LOTUS Guidelines

Energy Performance Calculation Method

Revision D

Guidelines for building energy simulation in LOTUS.

For use with LOTUS NC rating system.

CONTENTS

1. GENERAL

1.1 Background

To optimise the energy use of buildings in Vietnam, the VGBC has developed a method for comparing the performance of a proposed building design with a baseline case scenario. This method is mostly based on QCVN 09:2017/BXD, the Vietnamese national technical regulation on energy efficient buildings and on the appendix G – Performance Rating Method – of ASHRAE 90.1-2007.

The aim of this methodology is not to predict the energy consumption or energy costs of the actual building after construction but to set guidelines on how to perform the building energy simulation to calculate the energy performance for the prerequisite E-PR-3 and credit E-1 Total Building Energy Use in LOTUS NC rating system.

1.2 Performance Rating

The energy performance calculation method is required to evaluate the energy efficiency performance of building designs.

The calculation method requires the building energy simulation to be performed twice. Firstly for the proposed building performance, as per the architectural design and drawings and secondly for the baseline building performance, as per the VBGC baseline modelling requirements. The two cases are then compared, establishing a percentage improvement.

The following formula is used to determine this improved percentage performance:

$$\textbf{PERCENTAGE IMPROVEMENT}\ [\%] = 100 \times \frac{\text{Baseline building performance} - \text{Proposed building performance}}{\text{Baseline building performance}}$$

To determine the performance of the proposed building and the baseline building, the total energy use of both are calculated using a VGBC approved computer based simulation program in line with the VBGC modelling requirements (Refer to *Section 1.4 Simulation software*).

The building performance calculations include all small and large end-use load components and are required to conform with the following Sections of QCVN 09:2017/BXD:

Section 2.1 *- Building Envelope*

Section 2.2 *- Ventilation and Air Conditioning*

Section 2.3 *- Lighting*

Section 2.4 – *Other electric equipment*

1.3 Building performance documentation

The simulated performance of the building shall be documented and then submitted to the VGBC. The information submitted shall include the following:

- A brief description of the project, the key energy efficiency improvements, the simulation program used, and the results of the energy analysis. This summary shall contain the calculated values (kWh/year) for the baseline building performance, the proposed building performance, and the percentage improvement.
- A space summary of the building including the total area, the conditioned and unconditioned areas and the space usage type for all the different spaces.
- A list of the energy-related features that are included in the design and on which the performance rating is based. This list shall document all energy features that differ between the models used in the baseline building performance and proposed building performance calculations
- A diagram showing the thermal zones used in the computer simulation
- Schedules with hourly variations used for occupancy, lighting and HVAC
- An explanation of any significant modeling assumptions
- Back-up calculations and material to support data inputs. All this back-up information should be in line with the other LOTUS credits. Should be included:
    - fenestration and opaque envelope types and areas;
    - interior and exterior lighting power;
    - HVAC system types, sizes and efficiencies;
    - service water heating systems sizes and efficiencies;
    - all end-use load components within and associated with the building
- Input and output report(s) from the simulation program or compliance software including a breakdown of energy usage by at least the following components: internal and external lighting, internal equipment loads, service water heating equipment, space heating equipment, space cooling and heat rejection equipment, fans, and other HVAC equipment (such as pumps). The output reports shall also show the amount of unmet load hours for both the proposed design and baseline building design.

- An explanation of any error messages noted in the simulation program output.
- For any exceptional calculation method(s) employed, document the predicted energy savings by energy type, a narrative explaining the exceptional calculation method performed, and the theoretical or empirical information supporting the accuracy of the method.

1.4 Simulation software

The energy intensity values of both the proposed and the baseline building shall be calculated using a computer based simulation program in line with following requirements.

Whichever modelling tool is chosen to simulate the buildings energy intensity values, the program is required to undertake building performance calculations for all the building components being modelled. The simulation program shall have the ability to directly determine the proposed and baseline building performance, and at a minimum model all the following:

- *8760 hours per year (i.e 24 hours a day)*
- *Hourly variations in occupancy, lighting power, small and large equipment power, thermostat set points and HVAC system operation, defined separately for each day of the week and holydays*
- *Thermal mass transfer*
- *10 or more thermal zones*
- *Part-load capacity and efficiency correction curves for mechanical and HVAC equipment*
- *Input and output evidence; including a breakdown of energy usage by at least the following components: lights, internal equipment loads, service water heating equipment, space heating, space cooling, and other HVAC equipment (such as fans and pumps)*

1.5 Climatic data

The simulation program shall use the same climatic data for both the proposed building and baseline building calculations. The climate data used shall cover a full calendar year (8,760 hours), shall reflect approved coincident hourly data for temperature, solar radiation, humidity and wind speed for the building location.

The building location shall be either the province or city where the building is located. If facing difficulty to find the appropriate climatic data, projects should contact the VGBC.

1.6 Exceptional Calculation Method

Where no simulation program is available that adequately models a design, material or device, the VGBC may approve an exceptional calculation method to demonstrate improvements to the baseline model using this method.

For approval, the exceptional method shall include documentation of the calculations performed and information supporting the accuracy of the method.

This method is particularly useful for the process loads which shall be the same for both the baseline and design models unless it can be proven that the equipment used are more energy efficient than standard equipment.

2. MODELLING REQUIREMENTS

2.1 Baseline building

The baseline building is used to set a standard minimum energy efficiency performance level to which the proposed building design can be compared. The value for comparison will be the yearly energy consumption values expressed as *kWh/year.*

The baseline building design shall be modelled with the same number of floors and identical conditioned floor area as the proposed building design, sharing all the same characteristics with the exception of the following which is detailed in *Section 3 Modelling Parameters:*

- Building Envelope
- Artificial Lighting
- Thermal Blocks
- HVAC Systems
- Hot Water Systems
- Small and Large Power
- Renewable and recovered Energy

2.2 Proposed building

A proposed building is the building design which the energy efficiency is being calculated. The value for comparison will be the yearly energy consumption values expressed as *kWh/year.*

The simulation model of the proposed design shall be consistent with all design documents, including all small and large power.

Where the simulation program documents do not model the consumption and output, additional spreadsheets or other documentation of the assumptions used to generate the power demand and operating schedule of the systems must be provided.

2.3 Calculation of the proposed and baseline building performance

The proposed and baseline building performance are given by calculating the total energy consumption values (kWh/year) of both, using the set of modelling parameters (section 3) defined by the VGBC to ensure an accurate and consistent outcome.

3. MODELLING PARAMETERS

The simulation models of the proposed and baseline buildings shall be developed in accordance with the following parameters:

3.1 Building and zone type

BUILDING AND ZONE TYPE		
CATEGORY	PROPOSED BUILDING PERFORMANCE	BASELINE BUILDING PERFORMANCE
1. Building and zone type	Space usage in the building shall be specified using the space type lighting classifications in accordance with the Table 3.5.1 - Lighting Power Density Requirements. These classifications will be used to determine the lighting power for the baseline building and to differentiate areas within the building that may have different operating schedules and characteristics (thermostat settings, ventilation rates, etc.)	Baseline Building shall be the same as the Proposed Design

3.2 Additions and Alterations

ADDITIONS AND ALTERATIONS		
CATEGORY	PROPOSED BUILDING PERFORMANCE	BASELINE BUILDING PERFORMANCE
1. Alterations	The model shall reflect all the actual components of the existing building that will not be altered and all the new components of the building.	Baseline Building shall be based on the Proposed Building components (both new and existing) and follow all the requirements of the *Section 3 Modelling Parameters*.
2. Additions	Parts of the existing building can be excluded from the modelling if the following conditions are met: 1. Excluded parts of the building are served by HVAC systems that are entirely separate from those serving parts of the building that are included in the building model. 2. Space temperature and HVAC system operating setpoints and schedules on either side of the boundary between included and excluded parts of the building are essentially the same.	Baseline Building shall be based on the Proposed Building components (both new and existing) and follow all the requirements of the *Section 3 Modelling Parameters*.

3.3 Occupancy and Consumption Schedules

OCCUPANCY AND CONSUMPTION SCHEDULES		
CATEGORY	PROPOSED BUILDING PERFORMANCE	BASELINE BUILDING PERFORMANCE
1. Occupancy and Consumption Schedules	Schedules capable of modelling hourly variations in occupancy, lighting power, miscellaneous equipment power, thermostat set points and HVAC system operation shall be used and shall represent accurately the operation of the building.	Baseline Building shall use the same occupancy rates, operation schedules and indoor thermal conditions as the Proposed Design Exception: Schedules may be allowed to differ between proposed design and baseline building design when necessary to model nonstandard efficiency measures, provided that the revised schedules have the approval of the VGBC. Measures that may warrant use of different schedules include, but are not limited to, lighting controls, natural ventilation, demand control ventilation, and measures that reduce service water heating loads.

3.4 Building Envelope

BUILDING ENVELOPE		
CATEGORY	PROPOSED BUILDING PERFORMANCE	BASELINE BUILDING PERFORMANCE
1. General	All components of the building envelope in the proposed design shall be modelled as shown on architectural drawings for both existing and new parts of the building.	Equivalent dimensions shall be the same for each exterior envelope component type as in the proposed design.
2. Orientation	The proposed building performance shall be generated by simulating the building with its actual orientation.	The baseline building performance shall be generated by simulating the building with its actual orientation.
3. Opaque Assemblies	All opaque assemblies in the proposed design shall be modelled as shown on architectural drawings.	a. U-values of opaque wall assemblies shall be set at 1.8 $W/m^2.K$ b. U-values of opaque roof assemblies shall be set at 1 $W/m^2.K$ Exception: For roofs with gradient of 15 degrees or above, U-value of the roof shall be set at 1.18 $W/m^2.K$ c. U-values for Interior Walls, Floors, and Opaque Doors shall be modelled as equal to the proposed building.
4. Opaque surfaces reflectivity	For exterior roofs and walls, the actual surface reflectance values shall be used. If not available, roof and wall surfaces shall be modelled with a reflectivity of 0.30.	All exterior roof and wall surfaces shall be modelled with a reflectivity of 0.30.
5. Vertical Fenestration	a. All vertical fenestrations in the proposed design shall be modelled as shown on architectural drawings. b. Fenestration Solar Heat Gain Co-efficient (SHGC) is to be modelled in using values appropriate for the materials specified in the design c. Fenestration U-values are to be modelled in using values appropriate for the materials specified in the design	a. All vertical fenestrations in the baseline design shall be modelled with the same location and sizes as the Proposed Design. All vertical glazing shall be assumed to be flush with the exterior wall. b. Fenestration Solar Heat Gain Co-efficient (SHGC) shall meet the minimum requirements in Table 3.4.5. Note: If WWR does not match the values in the first column, SHGC shall be determined through linear interpolation using the nearest higher and lower WWR values c. Fenestration shall be modelled with U-values of 6.81.

6. Shading	a. Manual internal shading devices such as blinds or shades shall not be modelled. b. Permanent shading devices such as fins, overhangs, and light shelves can be modelled as shown on architectural drawings. c. Adjustable external shading devices (whether automated or manual) can be modelled. d. Shaded roof should be modelled as shown on architectural drawings.	Baseline Building shall not model any shading devices.
7. Skylights	a. All skylights in the proposed design shall be modelled as shown on architectural drawings b. Skylight SHGC values are to be modelled in using values appropriate for the materials specified in the design c. Skylight U-values are to be modelled in using values appropriate for the materials specified in the design	a. Skylight orientation and tilt shall be the same as in the proposed building design. Skylight area shall be equal to that in the proposed building design or 3% of the gross roof area that is part of the building envelope, whichever is smaller. b. Skylights shall be modelled with SHGC values of 0.30. c. Skylights shall be modelled with U-values of 4.26.

Table 3.4.5 - Baseline SHGC values for glazing for different WWR and orientations
(Source: Table 2.1 of QCVN 09:2017/BXD and Table 2.3 of QCVN 09:2013/BXD)

WWR (%)	N	S	All other orientations
20	0.90	0.90	0.80
30	0.64	0.70	0.58
40	0.50	0.56	0.46
50	0.40	0.45	0.38
60	0.33	0.39	0.32
70	0.27	0.33	0.27
80	0.23	0.28	0.23
90	0.2	0.25	0.2
100	0.17	0.22	0.18

3.5 Artificial Lighting

ARTIFICIAL LIGHTING		
CATEGORY	PROPOSED BUILDING PERFORMANCE	BASELINE BUILDING PERFORMANCE
1 Interior Lighting System	Where a lighting system has been designed, lighting power density shall be modelled in accordance with design documents. Lighting system power shall include all lighting system components shown for on plans (including lamps and ballasts and task and furniture mounted fixtures)	a. Lighting power in the baseline building design shall be determined using the same space functions as in the proposed building. b. Lighting power densities shall be set equal to the maximum allowed for the corresponding space types in Table 3.5.1 Lighting Power Density Requirements. Where a space type is not included in the table, projects should contact the VGBC for further information. c. Additional task lighting (including lamps and ballasts and task and furniture mounted fixtures) shall not be modelled in the baseline building
2 Exterior Lighting System	Lighting power for building exteriors (including parking areas) shall be modelled in accordance with design documents.	The lighting power for exterior lighting applications shall be set using the specified lighting power limits in the Table 3.5.2. Only walls or surfaces illuminated in the proposed model can be affected with a lighting power in the baseline.
3 Lighting operation schedule	a. Lighting schedules for exterior and interior lighting shall match with the actual operation schedules. b. In case automatic lighting controls are installed in the building and are not directly modelled in the building simulation, it is possible to make some schedule adjustments (subject to VGBC approval)	Lighting schedules for exterior and interior lighting shall be the same as the proposed design. Exception: the baseline schedule should not include the schedule adjustments made in the proposed model to take in to account the automatic lighting controls installed in the building.
4 Lighting Controls for daylight	Operation of lighting controls for daylight can be modelled in 2 different ways: either directly in the building simulation or in the building simulation through schedule adjustments determined by a separate daylighting analysis approved by the VGBC.	No lighting controls for daylight shall be modelled in the baseline building.

5 Other types of automatic Lighting Controls	For automatic lighting controls, credit may be taken for the spaces with automatically controlled systems by reducing the connected lighting power in the space by the applicable percentages listed in Table 3.5.5. Alternatively, credit may be taken for these devices by modifying the lighting schedules used for the proposed design, provided that credible technical documentation for the modifications are provided through the exceptional calculation method.	No automatic lighting control shall be modelled in the baseline building.

Table 3.5.1 – Lighting Power Density Requirements

(Sources: QCXDVN 09:2005, ASHRAE 90.1 – 2007 & 2010, ECBC – 2007)

Building Categories	Space types	LPD (W/m^2)	Building Categories	Space types	LPD (W/m^2)
Typical of all buildings	Corridor	6	Offices	Accounting	12
	Lobby	12		Audio Visual areas	12
	Restrooms	10		Conference areas	13
	Food Preparation	13		General and private offices	12
	Storage, Active	8	Printing	Off-set printing and duplicating area	13
	Storage, Inactive	3	Restaurants	Fast Food/ Cafeteria	15
	Electrical/Mechanical	14		Leisure Dining	14
	Dressing/Locker/Fitting Room	7		Bar/ Lounge	12
Apartments	Apartments / Condos (Public spaces)	9	Retail, shops, stores	Conventional with counters	15
Banks	Lobby, General	9		Conventional with wall display	15
	Lobby, Writing area	13		Self Service	14
	Tellers' stations	16		Supermarkets	17
Convention center	Exhibit Space	14		Mall concourse/ multi-store service	8

Hotels	Bathrooms	14
	Guest/ Bed Rooms, General	13
	Guest/ Bed Rooms, Reading	16
	Corridors, elevators and stairs	8
	Banquet and Exhibit	16
	Lobby, Front Desk, Reading	12
	Lobby, General Lighting	10
Hospitals	Consulting areas, General	12
	Consulting areas, Examination	12
	Corridors, General, Waiting Rooms	8
	Ward Corridors, Day / Night	9
	Laboratories, General	15
	Laboratories, Examination	20
	Nurses Stations	12
	Ward Bed Head, Reading	14
	Surgeries, General	17
Libraries	Libraries	14
Nursing Homes	Nursing Homes	12
Schools	Pre/elementary	13
	High/ Tech/ University	13
Worship	Temples/ Churches/ Synagogues	14
Parking / Garage	Garage area	2
Dormitory	Living Quarters	10
Manufacturing	Low Bay (<25 ft Floor to Ceiling Height)	13
	High Bay (≥25 ft Floor to Ceiling Height)	15
	Detailed Manufacturing	16
	Equipment Room	11
	Control Room	5
Warehouse	Fine Material Storage	14
	Medium/Bulky Material Storage	9

Table 3.5.2 - Lighting power for exterior lighting applications *(Source: ECBC 2007 and ASHRAE 90.1-2007)*	
Exterior lighting applications	Power limits
Building entrance (with canopy)	13 W/m^2 of canopied area
Building entrance (without canopy)	90 W/lin m of door width
Building exit	60 W/lin m of door width
Building façades	2 W/m^2 of vertical façade area
Uncovered parking areas	1.6 W/m^2

Table 3.5.5 - Power adjustment percentages for automatic lighting controls *(Source: ASHRAE 90.1-2007)*		
Automatic control device(s)	Non 24h/day buildings	24h/day buildings
1. Program schedule control	10%	0%
2. Occupancy sensor	15%	10%

3.6 Thermal Blocks

THERMAL BLOCKS		
CATEGORY	PROPOSED BUILDING PERFORMANCE	BASELINE BUILDING PERFORMANCE
1. Thermal Blocks	Where HVAC zones are defined on HVAC design drawings, each HVAC zone shall be modelled as a separate thermal blocks. Exceptions: Different HVAC zones may be combined to create a single thermal block provided that: - The space use classification is the same throughout the thermal zone. - All of the zones are served by the same HVAC system or by the same kind of HVAC system.	Baseline Building shall be the same as the Proposed Design.

3.7 HVAC Systems

HVAC SYSTEMS		
CATEGORY	PROPOSED BUILDING PERFORMANCE	BASELINE BUILDING PERFORMANCE
1. Mechanical cooling system	Where a HVAC system has been designed, the HVAC system type and all related performance parameters in the proposed model, such as equipment capacities and efficiencies, shall be consistent with design documents. Exception: When an ice storage system is used in the building as an energy demand reduction solution, it shall not be simulated in the proposed model. Cooling equipment shall be operated as if no ice storage has been designed.	The HVAC system(s) in the baseline building design shall be of the type and description specified in Section 3.7.1, shall meet the general HVAC system requirements specified in Section 3.7.2, and shall meet any system-specific requirements in Section 3.7.3 that are applicable to the baseline HVAC system type(s). Exception: Where no heating system exists or no heating system has been specified, the baseline building design shall be modelled without any heating system.
2. Schedule and setpoints	Temperature and humidity control setpoints and schedules shall be simulated as designed.	Temperature and humidity control setpoints and schedules shall be the same for proposed and baseline building designs.
3. Natural ventilation	The proposed model shall respect the design: naturally ventilated spaces shall be modelled as such.	Spaces that are naturally ventilated spaces in the proposed building shall be considered as unconditioned spaces and shall not be modelled with air conditioning or mechanical ventilation in the baseline building.
4. Evaporative Cooling	The proposed model shall respect the design and evaporative cooling systems shall be modelled as designed.	The baseline building for the project should be modelled with a HVAC system selected according to section 3.7.1 and using a temperature setpoint of 29 degrees C.

3.7.1 Baseline HVAC system

HVAC systems in the baseline building design shall be based on usage, number of floors and conditioned floor area as specified in Table 3.7.1A and shall conform with the system descriptions in Tables 3.7.1A, 3.7.1B and 3.7.1C.
For systems 1, 2, 5, and 6, each thermal block shall be modeled with its own HVAC system. For systems 3, 4, 7 and 8, each floor shall be modeled with a separate HVAC system. Floors with identical thermal blocks can be grouped for modeling purposes.

Exceptions:

a. Use additional system type(s) for non-predominant conditions (i.e., residential/nonresidential) if those conditions apply to more than 1900 m^2 of conditioned floor area.

b. If the baseline HVAC system type is 3, 4, 7, or 8, use separate single-zone systems conforming with the requirements of Systems 2 and 6 for any spaces that have occupancy or process loads or schedules that differ significantly from the rest of the building. Peak thermal loads that differ by 31.2 W/m^2 or more from the average of other spaces served by the system or schedules that differ by more than 40 equivalent full-load hours per week from other spaces served by the system are considered to differ significantly. Examples where this exception may be applicable include, but are not limited to, computer server rooms, natatoriums, and continually occupied security areas.

c. If the baseline HVAC system type is 3, 4, 7, or 8, use separate single-zone systems conforming with the requirements of Systems 2 and 6 for any zones having special pressurization relationships, cross-contamination requirements, or code-required minimum circulation rates.

d. For laboratory spaces with a minimum of 2400 L/s of exhaust, use system type 3, 4, 7 or 8, that reduce the exhaust and makeup air volume to 50% of design values during unoccupied periods.

Table 3.7.1A – Baseline HVAC system types *(adapted from ASHRAE 90.1 2007)*

Building Type and conditioned area	System (with heating)	System (without heating)
Residential	System 1 - Split-HP	System 5 - Split-AC
Non-residential and 3 floors or Less and <2,300 m^2	System 2 - PSZ-HP	System 6 - PSZ-AC
Non-residential and 4 or 5 floors and <2,300 m^2 or 5 floors or Less and 2,300 m^2 to 14,000 m^2	System 3 - Packaged VAV with PFP Boxes	System 7 - Packaged VAV with PFP Boxes
Non-residential and more than 5 floors or >14,000 m^2	System 4 - VAV with PFP Boxes	System 8 - VAV with PFP Boxes

Where attributes make a building eligible for more than one baseline system type, use the predominant condition to determine the system type for the entire building.

Projects that would have designed a Fossil Fuel or a Fossil/Electric Hybrid heating system should contact the VGBC to receive guidance on the modeling of the heating system.

Table 3.7.1B – Baseline system including heating descriptions *(adapted from ASHRAE 90.1 2007)*				
System	System Type	Fan Control	Cooling Type	Heating Type
System 1 - SHP	Split heat pump	Constant volume	Direct expansion	Electric heat pump
System 2 - PSZ-HP	Packaged rooftop heat pump	Constant volume	Direct expansion	Electric heat pump
System 3 - Packaged VAV with PFP Boxes	Packaged rooftop VAV	VAV	Direct expansion	Electric Resistance
System 4 - VAV with PFP Boxes	VAV	VAV	Chilled water	Electric Resistance

Table 3.7.1C – Baseline system not including heating descriptions *(adapted from ASHRAE 90.1 2007)*			
System	System Type	Fan Control	Cooling Type
System 5 - SAC	Split air conditioner	Constant volume	Direct expansion
System 6 - PSZ-AC	Packaged rooftop air conditioner	Constant volume	Direct expansion
System 7 - Packaged VAV with PFP Boxes	Packaged rooftop VAV	VAV	Direct expansion
System 8 - VAV with PFP Boxes	VAV	VAV	Chilled water

3.7.2 General baseline HVAC system requirements

3.7.2.1 Equipment Efficiencies

All HVAC equipment in the baseline building design shall be modeled at the efficiency levels, both part load and full load, indicated in Tables 3.7.2.1A to 3.7.2.1E using the test procedures as listed. Where efficiency ratings, such as COP, include fan energy, the descriptor shall be broken down into its components so that supply fan energy can be modeled separately.

Table 3.7.2.1A – Baseline cooling efficiencies for Split systems heat pump– For system 1 *(Source: ASHRAE 90.1-2007)*			
Equipment Type	Size Category (Input)	Minimum Efficiency	Test Procedure
Air cooled (cooling mode)	< 19 kW	3.81 SCOP	ARI 210/ 240
Air cooled (heating mode)	< 19 kW (cooling capacity)	2.25 $SCOP_H$	ARI 210/ 240

Table 3.7.2.1B – Baseline cooling efficiencies for Packaged rooftop heat pump – For system 2 *(Source: ASHRAE 90.1-2007)*				
Equipment Type	Size Category (Input)	Subcategory or Rating Condition	Minimum Efficiency	Test Procedure
Air cooled (cooling mode)	< 19 kW	-	3.81 SCOP	ARI 210/ 240
	≥ 19 kW and < 40 kW	-	3.16 COP_C	ARI 340/360
	≥ 40 kW and < 70 kW	-	3.04 COP_C	
	≥ 70 kW	-	2.72 COP_C	
			2.64 IPLV	
Air cooled (heating mode)	< 19 kW (cooling capacity)	-	2.25 $SCOP_H$	ARI 210/ 240
	≥ 19 kW and < 40 kW (cooling capacity)	8.3°C db/6.1°C wb outdoor air	3.3 COP_H	ARI 340/360
	≥ 40 kW (cooling capacity)	8.3°C db/6.1°C wb outdoor air	3.2 COP_H	

Table 3.7.2.1C – Baseline cooling efficiencies for electrically operated air-conditioners – For systems 3, 6 and 7 *(Source: Adapted from QCVN 09:2017/BXD Table 2.3 and ASHRAE 90.1-2013 Table 6.8.1-1)*			
Equipment Type	Capacity	Minimum Efficiency	Test Procedures
Air Conditioners, Air-Cooled	< 19 kW	3.81 $SCOP_C$	TCVN 6307:1997 or ARI 210/240
	≥ 19 kW and < 40 kW	3.28 COP	ARI 340/360
	≥ 40 kW and < 70 kW	3.22 COP	
	≥ 70 kW and < 223 kW	2.93 COP	
	≥ 223 kW	2.84 COP	

Table 3.7.2.1D – Baseline cooling efficiencies for water chilling packages - For systems 4 and 8 *(Source: QCVN 09:2017/BXD Table 2.4 and ASHRAE 90.1 – 2013 Table 6.8.1-3)*			
Equipment Type	Capacity	Minimum Efficiency	Test Procedures
Water Cooled, Electrically Operated, Positive Displacement (Rotary Screw)	< 264 kW	4.51 COP	ARI 550/590
		5.5 IPLV	
	≥ 264 and < 528 kW	4.53 COP	
		5.7 IPLV	
	≥ 528 kW and < 1055 kW	5.17 COP	
		6.0 IPLV	
	≥ 1055 kW	5.67 COP	
		6.5 IPLV	
Water Cooled, Electrically Operated, Centrifugal	< 1055 kW	5.55 COP	
		5.9 IPLV	
	≥ 1055 kW and < 2110 kW	6.11 COP	
		6.4 IPLV	
	≥ 2110 kW	6.17 COP	
		6.5 IPLV	

Table 3.7.2.1E – Baseline cooling efficiencies for Split systems air conditioners – For system 5 *(Source: QCVN 09:2013/BXD)*			
Equipment Type	Size Category (Input)	Minimum Efficiency	Test Procedures
Split air-conditioner	<4.5 kW	2.60 COP	TCVN 7830:2012 and TCVN 6307:1997
	≥ 4.5 kW and < 7.0 kW	2.50 COP	
	≥ 7.0 kW and < 14.0 kW	2.40 COP	

3.7.2.2 Equipment Capacities

The equipment capacities for the baseline building design shall be based on one sizing run (based on building actual orientation) and shall be oversized by 15% for cooling and 25% for heating, i.e., the ratio between the capacities used in the annual simulations and the capacities determined by the sizing run shall be 1.15 for cooling and 1.25 for heating.

Unmet load hours for the proposed design or baseline building designs shall not exceed 300 (of the 8760 hours simulated), and unmet load hours for the proposed design shall not exceed the number of unmet load hours for the baseline building design by more than 50.
If unmet load hours in the proposed design exceed the unmet load hours in the baseline building by more than 50, simulated capacities in the baseline building shall be decreased incrementally and the building resimulated until the unmet load hours are within 50 of the unmet load hours of the proposed design.
If unmet load hours for the proposed design or baseline building design exceed 300, simulated capacities shall be increased incrementally, and the building with unmet loads resimulated until unmet load hours are reduced to 300 or less.
Alternatively (in particular for natural ventilation), unmet load hours exceeding these limits may be accepted at the discretion of the rating authority provided that sufficient justification is given indicating that the accuracy of the simulation is not significantly compromised by these unmet loads.

Weather conditions used in the sizing run to determine baseline equipment capacities may be based either on hourly historical weather files containing typical peak conditions or on design days developed using 99.6% heating design temperatures and 1% dry-bulb and 1% wet-bulb cooling design temperatures.

3.7.2.3 Fan System Operation

Supply and return fans shall operate continuously whenever spaces are occupied. Supply, return, and/or exhaust fans will remain on during occupied and unoccupied hours in spaces that have health and safety mandated minimum ventilation requirements during unoccupied hours.

3.7.2.4 Ventilation

Minimum outdoor air ventilation rates shall be the same for the proposed and baseline building designs.
<u>Exception</u>: When modeling demand-control ventilation in the proposed design

3.7.2.5 Economizers

Outdoor air economizers shall not be included in baseline HVAC Systems.

3.7.2.6 Design Airflow Rates

System design supply airflow rates for the baseline building design shall be based on a supply-air-to-room-air temperature difference of 11°C or the required ventilation air or makeup air, whichever is greater. If return or relief fans are specified in the proposed design, the baseline building design shall also be modeled with fans serving the same functions and sized for the baseline system supply fan air quantity less the minimum outdoor air, or 90% of the supply fan air quantity, whichever is larger.

3.7.2.7 System Fan Power

HVAC system fan electrical power for supply, return, exhaust, and relief (excluding power to fan-powered VAV boxes to be calculated as per 3.7.3.9; and individual exhaust fans with motor nameplate ≤ 0.75 kW and fans exhausting air from fume hoods) shall be calculated using the following formulas:

For system 1 and 5, $P_{fan} = L_S \times 0.64$

For systems 2, 3, 4, 6, 7 and 8, P_{fan} = input kW × 1000 / Fan Motor Efficiency

Where:

- Pfan = electric power to fan motor (watts)
- input kW = input kW of baseline fan motor from Table 3.7.2.7A
- Fan Motor Efficiency = the efficiency from Table 3.7.2.7B for the next motor size greater than the input kW using a totally enclosed fan cooled motor at 1800 rpm.
- L_S = the baseline system maximum design supply fan airflow rate in L/s (calculated following section 3.7.2.6 Design Airflow Rates)

Table 3.7.2.7A – Baseline Fan Motor Power *(Source: ASHRAE 90.1-2007)*	
Constant volume - Systems 2 and 6	Variable volume - Systems 3, 4, 7 and 8
kW = L_S x 0.0015 + A	kW = L_S x 0.0021 + A

Where A is calculated according to the following formula using the pressure drop adjustment from the proposed building design and the design flow rate of the baseline building system.

A = sum of (PD x CFMD /650,100) where:

PD = each applicable pressure drop adjustment from Table 3.7.2.7C in Pa.

CFMD = the design airflow through each applicable device from Table 3.7.2.7C in liters per second

Table 3.7.2.7B – Fan motor efficiency *(Source: QCVN 09:2017/BXD)*						
Motor type	Open Drip-Proof Motors			Totally Enclosed Fan-Cooled Motors		
Number of poles	2 poles	4 poles	6 poles	2 poles	4 poles	6 poles
Synchronous Speed (RPM)	3600	1800	1200	3600	1800	1200
Motor Kilowatts	Full-Load Efficiency, %					
0,8	77,0	85,5	82,5	77,0	85,5	82,5
1,1	84,0	86,5	86,5	84,0	86,5	87,5
1,5	85,5	86,5	87,5	85,5	86,5	88,5
2,2	85,5	89,5	88,5	96,5	89,5	89,5
3,7	86,5	89,5	89,5	88,5	89,5	89,5
5,6	88,5	91,0	90,2	89,5	91,7	91,0
7,5	89,5	91,7	91,7	90,2	91,7	91,0
11,1	90,2	93,0	91,7	91,0	92,4	91,7
14,9	91,0	93,0	92,4	91,0	93,0	91,7
18,7	91,7	93,6	93,0	91,7	93,6	93,0
22,4	91,7	94,1	93,6	91,7	93,6	93,0
29,8	92,4	94,1	94,1	92,4	94,1	94,1
37,3	93,0	94,5	94,1	93,0	94,5	94,1
44,8	93,6	95,0	94,5	93,6	95,0	94,5
56,0	93,6	95,0	94,5	93,6	95,4	94,5
74,6	93,6	95,4	95,0	94,1	95,4	95,0
93,3	94,1	95,4	95,0	95,0	95,4	95,0
111,9	94,1	95,8	95,4	95,0	95,8	95,8
149,2	95,0	95,8	95,4	95,4	96,2	95,8
186,5	95,0	95,8	95,4	95,8	96,2	95,8
223,8	95,4	95,8	95,4	95,8	96,2	95,8
261,1	95,4	95,8	95,4	95,8	96,2	95,8
298,4	95,8	95,8	95,8	95,8	96,2	95,8
357,7	95,8	96,2	96,2	95,8	96,2	95,8
373,0	95,8	96,2	96,2	95,8	96,2	95,8

Table 3.7.2.7C – Fan Power Limitation Pressure Drop Adjustment *(Source: ASHRAE 90.1-2007)*	
Devices	Adjustment
Fully ducted return and/or exhaust air systems	125 Pa
Return and/or exhaust airflow control devices	125 Pa
Exhaust filters, scrubbers, or other exhaust treatment	The pressure drop of device calculated at fan system design condition
Particulate Filtration: MERV 9 through 12	125 Pa
Particulate Filtration: MERV 13 through 15	225 Pa
Particulate Filtration: MERV 16 and greater and electronically enhanced filters	Pressure drop calculated at 2× clean filter pressure drop at fan system design condition
Carbon and other gas-phase air cleaners	Clean filter pressure drop at fan system design condition
Heat recovery device	Pressure drop of device at fan system design condition
Evaporative humidifier/cooler in series with another cooling coil	Pressure drop of device at fan system design condition
Sound Attenuation Section	38 Pa

3.7.3 System-Specific Baseline HVAC System Requirements

Baseline HVAC systems shall conform with provisions in this section, where applicable, to the specified baseline system types as indicated in section 3.7.1.

3.7.3.1 Heat Pumps (Systems 1 and 2)

Electric air-source heat pumps shall not be modeled with electric auxiliary heat.

3.7.3.2 Split-units (Systems 1 and 5)

In each thermal zone, the baseline building HVAC system shall be modeled with the minimum possible number of equally sized split-units while using capacity values in the range of values listed in tables 3.7.2.1A or 3.7.2.E.

3.7.3.3 Piping Losses (Systems 4 and 8)

Piping losses shall not be modeled in either the proposed or baseline building designs for hot water, chilled water, or steam piping.

3.7.3.4 Type and Number of Chillers (System 4 and 8)

Electric chillers shall be used in the baseline building design regardless of the cooling energy source, e.g., direct-fired absorption or absorption from purchased steam. The baseline building design's chiller plant shall be modeled with chillers having the number and type as indicated in Table 3.7.3.4 as a function of building peak cooling load.

Table 3.7.3.4 – Type and Number of Chillers *(Source: ASHRAE 90.1-2007)*

Building Peak Cooling Load	Number and type of Chiller(s)
≤ 1055 kW	1 water-cooled screw chiller
> 1055 kW and < 2110 kW	2 water-cooled screw chillers sized equally
≥ 2110 kW	2 water-cooled centrifugal chillers minimum with chillers added so that no chiller is larger than 2813 kW, all sized equally

3.7.3.5 Chilled-Water Design Supply Temperature (System 4 and 8)

Chilled-water design supply temperature shall be modeled at 6.7°C and return water temperature at 13°C.

3.7.3.6 Chilled-Water Pumps (System 4 and 8)

The baseline building design pump power shall be 349 kW/m^3/s. Chilled-water systems shall be modeled as primary/secondary systems with variable-speed drives on the secondary pumping loop.

3.7.3.7 Heat Rejection (System 4 and 8)

The heat rejection device shall be an axial fan cooling tower with two speed fans and the fan nameplate rated motor power should be set at 40 W/Tc (where Tc is a condenser ton and Tc = RT × 1.25 = 3.516 × 1.25 = 4.395 kW).
Condenser water design supply temperature ($CWST_{design}$) shall be calculated using the cooling tower approach generated by the formula below, with a design temperature rise of 5.6°C:

$CWST_{design} = WB + Approach_{5.6°C\ Range} = WB + [10.02 – (0.24 \times WB)]$ (where WB is the 0.4% evaporation design wet-bulb temperature in °C)

The tower shall be controlled to maintain a 21°C leaving water temperature where weather permits, floating up to leaving water temperature at design conditions. The baseline building design condenser-water pump power shall be 310 kW/m^3/s. Each chiller shall be modeled with separate condenser water and chilled-water pumps interlocked to operate with the associated chiller.

3.7.3.8 Supply Air Temperature Reset (Systems 3, 4, 7 and 8)

The air temperature for cooling shall be reset higher by 2.3°C under the minimum cooling load conditions.

3.7.3.9 Exhaust Air Energy Recovery (Systems 3, 4, 7 and 8)

Enthalpy recovery systems shall be included in baseline central HVAC Systems. Energy recovery efficiency shall be modeled at 50%.

3.7.3.10 Fan Power (Systems 3, 4, 7 and 8)

Fans in parallel VAV fan-powered boxes shall be sized for 50% of the peak design flow rate and shall be modeled with 0.74 W per L/s fan power. Minimum volume setpoints for fan-powered boxes shall be equal to 30% of peak design flow rate or the rate required to meet the minimum outdoor air ventilation requirement, whichever is larger. The supply air temperature setpoint shall be constant at the design condition.

3.7.3.11 VAV Fan Part-Load Performance (Systems 3, 4, 7 and 8)

VAV system supply fans shall have variable speed drives, and their part-load performance characteristics shall be modeled using either Method 1 or Method 2 specified in Table 3.7.3.11.

Table 3.7.3.11 – Part-Load Performance for VAV Fan Systems *(Source: ASHRAE 90.1-2007)*

Method 1 - Part-Load Fan Power Data	
Fan Part-Load Ratio	Fraction of Full-Load Power
0.00	0.00
0.10	0.03
0.20	0.07
0.30	0.13
0.40	0.21
0.50	0.30
0.60	0.41
0.70	0.54
0.80	0.68
0.90	0.83

Method 2 - Part-Load Fan Power Equation
$P_{fan} = 0.0013 + 0.1470 \times PLR_{fan} + 0.9506 (PLR_{fan})^2 - 0.0998 \times (PLR_{fan})^3$ where P_{fan} = fraction of full-load fan power and PLR_{fan} = fan part-load ratio (current cfm/design cfm).

1.00	1.00

3.8 Service hot water systems

ARTIFICIAL LIGHTING		
CATEGORY	PROPOSED BUILDING PERFORMANCE	BASELINE BUILDING PERFORMANCE
1 General	Service hot-water energy consumption shall be calculated on the volume of service hot water required, the entering makeup water (which shall be set to 14°C) and the leaving service hot-water temperatures. For buildings that will have no service hot-water loads, no service hot-water system shall be modelled.	Baseline Building shall be the same as the Proposed Design
2 Electrical or Fuel Hot Water System	Where an electrical (electric resistance or heat pump) or fuel hot water system has been designed the model shall be consistent with design documents.	The service hot-water system in the baseline building design shall use the same energy source as the corresponding system in the proposed design and shall conform with the following conditions: a. The baseline building design shall reflect the actual system type using the actual component capacities. b. The system shall meet the minimum efficiency values in Table 3.8.2 Minimum Efficiency of Water Heating Equipment.
3 Hot Water from other sources	Where a solar hot water system or a heat recovery water heater has been designed the model shall only include the backup system which shall be consistent with design documents. Backup system energy use for service hot water can be demonstrated to be reduced by increasing the temperature of the entering makeup water. Such reduction shall be demonstrated by calculations. *(Refer to Sections 3.8.4 and 3.10.2)*	The service hot-water system in the baseline building design shall conform with the following conditions: a. The baseline building design shall use the same energy source as the backup system in the proposed building and hot water use shall be equal to the total service hot water loads as calculated in section 3.8.4 below. b. The baseline system shall meet the minimum efficiency in Table 3.8.2 Minimum Efficiency of Water Heating Equipment.

<table>
<tr>
<td>4
Hot Water Demand</td>
<td>Service hot water loads shall be calculated in accordance with manufacturers' published sizing guidelines or generally accepted engineering standards and handbooks acceptable to the VGBC or as follow:
• Calculate the proposed domestic water consumption of the fixtures connected to the hot water system as per the LOTUS credit on Water efficient fixtures.
• Define a mixed temperature desired for each of the different fixtures using hot water (if not known, use the values in Table 3.8.4)
• Calculate the ratio of hot water to be used in the different fixtures to deliver water at the designed mixed temperature as per the following formula:
$$\text{Ratio (\%)} = 100 \times \frac{\text{Mixed Water T°C} - \text{Cold Water T°C}}{\text{Hot Water T°C} - \text{Cold Water T°C}}$$
• Define the percentage of mixed temperature water usage versus cold water usage for each fixture
• For each fixture, the hot water demand is equal to the water consumption multiplied by the ratio of hot water and the percentage of mixed temperature water usage.</td>
<td>Service water loads and usage for the baseline building shall be the same as the proposed building.

Exceptions:
1. Service hot-water usage can be demonstrated to be reduced by using calculations from the LOTUS credit on Water efficient fixtures.

2. Service hot-water energy consumption can be demonstrated to be reduced by reducing the required temperature of service mixed water, or by increasing the temperature of the entering makeup water. Examples include alternative sanitizing technologies for dishwashing and heat recovery to entering makeup water. Such reduction shall be demonstrated by calculations.</td>
</tr>
</table>

Table 3.8.2 - Minimum Efficiency of Water Heating Equipment
(Source: QCVN 09:2017/BXD and ASHRAE 90.1 -2007)

Equipment Type	Minimum Efficiency	Equipment Type	Minimum Efficiency
Gas Storage Water Heaters	78% E_T	Oil Hot Water Supply Boilers	80% E_T
Gas Instantaneous Water Heaters	78% E_T	Firewood/paper-fired boilers	60% E_T
Gas Hot Water Supply Boilers	77% E_T	Molded brown coal boilers	70% E_T
Dual Fuel Gas/Oil Hot Water Supply Boilers	80% E_T	Pitcoal-fired boilers	73% E_T
Electric Water Heater (Resistance or Heat Pump)	EF: 0.93 - 0.00035V		

EF refers to Energy factor, E_t to thermal efficiency and V is the rated volume in liters.

Table 3.8.4 - Representative Hot-Water Temperatures *(Source: ASHRAE 2011-HVAC Applications)*	
Use	Temperature °C
Lavatory	
Hand washing	40
Shaving	45
Showers and tubs	43
Therapeutic baths	35
Commercial or institutional laundry, based on fabric	up to 82
Residential dish washing and laundry	60
Surgical scrubbing	43
Commercial spray-type dish washing	
Single or multiple-tank hood or rack type	
Wash	65 min
Final rinse	82 to 90
Single-tank conveyor type	
Wash	71 min
Final rinse	82 to 90
Single-tank rack or door type	
Single-temperature wash and rinse	74 min.
Chemical sanitizing types	60
Multiple-tank conveyor type	
Wash	65 min
Pumped rinse	71 min.
Final rinse	82 to 90
Chemical sanitizing glass washer	
Wash	60
Rinse	24 min.

3.9 Process loads

PROCESS LOADS		
CATEGORY	PROPOSED BUILDING PERFORMANCE	BASELINE BUILDING PERFORMANCE
1 General	Process loads (receptacle and other loads) shall be estimated based on building use requirements and shall be included in simulations of the building. It is possible to use the Receptacle Power Density values from Table 3.9.1 to estimate receptacle loads. In case some of the loads have above-standard performance, refer to 1.7 Exceptional Calculation Method to claim energy savings from baseline.	Baseline Building shall be the same as the Proposed Design. Exception: when Exceptional Calculation Method is followed in the proposed model, the baseline shall be modelled based on standard performance. Process energy consumption should not be less than 25% of baseline total energy consumption. If no documentation substantiating low process energy is provided, process loads shall be increased until total process energy consumption is equivalent to 25% of the total.
2 Exhaust Fans	Exhaust fans not interlocked with HVAC operation (such as parking garage ventilation fans), and exhaust fans not required in the calculations of section 3.7.2.7 shall be considered as process load	Such exhaust fans shall be modelled as identical to those in the proposed design

Table 3.9.1 - Acceptable Receptacle Power Densities (Source: *ASHRAE Standard 90.1-1989 and addenda*)	
Building Type	Receptacle Power Density (Watts/m^2)
Health/Institutional	10.8
Hotel/Motel	2.7
Light Manufacturing	2.2
Office	8.1
Restaurant	1.1
Retail	2.7
School	5.4
Warehouse	1.1

Notes on Table 3.9.1: Values are in Watts per square meter of conditioned floor area. These values are the minimum acceptable. If other process loads are not input (such as for computers, cooking, refrigeration, etc.), it is recommended that receptacle power densities be increased until total process energy consumption is equivalent to 25% of the total.

3.10 Renewable and recovered Energy

RENEWABLE AND RECOVERED ENERGY		
CATEGORY	PROPOSED BUILDING PERFORMANCE	BASELINE BUILDING PERFORMANCE
1. Electricity production	Electricity produced from renewable energy sources shall be deducted from the total building energy use of the proposed building	No electricity produced from renewable energy source shall be considered in the baseline building.
2. Others	Non-electrical renewable energy or recovered energy shall be directly modelled by reducing the energy loads in the proposed building (i.e. hot water load, cooling load, receptacle load...)	The baseline building shall not consider any renewable or recovered energy. No energy loads in the building shall be modified.

4. GLOSSARY

All the terms below are completing the terms already defined in LOTUS Technical Manuals.

Automatic control device - a device capable of automatically turning loads off and on.

Conditioned space - an enclosed space within a building which is a cooled space, heated space, or indirectly conditioned space.

Coefficient of performance (COP) - The ratio of the rate of heat removal to the rate of energy input in consistent units, for a complete cooling system or factory assembled equipment, as tested under a nationally recognized standard or designated operating conditions. COP for air-cooled electrically driven air conditioners includes compressor, evaporator, and condenser. COP for water chilling packages does not include chilled water or condenser water pumps or cooling tower fans.

Cooling Seasonal Performance Factor (CPSF) - As defined in ISO 5151, CPSF is the ratio of the total annual amount of heat that the equipment can remove from the indoor air when operated for cooling in active mode to the total annual amount of energy consumed by the equipment during the same period. Unlike COP that represents the efficiency of an equipment at given conditions, CPSF represents the efficiency over a full year of operation.

Design conditions - specified environmental conditions, such as temperature and light intensity, required to be produced and maintained by a system and under which the system must operate.

Energy factor (EF) - a measure of water heater overall efficiency.

Energy loads - quantity of energy needed by the building to operate (cooling load, lighting load, hot water load, receptacle load…)

Fan system power - the sum of the motor nameplate kilowatts (kW) of all fans that are required to operate at design conditions to supply air from the heating or cooling source to the conditioned space(s) and return it to the source or exhaust it to the outdoors.

HVAC (Heating, Ventilating and Air Conditioning) - The equipment, distribution network, and terminals that provides either collectively or individually the processes of heating, ventilating, or air conditioning to a building.

IPLV (Integrated Part Load Value) - A single-number figure of merit based on part-load COP expressing part-load efficiency for air-conditioning and heat pump equipment on the basis of weighted operation at various load capacities for the equipment.

Occupant sensor - a device that detects the presence or absence of people within an area and causes lighting, equipment, or appliances to be regulated accordingly.

Process energy - energy consumed in support of a manufacturing, industrial, or commercial process other than conditioning spaces and maintaining comfort and amenities for the occupants of a building.

Process load - the load on a building resulting from the consumption or release of process energy.

Pump power - the sum of the nominal power demand (nameplate kW) of motors of all pumps that are required to operate at design conditions to supply fluid from the heating or cooling source to all heat transfer devices (e.g., coils, heat exchanger) and return it to the source.

Reset - automatic adjustment of the controller setpoint to a higher or lower value.

SHGC (Solar Heat Gain Coefficient) - The SHGC of a glass is the percent of solar energy incident on the glass that is transferred indoors both directly and indirectly through the glass.

Service water heating - heating water for domestic or commercial purposes other than space heating and process requirements

Setpoint - point at which the desired temperature (°C) of the heated or cooled space is set.

Thermal block - a collection of one or more HVAC zones grouped together for simulation purposes. Spaces need not be contiguous to be combined within a single thermal block.

Unconditioned space - an enclosed space within a building that is not a conditioned space. Crawlspaces, attics, and parking garages with natural or mechanical ventilation are not considered enclosed spaces.

Unmet load hour - an hour in which one or more zones is outside of the thermostat setpoint range.

Variable-air-volume (VAV) system - HVAC system that controls the dry-bulb temperature within a space by varying the volumetric flow of heated or cooled supply air to the space.

Zone, HVAC - a space or group of spaces within a building with heating and cooling requirements that are sufficiently similar so that desired conditions (e.g., temperature) can be maintained throughout using a single sensor (e.g., thermostat or temperature sensor).

5. APPENDIX

Appendix 1 – List of the amendments brought to Revision D from Revision C

Section	Amendments
1. GENERAL	
All	- The LOTUS Guidelines are now based on QCVN 09:2017/BXD.
3. MODELLING PARAMETERS	
3.4 Building Envelope	
5 - Vertical Fenestration	- Baseline SHGC values in Table 3.4.5 are now based on Table 2.1 of QCVN 09:2017/BXD (values for 90% & 100% of WWR are from QCVN 09:2013/BXD)
7 - Skylights	- Skylight area shall not be larger than 3% of the gross roof area (instead of 5% in Revision C) - Skylights in baseline building shall be modelled with SHGC values of 0.30, in accordance with QCVN 09:2017/BXD. - Skylights in baseline building shall be modelled with U-values of 4.26
3.5 Artificial Lighting	
3 - Lighting operation schedule	- The baseline schedule should not include any schedule adjustment.
4 - Lighting Controls for daylight	- No lighting controls for daylight shall be modelled in the baseline.
3.7 HVAC Systems	
4 - Evaporative Cooling	- New section included for projects that include evaporative cooling.
3.7.2.1 Equipment Efficiencies	- Values in Table 3.7.2.1C and Table 3.7.2.1D have been updated based on QCVN 09:2017/BXD. Table 3.7.2.1E is still based on QCVN 09:2013/BXD.
3.7.2.2 Equipment Capacities	- One sizing run with actual building orientation should be made. - The sizing run can be based on design days developed using 99.6% heating design temperatures and 1% dry-bulb and 1% wet-bulb cooling design temperatures.
3.7.2.7 System Fan Power	- Fan Motor Efficiency is based on a totally enclosed fan cooled motor at 1800 rpm. - Values in Table 3.7.2.7B have been updated based on QCVN 09:2017/BXD.
3.7.3.7 Heat Rejection	- Condenser water design supply temperature shall be calculated with a design temperature rise of 5.6°C and using the 0.4% evaporation design wetbulb temperature in °C)
3.9 Process Loads	
1 - General	- It is possible to use the Receptacle Power Density values from Table 3.9.1 to estimate receptacle loads
3 - Elevators and escalators	- This section has been removed as there are no difference on how to model elevators and escalators compared to receptacle and other loads
4. GLOSSARY	
All	- New definitions for COP, CPSF, HVAC, IPLV and SHGC are included.