CAN ARCHITECTURE AFFECT CLIMATE CHANGE?

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Since 36% of global energy is devoted to the construction and operation of buildings, with 8% of global emissions caused by the production of concrete alone., it is imperative we apply our skills to reduce the increasing pressures on the environment.   As architects, we have the responsibility and opportunity to take the lead on how we design and detail energy efficient buildings, which are the single largest source of emissions in New York City.

In order to achieve the goal of the reduction of carbon emissions, the NYC Energy Conservation Code (2020 NYCECC) plays an important role, requiring buildings to be significantly more energy efficient. Especially with regard to designing and detailing the assemblies of the building exterior envelope. The challenge of how to stop the thermal transmission through the exterior wall assembly is always a critical focus. The careful design of the thermal envelope, ensuring continuous insulation makes a big difference in energy efficiency. After New York City released 2020 NYCECC, there is much more focus on reducing potential "thermal bridge" conditions that cause heat transfer through the thermal envelope.

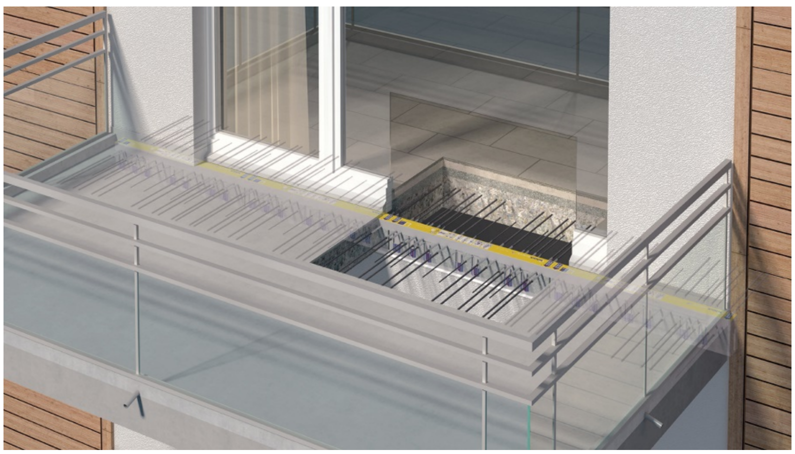
In our newly designed multi-family residential building in Brooklyn, in order to enhance the performance of the thermal envelope, our exterior detailing has been refined to stop the heat transfer through all exterior portions of the building and especially the concrete balcony slabs and parapets by using a product called "thermal break."   We carefully studied the envelope design and documented all the potential thermal bridge conditions to make sure we can minimize the energy lost.

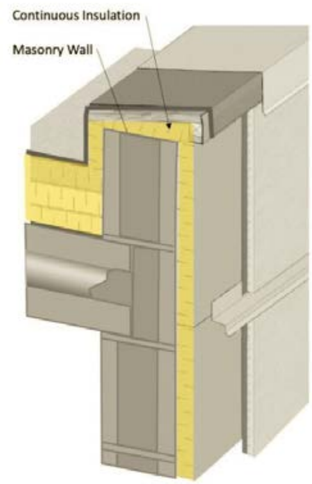
Here are the biggest changes of the 2020 NYC Energy Conservation Code, which took effect in January of 2020, with respect to building design:

1. **More stringent insulation and fenestration requirements for most assembly types**
   There are more stringent insulation requirements for almost all components of the building's thermal envelope including walls, floors, roof, and any other elements that enclose conditioned space.
   Requirements for fenestration (windows, skylights, and transparent doors) are more stringent for both the maximum allowable U-factor and SHGC (solar heat gain coefficient), and all glazing components must be thoroughly documented. The new code also differentiates vertical fenestration requirements depending on the height of

the windows above grade. Windows below 95 feet have more stringent U-factor requirements than the same type of fenestration at 95 feet or above.

2. **Mandatory thermal break for balconies and parapets.**
   In new construction, balconies and parapets that interrupt the building's thermal envelope must either be wrapped with continuous insulation with an R-value equivalent to the adjacent wall, or provide a minimum R-3 structural thermal break in order to mitigate thermal bridging. There a number of structural thermal bridge products now available, which essentially knit concrete slabs together with re-bar through a non-conductive break.





Left: *Schock Isokorb Structural Thermal Break*
Right: Photo Source BC Hydro Building envelope thermal Bridging Guide V. 1.2 - Sept. 2018

3. **Documentation of thermal bridges including clear field, point and linear thermal bridges**.
   There are three basic types of thermal bridges:
   a. Clear field – this type applies to areas of envelope assemblies which incorporate repetitive small connecting elements such as masonry walls with brick ties, rain screen walls with backup clip connections, and even EIFS walls with pin connections holding down the rigid insulation.
   b. Point – element-based thermal transmittance associated with a discrete element that penetrates the building envelope, such as a beam penetrating a wall (often seen at projecting canopies), or an element penetrating a roof or floor (such as posts supporting a roof stair, open screen wall, or mechanical equipment platforms).
   c. Linear – length-based thermal transmittance associated with horizontal, vertical, or diagonal elements within the building envelope such as balcony, floor, fenestration perimeter transition, parapet, and floor slab edge.

The updated code also requires extensive building wide diagramming of each type of thermal bridge to now be part of the construction document set along with representative fully worked out construction details. For point thermal bridges (where the single penetration is larger than 12 sq in in commercial building or 8 sq in in residential building), we need to provide the size and quantity for each condition. For linear thermal bridges, we need to provide the total length of each condition and also provide diagrams to show how they are entered into the envelope energy analysis.

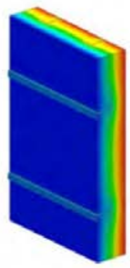


Figure 6: Example clear field assembly

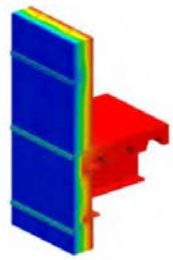


Figure 7: Example linear transmittance of a floor slab detail

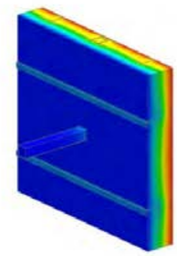
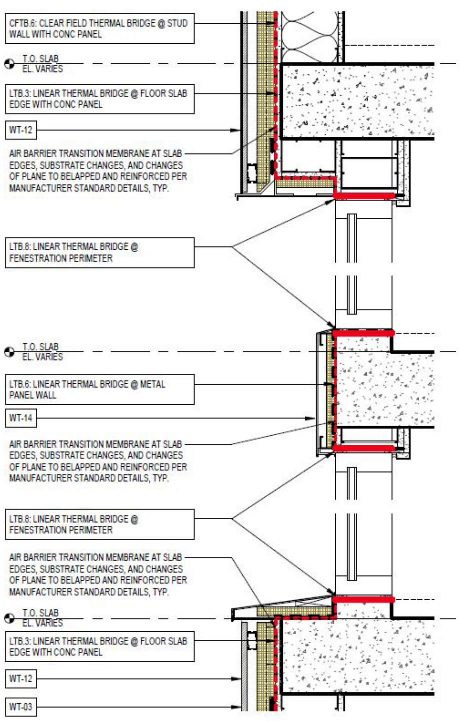


Figure 8: Example point transmittance of a beam penetration detail

Photo source: BC Hydro Building Envelope Thermal Bridging Guide V. 1.2 - Sept. 2018

4. **Air leakage/barrier testing and air barrier continuity plan (ABC Plan).**
   The updated code reduces the threshold for air barrier testing to 10,000 sf. for new, additions and existing building, and requires an “air barrier continuity plan” set of diagrams. A typical drawing would be a building envelope section with a bold line highlighting the path of the continuous air barrier, along with details and product information of membrane barriers and sealants and their associated assembly U-values and R-values.



Air barrier continuity plan with continuous insulation

5. **Sustainable Roof Features**
   Areas of roof over 200 square feet that are not used for occupiable terraces, or mechanical and service areas will now need to be either covered with planted roof area, or banks of photovoltaic cells.

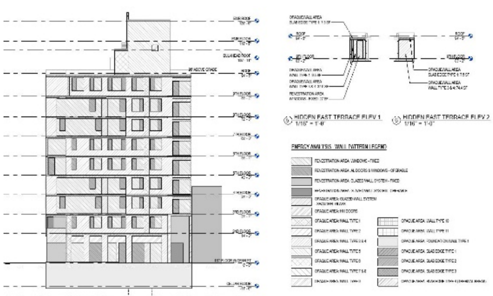
   
   NYC DDC – Green Roofs, Creating a More Sustainable New York City

These are big improvements in terms of energy efficiency for the building envelope. However, to be sure that the elements discussed above are not only identified correctly, but documented accurately, before an analysis is even started, the applicable code compliance path needs to be established:

1. **2020 NYCECC Compliance Path vs. ASHRAE 90.1-2016 (2020 NYCECC, Appendix CA) Compliance Path.**
   To use commercial building as example, there are two paths we can follow. The easiest way to determine which compliance path we want to use is to check the vertical fenestration. ECC compliance path allow up to 30% of the gross above-grade wall area to be vertical fenestration. Alternatively, we can choose ASHRAE 90.1 (2020 NYCECC, Appendix CA) as our compliance path so the maximum allowance for the vertical fenestration could be up to 40% of gross above-grade wall area. If the vertical fenestration exceeds 40% of the gross above-grade wall area, the design team must use an energy modeling method.

2. **Options of prescriptive compliance – Tabular vs. COMcheck**

There are two options to demonstrate “prescriptive” ECC compliance, which means that individual building components meet a pre-set energy performance value spelled out (prescribed) in the code. (Such as R-33 insulation required for a roof) For commercial building (or residential building over 4 stories), there is the option to use either a tabular analysis approach, which is simply listing the applicable performance value required and illustrating how a specific assembly or product meets the performance threshold. (Such as showing a roof detail that shows 7” of rigid insulation providing an R-35 for the roof example above – exceeding the required R-33) This approach is typically used for smaller projects where a limited number of conditions are to be documented. For larger more complicated projects, the use of a free and easily downloaded software program called COMcheck is a better solution. This is a program that allows for a “trade-off” approach to designing the energy conserving components, where for example, thicker insulation on the roof can compensate for less insulation in the walls, as long as in the aggregate the overall performance of all of the building envelope pieces meets code.



	Component	Assembly	Building Area Type	Orientation	Fenestration Details	Concrete Density	Construction Details	Gross Area or Slab Perimeter	Units	Cavity Insulation R-Value	Continuous Insulation R-Value	U-Factor
	▾ Building											
1	WT-01 / EXTERIOR WALL TYPE 1	Solid Concrete:12" Thi...	1 - Multifamily ...	North		Norma...	Furring: M...	201	ft2	15.0	10.0	0.057
2	WT-02 / EXTERIOR WALL TYPE 2	Concrete Block:8", Soli...	1 - Multifamily ...	North		Norma...	Furring: M...	23	ft2	15.0	7.5	0.067
3	▾WT-03, 04 / EXTERIOR WALL TYPE 3 & 4	Steel-Framed, 16" o.c.	1 - Multifamily ...	North				5585	ft2	21.0	10.0	0.051
4	WINDOWS - FIXED	Metal Frame:Fixed, < 9...			Product ID: REY...			2141	ft2			0.290
5	AL DOORS & WINDOWS - OPERABLE	Metal Frame:Operable,...			Product ID: REY...			863	ft2			0.310
6	GLAZED WALL SYSTEM - FIXED	Curtain Wall:Fixed			Product ID: REY...			281	ft2			0.300
7	GLAZED WALL SYSTEM - OPERABLE	Curtain Wall:Operable			Product ID: REY...			79	ft2			0.390
8	▾WT-05 / EXTERIOR WALL TYPE 5	Solid Concrete:12" Thi...	1 - Multifamily ...	North		Norma...	Furring: M...	558	ft2	15.0	10.0	0.057
9	HM DOOR	Uninsulated Double-L...					Non-Swin...	9	ft2			0.500
10	WT-06 / EXTERIOR WALL TYPE 6	Concrete Block:8", Soli...	1 - Multifamily ...	North		Norma...	Furring: M...	75	ft2	15.0	10.0	0.057
11	WT-09 / EXTERIOR WALL TYPE 9	Steel-Framed, 16" o.c.	1 - Multifamily ...	North				182	ft2	15.0	10.0	0.054
12	GLAZED WALL SYSTEM - OPAQUE	Other Exterior Wall	1 - Multifamily ...	North				286	ft2			0.290
13	WT-12 / SLAB EDGE TYPE 1	Solid Concrete:7" Thic...	1 - Multifamily ...	North		Norma...	Furring: N...	370	ft2		10.0	0.085
14	WT-13 / SLAB EDGE TYPE 2	Solid Concrete:7" Thic...	1 - Multifamily ...	North		Norma...	Furring: N...	9	ft2		10.0	0.085
15	WT-14 / SLAB EDGE TYPE 3	Solid Concrete:6" Thic...	1 - Multifamily ...	North		Norma...	Furring: N...	89	ft2		5.0	0.150
16	WT-15 / SLAB EDGE TYPE 4 (THERMAL BREAK)	Solid Concrete:7" Thic...	1 - Multifamily ...	North		Norma...	Furring: N...	34	ft2		3.44	0.193
17	F-01 / FOUNDATION WALL - TYPE 1	Solid Concrete:12" Thi...	1 - Multifamily ...	North		Norma...	Furring: N...	925	ft2		20.0	0.046
18	WT-01 / EXTERIOR WALL TYPE 1	Solid Concrete:12" Thi...	1 - Multifamily ...	East		Norma...	Furring: M...	266	ft2	15.0	10.0	0.057

COMcheck report with wall assembly diagram

As architects in New York City, one of the biggest cities in the world, we are key players in the fight to slow climate change. Spending a bit of mental energy now to surmount the learning curve required to absorb these new code updates into our planning process will result in vastly less energy spent in the buildings we design, and our planet that we all call home will thank us for it!

See more information regarding of 2020 NYC Energy Conservation Code:
How-to Guide by NYC DOB -
https://www1.nyc.gov/assets/buildings/pdf/h2g_all_2020_nycecc.pdf

NYC ECC Chapter 5000 - https://www1.nyc.gov/assets/buildings/rules/1_RCNY_5000-01.pdf
Introducing the 2020 NYCECC -
https://cdn.ymaws.com/acecny.org/resource/resmgr/membersonly/nycdob_presentation_2020_ene.pdf

BC Hydro building envelope thermal bridging guide -
https://www.bchydro.com/powersmart/business/programs/new-construction.html#thermal