DESIGN GUIDE

Isobloc wall construction is carried out in the same way as standard concrete blocks. However, certain special features apply. This design guide compiles technical information and the various constraints of Isobloc to help you simplify the specification of Isobloc for your projects.

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User Information

This guide is intended to be a generic work and is not designed for a specific building. The information contained in this document is at most up to date at the date of its writing and must be continually checked by the designer in conjunction with the rules, standards and laws applicable to the building whose design and construction is planned, following the analysis by the said designer and/or installer.

As mentioned above, it is the user's responsibility to ensure that the assemblies comply with the building code and standards in force, as well as the reference publications, technical data sheets and instructions from the manufacturers of the products that will be used in the project.

All principles illustrated must be analyzed in their context of use.

Waterproofing system and building envelope

The envelope of a building must be treated with care, from design to construction, to ongoing maintenance, because it integrates multiple important functions:

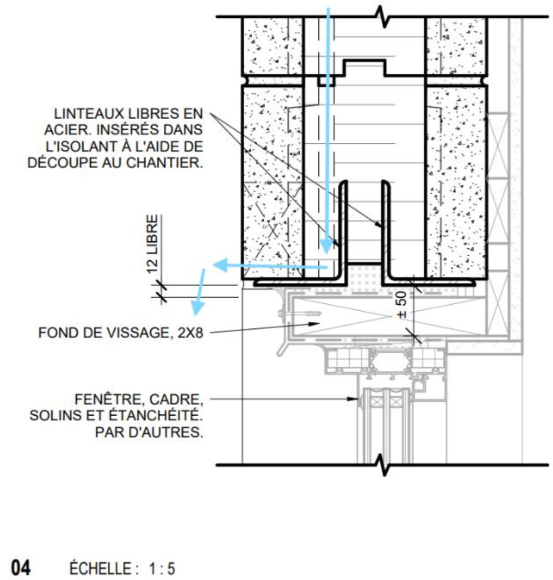
- Rainscreen
- Air barrier
- Vapor barrier
- Thermal and acoustic insulation
- Sustainability
- Protection against fire risks
- Safety of its occupants
- Comfort of its occupants
- Aesthetic
- And all the requirements dictated by the function and specific use of the building.

All of these functions are addressed by the Isobloc wall system. The following sections discuss these points in more detail.

Rainscreen and water drainage in the cavity

The weather barrier, also called a rainscreen, is provided by the concrete wall on the exterior side. Water passing through the concrete wall is channeled through grooves in the polystyrene and evacuated through weep holes at the bottom of the wall or above the openings.

Just like a "conventional" wall, it is therefore important to provide weep holes and vents to allow some air circulation in the space. It is also always necessary to design details, assemblies or junctions to allow water to drain from the cavity.



Extract from sheet **ISB.FE.01** Available on the Isobloc website

Air barrier and vapor barrier screen

The air and vapor barrier in an Isobloc wall is provided by the polystyrene core and mortar joints. The tongue and groove joints between each unit ensure the entire structure is airtight and vapor tight.

Like all construction systems, the vast majority of air and vapor barrier defects occur at junctions.

Since the polystyrene core is the vapor and air barrier, during design and installation, the insulation must be well tongued and there must be no gaps between the units. The height of the mortar joints must therefore always be 10mm.

*If necessary, the plates can be replaced to obtain an aesthetic finish, but care must be taken to ensure the continuity of the insulation. *

To ensure good long-term performance, minimize the deflection of the various components supporting the Isobloc walls.

Continuous thermal insulation and management of thermal bridges

Thermal insulation in an Isobloc wall is provided by the polystyrene core. The Isobloc system is 100% thermal bridge-free.

To make a detail at the junction to the foundation completely without thermal bridge. It is recommended to insert insulation directly into the casting. Data sheet **ISB.F.01** Available on the Isobloc website illustrates this condition.

Thermal mass and temperature storage capacity.

An Isobloc wall, thanks to its interior concrete wall, is able to store the desired temperature and diffuse it when required. Just like a radiant or refrigerated concrete slab. The thermal mass of Isobloc is a major advantage compared to a conventional wall composition.

Thermal mass is very beneficial for technical spaces or warehouses that experience significant air changes when garage doors are opened, for example.

Mortar:

Type N or Type S mortar can be used in the construction of an Isobloc wall. The mortar must comply with the requirements described in CSA Standard A179-94, “Mortar and Grout for Large Masonry.”

Like any masonry work, the mortar must be weaker in compression than the masonry elements it binds together and in the absence of failure joints, it is the mortar joint that will yield (crack) in various places under the effect of different stresses or movements. The mortar joints therefore play a sacrificial role.

Example of insulation overlap and continuity.

As mentioned in CSA A371:
The thickness of the vertical and bed mortar joints for unit masonry must be 10 mm. The permissible tolerance is ± 3 mm, so the actual thickness can vary between 7 mm and 13 mm. However, remember that the insulation must be well tongued and there must be no gaps between the units. It is important to ensure the continuity of the insulation, and this takes precedence over the thickness of the joints as long as the above tolerances are respected.

Expansion joint:

Strategically positioned expansion joints will prevent unintentional cracking in the masonry veneer.

The Quebec Masonry Institute (IMQ) recommends positioning the control joints every 6 m for concrete masonry. However, the joints can be spaced no more than 12 m (40 ft).

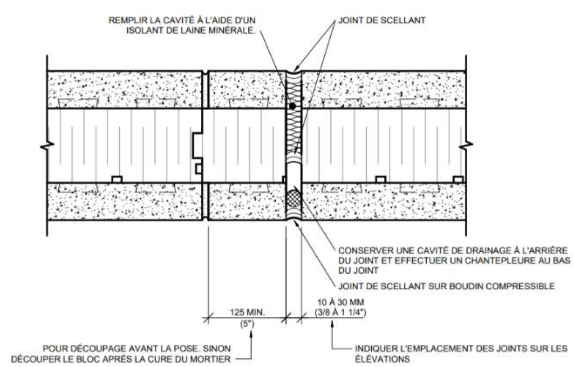
The spacing between control joints is determined by the width of the control joints and the nature of the sealant. For a sealant that has a mobility of ±50%. If a joint width of 10 to 12 mm (3/8 to ½ in.) is desired, then the spacing between the joints will be approximately 8 m (25 ft.). If the walls are 12 m (40 ft.) long, the control joint width may need to be 22 mm (7/8 in.).

At least one joint per facade. Especially if the facade is not a multiple of the 400mm module. As the corners are the first blocks to be installed, the joint allows the wall sections to be joined. Locate the joints at the center of the structure's spans, if applicable.

For doors and windows, control joints should be at least 600 mm (24 in) from the jamb of the doors and windows.

Also, here are some additional factors to consider:

- Very long walls
- Multiple openings
- Complex building geometry
- Corners (inward or outward)
- Drops and projections
- Recessed éléments
- Creep
- Shrinking of the building structure (wooden structure)
- Different supports
- Height changes
- Sag of the load-bearing elements
- Expansion of steel elements



Extract from sheet **ISB.TYP.02** Available on the Isobloc website

Limitations:

Isobloc should not be used for foundation walls.

If ducts or pipes pass through an Isobloc wall, you should consider whether there are chemicals, high-pressure steam, or any other element that could interact with the polystyrene insulation. In that case, it is recommended to make an opening larger than the ducts or pipes and to fill the space between the ducts or pipes and Isobloc with a non-combustible insulation and a non-combustible covering. It would be possible to use only Isobloc concrete slabs to continue the finish.

Sustainable development and eco-responsible construction:

The principles of sustainable development have been known for a long time, but one of the challenges is their practical application. In all aspects of sustainable development, here are the points where Isobloc stands out:

- A reduction and recovery of waste.
  Isobloc is recyclable at the end of its life. No glue is used in the assembly, so 100% of the wall can be recycled and reused.
- A reduction in its carbon footprint.
  A wall with fewer components necessarily generates fewer greenhouse gas emissions. With Isobloc Zero and its patented technology CarbiCrete, emissions can be reduced even further.

  Visit https://isobloc.com/en/isobloc-zero/ for more details

  ISOBLOC ZERO
  INSULATED MASONRY

- Optimization of energy resources and materials used.
  With its 100% continuous insulation and innovative assembly, Isobloc optimizes its use of natural and energy resources.

- The development of local resources and skills and support for local and responsible entrepreneurship.
  Isobloc has been designed and manufactured locally in Canada since 1985. By using Isobloc you are supporting a local company that is committed to innovating and developing local expertise.

Criteria and challenges of loads applied to and absorbed by the wall:

General notes on using Isobloc

The design of the junctions between the load-bearing components of the building must be coordinated between the manufacturers of the different components.
Isobloc disclaims all liability for the use of its products without prior consultation with one of its duly authorized representatives.

Compressive loads

The concrete walls of an Isobloc unit have a compressive strength that meets the minimum compressive strength requirement of 15 MPa of CSA CAN3-A165-1 for exterior blocks.

The values in Table 2 of CSA Standard CAN-S304 "Design of Masonry for Buildings" apply to Isobloc masonry. The ultimate compressive strength of masonry, f'm , used to determine allowable stresses, shall not exceed the values established in Table 2 of CSA Standard CAN3-S304-M84 (R1997).

Isobloc walls shall not support beams or columns. Beams and columns shall be supported independently in accordance with NBC 9.20.8.4.

*** Note on the distribution of charges:**
When the eccentricity is low, there is no significant effect on the overall capacity of the Isobloc. As the eccentricity increases, more and more of the load is resisted by the most heavily loaded wall, until practically all of the load is absorbed by a single wall. Although the Isobloc wall is not exactly a cavity wall from a building science perspective, in a structural sense, it behaves like a cavity wall in a predictable manner.

*** Note on the buckling effect:**
The buckling behavior of an Isobloc wall can be reasonably well predicted using values from the CSA CAN-S304 standard, for an Isobloc wall thickness equal to the sum of the thicknesses of the two walls.
Using the standard limit formula for the buckling ratio: $(h/t) \leq 10(3 e_1/e_2)$,
the height of a load-bearing Isobloc masonry wall which is not braced must not exceed 3.2m based on an effective thickness of 106.4 mm and an $e_1/e_2 = 0$.

It should also be noted that height limits vary depending on the particular design details of a project and that to retard buckling, only a small lateral stabilizing force is required for an Isobloc wall to achieve relatively high compression capacities.

Under an eccentric load, the load must be distributed on each wall in accordance with the eccentricity of the load from the axis applying to the center of gravity of the wall.
The slenderness ratio used in the evaluation of vertical load capacity shall be based on the sum of the thickness of the two concrete walls only.
The critical slenderness ratio in paragraph 5.6.1.1 of S304 shall be determined using the formula $e1/e2 > 0$.
No compound action should be assumed between the two walls of an “Isobloc” wall in the design calculations.

Wind loads and pressure

The designer must ensure that all Isobloc walls can adequately withstand the lateral loads imposed on them.

In the design of an Isobloc wall, the wall can be considered as a cavity wall with two walls acting independently in the vertical direction and bonded together in the horizontal direction such that the two walls share the lateral loads imposed on them. For most combinations of vertical and lateral loads, the design of the "Isobloc" wall will be based on the horizontal wall span between stiff vertically spanning lateral supports.

The polystyrene core and concrete wall assembly is relatively strong and rigid in compression, but its tensile strength is lower. The fiberglass fasteners supplied with the system compensate for this weakness by stiffening the assembly.

Factors that influence the ranges and number of additional components are:

- The height of the wall,
- The center of gravity of the wall and the eccentricity relative to the supports,
- Non-structural or structural use,
- The top of the wall is held at the head or not,
- The projections of the walls in relation to the structural axes,
- The wall supports elements or not.

For optimal wind load recovery, here are the recommendations:

- The maximum wall height should be 2440mm or 8ft if the wall has no horizontal braces or tie bracket. The **ISB.CP.03 sheet** available on the Isobloc website illustrates this condition. Make sure to restrain the Isobloc wall at the head.
- The length between 2 vertical supports, columns, perpendicular wall or wall corners, should comply with the tables in **ISB.E.01** and **ISB.E.02 sheets** available on the Isobloc website.

Seismic Loads and Movement

An Isobloc wall must be considered as an unreinforced but ductile masonry wall (because of the polystyrene core) ; the assembly to the structure is also ductile.

When the wall is load-bearing, as it does not have any internal reinforcement, it is necessary to add some externally, either by installing steel bars or angles or by using extruded polymer composite strips.

When the wall acts only as a facing, the structure will fully absorb the seismic forces; the wall must be anchored to it. For significant heights, braces between the columns will probably be required to meet the NBC requirements. The spacing of the braces is similar to other systems; each block must be fixed to it with concrete screws.

In seismic zones with an acceleration rate of more than 4, it is prohibited to use load-bearing masonry elements made of Isobloc.

In seismic zones with acceleration rates of 2, 3 and 4, load-bearing masonry elements made of Isobloc must not exceed one story in building height.

In seismic zones with acceleration rates of 0 and 1, load-bearing Isobloc masonry units must not exceed two stories in building height, except for gable walls that rise above the second-story wall.

Modulus of elasticity:

The permissible shear stress for Isobloc walls constructed with type S mortar must not exceed 0.20 MPa and with type N mortar, must not exceed 0.14 MPa.

For design purposes, it is recommended to use $E_m = 650\ f'_m$

For calculation purposes, the modulus of elasticity, Em , should be taken as 650 f'm .

Anchoring of floor elements:

Where the floor load is transmitted to the interior wall of the Isobloc wall via the joist hangers, the wall design must take into account the effect of the eccentricity of the load and the amplification of the bending moment based on the slenderness of the wall.

The recommended methods for fixing the structural elements of a floor to an Isobloc load-bearing wall are as follows:

- Either an edge element and ordinary stirrups to take up the beams or joists.
- Or an edge element and then the beams are placed on top. The **ISB.PL.02 sheet** available on the Isobloc website illustrates this condition.

In both cases, this does not limit the installation height and allows for height adjustment if required.

Anchoring of roof structural elements

Roof uplift forces create tensile forces on the walls which, in the case of unreinforced masonry such as Isobloc masonry, must be resisted by specially designed and detailed elements. Since Isobloc masonry does not lend itself to internal reinforcement and pointing, it is easier to use vertical timber furring strips, timber studs, or metal studs attached to the roof elements and the Isobloc wall. It is essential that these anchor strips or studs be vertically continuous and extend to the adjacent floor to effectively anchor the roof uplift forces.

Issues related to loads applied by elements attached to the block

When an element is fixed in an Isobloc wall, it is necessary to consider that chemical/mechanical anchors may not be able to achieve the usual tensile equivalent of the fastening system. Tensile values are often limited by the thickness of the plate and not the diameter, the grade of the rod or the resin of the anchor.

On the other hand, it is necessary to plan the anchors at a more regular interval in order to obtain the desired tensile values. In addition, it is strongly recommended to locate the fixings in the areas illustrated in red in the photo opposite.
The plate is full thickness in these places, i.e. 1/3 - 2/3 .

Photo of the back of a concrete plate.

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