Factsheet no. 6: MEXX DAY hall, Timisoara, Romania

Project summary

Client:	S.C. MEXX DAY S.R.L.
Architect:	S.C. Seko Studio S.R.L. Timisoara
Structural engineers:	S.C. Seko Studio S.R.L. Timisoara

Description of the existing building

The building is located near Timisoara (approximately 60 km away). The structure was designed in 2008 as a ***standard kit*** to be adapted for different locations (climatic/seismic conditions) and applications (production, warehouse etc.). It was erected in 2009 (just the structural system, without cladding). In 2012, the project was adapted for a "Pasta fabrication" plant, intending to use only half of the span of the hall; however, the project was not implemented. Currently, a new owner is preparing the existing structure, using the entire hall, for a Cereals Storage Unit, with some functional interventions, i.e. a partial mezzanine over two bays for offices and laboratories. The structure is intended to be reused by relocating it to another site. The site plan for the new location of the building, the new ground floor plan of the hall and the first floor plan of the offices can be seen in Figures 1, 2 and 3, respectively.

Fig. 1. Site plan of the new location of the hall

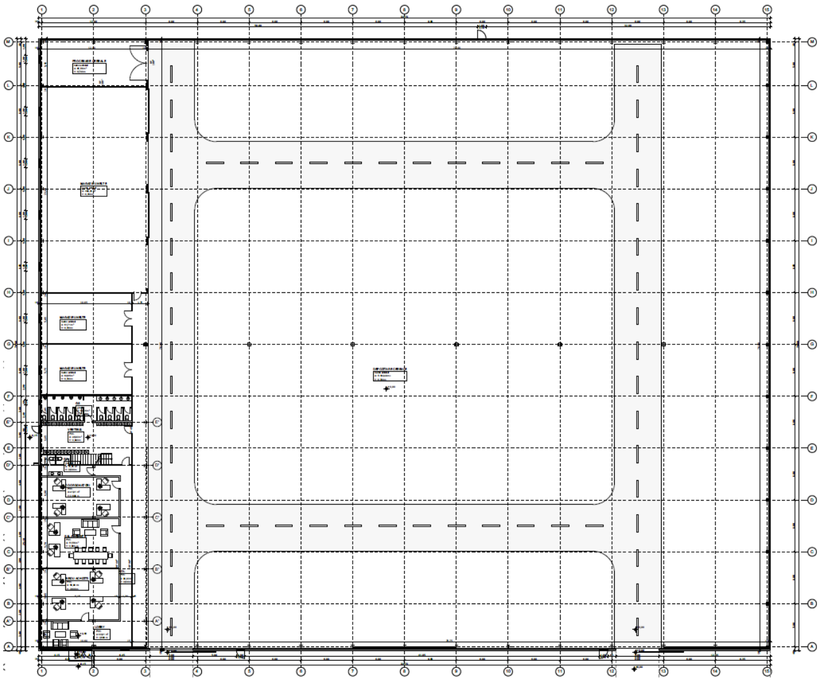

Fig. 2. New ground floor plan of the hall; the additional offices are located in the bottom left corner

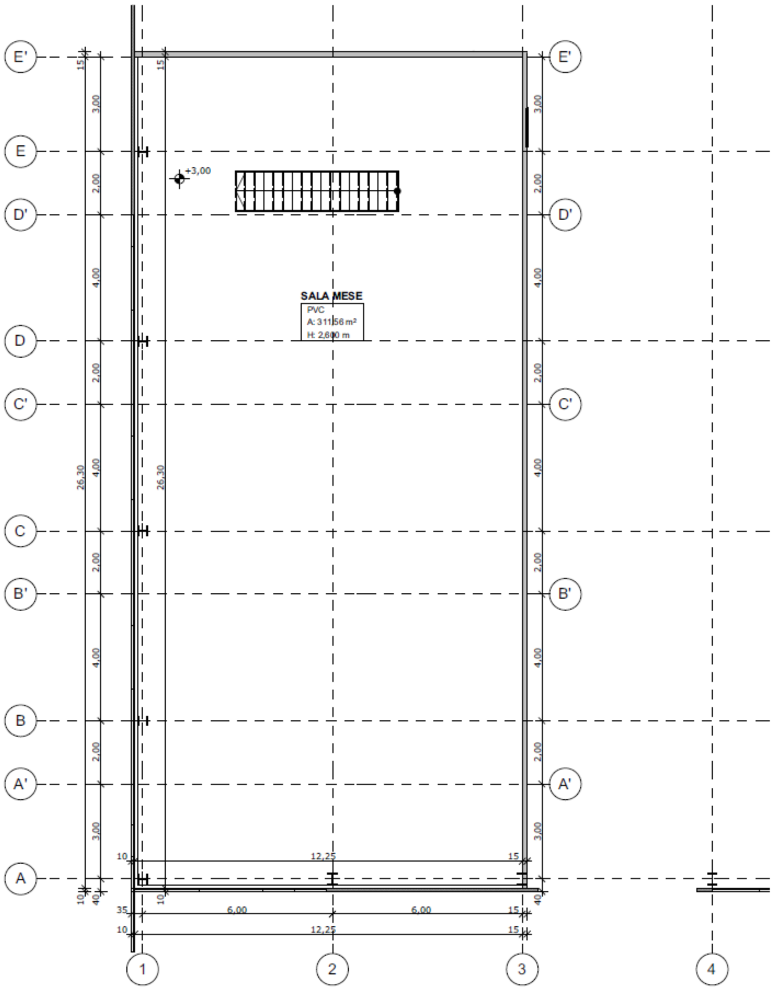

Fig. 3. First floor plan of the additional offices

Although the entire structure was erected, the full corrosive protection was applied only on half of the structure, the other half being only partially protected. For the unprotected half, some of the elements have been affected by corrosion (see Figures 8 and 9).

The industrial building has 2 spans of 35 m, 14 bays of 6 m (84 m in length) and the height is 8 m at the eaves and 10.7 m at the ridge, with the roof slope of 8%. The 3D view of the structural model is presented in Figures 4 while Figure 5 presents a transversal frame in the odd axes. The gable frames, in axes 1 and 15, are composed of columns and beams with H cross-section made from welded plates and pinned braces at both ends with CHS121x8. The intermediate frames are composed of columns with H cross-section and haunched beams made from welded plates. The columns have fixed based connections to foundations and are connected to the transversal beams by bolts forming a semi-rigid connection. The beams of the intermediate transversal frames are connected to the columns by bolted end plates. For the intermediate transversal frames, in the axes 2-14, the central columns (columns in the longitudinal axis G) are provided at each second axis. Braces made of round bars having the cross-section of ϕ20 are provided in the plane of the roof. The position of the braces can be observed in Figure 4. In the longitudinal direction the structural system is composed of 3 longitudinal frames; 2 exterior braced frames and 1 interior (in the middle) unbraced frame. The transversal frames are connected longitudinally by beams pinned at both ends having a CHS of 121x5 and pinned braces with CHS of 121x8.

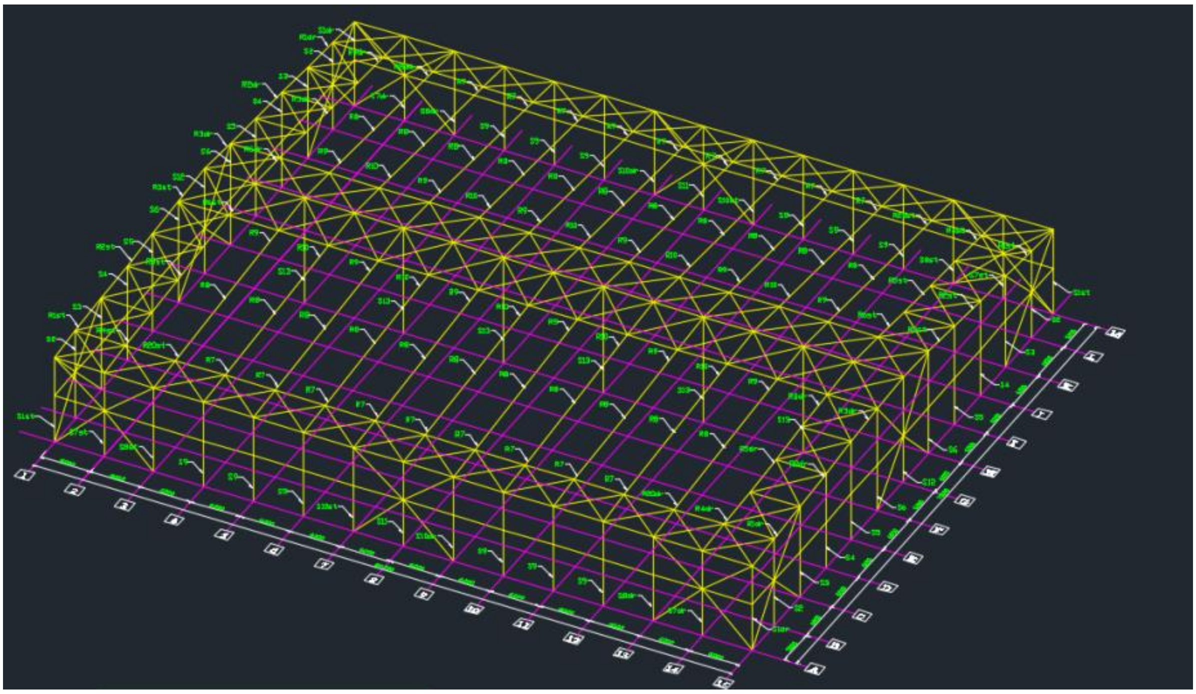

Fig. 4. 3D view of the structure

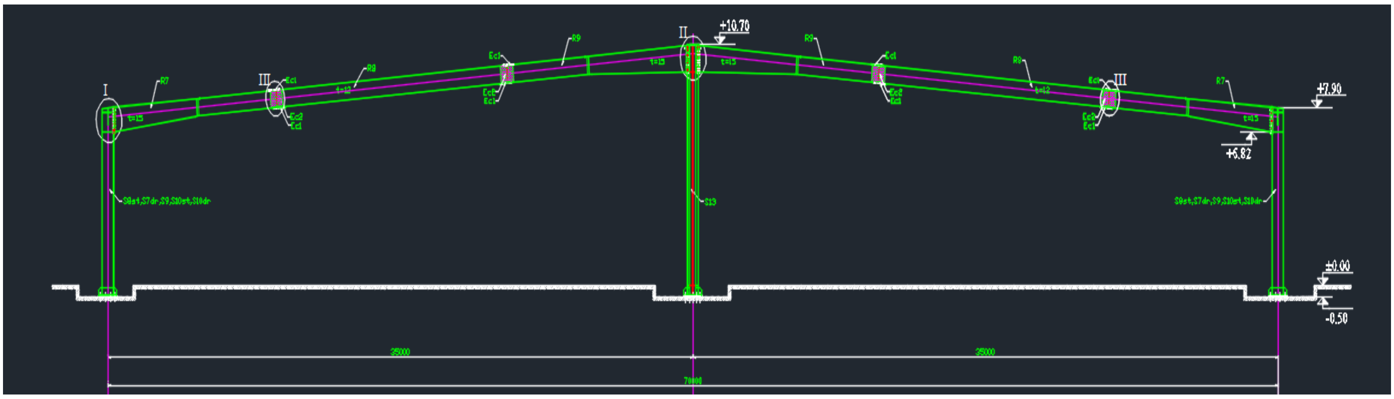

Fig. 5. Transversal frames in axes 3,5,7,9,11,13

Figures 6 to 9 presents some images with the structure before relocation.

Fig. 6. View of the transversal frames

Fig. 7. Detail of the beam-to-column connection

Fig. 8. The longitudinal bracing system

Fig. 9. Detail of the column base connection

As the structure was designed in 2008, it needs to be evaluated and strengthened due to the fact that the current codes operate with higher climatic (snow and wind) and seismic loading than the codes at the time of design. Although the structure is relocated, the intensities of the climatic and seismic loads remain the same for the new location as for the initial location.

The structure is reused by relocation and its layout will be changed by adding the offices which require an additional steel structure. The entire main and secondary structure is reused, with the addition of new components.

Design process

Following a technical examination of the structure, a series of weaknesses were identified in the initial design. A structural analysis was performed using the 3D model, as shown in Figure 10 that highlights the necessary interventions. In order to strengthen the initial structure (without considering for the moment the mezzanine), the following measures have to be taken (the view of the strengthened structure without the mezzanine can be seen in Figure 11):

- the braces having circular hollow section of 121x8 are replaced with ones having the cross-section of 135x8, made of S355 steel;
- longitudinal beams with circular hollow section of 121x5 are provided in the plane of the roof, in the axes C, D, E, I, J and K;
- fly bracings at 45° are provided at 3 m, connected to the bottom flange of the transversal beam and to the longitudinal beams or purlins;
- the flanges of the ridge haunches are strengthened by welding additional steel plates with a thickness of 12 mm;
- additional bracings are provided in the roof, with a cross-section of ϕ24 (S355 steel grade), in the axes A7-A8-A9 and M7-M8-M9;
- the column base connections of the columns in axis G has to be strengthened by providing additional stiffeners (see Figure 12).

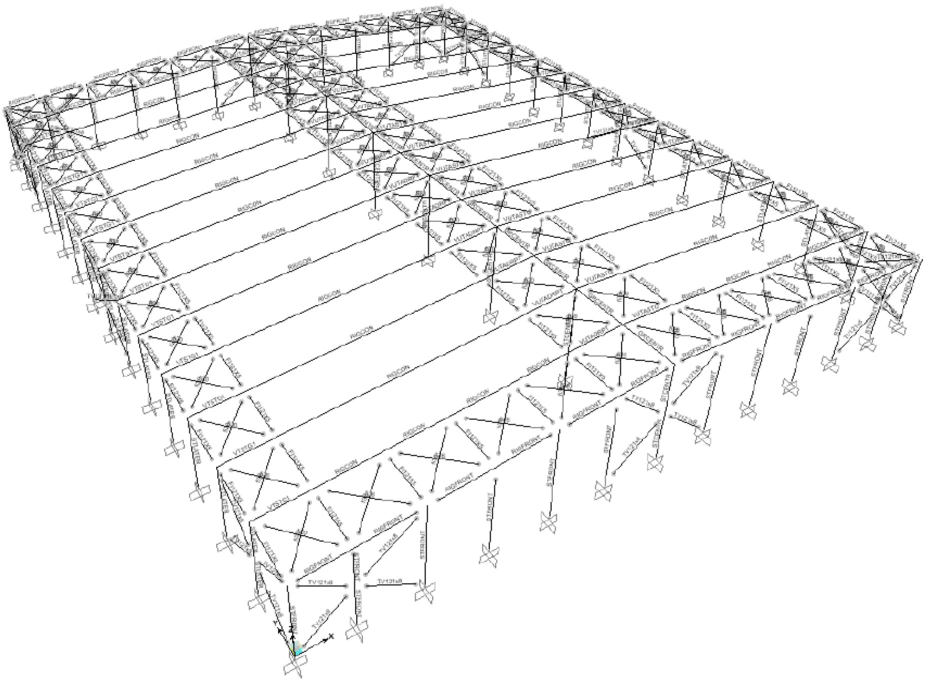

Fig. 10. 3D model used for the structural analysis

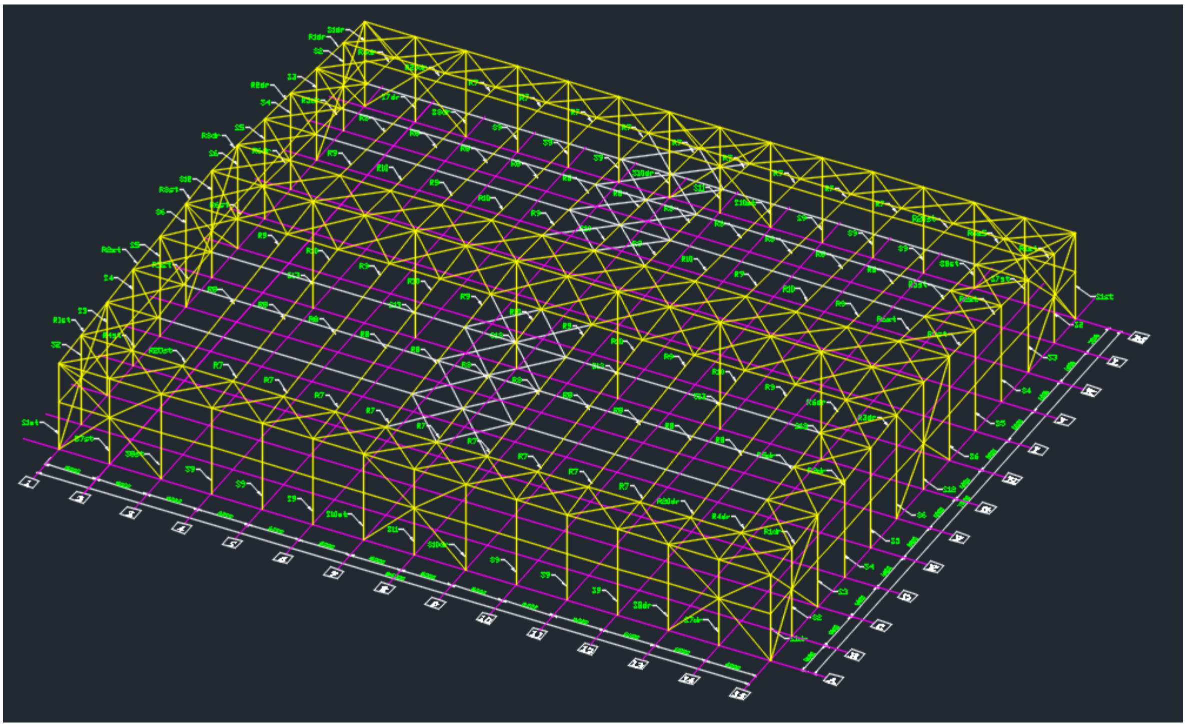

Fig. 11. 3D view of the strengthened structure without the mezzanine

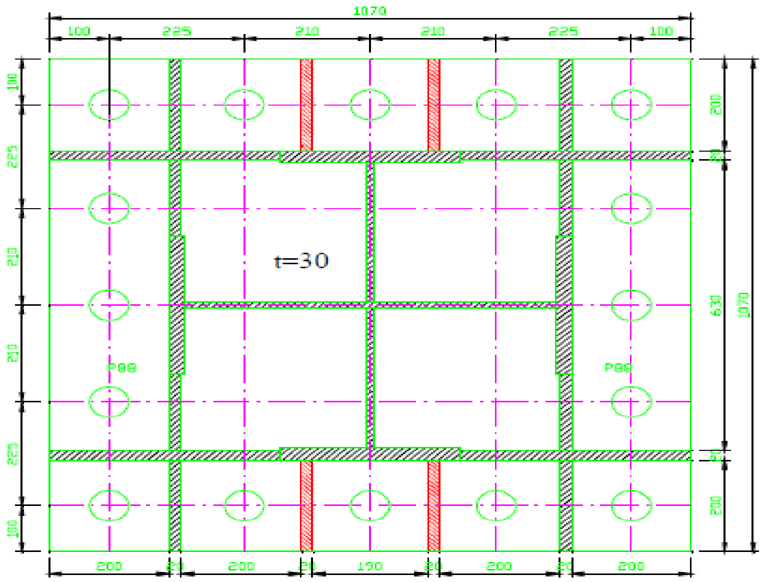

Fig. 12. Strengthening of the column base connection of the columns in axis G

In order to adapt the structure for reuse, the mezzanine structure has to be inserted in the existing structure and fire protection requirements for the closed cereals storage warehouse need to be ensured. The exterior wall and roof cladding will be made from sandwich panels, while the façade of the administrative area will be made of glass. The interior walls in the offices are lightweight gypsum plasterboards and the slab is composed of corrugated steel sheeting and reinforced concrete. The two floors are connected by an interior steel staircase. An additional steel structure will be erected to support the offices:

- along the axes A1-A3, respectively A1-F1, the beams of the mezzanine will be connected to the existing columns;
- new columns are provided in axes B2, C2, D2 and E2 up until the level of the slab;
- -new columns are provided in axes F2, B3, C3, D3, E3 and F3 that stop under the beams of the existing structure (see Figure 13).

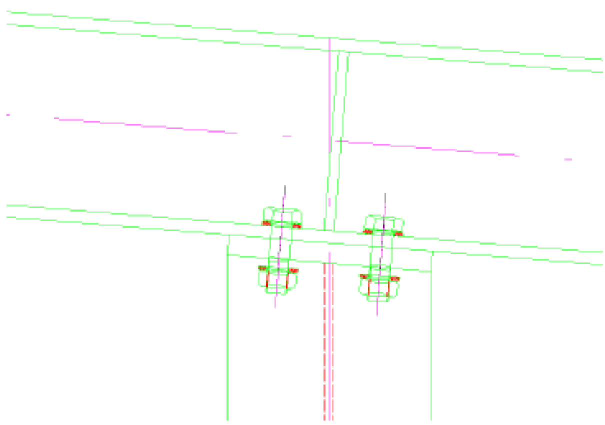

Fig. 13 The connection between the additional column and the transverse beam

Conclusions

Several conclusions have been drawn from this case study:

- It was very helpful that the original drawings and full design were available, making the reuse process easier;

- An issue was represented by the fire protection requirements needed to be ensured due to the fact that the utilization of the building was changed for its reuse;
- The reuse process was also hardened by the addition of the mezzanine because the structural system had to be adapted to allow this change.

Further information

The present case study is presented at the level of design. The relocation process started and the intention of the owner is to have the building ready in the second half of 2018.