

IV-2. Some Early Reinforced Brickwork Masterpieces Revisited

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ABSTRACT

Reinforced through the wall (perforated) 4-inch brick masonry was built in Paris at the end of the last century on a number of sites. Non-galvanised steel was used with a rich grout and bricks with very low absorption. All the structures have been revisited and examined. They are still generally in excellent shape and need a minimum of maintenance. A word of caution on weather resistance is added.

Plusieurs bâtiments en brique armée de 11 cm furent construits à la fin du siècle dernier à Paris. On employait des fils d'acier non-galvanisés de 3 mm avec un mortier de dosage fort en ciment et des briques peu poreuses. On a examiné ces constructions. Elles sont toujours en très bon état et nécessitent peu d'entretien; il est important d'assurer la protection des points exposés.

Am Ende des 19 ten Jahrhundert wurden in Paris mehrere Konstruktionen aus bewehrtem 11 cm dicken hochloch Ziegelmauerwerk gebaut. Stahlkräfte von 3 mm wurden mit einem Zementreichen Mortel und mit Ziegel einer niedrigen Saugfähigkeit benützt. Diese Gebäude wurden jetzt wieder untersucht. Sie sind immer in sehr gutem Zustand und bedarfen nur sehr wenig Unterhalt. Eine Warnung betreffs Feuchtigkeitsschutz ist aber doch nötig.

Varie fabbriche di mattoni armati di cm 11 di spessore erano costruiti in Parigi alla fine dell'ottocento con un filo d'acciaio di mm 3 e con calcina ricca di cemento. All'ispezione si puo' notare la loro buona condizione e richiedono una minima manutenzione. Si deve nondimeno assicurare contro l'acqua gli elementi piu esposti.

The engineer Cottancin patented his system in 1889. He presented it at the World Exhibition in the same year. Anatole de Baudot, an architect, disciple of Viollet-Le-Duc, builder (and restorer) of churches, schools, houses and an eminent teacher was 55 at the time.

He seems to be searching still for the technology which will allow him, without turning to the gothic style, to produce the opaque, tense, nervous and structurally unified architecture of which the rationalist movement was dreaming. Amongst the various new methods of reinforced concrete or mortar, he, therefore, chose Cottancin's. It seems to him to possess, to the highest degree, the unity and continuity looked for, mainly because of the very fine woven mesh of wire which penetrates every part of the structure.

It is most probably A. de Baudot himself who introduced into Cottancin's system the ribs (on the underside of the floor plates) and the reinforced brick walls and columns, producing thus, in his own words "monoliths, or at least structures of which the elements can be well connected."¹ One can imagine how dissatisfied he must have been with his own house (1892), in which reinforced mortar floors rest on an external unreinforced cavity wall: one leaf being in stone, the other in brick, the two connected through pilasters composed of headers in both materials (figure 1).

The collapse of a building with reinforced concrete floors in Madrid gave him, later, the final technical proof of the soundness of the principles of unity and monolithism.

The reinforced brickwork of Baudot resembles today's low-lift technique in most respects (see figures 2, 3 and 4). Certain differences may be noted nevertheless:

- (1) The vertical wires were smaller and more closely spaced.
- (2) The horizontal reinforcement was more closely spaced and entwined the verticals.
- (3) None of the reinforcement was galvanised.
- (4) Horizontal reinforcement was at about 2 inch (50mm) from the external face.
- (5) More use was made of 7/16 inch (12mm) plates.

On the other hand one can recognize a close resemblance in the size of brick (4 inch × 9 inch or 105 mm × 220 mm)* in the size of horizontal wires (3/16" or 4 to 5 mm), in the size of the perforations (about 2 inch or 50 mm) and the walls around them (about 1 inch or 25 mm) and in the composition of grout (1 cement:2 sand by volume, probably on the "rich" side).

Three houses built at Antony, near Paris, in 1893 are the first of Baudot's in reinforced brick. Floors and roof are in reinforced mortar. Figure 6 indicates the positions of the 9 inch square reinforced brick columns. (220 × 220 mm) spaced at 8 to 16 feet intervals (2,50 to 5,00 m).

The external leaf is reinforced brick the internal is in plaster (figure 4). The state of the two houses constructed according to the plan in figure 6 is excellent. The third, which is bigger and slightly more exposed, has suffered quite a lot of damage externally. The lack of maintenance in recent times has been the cause of an acceleration in the process.

The main reason for this failure is, doubtlessly, the great number of salient mouldings and strings (figure 7) which are not watertight and permit therefore the ingress of water through their upper horizontal surfaces. The roof is flat and the parapet affords little protection even though

rendered. Cracks due to the corrosion of the wire combine with frost action and big pieces of brick are expelled eventually, exposing grout and reinforcement (figure 8). Other secondary phenomena have been noted: the damage caused by external fixings, and the deposition of quantities of carbonate and sulphate of calcium, darkened by soot, originating probably in the cement (we are in the course of testing this hypothesis).

We have noted similar failures on the belfry of St. Jean de Montmartre (1894–1905), which is in an extremely exposed, and polluted, position (figure 9).

Unfortunately Baudot had not been able to continue experimenting with the new system, except through the marvelous drawings, which anticipate the works of Nervi. But his disciples continued for a few years: Paquet, Le Coeur, Bonnier, Deneux and others.

The Lycée Jules Ferry by Paquet is 70 years old. The older part of the building has not needed repairing (except waterproofing of the roof). We noticed only one damaged brick on the exterior. The plans for the extensions in 1931 show that the technique of reinforced brick had been lost. Only the form of the bricks is repeated, but the perforations do not align. The extensions are not in reinforced brick therefore. One can see in the extensions (figure 11) that the cracks of the cornice propagate into the stackbonded brick below (figure 11). Not so in the older part. A crack can, in fact, be seen above the entry in the old part (figure 12), but the ground floor is built in plain unreinforced masonry, as demanded by the authorities at the time.

The Fontaine house by Le Coeur is also badly cracked at the unreinforced masonry base. The rather large telephone exchange in rue Bergère, also by Le Coeur, is in very good shape with a history of little maintenance. Let us mention finally Deneux's 4 story building in which the

reinforced brick (according to Baudot²) is entirely covered with ceramics which are today as good as new. Other buildings, using reinforced brick only internally, have been visited and noted for their good state (clinic of rue Remusat, school of rue Sextius).

These are our conclusions concerning the use of reinforced brick today:

1. The advantages in relation to the integrity of structure and the prevention of cracks (especially in stackbond) are confirmed by the 70 to 80 years old structures.
2. One must avoid water penetration through horizontal surfaces. It is therefore essential to provide good flashings at window cills, parapets, etc.
3. One should avoid external fixings into the brick.
4. Bricks with low porosity afford good protection to reinforcement but need a richer grout. (We tested some of the original bricks according to NF P13-305, French standard)
5. If these, and other principles of good practice, are observed it may be possible to use non-galvanised reinforcement not only in the vertical perforations but also in the horizontal joints provided a cover of 2 inch (50 mm) is maintained externally.

BIBLIOGRAPHICAL SOURCES

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*Several "specials" were made as well (figure 5).

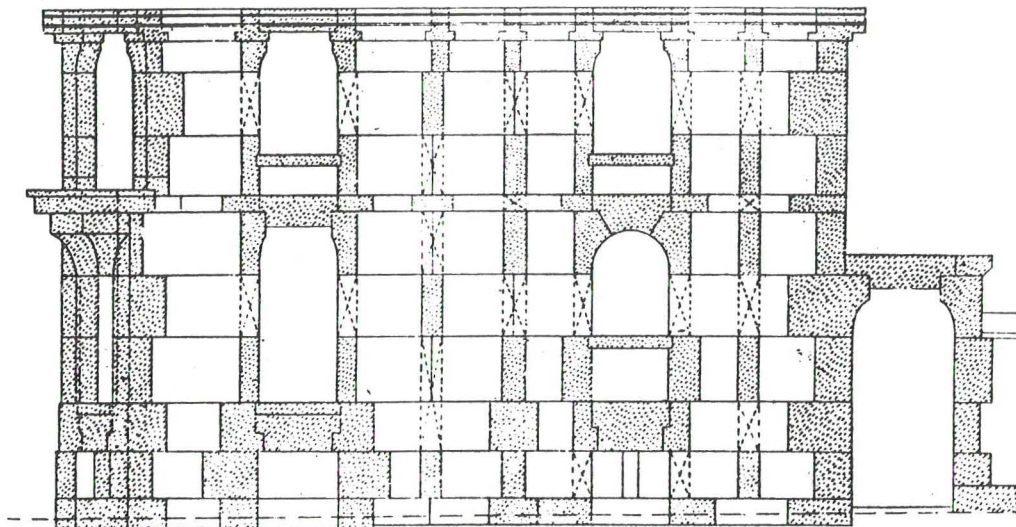


Figure 1.

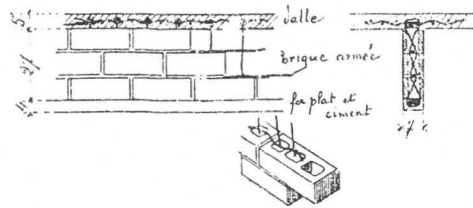


Figure 2.

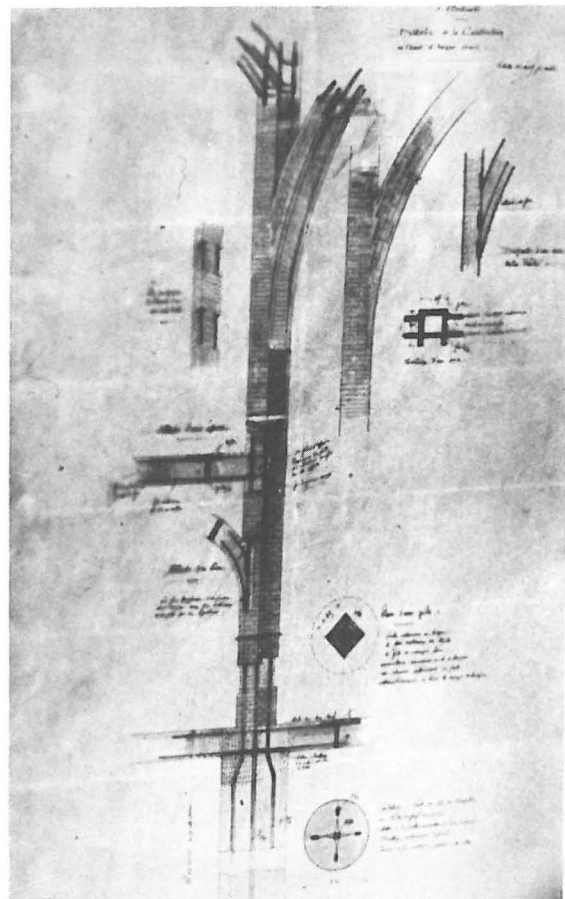
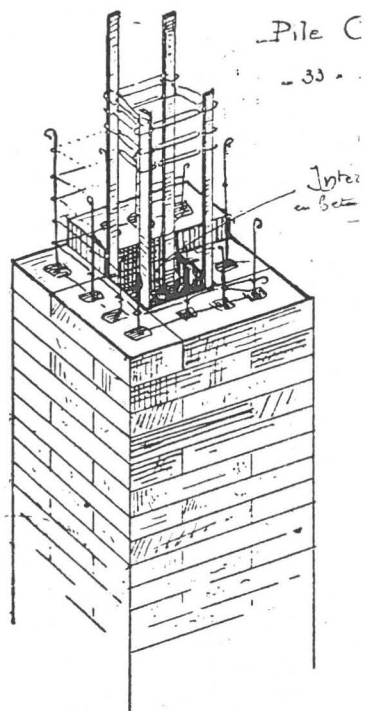


Figure 3.

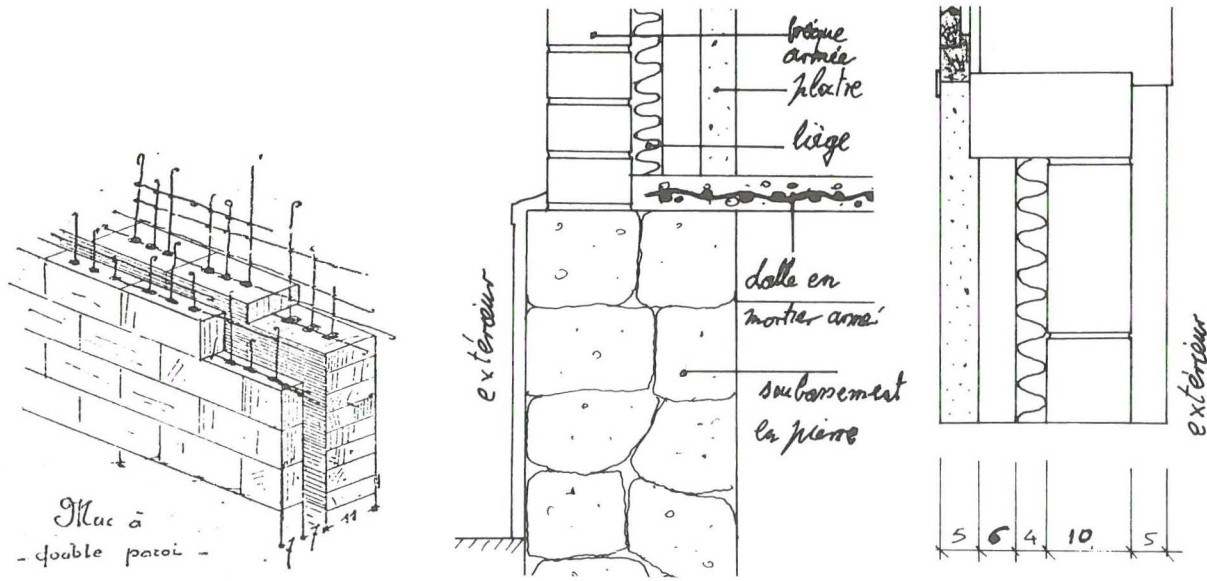


Figure 4.

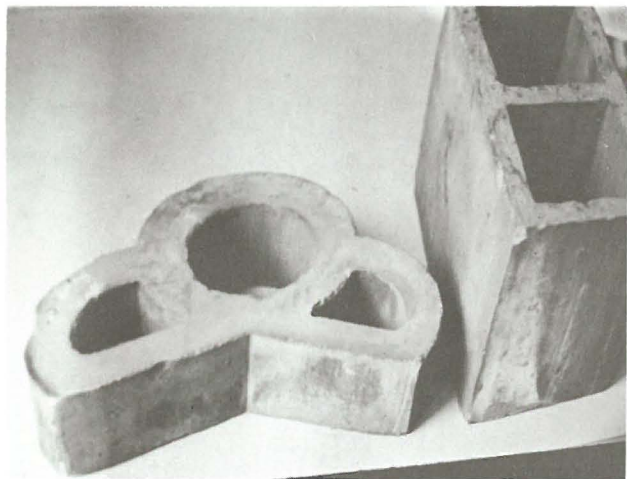


Figure 5.

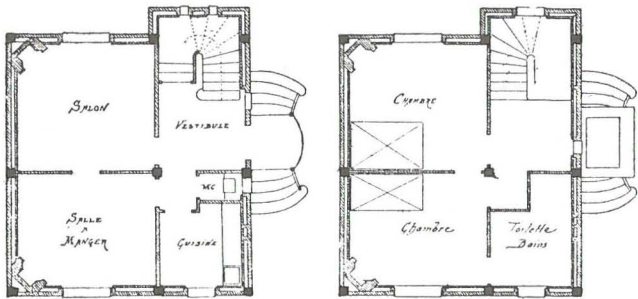


Figure 6.

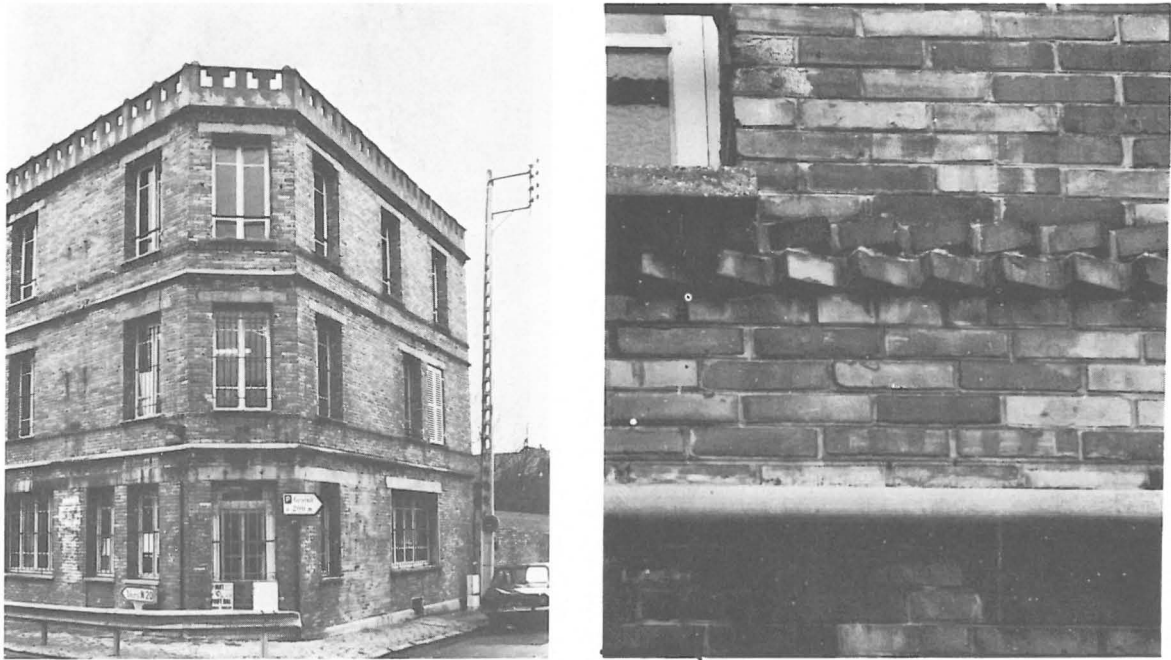


Figure 7.

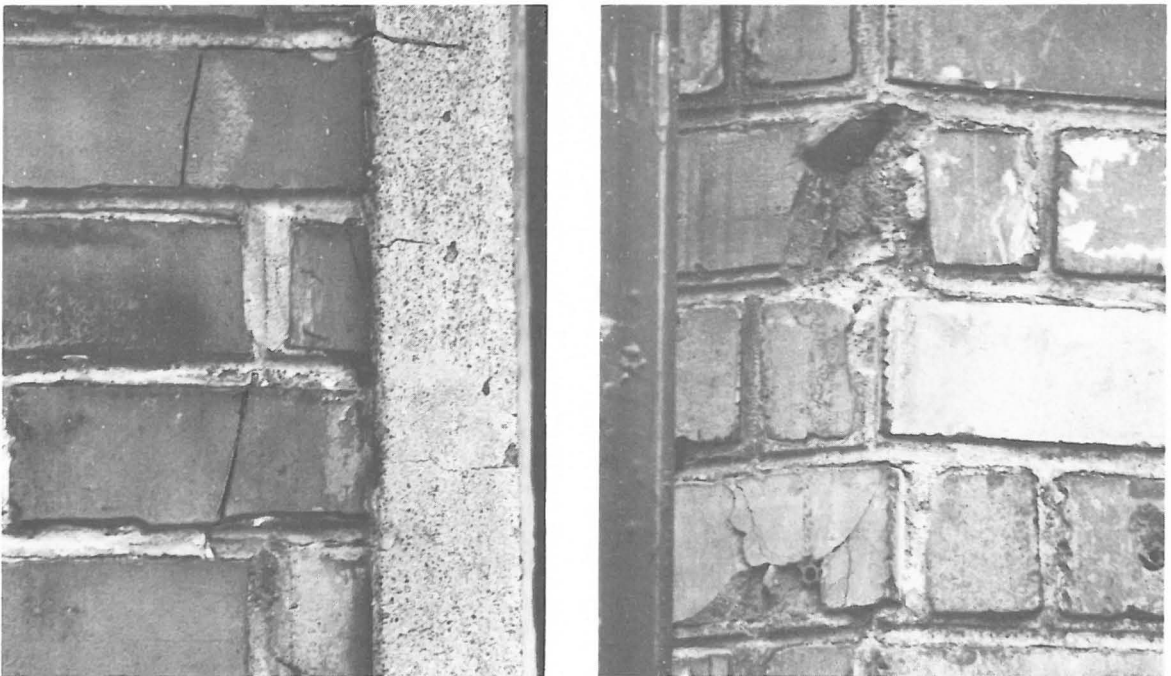


Figure 8.

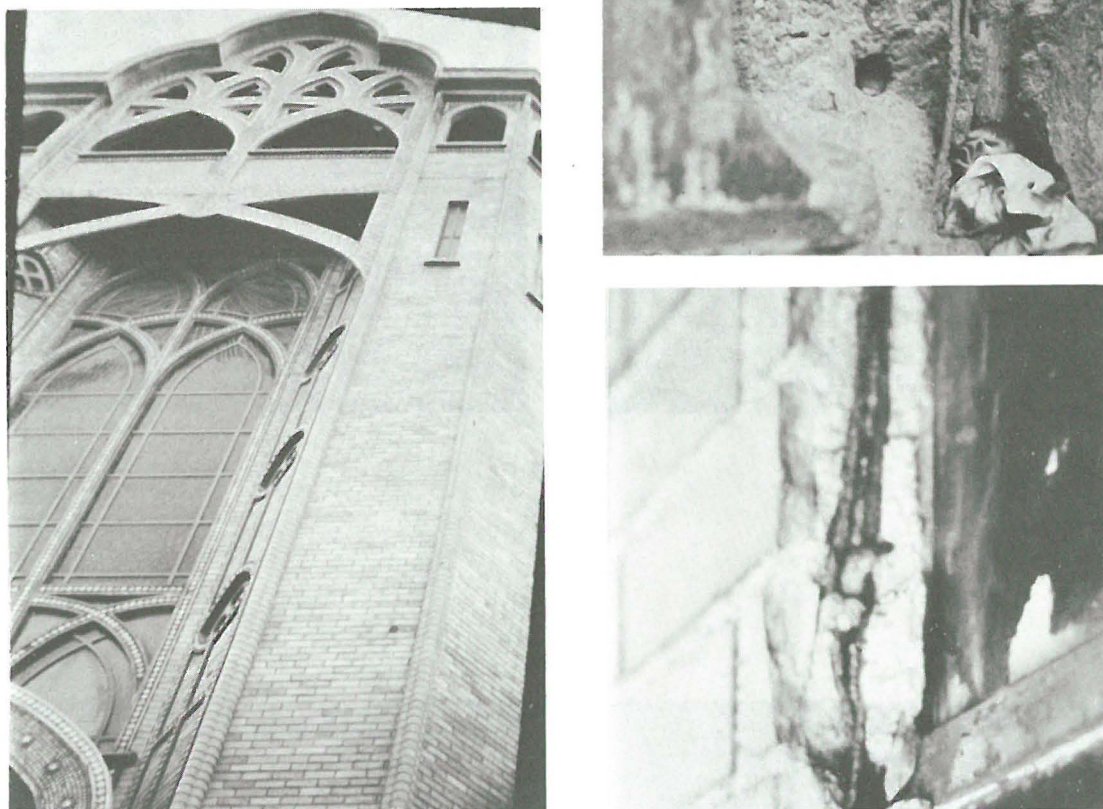


Figure 9.

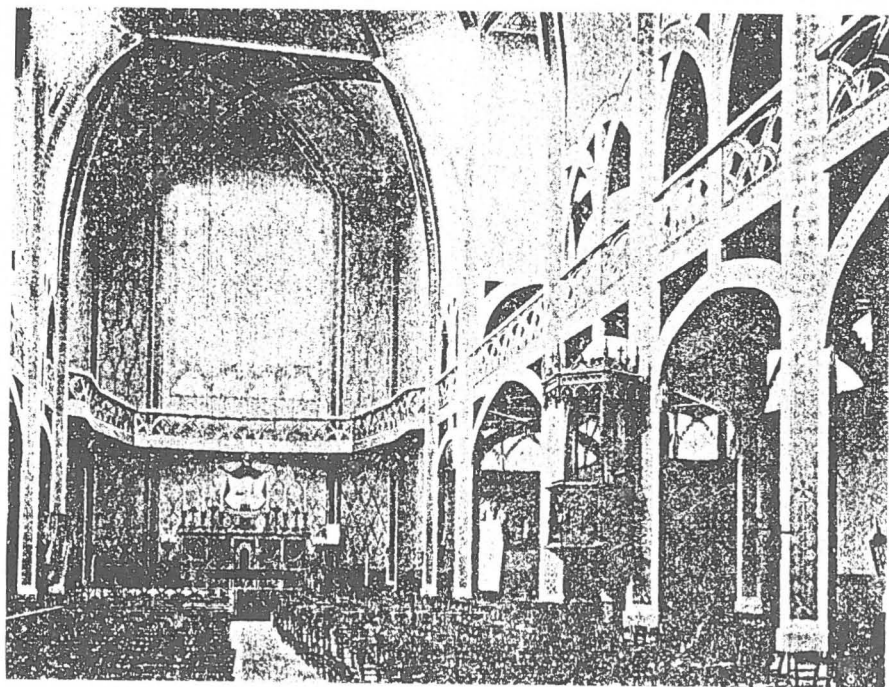
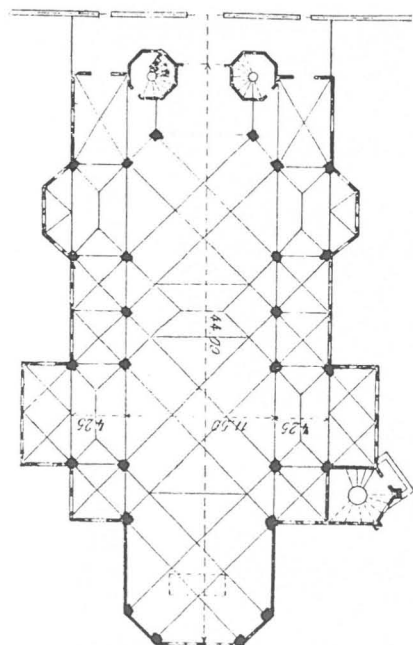


Figure 10.



Figure 11.

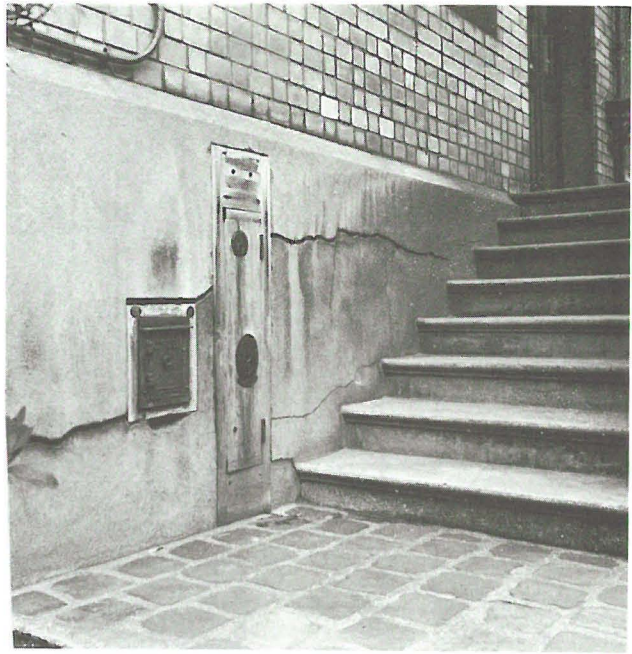


Figure 12.