Technical Note No. 30

CLADDING OF BUILDINGS SUBJECT TO EARTHQUAKES

Introduction

In many countries it is necessary to consider the effects of earthquakes when designing and constructing buildings. Earthquakes occur frequently but most are of insignificant magnitude. The larger earthquakes are less frequent but may be extremely damaging.

Building structures are designed to resist earthquakes as appropriate but the same attention is not always given to the design of cladding.

This Technical Note describes the behaviour of buildings during earthquakes, the effect on cladding and the risks associated with cladding failure.

Seismic design of building structures

In most countries affected by earthquakes building standards or codes exist. However, the type of earthquake and risk of occurrence vary and many regional or city building codes include specific earthquake requirements. For buildings that are small, of simple geometry and standard construction, the codes are applied as simple calculations. This leads to pseudo-static design methods in which equivalent horizontal forces are applied to the structure at each storey as static loads. The code will limit the permissible building structural movements, which are normally stated as allowable relative floor movements for any storey.

The effect of the earthquake depends not only on the form of the building and its geographical location but also on the site ground conditions.

In pseudo-static calculations this is handled by factoring the horizontal loads.

For more complex building geometries, difficult ground conditions or buildings that have to survive (hospitals, utilities, etc.) it is normal to undertake a full dynamic analysis. If such an analysis has been performed then the displacements and accelerations experienced by the building frame will be available from the structural engineer.

Seismic resistance of structures

When designing buildings to resist earthquakes two strategies are possible:

- Flexible construction
- Semi-rigid construction

In the first case the structure is made comparatively flexible, Figure 1a, so that the structure attracts lower loads but experiences larger relative internal movements. The ground is then able to move during the earthquake while the mass of the building remains more or less static.

Semi-rigid designs are made stiff so that little relative internal displacement occurs, Figure 1b. The mass of the building then has to move with the ground and large forces are generated within the structural frame.