

Electric floorwarming systems — For use with off-peak and similar supplies of electricity

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Foreword

This Code of Practice makes reference to the following British Standard Codes of Practice:

CP 204, *In-situ floor finishes*.

This Code of Practice gives guidance on electric floorwarming systems intended for use with off-peak and similar supplies of electricity. It is not concerned with other floorwarming systems, although much of the Code is applicable to them.

Such floorwarming systems are suitable for use in floors of concrete or similar construction of high thermal capacity; the construction of the walls and ceiling also has important bearing on the performance of the installation and its suitability to meet the heating requirements.

The Code deals with factors affecting the design of the systems for heating and the electrical and building requirements. Prefabricated and industrialized structures are not included, and in these additional requirements may be necessary.

For the Code to be effective it is necessary that the structural and building design be carried out in accordance with appropriate British Standards and Codes of Practice. Guidance on the calculation of heat requirements and electrical input is contained in the Electricity Council Floor-Warming Design Manual which also contains recommendations on screed thickness. The "Guide to current practice" of the Institution of Heating and Ventilating Engineers contains information on the computation of transmittance coefficients of building elements.

Metric conversions are given in International System (SI) units and are approximate. More accurate conversions should be based on BS 350-2¹⁾, and PD 6203²⁾. For further information, reference should be made to BS 3763³⁾ and PD 5686⁴⁾. The Code will be revised in metric terms as part of BSI's programme of metrification.

This Code of Practice represents a standard of good practice and therefore takes the form of recommendations. Compliance with it does not confer immunity from relevant legal requirements including byelaws.

Attention is, however, drawn to the fact that in certain byelaws, notably those Building Byelaws based upon one of the models issued by the Ministry of Housing and Local Government and the Department of Health for Scotland, compliance with the provisions of certain British Standards or British Standard Codes of Practice, or of specific clauses therein, is "deemed to satisfy" the requirements of certain of the byelaws in the fields covered by the British Standards and Codes of Practice, or by the specific clauses referred to.

Summary of pages

This document comprises a front cover, an inside front cover, pages i to iv, pages 1 to 18 and a back cover.

This standard has been updated (see copyright date) and may have had amendments incorporated. This will be indicated in the amendment table on the inside front cover.

¹⁾ BS 350, "Conversion factors and tables," Part 2, "Detailed conversion tables".

²⁾ PD 6203, "Additional tables for SI conversions".

³⁾ BS 3763, "International System of units (SI)".

⁴⁾ PD 5686, "The use of SI units".

1 General

1.1 Scope

This Code of Practice gives guidance on the design and construction of electric floorwarming systems intended for use with off-peak and similar supplies of electricity.

The following systems are covered:

- 1) Heating cables, electrically insulated and operated at mains voltage, embedded in the floor.
- 2) Heating cables, electrically insulated and operated at mains voltage, drawn into ducts laid or formed in the floor.
- 3) Bare, uninsulated conductors embedded in the floor and energized at extra-low voltage from a transformer.

1.2 Exchange of information

Electric floorwarming uses parts of the building structure as heating appliances, and this calls for close co-operation between the heating engineer and the building and electrical designers and trades. Each should have full knowledge of the work involved, in order to complete a satisfactory installation.

At the design stage the local electricity supply authority should be consulted to ensure that the proposed load can be accepted on the distribution network and to ascertain the off-peak or similar rate available. When the design has been finalized changes should not be made without full consultation by all concerned.

1.3 Drawings, records and advice to users

Adequate information should be given to the building owner and/or occupier regarding the operation of the system, together with all relevant layout drawings and records. Architects' drawings should clearly indicate all floor fitments and fixtures of a down-to-floor nature, including any fixings or other apparatus designed to penetrate the floor screed. In the case of factories and offices or similar spaces the line of future possible internal wall partitioning should be shown, the position of the floor expansion and construction joints should be marked, together with floor ducts, piped services, drain inspection covers, mat wells, etc.

The extent of heating panels as laid should be clearly indicated, together with the positions of wall and floor thermostats and connection points. Each panel, or sub-panel in the case of an irregularly shaped area, should be referred to a schedule detailing the panel or sub-panel dimensions, its location, electrical input and cable requirements, with spacing details and the run of cables for embedded systems. Access and connection points should be marked.

The layout drawings and records should be retained by the owner of the building for future reference.

1.4 Related publications: British Standards, Codes of Practice, regulations, etc.

This code takes cognizance of the following publications, and where appropriate refers to them:

CP 204, *In-situ floor finishes*

Regulations for the electrical equipment of buildings (14th edition) (published by the Institution of Electrical Engineers)

Guide to current practice (published by the Institution of Heating and Ventilating Engineers)

Floor-warming design manual (published by the Electricity Council)

Fault location on electric floor-warming cables (published by the Electricity Council)

Factories Act, 1961 (published by H.M. Stationery Office)

Offices, Shops and Railway Premises Act, 1963 (published by H.M. Stationery Office)

2 Basic principles

2.1 General

Off-peak floorwarming relies on the heat stored in the base concrete or screed which should be of sufficient thermal capacity to give continuous adequate heat emission from a system which is charged intermittently. The electrical energy is supplied to heating elements either embedded directly in the screed or passing through ducts similarly embedded.

A warm floor is a low temperature heat source of large area. The surface temperatures of the enclosing surfaces, walls, windows, ceilings, and the temperature of the air affect the amount of heat to be transmitted upward from the surface of the floor. For calculation purposes the effective ambient temperature should be used instead of the air temperature of the room.

A proportion of the heat supplied by the heating elements is lost downward into the ground or to the space below the floor. Where the space below is to be heated the downward heat flow is a heat gain to that space and should be taken into account in the design.

The type of construction of a building and the thermal inertia of the floors determine the rate at which the heated space cools when the cables are not energized. Some variation of the floor and room temperatures will occur, but in a satisfactory installation this is limited to a tolerable amount.

A heating installation should maintain specified temperature conditions within the heated space during certain periods of the day. These conditions are usually, but not necessarily, associated with comfort. Physiological considerations dictate limits to floor surface temperatures and so limit the maximum rate of heat transmission from unit floor area. As a general guide it is difficult to achieve comfort conditions by floorwarming alone if the 24 h average rate of heat loss exceeds about 22 Btu/ft² h (70 W/m²) of floor area, excluding downward heat loss.

2.2 Heat requirements and electrical input

Guidance on the calculation of heat requirements and electrical input may be found in the Electricity Council Design Manual.

2.3 Transmittance coefficients of building elements

Guidance on the computation of the heat transmittance coefficients of building elements used in calculating the heat requirements may be found in the "Guide to current practice" of the Institution of Heating and Ventilating Engineers.

2.4 Floor and room temperatures

As stated in 2.1 some variation of floor and room temperatures will occur, and these are affected by:

- 1) the thickness of screed or solid material above, below and around the heating cable (information on some acceptable screed thicknesses for different conditions is given in the Electricity Council Design Manual),
- 2) the presence of insulating floor coverings,
- 3) the position and thickness of included thermal insulation in suspended floors and of base insulation in ground floors,
- 4) the thermal insulation and thermal capacity of the space being heated.

2.5 Temperature swing

The air temperature is usually at its maximum at the end of the night-time charge and at a minimum at the end of the day-time discharge.

The maximum calculated swing during occupation, exclusive of fortuitous heat gains, should not exceed 6 °F (3 °C) at the design temperature. A method of calculating the temperature swing is given in the Electricity Council Design Manual and if this indicates that a greater swing will occur for any projected installation the screed thickness and/or building thermal insulation should be readjusted and the swing recalculated. (See 3.7.)

2.6 Thermal insulation of warmed floors

All thermal insulation used in warmed floors should have a thermal resistivity of not less than $1/k = 4 \text{ ft}^2 \text{ h } ^\circ\text{F/Btu in}$ ($28 \text{ m } ^\circ\text{C/W}$). All thicknesses should be related to this value of resistivity.

2.6.1 Floors laid directly on the ground. On wet sites, floors should be insulated over the whole area, preferably by 2 in (50 mm) of non-absorbent thermal insulation and this should be continued up at the sides to insulate the edges. According to the position of the damp-proof membrane the insulation may be laid above or below the base but should always be above the damp-proof membrane itself. The necessary screed or concrete thickness above the cables for adequate thermal storage is affected by the position of the insulation.