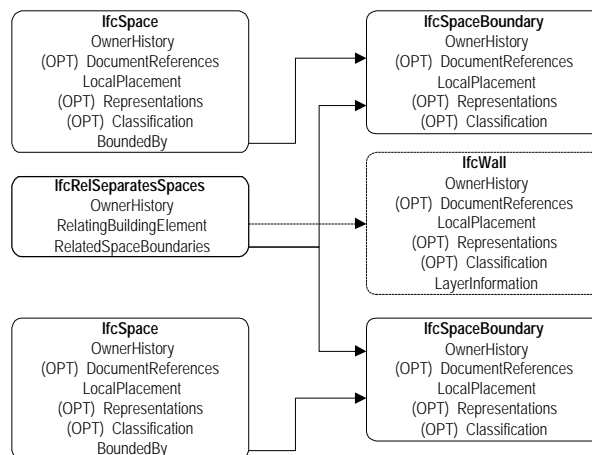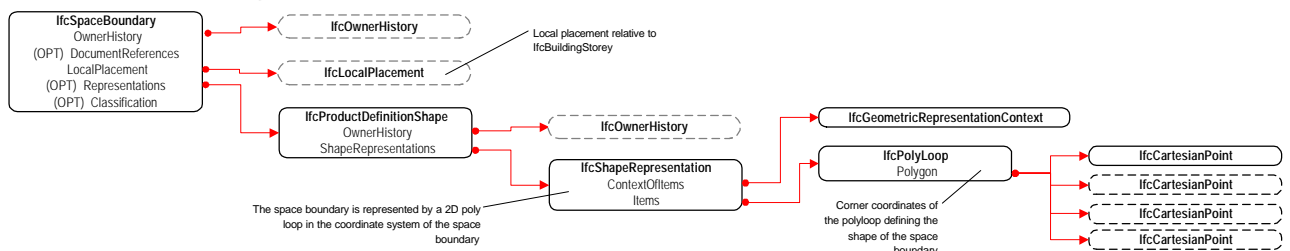# Space boundaries in IFC R2.0
DRAFT 1 – 24.11.1999

Space boundaries are a concept for defining boundaries for spaces. For one space boundaries provide a logical connection between spaces and the building elements (e.g. walls and slabs) that enclose a space. Space boundaries also provide the geometry associated with the boundary independent from the geometry of the bounding element.

Space boundaries are a property of the space. They are used to connect spaces and building elements, but they clearly belong to the space.

Space boundaries can be useful for thermal calculations, quantity takeoff and any kind of application that needs to know the relationship between spaces and the building elements enclosing the space. These applications have their special needs and defining and implementing space boundaries is very much a balance between trying to satisfy these needs and the ability of design applications to provide this kind of information.

Space boundary geometry

In IFC R2.0 space boundaries are defined by a simple plane in 3D geometry. Much in the same way as bounding boxes are an approximation of the actual geometry the geometry of space boundaries is an approximation of the actual boundary. It is a simple 'bounding plane'.

Since spaces cannot have any 'holes' in R2.0 the space boundaries only define the outer perimeter of a space. If there is e.g. a freestanding wall or column inside the space this is ignored by the space boundary.

Also space boundaries cannot have holes in them. This has the consequence that door and window openings are ignored by space boundaries. An application receiving the space boundary has to assign the right openings (doors and windows) to the space boundary and subtract their area from the space boundary area.

Since the space boundaries are an approximation of the actual boundary they don't tightly wrap the space, e.g. the reveal for door and window openings is ignored by the space boundary.

One space boundary defines one 'geometric' side of a space. If one side of the space is aligned to more than one wall instance the space boundary ignores this and spans the whole side of the space. However, the one space boundary has a relationship to all wall instances it touches.
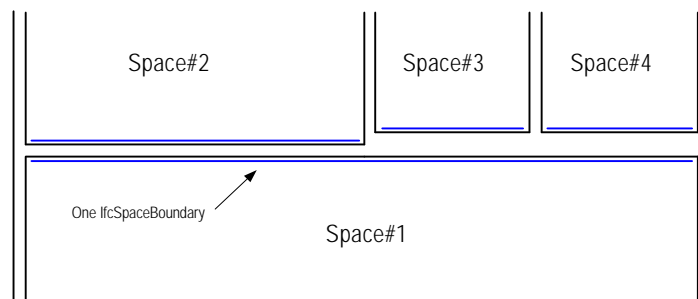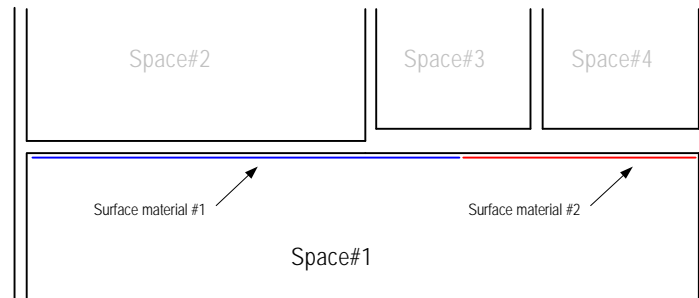

Thermal calculation vs. quantity takeoff

The requirement of thermal calculation is to have the space boundaries divided in a way that corresponds to what can be found behind the walls or slabs bounding a space.
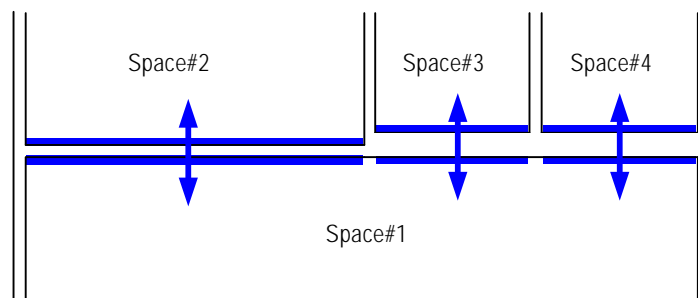
Quantity takeoff does not care about the walls, slabs and what can be found behind them. Quantity takeoff needs to know the inner surfaces of the space, including freestanding walls and columns as well as door and window opening reveals. The space boundaries should be divided according to the materials and material finishes of the space surface.

Current design applications can satisfy neither the needs of thermal calculation nor the needs of quantity takeoff. All they are able to provide is the 'bounding plane' approximation described above. When design applications can provide more detailed information the model has to be expanded to deal with more than one type of geometry for space boundaries. The 'bounding plane' will probably remain the basic representation, like the bounding box is for building elements.

Virtual space boundaries

Sometimes spaces are not bounded by building elements, instead they are directly connected to each other. In this case we have the special case of a virtual space boundary. Virtual boundaries are of interest for thermal calculations, but not for quantity takeoff.

From the modelling point of view the virtual boundaries are somewhat different than the physical boundaries. In physical boundaries the boundaries are first connected to a wall through a IfcRelSeparatesSpaces relationship. This relationship holds information of all space boundaries that are connected to a specific space.

IfcSpace -> IfcSpaceBoundary -> IfcRelSepartesSpaces -> IfcSpaceBoundary -> IfcSpace

In the case of virtual boundaries there is no building element between the spaces, consequently the spaces are connected to each other directly by sharing a common space boundary

IfcSpace -> IfcSpaceBoundary -> IfcSpace

One of the rules for physical boundaries was that each side of the space is represented by exactly one space boundary. It is the responsibility of the receiving application to divide the boundary into sub areas according to what can be found behind the boundary. In the case of virtual boundaries it is the responsibility of the design application to make this division. It remains to be seen how well design applications are up to this challenge.

Challenges and limitations

For quantity takeoff the 'bounding plane' poses quite severe limitations. For basic uniform planes the fact that all openings are missing from the boundary is already a limitation. The ability to query the geometric model to locate and assign these openings is not normal functionality for this type of programs.

The second limitation is that the boundaries are uniform, this is they consist of one geometric entity and there is no possibility to have sub boundaries inside this entity. This certainly is a limitation, but on the other hand the design applications do not currently support this kind of information anyway. Assigning openings to the boundaries could be supported by design applications quite easily.

For the foreseeable future thermal simulation applications will be responsible for dividing the space boundaries into areas that correspond to their special needs. However, at the moment it is unnecessary complicated to assign doors and windows to a specific part of a space boundary. The proposal "Assigning doors and windows to spaces" deal with this question in more detail.