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Seismic Load Receiver Reinforced Concrete Frames Infilled With Masonry

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Annotation: *This article shows that the performance of reinforced concrete frames infilled with masonry and bare frames under seismic load was studied and compared using Lira 9.6 software.*

Keywords: reinforced concrete frames with infilled masonry, seismic load, crack, design model

I. INTRODUCTION

Barrier structures in reinforced concrete frame buildings can be light and heavy. Regardless of the type of barrier structures, the applicable building codes do not consider them as load-bearing structures, on the contrary, in the calculation process, its calculation scheme is taken as an open frame. However, if the barrier structure consists of brick, it acts as a load-bearing structure with a reinforced concrete frame. In general, the stiffness, strength, and resistance to periodic loads of brick-filled carcasses increase. The interaction of carcass and filler is a complex process and little research has been done on this. However, unlike many non-load-bearing elements, brick-filled carcasses can transmit loads to each other with the frame under the influence of seismic loads, in such cases it is difficult to fully determine how brick-filled carcass buildings resist seismic loads.

II. METHODS

The neglect of filler walls at the design stage is due to insufficient knowledge about the performance of filler carcasses, the variability of material properties, geometric dimensions, and construction methods. In addition, the dimensions of the structure, the filling ratio relative to the open projection, the openings of doors and windows in the filling structure must be taken into account.

It should be noted that in buildings of complex construction, the connection between the two structures is considered to be strong when the brick wall is first raised and then a reinforced concrete frame is formed. However, in reinforced concrete frames with brick filling, first the frame elements are formed and then the brick wall is restored. This condition is considered to be a hinged combination of reinforced concrete and brick materials.

III. ANALYSIS AND RESULTS

Analysis of the literature shows that in the last 50-60 years, practical and theoretical research on filler carcass structures has almost never been conducted after Russian scientist S.V. Polyakov. Despite many studies, a number of uncertainties remain, and how the filler carcasses work under the influence of seismic loads is becoming a major problem for scientists and engineers today.

The nature of the performance of brick-filled carcasses during an earthquake is very complex and there are different approaches in the design normative documents. Like the building codes of many countries, BSR (Building Standards and Regulations) 2.01.03-96 “Construction in Earthquake Zones” ignores the work of filler bricks in frame buildings and the calculation scheme of the structure is taken as an open frame.

Several experimental studies have been conducted to study the performance of a brick-filled frame. Major experimental studies have been conducted by Polyakov, Holmes, Stefford Smith, Fiorato and Bertero, Zarnik and Tomazevich, Negro and Zergeletti, Fardi et al, Hashemi Musalam. All studies have shown that the filler frame has higher strength and stiffness than the open frame [3].

In addition to experimental studies, theoretical studies have also been studied by numerical analysis methods, as in many cases this type of analysis has some advantages over experimental testing. In addition to being inexpensive, this method allows the study of the parameters that determine the performance of this type of construction.

Various methods of modeling this type of construction can be found in the literature. These methods can be divided into 2 groups in the general case, i.e. local or micro models and simplified or macro models. Macro models are used to study the overall performance of a structure. This method is distinguished by the ease and efficiency of modeling. Micro-models are implemented using the finite element method, in which the design must be divided into multiple elements in order to more accurately analyze and take into account local effects [2].

During the earthquake, many observations were made about the operation of this type of structure and included in the sources. There are several examples that allow a better understanding of the seismic performance of brick-filled frames during a strong earthquake. For example, a study of the effects of an earthquake in Mexico City in 1985 showed that bricklaying was an important factor in the resistance of low-rise reinforced concrete frame buildings with brick fill.

According to the Brunea and Satchioglu data from the 1992 Erzinkan earthquake (Turkey), the brick-filled carcass resisted seismic loads without damage. According to the findings of the Northridge (1994, USA) earthquake by Bennett et al, Some cracks were observed in the brick walls, but the performance of the structure under seismic influences was positively evaluated [3].

In recent years, Mosalam has studied cases of breakage, damage, and crack formation of reinforced concrete frames with unreinforced brick in earthquakes in Venchuan (2008) and L'Aquilla (2011).

It is difficult to predict the type of distortions that occur in filler frames, and they depend on several factors. Based on the experimental and analytical results of recent years, El-Daxahni concluded that 5 forms of deformation in brick-filled reinforced concrete frames were cited. The occurrence of various distortions depends on the properties of the material and the stress in it. The research carried out by F.J. Krisafulli on the deformation forms of filler frame constructions is also of great importance. El-Daxah et al showed that the first 2 forms (Figures 1a and b) are of practical importance, and that distortions in them can cause distortions at diagonal angles and shifts in the horizontal direction. The third figure (Fig. 1.v) is very rare, which corresponds to cases where the ratio of the height of the wall to the width is large. The required value of wall thickness is determined based on acoustic and fire resistance requirements [4].

In the fourth figure (Fig. 1.g), diagonal cracks are formed, in which the structure retains its load-bearing capacity even after the crack is formed. The fifth figure (Figure 1.d) is important for reinforced concrete frames.

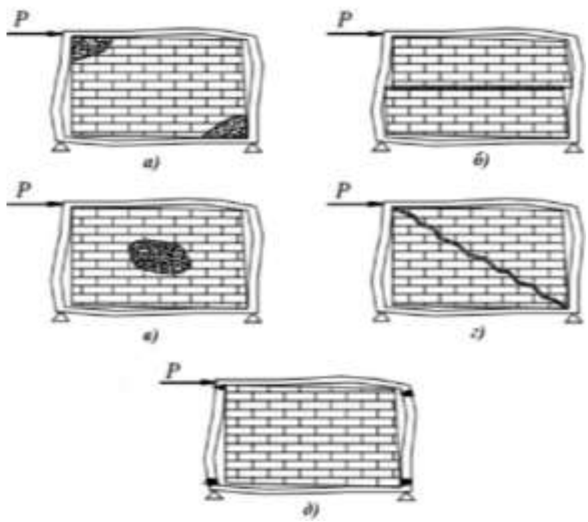


Figure 1. Deformation forms of reinforced concrete frames with brick filler

The article focuses mainly on the seismic performance of a brick-filled reinforced concrete frame. A 3-storey and a 3-storey building were taken into account (Fig. 2). Figure 2.a shows an open frame with a middle prolot brick filling, Figure 2b.

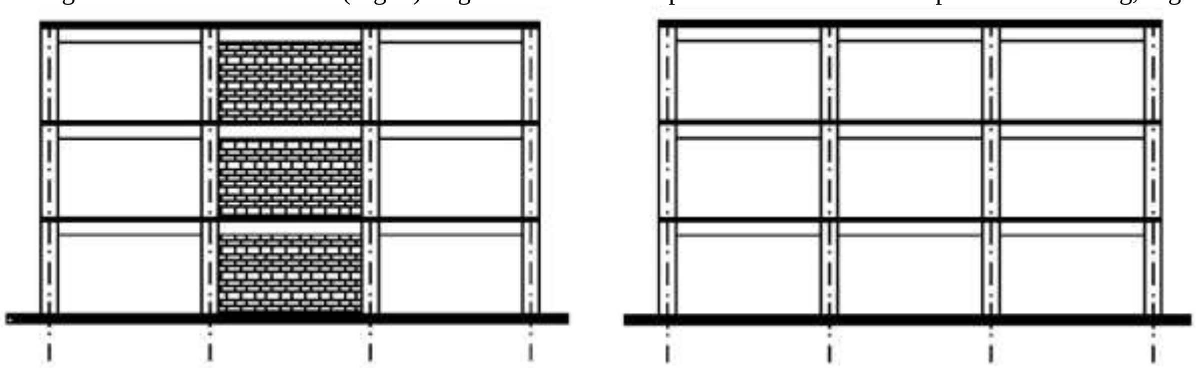


Figure 2. Schemes adopted for the account

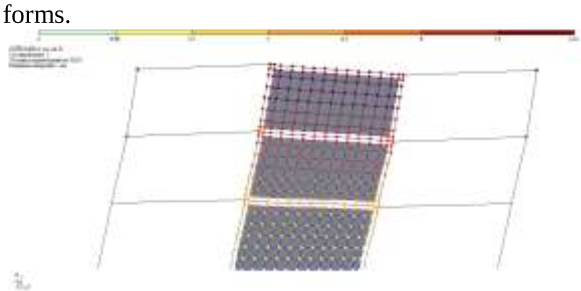
a–a frame filled with brick of the middle proletariat

b-a frame without taking into account the brick wall work

The cross-section of the columns and crossbars of the frame was bxh = 40x40 cm, V25 was used as concrete class, A-III class reinforcement was used as working reinforcement. For the brick harvest, a material of brand M75 brick and a mixture brand M50 were adopted. The calculations were performed using the Lira 9.6 software and analyzed the displacement of the circuits in Figure 2, their resistance to seismic loads, and the amount of reinforcement required.

The frame was exposed to permanent, temporary and seismic loads. In addition to the specific gravity of the structures as a permanent load, q = 30 kN / m for the crossbars, the value of the temporary load is q = 25 kN / m.

As can be seen from Figure 3, the displacement value under the influence of seismic load is 9.01 mm (Fig. 3.a), taking into account the brickwork in the middle prolot, 66.2 mm in the open frame (Fig. 3.b) and the displacement difference is 57.19 mm. forms.



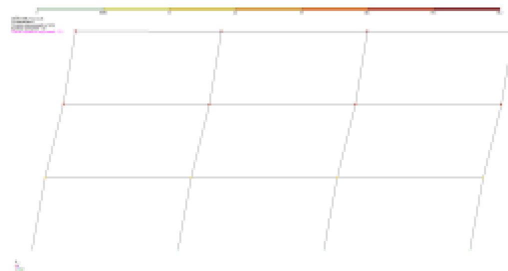


Figure 3. Movements in frame elements

a - a frame filled with middle proletarian bricks b - frame without taking into account the brick wall work

The maximum reinforcement percentage of a brick-filled frame column is 1.25%, on a crossbar 1.09%, on an open frame column 1.45%, on crossbars 1.51%.

IV. CONCLUSION

The results obtained show that the dynamic properties of the structure and its resistance to seismic influences are increased when taking into account the work of the brick filler in the frame. Therefore, taking into account the brick wall prevents deformation and breakage of the structure.

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