# RWANDA STANDARD

# DRS 514-1

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# Compressed earth blocks —

# Part 1: Definitions, classification and specifications

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# Foreword

Rwanda Standards are prepared by Technical Committees and approved by Rwanda Standards Board (RSB) Board of Directors in accordance with the procedures of RSB, in compliance with Annex 3 of the WTO/TBT agreement on the preparation, adoption and application of standards.

The main task of technical committees is to prepare national standards. Final Draft Rwanda Standards adopted by Technical committees are ratified by members of RSB Board of Directors for publication and gazettment as Rwanda Standards.

DRS 514-1 was prepared by Technical Committee RSB/TC 9, *Civil engineering and building materials*.

In the preparation of this standard, reference was made to the following standard:

ARS 670-1-2014, *Compressed earth blocks - Part 1: Definitions, classifications, specifications*

The assistance derived from the above source is hereby acknowledged with thanks.

DRS 514 consists of the following parts, under the general title *Compressed earth blocks*:

— *Part 1: Definitions, classifications and specifications*

— *Part 2 Earth mortars*

— *Part 3: Test methods*

— *Part 4: Code of practice for production and construction*

## Committee membership

The following organizations were represented on the Technical Committee on *Civil engineering and building materials* (RSB/TC 9) in the preparation of this standard.

A+Construction Group Ltd

Africeramics Ltd

Consultants Engineers Group (CEG) Ltd

D&D Resources Ltd

Dutureheza Ltd

Enabel Rwanda



 

Greenpack Africa Ltd

Integrated Polytechnic Regional Centre (IPRC) - Musanze

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# Introduction

The aim of the present standard is to define compressed earth blocks (CEBs) and compressed earth block masonry (CEBM), to classify them according to their typology, appearance and conditions of use, and to determine the categories into which they fall as well as their designations.

The definitions, classifications and designations of the present standard are applicable in establishing any technical, administrative or contractual document relating to compressed earth block technology, and relate to both public and private contracts.

The standard applies exclusively to CEBs and CEBMs intended for the realisation of simple built structures in common masonry with thick mortar joints (walls, partitions, piers, small lintels, arches, vaults, domes, etc.) and of any similar built structure.

# Compressed earth blocks — Part 1: Definitions, classification and specifications

## 1 Scope

This Draft Rwanda Standard applies to compressed earth blocks (CEBs) used for the construction of buildings for residential, public and related purposes. It gives the definitions of different types of CEBs and their classification. It also provides the requirements and test methods and the conformity criteria of the CEBs depending on their intended uses.

The standard does not apply to CEBs and CEMBs used for flooring or tiling, nor to CEBs or CEMBs designed to be assembled dry, interlocking, using glue-mortar, or used in reinforced masonry.

The standard is not applicable in areas subject to earthquakes, floods or cyclones to an extent that requires the application of appropriate rules in order to avoid major damage.

## 2 Normative references

The following documents are referred to in the text in such a way that some or all of their content constitutes requirements of this document. For dated references, only the edition cited applies. For undated references, the latest edition of the referenced document (including any amendments) applies.

DRS 546, Clay products for buildings — Vocabulary

## 3 Terms and definitions

For the purposes of this standard, the terms and definitions given in DRS 546 and the following apply.

### 3.1 Terms applicable to compressed earth blocks

#### 3.1.1 Compressed earth blocks (CEBs)

Masonry elements, which are small in size and which have regular and verified characteristics obtained by the static or dynamic compression of earth in a humid state followed by immediate demoulding.

Compressed earth blocks generally have a rectangular parallelepiped format and are full or perforated with vertical and/or horizontal indentations.

Compressed earth blocks are principally made of raw earth and owe their cohesion in a humid state and in a dry state essentially to the clay fraction within the earth; an additive can, however, be added to the earth to improve or enhance particular characteristics of the product.

The final characteristics of CEBs depend on the quality of the raw materials used (earth, additive) and on the quality of the execution of the various manufacturing stages (preparation, mixing, compression, curing).

NOTE This definition therefore excludes blocks obtained by extrusion, as well as agglomerated products where the chemical binder plays an essential part in ensuring cohesion when dry.

### 3.1.2 Description

The most common type of CEB can be described geometrically stating its format. The format of the product described consists of its general shape, its principal dimensions and the nature of any indentations (hollows, perforations etc.) incorporated into the product.

The most common format is a rectangular parallelepiped (or prismatic) format with a length (l), a width (w) and a height (h). Giving these three dimensions in this order (l, w, h) is sufficient for their use.

Non parallelepiped rectangular formats require a fuller description (cylindrical, conical, hexagonal, wedge-shaped, in the form of a truncated cone, etc.). The format used for the description is the nominal format which takes into account the manufacturing dimensions.

The format may be principal or secondary. The principal format or common format corresponds to the basic format from which secondary formats are obtained, these being merely fractions or multiples of the basic format in relation to its length. The most frequently found secondary formats are the «3/4», the «1/2» and the «1/4» the respective lengths of which are:

a) l 3/4= (l 4/4 - tm/3) ¾;

b) l 1/2= (l 4/4 - tm) ½; and

c) l 1/4= (l 4/4 - 3tm) ¼.

where

tm is the thickness of the vertical joint.

There are also CEBs reduced by half in height.

Secondary format CEBs are required to ensure bonding continuity throughout the built structure, for example at wall corners, and at the intersections of walls and partitions.

Secondary format CEBs are obtained either directly by manufacturing, or cut at the moment of use.

The «nominal format» should not be confused with the «work format» which corresponds to a description using real dimensions to which a corresponding joint thickness has been added.

The work format is therefore a unit of measurement for practical use enabling the dimensions of a built structure to be rapidly calculated.

To recapitulate:

a) nominal format: (l, w, h)



 

b) work format: (l + tm, w + tm, h + tm)

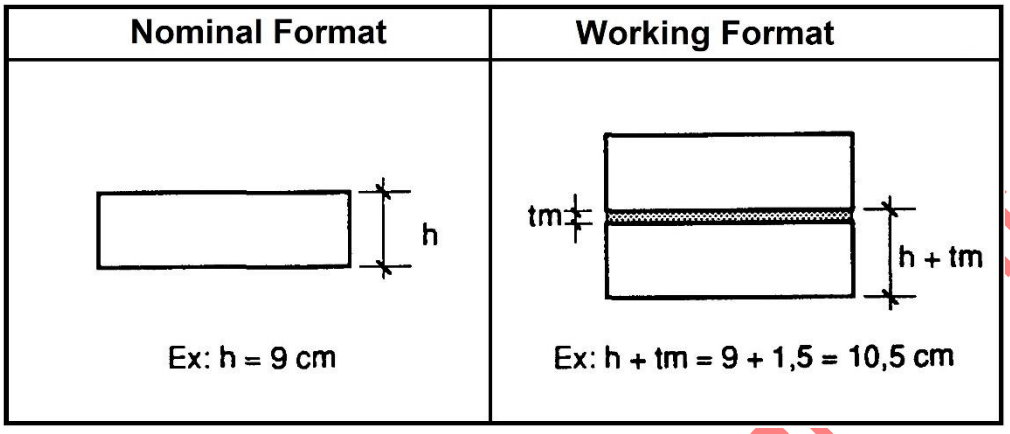


**Figure 1 — Example relating to the height of blocks**

The nominal format is the one normally used and in the event of any danger of confusion it is recommended that the nature of the format being used should be specified.

### 3.1.3 Description of the parts of CEBs

The prismatic block has 6 faces, each of which has a name:

a) 2 faces are known as surface «stretchers» (l × h);

b) 2 faces are known as surface «headers» (w × h);

c) 1 face is known as the «laying face» (l × w), being the upper face of the CEB when laid;

d) 1 face is known as the «bed face» (l × w), being the lower face of the CEB when laid.

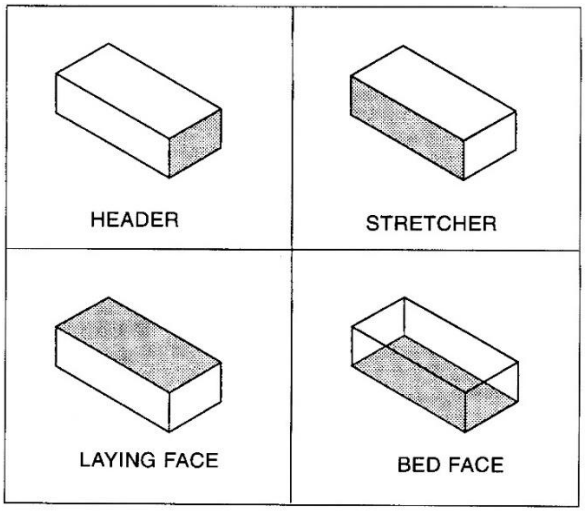


**Figure 2 — CEB faces**

The details describing a CEB should include the following values:

a) gross section: l × w (l and w measured on the same plane);

b) net section: gross section less any hollow;

c) bed section: surface common to the laying and the bed faces when superimposed in contact with the mortar joints and capable of transmitting the load.

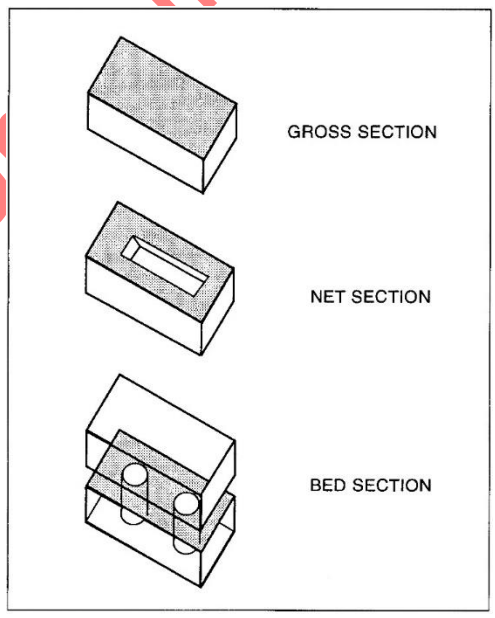


**Figure 3 — CEB sections**

## 3.2 Terms applicable to compressed earth block production and production equipment

### 3.2.1 Terms applicable to CEB constituents

#### 3.2.1.1 Earth

Earth intended for CEB construction designates the basic material made up essentially and in carefully controlled proportions of the following components, before any mixing with an additive or with water: gravel, sand, silt and clay. These components can be defined using a metric classification, or with regard to the fines, by their mineralogical nature.

The metric classification shall be as per Table 1.

**Table 1 — Metric classification**

| Classification | Component | | Size |
|---|---|---|---|
| gravel fraction: | coarse gravel | - | 60 mm to 20 mm; |
| | medium gravel | - | 20 mm to 6 mm; |
| | fine gravel | - | 6 mm to 2 mm; |
| sand fraction: | coarse sand | - | 2 mm to 0.6 mm; |
| | medium sand | - | 0.6 mm to 0.2 mm; |
| | fine sand | - | 0.2 mm to 0.06 mm; |
| silt fraction: | coarse silt | - | 0.06 mm to 0.02 mm; |
| | medium silt | - | 0.02 mm to 0.006 mm; |
| | fine silt | - | 0.006 mm to 0.002 mm; |

| | | | |
|---|---|---|---|
| clay fraction: | passes the | - | 0.002 mm sieve. |

There are other classifications which are also acceptable.

Coarse material (gravel and part of the sand fraction) consists of components with a diameter in excess of 0.08 mm. Coarse material provides the stable "skeleton" of CEBs thanks to its internal friction and its inertia.

Fine material (a part of the fine sand fraction, silt and clay) consists of components with the diameter of which is less than or equal to 0.08 mm. From a mineralogical point of view, the notions of clay and of silt are not restricted to the metric values given above. Understanding the mineralogical nature of fines may be vital when selecting types of earth.

Fines fill in the voids in the "skeleton". Clay and part of the silt fraction provide the cohesion of CEBs because they act as binders.

#### 3.2.1.2 Additive

An additive is a substance added during manufacture, intended to improve the final characteristics of the CEB or to enhance particular characteristics.

The most common additives are stabilisation products, known as stabilisers, such as cement, lime, pozzolonas, etc. intended to neutralise the sensitivity to water of the fine fraction and thus to maintain cohesion at an acceptable level even in a humid state. But other additives can also be used to modify other characteristics such as colour (colouring agents), tensile strength and reducing shrinkage cracks (fibres), etc.

#### 3.2.1.3 Filler

A filler is a granular material, generally of a sandy type, employed as an additive in types of earth which contain too great or too active a silt and/or clay fraction.

#### 3.2.1.4 Mix

The mix is the material obtained by adding additives and/or filler and water to the earth, preparatory to being introduced into the press for the manufacture of the CEB.

### 3.2.2 Terms applicable to the production of compressed earth blocks

#### 3.2.2.1 Preparing the earth

This consists of the following operations:

a) drying;

b) screening; and



 

c) pulverising.

#### 3.2.2.1.1 Screening

This operation is intended to eliminate all undesirable components (roots, leaves, any other organic material…etc.) together with any components with a diameter greater or lesser than that required. This operation also enables the earth to be loosened in a uniform manner.

#### 3.2.2.1.2 Pulverising

This operation is intended to break down lumps made up of coarse material and/or fines. It can also be used to split coarse material to reduce it to smaller diameter aggregates.

### 3.2.2.2 Mixing

This is a series of technical operations aimed at making the prepared earth, homogeneous.to which additives and/or a filler may have been added, homogeneous. Mixing most often takes place in two stages: dry mixing before adding water and wet mixing after adding water. There may also be a third stage, after a given reaction time, which consists in subjecting the mix to a further phase of stirring.

### 3.2.2.3 Retention time

Retention time is the delay between the start of wet mixing and the compression of the earth.

### 3.2.2.4 Compression

Compression is the operation which consists in compressing the material in a confined space known as a mould using a static or dynamic mode; compression is followed by immediate demoulding, freeing the shaped block.

### 3.2.2.5 Curing

Curing is the period following compression during which two types of phenomena principally occur. These can be differentiated as follows:

a) physicochemical reactions between the various components of the mix and above all between the earth and the additives resulting in the stabilisation of the block; during this phase, conditions of relative hygrometry and of heat are crucial and require careful attention;

b) drying which consists in the gradual removal of manufacturing humidity by evaporation.

## 3.2.3 Terms applicable to production equipment

### 3.2.3.1 Preliminary note

All production operations can be carried out manually with simple tools or using manual or motorised mechanical equipment.

### 3.2.3.2 Earth preparation equipment

Preparation equipment includes:

a) screens, to remove components with too large a diameter; and

b) pulverisers, which allow the particle size of coarse components to be reduced or silt and clay aggregates to be broken down without affecting the particle size distribution.

### 3.2.3.3 Mixing equipment

Mixing is carried out using a mixer. Mixers can be planetary, where the mixing system is mounted on a vertical axis, or linear, where the mixing system is driven by a horizontal axis.

### 3.2.3.4 Presses

Presses are classified using several criteria:

a) the energy source: manual or motorised (with a distinction between thermal and electric motors);

b) the system by which the energy is transmitted to the moulding system: mechanical, hydraulic, or combined.

### 3.2.3.5 Specific characteristics of presses

In describing presses, certain specific criteria are used.

a) **Compression action:** this is the very principle of the operation of the compression system. Compression may be static, dynamic by vibration or dynamic by impact;

b) **Usable force:** the force potentially available to compact the earth; and

c) **Compression pressure:** the pressure theoretically applied to the mix and which expresses the ratio of usable force to the surface to which it is applied; compression pressure is classified as Table 2.

**Table 2 — Classification of compression pressure**

| | |
|---|---|
| - very low pressure: | 1 to 2 N/mm$^2$; |
| - low pressure: | 2 to 4 N/mm$^2$; |

| | |
|---|---|
| - medium pressure: | 4 to 6 N/mm$^2$; |
| - high pressure: | 6 to 10 N/mm$^2$; |
| - hyperpressure: | 10 to 20 N/mm$^2$; |
| - megapressure | 20 N/mm$^2$ and over. |

NOTE It should be noted that the highest compression pressures are not necessarily the most efficient.

d) **Pressure at the end of compression:** the pressure actually applied to the mix at the end of compression.

e) **Dynamic effect coefficient:** the effect, on static compression presses, due to the inertia of the lever movement of the machine, which increases the pressure at the end of compression.

f) **Compression mode:** the principle of spreading the pressure across the mix. In simple compression, pressure is transmitted by displacing a single plate onto the laying or the bed face. In double compression, pressure is applied by displacing both plates onto the laying and the bed face simultaneously or alternatively.

g) **Compression ratio:** the ratio between the depth of the press mould before compression and the depth at the end of compression (which corresponds to the height of the CEB product).

h) **Output:** theoretical output corresponds to the sum of the number of CEBs produced per cycle, by number of cycles (filling, compression, demoulding) per hour; practical output corresponds to the theoretical output adjusted for estimated down time (machine maintenance etc.); actual output is the output measured in the context of normal activity.

### 3.2.4 Terms applicable to delivery conditions

#### 3.2.4.1 Order

##### 3.2.4.1.1 Ordering earth

The order specifies the designation of the earth (gravely earth, sandy earth, clayey earth, etc.), the quantity, the place of delivery, and the procedure for accepting or rejecting delivery. The order may also specify the location of the quarry and the depth of the quarrying operation.

##### 3.2.4.1.2 Order for CEBs

The order specifies the designation of the CEBs, the quantity, the delivery location, and the procedure for accepting or rejecting delivery.

#### 3.2.4.2 Supply

The quantity of merchandise corresponding to one and the same order.

#### 3.2.4.3 Delivery

The quantity of merchandise delivered or intended to be delivered on one single occasion, whatever the number and the nature of the means of transport used.

#### 3.2.4.4 Lot

The quantity of merchandise serving as a basis for determining samples for testing.

#### 3.2.4.5 Taking delivery

A series of operations enabling the conformity of the merchandise to be checked against the specifications of the standard.

### 3.3 Terms applicable to construction with CEBs

Compressed earth blocks being masonry elements, when referring to their use, one therefore applies the common terminology of traditional masonry with thick mortar joints (around 15 mm).

#### 3.3.1 Earth mortar

An earth mortar (EM) is a mortar used for compressed earth block masonry of a traditional type using thick mortar joints.

An earth mortar consists principally of raw earth and water and owes its cohesion in a humid or a dry state essentially to the clay fraction of the earth; an additive and/or a filler can, however, be added to the earth to improve or enhance particular characteristics of the mortar.

#### 3.3.2 Compressed earth block masonry

Compressed earth block masonry (CEBM) is masonry of a traditional type using thick earth mortar joints.

### 3.4 Terms applicable to assessing the characteristics, performance and suitability for use of CEBs

To assess the characteristics, performance and suitability for use of compressed earth blocks, one should use the terminology commonly used for other small masonry elements, excluding the elements provided in the present standard relating to terminology.

## 3.5 Symbols and units

### 3.5.1 Units of measurements

**Table3 — Symbols and basic units of measurement**

| Symbols | English | French | SI Units | | Units used in the building sector |
|---|---|---|---|---|---|
| L | Length | Longueur | metre | m | m, cm, mm |
| F | Force | Force | newton | N | MN, kN, N |
| σ | Pressure, Stress | Pression, Contrainte | pascal | $N/m^2$ | $MPa=N/mm^2=MN/m^2$ |
| m | Mass | Masse | kilogramme | Kg | t, kg, g |
| t | Temperature | Temprature | degrees Celsius | °C | °C |
| T | Time | Temps | seconds | s | h, min, s |

### 3.5.2 General notations

**Table 4 — Symbols and units of general notations**

| Symbol | English | French | Formula | Unit |
|---|---|---|---|---|
| Ph | Humid weight | Poids humide | | g, kg |
| Pd | Dry weight | Poids sec | | g, kg |
| Pw | Weight of water | Poids d'eau | | g, kg |
| V | Volume of sample | Volume de l'échantillon | | $cm^3$, $m^3$ |
| W | Water content | Teneur en eau | $W = \frac{Pw \times 100}{Pd}$ | % weight |
| Wopt | Optimum water content | Teneur en eau optimale | | % weight |

| Symbol | English | French | Formula | Unit |
|---|---|---|---|---|
| $\gamma_d$ | Dry density | Masse volumique séche (Densité séche) | $\gamma_d = \frac{Ph}{V \times (1+W)}$ | kN/m$^3$ |
| $\gamma_h$ | Apparent density | Masse volumique apparente (Densité apparente) | $\gamma_h = \frac{Ph}{V}$ | kN/m$^3$ |
| $\gamma_s$ | Solid grains density | Masse volumique des grains solides (Densité des grains solides) | $\gamma_s = 26.5$ | kN/m$^3$ |
| Pstab | Weight of binder | Poids de liant | | g, kg |
| Stab | Binder content | Teneur en liant | $S_{stab} = \frac{P_{stab} \times 100}{Pd}$ | % weight |
| D | Largest grain diameter | Diamétre du plus gros grains | | mm |
| 0/d | Grain fraction between 0 and d mm | Fraction granulométrique entre 0 et d mm | | |
| LL | Liquid limit | Limite de liquidité | | % weight |
| PL | Plastic limit | Limite de plasticité | | % weight |
| $I_P$ | Plasticity index | Indice de plasticité | $I_p$ = LL - PL | |
| VBS(0/d) | Methylene blue value of the 0/d fraction of soil | Valeur de bleu de méthylène de la fraction 0/d du sol | | |
| VBS total | Methylene blue value of the entire soil | Valeur de bleu de méthylène totale du sol | | |
| l | Length of CEB | Longueur du BTC | | mm, cm |
| w | Width of CEB | Largeur du BTC | | mm, cm |
| h | Height of CEB | Hauteur du BTC | | mm, cm |
| $t_m$ | Thickness of mortar | Epaisseur du mortier | | mm, cm |
| $f_b$ dry | Dry compressive strength of CEB tested in homogeneous conditions | Résistance à la compression sec du BTC teste dans des conditions homognes | | N/mm$^2$ |
| $f_b^t$ dry | Dry tensile strength of CEB | Résistance à la traction sec du BTC | | N/mm$^2$ |
| $f_b$ wet | Wet compressive strength of CEB | Résistance à la compression humide du BTC | | N/mm$^2$ |
| $f_b^t$ wet | Wet tensile strength of CEB | Résistance à la traction humide du BTC | | N/mm$^2$ |
| $f_m$ dry | Dry compressive strength of mortar | Résistance à la compression sec du mortier | | N/mm$^2$ |

| Symbol | English | French | Formula | Unit |
|---|---|---|---|---|
| $f_m^t$ dry | Dry tensile strength of mortar | Résistance à la traction sec du mortier | | $N/mm^2$ |
| $E_b$ | Young's modulus of CEB | Module d'Young du BTC | | $N/mm^2$ |
| $V_b$ | Poisson's ratio of CEB | Coefficient de Poisson du BTC | | |
| $E_m$ | Young's modulus of EM | Module d'Young du MT | | $N/mm^2$ |
| $V_m$ | Poisson's ratio of EM | Coefficient de Poisson du MT | | |
| $h_{ef}$ | Effective height of wall | Hauteur effective du mur | | cm, m |
| t | Thickness of wall | Epaisseur du mur | | cm, m |
| $f_k$ | Dry characteristic compressive strength of masonry | Résistance nominale la compression sec de la maçonnerie | | $N/mm^2$ |
| $f_{vk}$ | Dry characteristic shear strength of masonry | Résistance au cisaillement sec de la maçonnerie | | $N/mm^2$ |
| $f_{vko}$ | Dry characteristic shear strength of masonry at zero precompression | Résistance au cisaillement sec de la maçonnerie sans précompression | | $N/mm^2$ |

# 4 Classification and designation of compressed earth blocks

## 4.1 Classification of CEBs

### 4.1.1 Classification of CEBs by type

Compressed earth blocks are classified according to several types.

#### 4.1.1.1 CEB type 1

Full rectangular parallelepiped format with no indentation on any face.

#### 4.1.1.2 CEB type 2

Full rectangular parallelepiped format with an indentation on one or both of its larger faces (laying and bed face). Various common indentations include:

a) hollows (frogs), which makes the CEB lighter and easier to handle;

b) slight horizontal grooves allowing a better bond with the mortar;

c) horizontal grooves to receive thin construction elements, such as pipes, electric cables etc.;

d) deep horizontal grooves to receive construction elements such as ring beams etc.; and

e) lateral grooves enabling claustra-work structures to be built without needing to use special bonding.

#### 4.1.1.3 CEB type 3

Full rectangular parallelepiped format with one or more indentations (e.g. hollows, rounded or chamfered corners, etc.) on the stretcher or header faces or simultaneously on several faces.

Indentations in the vertical (header or stretcher) faces of CEBs are most often grooves intended to receive thin construction elements.

#### 4.1.1.4 CEB type 4

Rectangular parallelepiped format with holes or perforations between the largest faces. Depending on the section of the holes and on how many there are, one refers to perforated blocks (a few, small holes), hollow blocks (a few, large holes) or alveolar blocks (many small perforations).

#### 4.1.1.5 CEB type 5

Rectangular parallelepiped format with holes or perforations in combination with indentations on its larger faces (laying face and bed face).

#### 4.1.1.6 CEB type 6

Rectangular parallelepiped format with holes or perforations and with indentations on the stretcher and header faces sometimes in combination with indentations on its larger faces.

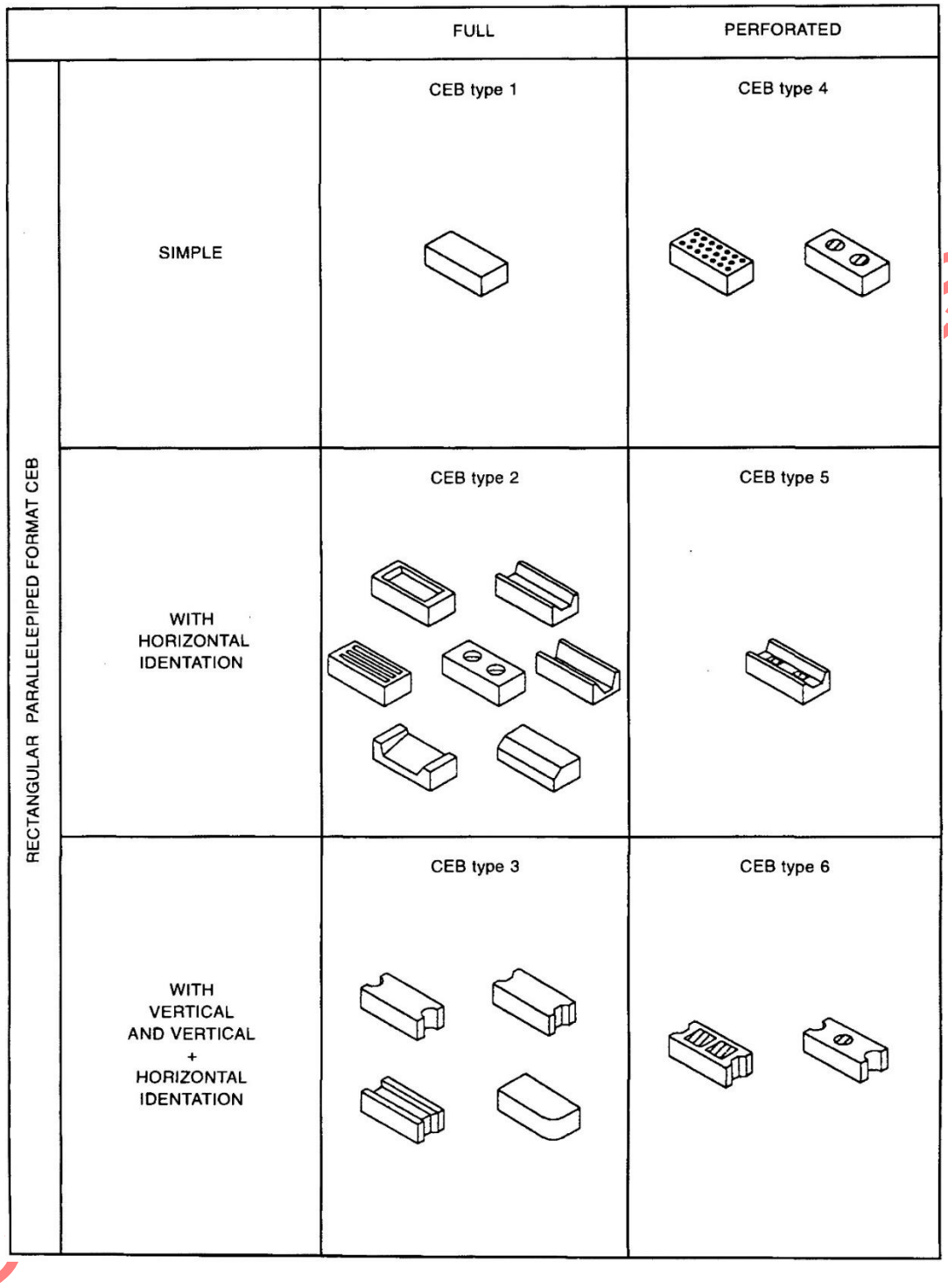


**Figure 4 — The 6 types of CEB**

### 4.1.2 Classification according to use

CEBs can be classified into two groups according to use:

a) ordinary CEBs;

b) facing CEBs.

#### 4.1.2.1 Ordinary CEBs (CEB O)

These are CEBs used in masonry structures intended to be covered by some form of protection.

#### 4.1.2.2 Facing CEBs (CEB F)

These are CEBs used in masonry structures intended to remain visible. One can differentiate between:

a) normal facing CEBs (CEB NF); and

b) fine facing CEBs (CEB FF).

The difference between these two facing CEBs is restricted to their appearance without affecting their other characteristics.

#### 4.1.2.3 Classification according to field of use

The fields of use of CEBs within masonry structures are classified according to two types of constraints which can occur simultaneously:

a) mechanical constraints; and

b) environmental constraints.

#### 4.1.2.4 Mechanical constraints

These are defined according to three categories of resistance:

a) **category 1:** structural elements which are not load-bearing and structural elements capable of withstanding limited external (live) loads: for example — fill-in in a load-bearing structure; boundary wall; a single-storey building made of load-bearing structural elements;

b) **category 2:** structural elements capable of withstanding important external (live) loads: for example — a two storey building with accessible terrace made of thin load-bearing structural elements; and

c) **category 3:** structural elements capable of withstanding high external (live) loads: for example — a three storey public building made of thin load-bearing structural elements.

#### 4.1.2.5 Environmental constraints

These are defined according to 4 categories of environment:



 

a) **category D:** structural elements located in a dry environment with no danger of being wet: e.g. internal partitions; external walls which are not exposed or which are protected from water damage;

b) **category R:** structural elements capable of withstanding water damage by lateral spraying: e.g. lateral walls exposed to rain; bathroom walls being splashed;

c) **category C:** structural elements capable of withstanding water damage by vertical penetration (capillary rise, penetration by gravity, suction or internal condensation): e.g. external walls unprotected from capillary rise; internal walls unprotected from water leaking through the roof; and

d) **category A:** structural elements capable of withstanding mechanical abrasion (impact, rubbing or wind damage): e.g. corners or walls subject to impact; areas subject to rubbing by animals; areas subject to sand storms.

## 4.2 Designation of CEBs

The designation of compressed earth blocks includes the following indications, to be given in the same order:

a) product designation

CEB for «compressed earth block»;

b) designation according to use:

O for «ordinary»

F for «facing»

NF for «normal facing»

FF for «fine facing»;

c) designation according to mechanical constraints:

1 for «category 1»

2 for «category 2»

3 for «category 3»;

d) designation according to the constraints of the hygrometric environment:

D for «category D»

R for «category R»

C for «category C»;

e) designation according to the constraints of the mechanical abrasion environment:

A for «category A».

The CEB designation may also include the following indications to be given in the same order:

a) type of CEB;

b) manufacturer's trade name or mark;

c) the manufacturing dimensions (L, w, h);

d) colour;

e) any other feature which helps to identify the CEBs.

**Table 5 — Examples of designation**

| Designation | Description | Example |
|---|---|---|
| CEB O 1 D | Ordinary compressed earth block used as an element in a non-load bearing structure in a dry environment not subject to mechanical abrasion | Internal partition of a single family ground floor house |
| CEB FF 3 RA | Fine facing compressed earth block used as an element in a load-bearing structure exposed to rain weathering by lateral spraying as well as to mechanical abrasion | External wall of a 3-storey building of high quality appearance exposed to driving rain and to sand storms |

# 5 Classification and designation of compressed earth block masonry

## 5.1 Classification of CEBM

### 5.1.1 Classification according to use

CEBMs can be classified into two groups according to use:

a) ordinary CEBMs; and

b) facing CEBMs.

#### 5.1.1.1 Ordinary CEBM (CEBM O)

These are CEBMs used in structures intended to be covered by some form of protection. They are assembled using ordinary CEBs and ordinary EMs.

#### 5.1.1.2 Facing CEBM (CEBM F)

These are CEBMs used in structures intended to remain visible. They are assembled using facing CEBs and facing EMs. One can differentiate between:

a) normal facing CEBMs (CEBM NF) assembled using CEB NF and EM NF;

b) fine facing CEBMs (CEBM FF) assembled using CEB FF and EM FF.

The difference between these two facing CEBMs is restricted to their appearance without affecting their other characteristics.

### 5.1.2 Classification according to field of use

The fields of use of CEBMs within masonry structures are classified according to two types of constraint which can occur simultaneously:

a) mechanical constraints; and

b) environmental constraints

#### 5.1.2.1 Mechanical constraints

These are defined according to three categories of resistance:

a) **category 1:** structural elements which are not load-bearing and structural elements capable of withstanding limited external (live) loads: e.g. fill-in in a load-bearing structure; boundary wall; a single-storey building made of load-bearing structural elements);

b) **category 2:** structural elements capable of withstanding important external (live) loads: for example, a two storey building with accessible terrace made of thin load-bearing structural elements); and

c) **category 3:** structural elements capable of withstanding high external (live) loads: e.g. a three storey public building made of thin load-bearing structural elements.

#### 5.1.2.2 Environmental constraints

These are defined by 4 categories of environment:

a) **category D:** structural elements located in a dry environment with no danger of being wet: e.g. internal partitions; external walls which are not exposed or which are protected from water damage;

b) **category R:** structural elements capable of withstanding water damage by lateral spraying: e.g. lateral walls exposed to rain; bathroom walls being splashed;

c) **category C:** structural elements capable of withstanding water damage by vertical penetration (capillary rise, penetration by gravity, suction or internal condensation): e.g. external walls unprotected from capillary rise; internal walls unprotected from water leaking through the roof; and

d) **category A:** structural elements capable of withstanding mechanical abrasion (impact, rubbing or wind damage): e.g. corners or walls subject to impact; areas subject to rubbing by animals; areas subject to sand storms.

## 5.2 Designation of forms of CEBM

The designation of forms of compressed earth block masonry includes the following indications, to be given in the same order:

a) product designation:

CEBM for «compressed earth block masonry»;

b) designation according to use:

O for «ordinary»

F for «facing»

NF for «normal facing»

FF for «fine facing»;

c) designation according to mechanical constraints:

1 for «category 1»

2 for «category 2»

3 for «category 3»;

d) designation according to the constraints of the hygrometric environment:

D for «category D»

R for «category R»

C for «category C»;



 

e) designation according to the constraints of the mechanical abrasion environment:

A for «category A».

The CEBM designation may also include the following indications to be given in the same order:

a) type: load bearing or non-load bearing;

b) colour;

c) decorative effects;

d) any other feature which helps to identify CEBM.

**Table 6 — Examples of designation**

| Designation | Description | Example |
|---|---|---|
| CEBM O 1 D | Ordinary compressed earth block masonry used as a component of a non-load bearing structure in a dry environment not subject to mechanical abrasion | Internal partition of a single family ground floor house |
| CEBM FF 3 RA | Facing compressed earth block masonry used as a component in a load-bearing structure exposed to rain weathering by lateral sprinkling as well as to mechanical abrasion | External wall of a 3-storey building of high quality appearance exposed to driving rain and to sand storms |

# 6 Technical specifications for ordinary compressed earth blocks

## 6.1 Textural characteristics

The earth should not contain any particles with a diameter greater than 10 mm. To obtain an optimal result, the diameter of the largest particles will be restricted to 5 mm.

## 6.2 Dimensional characteristics

### 6.2.1 Dimensions

The most commonly employed full compressed earth blocks have the following theoretical moulding dimensions and nominal dimensions:

a) length: 29.50 cm;

b) width: 14.00 cm; and

c) height: 9.00 cm to 9.50 cm.

These blocks are used as a reference here for the terms of the specifications which follow. For CEBs of different dimensions, tolerances should be adjusted using a linear mathematical relationship.

The measurements given are the net block dimensions, not counting any hollows or indentations.

Special blocks can be developed using other main formats. Dimensional tolerances are as follows:

a) length: + 2 to - 3 mm;

b) width: + 2 to - 3 mm; and

c) height: + 3 to - 3 mm.

In addition, the difference between the corresponding dimension of two CEBs of any kind from the same supply must not exceed 4 mm for the length, 3 mm for the width and 5 mm for the height.

#### 6.2.2 Thickness of sides of indented or hollow blocks

For all faces: minimum 25 mm or 3 times the diameter of the largest particle if the diameter of the largest particle exceeds 8 mm.

### 6.3 Geometric characteristics

#### 6.3.1 Irregular geometry

CEBs which have a deliberately irregular geometrical form are not subject to the specifications of this article. However, the flatness of the bed faces must meet the conditions which follow.

#### 6.3.2 Parallelism

Defects of parallelism or of right angles, and also the acceptable sweep of a face, cannot exceed the tolerance for the dimension affected.

#### 6.3.3 Surface smoothness

a) Sides: the sweep must not exceed 2 mm; and

b) Compression surfaces: the sweep must not exceed 3 mm.

#### 6.3.4 Edge smoothness

a) The sweep must not exceed 3 mm.



 

b) Some roughness on the edges can be tolerated, whether it is due to demoulding or caused by mishandling.

#### 6.3.5 Surface obliquity

a) For exterior faces, form and dimensional tolerances must be respected.

b) Interior faces and the hollows of hollow or indented blocks must be oblique and must have no sharp corners.

### 6.4 Appearance characteristics

#### 6.4.1 Damage

A distinction is made between mechanical damage caused by impact when handling CEBs and cracks or other defects which result from an imperfect production process.

For cracks and other manufacturing defects, the prescriptions which follow are applicable.

For mechanical damage, the following rule is to be respected: damage which has no effect on the appearance of the masonry (such as chips on the side of the CEB which is not visible) will not be taken into account.

The following are regarded as damaged:

a) any broken CEB;

b) any CEB displaying chipped edges or corners the overall volume of which exceed 5% of the volume of the CEB.

#### 6.4.2 General appearance

The CEBs should display no systematic defects such as cracks or significant chips of a kind likely to jeopardise correct execution and the stability of the masonry.

#### 6.4.3 Holes, punctures and scratches

For exposed faces, these must affect no more than 20% of the surface and not exceed 5 mm in depth.

#### 6.4.4 Roughness

The exposed faces can have a grainy and rough appearance.

#### 6.4.5 Chipped corners

Chipped corners and edges which do not extend over more than 10 mm and which do not exceed 10 mm in depth **are** tolerated on all surfaces.

### 6.4.6 Flaking, splitting

These are tolerated provided mechanical performance is not affected.

### 6.4.7 Cracks, crazing, fissures

a) Micro-cracks: are tolerated on all faces.

b) Macro-cracks: Conditions of acceptability for all faces:

1) they must not exceed 1 mm in width;

2) they must not exceed 40 mm in length;

3) they must not exceed 10 mm in depth;

4) they must not exceed 3 in number on any one surface.

## 6.5 Physicochemical characteristics

### 6.5.1 Pitting

No pitting due to the bursting of expansive materials is tolerated.

### 6.5.2 Efflorescence

CEBs must not display any significant and lasting efflorescence covering more than 1/3 of the total surface of the CEBs. A faint whitish film or a thin band are not taken into account.

## 6.6 Mechanical, hygrometric and physical characteristics

Mechanical, hygrometric and physical characteristics are determined by the values shown in the following table.

**Table 7 — Mechanical, hygrometric and physical characteristics required for ordinary CEBs**

| Designation | Environmental constraint category | Mechanical constraint category | $f_b$ dry N/mm$^2$ | $f_b$ wet N/mm$^2$ | Water absorption % | Abrasion Loss of matter % |
|---|---|---|---|---|---|---|
| CEB O 1 D | Dry environment (D) | 1 | ≥2 | N/A | N/A | N/A |
| CEB O 2 D | | 2 | ≥4 | N/A | N/A | N/A |

| | | | | | | |
|---|---|---|---|---|---|---|
| CEB O 3 D | | 3 | ≥6 | N/A | N/A | N/A |
| CEB O 1 R | Effect of water by lateral spraying (R) | 1 | ≥2 | ≥1 | N/A | N/A |
| CEB O 2 R | | 2 | ≥4 | ≥2 | N/A | N/A |
| CEB O 3 R | | 3 | ≥6 | ≥3 | N/A | N/A |
| CEB O 1 C | Effect of water by vertical penetration (C) | 1 | ≥2 | ≥1 | ≤15 | N/A |
| CEB O 2 C | | 2 | ≥4 | ≥2 | ≤10 | N/A |
| CEB O 3 C | | 3 | ≥6 | ≥3 | ≤5 | N/A |

1) N/A = not applicable

2) The use of CEBs in R and C category environments requires using a stabiliser if the protection provided is not guaranteed. If the protection provided against water damage is guaranteed, the environment is regarded as category D.

3) If tests to establish water absorption or abrasion are not feasible, or if the results are not available, this deficiency can be compensated by increasing the requirements for the dry and/or wet compressive strength by one category.

4) The values given are the average values obtained from tests carried out on a set of samples.

# 7 Technical specifications for facing compressed earth blocks

## 7.1 Textural characteristics

The earth should preferably not contain any particles with a diameter greater than 10 mm. To obtain an optimal result, the diameter of the largest particles will be restricted to 5 mm.

## 7.2 Dimensional characteristics

### 7.2.1 Dimensions

The most commonly employed full compressed earth blocks have the following theoretical moulding dimensions and nominal dimensions:

a) length: 29.50 cm;

b) width: 14.00 cm; and

c) height: 9.00 cm to 9.50 cm.

These blocks are used as a reference here for the terms of the specifications which follow. For CEBs of different dimensions, tolerances should be adjusted using a linear mathematical relationship.

The measurements given are the net block dimensions, not counting any hollows or indentations.

Special blocks can be developed using other main formats. Dimensional tolerances are as follows:

a) length: + 1 to - 3 mm;

b) width: + 1 to - 2 mm; and

c) height: + 2 to - 2 mm.

In addition, the difference between the corresponding dimension of two CEBs of any kind from the same supply must not exceed 3 mm for the length, 2 mm for the width and 3 mm for the height.

#### 7.2.2 Thickness of sides of indented or hollow blocks

For all faces: minimum 25 mm or 3 times the diameter of the largest particle if the diameter of the largest particle exceeds 8 mm.

### 7.3 Geometric characteristics

#### 7.3.1 Irregular geometry

CEBs which have a deliberately irregular geometrical form are not subject to the specifications of this article. However, the flatness of the bed faces must meet the conditions which follow.

#### 7.3.2 Parallelism

Defects of parallelism or of right angles, and also the acceptable sweep of a face, cannot exceed half the tolerance for the dimension affected.

#### 7.3.3 Surface smoothness

a) Sides: the sweep must not exceed 1 mm.

b) Compression surfaces: the sweep must not exceed 3 mm.



 

### 7.3.4 Edge smoothness

a) The sweep must not exceed 2 mm; and

b) Some roughness on the edges can be tolerated, provided this is due to demoulding and not caused by mishandling.

### 7.3.5 Surface obliquity

a) For exterior faces, form and dimensional tolerances must be respected.

b) Interior faces and the hollows of hollow or indented blocks must be oblique and must have no sharp corners.

## 7.4 Appearance characteristics

These characteristics are common to both NF and FF blocks except where specific indications are given.

### 7.4.1 Damage

A distinction is made between mechanical damage caused by impact when handling CEBs and cracks or other defects which result from an imperfect production process.

For cracks and other manufacturing defects, the prescriptions which follow are applicable.

For mechanical damage, the following rule is to be respected: damage which has no effect on the appearance of the masonry (such as chips on the side of the CEB which is not visible) will not be taken into account.

The following are regarded as damaged:

a) any broken CEB;

b) any CEB displaying chipped edges or corners the overall volume of which exceed 2% of the volume of the CEB.

### 7.4.2 General appearance

The CEBs should display no systematic defects such as cracks or significant chips of a kind likely to jeopardise correct execution and the stability of the masonry.

90% of facing compressed earth blocks should not display on the faces intended to remain visible, any cracks, chips or efflorescence compromising the appearance of the built structure required, visible at a distance of two metres.

### 7.4.3 Holes, punctures and scratches

For exposed faces in the NF category, these must affect no more than 10% of the surface and not exceed 2 mm in depth.

For exposed faces in the FF category, these must affect no more than 2.5% of the surface and not exceed 1 mm in depth.

### 7.4.4 Roughness

The exposed faces can be rough for the NF category, must be smooth for the FF category, other than when a particular effect is being sought by the client.

### 7.4.5 Chipped corners

Chipped corners and edges which do not extend over more than 10 mm and which do not exceed 10 mm in depth are tolerated on all surfaces.

### 7.4.6 Flaking, splitting

These are not tolerated on any surface.

### 7.4.7 Cracks

a) micro-cracks: can be tolerated on all faces;

b) macro-cracks: Conditions of acceptability for all faces:

   1) they must not exceed 0.5 mm in width;

   2) they must not exceed 20 mm in length;

   3) they must not exceed 5 mm in depth;

   4) they must not exceed 2 in number for NF category CEBs, 1 in number for FF category CEBs, on any one surface.

### 7.4.8 Colour

This can be:

a) uniform colour: all the facing CEBs of the lot have the same basic colour on all visible faces; and

b) varied colour: facing CEBs from the same lot have different shades of colour as defined by the client.

### 7.4.9 Structure

CEBs must have a uniform and homogeneous structure.

Depending on the structure, the following main indications of the surface of materials can be distinguished:

a) smooth: a closed structure surface for which the voids between grains have been completely filled; any hollows are superficial and spread evenly over the surface; and

b) granulated: a surface with a practically closed surface, characterised by the calibre of the grains and by the voids spread evenly between these particles.

### 7.4.10 Surface texture

The surface of CEBs has a homogeneous texture. The following indications of the surface texture depending on their particular treatment, mechanical or not, can be distinguished: flat, split, grooved, streaked, etc. This list is not restrictive.

## 7.5 Physicochemical characteristics

### 7.5.1 Pitting

No pitting due to the bursting of expansive materials is tolerated.

### 7.5.2 Efflorescence

CEBs must not display any significant and lasting efflorescence covering more than 1/4 of the total surface of the CEBs. A faint whitish film or a thin band are not taken into account.

## 7.6 Mechanical, hygrometric and physical characteristics

Mechanical, hygrometric and physical characteristics are determined by the values shown in the following table.

**Table 8 — Mechanical, hygrometric and physical characteristics required for facing CEBs**

| Designation | Environmental constraint category | Mechanical constraint category | $f_b$ dry N/mm$^2$ | $f_b$ wet N/mm$^2$ | Water absorption % | Abrasion Loss of matter % |
|---|---|---|---|---|---|---|
| CEB NF 1 D or CEB FF 1 D | Dry environment (D) | 1 | ≥2 | N/A | N/A | ≤10 |
| CEB NF 2 D or CEB FF 2 D | | 2 | ≥4 | N/A | N/A | ≤5 |

| | | | | | | |
|---|---|---|---|---|---|---|
| CEB NF 3 D or CEB FF 3 D | | 3 | ≥6 | N/A | N/A | ≤2 |
| CEB NF 1 R or CEB FF 1 R | Effect of water by lateral spraying (R) | 1 | ≥2 | ≥1 | N/A | ≤10 |
| CEB NF 2 R or CEB FF 2 R | | 2 | ≥4 | ≥2 | N/A | ≤5 |
| CEB NF 3 R or CEB FF 3 R | | 3 | ≥6 | ≥3 | N/A | ≤2 |
| CEB NF 1 C or CEB FF 1 C | Effect of water by vertical penetration (C) | 1 | ≥2 | ≥1 | ≤15 | ≤10 |
| CEB NF 2 C or CEB FF 2 C | | 2 | ≥4 | ≥2 | ≤10 | ≤5 |
| CEB NF 3 C or CEB FF 3 C | | 3 | ≥6 | ≥3 | ≤5 | ≤2 |

1) N/A = not applicable

2) The use of CEBs in R and C category environments requires using a stabiliser if the protection provided is not guaranteed. If the protection provided against water damage is guaranteed, the environment is regarded as category D.

3) If tests to establish water absorption or abrasion are not feasible, or if the results are not available, this deficiency can be compensated by increasing the requirements for the dry and/or wet compressive strength by one category.

4) The values given are the average values obtained from tests carried out on a set of samples.



# 8 Technical specifications for ordinary compressed earth block masonry

## 8.1 Configuration characteristics

Bonding patterns will be those used for traditional masonry using small masonry elements.

The vertical and horizontal joints should be perfectly executed to ensure the best adhesion possible between blocks and mortar thus ensuring the optimal transmission of loads.

In order to avoid superimposed vertical joints, the overlap between CEBs must be at least 1/4 of their length.

## 8.2 Dimensional characteristics

The vertical and horizontal joints should be minimum 8 mm and maximum 15 mm in thickness. Locally, a thickness of 20 mm can be tolerated.

Load bearing masonry will have a minimum thickness of 14 cm with a maximum slenderness ratio of 20. Non load bearing masonry will have a minimum thickness of 9 cm.

## 8.3 Geometric characteristics

The position of the vertical and horizontal joints must be consistent with the brickwork drawings which are provided before building work begins.

The acceptable sweep of any surface cannot exceed 10 mm along any vertical or horizontal length. Deviation from verticality cannot exceed 7 mm per storey.

a) Tolerance along the length of the masonry elements is as follows:

b) For thin walls (<20 cm thick):

   1) for small size sections of masonry (<100 cm), the tolerance is 10 mm;

   2) for larger size sections of masonry (>100 cm), the tolerance is 25 mm.

c) For thick walls (>20 cm thick):

   1) for small size sections of masonry (<100 cm), the tolerance is 15 mm; and

   2) for larger size sections of masonry (>100 cm), the tolerance is 30 mm.

## 8.4 Physical-chemical characteristics

### 8.4.1 Efflorescence

The masonry must not display any significant and lasting efflorescence covering a large area of the surface. A faint whitish film or a thin band are not taken into account.

### 8.4.2 Mechanical, hygrometric and physical characteristics

The mechanical, hygrometric and physical characteristics of the masonry are not only a function of the quality of its component products (compressed earth blocks and earth mortars), but are also highly dependent on the quality of the workmanship and curing conditions.

### 8.4.3 Dry characteristic compressive strength of the CEBM wall

The dry characteristic compressive strength ($f_k$) of the CEBM wall must be at least equal to the dry characteristic compressive stress at the foot of the wall, determined by a static calculation of the vertical load on the masonry, in accordance with the standards in force.

### 8.4.4 Compressive strength of the CEBs

For CEBMs in a dry or protected environment, the CEBs must have a dry compressive strength ($f_b$ dry) at least equal to 10 times the value of the dry characteristic compressive strength ($f_k$) required for the wall.

For CEBMs in a wet environment, with no protection against water damage, the CEBs should have a wet compressive strength ($f_b$ wet) at least equal to 10 times the value of the dry characteristic compressive strength ($f_k$) required for the wall.

The value of the compressive strength of the CEBs fixed in this way will determine the category of resistance of the CEBs to mechanical constraints.

### 8.4.5 Thermal resistance

The thermal resistance of masonry under internal or external climatic conditions is specified only in the case of masonry expressly designed to provide thermal insulation.

### 8.4.6 Thermal capacity

Thermal capacity per unit of volume is specified only in the case of masonry specifically intended to provide thermal capacity. Thermal capacity is determined in the light of the project requirements.

### 8.4.7 Acoustic attenuation coefficient

The acoustic attenuation coefficient is specified only in the case of masonry expressly designed to provide acoustic insulation.

### 8.4.8 Fire resistance

The fire resistance of masonry is specified only in the case of masonry expressly designed to resist fire.

# 9 Technical specifications for facing compressed earth block masonry

## 9.1 Configuration characteristics

Bonding patterns will be those used for traditional masonry using small masonry elements.

The vertical and horizontal joints should be perfectly executed to ensure the best adhesion possible between blocks and mortar thus ensuring the optimal transmission of loads.

In order to avoid superimposed vertical joints, the overlap between CEBs must be at least 1/4 of their length.

## 9.2 Dimensional characteristics

The vertical and horizontal joints should be minimum 8 mm and maximum 15 mm in thickness.

Load bearing masonry will have a minimum thickness of 14 cm with a maximum slenderness ratio of 20. Non load bearing masonry will have a minimum thickness of 9 cm.

Walls less than 20 cm thick will have an expansion joint every 5 m maximum.

## 9.3 Geometric characteristics

The position of the vertical and horizontal joints must be consistent with the brickwork drawings which are provided before building work begins.

The acceptable sweep of any surface cannot exceed 7 mm along any vertical or horizontal length. Deviation from verticality cannot exceed 5 mm per storey.

Tolerance along the length of the masonry elements is as follows:

d) For thin walls (<20 cm thick):

   1) for small size sections of masonry (<100 cm), the tolerance is 5 mm;

   2) for larger size sections of masonry (>100 cm), the tolerance is 15 mm.

e) For thick walls (>20 cm thick):

   1) for small size sections of masonry (<100 cm), the tolerance is 10 mm;

   2) for larger size sections of masonry (>100 cm), the tolerance is 20 mm.

## 9.4 Appearance characteristics

### 9.4.1 Drips

The execution should be flawless and with no drips. All the mortar joints should be perfectly smooth.

### 9.4.2 Cracks

a) micro-cracks: can be tolerated on all exposed faces.

b) macro-cracks: Conditions of acceptability for all faces:

   3) they must not exceed 0.5 mm in width;

4) they must not exceed 200 mm in length;

5) the presence of tolerated macro-cracks should not be concentrated in or found throughout one part or the whole of the built structure.

#### 9.4.3 Chipped corners

Corners should be perfect and chips at corners are acceptable only within the limit of chipped corners acceptable for facing CEBs.

#### 9.4.4 Colour

The masonry colour will be as homogeneous as possible, other than if for aesthetic reasons, a more varied appearance is required.

#### 9.4.5 Surface texture

The masonry should have a homogeneous surface texture. However, one can seek special effects by introducing different textures in precise areas (e.g. around openings, at corners, etc.)

### 9.5 Physicochemical characteristics

#### 9.5.1 Pitting

No pitting due to the bursting of expansive materials is tolerated.

#### 9.5.2 Efflorescence

The masonry must not display any significant and lasting efflorescence covering a large area of the surface. A faint whitish film or a thin band are not taken into account.

### 9.6 Mechanical, hygrometric and physical characteristics

The mechanical, hygrometric and physical characteristics of the masonry are not only a function of the quality of the component products (the compressed earth blocks and the earth mortars), but are also highly dependent on the quality of the workmanship and curing conditions.

#### 9.6.1 Dry characteristic compressive strength of the CEBM wall

The dry characteristic compressive strength ($f_k$) of the CEBM wall must be at least equal to the dry characteristic compressive stress at the foot of the wall, determined by a static calculation of the vertical load on the masonry, in accordance with the standards in force.

#### 9.6.2 Compressive strength of the CEBs

For CEBMs in a dry or protected environment, the CEBs must have a dry compressive strength ($f_b$ dry) at least equal to 10 times the value of the dry characteristic compressive strength ($f_k$) required for the wall.

For CEBMs in a wet environment, with no protection against water damage, the CEBs should have a wet compressive strength ($f_b$ wet) at least equal to 10 times the value of the dry characteristic compressive strength ($f_k$) required for the wall.

The value of the compressive strength of the CEBs fixed in this way will determine the category of resistance of the CEBs to mechanical constraints.

### 9.6.3 Thermal resistance

The thermal resistance of masonry under internal or external climatic conditions is specified only in the case of masonry expressly designed to provide thermal insulation.

### 9.6.4 Thermal capacity

Thermal capacity per unit of volume is specified only in the case of masonry specifically intended to provide thermal capacity. Thermal capacity is determined in the light of the project requirements.

### 9.6.5 Acoustic attenuation coefficient

The acoustic attenuation coefficient is specified only in the case of masonry expressly designed to provide acoustic insulation.

### 9.6.6 Fire resistance

The fire resistance of masonry is specified only in the case of structural masonry expressly designed to resist fire.

Price based on 35 pages