QUALICheck input to BUILD UP Skills

Alexander Deliyannis, Marianna Papaglastra
Sympraxis Team
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’.
Regulatory context

**EPBD Directive 2010/31/EU**
- Article 8 specifies the need to establish **requirements for the proper installation, dimensioning, adjustment and control of technical building systems**.
- Article 18: MS shall establish **independent control systems** meeting the verification requirements given in Annex II. According to this annex, the verifications shall be based on more or less extensive checks of the EPC input data, results stated in the certificates, and recommendations. Article 17 also requires Member States to implement penalties in case of infringements of the national provisions.
- Article 11 requires "to make it possible for owners or tenants of the building or building unit to compare and assess its energy performance".

**RES Directive 2009/28/EC**
- Article 14: Member States shall ensure ... (3) that certification schemes or equivalent qualification schemes are available for installers of small-scale biomass boilers and stoves, solar photovoltaic and solar thermal systems, shallow geothermal systems and heat pumps and ... (5) guidance is made available to planners and architects so that they are able properly to consider the optimal combination of renewable energy sources, of high-efficiency technologies and of district heating and cooling when planning, designing, building and renovating industrial or residential areas.

**EE Directive 2012/27/EU**
- **Article 16 (1):** Member State shall ensure that certification and/or accreditation schemes and/or equivalent qualification schemes, including, where necessary, suitable training programmes, are available for providers of energy services, energy audits, energy managers and installers of energy-related building elements.
"Quality of the works" refers to the potential gap between the works realised and the works expected to meet stated or implied needs.

When looking specifically at how quality of the works impacts energy performance certificates, "quality of the works" may be further defined as a measure of the gap between the specifications of the works stated or implied to be consistent with the input values assumed to be used in the energy performance certificate, and the actual execution of the works. It is assumed that the desired level(s) of the corresponding input data is (are) explicitly defined.

The quality of the works can be considered as "good" or "compliant" if this gap does not degrade the expected performance.

Therefore, the quality of the works may be qualified as "good" or "compliant" if, for example:

- a system is installed according to the technical specifications agreed within a given context (e.g. technical prescriptions, a technical approval, rules of a professional association, etc.)
- products are installed according to the designer and manufacturer specifications

Analysis of additional costs in the European construction sector caused by faults having occurred during the construction process identified nearly 10% of the turnover of the construction sector. Thus, quality of works is not only crucial for achieving EU energy and climate goals but also essential from the economic point of view.

IEE/13/610/SIO2.675574 01/03/2014-­‐28/02/2017
QUALICHeCK conducted 10 new field studies, each on samples of 25+ buildings; significant non-compliance issues were found e.g.:

- In Austria, 20% of the EPC input data had not been updated between design and completion, resulting in 5-28% errors in Space Heating Demand assessments.
- In Belgium, 46% of the cavity wall insulation of existing buildings investigated reported a wrongly reported single value for the cavity width.
- In Cyprus, 37% of the buildings examined did not comply with the applicable decree in terms of U-values.
- In Estonia, 68% of the buildings investigated did not comply with the regulatory summer comfort requirement.
- In Greece, 41% of the studied buildings were not compliant as concerns U-values of doors/windows, 56% of external insulation U-values and 73% for solar collectors area.
- In Romania, recalculation of the EPCs lead to a change in energy class in almost 40% of the sample for the total energy use, 50% for the space heating energy use.
- In Spain, significant differences were found between the results given using different EPC software tools.
- In Sweden, the non-compliance rate based on the availability of the EPC alone was found of 56% on a sample of 100 new houses.

In general, the field studies conducted by QUALICHeCK show:

- In many countries development with 5 years’ step can be seen;
- Systemic changes evidently will need time, legislative changes are to be supported with relevant compliance procedures, supervision, commissioning, performance measurements, piloting, model solutions, guidelines, training etc.;
- More ambitious and sophisticated systems are more difficult to implement in practice - longer learning curves;
- Compliance frameworks must be extended in many countries to be able to assess as built performance.
Indications of quality problems - Overview

The QUALICheck Consortium also analysed 31 existing studies based on which it can be concluded that:

- Poor ventilation is seen as a major European problem as ventilation rates and noise typically did not comply with requirements;
- Ductwork air tightness is an issue in Central Europe, but was solved 30 years ago in North Europe;
- Building leakage showed both good and bad examples;
- Studies on transmission characteristics were quite limited and mostly inconclusive;
- Heat pumps, solar thermal and other renewables showed good performance if certified installers type schemes were applied;
- Available data on summer thermal comfort was very limited however the issue was somehow addressed in majority of building codes.
- In general, the studies highlighted critical issues, in particular, inappropriate product characteristics and workmanship, lack of competence or insufficient knowledge of technologies implemented.
- Over 50% of non-compliant ventilation provisions in France or The Netherlands, and serious indoor climate problems in nearly 2/3 of Estonian buildings.
- Numerous common problems in renewables in multi-energy systems in Austria, France, Germany and Sweden (e.g., 50% to 83% of unused pipe connections not insulated that degrade heat storage tank performance).
500 residential units in low energy level
Fraunhofer IBP contracted by city of Stuttgart to check EP calculations, design of joints, realisation on site

Quality check for all three parts was important:
- 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 properly executed, filled partly with mortar or concrete, and damages in cases of thermal separation as part of pre-fabricated balconies (thermal bridges)
- Overlap of wall insulation on window frame not properly understood/realized (danger for rainwater entering insulation and increased thermal bridges)
- Window seams filled with polyurethane foam only (not durably elastic → holes → bad airtightness of window joints)
- Insulation material with inferior thermal conductivity, smaller insulation thickness
- 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)
- Proofs of thermal protection had to be corrected, up to 4 times
- Many of the details had to be improved/clarified by adding material descriptions, etc.
Mapping of the status of loose fill insulation in attics in Sweden:

- the thickness of attic insulation is lower than ordered in \( \frac{1}{4} \) of buildings;
- there is damage in the form of cavities, created by for example mice, or decreased thickness due to people stepping on the insulation in 50 % of the buildings;
- the wind protection has fallen onto the insulation in \( \frac{1}{4} \) of buildings;
- wind impact (and in some cases people) had caused the insulation to move in 13 % of the buildings;
- some attic floor areas had no insulation at all;
- the insulation settlement was in some buildings larger than expected.
Indications of quality problems
Focus on summer comfort
Overheating assessment of residential apartment buildings, Estonia

Assessment of overheating index in 25 buildings (based on simulated hourly mean room temperature in degree-hours above 27°C in “worse case” dwellings between 1st of July-31st of August). Estonian study on 25 buildings (QUALICHeCK project).
In Estonia approximately 63% of the inhabitants live in apartments with serious indoor climate problems, including:

- **joints** between windows and walls *not watertight/airtight*;
- no accessibility for cleaning;
- joints with other system components *not airtight*: fan, AHU;
- wrong air flow rate settings, setting on default instead of specific necessary setting;
- required **filters not included**;
- installation *without accessibility for maintenance*
Indications of quality problems
Focus on ventilation and air tightness
Non-compliance or defects in residential ventilation systems, France

Number of non-compliance or defects found in residential ventilation systems (France), per category, on a sample of 1,287 dwellings, see QUALICheck fact sheet #6.
A Swedish study showed that none of the 30 studied building projects without focus on air tightness reached lower air leakage than 0.4 l/sm² (of exterior envelope area).

The biggest contribution in achieving an air leakage rate of 0.3 l/sm² would be the installation layer (recessed air barrier), in combination with other methods.

More awareness, attention and commitment during execution would result in better tightness.
Indications of quality problems
Focus on ventilation and air tightness
Quality management scheme for building air tightness, France

Distribution of measured airtightness of houses with and without implementation of a certified QM approach (see Fact Sheet #01^37).
Combisol project (Austria, France, Germany, Sweden) evaluated 70 solar thermal installations—45 of which monitored. Results met the expectations regarding solar yield and solar coverage, but adjustments had to be made to most installations. Frequent mistakes were found regarding, e.g., uninsulated pipe fittings, absence of thermosiphon heat traps, wrongly connected expansion vessels, poor integration in the building's heating circuit.

An Austrian study showed common problems regarding combined solar thermal / heat pump installations, and calls for quality assurance as a priority task.

Four court experts interviewed reported common problems of quality of works in domestic heat pump installations in France, incl.: oversizing, insufficient amount of refrigerant, wrong positioning of units, absence of drains, undersized pumps, nonoperational electrical resistance back up, inappropriate defrosting cycles, undersized surface of ground exchangers. The experts point out that very few problems occur at installations carried out by installers that hold the quality label QualiPac.
Points re quality of the works

Key elements that hinder good quality of the works:

- Poor specifications at level of projects, standards and/or regulations with respect to:
  a. materials to be used (e.g., characteristics of insulation, correct construction details (joints), etc.);
  b. performance levels to be achieved (e.g., air- and water-tightness, wind resistance for PV panels, acoustical performance of ventilation systems, etc.);
  c. execution method (e.g., under which conditions roofing may be installed).

- Lack of competence:
  a. at designer level;
  b. at execution level;
  c. with respect to language barriers.

- Critical economic conditions:
  a. critical financial conditions;
  b. critical timing conditions.

- Lack of control
  a. by parties involved in the project;
  b. by third parties (government, independent control organisations, ...).
### Reasons for good quality of the works

<table>
<thead>
<tr>
<th>Aspects which are important for good quality of the works</th>
<th>Reasons for good quality of the works</th>
<th>Reasons for poor quality of the works</th>
</tr>
</thead>
<tbody>
<tr>
<td>Clear description of work specifications</td>
<td>Target groups have clear instructions how to install building and technical elements and what to consider</td>
<td>No consensus between target groups regarding responsibilities</td>
</tr>
<tr>
<td>Clear procedures to show evidence of compliance</td>
<td>From the beginning of the process a clear procedure is defined to show the evidence</td>
<td>Unclear what are the criteria and who checks them</td>
</tr>
<tr>
<td>Tracing procedures</td>
<td>A comprehensive continuous documentation allows early recognition of faults</td>
<td>All documentation will be checked at the final stage only, which does not allow the craftsmen to react in time</td>
</tr>
<tr>
<td>Handling of innovative solutions</td>
<td>Continually trained and experienced craftsmen</td>
<td>Overstrained craftsmen who have not followed the developments on the market</td>
</tr>
<tr>
<td>Usability of the specifications in practice</td>
<td>The craftsmen understand clearly, what is expected from them and where possible problems are</td>
<td>Incomplete specifications written in a difficult language style</td>
</tr>
<tr>
<td>Giving benefits to systems that have a high probability to perform well</td>
<td>Easy to implement technology in combination with other beneficial effects for the craftsmen</td>
<td>Technologies which need highly experienced craftsmen for the installation and have no beneficial effects for the craftsmen</td>
</tr>
<tr>
<td>Rewarding good practice</td>
<td>High motivation of the craftsmen</td>
<td>No sanctioning in case of poor quality of the works</td>
</tr>
<tr>
<td>Specific issues for existing buildings</td>
<td>The specific challenges in existing buildings are taken into account</td>
<td>Quality frameworks are not sufficiently specific</td>
</tr>
<tr>
<td>Quality management approaches</td>
<td>Advantage of a reduced effort for daily compliance procedures, if the company uses a collective compliance procedure</td>
<td>Too high costs for the compliance procedures leads to failure to comply</td>
</tr>
<tr>
<td>Market surveillance and integrating lessons learned</td>
<td>An organisation running a quality framework was involved</td>
<td>Reasons can be of different nature: too low requirements or too high and unnecessary costs</td>
</tr>
<tr>
<td>Interrelation with European and national legislations and standards</td>
<td>Possible synergies are investigated and made use of</td>
<td>Limitations are not respected causing refusal of the procedures, thus hindering implementation</td>
</tr>
</tbody>
</table>

### Reasons for poor quality of the works
Framework for providing compliant services

**TRAINING**
Need for more and/or improved training?

- Yes: New offers of training, Upgrading existing trainings...
- No: **COMPETENCE**

**COMPETENCE**
Need for checking competence of persons?

- Yes: Examinations, Certified persons...
- No: **COMPLETION**

**COMPLETION**
Need for checking proper completion?

- Yes: Need for checking proper completion
- No: High probability of compliant service

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Path to question relevance of developing specific schemes for training, competence checks, and proper completion checks.
<table>
<thead>
<tr>
<th>Best practice</th>
<th>Country</th>
<th>Covered areas</th>
<th>Type of solution</th>
<th>Application</th>
</tr>
</thead>
<tbody>
<tr>
<td>Training and certification schemes for installers at AIT</td>
<td>AU</td>
<td>heat pumps, PV, solar thermal and ventilation systems</td>
<td>training and certification of installers</td>
<td>Voluntary, recommended by klimaaktiv</td>
</tr>
<tr>
<td>Guidelines, and commissioning protocols by professional associations</td>
<td></td>
<td>heat pumps, PV, solar thermal and ventilation systems</td>
<td>Guideline, checklist, commissioning protocol</td>
<td>Voluntary</td>
</tr>
<tr>
<td>Voluntary building certification including measurements</td>
<td></td>
<td>building envelope quality</td>
<td>Quality assessment by third party</td>
<td>Voluntary</td>
</tr>
<tr>
<td>IEE project WE-Qualify</td>
<td>CY</td>
<td>wet material, roller shutters</td>
<td>Education of workers</td>
<td>Recommendative/voluntary</td>
</tr>
<tr>
<td>Scheme of Vocational Qualifications: I have the qualifications. I certify!</td>
<td></td>
<td>Knowledge/training, specialisation</td>
<td>Education and certification of workers</td>
<td>Recommendative/voluntary</td>
</tr>
<tr>
<td>RAL Window and Front Door Installation Guideline</td>
<td>DE</td>
<td>Windows, airtightness, water tightness, thermal bridges</td>
<td>Guideline and education of workers</td>
<td>Accepted rules of technology</td>
</tr>
<tr>
<td>RAL Certification of Window Installation</td>
<td></td>
<td>Windows, airtightness, water tightness, thermal bridges</td>
<td>Certification of manufacturer including installation</td>
<td>Voluntary</td>
</tr>
<tr>
<td>Guidelines for dwelling designers, builders, owners</td>
<td>EE</td>
<td>Technical details, insulation layers, airtightness material, joints</td>
<td>Qualification scheme</td>
<td>Voluntary</td>
</tr>
<tr>
<td>BUILD UP Skills QualiShell project</td>
<td>RO</td>
<td>building envelope (opaque and transparent), transmission characteristics, airtightness</td>
<td>Qualification schemes, mechanism for long lasting large scale implementation</td>
<td>Integrated in the national qualification system</td>
</tr>
<tr>
<td>Swedish guidelines on water-proof layers in wet areas (GVK, BBV)</td>
<td>RO</td>
<td>Waterproof layers in wet areas</td>
<td>Education of workers, guidelines and authorisation of companies</td>
<td>Voluntary, several insurance companies require work according GVK/BBV</td>
</tr>
<tr>
<td>Quality framework for ducts</td>
<td>SE</td>
<td>Air duct tightness</td>
<td>Airtightness test and certification</td>
<td>Voluntary, but applied in 90-95% of buildings</td>
</tr>
<tr>
<td>Guideline BuildE - Energy efficient</td>
<td></td>
<td>Communication between planners and contractors</td>
<td>Checklist, guidelines, standardisation of calculation tools</td>
<td>Voluntary</td>
</tr>
<tr>
<td>Quality framework CIGA for insulation of cavity walls</td>
<td>UK</td>
<td>Cavity wall insulation</td>
<td>Certificate for installers, guarantee for home owners</td>
<td>Voluntary</td>
</tr>
<tr>
<td>Quality framework SWIGA for insulation of solid walls</td>
<td>UK</td>
<td>Solid wall insulation</td>
<td>Certificate for installers, guarantee for home owners</td>
<td>Voluntary</td>
</tr>
<tr>
<td>Guideline for selecting cool roofs</td>
<td>GR</td>
<td>Cool roofs</td>
<td>Guideline</td>
<td>Voluntary</td>
</tr>
</tbody>
</table>
Tools and guidelines to help designers and installers better specify and install their products:

- Austrian guidelines, commissioning protocols and checklists published by the Austrian Ministry of Agriculture, Forestry, Environment and Water Management in charge of climate protection that cover specific technologies or construction methods (e.g. building airtightness, pipe insulation, ventilation with heat recovery, solar thermal systems, etc), developed in the framework of the programme klimaaktiv which is based on stakeholders’ voluntary commitment.

- Estonian guidelines for dwelling designers, builders, owners, explaining how to plan, design and build low-energy detached houses, including data for building envelope elements, windows, ventilation, heating, domestic hot water, etc.

- Swedish Guideline BuildE - Energy efficient

- RAL Guidelines, developed by the German association of manufacturers of windows, front doors and facades, binding product quality and installation quality. It summarises the accepted rules of technology and includes principles of joint formation, basics of building physics, fixation and sealing, planning and tender offers. More specifically, the guideline addresses the preparation of the components before sealing, the different levels of sealing, the sealing functions, where to place the sealing system within the seam, the preferable seam size, and different sealing systems. It presents exemplary installation technologies for different types of window systems and situations.

- US Department of Energy Guidebook to help building owners and installers understand the principles and technologies of cool roofing and help them determine if cool roofing is appropriate for a specific building.
Qualification and certification

- Two Swedish schemes for waterproof layers in wet areas, GVK and BBV, involving about 440 and 600 companies, respectively, include qualification of companies and workers based on validation of trainings and application of guidelines, as well as random control of the service provided. The demand for these schemes is highly supported by several insurance companies that require these qualifications as precondition to offer insurance.

- In the UK, the Cavity Insulation Guarantee Agency (CIGA) and the Solid Wall Insulation Guarantee Agency (SWIGA) are two independent bodies that provide since 1995 and 2010, respectively, 25-year guarantees for cavity and solid wall insulation fitted by registered installers.

- Belgian framework, the installer confirms conformity of the installation with the technical guidelines and transfers a declaration of conformity to the client, which can be used for several purposes (confirmation of the compliance of the process, application to government subsidies, use of performance data as input data in EPC, etc.)
Commitment to integrated frameworks

- The Swedish example of **AMA** is interesting in that it has been very effective to drive the market towards high quality HVAC installations in Sweden. AMA consists of a collection of books of specifications developed since the 1950s, widely used by designers and installers to specify and follow quality requirements on products and systems as well as on design, installation, commissioning and maintenance. The AMA requirements are specified in measurable units and in such a way that the tenderers and contractors understand them and are able to calculate a price for their commitments. The AMA scheme has governed all major building projects in Sweden since a long time, likely because following the guidelines reduce risks for contractors.
Control and enforcement frameworks

- **Self control**: in the framework of voluntary quality assurance schemes
- **Second party control**: by the client, the owner, the architect, consulting engineers, a quality surveyor, ...
- **Third party control**: by a legally independent entity, imposed by government, public body, social housing company, voluntary schemes, private builder
QUALICheck approach to better enforcement frameworks

- Technical procedures to obtain and prove quality of the works
  - There should be clear procedures what must be done
- Formal procedures if non-compliance
  - There should be clear procedures how to decide on non-compliance and related actions
- Handling of non-compliance in practice
  - There should be an effective control and penalties if non-compliance
Structuring an approach to effective compliance

<table>
<thead>
<tr>
<th>Key questions to address</th>
<th>Elements to consider to address key questions</th>
</tr>
</thead>
<tbody>
<tr>
<td>What is the scope of the framework?</td>
<td>Issues found in the field and needs identified in terms of training, competence development, and checks. The scope can concern, for instance: all EPC input data, a selection or a unique EPC input data (e.g., envelope airtightness), ventilation airflow rates, window installation, cavity wall insulation, renewable energy systems, etc.</td>
</tr>
<tr>
<td>At which level and on which basis should it be imposed?</td>
<td>Various levels (project, sector, real estate development, bank or insurance company, local authority, government) and bases (regulation, subsidies, risk management, market differentiation, specific awareness) depending on the regulatory context, financial incentives, and private initiatives.</td>
</tr>
<tr>
<td>On which type of requirement should it be based, and which type of control should it foresee?</td>
<td>Any combination of qualification, certification, declaration, contractual specifications or technical rules, consistently with the controls foreseen—focus on actual service provided (direct) or on the actual competence or responsibility of the EPC input provider or the workers (indirect).</td>
</tr>
<tr>
<td>What are the procedures to comply with?</td>
<td>Written documents explaining technical and non-technical procedures to achieve and to show compliance, compatible with EU or national legislation.</td>
</tr>
<tr>
<td>What are the procedures for identifying and handling non-compliance?</td>
<td>Written documents allowing checks and identifying liabilities, as well as proportionate and dissuasive penalties. In a concern for efficiency, they should minimise interference with court system.</td>
</tr>
<tr>
<td>How will it be implemented in practice?</td>
<td>Political and stakeholders’ support, appropriate financial and human resources, use of information technologies, learning periods and scheme evaluation.</td>
</tr>
</tbody>
</table>
Improving the compliance of Energy Performance Certificates and the quality of building works

François Rémi Carré (ICEE/INIVE)

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Upcoming QUALICHeCK webinars

www.qualicheck-platform.eu/events/webinars

WEBINAR | Ventilative cooling potential and compliance — Status and perspectives in Spain and Germany
Posted on 2016/11/23 by Maria Dimitropoulou

Thursday 1 December 2016, 10:00 am Brussels time (CET)

Summary

Ventilative cooling potential and indoor overheating in Spain and Germany.

This webinar is part of a broader series of webinars on the context of compliance with building regulations.

In the first presentation, Prof. Dr. Servando Sánchez-Funes from the University of Seville, Spain, will discuss the potential of ventilative cooling for new buildings and its application for existing buildings.

In the second presentation, Dipl. Ing. Joachim Schröder from the Fraunhofer Institute for Building Physics in Germany will explain how to resolve overheating problems in existing buildings using natural ventilation.

WEBINAR | Status on the ground: Prevention of summer overheating — methods and results
Posted on 2016/11/23 by Maria Dimitropoulou

Friday 2 December 2016, 10:00 am Brussels time (CET)

Summary

This webinar will focus on summer overheating and related assessment methods as well as the latest research and policies in this area.

WEBINAR | A guide for policy makers to develop better frameworks for EPC compliance and enforcement
Posted on 2016/11/11 by Maria Dimitropoulou

Tuesday 13 December 2016, 10:00 Brussels time (CET)

Summary

This webinar will present a comprehensive guide for policy makers on how to develop better frameworks for EPC compliance and enforcement.
QUALICheck International Workshop | Performance of thermal insulation in low energy buildings and advanced building renovation projects, 15 December 2016, Brussels, Belgium

Posted on 2016/09/02 by Maria Dimitropoulou

Securing the compliance of product data and the quality of installed systems to reach high levels of energy performance

Description

The objective of this workshop is to discuss and identify ways to better secure the compliance of renewable heating and cooling product data as well as the quality of installed systems, thereby increasing the confidence in declared values on the Energy Performance Certificate (EPC) and achieving the expected energy performance.

Three aspects will be more specifically addressed:

- how to improve the quality of the installation works;
- how to provide compliant input data used to issue an Energy Performance Certificate;
- how to enforce compliance, and how to define/apply penalties in case of non-compliance.

The workshop discussions will be based on detailed presentations of schemes under development. Interaction between participants will allow exchange of knowledge and experience.

You may download the workshop flyer and the latest version of the agenda from

www.qualicheck-platform.eu/events/workshops

QUALICheck International Workshop | Renewable heating and cooling systems for buildings, 17 January 2017, Lyon, France

Posted on 2016/10/13 by Maria Dimitropoulou

International workshop on securing the compliance of product data and the quality of installed systems, to reach high levels of energy performance

Objective

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- how to enforce compliance, and how to define/apply penalties in case of non-compliance.
Looking forward to
see you at one of QUALICHeCK’s upcoming events
exchange ideas with you and
receive your feedback!

www.qualicheck-platform.eu

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