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Maximum Precipitation in Short Periods of Time

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MAXIMUM PRECIPITATION IN SHORT PERIODS OF TIME

CHARLES D. REED

For the first order Weather Bureau stations at Charles City, Davenport, Des Moines, Dubuque, Keokuk, Sioux City and Omaha, Nebraska, Table 1 shows the greatest rainfall of record in 5 minutes, 10 minutes, 15 minutes, 1 hour, 2 hours, and 24 hours.

Table 1—Maximum Precipitation in Short Periods of Time

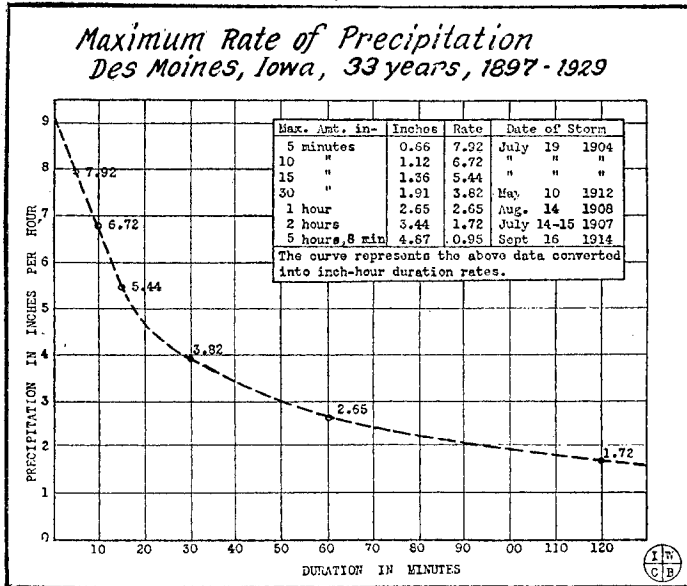
	LENGTH OF RECORD YEARS	5 MIN.	10 MIN.	15 MIN.	30 MIN.	1 HOUR	2 HOURS	24 HOURS
Charles City	25	0.57	0.87	0.99	1.54	1.85	2.92	3.87
Davenport	25	0.61	1.04	1.38	1.88	2.71	2.74	¹ 5.18
Des Moines	33	0.66	1.12	1.36	1.91	2.65	3.44	² 5.14
Dubuque	27	0.80	1.20	1.52	2.23	2.70	³ 4.50	⁴ 5.40
Keokuk	22	0.58	0.96	1.24	1.66	2.38	2.45	⁵ 4.80
Sioux City	23	0.77	1.40	1.75	2.17	2.94	3.20	¹ 4.65
Omaha, Neb.	33	0.67	1.01	1.27	1.71	2.53	3.17	² 7.03
State Record	27	0.80	1.40	1.75	2.23	2.94	4.50	7.03

It will be observed that Dubuque holds the record for greatest amount in 5 minutes, 30 minutes and 2 hours, and Sioux City for 10 minutes, 15 minutes and 1 hour. All of these records have probably been exceeded at cooperative observing stations but automatic recording devices were not available to give the rate for short durations. It would be interesting to have such a record for the storm at Toledo, Iowa, beginning at 11 p. m. August 1 and ending at 6 a. m. August 2, 1929, amounting to 8.27 inches, most of which fell in about 2 hours at a rate that may have been double the maximum rate for Des Moines shown in the table. However, the data for Des Moines are probably a fair average for the State, so they are here given a rather thorough analysis.

Herewith is a curve showing for the Des Moines data the rate per hour which is a convenient way to visualize the comparative rates for different durations. Note that the maximum intensity for 5 minutes is more than twice as great as for 30 minutes and 4.6 times as great as for 2 hours.

¹ Approximated.
² Record for 56 years.
³ Record for 49 years.
⁴ Record for 39 years.
⁵ Record for 57 years.

From the curve it is possible to estimate the maximum amounts for duration periods of lengths other than those for which actual records are available. For example, in 20 minutes the probable maximum rate would be 4.60 inches per hour, and for 1½ hours



(90 minutes) slightly more than 2 inches. By extrapolation of the curve it might be a fairly good guess that the maximum amount for one minute would be 0.15 inch or at the rate of 9 inches per hour.

Such data are useful in designing the drainage of large flat roofs or other areas, or in calculating the weight roofs must sustain. Where human lives are at risk, the maximum possible should be provided against. Where only property is at risk, as in the case of storm sewers, it is better to reimburse citizens for occasional damages from overflow than to expend large sums to take care of the maximum possible overflow. Interest on the cost of sewers, drainage ditches, culverts, etc., is a factor; hence the frequency as well as the intensity of rainfall must be considered. Obviously, brief periods of great intensity must be given first consideration.

As shown in the graph and table, the greatest rainfall of record in 33 years was 0.66 inch in 5 minutes, or at the rate of 7.92 inches per hour. There is, of course, only one case of this extreme intensity. At the other extreme is the fact that not a year in the 33 has passed when the greatest rainfall in 5 minutes has

been less than 0.21 inch, or at the rate of 2.52 inches per hour. The maximum intensity of rainfall most likely to occur in 5 minutes in any year is between 0.30 and 0.40 inch, or at the rate of 3.60 to 4.79 inches per hour. There are 14 years with such maxima out of the 33. There might be several rainfalls within these limits in a single year, not only in the 14 where the maxima are within these limits, but in other years when the maxima were higher.

Likewise, the graph shows the absolute maximum rainfall in 33 years for 10 minutes is 1.12 inches, or at the rate of 6.72 inches per hour, of which there is but one occurrence. The least maximum in any year is 0.32 inch, or at the rate of 1.92 inches per hour; and the most probable maximum for 10 minutes is between 0.60 and 0.80 inch, or at the same rate per hour as for 5 minutes. There were 14 out of the 33 years when the maximum rate for 10 minutes was within these limits.

Similarly, the absolute maximum in 15 minutes is 1.36 inches, or at the rate of 5.44 inches per hour, and the lowest maximum in 15 minutes in any year is 0.36 inch, or at the rate of 1.44 inches per hour. The maximum for 15 minutes is most frequently between 0.60 and 0.90 inch, or at the rate of 2.40 to 3.60 inches per hour, falling within these limits in 18 out of 33 years.

The absolute maximum for 30 minutes is 1.91 inches, or at the rate of 3.82 inches per hour, and the lowest maximum in 30 minutes in any year, is 0.64 inch, or at the rate of 1.28 inches per hour. The maximum for 30 minutes is most frequently between 0.60 inch and 1.20 inches, or at the rate of 1.20 to 2.40 inches per hour, falling within these limits in 21 out of 33 years.

The relative frequency for different rates and durations at Des Moines for the 33 years, 1897-1929, is shown in Table 2 below.

Table II—Frequency of Heavy Precipitation at Des Moines

Number of years in last 33 with the maximum rate within the limits in left-hand column for a duration of—

RATE PER HOUR	5 MIN.	10 MIN.	15' MIN.	30 MIN.
7.20—7.92	2	0	0	0
6.00—7.19	9	1	0	0
4.80—5.99	4	7	2	0
3.60—4.79	14	14	8	1
2.40—3.59	4	9	18	11
1.20—2.39	0	2	5	21
0.00—1.19	0	0	0	0

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