REFURBISHMENT
OF MULTI-FLAT RESIDENTIAL BUILDINGS
IN LITHUANIA

P5 Presentation  30/06/2015

Master track Building Technology
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Student: Irina Martjanova
Student number: 4321472
REFURBISHMENT OF MULTI-FLAT RESIDENTIAL BUILDINGS IN LITHUANIA

Introduction

Case study building
Real Estate
Design
Comparison
Final Design
Conclusions

CO₂ savings potential [MtCO₂] according to European Housing Ministries (adopted from (Guertler and Smith 2005))
REFURBISHMENT OF MULTI-FLAT RESIDENTIAL BUILDINGS IN LITHUANIA

**Introduction**

Case study building  
Real Estate  
Design  
Comparison  
Final Design  
Conclusions

**Benefits**

- **Energy efficiency**
  - MAX: Primary energy savings
  - MIN: Energy consumption
- **Environmental impact**
  - MIN: CO₂ emissions
- **Economic rationality**
  - MIN: Investment costs  
  - MIN: Payback time  
  - MAX: Energy saving costs  
  - MAX: Net present value  
  - MAX: Building’s price
- **Comfort**
  - MAX: Standards and norms
- **Life cycle**
  - MAX: Lifetime span

**Lifetime span**  
**Investment costs**  
**Energy consumption**  
**Energy saving costs**  
**Net present value**  
**Building’s price**  
**Comfort**  
**Standards and norms**  
**Lifetime span**
WHAT ARE THE DESIGN STRATEGIES THAT INTRODUCE THE ADDITIONAL VALUE OF THE REFURBISHMENT AND STIMULATE THE DECISION MAKING OF USERS TO INVEST IN THE REFURBISHMENT OF THE MULTI-FLAT RESIDENTIAL BUILDING?
REFURBISHMENT OF MULTI-FLAT RESIDENTIAL BUILDINGS IN LITHUANIA

LOCATION

Introduction

Case study building

Real Estate

Design

Comparison

Final Design

Conclusions

LOCATION

Klaipeda
Siauliai
Panevezys
Kaunas
Alytus
Vilnius

1 Naujininkai
2 Karoliniskes
3 Pilaite
4 Virsuliskes
5 Fabijoniskes
REFURBISHMENT
OF MULTI-FLAT RESIDENTIAL BUILDINGS
IN LITHUANIA

SPACIAL CONFIGURATION

Apartment Type 1
- 2xBalcony
- Living room 51m²
- Bathroom/toilet Bathroom 5.5m² Toilet 2.8m²
- Bedroom
  - B1 37m²
  - B2 34m²
  - B3 38m³
- Corridor 17m³
- Kitchen 18.6m³
- Storage 6.4m³

Apartment Type 2
- Balcony
- Living room 38m³
- Bathroom/toilet
  - Bathroom 5.5m³ Toilet 2.8m³
- Bedroom
  - 48m³
- Corridor 16.7m³
- Kitchen 18.8m³

Apartment Type 3
- Balcony
- Living room 46.6m³
- Bathroom/toilet
  - Bathroom 5.5m³ Toilet 2.8m³
- Bedroom
  - 38m³
- Corridor 17m³
- Kitchen 18.6m³
REFURBISHMENT OF MULTI-FLAT RESIDENTIAL BUILDINGS IN LITHUANIA

CONSTRUCTION

Introduction

Case study building Real Estate Design Comparison Final Design Conclusions
REFURBISHMENT OF MULTI-FLAT RESIDENTIAL BUILDINGS IN LITHUANIA

Introduction

Case study building

Real Estate Design Comparison

Final Design Conclusions

Details

120mm Loadbearing inner wall

Sealant

Concrete M150

Mineral wool insert

Cement mortar

Mineral wool insert

Prefabriated concrete balcony slab

Armored rubberoid
50mm prefabricated reinforced concrete slab
Air gap
100mm thick semirigid mineral wool boards
50mm prefabricated reinforced concrete slab

120mm Loadbearing inner wall

40mm Concrete layer
160mm Mineral wool board
35mm Concrete layer
15mm Cement mortar

Double glazed frame

Single glazed frame

Armored rubberoid
50mm prefabricated reinforced concrete slab
Air gap
100mm thick semirigid mineral wool boards
50mm prefabricated reinforced concrete slab
REFURBISHMENT
OF MULTI-FLAT RESIDENTIAL BUILDINGS
IN LITHUANIA

FACTORS

SOCIAL FORCES

ECONOMIC FORCES

PHYSICAL/ENVIRONMENTAL

GOVERNMENTAL
REFURBISHMENT
OF MULTI-FLAT RESIDENTIAL BUILDINGS
IN LITHUANIA

FACTORS

ECONOMIC FORCES

PHYSICAL/ENVIRONMENTAL

GOVERNMENTAL

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<th>3 persons</th>
<th>2 persons</th>
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<td>19.9</td>
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REFURBISHMENT OF MULTI-FLAT RESIDENTIAL BUILDINGS IN LITHUANIA

MARKET ANALYSIS

GOVERNMENTAL

670 €/MONTH BRUTO
49.6% UNEMPLOYED

FACTORS

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<thead>
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<td>19.9%</td>
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<tr>
<td>2 persons</td>
<td>28.7%</td>
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<td>1 person</td>
<td>32.4%</td>
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670 €/MONTH BRUTO

49.6% UNEMPLOYED
RE FURBISHMENT
OF MULTI-FLAT RESIDENTIAL BUILDINGS
IN LITHUANIA

MARKET ANALYSIS

SUBSIDIES

670 €/MONTH BRUTO
49.6% UNEMPLOYED

FACTORS

>5 persons
4 persons
3 persons
2 persons
1 persons

6.4%
14.2%
19.9%
28.7%
32.4%
### Comparison of price/m² in different districts old vs newly built

#### Price comparison

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<tr>
<td>Non-refurbished</td>
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#### MARKET ANALYSIS

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<tr>
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<tr>
<td>Year</td>
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<tr>
<td>Construction type</td>
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<td>Number of rooms</td>
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<td>Heating type</td>
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<tr>
<td>Physical state of the apartment</td>
<td>Decorated or furnished</td>
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<tr>
<td>Parking</td>
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<td>Orientation</td>
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<td>Parking</td>
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<td>Orientation</td>
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Comparison of price/m² in different districts old vs newly built

Price comparison

MARKET ANALYSIS
MARKET ANALYSIS

NEW APARTMENT

CASE STUDY BUILDING

<table>
<thead>
<tr>
<th>Room</th>
<th>New</th>
<th>Old</th>
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<tbody>
<tr>
<td>Bathroom and toilet</td>
<td>6.64</td>
<td>3.07</td>
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<tr>
<td>Kitchen</td>
<td>9.2</td>
<td>6.19</td>
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<tr>
<td>Corridor</td>
<td>2.3</td>
<td>6.93</td>
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<td>Living room</td>
<td>22.7</td>
<td>18</td>
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<td>Bedroom</td>
<td>20</td>
<td>14</td>
</tr>
<tr>
<td>Balcony</td>
<td>10</td>
<td>3</td>
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</tbody>
</table>

- Balcony
- Living room
- Bathroom/toilet
- Bedroom
- Corridor
- Kitchen
- Storage

m²
CONCLUSIONS ON REAL ESTATE PART

HARD TO DEFINE HOW EXACTLY EACH OF CRITERIAS INFLUENCE THE MARKET VALUE;

HARD TO APPLY ANY OF THE EXISTING EVALUATION METHODS;

NOT ENOUGH APARTMENTS IN THE REFURBISHED BUILDINGS FOR SALE TO COMPARE;

DIFFERENT APPROACH TO LIFESTYLE IN NEW APARTMENTS;

NEEDED IMPROVEMENTS:
DIFFERENT FUNCTIONAL ZONES;
AREA EXTENSION;
LOGGIAS;
PRIVATE AND COMMUNITY SPACE CREATION;
CONCLUSIONS

TECHNICAL

- POOR INSULATION
- CRACKS
- SEALANT BETWEEN PANELS
- VENTILATION
- COLD
- LEAKAGE
- MOISTURE PENETRATION
- MOULD

NON TECHNICAL

- FUNCTIONAL ZONES
- ARCHITECTURAL APPEARANCE
- NO COMMON SPACE
# Design Approach

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<td>N/A</td>
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## Climate Design

![Diagram](image25.png)

### 3 Strategies

**Introduction**  Case study building  Real Estate  Design  Comparison  Final Design  Conclusions
REFURBISHMENT OF MULTI-FLAT RESIDENTIAL BUILDINGS IN LITHUANIA

STRATEGY 1

Introduction   Case study building   Real Estate   Design   Comparison   Final Design   Conclusions
RE FURBISHMENT OF MULTI-FLAT RESIDENTIAL BUILDINGS IN LITHUANIA

STRATEGY 1

OLD SITUATION

Ground floor plan

Section A-A

STRATEGY 1

Ground floor plan

Section A-A

Legend:
- Balcony
- Living room
- Bathroom/toilet
- Bedroom
- Corridor
- Kitchen
- Storage

Introduction  Case study building  Real Estate  Design  Comparison  Final Design  Conclusions
CLIMATE DESIGN

SUMMER SITUATION

WINTER SITUATION

HOT WATER

24°C

20.6°C

-3.12°C

20°C

20°C

20°C

20°C

20°C

0°C

-3.12°C

0°C

24°C

20.6°C
REFURBISHMENT
OF MULTI-FLAT RESIDENTIAL BUILDINGS
IN LITHUANIA

STRATEGY 2

Introduction   Case study building   Real Estate   Design   Comparison   Final Design   Conclusions
REFURBISHMENT
OF MULTI-FLAT RESIDENTIAL BUILDINGS
IN LITHUANIA

STRATEGY 2

OLD SITUATION

Ground floor plan

STRATEGY 2

Ground floor plan

Section A-A

Section A-A

Balcony
Living room
Bathroom/toilet
Bedroom
Corridor
Kitchen
Storage

STRATEGY 2

OLD SITUATION

Ground floor plan

Section A-A

Section A-A

Balcony
Living room
Bathroom/toilet
Bedroom
Corridor
Kitchen
Storage

STRATEGY 2

Ground floor plan

Section A-A

Section A-A

Balcony
Living room
Bathroom/toilet
Bedroom
Corridor
Kitchen
Storage

STRATEGY 2

Ground floor plan

Section A-A

Section A-A

Balcony
Living room
Bathroom/toilet
Bedroom
Corridor
Kitchen
Storage

STRATEGY 2

Ground floor plan

Section A-A

Section A-A

Balcony
Living room
Bathroom/toilet
Bedroom
Corridor
Kitchen
Storage
REFURBISHMENT
OF MULTI-FLAT RESIDENTIAL BUILDINGS
IN LITHUANIA

STRATEGY 3

Introduction
Case study building
Real Estate
Design
Comparison
Final Design
Conclusions
REFURBISHMENT OF MULTI-FLAT RESIDENTIAL BUILDINGS IN LITHUANIA

STRATEGY 3

OLD SITUATION

Ground floor plan

Section A-A

STRATEGY 3

Ground floor plan

Section A-A

Legend:
- Balcony
- Living room
- Bathroom/toilet
- Bedroom
- Corridor
- Kitchen
- Storage

Introduction   Case study building   Real Estate   Design   Comparison   Final Design   Conclusions
REFURBISHMENT
OF MULTI-FLAT RESIDENTIAL BUILDINGS
IN LITHUANIA

CLIMATE DESIGN

SUMMER SITUATION

WINTER SITUATION

HOT WATER

-3.12°C

-3.12°C

24°C

24°C

20.6°C

20.6°C

20°C

20°C

6.2°C

-3.12°C

20.6°C

HOT WATER

24°C

20°C

0°C

6.2°C

-3.12°C

0°C

20.6°C

24°C

0°C

-3.12°C

20.6°C

24°C

0°C

6.2°C

-3.12°C

20.6°C

24°C
ADDITIONAL FLOOR LAYOUT

5TH FLOOR

6TH FLOOR

7TH FLOOR

REFURBISHMENT
OF MULTI-FLAT RESIDENTIAL BUILDINGS
IN LITHUANIA
REFURBISHMENT OF MULTI-FLAT RESIDENTIAL BUILDINGS IN LITHUANIA

STRATEGY 1

STRATEGY 2

STRATEGY 3
**REFURBISHMENT**
OF MULTI-FLAT RESIDENTIAL BUILDINGS
IN LITHUANIA

**HEAT BALANCE**

\[
Q_s - \text{Solar heat gain} \\
Q_i - \text{Internal heat gain} \\
Q_v - \text{Ventilation heat loss} \\
Q_c - \text{Conductive heat loss}
\]

\[
Q_s + Q_i = Q_v + Q_c
\]

STR 2.09.04:2008 “Building heating power. The energy consumption for heating.”
REFURBISHMENT
OF MULTI-FLAT RESIDENTIAL BUILDINGS
IN LITHUANIA

Introduction
Case study building
Real Estate
Design
Comparison
Final Design
Conclusions
Correction coefficient*:
For surfaces facing glazed areas 0.85
For surfaces facing greenhouse 0.8
For roof 1.15

*STR 2.01.09:2005 Appendix 2
REFURBISHMENT
OF MULTI-FLAT RESIDENTIAL BUILDINGS
IN LITHUANIA

HEAT BALANCE COMPARISON

![Heat Balance Comparison Graph]

- Solar gains
- Internal gains
- Transmission losses
- Mechanical ventilation losses
- Natural ventilation losses
- Infiltration/exfiltration losses

Legend:
- Present
- Strategy 1
- Strategy 2
- Strategy 3

W
**REFURBISHMENT**
OF MULTI-FLAT RESIDENTIAL BUILDINGS
IN LITHUANIA

**ENERGY CONSUMPTION**

\[ H_{\text{input}} = \frac{H_{\text{out}}}{\eta_1 \times \eta_2 \times \eta_3 \times \eta_4} \text{ (kWh)}; \]

\[ H_{\text{out}} = Q \times 24 \times D / 1000 \text{ (kWh)}; \]

\[ D = 225 \text{ days} \]

\[ H_{\text{water}} = 70 \times 5 \times 12 = 4200 \text{ kWh} \]

\[ H_{\text{water}} = 54 \text{ kWh/m}^2 \]

<table>
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<tr>
<td>STRATEGY 2</td>
<td>69.2%</td>
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<tr>
<td>STRATEGY 3</td>
<td>94.5%</td>
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REFURBISHMENT OF MULTIFLAT RESIDENTIAL BUILDINGS IN LITHUANIA

IMPROVEMENTS

CASES | T BUFFER ZONE
-------|---------
STRATEGY 1 | 5.6 °C
STRATEGY 2 | 19.6 °C
STRATEGY 3 | 35.2 °C
REFURBISHMENT
OF MULTI-FLAT RESIDENTIAL BUILDINGS
IN LITHUANIA

ENERGY CONSUMPTION

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**Refurbishment of Multi-Flat Residential Buildings in Lithuania**

**Costs**

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<td>13.1</td>
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<tr>
<td>STRATEGY 3</td>
<td>6</td>
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The graph shows the investment costs of the newly built part per square meter for different strategies.

- **Strategy 1**: Euro/m²
  - RC: 199
  - PMV: 916
  - NBMV: 1340

- **Strategy 2**: Euro/m²
  - RC: 633
  - PMV: 916
  - NBMV: 1340

- **Strategy 3**: Euro/m²
  - RC: 312
  - PMV: 916
  - NBMV: 1340

**Comparison**

**Final Design**

**Conclusions**
# Comparison

<table>
<thead>
<tr>
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<th>Strategy 2</th>
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<tr>
<td>Heat losses</td>
<td>5709.84</td>
<td>2223.29</td>
<td>2254.6</td>
<td>1803.57</td>
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<td>-</td>
<td>218.58</td>
<td>130.54</td>
<td>128.382</td>
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<td>Natural ventilation</td>
<td>1256.11</td>
<td>858.485</td>
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<td>Infiltration</td>
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<td>848.06</td>
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<td>2286</td>
<td>1225.76</td>
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<td>1561.594</td>
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<tr>
<td>Internal</td>
<td>677.6</td>
<td>677.6</td>
<td>677.6</td>
<td>677.6</td>
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<tr>
<td>Heating loads</td>
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<td>Use of energy</td>
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<td>Hot water loads</td>
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<td>Use of energy</td>
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<td>Delivered energy</td>
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<td>66.22</td>
<td>58.29</td>
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<td>Mechanical ventilation</td>
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<td>Heat recovery</td>
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<td>Ground air heating</td>
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<td>Thermal solar collectors</td>
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<td>Government support</td>
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<td>+</td>
<td>+/-</td>
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<td>Energy efficiency</td>
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<td>Increase of useful floor area</td>
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<td>Investment possibilities</td>
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<tr>
<td><strong>Social</strong></td>
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<tr>
<td>Living comfort</td>
<td>-</td>
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<td>+</td>
<td>++</td>
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<tr>
<td>Loggias</td>
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<td>-</td>
<td>+</td>
<td>+</td>
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<tr>
<td>Modernized layout</td>
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<td>+</td>
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<tr>
<td>Community space</td>
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<tr>
<td>Disabled people access</td>
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<td>Possibility to stay in the building during the refurbishment</td>
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<td>Architectural possibilities</td>
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<td>+++</td>
<td>+++</td>
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<td><strong>STRENGTHS</strong></td>
<td><strong>WEAKNESSES</strong></td>
<td></td>
<td></td>
<td></td>
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<tr>
<td>-----------------------------------</td>
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<td></td>
<td></td>
<td></td>
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<tr>
<td>CHEAP;</td>
<td>LOW ENERGY EFFICIENCY COMPARED TO OTHER STRATEGIES;</td>
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<td>BETTER AESTHETICAL APPEARANCE OF</td>
<td>NO ADDITIONAL BENEFITS AND IMPROVEMENT OF THE</td>
<td></td>
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<tr>
<td>THE BUILDING;</td>
<td>LIFESTYLE;</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>GOVERNMENT SUPPORT;</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>NO INSIDE WORKS;</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>SHORT PAYBACK TIME;</td>
<td></td>
<td></td>
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<table>
<thead>
<tr>
<th><strong>OPPORTUNITIES</strong></th>
<th><strong>THREATS</strong></th>
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<tbody>
<tr>
<td>EASY TO APPLY AND CONVINCE ALL</td>
<td>CHANCES TO FAIL IN ACHIEVING CO2 REDUCTION GOALS;</td>
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<td>THE PARTIES;</td>
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<tr>
<td>BECAUSE OF THE LARGE NUMBER OF</td>
<td></td>
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<tr>
<td>RESIDENTIAL BUILDINGS OF THIS</td>
<td></td>
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<tr>
<td>TYPE MULTIPLE PROJECT APPLICATION</td>
<td></td>
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<td>POSSIBILITIES;</td>
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## SWOT

<table>
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<tr>
<th><strong>STRENGTHS</strong></th>
<th><strong>WEAKNESSES</strong></th>
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</thead>
<tbody>
<tr>
<td>Community space for the residents; Direct benefits for owners of last floor apartments; Increased loggias areas; Better aesthetical appearance of the building; Better indoor comfort; Government support; No inside works; Increased useful floor area;</td>
<td>Compared to strategy 3, better energy performance can be achieved; High refurbishment costs; Long payback time</td>
</tr>
</tbody>
</table>

### OPPORTUNITIES

- Use of greenhouse for food production;
- Use the concept as a landmark of the area;
- Because of the large number of residential buildings of this type multiple project application possibilities;
- By providing the common spaces by mean of the greenhouse, it is possible to change the lifestyle of the residents and rise the community spirit;
- Job creation opportunities;
- Better image of the district creation;

### THREATS

- High refurbishment costs can influence the decision of home owners to apply this strategy in reality;
## SWOT

### Strengths

- Significant improvement of energy efficiency;
- Better aesthetical appearance of the building;
- Access for disabled people;
- Modernized layout of the apartment;
- Better indoor comfort;
- Increased loggias area;
- Use of renewable energy sources;
- Increased useful floor area;
- Short payback time;
- Direct benefits for owners of last floor apartments;

### Weaknesses

- High costs;
- Relocation of residents during the refurbishment;
- Complex refurbishment works;

### Opportunities

- Use the concept as landmark of the area;
- Because of the large number of residential buildings of this type multiple project application possibilities;
- New people with higher income are attracted, the life level has to increase.
- Job creation opportunities;
- If investors are attracted, possibility to minimize the financial burden on users and government;
- For the investors, there is no need to invest in the instalations;
- New created apartments can be rented for higher price, because of high energy efficiency of the building.

### Threats

- Convince the investors to subsidize the refurbishment process;
- Failure to find a way to relocate the home owners;
- Existing structure of the building has to be strong enough to care additional loads;
REFURBISHMENT
OF MULTI-FLAT RESIDENTIAL BUILDINGS
IN LITHUANIA
RE FURBISHMENT
OF MULTI-FLAT RESIDENTIAL BUILDINGS
IN LITHUANIA

Introduction
Case study building
Real Estate
Design
Comparison
Final Design
Conclusions
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REFURBISHMENT
OF MULTI-FLAT RESIDENTIAL BUILDINGS
IN LITHUANIA

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REFURBISHMENT OF MULTI-FLAT RESIDENTIAL BUILDINGS IN LITHUANIA
REFURBISHMENT
OF MULTI-FLAT RESIDENTIAL BUILDINGS
IN LITHUANIA

Present
393.17

Final design
65.22

Delivered energy for heating
Delivered energy for hot water
RE FURBISHMENT
OF MULTI-FLAT RESIDENTIAL BUILDINGS
IN LITHUANIA
Fig. 10.17 Private, semi-private and public space new vs old situations
### REFURBISHMENT OF MULTI-FLAT RESIDENTIAL BUILDINGS IN LITHUANIA

<table>
<thead>
<tr>
<th>REFURBISHMENT COSTS</th>
<th>REFURBISHMENT COSTS (EURO)</th>
<th>PAYBACK TIME (YEAR)</th>
<th>INTEREST RATE1 %</th>
<th>INTEREST RATE FOR ESTIMATED PERIOD (EURO)</th>
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<tbody>
<tr>
<td>BASIC REFURBISHMENT</td>
<td>16716</td>
<td>5.8</td>
<td>3</td>
<td>2908.584</td>
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<td>DEEP REFURBISHMENT</td>
<td>30744</td>
<td>7</td>
<td>3</td>
<td>6456.24</td>
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WHAT ARE THE DESIGN STRATEGIES THAT INTRODUCE THE ADDITIONAL VALUE OF THE REFURBISHMENT AND STIMULATE THE DECISION MAKING OF USERS TO INVEST IN THE REFURBISHMENT OF THE MULTI-FLAT RESIDENTIAL BUILDING?
REFURBISHMENT
OF MULTI-FLAT RESIDENTIAL BUILDINGS
IN LITHUANIA

Introduction
Case study building
Real Estate
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Final Design
Conclusions

Government

Users

Investors

Awareness

Participation

Regulatory framework

Contribution

Investments

Demand for deep refurbishment
IF YOU'RE TRYING TO ACHIEVE, THERE WILL BE ROADBLOCKS. I'VE HAD THEM; EVERYBODY HAS HAD THEM. BUT OBSTACLES DON'T HAVE TO STOP YOU. IF YOU RUN INTO A WALL, DON'T TURN AROUND AND GIVE UP. FIGURE OUT HOW TO CLIMB IT, GO THROUGH IT, OR WORK AROUND IT.

*Michael Jordan*
THANK YOU!