

BS EN 50600-2-1:2014



BSI Standards Publication

# Information technology -Data centre facilities and infrastructures -

## Part 2-1: Building construction

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### **National foreword**

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The UK participation in its preparation was entrusted to Technical Committee TCT/7, Telecommunications – Installation requirements.

A list of organizations represented on this committee can be obtained on request to its secretary.

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EUROPEAN STANDARD  
NORME EUROPÉENNE  
EUROPÄISCHE NORM

**EN 50600-2-1**

March 2014

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ICS 35.020; 35.110; 91.140.50

English version

**Information technology -  
Data centre facilities and infrastructures -  
Part 2-1: Building construction**

Technologies de l'information -  
Installation et infrastructures des centres  
de traitement de données -  
Partie 2-1: Construction des bâtiments

Informationstechnik -  
Einrichtungen und Infrastrukturen von  
Rechenzentren -  
Teil 2-1: Gebäudekonstruktion

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European Committee for Electrotechnical Standardization  
Comité Européen de Normalisation Electrotechnique  
Europäisches Komitee für Elektrotechnische Normung

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## Foreword

This document (EN 50600-2-1:2014) has been prepared by CLC/TC 215 “Electrotechnical aspects of telecommunication equipment”.

The following dates are fixed:

- latest date by which this document has to be implemented at national level by publication of an identical national standard or by endorsement (dop) 2015-01-06
- latest date by which the national standards conflicting with this document have to be withdrawn (dow) 2015-01-06

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## Introduction

The unrestricted access to internet-based information demanded by the information society has led to an exponential growth of both internet traffic and the volume of stored/retrieved data. Data centres are housing and supporting the information technology and network telecommunications equipment for data processing, data storage and data transport. They are required both by network operators (delivering those services to customer premises) and by enterprises within those customer premises.

Data centres need to provide modular, scalable and flexible facilities and infrastructures to easily accommodate the rapidly changing requirements of the market. In addition, energy consumption of data centres has become critical both from an environmental point of view (reduction of carbon footprint) and with respect to economical considerations (cost of energy) for the data centre operator.

The implementation of data centres varies in terms of:

- a) purpose (enterprise, co-location, co-hosting, or network operator facilities);
- b) security level;
- c) physical size;
- d) accommodation (mobile, temporary and permanent constructions).

The needs of data centres also vary in terms of availability of service, the provision of security and the objectives for energy efficiency. These needs and objectives influence the design of data centres in terms of building construction, power distribution, environmental control and physical security. Effective management and operational information is required to monitor achievement of the defined needs and objectives.

This series of European Standards specifies requirements and recommendations to support the various parties involved in the design, planning, procurement, integration, installation, operation and maintenance of facilities and infrastructures within data centres. These parties include:

- 1) owners, facility managers, ICT managers, project managers, main contractors;
- 2) consultants, architects, building designers and builders, system and installation designers;
- 3) facility and infrastructure integrators, suppliers of equipment;
- 4) installers, maintainers.

At the time of publication of this European Standard, EN 50600 series will comprise the following standards:

EN 50600-1: *Information technology — Data centre facilities and infrastructures — Part 1: General concepts*;

EN 50600-2-1: *Information technology — Data centre facilities and infrastructures — Part 2-1: Building construction*;

EN 50600-2-2: *Information technology — Data centre facilities and infrastructures — Part 2-2: Power distribution*;

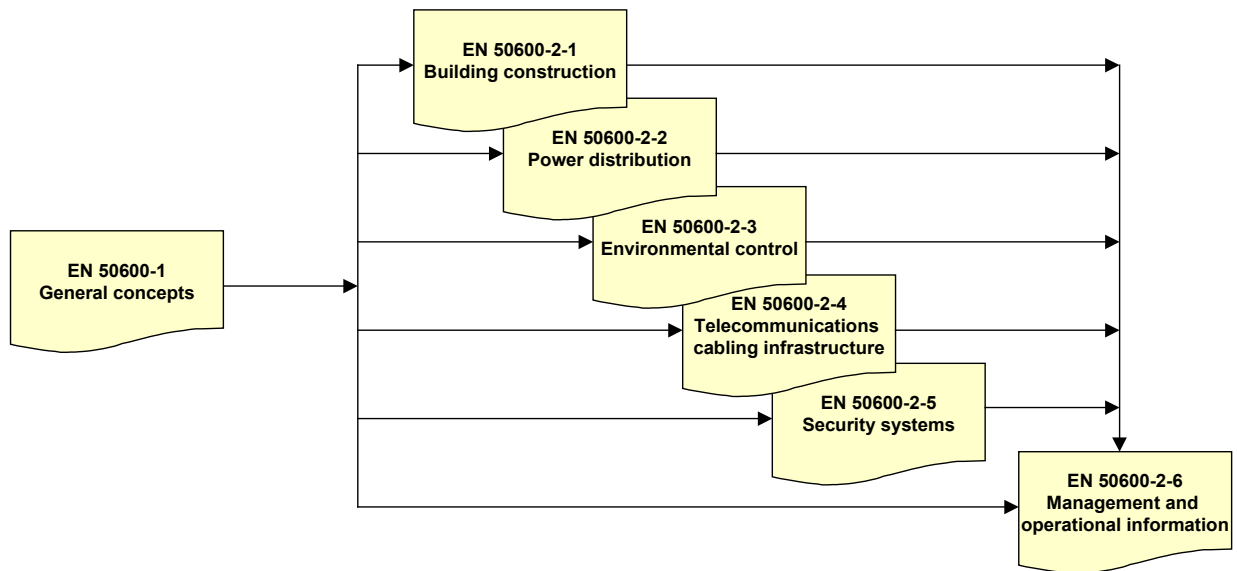
EN 50600-2-3: *Information technology — Data centre facilities and infrastructures — Part 2-3: Environmental control*;

EN 50600-2-4: *Information technology — Data centre facilities and infrastructures — Part 2-4: Telecommunications cabling infrastructure*;

EN 50600-2-5: *Information technology — Data centre facilities and infrastructures — Part 2-5: Security systems;*

EN 50600-2-6: *Information technology — Data centre facilities and infrastructures — Part 2-6: Management and operational information.*

The inter-relationship of the standards within the EN 50600 series is shown in Figure 1.



**Figure 1 — Schematic relationship between the EN 50600 standards**

EN 50600-2-X standards specify requirements and recommendations for particular facilities and infrastructures to support the relevant classification for “availability”, “physical security” and “energy efficiency enablement” selected from EN 50600-1.

This European Standard addresses the building design of data centres; it addresses security issues from a constructional point of view, whereas EN 50600-2-5 specifies the pertinent security system requirements of those facilities and infrastructures (in accordance with the requirements of EN 50600-1).

This European Standard is intended for use by and collaboration between architects, building designers and builders, system and installation designers.

This series of European Standards does not address the selection of information technology and network telecommunications equipment, software and associated configuration issues.



## 1 Scope

This European Standard addresses the construction of buildings and other structures which provide accommodation for data centres based upon the criteria and classification for “physical security” within EN 50600-1 in support of availability.

This European Standard specifies requirements and recommendations for the following:

- a) location and site selection;
- b) building construction;
- c) building configuration;
- d) fire protection;
- e) quality construction measures.

Safety and electromagnetic compatibility (EMC) requirements are outside the scope of this European Standard and are covered by other standards and regulations. However, information given in this European Standard may be of assistance in meeting these standards and regulations.

Conformance of data centres to the present document is covered in Clause 4.

## 2 Normative references

The following documents, in whole or in part, are normatively referenced in this document and are indispensable for its application. For dated references, only the edition cited applies. For undated references, the latest edition of the referenced document (including any amendments) applies.

EN 12825:2001, *Raised access floors*

EN 15004-1, *Fixed firefighting systems — Gas extinguishing systems — Part 1: Design, installation and maintenance (ISO 14520-1:2006, modified)*

EN 50174-1, *Information technology — Cabling installation — Part 1: Installation specification and quality assurance*

EN 50174-3, *Information technology — Cabling installation — Part 3: Installation planning and practices outside buildings*

EN 50310, *Application of equipotential bonding and earthing in buildings with information technology equipment*

EN 50600-1:2012, *Information technology — Data centre facilities and infrastructures — Part 1: General concepts*

EN 50600-2-2, *Information technology — Data centre facilities and infrastructures — Part 2-2: Power distribution*

EN 50600-2-3 <sup>1)</sup>, *Information technology — Data centre facilities and infrastructures — Part 2-3: Environmental control*

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<sup>1)</sup> Draft for formal vote under preparation.

EN 50600-2-4 <sup>2)</sup>, *Information technology — Data centre facilities and infrastructures — Part 2-4: Telecommunications cabling infrastructure*

EN 50600-2-5 <sup>3)</sup>, *Information technology — Data centre facilities and infrastructures — Part 2-5: Security systems*

EN 62305 (all parts), *Protection against lightning (IEC 62305, all parts)*

### 3 Terms, definitions and abbreviations

#### 3.1 Terms and definitions

For the purposes of this document, the terms and definitions in EN 50600-1 and the following apply.

##### 3.1.1

###### **access floor**

system consisting of completely removable and interchangeable floor panels that are supported on adjustable pedestals connected by stringers to allow the area beneath the floor to be used by building services

##### 3.1.2

###### **access provider**

operator of any facility that is used to convey telecommunications signals to and from a customer premises

##### 3.1.3

###### **building entrance facility**

facility that provides all necessary mechanical and electrical services for the entry of telecommunications cables into a building and which may allow for transition from external to internal cable

[SOURCE: EN 50600-1:2012, 3.1.2 and EN 50173-1:2011, 3.1.17]

##### 3.1.4

###### **modular construction**

method which uses standardized prefabricated construction elements with the possibility to add extra elements when more space is required

##### 3.1.5

###### **pathway**

defined route for different media between identified points

Note 1 to entry: Examples for media are bus bars, cables, conduits, ducts, pipes.

##### 3.1.6

###### **plenum**

compartment or chamber to which one or more air ducts are connected and that forms part of the air distribution system

##### 3.1.7

###### **room in room**

construction method to have a physically independent chamber (walls and ceiling) in a new or existing building

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<sup>2)</sup> Circulated for CENELEC enquiry.

<sup>3)</sup> Draft for CENELEC enquiry under preparation.

Note 1 to entry: Room in room can provide high level fire rating, water tightness, smoke tightness and intrusion protection required for IT environments.

## 3.2 Abbreviations

For the purposes of this document the following abbreviations apply:

DC	Direct Current
HVAC	Heating, Ventilation, Air Conditioning
IT	Information Technology

## 4 Conformance

For a data centre to conform to this European Standard:

- a) its location shall have been selected following a site assessment as required in Clause 5;
- b) it shall comply with the site requirements of Clause 6;
- c) it shall meet the building construction requirements of Clause 7 where the data centre spaces are within buildings;
- d) it shall meet the building configuration requirements detailed in Clause 8;
- e) it shall meet the fire protection requirements of Clause 9;
- f) it shall meet the quality construction measures of Clause 10;
- g) local regulations, including safety, shall be met.

## 5 Location

### 5.1 Assessment of location

#### 5.1.1 Requirements

The location of a site for a data centre can be assessed either for a “green field” construction of a new data centre or the evaluation of an existing site. The location shall be assessed against the following criteria:

- a) geographical location (see 5.2);
- b) natural environment (see 5.3);
- c) adjacencies (see 5.4);
- d) infrastructural factors (see 5.5);
- e) budgetary factors such as site costs and cost to bring utilities to the site;
- f) local regulation issues.

Personnel factors (operational personnel, security personnel) are not covered in this clause.

### **5.1.2 Recommendations**

None.

## **5.2 Geographical location**

### **5.2.1 Requirements**

The elevation above sea level can have a direct influence on the performance of technical equipment and shall be considered.

### **5.2.2 Recommendations**

The choice of a location of a new data centre should consider:

- a) assessment of its impact on the environment;
- b) any opportunities to take advantage of renewable sources of energy (e.g. wind, solar, aerothermal, geothermal, hydrothermal and ocean energy, hydropower, biomass, landfill gas, sewage treatment plant gas and biogases).

## **5.3 Natural environment**

### **5.3.1 Requirements**

An environmental risk analysis shall be conducted which, as a minimum, considers the following items:

- a) flooding;
- b) active seismic zones;
- c) high wind velocities;
- d) air contamination by natural causes (volcanic activities, etc.);
- e) near to coast lines;
- f) lower than sea level;
- g) on special purpose flood plains.

Where the placement of a data centre in a location with negative environmental influences is unavoidable, these influences shall be mitigated by protective constructional, technical, and/or organizational measures.

### **5.3.2 Recommendations**

None.

## **5.4 Adjacencies**

### **5.4.1 Requirements**

A risk analysis shall be conducted which, as a minimum, considers adjacency to the following items:

- a) facilities storing, processing or in other ways dealing with nuclear, explosive, flammable or toxic substances or other hazardous materials;

- b) transportation arteries like waterways, highways, railway tracks, flight paths;
- c) sources of vibration, e.g. hammer mills, railroad tracks;
- d) electromagnetic interference, created by e.g. high-voltage lines, transmitter stations;
- e) places of public interest, gatherings or political targets;
- f) tall and unstable installations that could damage the data centre if they collapsed;
- g) other not related or non-essential operations (e.g. uncontrolled operations in multi-tenant premises).

Where the placement of a data centre in a location with negative infrastructural influences is unavoidable, these influences shall be mitigated by protective constructional, technical, and/or organizational measures.

#### **5.4.2 Recommendations**

It is important to ensure that sufficient space is provided around the area or the building to enable the creation of buffer zones and a secure perimeter.

Data centres should be located adjacent to potentially advantageous infrastructure or installations including, but not limited to, the following:

- a) emergency response services;
- b) vendor support and service personnel;
- c) monitoring stations of external security providers.

### **5.5 Infrastructure factors**

#### **5.5.1 Requirements**

Consideration shall be given to access to all the utility supplies (e.g. electricity, telecommunications infrastructure, water, sewage and gas) that will be required over the intended lifetime of the data centre in terms of:

- a) accessibility (existence of utility services);
- b) redundancy (services originating from different sources);
- c) availability (reliability based on historical trends, if available);
- d) capacity (e.g. electricity: short circuit current; water: pressure and flow; sewage: sizing).

#### **5.5.2 Recommendations**

Under consideration.

## **6 Site configuration**

### **6.1 General**

EN 50600-1 contains a schematic representation of the typical spaces required by a data centre within a building. Figure 2 provides a simplified schematic and shows an example of the Protection Classes of

EN 50600-1 applied to the spaces of the data centre. The data centre is shown within Protection Class 2 and the protection increases as the importance of the facilities and infrastructure accommodated by the spaces increases.

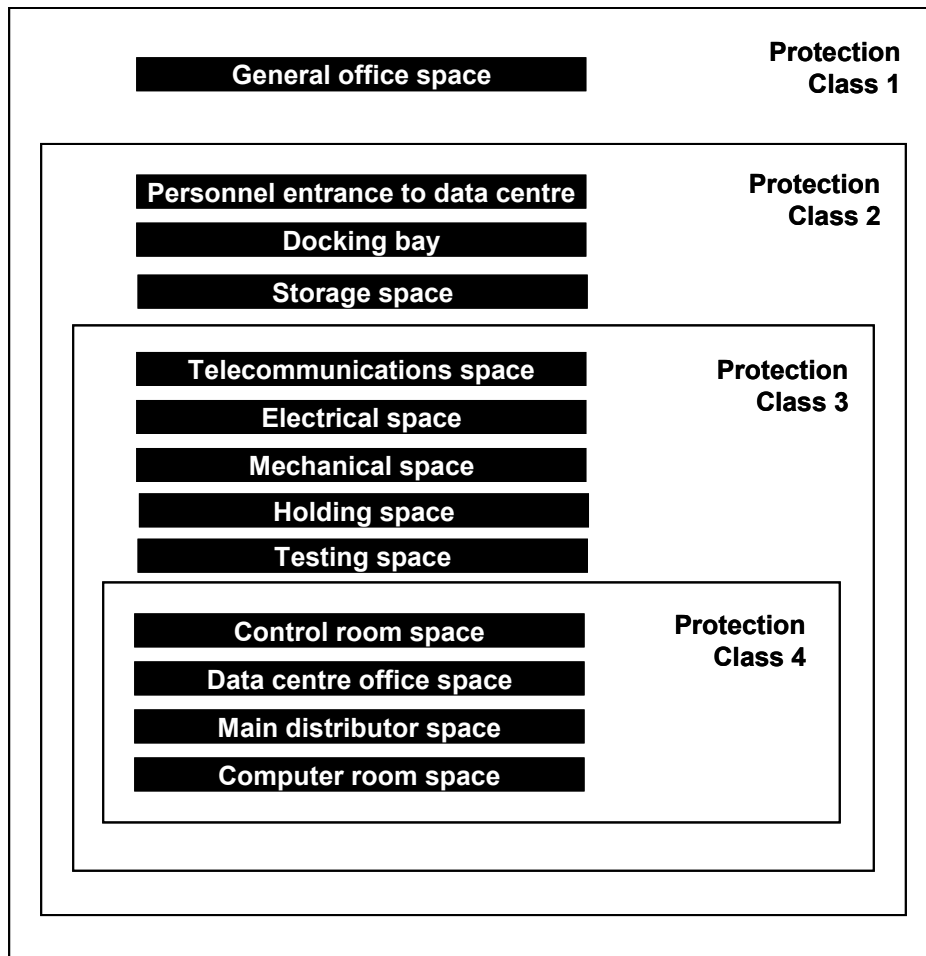


Figure 2 — Site of a Data Centre

## 6.2 Site selection

### 6.2.1 Requirements

The size and shape of a new site shall be suitable to accommodate the intended functions.

A site survey shall be commissioned to include both surface and geotechnical aspects. The results of the survey shall be relevant (i.e. based on current information).

The geotechnical survey shall include the following which would influence the construction and operation of the data centre:

- buried cavities (natural or man-made) and buried utility infrastructures;
- measurements, and expected variations of, soil resistivity and ground water conditions;
- presence of contamination.

The site survey report shall be used to assist in the design of:

- 1) foundation configurations (taking account of any load increases due to possible building growth);
- 2) drainage infrastructure.

The design of earthing connections shall be based on the soil resistivity information produced by the geotechnical survey.

The site survey shall consider any need to provide spaces for support equipment such as underground fuel tanks (diesel or natural gas) to supply the generator(s), HVAC heat rejection systems, etc.

The selection of a site shall take into account any restrictions that may exist concerning land use and environmental impact aspects of any hydrocarbon emissions and sound generation and that could restrict fuel storage and generator operation.

### **6.2.2 Recommendations**

The design of adequate drainage and foundation systems that will be required over the intended lifetime of the building should be based on the information provided by the geotechnical survey and should take into account possible future expansion.

## **6.3 Assessment of existing premises**

### **6.3.1 Requirements**

The suitability of the existing premises shall be determined by a risk analysis which reflects the specific needs of the proposed data centre which includes the assessment of criteria of Clause 5. An existing survey may be referred to if the documents are not older than 6 months. An existing risk analysis shall only be referred to if conducted with a similar objective (see Clause 5).

### **6.3.2 Recommendations**

Under consideration.

## **6.4 Utilities**

### **6.4.1 Requirements**

The provision of external utilities to the premises shall be adequate for the intended availability class of the data centre as defined in EN 50600-1.

Documentation shall be collated, which allows the risk to data centre operation arising from utility infrastructures to be assessed.

A composite utilities plan showing all underground and above ground utilities shall be provided.

### **6.4.2 Recommendations**

None.

## **6.5 Access routes**

### **6.5.1 Requirements**

The number of access routes to the site shall take into account the risk of blockage which may affect the delivery of labour and materials to the data centre. The design and construction of access routes shall consider expected loads and dimensions of vehicles.

## **6.5.2 Recommendations**

A secondary access route should be considered.

## **6.6 Deliveries**

### **6.6.1 Requirements**

The docking bay shall be designed to accommodate the largest items expected to be delivered or removed from the data centre during operation.

### **6.6.2 Recommendations**

The docking bay should provide protection against precipitation.

## **6.7 Parking**

### **6.7.1 Requirements**

Parking restrictions related to security are detailed in EN 50600-2-5.

### **6.7.2 Recommendations**

Consideration should be given to any additional parking facilities which would be necessary during emergency situations including those involving disaster recovery scenarios.

## **6.8 Exterior installations**

### **6.8.1 Underground facilities**

#### **6.8.1.1 Requirements**

Vehicular traffic shall not be routed over underground facilities unless they are protected by appropriate slabs installed above the facility.

Above ground exterior installations adjacent to access routes shall be protected.

The requirement for visual or acoustic screening of exterior installations shall be assessed.

#### **6.8.1.2 Recommendations**

Underground fuel storage tanks should be installed in proximity to the generator(s) but outside of potential future building expansion areas.

Pumps and refill station should be positioned at the boundary of the Protection Zone 1 (see EN 50600-2-5) to avoid the necessity for access of fuel vehicles to the site. The area for the fuel storage tanks should be located outside of potential future building expansion areas.

### **6.8.2 Telecommunications cabling**

#### **6.8.2.1 Requirements**

See EN 50174-3 for requirements relevant to information technology cabling installations outside buildings. All routes where conflicts could occur shall be clearly indicated on all plans and relevant details shall be mentioned.



### **6.8.2.2 Recommendations**

None.

## **6.9 Perimeter**

### **6.9.1 Requirements**

The perimeter of the data centre shall be provided in accordance with the outcome of the risk analysis in EN 50600-2-5.

### **6.9.2 Recommendations**

A data centre site may be completely or partly surrounded by a fence or wall. The number and functionality of gates and entrances for personnel and vehicles should be minimized and secured according to the level of security chosen (see EN 50600-2-5).

The exterior areas should be maintained and buffer zones created to minimize disturbance to or by neighbours.

## **7 Building construction**

### **7.1 Building structure**

#### **7.1.1 General**

##### **7.1.1.1 Requirements**

The design of, and the materials used in the construction of the structure protecting the data centre spaces, facilities and infrastructures shall be of a design that does not compromise the desired availability class based upon the risk assessment of external environmental events identified in Clause 5 and security requirements of EN 50600-2-5.

The requirement for unobstructed clearance above any floor slabs in areas within the structure reserved for data centre spaces shall be determined based on the environmental control concept from EN 50600-2-3 and other infrastructure details such as cabinet heights, the requirements of access flooring and of pathways.

##### **7.1.1.2 Recommendations**

It should be noted, that data centres typically require a higher physical protection level than is specified by local building regulations.

#### **7.1.2 Load-bearing structure**

##### **7.1.2.1 Requirements**

The load bearing structure shall be designed to support the anticipated point and distributed loading for the intended life of the data centre. Consideration shall be given to requirements for expansion.

##### **7.1.2.2 Recommendations**

None.

## **7.1.3 Building materials and finishes**

### **7.1.3.1 Requirements**

The use of fire resistant materials is required.

All open or rough surfaces shall be sealed to prevent dust or chemically-active particles being distributed by the constant airflow in air conditioned spaces.

The design of, and the materials used to construct, spaces intended to contain gaseous fire extinguishing systems shall provide the required level of air-tightness.

The design of, and the materials used to construct, spaces that have an identified risk of flooding shall provide the required level of watertightness.

Building materials shall be selected which minimize the particulate matter produced during construction, operation or alterations.

Building materials shall be selected to minimise mould growth and rodent damage.

Building materials shall be selected to minimise repetitive maintenance tasks.

The amount of insulation shall consider both the ambient environmental conditions and technical equipment heat rejection.

### **7.1.3.2 Recommendations**

Prefabricated modular construction elements can be selected based on the criteria in 7.1.3.1. Materials should be selected to minimise the emission of toxic gases and smoke during combustion.

The building should be insulated to minimize operating cost.

## **7.2 Foundations**

### **7.2.1 Requirements**

Any foundations used to support the structure(s) accommodating the data centres spaces shall take into consideration the result of the site survey (see 6.2). When looking into a floor below grade level, water infiltration issues shall be considered, including height below surrounding drainage systems, secure, continuous vapour barriers, water and vapour extraction systems.

The layout of the building's foundation and structure shall incorporate the earthing and bonding system as protection against lightning and electromagnetic interference. The design may vary according to the required Lightning Protection Level (LPL) and to the site parameters. See EN 50600-2-2 and the EN 62305 series.

### **7.2.2 Recommendations**

The design strength and extent of any foundations should consider any forecast expansion of the data centre spaces (vertical or lateral).

## **7.3 Exterior walls**

### **7.3.1 Requirements**

Requirements for Protection Class boundaries and access at them are specified in EN 50600-2-5.

Where exterior walls provide the boundary of Protection Class 1, they shall either be designed to be resistant to the predicted external climatic conditions during the lifetime of the enclosed data centre spaces or the construction of the boundaries of Protection Class 2 shall take into account the need for the repair of the exterior walls.

Where exterior walls provide the boundary of Protection Class 2, they shall be designed to be resistant to the predicted external climatic conditions during the lifetime of the enclosed data centre spaces.

Where exterior walls provide the boundary of Protection Classes 1 or 2, the number of openings shall be minimised consistent with the access requirements during both operation and emergency situations.

The position and size of openings that will provide pressure relief for gaseous fire suppression systems shall be addressed in the design phase.

### **7.3.2 Recommendations**

Recommendations for Protection Class boundaries and access at them are given in EN 50600-2-5.

## **7.4 Interior walls providing boundaries of Protection Class**

### **7.4.1 Requirements**

Requirements for Protection Class boundaries and access at them are specified in EN 50600-2-5. The number of openings at these boundaries shall be minimised consistent with the access requirements during both operation and emergency situations.

Interior walls shall provide the desired degree of physical security against internal fire and internal environmental events. Interior non-load bearing walls shall be constructed in a way to allow for modifications while at the same time provide the required protection against intrusion. See EN 50600-2-5. Openings in walls and doors in transportation routes shall be of sufficient width and height to allow for the largest pieces of equipment expected to be transported.

If the wall constitutes a fire barrier then any penetrations shall meet the requirements of Clause 9.

All doors shall be fitted at minimum with a mechanical security lock.

### **7.4.2 Recommendations**

Recommendations for Protection Class boundaries and access at them are specified in EN 50600-2-5.

## **7.5 Roofs**

### **7.5.1 General**

#### **7.5.1.1 Requirements**

Where a roof covers, directly or indirectly, any data centre spaces, the roof and its sub-structure (i.e. drainage channels) shall be designed and constructed to protect the data centre spaces from predicted external climatic conditions and from air-borne debris.

The design of sub-structures of the roof shall take into account the need for the repair of the roof and shall provide the required protection during the repair process.

The construction of the roof and its sub-structure shall be capable of supporting any additional loads created by, and provide permanent access to, any elements of the data centre facilities and infrastructures that are to be accommodated at roof level.

The requirements for visual screening of roof-top facilities and infrastructure shall be included in any calculations of loads to be supported.

Aesthetics are not a prime requirement for a data centre project. In some cases architectural features such as rooftop HVAC equipment screening can be necessary.

Where the roof acts as a Protection Class boundary, it shall meet the requirements of EN 50600-2-5.

Openings in roofs shall be protected against unauthorized access and external environmental events in accordance with EN 50600-2-5. Openings in roofs shall maintain the intended function of the roof.

### **7.5.1.2 Recommendations**

Under consideration.

## **7.6 Rain water drainage**

### **7.6.1 Requirements**

The roof and any sub-structure for the drainage of rain water from the roof or elsewhere shall be designed and constructed:

- a) to avoid accumulation of rain water which could affect data centre spaces;
- b) to ensure that all rain water is carried through a drainage system of appropriate capacity.

The drainage system shall be designed and constructed to facilitate inspection, cleaning and repair.

The routing of drainage systems shall respect Protection Class boundaries in accordance with EN 50600-2-5.

### **7.6.2 Recommendations**

None.

## **7.7 Floors and Ceilings**

### **7.7.1 General**

#### **7.7.1.1 Requirements**

Within data centres spaces containing telecommunications equipment the requirements of EN 50310 and EN 50174-1 shall be applied in relation to functional bonding structures and electro-static discharge respectively.

#### **7.7.1.2 Recommendations**

Flooring in spaces designated for human occupation should be selected to minimise noise. Flooring in testing and holding spaces should have similar properties to that installed in the computer room space. Flooring in secondary areas, i.e. storage, corridors, etc. can be of lesser conductivity.

## **7.7.2 Access floors**

### **7.7.2.1 Requirements**

Where used access floors shall be in accordance with EN 12825:2001, grade 5. They are highly unlikely to be used in a docking bay.

Where the finished floor height is above 500 mm independent standing steel grid floors shall be considered.

The assembly shall be levelled and locked at a selected height, requiring deliberate action to change height setting and preventing vibrating displacement. The assembly shall provide a range of adjustment from  $\pm 5$  mm.

The edge trim for the tile coverings shall be bonded to the panel surface and flush with the surface covering.

Ventilation panels shall be selected to provide the required airflow. Ventilation panels shall support the same load as solid panels.

### **7.7.2.2 Recommendations**

None.

## **7.8 Corridors and doors**

### **7.8.1 Requirements**

Access routes along which equipment and other goods are to be delivered to and from the data centre spaces shall be of sufficient width and height to allow for the largest pieces of equipment expected to be transported. Doors shall have no door sill and double doors shall have no centre post.

The fire rating of all data centre doors shall be minimum 1 h; the fire rating of all doors between different security zones and doors leading to information technology rooms, computer rooms, communication rooms and technical rooms shall be minimum 2 h. All doors shall be smoke-tight if early smoke detection systems are being used.

### **7.8.2 Recommendations**

Doors within access routes along which equipment and other goods are to be delivered to and from the data centre spaces should provide a minimum clearance of 2,4 m. Consideration should be given to the need for double width doors.

A combined freight and passenger lift is acceptable based on building size and occupancy. Being part of the transportation route, the size of the cabin should allow for large IT and technical components. For the height and width of a freight lift door, the criteria of interior wall openings apply. The load bearing capacity of the lift cabin should be minimum 1 500 kg. The material inside the lift cabin should be scratch resistant, e.g. brushed stainless steel.

## **8 Data centre spaces and access routes**

### **8.1 Accommodation**

#### **8.1.1 General**

The number and types of data centre spaces depends upon the size and complexity of the data centre. Consideration should be given to modular construction methods which enable future expansion.

## 8.1.2 Requirements

The provision of on-site monitoring and/or management functionality shall be considered for all data centres.

Consideration shall be given to locating toilet facilities in such a way as to minimise the requirements that the personnel has to cross the boundaries of Protection Classes.

## 8.1.3 Recommendations

The accommodation of data centre spaces should consider the impact of:

- a) new technologies (flexibility);
- b) adaptation to changing parameters (adaptability);
- c) increasing demands for space (scalability).

The spatial relationship between the different data centre spaces should facilitate the overall operation based on adjacency factors.

The floor plan should minimize the amount of demolition during any expansion phase.

The organisation of the building, the room program and floor layout should mirror the functional and security requirements of data centre operations. For the supply of the building with utility and data services this includes redundant and separate entrance rooms for telecommunication links, fuel lines, water and sewage. For the technical operation of the building this includes spaces for electrical and mechanical systems.

## 8.1.4 Data centre spaces

### 8.1.4.1 Control room space

The control room space typically houses computer system and network traffic monitors, and increasingly building automation systems and security systems monitoring equipment.

As needed, office(s) and meeting rooms should be provided adjacent to the control room space for supervisory functions and to form an emergency trouble-shooting area.

### 8.1.4.2 Computer room space

#### 8.1.4.2.1 Requirements

The computer room space shall be designed to provide adequate space for initial and predicted quantities of IT equipment and support equipment. Cabinets, racks and frames shall be aligned in rows to create aisles.

Factors to determine the location of a computer room space include:

- a) proximity to power to reduce lengths of bus bars or cabling,
- b) proximity to mechanical distribution rooms to reduce length of pipes and air ducts,
- c) proximity to the communications distribution point (carrier entrance rooms) of the building.

#### 8.1.4.2.2 Recommendations

Computer rooms should not exceed 600 m<sup>2</sup> and row length should not exceed 20 cabinets, racks or frames.

The arrangement of the rows should follow the 'cold aisle / hot aisle' methodology. Where this is applied:

- a) the fronts of the cabinets shall face each other in a 'cold aisle';
- b) the rears of the cabinets shall face each other in a 'hot aisle';
- c) for reasons of energy efficiency, maximum effort shall be made to prevent mixing of cool input air with hot exhaust air and to allow the shortest path possible for hot return air flowing back to the air conditioning units. See also EN 50600-2-3.

#### **8.1.4.3 Electrical space**

Under consideration.

#### **8.1.4.4 Mechanical space**

Under consideration.

#### **8.1.4.5 Telecommunications space**

Under consideration.

#### **8.1.4.6 Storage space**

Under consideration.

#### **8.1.4.7 Testing and holding spaces**

Under consideration.

#### **8.1.4.8 Docking bay**

Under consideration.

#### **8.1.4.9 General office space**

Office areas should be at or near the main building entrance on the building perimeter to allow outside visibility.

### **8.2 Protection**

#### **8.2.1 Requirements**

Where the accommodation of the data centre spaces and pathways connecting them lies wholly or in part below the predicted range of ground water level or is at identified risk of flooding then water infiltration issues shall be considered including:

- a) height below surrounding drainage systems;
- b) secure, continuous vapour barriers;
- c) water and vapour extraction systems.

#### **8.2.2 Recommendations**

None.

## 8.3 Floors

### 8.3.1 General

#### 8.3.1.1 Requirements

During the design phase the requirements for floor loading (including the weight of any access floors) in data centre spaces, and in access routes to those spaces, shall be determined.

Table 1 provides guidance on such loads.

**Table 1 — Load capacity guidance**

Load capacity guidance		Data centre spaces and access routes to those spaces			
		Other spaces	Electrical and mechanical spaces Computer room	Docking bay	Lifts
Floor loads	Uniform load (min)	5 kN/m <sup>2</sup>	12 kN/m <sup>2</sup>	20 kN/m <sup>2</sup>	-
	Point load (min)	2,0 kN	5,0 kN	7,5 kN	1,5 kN
Ceiling loads	Hanging load (min)	1,5 kN/m <sup>2</sup>	2,5 kN/m <sup>2</sup>	3,0 kN/m <sup>2</sup>	-

The floors and flooring materials shall be capable of supporting the required static and dynamic loads.

Flooring materials shall be resistant to the expected levels of abrasion.

#### 8.3.1.2 Recommendations

Future expansion should be considered when determining the finished floor elevation.

### 8.3.2 Access floors

#### 8.3.2.1 Requirements

The need for an access floor within any data centre space shall be considered during the design phase since it affects delivery of the infrastructures and any decision may be practically non-reversible.

Where it is desired to accommodate the pathways of the data centre infrastructures (power, environmental control and telecommunications cabling) beneath the equipment they service then an access floor shall be used in accordance with this sub-clause.

Access floors shall consist of interchangeable square or rectangular panels selected to meet specific load requirements, conforming to EN 12825. Panels shall be supported by adjustable pedestal assemblies which positively locate, engage and secure panels and which accommodate horizontal stringers. The pedestals are fixed to the floor with glue and/or bolts.

#### 8.3.2.2 Recommendations

PVC is not recommended as flooring material. Stringers should be bolted. The access floor should have a minimum clear height of 500 mm above the slab. Where, during the anticipated life of the data centre, the environmental control concept or the distribution of infrastructure precludes the installation of a 500 mm access floor, consideration should be given to access floor heights in excess of this height.



## 8.4 Ceilings

### 8.4.1 Requirements

During the design phase an assessment of the ceiling loading requirements in data centre spaces shall be made.

Table 1 provides guidance on such loads.

Where suspended ceilings are installed in data centre spaces, a ceiling system constructed from non-particulating materials shall be installed.

### 8.4.2 Recommendations

The minimum clear height of computer rooms between finished floor to ceiling or ceiling beams depends on the environmental control concept and other infrastructure details (e.g. raised floor, overhead cabling) and should be a minimum of 3,0 m.

In rooms conditioned by freely circulated air the underside of the ceiling should be even without any beams etc. If beams are present, they should run parallel to the air-flow in order not to present any obstruction to air circulation. If beams run in a right angle to the air-flow, a suspended ceiling should be considered.

Suspended ceiling systems should also be considered in areas permanently occupied by personnel (control centre, offices, lobby, etc.) for acoustical reasons. Technical rooms should not have a suspended ceiling, for the computer room and telecommunication spaces it is not recommended unless there are functional reasons, e.g. suspended ceiling space to be used for returning air.

## 8.5 Access to data centre spaces

### 8.5.1 Requirements

In data centre spaces and in access routes to those spaces along which equipment and goods will be transported, stairs shall be avoided in favour of ramps or lifts.

The width of ramps and lift doors shall be in accordance with those of doors in interior wall specified in 7.4.2.

### 8.5.2 Recommendations

None.

## 8.6 Vapour density

### 8.6.1 General

A data centre requires humidity control to maintain optimum environmental conditions for the IT and telecommunications equipment. Without humidity control, the electronic equipment can malfunction or experience unacceptable performance. Without vapour barriers, damaging ice or condensation can form behind exterior walls and under the roof during cold weather.

### 8.6.2 Requirements

A risk assessment concerning vapour seal necessities shall be conducted and measures shall be implemented accordingly. The vapour seal shall maintain a humidity level or prevent vapour infiltration to the controlled spaces.

### 8.6.3 Recommendations

Since vapour barriers are difficult to install and seal off in existing buildings, areas that could become humidified in the future should have barriers installed during new construction. Flexibility is required to facilitate any on-going expansion. Therefore, it is necessary to analyse and clearly identify the areas needing vapour barriers or may require them in the future.

## 9 Fire compartments, fire barriers and fire suppression systems

### 9.1 General

#### 9.1.1 Requirements

The data centre spaces together with the access routes and infrastructure pathways to and between those spaces shall comprise defined fire compartments bounded in three dimensions with appropriate levels of fire performance in order to prevent the spread of fire and its effluent and to minimize the extent of loss.

The selection of compartment boundaries shall take into account the impact of fire within each compartment. Fire compartments shall, at least, be defined by the boundaries of Protection Classes of EN 50600-2-5. The fire performance requirements of those boundaries are specified in EN 50600-2-5. However, the density of fire compartments may be greater than the areas defined by those boundaries.

To reduce the fire risk within a compartment, containment, detection and suppression systems are applied such that the smoke-producing and flame-spread properties of materials do not have to be considered. Where the compartment contains items of electrical equipment these systems should also be applied so that corrosive-gas-producing properties of materials do not have to be considered.

With each fire compartment, different approaches may be taken in relation to fire containment, detection and suppression. Fire containment, detection and suppression are addressed in EN 50600-2-5.

This sub-clause addresses the management of fire barriers together with the constructional aspects of fire compartments and associated spaces related to specific suppression systems.

#### 9.1.2 Recommendations

None.

### 9.2 Fire barriers

#### 9.2.1 Requirements

Fire compartments are separated in three dimensions by fire barriers with a defined fire rating performance.

All penetrations of fire barriers (e.g. walls, floors or ceilings) shall be protected by appropriate fire-stopping techniques (see EN 50600-2-5) that reinstate the original fire rating of the barrier.

NOTE Such techniques include fire-stopping materials and/or penetration sealing systems.

Fire-stopping techniques shall be installed in accordance with the manufacturer's/supplier's installation instructions. Each fire stop shall be clearly labelled or otherwise marked to indicate its function so as to be identifiable during future construction processes.

Any penetration of fire barriers (and seals supporting fire suppression systems) shall be opened only when necessary and resealed on completion of works to re-create original fire rating of the barrier. The reinstatement of the fire rating of fire barriers shall be implemented using the specified fire-stop materials and/or fire-stopping techniques.

When periods of infrastructure installation work are interrupted and unattended, the penetrations shall be at least temporarily sealed with appropriate materials (fire cushions, etc.).

### **9.2.2 Recommendations**

None.

## **9.3 Fire compartments for gaseous extinguishing systems**

### **9.3.1 Inert gaseous extinguishing systems**

#### **9.3.1.1 Requirements**

See EN 15004-1.

Where the suppression system employs the total flooding of a fire compartment, air-tightness shall be considered during design and engineering of the envelope of the fire compartments of the data centre spaces.

#### **9.3.1.2 Recommendations**

Longer standing time is recommended to create longer safe period, as fire can ignite again, when the suppression gas disappears.

### **9.3.2 Oxygen reduction systems**

#### **9.3.2.1 Requirements**

Where the suppression system employs the total flooding of a fire compartment, air-tightness shall be considered during design and engineering of the envelope of the fire compartments of the data centre spaces. The fire compartment shall be airtight according to the specified N-50 value.

#### **9.3.2.2 Recommendations**

None.

## **9.4 Fire suppression**

### **9.4.1 Requirements**

If the fire protection concept includes a gaseous suppression system, space shall be provided for the placement of storage containers of the fire suppression medium. The location of such storage facilities shall consider ease of maintenance.

### **9.4.2 Recommendations**

With most systems, the storage containers of the fire suppression medium should be installed in their own room and, depending on the fire suppression medium, in close proximity to the computer rooms.

Even if no fire suppression system is considered initially an appropriate space should be allocated.

## **10 Building configurations**

### **10.1 Design phase**

#### **10.1.1 Requirements**

Under consideration.

#### **10.1.2 Recommendations**

Under consideration.

#### **10.1.3 Areas, compartments**

##### **10.1.3.1 Requirements**

Under consideration.

##### **10.1.3.2 Recommendations**

Under consideration.

#### **10.1.4 Modularity and flexibility**

##### **10.1.4.1 Requirements**

During the design phase consideration shall be given to the use of modular prefabricated construction elements which offer the possibility to add extra elements when more space is required.

##### **10.1.4.2 Recommendations**

Multi-layered constructions such as room in room should be considered at the design phase.

### **10.2 Inter-relationship of functional spaces**

#### **10.2.1 General**

##### **10.2.1.1 Requirements**

During project initiation the requirements shall be defined by considering, as a minimum, the following:

- a) security level,
- b) capacity requirements,
- c) spatial layouts,
- d) project-specific technical and functional requirements.

##### **10.2.1.2 Recommendations**

Under consideration.

## **10.2.2 Space usage**

### **10.2.2.1 Requirements**

Under consideration.

### **10.2.2.2 Recommendations**

The entry to the computer room(s) should be positioned away from the direct access to the exterior.

See also A.2.

### **10.2.2.3 Recommendations**

Under consideration.

## **10.2.3 Computer room space**

### **10.2.3.1 Requirements**

See 8.1.4.2.1. Support equipment includes secondary or tertiary power distribution equipment, static switches, fire suppression tanks, etc. While the layout of the IT systems has priority, the data centre designer shall coordinate early on with mechanical and electrical systems engineers. A data centre may significantly change its IT equipment inventory in a 3 to 5 year period. IT equipment is typically installed in cabinets, racks or frames. The configuration of the cabinets, racks or frames and their contents shall consider requirements for flexibility of implementation over the design period.

For spacing between the rows of racks see EN 50600-2-4.

### **10.2.3.2 Recommendations**

As the core of the data centre the computer room spaces provide an appropriate physical and functional environment for the sensitive IT and telecommunications equipment in terms of floor size, shape, height, floor load and ceiling hanging load capacity, interior fit-out i.e. single person interlock, raised access floor, racks and cabinets etc.

To accommodate future expansion of the computer room space it is recommended to have expansion possibilities adjacent to the computer room inside the Protection Class 4 area. With the multitude of factors that affect the IT environment, it is difficult to plan for exact expansion needs. It is generally good to determine the expected life of the facility, look at past trends and allow for at least 20 % above the trend growth.

## **10.2.4 Telecommunications space**

### **10.2.4.1 Requirements**

Consideration shall be given to the accommodation of incoming fibre and/or copper cables. See EN 50600-2-4.

### **10.2.4.2 Recommendations**

In determining the space for the telecommunications spaces, consideration should be made for the incoming fibre and copper backbone and associated electronics, telecom switches, telecom electronic components, and fibre and copper patch and termination panels for distribution to patch panels and racks within the computer room.

## **Annex A** **(normative)**

### **Additional requirements and recommendations**

#### **A.1 Utilities**

Underground utility services are always preferred. Overhead services can only be accepted if there is more than one feed and for data centres of a lower availability class.

If redundant services are required, it is recommended that a minimum separation of 20 m be kept along the entire route. The distance between different utility feeds should be a minimum of 1,2 m along the entire route. If the distances between redundant or different utility feeds cannot be realised overall, special physical protection has to be provided.

#### **A.2 Personnel entrance and lobby**

As an intermediate room between IT rooms and public areas an entrance lobby shall be provided.

#### **A.3 Docking bay**

##### **A.3.1 Requirements**

A data centre shall have an area where deliveries can be brought into the data centre and equipment or waste can be taken out of the data centre.

##### **A.3.2 Recommendations**

Receiving rooms are located on the building perimeter wherever it is convenient. An enclosure, shading or other means should be provided for the protection of deliveries from adverse weather conditions. A loading dock should be designed for delivery truck access, as well as building design for electronic, electrical and mechanical equipment deliveries and distribution. This area should be able to accommodate all sizes of trucks. Small facilities can have exterior receiving areas, e.g. with a scissors lift. Large facilities can have interior receiving areas, e.g. with a dock leveller. The receiving area should also incorporate the ability for waste recycling.

#### **A.4 Storage rooms**

##### **A.4.1 Requirements**

Under consideration.

##### **A.4.2 Recommendations**

Storage rooms are located near receiving rooms and/or equipment rooms. Sufficient storage should be provided for all anticipated items such as paper, cabling, and hardware. In some cases, storage areas are convertible to support future electronic equipment, DC batteries, etc.

## Annex B (informative)

### Physical protection against external hazards

#### B.1 General

The physical protection against all threats from outside is one of the most important aspects of data centre buildings and computer rooms. The risk of fire, together with the heat radiation and smoke / toxic fumes generated by a fire have a direct affect on the operational safety at the data centre building and /or computer room and its availability.

Next to the aforementioned risk of fire, the IT equipment also requires high level protection against water ingress (leakage, floods, fire fighting water) and intrusion protection. The challenge is to combine the required protection level with the flexibility and modularity needed to be able to keep up with the rapidly changing and growing IT demands.

#### B.2 Building codes

All standard building codes regarding fire represent a protection level intended for the protection and safety of building occupants and minimise damage to its neighbours. A fire test is successful if the cold face of the specimen does not exceed 180 °C for the duration of the test. Although the test is successful, this temperature level does not meet IT equipment requirements. Protection of IT equipment has never been considered. Hence, protection levels stipulated by the building code are insufficient to protect areas which contain IT equipment and data storage. Also, protection against smoke and (fire fighting) water are not considered in these codes.

#### B.3 Protection for IT equipment and data storage

To meet the appropriate protection level, different types of fire protection needs to be considered:

- a) Protection against flaming and flash over (also known as Integrity). This is the fire rating according to the standard building code. Suppliers shall present a fire test report to prove the fire rating is achieved during a test. The test is successful when the temperature of the cold face of the test specimen stays below 180 °C.
- b) Protection against heat radiation generated by a fire. This is the main issue. When sourcing construction materials the selection should be based on the temperature levels which are recorded during the fire test. The recorded temperature levels can be found in the fire test report.

Calculation of the thermal performance of a material (also known as thermal resistance).

- 1) Thermal resistance ( $R$ ):

The thermal resistance  $R$  of a material is a measure of its ability to resist the passage of heat at a given material thickness. It is an effective method to determine the insulation performance. It is calculated according to Formula B.1:

$$R = t/\lambda \quad (B.1)$$

where

$t$  is the material thickness

$\lambda$  is the thermal conductivity (W/(m.K))

## 2) Thermal conductivity ( $\lambda$ )

Thermal conductivity  $\lambda$  is a measure of a material's ability to transmit heat (i.e. the heat flow in watts per meter of thickness of material for a temperature gradient of 1 Kelvin, measured in W/(m.K)). Generally dense materials have higher conductivity hence, are poor insulants. Lightweight materials have lower conductivity hence are better insulants. The lower the Lambda value the better the insulation performance.

During a fire temperatures of 1 000 °C can be reached for a certain amount of time. Fire tests represent a fire of 1000 °C for 30, 60, 90 or even 120 min (fire rating F30, F60 F90 and F120). Important is the heat load present. This is the amount of fuel which will maintain the fire.

Massive construction materials like concrete or brick walls are poor insulants due to their dense nature. Next to that these materials contain a lot of moisture, even decades after construction. When heated up on one side, the cold face of the massive wall will generate a huge amount of moisture resulting in condensation water running down. When the wall gets hot moisture will change into steam. The heat accumulated in the massive construction will generate heat radiation into the protected area and the temperature will keep rising even after the fire is put out.

In the field of protection against intrusion massive construction will perform satisfactory. Concrete walls are not often attacked by burglars. Regarding modularity and future expansion, massive construction materials will be a challenge.

Lightweight construction materials are better insulants due to their low density. They also contain less moisture hence generate less or no moisture/steam during a fire. To reach the desired fire rating its more complicated due to specific fireproof detailing at joints, door posts, wall/ceiling joint cable entries, etc.

Also in the field of protection against intrusion extra measures are required to reach the desired protection level. One of the main advantages of lightweight construction materials is flexibility and modularity. Many prefabricated solutions (sandwich panels) are available including panels with sufficient insulation values and smooth surfaces.

Fire protection of a data centre or computer room is a complicated field of protection. By just following standard building codes the achieved level of protection could be disappointing. The right fire protection for IT equipment is always a combination of choice of the proper construction materials in combination with an assessment of the heat load and the risk of fire at the outside.



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<sup>4)</sup> Draft for CENELEC enquiry in preparation.





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