

# Copenhagen

There was little in the way of building legislation prior to the 1700s, but this situation began to change in Copenhagen during the next century.

Following two extensive fires in 1728 and 1795, stricter provisions were issued concerning the construction methods and choice of materials to be used in the subsequent rebuilding and new building works.

In addition, the 1795 fire brought about the first very simple requirements for dimensions of exterior walls (according to their height/the number of floors) and beams (according to their span).

Later still – following the bombardment of 1807 – further provisions relating to materials and workmanship were issued. This applied to brickwork, for example, which thereafter could be completed of “half stone and debris” only if at least every third course was completed with whole stone and in the “proper bonding pattern”.

## **Building Act of 1856**

With the Building Act for the City of Copenhagen and its Suburbs of 17 March 1856, which came into force on 1 May of the same year, Copenhagen acquired its first amalgamated modern building legislation.

The law came into being after lengthy commission work followed by a thorough consideration in the new legislative assemblies of the Folketing (the Danish Parliament) and the Landsting. All previous provisions had been issued directly or indirectly by the Crown until the Constitution of 1849, after which time legislative work was laid down in a framework largely equivalent to that of today.

The Building Act of 1856 was pioneering in its many and clearly formulated provisions regarding the building and material conditions within mainstream (residential) construction. The provisions were also considered, at the time, to be unnecessarily extensive and detailed as well as intrusive in respect of builders' rights.

But these were provisions that were so accurately and presciently described that they would be largely applicable to the same kind of construction for more than a century – and not just in Copenhagen, as it will be seen.

The Act was also innovative in terms of building interiors. There were requirements for minimum room height (four alen, corresponding to our present requirement of 2.5 metres) as well as for access from all floors to two staircases. The fact that it was not worded precisely enough and resulted in a number of very small apartments being placed against long hallways was another matter, and one which would be resolved only some time later.

The legislation also incorporated most of the essential provisions on building in Copenhagen into a single act, with the immediate effect that a very large and unmanageable number of provisions (from previous centuries) could be lifted. This resulted in simpler and more transparent administration for builders as well as for the authorities.

The technical provisions of the Act used as their starting point (based on experience from the great fire) brick-built construction with “hard” roofs, i.e. all exterior walls to be constructed of masonry, interior walls constructed of either masonry or timber or as double board partitions, storey partitions and roof frames to be constructed of wooden structures and the roof to be covered with brick, slate or metal.

### **Exterior walls**

The provisions relating to exterior walls were determined by whether they had a load-bearing or non-load-bearing function (of joist/roof frames), as well as their role as either normal walls or fire walls.

Depending on the height and number of storeys, requirements were set for the dimension of brickwork with respect to a minimum pillar cross-section and a maximum overall size horizontally measured by window/door openings. To this were added minimum requirements for the thickness of window breasts and blinding wall brickwork.

Just as importantly, it was established that masonry was to be understood as bricks of burnt clay with specific dimensions that were built up using lime mortar.

### **Interior walls**

Provisions relating to interior walls were similar, though indirectly classed according to their function as load-bearing or non-load-bearing. Main partitions and other walls which extended over several floors were to be of brickwork in the basement and of brick or brick-lined timberwork on other floors, while walls “which did not have support from below” could be constructed as plastered plank or double board partitions.

### **Storey partitions**

Traditionally, provisions for storey partitions were related solely to joist frameworks of timber. Requirements were set for the dimensions of the (square) beam section. Minimum size, the effective span and the average distance between the beams were all determining factors.

There were also rules for the use of beams with non-square cross-sections and for the anchoring of beams to external walls. As (some) protection against the spread of fire from floor to floor, there was a requirement for pugging between beams to be made of wood sheathing covered with clay, and, at the same time, there was a ban on constructing ceilings of canvas or paper alone stretched under or between the beams.

### **Roofs**

Provisions relating to roofs were similarly linked to the traditional methods of constructing roof frames from wooden structures and were based on “span roofs” (saddle or pitched) as well as on a wealth of designs and designations according to their construction and connection to the tie beams.

In addition, the requirements for roof timbers were formulated in an entirely similar manner to those for the joist timbers.

However, unlike the joist timbers, where the effective span of the timber was unequivocally determined by the distance between the load-bearing walls, the corresponding distances in the roof frame were calculated partly by the horizontally measured span of the rafters and partly by the distance between the joints of constituent parts. By way of example, the joining of the rafter, collar beam and reciprocal rafter was counted as

a support. When the usual underpinning of the collar beam was present, this method resulted in such small spans that the roof frame could principally be constructed with the minimum required dimensions.

In determining the maximum building height – taken to the upper part of the roof frame – it was decided that the maximum permissible roof inclination should be 45 degrees, and, for single-pitch roofs, an additional requirement was set for the maximum height of the ridge.

As something new, a regulation was introduced giving permission to increase the building height alongside a simultaneous lowering of the roof ridge by a ratio of 1:2. In extreme cases, this resulted in an almost horizontal roof finished at the sides with a 45-degree inclined roof pane, with the flat section being covered with zinc.

### **Foundations**

Provisions for foundations were extremely sparse in relation to the requirements described above: “Every new building must be constructed on a foundation which is justifiable in relation to the building’s size and determination and to the nature of the building itself and the ground itself.”

With the addition of a few numerical quantities independent of the associated conditions relating to materials and workmanship, the provision would, in fact, be fully in line with later legislative principles of function-related requirements.

The rationale behind this paragraph’s formulation was quite simply down to the wide variation in foundation conditions across the city. But it was also in every builder’s personal interests to use the best foundations possible, precisely because this building element was of such importance to the entire investment.

### **Building Act of 1871**

Copenhagen was given its next building act on 21 November 1871, and with its simple title, Building Act for the City of Copenhagen, the reason for its adoption was clear: one set of rules would apply to the whole of the city, albeit with a few exceptions concerning the density of development.

Little was changed in respect of the provisions that were of a technical nature. The requirements for the dimensions of exterior walls without openings – the gable and back walls at the property boundary – were relaxed slightly.

Storey partitions would thereafter need to be “plastered or clad with some non-flammable material” when they divided rooms with fireplaces/stoves and have a certain minimum room height. The minimum room height was greater than the minimum required. In practice, this meant that all ceilings in standard Copenhagen multi-storey housing were to be constructed of a layer of boards mounted on the underside of the joists and finished with plaster.

The requirements in the provisions for dimensioning the roof frame timbers were relaxed slightly by indicating a larger starting span.

There was permission to raise the street-facing facade above the normally applicable maximum building height. When combined with the previously mentioned rule about increasing the building height and simultaneously lowering the roof ridge, this led to the

widespread adoption of the so-called “Copenhagen roof”.

The provisions on foundations removed the reference to “the ground”, as this was superfluous. A new provision was introduced to apply a damp-proof layer to the foundations/walls “where they protrude freely over the ground”.

For both the 1856 and 1871 Acts, their administration often demanded a stricter stance in respect of the contents of individual paragraphs. This led to a not insubstantial exchange of letters between the local housing committee, city clerk of works and building inspectors – and also with the Ministry of Justice when the final decision demanded it.

Such exchanges of letters are not immediately accessible in an assembled form, but should (still) be available in the archives of either the city clerk of works or in the city archives.

### **The 1875 Addendum**

Even during the consideration of the 1871 Act there had been strong criticism of the density of previous development and that which would follow the revision.

It led to yet another revision of the law: with the Act of 21 November 1875, three paragraphs concerning the requirements for open space and building height and distance were amended.

In particular, provisions on open space in front of windows would play a crucial role in subsequent construction work.

Such distances were measured perpendicular to the facade section in which windows were placed, and with the requirements otherwise applicable to the building’s open space, this resulted in a wealth of ingenuity in terms of the indentations and turnings applied to facade sections facing the courtyard area. This led in many instances to civil engineering solutions of a more individual nature than before.

### **Building Act of 1889**

During the parliamentary consideration of the 1875 addendum to the Act, it had become clear that the revision (in itself, barely a few years old) could easily have been more extensive. The 1871 opportunity should have been used to carry out a much more thorough inspection of the 1856 Act – a view which was formulated against the backdrop of the huge amount of construction that had taken place in the period up to the middle of the 1870s.

In 1880, following its approval by the city council and finalisation in the Landsting, the proposal for the new building act reached the Danish Parliament. And here it remained for almost a decade due to the political conditions under Estrup’s “provisional government”.

Consideration of the bill was resumed only in 1888, and in the spring of the following year, the Building Act of 12 April 1889 for the City of Copenhagen was finally passed, entering into force on 30 June of the same year.

Fundamentally, the Building Act of 1889 was a continuation of the two previous acts. Even so, a number of new provisions had been added and many of the provisions that had been carried forward were tightened.

The most important new aspects relating to the interior design of buildings were the requirement of access to daylight in the living areas and determination of their (minimum) size, as well as a requirement for unobstructed access from each residential apartment to two staircases.

In terms of building technology, the Act was generally seen as a tightening of the existing provisions.

### **Exterior walls**

New was the requirement for full-thickness facade walls in the basement, where thinner window breast masonry had previously been accepted in the absence of provisions thereon. Provisions were introduced on the maximum width of window and door openings.

### **Interior walls**

As far as the interior walls were concerned, there were significant changes. Main partitions and walls around staircases should now be constructed of brick of specified dimensions. The dimensioning of other brick-built interior walls was subject to rather detailed provisions, based on their width and height.

### **Storey partitions**

Storey partitions still had to be constructed of timber beams. Where effective spans were increased, requirements for the size of beam sections were tightened, and there were provisions on the maximum size of the rough edge of beam timbers.

There were requirements for the minimum dimension of floor and pugging boards, and a requirement for pugging boards to be fitted tightly together.

Above and below damp rooms or rooms that might be particularly prone to the risk of fire, there was a requirement for the use of kappedæk.

### **Roofs**

The requirements for joist and roof frame timbers were tightened. As a new requirement, wood sheathing was to be inserted between the rafters where the attic was designed as a living space.

### **Foundations**

The requirement for the installation of a damp-proof layer between the foundations and (basement) exterior wall was extended to apply to all walls in the basement or lower floor. In the basement walls, a damp-proof layer was also required to be installed at the intersection with the ground as well as vertical damp-proofing between these two horizontal layers.

### **Building Act and Statute of 1939**

In 1898, work began on the drafting of a new act. It was completed in 1908 and revised in 1915. It never went beyond an initial reading by a committee of the Landsting, in part due to the First World War and then the Great Depression of the 1930s.

Whereas in the 1880s people had been limited to (cold) water in the kitchen, a drain (external) from the kitchen sink and perhaps gas for the purposes of cooking, the range of utilities available in residential buildings quickly increased thereafter. Most of the new buildings of the 1930s had the same range of utilities that we have today.

The use of iron and concrete structures had become widespread. A number of new products had been introduced and the manufacture of building materials had become largely mechanised, and the same conditions as in other industries were slowly starting to be adopted.

The transportation of materials was no longer limited to movement by ship and horse-drawn vehicle. The country's rail network reached its greatest extent around 1930 and lorries had taken over transport by land – in cities at least.

Advancements in the technical sciences and an increased knowledge of the design and operation of structures and materials began to leave their mark on traditionally determined usage and workmanship.

Social development starting in the 1880s and spanning the next fifty years had also helped to increase the demand for standards in housing and its immediate surroundings. Although this development had not led to significant changes in the general design of apartments, it had on the other hand significantly influenced the design of residential areas and building forms.

The Act of 1889 was not explicitly designed to manage this situation, and over time this had led to a multitude of decisions (local as well as ministerial and judicial) on applications for exemptions from and alternative interpretations of the Act. Over 400 supplementary or clarifying provisions were drawn up by the city clerk of works alone, and these were compiled in a so-called "grey book". But this was intended for internal use only and was not directly available to the public.

The foreword to the Handbook of Building Legislation for Copenhagen and Frederiksberg – with a Supplement Containing the Building Act for Market Towns (E. Sivertsen, 1928) states as follows:

"The purpose of this book has been to submit to the public, in a complete and workable form, a presentation of the Copenhagen and Frederiksberg building legislation, as contained not only in the acts themselves but also in their many provisions...: and whatever has been clarified by the annually growing body of administrative and judicial decisions, is simultaneously lost in its organisation."

In the meantime, the principal parties of the building trade continued to be those who represented the traditional materials of stone and timber and who still practised according to traditional working methods.

The emergence of the utilities had merely led to more, though not particularly well-defined, professions. A few of the more commonly used new materials and structures were incorporated into the existing trades, and work on the building site was largely organised as before. This was taken into account during the drafting of the new act. The really new aspects were of limited importance from a purely technical point of view. The brick-built and otherwise traditionally constructed house was still taken as the starting point.

As something new, the more technical provisions were set out in a building statute, which by its nature could be changed relatively quickly as needed without the involvement of parliament. In order to expedite future desirable changes of a technical nature, a third section was introduced: Regulations. These merely required approval from a magistrate.

Of the 21 regulations set out in the building act, they included six strictly technical conditions relating to the execution of masonry, concrete stairs with enclosed/built-in steps, reinforced concrete structures, the insulation and rust-proofing of iron structures, foundations and bathrooms.

Five of the regulations concerned installations such as drains, ventilation, central heating, gas stoves and technical installations in general.

As before, the provisions of the 1939 act also required elaboration. Whereas previously this had simply been a matter of an internal letter exchange, once the Act had entered into force, the Directorate for the City Clerk of Works started a continuous flow of information by releasing regular "Communications from the Copenhagen Building Authority" (Meddelelser fra Københavns Bygningsvæsen: abbreviated to MKB).

These communications addressed actual problems and precautions taken in connection with both new building works and the maintenance and renovation of existing buildings.

More basic and/or general problems of a technical nature were also relayed in this manner. In fact, in accordance with the regulations, this was a fourth part of the building provisions for Copenhagen.

The Copenhagen Building Act and Statute of 1939 were in force right up to 1977. The technical provisions in the statute were mostly based on the provisions of the previous act, but in a few cases had been either relaxed or tightened.

Above all, the scope of the provisions was expanded, and in terms of content they were far more detailed than had previously been the case. The following descriptions of the changes are therefore more summarised in nature than the earlier ones.

### **Exterior walls**

The requirements for exterior wall construction were (indirectly) classed according to two categories: buildings with up to two floors and buildings with three to six floors. There were relaxations in both categories.

For the latter, the dimension requirements for (load-bearing) facade walls were relaxed in return for a simultaneous prohibition on continuous brick walls of equal thickness in both floors. (These relaxations had already been partially implemented at national level at the start of the 1920s, cf. later.)

The closing over of window and door cavities with wooden planks was prohibited. Load-bearing walls without openings (rear walls) and non-load-bearing walls (gables) were allowed to be constructed as hollow walls with stone ties in the upper floors. Exterior walls against stairways could thereafter be constructed with the same dimensions on all floors without making a special application.

Finally, there was also a requirement for the thermal insulation capacity of exterior walls: 1½-brick solid walls or walls with similar properties were stipulated as a minimum.

### **Interior walls**

For load-bearing internal walls (main partitions) the requirements relating to their dimension and height were relaxed and tightened respectively, and there were provisions for the maximum total extent of (door) openings in the same.

There was a requirement for the minimum dimension of walls on stairways constructed of enclosed concrete steps. (The possibility of a single-staircase system where this was fireproof had already been introduced at a national level – cf. later.)

The use of lightweight non-load-bearing internal walls constructed of boarding materials was permitted under more detailed provisions relating to their construction and maximum extent.

A new requirement was introduced whereby, if the building's size exceeded a limit determined either by the length of the facade or the area of the individual floors, the building sections were to be separated by firewalls. Furthermore, requirements were set for the demarcation of apartment walls for soundproofing purposes.

In addition to a maximum floor height and number of floors, and as a prerequisite for the stated requirements for load-bearing masonry walls, a maximum beam span and a minimum distance between transverse and supported walls were specified.

It was clearly stated that the specified minimum dimensions were not to be reduced by way of recesses or carvings. Otherwise, it was demanded that "the strength must be duly demonstrated in every single case".

With regard to masonry in general, there was an immediate opportunity for using smaller dimensions in some places by applying lime-cement mortar instead of lime mortar, and the emerging use of basement walls cast in concrete as an alternative to masonry led to requirements for the strength of said concrete.

### **Storey partitions**

Previously stated provisions on storey partitions constructed of wooden joists were expanded further, without being tightened in relation to the general good practices that had been developed over the years.

The first simple provisions were given on the use of iron in joist frameworks. In addition to references being made to the provisions for wooden beams, there were requirements for the approval of construction details and of calculations for the load-bearing capacity of the beams.

The same applied for bays and balconies whose construction involved the use of iron and did not deviate from otherwise normal practice.

On the use of reinforced concrete, reference was made to the provisions in the regulations, etc. This also applied to similar constructions when, in terms of structural and fire safety and thermal and sound insulation, they could be considered adequate (understood as at least equivalent to the properties of the wooden joists).

A requirement was made that storey partitions against the outside (e.g. over doors) or over rooms where hot temperatures developed (e.g. over boiler rooms) should be heat-insulated "in the proper manner", though without giving further clarification.

## **Roofs**

Roof regulations were also based on those for timber structures. They still used the saddle roof as their starting point, but were otherwise described in more detail than before.

With the introduction of new non-traditional roofing materials, there were differentiated requirements for the dimension of included timber according to the weight of the roof covering. A distinction was made between heavy and light, where all but those coverings made from tile were considered to be light.

All other roof structures and the use of materials other than wood would (still) be separately approved.

Roof surfaces that restricted living space were subject to minimum requirements for thermal insulation (two layers of 19 mm boards with felt or similar inserts).

## **Foundations**

Provisions relating to the supporting of load-bearing and non-load-bearing walls referred to elsewhere in the statute were extensively described.

The construction of foundations was described partly by the requirements for the use and minimum dimension of concrete with specified properties and partly by the assumption of a central load and a prescribed maximum bearing capacity of the ground.