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Rain and/or low temperatures as factors interrupting external building work in the Newcastle upon Tyne area

by

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RAIN AND/OR LOW TEMPERATURES AS FACTORS INTERRUPTING EXTERNAL BUILDING WORK IN THE NEWCASTLE UPON TYNE AREA

by G.M. Capstick, B.Sc

INTRODUCTION

1. This is an investigation of the same type as that described for the London, Manchester and Glasgow areas in Climatological Memoranda No. 27, 29 and 30 respectively. Although it is basically a continuation of these memoranda, it may be used separately; therefore the introductory remarks (paragrpah 3) and the sections PRECIPITATION, TEMPERATURE and COMMENT have been repeated.

2. No data was available for Newcastle itself. The nearest records of hourly temperatures and rainfall were for Acklington RAF Station, but the results of this investigation are considered to be applicable without appreciable error to the Newcastle area as a whole.

3. Weather factors most commonly responsible for interrupting external building work in the British Isles are probably rain and/or coldness. Building contractors sometimes wish to know (e.g. when estimating the completion date of a contract) the monthly percentage frequencies of time likely to be 'lost' due to rainfall or low air temperature, or to these factors in combination.

4. It is probable that the critical rate (or intensity) of precipitation which would be likely to cause external work to be interrupted, varies with a number of other meteorological factors including the direction and strength of wind, temperature (not restricted to a suggested threshold of 34°F as used in this particular analysis), state of ground (e.g. flooded, snow-covered, frozen), thick fog etc., and also with a number of non-meteorological factors. However it was considered that helpful results would be obtained by finding the percentage of time during the day that the rate of precipitation was 0.5 mm per hour or more.

DATA

Hourly observations (Rainfall data from Form 3440; temperature data from the daily register) for Acklington Airport for the 12 hour period 0600-1800 GMT daily during the ten year period 1949-1958 were used.

PRECIPITATION

Intensity or rate of fall is the determining factor in classifying precipitation (rain, drizzle, snow or hail) as slight, moderate or heavy not the total fall over a period of an hour or more and the rate of 0.5 mm per hour corresponds to the upper limit of slight rain. This scale of intensity needs to be inreased when applied to showers, for a threshold rate of 0.5 mm/hr would probably cause all showers to be included in the frequencies of 'appreciable' precipitation in this investigation. Special observational techniques are used to measure rainfall when all the precipitation has occurred as snow; as a rough approximation, a rate of rainfall of 0.5 mm/hr would correspond to an accumulation of snow at a rate of 6.0 mm/hr and it seems unlikely that external building operations would have to cease because of slight snow falling for a relatively short period at this rate (perhaps with the air temperature being 34°F or just above).

In the absence of any experimental evidence, and after discussion with the Building Research Station, D.S.I.R., it was decided that the lower limit of precipitation contributing to time 'lost' in the Building Industry should be set at this rate of 0.5 mm/hr. Since this figure was somewhat arbitrarily fixed, no advantage was to be gained by attempting to refine the procedure or to apply weighting factors to the results in order to allow for the unnecessary inclusion

/of

slight showers or occasions of slight snow; it seems reasonable to suppose that, as an average figure for each month over the whole year, and bearing in mind the complexity of the basic problem, the rate of 0.5 mm/hr is not likely to be very wrong.

TEMPERATURE

For London, Manchester and Glasgow, air temperatures were taken from punched cards where they are punched in whole degrees Fahrenheit and that part of the analysis which deals with temperatures less than 34°F actually uses a threshold temperature of 33.6°F i.e. 33.6°F would be rounded up and punched as 34 whilst 33.5°F would be punched as 33. The temperature criterion of 34°F (actually 33.6°F) would seem to be quite reasonable, but it must be remembered that there may be occasions when the ground is frozen for several hours with the air temperature 33.6°F or higher; perhaps the number of these occasions will be approximately counter balanced by the number of occasions when external work is able to proceed even though the air temperature is below 33.6°F.

COMMENT

It seems likely that the criteria of rain and temperature conditions liable to interrupt external building work will be more or less the same over the British Isles, although the critcal rate of rainfall may show a seasonal variation e.g. perhaps a rate of 0.7 mm/hr may be generally tolerable in the summer whereas a rate of 0.4 mm/hr might often induce men to take shelter in the winter.

As previously stated there are other meteorological factors, of which wind direction and speed are thought to be most important, and many non-meteorological factors which could be considered but which were referred to in a letter received from a firm of building contractors:-

> '... we would expect to find variations between the persistency of different gangs reflecting the different types of work being done, the extent to which protective clothing had been issued, the tenacity of the foreman, and even whether the men were on bonus or not'.

Polythene shelters to cover the building site, or part of the site, obviate loss of working time due to inclement weather, and this note may help contractors to decide for particular jobs whether it is an economic proposition to use them.

The effect of weather on building materials is a separate problem.

/TABULATION OF RESULTS

TABULATION OF RESULTS

A. Table 1 Frequency of hours between 0600 and 1800 GMT with the temperatures less than 34°F irrespective of precipitation for the years 1949-1958.

Month	Jan.	Feb.	Mar.	Apr.	May	June	July	Aug.	Sept.	Oct.	Nov.	Dec.
Total hours	3720	3384	3720	3600	3720	3600	3720	3720	3600	3720	3600	3720
No. of hours with temp. less then 34°F	708	715	308	43	-	-	-	-	1	26	133	462
Percentage hours	19.0	21.1	8.3	1.2	-	-	-	-	0.1	0.7	3.7	12.4

The above table gives the total number of hours with air temperature less than 34°F, the total number of hours (from 0600-1800 GMT daily) each month in the ten year period, and the percentage frequency of hours with the temperature less than 34°F (irrespective of precipitation).

B. Table 2 Duration of precipitation at a rate of 0.5 mm/hr or more between 0600 and 1800 GMT, irrespective of temperature for the years 1949-1958.

1	2	3	4	5	6
Month	Total No. of hours 06-18 GMT	Total duration of rainfall falling at a rate ≥ 0.5 mm per hour; in hours and tenths	Percentage duration of rain falling at a rate ≥ 0.5 mm per hour i.e (Col 3 ÷ col 2) x 100	Total number of hours in which rain fell at a rate ≥ 0.5 mm per hour	Average duration of rain at a rate ≥ 0.5 mm per hour per occasion in minutes, i.e (Col 3 ÷ col 5) x 60
Jan.	3720	225.4	6.1	361	37
Feb.	3384	166.9	4.9	332	30
Mar.	3720	158.3	4.3	282	34
Apr.	3600	116.1	2.7	218	32
May	3720	158.2	4.3	264	36
June	3600	136.8	3.8	247	31
July	3720	147.0	3.9	258	34
Aug.	3720	164.8	4.4	275	36
Sept.	3600	136.5	3.8	254	32
Oct.	3720	159.5	4.3	287	34
Nov.	3600	186.4	5.2	320	35
Dec.	3720	182.3	4.9	321	34

This table gives the total duration, the percentage total duration and the average duration for each month of precipitation at a rate of 0.5 mm per hour or more.

/C. Table 3

C. Table 3 Duration of precipitation at a rate of 0.5 mm per hour or more with the temperature less than 34°F between 0600 and 1800 GMT, for the years 1949-1958.

Month	Total No. of hours 06-18 GMT	Total duration of rainfall falling at a rate ≥0.5 mm per hour with the temperature < 34°F	Total No. of hours in which rain fell at a rate ≥0.5 mm per hour with the temperature <34°F	Average duration of rain at a rate ≥0.5 mm per hour with the temperature < 34°F per occasion in minutes i.e (Col 3 ÷ col 5) x 60.
Jan.	3720	36.2	54	40
Feb.	3384	45.7	103	27
Mar.	3720	20.6	40	31
Apr.	3600	0.2	1	-
Nov.	3600	0.5	1	-
Dec.	3720	21.5	34	38

This table gives the total duration and the average duration for each month with precipitation at a rate of 0.5 mm/per hour or more with temperature simultaneously less than 34°F.

CRITICISM OF RESULTS

In Tables 2 and 3 it should be stressed that the average durations have been computed from the hourly duration of rainfall at a rate of 0.5 mm per hour or more in the hourly observations on Form 3440; the number of occasions is the number of separate hours which have rainfall of this rate, irrespective of duration in that hour. Hence if a period of rain of rate 0.5 mm per hour occurs between, for example, 8.30 am and 9.30 am this will be reported for two hours as 30 minutes duration for each. Thus the 'average' duration is computed as 30 minutes whereas it should be 60 minutes. Thus it will be seen that the average durations quoted will be somewhat low. The average durations have been included, however, to make the results comparable with those available for the London, Manchester and Glasgow areas. It should be noted that the above criticism does not apply to total duration or to percentage duration.

The number of occasions in Table 3 is too small in April and November to allow a significant average duration to be computed and for those computed for other months the number of occasions is really too small to make them reliable.

DISCUSSION OF RESULTS

This discussion includes all days ignoring week-ends and holidays and it should be remembered that all the results refer to the period 0600 to 1800 GMT.

Let us consider the three simplified tabulations:-

Table (a) Temperature below 34°F no precipitation at or above the rate of 0.5 mm per hour.

Month	Jan.	Feb.	Mar.	Apr.	May	June	July	Aug.	Sept.	Oct.	Nov.	Dec.
Percentage hours	17.5	18.1	7.2	1.2	0	0	0	0	<0.1	0.7	3.7	11.5

/Table (b)

Table (b) Appreciable precipitation (i.e. at a rate of 0.5 mm per hour or more) with no restriction on temperature.

Month	Jan.	Feb.	Mar.	Apr.	May	June	July	Aug.	Sept.	Oct.	Nov.	Dec.
Percentage hours	6.1	4.9	4.3	2.7	4.3	3.8	3.9	4.4	3.8	4.3	5.2	4.9

Table (c) Temperature below 34°F and/or precipitation at rate of 0.5 mm per/hr or more.

Month	Jan.	Feb.	Mar.	Apr.	May	June	July	Aug.	Sept.	Oct.	Nov.	Dec.
Percentage hours	23.6	23.0	11.5	3.9	4.3	3.8	3.9	4.4	3.8	5.0	8.9	16.4

The above results are shown in the form of a histogram in Figure 1.

There is no reason to suspect that temperature and rainfall data at Acklington Airport for the period 1949-1958 inclusive are not reasonably representative of long term average conditions in the Newcastle area.

The results in Table (c) above show that the percentage number of hours with the temperature below 34°F and/or precipitation at a rate of 0.5 mm per hour or more is between 3.8 and 5.0 per cent in the Newcastle area between April and October inclusive and over 16 per cent from December to February inclusive reaching a peak of 23.6 per cent in January.

Table (b) shows that the annual variation of monthly percentage number of hours with precipitation at a rate of 0.5 mm per hour or more is from 2.7 per cent in April to 6.1 per cent in January, in the Newcastle area, the months of April, June, July and September are the best for building purposes in the Newcastle area from the aspect of rainfall as well as from the aspect of both rainfall and low temperatures.

The right hand column of Table 2 gives the average duration of precipitation at a rate of 0.5 mm or more the average for the year being a little under 34 minutes. The criticism of these results is described in the preceding section.

It may be computed from Table 3 that the percentage number of hours when the temperature is below 34°F and also precipitation is occurring at the rate of 0.5 mm per hour or more is given by expressing the number of occasions as a percentage of the total hours:-

Month	Jan.	Feb.	Mar.	Apr.	May	June	July	Aug.	Sept.	Oct.	Nov.	Dec.
Percentage hours	1.5	3.0*	1.1	<0.1	0	0	0	0	0	0	<0.1	0.9

*Note:- The February figure is probably a little high due to the period considered including the cold Februarys of 1955 and 1956 which accounted for 1.9 per cent of the 3.0 per cent given; perhaps a figure similar to the January figure of 1.5 per cent would be more appropriate.

/COMPARISON

COMPARISON WITH DATA FOR LONDON, MANCHESTER AND GLASGOW AREAS

Table 4 Temperature below 34°F and no precipitation at or above the rate of 0.5 mm per hour.

Month	Jan.	Feb.	Mar.	Apr.	May	June	July	Aug.	Sept.	Oct.	Nov.	Dec.
London Percentage Hours ..	15.1	17.1	5.9	0.2	-	-	-	-	-	1.4	3.7	10.2
Manchester "	19.0	18.1	7.1	0.5	-	-	-	-	-	0.9	4.4	11.0
Glasgow "	19.9	14.6	4.9	0.8	-	-	-	-	0.1	1.2	5.7	13.0
Newcastle "	17.5	18.1	7.2	1.2	-	-	-	-	< 0.1	0.7	3.7	11.5

Table 5 Appreciable precipitation at the rate of 0.5 mm per hour or more with no restriction on temperature.

Month	Jan.	Feb.	Mar.	Apr.	May	June	July	Aug.	Sept.	Oct.	Nov.	Dec.
London Percentage Hours ..	3.8	5.9	3.2	2.7	3.2	2.8	3.4	3.5	3.3	4.2	4.9	3.9
Manchester "	5.9	5.8	5.2	4.2	4.4	4.8	5.2	6.7	5.4	5.4	6.3	7.2
Glasgow "	8.9	7.4	5.3	4.7	5.2	4.7	5.9	6.4	7.6	7.6	7.6	10.2
Newcastle "	6.1	4.9	4.3	2.7	4.3	3.8	3.9	4.4	3.8	4.3	5.2	4.9

Table 6 Temperature below 34°F and/or precipitation at the rate of 0.5 mm per hour or more i.e. Table 4 and Table 5.

Month	Jan.	Feb.	Mar.	Apr.	May	June	July	Aug.	Sept.	Oct.	Nov.	Dec.
London Percentage Hours ..	18.9	23.0	9.1	2.9	3.2	2.8	3.4	3.5	3.3	5.6	8.6	14.1
Manchester "	24.9	23.9	12.3	4.7	4.4	4.8	5.2	6.7	5.4	6.5	10.7	18.2
Glasgow "	28.8	22.0	10.2	5.5	5.2	4.7	5.9	6.4	7.7	8.5	13.3	23.2
Newcastle "	23.6	23.0	11.5	3.9	4.3	3.8	3.9	4.4	3.8	5.0	8.9	16.4

Tables 4, 5 and 6 compare the data now provided for Newcastle with those previously provided for the London, Manchester and Glasgow areas.

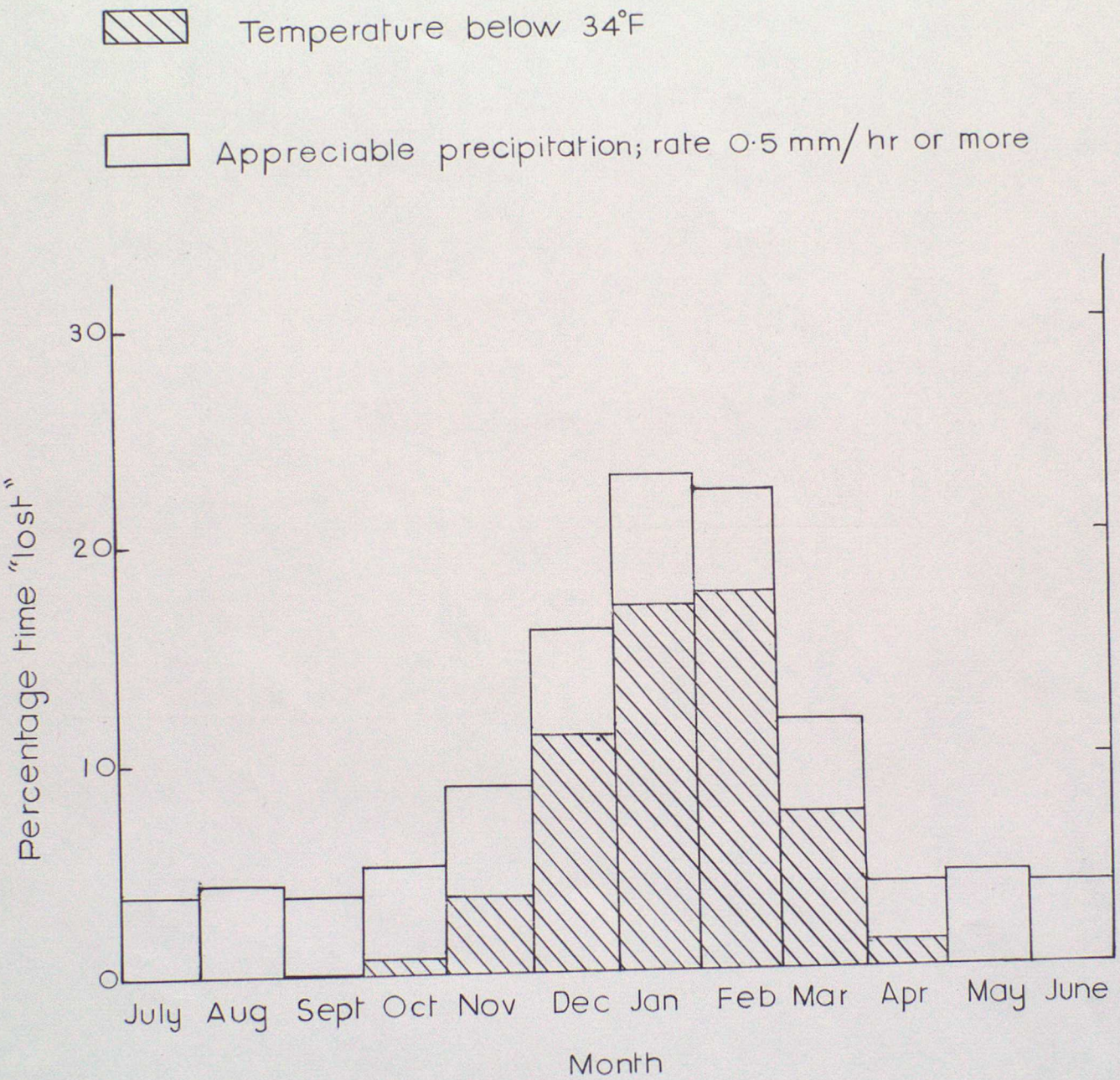

Fig 1. Percentage time "lost" due to rain and/or low temperature interrupting external building work in the Newcastle area