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- REPORT:** Expanded clay LWA in CEA
Lightweight fill and thermal insulation products for civil engineering applications.
Installation and structural quality control on site.
- STATUS:** Technical report
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Foreword

This Technical report was prepared by EXCA, the European Expanded Clay Association, in 2007 and revised in 2015.

The goal and purpose has been to present the current best practice and recommendations on the European level concerning proper construction works and in-situ quality control to ensure a correct and proper execution of civil engineering applications of Expanded Clay lightweight aggregates.

The basic material properties shall be documented and declared according to EN 15732 Light weight fill and thermal insulation products for civil engineering applications (CEA). Expanded clay lightweight aggregate products (LWA). /1/

This technical report is acknowledged by all the major partners in the European Expanded Clay industry, and thus should be considered as a recommendation from the industry.

This report provides general recommendations prepared by the EXCA-industry and has no legal status. National standards, recommendations, instructions and guidance given in the specific projects have to be followed.



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1. Scope

This technical report provides recommendations for the material delivery control on site, storage and handling, construction procedures and quality control of the installed products. The required product characteristics and procedures for testing, marking and labelling of expanded clay LWA for this application are given in EN 15732 /1/.

This technical report contains 2 annexes:

- Annex A – Marking and labelling
- Annex B – Delivery Control

This document covers the use of expanded clay LWA in Civil Engineering Applications, excluding the use as thermal insulation in and under buildings which are covered by European Standard EN 14063-1&2 /2/. The technical report intends to cover the use of expanded clay LWA as lightweight fill, drainage and insulation materials in e.g. embankments for roads, railways, and other traffic areas, as lightweight backfill e.g. for retaining walls or as foundation for structures. Recommendations for sheet pile quay structures is not completely covered.

This technical report gives recommendations for quality control of the expanded clay LWA product delivered on site, quality control of the construction work and for quality control of the structure during the construction and after completion.



2. Terms, definitions, symbols, units and abbreviated terms

2.1. Terms and definitions

For the purposes of this technical report, the following definitions apply.

2.1.1. Expanded clay lightweight aggregate (expanded clay LWA):

Insulation material or product composed of lightweight granular material having a cellular structure formed by expanding clay minerals by heat.

2.1.2. Delivery in bulk:

Loose-fill expanded clay delivered by truckload and installed directly from the truck by tipping or by blown delivery.

2.1.3. Blown (pneumatic) delivery:

Loose-fill expanded clay LWA applied or installed by a pneumatic unit.

2.1.4. Rounded particle:

Material consisting of expanded clay LWA particles produced with 50% or less of its surface crushed or broken /3/.

2.1.5. Crushed or broken material:

Material consisting of expanded clay LWA particles produced with more than 50% of its surface crushed or broken /3/.

2.1.6. Compaction:

The mechanical compression (e.g. by vibrator) of the installed layers.

2.1.7. Long term deformation:

The decrease of installed expanded clay LWA thickness with time, due to e.g. external loads, environmental loads or creep, expressed as a percentage of the initial installed thickness.

2.1.8. Design thickness:

Layer thickness after deformation and/or compaction as specified by the designer.

2.1.9. Installed thickness:

Layer thickness as installed by the installer including compaction if prescribed.

2.1.10. Structural elements:

The expanded clay LWA in an embankment is commonly covered with a capping layer of granular materials as lateral support. For traffic embankment there is also a pavement layer on top typically consisting of a sub-base and a top layer.



Definitions of the structural layers used in this report are presented in Figure 1.

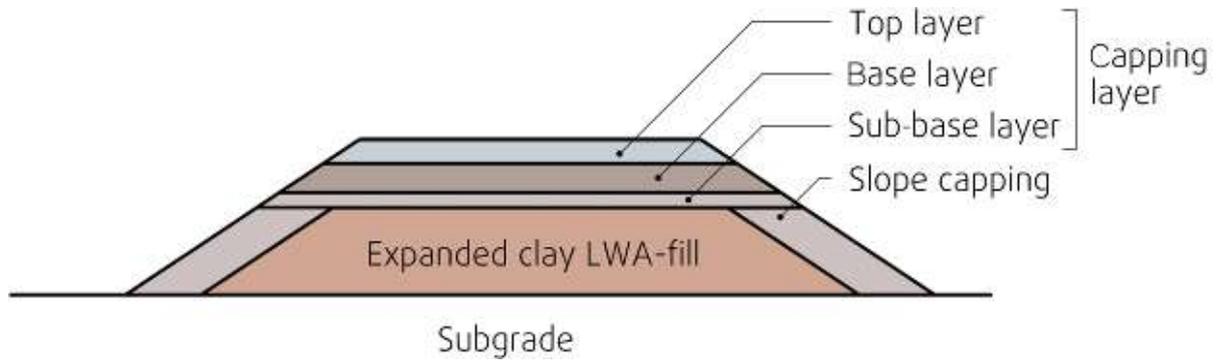


Figure 1 Definitions of structural layers in expanded clay LWA structures used in this report

Alternatively to the slope capping layer, a geotextile can be used as a wraparound solution for the lateral support of the edge of the embankment as illustrated in Figure 2. For permanent use the geotextile has to be covered or protected for damage and long term degradation (e.g. UV light).

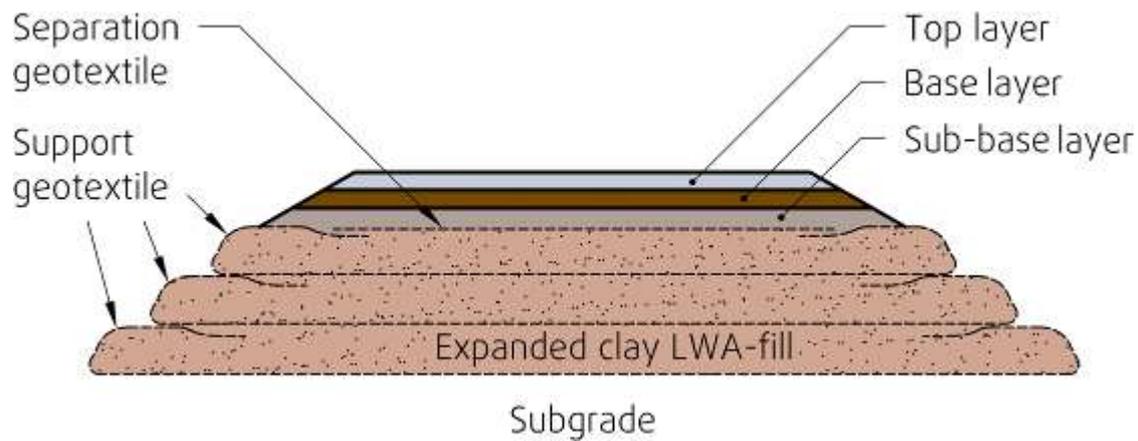


Figure 2 Embankment with layered structure and geotextile wrap around at the edges

3. Applications

Light weight aggregates can be used both for insulation purposes and to reduce settlement and improve stability of fills on soft subsoil. Some examples of applications are presented in Figures 3 to 7.

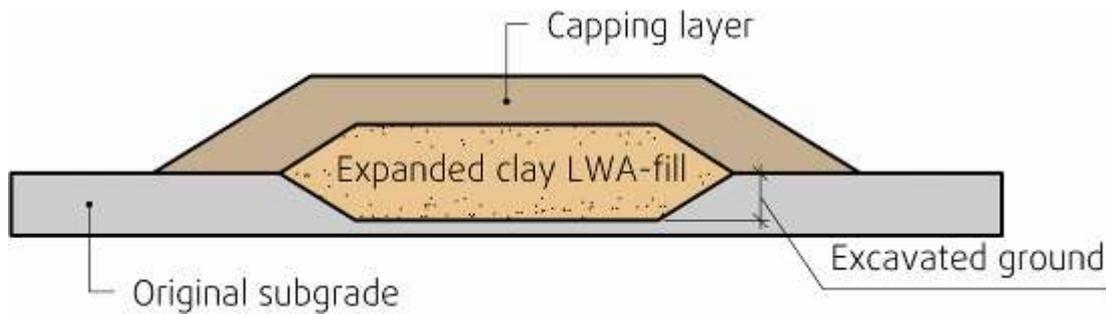


Figure 3 Expanded clay LWA used for load compensation to reduce settlement

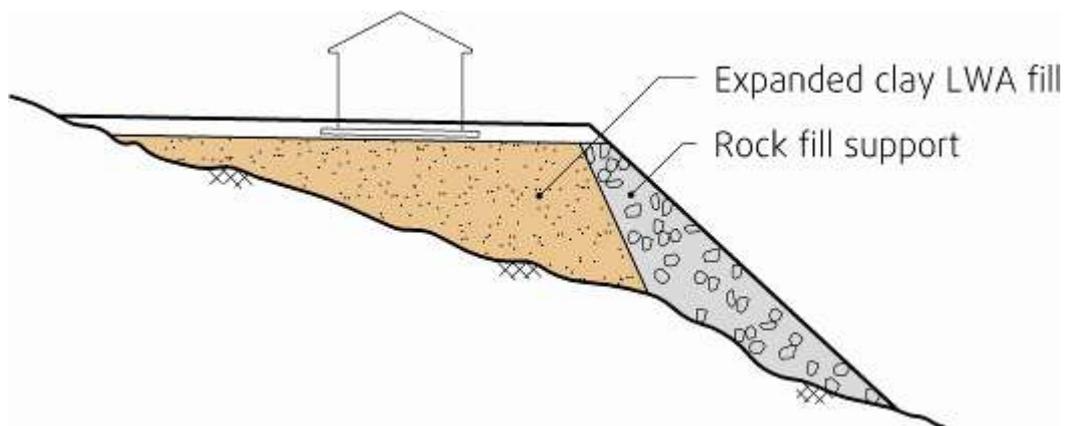


Figure 4 Expanded clay LWA to reduce weight and increase stability for embankments in slopes

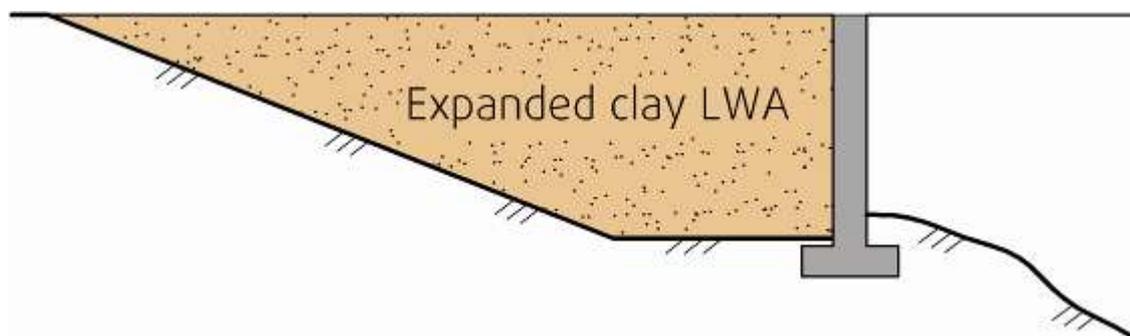


Figure 5 Expanded clay LWA as lightweight backfill to reduce weight and earth pressure to reduce differential settlement and horizontal load for a bridge foundation

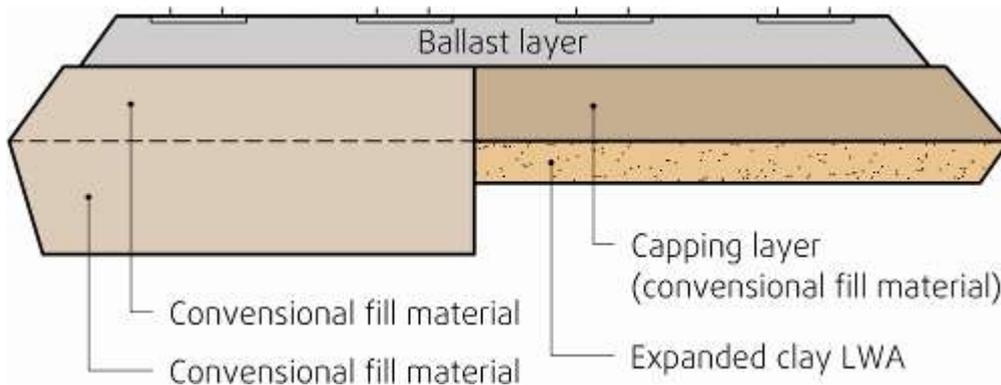


Figure 6 Expanded clay LWA as frost insulation in traffic embankment

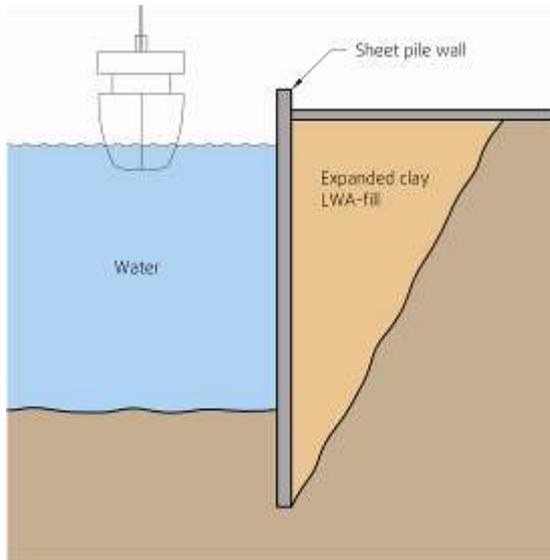


Figure 7 Expanded clay LWA used to reduce earth pressure on sheet pile wall for quay structure

4. Execution and Control

4.1. General

The installer shall use an expanded clay LWA product that complies with EN 15732 /1/.

The installer shall inspect the construction site in accordance with the requirements of the designer, Eurocode 7 and National Regulations in order to determine whether it is suitable for application of the product.

4.2. Delivery Control

The purpose of the delivery control is to verify that the material delivered on site is in accordance with the project specifications. The normal delivery control includes a checking of the Declaration of Performance document (DoP) and CE-marking of the product and additional accompanying documents.

If additional delivery control is required, including acceptance criteria, it shall be agreed upon before deliverance of expanded clay LWA. This can be done according to appendix B.

4.2.1. Marking and labelling

The marking and labelling of the delivered material shall be checked to verify that the product is in accordance with the project specifications. The marking of the delivered material shall be in accordance with EN 15732 /1/. An example of marking of the product is shown in appendix A. The accompanying document shall be made available on request and provide the required characteristics in accordance with EN 15732 /1/.

4.3. Handling and storage

Handling of the expanded clay LWA can be done using normal construction equipment, but care should be taken to avoid excessive impact on the material that may cause crushing of the aggregates (unnecessary traffic with heavy equipment). Care should be taken to avoid mixing with other materials during storing and handling. The material can be stored as conventional fill materials.

4.4. Construction

The construction control shall ensure that the material is installed in a proper way without being subjected to treatment that may reduce the intended function of the structure.

4.4.1. Preparatory work

The sub formation does not need levelling beyond the normal requirements for sub formation levelling.

The preparation of the sub formation for expanded clay LWA fills includes normal cleaning of the construction site (removal of e.g. tree roots, shrubs and other obstacles). If construction is taking place under winter conditions all snow and ice should be removed from the sub formation. When prescribed, a geotextile should be installed as a separator and filter between the subgrade and the expanded clay LWA-fill. Selection of geotextile should be done in accordance with national recommendations.

Excess water in the excavation pit should be avoided and pumped out to acceptable levels. A high water level could cause problems with uplift, and reduce the effect of compaction.

Note: High water levels in an uncovered expanded clay LWA fill can be dangerous and should be avoided. Floating expanded clay LWA could make the fill surface appear stable, but machines or workers going onto the fill may sink down into the water.

4.4.2. Installation

The material can be delivered by tipping from the truck or delivery and installation by blowing (Figure 8). The expanded clay LWA should be installed in layers of maximum 1 m after the installation of lateral support (supporting embankment or wrap around geotextile before compaction). Truck driving directly on top of the expanded clay LWA should be avoided. The material can be spread with a back excavator, dozer or other similar equipment (Figures 9 and 10). It is often convenient to combine the spreading of the material and the compaction procedure.



Figure 8 Installation by blowing



Figure 9 Spreading by a back excavator

Installation by blowing directly into the place can be convenient at construction sites with difficult access conditions. It is possible to blow expanded clay LWA up to 100 m horizontally or 20 m vertically and in some circumstances even further. Installation by blowing will in most cases result in an initial compaction of the material, thus reducing the need for additional mechanical compaction after the installation.

Expanded clay LWA can also be installed from big bags. The big bags commonly contain about 1 m³ material.

Construction traffic directly on the expanded clay LWA should be avoided with construction equipment having a belt or tire pressure higher than 50 kN/m². Traffic ability for the construction equipment on the expanded clay LWA fill can be achieved by the construction of an access road on top of the expanded clay LWA, as seen in figure 11. A separating geotextile should be used between the expanded clay LWA fill and the access road base layer. Provided the use of conventional trucks (axle load less than 150 kN), the access roads can be designed according to conventional recommendations. A general recommendation for total road base thickness for the access road is 300 mm unbound material above the expanded clay LWA. This is sufficient to provide required bearing capacity and avoid

crushing of the expanded clay LWA. By the use of geotextile reinforcement or stabilised material (cement or bitumen) it is possible to reduce the required thickness of the access road.

The base layer material for the access road should be of sufficient quality (e.g. gravel, crushed rock, crushed concrete, crushed masonry or binder improved soil according to national requirements for road base materials). Access for construction equipment may also be by the use of temporary measures like steel plate, wooden lodge elements etc.



Figure 10 Spreading by dozer



Figure 11 Access road on top of expanded clay LWA-fill

4.4.3. Compaction

Generally embankments with expanded clay LWA are used in areas with soft and compressible subsoil. It may be difficult to obtain a sufficient compaction of fill materials on this type of subsoil due to lack of response from the subsoil. Accordingly the compaction of expanded clay LWA fill in the embankment and the pavement should be considered carefully to obtain a good result.

For the most commonly used rounded material the contractor should be aiming at a compaction of about 10 - 12 % in relation to the loose fill state. When installing the material by blowing an initial compaction of maximum 5% is achievable, depending on the blowing pressure and the installation procedure. Hence the need for additional mechanical compaction is reduced. The rate of compaction can be controlled according to section 4.5.3.

Note: For some specific crushed materials (with or without fines) the amount of compaction can be significantly higher (up to 25%).

Over-compaction of the material (compaction leading to extensive crushing) should be avoided, especially if the material is used as frost insulation. This will increase the required volume and reduce the frost insulation properties.

Over-compaction will also reduce the volume of the material and increase the need for material on site compared to the theoretical volume.

Compaction of lightweight materials like expanded clay LWA requires less energy than conventional material, accordingly requirements for compaction equipment and

recommendations for layer thickness to achieve a proper compaction is not similar to conventional materials. Compaction of the expanded clay LWA fill is done in layers with a maximum thickness of 1 m. Proper compaction of the edge of the fill requires proper lateral support. This can be achieved either by a slope capping or by a geotextile wraparound of the edge. The equipment and procedure for compaction should be related to the type of structure. Compaction of small areas and close to structures will require smaller and lighter equipment than the compaction of large areas e.g. for a road or railway embankment.

Dependent on the required compaction energy and equipment, two different procedures are presented in this technical report:

- Compaction directly on the expanded clay LWA layers (4.4.3.1)
- Compaction after the installation of intermediate capping layers on top of the expanded clay LWA layers (4.4.3.2)

4.4.3.1. Compaction directly on layers of expanded clay LWA-fill

As the required energy is less than conventional materials it is not recommended to use heavy equipment or equipment with high contact stress levels. Generally the contact stress (belt pressure) should be less than 50 kN/m². Conventional compaction equipment (e.g. vibrating rollers) should not be used to compact directly on the expanded clay LWA-fill as this cause the machinery to sink into the fill.

Some recommendations on equipment characteristics and procedures for the compaction directly on the expanded clay LWA-fill are given in Table 1.

Table 1 Recommendations on equipment and procedures for compaction directly on expanded clay LWA fill

Equipment	Recommendations
Tracked vehicle (dozer, excavator)	Preferably compaction is combined with the installation Contact stress < 50 kN/m ²
Vibrating plate	Especially convenient close to other structures such as bridge abutments and for compaction of limited areas. Use of extended plate is recommended to avoid the plate sinking down in the fill. Typical Weight 50-140 kg, width 50-80 cm, contact stress < 5 kN/m ² , frequency 75-100 Hz

Examples of compaction by the use of a dozer and vibrating plate are presented in Figures 12 and 13.





Figure 12 Compaction by dozer



Figure 13 Compaction by vibrating plate

Recommendations to achieve proper compaction directly on the expanded clay LWA-layer are given in Figure 14. Often the specified compaction is reached during installation and no further compaction needs to be carried out. The optimum compaction varies with type of material and data for optimum compaction should be provided by the manufacturer.

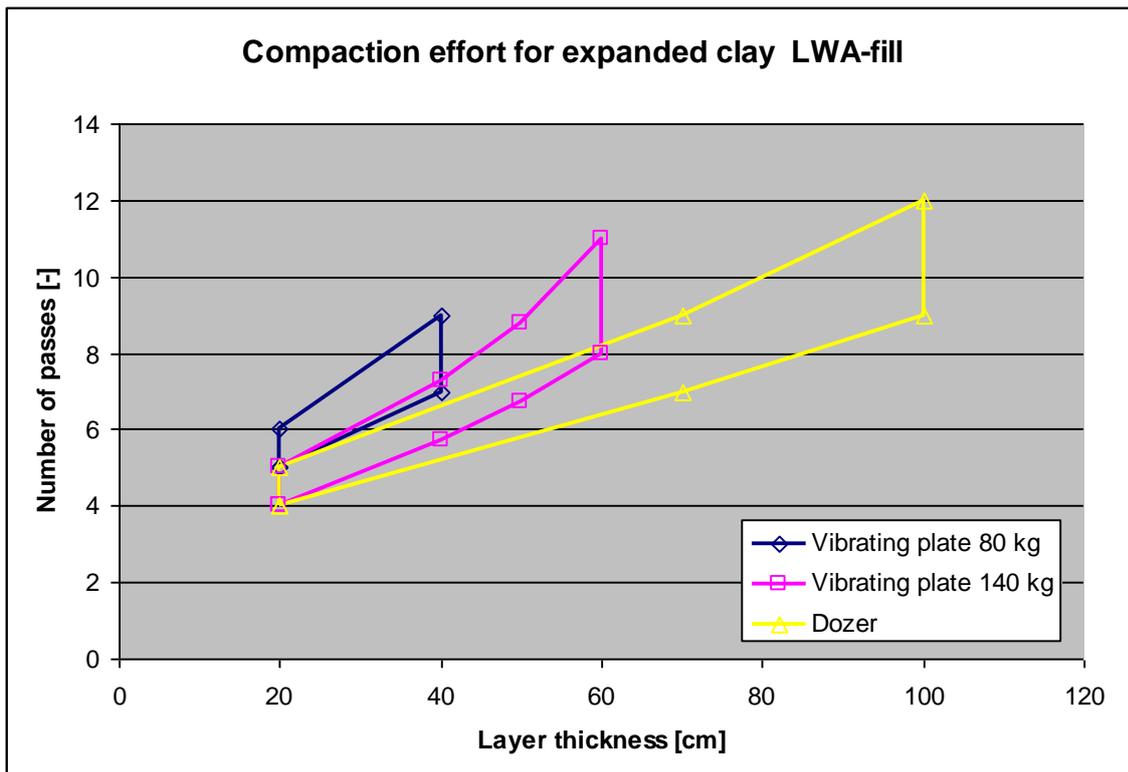


Figure 14 Recommendations on required compaction effort for expanded clay LWA-fill to achieve the intended level of compaction (vibrating plate 80 kg, vibrating plate 140 kg and dozer)

4.4.3.2. Compaction on LWA-fill with intermediate layers

For compaction with heavy vibrating rollers it is required to install intermediate layers of sand or stabilised material on top of the expanded clay LWA to obtain accessibility for the compaction equipment. Maximum thickness of the total layer (including intermediate layer) is 1 m. The intermediate layer typically consists of natural granular material or stabilised material (a typical solution is 0.8 m expanded clay LWA + 0.2 m natural granular material/stabilised material). If necessary a separating geotextile may be installed between the expanded clay LWA and the intermediate layer.

The principle of the structural layout for this procedure is presented in Figure 15.

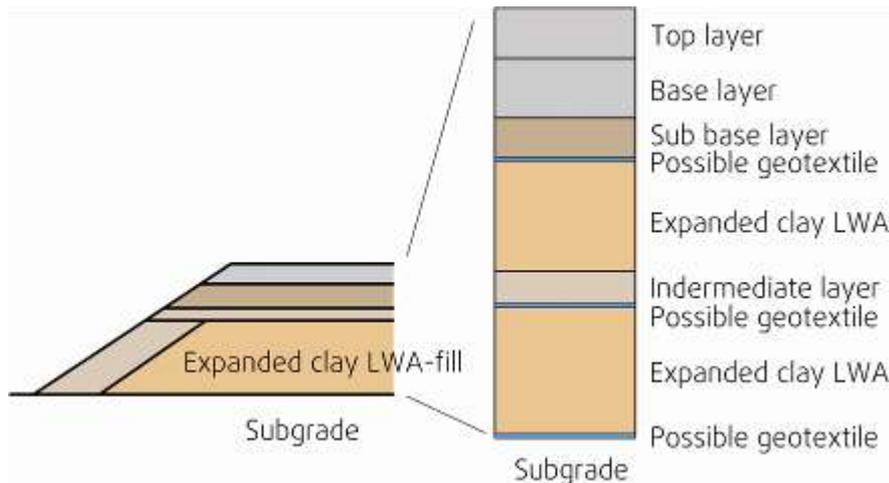


Figure 15 Structural layout for Expanded clay LWA-fill with intermediate layers

Compaction is performed with vibrating roller equipment, typically weight 15-50 kN. Recommendations on required compaction equipment and procedures should be based on national regulations and recommendations.

4.4.3.3. Final compaction of capping layer on top of expanded clay LWA fill

It is of high importance for the total quality of the whole structure to obtain a proper compaction of the capping layer on top of the expanded clay LWA. The compaction of the capping layer can be done with conventional appropriate equipment and procedures to achieve a proper compaction of all parts of the structure.

The compaction of unbound layers on top of expanded clay LWA should preferably be carried out with a vibrating oscillating roller with the possibility to adjust amplitude and/or frequency. The roller weight and compaction energy should be carefully considered based on the type of material and thickness of the base layer. Compaction energy should be limited to avoid risk of crushing of the expanded clay LWA-material underneath, and to obtain an optimum compaction effect of the base layer.

Compaction of the capping layer is commonly performed with vibrating roller equipment, typically weight 15-50 kN (Figure 16). It is recommended to use vibrating equipment with the possibility to modify amplitude and the frequency and to perform the compaction in 3 steps.

1. Compaction of the sub-base layer with high amplitude and high frequency
2. Compaction of base layer with low amplitude and high frequency
3. Additional compaction with low amplitude and low frequency followed by a levelling compaction (without vibration)



Figure 16 Compaction roller, impact 26/37 kN

4.5. Structural Quality control before installation of capping layer

The structural quality control is intended to verify that the material has been installed in a proper way and is fulfilling the intended function in the structure.

4.5.1. Visual inspection

The surface of the expanded clay LWA should be inspected visually to check for possible exceptions from proper execution, e.g. clear deviation from theoretical profile, excessive crushing of materials etc. If there are clear indications of deviations samples should be taken from the field according to annex B to control the material in the laboratory.

4.5.2. Installed thickness

The installed thickness and variations should be according to the project specifications and national requirements. Installed thickness is controlled by surface levelling, test pit etc.

4.5.3. Degree of compaction

The degree of compaction can be controlled by levelling, by relative volume control or by installed density.

Levelling should be performed on top of the expanded clay LWA layer and the degree of compaction should be estimated as the average deformation from at least 5 measuring points for each 1000 m² surface. It should be noted that possible changes in the fill profile should be evaluated as this will influence the measurements of compaction based on levelling only.

The relative compaction can be controlled on samples taken in the field. The samples should be minimum 5 litres and can be taken by the use of a sampling tube that is driven into the fill mechanically. Sampling of expanded clay LWA material can preferably be done by the use of a sampling tube combined with a vacuum cleaner device as seen in Figure 17. The method is described in reports from the Swedish Testing Institute /4/. The relative compaction can be controlled by comparing the volume of loose material from the sampling with the volume of the material in the tube in situ.



Figure 17 Sampling by vacuum cleaner device

The vacuum cleaner device can also be used for taking samples for further evaluation in the laboratory on installed density, moisture content etc. This is not commonly done, but can be relevant for more excessive control when required. The method is described in reports from the Swedish Testing Institute /5/.

4.5.4. Plate load test directly on expanded clay LWA

If static or dynamic plate load tests are performed directly on the expanded clay LWA layer it is necessary to use a modified load plate with increased diameter (minimum 600 mm). Testing procedures and evaluation of the results should be based on national experience with correlation with the bearing capacity of expanded clay LWA from field experience with similar structures.

4.6. Structural Quality control after installation of capping layer

4.6.1. Bearing capacity/stiffness measured on top of the capping layer

It is recommended that the measurements of the bearing capacity/stiffness are performed after the installation of a layer of minimum 300 mm or granular material on top of the expanded clay LWA-fill. For stabilized materials less cover layer thickness may be used.

4.6.1.1. Static plate bearing test

The bearing capacity/stiffness may be measured by a plate load tests on the capping layer on top of the expanded clay LWA fill according to DIN 18 134 /6/. The results should be based on the average result from minimum 2 tests per 1000 m² surface.

It should be noted that the result in this case will reflect the stiffness and bearing capacity of the entire structure, not the expanded clay LWA layer alone.

4.6.1.2. Dynamic plate bearing test

The method is basically using the same equipment as for static plate load tests, but with the application of a cyclic load. The method is not commonly used for verification of bearing capacity, but is used for development and research projects. An example of the use of this method and a summary of some previous studies is presented in Tingle & Jersey (2005) /7/.

It should be noted that the result in this case will reflect the stiffness and bearing capacity of the entire structure, not the expanded clay LWA layer alone.

4.6.1.3. Falling weight deflectometer

Falling weight deflectometer will provide information on the elastic stiffness of the structure and possibly each of the layers in the structure /8/.

It should be noted that the result in this case will reflect the stiffness and bearing capacity of the entire structure, not the expanded clay LWA layer alone.

4.7. Other methods not adopted

4.7.1. CBR

CBR (California Bearing Ratio) is generally used for evaluation of bearing capacity of granular materials in a number of countries. The method has proven not to be suitable for the use of controlling the bearing capacity of expanded clay LWA-material.

4.7.2. Other methods

Some other methods which may prove to be useful, but where relevant experience is still limited are:

- Compaction response on compaction equipment
- Light weight falling weight equipment
- CPT
- Loadman
- GeoGauge

These methods need to be evaluated more before they can be taken into use for general quality control of expanded clay LWA-materials.



5. References

- /1/ EN 15732 Light weight fill and thermal insulation products for civil engineering applications (CEA) - Expanded clay lightweight aggregate products (LWA).
- /2/ EN 14063-1 Thermal insulating products for buildings. Part 1: In situ formed expanded clay lightweight aggregate products.
- /3/ EN933-5 Test for geometrical properties of aggregates. Part 5: Determination of percentage of crushed and broken surfaces in coarse aggregate particles.
- /4/ SP Method 3751 LEHA method: Determining the compaction and bulk density of expanded clay lightweight aggregate embankments – simplified method.
- /5/ SP Method 3751 LEHA method: Determining the compaction and bulk density of expanded clay lightweight aggregate embankments.
- /6/ DIN 18134 Determining the deformation and strength characteristics of soil by the plate loading test.
- /7/ Tingle, J.S. & Jersey, S.R. 2005: Cyclic Plate Load Testing of Geosynthetic-Reinforced Unbound aggregate Roads, Transportation research Record, n 1936, pp 60-69.
- /8/ COST 336 Falling Weight Deflectometer.
- /9/ EN 932-1 Tests for general properties of aggregates. Part 1: Methods for sampling.
- /10/ EN 1097-3 Tests for mechanical and physical properties of aggregates. Part 3: Methods for determination of loose bulk density and voids.
- /11/ EN 933-1 Tests for geometrical properties of aggregates. Part 1: Determination of particle size distribution. Sieving method.
- /12/ EN 1097-5 Tests for mechanical and physical properties of aggregates. Part 5: Determination of the water content by drying in a ventilated oven.
- /13/ EN 932-2 Tests for general properties of aggregates. Part 2: Methods for reducing laboratory samples.



Annex A

Marking and labelling

For products conforming to the standard EN 15732 /1/, the manufacturer shall draw up a DoP (declaration of performance) before placing the product on the market. The content of the DoP is clearly defined in the CPR (Construction Products Regulation):

Content of the DoP (Article 6)

Required points of information:

- Product type reference.
- Assessment system(s).
- Standard (or ETA-) number and date of issue.
- Intended use(s).
- List of (all) essential characteristics.
- Performances (by levels or classes) of essential characteristics required for the intended use(s) in the relevant market(s).
- If required, performances (by levels or classes) of essential characteristics as specified in delegated act from the Commission.
- Always performance of min. 1 essential characteristic.
- State NPD where (further) performances are neither required nor declared.
- If required, supplementary information on hazardous substances in accordance with REACH, article 31 and article 33+57/59.

The DoP document shall have a unique product identification number, and the document shall be stored and made available for the customers for a period of 10 years.

DoP template - Expanded Clay Lightweight aggregates for CEA
acc. to table 2.1.1 of EN 15732-2012

EXCA
Company SA

DECLARATION OF PERFORMANCE
in accordance with EU Construction Products Regulation (CPR) no. 305/2011

No. DoP-ND-001

1. Unique identification code of the product type:
Loca[®] 10 - 20 R
2. Type, batch or serial number or any other element allowing identification of the construction product as required under Article 1(10):
Loca[®] 10-20 R (batch/production date/production site refer to this number – bulk delivery)
3. Intended use or uses of the construction product: in accordance with the applicable technical specification, as required by the manufacturer:
Expanded Clay Lightweight aggregate for light weight fill and thermal insulation in civil engineering applications
4. Name, registered trade name or registered trade mark and contact address of the manufacturer as required pursuant Article 1(10):
EXCA company SA SA
postal address:
WWW: www.excacompany.net
5. Where applicable, name and contact address of the authorised representative unless indicated on the label specified in Article 1(10):
Not applicable
6. System or systems of assessment and verification of constancy of performance of the construction product as set out in Annex B: A1/CP system 2
7. In case of the declaration of performance concerning a construction product covered by a harmonised standard:
EN 15732-2012
yyyy, notified testing laboratory No. xxxxx
yy/mm Product Type Determination on the bases of type testing under system 2
and under its report title: _____
8. In case of the declaration of performance concerning a construction product for which a European Technical Assessment has been issued:
Not applicable
9. Essential performance:

Essential characteristics (see table 1)	Performance (see table 2)	Harmonised technical specification (see table 3)
Reaction to fire	Euroclass A1 according Commission Decision 2009/555/EC	EN 15732 - 2012
Water permeability	= 10 ⁻¹ m/s	
Release of dangerous substances	NPD	
Thermal resistance:	Thermal conductivity: 0,12 W/mK	

Figure 18 Example of DoP document for Expanded clay LWA



A product with a DoP document shall be clearly marked on the label on the packaging or on an accompanying document with a CE-marking. An example of the content of the CE-marking is shown in Figure 19.

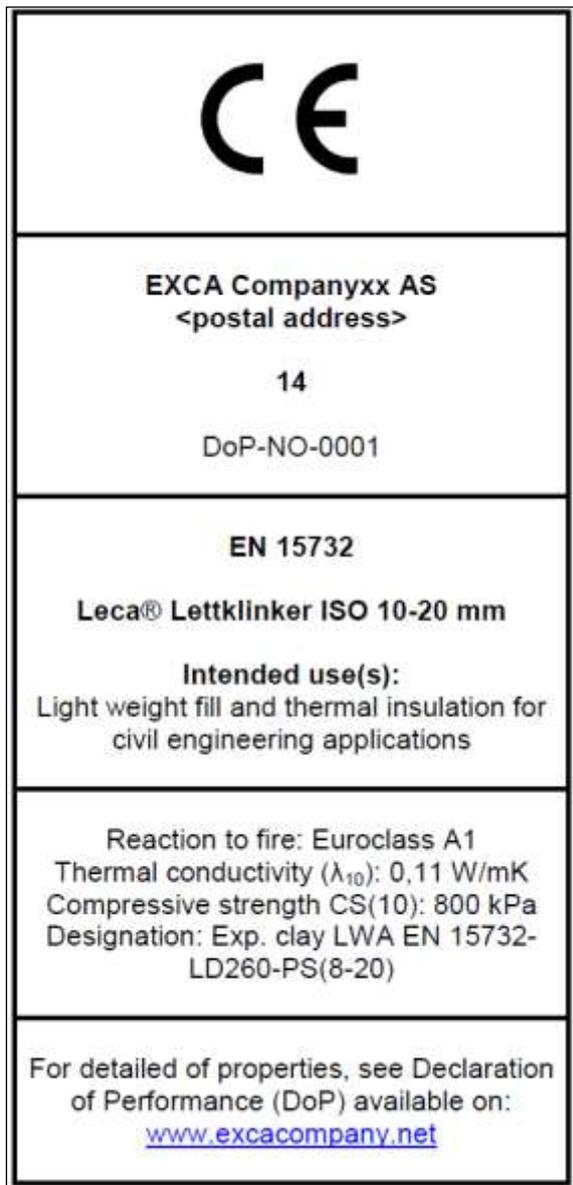


Figure 19 Example of CE-marking for Expanded clay LWA

Additional information is normally stated in the accompanying documents:

- Name or identifying mark and address of the manufacturer or his authorised representative
- Date of delivery, manufacturing plant and/or traceability code
- Quantity of material, in m³

Annex B

Additional delivery control

B.1. Sampling

The normal delivery control is performed by checking if the DoP documents and CE-marking and additional accompanying information are in accordance with the specifications.

If additional delivery control is required, sampling of the material shall be performed according EN 932-1 /9/. Sampling from conical stock piles of Expanded Clay LWA should be avoided because it is nearly impossible to follow the instruction given in EN 932-1 /9/, Annex C.

The number of tests and the procedure for sampling shall be agreed upon before delivery and installation. Note that there might be considerable variations in the loose bulk density depending on where the material is taken due to separation during handling of the material.

EXCA recommendation:

The required number of test samples for delivery control on site should be related to the total volume of material delivered. Some general recommendations for delivery control are given in Table 3. The sampling should be done as described in Table 4.

Table 3 Required numbers of tests for delivery control. One test result is the mean value of 3 test specimens

Volume delivered (m ³)	Loose bulk density /10/	Particle size distribution /11/	Water content /10/, /12/
< 5.000	1 per 1000 m ³	1 per 2000 m ³	1 per 1000 m ³
>5000	1 per 2000 m ³	1 per 4000 m ³	1 per 2000 m ³

Table 4 Sampling procedures

	The test sample is taken:	Sampling according to
Priority 1	During (loading or) unloading of the truck	EN 932-1, clause 8.2, 8.3 or 8.6
Priority 2	From the truck before unloading, or from a front-loader before spreading out)	EN 932-1, clause 8.9

The samples shall be taken from minimum 4 different places from one truck load according EN 932-1 /9/, using a sampling tube. The diameter of the sampling tube shall be at least 3 times the largest aggregates (3 x D).

Samples should be taken from at least 5 different truck loads, evenly distributed during delivery.

The volume of sampled material should be at least 30 litres, and handled as composite samples. The total volume should be divided in two equal portions (in accordance with EN 932-2 /13/), one for each party.

From these samples the loose bulk density (and water content when required) and particle size distribution shall be performed according /10/ and /11/.



B.2. Loose bulk density and moisture content

When determining the loose bulk density in accordance with EN 1097-3 /10/, the moisture content is also recorded. If only the moisture content shall be measured, EN 1097-5 /12/ can be applied.

B.3. Particle size distribution

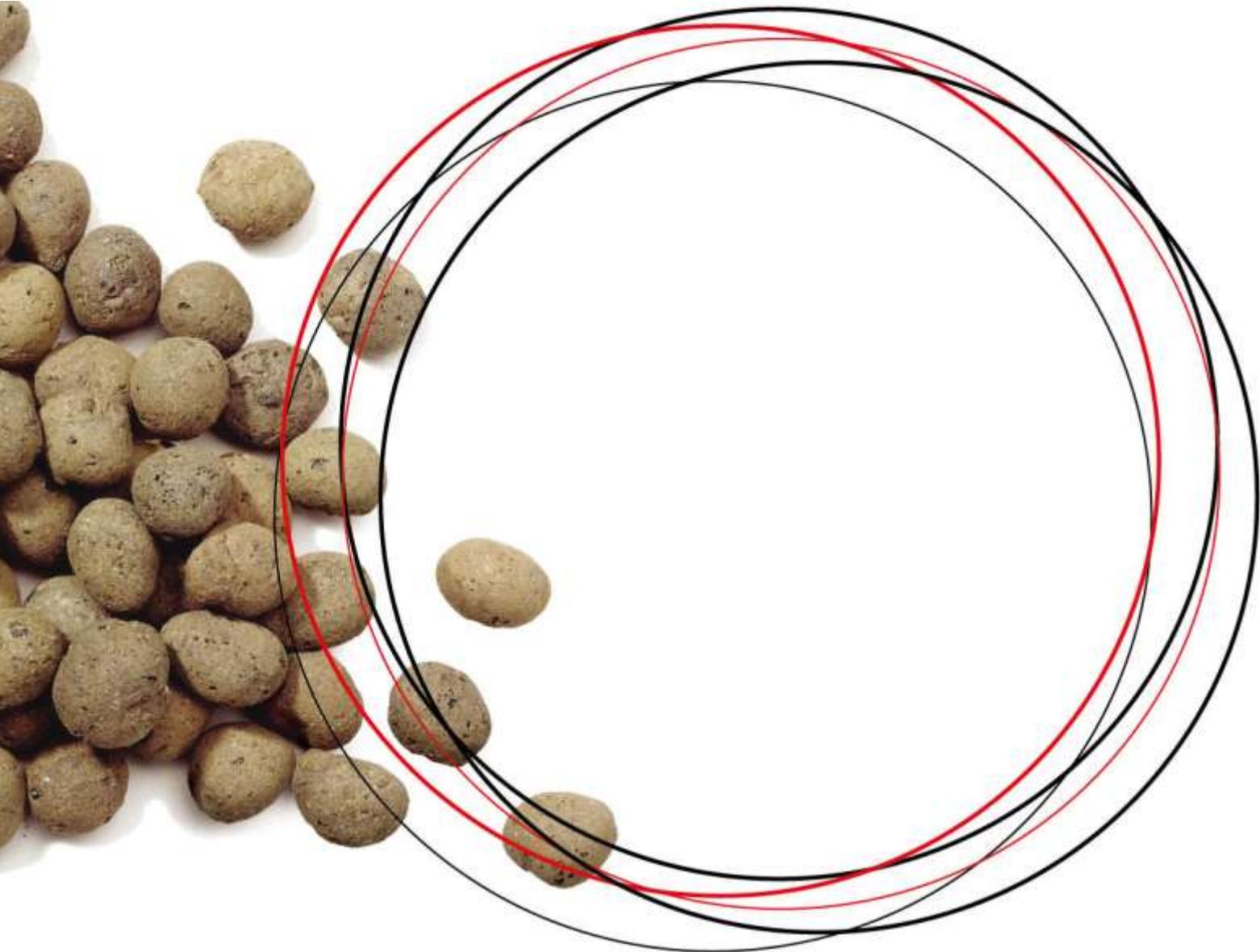
Particle size distribution shall be measured in accordance with EN 933-1 /11/. This standard is a general standard for normal weight aggregates, and is not directly applicable for expanded clay lightweight aggregates.

The EXCA recommendation is to use the amount of material as listed in table 5. The volumes for other aggregate sizes are calculated by interpolation.

Table 5 Required volume of expanded clay LWA for particle size distribution

Maximum aggregate size D (mm)	Minimum volume of expanded clay LWA (dm ³)
32	2.1
16	1.7
8	0.8
4	0.3





EXCA

EUROPEAN EXPANDED CLAY ASSOCIATION

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