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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,

A handwritten signature in cursive script, reading "Jas. H. Havens".

Jas. H. Havens
Director of Research

JHH:gd
Attachment
CC's: Research Committee

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16. Abstract <p>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.</p>					
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Research Report
373

STOLVAC: A TRAFFIC DATA SYSTEM

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

by

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The contents of this report reflect the views of the author who is responsible for the facts and the accuracy of the data presented herein. The contents do not reflect the official views or policies of the Kentucky Bureau of Highways. This report does not constitute a standard, specification, or regulation.

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.

Key																			
Control Elements												Location				Highway Description			
Date		Date				Time		Highway		Site				Number of Lanes	Max. All Gross Weight	Speed Limit	Direction		
Source	Validity	Year	Month	Day		Begin Count	End Count	Type	Number	County	City	Street Index	Milepoint Reference				Plus Distance	Lane Number	Cardinal
Division	Study Type			Checked	Changes			of Month						of Week	Holiday or Non Holiday	Urban or Rural			

Figure 1. Format of Control Elements Data.

Control Key																											
Highway I.D.										Count Station	Shift	Federal System	Count Date			Wisconsin Cars		Other Cars									
Delete Code	County Code	Type	Highway Number	Direction	RP Number	RP Plus Distance	Season	Traffic Direction	Count Hour				Month	Day of Month	Year	Standard	Small	Standard	Small								
Standard	Small	2 Axle	3 Axle	School	2 Axle Pickup	2 Axle Single	2 Axle Dual	3 Axle Single	4 Axle	2S1	2S2	3S1	3S2	2S3	3S3	4S2	4S3	4S4									
														2-1	2-2	3-1	2-3	3-2	3-3	4-2	3-4	Year	Month	Day	Year	Month	Day
Cycles		Buses		Single Unit Trucks			Tractor Semi-Trailers		Truck Trailers				Maintenance Date		History Date												
Filter																											

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 similarly 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 POWAN
 ROUTE NO. I-64

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

STATION NUMBER L-38
 DATE 1-12-15-71
 DAY Wed-Thur-Fri

VEHICLES MOVING TOWARD <u>Quincy Hill, Ky. (East) 5</u>														VEHICLES MOVING TOWARD <u>Morehead, Ky. (West) 7</u>																							
PASSENGER CARS AND ALL TRUCKS AND BUSES														PASSENGER CARS AND ALL TRUCKS AND BUSES																							
TIME PERIOD	PASSENGER CARS		LESS THAN 1/2 TONS	2 AXLE DUAL TIRES	3 AXLE	TRACTOR TRUCK & SEMI TRAILOR				BUSSES		TOTAL VEHICLES			LOCAL	FOREIGN	LESS THAN 1/2 TONS	2 AXLE DUAL TIRES	3 AXLE	TRACTOR TRUCK & SEMI TRAILOR				TOTAL VEHICLES		TOTAL ALL VEHICLES											
	LOCAL	FOREIGN				3 AXLE	4 AXLE	4 1/2 AXLE	SCHOOL	OTHER	PASS.	COML.	TOTAL	3 AXLE						4 AXLE	4 1/2 AXLE	SCHOOL	OTHER	PASS.	COML.	TOTAL	PASS.	COML.	TOTAL								
600-700 AM	17	1	4	2	-	-	-	-	-	-	-	18	6	24	16	1	8	1	-	-	-	-	17	9	26	33	15	50									
700-800	17	-	6	5	-	-	-	2	-	-	-	17	13	30	35	-	10	1	-	-	-	1	-	-	35	12	47	52	25	77							
800-900	31	1	10	11	1	-	-	3	1	-	-	32	26	58	58	2	10	9	1	-	-	1	-	-	60	21	81	92	47	139							
900-1000	36	3	16	10	-	-	-	1	-	-	-	39	23	64	35	-	16	11	-	-	-	1	-	-	53	28	61	72	33	125							
1000-1100	32	7	17	8	-	-	-	-	-	-	-	42	23	67	43	1	20	8	-	-	1	-	-	44	30	74	84	53	141								
1100-1200	36	4	16	13	-	-	-	-	-	-	-	40	29	69	35	1	13	8	-	-	1	-	-	36	24	60	70	33	129								
1200-100 PM	40	2	11	4	-	-	-	-	-	-	1	50	14	64	34	-	10	6	-	-	1	-	-	34	17	51	64	33	117								
100-200	44	5	12	7	-	-	-	-	-	-	-	49	19	68	36	-	8	5	-	-	-	-	-	36	13	49	65	32	117								
200-300	48	12	8	4	1	-	-	4	8	-	-	60	25	85	34	16	14	4	2	-	-	4	12	-	50	36	86	110	61	171							
300-400	50	27	7	7	1	-	-	1	8	-	-	63	24	107	34	21	9	1	-	-	-	4	12	-	53	26	81	138	50	188							
400-500	51	20	10	5	-	-	-	1	2	6	1	71	26	97	46	19	7	3	-	-	-	2	1	10	-	63	23	88	136	49	185						
500-600	59	13	9	3	-	-	-	2	3	10	-	52	27	79	64	7	4	-	-	-	-	1	8	-	71	14	85	123	41	164							
600-700	42	4	1	1	-	-	-	3	6	-	-	46	11	57	44	15	2	4	-	-	-	2	6	-	59	14	73	102	25	130							
700-800	35	6	3	2	-	-	-	1	10	-	-	41	17	58	30	10	1	2	-	-	-	3	5	-	40	11	51	81	28	109							
800-900	26	4	-	2	-	-	-	5	3	-	-	30	8	38	29	11	-	3	-	-	-	3	9	-	40	16	56	70	24	94							
900-1000	19	7	1	1	-	-	-	2	8	-	-	26	14	40	25	4	-	1	-	-	-	2	3	4	-	29	10	39	55	21	79						
1000-1100	13	4	1	2	-	-	-	1	3	-	-	17	7	24	16	4	-	2	-	-	-	2	3	11	-	20	18	38	37	25	62						
1100-1200	10	10	1	1	-	-	-	1	2	12	-	20	17	37	14	2	-	2	-	-	-	2	6	-	16	10	26	36	27	63							
1200-100 AM	9	6	-	-	-	-	-	1	6	-	-	13	7	22	10	4	1	1	-	-	-	3	10	-	14	16	30	29	23	52							
100-200	7	3	-	-	-	-	-	1	6	-	-	10	9	19	6	6	-	-	-	-	-	1	3	-	12	4	16	22	13	35							
200-300	4	6	-	1	-	-	-	2	3	10	-	10	16	26	2	7	-	1	-	-	-	2	3	6	-	9	12	21	12	28	47						
300-400	2	3	-	-	-	-	-	2	4	-	-	5	6	11	9	2	-	-	-	-	-	1	2	10	-	5	13	18	10	19	29						
400-500	4	2	3	2	-	-	-	1	6	-	-	6	12	18	1	1	-	2	-	-	-	1	3	-	2	8	10	8	20	28							
500-600	5	4	1	2	3	-	-	3	4	-	-	7	13	20	11	2	4	1	3	1	-	2	6	-	15	17	30	20	30	50							
TOTAL	632	154	135	93	6	9	35	118	2	-	-	766	398	1164	659	136	139	76	7	14	39	12	-	795	402	1197	1381	800	2381								
TOTAL	632	154	135	93	6	9	35	118	2	-	-	766	398	1164	659	136	139	76	7	14	33	18	2	2	786	398	1184	526	2381	27.09% T							
TOTAL	1291	290	274	169	13	23	72	26	2	-	-	1581	800	2381	1975	326	375	162	14	28	52	26	2	2	1581	800	2381	1975	326	375	162	14	28	52	26	2	2

Figure 3. Sample Classification Form.

Automobiles						Cycles	Pickups		
Local (Kentucky)			Foreign (out of state)			Total	with trailer	without trailer	with trailer
Total Local	Standard Size	Small Size	Total Foreign	Standard Size	Small Size				

Trucks										
Single unit					Combinations					
2 Axle		3 Axle		Total	3 Axle		4 Axle			Total
3/2 ton	Dual fire				2 S1	2-1	2 S2	3 S1	2-2	

Trucks															
Combinations															
5 Axle			6 Axle				7 Axle			8 Axle					
2 S3	3 S2	2-3	3-2	Total	3 S3	4 S2	3-3	4-2	Total	3 S4	4 S3	3-4	4-3	Total	4-4

School (nonrevenue)	Buses		Total Volume	File Date			Continuation Code
	Commercial			Year	Month	Day	
	2 Axle	3 Axle	Total				

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 formatted 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.

Vehicle			Axle Weights								Height	Width	
Type	L or E	Body type	A	B	C	D	E	F	G	H	Total		

Axle Spacing							Wheel Base	Commodity	Origin		Destination		File Date			Continuation Code
A-B	B-C	C-D	D-E	E-F	F-G	G-H			State	County	State	County	Year	Month	Day	

Figure 6. Loadometer File Format.

Delete Code	Control Key							County Location	Count Type	Average Daily Traffic	Data Year	Maintenance Date			To Date			Filler
	Highway ID			RP		Dist.	Year					Month	Day	Year	Month	Day		
	County	Type	Highway Number	Direction	Number	Letter											Miles	

Figure 7. HNDI Traffic Counts File.

Hourly Volumes (Ten vehicles per hour)													
Count Type	1	2	3	4	5	6	7	8	9	10	11	12	13
Hourly Volumes (Ten vehicles per hour)													Actual Count
14	15	16	17	18	19	20	21	22	23	24			
ADT	File Date			Continuation Code									
	Year	Month	Day										

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 formatted 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 formatted 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 supposedly 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.

COMMONWEALTH OF KENTUCKY
DEPARTMENT OF HIGHWAYS

HD 72-3
Rev. 11-65

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			SPEED	TRUCKS	BUSES	CUMULATIVE	
	TOT.	TOTAL	PERCENT				TOTAL	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.

Vehicle		Speeds (miles per hour)												
Type	<10	10	15	20								30		

Speeds (miles per hour)														
40				50				60						

Speeds (miles per hour)														
70				80		85	90	95	100	>100				

File Date			Continuation Code
Year	Month	Day	

Figure 10. Speed File Format.

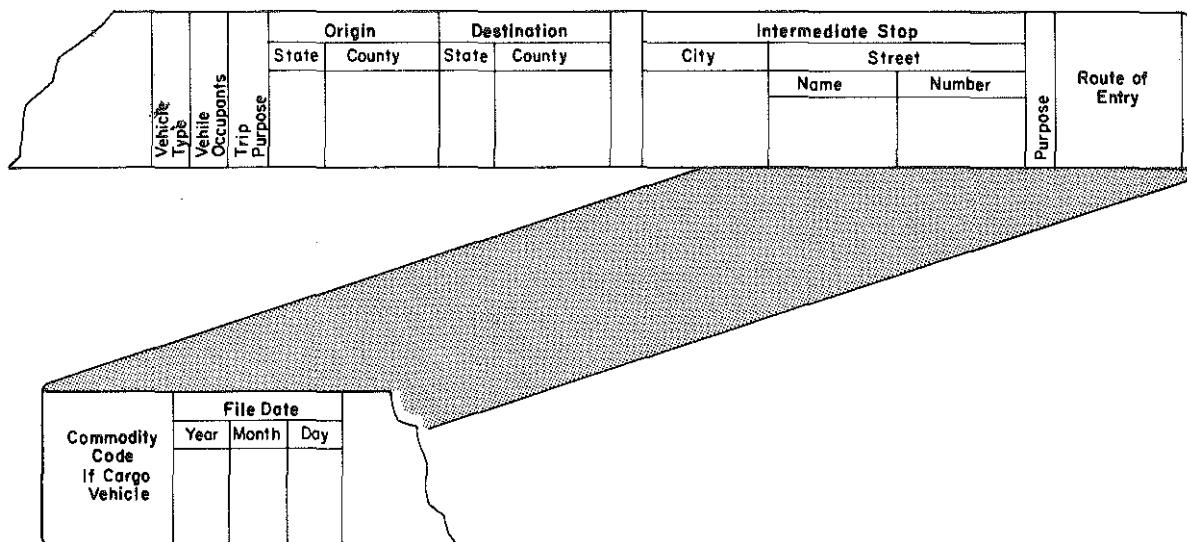


Figure 12. Origin-Destination File Format.

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 maneuvers 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 formatted 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			

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 existence 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, additionally, 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 formatting 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.

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APPENDIX A
CODING INSTRUCTIONS

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

19	b) Class of facility		Breathitt	013
	Interstate	1	Breckinridge	014
	Toll road	2	Bullitt	015
	US numbered	3	Butler	016
	KY numbered	4	Caldwell	017
	Other	5	Calloway	018
20-23	2. Route number		Campbell	019
	a) Alternate and east or west routes need special consideration:		Carlisle	020
	US 25 E	2025	Carroll	021
	US 25 W	4025	Carter	022
	US 31 E	2031	Casey	023
	US 31 W	4031	Christian	024
	US 41 Alternate	5041	Clark	025
	b) Interstates:		Clay	026
	I 24	9024	Clinton	027
	I 64	9064	Crittenden	028
	I 65	9065	Cumberland	029
	I 71	9071	Daviess	030
	I 75	9075	Edmonson	031
	I 264	9264	Elliot	032
	I 275	9275	Estill	033
	I 471	9471	Fayette	034
	c) Toll roads:		Fleming	035
	Kentucky Turnpike	0000	Floyd	036
	Mountain Parkway	9000	Franklin	037
	Western Kentucky Parkway	9001	Fulton	038
	Bluegrass Parkway	9002	Gallatin	039
	Pennyrile Parkway	9003	Garrard	040
	Jackson Purchase Parkway	9004	Grant	041
	Cumberland Parkway	9005	Graves	042
	Green River Parkway	9006	Grayson	043
	Daniel Boone Parkway	9007	Green	044
	Audubon Parkway	9008	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
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		

Letcher	067	27-30	J.	City(see IBM Manual of Numerical Codes for States, Counties, and Cities)	
Lewis	068				
Lincoln	069				
Livingston	070	31-34	K.	Street Intersection Index Number	
Logan	071				
Lyon	072	35-37	L.	Milepoint Reference	
McCracken	073			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:	
McCreary	074				
McLean	075				
Madison	076				
Magoffin	077				
Marion	078				
Marshall	079				
Martin	080			Tennessee	200
Mason	081			Missouri	300
Meade	082			Illinois	400
Menifee	083			Indiana	500
Mercer	084			Ohio	600
Metcalfe	085			West Virginia	700
Monroe	086			I 71 or Toll Road	
Montgomery	087			Terminus	900
Morgan	088			Highway Terminus within the	
Muhlenburg	089			County	000
Nelson	090				
Nicholas	091	38-42	M.	Milepoint (tenths of a mile)	
Ohio	092				
Oldham	093	43	N.	Number of Lanes in Both Directions	
Owen	094				
Owsley	095	44	O.	Maximum Allowable Gross Weight	
Pendleton	096			73,280 pounds	1
Perry	097			62,000 pounds	2
Pike	098			44,000 pounds	3
Powell	099			30,000 pounds	4
Pulaski	100			Other	5
Robertson	101				
Rockcastle	102	45	P.	Speed Limit	
Rowan	103			70 mph	1
Russell	104			60 mph	2
Scott	105			55 mph	3
Shelby	106			50 mph	4
Simpson	107			45 mph	5
Spencer	108			40 mph	6
Taylor	109			35 mph	7
Todd	110			30 mph	8
Trigg	111			25 mph	9
Tremble	112			< 25 mph	0
Union	113				
Warren	114				
Washington	115				
Wayne	116				
Webster	117				
Whitley	118				
Wolfe	119				
Woodford	120				

46	Q. Lane Number		49-50	B. Vehicle	
	Lane of the traffic stream sampled			1. Type	
	Count includes all lanes going in same direction	0		Automobiles pulling trailers	00
	Shoulder lane is 1 and the number increases by one for each lane to the median lane	1, 2, 3, 4		All automobiles	01
	Exit ramp	5		Local automobiles	02
	Entrance ramp	6		Foreign automobiles	03
	Count includes all traffic regardless of lane and direction	9		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
47	R. Cardinal Direction			All single-unit trucks (SU)	11
	North-South highway	1		2-Axle, 4-tired single unit trucks (SU2A4T)	12
	East-West highway	2		2-Axle, 6-tired single unit trucks (SU2A6T)	13
48	S. Direction of Traffic Flow			3-Axle single unit trucks (SU3A)	14
	Both directions	0		4-Axle single unit trucks (SU4A)	15
	From 0.00 terminus	1		All semi-trailer trucks	20
	Toward 0.00 terminus	2		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
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)				

	3-Axle commercial buses	43	135
	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	16-17
	Loaded	1	18-21
52	3. Body type (see FHWA Truck-Weight Study Manual, Highway Planning Program Manual, Appendix 51)		22-24 25-28 29-32
53-76	C. Axle Weights in 1000 pounds (8 fields three columns wide)		33-35 36-40
77-80	D. Total Weight (1000 pounds)		41
81-86	E. Height and Width (2 fields three columns wide) (tenths of a foot)		42 43
87-107	F. Axle Spacings (7 fields three columns wide) (tenths of a foot)		44-45
108-111	G. Wheel Base (tenths of a foot)		46
112-116	H. Commodity (see FHWA Truck Weight Study Manual)		
117-128	I. Origin-Destination		
	1. State (see FHWA Truck-Weight Study Manual)		47
	2. County (see IBM Manual Numerical Code for States, Counties and Cities)		
129-134	J. File Date (see II.D. Classification Coding Scheme)		

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

IV. ACCIDENT RECORD CODING SCHEME

A. General Coding

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

B. Roadway Description

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

Continuation of Roadway Description

1. Highway System (see FHWA Truck-Weight Study Manual)
2. Road character
 - a) Grade

Level	1
On grade	2
On hill crest	3
Not stated	4
 - b) Alignment

Tangent section	1
Curve	2
Not stated	3

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

3.	Non-Intersection (two vehicles)			Crossing or entering, not at an intersection	02
	Going opposite direction			Getting on or off vehicle	03
	- both moving	16		Walking with traffic	04
	Going same direction			Walking against traffic	05
	- both moving	17		Standing	06
	One car parked	18		Push, working on vehicle	07
	One car stopped in traffic stream	19		Other working	08
	One car entering parked position	20		Playing	09
	One car leaving parked position	21		Other	10
	One car entering alley or driveway	22		Not in roadway	11
	One car leaving alley or driveway	23	70	Not stated	12
	All others	24		2. Violation	
	Not stated	25		Arrested	0
4.	All other accidents	71-72		Public drunkenness	1
	Collision with non-motor vehicle, train, streetcar, bicycle, etc. at intersection	73		3. Age	
	Collision with fixed object in roadway at intersection	26	74	4. Sex	
	Overturned in roadway at intersection	27		Male	1
	Left roadway at intersection	28		Female	2
	Same as 26 -- not at intersection	29		5. Injury	
	Same as 27 -- not at intersection	30		K - Death	1
	Overturned in roadway not at intersection	31	75-79	A - Bleeding wound, distorted member, or had to be carried from scene	2
	Left roadway at curve -- not at intersection	32		B - Other visible injury such as bruises, abrasions, swelling, limping, etc.	3
	Left roadway on straight curve -- not at intersection	33		C - No visible injury, but complaint of pain	4
	Fell from moving vehicle	34	80	K. Case Number	
	All others	35		L. End of Card or First Record	
	Not stated	36		End of set	0
		37	3-4	More of set follows	1
				New Record Continuation	
				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 preceding vehicle card)	
				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
68-69	J. Pedestrian				
	1. Action				
	Crossing or entering at an intersection	01			

	Farm tractor and(or) farm equipment	06	20-21				
	Taxicab	07	22				
	Bus	08	23				
	Motorcycle	10					
	Motor-scooter or motor-bike	11	24-25				
	Other and not stated	12	and				
	Emergency vehicle (including privately owned)	13	26-27				
	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	28				
	Not started	7					
17-18	E. Vehicle Maneuver		29				
	Straight ahead	01					
	Overtake	02					
	Make right turn	03	30				
	Make left turn	04	31-32				
	Make U turn	05					
	Slow or stop	06					
	Start in traffic lane	07					
	Start from park	08					
	Back up	09	33-34				
	Remain parked	11	35-36				
	Other	12	37				
	Not stated	13	38				
	Car in motion (driverless)	14					
19	F. Direction of Movement		39				
	North on North-South highways (odd numbered)	1	40-74				
	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						
	1. Age						
	2. Sex (see IV.J.4.)						
	3. Residency						
	Out of state	0					
	In state	1					
	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					
	5. Citation						
	No	0					
	Yes	1					
	6. Safety belt						
	No	0					
	Yes	1					
	7. Injury (see IV.J.5.)						
	8. State issuing license (see III.I. Loadometer Coding Scheme)						
	H. Occupants (if injured)						
	1. Seating position						
	2. Age						
	3. Sex (see IV.J.4.)						
	4. Safety belt (see IV.G.6. (continuation))						
	5. Injury (see IV.J.5.)						
	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)	49-54	B.	Route Numbers at Intersection (see I.H. General Coding Scheme)
			55-60	1.	North-South route type and number.
				2.	East-West route type and number
165-167		Blank	61-108	C.	Vehicles making each maneuver from each approach (12 fields four columns wide) (see Figure 14)
168-173	D.	File Date (see II.D. Classification Coding Scheme)	109		Blank
174		Blank	110-114	D.	File Date (see II.D. Classification Coding Scheme)
175	E.	Continuation (see II.E. Classification Coding Scheme)	115	E.	Continuation (see II.E. Classification Coding Scheme)

VIII. TURNING MOVEMENTS CODING SCHEME

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

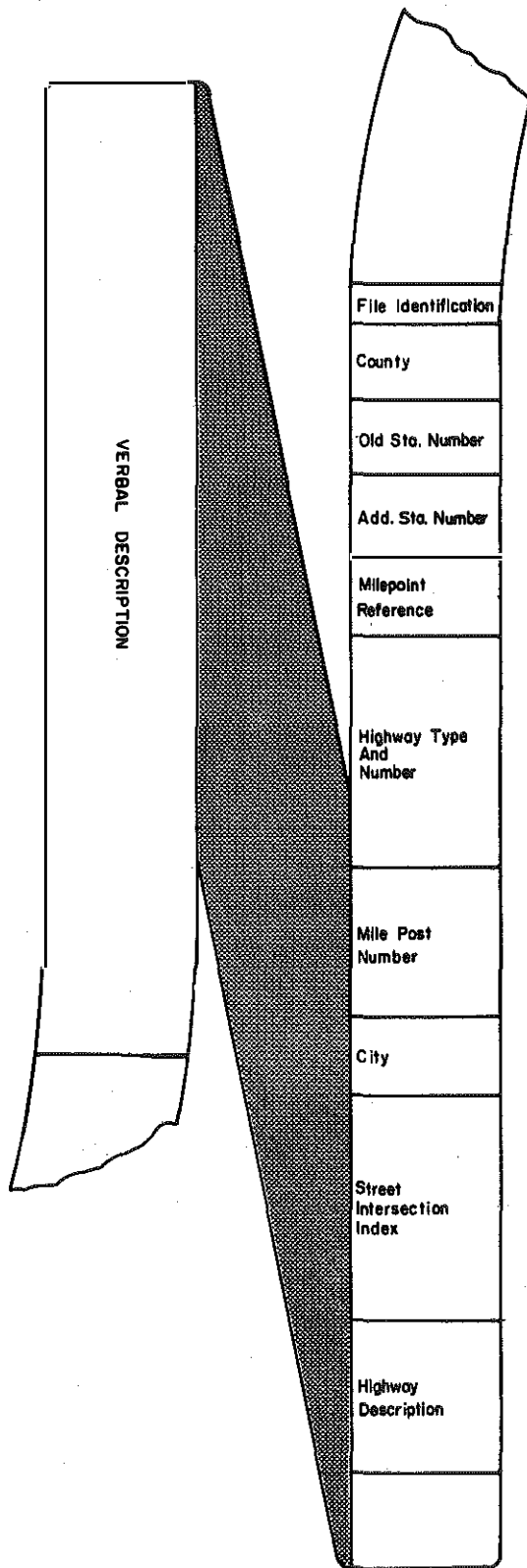


Figure B1. Reference File Format.