

## ADOPTION OF RETROFIT STRATEGIES FOR THE HOUSING SECTOR IN NORTHERN CYPRUS

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**Abstract:** This research project is undertaken in the Turkish Republic of Northern Cyprus (T.R.N.C.). The study focuses on identifying refurbishment activities capable of diagnosing and detecting the *underlying problems alongside the challenges offered by the buildings' typology* in addition to identifying the correct construction materials in the refurbishment process, which allow for the maximisation of expected energy savings. The objective of the research is to investigate the *occupants' behaviour and role in the refurbishment activity by exploring how and why occupants* decide to change building components and how to understand why and how occupants consider using energy-efficient measurements. The housing estates are chosen from 22 different projects in four different regions of the T.R.N.C. that include urban and suburban areas. There is, therefore, a broad representation of the common drivers in the property market, each with different levels of refurbishment activity and this is coupled with different samplings from different climatic regions within the country. The study is conducted through *semi-structured interviews to identify occupants'* behaviour as it is associated with refurbishment activity. This paper presents the results of semi-structured interviews with 70 homeowners in a selected group of 22 housing estates in five different parts of the T.R.N.C. Alongside the construction process and its impact on the environment, the results point out the need for control mechanisms in the housing sector to promote and support the adoption of retrofit strategies and to minimize non-controlled refurbishment activities, in line with diagnostic information of the selected buildings. The expected solutions should be effective, environmentally acceptable and feasible, given the type of housing projects under review, with due regard for their location, the climatic conditions within which they were undertaken, the socio-economic standing of the house owners and their attitudes, local resources and legislative constraints. Furthermore, the study goes on to insist on the practical and long-term economic benefits of refurbishment under the proper conditions and why this should be fully understood by the householders.

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**Keywords:** Construction Process, Energy Efficiency, Refurbishment Activity, Retrofitting, Northern Cyprus.

## 1 Introduction

This research project is undertaken in the Turkish Republic of Northern Cyprus (T.R.N.C.). This research investigates the socio-political developments that have had an impact on the architecture and the urban planning process in this particular region. The study focuses on identifying refurbishment activities capable of diagnosing and detecting the underlying problems alongside the challenges offered by the mass housing estates design and planning in addition to identifying the cultural influences in the refurbishment process, which allow for the maximisation of expected energy savings. The United Nations (2007) reports that rapid construction activities are responsible for the consumption of approximately two-thirds of global energy demand in urban and suburban areas, and are therefore responsible for major changes in the built environment. The Intergovernmental Panel on Climate Change (2007) indicates that urbanisation has led to an increase in temperatures of 0.006 Celsius per decade since 1900 on the global land record and 0.002 Celsius on the global and ocean record. In the T.R.N.C. the increasing number of construction activities has had an impact on the environment which is included in future assessments of problems for the mass housing sector. At the same time, as a result of an increase in summer temperatures and a decrease in temperatures during winter months have brought changes in urban energy use. The Ministry of Environment and Natural Resources Department of Meteorology-T.R.N.C. (Çevre ve Doğal Kaynaklar Bakanlığı Meteoroloji Dairesi Mudurluğu in Turkish) statistics (2015) shows that the average annual temperature was 17.2°C between 1960 and 1991 and this increased to 17.7°C between 1991 and 2007. These results show that the island is threatened by the climate change impact now affecting the whole planet but within the T.R.N.C.

The rapid construction during the 'property boom' years led to a revived interest in the property market. Ghosh and Aker (2006) state that the expectations of the Annan Plan and changing market conditions throughout the world is prominent evidence that people from countries like Russia, Turkey, Greece, the United Kingdom, and Germany citizens began to show significant interest in buying their 'second homes' in the T.R.N.C. The increasing energy demand by the residential sector was felt mainly through rapid construction activities and a renewed concentration on economic improvement. In the T.R.N.C. the rapid and varied construction activity throughout the building sector resulted in economic growth. The State Planning Organisation-T.R.N.C. (Devlet Planlama Orgütü – K.K.T.C. in Turkish) (2008) statistics show that in the pre-construction period between 1997 and 2001, the GNP rate had an average of 1.8%. However, during the accelerated construction activity period between 2002 and 2006, this rate had jumped to 11% per annum. It should also be noted that during this same time the construction industry accounted for 8.1% of GNP in the T.R.N.C. (ibid). The results show how construction activity activated interest in construction projects. However, the situation led to unsustainable environmental problems, ecological constraints and energy issues.

The expected solutions of retrofit strategies should be effective, environmentally acceptable and feasible given the type of mass housing projects under review, with due regard for their location, the climatic conditions, within which they are undertaken, the socio economic standing of the house owners and their cultural assessments, local resources and legislative constraints. Furthermore, the study goes on to insist on the practical and long-term economic benefits of implementation of retrofit strategies under the selected research methodology (ethnographic study) and why this should be fully understood by the construction companies and householders. The subsequent sections in this paper are structured as follows; the paper will first discuss the background and justification of research, followed by the hypothesised relationships with regard to the

relevant literature. This is then continued with explanations on the methodology employed. Preliminary findings and discussions are given prior to the conclusion. Limitations and future research directions will also be discussed.

## 2 Literature Review

Cohen (2006) claims that in developing countries where urban growth and rapid urbanisation are occurring, un-controlled urban sprawl, poor land use planning and poorly-built housing estates has led to an impact on the current state of urbanisation and growth. Hence, regarding the T.R.N.C. case, changing the physical layout of the land together with un-planned land use are two major factors, which have resulted in architectural, urban and environmental devastation (Fig.1). For instance, the construction companies started their invasive developments in many cases without any official permission in the virgin shorelines, mountain regions and river beds and also before laying down any ground infrastructures such as roads, water, electricity. This situation has prevented efficient services being made available to the project sites for their completion; therefore, it has resulted in the abandonment of the mass housing estates by the construction companies.



**Figure 1: Invasive and destructive mass housing development of the untouched natural habitat**

In the T.R.N.C. urbanisation started in the 1980's because of the development in the economy which prompted a simultaneous demand in the mass housing sector. This led to rapid construction of the apartment blocks, detached, semi-detached and terraced houses being built randomly across the country in both urban and suburban areas. As a result of this exponential growth in the property market without any political agenda for controlling urban planning, infrastructure and the physical quality of the building and its adaptability to the local environmental climate. This led to poorly built houses without any initiative in the reduction of energy consumption from the buildings.

One of the main principal problems in evaluating the energy performance of the recently built housing stock is represented by the lack of current building regulations in the Town Planning Law 55/89 (Sehir Planlama Yasasi in Turkish). The current policies are adopted from similar regulations left over from the British administration. Ulucay (2013) states that the Town Planning Law no longer reflects the need and priorities of today's development of urban and suburban areas. Because of the structure of the Town Planning Law 55/89, the problems of its existing poor urbanism approach in planning concerns are now an on-going hindrance to the introduction and enforcement of proper architectural design tools and control mechanisms in the construction of buildings.

In the following research, which has been published previously, indicates that there is a lack of awareness in understanding the importance of energy use (Ulucay 2008). According to Ratti et al (2005), on strategy for putting this deficiency in understanding its right to explain the variance in energy performance in terms of the gap between design and construction process. Furthermore, Swan and Ugursal (2009) claims that the identification of the building diagnosis varies according to the age, size, type etc. of building. One prevailing opinion is therefore to transcend the benefits of simple energy efficiency and broaden it to a much wider perspective of energy performance in the current housing stock so as to begin accounting and combating the complex environmental processes that have already taken place.

In the T.R.N.C., the majority of the housing stock is built by private construction companies as stated in the previous paragraphs without any regulatory bodies to oversee and bring the industry into European Union standards to ensure that the housing stock is energy efficient. Here, particular attention is drawn to the existing legislative policies and its plans to promote at government level for the improvement of the energy efficiency of the recently built housing stock.

Another factor to be considered is the current economic downturn in the T.R.N.C., which means that the financial crisis has prevented construction companies and house owners from implementing energy-efficient technologies even though there is awareness of this factor. However, at the same time, the energy-efficient technologies offer an opportunity for highlighting the permanent benefits and the economic advantages of such improvements for the present time and the future. It is a given fact that a reduction in operating, maintenance and management costs, amongst others, are very convincing arguments for adopting retrofit strategies.

Recent studies indicate that the evolution of mass housing estates after the property boom in the T.R.N.C. brought massive changes in construction strategy, which now responds less favourably to occupants' requirements and also their current social and economic aspects (Yorucu & Keles 2007; Mehmet & Yorucu 2008; Safakli 2011 and Yapicioglu & Wright 2014). In order to reverse the above man-made problems, Bourdic, Salat and Nowacki (2012) stress that an improvement in the physical quality of building stock is very directly related to such demands as a reduction in energy consumption and so a depletion in carbon-dioxide emissions. In this study, the one main point is for the construction companies to asses and adopt the necessary principles of retrofit strategies to the present mass housing stock in order to bring into effect the above stated matters.

The approach here is to look at buildings that have been built by private construction companies and have already been retrofitted by occupants in order to make the building more energy-efficient and adaptable to the local environment. This research is prompted by a recognition that the current planning policies have not been effective in taking into account the energy consumption of the recently built mass housing estates by the construction companies in the T.R.N.C. between 2003 and 2015 (The property boom occurred during this particular period because of the political changes in Cyprus). This research reveals that there is an urgent need for the governmental bodies to bring out new and effective polices for the mass housing sector to force the construction industry to apply the necessary retrofit strategies on a rapid and large-scale basis in order to reduce energy consumption.

### 3 Methodology

This research consists of interdisciplinary collaboration in the area where single disciplinary studies often takes place. In that sense there is communication and collaboration between research, design, and the implementation of policies and objectives for the construction industry. This research utilises a combination of qualitative research methods (ethnographic case study); semi-structured interviews and focus group discussions are all contained within this underlying approach.

Before undertaking these ethnographic study observations were carried out to include photographic documentation of housing estates, drawings, maps of cities and housing estates. The researcher applied ethnographic studies as follows:

- (1) Semi-structured interviews with construction company owners in order to understand the current condition of the construction industry and to understand the nature and benefits of implementing energy efficient technologies.
- (2) Semi-structured interviews with house owners to understand their willingness to participate in implementing retrofit strategies in their homes.
- (3) Focus group discussions with house owners to investigate why house owners intend to be involved in the refurbishment activity of the recently built mass housing estates.

These methodologies were set out to address the issues of the housing sector. Although, these research methods were tested in the T.R.N.C., at the same time it was designed to be applicable in the Republic of Cyprus with similar energy saving targets.

In addition, the research hypothesis is that energy saving actions such as adoption of retrofit strategies could contribute to the reduction of the negative environmental impacts of the un-controlled construction and refurbishment activities. This was mostly tested on mass housing estates, which have been recently built en-mass mainly by private construction companies.

This research includes some case studies, which considers different aspects of the housing estates such as location, characteristics, demographic structure of households and also information on the construction companies. The housing estates were chosen from 22 different projects in four different regions (coastal, inland, semi-mountainous and mountainous climatic zones) including urban and sub-urban areas; thus in order to have a good representation of the common drivers in the property market with different levels of required refurbishment activity and different samplings from different climatic regions.

It is further emphasised that the documentation of the field data has come from the identification of construction companies' projects, their policies, their targets and the problems they encountered in both the design and building process. This goes some way in providing information on the current condition of the industry in a particular centre or region.

During the research process, the researcher contacted 15 construction companies. This research aim and targets were presented in order to get permission from these companies to examine their housing estate projects. For this purpose, 15 small and medium size architectural companies were identified in terms of their willingness to participate in the research process. These companies were key players, which have responded to the growing demand in the property market. Their structures and target groups showed variations within the location of the construction company and its projects.

Before starting to conduct semi-structured interviews with households, a questionnaire survey on 'refurbishment activity and energy consumption patterns' was prepared. This was partly to hear their views on how the retrofit strategies impacted on their own cultural assessment, but also to collect concrete examples of retrofitting experiences, which could be (anonymously) related to policy actors (institutions) to hear their responses. These data collection methods were looked at selected housing estate projects in terms of understanding typical energy consumption values and the effect of refurbishment activities. This method was also utilised in examining how occupants can play a key role during the implementation of the retrofit strategies. These interviews were intended to utilize information for each occupants' demographic structure needs and intentions in its involvement of any aspect of the refurbishment process.

The people who were interviewed in order to participate in this study are all residents of single or multifamily owner occupied housing units. The participants were people who do not identify themselves as vulnerable. Each were given a questionnaire to complete and were also interviewed by the researcher. Furthermore, the economic, physical, social and cultural environment in which the study was guided was observed. This approach combines regular site visits to the same households for two seasons (summer and winter) for a report on the environmental impact of the built environment over a period of one year in different climatic locations. The researcher contacted households in different project sites to get permission to re-undertake the questionnaire survey in the following research period.

The interview guide was therefore pilot-tested. The objective of this methodology is to calibrate the policies of implementing the adaptation of retrofit strategies in order to illustrate a trend of refurbishment activity in the recently built mass housing estates. This method was used as background information for this study to fill a research gap and contribute to knowledge on implementing an adaptation of retrofit strategies.

The qualitative analysis software of NVivo was used to analyse the fieldwork data. The analysis was guided by a preliminary thematic analysis of the key concepts prompted on the interviews. The first three concepts consider the housing stock in terms of characteristics, quality and developments. The other three concepts deal with current policies and action plans to introduce control mechanisms for retrofitting projects. It should also be noted that the semi-structured interviews and focus group discussions were conducted with households only on certain selected buildings and so the findings of the study apply to the narrow field under investigation and was not broadened to include some form of generalised opinion.

Another contribution to the field is the general evaluation carried out on understanding energy consumption of recently built housing estates in the T.R.N.C. As this study shows, there is very little research available or undertaken in the academic world that targets 'retrofit strategies'. This research concept will finally lead to assessing and generating new pathways of research and innovative design tools in the management of the mass housing renewal and urban development but at the same time involving the notion of a socio-cultural paradox. The aspect of this research is to understand how it's best possible to integrate the application of energy efficiency technologies to the adaptability of the prototype retrofit scenario. It will include cross-cultural studies as a research concept to investigate the pattern interpretation of energy consumption use and retrofitting.

#### 4 Analysis and Results

The study found that refurbishment activities are identified according to the degree to which the building components used by occupants with reference to three main indicators are interrelated; the age of the building, the construction material and its energy demand. Through these variations, it is possible to define a decay representing all major classes of buildings in the housing sector and to utilise the obsolescences as an indicator in an analysis of the buildings (ibid). This is one of the main reasons why different building typologies are widely investigated and considered strategic in the selected housing estates. For these reasons, an expected analysis is co-related to both these parameters concerning the construction material and its system, the obsolescent part of the building components, the energy efficient requirements and the interventions that come into play over time.

Another important fact is the role of the house owners' requirements in the design process and how these may impact the construction process. Therefore, the great challenge is to create collaborative mechanisms whereby both the construction companies and the house owners may contribute and co-ordinate efforts in solving the energy problem. To reach this goal, the demographic structure of occupants and their behaviour is required. Each single household has to be convinced and assured of the reasonableness and the economic advantages that will accrue from investing in the improvement of building components concerning energy efficiency in and on their property.

Thus, in order to obtain reliable and effective results in terms of energy efficient improvements, it is important that the interventions are articulated by occupants in the housing sector, as they represent now the common problems of the new-built housing stock. In this research context, the selected housing projects are composed of heterogeneous buildings with different typologies and dimensions, and consequently with different built purposes applied.

Today primary needs have evolved according to the demographic structure of the occupants and their lifestyles, financial capacities and several different occupants' profiles are identified naturally, these householders' profiles differ according to which housing estate project is under discussion and what the construction companies' targets were during the design process. However, it should also be remembered that house owners are now much more willing now to improve the physical conditions of their dwellings than they were in the past and the trend for refurbishment continues. Consequently, profiling occupants and their behaviour is a much more complex activity when it also takes into consideration the refurbishment habits of the occupants.

The construction systems and materials are common nominators in the selected buildings and are strictly connected with the choice of construction companies' progress at the time. Therefore, the materiality of buildings is a significant indicator not only of its level of physical obsolescence, but also the rapid construction demand linked to implement poorly built materials at that time.

Table 1 shows the several differences occur among apartments, terraced houses, semi-detached and detached buildings due to typology, built-form, distribution and construction systems. The common factor is generally that the housing stock after the great expectations raised by the Annan Plan was not designed to meet today's energy efficient standards especially concerning the control of indoor comfort conditions (heating and cooling) and the thermal losses due to poorly-built construction material choices. This means that offering adaptation of retrofit packages for improving energy efficiency in the

housing sector would not only bring a relevant reduction in energy consumption in the selected housing estates, but also that households can be strongly involved in reducing their energy costs.

**Table 1: The structure for identifying the problem of the selected building typologies**

	House Typology	Target Group	Hazard	Exposure
	Detached house	Upper-middle income/ high income	Overcooling demand in summer time  Non-control mechanisms in the building regulations and codes	Location of the housing estates  The built-purposes  The built period
	Semi-detached house	Upper-middle income/middle income	Non-central structure to regulate construction companies under the umbrella of 'energy-efficiency' thinking	Housing typology  Construction typologies and elements
	Terraced House	Middle income/ lower-middle income		Occupant variables
	Apartment	Upper middle income/middle income/ low income	Non-regulations to control occupants activities on the refurbishment process	Refurbishment activities

In addition, the study also revealed that the changes of building components as articulated by occupants is on the increase. Even though some of the buildings have undergone major renovation, the addition of more spaces and the covering of terrace areas account for a high percentage of the renovation activity. Hence, the quality profile of this new-built housing stock changes gradually and only the construction process and renovations differ substantially from the housing stock.

Subsequently, it is quite hard to have a reliable forecast of the renovation trends without having a control mechanism and adaptation packages developed through an investigation of the selected buildings. At this stage, the preliminary findings show that identification of the diagnosis in selected buildings can be useful for understanding what main changes occupants are expecting in the housing sector, and for further investigating their requirements from the construction companies and their involvement in the decision-making process.

Moreover, the study found that the occupant's refurbishment trends affect not only the energy performance of buildings but also increases carbon-dioxide emissions in the environment. It is also worth commenting that the impact of the construction activity has produced further problems in the housing sector and this contributes to making an investigation of the potential adaptation packages much more complex. To compensate for this, a useful starting point could be identified as the diagnosis of buildings in the selected housing estates. What seems to be clear is that the physical quality of the buildings, the demographic structure of households and the quality of refurbishment activity is perceived as inappropriate in meeting the emerging demand of the housing sector.

## 5 Discussion

In this case study approach, 70 buildings are analysed and three key components of energy consumption are calculated in accordance with the contribution they make to an increase in energy demand. The key components derived from this case study approach are as follows:

- Building design performance (e.g. shape, envelope area)
- Efficiency of construction systems (e.g. age of boiler)
- Behaviour of occupants

In these selected housing estates, three main requirements have been associated with refurbishment trends.

The first one deals with the covering of terrace spaces in the detached and semi-detached buildings and balconies in the apartments and terraced houses and adding more room spaces as a whole (which is strictly related to the demographic structure of the occupants) in order to obtain two different kinds of result. First adaptable spaces allow for the extension of the living room, dining area and entry lobby of the buildings according to changes in the lifestyles of occupants. Second, it allows some spaces to be widened and given a more specialised function such as, more ample living spaces for a family or a room. This could be achieved by extending the spatial layout of the existing building. These kinds of interventions are generally integrated to the on-going changes of users' profiles and to the trends of refurbishment activities and do not belong to concerns about reducing energy consumption demand but rather to the idea of improving the quality of living conditions.

The second refurbishment activity involves a general improvement of the dwelling and also of the building as a whole in terms of the replacement of kitchen units or bathrooms, roof insulation, installation of double-glazing windows and addition of shading panels (pergolas) directly to the outside of the building. Most of these activities are an expression of trends of informed high-quality interventions. Therefore, the problem is related to understanding the benefits of 'energy-efficiency' during the refurbishment process in order to meet the requirements of building standards. In most cases the refurbishment activity is perceived by the occupants not only as improving the quality of living conditions but also as a real opportunity to reduce energy consumption in the residential sector.

The third refurbishment activity deals with access to fresh water supply, the recycling of rain water and grey water and the connection to the grid which varies depending on the location of each housing estates. Nevertheless, these activities to improve the infrastructure of the buildings may have relevant effect in terms of the utilisation level of the housing estates. At the same time, many buildings are being fitted with solar panels.

It has also to be said that the most common refurbishment activity is the addition of new volumes adjacent to the existing building or open terrace areas on both the ground and first floors. These often unintentionally lead to increase in energy consumption of the buildings. Consequently, the changes on the current market conditions after the Annan Plan lead to the housing sector to becoming aware of the necessary EU objectives in the design process as regards to energy efficiency and also in defining the construction process and its impacts on the built environment.

## 6 Conclusions, Limitations and Future Research Direction

From the findings of the study, it can be concluded that the original contribution of this research lies in adoption of the retrofit strategies that systematically integrates energy efficiency standards in order to improve conditions within the housing sector under the combined influence of three variables namely the construction activities, occupants' behaviour and the energy consumption of buildings. In summary, this study process investigation analyses the pattern interpretation of the occupants' behaviour and their cultural assessment embedded energy performance of buildings during the implementation of retrofit strategies. In this context, no existing research was identified applying energy efficiency standards of retrofitting to any types of buildings, whether recently built mass housing estate projects or otherwise.

The results of the research will contribute to facilitate private construction companies that aim to support retrofit strategies by providing them with new guidelines and policies together with the necessary data about the implementations needed for the improvement of the housing sector in the T.R.N.C.

This research will enable households to become involved in the process of identifying the applicable retrofit scenarios, to improve living conditions and achieve minimum energy efficiency consumption of buildings. This research will provide the context with the knowledge to realise the main goals: the identification of possible future instruments and incentives that are needed to overcome the weakness in current legislation and so bring about a more energy efficiency housing sector.

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