Running PCAPAV

Boot your system. Insert the PCAPAV disk into drive A:, and type:

PCAPAV

(Note: Starting PCAPAV from a fixed-disk system is done by setting the default drive to C:. At the C> prompt, type PCAPAV.)

PCAPAV is loaded into memory and screen page 1 looks like:

```
14:05:23                    PCAPAV(TM) 1.10                          Page 1
02-06-86   Proprietary Software of PORTLAND CEMENT ASSOCIATION
                          Pavement Design
                      PPPPP      ccccc      aaaaa
                      P    P     c     c    a    a
                      P    P     c     c         a
                      P    P     c          aaaaa
                      PPPPP      c     c    a    a
                      P          c     c    a    a
                      P          ccccc     aaaaa
            (C) Copyright Portland Cement Association 1985
                          All Rights Reserved
    This program is to be used as a design aid by experienced qualified
    ENGINEERS.   This program is not intended for use as a final design
    or a substitute for  sound  engineering  judgement.   The purchaser
    assumes all responsibilty for the use of this program in connection
    with any project.

  Input File: PAVEMENT.EX1              Output File: PAVEMENT.EX1
  Project ID. example 1
  Engineer:   Everyman, USA
  Solution Options: Normal

  Esc-QUIT F8-Print Data F9-Save F10-compute   move cursor  PgDn-Next Page
```

Fig. 1 shows the input format that will appear on the screen. The input items (menu items) are listed in the order that input data is entered.

```
14:07:47                    PCAPAV(TM) 1.10                          Page 2
02-06-86    Proprietary Software of PORTLAND CEMENT ASSOCIATION
                        Pavement  Design  Data
Modulus of Subg/Subb K  150.0 PCI       Axle Load Cat.  1.Light
Modulus of Rupture  MR  600.0 PSI                       2.Medium
                                                        3.Heavy
A D T T  290.00                                         4.Very Heavy
                                                        5.Input Axles
Design Life  20 Years

Load Transfer
  At Joint        1.Dowel
                  2.Agg. Interlock

  At Shoulder     1.Conc. Shoulder
                  2.No Conc. Shoulder

 Load Safety Factor    1. 1.0
                       2. 1.1
                       3. 1.2

 Estimated Pavement Thickness 7.0  IN

  Esc-QUIT F8-Print Data F9-Save F10-compute   move cursor  PgDn-Next Page
```

Fig. 1 - Input Format

Identification Screen

Input File

Data already stored in the file may be recalled onto the input screen for running a design problem. The data at this point may be altered if desired before executing the problem without changing the data on file. The disk is issued with six design examples which may be recalled or deleted as the user desires.

Output File

Input data may be stored in the file under the name typed into the output file by the user. The input data is stored in the file by typing the F9 SAVE key after the data has been entered onto the input screen.

Solution Options

The user may choose the normal mode or single thickness mode of operation by typing any character or using the space bar to select a design solution for either an optimum thickness or a desired trial thickness.

Average Daily Truck Traffic

The average daily truck traffic (ADTT) in both directions is selected as any number between 0.01 and 200,000. This includes only trucks with six tires or more and does not include panel and pickup trucks and other four-tire vehicles. For facilities of four lanes or more, the ADTT is adjusted by the use of Fig. 2.

Axle-Load Categories

Several axle-load data sets are stored in the computer program. These are shown in Table 1 (reproduced from Table 15 of Reference 1). The specific category is selected by the user when typing any character or using the space bar to select the desired axle-load category. In the case of Categories 1 through 4, no additional input is required on this menu item.

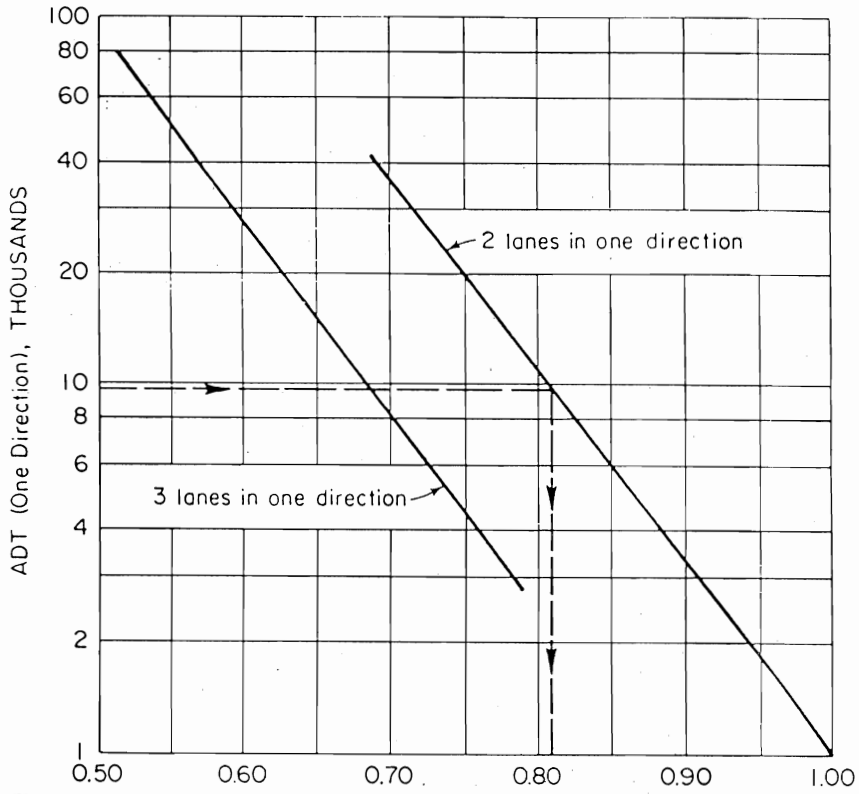

Fig. 2 - Proportion of Trucks in Right Lane of a Multilane Divided Highway

Axle-Load, kips	Axles per 1000 Trucks (excluding all two-axle, four-tire trucks)			
	Category 1	Category 2	Category 3	Category 4
Single Axles				
4	1693.31			
6	732.28			
8	483.10	233.60		
10	204.96	142.70		
12	124.00	116.76	182.02	
14	56.11	47.76	47.73	
16	38.02	23.88	31.82	57.07
18	15.81	16.61	25.15	68.27
20	4.23	6.63	16.33	41.82
22	0.96	2.60	7.85	9.69
24		1.60	5.21	4.16
26		0.07	1.78	3.52
28			0.85	1.78
30			0.45	0.63
32				0.54
34				0.19
Tandem Axles				
4	31.90			
8	85.59	47.01		
12	139.30	91.15		
16	75.02	59.25	99.34	
20	57.10	45.00	85.94	
24	39.18	30.74	72.54	71.16
28	68.48	44.43	121.22	95.79
32	69.59	54.76	103.63	109.54
36	4.19	38.79	56.25	78.19
40		7.76	21.31	20.31
44		1.16	8.01	3.52
48			2.91	3.03
52			1.19	1.79
56				1.07
60				0.57

Table 1 - Four Axle-Load Categories Stored in Program

If the user elects to input his own axle-load data, he selects Category 5 under Axle-Load Category. In this case, additional input data is required (refer to Fig. 3 for a description of the appropriate input). The user can input any value (integer only) to a maximum of 998 kips for the maximum single-axle load or 996 kips for the maximum tandem-axle load. For both single- and tandem-axle loads, the user inputs 10 values of the expected number of load repetitions expressed as axles per 1000 trucks starting with the maximum load, decremented by 2 kips for single axles and 4 kips for tandem axles. The number of load repetitions must be a number between 0.01 and 9999.99. The user may move the cursor up or down while in this category by using the cursor left [←] or cursor right [→] keys, respectively. (See, for example, Column 3 of Table 5 in Reference 1.)

```
 14:17:03                    PCAPAV(TM) 1.10                          Page 2
 02-06-86    Proprietary Software of PORTLAND CEMENT ASSOCIATION
                        Pavement  Design  Data
Modulus of Subg/Subb K  150.0 PCI        Axle Load Cat.  1.Light
Modulus of Rupture  MR  600.0 PSI                        2.Medium
                                                         3.Heavy
A D T T    0.25                                          4.Very Heavy
                                                         5.Input Axles
Design Life  20 Years                      Maximum Single axle load   22  KIPS
                                           Maximum Tandem axle load   36  KIPS
Load Transfer                                    A X L E   L O A D S
  At Joint        1.Dowel                  SAL     Axles     TAL     Axles
                  2.Agg. Interlock         KIPS    /1000     KIPS    /1000
                                             22      0.96      36      4.19
  At Shoulder     1.Conc. Shoulder           20      4.23      32     69.59
                  2.No Conc. Shoulder        18     15.81      28     68.48
                                             16     38.02      24     39.18
 Load Safety Factor   1. 1.0                 14     56.11      20     57.10
                      2. 1.1                 12    124.00      16     75.02
                      3. 1.2                 10    204.96      12    139.30
                                              8    483.10       8     85.59
 Estimated Pavement Thickness 5.5  IN         6    732.28       4     31.90
                                              4   1693.31       0      0.00
  Esc-QUIT F8-Print Data F9-Save F10-compute   move cursor  PgDn-Next Page
```

Fig. 3 - Example of Input Using Axle-Load Category 5 & User Data

Note: For the maximum axle loads, the program will not accept values less than 22 kips for single axles and 36 kips for tandem axles. If the user's values are not this high for "Axles per 1000 trucks," he can assign values of zero to the highest loads that are not wanted.

Load-Safety Factors

In the design manual[1], appropriate load-safety factors of 1.0, 1.1, 1.2, and 1.2, respectively, have been incorporated into design tables for axle-load categories 1, 2, 3, and 4. However, in the computer program, these values are not automatically assigned to axle-load categories. It is generally intended that the program user should input the appropriate value specified above depending on the axle-load category selected. Once the load safety factor item is selected for input, the user can choose the desired factor by typing any character or using the space bar to move the cursor down.

Load Transfer—At Joint and Shoulder

When the load transfer item has been selected, the user may select the type of load transfer provided at the joint. By typing any character or using the space bar, the cursor is moved down and the selection is made between a doweled joint or aggregate interlock (undoweled) joint. When the load transfer is selected, the carriage return key is pressed, giving the user the next choice of either a concrete shoulder (curb and gutter) or no concrete shoulder. This selection is made by moving the cursor down by typing any character or using the space bar. The carriage return key is then pressed to enter the shoulder type selected.

14:19:29 PCAPAV(TM) 1.10 Page 1
02-06-86 Proprietary Software of PORTLAND CEMENT ASSOCIATION

Project: example 3
Engineer: Everyman, USA
Input Data: Axle Load Category 2.Medium
Subgrade / Subbase K 150.0 PCI
Modulus of Rupture MR 600.0 PSI
Avg. Daily Truck Traffic (2 way) ADTT 2100.00
Design Life 20 years
Doweled Joints
No Concrete Shoulders
Load Safety Factor 1.1
Estimated Pavement Thickness 6.0 IN
Design Thickness =8.0 Inches

		Load Repetitions		---Fatigue Analysis-----			----Erosion Analysis---		
SAL	*LSF	Axle/ 1000	Expected Reps	Stress Ratio	Allowable Reps	Fatigue Consump	Power	Allowable Reps	Erosion
26	28.6	0.07	537.	0.656	6577.	8.16	39.411	1300473.	0.04
24	26.4	1.60	12264.	0.608	24661.	49.73	33.581	2103953.	0.58
22	24.2	2.60	19929.	0.560	93087.	21.41	28.217	3623011.	0.55
20	22.0	6.63	50819.	0.512	438472.	11.59	23.320	6814367.	0.75
18	19.8	16.61	127316.	0.464	9082815.	1.40	18.889	14696439.	0.87
16	17.6	23.88	183040.	0.415	**********	0.00	14.925	40629368.	0.45
14	15.4	47.76	366080.	0.366	**********	0.00	11.427	211779898.	0.17
12	13.2	116.76	894965.	0.317	**********	0.00	8.395	**********	0.00
10	11.0	142.70	1093796.	0.267	**********	0.00	5.830	**********	0.00
8	8.8	233.60	1790544.	0.217	**********	0.00	3.731	**********	0.00

TAL	*LSF	Axle/ 1000	Expected Reps	Stress Ratio	Allowable Reps	Fatigue Consump	Power	Allowable Reps	Erosion
44	48.4	1.16	8891.	0.492	1163597.	0.76	39.369	1304593.	0.68
40	44.0	7.76	59480.	0.450	**********	0.00	32.536	2317990.	2.57
36	39.6	38.79	297325.	0.407	**********	0.00	26.354	4519721.	6.58
32	35.2	54.76	419735.	0.365	**********	0.00	20.823	10179958.	4.12
28	30.8	44.43	340556.	0.322	**********	0.00	15.943	29826993.	1.14
24	26.4	30.74	235622.	0.278	**********	0.00	11.713	173686912.	0.14
20	22.0	45.00	344925.	0.234	**********	0.00	8.134	**********	0.00
16	17.6	59.25	454151.	0.190	**********	0.00	5.206	**********	0.00
12	13.2	91.15	698665.	0.145	**********	0.00	2.928	**********	0.00
8	8.8	47.01	360332.	0.099	**********	0.00	1.301	**********	0.00

Total Fatigue Used = 93.05 Erosion Damage = 18.64

7.5 Inch Thickness Inadequate, Fatigue Used= 477.20 Erosion Damage = 33.46

Fig. 5 - Example of Output

Most of the output is self-explanatory. Additional information concerning specific output items is explained below:

MR The input 28-day concrete flexural strength (modulus of rupture). The computer program automatically decreases this by a 15% coefficient of variation.

SAL Single-Axle Loads in kips.

TAL Tandem-Axle Loads in kips (a Tandem-Axle Load is the total load on two axles).

LSF Load-Safety Factor. It is multiplied by the axle loads. (See page 10 of Reference 1.)

Axle/1000 Axles per thousand trucks inputted for each axle load.

Expected Reps - the computed number of these axles in the design period (Axle/1000 x ADTT/2 x 365 days x Age) in one direction only.

Stress Ratio (Fatigue Analysis) - The stress due to load divided by concrete strength.

Allowable Reps - the allowable number of axle-load repetitions based on the fatigue criteria.

Fatigue Consump - the fatigue consumption (expected repetitions divided by allowable repetitions).

Power (Erosion Analysis) - The rate of work (magnitude and speed of deflection) applied to a slab corner by the axle load.

Allowable Reps - the allowable number of axle-load repetitions based on the erosion criteria.

Erosion - erosion damage (expected repetitions divided by allowable repetitions).