Ernst & Sohn
A Wiley Brand

WILEY

Edited by F. Garde, J. Ayoub, L. Aelenei,
D. Aelenei, and A. Scognamiglio

Solution Sets for Net Zero Energy Buildings

Feedback from 30 Net ZEBs worldwide

SOLAR HEATING & COOLING PROGRAMME
INTERNATIONAL ENERGY AGENCY

EBC
Energy in Buildings and
Communities Programme

Edited by
François Garde
Josef Ayoub
Daniel Aelenei
Laura Aelenei
Alessandra Scognamiglio

Solution Sets for Net Zero Energy Buildings

Feedback from 30 Net ZEBs worldwide

Ernst & Sohn
A Wiley Brand

Table of Contents

Foreword

This work was produced in the context of a joint collaboration between approximately 75 national experts from 19 nations in Europe, North America, Oceania, and Southeast Asia of the International Energy Agency (IEA), under the framework of the IEA Solar Heating and Cooling (SHC) and Energy in Buildings and Communities (EBC) Technology Collaboration Programs. The joint SHC Task 40/EBC Annex 52 (T40A52) "Towards Net-Zero Energy Solar Buildings" sought to study current net-zero, near-net-zero and very low energy buildings and to develop a common understanding of a harmonized international definitions framework, tools, innovative solutions, and industry guidelines to support the conversion of the Net ZEB concept from an idea into practical reality in the marketplace. This Task/Annex pursued optimal integrated design solutions that provided good indoor environment for both heating and cooling situations. The process recognized the importance of optimizing a design to meet the functional requirement, reducing loads, and designing energy systems that pave the way for seamless incorporation of renewable energy innovations, as they become cost effective. To achieve these results, the National Experts met twice annually at a hosting member country to coordinate the R&D activities and advance the work plan comprised of the following four major activities:

1) **Subtask A** dealt with establishing an internationally agreed understanding on Net ZEBs based on a common methodology. This was done by reviewing and analyzing existing Net ZEB definitions and data with respect to the demand and the supply side; studying grid interaction (power/heating/cooling) and time-dependent energy mismatch analysis; developing a harmonized international definition framework for the Net ZEB concepts considering large-scale implications, exergy, and credits for grid interaction (power/heating/cooling); and, developing a monitoring, verification and compliance guide for checking the annual balance in practice (energy, emissions, and costs) harmonized with the definition;
2) **Subtask B** aimed to identify and refine design approaches and tools to support industry adoption. This was done by conducting work along four major R&D streams: (i) in documenting and analyzing processes and tools currently being used to design Net ZEBs and under development by participating countries; (ii) assessing gaps, needs, and problems to inform simulation engine and detailed design tool developers of priorities for Net ZEBs; (iii) qualitative and quantitative benchmarking of selected tools; and (iv) selecting four case study buildings to conduct a detailed analysis of simulated/designed vs. actual performance, and proposing the redesign/optimization of these buildings;
3) **Subtask C** focused on developing and testing innovative, whole building net-zero solution sets for cold, moderate, and hot climates with exemplary architecture and technologies that would be the basis for demonstration projects and international collaboration. This was achieved by documenting and analyzing current Net ZEBs designs and technologies, benchmarking with near Net ZEBs and other very low energy buildings (new and existing), for cold, moderate, and hot climates considering sustainability, economy, and future prospects using a projects database, literature review, and practitioner input (workshops); developing and assessing case studies

and demonstration projects in close cooperation with practitioners; investigating advanced integrated design concepts and technologies in support of the case studies, demonstration projects, and solution sets; and developing Net ZEB solution sets and guidelines with respect to building types and climate, and to document design options in terms of market application;

4) **Subtask D** was crosscutting work that focused on dissemination to support knowledge transfer and market adoption of Net ZEBs on a national and international level. This was accomplished by establishing a Net ZEB web page within the IEA SHC/EBC Programmes' framework and a database that can be expanded and updated with the latest projects and experiences; transferring the outputs (reports, sourcebooks, guidelines, other) to national policy groups, industry associations, utilities, academia, and funding programs; participating in national and international workshop, seminars, and industry exhibitions highlighting the results and activities of the Task/Annex contributing high-quality technical articles and features in journals to stimulate market adoption; and, establishing an education network of highly qualified people that will continue the work in the field in their future endeavors.

I am pleased to present the research results of Subtask C compiled in this volume of work entitled "*Solution Sets from Net Zero Energy Buildings: Feedback from 30 Net ZEBs worldwide"* as a major accomplishment in this field of research. Building energy design is currently going through a period of major changes driven largely by three key factors and related technological developments: (i) the increasingly widespread adoption in most OECD member countries and by influential engineering societies, such as ASHRAE, of net-zero energy as a long-term goal for new buildings; (ii) the need to reduce the peak electricity demand for buildings through optimal operation; and (iii) the need to efficiently integrate advanced energy technologies into buildings, such as photovoltaic/thermal systems, windows with semitransparent photovoltaic glazing, controlled shading/daylighting devices, and integrated thermal storage. This body of work encapsulates the many and varied lessons learned of designing, building and operating net-zero energy buildings by government research organizations, international and regional research centers, academia, and industry. I am confident this book will find many interested readers.

Josef Ayoub
Former Operating Agent, IEA SHC Task 40/EBC Annex 52
Senior Planning Advisor, Energy Science & Technology
CanmetENERGY | Natural Resources Canada | Government of Canada
www.task40.iea-shc
E-mail: josef.ayoub@Canada.ca

3 Net ZEB case study buildings, measures and solution sets

Editors: Laura Aelenei,[1] David Waldren,[2]

Authors: Laura Aelenei,[1] David Waldren,[2] Daniel Aelenei,[3] Eduard Cúbi,[4] Kim Wittchen,[5] Jun-Tae Kim,[6]

Contributors: Eike Musall,[7] Tobias Weiss,[8] François Garde,[9] Michael Donn,[10] and Aymeric Delmas[11]

[1]Unidade de Energia no Ambiente Construído - UEAC, Laboratório Nacional de Energia e Geologia - LNEG, Estrada do Paço do Lumiar, Edifício Solar XXI, 1649-038 Lisboa, Portugal
[2]GROCON, 3 Albert Coates Lane, Melbourne, Victoria 3000, Australia
[3]Department of Civil Engineering, Faculty of Science and Technology, Universidade Nova de Lisboa, 2829-516 Caparica, Portugal
[4]Schulich School of Engineering, University of Calgary, 2500 University Drive NW, Calgary, Alberta T2N 1N4, Canada
[5]Danish Building Research Institute, Aalborg University, Dr. Neergaards Vej 15, 2970 Horsholm, Denmark
[6]Department of Architectural Engineering & Graduate Program of Energy Systems Engineering, Kongju National University, 1223-24 Cheonandae-Ro, Cheonan, Chungnam Province 31080, Republic of Korea
[7]Bergische Universität Wuppertal, Faculty of Architecture, Building physics and technical services, Haspeler Straße 27, D - 42285 Wuppertal, Germany
[8]AEE INTEC, Feldgasse 19, 8200 Gleisdorf, Austria
[9]PIMENT Laboratory, Université de La Réunion, Campus universitaire Sud, 117 rue Général Ailleret, 97430 Le Tampon, La Réunion, France
[10]Victoria University of Wellington School of Architecture, PO Box 600, 139 Vivian St., Wellington, New Zealand
[11]PIMENT Laboratory, Université de La Réunion, Campus universitaire Sud, 117 rue Général Ailleret, 97430 Le Tampon, La Réunion, France

3.1 Introduction

In this chapter, the data (buildings and measures) gathered from the *Task 40 Net Zero Energy Solar Buildings Research Project* is presented with detailed descriptions and summaries. As discussed in Chapter 2, the thirty case study buildings are partitioned into five groups by Climate and Building type (See Table 3.6). The measures deployed by these buildings are grouped by Building Requirement and this is not a strict partitioning as it is common that one measure contributes to meeting more than one requirement (e.g., BIPV/T deployed to address Electricity and Heating requirements). The case studies of the IEA SHC Task 40/EBC Annex 52 are portioned into groupings according to building types, climate efficiency measures.

The presentation begins with a summary description of the Case Study Buildings of this project including the selection criteria and geographic distribution. After this descrip-

Solution Sets for Net Zero Energy Buildings: Feedback from 30 Net ZEBs worldwide. First Edition.
Edited by François Garde, Josef Ayoub, Daniel Aelenei, Laura Aelenei, and Alessandra Scognamiglio.

tion, the thirty buildings are listed in two tables (Residential and Non-Residential) including size and energy data.

The bulk of this chapter consists of descriptions of each measure in the context of example Case Study building implementation. This measure presentation is organized by measure category (Passive, Energy Efficiency, Renewable Energy) and Building Requirement. Pictures of example building implementations are included.

The chapter closes with summaries of all measures adopted by all Case Study buildings. Frequency histograms of measure counts of each Building-Climate Partition are presented in two figures (Residential and Non-Residential buildings). These histograms enable the reader to determine characteristics about these buildings such as: "*What are the most deployed Passive Measures adopted by Residential Case Study Buildings in a Heating Climate?*" Finally, the Measure Summary Matrices are presented. A matrix for each Building-Climate Partition lists all measures adopted by each building in the partition, organized by Building Requirements and the three Measure Categories. From these matrices it is possible for the reader to extract Solution Sets such as "*The set of all measures adopted by all Residential Buildings in a Heating Climate*." The same set for *individual buildings* can also be extracted.

Table summary

- Section 3.2. Tables 3.1 and 3.2: High-level description of all buildings.
- Section 3.3. Table 3.3: Generic listing of all measures adopted by all buildings organized by Building Requirement and Measure Categories (Passive, Energy Efficiency, Renewable Energy).
- Section 3.5. Figures 3.29 and 3.30: Histograms of measure counts of Building–Climate Partitions organized by Measure Category.
- Section 3.5. Tables 3.7, through 3.11: Measure listings of all buildings with one table per Building–Climate Partition organized by Measure Category and Building Requirement. Solution Sets and individual building measure sets can be determined here.

3.2 The case study buildings

The database of thirty case study buildings was established to enable analysis of approaches to Net ZEB design and performance. These buildings are located in many IEA member countries and feature technologies and approaches that are relevant to current and future building projects. An overview of the case study buildings is presented in this section, including physical and energy characteristics. Later in the chapter the projects are described in the context of Net ZEB measures and the methodology set out in Chapter 2. First a description is given of how the database was established and the nature of the information that has been gathered.

Nearly 400 projects worldwide were identified by the participant building project leaders that are claimed to have been constructed to high performance or Nearly Zero Energy, Net Zero Energy or Plus Energy status. The location and other information pertaining to these 400 projects can be seen on a map shown at this web page: http://batchgeo.com/map/net-zero-energy-buildings. The research information was gathered from literature; reports from building owners and design teams; and from scientists who undertook performance measurements (or related research) of these buildings.

The database of Case Study buildings compiled for this book was developed with the aim of compiling a group of exemplar buildings that design teams can use as an information source of new building techniques. The selection criteria included: (i) a building must be fundamentally or nearly Net Zero Energy, meaning it includes its own energy generation and (ii) a building must be connected to local energy grids (not energy autonomous or off-grid buildings, see chapter 2). Another significant requirement is that by the end of the project, data was available on measured energy use and energy production in the building. The selected buildings should not just present the hopes of the design teams; the goal was to provide the performance analysis in relation to the building design features. The energy performance of the Case Study buildings is presented in Table 3.1 and compared in Figures 5.1 and 5.2.

A further critical factor in the building selection was that the energy demand of these buildings should be at most 50% of the energy use of a similar building designed to code in the same climate. This selection criterion ensures that the Case Study buildings are genuinely high performance. The basis of this criterion is the presumption that the ideal Net ZEB design minimizes the energy load so that the energy production system needed to meet this load is not impractically large.

Using this selection criteria, approximately forty buildings were identified and over the course of the project, this reduced to thirty due to practical difficulties related to data availability. As a result of the selection criteria and process, the database is a somewhat random collection of interesting buildings. Each provides an insight into Net ZEB performance. The map in Figure 3.1 shows the geographic locations of these buildings.

As shown in Figure 3.1, the majority of the Case Study buildings (23 of 30) are located in Continental Europe including all but two Canadian Residential buildings. Triangle icons mark the locations of Non-Residential buildings, with all Non-Residential Buildings in Cooling climates, located outside of Continental Europe.

3.2.1 Residential buildings

There are twelve residential Case Study buildings (ten in Europe and two in Canada) located in two climate types: (i) Heating and (ii) Heating and Cooling. Residential buildings include both single dwellings and multi-unit types. These buildings generally have only one or two levels. Kleehaeuser is the exception being an apartment building having a mix of three and five levels.

The twelve residential Case Study buildings are listed in Table 3.1 including general information and energy performance data: primary energy consumption, generation and balance. In Chapter 5, the target (design) energy performance and the measured performance are compared and discussed. Five buildings are located in a Heating Climate and seven buildings are located in a Heating and Cooling Climate. There was no building located in a Cooling climate available for study that met the selection criteria.

Table 3.1 Residential buildings energy characteristics.

Building	Net floor area [m²]	Year	Architect	Type	Primary Energy Consumption [kWh/m².year]	Primary Energy Generation [kWh/m².year]	Primary Energy Balance [kWh/m².year]
Heating Climate				**Residential Buildings**			
 **ÉcoTerra, Eastman, Canada**	230	2008	Masa Noguchi	Residential	50.8	16.35	−34.45
 **Riverdale, Alberta, Canada**	234		Habitat Studio and Workshop Ltd	Residential	44.10	29.60	−14.50
 **Riehen, Switzerland**	315	2007	Setz-Archtektur	Residential	63.00	85.00	22.00
 **Kleehaeuser, Freiburg, Germany**	2520	2006	Common and Gies Architekten	Residential (apartments)	152.00	148.00	−4.00

 **Kraftwerk B, Bennau, Switzerland**	1403	2009	grab architektur ag	Residential (apartments)	38.00	47.80	9.80
 **Plus Energy Settlement am Schlierberg, Freiburg, Germany**	7890	2006	Rolf Disch SolarArchitektur	Residential (single family houses)	70.00	142.00	72.00
 **Plus Energy Houses Weiz, Austria**	856	2006	Arch Buero Kaltenegger	Residential (single family houses)	129.51	150.40	20.89
Heating and Cooling Climate				**Residential Buildings**			
 **Zero energy house, Tricesimo, Italy**	378	2010	Arnaldo Savorelli/ Laboratory of Building Design	Residential	188.59	151.98	−36.61

(Continued)

Table 3.1 (*Continued*)

Building	Net floor area [m^2]	Year	Architect	Type	Primary Energy Consumption [kWh/m^2.year]	Primary Energy Generation [kWh/m^2.year]	Primary Energy Balance [kWh/m^2.year]
 **Lima, Barcelona, Spain**	45		Joan Sabate, Christoph Peters, Horacio Espeche – SaAS	Residential	79.80	61.56	−18.24
 **Leafhouse, Rosora, Italy**	477	2008	Arch Pacifico Ramazzotti	Residential	151.24	128.00	−23.24
 **EnergyFlex, Taastrup, Denmark**	216	2009	Henning Larsens Architects	Residential	90.30	108.30	18.00
 **IESC Cargese, France**	713	2011	M. Battesti-Mme Villa	Residential (apartments)	101.00	158.00	57.00

Figure 3.1 World map illustrating STC Database: 30 Net ZEBs by building and climate type. Totals for Continental Europe are shown. The three pictures are the Net ZEBs located in tropical climates: ENERPOS (left) and Ilet du Center (middle) in Reunion Island, Saint-Pierre and BCA Academy in Singapore (right).

3.2.2 Non-residential buildings

The eighteen non-residential Case Study buildings are located in three climate types: Cooling Climate (four buildings), Heating Climate (five buildings) and Heating and Cooling Climate (nine buildings). These buildings include office buildings and educational facilities. Table 3.2 lists general building information and energy performance data: primary energy consumption, generation and balance.

Figure 3.2 Leaf house, optimized utilization of solar gains during winter.

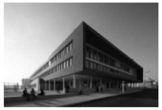
Table 3.2 Non-Residential buildings.

Building	Net floor area [m^2]	Year	Architect	Type	Primary Energy Balance [kWh/m^2.year]	Primary Energy Generation [kWh/m^2.year]	Primary Energy Consumption [kWh/m^2.year]
Heating Climate				**Non Residential Buildings**			
 **Villach Offices, Villach, Austria**	292	2002	Anton Oitzinger	Office	104.00	228.00	124.00
 **School in Hohen Neuendorf, Germany**	6563	2011	IBUS Architekten	Educational	−5.36	38.64	44.00
 **Schiestlehaus Hochschwab, Austria**	550	2005	ARGE pos architekten und Treberspurg and Partner Architekten	Hotel	−21.23	85.74	106.97
 **Die Sprösslinge Monheim, Germany**	969	2009	tr achitekten	Educational	2.99	113.62	116.61

 **Marché Kemptthal, Switzerland**	1267	2007	kämpfen für architektur ag	Office	−26.40	51,70	78.10
Heating and Cooling Climate				**Non Residential Buildings**			
 **Circe Zaragoza, Spain**	1743	2010	Petra Jebens Zirkel	Office	−56.20	31.00	87.20
 **Green Office Paris, France**	21 807	2011	ATELIER 2 M	Office	0.86	107.90	107.04
 **Elithis Tower Dijon, France**	4567	2009	Arte Charpentier	Office	−62.00	44.00	106.00

(Continued)

Table 3.2 (*Continued*)

Building	Net floor area [m²]	Year	Architect	Type	Primary Energy Balance [kWh/m².year]	Primary Energy Generation [kWh/m².year]	Primary Energy Consumption [kWh/m².year]
 **Kyoto High School, Poitiers, France**	13 942	2009	SCAU, Guy Autran and François Gillard	Educational	−113.00	78.00	191.00
 **Lajon School, Italy**	700	2006	arch.TV | architetti Trojer Vonmetz	Educational	35.00	57.00	22.00
 **Limeil-Brévannes, France**	2935	2007	Lipa and Serge GOLDSTEIN	Educational	−44.00	48.00	92.00
 **Meridian Wellingthon, New Zealand**	5246	2007	Marc Woodbury - Studio of Pacific Architecture	Office	0.00	168.00	168.00

 **Pantin School, France**	3560	2010	Méandre, architects	Educational	1.87	71.47	69.60
 **Solar XXI Lisbon, Portugal**	1500	2006	Pedro Cabrita	Office	−3.00	84.00	87.00
Cooling Climate				**Non Residential Buildings**			
 **Ilet do center, Saint-Pierre, France**	310	2008	Michel Reynaud/ Antoine Perrau	Office	189.00	304.00	219.00
 **ZEB@BCA, Singapore**	4500	2009	DP Architects Pte Ltd	Educational	0.64	43.66*	43.00*
 **ENERPOS Saint-Pierre, France**	681	2008	Atelier FAESSEL BOEHE	Educational	294.66	344.66	50.00

(Continued)

Table 3.2 (*Continued*)

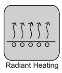
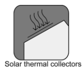
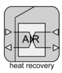
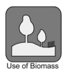
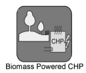
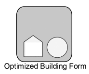
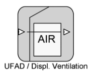
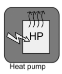
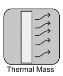
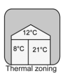
Building	Net floor area [m^2]	Year	Architect	Type	Primary Energy Balance [$kWh/m^2.year$]	Primary Energy Generation [$kWh/m^2.year$]	Primary Energy Consumption [$kWh/m^2.year$]
 **Pixel Melbourne, Australia**	1084,6	2010	studio 505	Office	−231.00	44.00	275.00

As in the case of residential buildings, these non-residential buildings are very high energy performance buildings with claims to be Net ZEB or nearly Net ZEB. These buildings range widely in size and scale form the very large Green Offices in France to the modest Villach Offices in Austria. Building heights vary from 2–3 levels to multi-story buildings and the building form ranges from rectilinear floor plates to cylindrical floors and combinations of these.

3.3 Net ZEB measures

This section presents a list of all measures adopted by the Case Study buildings in the Net ZEB database as a summary table (Table 3.3). As this list is based on the Case Study buildings, it should not be considered an exhaustive list of possible means to obtain Net ZEB status. As technology advances and Net ZEB design concepts evolve, other solutions will develop. It is also worth noting that changes to the energy grid will have an impact on the amount of renewable energy required on site to off-set energy required to run the building from the grid. Regardless, the need to apply passive and energy efficiency measures will always be a high priority in Net ZEB design.

Table 3.3 Measure Summary (categories: PA - Passive, EE - Energy Efficiency, RE - Renewable Energy).

BUILDING REQUIREMENT	PA Icon	PA Measure	EE Icon	EE Measure	RE Icon	RE Measure
Heating		Passive Solar Heat Gain		Radiant Heating		Solar Thermal
				Mechanical Air Heat Recovery		Biomass Fired Boilers
						Biomass Powered CHP
Heating and Cooling		Optimized Building Form		UFAD Displacement Ventilation		Geothermal
		Advanced Envelope				
		Advanced Glazing		Heat Pump		
		Thermal Mass				
		Thermal zoning				

(*Continued*)

Table 3.3 (*Continued*)

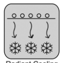
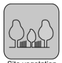
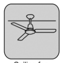
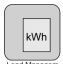
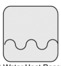
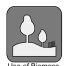
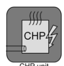
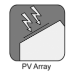
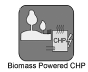
BUILDING REQUIREMENT	PA Icon	PA Measure	EE Icon	EE Measure	RE Icon	RE Measure
Cooling	 Natural Ventilation	Natural Ventilation	 Radiant Cooling	Radiant Cooling		
	 Site vegetation	Site Vegetation				
	 Sunshading	Sun Shading				
	 Ground cooling	Ground Cooling	 Ceiling fan	Ceiling Fans/ Evaporative Cooling		
Lighting	 Sky Lights	Skylights	 Advanced Lightning Control	Advanced Lighting Control		
	 Solar Tubes	Solar Tubes	 Energy Efficient Lightning	Energy Efficient Lighting		
Plug Loads			 Load Managem.	Load Management		
			 Eff Household Appliances	Efficient Household Appliances		
			 Efficient office equipment	Efficient Office Equipment		
Domestic Heat Water			 Hot Water Heat Recovery	Hot Water Heat Recovery	 Solar thermal collectors	Solar Thermal
					 Use of Biomass	Biomass Fired Boilers
					 CHP unit	Biomass powered CHP
					 Geothermal Heat	Geothermal

Table 3.3 (*Continued*)

BUILDING REQUIREMENT	PA Icon	PA Measure	EE Icon	EE Measure	RE Icon	RE Measure
Electricity						Photovoltaics
						Wind Turbine
						Biomass Powered CHP

The measures of Table 3.3 are organized by building requirement (e.g., lighting) and include measures from the three measure categories. This provides the reader with a *generalized* Solution Set of measures that address Building Requirements *without* regard to Climate and Building Type. Individual Solution Sets, specific to a Building-Climate and Building Requirement combination, can be extracted from the tables presented in Section 3.5.

The Case Study buildings illustrate that in order to approach or attain Net ZEB status, multiple building requirements need to be met by implementing various measures. In Section 3.4 each measure is discussed in the context of example implementations at Case Study buildings.

As previously discussed, Net ZEB or near Net ZEB performance is always a result of the combination of various measures implemented and working together in a building. Building requirements are met by Passive Measures to reduce the space energy demands, Energy Efficient Measures reduce the user demand (be it for direct use via plug loads or indirect use for example, heating) and Renewable Energy Measures (systems) are then used for energy generation to balance the overall demand. Nevertheless it is beneficial to discuss each particular measure in the context of the Case Study buildings.

3.4 Net ZEB measures in case study buildings

The measure descriptions are organized by Measure Category (Passive, Energy Efficiency and Renewable Energy) and Building Requirement (e.g., lighting) and include implementation examples from the Case Study buildings.

Many measures have been adopted by both Residential and Non-residential Case Study buildings. For example, Passive Strategies are the usual starting point for designers and as they are equally applicable for residential and non-residential buildings, there is extensive overlap between these uses. However, as the scale of the buildings increases so too does the magnitude of the external envelope requirements, resulting in other Strategies or Measures carrying a greater responsibility for performance outcomes.

BESTELLSCHEIN

Stück	Bestell-Nr.:	Titel	Preis* €
	978-3-433-03072-1	Solution Sets For Net Zero Energy Buildings	79,00
	909538	Gesamtverzeichnis Ernst & Sohn 2016/2017	kostenlos
Monatlicher E-Mail-Newsletter: Anmeldung unter www.ernst-und-sohn.de/newsletter			

Liefer- und Rechnungsanschrift: □privat □geschäftlich

Firma			
Ansprechpartner			Telefon
UST-ID Nr. / VAT-ID No.			Fax
Straße//Nr.			E-Mail
Land	-	PLZ	Ort

Vertrauensgarantie: Dieser Auftrag kann innerhalb von zwei Wochen beim Verlag Ernst & Sohn, Wiley-VCH, Boschstr. 12, D-69469 Weinheim, schriftlich widerrufen werden.

Wilhelm Ernst & Sohn
Verlag für Architektur und
technische Wissenschaften
GmbH & Co. KG
Rotherstraße 21, 10245 Berlin
Deutschland
www.ernst-und-sohn.de

Datum / Unterschrift

*€-Preise gelten ausschließlich in Deutschland. Alle Preise enthalten die gesetzliche Mehrwertsteuer. Die Lieferung erfolgt zuzüglich Versandkosten. Es gelten die Lieferungs- und Zahlungsbedingungen des Verlages. Irrtum und Änderungen vorbehalten.
Stand: Mai 2017 (homepage_Probekapitel)