

ANNEX 4-B

Case study

SHOPPING CENTRE CACTUS IN ESCH/ALZETTE

This urban project in the city centre of Esch/Alzette provides a modern vision of steel structure using curved cellular beams with glazed façade. The luminosity inside this building highlights the lightness of visible steel structure. This visible and aesthetic steel solution was obtained due to modern fire engineering approach.

SHOPPING CENTRE CACTUS IN ESCH/ALZETTE



General information

This medium size supermarket is situated in the city centre, of Esch/Alzette and it will replace an older structure, which is situated in the proximate neighbourhood. The owner wanted to have a non-typical hall and opted for an open space with huge glassing surface in two of the façades. The steel structure, with long span curved cellular beams should maintain visible.

Due to the location of the supermarket in a city centre, the authorities required a fire resistance of 90 minutes for the steel structure supporting the roof. The Natural Fire Safety Concept has been applied to calculate the evolution of the fire in the supermarket. Using this concept, the opportunity for a building with a fully glazed façade and visible steel structure has been retained.

Processing time: 2003

Total height: 9,13m

Ground-plan: 28,51 x 48,16m

Structure

The structure is a hall made up with portal frames comprising steel columns and cambered cellular beams. The frames are interconnected by means of steel roof purlins and bracing system.

The frame is constituted one bay of 20m span. The ground level is at 0m, the top of the column at 7,55m and the top height in middle of the cambered beam is 9,13m.

The distance between adjacent main frames is 7,50m. Frames are connected by continuous purlins (IPE200). The roofing is made with a steel sheet (HOESH TR44A), insulation and waterproofing.

The beams are Arcelor Cellular Beams © build from an HEB450 in S235. The height of the final beam is 590mm, the openings diameter is 400mm and the distance between the openings axes is 600mm. The distance between the edges of two consecutive openings is thus 200mm.

Application Benefits

Column free internal space provides maximum flexibility
Transparent appearance due to curved cellular beams
Architectural solution
Unprotected steel due to fire engineering approach

Project Team

Client:	Cactus S.A
Architect	Paczowski Fritsch Associés
Structural Engineer	Schroeder & Associés S.A
Constructor	MABILUX S.A.
Fire engineering	Arcelor Profil Luxembourg R&D



Top: Building during use

Bottom: Building during erection

Natural Fire Safety Concept

Arcelor Profil Luxembourg Research has been asked to perform the fire engineering of the structure. The authorities accepted to apply the Natural Fire Safety Concept. The fire design was based on the prescriptions of EN1991-1-2 (Characteristic fire load for office building: 730MJ/m²) and by taking into account the active fire fighting measures (Automatic alarm & transmission to the fire brigade, smoke exhaust systems...). No sprinklers were foreseen due to the small size of the building. The gas temperature has been calculated using the 2 zone software Ozone and localised temperature were calculated using Hasemi methodology. A set of simulations has been made to analyse the breaking of the glazed surfaces (front and back façades are

completely glazed). As the maximum resulting steel temperatures in the columns reached up to 880°C, a 3-D finite element analysis was performed, taking into account the whole structure of the building. One complete model of the building in 3 dimensions was analysed. All the simulations were made using the FE software SAFIR.

The result of this fire engineering approach was that the whole steel beams and columns will remain without any passive fire protection.