Example 2-2: Developing a Design Storm Hyetograph from SCS Distributions

Develop a design storm hyetograph for a 50-year, 24-hour storm in Boston, Massachusetts. Assume that $\Delta t = .1$ hr is a reasonable choice for the drainage basin to which the design storm will be applied.

Solution

Figure 2-5 illustrates that a Type III storm distribution is a reasonable choice for Boston. From TP 40, the total depth of a 50-year, 24-hour storm in Boston is estimated to be 6.0 inches. Table 2-3 illustrates the calculation of the storm hyetograph.

The first column of the table is the time, in hours, since the beginning of the storm, and is tabulated in 1-hr increments for the total storm duration of 24 hours. (In actuality, the Δt* used in the calculations would be 0.1 hr; the 1-hr increment is used here for brevity.) The second column is the fraction of the total storm depth that has accumulated at each time during the storm. These values are obtained by interpolation from Table 2-2 for the Type III storm distribution. The third column contains the cumulative rainfall depths for each time during the storm and is obtained by multiplying each fraction in the second column by the total storm depth of 6.0 in. The fourth column contains the incremental depths of rainfall within each time interval during the storm; these values are computed as the difference between the current and preceding values in the third column.

The resulting graph of cumulative precipitation is shown in Figure 2-6, and the hyetograph is shown in Figure 2-7. The height of each bar on the hyetograph is the average rainfall intensity during that time interval, and the area of each bar is the incremental rainfall depth during that time interval. Because the time increment is 1 hr (1-hr increment is shown for simplicity; actual Δt

* $\Delta t = \frac{1}{4}$ to $\frac{1}{5}$ of basin lag time, t_L

or $\frac{1}{6}$ of basin time of concentration, t_C

TABLE 2-3 50-Year, 24-Hour Storm Hyetograph for Boston, Massachusetts

| t (hr)	Fraction	Cum. P (in)	Incr. P (in)
0	0.000	0.000	
1	0.010	0.060	0.060
2	0.020	0.120	0.060
3	0.031	0.186	0.066
4	0.043	0.258	0.072
5	0.057	0.342	0.084
6	0.072	0.432	0.090
7	0.091	0.546	0.114
8	0.114	0.684	0.138
9	0.146	0.876	0.192
10	0.189	1.134	0.258
11	0.250	1.500	0.366
12	0.500	3.000	1.500
13	0.750	4.500	1.500
14	0.811	4.866	0.366
15	0.854	5.124	0.258
16	0.886	5.316	0.192
17	0.910	5.460	0.144
18	0.928	5.568	0.108
19	0.943	5.658	0.090
20	0.957	5.742	0.084
21	0.969	5.814	0.072
22	0.981	5.886	0.072
23	0.991	5.946	0.060
24	1.000	6.000	0.054
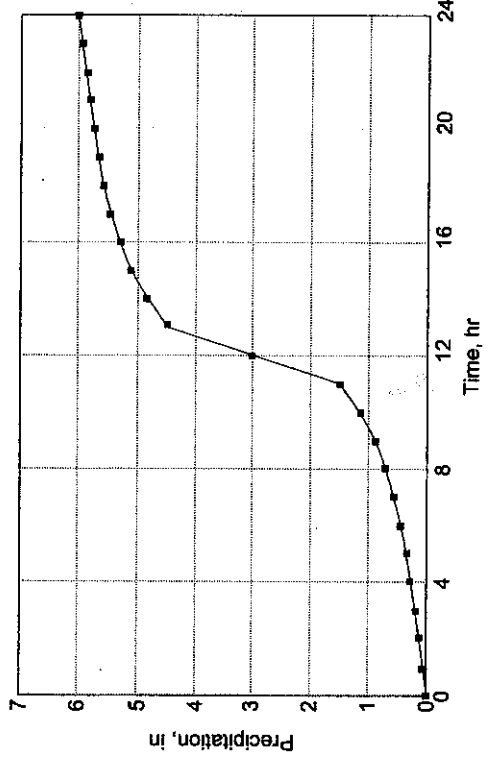
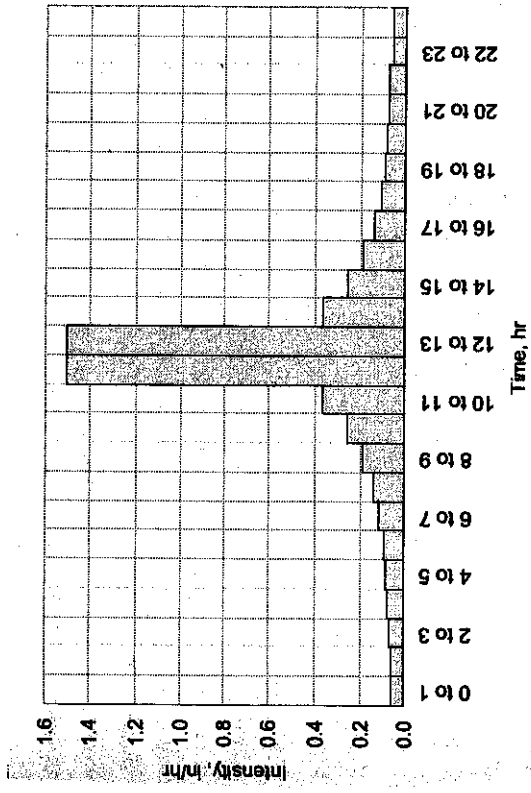FIGURE 2-6: Graph of Derived Design Storm Cumulative Precipitation

FIGURE 2-7: Derived Design Storm Hyetograph

SOURCE : Bentley, CAHE, 8th Ed., 2013