The structural analysis of Victor Horta’s oeuvre is studied within the framework of the PhD thesis “Analysis of the structural behaviour of riveted connections in historical iron and steel structures in buildings”. The historical part of the research aims to put Horta’s innovative structural use of iron into picture regarding buildings mainly located in Brussels.

The Belgian architect Victor Horta (1861-1947) was one of the greatest personalities of the Art Nouveau trend in Europe and was also one of the founders of Modern architecture. The majority of his constructions are private mansions but he also built department stores and other public buildings. He revolutionizes the typical traditional plan of the private house in Brussels (with three adjoining rooms) by means of an organic ornamental architecture that privileges light and space.

The design and the structural choices of Horta’s constructions result from both the architectural and the technical/structural context of that time. Considering the social and cultural mutations and evolutions, the architect became aware of the need for new architectural programmes that had to meet the expectations of this period. Horta’s inspiration was drawn from the theories - based on the notion of rationality - of Eugène Viollet-le-Duc who considered the architecture of a building to correspond to the structural needs. In analogy, according to the Art Nouveau movement, each material type should be represented by its own formal expression based on its mechanical properties. Concerning the technical/structural context, theoretical developments as well as experimental testing have permitted the architects and engineers of the 19th century to acquire insights in the understanding of the structural behaviour of iron. More precisely, from the second half of the nineteenth century, an important progress of the calculation methods had caused the design of new structures. As a result, Horta introduced the new material ‘iron’ (cast- and wrought iron) - which was at the time only accepted for industrial use - into the design of buildings in order to develop innovative designs.

Some significant facts, which reflect the innovative character of iron practice in his oeuvre, draw our attention. For the first time with the Hôtel Tassel (1893), Horta opted for visible iron components with organic and natural forms. Being conscious of the strength of the material, he exploited this until its ultimate carrying capacity. Thus, Horta used very slender cross-sections for the different structural components of the structure. Also, in order to provide daylight to enter the buildings, the architect took advantage of the mechanical properties of iron to enlarge bay windows, to build wide glass roofs and to create open floor spaces.

Through his global oeuvre, iron components can be divided into three main categories. First of all, the elements of the principal bearing structure of the building (beams, columns, etc.): these unornamented components are generally not or only partially apparent. Most of these bearing structures are composite masonry and iron structures where the bearing function of iron becomes more and more important as Horta’s oeuvre evolves (e.g. Maison du Peuple (1896-99), A l’innovation department store (1901-03)). Secondly, there are structural components that form the secondary structure. These elements such as annex winter gardens and bow windows - a frequently employed typology in his oeuvre in the main frontage - are always apparent and their design is quite sophisticated and elaborated. In some configurations, these secondary structures highlight the existence of an inefficient structural logic: esthetical considerations linked to design choices are of prime importance and damage the structural efficiency. Finally, the third category represents non structural shapes used for decorations, railings and technical equipments (e.g. lighting elements, radiator).

We can conclude that Victor Horta learns to take advantage of the ambiguity between architectural, esthetical and structural issues in order to design structures where the formal language of the material is a result of its structural needs.

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