CIVIL DEFENCE.

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Air Raid Shelters.

ORDER, DATED THE 21ST DAY OF AUGUST, 1942, MADE BY THE MINISTRY OF PUBLIC SECURITY UNDER SECTION 11 OF THE CIVIL DEFENCE ACT (NORTHERN IRELAND), 1939.

1942. No. 127.

WHEREAS by the Civil Defence (Approval and Revision of Code) Order (Northern Ireland), 1939, a Code for the guidance of occupiers and owners of factory premises, factories and commercial buildings and other persons concerned in providing air-raid shelter was approved and revised so as to bring the said Code into conformity with the Revised Code set out in the Schedule to the said Order :

AND WHEREAS the said Revised Code was further revised by the Civil Defence (Revision of Code) Order (Northern Ireland), 1940 :

AND WHEREAS it is expedient that the said Revised Code should be further revised :

NOW, THEREFORE, the Ministry of Public Security in exercise of its powers under Section eleven of the Civil Defence Act (Northern Ireland), 1939, and subsequent enactments and of all other powers enabling it in that behalf hereby orders and directs as follows :—

1.—The said Revised Code shall be amended by such revocation and variation of and addition to its provisions as are necessary to bring the said Revised Code into conformity with the Amended Code set out in the Schedule hereto.

2.—The Interpretation Act, 1889, as applied to Northern Ireland by the Interpretation Act, 1921, shall apply for the purpose of the interpretation of this Order as it applies for the purpose of the interpretation of an Act of Parliament.

3.—This Order may be cited as "The Civil Defence (Amendment of Code) Order (Northern Ireland), 1942."

Sealed with the Official Seal of the Ministry of Public Security for Northern Ireland this 21st day of August, One thousand nine hundred and forty-two, in the presence of

(L.S.) *E. W. Scales*,
Secretary.

SCHEDULE.

AMENDED CODE (SECTION 11 OF THE CIVIL DEFENCE ACT (N.I.), 1939) FOR THE GUIDANCE OF OCCUPIERS AND OWNERS OF FACTORY PREMISES, FACTORIES AND COMMERCIAL BUILDINGS, AND OTHER PERSONS CONCERNED.

PART I.

REQUIREMENTS WITH WHICH SHELTER MUST COMPLY.

1. *Definitions.*—For the purposes of this Code the following expressions shall have the meanings hereby respectively assigned to them :—

" Air Raid Shelter " means protection otherwise than by war-like means or by any article of apparel, from hostile attack from the air, and " an air raid shelter " means any premises, structure or excavation used or intended to be used to provide air raid shelter.

" Surface Shelter " means an air raid shelter situated wholly above ground (or on the lowest floor if in a building) constructed as an independent unit to accommodate not more than 50 persons, and designed to the satisfaction of the Ministry in the form of a reinforced box-like structure.

" Trench Shelter " means an air raid shelter in the form of a covered trench or tunnel below or partly below ground level.

" Accommodation " relates to the number of persons to be accommodated in an air raid shelter or in any section or compartment thereof.

" Prescribed stresses " shall mean the maximum permissible working stresses specified,

(*a*) in respect of reinforced concrete, in the " Recommendations for a Code of Practice for the use of Reinforced Concrete in Buildings " of the Reinforced Concrete Structures Committee of the Building Research Board,

(*b*) in respect of steel, in British Standard Specification No. 449-1937 (" The Use of Structural Steelwork in Buildings "),

(*c*) in respect of pressures on load-bearing concrete and masonry (brick and stone), in " Notes on the Use of Materials and Construction in Connection with Steel Structures " appended to B.S.S. 449-1937,

(*d*) in respect of timber, in " Byelaws for the Use of Timber " made by the London County Council on the 30th November, 1937. (*See* Appendix II.)

" Sound brickwork " means brickwork consisting of sound, well-fired clay bricks, or cement concrete bricks, having a crushing strength of not less than 1500 lbs. per square inch when tested in accordance with the methods laid down in the second schedule of Ministry of Health Model Byelaws, Series IV, Buildings, 1939 (see Appendix I), or sand-lime bricks complying with the requirements of British Standard Specification 187-1934 for building bricks Class A, properly bonded and jointed in mortar which is properly set and hardened.

"Brickwork in cement mortar" means brickwork consisting of bricks as described above for sound brickwork, properly bonded and jointed in cement mortar not weaker than one volume of cement to three volumes of sand.

"Sound stonework" means coursed natural or cast stone masonry in sound condition.

"Structural concrete" means concrete of a quality permissible under the recommended Code of Practice for the use of Reinforced Concrete in Buildings of the Reinforced Concrete Structures Committee of the Building Research Board, consisting of not less than 112 lb. of cement, complying with the requirements of British Standard Specification No. 12-1931 or of British Standard Specification No. 146-1932, to 2½ cubic feet of suitable fine aggregate and 5 cubic feet of suitable coarse aggregate.

"Reinforced concrete" means structural concrete as described above, reinforced in accordance with the Code of Practice, such reinforcement amounting in each cubic foot of concrete to not less than 2 lb. of steel total (exclusive of laps and hooks), suitably distributed in the concrete, of which total at least 0.7 lb. is distribution steel at right angles to the main steel.

"Reinforced," in relation to brickwork in cement mortar, or structural concrete means reinforced with steel.

"Steel" means mild steel complying with the requirements of British Standard Specification No. 15-1936.

2. *Lateral and overhead protection.*—An air raid shelter must be of such construction as to give

(*a*) Lateral protection by means of not less than :—
- (i) 1½ in. thickness of mild steel plate or plates,
- (ii) 12 in. thickness of structural concrete,
- (iii) 13½ in. thickness of sound brickwork or sound stonework,
- (iv) 2 ft. thickness of ballast or broken stone,
- (v) 2 ft. 6 in. thickness of earth or sand, or
- (vi) a corresponding aggregate thickness of a proportionate combination of such materials ; and

(*b*) Overhead protection, subject to the requirements of paragraph 3 and 4 for protection from falling debris, by means of not less than :—
- (i) ½ in. thickness of mild steel plate,
- (ii) 6 in. thickness of structural concrete reinforced if and as necessary or otherwise suitably strengthened or effectively supported,
- (iii) structural concrete in the form of precast solid units of not less than 6 in. thickness, reinforced as necessary and adequately supported,
- (iv) 8½ in. thickness of arching in sound brickwork or sound stonework,
- (v) 3 ft. thickness of ballast, broken stone or earth,
- (vi) a corresponding aggregate thickness of a proportionate combination of such materials, or
- (vii) a substantial building overhead consisting of a roof and not less than three floors (including that covering the shelter) where such structure is enclosed with walls of brick, stone or concrete.

Provided that, subject to the approval of the Ministry, other materials of such thickness as it may prescribe, may be used to give protection.

The material affording overhead protection must in all cases be such, or be so secured, as to resist an upward force of 300 lbs. per square foot of horizontal internal surface.

The lateral protection must extend throughout the height of the air raid shelter, except as specially provided hereafter, and similarly the overhead protection must extend over the whole area of the air raid shelter.

Provided that in the case of an air raid shelter formed by the adaptation of existing accommodation, wholly above ground, within a building, where the aggregate area of door and window openings in any one wall of a shelter compartment does not exceed

one-quarter the surface area of such wall and the total width of such openings does not exceed one-third the total length of such wall, it shall suffice if the protection in such openings extends to a height of 6 feet above the floor of the air raid shelter, subject to movable protection being provided to the space above, such protection consisting of timber shutters not less than 2 inches thick or mild steel shutters not less than ¼ inch thick or other approved material; or it shall suffice if the openings are protected by a screen wall or walls giving the lateral protection required under paragraph 2 above, situated not more than 6 feet from the face of the wall of the shelter and extending beyond such openings for a distance sufficient to prevent the entrance of splinters, this latter requirement being deemed to be met where the extent of such screen beyond the opening is not less than its distance from the opening. Where the lateral protection to glazed openings is situated on the outer side of the glass, adequate precautions must be taken against danger from flying splinters of glass by the provision of suitable screens on the inner side.

3. *Protection from falling debris.*—Adequate provision must be made to afford protection from falling loads due to the collapse of any structure over an air raid shelter or within a distance from such air raid shelter equal to one-half the height of such structure, by the provision of a floor or by the strengthening of the existing floor where necessary or by a suitable roof or other construction based on an estimated static loading as representing the effect of impact, to the satisfaction of the Ministry.

Provided that where such falling loads would not include heavy machinery, materials and goods of abnormal weight, nor such constructions as chimney-shafts, towers, heavy colonnades, pediments or cornices, but would comprise only the loads of a normal structure and superimposed loading of ordinary goods or light plant and equipment, it shall suffice if, for purposes of calculation, the falling loads be deemed to be static loads in accordance with the following requirements :—

(*a*) For buildings wherein the loads are carried on load-bearing brickwork or stonework :—

Number of Storeys at a Higher Level than the Top of the Shelter.	Minimum Static Load (in addition to the Floor Load) to be assumed to represent the effect of the Debris. lb. per square foot of Floor Area.
None, 1 or 2	200
3 or 4	300
over 4	400

(*b*) For buildings wherein the whole of the loads are carried on steel or reinforced concrete framing, the effect of the debris load may be assumed to be a static load of 200 lb. per sq. ft. of floor area (in addition to the floor load) irrespective of the number of storeys at a higher level than the top of the shelter.

For the purposes of this clause, the expression " floor load " means the combined dead and superimposed floor load calculated in accordance with the Ministry of Health Model Byelaws, Series IV—Buildings, 1939 (See Appendix I).

External air raid shelters must in all cases be protected from falling debris, projected from a distance, by providing for a static roof loading of not less than 200 lb. per sq. foot.

4. *Stability.*—All new constructions, extensions, additions and alterations in connection with air raid shelters must be so executed that all loading occasioned thereby shall be safely sustained and transmitted to the ground without exceeding the limitations of the prescribed stresses.

Any structure specially erected as an external air raid shelter must be in the form of a surface shelter if wholly above ground, or of a trench shelter if wholly or partly below ground.

In surface shelters, if the lateral protection is provided by brickwork or concrete, this protection must be by brickwork in cement mortar, by structural concrete or by a combination of these materials, and must be reinforced with mild steel vertical rods

of not less than ¾ inch diameter, arranged in two rows, spaced at not greater than 18 inch centres in each row and staggered. These rods must extend 4½ inches upwards into the roof slab and then at right angles a further 1 ft. 3 ins. within the roof slab. The lateral protection of the shelter must also be tied to the floor slab by two rows of mild steel dowel rods of not less than ¾ inch diameter, at approximately 9 inch centres between pairs, extending 1 ft. 9 ins. upwards into the walls and 4½ inches downwards into the floor slab, and then at right angles a further 1 ft. 9 ins. within the floor slab.

The overhead protection to these types of surface shelter must be cast-in-situ structural concrete at least 6 inches thick reinforced as necessary to resist the prescribed debris load. The floor slab must be constructed of cast-in-situ structural concrete at least 6 inches thick, with steel reinforcement having the main rods spaced at not more than 8 inch centres and weighing not less than 2¾ lbs. per sq. yard, and having the longitudinal rods spaced at not more than 18 inch centres and weighing not less than 1 lb. per sq. yard.

The whole structure must be separated from an even consolidated sub-floor by a cleavage plane.

Surface shelters may be constructed in alternative designs and materials, but in all cases the structure must be of a "box-like" form able to suffer severe distortion without collapsing.

All surface shelters must be designed so as to resist a lateral live load of 200 lbs. per foot run of shelter acting at the roof level, in addition to the prescribed debris loading. They must be separated as widely as the site conditions permit, and should not be sited immediately adjoining any other substantial structure.

Except where executed in hard rock, trench shelters must be provided with linings consisting wholly of in-situ structural concrete with continuous reinforcement in walls, floor and roof; such linings must be designed and constructed in accordance with normal engineering principles as a box section, in such manner as safely to resist, in addition to the superimposed load, a lateral load varying in intensity from 200 lbs. per sq. ft. at the roof to 400 lbs. per sq. ft. at the base, or such greater loads as the Ministry may consider it necessary to provide for.

Except in the case of a surface shelter or trench shelter, any air raid shelter provided in a building of a type other than that described in 3 (*b*) above must have the roof supported by a system of strengthening designed in structural steelwork, independent of the existing structure and capable not only of resisting the debris loads specified in para. 3 (*a*) but in addition a horizontal load applied at shelter ceiling level. This load should be assumed as a normal force of 200 lbs. per foot run acting on any side of the shelter, subject to the provision that the total maximum working stresses in the steelwork may exceed the prescribed stresses by not more than 33⅓ % in cases where the excess is due solely to the horizontal loading of 200 lbs. per foot run. All parts of the strengthening system must be kept at least 12 ins. from surrounding walls forming the lateral protection of the shelter.

In the case of air raid shelter provided in framed buildings as described at 3 (*b*) above, if strengthening is necessary this must be carried out by providing an adequate system of structural steel or reinforced concrete intimately connected with the existing structural framework of the building.

5. *Gas-proofing.*—Every air raid shelter providing accommodation for more than twelve persons must be so constructed as to permit of its being rendered gas-proof without structural alteration should the need arise.

6. *Space required in shelters.*—The accommodation of an air raid shelter must, subject to the ultimate limitations specified in paragraph 7, be determined in accordance with the following rules, that is to say :—

(1) (*a*) In the case of a shelter accommodating not more than twelve persons, or (*b*) in the case of a trench shelter having openings at both ends of each section into the open air, or (*c*) in the case of a shelter wholly or partly above ground accommodating not more than 50 persons and freely ventilated by two entrances connecting directly or indirectly with the open air, it must have for every person accommodated not less than 3¾ sq. ft. of floor area. Provided that any such shelter which is used as a dormitory must have for every person so using it not less than 6 square feet of floor area and not less than 50 cubic feet capacity.