

CHAPTER 7

SERVICES FOR BUILDING, CONSTRUCTION AND CIVIL ENGINEERING

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SERVICES FOR BUILDING, CONSTRUCTION AND CIVIL ENGINEERING

7.1 Introduction

7.1.1 This market sector includes services to all those organizations concerned with the construction of houses, shops, public buildings, industrial premises, roads, bridges, tunnels, harbours, etc. which are all 'operations' to a greater or lesser extent that are weather sensitive. At the lower end of the scale the whole operation may be carried out by a single individual or firm of builders. For the larger projects a wide range of companies may be involved from the initial feasibility studies through design, planning, invitations and submissions to tender, carrying out the actual site work, monitoring of progress and contractual problems which may result. The work functions of the contractor's staff working on large projects are described in a paper 'The responsibilities of staff working on construction projects' which is available from the Services & Business (S&B). Typically the client will be represented by a firm of consulting engineers or architects who oversee the various stages, consider tenders, monitor progress and adjudicate over claims for extension to contract, while the work itself is contracted and subcontracted to construction companies and specialists involved in steel erection, electrical installations, roofing, glazing, painting, etc. Various suppliers of materials will also be involved. The market also includes governmental, administrative or research and development organizations such as the Building Research Establishment (BRE). A further useful subdivision of the market may be made between land based operations and those at the tideline or in the open sea, where information about waves and tides becomes critical.

7.1.2 The market sector also includes shipbuilding. However, those activities involving the construction of rigs or platforms for the extraction of oil or natural gas from the sea bed are not included, being considered part of the offshore oil and gas sector (chapter 15). The full market segmentation is given in Annex B to chapter 2.

7.1.3 The meteorological needs of the industry can be divided into 5 categories relating to the stage of the work:

- a. Design Climatological information is needed to assist architects, consulting engineers, building services engineers, transportation planners, etc. when designing a building, structure or road to function as required, and withstand expected weather extremes during its lifetime. This is expanded further in section 7.2.
- b. Tendering and planning Both the client's representative and the contractors require climatological information, concerning the likelihood of adverse weather, when costing and planning contracts, setting tender specifications and submitting tenders. This is discussed in section 7.3.
- c. Construction stage Weather forecasts and/or warnings are required by contractors on a day to day basis so that the work may be carried out as efficiently as possible, with the minimum delay and minimum danger to personnel, and achieving maximum economy (see section 7.4).
- d. Monitoring Summaries of recent weather are used to monitor on-site progress. This is because weather-related delays often occur and information is needed to support a claim for an extension to contract; the clients representative (e.g. architect or consulting engineer) may need to verify any claim. This is expanded in section 7.5.
- e. Post-construction Weather information is required by designers or managers either to monitor how a building or structure is functioning, e.g. energy consumption, or in connection with a specific failure, e.g. gale damage.

7.1.4 SiteWise Since autumn 1990 the Met. Office services to the construction industry have been promoted and provided using the brand name 'SiteWise'. A 'SiteWise' brochure giving details of the range of services is available; copies can be obtained from MSM(B).

7.2 Climatological data for design (and post-construction)

7.2.1 General Climatological data for design, and the related post-construction enquiries, are primarily the province of the CP enquiry bureaux at Bracknell, Glasgow and Belfast. Design data for coastal and marine projects are dealt with by CP Marine Consultancy Services. Liaison is maintained with appropriate sections of the Departments of Energy (DEn), Environment (DoE) and Transport (DTp). The CP Environmental Consultancy Service at Bracknell carries out specialist enquiries and consultancies, e.g. for the BRE and the DTp, and participates in British Standards Institution committee work.

7.2.2 Wind Engineers are required to design structures to withstand the maximum wind likely to be experienced at the site on average only once in so many years; once in 50 years is a frequently used design standard. Techniques for extreme value analysis of wind records have been developed in CP. All requests for design wind speeds should be referred to CP Environmental Consultancy Service (or for offshore structures to CP Marine Consultancy Services, see chapter 15). It is essential to know the location and type of structure and the purpose for which the extreme value is required (e.g. for glass specification)

7.2.3 Rainfall The heaviest rainfall expected in various periods of time has a bearing on the design of drainage systems of all kinds, from the size of gutters and downpipes on a single building to the drainage of motorways, the design of storm sewers and the problems of flood control in rivers and streams. Design rainfall information may be supplied using statistical analysis of past rainfall events based on the results used in the *Flood Studies Report* (Natural Environment Research Council report, 1975). These give tables of rainfall for specified durations and return periods, at a point or over a specified area, and also, given the concentration time for a drainage system, can provide storm profiles for various return periods. It is found that many potential customers are unfamiliar with the amount-duration return period concept and a discussion with the enquiry staff in the CP Branch is usually required to establish the particular need.

7.2.4 Driving rain The combination of wind and rain is of special interest and has an important bearing on building design, in particular in connection with the practice of filling cavity walls with insulating material. Requests for advice concerning driving rain should be referred to CP Environmental Consultancy Service.

7.2.5 Temperature In order to design heating plant for a building, it is necessary to have information about the temperature of the environment in which the building is to be sited. Such information is available in simple form in publications summarizing averages of maximum and minimum temperatures by month throughout the year. A more detailed picture of temperature variation is provided by tables giving the frequency of occurrence of particular temperatures on an hourly basis. Information of this kind, and similar data on humidity, are needed for the design of air conditioning systems and cooling towers.

7.2.6 Degree days It has been shown that the fuel needed over a period of at least a month to maintain a temperature of 18.3 °C in domestic or office buildings is closely related to the product of the amount by which the outside air temperature falls below 15.5 °C and the time the temperature remains at this level; the figures are normally expressed as degree days. Background information about degree days is contained in Fuel Efficiency Booklet No.7, copies of which are available free from the Energy Efficiency Office, DEn. Degree day figures are provided monthly by CP to DEn, but a range of routine and non-routine services is also available and enquiries should be directed to the Degree Day Product Manager, TWI.

7.2.7 Enquiries General enquiries for climatological information received at outstations from designers may often be met by reference to official publications. Requests for recent information, in connection with a building failure for example, can sometimes be answered using local records. Requests for more detailed information or advice other than is available locally should be referred to the CP enquiry bureaux in Bracknell, Glasgow or Belfast (or to CP Marine Consultancy Services for marine matters). The CP Environmental Consultancy Service can assist with enquiries concerning design codes of practice and publications by the BRE, DEn, Transport Research Laboratory (TRL), manufacturers' associations, etc.

7.3 Climatological data for tendering and planning

7.3.1 For tendering and planning, contractors need to be able to assess the possible loss of working time ('downtime') due to adverse weather which may delay completion of a contract. Some contractors allow for bad weather by including a standard factor in the design estimates or by relying on past experience; these methods are haphazard and can be unrealistic. Tendering can be put on a more scientific basis by using climatological analyses, e.g. monthly averages of working hours with adverse weather determined for representative observing sites. Requests for such analyses should be passed to CP enquiry bureaux at Bracknell, Belfast or Glasgow.

7.3.2 The METBUILD range of services includes a set of booklets 'Downtime Averages for Tendering and Planning'. Each booklet contains monthly averages, for periods Monday to Friday and Monday to Saturday for one of approximately 50 observing stations used in the METBUILD service. The averages include working hours (0700-1700 UTC) with air temperatures below various thresholds, working hours with rainfall, working days with snow lying, working hours with wind speeds above various thresholds, and working hours with high humidity (see paragraph 7.5.2).

7.3.3 Requests for information for locations or weather thresholds not covered by METBUILD averages may be met using other climatological stations or the set of specially prepared CLIMEST maps showing averages of a wide range of parameters available from the CP enquiry bureaux.

7.4 Forecast and warning services

7.4.1 To a certain extent, construction, and particularly building operations are less weather sensitive than was the case some years ago, e.g. by the use of plastic sheeting to give protection within building frameworks. Nevertheless, many tasks remain liable to interruption due to the weather, and the prudent contractor will always need forecast advice to assist with particular activities. Site-specific forecast services, tailored to the exact needs of the construction operation, are available from the Weather Centres.

7.4.2 Tower cranes are designed to withstand, but cannot be operated in, high winds. The maximum operating wind speed varies with different types of crane and with the type of load, though a commonly accepted limiting level is the occurrence of gusts in excess of 40 knots at jib height. Most tower cranes are fitted with anemometers to give warning of unacceptable wind speeds, and when these occur, contractors need to know how long the high winds will last; this often leads to enquiries at S&B outstations.

7.4.3 The pouring of concrete is sensitive to frost. Relatively simple protective measures can be taken, but these can be expensive and worthwhile savings can be made by not taking them unnecessarily.

7.4.4 Large-scale earth moving operations are sensitive to prolonged heavy rainfall, particularly on certain soils. Forecasts of rainfall and duration can be of considerable economic benefit.

7.4.5 A useful guide to forecasting for construction sites can be found in the article 'Weather forecasting for construction sites' by M.J. Prior and E.G.E. King (*Meteorol Mag*, Vol. 110, 1981, pp. 260-266). Copies of this article are available from Headquarters. Annex A is reproduced from Table I of that article.

7.4.6 One of the major problems with the organization of routine services for construction sites is that of communications, relatively few site offices having access to anything more than a telephone or facsimile. For large contracts, it may be possible to send forecasts direct PC to PC and some projects may find the use of a MIST system more suitable. For those with just a telephone, a 'direct access' service for the construction industry is available. It is designed to provide up-to-date and relevant weather information at all stages of a contract. Subscribers are given access to the forecaster via an ex-directory line and may discuss any aspect of the weather which is of particular concern. The service is advertised as giving 24-hour immediate access to a forecaster and all 'direct access' calls should receive priority response.

7.4.7 Those contractors who prefer to receive forecasts in a standard format may be offered a routine service; this normally consists of two forecasts per day sent by telephone, telex or facsimile with amendments as necessary. Warning services may also be appropriate.

7.4.8 In order to provide more effective services it is necessary to have a sound mental picture of the site and its surroundings. Visits to construction sites are encouraged, but in the absence of these, forecasters should attempt to get some feedback from the site regarding peculiarities of the location.

7.4.9 Energy management is another field where forecasts can play an important part. Such a forecast service, relating to the maintenance, or otherwise, of heating in a building to counteract heat loss over the weekend, is referred to in chapter 8.

7.5 Climatological data for monitoring

7.5.1 Contractors may need a summary of recent weather to monitor progress, especially if operations have been delayed and a claim for an extension to contract is to be made. The client's representative (e.g. architect) may also need a summary. Such requests can normally be met using METBUILD monthly downtime summaries or local products. More specialized requests should be passed to the CP enquiry bureaux, e.g. for information about a working day other than 0700-1700 UTC or about a combination of elements (rain or strong wind, high humidity or low temperature) or help interpreting if the weather has been 'exceptionally adverse' (contractual term).

7.5.2 METBUILD monthly downtime summaries provide day by day totals of working hours (0700-1700 UTC) with adverse weather, with the monthly totals for Monday to Friday and Monday to Saturday periods being compared with averages. These summaries are available for about 50 principal observing sites and are dispatched during the first week of the month following that to which they refer. The items covered are listed in Annex B. Advertising material (e.g. leaflet describing service, order form, sample copy) is available from the CP enquiry bureaux at Bracknell, Belfast and Glasgow, or MSM(B).

7.5.3 The information for METBUILD is compiled centrally using data available from the routine daily National Climatological Messages (NCMs), and the reports are professionally printed to an agreed design. The reports are provided as a regular monthly subscription service, ordered in advance, although back numbers can be supplied on request.

7.5.4 Contracts are increasingly using the New Engineering Contract (NEC), where exceptionally inclement weather is defined as 'has occurred on average less frequently than once in 10 years'.

7.5.5 The NEC Monthly Summaries are tailored exactly to meet the standard weather requirements of the NEC. These summaries are available for 43 sites and compare: monthly rainfall total; number of days in the month with rainfall greater than 5 mm; number of days in the month with an air frost; number of days in the month with snow lying at 0900 UTC; with one-in-ten-year values.

WEATHER INIMICAL TO CONSTRUCTION OPERATIONS

Operation	Rainfall intensity	Snow	Wind gusts exceeding (knots)*	Air temperature (degrees Celsius)	Other factors
Surveying and setting out	Slight or more (but not 'very slight')	Falling	35	-	Hard frozen ground (for peg driving). Fog
Excavation and earth moving ⁺	Prolonged moderate/ heavy	Falling/lying	-	Severe frost	Hard frozen ground. Drying conditions. Dense fog
Concreting ⁺	'Slight to moderate' or more	Falling/lying	-	<+2 when falling <+1 when rising	Sub-surface frozen or flooded - roads. Frost on reinforcement or shuttering - casting
Roads: asphaltting ⁺	Slight or more (but not 'very slight')	Falling/lying	-	<0 when) falling) recipe <-1 when) mixes rising) <8 designed mixes	Sub-surface wet or frozen <2 °C surface temperature - recipe mixes <5 °C surface temperature - designed mixes
Roads: surface dressing ⁺	Slight or more (but not 'very slight')	Falling/lying	-	<15 stone chippings <8 using hot binder <5 using emulsion	Sub-surface wet or frozen
Sheet steel piling	Moderate or more	-	35	-	-
Steel frame erection	Any intensity	Falling/lying	20	-	Frost or ice on frame members. Dense fog
Welding	Slight or more (but not 'very slight')	Falling/lying	30	-	Very cold members, especially when large
Scaffolding	Slight or more (but not 'very slight')	Falling/lying	30	-	Frost or ice on members
Cradles	Heavy	Heavy snow falling	25	-	Task may dictate criteria
Tower cranes	-	Heavy snow falling	40 at jib height	-	Dense fog on ground or at jib height.
Craning lightweight panels	-	Heavy snow falling	25 at load height	-	Dense fog on ground or at load height
Bricklaying	Slight or more (but not 'very slight')	Falling/lying	30	<2 when falling <1 when rising	Frost on building surfaces
Roofs: slating and tiling	Slight to moderate' or more	Falling/lying	30	-	-
Roofs: asphaltting	Slight or more (but not 'very slight')	Falling/lying	25	<7	Sub-surface wet, frosty or icy
Roofs: built-up felt	Any intensity	Falling/lying	25	<1	Sub-surface wet, frosty or icy
Roofs: sheeting (e.g. corrugated asbestos)	Slight or more (but not 'very slight')	Falling/lying	25	-	-
Rendering	Slight or more (but not 'very slight')	Lying	35	<3 when falling <2 when rising	- -
External painting ⁺ and joint sealing	Any intensity	Falling	25 (painting only)	<4 or >32	Moisture on surfaces relative humidity >90%
Glazing	Any intensity	Falling	25	-	Surfaces wet or frozen
Materials: storage or access to	Moderate/heavy	Lying	-	Severe frost	Frost following > 5 mm rain (bricks)
Partially completed structures: damage risk	Prolonged moderate/heavy	Substantial snow depth	40	Moderate/severe frost	Large hail. Sudden temperature changes

*Some users will be more familiar with speeds expressed in miles per hour, metres per second or Beaufort Force.

⁺Special considerations for these processes are described in the article by Prior and King "Weather Forecasting for construction sites" (Meteorol Mag, Vol. 110, 1981, pp. 260-266)

**ELEMENTS INCLUDED IN METBUILD MONTHLY DOWNTIME SUMMARY AND
METBUILD DOWNTIME AVERAGES FOR TENDERING AND PLANNING**

7B.1 Items covered are temperature, humidity, rainfall, snow and wind as follows, with working hours being 0700–1700 UTC.

- a. Temperature The number of working hours below 0, 1, 2, 3, 4, 5, 8 and 15 °C.
- b. Relative humidity The number of working hours over 90%.
- c. Rainfall Totals in millimetres are given 00–24 and 07–17 UTC and the number of working hours with over 0.2 mm rainfall.
- d. Snow The number of working hours when snow fell is given and also whether snow was lying in the period 0600–1800 UTC.
- e. Wind The number of working hours with spot winds greater than 15, 18, 23, 26, 32 and 39 m.p.h. The number of hours with gusts greater than 39 and 46 m.p.h .

The Metbuild service also includes also includes the following daily (0900–0900 UTC) information:

- f Minimum air temperature
- g. Minimum grass temperature
- h. Rainfall amount
- i. Snow depth (at 0900 UTC)
- j. Mean wind speed
- k. Maximum gust speed.

ELEMENTS INCLUDED IN MONTHLY CLIMATE SUMMARY

7C.1 For each day of the month the following data are given:

Maximum temperature	09-09 GMT)	
Minimum temperature	09-09 GMT)	Monday-Friday
Mean temperature	09-09 GMT)	Monday-Saturday
Grass minimum)	+ Month
Concrete minimum)	
			Mean, normal
			and previous
			year mean
Rainfall	09-09 GMT)	Monday-Friday
Day rain	09-21 GMT)	+ Monday-Saturday
Night rain	21-09 GMT)	Month
			Sum, normal
			% of normal
			previous year.

Snow amount at 09 GMT

Weather

State of ground

Mean wind speed 00-24 GMT

Maximum gust 00-24 GMT

Hours of wind in range 0-15 knots

" " " " " 16-30 knots

Relative humidity at 00, 06, 12, 18 GMT

Sunshine hours 00-24 GMT

Number of days with mean temperature in given ranges

" " " of air frost

" " " " ground frost

" " " " rainfall in given ranges

" " " " maximum gust in given ranges