How to achieve quality of the works?

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The trend towards Nearly Zero-Energy Buildings (NZEB) implies the correct execution of classical building works, in line with the NZEB principles of good workmanship, and the use of advanced technologies requiring specific skills of the workforce.

2 objectives of QUALICHeCK

• To set up a series of actions which should result in more attention and practical initiatives for **actual compliance with the EPC for new and renovated buildings**
  i.e. ‘Boundary conditions which force people to do what they declare’;

• To set up a series of actions, which should result in more attention and practical initiatives for **achieving a better quality of the works**, i.e. ‘Boundary conditions which stimulate and allow the building sector to deliver good quality of the works’.
QUALICheck products and outcomes

1. About the status on the ground...

2. About interesting approaches...

3. About guidance for improvements
4 focus areas in QUALICHeCK

- Transmission characteristics
- Ventilation and airtightness
- Sustainable summer comfort techniques
- Renewables in multi-energy systems
Approx 10 % of the total cost of buildings are due to construction errors.
What is „Quality of Works“

QUALICHeCK Reference Document ‘TERMS AND DEFINITIONS’

“Quality of the works” refers to the potential gap between the works realized and the works expected to meet stated or implied needs.
Documented Examples of existing situations regarding Quality of the Works

Reasons for poor quality:

1. **Poor specifications** at level of projects, standards, regulations:
   a. Materials to be used (e.g. material characteristics of insulation, correct construction details (joints), ...)
   b. Performances to be achieved (e.g. air- and watertightness, wind resistance for PV panels, acoustical performances of ventilation systems, ...)
   c. With respect to the execution principle (e.g. under which conditions may roofing be installed)

2. **Lack of competence**
   a. Designer level (see also QUALICHeCK work package “Reliable and easily accessible input data”)
   b. Execution level
   c. Language barriers

3. **Critical economic conditions**
   a. Critical financial conditions
   b. Critical timing conditions

4. **Lack of control**
   a. By parties involved in the project
   b. By third parties (government, independent control organisations, ...)
# 28 documented Examples of existing situations regarding Quality of the Works

<table>
<thead>
<tr>
<th>Study</th>
<th>Country</th>
<th>Reported by</th>
<th>Covered areas</th>
<th>Date of study</th>
<th>Transferability</th>
<th>Results/consequences</th>
</tr>
</thead>
<tbody>
<tr>
<td>Field test on combined heat pump and solar thermal systems</td>
<td>Austria</td>
<td>OEGNB</td>
<td>Heat pumps, solar thermal systems</td>
<td>2010-2013</td>
<td>National, international</td>
<td>Revised training material for installers</td>
</tr>
<tr>
<td>Study on ventilation systems in classrooms</td>
<td>Austria</td>
<td>OEGNB</td>
<td>Mechanical ventilation systems in classrooms</td>
<td>2008</td>
<td>National, international</td>
<td>Revised training material for ventilation installers</td>
</tr>
<tr>
<td>Impact of storm on PV systems</td>
<td>Belgium</td>
<td>BBRI</td>
<td>Installation of PV systems</td>
<td>2010-2013</td>
<td>National, international</td>
<td>Development of design and installation specifications</td>
</tr>
<tr>
<td>Cypriot analysis of the National Status Quo within BUILD UP Skills</td>
<td>Cyprus</td>
<td>The Cyprus Institute</td>
<td>Insufficient knowledge/training, necessary specialists not part of construction team</td>
<td>2012</td>
<td>National, international</td>
<td>Roadmap for policies and actions for construction sector employees</td>
</tr>
<tr>
<td>Burgholzhof study</td>
<td>Germany</td>
<td>Fraunhofer IBP</td>
<td>Insulation material, quality of windows, thermal bridges, window seams, roller shutters</td>
<td>2002</td>
<td>National, international</td>
<td>General: U-value definitions of glazings have been revised; practical recommendations</td>
</tr>
<tr>
<td>Estonian analysis of the National Status Quo within Build Up Skills</td>
<td>Estonia</td>
<td>Tallinn University of Technology</td>
<td>Insufficient knowledge of new technologies/construction workers not adequately trained</td>
<td>2012</td>
<td>National</td>
<td>The number of skilled workforce needs to be increased</td>
</tr>
<tr>
<td>Estonian housing stock technical condition - apartment buildings (1990-2010)</td>
<td>Estonia</td>
<td>Tallinn University of Technology</td>
<td>Insulation material, damages on construction site, wet insulation, waterproof layers, built-in moisture, moisture and air barriers, joints</td>
<td>2010-2012</td>
<td>National, countries with similar constructions &amp; climate, partly international</td>
<td>Guidelines for designers and builders</td>
</tr>
<tr>
<td>Quality of ventilation systems in residential buildings: status and perspectives in Estonia</td>
<td>Estonia</td>
<td>Tallinn University of Technology</td>
<td>Ventilation systems: Joints not airtight, no accessibility for cleaning/maintenance, wrong settings, filters not included</td>
<td>2013</td>
<td>National, partly international</td>
<td>Guidelines for HVAC designers and builders</td>
</tr>
<tr>
<td>EU project SAVE DUCT</td>
<td>EU (focus on BE, F, S)</td>
<td>BBRI</td>
<td>Ductwork, airtightness</td>
<td>1997-1998</td>
<td>International</td>
<td>Recommendations to use circular ducts and factory-fitted sealing gaskets</td>
</tr>
</tbody>
</table>
Example: Burgholzhof: Surveillance of Design and Construction Work

- 500 residential units in low energy level
- Fraunhofer IBP contracted by city of Stuttgart
dclarations, design of joints,

Quality check for all three parts was important:
- EP declarations had to be corrected (due to mistakes), up to 4 times
- Many of the details had to be improved/clarified by adding material descriptions, etc.
- Windows U-values and g-values did not meet specifications (at that time two types of U-
values: measured acc. DIN and officially published with „safety“ allowances, g-
values deemed less important)
- Thermal separation of balcony plates not accurate, filled partly with mortar or concrete
(thermal bridges)
- Window seams filled with polyurethane foam (not durable elastic)
- Insulation material with inferior thermal conductivity
- Top mounted roller shutters create thermal bridges at the location where the shutters are on
top of the wall
- Additional insulation on the inner side of cellar walls problematic (pipes, fixtures)
## 18 Best Practice Examples to solve the critical Situations

<table>
<thead>
<tr>
<th>Solution</th>
<th>Country</th>
<th>Reported by</th>
<th>Covered areas</th>
<th>Date of solution</th>
<th>Type of solution</th>
<th>Legal/ other</th>
<th>Transferability</th>
</tr>
</thead>
<tbody>
<tr>
<td>Training and certification schemes for installers at AIT</td>
<td>Austria</td>
<td>OEGNB</td>
<td>Installation of heat pumps, PV, solar thermal and ventilation systems</td>
<td>Since 2001</td>
<td>Training and certification of installers</td>
<td>Voluntary, recommended by klimaaktiv</td>
<td>Yes</td>
</tr>
<tr>
<td>Guidelines, checklists and commissioning protocols by professional associations</td>
<td>Austria</td>
<td>OEGNB</td>
<td>Installation of heat pumps, PV, solar thermal and ventilation systems</td>
<td>Since ca. 2005</td>
<td>Guideline, checklist, Comm. protocol</td>
<td>Voluntary</td>
<td>Yes</td>
</tr>
<tr>
<td>Voluntary building certification including measurements</td>
<td>Austria</td>
<td>OEGNB</td>
<td>Building envelope quality</td>
<td>Pilot phase in 2001, in place since 2003</td>
<td>Quality assessment by third party</td>
<td>Voluntary</td>
<td>Yes</td>
</tr>
<tr>
<td>IEE project WE-Qualify</td>
<td>Cyprus</td>
<td>The Cyprus Institute</td>
<td>Knowledge/training, specialisation, material, installation, damages during construction, wet material, roller shutters</td>
<td>2013 + 36 months</td>
<td>Education of workers (training material + training)</td>
<td>Recommended/ voluntary</td>
<td>In general yes</td>
</tr>
<tr>
<td>Scheme of Vocational Qualifications: I have the qualifications. I certify!</td>
<td>Cyprus</td>
<td>The Cyprus Institute</td>
<td>Knowledge/training, specialisation</td>
<td>2013, ongoing</td>
<td>Education and certification of workers</td>
<td>Recommended/ voluntary</td>
<td>In general yes</td>
</tr>
<tr>
<td>RAL Window and Front Door Installation Guideline</td>
<td>Germany</td>
<td>Fraunhofer IBP</td>
<td>Window installation, airtightness, water tightness, thermal bridges at window/wall connection</td>
<td>Since 1998, regular updates</td>
<td>Guideline and education of workers</td>
<td>Accepted rules of technology</td>
<td>Yes</td>
</tr>
<tr>
<td>RAL Certification of Window Installation</td>
<td>Germany</td>
<td>Fraunhofer IBP</td>
<td>Window installation, airtightness, water tightness, thermal bridges at window/wall connection</td>
<td>Since 1998</td>
<td>Certification of manufacturer including installation</td>
<td>Voluntary</td>
<td>Yes</td>
</tr>
</tbody>
</table>
Example: Training and Certification Schemes for Installers at AIT (Austria)

- Accredited certification body: AIT – Austrian Institute of Technology

<table>
<thead>
<tr>
<th>System</th>
<th>Training since</th>
<th>Accreditation since</th>
</tr>
</thead>
<tbody>
<tr>
<td>Heat pumps</td>
<td>2001</td>
<td>2005</td>
</tr>
<tr>
<td>Solar thermal</td>
<td>2004</td>
<td>2009</td>
</tr>
<tr>
<td>PV</td>
<td>2006</td>
<td>2009</td>
</tr>
<tr>
<td>Ventilation</td>
<td>2007</td>
<td>Not yet</td>
</tr>
</tbody>
</table>

- Comprehensive training is complemented by option to obtain certification
- Certificate is voluntary, but recommended in sustainable building guidelines of klimaaktiv programme
- Certificate is visible sign of strong commitment to quality, competitive advantages
- Certificate is valid for 3 years, then re-certification necessary
- Certified heat pump installer, solar heating installer and planner, solar heating practitioner, photovoltaic installer and planner
- > 2500 participants have successfully completed the training courses (by end of 2014)
- Training modules: 5 – 8 days plus 1 day for examination
- Costs: 1,400 – 1,450 € plus 120 – 200 € for examination
Success of the Austrian programme?

- **Trainings:** Until April 2015, some 2,500 participants have successfully completed the training courses.

- **Certifications:** Until April 2015, AIT has certified or re-certified in total more than 540 installers: 235 installers for heat pumps systems, 205 installers for solar thermal systems, 102 installers for PV and 2 installers for ventilation systems.

- **Their motivation / expectation:**
  - to gain direct access to the latest trends and technological innovations;
  - to have a clear competitive edge in their industry.

- **Voluntary scheme:**
  - In practice: not much demand for certified installers.
  - It is recommended in the sustainable building guidelines of the klimaaktiv programme to contract certified installers. The certification is however currently no prerequisite for support programmes.

It should be considered to introduce mandatory requirements regarding qualification, at least in support programmes.
<table>
<thead>
<tr>
<th>Characteristics of programme</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>PV system</strong></td>
</tr>
<tr>
<td><strong>Prerequisites</strong></td>
</tr>
<tr>
<td><strong>Course duration</strong></td>
</tr>
<tr>
<td><strong>Cost of course (excl. VAT) [€]</strong></td>
</tr>
<tr>
<td><strong>Cost of examination (excl. VAT) [€]</strong></td>
</tr>
<tr>
<td><strong>Condition for certification</strong></td>
</tr>
</tbody>
</table>
Reasons why companies do not invest in vocational training

Results and conclusions (1)

- It seems that the market does not strongly demand for better quality of the works. However, this does not mean that there is no need for it.

- Experience shows that there is definitely a need for better quality of the works in terms of achieving better indoor air quality, energy performance and reduce loadings for the environment.

- Initiatives such as CrossCraft [http://buildupskills-crosscraft.at](http://buildupskills-crosscraft.at) try to come in with tailor-made training offers responding to time and cost pressure and communication problems due to lacking language skills.

- Blower door tests carried out in the presence of the workers are considered most effective, because “showing them where the leakage is will be more effective than any lecture”.

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Results and conclusions (2)

- Success of trainings:
  - **3-hours on-site training** on airtightness: how to avoid frequently made mistakes
  - **Other trainings:** still difficult to motivate companies to participate

- How to increase the motivation for qualification resulting in better quality of the works:
  - Independent Control System according to Art. 18 EPBD should address the quality of the building envelope: compare EPC input data with the actual situation on-site
  - Independent Control System according to Art. 18 EPBD should address the efficiency and performance of building services systems by means of requiring acceptance reports and checking them
Final result: Source Book on Guidelines for better enforcement of Quality of the Works

Extract of content:

3. Analysis of reasons for good/poor quality of works
4. Overall philosophy regarding improved boundary conditions for a better quality of the work
5. Documented set of best practices Part 1: Procedures to obtain and prove good quality of the works
6. Documented set of best practices Part 2: Robust legal procedures for handling non-compliance
7. Documented set of best practices Part 3: Operational framework for better compliance and effective penalties related to quality of the works
5. Documented set of best practices Part 1: Procedures to obtain and prove good quality of the works

5.1 Clear descriptions and work specifications
5.2 Clear description of the procedures to show evidence of compliance
5.3 Tracing procedures
5.4 Handling of innovative solutions
5.5 Usability of the specifications in practice
5.6 Consider simpler on-site compliance procedures for meeting compliance criteria at system level
5.7 Consider simpler on-site compliance procedures for companies meeting compliance criteria at company level
5.8 Rewarding good practice
5.9 Specific issues for existing buildings
5.10 Quality management approaches
5.11 Market surveillance and integrating lessons learned
5.12 Interrelation with European and national legislation and standards
Clear Descriptions and Work Specifications: Interesting Examples

- Swedish AMA General material and workmanship specification system
- German guideline on accepted rules of technology for installing windows and front door by industry initiative Gütegemeinschaft Fenster und Haustüren e.V.
- German STLB-Bau specification system (Standardleistungsbuch für das Bauwesen)
Exemplary examples: Stepwise approach for combining capacity building with enforcement schemes

Example: Market uptake of new energy efficient products without specific challenges for the building workers

Example: Quality frameworks for cavity insulation of existing walls in the UK and the Belgian Flemish Region
To know more...

• QUALICHeCK reports on quality of the works:
  • “Towards improved quality of the work – Documented examples of existing situations regarding quality of the works”
    • 18 Best Practice Examples how to achieve better quality of the works
  • “Source book on Guidelines for better enforcement of quality of the works”
    • Coming soon

• Available at http://qualicheck-platform.eu
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