RISK ELEMENTS IN MODELLING, DESIGNING AND BUILDING-UP PORTANT MASONRY STRUCTURES

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ABSTRACT
The paper emphasized conforming, designing and execution problems revealed in current practice. Will be discuss about portant masonry walls structure, which, according to Romanian standards, have to respect even from conformation phase, rules and prescriptions. The study shows frequently faults in conceptual and finishing these structures and propose some discharging solutions of these, as like: preliminary architectural-structural design, introducing mandatory complete structural project for authorising begin of works, establishing crafts and vocational schools in construction field.

Keywords: ceramic blocks, confinement, thermal bridge, building site supervisor

INTRODUCTION
Over the time, normatives of design and execution has changed, new approach concept of designing and effective building are born. In our days buildings with some high seismic resistance are designed and built up. The direct consequence of these low seismic risk class, is the high price of the new build properties, also interventional high costs on existing constructions.

Masonry structures have always been a constant subject of concern for manufacturers. These, without a rigorous conformation, according to current specific norms, can get a comparable cost to frames structures buildings due to materials consumption.

Existing edifice, majority from masonry, become often target of interventional works caused by seismic unconfomed status, changing functionality, perturbing phenomenons, new standars of loadings reckoning. It can be obtained a lower seismic risk grade buildings by using current standards and codes for rehabilitation.

Earthquake risk class of a structure is the direct result of conformating, designing, buildworking and building exploitation. For assuring this aspect the architect, designer and constructor of the structure, are responsive.

MATERIALS AND METHODS
Choosing entire view buildings configuration is the architect main job. Structure concept is the structural engineer computation but can not be independent from functions and plastics-esthetic wishes of investor and architect [1]. Effective works are the appanage of executor engineer, of building site supervisor. This paper shows problems resulting in non-respecting current standards during technical project elaboration or during works of building with portant masonry structure.

1. Architectural-Structural design
It required going through an iterative process of “proposal-evaluation” that have to attend, from an early stage of the project, the architect and structural engineer.

1.1. Choosing materials respectively ceramic blocks, also imposed materials commissioning work by project, are very important. In table 1 is a study report on 20 structures of portant masonry with residential homes function, about using of ceramic blocks required by the project.
Table 1. Study report commissioning work of designed materials

<table>
<thead>
<tr>
<th>No. of structures</th>
<th>Ceramic blocks indicate in project</th>
<th>Ceramic blocks different that indicate in project</th>
<th>Other structure than indicate in initial project</th>
</tr>
</thead>
<tbody>
<tr>
<td>20</td>
<td>14</td>
<td>6</td>
<td>1*</td>
</tr>
</tbody>
</table>

* Beneficiary achieved materials considering energy savings and thermal insulation and modified project from portant masonry structure to concrete frames structure, to use the purchased materials.

1.2. **Structure conformation** are made fully according to CR6 standard rules, both by architect and structural engineer. Opposite, a non-conforming of the building depending of its structure, involve a high price of the works.

Horizontal and as vertical conforming, choosing masonry type, same time how many floors, stay in focus of both, architect and structural engineer. Also, in their attention will stay thickness of the walls, spaletti dimensions and slabs stiffness.

Coroborating architectural plans with structural design is mandatory. In case of missing of pillars from architectural plans, it may cause errors in execution works, because the constructor achieve masonry just consulting the architectural drafts. Thus, many times, gaps larger than 2.50 msq are not bordered, resulting the masonry cracking (fig 1).

![Wrong disposal of reinforced concrete pillars](image)

*Fig. 1. Wrong disposal of reinforced concrete pillars
  a. Ceramic blocks cracking at diaphragm end; b. Lack of gaps bordering*

2. **Structural design versus execution**

2.1. **Masonry confinement**, according to pillars disposal rules, is very important. Most times, gaps bordering are missing from structural designers plans. Noncompliance of standards, in case when ceramic blocks with thin walls are used, result in masonry cracking risk (fig. 1).

Anchoring masonry pillars by streps and wiskers, depending on ceramic blocks dimensions, must respect the practice and execution masonry works code. Oftenly, in building site, anchoring is missing or it is faulty, vicious accomplished (fig. 2).
2.2. Thermal bridges discharge it is mandatory to health and hygiene confort assurance, most design faults are non disposing in project or non executing a suplementary thermal insulation measures at reinforced concrete confinement elements (fig 3):


2.3. Accurate details execution is a current problem, especially in case of present legislation, when authorisation building construction not compel structural project, just only for foudation plan and details. A consequnce of this deficiency is in figure 3 exposed, where wrong executions of the lintels is shown.

![Fig.3. Wrong execution of the lintel](source: http://www.diypedia.ro/constructii/lucrari-din-zidarie, accessed in 30.12.2012)

RESULTS AND DISCUSSIONS
It can reduce substantially costs around 25% for a portant masonry structure versus reinforced concrete frames structure according same building, due to a preliminary architectural-structural and a good conformation. In table no. 2, are emphasized concrete, reinforcements and
brick consumption for a construction bound for the family home with a usable area of 97.60 square meters; it was considered in, two solutions to achieve the structure:
- confined masonry block bearing ceramic hollow vertical;
- reinforced concrete frames with masonry filler perimeter closings of vertical hollow ceramic blocks in initial design and redesigned according to materials efficiency [1].

**Table 2. Consumption per square foot due to constructive solution**

<table>
<thead>
<tr>
<th>Main materials</th>
<th>Consumption/square meter place:</th>
<th>reinforced concrete frames with masonry filler perimeter</th>
<th>confined masonry block bearing ceramic hollow vertical</th>
<th>redesigned confined masonry block bearing ceramic hollow vertical</th>
</tr>
</thead>
<tbody>
<tr>
<td>Concrete</td>
<td>0.75 mc</td>
<td>0.68 mc</td>
<td></td>
<td>0.60 mc</td>
</tr>
<tr>
<td>Reinforcements</td>
<td>24,12 kg</td>
<td>20,10 kg</td>
<td></td>
<td>18.2 kg</td>
</tr>
<tr>
<td>Bricks</td>
<td>0.40 mc</td>
<td>0.45 mc</td>
<td></td>
<td>0.50 mc</td>
</tr>
</tbody>
</table>

The true measure of a house lies in details. It must be evaluated by details quality and must known every detail even from designing phase. Here is the role of executor, of the building site supervisor, and Construction State Inspectorate to enforce the building execution according to detailed technical project.

**CONCLUSIONS**

To eliminate the risks of poor execution it is required:
- a preliminary architectural-structural and a good conformation;
- mandatory buildings execution, according to a detailed technical project, even low importance buildings, like residential homes;
- knowing and respecting regulations in force, for all actors participating to the investment process: architect, structural engineer, executor, building site supervisor;
- future specialist education from highschool, the idea of teamwork, of a solid bond between architect, structural engineer and instalation engineer, between designer and executor;
- Romanian education orientation to crafts and vocational schools.

**ACKNOWLEDGMENTS**

The work is original, and refers especially on structural masonry design and execution elements. Some of the shown images were taken in situ on recently designed buildings, and the other images of good practice are from references.

**REFERENCES**