

3

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Improving the Quality of Existing Urban Building Envelopes

NEEDS

COST C16

Improving the Quality of Existing Urban Building Envelopes

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edited by:

Ebbe Melgaard
George Hadjimichael
Manuela Almeida
Leo G.W. Verhoef

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Table of Contents

Preface	vii
<i>L.G.W. Verhoef</i>	
Introduction	1
<i>G. Hadjimichael</i>	
Problems, Needs and Solutions	
General Overview of the Problems, Needs and Solutions in the Belgian Urban Building Envelopes	5
<i>A. De Naeyer</i>	
General Overview of the Problems, Needs and Solutions in the Cyprian Urban Building Envelopes	21
<i>G. Hadjimichael, Ch. Efstathiades, P. Lapithis</i>	
General Overview of the Problems, Needs and Solutions in the Danish Urban Building Envelopes	27
<i>E. Melgaard, T. Dahl, J. Engelmark</i>	
General Overview of the Problems, Needs and Solutions in the French Urban Building Envelopes	39
<i>D. Groleau, B. Peaudeau, L. Chaze, F. Allard, G. Guarracino</i>	
General Overview of the Problems, Needs and Solutions in the Greek Urban Building Envelopes	49
<i>D. Bikas, C. Baniotopoulos, T. Stathopoulos</i>	
General Overview of the Problems, Needs and Solutions in the Hungarian Urban Building Envelopes	59
<i>Á. Novák</i>	
General Overview of the Problems, Needs and Solutions in the Italian Urban Building Envelopes	69
<i>E. Arbizzani, P. Civiero</i>	
General Overview of the Problems, Needs and Solutions in the Macedonian Urban Building Envelopes	81
<i>T. Stojkov</i>	
General Overview of the Problems, Needs and Solutions in the Maltese Urban Building Envelopes	89
<i>V. Buhagiar, R.P. Borg</i>	
General Overview of the Problems, Needs and Solutions in the Dutch Urban Building Envelopes	101
<i>F.W.A. Koopman</i>	
General Overview of the Problems, Needs and Solutions in the Polish Urban Building Envelopes	109
<i>A. Rybka, A. Kozłowski, Z. Plewako</i>	
General Overview of the Problems, Needs and Solutions in the Portuguese Urban Building Envelopes	121
<i>M. Guedes de Almeida, L. Bragança, R. Mateus</i>	
General Overview of the Problems, Needs and Solutions in the Swedish Urban Building Envelopes	131
<i>S. Schulz, S. Vidén, S. Chandra</i>	

Overview and Analysis

Overview of the Needs for Improvement of Urban Building Envelopes in the COST-C16 Countries <i>P. Civiero, D. Bikas, F. Koopman</i>	141
---	-----

General Conclusions <i>E. Melgaard</i>	149
---	-----

Appendix

Table Cyprus	153
Table Denmark	163
Table France	171
Table F.Y.R. of Macedonia	181
Table Greece	191
Table Hungary	199
Table Italy	209
Table Malta	221
Table the Netherlands	231
Table Poland	241
Table Portugal	255
Table Sweden	265

Case Study: The Needs for Suitable Housing for Senior Citizens <i>M.T. Andeweg</i>	273
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COST C16 Management Committee	281
-------------------------------	-----

COST C16 Working Group Members	285
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Overview of the Needs for Improvement of Urban Building Envelopes in the COST- C16 Countries

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ABSTRACT: Overview of the needs, the solutions and the priorities in the existing urban building envelopes in the countries of Working Group 2 of the COST action C16. The focus of the action C16 was the building envelopes of multi storey houses from the period 1945 to 1980. The majority of these houses were build with non-traditional building methods and techniques. In this overview, the ten aspects related to the needs will be discussed.

1 DESIGN ASPECTS

1.1 *Planning aspects*

The planning of housing estates in the period 1945 to 1980 was in many European countries driven by the need to build a high amount of dwellings in a short time. Industrialized production methods made it possible to build more houses with the same or less material and labour than with traditional techniques. To use these building methods in an effective way, big housing estates were planned with much repetition and in many cases based on the efficient use of cranes rather than a careful design of urban areas.

The planning regulations were focussed on big housing estates on big sites, mainly exclusive for housing. This resulted in single-use developments with no mixture of functions. In few, mainly Mediterranean countries the opposite happened. Here the building sites were small as result of planning regulations, with small developments at a high cost as a result. If planning by the government was absent, the result was a disorganized urban development.

For the distribution of the building volumes on the site often a grid-like structure was used, based on a high production rate with cranes. Monotonous estates with low aesthetic quality and low quality urban areas between the buildings were the result.

To find space for the big estates, they were in some cases built far from existing urban areas. The lack of facilities is resulting in lots of traffic movement. Either public transport or private cars have to take care of this. In situations with inadequate public transport the abundant use of private cars is giving heavy traffic in rush hours, high energy use with environmental problems and parking problems in neighbourhoods not designed for this amount of cars. For the tenants that cannot afford a private car, isolation and segregation with a poor social life will be the result.

Normally during the planning and design of the building complexes, not much attention was given to the local microclimate and environmental variables. The same technologies were used in different conditions, with neglect of local environmental conditions. Result of this neglect is dwellings with low climatic comfort: overheating in summer and moisture problems in winter. To compensate this discomfort high energy costs will result.

1.2 *Land use aspects*

The use of repetition in the housing estates built with industrialized building methods influences the land use by these complexes. The absence of variety and well designed areas for common use, like meeting places and playing areas, will not provide enough facilities for social interaction. Passive areas around buildings with lack of attention by tenants for maintenance and problems with safety can be the result.

In the theories of 'Modern architecture', the layout of the building complexes was organized by separation of functions. The sub-urban locations and absence of supporting facilities resulted in large 'dormitories' with insufficient common facilities. These building complexes often have a poor connection with surrounding urban- and green-areas.

1.3 *Architectural Aspects*

In the search for appropriate forms for their buildings, architects have always been faced with at least two important aspects: the aesthetic aspect and the functional aspect.

The reasons behind the "Bauhaus mass-production residential prototypes" were to promote standardized prefabrication and to employ characteristic, primary forms and colours, readily accessible to everyone.

Since architecture is closely related to the technical disciplines, envelopes become the site of the dialogue between building issues and external areas and the requirements of inhabitants.

The use of the innovative construction technologies improved the quality of life in the flats, and was related to the possibility of reflecting a town's urbanism and modernity. Nowadays this scenario does not fulfil the current tenants' demands.

Several key demand factors can be identified in each country concerning functional and aesthetic aspects, but each is considered more or less important than the other because of the priorities rising from the seriousness of the problems faced.

The refurbishment of the external envelope, such as the façades, the balconies and the loggias, involves firstly the aesthetic domain.

The lack of architectural identity is usually the result of a massive and rapid building development, which was focused on a quantity that had to be attained, and planned according to a set of modular principles and standards, rather than an aesthetic quality to be achieved.

However, the functional quality has decreased so much that many of these buildings have become unpleasant places to live in. Changing demographics and family structures are two of the most important reasons of the changed requirements of the buildings and, at the same time, are the major priorities to solve through refurbishment.

Changes in lifestyle, the current attention being paid to the weaker members of society (such as the elderly and disabled or children) appears to be the major reasons for improving the dwellings. At the same time, to comply with new local standards for the units and for ground-floor parking or the lack of shaded, semi-closed areas as enlargements of liveable areas have to be considered.

The renovation and reconstruction of the facades, based on a change in the comfort requirements, regard a redistribution of the apartments, of function at the ground floor and of the layout as a whole. The increased flexibility of the construction technologies adopted, support the separation between day and night zones or the conversion of two apartments into one.

Moreover, the necessity to satisfy the functional issues offers the opportunity to raise the aesthetic quality of the buildings. Changing an established image requires effective improvements to be made.

2 TECHNICAL ASPECTS

2.1 *Building Physics aspects*

For building physic aspects the use of dangerous materials, thermal insulation, moisture isolation and acoustic isolation are considered.

The material used in the post-war building stock with the highest potential health risk is asbestos. It was used in the form of asbestos reinforced cement as building material. The health risk is a severe higher risk on cancer in the lungs. This can occur when the material is exposed and disintegrated.

Other building materials with potentially health risks when applied are formaldehyde and synthetic solvents. In existing buildings of the considered period, they will be no longer harmful.

Another source of health risk is radon-gas escaping from the soil under ground floors. This can be solved by making the ground floor impermeable for air from below.

The poor thermal insulation of the building envelopes is by most countries considered as one of the biggest problems. During the time of construction, energy was cheap and abundant, so there was no need for legal standards for insulation. If insulating material was applied, it had high U-value for current standards. In addition, thermal bridges were not recognised as a problem. The results are problems with low comfort for tenants, high energy consumption and condensation. The unnecessary high production of CO₂ is a very urgent problem that needs to be solved.

Moisture problems often have a direct relation with thermal problems. Improper design and application of a vapour barrier will result in internal condensation in constructions. In addition, the relation between condensation and ventilation has to be considered to prevent the effects of moisture in constructions: degradation of materials, decay of constructions and the forming of mould and other allergens with risk for hygiene and health problems.

2.2 Structural aspects

The production methods for housing of the 1950s, 1960s and 1970s were mainly driven by the demand for quantity and speed, not quality and choice. Especially the publicly funded sector was dominated by the achievement of lowest initial costs.

The structural aspects reports show a satisfactory general picture on the construction. Special remarks have been made regarding low quality of materials, not sufficiently tested technologies, poor maintenance and degradation of concrete structures and inadequate soil tests.

Reports related to construction pathology do not mention critical situations about their structural behaviour. The main reasons of cracks or structural damages concern building structures pathologies, such as cracks and disintegration in the concrete, or corrosion of the tension rods, which are the result of the lack of maintenance or control actions. In some cases the lack of soil tests and the poor quality of the foundation works caused cracks on building elements.

Exceptions are the serious problems dealt with in the countries with high earthquake risks. There the impact of earthquake loads on the building and the envelope can be enormous. Not all the buildings from the considered period are calculated on that load.

2.3 Environmental aspects

The environmental aspects include the behaviour of buildings concerning lighting, heating, cooling, ventilation and general energy performance.

A primary goal of a building and its systems is the attainment of user's comfort, which means a healthy and satisfactory indoor environment. Buildings that produce environments of moderate quality can leave dissatisfied occupants, and in extreme cases illness.

In most countries, only few buildings have been studied from the environmental point of view, mainly because there was not any relevant legislation. In most buildings of the post-war housing stock ventilation, lighting and thermal performance of buildings are some of the major problems observed. These buildings offer a bad interior climate to their inhabitants. The lack of ventilation is one of the causes of moisture problems, material's degradation and summer overheating.

Many problems are connected with insufficient thermal insulation and thermal inertia and, consequently, of big energy waste and thermal discomfort. Especially in the southern countries summer overheating represents one of the most significant problems. The lack of thermal insulation and the absence of solar shading devices are causing an increasing use of artificial cooling systems.

Because of the poor building envelope insulation, the general energy performance of the majority of the post-war buildings is poor. In recent years, strategies to promote the use of active and passive measures and to improve environmental performances are implemented, sometimes with the use of incentives.

To use energy-saving measures efficiently, overall energy concepts need to be developed, to achieve an effective interaction between the environment, the materials and the technical systems of the buildings.

Buildings contribute to environmental degradation not only by means of their operational energy use. The environment is also degraded in the mining of raw materials, the manufacturing of building materials and products, and finally their transportation and assembly into buildings. Furthermore, over the lifetimes of the buildings, resources are consumed for their maintenance, refurbishment and demolition. Natural resources and wider environmental aspects have to be taken into account.

3 NON TECHNICAL ASPECTS

3.1 *Managerial aspects*

Maintenance work makes it possible to preserve buildings and their technical installations for the length of their functional lifespan. Conservation, rehabilitation and refurbishment are activities that try to extend the time span in which the quality of the buildings continues to meet with the acceptance of the owner and the occupants.

Nevertheless, all these activities of building's regeneration are not exclusively a matter of technical approach. A variety of non-technical aspects are becoming increasingly important. Lack of maintenance, building damages, social, economic and physical decay, are related to the fact that management of the housing schemes is in most cases too bureaucratic and without sufficient involvement of the tenants.

In most countries, despite the fact that the market is increasing, very little progress has been made in developing new technologies and assessment procedures to improve and to plan a successful refurbishment strategy.

An integrated approach, incorporating all the technical, financial and social aspects is needed. Appropriate policies of building management for the different ownership situations have to be developed and legislative frameworks have to be implemented. This will provide the market with the needed flexibility and the financial means to proceed to the necessary improvements.

3.2 *Financial aspects*

The issue of renovation measures in the building stock is important and complex. The way in which buildings and cities were built in the post-war period led to a situation where effective interventions are often leading to exceeding costs and unacceptable economic results.

The form of ownership and the rental policies have a strong influence on maintenance and refurbishing activities of buildings. The general financial environment is also a factor of dominant influence for the whole construction industry and the supply and demand market. The lack of economic capacity of the owners to face maintenance and refurbishment costs can strongly affect the possibilities for proper interventions.

Energy performance and environment conscious solutions are very important, in order to lower the costs for tenants and the community. Residential buildings are significant energy consumers and are therefore suitable candidates for energy reduction measures. The increase in energy prices is a very good reminder of how shortsighted the neglect to implement such measures is. The inefficiencies in the thermal and environmental protection of the building envelopes need wider considerations regarding renewal programs. Flexible financial schemes are necessary to promote viable solutions.

3.3 *Social aspects*

In these years of industrialization and prefabrication, Modernist or Functionalist ideas gained their most widespread expression. Buildings were planned according to a set of common principles covering countries as a whole. The position, size and scale of the estates may differ enormously between cities, regions and countries, but the possibility of creating homes through prefabrication reinforced the idea that every social problem had a solution and social development could be controlled more effectively than ever before. The reality was quite different: almost all housing estates have serious problems, which concern the characteristics of their open spaces, the chances for social relations between the users of the buildings and with regard to the complex and the surrounding urban configuration.

Social aspects are usually ignored by designers and contactors but serious problems have until now especially affected the poorest social rented buildings.

Social segregation, weakness of social relations and crime on one hand, and lack of individuality and alienation on the other, highlight the opportunity to offer residents different chances and ways of relating with their neighbours, improving everyone's security.

Moreover, sociologists describe new multi-ethnic societies whose growth in each estate lead to an increasing diversity of needs and preferences, and focuses attention on the opportunity of regulations concerning the amount of immigrants and the allocation system of social housing (low-income families, students, and disabled people).

Social measures have to be taken by making additional provisions and by undertaking community work, such as stimulating voluntary organizations and residents' associations for the definition of the private, semi-private, common and public space ratio.

Creation of quality accommodation and the redesign and expansion of areas that provide public and private services (i.e. cafes, shops, offices, kindergarten, etc.) have to be backed by active community participation. Their management and maintenance have to be correctly planned with the local municipalities prior to the intervention.

The participation of an area's inhabitants in the renewal process will increase their responsibility in order to strengthen identification with the place and their taking care of the environment.

3.4 *Cultural aspects*

Architecture is one the most important expression of the cultural and technological levels achieved by a nation. In practically every country, the concept of culture is promoted and supported, and the impact of buildings was always substantial.

Since architectural surfaces are very much connected the culture of representation, in its expression people should be able to find their origins, traditions and values reflected, and last but not least a degree of aesthetic satisfaction. In this scenario, the cultural issue appears as a methodological key for understanding local societies and as a generator of action and planning tools.

The promotion of prefabrication and industrialization was in the past closely associated with the desire to achieve a modern and rational way of life, together with the need for housing units. However too much "box-type housing" was built in one place at the same time, creating a new monoculture of living in the peripheral areas of our cities, without any relation to, and continuation of traditional values (i.e. square, streets, facilities, etc.).

Those areas today form part of the structure of the city and often represent their dark out-of-scale residential hinterland encircling the historic centre. Unlike some cities in northern Europe, (destroyed during the Second World War and partially rebuilt), the scale of the buildings in gen-

eral is appropriate to the surrounding urban configuration and at least their existence is normally accepted.

On the contrary, the rejection of this in some Mediterranean countries moves substantially against the internalization of the image of the cities, which is closely related to the deep and rapid distance from their past, and the presence of a deep-seated cultural tradition promoted by the post-war building boom. Thus, globalization stimulates the reinforcement of local values and people require preservation to be carried out on their cultural heritage: globalization is making us increasingly uniform, so it is essential to construct and promote our differences.

It is doubtful whether old traditional values can be replicated in contemporary cities, however valuing and paying attention to the cultural context during the intervention will increase the value and coincide with the inhabitants' sense of identity. This approach includes a strategic dimension: monitoring and popular participation are necessary to reach a good result. The absence of an investigation of local cultures generates errors in the formulation of action and implementation strategies.

Sooner or later, the building envelopes of multi storey houses from the period 1945 to 1980 will be appreciated as part of our past, and it would be responsible to try to understand them now and appreciate their existing richness, qualities and potential.

PRESENCE OF THE PROBLEMS

High: A, Medium: B, Low: C, No presence: -

DOMAIN	BE	CY	DK	FYRO M	FR	D	GR	HU	IT	MA	NL	PL	P	SL	SW
Planning aspects															
Planning regulation for the plot		C	B	C	C		B	B	B	C	B	B	B		B
Distribution of volumes		C	B	A	C		B	A	C	C	A	A	C		B
Transportation, flow, movement		C	B	A	C		B	C	C	C	B	C	A		B
Relation with microclimatic - environmental variables		C	C	B	C		B	-	B	C	C	-	C		C
Land use aspects															
Concerning building as a single entity		C	B	B	C		A	B	B	C	B	-	-		C
Relation with the bigger building complex layout		C	B	A	C		A	C	C	C	B	C	C		B
Surrounding urban land uses, relations, provisions, formations and dynamics		C	B	B	C		A	B	C	C	B	B	C		B
Environmental aspects															
Lighting performance		-	-	A	-		C	C	B	C	-	C	C		C
Ventilation performance		C	C	B	C		B	B	C	C	C	A	A		B
Heating cooling performance		B	B	A	C		A	A	B	C	B	A	B		C
General energy performance		A	B	A	C		B	A	C	B	A	B	A		A
Architectural aspects															
Functional aspects		C	C	A	C		A	B	A	A	A	B	B		C
Aesthetic aspects		A	B	A	B		A	B	A	A	B	C	-		B
Structural aspects															
Dead load		C	-	B	C		-	B	C	C	B	D	C		-
Earthquake load		C	-	A	C		A	-	C	C	-	-	-		-
Wind, snow load		-	-	B	-		C	C	-	C	-	A	-		-
Fire safety		-	-	B	-		C	C	C	C	B	-	-		C
Building physics aspects															
Dangerous materials		-	C	A	-		C	A	C	-	C	A	C		B
Thermal insulation		B	B	A	B		A	A	A	B	B	A	B		B
Moisture		B	B	B	B		B	B	B	B	C	B	A		B
Acoustic insulation		C	B	D	C		B	A	A	C	A	D	B		C
Cultural aspects															
Traditional housing layouts, types, designs, skylines, materials, decorations, colours etc.		C	C	A	C		B	A	B	C	B	A	-		B
Social aspects															
Anonymity, individuality or privacy, sociality of the spaces		B	A	A	B		B	A	A	B	B	A	-		B
Chances for relations among the users of the buildings		C	A	A	C		B	B	B	C	A	C	C		B
Chances for relations with other persons related to the respective complex and the surround		C	B	A	C		B	B	B	C	A	B	C		B
Managerial aspects															
Effective and viable management of the building that allows changes, interventions		A	C	A	B		A	C	A	B	B	C	B		C
Financial aspects															
Financial considerations that affect the possibilities for proper interventions		B	C	A	B		A	C	B	B	B	C	B		B

SERIOUSNESS OF THE PROBLEMS

High: A, Medium: B, Low: C, No presence: -

DOMAIN	BE	CY	DK	FYROM	FR	D	GR	HU	IT	MA	NL	PL	P	SL	SW
Planning aspects															
Planning regulation for the plot		B	C	C1			B	B4	B	B	A10	B	C		
Distribution of volumes		D	C	A1			B	A4	C	D	A9	A5	B		
Transportation, flow, movement		C	C	A1			B	C3	B	C	B	C	A4		
Relation with microclimatic - environmental variables		B	C	B1			B	-	A9	B	D	-	C		
Land use aspects															
Concerning building as a single entity		D	C	B1			A	B3	B	D	B	-	-		
Relation with the bigger building complex layout		C	B	A1			A	C4	C	C	A8	C	D		
Surrounding urban land uses, relations, provisions, formations and dynamics		C	B	B1			A	B3	C	D	C	B	C		
Environmental aspects															
Lighting performance		C	-	A2			B	C2	C	C	D	C	D		
Ventilation performance		C	D	B2			B	B4	B	C	C	A4	B		
Heating cooling performance		C	D	A1			A	A4	B	C	A5	A3	B		
General energy performance		A4	B	A1			B	A4	A1	A4	A4	B	A1		
Architectural aspects															
Functional aspects		C	C	A2			A	B	A3	C	A6	B	A5		
Aesthetic aspects		A3	D	A1			A	B3	A4	A3	B	C	-		
Structural aspects															
Dead load		B	-	B1				D	D	-	B	D	D		
Earthquake load		D	-	A1			A	D	C	-	-	-	-		
Wind, snow load		-	-	B2			C	D	-	-	-	A2	-		
Fire safety		-	-	B2			C	B	C	-	B	-	-		
Building physics aspects															
Dangerous materials		-	D	A1			C	A3	B	-	D	A5	C		
Thermal insulation		A2	D	A2			A	A4	A6	A2	A3	A1	A3		
Moisture		C	D	B1			B	B3	B	C	B	B	A2		
Acoustic insulation		D	D	D2			B	A2	A8	D	A7	D	B		
Cultural aspects															
Traditional housing layouts, types, designs, skylines, materials, decorations, colours etc.		B	D	A2			B	A4	A5	B	C	A7	-		
Social aspects															
Anonymity, individuality or privacy, sociality of the spaces		B	B	A1			B	A2	A7	B	B	A6	-		
Chances for relations among the users of the buildings		C	B	A2			B	B2	B	C	A2	C	C		
Chances for relations with other persons related to the respective complex and the surround		C	C	A1			B	B2	C	C	A1	B	C		
Managerial aspects															
Effective and viable management of the building that allows changes, interventions		A1	C	A1			A	C4	A2	A1	D	C	B		
Financial aspects															
Financial considerations that affect the possibilities for proper interventions		B	D	A1			A	C2	B	B	B	C	B		

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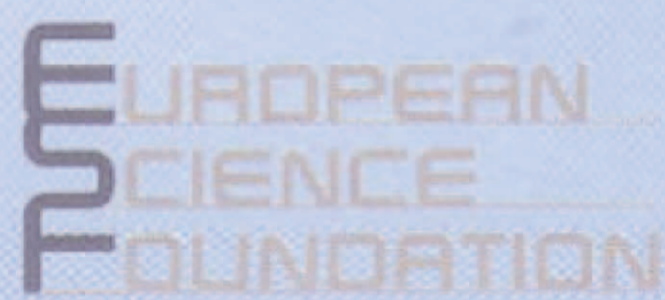
COST Action C16

As a result of changes in the composition of the population, society changes continuously with respect to various factors including age-structure, family composition and the availability of energy. Changes lead to situations that are reflected in the commissioning of buildings, which is gradually shifted from new construction to the reuse and renovation of existing buildings. The adaptation of buildings often requires the modification of facades and the construction behind.

The scope of this action within the COST Transport and Urban Development Domain is to improve techniques and methods for envelopes of buildings constructed during the last half of the 20th century in the COST countries. In other words it is directed on the building envelopes of the so-called non-traditional buildings.



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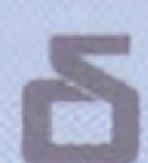
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