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**SOME PARTICULAR APPLICATIONS OF
REINFORCED MASONRY IN BELGIUM**

Ir. O. Pfeffermann and Ir. B. Van Hoorickx

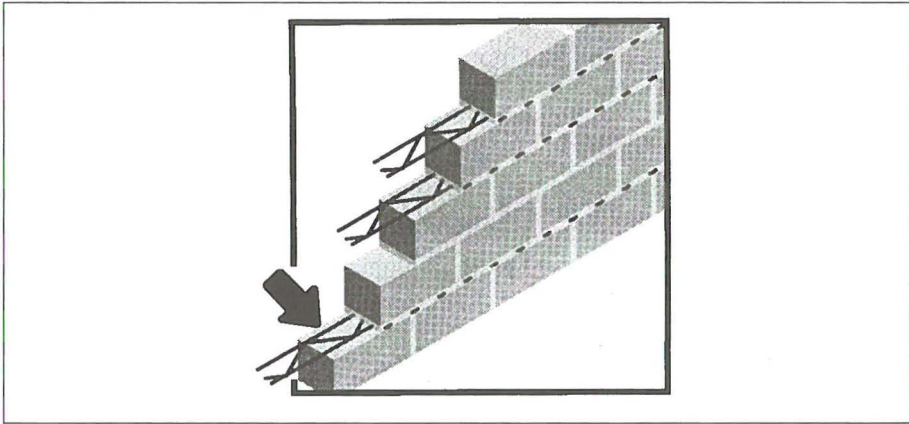
ABSTRACT

During the last 25 years, the use of bed joint reinforcement has become a daily custom in masonry structures in Belgium.

Because of the limited tensile strength of masonry in comparison to its compression strength, the addition of reinforcement is complementary.

It can not only be used to prevent cracks, but also increases the mechanical properties of the masonry, which offers the architects greater flexibility in design.

Figure 1. MURFOR Reinforcement.



The problem of reinforced masonry is the use of an appropriate reinforcement that can guarantee:

- the constant mechanical qualities
- the good placement in the masonry
- the durability in the time (problem of corrosion).

In Belgium we are using an adapted joint reinforcement since 1970. The Belgian Company BEKAERT manufactures a reinforcement named “MURFOR”. This reinforcement is made in sizes that are appropriate to the shapes of the masonry units and the thickness of the bed joints.

A lot of lab tests were made in this 30 years of application of this reinforcement.

The reinforcement is also manufactured with different type of protection (coating)

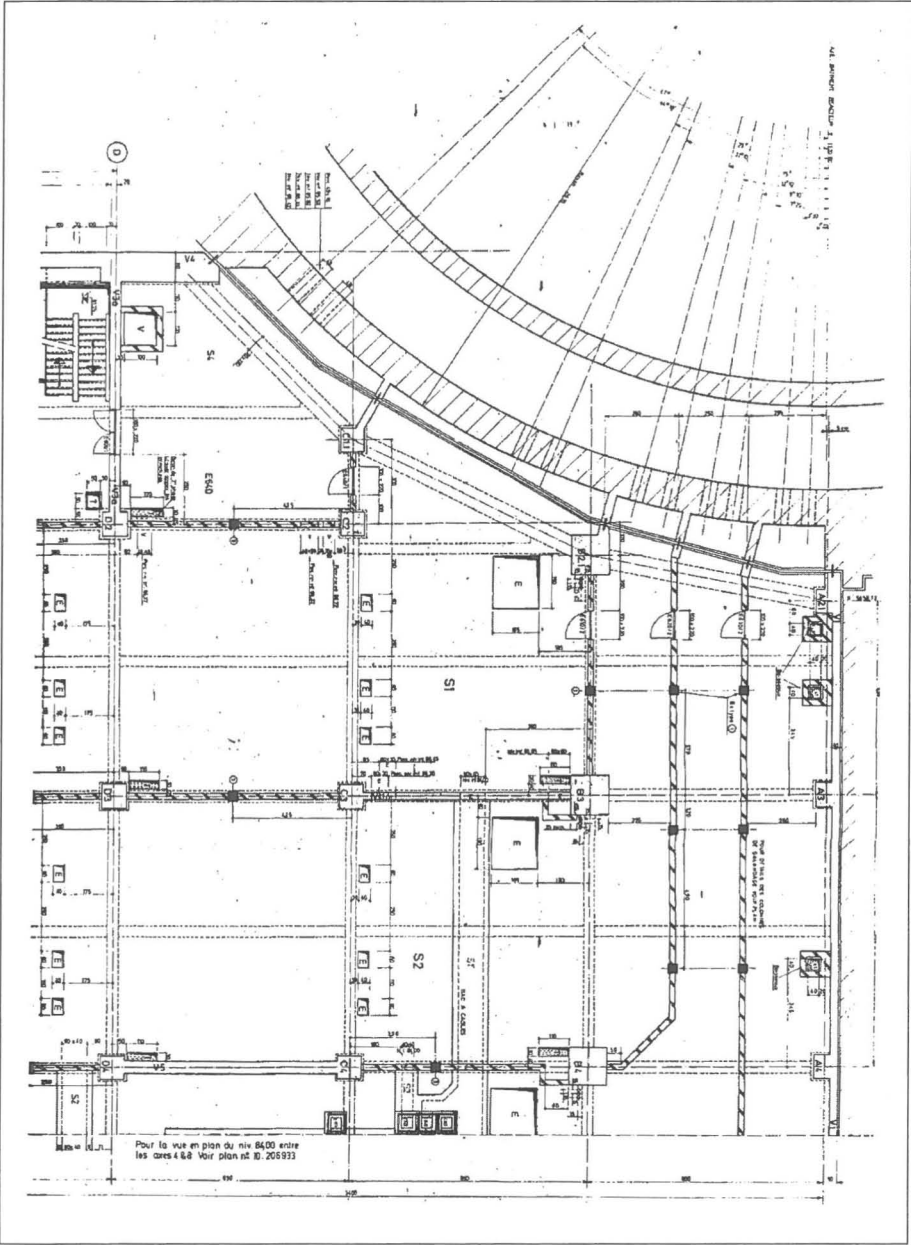
- normally galvanised
- epoxy coated
- Stainless wire.

In our paper we will show some examples of contemporary architecture that utilize this improvement of structural behaviour. For each case we will expose the specific solicitations, a brief explanation of the design and details of execution.

1. WALLS IN ELECTRICITY CENTRAL

For the construction of the *Thermal Central* of TIHANGE (Belgium), they used for the interior walls, concrete block masonry of 19-cm thickness.

Figure 2. Electricity Central of Tihange – Planview (extract).



Although Belgium is not considered as a seismic region, periodically we have some earthquakes affecting a part of Belgium.

For the construction of the electrical station of Tihange the structure was calculated for seismic solicitations till 7 on the Richter scale.

Figure 3. Connection between columns and reinforced walls.

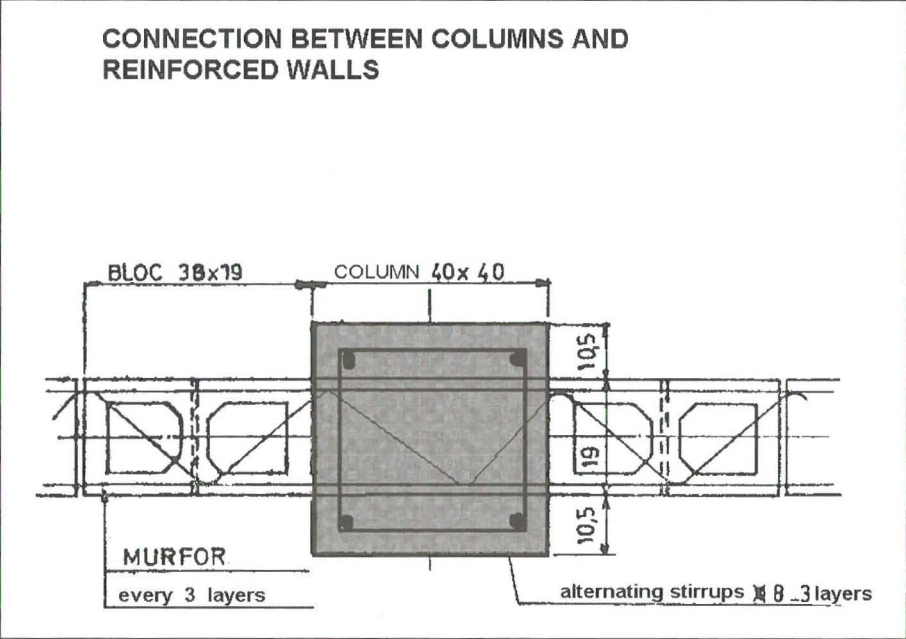


Figure 4. Connection between columns and reinforced walls using anchors.

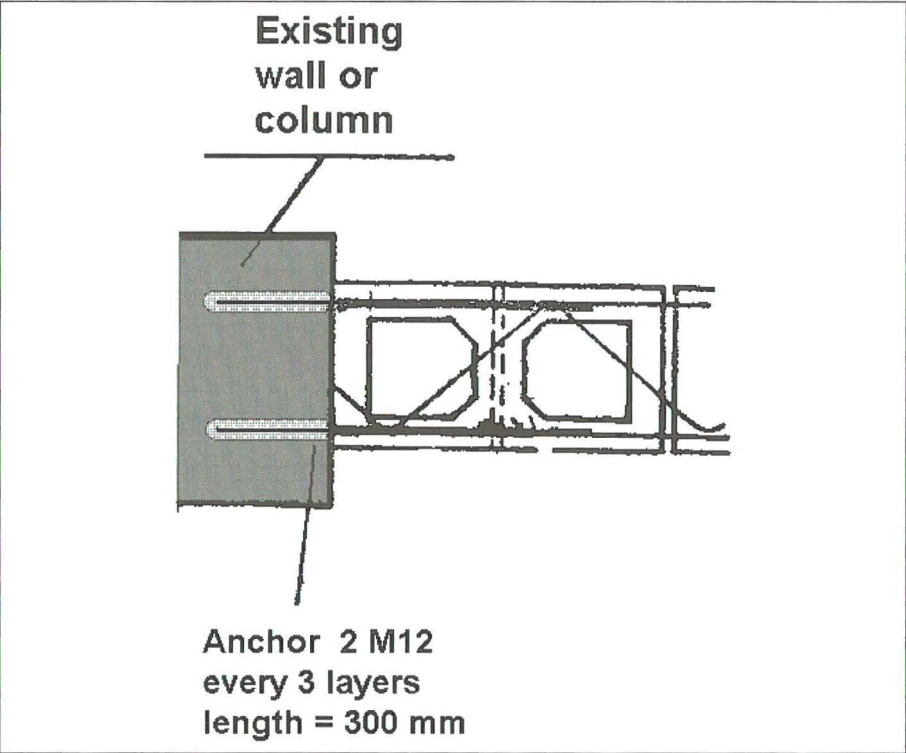


Fig 2 is showing the position of the walls.

On Fig. 3 and 4 we are seeing the detail of the connection structure wall.

To avoid the construction of the walls together with the structure they incorporated in the concrete structure screw bars on the places where joint reinforcement will be placed. With this means, it was possible to make the erection of masonry in ideal climatic conditions.

2. ADMINISTRATION TOWER IN BRUSSELS

This tower is a +/- 60-m high building in the centre of Brussels (see fig.5).

The underground is from a very bad quality. The calculation indicated:

- A possible differential settlements of +/- 17 cm.
- Floor (slab) deformations of +/- 3 cm (see fig 6)

The separation walls are constituted (see fig. 7) from double clay brick walls.

The quality of the walls are different (for acoustical reasons) In addition the walls have a height of 4.52 m what is increasing the danger of a lateral deformation.

Figure. 5 Administration Tower - elevation.

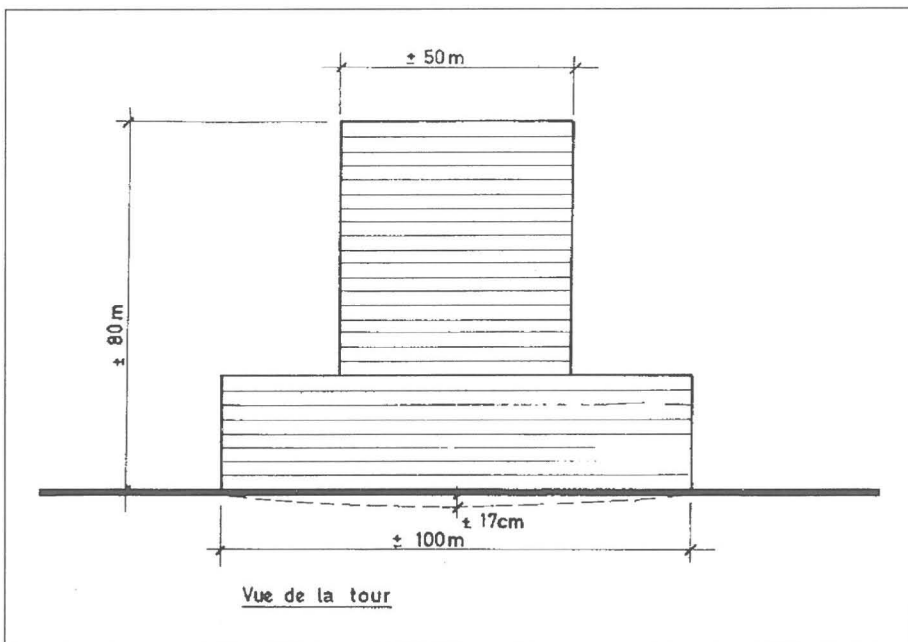


Figure 6. Slab deformation causing cracks in unreinforced masonry.

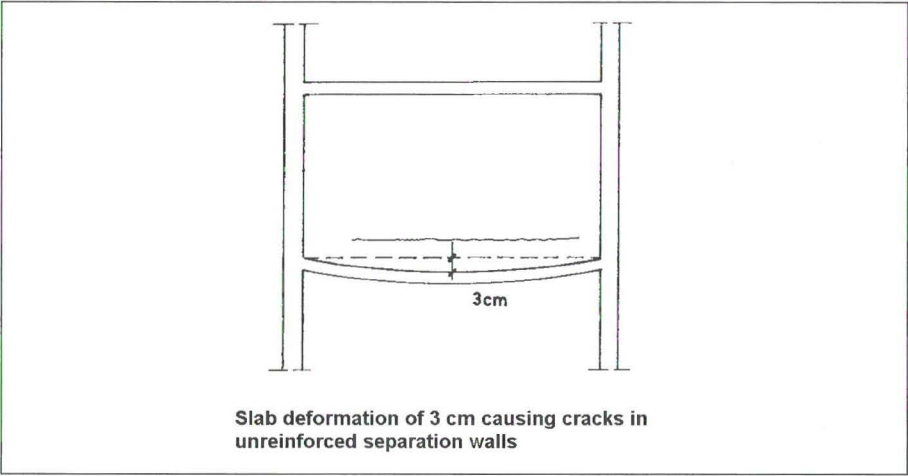
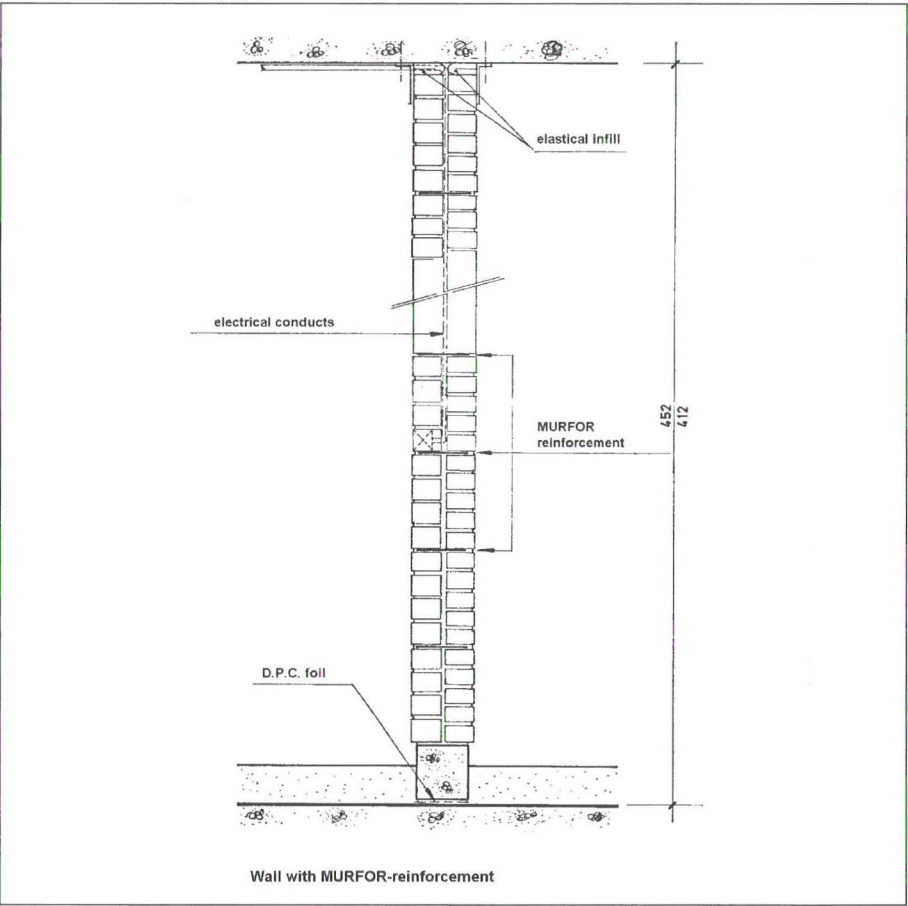


Figure 7. Detail of wall on deflecting slab.



- The proposed and adapted solution can be resumed as following (see fig 7).
- The walls were effectuated independently from the slabs (with the interposition of a D.P.C. foil).
- The walls were reinforced with joint reinforcement, so is the masonry acting as a “wall beam”.
- The deformations of the slabs are not influencing the behaviour of the walls.

3. HEADQUARTERS V.E.V. – ANTWERP

This office building is situated in the center of Antwerp, near the Schelde.

As it is the case in most of the constructions in Belgium, external walls have an inner leaf wall and an outer leaf wall.

The climate in Belgium is colder and wetter than in Southern Europe, so the space between both walls allows the implementation of isolation and the evacuation of the water that comes through the outer leaf.

Figure 8. Elevation V.E.V. - Antwerp.

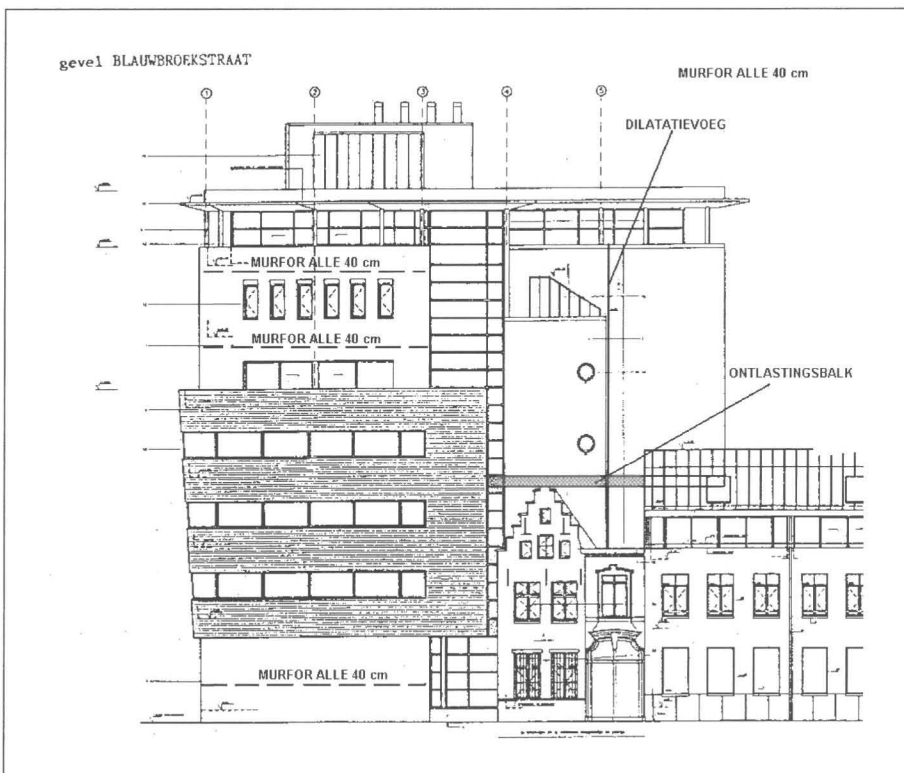


Figure 9. Distances between movement joints in function of reinforcement ratio.

Maximum distance between movemet joints						
material	wall thicknes ≤ 140 mm			will thickness > 140 mm		
	not reinforced	reinforced every 400 mm	reinforced every 200 mm	not reinforced	reinforced every 400 mm	reinforced every 200 mm
clay bricks	15m	20m	24m	15m	20m	24m
calcium-silicate bricks	8m	12m	14m	8m	14m	16m
dense concrete blocks						
lightweiht concrete blocks	6m	10m	12m	6m	12m	14m
AAC blocks						

In this particular case the inner leaf wall is made of concrete.

The use of reinforcement in the masonry had 2 reasons:

- Allowing higher distance between movement joints in the outer leaf walls
- Crack control, especially above the longitudinal openings

The table below shows the distances between the movement joints in function of the reinforcement ratio.

To avoid corrosion of the reinforcements in the outer leaf walls, all reinforcements have an additional epoxy-coating

4. ABBAY OF “SAINTE MARIE DE LA PIERRE-QUI-VIRE”

This realisation of architect Jean Cosse (Winner of the 5th Belgian Architectural Awards 1993) is an extension of the existing abbay of Morvan, near to Vezelay.

In his design, the architect tried to preserve the rythm of the existing contruction.

The construction is made of massive self-supporting masonry.

All the lintels were made by incorporation of reinforcement, so that the masonry stays visible at both sides.

At the square-side, the wall is made of self-supporting columns.

In planview, these columns have a “T”-shape so that they have enough strength to resist to the windloads. (see fig. 11).

In elevation they end with a triangular shape that supports the massive upper part of the wall.

Figure 10. Abbey of Sainte-Marie de la Pierre-qui-Vire (Morvan).

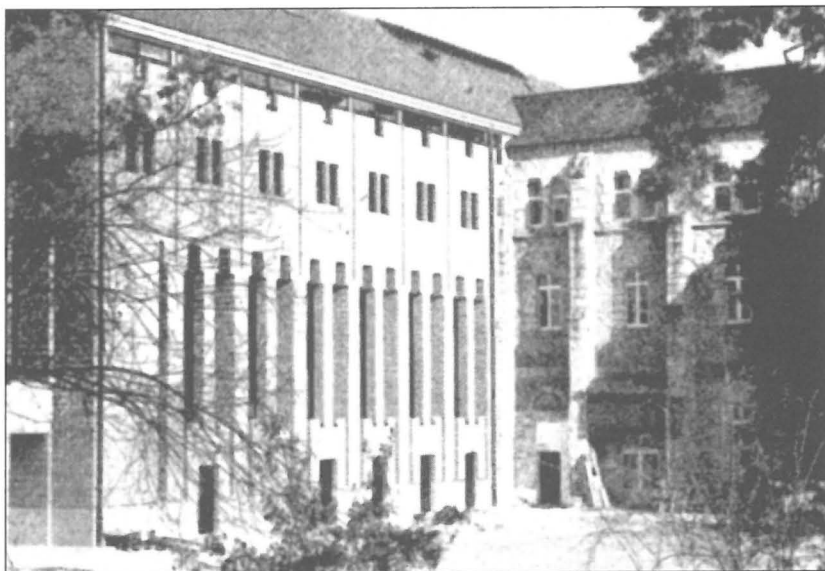
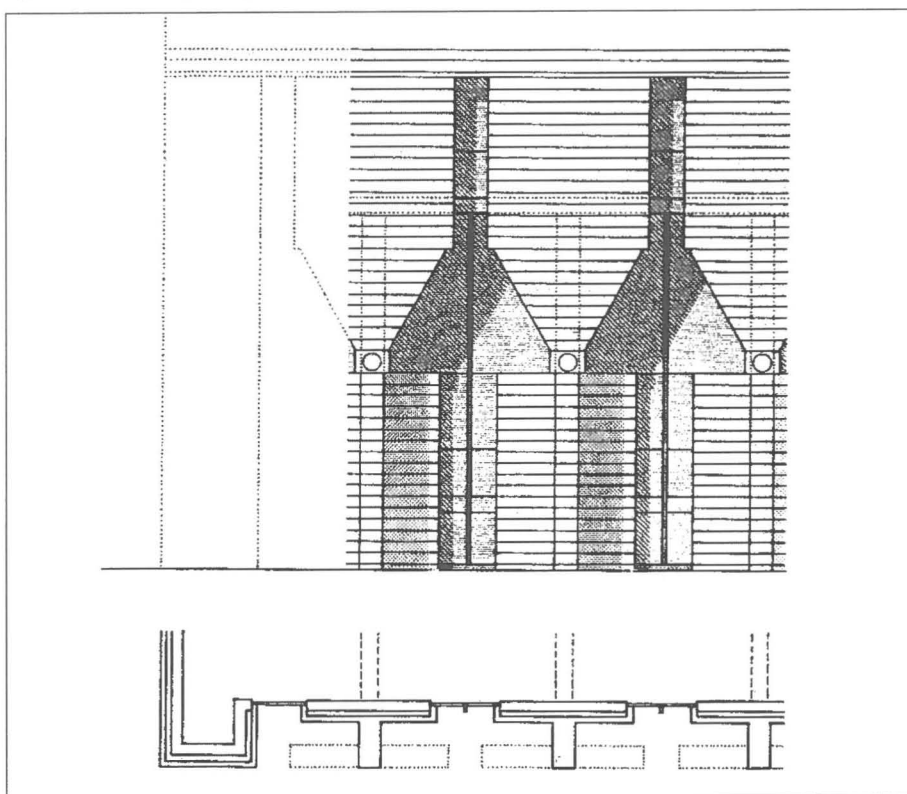


Figure 11. Self Supporting Columns at the Square-side.



The reinforcement was designed to resist to the horizontal traction forces that are caused by the spread of the punctual reaction forces of the columns, as shown on the design extract below:

The result is a construction with strong emphasis of volumes and openings as shown on Figure 13.

Figure 12. Extract of calculations of reinforcement.

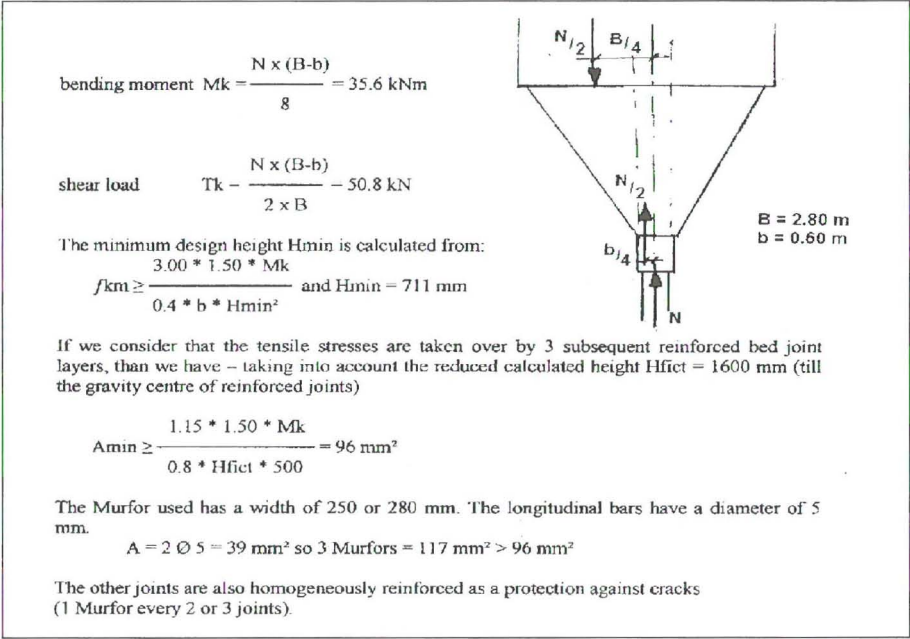


Figure 13. Abbey of Sainte-Marie de la Pierre-qui-Vire (Morvan) – Square Side.

