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The Role of Geometry on Livestock Facilities under Different Types of Actions

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Abstract

The objective of the paper is the investigation of the livestock facility response, in the specific conditions of seismicity of Romania. All buildings are designed for a particular use, and this is reflected in their shape, size and layout. The design and development of a traditional livestock facility can provide important information about agricultural or industrial practices in the past. Small details and the patina of age contribute to the creation of a building’s unique character. There are situations in which the geometric conformation of the buildings as a result of modernization and structural interventions has been changed, but it is known that all buildings have to respect the provisions of design codes. This is the reason for that the role of geometry and materials in the response of buildings under different type of actions as seismic and temperature actions were analysed. The only difference between two types of actions consists in time: the earthquakes are acting quickly; they need just a few seconds for damaging the structures while the temperature is acting slowly, and the dramatic time is measured in hours. The validation of these results was made with the aid of modal analysis software. The obtained results characterize the building’s behaviour in the small amplitude vibration range

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1. Introduction

The Vrancea seismogenic zone is the most important seismic zone, taking into account the energy, the extent of the macroseismic effects and the persistent and confined character of the earthquakes that occur in this narrow area.

A very small mantle volume of about 30×70×160 km hosts earthquakes that occur repeatedly with magnitudes in excess of 7.5. All intermediate-depth earthquakes are contained in the high-velocity volume beneath Vrancea which is bigger than the seismogenic volume (Wenzel et al., 2002).

After Vrancea and others crustal seismic sources the entire territory of Romania is considered as seismic territory. Thus, according to the new seismic design code of buildings, the values of the peak ground accelerations are from 0.08 to 0.40g, for earthquakes with the mean recurrence interval IMR = 475 yr. The value for control period are according with considered are Tc = 0.7s, 1.0s and 1.6s (MDRAP, 2013).

The rural residential buildings (non-engineered buildings) can be divided into two main categories. The first category of non-engineered buildings is those built according to tradition, their types suiting the culture and materials available in that area- the traditional rural dwellings. The second category of non-engineered buildings is the rural city type dwellings or a combination of traditional look only, but not adopting the traditional skills and crafts in detailing, material use etc.

This paper emphasizes the behaviour of reinforced concrete buildings with different type of plans: with regular or irregular shape.

2. Research Methods

Autodesk Robot Structural Analysis Professional software uses the equivalent static seismic forces and modal analysis with response spectra as methods of structural analysis.

The method of equivalent static seismic forces can be applied to buildings for which the characteristics can be calculated through the consideration of two plane models on orthogonal directions and for which the total seismic response is not significantly altered by the higher oscillation Eigen modes. In this case, its fundamental mode of translation has a predominant influence in the total seismic response. The main shear force corresponds to the proper fundamental mode, for each of the primary horizontal directions considered in the building's calculations, is determined as followed:

$$F_b = \gamma_I S(T_1) \tag{1}$$

where

$S(T_1)$ - is the design response spectrum ordinate correspondent to the fundamental period;

T_1- is the primary fundamental period of oscillation for the building in the plan that contains the considered horizontal line;

m – is the building's total mass;

γ_I is the importance (exposure) factor of building;

λ is the correction factor that considers the proper fundamental mode through the effective modal mass associated to it, whose values are λ = 0,85 if $T_1 \leq T^C$ and the building has more than 2 floors and λ = 1,0 in the other cases.