QUALICHeCK

Towards better quality and compliance

Quality of works, compliance with existing legislation and reliability of EPC data in Greece

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Greek New Study Collection

Scope

- 26 residential and non residential buildings
- Newly built/renovated buildings
- Well documented buildings
- Focus area: Quality of Works, Compliance with reference values, Reliability of EPC input data
- Location: Greece

Aim

- The aim of the study is to examine in newly built and renovated buildings the quality of works through on-site inspections and measurements, the compliance with the reference values of the National Technical Guides, the reliability of EPC input data

Methodology

- The quality of works through on-site inspections and measurements include:
  - Air tightness tests
  - Infrared thermography of the building envelope
  - Site visits and inspections to check actual construction
- The compliance with the reference values of the National Technical Guides includes
  - Ventilation measurements
  - Measurements of temperature and relative humidity
- The reliability of EPC input data by:
  - Comparing the U-values of the design with actual U-values of the materials used in the construction as reported in the final EPC.
  - Comparing the design values of technical characteristics of the solar collectors with the technical characteristics used in the construction as reported in the final EPC.
  - Checking the accuracy of EPC calculations

Selected case studies and methods

	Type of interventions			Type of quality and compliance control			
Case Study	Frames	Insulation	Solar panels	Measurements	On-site visits	Invoices checking	EPC calculations checks
01	-	-	-	✓	✓		
02	✓		✓	✓	✓	✓	✓
03	✓		✓			✓	✓
04	✓					✓	✓
05	✓	✓	✓			✓	✓
06	✓		✓			✓	✓
07	✓			✓	✓	✓	✓
08							
09	✓	✓	✓	✓	✓	✓	✓
10	✓	✓	✓	✓	✓	✓	✓
11	✓	✓	✓	✓	✓	✓	✓
12	✓	✓	✓	✓	✓	✓	✓
13	✓		✓	✓	✓	✓	✓
14	✓	✓	✓	✓	✓	✓	✓
15	✓	✓	✓	✓	✓	✓	✓
16	✓	✓	✓	✓	✓	✓	✓
17	✓	✓	✓	✓	✓	✓	✓

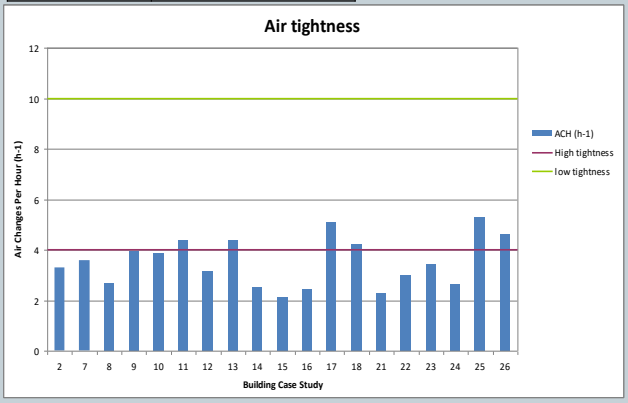
Selected case studies and methods

	Type of interventions			Type of quality and compliance control			
Case Study	Frames	Insulation	Solar panels	Measurements	On-site visits	Invoices checking	EPC calculations checks
18	✓		✓	✓			
19	✓	✓				✓	✓
21	✓	✓	✓	✓	✓	✓	✓
22	✓	✓	✓	✓	✓	✓	✓
23	✓		✓	✓	✓	✓	✓
24	✓	✓		✓	✓	✓	✓
25	✓	✓	✓	✓	✓	✓	✓
26	✓	✓	✓	✓	✓	✓	✓

Quality of works

n_{50} [h^{-1}]	Envelope tightness level
≥10	Low
4<n_{50}<10	Medium
≤4	High

Tightness levels for natural ventilated, non-shielded single-family buildings (EN 13790)



The majority of the buildings (68%) that were examined has ACH values lower 4 and that shows a high level of envelope air tightness

Quality of works

- **Thermographic inspections**

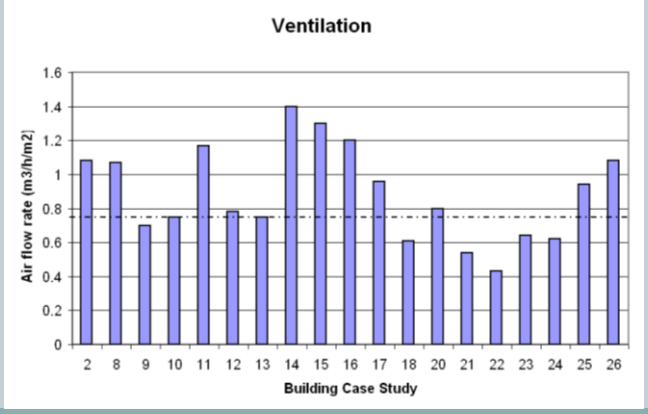
Thermographic inspections were carried out in 7 buildings that external thermal insulation was implemented in order to detect defects in the insulation. The inspections showed that the external thermal insulation of the buildings' envelope was well implemented without any gaps between the insulation boards. This shows a good quality of works in these buildings.

- **On-site visits**

On-site visits took place in nineteen buildings and the quality of works was investigated. More specifically the implementation of the window frames and the external insulation was checked and the inspection showed that the frames' installation was of good quality and no gaps between the frames and the wall were detected. The checking of implementation of external insulation confirms the findings of thermal mappings. These findings are due to the fact that the vast majority of the case studies are buildings renovated under the "Energy Efficiency at Household Buildings" Program and this program has strict quality assurance measures.

Compliance with the reference values

Air flow for single and multi family buildings compared to the reference value of 0.75m3/h/m2 (Technical Chamber of Greece Directive TOTEE 20701/2010)



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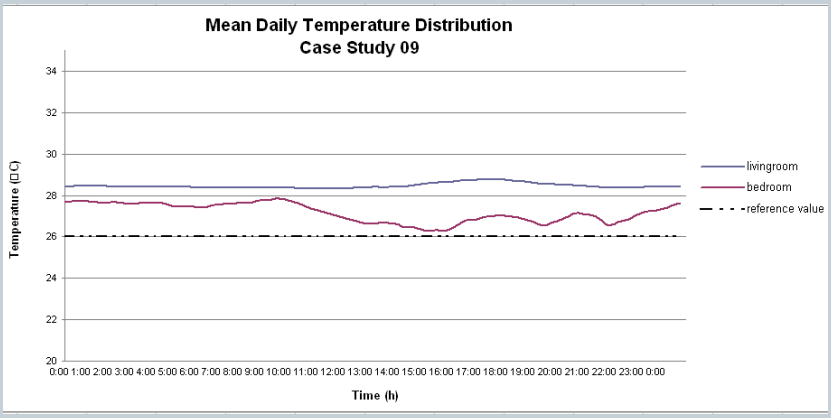

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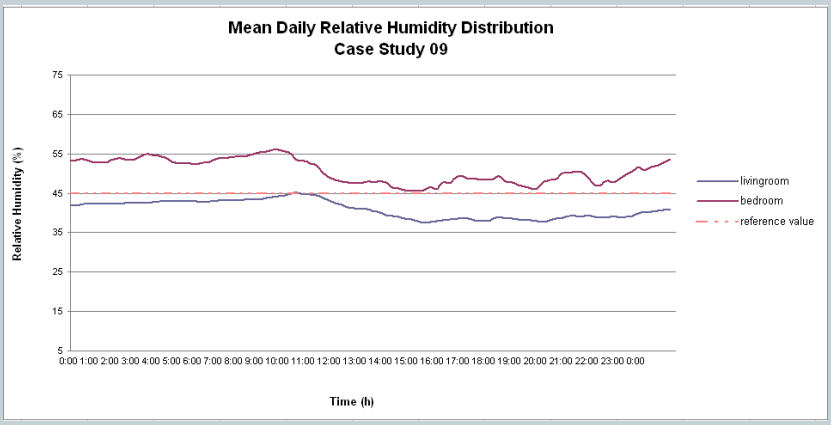

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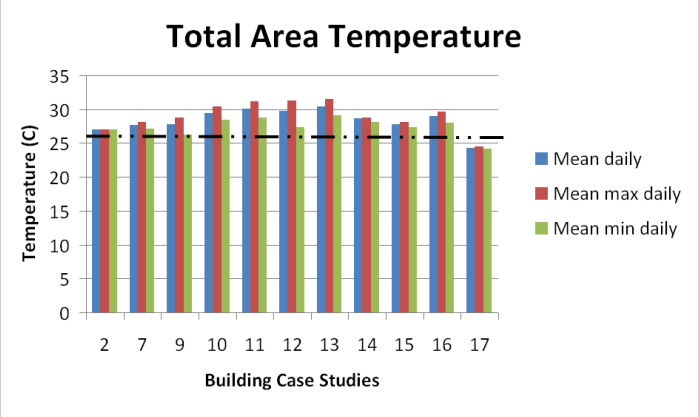

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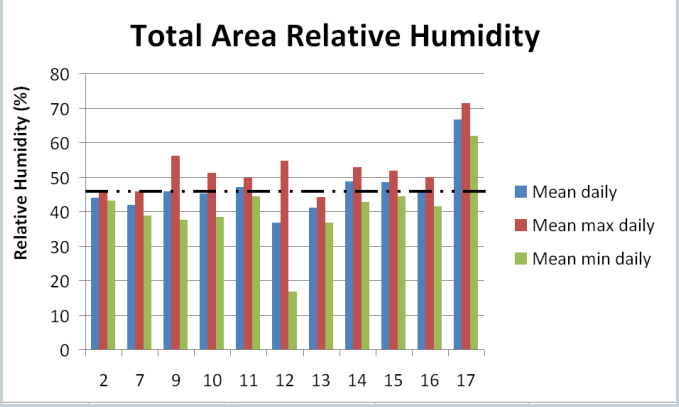
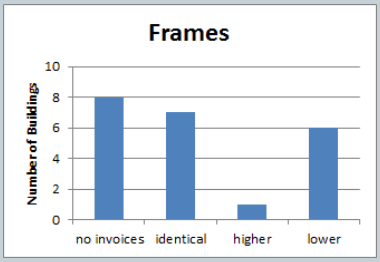
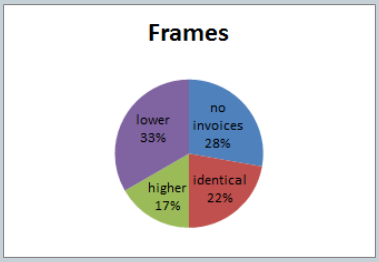


Reliability with EPC input data

Comparison of the materials' implementation values as reported in the final EPC with the design values

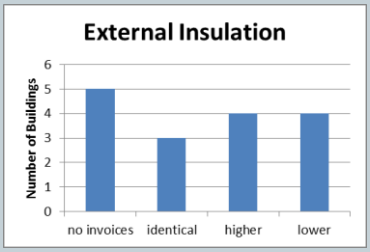


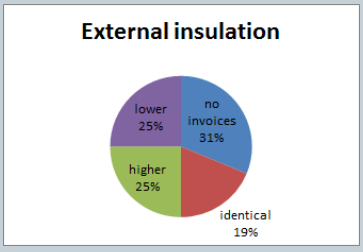


	Implementation values higher than the design	Implementation values lower than the design
Range of difference for frames U-values	25%	0.6-35%

Reliability with EPC input data

Comparison of the materials' implementation values as reported in the final EPC with the design values

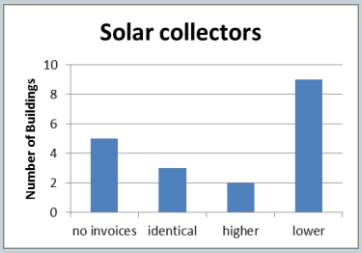


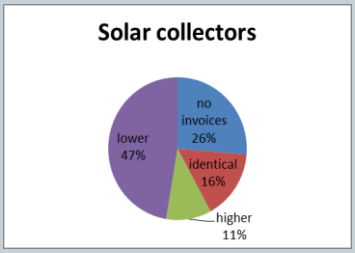


	Implementation values higher than the design	Implementation values lower than the design
Range of difference for external insulation U-values	12%	8-23%

Reliability with EPC input data

Comparison of the materials' implementation values as reported in the final EPC with the design values





	Implementation values higher than the design	Implementation values lower than the design
Range of difference of solar collectors' area	4-15%	5-22%

Reliability with EPC input data

In order to investigate **the accuracy of EPC calculations** the following documents were collected:

•Drawings, construction characteristics of the buildings and corresponding technical reports.

•Files of EPC calculations: These are the input files and incorporate all the required data for the execution of the calculations with the software that is approved by the Technical Chamber of Greece.

•Certificates and invoices of the materials used in the construction in each case study.

•Energy Performance Certificates (EPCs) before and after the renovation including the energy performance classification of the buildings

Reliability with EPC input data

The validity of the calculations in EPCs was examined and input values were also checked and compared with the proposed values by the National Building Codes (TOTEE).

This control was made by cross checking the values that are inserted in the corresponding EPC input file of each case study with the implemented values and when a mistake was found it was replaced by the right one. After the completion of the cross checking the EPC software was executed again in order to assess the building's energy class.
The procedure showed that in most of the cases faults weren't involved. This can be attributed to the fact that these buildings are renovated in the framework of "Energy Efficiency at Household Buildings" Program and the controls and the sanctions are strict. However, in one EPC errors were found affecting the energy classification of the building, making it an actual G instead of F

Greek New Study Collection

Challenges

- The number of completed case studies with EPC before and after renovations is small so there were difficulties in finding them
- Not easily accessible data, persons in charge in some cases were reluctant/negative in providing information
- Even if data was accessible, there were difficulties from the owners to provide permission
- Inhomogeinity of accessible data (eg. it was not possible for one parameter to be checked in all case studies)

Lessons learnt

- Other building types such as commercial buildings that are constantly air conditioned would also give interesting results regarding the internal temperature and relative humidity.
- In buildings that are under construction is easier to check issues such as the insulation and the right installation of it as well as the installation of the window frames. In the present study these buildings were not available.