ENERGY STAR® Progress & Goals Report

98

ENERGY STAR® Score[1]

T2K Enterprise

Primary Property Type: Office
Gross Floor Area (m²): 1,147
Built: 2022

For Year Ending: November 30, 2023
Date Generated: December 13, 2023

Property Address:
T2K Enterprise
103 Progress Way
Oak Bluff, Manitoba R4G0E3

Property ID: 31642589

1. The ENERGY STAR score is a 1-100 assessment of a building's energy efficiency as compared with similar buildings nationwide, adjusting for climate and business activity.

Performance Comparison

	Progress			Performance Goals		
	Baseline (Ending Date 4/30/2023)	(Ending Date 11/30/2023)	**% Change**	**Property's Target**	**National Median**	**ENERGY STAR Score of 75**
ENERGY STAR Score	99	98	-1	N/A	50	75
Energy						
Site EUI (GJ/m²)	0.39	0.44	12.9	N/A	1.05	0.81
Source EUI (GJ/m²)	0.56	0.63	13.7	N/A	1.51	1.17
Energy Cost ($)	8,836.37	8,503.15	-3.8	N/A	20,213.25	15,623.85
Energy Cost Intensity ($/m²)	7.7	7.41	-3.8	N/A	17.62	13.62
Total (Location-Based) GHG Emissions						
Total (Location-Based) GHG Emissions (Metric Tons CO2e)	11.8	13	10.2	N/A	30.9	23.9
Total (Location-Based) GHG Emissions Intensity (kgCO2e/m²)	10.3	11.3	10.2	N/A	27	20.8
Water						
All Water Use (m³)	N/A	N/A	N/A	*	*	*
Indoor Water Use (m³)	N/A	N/A	N/A	*	*	*
Indoor Water Use Intensity (m³/m²)	N/A	N/A	N/A	*	*	*
Total Water Cost ($)	N/A	N/A	N/A	*	*	*

*Setting and managing water targets is not yet available in Portfolio Manager.

T2K HQ – A Case Study in High-Performance Enclosures for Office Buildings using Quik-Therm Matrix System

Revision 1
September 17, 2024

EVOKE
Sensible building solutions

Contents

Introduction

Evoke Buildings Engineering was hired to assess the energy benefits of highly insulated enclosures for office buildings in cold Canadian cities using the T2K Enterprises HQ Office (T2K HQ) as a case study office building. The walls and roof are constructed using the Quik-Therm Matrix exterior insulation system.

This case study highlights the energy and utility cost savings that can be realized with high-performance building envelopes, as well demonstrating how exterior insulation systems like Quik-Therm Air-Dry Connect can be used to meet increasingly stringent energy standards, such as the NECB 2020. High-performance enclosures also provide additional benefits including superior occupant thermal comfort, and greater resilience to power outages.

T2K HQ Building Description

T2K HQ is a 12,000 ft² 2-storey office building in Oak Bluff Manitoba, just east of Winnipeg. T2K HQ is divided into two units. Unit A provides a combination of office and industrial shop space. The second unit, Unit B, was built as an unfinished unit for future tenant fit-out. T2K HQ is shown in the rendering below.

Figure 1. T2K HQ

Unit A office spaces are heated with 96% efficient condensing gas fired furnaces, and the industrial shop space is heated with 82% efficient indirect gas fired unit heaters. Unit B was built with only electric force-flow heaters for the interim. During operating hours, continuous ventilation is supplied to Unit A by two heat recovery ventilation (HRV) units, with an operating sensible effectiveness of around 50%. T2K HQ floorplans are shown below.

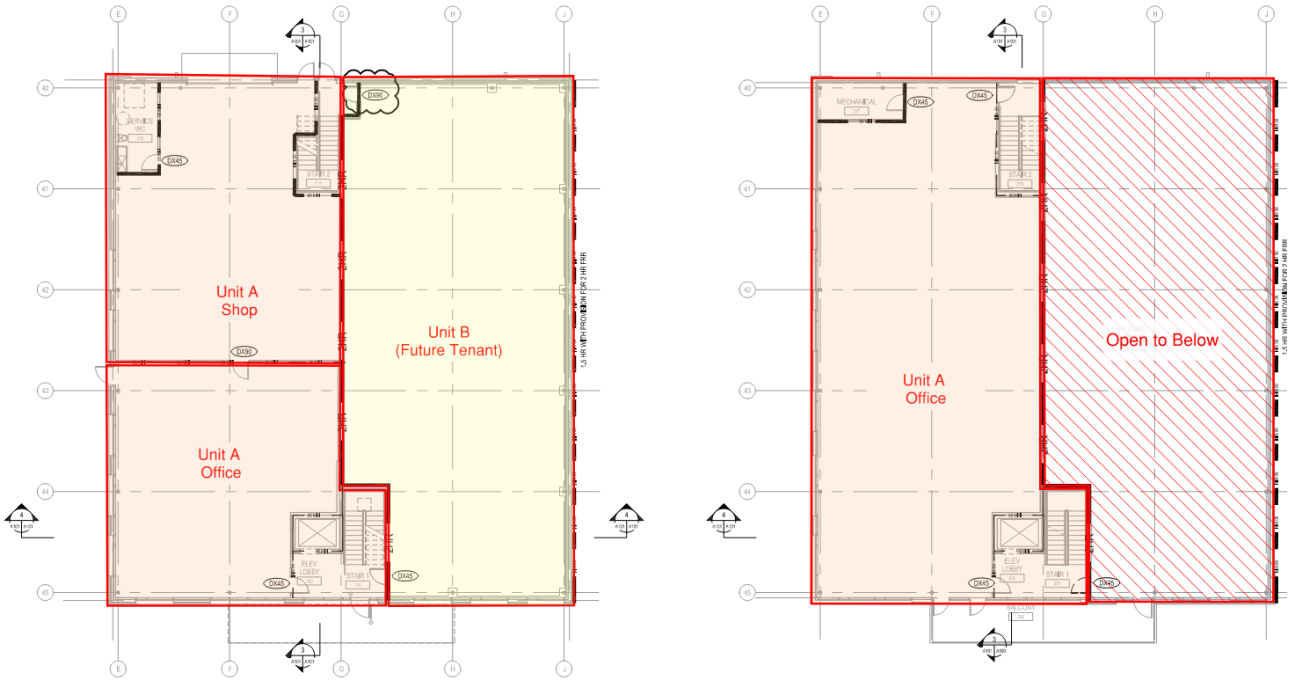


Figure 2. T2K HQ Floorplan

Building Enclosure

T2K HQ is a structural steel framed building with primarily steel-stud infill walls, and some locations with concrete block. The walls have exterior gypsum sheathing, a self-adhered air-barrier membrane, and are insulated two layers of 3 inch (76 mm) Quik-Therm Matrix panels. The roof has two layers of 6 inch (152 mm) Quik-Therm Matrix panels. The at-grade structural concrete floor slab is supported by perimeter foundation walls that are insulated with a continuous layer of 4 inch (102 mm) of Quik-Therm Sub-Grade Insulation (SGI) outboard the foundation walls and with 2 inch (51 mm) below the concrete floor slab.

T2K HQ has fiberglass double glazed low-e windows on the west elevation of unit A, and a combination of aluminum and fiberglass double glazed low-e windows and doors along the south elevation (main entrance). Unit B does not have windows along the East elevation, resulting in an overall window to wall ratio (WWR) of around 17%.

The Quik-Therm Matrix panels have built-in strips of plywood furring, metalized polymer faces, and tongue-and-groove edges. The built-in furring allows the insulation to be attached to the wall in multiple layers, which minimizes the impact of the fasteners from a heat loss perspective, and eliminates the need for thermal clips. Tongue-and-groove edges improve panel alignment and joint rigidity. A mid-construction photo of T2K HQ and a rendering of the roof system are shown below.

Figure 3. T2K Enterprises HQ Office being insulated with Quik-Therm Exterior Insulation)

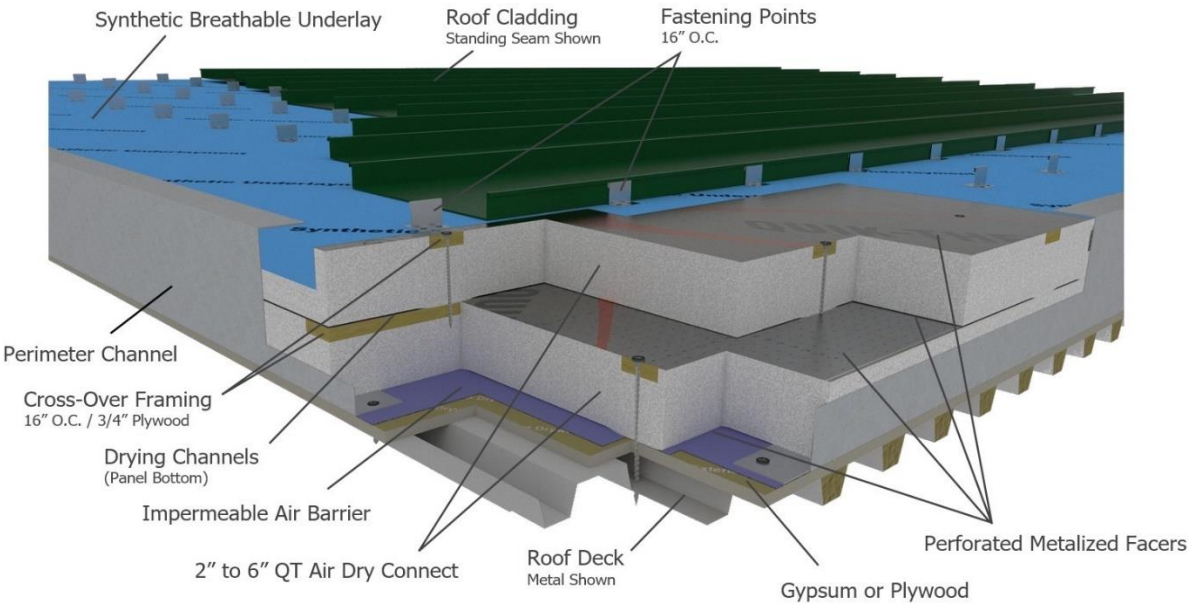


Figure 4. Quik-Therm Matrix System at the Roof (Cutaway)

Energy Performance

Benchmarking and energy modelling were undertaken to better understand energy use at T2K HQ and the potential for energy and utility cost savings for low-rise office buildings in other Canadian cities.

Benchmarking

Using an Energy Star Portfolio Manager report supplied by Quik Therm, T2K HQ was benchmarked against the 17 other office buildings in Winnipeg from the Building Energy Disclosure Project (BEDP) database, as well as against the Canadian Energy Star Portfolio Manager database. Energy Star Portfolio Manager is an online benchmarking tool that corrects for certain operational and environmental differences (such as weather, occupant density, and operating schedule) using statistical tools, and then gives the building a score compared to similar Canadian buildings.[1] The Energy Star Score represents how a building is ranked amongst the other similar buildings in the database by percentile. For example, the 10% of office buildings with the best energy performance, after correcting for weather and operating parameters, will receive Energy Star scores of 90%. Using the Energy Star Portfolio Manager portal, T2K HQ received an Energy Star Score of 98, which means it is better than 98% of existing office buildings in Canada. T2K HQ has the highest Energy Star Score of any of the office buildings in the Winnipeg BEDP database. Figure 7 shows the Energy Star Score for T2K HQ plotted along with the other Winnipeg office buildings in the BEDP database.

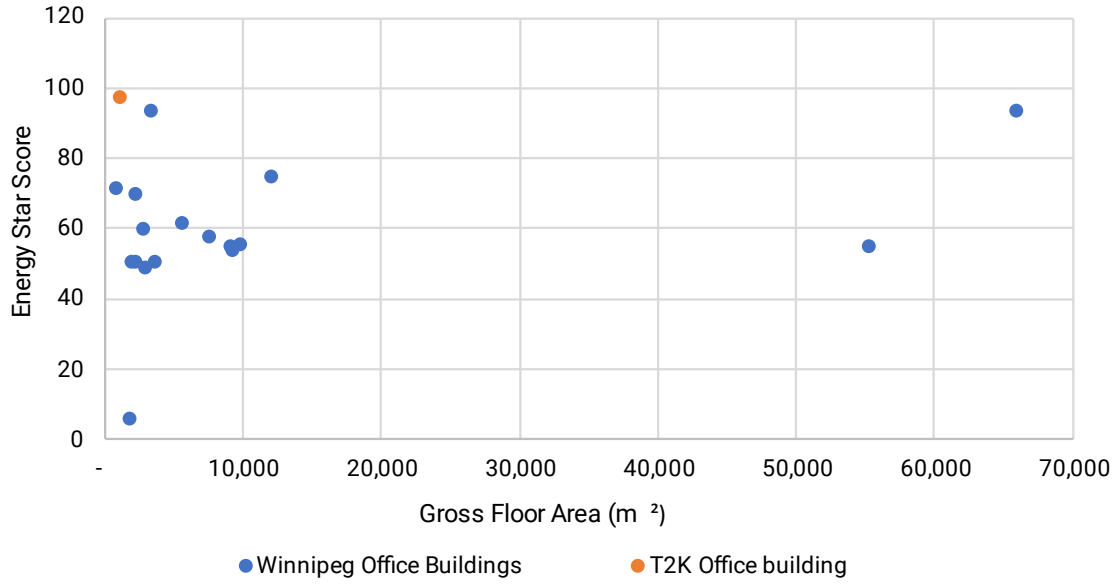


Figure 5. T2K HQ Energy Star Score vs. Winnipeg Offices in BEDP Database

While Energy Star scores correct for many building operational factors, the classifications may lack the input granularity required to fully capture that buildings have not completed tenant fit-out. For example, the Energy Star Score calculation had only 3 options for the percentage of the building

1 "Technical Reference - Energy Star Score for Offices in Canada", https://www.energystar.gov/sites/default/files/tools/Canada_Office_Technical_Reference_EN_February_2018_508.pdf

that can be heated; 0%, less than 50%, and 50% or More. T2K HQ falls under the category of "50% or more", however approximately 1/3 of the building is not occupied, meaning it does not have a ventilation system, and is only heated to 18°C. This lack of ventilation, in particular, results in lower heating usage than if the building were fully tenanted. Further, the unoccupied portion of the building has much lower lighting loads and no domestic hot water loads.

During the final fit-out of T2K HQ, the building floor area and total energy use (kWh) will both increase. The floor area will increase by approximately 1/3, and new lighting, hot water, and HVAC systems will be added. These factors will all have a significant impact, and given the details of the fit-out are unknown, it's unclear what the net effect will be on energy use intensity (kWh/m²). As such, the Energy Star score should be updated once T2K HQ is fully occupied.

Energy Model Development

A calibrated hourly energy model was created for T2K HQ to better understand the key energy use drivers. The energy model was created in EnergyPlus version 22.2 based on:

- the issued for construction (IFC) drawings and addendums,
- schedules and setpoints based on conversations with the occupant, and
- detailed enclosure R-value calculations including linear and point thermal transmittances and meeting NECB 2020 calculation requirements.

The model was calibrated against 12 months of operating utility bills and actual weather data from the Winnipeg Airport weather station. A good fit was achieved with the utility data, however there appears to be operational changes during the monitoring period, which meant the model significantly underpredicted during October, November and December, and overpredicted In January, February and March. Notably, this occurred for both electricity and natural gas.

Since it varied significantly in the same season, and both electricity and natural gas usage were affected, this indicates likely changes in building usage or operations. This could be due to a change in temperature setpoints, changes in mechanical ventilation, or differences in occupant behaviour. Since the modelled schedules are for a full year, correcting the overpredicted or underpredicted period would result in greater misalignment at other times. Since the cause of the difference was not known, the model was calibrated to an intermediate point between the two behaviours. Overall, the annual energy use of the calibrated model was within 10% for natural gas, and 20% for electricity[2]. Although this intermediate approach is not precise enough to meet the targets from the ASHRAE Guideline 14 (5%), its predictions appear to fall in the range of typical operations for T2K HQ, and is suitably accurate for the purposes of this case study. For more detailed model inputs, refer to Appendix A. The monthly energy consumption from utility bills is compared to modelled energy consumption in the figure below.

[2] Normalized Mean Bias Error (NMBE). Coefficient of Variation of the Root Mean Square Error (CVRMSE) was within 30% for both electricity and natural gas usage.

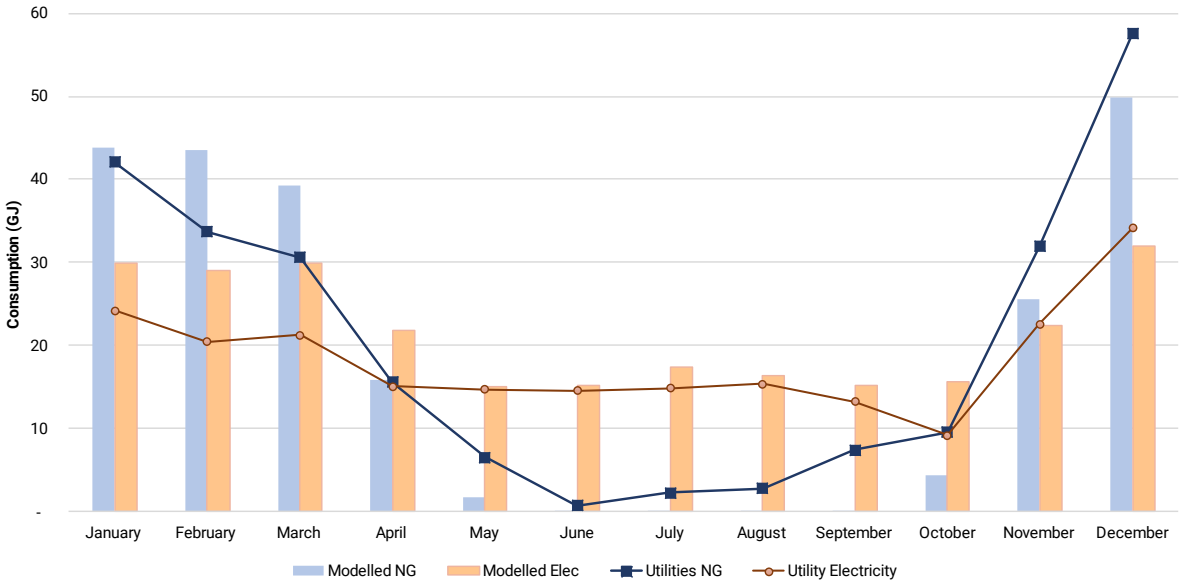


Figure 6. T2K HQ Calibrated Model Energy Use Vs. Measured Energy Use

While T2K HQ is fairly representative for small stand-alone office buildings, it has a large unused space. In an effort to make it more representative and demonstrate the potential of the Quik-Therm insulation system, several adjustments were made to the model. Starting from the calibrated model, an adjusted energy model was created by increasing office and shop heating setpoints from actual setpoints to match NECB 2020 standard assumptions, and increasing the unoccupied portion's (Unit B's) occupant density, lighting power, and plug loads to match the occupied portion (Unit A). Unit B was assumed to remain a double height space, thus the total floor area was not changed. The model was then modelled using typical meteorological year weather files. These adjustments lead to a modest increase in heating use and proportionally large increases in lighting and interior equipment. In total, modelled energy use intensity increased by 24%. In Figure 7, the energy use breakdowns for the Calibrated and Adjusted Models are compared.

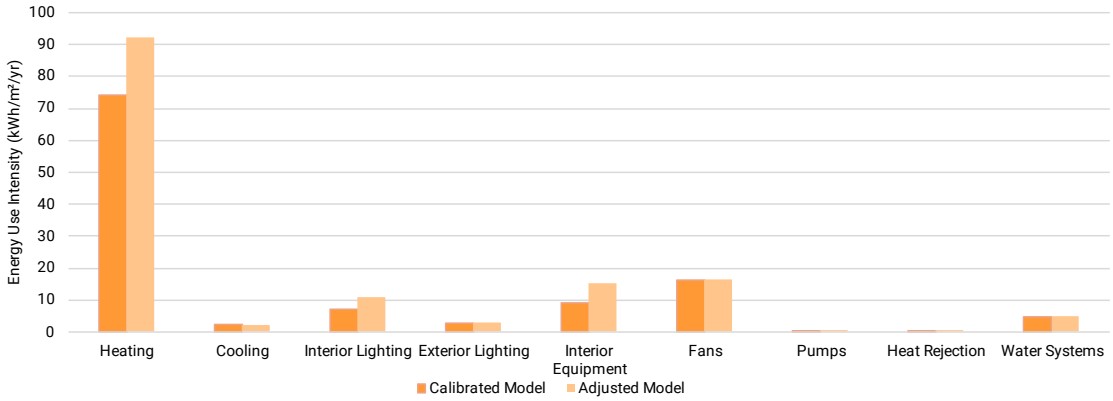


Figure 7. Energy Usage for T2K HQ Calibrated & Adjusted Energy Models

Energy and Utility Cost Savings

The adjusted model was simulated with different wall R-values and window areas in several Canadian cities to demonstrate the energy and energy cost savings possible with improved building enclosure performance. Utility costs were calculated based on the current posted electricity and natural gas costs for commercial buildings in each location, and assuming the heating system is natural gas. For electricity, an annual average cost per kWh was calculated based on the simulated buildings energy and peak power usage. Utility cost and emission factors are summarized in the table below.

Table 1. Utility Costs and Emissions Factors

Location	Elec Cost, $/kWh	Elec GHG[1] $kgCO_2/kWh$	NG Cost $/GJ	NG Cost $/kWh	NG GHG[2] $kgCO_2/kWh$
Winnipeg, MB	0.10	0.0021	13.2	0.05	0.177
Iqaluit, NU	0.50	0.84	39	0.14	0.177
Toronto, ON	0.14	0.03	6.3	0.02	0.177
Saskatoon, SK	0.134	0.73	13.0	0.047	0.177

[1]ECCC 2023, Canada GHG Inventory Annex 13
[2]ECCC 2023, Canada GHG Inventory Annex 6

Results are shown for Winnipeg and Iqaluit below, and detailed energy modelling results for all four locations are presented in Appendix B.

Table 2. Energy Performance and Energy Costs for T2K HQ Adjusted Model in Winnipeg, MB

Wall Effective* R-Value	20% WWR		30% WWR		40% WWR	
	Total Energy Use Intensity (kWh/m²**/yr)	Energy Cost ($/m²/yr)	Total Energy Use Intensity (kWh/m²/yr)	Energy Cost ($/m²/yr)	Total Energy Use Intensity (kWh/m²/yr)	Energy Cost ($/m²/yr)
R-10	167.6	$13.34	169.7	$13.54	172.4	$13.77
R-15	153.8	$12.35	158.1	$12.70	162.6	$13.08
R-20	146.8	$11.84	152.1	$12.28	157.7	$12.73
R-25	142.5	$11.54	148.5	$12.02	154.7	$12.52
R-30	139.6	$11.33	146.1	$11.85	152.7	$12.37
R-35	137.6	$11.19	144.3	$11.73	151.3	$12.27

*Including Linear Transmittances, calculated according to NECB 2020
** T2K HQ has a modelled (conditioned) floor area of 1147 m²

Table 3. **Energy Performance and Energy Costs for T2K HQ Adjusted Model in Iqaluit, NU**

Wall Effective* R-Value	20% WWR		30% WWR		40% WWR	
	Total Energy Use Intensity (kWh/m²**/yr)	Energy Cost ($/m²/yr)	Total Energy Use Intensity (kWh/m²/yr)	Energy Cost ($/m²/yr)	Total Energy Use Intensity (kWh/m²/yr)	Energy Cost ($/m²/yr)
R-10	259.0	$86.13	263.8	$87.86	269.2	$89.73
R-15	234.6	$78.71	242.9	$81.54	251.8	$84.47
R-20	222.1	$74.92	232.3	$78.32	242.9	$81.80
R-25	214.4	$72.61	225.8	$76.37	237.5	$80.18
R-30	209.4	$71.07	221.4	$75.05	233.8	$79.09
R-35	205.7	$69.96	218.3	$74.11	231.2	$78.31

*Including Linear Transmittances, calculated according to NECB 2020

** T2K HQ has a modelled (conditioned) floor area of 1147 m²

The results for Winnipeg highlight that significant energy savings are possible. R-10 effective is comparable to if T2K HQ had been built exclusively with steel-framed wall with batt insulation. Compared to results with the effective R-10 wall, an effective R-25 wall results in 16% energy savings. This equates to $2,100 per year in energy cost savings. In Iqaluit, the energy cost savings are much greater. Upgrading the wall R-value from R-10 to R-25 reduces modeled energy costs by $15,500 each year, or equivalently $155,000 over a 10-year period.

Building Enclosure Performance

This section discusses the performance of the T2K HQ Quik-Therm wall system in more detail, and highlights how the Quik-Therm can be used to meet the upcoming NECB 2020 requirements.

In the National Energy Code for Buildings (NECB) 2020, the calculation method for effective R-values has been updated compared to the NECB 2015. As the NECB 2020 is adopted by each province, it will make the R-value targets more challenging to meet, especially for walls, which tend to have more interfaces than roofs or floors. The Quik-Therm insulation system used at T2K HQ is a cost-effective solution to meet these requirements.

The new NECB 2020 enclosure requirements are outlined below.

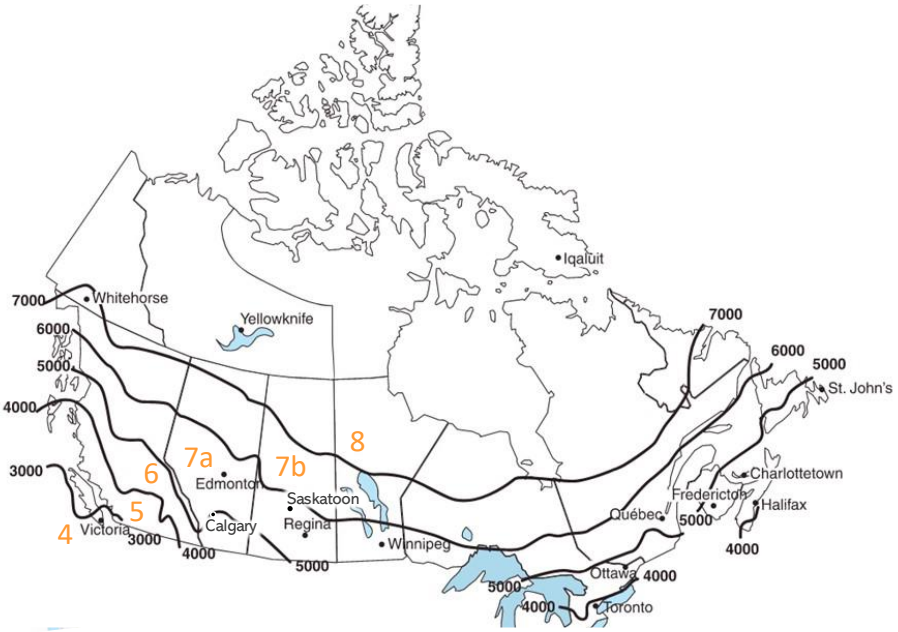


Table 4. **NECB 2020 Prescriptive Enclosure Requirements**[3]

Climate Zone	Walls		Roof		Window	
	U, W/m²K	R-value, ft² hr °F/Btu	U, W/m²K	R-value, ft² hr °F/Btu	U, W/m²K	U, Btu /ft²-hr-°F
CZ-4	0.290	20	0.164	35	1.90	0.33
CZ-5	0.265	21	0.156	36	1.90	0.33
CZ-6	0.240	24	0.138	41	1.73	0.30
CZ-7a	0.215	26	0.121	47	1.73	0.30
CZ-7b	0.190	30	0.117	49	1.44	0.25
CZ-8	0.165	34	0.110	52	1.44	0.25

[3] Effective R-values are adapted from the overall thermal transmittances of above-ground opaque building assemblies (U-value) in Table 3.2.2.2. of NECB 2020

T2K HQ Wall Clear-Field R-Values

A "clear-field" R-value accounts for repetitive structural members but excludes thermal bridging at the interface of building envelope components, such as window-to-wall interfaces. This is how effective R-values were calculated in NECB 2015 and earlier versions.

T2K HQ has 6 inches of exterior insulation on the walls. The fasteners for the insulation do not penetrate all the way from the outside to the sheathing, which makes the insulation highly effective. With common methods of attaching cladding through exterior insulation, large fasteners through the insulation or metal clips can reduce insulation effectiveness by as much as 20-30%[4,5], whereas thermal modelling of the Quik-Therm Insulation system shows that effectiveness is reduced by less than 5%. Thanks to the effects of exterior insulation and thermally efficient cladding attachment, 6 inches of Quik-Therm exterior insulation has an assembly clear field R-value of approximately R-26, whereas a steel stud wall with 6 inches of batt insulation achieves R-12 clear field.

T2K HQ Wall Effective R-Values

NECB 2017 and 2020 revised the definition of effective R-value to account for thermal bridging at the interface of building envelope components. These new effective R-value calculations require a more detailed heat loss calculation that accounts for interfaces such as window-to-wall, roof-to-wall, slab edges, and intermediate floors. Experience shows that for exterior insulated walls, poor attention to these interface details frequently leads to reductions in effective R-value of at least 50% compared to the clear-field R-value. Thus, focusing on minimizing heat loss from the interfaces is much more important than in previous codes.

At T2K HQ, the Quik-Therm insulation system was installed in a manner to minimize thermal bridging at the interfaces between different assemblies, and most interfaces are covered with 4 to 6 inches of continuous insulation. The opaque walls achieved R-19 effective. In comparison, a comparable building built with steel stud and no exterior insulation would have achieved approximately R-10 effective.

T2K has fiberglass windows installed in line with the steel stud framing. While using fiberglass windows in this scenario reduces thermal bridging somewhat, this could be further improved if the window installed further outwards, centered in the exterior insulation plane.

---

[4] RDH 2018, "Cladding Attachment Solutions for Exterior-Insulated Commercial Walls"

[5] ThermalEnvelope.ca and Building Envelope Thermal Bridging Guide

Effect of Interface Details on Wall Effective R-Values

To highlight the importance of interface detailing on overall effective wall R-value (per NECB 2020), 3 possible scenarios are explored in Table 5. The 3 scenarios include an unmitigated scenario(no effort to address thermal bridging at interfaces), the T2K HQ details, and a scenario with T2K HQ details plus windows installed in alignment with the exterior insulation.

- Unmitigated Details
  - **Wall-to-floor:** exposed concrete floor edges at grade
  - **Wall-to-Roof Interface:** uninsulated parapets
  - **Windows to wall interface:** Windows are installed in line with the steel stud wall.
- T2K HQ details
  - **Wall-to-floor:** highly insulated transition
  - **Wall-to-Roof Interface:** highly insulated transition
  - **Windows to wall interface:** Windows are installed in line with the steel stud wall.
- T2K HQ Details + Additional Window Detailing
  - **Wall-to-floor:** Matches T2K HQ
  - **Wall-to-Roof Interface:** Matches T2K HQ
  - **Windows to wall interface:** Windows installed in line with exterior insulation.

Typical example details for unmitigated and efficient interface details are provided in Appendix C.

For each of the 3 scenarios, Table 5 presents how much Quik-Therm exterior wall insulation is needed to achieve each a certain overall Wall effective R-value for buildings like T2K HQ. These values highlight the importance of addressing interface details for achieving higher overall effective R-values of the building enclosure.

With upcoming NECB 2020 requirements, all climate zones will require walls to be built to R20+. Table 5 highlight that achieving an R-20+ wall requires significant attention to mitigating thermal bridging at interfaces.

Table 5. Inches of Quik-Therm Wall Insulation Required to Achieve Target R-Value (20% WWR)

Wall Effective R-Value	Quik-Therm with Unmitigated details (Inches Exterior Insulation)	Quik-Therm with T2K HQ details (Inches Exterior Insulation)	Quik-Therm with T2K HQ details + Enhanced Window Installation (Inches Exterior Insulation)
R-10	4in	4in	4in
R-15	8in	4in	4in
R-20	(Requires > 12in)	8in	6in
R-25		10in	8in
R-30		12in	10in
R-35		(Requires > 12in)	12in

Using Quik-Therm Insulation Systems with Simple Trade-Off for Design Flexibility

Due to the stringent thermal performance targets for the opaque wall area and windows in the NECB 2020, many projects will likely choose to pursue the simple trade-off or performance path approaches instead of the prescriptive path. This section provides several worked examples of using the Simple Trade-Off Path.

For the Simple Trade-Off Path, the performance of the whole vertical enclosure is compared to a reference enclosure designed to meet the prescriptive requirements. Buildings can trade off wall R-value, fenestration and door U-Values, and fenestration and door areas. The reference building is assumed to have the maximum allowable window area specified by the prescriptive path.

With the cost-effective wall performance available using the Quik-Therm Insulation system, the simple trade-off approach can be used to optimize the design, such as enabling the use of lower-cost windows, or to increase the window-to-wall ratio.

Example 1: Using the Quik-Therm Insulation system to enable use of lower cost windows

Assuming that window area in the design is already fixed, wall performance can be increased to compensate for lower performance, less costly windows. The table below provides an example of simple trade-off calculations for a building with a 20% window-and-door to wall ratio, similar to T2K HQ.

Using the trade-off path for an example building in Winnipeg, an extra 2 inches of Quik-Therm Insulation means the building can use utilize double-glazed windows (U-0.35 btu/hr-ft^2-F), instead of requiring triple-glazed windows with metal frames (U-0.25 btu/hr-ft^2-F).

Table 4. Simple Trade-Off Example: Trading Wall Performance for Window Performance (SI units)

		Reference (Ref) and Proposed (Prop) Inputs	Winnipeg, MB	
Reference (Simple Trade-Off Inputs)	1	HDD	5670	
	2	Max U-value (Wall)	0.215	
	3	Max U-value (Fenestration)	1.73	
	4	Max Fenestration to Wall Ratio	0.29	
Max U-value	5	Reference: Max U-value (W/m^2-K)	0.65	
Proposed (Simple Trade-Off Calculation)	6	Proposed Fenestration to Wall Ratio	20%	20%
	7	Prop. $U_{Fenestration}$ (SI) (U-value, IP)	1.42 (0.25)	1.99 (0.35)
	8	Prop. U-Wall (SI) (R-value, IP)	0.46 (R-12.3)	0.32 (R-17.8)
	QT	Inches of Quik-Therm Matrix Wall Insulation with Thermally Efficient Details	4in	6in

Example 2: Using Quik-Therm to enable higher Window-to-Wall Ratios

Higher wall performance can also be used to allow higher window-to-wall ratios.

When looking at window to wall ratio, an extra 2 inches of Quik-Therm insulation enables an additional 10% window to wall ratio for the this example building in Iqaluit.

Table 5. **Simple Trade-Off Example: Trading Wall Performance for Window Area (SI units)**

		Reference (Ref) and Proposed (Prop) Inputs	Iqaluit, NU	
Reference (Simple Trade-Off Inputs)	1	HDD	9980	
	2	Max U-value (Wall)	0.165	
	3	Max U-value (Fenestration)	1.44	
	4	Max Fenestration to Wall Ratio	0.2	
Max U-value	5	Reference: Max U-value	0.42	
Proposed (Simple Trade-Off Calculation)	6	Proposed Fenestration to Wall Ratio	15%	25%
	7	Prop. $U_{Fenestration}$ (SI) (U-value, IP)	1.08 (0.19)	1.08 (0.19)
	8	Prop. U-Wall (SI) (R-value, IP)	0.3 (R-18.7)	0.20 (R-28.3)
	QT	Inches Quik-Therm Matrix Wall Insulation with Thermally Efficient Details	6in	8in

Other benefits of high-performance building enclosures

In addition to reducing energy consumption, a highly insulated and airtight enclosure with exterior insulation improves thermal comfort, durability, and resilience.

Resilience is increased by maintaining the internal temperature of a building in the event of a power outage through less heat loss through the building enclosure. During a winter power-outage, highly insulated buildings with a high level of airtightness can last days, instead of hours, without heating before they reach freezing temperatures and risk damage, for example burst pipes[6].

[6] RMI 2020 "Hours of safety in cold weather: A framework for considering resilience in building envelope design and construction"

Conclusion

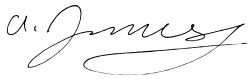
This report highlights the numerous benefits that are possible with optimizing the Quik-Therm Insulation system with the entire building enclosure, such as energy savings, utility cost savings, or construction cost savings using the simple trade-off approach.

As the NECB 2020 is adopted by provinces, providing exterior insulation and mitigating the impact of thermal bridging will be critical to meeting code. The Quik-Therm Insulation system used at T2K HQ is an example that is well positioned to meet the NECB 2020 requirements, and can exceed requirements thus creating opportunities to optimize for constructability or cost.

We trust this report has provided you with the necessary insights into T2K HQ and the Quik-Therm Insulation system. Please do not hesitate to reach us if you require further information.

Sincerely,

Evoke Buildings Engineering Inc.



Alex Janusz, P.Eng., M.A.Sc., CPHD
Building Energy Consultant

Alex Blue, P.Eng. (BC, AB, ON), LEED AP BD+C, BEMP
Principal, Building Energy Specialist

Appendixes:

Appendix A: Detailed Energy Model Inputs

Appendix B: Complete Energy Model Results

Appendix C - Typical Unmitigated and Efficient Interface Details

Appendix A: Detailed Energy Model Inputs

PROJECT INFORMATION

Project Name	103 Progress Way – T2K Enterprise Inc. HQ
Stage of Project	Calibrated Energy Model
Project Identifier	Newly Built
Location (Jurisdiction)	Winnipeg
Project Address	103 Progress Way, Oak Bluff, MB.
HDD Below 18 °C	5670
Climate Zone	7A
Building Description	Office building, partly unoccupied.
Building Area	Calibrated Model: Conditioned Floor – 1147 m^2 Adjusted Model: Conditioned Floor – 1147 m^2 (Unit B remains double height)

MODELLING SOFTWARE INFORMATION

Software	EnergyPlus v22.2
Weather File	MB_WINNIPEG-IAP_718520_23-22.epw

LOADS AND SCHEDULES

Space Types	Lighting LPD (W/m^2)	Occupants (m^2/Occ.)	Plug loads (W/m^2)	DHW (W/person)	Schedules
A-Shop	2.7	30	1	90	2 hrs/day
A-Tenant	4.9	20	7.5	90	M-F 8-5
B-Tenant	0.2	200	0	0	Service
ElecMech	10	200	1	0	Service
Elevator	0	200	0	0	Service
Lobby	1.7	10	0	0	M-F 8-5
Stairs	1.7	200	0	0	M-F 8-5
Washroom	5.6	30	1	0	M-F 8-5

Lighting Notes	Calibrated Model: The LPDs are based on a takeoff. The electrical room and washroom are on a 2 hour/day schedule. Adjusted Model: B-Tenant loads (Lights, occupants, plug loads) set to match A-Tenant
Occupancy Notes	Occupancy is using NECB 2011 default.
Plug Load Notes	NECB 2011 default is used.
DHW Notes	NECB 2011 default is used.
Exterior Lighting	739W, controlled by photocell.
Temperature Setpoints	Calibrated Model: Office is heated to 21-24°C, shop is 19°C. Since the building has in-floor heating on bottom floor, the thermostat is adjusted by 2°C in the model for those zones, as per NECB. Adjusted Model: All offices and shops (Unit A + B) heating set to NECB Sch A (Office, Workshop/Warehouse) - 22°C daytime, 18°C setback
Additional Loads	Exhaust fans based on drawings. Elevator estimated to be 3kW.

BUILDING ENVELOPE

OPAQUE ENVELOPE	
Exterior Walls	R_{eff}-19 Exterior insulated Steel Framed. 6" Quik-Therm of rigid insulation. Including thermal bridging of fasteners, windows, base of wall and roof transitions.
Exterior Roofs	R-53 nominal, R_{eff}-47 Quik-Therm Matrix System. 12" of rigid insulation. Including thermal bridging.
Below Grade Slab	Ffactor-0.38 R-10 of insulation on entire slab floor and R-19 for 48" on grade beam. Based on table A6.3, from ASHRAE 90.1.
GLAZING	
Windows	Most windows are fiberglass, modeled as USI-1.5, SHGC 0.3 Entryway glazing and small number of other windows are aluminum framed, modeled as USI-2.0, SHGC: 0.4 Glass Doors: USI-2.2, SHGC: 0.4
Window-to-wall Ratio	~16%
SHADING	
Exterior Building Shades	At Balcony.
AIR TIGHTNESS	
Infiltration	Modeled as: 0.25 L/s/m^2 of exterior wall and roof area at typical operating pressure, with 0.224 wind coefficient. Air tightness testing not conducted; estimated based on calibration.

MECHANICAL SYSTEMS

HVAC SYSTEM	
Office	System Type: Furnace for heating, cooling and ventilation. Heat recovery units, two, 500 CFM each. Ventilation CFM based on mechanical drawing. Performance: Heating: 96% effectiveness. Cooling: 3.7 HRV: 70% efficiency (150 CFM), 45% (500 CFM) Fans: 0.26 W/CFM (Furnace) 1 W/CFM (HRV) Others: Exhaust fan in washroom, and mechanical room.
Others	Gas unit heaters in shop/garage and lobby. Electric unit heaters in future tenant space. In-floor heating supplied by boiler for first floor.
DOMESTIC HOT WATER (DHW)	
DHW Load	As per NECB.
DHW Heating Equipment	Electric heater.

Appendix B: Complete Energy Model Results

Table B1. Energy Performance and Energy Costs for T2K HQ Adjusted Model in Winnipeg, MB

Wall Effective * R-Value	20% WWR		30% WWR		40% WWR		50% WWR	
	Total Energy Use Intensity (kWh/m²**/yr)	Energy Cost ($/m²/yr)	Total Energy Use Intensity (kWh/m²/yr)	Energy Cost ($/m²/yr)	Total Energy Use Intensity (kWh/m²/yr)	Energy Cost ($/m²/yr)	Total Energy Use Intensity (kWh/m²/yr)	Energy Cost ($/m²/yr)
R-10	167.6	$13.34	169.7	$13.54	172.4	$13.77	175.3	$14.02
R-15	153.8	$12.35	158.1	$12.70	162.6	$13.08	167.5	$13.47
R-20	146.8	$11.84	152.1	$12.28	157.7	$12.73	163.5	$13.18
R-25	142.5	$11.54	148.5	$12.02	154.7	$12.52	161.1	$13.01
R-30	139.6	$11.33	146.1	$11.85	152.7	$12.37	159.5	$12.90
R-35	137.6	$11.19	144.3	$11.73	151.3	$12.27	158.3	$12.82

*Including Linear Transmittances, calculated according to NECB 2020

** T2K HQ has a modelled (conditioned) floor area of 1147 m²

Table B2. Energy Performance and Energy Costs for T2K HQ Adjusted Model in Iqaluit, NU

Wall Effective* R-Value	20% WWR		30% WWR		40% WWR		50% WWR	
	Total Energy Use Intensity (kWh/m²**/yr)	Energy Cost ($/m²/yr)	Total Energy Use Intensity (kWh/m²/yr)	Energy Cost ($/m²/yr)	Total Energy Use Intensity (kWh/m²/yr)	Energy Cost ($/m²/yr)	Total Energy Use Intensity (kWh/m²/yr)	Energy Cost ($/m²/yr)
R-10	259.0	$86.13	263.8	$87.86	269.2	$89.73	275.0	$91.73
R-15	234.6	$78.71	242.9	$81.54	251.8	$84.47	260.9	$87.50
R-20	222.1	$74.92	232.3	$78.32	242.9	$81.80	253.7	$85.35
R-25	214.4	$72.61	225.8	$76.37	237.5	$80.18	249.4	$84.04
R-30	209.4	$71.07	221.4	$75.05	233.8	$79.09	246.4	$83.17
R-35	205.7	$69.96	218.3	$74.11	231.2	$78.31	244.3	$82.54

*Including Linear Transmittances, calculated according to NECB 2020

** T2K HQ has a modelled (conditioned) floor area of 1147 m²

Table B3. **Energy Performance and Energy Costs for T2K HQ Adjusted Model in Toronto, ON**

Wall Effective* R-Value	20% WWR		30% WWR		40% WWR		50% WWR	
	Total Energy Use Intensity (kWh/m²**/yr)	Energy Cost ($/m²/yr)	Total Energy Use Intensity (kWh/m²/yr)	Energy Cost ($/m²/yr)	Total Energy Use Intensity (kWh/m²/yr)	Energy Cost ($/m²/yr)	Total Energy Use Intensity (kWh/m²/yr)	Energy Cost ($/m²/yr)
R-10	120.6	$12.68	121.1	$12.83	122.1	$13.01	123.4	$13.22
R-15	111.4	$11.97	113.4	$12.24	115.7	$12.54	118.4	$12.84
R-20	106.8	$11.61	109.4	$11.94	112.5	$12.29	115.8	$12.65
R-25	103.9	$11.39	107.1	$11.75	110.6	$12.14	114.2	$12.53
R-30	102.0	$11.25	105.5	$11.63	109.3	$12.05	113.2	$12.46
R-35	100.7	$11.15	104.4	$11.55	108.3	$11.98	112.4	$12.40

*Including Linear Transmittances, calculated according to NECB 2020

** T2K HQ has a modelled (conditioned) floor area of 1147 m²

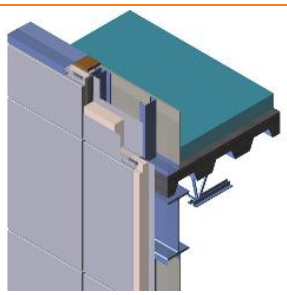
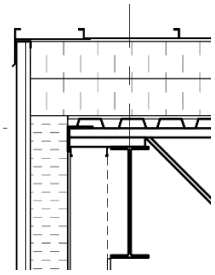
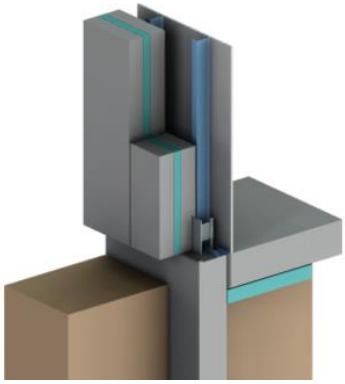
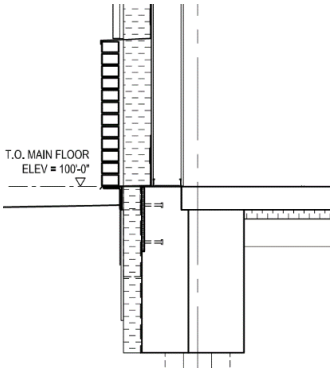
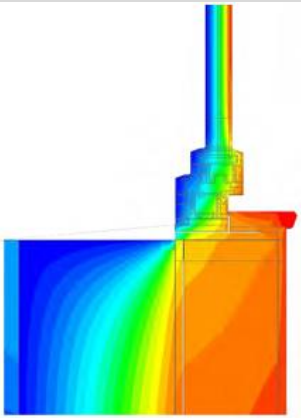
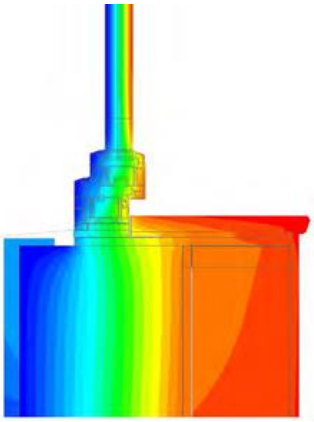
Table B4. **Energy Performance and Energy Costs for T2K HQ Adjusted Model in Saskatoon, SK**

Wall Effective* R-Value	20% WWR		30% WWR		40% WWR		50% WWR	
	Total Energy Use Intensity (kWh/m²**/yr)	Energy Cost ($/m²/yr)	Total Energy Use Intensity (kWh/m²/yr)	Energy Cost ($/m²/yr)	Total Energy Use Intensity (kWh/m²/yr)	Energy Cost ($/m²/yr)	Total Energy Use Intensity (kWh/m²/yr)	Energy Cost ($/m²/yr)
R-10	153.6	$15.60	156.0	$15.90	158.8	$16.23	162.0	$16.59
R-15	139.9	$14.41	144.4	$14.90	149.2	$15.40	154.2	$15.92
R-20	132.8	$13.80	138.5	$14.39	144.3	$14.98	150.3	$15.58
R-25	128.6	$13.43	134.9	$14.08	141.3	$14.73	147.9	$15.38
R-30	125.7	$13.19	132.4	$13.87	139.3	$14.55	146.3	$15.24
R-35	123.7	$13.01	130.7	$13.72	137.9	$14.43	145.1	$15.14

*Including Linear Transmittances, calculated according to NECB 2020

** T2K HQ has a modelled (conditioned) floor area of 1147 m²

Appendix C: Typical Unmitigated and Efficient Interface Details

Interface Details	Unmitigated Details	Efficient Details
Roof to Wall	 BETBG[7] 6.4.2	 T2K HQ – As Built
	0.5 W/mk	**0.2 W/mk**
Wall to Floor	 BETBG 7.7.3	 T2K HQ – As Built
	0.6 W/mk	**0.1 W/mk**
Window to Wall	 Fiberglass Window aligned with steel framing[8]	 Fiberglass Window aligned with insulation[8]
	0.16 W/mk	**0.05 W/mk**

[7] Building Envelope Thermal Bridging Guide (BETBG), details from https://thermalenvelope.ca/

[8] BC Hydro 2020, Guide to Low Thermal Energy Demand for Large Buildings