The Atomium of Brussels – "Irreparably Improved"?

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Although built relatively recently, the Atomium is part of our country's heritage. In 1958, the Atomium was intended to be a symbol of an era when scientists and engineers were pushing the boundaries of knowledge; it was an emblem of the achievements of Belgian industry, its ability to take on difficult, innovative projects. It has now become a feature of Brussels, a landmark for the capital of Europe and no one would dispute the need for it to be preserved. When it was designed in 1955, it was intended that the Atomium would remain in place for six months, for the duration of the 1958 World Fair. Consequently, it was designed for this limited lifetime. However, 60 years on, the Atomium is still there. This monument underwent renovation in 2006 to ensure its preservation and continued influence. We will now take a close look at today's Atomium. Is it the same as the one built for Expo 58? Has the renovated Atomium retained its authenticity? How do the adaptations to the original design work from the point of view of heritage conservation?

Brief history

For the World Fair of 1958, Belgium wanted to build a spectacular construction that would serve as both a symbol of the event and a celebration of Belgian industry. André Waterkeyn, the director of Fabrimetal, came up with the idea for the Atomium, representing an iron crystal, and so referencing the iron and steel industry that sponsored the project. The Atomium drew attention to the importance of scientific research and especially to the huge potential of energy concentrated in the atom. The project involved magnifying the distance between the atoms that form the crystal 160 billion times.

Architecture, geometry, habitability

Fig. 1 shows the names used by the Atomium's designers for the spheres and identifies them by their symbols: I for the lower spheres, M for the upper spheres and B, C, S for the bottom, middle and top spheres. For aesthetic reasons, the crystal was arranged to form a vertical diagonal. The Atomium is 102.705 metres high (from the ground to the top of the upper sphere) and its shape projected on the ground is of a hexagon with a diagonal of 94.750 metres. The perception of the Atomium's size would be quite different if there were houses along the road leading up to it. The diameter of the spheres is 18 metres.

All the spheres, except for the M spheres, are divided into several levels inside. Due to the Atomium's distinctive geometry, as well as the central support, the structure needed to be stabilised by three peripheral supports provided by bipods. These bipods have two important functions: to support the three lower spheres and to accommodate the stairways required for visitor access.

The top-most sphere was fitted out as a restaurant in the upper part with a circular viewing platform below. The main

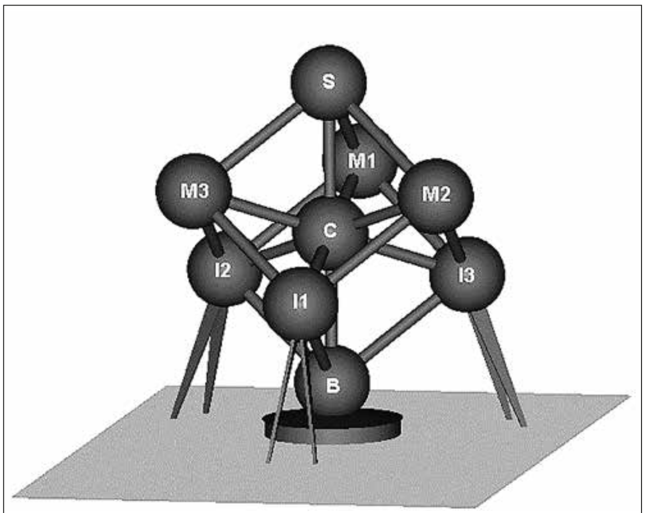

Fig. 1: The Atomium, identification of the spheres (Drawing Bgroup – 1999)

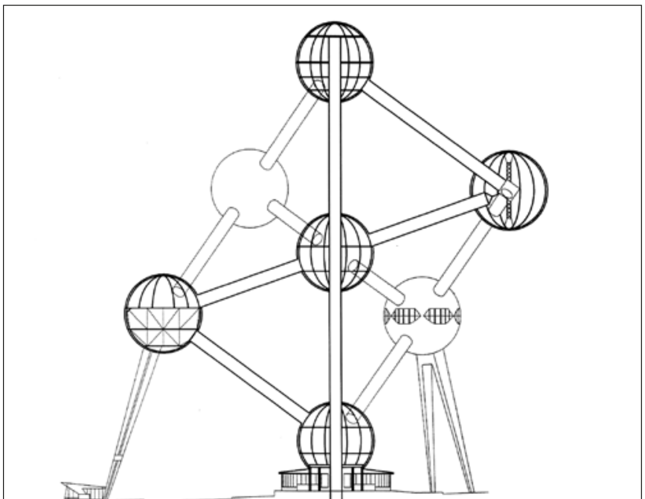

Fig. 2: Diagram of the main structure of the Atomium (Drawing Bgroup – 1999)

access to this sphere was via a lift with capacity for 22 persons, which was, at the time, the fastest in Europe, travelling at a speed of five metres per second. Most of the accessible spheres were designed to house a scientific exhibition on the peaceful applications of nuclear power.

The structure

The central vertical tube, the three bipods, the framework of the lower I spheres and the six connecting tubes linking them form the main structure of the Atomium (Fig. 2). The upper M spheres rest on the connecting tubes via metal frames and for this reason they cannot be occupied.

A point to note is that due to the simplification of the calculations performed using the resources available in 1956, the Atomium's structure has been rendered isostatic. Two links (I1-C and C-M1) have been removed, allowing these tubes to be moved to one of their ends using slotted joints. To reduce the weight of the structure, high yield strength steel of grade A52 was used, equivalent to today's steel S355 JR with a yield strength of 355N/mm² – for the central mast, the arcs making up the various spheres and the bipods. The other structural elements were designed in grade A37 steel, now steel S235 JR. The total dead weight of the Atomium is around 2,500 tonnes.

During the renovation studies, the metal framework was tested by Liège University to detect any vulnerable areas and any problems with fatigue on the joints. The checks were carried out by analysing the original calculations, by a visual inspection on site and by a finite-element study. One of the findings was that the wind loading allowed for in the original calculations following testing in a wind tunnel corresponded to the current recommendations of the Belgian standard.

The analysis of corrosion on the structure was carried out by Vrije Universiteit Brussels. Corrosion was observed mainly at the following points:

– Tubes linking the spheres: localised corrosion of the tubes, reinforcing rings and stiffener angles. Some metal parts were perforated by corrosion;
– Floor plates of the spheres were corroded locally, and some more extensively;
– The profiles on the structure of the M spheres;
– The bipods: bipod I1 showed major corrosion between the joining plates of the beams for the staircase. The staircase in bipod I3 was in very poor condition and was replaced.

This analysis revealed that the stability of the Atomium was not compromised, but that some remedial work was required in order to ensure its durability.

All the elements of the metal structure were cleaned and anti-corrosion treatment was applied. Some profiles were reinforced locally or replaced. The visible structural elements were repainted.

The original skin

In 1958, the spheres were covered with aluminium plates 1.20 mm thick made of alloy Peraluman 15, laminated with a layer of Reflectal giving a mirror effect. These plates, mainly in the shape of arced triangles, were assembled using a system of curved aluminium profiles. Tightness between the plates was provided by an initial PVC seal and a second rubber seal.

Where the aluminium profiles intersected, they were joined by circular plates, via expansion joints (silentblocs),

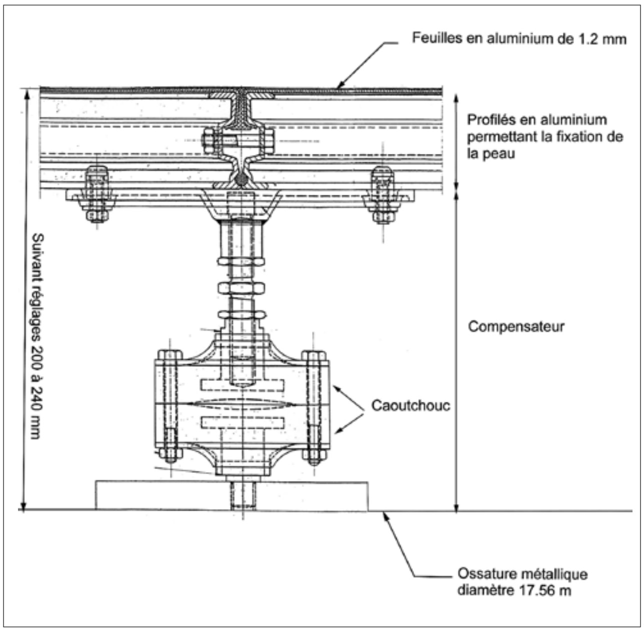

Fig. 3: Detail of the aluminium skin and its fixing to the metal framework (detail: Mét. D'Enghien St Eloi, 1957) N.B. these two drawings must be on the same scale

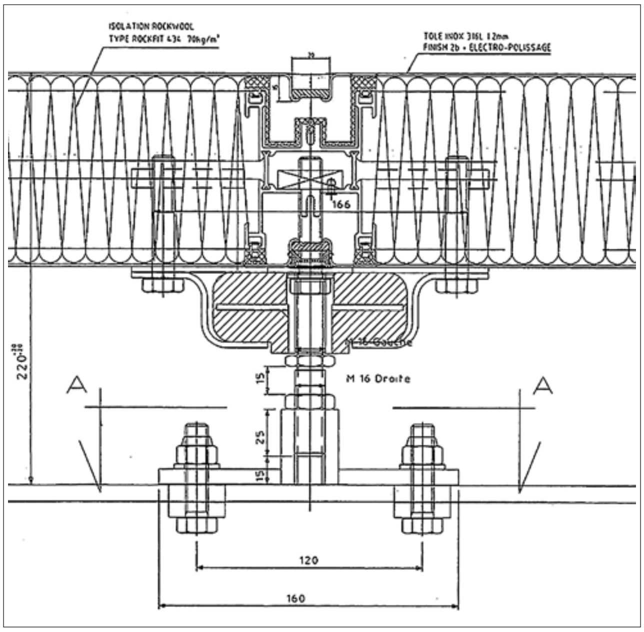

Fig. 4: Detail of the new skin, its insulation and attachment to the structure (drawing: Temporary Partnership Besix – J. Delens, 2004)

between the aluminium skin (plate + profile) and the secondary steel structure (bracing of the arcs of the main structure) (Fig. 3). These expansion joints were needed to absorb the differential expansion between the aluminium profiles and the steel structure and made it possible to avoid all contact between the steel and the aluminium to prevent risks of galvanic corrosion. The skin incorporated portholes and window frames. These openings were fitted with plexiglass.

The new skin

The new skin of the six spheres accessible to the public is made of sandwich panels of a total thickness of 100 mm, made up of a stainless steel plate 1.2 mm thick of the type 316 L 2B on the outside, insulation of rigid rock wool panels and a 1 mm-thick raw galvanised steel plate on the inside. These sandwich panels are fixed to the structure via expansion joints (Fig. 4). The three unoccupied spheres are covered only with the outer stainless-steel plates. The risks of condensation inherent in this cost-saving choice are limited by the inclusion of ventilation. The skin's shiny finish is obtained by electro-chemical polishing giving a polished mirror appearance, improved corrosion-resistance and a smooth compact surface. This makes it much easier to maintain. The new skin retains the same external layout as the original.

For speed of installation, 48 large triangles made up of 15 pre-assembled pieces reproducing the exact dimensions of the original triangles were affixed to each sphere (Fig. 5). Aluminium profiles were added at the joints to provide stiffness for the panels and create drainage channels in case the outer silicone seals fail. On economic grounds, some joints in the large pre-assembled triangles were replaced by dummy joints, thus also reducing the risk of infiltration. The meridian elements (mainly rectangular panels) were assembled in situ, piece by piece, as they provide the connection between the large triangles (Fig. 6). The windows have an aluminium frame with thermal break and double glazing with a double curvature to follow the spherical form.

The original brilliance of the aluminium panels cannot be reproduced these days on large-scale panels and so the material had to be changed. There were various options: steel, titanium, polyester, etc. As the Atomium symbolises an iron crystal, the choice of stainless steel was both obvious and appropriate. Raw galvanised steel was chosen for the inner plate. The main reason for this choice was to reduce the cost compared with using stainless steel. Also, the galvanised steel was intentionally left on show to recapture more closely the raw appearance of the original. Of particular note is that the new skin is more than five times heavier than the original skin. It was checked that the structure would allow for this extra weight.

From a technical point of view, the advantages of choosing stainless steel are mechanical strength, corrosion resistance and ease of maintenance. However, the current appearance differs slightly from the original as the Atomium of 1958 was shinier and less grey.

Fig. 5: Installing a panel of pre-assembled triangles (photo Origin 2005)

Fig. 6: Installing the meridian plates (photo Origin 2005)

Fig. 7: View of the Atomium today (© www.atomium.be – SOFAM – Christophe Licoppe)

Conclusion

The original Atomium was a daring structure of very high quality. Though designed to last only six months, it was still sound even before its renovation. The weaknesses identified were mainly on the outer skin and the finish.

Giving the Atomium a new future involves more than just restoring and renovating it. It also involves informing, documenting, innovating, optimising its use so that it can be passed on to new generations. We are very happy to have played a part in this prestigious project and to once more see the Atomium shine, day and night, on the Heysel plateau.

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