be expected to handle the bulk storage that would be demanded. The offline files will be maintained indefinitely and the online summary and current files, to be created later, will be retained one year. As these summary files are developed, it may become necessary or reasonable to have longer online retention.

Development of the STOLVAC system may most easily be achieved by a staging process. Priorities for staging need to be established. The basic files will be created first and then the summary and current files. Other priorities should be assigned with regard to the benefit of the particular files to the Bureau and the Commonwealth. Another influencing factor to be considered is the level of effort required for implementation.

Highway safety is a primary concern of the highway engineer and should be given top priority. Highway engineering's approach to safety is dependent upon accident statistics which in turn are dependent upon traffic volume. Classification and loadometer data are used constantly for planning and design purposes and research has many times used these data. The latter two data types are of value to the Bureau and should be assigned second priority. Origin-destination is equally as important but the manpower to process it drops the priority below that of classification and loadometer files. Speed and turning movements have been assigned a lower priority because they are of less value to the Bureau as a whole than to specific divisions.

Although priorities just described dictate that highway safety related information receive highest priority, the staging of STOLVAC will vary the order. The Division of Research, in an attempt to illustrate the potential of the system, has already initiated work on the classification and loadometer files. These files were chosen because the Division has significant interest in these files. This was not an attempt to discount the importance of accident and volume data. A useable accident file is now in existance and the Division cannot meet the manpower requirements that would be needed to handle the creation of a volumes file. Thus, the staging should be carried out in the following order:

1. classification and loadometer files,
2. accident and volume files,
3. origin-destination file, and
4. speeds and turning movements files.

Stage One

With the commencement of this study, work began toward the creation of the classification and loadometer files. This work has resulted in the building of the basic classification and loadometer files containing data collected from throughout the Commonwealth from 1967 through 1971. The classification file is loaded on magnetic tape in the designed format. Records of the file are ordered sequentially, first by year and then by county. The loadometer file is a tape copy of cards produced by the Division of Planning for the FHWA.

This file as yet is not in final format.

Creation of the classification file included four basic steps:

1. obtaining the data in original, handwritten form,
2. determination of station locations according to the STOLVAC reference scheme (APPENDIX B),
3. coding and keypunching data, and
4. transposing card records to magnetic tape.

Involved in the process were one engineer and two engineering aides. The effort required can be expressed as 17 man-months. Time estimates for the other files will be extrapolated from this figure. The loadometer file will not require the same level of effort because the information is already keypunched. The simple application of computer programming can accomplish the file creation, which will be completed concurrently with the updating of the classification file. The classification data updating has begun with the 1972 data now being processed. Presently, the initiation date for both these files will be 1967, but future plans are to add older information.

Stage Two

There now exists an accidents file, but no volumes file is available. The present accidents file is obtained from a magnetic tape supplied by the Department of Justice. This tape contains records of all accidents investigated by the State Police and, additionaly, all fatalities. Because Kentucky does not require its law enforcement agencies to report all accidents investigated to a central agency, the file is basically rural (city police agencies do not send in reports). The system will eventually need at least one year of current data online, but preferably 3 years. The initiation date for this file will be 1967, and it may be created by applying computer programming techniques to the Department of Justice's source tapes.

The volume file will be started from scratch, and because of the large quantities of data, the initiation date should be January 1, 1974. It will require similar efforts to those put forth in the classification file creation.

The completion of this stage will require approximately 16 man-months.

Stage Three

This stage will require an extensive effort to build the origin-destination file. It will be difficult to create a complete historical file for O & D data because of the voluminous data available. The only realistic approach would be to build this file from the present with an initial date of January 1, 1974. It is difficult to make a time estimate for this stage.

Stage Four

Speed and turning movements data would be loaded in this stage. There may be difficulties in accomplishing this phase of system implementation. Most of this information is collected in the districts by the Traffic Division and is often discarded after immediate use. Implementation on a limited scale might be considered, with the techniques of formating being used in computer applications of the data.

File Maintenance

The necessity of maintaining the system is evident. Maintenance procedures should be established from the prospective of the system as a whole although the actual procedures for updating each file may vary somewhat. A staff similar to that required for creating the files should be employed and should consist of a minimum of two engineering helpers to aid with coding and keypunching. The engineer will occasionally require the assistance of a computer programmer.

Maintenance should be conducted on a regular schedule, according to the seasonal aspects of data collection. Such a schedule would be as outlined:

1. reference file -- updated as any new information is placed in any of the other files (listing stored within the system identifying locations as discussed in APPENDIX B)
2. classification file -- maintained on a basis of being updated twice yearly (May and September),
3. volumes file -- updated continuously,
4. loadometer file -- updated once a year (in March) by obtaining copies of those cards coded by Planning and applying a computer program to change data format,
5. accident records -- updated continuously, and
6. origin-destination files -- updated continuously.

Although the system may be maintained according to the schedule, it will be lagging (time wise) because of processing. The development of summary files will be a maintenance function. Some such files would include

1. AADT file,
2. accident statistics, and
3. EAL summaries.

CONCLUSIONS

The following conclusions reached in the course of this study are summarized for convenience of reference:

1. implementation of STOLVAC should take place in stages,
2. staging should be according to the following priorities:
   a) classification and loadometer files,
   b) accident records and volumes file,
   c) origin-destination file,
   d) vehicle speeds and turning movements (This stage is not recommended for implementation in the near future but its concepts should be considered for future reference.),
3. retention time for data should be indefinitely for basic files and one year for summary files,
4. the accidents file should not replace the present one immediately, but the conversion should be orderly, not interrupting present operations, and
5. further considerations should be given to the possibility of summary files and online aspects of the system.

REFERENCES

1. Deacon, J. A. and Lynch, R. L., *Determination of Traffic Parameters for the Prediction, Projection, and Computation of EWL's,* Division of Research, Kentucky Department of Highways, 1968.

2. Oral Communications with Joe Wollums, Division of Data Processing, Kentucky Department of Highways, June 1972.

3. **Highway Planning Program Manual,** Federal Highway Administration, U.S. Department of Transportation, 1971.

4. Oral Communications, Kentucky Bureau of Highways, Division of Planning, Traffic Section, 1972.

5. **HNDI SYSTEM: Planning Manual,** Bureau of Program Planning, Wisconsin Department of Transportation, July 1971.

6. **Truck Weight Study Manual**, Federal Highway Administration, U.S. Department of Transportation, April 1971.

7. Buffington, J. L., Schafer, D. L., and Adkins, W. G., *Procedures for Estimating the Total Load Experience of a Highway as Contributed by Cargo Vehicles,* Texas Transportation Institute, Texas A & M University, September 1970.

8. *Evaluation of Criteria for Safety Improvements on the Highway,* Roy Jorgenson and Associates - Westat Research Analyses, Inc., Gaithersburg, Maryland, 1966.

9. Jordan, A. D. and Wilson, J. E., *Traffic Records, A Conceptual View,* **Traffic Engineering**, July 1971.

10. *Highway Location Reference Methods,* Federal Highway Administration, U. S. Department of Transportation, February 1972.

BIBLIOGRAPHY

1. Agent, K. R., *Evaluation of the High Accident Location Spot-Improvement Program in Kentucky,* Division of Research, Kentucky Department of Highway, 1973.

2. *Automation Systems for Highway Organizations,* **Special Report 128**, Highway Research Board, 1969.

3. Deen, R. C., *Highway Information Management Systems,* Division of Research, Kentucky Department of Highways, April 1970.

4. Deen, R. C., *Reference Point Signing Manual,* Division of Research, Kentucky Department of Highways, April 1970.

5. **Design Manual of State Traffic Records System, Volume 1: System Design and Development,** National Highway Traffic Safety Administration, U. S. Department of Transportation, April 1971.

6. Garret, J. W. and Tharp, K. L., *Development of Improvements Methods for Reduction of Traffic Accidents,* **NCHRP Report 79**, Highway Research Board, 1969.

7. Gear, C. W., **Computer Organization and Programming**, McGraw-Hill, 1969.

8. *Highway Inventory System, Hardin County Model Description and Specification,* TRW Systems Group, McLean, Virginia, July 1971.

9. *Highway Location Reference Methods,* Federal Highway Administration, U.S. Department of Transportation, February 1972.

10. Ireland, S. D. and Burke, J. W., *Compatibility File - An Information Retrieval System,* Connecticut Department of Transportation, June 1971.

11. Lynch, J. M., *Importance of and Technique for Accident Identification and Analysis,* Institute of Traffic Engineers, Birmingham, Alabama, 1970.

12. Lynch, R. L., *Analysis of Traffic Loads on Bridges: Report II, Characteristics of Traffic on Ohio River Bridges - 1968,* Division of Research, Kentucky Department of Highways, March 1969.

13. Lynch, R. L. and Hamby, G. N., *Lateral Distribution of Traffic on a Four-Lane and Six-Lane Section of I 75 South of Covington,* Division of Research, Kentucky Department of Highways, June 1969.

14. *Management Information System, Operations Element*, Kentucky Department of Highways, October 1971.

15. *Management Information System, Property Supplement*, Kentucky Department of Highways, July 1971.

16. Pigman, J. G., *Influence of Recreational Areas on the Functional Service of Highways,* Division of Research, Kentucky Department of Highways, August 1971.

17. Oglesby, C. H. and Hewes, L. I., **Highway Engineering,** John Wiley and Sons, 1966.

18. Threlkeld, R., *Acquisition and Analysis of Traffic Data in Georgia,* Division of Highway Planning, Traffic Survey Section, State Highway Department of Georgia, September 1965.

19. Winfrey, R., **Economic Analysis for Highways,** International Text Book Company, 1969.

APPENDIX A

CODING INSTRUCTIONS

RECORD COLUMN	ITEM	CODE
	I. GENERAL CODING SCHEME FOR CONTROL ELEMENTS	
1	A. Data Type	
	Classification file	C
	Loadometer file	L
	Volume file	V
	Speed file	S
	Origin-Destination file	O
	Accident records	A
	Turning Movements file	T
	Station Location file	R
	B. Source of Information	
2	1. Collecting Division	
	Planning	1
	Research	2
	Traffic	3
	Department of Justice	4
	Other	5
3	2. Was the information collected routinely or was it from a specific study?	
	Routine study	1
	Non-routine or specific study	2
	C. Validity of Information	
4	1. Has the information been checked?	
	No	1
	Yes	2
5	2. Changes in the record over time:	
	Highway location has been changed, changing the milepoint	1
	Data has become outdated and invalid	2
	Data is currently correct	3
6-7	D. Year	
	Last two digits of the year data was collected	
8-9	E. Month	
	January	01
	February	02
	March	03
	April	04
	May	05
	June	06
	July	07
	August	08
	September	09
	October	10
	November	11
	December	12
	F. Day	
10-11	1. Day of Month	
12	2. Day of Week	
	Sunday	1
	Monday	2
	Tuesday	3
	Wednesday	4
	Thursday	5
	Friday	6
	Saturday	7
	Weekday -- no indication of day or count taken on more than one day of the same week	8
	Weekend -- no indication of day	9
13	3. Was it a holiday or not?	
	Non-holiday	0
	Holiday	1
	G. Time	
14-15	1. Beginning hour (Midnight = 00 through 11 p.m. = 23)	
16-17	2. Ending hour	
	H. Highway Identification	
	1. Type	
18	a) Urban or rural location	
	Rural	1
	Urban	2

19	b)	Class of facility	
		Interstate	1
		Toll road	2
		US numbered	3
		KY numbered	4
		Other	5
20-23	2.	Route number	
		a) Alternate and east or west routes need special consideration:	
		US 25 E	2025
		US 25 W	4025
		US 31 E	2031
		US 31 W	4031
		US 41 Alternate	5041
		b) Interstates:	
		I 24	9024
		I 64	9064
		I 65	9065
		I 71	9071
		I 75	9075
		I 264	9264
		I 275	9275
		I 471	9471
		c) Toll roads:	
		Kentucky Turnpike	0000
		Mountain Parkway	9000
		Western Kentucky Parkway	9001
		Bluegrass Parkway	9002
		Pennyrile Parkway	9003
		Jackson Purchase Parkway	9004
		Cumberland Parkway	9005
		Green River Parkway	9006
		Daniel Boone Parkway	9007
		Audubon Parkway	9008

24-26	I.	County Number	
		Adair	001
		Allen	002
		Anderson	003
		Ballard	004
		Barren	005
		Bath	006
		Bell	007
		Boone	008
		Bourbon	009
		Boyd	010
		Boyle	011
		Bracken	012
		Breathitt	013
		Breckinridge	014
		Bullitt	015
		Butler	016
		Caldwell	017
		Calloway	018
		Campbell	019
		Carlisle	020
		Carroll	021
		Carter	022
		Casey	023
		Christian	024
		Clark	025
		Clay	026
		Clinton	027
		Crittenden	028
		Cumberland	029
		Daviess	030
		Edmonson	031
		Elliot	032
		Estill	033
		Fayette	034
		Fleming	035
		Floyd	036
		Franklin	037
		Fulton	038
		Gallatin	039
		Garrard	040
		Grant	041
		Graves	042
		Grayson	043
		Green	044
		Greenup	045
		Hancock	046
		Hardin	047
		Harlan	048
		Harrison	049
		Hart	050
		Henderson	051
		Henry	052
		Hickman	053
		Hopkins	054
		Jackson	055
		Jefferson	056
		Jessamine	057
		Johnson	058
		Kenton	059
		Knott	060
		Knox	061
		Larue	062
		Laurel	063
		Lawrence	064
		Lee	065
		Leslie	066

Letcher	067
Lewis	068
Lincoln	069
Livingston	070
Logan	071
Lyon	072
McCracken	073
McCreary	074
McLean	075
Madison	076
Magoffin	077
Marion	078
Marshall	079
Martin	080
Mason	081
Meade	082
Menifee	083
Mercer	084
Metcalfe	085
Monroe	086
Montgomery	087
Morgan	088
Muhlenburg	089
Nelson	090
Nicholas	091
Ohio	092
Oldham	093
Owen	094
Owsley	095
Pendleton	096
Perry	097
Pike	098
Powell	099
Pulaski	100
Robertson	101
Rockcastle	102
Rowan	103
Russell	104
Scott	105
Shelby	106
Simpson	107
Spencer	108
Taylor	109
Todd	110
Trigg	111
Tremble	112
Union	113
Warren	114
Washington	115
Wayne	116
Webster	117
Whitley	118
Wolfe	119
Woodford	120

27-30 J. City(see IBM Manual of Numerical Codes for States, Coiunties, and Cities)

31-34 K. Street Intersection Index Number

35-37 L. Milepoint Reference
Either a county line, state line, or highway terminus from which the survey site is located by plusing mileage. If it is the county line, the number of the adjoining county is used; if it is a state line or highway terminus, the following scheme is used:

Tennessee	200
Missouri	300
Illinois	400
Indiana	500
Ohio	600
West Virginia	700
I 71 or Toll Road Terminus	900
Highway Terminus within the County	000

38-42 M. Milepoint (tenths of a mile)

43 N. Number of Lanes in Both Directions

44 O. Maximum Allowable Gross Weight

73,280 pounds	1
62,000 pounds	2
44,000 pounds	3
30,000 pounds	4
Other	5

45 P. Speed Limit

70 mph	1
60 mph	2
55 mph	3
50 mph	4
45 mph	5
40 mph	6
35 mph	7
30 mph	8
25 mph	9
$<$ 25 mph	0

46	Q.	Lane Number Lane of the traffic stream sampled	
		Count includes all lanes going in same direction	0
		Shoulder lane is 1 and the number increases by one for each lane to the median lane	1, 2, 3, 4
		Exit ramp	5
		Entrance ramp	6
		Count includes all traffic regardless of lane and direction	9
47	R.	Cardinal Direction	
		North-South highway	1
		East-West highway	2
48	S.	Direction of Traffic Flow	
		Both directions	0
		From 0.00 terminus	1
		Toward 0.00 terminus	2

II. CLASSIFICATION CODING SCHEME

1-48	A.	General Coding (see I. General Coding Scheme)	
49-212	B.	Vehicle count by Type (see Figure 4) (16 fields five columns wide and 28 fields three columns wide)	
213-217	C.	Total Volume	
218-223	D.	File Date Year, month, and day information was added to the file	
224		Blank	
225	E.	Continuation Code	
		End of record set	0
		Record set continues	1

III. LOADOMETER CODING SCHEME

1-48	A.	General Coding (see I. General Coding Scheme)	
	B.	Vehicle	
49-50	1.	Type	
		Automobiles pulling trailers	00
		All automobiles	01
		Local automobiles	02
		Foreign automobiles	03
		Local standard size automobiles	04
		Local small size automobiles	05
		Foreign standard size automobiles	06
		Foreign small size automobiles	07
		Pickup trucks	08
		Pickup trucks pulling trailers	09
		All trucks	10
		All single-unit trucks (SU)	11
		2-Axle, 4-tired single unit trucks (SU2A4T)	12
		2-Axle, 6-tired single unit trucks (SU2A6T)	13
		3-Axle single unit trucks (SU3A)	14
		4-Axle single unit trucks (SU4A)	15
		All semi-trailer trucks	20
		3-Axle semi-trailer trucks (2S1)	23
		4-Axle semi-trailer trucks (2S2 or 3S1)	24
		5-Axle semi-trailer trucks (2S3 or 3S2)	25
		6-Axle semi-trailer trucks (3S3 or 4S2)	26
		7-Axle semi-trailer trucks (3S4 or 4S3)	27
		All truck-trailer combinations	30
		3-Axle truck-trailer combinations (2-1)	33
		4-Axle truck-trailer combinations (2-2 or 3-1)	34
		5-Axle truck-trailer combinations (2-3 or 3-2)	35
		6-Axle truck-trailer combinations (3-3 or 4-2)	36
		7-Axle truck-trailer combinations (3-4 or 4-3)	37
		8-Axle truck-trailer combinations (4-4)	38
		All buses	40
		School buses	41
		2-Axle commercial buses	42

3-Axle commerical buses 43
All commercial buses 44
All combination trucks (no distinction between semi's and truck-trailers) 50
3-Axle combination trucks (no distinction between semi's and truck-trailers) 53
4-Axle combination trucks (no distinction between semi's and truck-trailers) 54
5-Axle combination trucks (no distinction between semi's and truck-trailers) 55
6-Axle combination trucks (no distinction between semi's and truck-trailers) 57
8-Axle combination trucks (no distinction between semi's and truck-trailers) 58

51 2. Loaded or empty
Empty 0
Loaded 1

52 3. Body type (see FHWA Truck-Weight Study Manual, Highway Planning Program Manual, Appendix 51)

53-76 C. Axle Weights in 1000 pounds (8 fields three columns wide)

77-80 D. Total Weight (1000 pounds)

81-86 E. Height and Width (2 fields three columns wide) (tenths of a foot)

87-107 F. Axle Spacings (7 fields three columns wide) (tenths of a foot)

108-111 G. Wheel Base (tenths of a foot)

112-116 H. Commodity (see FHWA Truck Weight Study Manual)

117-128 I. Origin-Destination
1. State (see FHWA Truck-Weight Study Manual)
2. County (see IBM Manual **Numerical Code for States, Counties and Cities)**

129-134 J. File Date (see II.D. Classification Coding Scheme)

135 K. Continuation (see II.E. Classification Coding Scheme)

IV. ACCIDENT RECORD CODING SCHEME

A. General Coding

1 1. Data Type (see I. General Coding Scheme)
2-3 2. Source of Information (see I.B.)
4-5 3. Year (see I.D.)
6-7 4. Month (see I.E.).
8-9 5. Day of Month.
10 6. Day of Week (see I.F.).
11 7. Was it a holiday or not? (see I.F.)
12-15 8. Time in international time (example: 6:32 p.m. = 1832 and 2:01 a.m. = 0201)
9. Highway Identification
16-17 a) Type (see I.H.1.)
18-21 b) Route Number (see I.H.2.)
22-24 c) County Number (see I.I.)
25-28 d) City (see I.J.)
29-32 e) Street Intersection Index Number
33-35 f) Milepoint Reference (see I.L.)
36-40 g) Milepoint (see I.M.)

B. Roadway Description

41 1. Number of Lanes in Both Directions
42 2. Speed Limit (see I.P.)
43 3. Cardinal Direction (see I.R.)

Continuation of Roadway Description

44-45 1. Highway System (see FHWA Truck-Weight Study Manual)
2. Road character
46 a) Grade
Level 1
On grade 2
On hill crest 3
Not stated 4
47 b) Alignment
Tangent section 1
Curve 2
Not stated 3

Column	Item	Code
48	c) Other	
	Intersection	1
	Alley or driveway	2
	Railroad	3
	Other or not stated	4
49	3. Surface condition	
	Dry	1
	Wet	2
	Snowy or icy	3
	Other or not stated	4
50	4. Light condition	
	Daylight	1
	Dawn or dusk	2
	Darkness	3
	Not stated	4
	5. Traffic control	
51-52	a) Type	
	Stop sign	01
	Stop and go signal	02
	Officer or watchman	03
	Railroad gates or signals	04
	Yield sign	05
	Flash beacon	06
	Center line	07
	No passing zone	08
	Curve sign	09
	Speed zone	10
	Advisory speed sign	11
	Other	12
53	b) Functioning or sign still up	
	Yes	1
	No	2
54	6. Defects	
	Defective shoulder	1
	Holes, deep ruts, bumps	2
	Loose materials on surface	3
	Road under construction	4
	Specify other	5
	No defects	6
	Not stated	7
55	C. Weather	
	Clear-Mild	1
	Windy	2
	Snow	3
	Rain	4
	D. Accident	
56	1. Type	
	Pedestrian	0
	Other motor vehicle	1
	Railroad train	2
	Animal-drawn vehicle	3
	Bicycle	4
	Animal	5
	Fixed object	6
	Overturned in roadway	7
	Ran off roadway	8
	Other non-collision	9
57	2. Severity	
	Fatal accident	0
	Non-fatal (injury)	1
	Property damage only	3
58-59	E. Number of Vehicles Involved	
60-61	F. Number of Pedestrians Involved	
62-63	G. Number of Injuries	
64-65	H. Number of Fatalities	
66-67	I. Directional Analysis	
	1. Pedestrian accidents	
	Car going straight	01
	Car turning right	02
	Car turning left	03
	Car backing	04
	All others	05
	Not stated	06
	2. Intersection (two vehicles)	
	Entering at angle	07
	From same direction:	
	both going straight	08
	one turning, one straight	09
	one stopped	10
	other	11
	From opposite directions:	
	both going straight	12
	one turning left, one straight	13
	all others	14
	not stated	15

3. Non-Intersection (two vehicles)

	Going opposite direction - both moving	16
	Going same direction - both moving	17
	One car parked	18
	One car stopped in traffic stream	19
	One car entering parked position	20
	One car leaving parked position	21
	One car entering alley or driveway	22
	One car leaving alley or driveway	23
	All others	24
	Not stated	25

4. All other accidents

	Collision with non-motor vehicle, train, streetcar, bicycle, etc. at intersection	26
	Collision with fixed object in roadway at intersection	27
	Overturned in roadway at intersection	28
	Left roadway at intersection	29
	Same as 26 -- not at intersection	30
	Same as 27 -- not at intersection	31
	Overturned in roadway not at intersection	32
	Left roadway at curve -- not at intersection	33
	Left roadway on straight curve -- not at intersection	34
	Fell from moving vehicle	35
	All others	36
	Not stated	37

J. Pedestrian

68-69	1. Action	
	Crossing or entering at an intersection	01
	Crossing or entering, not at an intersection	02
	Getting on or off vehicle	03
	Walking with traffic	04
	Walking against traffic	05
	Standing	06
	Push, working on vehicle	07
	Other working	08
	Playing	09
	Other	10
	Not in roadway	11
	Not stated	12
70	2. Violation	
	Arrested	0
	Public drunkenness	1
71-72	3. Age	
73	4. Sex	
	Male	1
	Female	2
74	5. Injury	
	K - Death	1
	A - Bleeding wound, distorted member, or had to be carried from scene	2
	B - Other visible injury such as bruises, abrasions, swelling, limping, etc.	3
	C - No visible injury, but complaint of pain	4
75-79	K. Case Number	
80	L. End of Card or First Record	
	End of set	0
	More of set follows	1

New Record Continuation

1-2	A. Card Code indicates the number of the vehicle involved. Goes to total number of vehicles involved: 01 to XX (00 indicates additional information for preceeding vehicle card)	
3-4	B. Vehicle Type	
	Passenger	01
	Passenger car and trailer	02
	Truck or truck-trailer	03
	Truck tractor and semi-trailer	04
	Other truck combinations	05

	Farm tractor and(or) farm equipment	06
	Taxicab	07
	Bus	08
	Motorcycle	10
	Motor-scooter or motor-bike	11
	Other and not stated	12
	Emergency vehicle (including privately owned)	13
	Military vehicle	14
	Other publicly owned vehicle	15
	Go cart	16
	Bicycle	17
	C. Vehicle License	
5-6	1. State	
7-15	2. Number	
16	D. Vehicle Defects	
	Brakes	0
	Lights	1
	Steering	2
	Tires	3
	Puncture or blow out	4
	No trailer brakes	5
	None	6
	Not started	7
17-18	E. Vehicle Maneuver	
	Straight ahead	01
	Overtake	02
	Make right turn	03
	Make left turn	04
	Make U turn	05
	Slow or stop	06
	Start in traffic lane	07
	Start from park	08
	Back up	09
	Remain parked	11
	Other	12
	Not stated	13
	Car in motion (driverless)	14
19	F. Direction of Movement	
	North on North-South highways (odd numbered)	1
	South on North South highways (odd numbered)	2
	East on East-West highways (even numbered)	3
	West on East-West highways (even numbered)	4
	G. Driver	
20-21	1. Age	
22	2. Sex (see IV.J.4.)	
23	3. Residency	
	Out of state	0
	In state	1
24-25 and 26-27	4. Violation (can be two violations)	
	Speeding	01
	Under influence	
	Ability impaired	02
	Not impaired	22
	Passing on hill	03
	Ran stop sign	04
	Other improper passing	05
	Passing on curve	06
	On wrong side of road	07
	Following too closely	08
	Failure to yield right of way	09
	Inattentive	10
	Failure to signal	11
	Other - Public Drunk	12
	No operator's license	13
	Not stated	14
	Hit and run	15
	Racing	16
	Reckless driving	17
28	5. Citation	
	No	0
	Yes	1
29	6. Safety belt	
	No	0
	Yes	1
30	7. Injury (see IV.J.5.)	
31-32	8. State issuing license (see III.I. Loadometer Coding Scheme)	
	H. Occupants (if injured)	
33-34	1. Seating position	
35-36	2. Age	
37	3. Sex (see IV.J.4.)	
38	4. Safety belt (see IV.G.6. (continuation))	
39	5. Injury (see IV.J.5.)	
40-74	6. Repeat Items 1-5 for each occupant injured (Repeat up to five times. If more than five are needed, use additional record.)	

75-77 Blank

I. Police Involvement

78 1. Investigated

No	0
Yes	1

79 2. Investigating authority

Kentucky State Police	0
City Police (metro)	1
Sheriff's Office	2
County Police	3

80 J. Continuation

End of record set	0
Record set continues (complete*)	1
Record set continues (partial**)	2

*Next record for other vehicle(s)

**Continues information for vehicle of preceding record

V. ORIGIN-DESTINATION CODING SCHEME

1-48 A. General Coding (see I. General Coding Scheme)

49-50 B. Vehicle Type (see III.B.1.)

51-52 C. Number of Vehicle Occupants

53-54 D. Trip Purpose

Work	01
Personal business	02
School	03
Social	04
Recreational	05
Shopping	06

55-66 E. Origin-Destination (see I.J.)

Urban	1
Rural	0

F. Intermediate Stop

67-70 1. City (see III.I Loadometer Coding Scheme)

71-79 2. Street -- name or abbreviation

80-83 3. Number

84-85 4. Purpose (see V.D. Trip Purpose)

86-89 G. Route of Entry
Four-digit route number (see I.H.2. General Coding Scheme)

90-95 H. Commodity (see III.H. Loadometer Coding Scheme)

96-98 Blank

99-104 I. File Date (see II.D. Classification Coding Scheme)

105 J. Continuation (see II.E. Classification Coding Scheme)

VI. VOLUME CODING SCHEME

1-48 A. General Coding (see I. General Coding Scheme)

49 B. Count Type

ATR	1
Temporary	2
Other	3

50-121 C. Volumes for Each Hour (24 fields three columns wide)

122-127 D. Actual Count (total)

128-132 E. ADT

133-138 F. File Date (see II.D. Classification Coding Scheme)

139 Blank

140 G. Continuation (see II.E. Classification Coding Scheme)

VII. SPEEDS CODING SCHEME

1-48 A. General Coding (see I. General Coding Scheme)

49-50 B. Vehicle Type (See III.B. Loadometer Coding Scheme)

51-164	C.	Number of Vehicles at Each Speed (3 fields two columns wide and 36 fields three columns wide)
165-167		Blank
168-173	D.	File Date (see II.D. Classification Coding Scheme)
174		Blank
175	E.	Continuation (see II.E. Classification Coding Scheme)

VIII. TURNING MOVEMENTS CODING SCHEME

1-48	A.	General Coding (see I. General Coding Scheme)
	B.	Route Numbers at Intersection (see I.H. General Coding Scheme)
49-54		1. North-South route type and number.
55-60		2. East-West route type and number
61-108	C.	Vehicles making each maneuver from each approach (12 fields four columns wide) (see Figure 14)
109		Blank
110-114	D.	File Date (see II.D. Classification Coding Scheme)
115	E.	Continuation (see II.E. Classification Coding Scheme)

APPENDIX B

THE STOLVAC MILEPOINT REFERENCE SYSTEM

THE STOLVAC MILEPOINT REFERENCE SYSTEM

The foundation of any data acquisition and analysis program is the method by which data collection sites are referenced along the highway network. Varying reference schemes based on point locations and networks involving links and nodes are used by many states and within the Kentucky Bureau of Highways. These general categories of schemes in turn have numerous variations. For example, point locations might be based on reference points or a scheme which arbitrarily assigns station numbers to locations. The tendency is for highway organizations to standardize referencing systems because it simplifies inter-office transactions involving collection and retrieval. It is essential to have a standard scheme if the computer is used to process and analyze data.

Many referencing schemes are based on the concept of reference points. According to the Federal Highway Administration, other methods have not yet proven to be as operable *(10)*. There are two distinct categories of reference point systems, one being office oriented and the other field oriented. Office-oriented systems require the use of strip maps, straight line diagrams, maps with street names and addresses, and printed logs to show landmarks along the roadway as reference points.

The field-oriented systems are divided into two classes, both having signs and posts installed along the highway network. These signs indicate mileage from a base point in one type, while in the second method unique numbers (not necessarily reflecting mileage) identify reference points. Reference point systems are amenable to use with computer data systems, as are mileposting systems.

The location scheme adopted for STOLVAC must be compatible with identifications used throughout the Bureau. There is presently an attempt to develop a standard scheme to replace a number of different systems presently used within the Bureau. At this time, a system has been proposed but has not be established. The Traffic Section of the Division of Planning uses a method of assigning unique station numbers to data collection sites. Some stations are numbered sequentially while others according to the quandrant of the county in which they lie. Also in the Division of Planning, work on the statewide traffic model uses a technique involving a network of links and nodes. The Division of Traffic uses a milepost system, basically a reference point system that involves the accumulation of mileage from a base point, which is usually a county line or state border.

When the new Bureau-wide referencing scheme is adopted, it should be used with STOLVAC. Until such a scheme is available, a temporary scheme must be used. The Division of Traffic's milepost system, with some minor modifications, should surely suffice as an interim scheme until one is completely developed. It will involve the determination of a base point from which mileage is accumulated and will be referred to as the milepoint reference. The scheme is office oriented because locations will be selected from maps. This base point will be one of the following:

1. where the southern or western extremity of the highway crosses a county line,
2. where the road crosses a state line to the south or west, or
3. the southern or western terminus of the highway if it does not cross a state or county line west and south of the survey station in that county.

Some other identifying information will be used in conjunction with the reference system, and if the Traffic Inventory is to be functional, a station location file containing this additional information would be useful. Such a file would be very helpful in updating the system in the future. This file will be formated as in Figure BI and be coded as follows:

RECORD COLUMN	ITEM
1	File Identification (always coded R)
2-4	1) County (see APPENDIX A.I., General Coding Scheme)
5-7	2) Station Number (old number)
8-9	3) Additional Station Number (if four-lane divided facility)
10-12	4) Milepoint Reference
13-18	5) Highway Type and Number (see APPENDIX A.I., General Coding Scheme)
19-22	6) Milepoint
23-26	7) City (See APPENDIX A.I., General Coding Scheme)
27-30	8) Street Intersection Index (see APPENDIX A.I., General Coding Scheme)
	9) Highway Description
31	a) Number of Lanes
32	b) Maximum Allowable Gross Weight (see APPENDIX A.I., General Coding Scheme)
33	c) Speed Limit (see APPENDIX A.I., General Coding Scheme)
34	d) Cardinal Direction (see APPENDIX A.I., General Coding Scheme)
35-80	Verbal Description

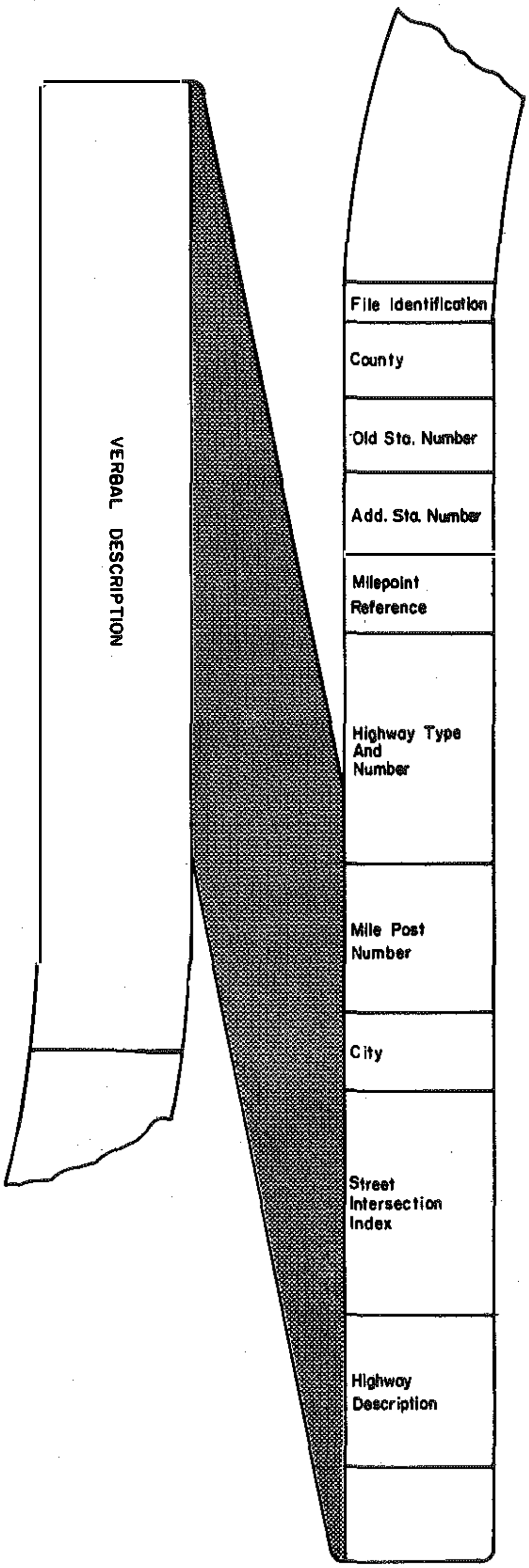


Figure B1. Reference File Format.