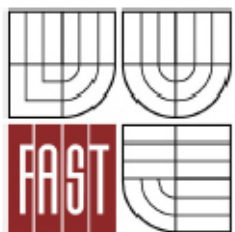




**VYSOKÉ UČENÍ TECHNICKÉ V BRNĚ**  
BRNO UNIVERSITY OF TECHNOLOGY



**FAKULTA STAVEBNÍ**  
**ÚSTAV POZEMNÍHO STAVITELSTVÍ**

FACULTY OF CIVIL ENGINEERING  
INSTITUTE OF BUILDING STRUCTURES

## **FOLDER NO. 6 - BUILDING PHYSICS**

### **APEX 4- Protocol for the energy performance certificate**

**BAKALÁŘSKÁ PRÁCE**  
BACHELOR 'S THESIS

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BRNO 2015

# Protocol for the Energy Performance Certificate

## Purpose of the certificate processing

New building	Building used by public authorities
Sale of the building or its part	Lease of the building or its part
Larger change of the completed building	
Another purpose:	

## Basic information about the evaluated building

Building identification data	
Building address (place, street, street number, ZIP code):	
Cadastral area:	
Parcel number:	
Date of building commissioning (or expected date of commissioning):	
Owner or builder:	
Address:	
Company identification number:	
Tel./e-mail:	

Building type		
Family house	Residential house	Building for accommod. and catering
Administrative building	Building for health service	Building for education service
Building for sport activities	Building for business purposes	Building for culture activities
Another building type:		

Geometric characteristics of the building		
Parameter	units	value
Volume of the building V (volume of building zones with conditioned internal environment defined by the outer surfaces of building envelope constructions)	[m <sup>3</sup> ]	781,9
Total area of the building envelope A (the sum of areas of external building constructions surrounding the volume of the building V)	[m <sup>2</sup> ]	532,5
Shape factor A/V	[m <sup>2</sup> /m <sup>3</sup> ]	0,68
Total energy reference area of the building A <sub>c</sub>	[m <sup>2</sup> ]	254,3

Types of energy (energy carriers) used in the building	
Lignite	Coal
Oil	Propan-butan/LPG
Wood (logs), wood chips	Wood pellets
Natural gas	Electricity
System of thermal energy supply (district heating): <i>RES rate:</i> to 50 % including,      over 50 to 80 %,      over 80 %	
Energy of surrounding environment (e.g. solar energy): <i>purpose:</i> for heating,      for hot water preparing,      for the electricity production	
Other fuels or other types of energy supply:	

Types of energy delivered outside of the building		
Electricity	Heat	None

## Information about building components and technical systems

### A) building components and constructions

#### a.1) requirements for thermal transmittance

Building envelope constructions	Area	Thermal transmittance			Temper. reduction factor	Heat transfer coeff. by transmission
	$A_j$	Calculated value $U_j$	Reference value $U_{N,rc,j}$	Fulfilled	$b_j$	$H_{T,j}$
	[m <sup>2</sup> ]	[W/(m <sup>2</sup> .K)]	[W/(m <sup>2</sup> .K)]	[yes/no]	[-]	[W/K]
	127,14	0,231			0,63	18,3
	41,25	1,100			1,00	45,4
	5,88	1,100			1,00	6,5
	127,10	0,150			0,83	15,8
	231,10	0,180			1,00	41,6
						10,6
<b>Total</b>	<b>532,5</b>	<b>x</b>	<b>x</b>	<b>x</b>	<b>x</b>	<b>138,2</b>

Note: The evaluation of the fulfillment of requirements is required only for larger changes of the building and for other than larger changes of the completed building in the case of evaluation of energy performance in accordance with § 6, paragraph 2, point. c).

#### a.2) requirements for mean thermal transmittance

Zone	Prevailing design internal temperature	Zone volume	Reference value of the mean thermal transmittance of the zone	Product
	$\Theta_{im,j}$	$V_j$	$U_{em,R,j}$	$V_j \cdot U_{em,R,j}$
	[°C]	[m <sup>3</sup> ]	[W/(m <sup>2</sup> .K)]	[W.m/K]
Obytná zóna	20,0	781,9	0,32	250,21
<b>Total</b>	<b>x</b>	<b>781,9</b>	<b>x</b>	<b>250,21</b>

Building	Mean thermal transmittance of the building		
	Calculated value $U_{em}$ ( $U_{em} = H_T/A$ )	Reference value $U_{em,R}$ ( $U_{em,R} = \Sigma(V_j \cdot U_{em,R,j})/V$ )	Fulfilled
	[W/(m <sup>2</sup> .K)]	[W/(m <sup>2</sup> .K)]	[yes/no]
	0,26	0,32	ano

Note: The evaluation of the fulfillment of requirements is required for a new building, a building with almost zero energy consumption and for larger changes of the completed building in the case of evaluation of energy performance in accordance with § 6, paragraph 2, point. a) and point b).

**B) technical systems****b.1.a) heating**

Assessed building/zone	Source type	Energy carriers	Coverage of partial energy needs for heating	Energy output	Efficiency of heat source <sup>2)</sup>		Efficiency of energy distribution $\eta_{H,dis}$	Efficiency of energy emission $\eta_{H,em}$
	[-]	[-]	[%]	[kW]	$\eta_{H,gen}$	COP	[%]	[%]
Reference building	x <sup>1)</sup>	x	x	x	80	--	85	80
Assessed building/zone:								
Obytná zóna		zemní plyn			95		87	88

Note: <sup>1)</sup> x symbol means that there is no required reference value

<sup>2)</sup> it is not filled-in in the case of thermal energy supply system

**b.1.b) requirements for the efficiency of the heating system**

Assessed building/zone	Source type	Efficiency of heat source energy production $\eta_{H,gen}$ nebo $COP_{H,gen}$	Efficiency of reference heat source energy production $\eta_{H,gen,rq}$ or $COP_{H,gen}$	Fulfilled
	[-]	[%]	[%]	[yes/no]

Note: The evaluation of the fulfillment of requirements is required only for larger changes of the building and for other than larger changes of the completed building in the case of evaluation of energy performance in accordance with § 6, paragraph 2, point. c).

**B) technical systems****b.2.a) cooling**

Assessed building/zone	Type of cooling system	Energy carriers	Coverage of partial energy needs for cooling	Cooling output	Cooling factor of cold source $EER_{C,gen}$	Efficiency of energy distribution $\eta_{C,dis}$	Efficiency of energy emission $\eta_{C,em}$
	[-]	[-]	[%]	[kW]	[-]	[%]	[%]
Reference building	x	x	x	x			
Assessed building/zone:							

**b.2.b) requirements for the efficiency of the cooling system**

Assessed building/zone	Type of cooling system	Cooling factor of cold source $EER_{C,gen}$	Cooling factor of reference cold source $EER_{C,gen}$	Fulfilled
	[-]	[-]	[-]	[yes/no]

Note: The evaluation of the fulfillment of requirements is required only for larger changes of the building and for other than larger changes of the completed building in the case of evaluation of energy performance in accordance with § 6, paragraph 2, point. c).

**B) technical systems****b.3) ventilation**

Assessed building/zone	Type of ventilation system	Energy carriers	Heating energy output	Cooling energy output	Coverage of partial energy needs for ventilation	Nominal electricity input of ventilation system	Nominal volume flow of ventilation air	Specific input of fans for forced ventilation $SFP_{ahu}$
	[-]	[-]	[kW]	[kW]	[%]	[kW]	[m <sup>3</sup> /hour]	[W.s/m <sup>3</sup> ]
Reference building	x	x	x	x	x	x	x	
Assessed building/zone:								
Obytná zóna								

**B) technical systems****b.4) air humidity adjustment**

Assessed building/zone	Type of humidification system	Energy carriers	Nominal electricity input	Nominal energy output	Coverage of partial energy needs for air humidification	Efficiency of air humidification $\eta_{RH+,gen}$
	[-]	[-]	[kW]	[kW]	[%]	[%]
Reference building	x	x	x	x	x	
Assessed building/zone:						

Assessed building/zone	Type of dehumidification system	Energy carriers	Nominal electricity input	Nominal energy output	Coverage of partial energy needs for air dehumidification	Cooling output	Efficiency of air dehumidification $\eta_{RH-,gen}$
	[-]	[-]	[kW]	[kW]	[%]	[kW]	[%]
Reference building	x	x	x	x	x	x	
Assessed building/zone:							

**B) technical systems****b.5.a) hot water preparation**

Assessed building/zone	Type of hot water preparation in the building	Energy carriers	Coverage of partial energy needs for hot water preparation	Energy input for hot water preparation	Hot water tank volume	Efficiency of heat source for hot water preparation <sup>1)</sup>		Specific heat loss of hot water tank $Q_{W,st}$	Specific heat loss of hot water distribution $Q_{W,dis}$
						$\eta_{W,gen}$	COP		
	[-]	[-]	[%]	[kW]	[liters]	[%]	[-]	[Wh/l.d]	[Wh/m.d]
Reference building	x	x	x	x	x	85	--	7,0	150,0
Assessed building/zone:									
Obytná zóna		zemní plyn			100	95		7,9	114,6

Note: <sup>1)</sup> not filled in case of thermal energy supply

**b.5.b) requirements for the efficiency of the hot water preparation system**

Assessed building/zone	Type of hot water preparation system	Efficiency of heat source for hot water preparation $\eta_{W,gen}$ nebo COP $_{W,gen}$	Efficiency of reference heat source for hot water preparation $\eta_{W,gen,rq}$ nebo COP $_{W,gen}$	Fulfilled
	[-]	[%]	[%]	[yes/no]

Note: The evaluation of the fulfillment of requirements is required only for larger changes of the building and for other than larger changes of the completed building in the case of evaluation of energy performance in accordance with § 6, paragraph 2, point. c).

**B) technical systems****b.6) lighting**

Assessed building/area	Type of lighting system	Coverage of partial lighting energy needs	Total electricity input for lighting of the building	Mean specific input for lighting related to the illumination zone $P_{L,lx}$
	[-]	[%]	[kW]	[W/(m <sup>2</sup> .lx)]
Reference building	x	x	x	0,05
Assessed building/area:				
Obytná zóna				0,05

**Energy performance of assessed building****a) list of considered zones and partial delivered energies in the building**

Assessed building/zone	Heating $EP_H$	Cooling $EP_C$	Mechanical ventilation $EP_F$		Hot water preparation $EP_W$	Lighting $EP_L$	Energy production from renewable energy source or cogeneration	
			Without humid. adjustment	With humidity adjustment			For the building	For the building and external delivery
Obytná zóna								

**b) partial delivered energies**

r.			Heating		Cooling		Ventilation		Air humidity adjustment		Hot water preparation		Lighting	
			Ref. building	Ass. building	Ref. building	Ass. building	Ref. building	Ass. building	Ref. building	Ass. building	Ref. building	Ass. building	Ref. building	Ass. building
(1)	Energy need	[MWh/year]	15,703	11,001			x	x			4,196	4,196	x	x
(2)	Calculated energy use	[MWh/year]	28,866	15,125							8,255	6,783	1,530	1,530
(3)	Auxiliary energy use	[MWh/year]												
(4)	Partial delivered energy (r.4)=(r.2)+(r.3)	[MWh/year]	28,866	15,125							8,255	6,783	1,530	1,530
(5)	Specific partial delivered energy related to total energy reference surface (r.4) / m <sup>2</sup>	[kWh/(m <sup>2</sup> .year)]	114	59							32	27	6	6

**c) energy production facility located in the building, on the building or on attached auxiliary objects**

Production type	Utilization of produced energy	Produced energy	Total primary energy factor	Non-renewable primary energy factor	Total primary energy	Non-renewable primary energy
units		[MWh/year]	[-]	[-]	[MWh/year]	[MWh/year]
Cogeneration unit $EP_{CHP}$ - heat	Building					
	Delivery out of the building					
Cogeneration unit $EP_{CHP}$ - electricity	Building					
	Delivery out of the building					
Photovoltaic panels $EP_{PV}$ - electricity	Building					
	Delivery out of the building					
Solar thermal systems $Q_{H,sc,sys}$ - heat	Building					
	Delivery out of the building					
Others	Building					
	Delivery out of the building					

**d) distribution of partial delivered energies, of the total primary energy and of the non-renewable primary energy according to energy carriers**

Energy carriers	Partial calculated energy use/ Auxiliary energy use	Total primary energy factor	Non-renewable primary energy factor	Total primary energy	Non-renewable primary energy
	[MWh/year]	[-]	[-]	[MWh/year]	[MWh/year]
zemní plyn	21,908	1,1	1,1	24,099	24,099
elektrina ze sítě	1,530	3,2	3,0	4,894	4,589
<b>Total</b>	<b>23,438</b>	<b>x</b>	<b>x</b>	<b>28,994</b>	<b>28,688</b>

**e) requirement for total delivered energy**

(6)	Reference building	[MWh/year]	38,650	Fulfilled (yes/no)	ano
(7)	Assessed building		23,438		
(8)	Reference building	[kWh/m <sup>2</sup> .year]	152		
(9)	Assessed building		92		

**f) requirement for non-renewable primary energy**

(10)	Reference building	[MWh/year]	40,879	Fulfilled (yes/no)	ano
(11)	Assessed building		28,688		
(12)	Reference building (r.10 / m <sup>2</sup> )	[kWh/m <sup>2</sup> .year]	161		
(13)	Assessed building (r.11 / m <sup>2</sup> )		113		

**g) primary energy of the assessed building**

(14)	Total primary energy	[MWh/year]	28,994
(15)	Renewable primary energy (r.14 - r.11)	[MWh/year]	0,306
(16)	The use of renewable energy sources from the point of view of primary energy (r.15 / r.14 x 100)	[%]	1,1

**h) values for the derivation of energy classes levels**

Values corresponding to the upper limit of Class C:	Total delivered energy	[MWh/year]	38,650
	Non-renewable primary energy	[MWh/year]	45,422
	Mean thermal transmittance of the building	[W/m <sup>2</sup> .K]	0,32
	Partial delivered energy: heating	[MWh/year]	28,866
	cooling	[MWh/year]	
	ventilation	[MWh/year]	
	air humidity adjustment	[MWh/year]	
	hot water preparation	[MWh/year]	8,255
	lighting	[MWh/year]	1,530
Table h) contains values used for the derivation of energy classes levels according to Annex No. 2.			

**Analysis of the technical, economical and environmental suitability of alternative energy supply systems for new buildings and larger changes of completed buildings**

Alternative systems	Feasibility assessment			
	Decentralized energy supply systems based on renewable energy sources	Cogeneration	System of the thermal energy supply	Heat pump
Technical suitability				
Economical suitability				
Ecological suitability				
<b>Recommendations for implementation and justification</b>				
<b>Date of analysis completion</b>				
<b>Author of analysis</b>				
<b>Energy assessment</b>	Obligation of the energy assessment preparation			
	Energy assessment is a part of the analysis			
	Date of the energy assessment preparation			
	Author of energy assessment			

## **Recommended technically and economically suitable measures to improve energy performance of the building**

Measure description		Expected mean thermal transmittance of the building	Expected delivered energy	Expected nonrenewable primary energy	Expected savings of total delivered energy	Expected savings of the nonrenewable primary energy
		[W/(m <sup>2</sup> .K)]	[MWh/year]	[MWh/year]	[MWh/year]	[MWh/year]
<i>Building components and building constructions:</i>						
			x	x		
<i>Building technical systems:</i>						
heating:		x		x		
cooling:		x		x		
ventilation:		x		x		
air humidity adjustment:		x		x		
hot water preparation:		x		x		
lighting:		x		x		
<i>Operation and maintenance of the building systems:</i>						
		x	x	x		
<i>Other - please specify:</i>						
		x	x	x		
<b>Total</b>		x				

Measure	Assessment of appropriateness			
	Building components and constructions	Technical systems in the building	Maintenance and operation of building systems	Other - please specify:
Technical suitability				
Functional suitability				
Economical suitability				
<b>Recommendations for implementation and justification</b>				
<b>Date of recommended measures preparing</b>				
<b>Author of analysis</b>				
<b>Energy assessment</b>	Energy assessment is a part of the analysis			
	Date of the energy assessment preparation			
	Author of energy assessment			

**Energy specialist's final evaluation**

<b>New building or building with almost zero energy consumption</b>	
• Building meets the requirement according to § 6 paragraph 1	
• Building energy performance class for the total delivered energy	B
<b>Larger change of completed building or other change of the building</b>	
• Building meets the requirement according to § 6 paragraph 2 point a)	
• Building meets the requirement according to § 6 paragraph 2 point b)	
• Building meets the requirement according to § 6 paragraph 2 point c)	
• Fulfillment of requirements on the building energy performance is not required	
• Building energy performance class for the total delivered energy	
<b>Building used by public authorities</b>	
• Building energy performance class for the total delivered energy	
<b>Sale or lease of the building or its part</b>	
• Building energy performance class for the total delivered energy	
<b>Another purpose of certificate processing</b>	
• Building energy performance class for the total delivered energy	

**Identification data of energy specialist who created the certificate**

Name and surname	
Authorization No. of Ministry of Industry and Trade	
Energy specialist's signature	

**Date of certificate creation**

Date of certificate creation	
------------------------------	--

# ENERGY PERFORMANCE CERTIFICATE

issued according to Act No. 406/2000 Coll., about energy management,  
and Directive No. 78/2013 Coll., about building energy performance

Street, number:

ZIP code, place:

Building type:

Building envelope area:

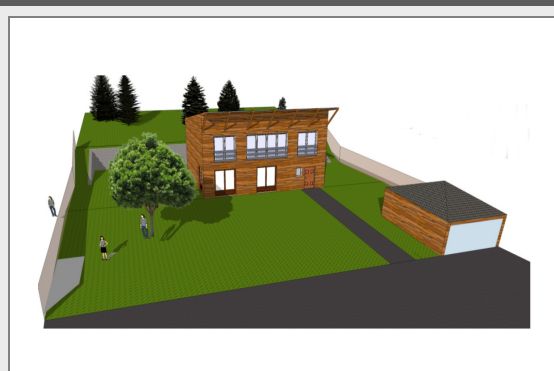
532,5 m<sup>2</sup>

Shape factor A/V:

0,68 m<sup>2</sup>/m<sup>3</sup>

Total energy reference area:

254,3 m<sup>2</sup>

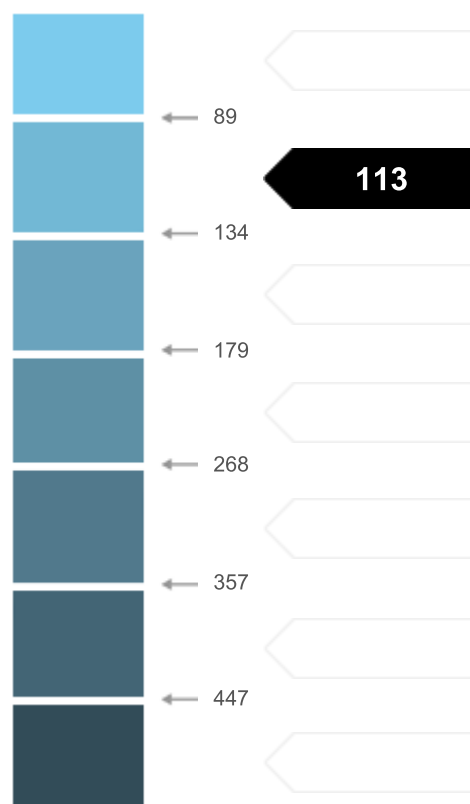
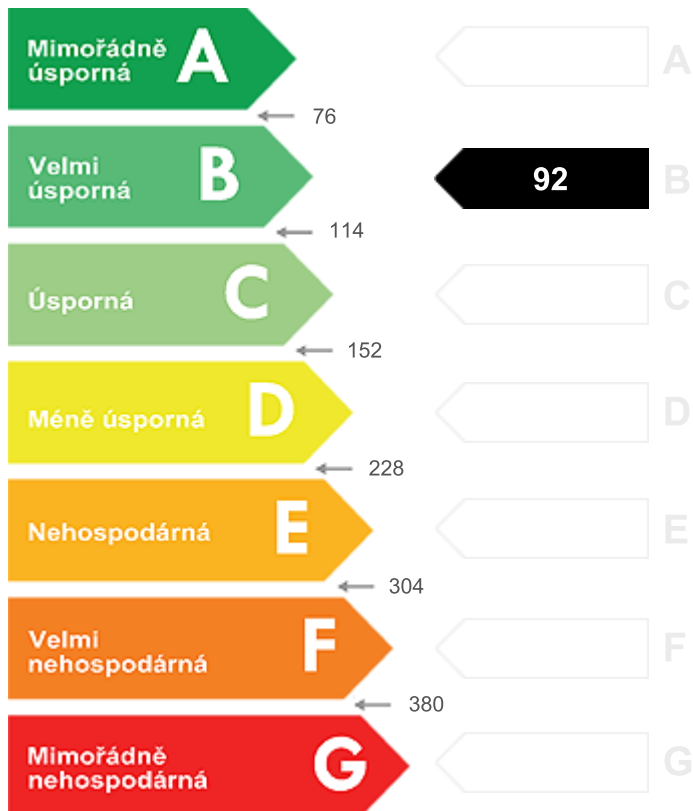


## ENERGY PERFORMANCE OF THE BUILDING

**Total delivered energy**  
(Energy input to the building)

**Non-renewable primary energy**  
(Impact of the building on the environment)

**Specific values** kWh/(m<sup>2</sup>·year)



**Values for the whole building**  
MWh/year

**23,438**

**28,688**

## RECOMMENDED MEASURES

Measure for	Defined	Description of measures can be found in protocol and their impact on energy performance is shown by an arrow. <b>Doporučení</b>
Outdoor walls:		
Windows and doors:		
Roof:		
Floor:		
Heating:		
Cooling:		
Ventilation:		
Hot water prepar.:		
Lighting:		
Others:		

## DELIVERED ENERGY DISTRIBUTION TO ENERGY CARRIERS

Values for the whole building  
MWh/year



Elektřina ze sítě: 1,5  
Zemní plyn: 21,9

## BUILDING ENERGY PERFORMANCE INDICATORS

	The building envelope	Heating	Cooling	Ventilation	Humidity adjustment	Hot water	Lighting
	$U_{em}$ W/(m <sup>2</sup> ·K)	Partial delivered energy		Specific values		kWh/(m <sup>2</sup> ·year)	
Mimořádně úsporná							
<b>A</b>							
<b>B</b>		59					
<b>C</b>	0,26					27	6
<b>D</b>							
<b>E</b>							
<b>F</b>							
<b>G</b>							
Mimořádně neohospodárná							
Values for the whole building MWh/year		15,13				6,78	1,53

Author:  
Contact:

Certificate No.:  
Prepared on:  
Signature: