

Heike Erhorn-Kluttig, Hans Erhorn
Sarah Doster, Linda Lyslow

QUALICHeCK – Qualitätssicherung bei der Planung und der Realisierung von energieeffizienten Gebäuden

F 3060

Bei dieser Veröffentlichung handelt es sich um die Kopie des Abschlussberichtes einer vom Bundesinstitut für Bau-, Stadt- und Raumforschung (BBSR) im Bundesamt für Bauwesen und Raumordnung (BBR) im Rahmen der Forschungsinitiative »Zukunft Bau« geförderten Forschungsarbeit. Die in dieser Forschungsarbeit enthaltenen Darstellungen und Empfehlungen geben die fachlichen Auffassungen der Verfasser wieder. Diese werden hier unverändert wiedergegeben, sie geben nicht unbedingt die Meinung des Zuwendungsgebers oder des Herausgebers wieder.

Dieser Forschungsbericht wurde mit modernsten Hochleistungskopierern auf Einzelanfrage hergestellt.

Die Originalmanuskripte wurden reprototechnisch, jedoch nicht inhaltlich überarbeitet. Die Druckqualität hängt von der reprototechnischen Eignung des Originalmanuskriptes ab, das uns vom Autor bzw. von der Forschungsstelle zur Verfügung gestellt wurde.

© by Fraunhofer IRB Verlag

2018

ISBN 978-3-7388-0126-2

Vervielfältigung, auch auszugsweise,
nur mit ausdrücklicher Zustimmung des Verlages.

Fraunhofer IRB Verlag

Fraunhofer-Informationszentrum Raum und Bau

Postfach 80 04 69

70504 Stuttgart

Nobelstraße 12

70569 Stuttgart

Telefon 07 11 9 70 - 25 00

Telefax 07 11 9 70 - 25 08

E-Mail irb@irb.fraunhofer.de

www.baufachinformation.de

www.irb.fraunhofer.de/tauforschung

Fraunhofer-Institut für Bauphysik IBP

Forschung, Entwicklung,
Demonstration und Beratung auf
den Gebieten der Bauphysik

Zulassung neuer Baustoffe,
Bauteile und Bauarten

Bauaufsichtlich anerkannte Stelle für
Prüfung, Überwachung und Zertifizierung

Institutsleitung

Prof. Dr. Philip Leistner

Prof. Dr. Klaus Peter Sedlbauer

IBP-Bericht WB 197/2017

QUALICHeCK – Qualitätssicherung bei der Planung und der Realisierung von energieeffizienten Ge- bäuden – Abschlussbericht

Der Forschungsbericht wurde mit Mitteln der
Forschungsinitiative Zukunft Bau des Bundesinstitutes
für Bau-, Stadt- und Raumforschung (BBSR) gefördert
(AZ: SWD-10.08.18.7-14.36)

Der Bericht umfasst
81 Seiten Text

Heike Erhorn-Kluttig
Hans Erhorn
Sarah Doster
Linda Lyslow

Stuttgart, 24. Juli 2017

Inhalt

| | | |
|----------|--|-----------|
| 1 | Kurzfassung | 11 |
| 2 | Summary | 15 |
| 3 | Ausgangslage | 19 |
| 4 | Projektdurchführung | 20 |
| 4.1 | Aufgaben des Fraunhofer-Instituts für Bauphysik (IBP) | 20 |
| 4.2 | Projektergebnisse | 21 |
| 4.2.1 | Bericht: Quality of Works – Documented examples of existing situations regarding quality of works [2] | 21 |
| 4.2.2 | Bericht: Compliant and Easily Accessible EPC Input Data - How to get compliant and accessible data for the energy rating calculation of a building [3] | 22 |
| 4.2.3 | Bericht: Status on the Ground - Overview of existing surveys on energy performance related quality and compliance [4] | 22 |
| 4.2.4 | Bericht: Source book on Guidelines for better enforcement of quality of the works [5] | 23 |
| 4.2.5 | Bericht: Source book for improved compliance of Energy Performance Certificates (EPCs) of buildings [6] | 23 |
| 4.2.6 | Bericht: Overview of Energy Performance Certificate (EPC) compliance, and quality issues on the ground - Summary of all collected data [7] | 24 |
| 4.2.7 | Bericht: Austria Assessment of EPC input data based on recalculation and on-site validation – New field study/2016 [8] | 24 |
| 4.2.8 | Bericht: Belgium Compliance of EPC input data for window thermal performance in new buildings – New field study/2016 [9] | 25 |
| 4.2.9 | Bericht: Belgium Assessment of quality control framework for cavity wall insulation – New field study/2016 [10] | 25 |
| 4.2.10 | Bericht: Cyprus Compliance of heat transmission coefficients reported in EPCs in new residential properties – New field study/2016 [11] | 26 |
| 4.2.11 | Bericht: Estonia Summer thermal comfort compliance in new apartment buildings – New field study/2016 [12] | 26 |

| | | |
|--------|---|----|
| 4.2.12 | Bericht: France Compliance of regulatory and design studies on energy performance of new buildings – New field study/2016 [13] | 27 |
| 4.2.13 | Bericht: Greece Compliance and quality of works in new case studies – New field study/2016 [14] | 27 |
| 4.2.14 | Bericht: Romania Assessment of quality and compliance in the certification of energy performance of buildings – New field study/2016 [15] | 28 |
| 4.2.15 | Bericht: Spain Different data/tools for getting EPC – New field study/2016 [16] | 28 |
| 4.2.16 | Bericht: Sweden Different between measured and calculated energy use in EPCs versus building permits – New field study/2016 [17] | 29 |
| 4.2.17 | Broschüre: Improving the compliance of Energy Performance Certificates and the quality of building works [18] | 29 |
| 4.2.18 | Broschüre: Compliance and quality of works for improved energy performance of buildings – The QUALICHeCK outcomes in brief [19] | 30 |
| 4.2.19 | Referenzdokument: Terms and Definitions [20] | 30 |
| 4.2.20 | Fact Sheet #01: Building regulations can foster quality management – the French example on building airtightness [21] | 31 |
| 4.2.21 | Fact Sheet #02: The German contractor’s declaration: supporting compliance with minimum energy performance requirements [22]. | 31 |
| 4.2.22 | Fact Sheet #03: French voluntary scheme for harmonised publication of ventilation product data [23] | 32 |
| 4.2.23 | Fact Sheet #04: European voluntary rating programme of cool roofing products [24] | 32 |
| 4.2.24 | Fact Sheet #05: Voluntary scheme and database for compliant and easily accessible EPC product input data in Belgium [25] | 33 |
| 4.2.25 | Fact Sheet #06: Regulatory compliance checks of residential ventilation systems in France [26] | 33 |
| 4.2.26 | Fact Sheet #07: Building Airtightness in France: Regulatory context, control procedures, results [27] | 34 |
| 4.2.27 | Fact Sheet #08: Quality control of Stuttgart’s retrofit standard released by the city’s energy consultancy office [28] | 34 |
| 4.2.28 | Fact Sheet #09: AMA – General material and workmanship specifications [29] | 35 |
| 4.2.29 | Fact Sheet #10: The Swedish Lågan programme for buildings with low energy use [30] | 35 |
| 4.2.30 | Fact Sheet #11: The Swedish Sveby scheme – standardise and verify the energy performance of buildings [31] | 36 |

| | | |
|--------|---|----|
| 4.2.31 | Fact Sheet #12: QUALICHeCK Study Austria – Assessment of EPC input data based on recalculation and on-site validation [32] | 36 |
| 4.2.32 | Fact Sheet #13: QUALICHeCK study Belgium – Assessment of the Belgian quality control framework for installation of thermal insulation in existing cavity walls [33] | 37 |
| 4.2.33 | Fact Sheet #14: QUALICHECK study Cyprus – Compliance of Energy Performance Certificates (EPCs): differences between calculated U-values in EPCs versus actual U-values [34] | 37 |
| 4.2.34 | Fact Sheet #15: QUALICHeCK study Estonia – Summertime overheating prevention requirements and compliance assessment [35] | 38 |
| 4.2.35 | Fact Sheet #16: QUALICHeCK study France – Compliance of regulatory and design studies on energy performance of new buildings [36] | 38 |
| 4.2.36 | Fact Sheet #17: QUALICHECK Study Greece – Compliance of Energy Performance Certificates (EPCs): comparison of the implemented U-values as reported in the EPC with the design U-values for door/window frames and external insulation [37] | 39 |
| 4.2.37 | Fact Sheet #18: QUALICHECK Study Greece – Compliance with the reference values of the technical directives: on-site measurements of ventilation, temperature and relative humidity and comparison with the reference values of the national technical guides [38] | 39 |
| 4.2.38 | Fact Sheet #19: QUALICHECK Study Romania – Assessment of quality and compliance in the certification of energy performance of buildings [39] | 40 |
| 4.2.39 | Fact Sheet #20: QUALICHeCK Study Sweden – Compliance of energy performance certificates: Differences between measured and calculated energy us in EPCs versus building permit [40] | 40 |
| 4.2.40 | Fact Sheet #21: Quality framework for reliable fan pressurisation tests [41] | 41 |
| 4.2.41 | Fact Sheet #22: Scheme of vocational qualifications in Cyprus „I have the qualifications. I certify!“ [42] | 41 |
| 4.2.42 | Fact Sheet #23: Procedures for determining input data for the energy performance certificate (EPC) of existing residential buildings in Belgium [43] | 42 |
| 4.2.43 | Fact Sheet #24: EPC database and control system for compliant EPC input data in Sweden [44] | 42 |
| 4.2.44 | Fact Sheet #25: Compliant EPC input data for window thermal performance: Status for new buildings in Flanders, Belgium [45] | 43 |
| 4.2.45 | Fact Sheet #26: BuildE – A method for quality assurance of energy efficient buildings [46] | 43 |

| | | |
|--------|--|----|
| 4.2.46 | Fact Sheet #27: The Austrian building certification system IBO OEKOPASS [47] | 44 |
| 4.2.47 | Fact Sheet #28: Voluntary green building assessment paves the way for better as-built quality [48] | 44 |
| 4.2.48 | Fact Sheet #29: We-Qualify project: Improving the Cypriot workforce skills [49] | 45 |
| 4.2.49 | Fact Sheet #30: Critical situations on the construction site and ideas for quality assurance procedures: The German perspective [50] | 45 |
| 4.2.50 | Fact Sheet #31: Summer thermal comfort requirements and compliance assessment frameworks [51] | 46 |
| 4.2.51 | Fact Sheet #32: Requirements and compliance related to thermal bridges [52] | 46 |
| 4.2.52 | Fact Sheet #33: Building air leakage rate in energy calculation and compliance procedures [53] | 47 |
| 4.2.53 | Fact Sheet #34: Voluntary control scheme developed by the province of Salzburg: Building service systems declaration based on as-built characteristics [54] | 47 |
| 4.2.54 | Fact Sheet #35: Different data tools for getting EPC [55] | 48 |
| 4.2.55 | Fact Sheet #36: Investing in building energy efficiency: The role of the EPC in economic decision making [56] | 48 |
| 4.2.56 | Fact Sheet #37: Improving energy efficiency: Labelling schemes and their role in building related compliance frameworks [57] | 49 |
| 4.2.57 | Fact Sheet #38: Compliance assessment studies in focus countries [58] | 49 |
| 4.2.58 | Fact Sheet #39: Voluntary quality assurance systems for retrofitting multi-unit residential buildings based on self-commitment [59] | 50 |
| 4.2.59 | Fact Sheet #40: Voluntary schemes as a pool of ideas for designing and improving EPC compliance frameworks: The BOILEFF quality assurance system [60] | 50 |
| 4.2.60 | Fact Sheet #41: In view of revised EU-Directives: Dealing with renewable energy systems in the EPC of energy efficient buildings [61] | 51 |
| 4.2.61 | Fact Sheet #42: Selecting EPC input data for HVAC systems: A series of French guidance sheets [62] | 51 |
| 4.2.62 | Fact Sheet #43: baubook – Easily accessible product information for EPC calculation provided by the Austrian database [63] | 52 |
| 4.2.63 | Fact Sheet #44: The quality assurance system of the German reconstruction loan corporation (Kreditanstalt für Wiederaufbau, KfW) in the field of energy-efficient construction and retrofitting (residential buildings) [64] | 52 |
| 4.2.64 | Fact Sheet #45: The Effinergie approach to ease transitions to new regulatory requirements [65] | 53 |
| 4.2.65 | Fact Sheet #46: Default values in energy performance of buildings standards [66] | 53 |

| | | |
|--------|--|----|
| 4.2.66 | Fact Sheet #47: Quality control frameworks for cavity wall insulation [67] | 54 |
| 4.2.67 | Fact Sheet #48: Belgium/Flemish Region control and penalty scheme of the energy performance legislation: Checking procedure and fines [68] | 54 |
| 4.2.68 | Fact Sheet #49: Easy access, compliance of EPC input data and quality assurance of EPCs [69] | 55 |
| 4.2.69 | Fact Sheet #50: European certification of HVAC products can provide EPC input data [70] | 55 |
| 4.2.70 | Fact Sheet #51: Increasing the expertise of building professionals for a better quality of construction: The French programme PACTE [71] | 56 |
| 4.2.71 | Fact Sheet #52: QualiShell: Romanian qualification schemes for installers of opaque building elements and/or window systems [72] | 56 |
| 4.2.72 | Fact Sheet #53: European solar-shading database, ES-SDA [73] | 57 |
| 4.2.73 | Fact Sheet #54: Ductwork airtightness in France: Regulatory context, control procedures, results [74] | 57 |
| 4.2.74 | Fact Sheet #55: Belgian/Flemish evaluation scheme for ventilation systems [75] | 58 |
| 4.2.75 | Fact Sheet #56: Certification of experts for the issuance of EPCs in Sweden [76] | 58 |
| 4.2.76 | Fact Sheet #57: The list of energy-efficiency experts for Germany federal funding programmes [77] | 59 |
| 4.2.77 | Fact Sheet #58: Energy efficiency standards as drivers and barriers for innovation in the building sector [78] | 59 |
| 4.2.78 | Newsletter #01: Oktober 2014 [79] | 60 |
| 4.2.79 | Newsletter #02: Februar 2015 [80] | 60 |
| 4.2.80 | Newsletter #03: August 2015 [81] | 61 |
| 4.2.81 | REHVA journal 04/2015 [82] | 61 |
| 4.2.82 | REHVA journal 04/2016 [83] | 62 |
| 4.2.83 | REHVA journal 04/2017 [84] | 62 |
| 4.2.84 | QUALICHeCK Konferenz #1: Brüssel, 30.09.2014 [85] | 63 |
| 4.2.85 | QUALICHeCK Konferenz #2: Brüssel, 04.09.2015 [86] | 63 |
| 4.2.86 | QUALICHeCK Konferenz #3: Brüssel, 10.05.2016 [87] | 63 |
| 4.2.87 | QUALICHeCK Konferenz #4: Brüssel, 21.02.2017 [88] | 64 |
| 4.2.88 | QUALICHeCK Internationaler Workshop #1: Lund, 16.-17.03.2015 [89] | 64 |
| 4.2.89 | QUALICHeCK Internationaler Workshop #2: Athen, 09.-10.03.2016 [90] | 65 |
| 4.2.90 | QUALICHeCK Internationaler Workshop #3: Brussels, 15.12.2016 [91] | 65 |
| 4.2.91 | QUALICHeCK Internationaler Workshop #4: Lyon, 17.01.2017 [92] | 65 |
| 4.2.92 | QUALICHeCK Webinar #1: 27.04.2015 [93] | 66 |
| 4.2.93 | QUALICHeCK Webinar #2: 17.12.2015 [94] | 66 |
| 4.2.94 | QUALICHeCK Webinar #3: 12.01.2016 [95] | 66 |

| | | |
|----------|---|-----------|
| 4.2.95 | QUALICHeCK Webinar #4: 15.06.2016 [96] | 66 |
| 4.2.96 | QUALICHeCK Webinar #5: 23.06.2016 [97] | 67 |
| 4.2.97 | QUALICHeCK Webinar #6: 28.06.2016 [98] | 67 |
| 4.2.98 | QUALICHeCK Webinar #7: 05.07.2016 [99] | 67 |
| 4.2.99 | QUALICHeCK Webinar #8: 16.09.2016 [100] | 67 |
| 4.2.100 | QUALICHeCK Webinar #9: 28.09.2016 [101] | 68 |
| 4.2.101 | QUALICHeCK Webinar #10: 01.12.2016 [102] | 68 |
| 4.2.102 | QUALICHeCK Webinar #11: 02.12.2016 [103] | 68 |
| 4.2.103 | QUALICHeCK Webinar #12: 13.12.2016 [104] | 69 |
| 4.2.104 | QUALICHeCK Webinar #13: 24.01.2017 [105] | 69 |
| 4.2.105 | QUALICHeCK Webinar #14: 25.01.2017 [106] | 69 |
| 4.2.106 | QUALICHeCK Webinar #15: 23.02.2017 [107] | 69 |
| 4.2.107 | QUALICHeCK Webinar #16: 28.02.2017 [108] | 70 |
| 4.2.108 | QUALICHeCK Plattform Meetings #1 - #4: 01.10.2014 [109], 03.09.2015 [110], 11.05.2016 [111], 22.01.2017 [112] | 70 |
| 5 | Empfehlungen | 71 |
| 6 | Literatur | 72 |