

ACEI Advice Note to Structural Engineers: Blockwork

1 Introduction

1.1 This Advice Note has been prepared by the ACEI Structures Committee to provide information to members on certain matters relating to concrete blockwork (aggregate concrete masonry units). Recently, the durability and compliance of concrete block has become a significant industry issue and, in certain geographic areas, structural problems have arisen due to the presence of deleterious materials (predominantly pyrite/sulphides/pyrrhotites) and muscovite mica) in aggregates used to manufacture concrete blockwork.

1.2 Concrete blockwork is a complex composite material, containing aggregates which can contain naturally occurring materials such as Mica and/or Pyrite. There is an understanding in relation to Pyrite and its oxidation in the presence of moisture and Sulphur, producing gypsum, which can result in swelling and which may cause damage. Where Mica is responsible for damage to structures, it does so by a different mechanism. Mica is a hygroscopic material - it attracts and stores water and makes blockwork containing mica susceptible to freeze / thaw action. The degree of susceptibility and resistance to freeze / thaw action is dependent on the extent of Mica present and the strength and density of the blockwork unit. There is currently no Irish or European harmonised standard advising a limit on the percentage or volume of Mica that can be present in Blockwork.

2 Guidance & Relevant Standards

2.1 Members are advised to refer to the April 2022 document '***A Guide to the Marketing and Use of Aggregate Concrete Blocks to EN 771-3 in Ireland***' published by the Department of Housing, Local Government and Heritage. This document provides guidance to economic operators (manufacturers, importers and distributors) on the marketing of aggregate concrete blocks to EN 771-3 standard (as a harmonised European standard under the Construction Products Regulation (CPR)). It also outlines the responsibilities of specifiers, designers, builders, certifiers and end users for compliance with current Building Regulations. This guide sets out the details of the relevant Harmonised European Standards and National Provisions that provide the technical basis that enable manufacturers to provide the Declarations of Performance (DoP) required under the CPR and include the following:

- Concrete blockwork manufactured to meet the requirements of I.S EN 771- 3:2011+A1:2015 –Specification for Masonry Units: Aggregate Concrete Masonry Units (Dense and Lightweight Aggregates).

- Aggregates used in the manufacture of concrete masonry units are required to comply with I.S. EN 12620:2002+A1:2008- Aggregates for Concrete.
- Standard Recommendation 16 (S.R. 16;2016) is the Irish national guidance on the harmonised standard, I.S. EN 12620:2002+A1:2008, which defines the characteristics and properties required of aggregates for concrete, and with which all such aggregates must comply. This includes aggregates used in the manufacture of concrete blocks.

2.2 The above standards are referenced in BR TGD Part A Structures and Section 1.1.3.5 stipulates that solid concrete blocks should be Group 1 masonry units conforming to I.S. EN 771-3. SR 325: *Recommendations for the design of masonry structures in Ireland to Eurocode 6* is also a key document for designers with reference to all aspects of blockwork design, including durability.

The NSAI Aggregates Panel is currently reviewing SR16:2016 with specific working groups reviewing matters such as geology/petrography, sulphur and fines quality, fines content, freeze / thaw, water absorption and recycled aggregates and some research is being undertaken in relation to blockwork durability issues.

3 Responsibility for Compliance with Construction Products Regulation (CPR)

3.1 The manufacturer of aggregate concrete blocks is responsible for compliance with the CPR and in particular for the DoP and CE marking of the construction product placed on the market, having full knowledge of the raw material, implementation of a factory production control system (certified by a notified body), and having regard to the end product’s suitability for use in construction works in accordance with the relevant Standard Recommendation published by the NSAI and other performance criteria specified in Technical Guidance Documents to the Building Regulations 1997 to 2021.

3.2 In 2017 the Report of the Expert Panel on Concrete Blocks noted the following: “The Panel suggests that the extractive and concrete products industry assess their onsite quality control measures to ensure full compliance with their legal obligations, relevant harmonised standards, that their products are always fit for purpose and suitable for the conditions in which they are to be used.”

4 Roles and Responsibility

4.1 The relevant documents that set out the roles and responsibilities of economic operators (manufacturers, importers and distributors), specifics, designers, certifiers and building owners are:

- **'A Guide to the Marketing and Use of Aggregate Concrete Blocks to EN 771-3 in Ireland'** (April 2022) Department of Housing, Local Government and Heritage (DoHLGH)
- **'Code of Practice for Inspecting and Certifying Buildings and Works'**, (Sept 2016) - Department of Housing, Planning, Community and Local Government

4.2 The Code of Practice for Inspecting and Certifying Buildings and Works states that the Builder should:

- Ensure that the materials they select and for which they are responsible comply with the requirements of the Building Regulations and are proper materials which are fit for the use for which they are intended and for the conditions in which they are to be used.
- ensure the co-ordination and provision of all test certificates and confirmations (for which he is responsible) to the satisfaction of the Assigned Certifier or other designated inspector or certifiers providing Ancillary Certificates
- check the DoP and make it available for inspection by others (Assigned Certifier, Ancillary Certifiers, Inspectors, etc.)

4.3 Manufacturers of aggregate concrete blocks are responsible for compliance with the CPR and in particular for the DoP/CE certification of the blockwork products being placed on the market.

4.4 Designers should design and specify the elements of work for which they are responsible in accordance with the applicable requirements of the Building Regulations and when specifying aggregate concrete blocks should:

- refer to the harmonised European standard (EN 771-3), and specifically to the requirements of individual characteristics for the particular end use.
- review the manufacturer's Declaration of Performance, which has been checked and made available by the Builder
- check S.R. 325, S.R. 16 and Technical Guidance Documents (TGDs) which give guidance on appropriate minimum performance levels for specific intended uses of the product in Ireland

5 Blockwork Testing

5.1 It is the ACEI's advice that members have no duty to specify material testing of blockwork for any performance criteria of those essential characteristics which are related to the intended use of blockwork, including deleterious materials. It is the responsibility of suppliers and manufacturers to provide CE Certification and Declarations of Performance (DOP) to demonstrate compliance of the

blockwork products with the relevant European harmonised standards. Example documentation tailored for concrete blocks are provided in section 3 of the DoHLGH publication '***A Guide to the Marketing and Use of Aggregate Concrete Blocks to EN 771-3 in Ireland***' illustrating the information that should be provided by the manufacturer.

5.2 Where clients or end users require any further confirmations in relation to the suitability of blockwork products material for its proposed end use, they should seek specialist advice and a statement of compliance for the suitability of the material from a '*Competent Person*', defined in SR 16:2016 Annex C as a Professional Geologist. Table A1 in SR16:2016 (Annex A) lists recommended values/categories and test methods for aggregates used to manufacture concrete masonry units. Annex C also provided guidance on the geological and petrographic assessment of concrete blockwork products.

6 Blockwork Durability

6.1 If Blocks are stored externally (either in the manufacturing facility or on site before use), are used in rising work below ground level with or without high water table, or if external renders do not offer adequate weather protection, the blocks may become saturated. In these cases the resistance to freeze / thaw action is reduced, possibly significantly. There is no current approved testing method for freeze / thaw action in blockwork or a limit on the coefficient of water absorption within current Irish or European standards.

6.2 Recent research and testing of blockwork samples taken in-situ in Irish exposed conditions has demonstrated high moisture content levels in rising blockwork and the blockwork outer leaf constructed under normal conditions freeze / thaw action can damage masonry depending upon the blockwork's susceptibility to such damage on freezing in a wet or saturated condition. Where low strength blocks have been used, results of freeze / thaw testing demonstrates that significant deterioration of concrete blockwork can occur over relatively few freeze / thaw cycles.

7 Minimum Strength of Concrete Blockwork

In the context of the significant durability issues (including those associated with pyrite / sulphides / pyrrhotites and muscovite mica) and in the absence of updated national standards, it is the ACEI's opinion that particular attention needs to be given by designers to the specification of minimum strength of concrete blockwork where such units are likely to either become and remain saturated or partially saturated for periods of time (refer to SR 325:2013+A2:2018, Table 14). It is accepted that increasing blockwork strengths, densities and cement content provides a harder and more durable block. Technical Guidance Document A (TGD A) requires that solid concrete blocks should be

Group 1 masonry units with a mean compressive strength of 7.5N/mm^2 . This minimum standard of TGD A does not comply with the requirements of SR 325:2013+A2:2018, Table 14 of which requires blocks of declared mean compressive strength of 13 N/mm^2 for:

- Work below or near external ground level with a high risk of saturation with freezing, and
- Unrendered external walls.

The ACEI Structures Committee recommends the following for blockwork with a high risk of saturation and freezing:

- Blocks used below or near external ground level and in external walls should have a declared mean compressive strength $\geq 13\text{N/mm}^2$
- Concrete blocks should be Category 1 masonry units of approved manufacture to I.S. EN 771-3. Solid blocks for all rising walls and external walls, both the inner and outer leaves, should be Group 1 masonry units and should have a declared mean compressive strength of $\geq 13\text{ N/mm}^2$, tested in accordance with I.S. EN 772-1.
- Refer to Table 14 of S.R. 325 for mortar strength class to meet specific durability requirements. Mortar of a higher strength class than M4, [1: 1: 5 to 6] will frequently be required. (e.g. Mortar of Compressive Strength Class M12, [1: 1 to $\frac{1}{4}$: 3] should be used in conjunction with concrete blocks of declared mean Compressive Strength of $\geq 13\text{ N/mm}^2$ where there is a high risk of saturation and freezing for work below or near external ground level.)

Solid blocks for internal walls should also be Group 1 masonry units and should have a declared mean compressive strength of $\geq 13\text{N/mm}^2$ unless the Contractor can provide documentary evidence of a control system that will ensure that mixing of blocks of different strengths cannot occur, in which case blocks with a declared mean compressive strength of $\geq 7.5\text{ N/mm}^2$ would be acceptable.