

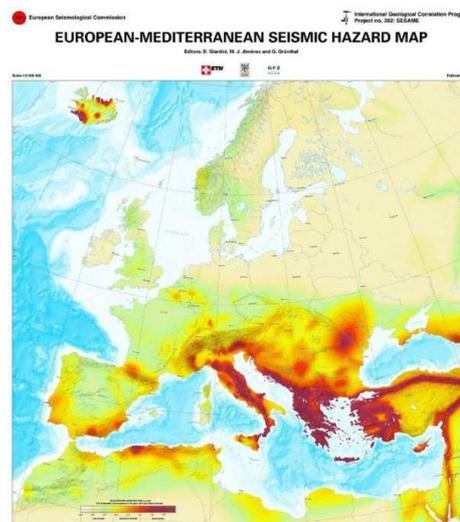
EPOXY21: The chemical anchor obtains the C2 seismic certification

INTRODUCTION

The methodologies of seismic design acquired in the last years an increasingly importance not only for areas of high seismicity, such as the west coast of the United States and Japan, but also for other territories like the European one, which in the last 30 years recorded several earthquakes with a magnitude of 5 and more.

Referring to the European seismicity, most of the countries require an appropriate seismic design and the authorities approved follow-up studies for the protection of the economic and social aspects and for the safety.

In other words, in case of architectural and industrial buildings, in addition to the issue of the protection of life, it has to be considered also the issue of the protection of the monumental value, the equipment, such as processed and work in process goods store and, especially, the continuous efficiency of companies.



A correct design in seismic conditions considers how the basic material reacts during the earthquake and the possible displacements of the structure and then the deformation in its constituent items that cause, in turn, the opening of cracks in the concrete components. Therefore all the anchoring agents intended to transfer seismic loads must be suitable for their use in cracked concrete and their design must be based on the assumption that the cracks in the basic material may have a cycle opening and closing all along the earthquake.

These problems, very important in the European area, were systematically faced by EOTA (European Organization for Technical Approvals), appointed by the European Commission to determine the new test procedure and establish the suitability of the post-installed anchor agents during a seismic activity. Up to now, after 5 years collaborating with multinational corporations, European experts in seismic activities, small and medium-sized enterprises together with ECAP (European Consortium of Anchors Producers) and the Polytechnic of Milan, the European guideline for seismic approval of anchors has been developed and has reached its final format in terms of the technical content with structural and non-structural area applications.

They are tests and suitable check parameters that are necessary for the correct evaluation of the performances of an anchor agent under seismic activities. In fact, only anchor agents certified on the base of these requisites are suitable for the connections that are relevant for the safety.

Anchors subject to this new certification procedure must include all technical information necessary for ETA, both in terms of load and displacement, according to the guideline ETAG 001 -Annex E.

Specifically, two test protocols are identified depending on the seismicity of the area and the class of importance of the building on which work has to be performed:

- C1: only for non-structural uses and for levels of low seismicity,
- C2: for structural uses and non-structural uses and for levels of significant seismicity.

The C1 test protocol includes everything that is recommended already in the United States regulatory document ACI 355-2 and provides 10 tests to be performed with tensile and shear seismic simulation for every diameter of the anchor to certify.

On the other hand, the test protocol C2 is stricter and provides a minimum of 30 tests per diameter and tests in which the anchors are qualified for the load cycling and in cracks up to 0,8 mm in width by simulating the inversion of the moment through the active compression of the concrete around the anchor.

To sum up, the following table of the C1 and C2 seismic category is based on two factors: the seismicity of the geographic area and the importance class of the building. ¹

SEISMICITY LEVEL		IMPORTANCE CLASS ACCORDING TO EN 1998-1:2004, 4.2.5			
Class	$a_g \cdot S$	I	II	III	IV
VERY LOW	$a_g \cdot S \leq 0,05 \text{ g}$	ETAG 001 Part 1 to Part 5 (No additional requirement)			
LOW	$0,05 \text{ g} < a_g \cdot S \leq 0,1 \text{ g}$	C1	C1 or C2		C2
> LOW	$a_g \cdot S > 0,1 \text{ g}$	C1	C2		

- $a_g = \gamma_1 \cdot a_{gR}$ Design ground acceleration on type A ground (Ground types as defined in EN 1998-1).
- γ_1 = importance factor (see EN 1998-1, 4.2.5)
- a_{gR} = reference peak ground acceleration on type A ground (see EN 1998-1:2004, 3.2.1)
- S = Soil factor (see e.g. EN 1998-1_2004,3.2.2)
- C1 for fixing non-structural elements to structures
- C2 for fixing structural elements to structures

In relation to the soil seismicity, it must be considered the soil profile and, thanks to the description of the stratigraphic profile, the classification can be made in this way:

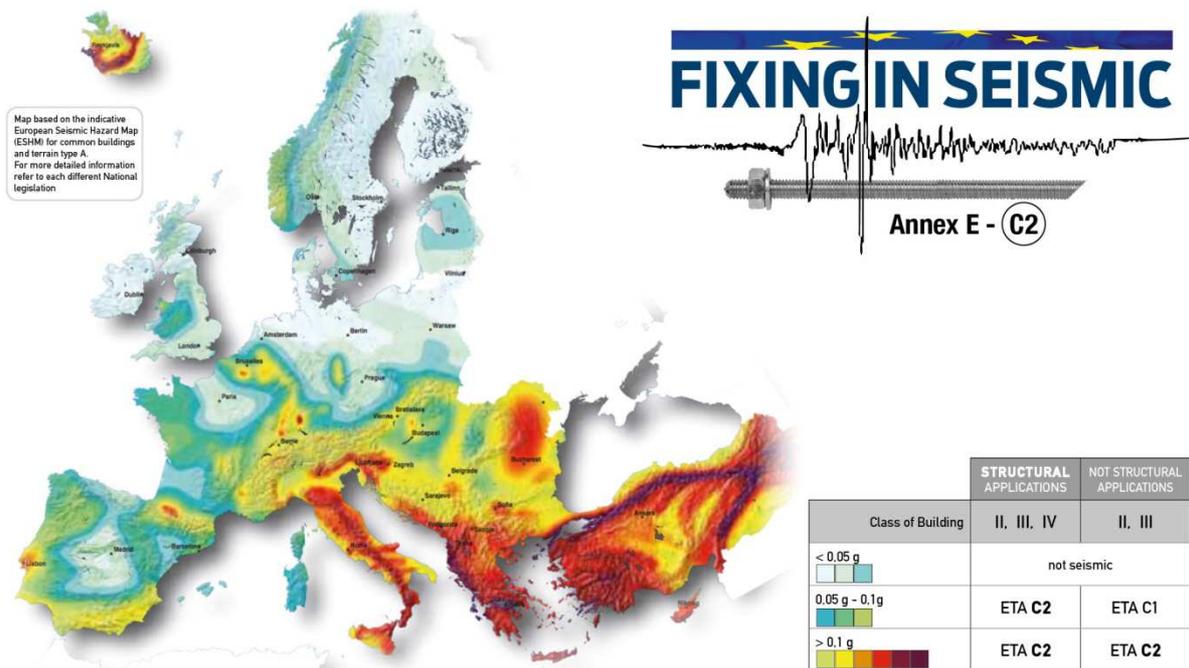
- Ground type A: rock or other rock-like geological formation, including at most 5 m of weaker material at the surface
- Ground type B: deposits of very dense sand, gravel, or very stiff clay, at least several tens of m in thickness, characterized by a gradual increase of mechanical properties with depth.
- Ground type C: deep deposits of dense or medium-dense sand, gravel or stiff clay with thickness from several tens to many hundreds of m
- Ground type D: deposits of loose-to-medium cohesion less soil (with or without some soft cohesive layers), or of predominantly soft-to-firm cohesive
- Ground type E: a soil profile consisting of a surface alluvium layer with v_s values of type C or D and thickness varying between about 5 m and 20 m, underlain by stiffer material with $v_s > 800 \text{ m/s}$
- Ground type S1: deposits consisting – or containing a layer at least 10 m thick – of soft clays/silts with high plasticity index ($PI > 40$) and high water content
- Ground type S2: deposits of liquefiable soils, of sensitive clays, or any other soil profile not included in types A – E or S1

The Soul factory is equal to one for soil type A and it increases in value by gradually moving to souls that represents less and less consistency.

¹ Source: European Organization for Technical Approvals – TECHNICAL REPORT TR 045 for ETAG 001 – Design of Metal Anchors For Use In Concrete Under Seismic Actions

The second parameter for the evaluation of the suitability of the seismic load is the classification of the buildings according to their importance class. There are four classes of different types of buildings and the more the class is higher, the more importance have the buildings. The first class includes buildings of less importance for the public safety (such as agricultural buildings), the second class refers to ordinary buildings that are not included in other categories, such as residential buildings. The third class is for buildings whose seismic resistance is important for the consequences associated to a collapse (for example schools, meeting rooms, cultural institutions). So the last class, the most important one, includes building whose integrity during earthquakes is essential for the civil protection (for example hospitals, fire stations, energy plants). The next image represent the European seismic areas according to the previous parameters:

STRUCTURAL (AND NOT STRUCTURAL) FIXING IN SEISMIC



According to it, most areas like Italy are included in the C2 category.

In this field, Bossong, that cares for the safe design of buildings, has obtained the European qualification for the EPOXY 21 in the seismic C2 category, according to Annex E. The product is also suitable for structural uses and non-structural uses and for every level of seismicity.

EPOXY 21 is one of the best chemical anchors in the European market with double approval. It is made with a Bossong high-adhesion Epoxy resin for heavy-duty fastenings for use in different base materials as concrete, solid masonry and wood. It is suitable for electrically isolated fixings and allows high-potential dielectric fixings eliminating stray voltage effects. The resin, due to its strong adhesion value and its easy penetration in holes and hollow areas, allows a safe fixing without expansion and so without stresses in the base material.

It does not need premixing, the resin and hardener are mixed only during the extrusion through a special mixer and do not need a premixing.