RESEARCH ON REINFORCED CONCRETE BLOCKS OF FLATS SUBJECT TO EARTHQUAKE HAZARD IN EUROPE – A TALE OF MARIE CURIE FELLOWSHIPS

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ABSTRACT
Urban blocks of flats with reinforced concrete structure were a solution for housing buildings 1890-1940, when densification of some of the city centres in Europe was looked for. This was not the Avant-Garde architectural history writes about, as that one was more active in building social housing at the periphery. Social housing was also performed in urban blocks of flats, although the typology was mostly suitable for the middle class apartment. It is a typology adapted to the environment and which proves suitable even today, when in some of the locations of the investigations low rise housing makes place to speculative development. On the other hand, it is vulnerable to earthquake hazard, as the possibilities of the construction material, when employed, had not yet been researched enough. Research on this topic was done since 2002, benefiting of training during the Marie Curie Actions scheme of the European Commission: a Training Site Fellowship, an Intra-European Fellowship, both in Italy, and a European Reintegration Grant in Romania. The focus moved from the response to environmental hazards such as earthquakes of this housing typology, over topics of preservation of historic materials finally to the investigation of this typology of sustainable development of cities.

Keywords: earthquakes, sustainable development, reinforced concrete, local culture, resource, housing

INTRODUCTION
We started our research when little research was done on buildings with reinforced concrete structure with cultural value, as mostly these were considered too new for this. These housing buildings with reinforced concrete structure proved to be the blocks of flat for the middle class. Unlike in most Western European countries, where we find solutions for social housing of the Avant-Garde, in these countries we find a so-called “Other Modernism”.

MATERIALS
1. Between environmental tradition and industrial innovation
“Other Modernisms” was the topic of the DOCOMOMO (Association for the DOcumentation, COnservation of buildings, sites and neighbourhoods of the MOdern MOvement) meeting in Istanbul and Ankara
in 2006. We can call, after consulting various definitions of Modernism and Modernity [1], [2], that in the blocks of flats for the middle class of the first half of the 20th century, which from a structural point of view have reinforced concrete structure, not the principles of the Avant-Garde were followed, but those of Modernity. As such, they can be put in the Modernity discussion starting from the 18th century, and their classification is not limited to the short span of time when they were raised.

In the countries object of the study reinforced concrete was the material for the load-bearing structure. During the Modernism this was a new material, as Modernism promoted the employment of new materials instead of traditional ones, and the possibilities were not yet researched enough. Especially in countries where before the massive walls were the tradition, the employment of reinforced concrete skeleton structures was a challenge. In Germany, where before the Fachwerk was a tradition, the employment of steel, as this was a cheaper structure than reinforced concrete in the context of the industrial developments in the Ruhr area, the problems are different and the degradation of buildings does not come from environmental hazards as earthquakes but from weathering and unproper response of the Modernism buildings to building physics problems.

A recent example of housing worth to be followed is that of the one in Estonia. In Estonia we notice a dialogue between traditional and modern, which can be seen as the pair in which to deconstruct the term of “Modernity”. Such dialogue between traditional and modern, in use of local materials with modern architecture language elements, was done in the architecture of the Romanian Henrietta Delavrancea-Gibory [3], who built mostly villas in Balchik (Fig. 1), today Bulgaria. The only example of this kind of architecture in Bucharest, Romania, was recently (2009) demolished (Fig. 2), to make place for speculative development.

This only highlights the issues put in question by Sonne [4], regarding the compact urban block of flats proving more sustainable today than the peripheric Garden City. Also the architecture of Jože Plečnik incorporates local materials, as does the Italian Rationalism, since Slovenia and Italy are countries rich in natural stone and it belongs to tradition. The dialogue between traditional and modern will be further investigated for the case of Romania in the architecture of Károly Kós (Fig. 3) and other architecture of Hungarian influence, the object of the European Reintegration Grant research.

Environmental tradition can be seen not only in the use of local resources, but also in the local culture to respond to natural hazards. There is research on showing that the timber skeleton structures are an example of the local seismic culture [5], as this responds better to earthquakes.
But the local culture does not relates only to earthquake, as we can also mention the local architecture of adaptation to the climate, between extreme hot or cold weather conditions, for example the natural ventilation in the typology of houses with atria of the Arab culture. Our research shows however, that the half timbered typology is rather related to the existence of adequate natural resources such as a suitable timber than to the occurrence of earthquakes. “Resource architecture” was the topic of the 21st of World Congress of Architecture in Berlin 2002, and is therefore a timely subject for when this research started.

2. A sustainable housing typology

The type of building we deal with in our research has been one serving the raising of density in city centres. More even, Sonne [4] remarks when analyzing the typology of the compact urban blocks of flats that they prove a sustainable typology, a viable model for today’s development of cities. Sonne [3] follows typologies with atria which had the aim to ensure green spaces and thus a better adaptation to climate; although differentiation according between the different climates in the countries considered is not highlighted. Western Europe and North America are discussed:

- Berlin and Germany,
- Vienna and for Central and Eastern Europe (Prague, Budapest, Switzerland and Russia are given,
- Amsterdam and the Netherlands (namely Rotterdam),
- Copenhagen and Skandinavia,
- Paris and France,
- Milan and Southern Europe, namely Spain,
- London and Great Britain,
We notice that examples from both Romania and Greece are missing, the only common point being the examples from Italy: the ‘Novecento’ architecture and the contextual architecture of the Rationalism, the so-called ‘ambientismo’. Also from the other countries investigated in order to find similarities (Slovenia, Portugal) [6] we miss the discussion, the only common point being Hungary, for which limited examples are given. However, the work by Sonne [4] gives a larger context in which we can integrate our research.

In Western Europe innovation was done in social housing at the periphery, in so-called Siedlungen. An exception are the Wiener Höfe [7], in Vienna, Austria, but these are a housing type many times neglected by architectural history. In countries like Romania or Greece, but also in Portugal, housing was in the hands of the private sector. While these countries developed economically very much between the two World Wars, housing was done for the middle class, as investments from state were scarce. Research on social housing of the time is even more scarce. In Bucharest, Romania, these building were even raised in the city centre, along newly cut boulevards after an Haussmannian scheme in the urban structure which formerly was predominated by single family houses with large gardens. In Athens, Greece such housing [8] was done in the quarter close to the railway station, as the railway brought new industrial developments and the extension of cities. These two different locations led to different vulnerabilities, as the superposition of planed urbanism with spontaneous development in Bucharest led to irregular parcel shapes, which, being used to full in order to raise density, let to irregular structures, which are highly vulnerable to earthquakes. In Athens the new city blocks were a minimal urbanism with regular shape, and so were the buildings.

Although housing was the programme in which the Modernism expressed best its ideas, today, when there is about preserving this heritage, not housing buildings are forefront in interventions. In Athens the only listed building is the former Army Pension Fund building, today Citylink (Fig. 4), which was reinforced for earthquake and also restored architecturally, an example of preservation of reinforced buildings from the time [9]. In Italy an exemplary project is given by the Tower of Nations in Napoli (Fig. 5) [10], a trade fair building. The initial focus of the research was on the structural response of the buildings of the interwar time in Romania to earthquake hazard. For this purpose dynamic analysis was run with finite elements simulation software, and the results were further processed in order to determine the economic impact of retrofit, as this was integrated in the doctoral research.
With the Intra-European Fellowship the focus moved from the economic aspects to decision making in matters of preservation. The study area was enlarged to also Italy, the host country, and to Greece, where the typology proved similar to that of Romania in terms of load-bearing structure, affecting environmental hazards, housing typology and the socio-economics behind that, etc.

In the European Reintegration Grant we wish to integrate zoning at the level of the apartment, as reflection of the life style, to zoning at the level of the city. Thus, we study the best practice examples in European cities for the heritage from the early 20th century also in term of urban integration.

For example Como in Italy and Ljubljana in Slovenia are examples where the architecture of the time is being promoted in tourist circuits, namely that of Rationalism (mainly Giuseppe Terragni, Fig. 6) and respectively Jože Plečnik (Fig. 7). Also in Bucharest attempts are made for creating such tours, with the elaboration of urban parcour for the architecture of Marcel Iancu (Fig. 8).

3. Research training across various Marie Curie fellowship schemes

The author benefitted from a Marie Curie Intra-European Fellowship under the Framework Programme 6 of the European Commission, from the 15th of June 2005 till the 14th of June 2007, at the host institution Istituto Universitario di Studi Superiori di Pavia, Italy, for the project CA’REDIVIVUS „Preservation of historic reinforced concrete housing buildings across Europe“ [11]. Two years is the maximum duration of such a fellowship, while the minimum duration is 1 year.
"Marie Curie Intra-European Fellowships are individual fellowships that aim at providing advanced training tailored to the researchers' individual needs with a view to adding different/complementary scientific competencies.” [12] One of the aims of the action is to allow “to reach or reinforce a position of professional maturity and independence”. For this reason one important evaluation criteria are the leadership qualities of the applicant. European Intra-European Fellowships can be applied for by experienced researchers from the EU or Associated states (holding a Ph.D. or having at least 4 years of research experience from the university degree
giving access to doctorate) in order to spend a mobility period in a host institution in another EU or associated state than the one where they hold fellowship or were active more than 1 year in the past 3 years.

Contacts to the host institution of the Marie Curie Intra-European Fellowship were established through research conducted there during a stay at a Marie Curie Training Site funded under FP5, between 1st of November 2002 and 30th of April 2003. “This scheme […] support short stays by young researchers pursuing doctoral studies, providing them with the possibility of undertaking part of their doctoral studies in a country other than their own, and allowing them the benefit of working within an internationally recognised group in their specialised area of research” [13]. Stays at the host institution lasted a minimum of 3 months and a maximum of 12 months and had to be integrated within the doctoral research. The Marie Curie Fellowship Association had in its statutes the possibility to become full member of the Association even if not completing 1 year of fellowship, if the doctorate was obtained following a fellowship; such fellowship would have been accounted for in such a scheme. These were host driven actions, in total 17 fellows benefited from the excellent research environment in earthquake engineering through these fellowships. The author was the second of such fellows, contacts to other fellows are being maintained, some of them through meeting at conferences later on, some other leading to common publications. More about the training during the host fellowship was written in Bostenaru [14] and more on the research results in Bostenaru [15].

In order to be able to apply for a Marie Curie European Reintegration Grant, under FP6 the whole 2 years had to be completed, while in FP7 the limit was put to 1 ½ years, and then changed to Career Integration Grants which don’t require anymore a previous fellowship [16]. During FP5 it was only possible to return to less favoured countries of the EU [13]. It must be noted that Marie Curie Intra-European Fellowships are not the only ones assuring the eligibility conditions to apply for a Marie Curie European Reintegration Grant; so do also host driven fellowships such as, for example, holding a fellowship within a research training network. The research performed with support of the reintegration grant [17] continued the research started with the support of the other fellowships. All of them were performed in the panel of “engineering”.

REFERENCES


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