Project Documentation
Gebäude-Dokumentation

Abstract | Zusammenfassung

© ERA Architects

Ken Soble Tower EnerPHit

Data of building | Gebäudedaten

Year of construction Baujahr	2021	**Space heating** **Heizwärmebedarf**	**24** **kWh/(m²a)**
U-value external wall U-Wert Außenwand	0.131 W/(m²K)		
U-value basement U-Wert Kellerdecke	3.728 W/(m²K)	Primary Energy Renewable (PER) Erneuerbare Primärenergie (PER)	106 kWh/(m²a)
U-value roof U-Wert Dach	0.09 W/(m²K)	Generation of renewable Energy Erzeugung erneuerb. Energie	0 kWh/(m²a)
U-value window U-Wert Fenster	1.09 W/(m²K)	Non-renewable Primary Energy (PE) Nicht erneuerbare Primärenergie (PE)	155 kWh/(m²a)
Heat recovery Wärmerückgewinnung	84 %	Pressurization test n_{50} Drucktest n_{50}	0.2 h^{-1}
Special features Besonderheiten	Air Admittance Valves used for all sanitary stacks. Tempering of cooling with ceiling fans and low-e shading.		

Brief Description

Ken Soble Tower EnerPHit

This 18 story 146 unit social housing retrofit is the largest EnerPHit of it's kind in the the world. Built in 1967 the client was faced with the question of tearing it down or improving it. The decision to retrofit it to the EnerPHit standard was made and realized.

The project is part of City Housing Hamilton's portfolio and is occupied primarily by seniors. The project included a full interior and exterior update, addition of ducted ventilation to each space, new hot water risers, internal and external insulation, new heat recovery ventilation and ductless commercial dryers.

Given the low window to wall ratio, no active cooling was installed. Instead tempering of the hygienic air, ceiling fans, low-e internal blinds, moderate solar heat gain windows and fully operable windows create the comfort strategy.

Responsible project participants
Verantwortliche Projektbeteiligte

Architect Entwurfsverfasser	ERA Architects https://www.eraarch.ca/
Building systems Haustechnik	Reinbold Engineering Group https://reinboldengineering.com/
Structural engineering Baustatik	Entuitive https://www.entuitive.com/
Building physics Bauphysik	Entuitive https://www.entuitive.com/
Passive House project planning Passivhaus-Projektierung	Josh Vanwyck, JMV Consulting https://www.jmvconsulting.ca/
Construction management Bauleitung	PCL Construction https://www.pcl.com/ca/en

Certifying body
Zertifizierungsstelle

Herz & Lang
https://www.herz-lang.de/de/

Certification ID
Zertifizierungs ID

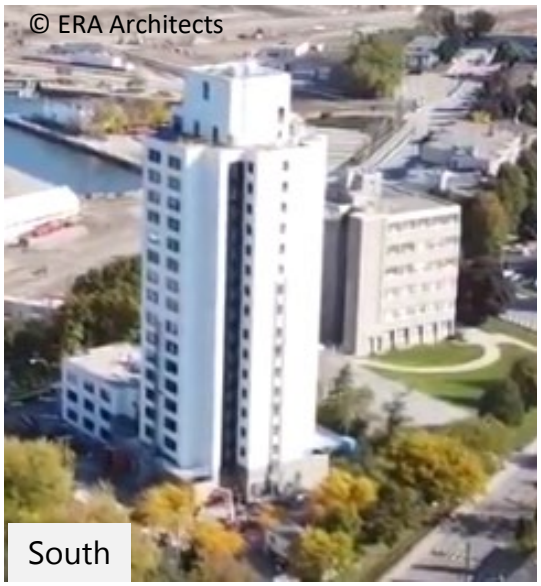
6773	https://passivehouse-database.org/#d_6773 Projekt-ID (www.passivhausprojekte.de)

Author of project documentation
Verfasser der Gebäude-Dokumentation

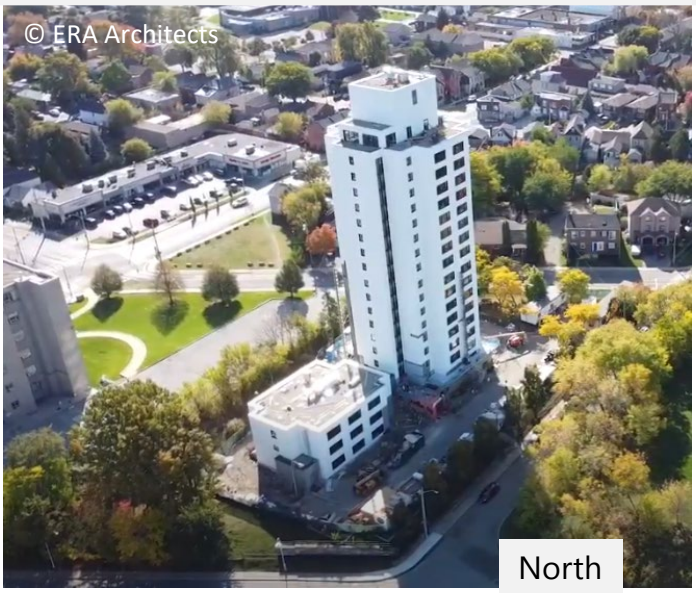
Joshua Vanwyck, JMV Consulting

Date Datum	Signature Unterschrift
March 9, 2023	

1. Site Photos

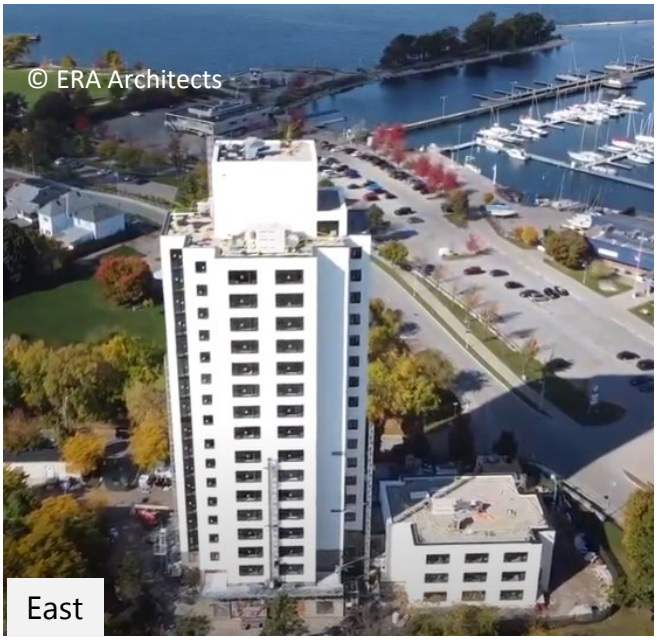


South



North

West



East

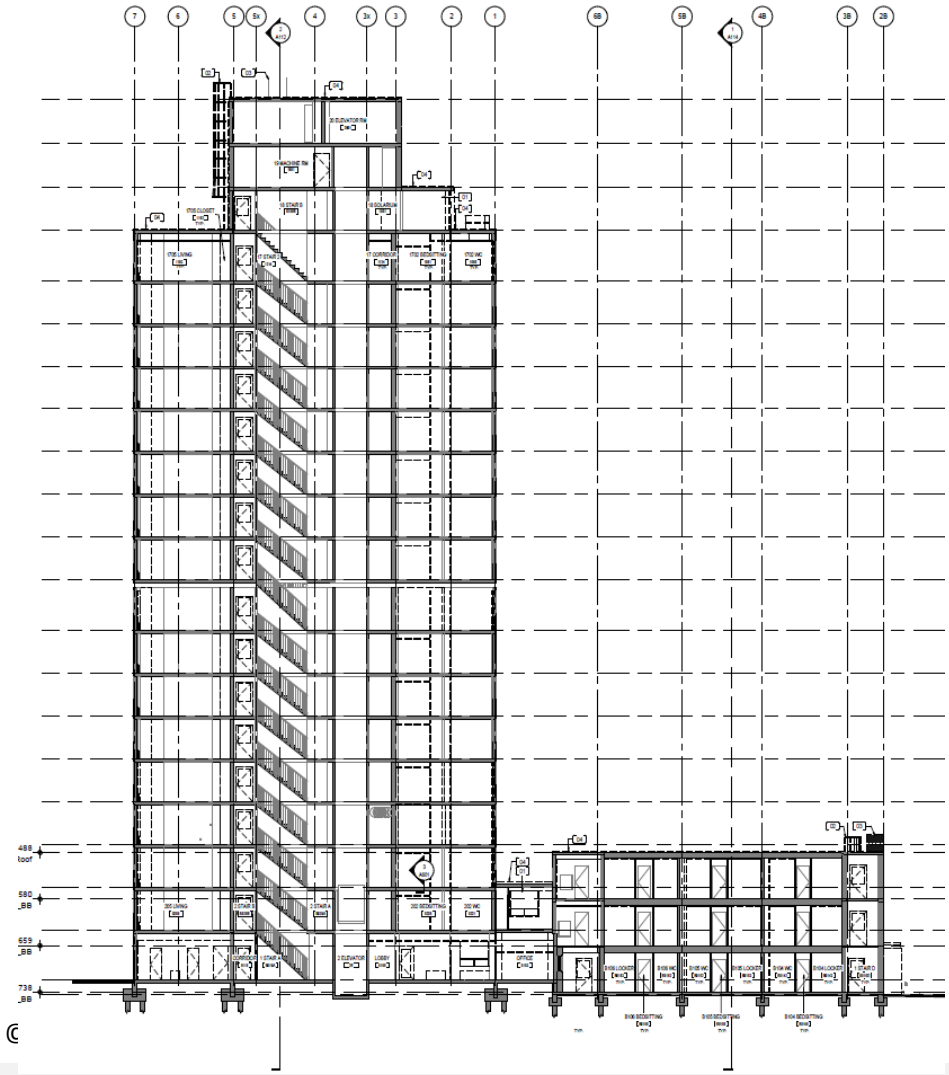
Entrance

2. Example Interior Photos

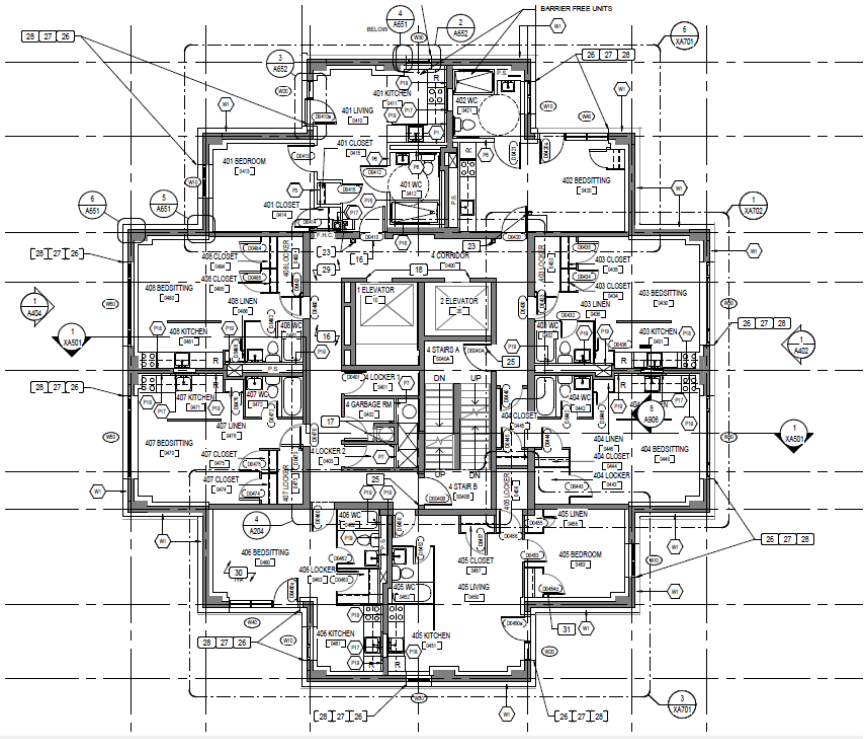
Sample Unit

Solarium View

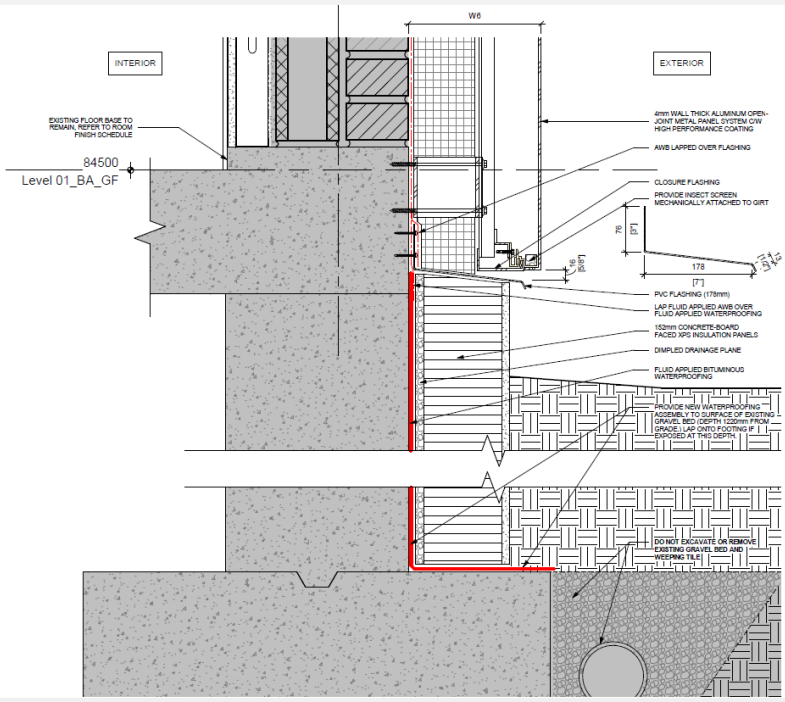
3. Section: The below section shows the shape of the building but doesn't fully capture the added insulation and mechanical upgrades.



4. Typical Floor Plan: This floor plan shows a typical floor layout on one of the tower floors. Addition of ceiling fans, direct ducting, and controls are shown in the mechanical and electrical drawings.



5.1 Ground Floor Construction



The existing foundation and floor was left untouched in the retrofit. 152 mm thick XPS perimeter insulation was added to the exterior of the foundation, from the ground slab to the footings of the building.

Thermal bridge studies were done to ensure the surface temperature in the residential spaces would stay above the minimum Frsi values.

Assembly no. 04ud — **Floor Slab** — Interior insulation?

Heat transmission resistance [m²K/W]

Orientation of building element: **3-Floor** — interior R_{si}: 0.17

Adjacent to: **2-Ground** — exterior R_{se}: 0.00

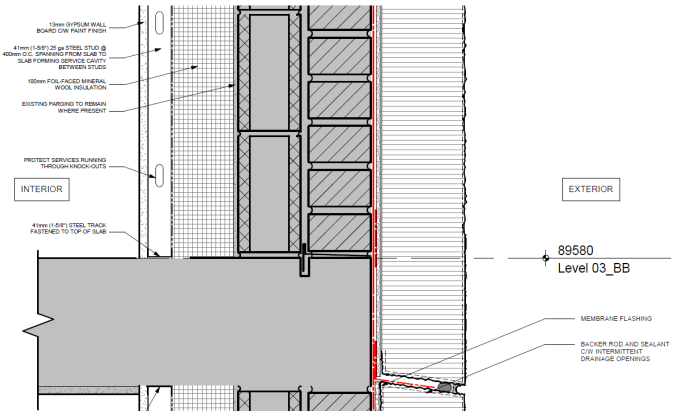
Area section 1	λ [W/(mK)]	Area section 2 (optional)	λ [W/(mK)]	Area section 3 (optional)	λ [W/(mK)]	Thickness [mm]
Flooring	**0.300**					**5**
Concrete	**2.500**					**204**

Percentage of sec. 1: 100% — Percentage of sec. 2: — Percentage of sec. 3: — Total: **20.9** cm

R 1.5

U-value supplement: — W/(m²K) — **U-value:** **3.728** W/(m²K)

5.2 Construction of Exterior Walls



A split insulated approach was used for the exterior walls. 4" (100mm) of foil backed rockwool was used on the inside as both insulation and a vapour barrier. A liquid applied air barrier membrane was applied to the exterior existing brick

Assembly no.	Building assembly description					Interior insulation?
01ud	W1 - Exterior Wall with EIFS w P13					

Heat transmission resistance [m²K/W]

Orientation of building element: 2-Wall — interior R_{si}: 0.13

Adjacent to: 1-Outdoor air — exterior R_{se}: 0.04

Area section 1	λ [W/(mK)]	Area section 2 (optional)	λ [W/(mK)]	Area section 3 (optional)	λ [W/(mK)]	Thickness [mm]
Gypsum Wall	0.250					13
air gap	0.125	incl. steel studs				41
Foil lined Batt Mineral Wool	0.034					100
Plaster + concrete blocks	0.800					110
air gap	0.079					13
brick	1.000					102
rigid mineral wool	0.036					152

Percentage of sec. 1	Percentage of sec. 2	Percentage of sec. 3	Total
100%			53.1 cm

R 43.3

U-value supplement: 0.0081 W/(m²K)

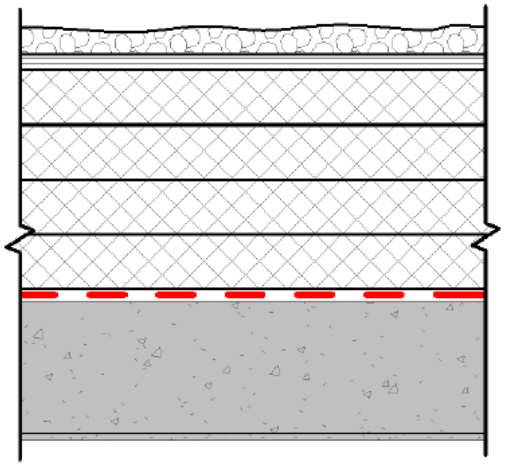
U-value: 0.131 W/(m²K)

insulfast fasteners without cap 8.07 pieces / m² with correction factor of 0.5 for interior insulation

5.3. Roof Construction

PROPOSED ROOF ASSEMBLIES - INVERTED ROOF

R2



R VALUE: 43.02

ABOVE

- RIVERSTONE GRAVEL BALLAST
- FILTER FABRIC
- 400mm (4 LAYERS OF 100mm) EXTRUDED POLYSTYRENE RIGID INSULATION
- FLUID-APPLIED POLYURETHANE ROOF MEMBRANE
- EXISTING CONCRETE SLAB AND STRUCTURE
- EXISTING PLASTER CEILING

BELOW

The installed roof was an inverted roof with 400 mm (16") of rigid polystyrene insulation. A fluid applied membrane was applied to create a new air barrier, and all penetrations (drains, roof anchors, etc) were addressed in the thermal bridges.

Assembly no.						Interior insulation?
02ud	R2 - Inverted Roof Assembly					

Heat transmission resistance [m²K/W]

Orientation of building element	1-Roof	interior R_{si}	0.10
Adjacent to	1-Outdoor air	exterior R_{se}	0.04

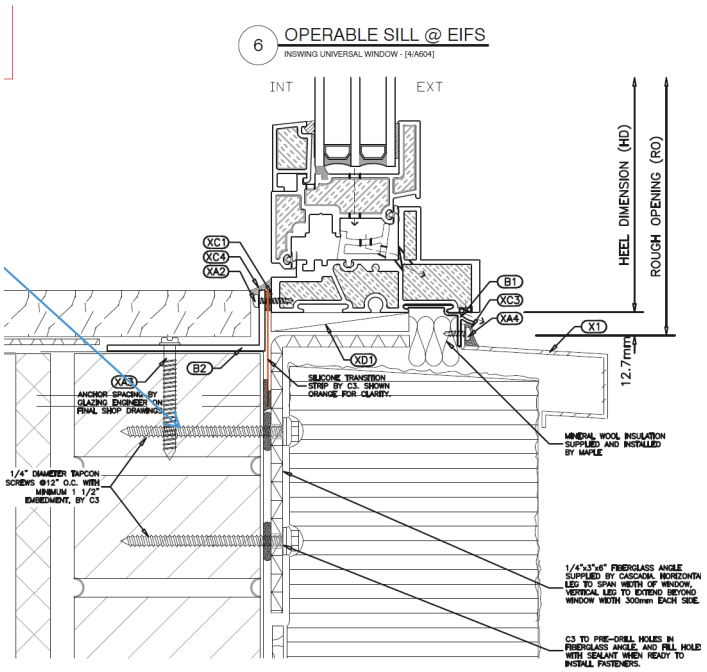
Area section 1	λ [W/(mK)]	Area section 2 (optional)	λ [W/(mK)]	Area section 3 (optional)	λ [W/(mK)]	Thickness [mm]
Plaster	0.700					13
Concrete	2.500					204
Rigid Insulation (XPS)	0.037					400
Filter Fabric						
Gravel Ballast						

Percentage of sec. 1	Percentage of sec. 2	Percentage of sec. 3	Total
100%			61.7 cm

U-value supplement: W/(m²K)

U-value: 0.090 W/(m²K)

5.6 Windows



Majority of windows were Passive House Certified Fiberglass windows. On the ground floor some of the doors and small amount of storefront was aluminum doors from Old Castle and insulated steel fire exit doors.

Description of Window Frame Manufacturer	**Cascadia Windows Ltd.**
Window Name	Universal Window (Fiberglass Frame with Tri-Seal Super Spacer)
Frame U-Value (Uf)	0.88 W/(m²K) (Operable) 0.81 W/(m²K) (Fixed)
Glass Description	Argon Filled 6 mm Low-E Cardinal 270 | 11 mm spacer | 6 mm Cardinal 180 | 11 mm spacer | 6 mm Low-E Cardinal i89
Glazing u-value (Ug)	0.72 W/(m²K) and 0.70 W/(m²K) depending on orientation
g-value of glass	0.38 and 0.50 depending on orientation

6. Description of Airtight Envelope

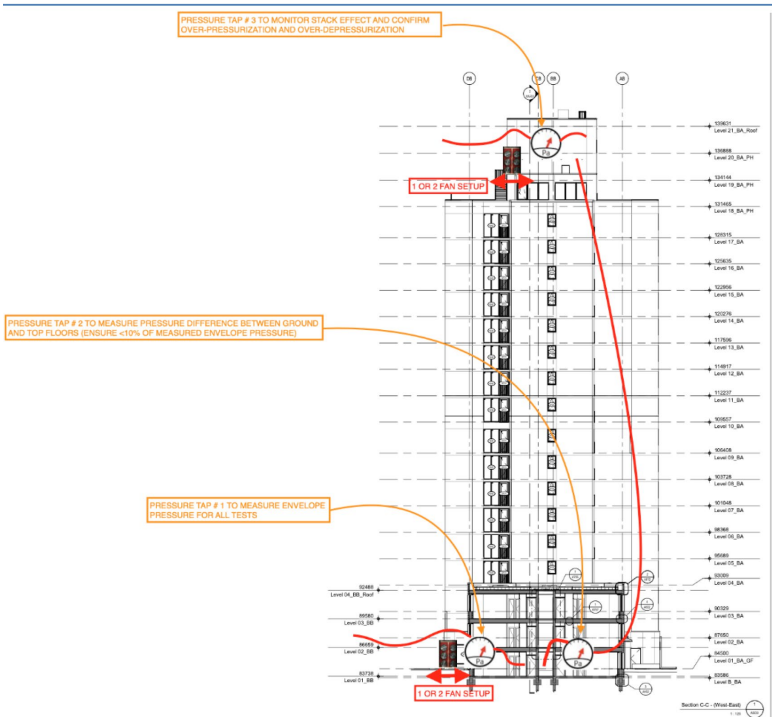
The airtightness of the building was done by creating a new exterior airbarrier. For the external walls a fluid applied membrane was used. The transition to the windows was done with silicone inserts for the corners and rough opening. The transition to the roof goes over the parapet and and connects to the external fluid applied membrane on the roof.

At the ground floor no additional airtightness measures were taken beyond the fluid applied membrane and new flooring inside the building.

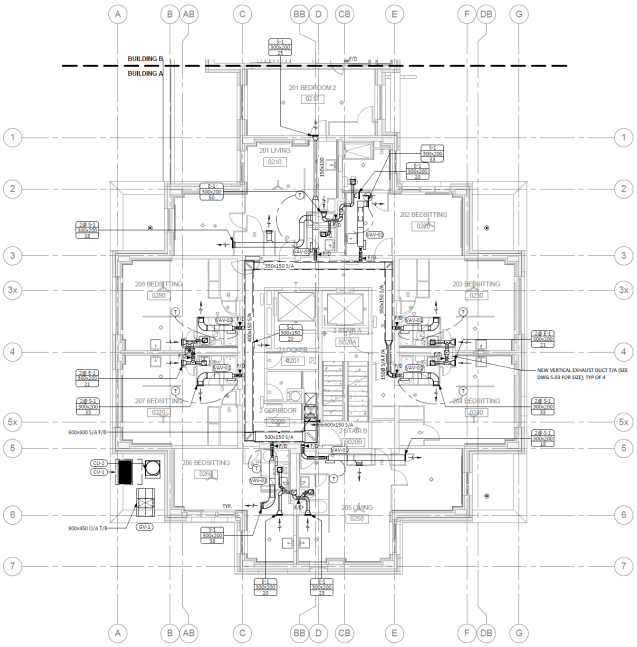
The contractor did continuous airtightness testing during construction, testing window installs, guarded floor tests and a baseline full building test and a final blower door test. The final test followed the testing protocol recommended in the Airtightness measurements of high-rise buildings from the PHI. This was very helpful in ensuring full pressurization was reached. Final results exceeded expectations with a 96% improvement in airtightness.

Final test was completed by EngineeringLink on March 13, 2021 with a final result of 0.235 ACH at 50Pa.

Air Tightness Criteria	ACH 50
Baseline Test (Full Building)	5.41
EnerPHit Limit	1.0
Construction Target	0.6
Final Test (Full Building)	**0.235**



7.1. Ventilation Ductwork



Supply air is provided to each room with a VAV box and a post heater for additional heating. The individual unit air supply comes via the central ducts in the central shafts. For the tower the bottom half of the building is supplied from the mechanical room and the top half is supplied from the ERV on the roof.

Exhaust air is taken from the bathroom and near the kitchen. The kitchen range hood is a recirculation hood to remove odors and oils.

The corridors are slightly pressurized to ensure no cross contamination between suites.

7.2. Air Handling Unit Description

Ventilation Unit	Electrical Efficiency	Effective Heat Recovery Efficiency
Swegon - GOLD RX 50	0.45	84%
Swegon - GOLD RX 50	0.45	84%
Swegon - GOLD RX 12	0.49	84%
Zehnder ComfoAir Q600 ST ERV	0.22	78%
Zehnder - ComfoAir160 ERV, ComfoD160 ERV, ComfoD150 ERV	0.33	80%
RenewAire EV Premium L	0.52	58%

Multiple AHUs were used in the project, to serve the different parts of the building. The SWEGON units serve the residential areas, the Zehnder units serve the ground floor common areas and the RenewAire serves the garbage chute.

8. Heat supply system

The primary heating and cooling of the air supply comes from the LG VRF heat pumps. The additional heating is provided via electric resistance heaters in the supply air at each unit.

A condensing gas boiler is used for the domestic hot water supply. Drain Water heat recovery is installed below all showers and baths.

9. PHPP-Key Results

EnerPHit Verification

Building:	Ken Soble Tower		
Street:	500 MacNab St N		
Postcode/City:	L8L 1L8	Hamilton	
Province/Country:	Ontario		CA-Canada
Building type:	Multi-story affordable Housing		
Climate data set:	CA0001b-Toronto		
Climate zone:	3: Cool-temperate	Altitude of location:	83 m
Home owner / Client:	CityHousing Hamilton		
Street:	55 Hess St S, 23rd Floor		
Postcode/City:	L8N 4E5	Hamilton - PO Box 2500	
Province/Country:	Ontario		CA-Canada

Architecture:	ERA Architects		
Street:	625 Church St #600		
Postcode/City:	M4Y 2G1	Toronto	
Province/Country:	Ontario		CA-Canada
Energy consultancy:	JMV / Transsolar GmbH		
Street:	1586 Robb Ave.		
Postcode/City:	V9M 2Y2	Comox	
Province/Country:	British Columbia		CA-Canada

Mechanical engineer:	REINBOLD ENGINEERING GROUP		
Street:	214 King Street West, Suite 212		
Postcode/City:	M5H 3S6	Toronto	
Province/Country:	Ontario		CA-Canada
Certification:	Herz & Lang GmbH		
Street:	Ritzensonnenhalb 5a		
Postcode/City:	87480	Weitnau	
Province/Country:	Bavaria		DE-Germany

Year of construction:	2019	Interior temperature winter [°C]:	20.0	Interior temp. summer [°C]:	25.0
No. of dwelling units:	146	Internal heat gains (IHG) heating case [W/m²]:	3.5	IHG cooling case [W/m²]:	3.7
No. of occupants:	181.3	Specific capacity [Wh/K per m² TFA]:	156	Mechanical cooling:	x

Specific building characteristics with reference to the treated floor area

					Criteria	Alternative criteria	Fullfilled?[2]
	Treated floor area	m²	5353.4				
Space heating	Heating demand	kWh/(m²a)	24	≤	25	-	yes
	Heating load	W/m²	15	≤	-	-	
Space cooling	Cooling & dehum. demand	kWh/(m²a)	4	≤	19	19	yes
	Cooling load	W/m²	7	≤	-	11	
	Frequency of overheating (> 25 °C)	%	-	≤	-		-
	Frequency of excessively high humidity (> 12 g/kg)	%	9	≤	10		yes
Airtightness	Pressurization test result n_{50}	1/h	0.2	≤	1.0		yes
Non-renewable Primary Energy (PE)	PE demand	kWh/(m²a)	155	≤	196		yes
Primary Energy Renewable (PER)	PER demand	kWh/(m²a)	106	≤	-	-	-
	Generation of renewable energy (in relation to pro-jected building footprint area)	kWh/(m²a)	0	≥	-	-	

[2] Empty field: Data missing; '-': No requirement

I confirm that the values given herein have been determined following the PHPP methodology and based on the characteristic values of the building. The PHPP calculations are attached to this verification.

EnerPHit Classic? yes

Task: First name: Surname: Signature:

The project comfortable hit the EnerPHit Targets with a small extension for the Primary Energy based on the project density. The airtightness results were key to hitting the final targets.

10. Costs

Total project costs were approximately $34 000 000 CAD with a GFA of 7525 m² and 146 units. The federal government of Canada provided $17 000 000 CAD in financial support. This helps to support providing rents at 50% below the market rate.

Funding partners for the project include: City of Hamilton; Federation of Canadian Municipalities (FCM) Green Municipal Fund; CMHC National Housing Co-investment Fund; CMHC Affordable Housing Innovation Fund; Province of Ontario

11. Measurement and Verification

There is an ongoing measurement and verification study being led by the University of Toronto. The study includes qualitative interviews with occupants, and quantitative measurements including energy use, temperature and humidity, fan and operable window usage, energy usage from pumps, fans, boilers, etc.

Final results will be available 2 – 2.5 years after occupation.

12. Awards

- Hamilton Urban Design Awards: Civic Achievement, 2021
- Toronto Construction Association (TCA): Best of Best Awards: Project Achievement, 2022
- EIFS Council of Canada (ECC): Architectural Design Awards Grand Prize, 2022
- Canada Green Building Council (CaGBC) Awards: Green Building Excellence: Deep Carbon Retrofit, 2022
- Engineering News Record (ENR): Global Best Projects: Best Green Project, 2022
- Urban Land Institute (ULI): Terwilliger Center Award for Innovation in Attainable Housing, 2022
- Federation of Canadian Municipalities (FCM) Sustainable Community Awards: Affordable Housing Retrofit, 2022
- Ontario Heritage Trust: Lieutenant Governor's Award, 2022

13. Articles and Publications

- National Housing Strategy Case Study, September 2021: https://assets.cmhc-schl.gc.ca/sites/cmhc/professional/housing-markets-data-and-research/housing-research/research-reports/nhs-outcomes/2021/ken-soble-tower-renewal-en.pdf?rev=42663f16-aa43-4467-af6e-21e89d04c0ec
- Canadian Architect, ERA Architects designs the Ken Soble Tower, https://www.canadianarchitect.com/era-architects-designs-the-ken-soble-tower/
- ERA Architects, Canada's Ken Soble Tower certified as world's largest residential Passive House EnerPHit retrofit, https://www.eraarch.ca/2022/canadas-ken-soble-tower-certified-as-worlds-largest-residential-passive-house-enerphit-retrofit/
- CBC, The social housing high-rise at 500 MacNab is now newer, greener and welcoming back tenants, https://www.cbc.ca/news/canada/hamilton/500-macnab-1.6188431
- Revitalization, AN AGING, AFFORDABLE RESIDENTIAL TOWER FOR SENIORS IS RENOVATED INTO ONE OF THE LARGEST "PASSIVE HOUSE" RETROFITS IN NORTH AMERICA, https://revitalization.org/article/affordable-seniors-residential-tower/
- Building, The Ken Soble Tower, https://building.ca/gallery/the-ken-soble-tower/
- Toronto Star, A 'quantum leap' for Ken Soble Tower in North End, https://www.thestar.com/ths/news/hamilton-region/2021/09/24/hamilton-cityhousing.html
- Dezeen, Tower in Ontario becomes world's tallest retrofitted Passivhaus structure, https://www.dezeen.com/2022/03/23/ken-soble-tower-ontario-tallest-retrofitted-passivhaus/
- Metropolis, In the Toronto Suburbs, Affordable Senior Housing is Overhauled to Meet the Highest Efficiency Standards , https://metropolismag.com/projects/ken-soble-era-toronto/
- AZURE, (Almost) Never Demolish: Reviving Social Housing Through Preservation, https://www.azuremagazine.com/article/the-most-innovative-approach-to-social-housing-is-preservation/