www.insightcore.com

Journal of Buildings and Sustainability

2019
Vol. 1
No. 1

Managing the vulnerability of the residential stock in Europe

Giuliana Scuderi[1]

Department of Civil Engineering, HZ University of Applied Sciences, Edisonweg 4, 4382 NW Vlissingen, The Netherlands

A B S T R A C T

Managing the vulnerability of the residential stock is today a social issue to include in the European agenda, despite the many barriers and constraints and the complexity of the parameters to consider - architectural design and construction, energy efficiency along with political support and incentives, socio-financial effects and users' behaviour, and so on. In particular, the building heritage produced after the massive destruction of the Second World War is recently the object of urban policies towards requalification and rehabilitation. Typically, the most effective interventions are the ones that allow a balance between costs and performance, and this is the reason why current programmes are propending towards integrated approaches, able to solve contemporarily architectural, functional, and structural problems. This paper discussed some solutions to "manage the quality" of a building, with a focus on seismic retrofit and energy retrofit.

Keywords: seismic retrofit, energy retrofit, social housing, residential heritage, integrated retrofit, housing vulnerability

1. Introduction

This paper discusses the building heritage produced after the massive destruction of the Second World War, period that saw especially the emergence of new social housing districts (Turkington et al., 2004). These new districts, accepted positively by the market and the residents, proposed a new way of living, with large building blocks

(Murie et al., 2003) mostly built exploiting prefabrication techniques, in order to provide affordable housing in short time. The new construction methods (Andeweg et al., 2007) were soon supported by applications in many central, east and north European countries, because successful schemes were reproduced almost identically in different social housing estates throughout each country.

It was only during the oil crisis in the 1970s that these estates revealed inadequate performances in terms of energy efficiency, and from the 1980s this problem added to functional, architectural and structural obsolescence. The districts, once popular among the citizens, lost their attractiveness (Power, 1997; Andersen, 2003; Murie et al., 2003, Wassenberg, 2004).

Turkington et al., 2004 have determined three main classes of problems affecting the social housing stock: intrinsic problems related to the building characteristics, management problems, and finally problems caused by a critical socio-economic environment (van Beckhoven et al., 2005).

This classification derives from Prak and Priemus's (1986) three "spirals of decay", used to describe the housing decline of the Post Second World War social housing estates. Inadequate initial quality, due to limited construction time, poor materials and lack of experience, activates the first spiral of technical decay, which is further aggravated by the lack of proper management and maintenance. As a result, the population of the estates experiences a detrimental turnover in which dwellers are replaced by weaker socio-economically groups, leading to the second spiral of social decay. The new residents, economically weaker, require lower rents, while maintenance costs increase, activating the

[1] scud0001@hz.nl

third spiral of financial decay. The lack of maintenance also exacerbates technical problems and so on, in a way that technical, social and financial decay reinforce one another, in a vicious cycle.

Nevertheless, these estates still accommodate 41 million people in Western Europe and represent a fundamental part of the housing market.

In recent years, social housing estates are the main target of urban policies, at first focusing on demolition and reconstruction (Priemus, 1989). However, since the 1990s the new policies are shifting towards the market of recovery, which appears today as the only horizon for a building sector in continuous decrease (Scuderi, 2016). Today, demolition is not a sustainable solution (Preservation Green Lab, 2011) because it produces waste and consumes resources. A more sustainable solution is to requalify the existing building heritage (Langston et al., 2008) considering that the costs are lower because of the pre-existing elements, the time is half than the one necessary for demolition and reconstruction of the same floor areas, and consequently the financing is also reduced, with lower risks connected to inflation and unexpected events (Johnson, 1996).

Additionally, the Buildings Performance Institute Europe (2011) stated that considering the almost irrelevant annual growth rate of the residential sector (Jaretti, 2008), the target of energy saving should be associated with buildings dated from the 1960s.

In seismic prone countries, problems about energy performance are also coupled with structural safety, (Rodrigues & Teixeira, 2006). The key issues connected with seismic vulnerability are the inefficient methods of classification of the territory (Dolce, 2012, Martelli, 2006), the inefficiency in controlling and monitoring the degradation process of the building life cycle (Rodrigues & Teixeira, 2006) and the lack of prevention measures. To avoid dramatic cultural, social and economic losses it is necessary to focus on campaign of seismic retrofit, by recovering the original performances of structures, upgrading them or reducing the seismic response of the building (Fukuyama and Sugano, 2000). Selecting among the different strategies is a complex process which depends on several factors (Thermou & Elnashai, 2006): for instance, the cultural, social and economic importance of the building, the expected damage and the structural typology and technology are some of the key issues to consider (Caterino et al., 2008).

Typically, the most effective retrofit is the one that allows a balance between costs and performance, and this is the reason why current programmes are propending towards integrated approaches, able to solve contemporarily architectural, functional, and structural problems.

From the definition of Caffrey (1988), an “Intelligent retrofit” should provide a “productive and cost-effective environment through optimization of its four basic elements: Structures, Systems, Services, Management, and the interrelation between them”.

The money invested in “Intelligent” and therefore integrated retrofits can be capitalized in relatively short time considering the improved level of performance and safety, and also the increased popularity of the estates which can reverberate on the marketability of the dwellings (Egbelakin and Wilkinson, 2008).

2. Managing the built heritage

Tenner and DeToro (2008) introduced the possibility to “manage the quality” of a building through eight factors, namely performance, features, reliability, conformance, durability, serviceability, aesthetics and perceived quality. It is important to mention that those factors are closely interlaced and they influence each other; for instance, technical problems or aesthetical obsolescence often have impacts on users’ satisfaction.

The first fundamental step is to recognize the loss of performance and the consequent degradation as a natural and expected part of the life cycle of a construction (Gruis at al., 2006). The objective of interventions is then an ideally endless extension of the life span of a building, throughout modifications of its physical, functional, architectural and environmental characteristics (van der Flier and Thomsen, 2006; Thomsen and van der Flier, 2008; Thomsen, 2011).

Another key point is that the life span of the different elements of a construction greatly differs, going up to 300 years for structural elements and up to only 20 years for envelopes. This means that interventions can often be directed towards specific components of the construction, still allowing the overall life-cycle extension of the building (Gruis at al., 2006).

Many procedures can lead to different results (Priemus, 2005). When speaking about retrofit, in general the word indicates an intervention focusing on upgrading the building to current technical, functional and architectural standards, in opposition with refurbishments which restore the initial performance of the building.

In general terms, when retrofit is considered the best operative option, the next steps have to be undertaken in order to assess the condition of the building:

a. Selection and design of retrofit strategies.
   The selection of an option depends on the available technical expertise and inconvenience during the intervention. The strategies can be grouped under global and local strategies. The final scheme should be cost effective.
b. Verification of the retrofit scheme.
   The scheme should be ensured through analyses of the retrofitted building and that the selected scheme satisfies the identified objectives. The scheme should be viable in terms of costs and execution.
c. Construction.
   The effectiveness of the retrofit scheme greatly depends on the quality of construction. Hence, the construction as per the suggested details and specifications is imperative.
d. Maintenance and monitoring.

2.1 *Introduction to seismic retrofit*

The purpose of seismic retrofit is to enhance the structural capacity of a building acting on its strength, stiffness, ductility, stability and integrity in order to upgrade its performance to the current standards.

Tierney (2005) showed how the seismic retrofit can lead to risk mitigation and disaster prevention, fundamental since earthquakes are more and more random in place, time and intensity (Nuti & Vanzi, 2003). Stevens and Wheeler (2008) underlined that improving the quality of the building heritage guarantees the sustainability of the construction industries and of the cities.

However, while many ordinary buildings are considered unsafe, financial implications are always fundamental in order to select the best retrofit campaign. Nuti and Vanzi (2003) declared that in order to make retrofit a good investment, the ratio between costs and reduction of the risk should be calculated.

When the campaign is considered economically viable, it is possible to select global and local strategies, which are not always mutually exclusive: a global retrofit targets the performance of the entire building, while local retrofit targets the seismic resistance of a member, without necessarily affecting the overall resistance of the building. In many cases, it may be necessary to combine both local and global retrofit strategies under a feasible and economic retrofit scheme. In general, when a building is severely deficient in withstanding seismic forces, a global retrofit strategy is recommended to strengthen and stiffen the structure. Consequently, if deficiencies still exist in the members, local retrofit strategies are to be selected. Beyond this recommendation, it is not prudent to prescribe a retrofit strategy as a generic application, since each one has merits and demerits in relation to the project (Scuderi, 2016).

Some examples of retrofit goals are: increasing the lateral strength and stiffness of the building, increase the ductility of the structural elements, improving the continuity of the members, eliminating or reducing the effects of irregularities, or enhancing the redundancy of the structural elements resisting to seismic loads.

In Table 1, some of the most common global retrofit strategies with their advantages and disadvantages.

Table 1. Common global retrofit strategies.

Retrofit	Description	Merits	Demerits	Comments
Addition of infill walls	Addition of infill walls in the ground storey is a viable option to retrofit buildings with open ground storeys. Due to the "strut action" of the infill walls, the flexural and shear forces and the ductility demand on the ground storey columns are reduced.	-It increases lateral stiffness of a storey. -It can support vertical load if adjacent column fails.	-It may have premature failure due to crushing of corners or dislodging. -It does not increase ductility. -It increases weight.	-Low cost. -Low disruption. -Easy to implement
Addition of shear walls, wing walls and buttress walls	Shear walls, wing walls or buttress are added to increase lateral strength and stiffness of a building. The shear walls are effective in buildings with flat slabs or flat plates. Usually the shear walls are placed within bounding columns, whereas wing walls are placed adjacent to columns. The buttress walls are placed on the exterior sides of an existing frame.	-It increases lateral strength and stiffness of the building. -It may increase ductility.	-It may increase design base shear. -Increase in lateral resistance is concentrated near the walls. -Necessity of distributed and symmetrically placed walls.	-It needs integration of the walls to the building. -High disruption based on location, involves drilling of holes in the existing members. -Design issues connected to integrate the wall to the building and to design their foundations.
Addition of braces	A steel bracing system can be inserted in the frame to provide lateral stiffness, strength, ductility, hysteretic energy dissipation or any combination of these. For an open ground storey, the braces can be replaced in appropriate bays while maintaining the functional use.	-It increases lateral strength and stiffness of a storey. -It increases ductility.	-Connection of braces to an existing frame can be difficult.	-Passive energy dissipation devices can be incorporated to increase damping, stiffness of both. -More effective for flexible frames. -If added from the outside, least disruption of the building use.
Addition of frames	A new frame can be introduced to increase the lateral strength and stiffness of a building. Similar to a new wall, integrating a new frame to the building and providing foundations are critical design issues.	-It increases lateral strength and stiffness of the building. -It may increase ductility.	-It needs adequate foundations and appropriate integration.	- It needs integration of the frames to the building to work properly.
Reduction of irregularities	The plan and vertical irregularities are common causes of undesirable performance of a building under an earthquake. Some typical irregularities are discontinuous components of the lateral load resisting system, torsional irregularities, and eccentric masses.	-It can reduce force and deformation demands in the members to acceptable levels.	-It requires partial demolitions.	-The appearance and the utility of the building can be substantially affected.
Reduction of mass	This option can be considered instead of structural strengthening.	-It results in reduction of lateral forces.	-It requires heavy demolitions and changes.	-Realized by demolishing additional storeys, replacing heavy cladding or heavy equipment, or change in the use of the building.

The effectiveness of the retrofit is monitored by the operationalization of the demand to capacity ratio for both vertical and lateral loads, and by the reduction of the inter-storey drift. In general, these two objectives can be achieved through two methods: by reducing the design forces within the elastic level or by providing some critical components of additional dissipation potential.

Consequently, in recent years, considerable attention has been paid to research and development of seismic dissipative devices, which can provide passive, active or semi-active control.

Among the possible solutions, many studies have been conducted in order to assess the practical feasibility and economic convenience of using smart materials (SMA) to implement these dissipative devices (Dolce and Marnetto, 2000) however the high material costs prevent extensive applications in the field of civil engineering so far (Alam et al., 2007). A viable solution is to use the alloys in smaller devices or in selected regions of the structure (Janke et al., 2005). With reference to bracing systems for framed structures, apparently the cost of SMA is negligible with respect to the cost of the dissipative device. Consequently, the cost of SMA braces is practically identical to the cost of steel braces.

SMA-based passive control systems, other than providing better performances, do not imply higher costs if compared to other passive control systems (Dolce et al.,2000a; Bruno and Valente, 2002).

Additionally, the cost of shape memory alloy has decreased significantly, due to increased demand and improved in manufacturing (Frick et al., 2004) and it is realistic to assume that the price will further drop in the next years, as new applications in the civil engineering field develop (DesRoches et al., 2004).

These experimentations about innovative materials and technologies open to a wide range of new possibilities for the construction field, a sector that is still firmly grounded in the tradition.

2.2 *Introduction to energy retrofit*

Today, the building stock produced after the Second World War is generally characterized by poor energy performances (Itard, 2008) and it can a huge resource towards the targets of energy saving and reduction of carbon dioxide emissions, especially considering that the housing sector is responsible of approximately the 40% of the energy consumed in EU.

Retrofitting the social housing stock could be an important step to ensure a sustainable development, reduce the depletion of fossil fuels and mitigate the effects of climate change.

Hermelink and Muller (2011) studied that a deep retrofit, adopting an integrated set of measures and achieving savings between 60% and 90% has the potential to reach the EU decarbonisation targets for 2050.

Despite these considerations, there are still no European guidelines to address systematically the energy retrofit and most of the implementations are still undertaken as a case by case operation (Nemry et al., 2010). This approach dramatically decreases the overall impact of the retrofitted buildings into the urban environment, providing only local solutions.

Another limitation within the energy retrofit process is that, among the different parameters to consider, energy evaluations are typically calculated at the end of the design, in the form of regulatory or voluntary certificates (Dakwale et al., 2011). This means that the performance evaluation comes after the strategy has been developed, without influencing the decisions made (Attia, 2012).

A shift in the process is needed, and the energy retrofit must be designed in the early stages of the design process, when it can be integrated with other measures – structural, architectural, etc. – resulting in a greater impact and lower costs (Bogenstatter, 2000).

Recent researches focused on trying to address these issues in relationship to the building envelope, which is considered to be the most relevant component in terms of energy demand and consumption.

3. Barriers and Constraints

The “large and unused cost-effective potential for improving the performance of buildings is evidence that consumers and investors, as well as society in general, are not keen on investing in innovation in the construction sector” (Scuderi, 2016).

The report “Europe’s Buildings under the microscope” (BPIE, 2011) tried to classify the barriers and constraint to the up taking of extensive retrofit campaigns: financial barriers, institutional/administrative barriers, barriers related to awareness, advice and skills, and finally the separation between expenditure and benefit.

Among those classes, financial barriers are the most relevant since the lack of funds prevents investment on retrofit programmes. Long term incentives are necessary to stimulate the market towards integrated retrofit programmes.

Administrative issues are also particularly evident in case of private social housing, which requires higher incentives and residents' consensus, while for public stock control and coordination is generally easier (Waide et al., 2006).

The third class of barriers is related to the lack of technical expertise in the field of retrofit, which requires completely new technical, social and managerial skills and new company organization. This also applies to designers, developers, commissioners and governments, whose knowledge must adapt to new requirements for design, management and monitoring (Thomsen, 2011).

In addition, already in the 1991, Sandivo identified four main constraints to retrofit: time, space, information and environment. These constraints affect the performance of the project in terms of schedule, budget, and scope of work.

Constraints and barriers can both be removed through careful front-end planning and wise decision-making early in the project delivery (Gibson et al., 2007). A common problem for retrofit programme is indeed connected to conditions identified late in the design process, that may have several impacts on the renovation project (Mitropoulos and Howell, 2002), such as affecting the cost and time required or limiting the design options. A possible solution is to identify project constraints that design and construction have to meet early in the planning phase and to act at the beginning of the process.

On the other hand, many professionals still see as a challenge to apply whole-system thinking and to understand the interaction between the different building systems throughout the retrofit process (Olgyay and Seruto, 2010), thus limiting the maximization of the cost-benefit within the retrofit project. There is still limited experience in the field of integrated retrofit, because of the focus of the construction sector towards traditional practice instead of innovative and holistic techniques.

Finally, end users need to be educated on behavioural issues and sustainability issues, especially in context where social housing is privately owned. In fact, studies proved that neighbourhood satisfaction depends mostly on housing satisfaction and on the reputation of the area, factors that should be considered in a retrofit programme through residents' involvement (Wassenberg, 2004).

4. Conclusion

The "Broken Window Theory" (Wilson and Kelling, 1989) is a criminological theory of the norm-setting, signalling effect of urban disorder on anti-social behaviour. The theory states that if a "broken window is left unrepaired, all the rest of the windows will soon be broken", promoting the importance of managing and maintaining the housing estate in order to prevent major damages and detrimental social behavior.

A neglected and vulnerable property is the signal of a neglected and vulnerable community. "Vulnerable buildings are a manifestation of the vulnerability of an urban system, since the response of the city can be interpreted as the sum of the single responses of its composing elements but also because they are the expression of the attitude of the community towards disasters and unexpected events" (Scuderi, 2016; D'Amico and Currà, 2014; Gargiulo and Papa, 1993; Fistola and La Rocca, 2009).

Integrated retrofit is first of all a social issue to include in the European agenda, despite the many barriers and constraints and the complexity of the parameters to consider - architectural design and construction, energy efficiency along with political support and incentives, socio-financial effects and users' behaviour, etc.

While a real estate market failure is more and more probable, the building sector is still not able to find a recipe to transform the new challenges into opportunities.

Towards this direction, Druot, Lacaton and Vassal proposed the concept of "economies of scale", within which "light" techniques based on sustainable solutions can be applied to "mass retrofit" of the housing built after the Second World War.

Another relevant reason to adopt these "economies of scale" is that most of the technological solutions are today still too expensive and require long-span intervention campaign to reduce the effect of unit-manufacturing costs. The construction processes lack productivity and quality, so that the most promising technologies will deliver savings only if their building integration has been carried out properly and controlled step by step. Innovation on construction processes need to find reliable approaches where existing gaps between performance by design and performance at commissioning are narrowed down. On the other hand, the broad scale of the intervention faces the necessity to break the visual monotony widely imposed to the social housing districts, leaving space to individuality and variety for more vibrant and dynamic realities.

References

Alam, M. S., Youssef, M. A., and Nehdi, M. (2007). Utilizing shape memory alloys to enhance the performance and safety of civil infrastructure: a review. Canadian Journal of Civil Engineering, 34(9), 1075-1086.

Andersen, H. S. (2003). Urban Sores. On the Interaction between Segregation, Urban Decay and Deprived Neighbourhoods. Ashgate.

Andeweg, M. T., Brunoro, S., and Verhoef, L. G. (2007). Cost C16, Improving the Quality of Existing Urban Building Envelopes: State of the Art (Vol. 1). IOS Press.

Attia, S. (2012). A Tool for Design Decision Making Zero Energy Residential Buildings in Hot Humid Climates. (Doctorate). Universite catholique de Louvain, Louvain.

Bogenstatter, U. (2000). Prediction and optimization of life-cycle costs in early design. Building Research & Information, 28(5-6), 376-386.

Bruno, S., and Valente, C. (2002). Comparative response analysis of conventional and innovative seismic protection strategies. Earthquake engineering & structural dynamics, 31(5), 1067-1092.

Building Performance Institute Europe BPIE (2013). A Guide to Developing Strategies for Building Energy Renovation: Delivering the Energy Efficiency Directive Article 4 Brussels: Building Performance institute Europe.

Caffrey, R. J. (1988). The Intelligent Building: An ASHRAE Opportunity. ASHRAE.

Caterino, N., Iervolino, I., Manfredi, G., and Cosenza, E. (2008). Multi-criteria decision making for seismic retrofitting of RC structures. Journal of Earthquake Engineering, 12(4), 555-583.

D’Amico, A., and Currà, E. (2014). Urban Resilience and Urban Structure: Vulnerability assessment of historical Italian towns. Paper presented at the ANDROID Residential Doctoral School.

Dakwale, V. A., Ralegaonkar, R. V., and Mandavgane, S. (2011). Improving environmental performance of building through increased energy efficiency: A review. Sustainable Cities and Society, 1(4), 211-218.

DesRoches, R., McCormick, J., and Delemont, M. (2004). Cyclic properties of superelastic shape memory alloy wires and bars. Journal of Structural Engineering, 130(1), 38-46.

Dolce, M. (2012). The Italian National Seismic Prevention Program. In Proc. of 15th World Conference on Earthquake Engineering, pp. 24-28.

Dolce, M., Cardone, D., and Nigro, D. (2000a). Experimental tests on seismic devices based on shape memory alloys. Stress (N/mmq), 500, 750.

Dolce, M., and Marnetto, R. (2000). Passive seismic devices based on shape memory alloys. In 12th World Conference on Earthquake Engineering. Paper No 2386.

Egbelakin, T., and Wilkinson, S. (2008). Factors affecting motivation for improved seismic retrofit implementation. In Australian Earthquake Engineering Conference (AEES).

Fistola, R., and La Rocca, R. A. (2009). Metodi expert knowledge based per la definizione del rischio globale urbano (GURU). In Atti della XXX Conferenza Italiana di Scienze Regionali, Firenze (pp. 9-11).

Frick, C. P., Ortega, A. M., Tyber, J., Gall, K., and Maier, H. J. (2004). Multiscale structure and properties of cast and deformation processed polycrystalline NiTi shape-memory alloys. Metallurgical and Materials Transactions A, 35(7), 2013-2025.

Fukuyama, H., and Sugano, S. (2000). Japanese seismic rehabilitation of concrete buildings after the Hyogoken-Nanbu Earthquake. Cement & Concrete Composites, 22: 59-79.

Gargiulo, C., and Papa, R. (1993). Caos e caos: la città come fenomeno complesso. Per il XXI Secolo: una enciclopedia e un progetto, 297-306.

Gibson, G. E., Cui, Q., Howard, S., and Irons, K. T. (2007). Front end planning for renovation projects. In Proceedings of the Construction Research Conference.

Gruis, V., Visscher, H., and Kleinhans, R. J. (2006). Sustainable neighbourhood transformation (Vol. 11). IOS Press.

Hermelink, A., and Muller, A. (2011). Economics of deep renovation. Berlin: Ecofys by order of Eurima – European Insulation Manufacturers Association.

Itard, L. (2008). Towards a Sustainable Northern European Housing Stock: Figures, Facts, and Future (Vol. 22). Ios Press.

Janke, L., Czaderski, C., Motavalli, M., and Ruth, J. (2005). Applications of shape memory alloys in civil engineering structures—overview, limits and new ideas. Materials and Structures, 38(5), 578-592.

Jaretti, S. (2008). Riflessioni sul riuso del patrimonio edilizio globale. P. Lombardi (ed.) Riuso edilizio e rigenerazione urbana, innovazione e partecipazione, Celid, Torino.

Johnson, A. (1996). Rehabilitation and re-use of existing buildings. Mills (Ed.), Building maintenance and preservation: a guide to design and management (2nd ed.), Architectural Press, Oxford, 209-230.

Martelli, A. (2006). Modern seismic protection systems for civil and industrial structures. An advanced approach to earthquake risk scenarios, with applications to different European towns.

Mitropoulos, P., and Howell, G. A. (2002). Renovation projects: Design process problems and improvement mechanisms. Journal of Management in Engineering, 18(4), 179-185.

Murie, A., Knorr-Siedow, T., and Van Kempen, R. (2003). Large housing estates in Europe: general developments and theoretical backgrounds. Utrecht University. Faculty of Geosciences. Urban and Regional Research Centre.

Nemry, F., Uihlein, A., Colodel, C. M., Wetzel, C., Braune, A., Wittstock, B., ... and Frech, Y. (2010). Options to reduce the environmental impacts of residential buildings in the European Union—Potential and costs. Energy and Buildings,42(7), 976-984.

Nuti, C., and Vanzi, I. (2003). To retrofit or not to retrofit? Engineering structures,25(6), 701-711.

Olgyay, V., and Seruto, C. (2010). Whole-building retrofits: A gateway to climate stabilization. ASHRAE Transactions, 116(2), 1-8.

Power, A. (1997). Estates on the Edge. The Social Consequences of Mass Housing in Northern Europe. Macmillan.

Prak, N. L., and Priemus, H. (1986). A model for the analysis of the decline of postwar housing. International Journal of Urban and Regional Research, 10(1), 1-7.

Preservation Green Lab. (2011). The Greenest Building: Quantifying the Environmental Value of Building Reuse. National Trust for Historic Preservation.

Priemus, H. (1989). Upgrading of large-scale housing estates in The Netherlands. Journal of Housing and the Built Environment, 4(2), 145-160.

Priemus, H. (2005). Decay of large housing estates revisited. In van Kempen, R., Cernic Mali, B., (eds.). Restructuring large housing estates in Europe: policies, practices and perspectives. Urban Planning Institute of the Republic of Slovenia, Ljubljana.

Rodrigues, M. F., and Teixeira, J. M. C. (2006). Building pathologies in social housing: the portuguese state of the art.

Sanvido, V. E. (1991). Managing retrofit projects (Doctoral dissertation, University Park, PA 16802 Georgia).

Stevens, C. M., and Wheeler, K. E. (2008). Implementing earthquake prone building policy under the Building Act 2004—Wellington City's approach. In Proceedings of the New Zealand Society for Earthquake Engineering,'Engineering an Earthquake Resilient New Zealand'(NZSEE) Conference, Wairakei, New Zealand (pp. 11-13).

Tenner, A. R., and DeToro, I. J. (2008). Garvin's Eight Dimensions of Product Quality. In: Total Quality Management. Addison-Wesley Pub (Sd).

Thermou, G. E., and Elnashai, A. S. (2006). Seismic retrofit schemes for RC structures and local-global consequences. Progress in Structural Engineering and Materials, 8(1), 1-15.

Thomsen, A. (2011). A paradigm shift or chocke? The future of western Europe housing stocks. In Management and Innovation for a Sustainable Built Environment MISBE 2011, Amsterdam, The Netherlands, June 20-23, 2011. CIB, Working Commissions W55, W65, W89, W112; ENHR and AESP.

Tierney, K. (2005). Effective Strategies for Hazard Assessment and Loss Reduction: The Importance of Multidisciplinary and Interdisciplinary Approaches (Report from Internet). Natural Hazards Research and Applications Information Center, Institute of Behavioral Science, University of Colorado, Boulder, CO.

Turkington, R., Van Kempen, R., and Wassenberg, F. (2004). High-rise housing in Europe: Current trends and future prospects. Delft: DUP Science.

van Beckhoven, E., Bolt, G., and van Kempen, R. (2005). Theories of neighbourhood change and neighbourhood decline: Their significance for post-WWII large housing estates. Příspěvek přednesený na konferenci Housing in Europe: New Challenges and Innovations in Tomorrow's Cities. Reykjavik,29(6), 2.

Waide, P., Guertler, P., and Smith, W. (2006). High-rise refurbishment: The energy-efficient upgrade of multi-story residences in the European Union.International Energy Agency.

Wassenberg, F. (2004). Renewing stigmatised estates in the Netherlands: A framework for image renewal strategies. Journal of Housing and the Built environment, 19(3), 271-292.

Wilson, J. Q., and Kelling, G. L. (1989). Making neighborhoods safe. Atlantic Monthly, 263(2), 46-52.