Reinforced brick light-weight vaults

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Highlights

Different systems for the construction of light-weight vaulted roofing in reinforced bricks were examined. This building technique has been widespread in all of Italy from the beginning of the Thirties of the last century and has been the subject of numerous studies leading to different solutions, patented by many brick manufacturing companies and used in the construction of some interesting examples of vaulted roofing. Moreover, of undoubted importance, has been the aspect concerning the prefabrication which was experimented with and which characterized for some decades the history of construction in Italy.

Abstract

At the beginning of the Thirties, Italy witnessed a widespread experimentation in new building methods resulting in the construction of examples of quite daring vaulted roofing using reinforced and partly prefabricated brick blocks, a predominantly national material. This research resulted in the construction of many buildings, initially to be used for industrial purposes, which offer interesting construction and structural solutions and are distinguished by their large-sized roofing, with single or double curved surfaces, a significant feature of internal spaces.

Keywords

Light-weight vaults, Prefabrication, Brick blocks, History of construction, Roofing

Given the enormous potential of reinforced concrete (R.C.) in construction, the study of double-curved surfaces, which offer optimal resistance and an incomparable rigidity, led various important designers to experiment with new impressive vaulted structures. In the many works of Torroja, Candela or Lafaille the thin cement shells in reinforced cement, with their thicknesses of only a few centimetres, cleverly resolved the problems related to large roofing structures and explored the numerous design possibilities which the use of this material consented. Innumerable solutions for light-weight vaults in R.C. were thoroughly studied and symbolized the formal image of many buildings. However, the use of light-weight R.C. vaults did not enjoy the widespread use that “such an ingenious construction idea deserved” [1], one of the reasons probably being found in the fact that the calculations of such structures proved to be quite complicated, taking into consideration the flexural and

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torsional work involved. Moreover, the creation of the formwork required for the construction of geometric single or double-curved surfaces was quite complicated and, consequently, very expensive to carry out. Due to the latter reason, in the Thirties in Italy, a good part of the experimentation carried out by brick manufacturing companies was focused on developing construction techniques that, besides simplifying the support framework and allowing for a quicker on-site installation, would result in building structures that, in using simple materials, could complement the lightness of the finer reinforced cement vaults. The underlining idea was to use, as had been done previously for horizontal planes, load-bearing linear structures combined with light-weight brick blocks. Thus, soon after, different techniques were individuated to construct light-weight, thinner reinforced cement brick blocks, prefabricated or cast on-site, which became widely used to solve the problem of very large roofing structures.

In Italy, the methods used to construct vaults cast on-site, soon accompanied by the use of prefabricated materials, involved the use of light brick blocks shaped to accommodate the reinforcement bars, supported by arch frames on which the concrete was poured. The advent of prefabricated materials quickly led to a proliferation of numerous building procedures, often patent-protected, which utilized reinforced bricks to build straight or curved prefabricated joists depending on the construction method.

By 1925, the S.A.P. system of Erredibi had already been patented. It was based on a parallelepiped shaped brick with holes near the edges and in the centre of the lower area, which were the slots for small-diameter metal support bars. In using this type of brick, joists could be quickly built resulting in almost eliminating the temporary scaffolding and, moreover, it was an advantage for the national economy as Italian materials were used, thus reducing to a minimum the importation of materials (roofing had previously been built using metal beams) [2].

With a similar method and the same perforated bricks, there soon followed the production of beams, assembled on-site, which were already slightly curved, parabolic or round, and of a length equal to a submultiple of the planned arch. Once the foundations were set up on which the stacks of beams were to be built, depending on the pre-set curvature, the surfaces were levelled with sand and an initial layer of brick blocks were laid. Then, the reinforcement bars were inserted into the slots and sealed with cement mortar. A thin layer of sand of about one centimetre in thickness was laid on this first beam on which to lodge the perforations of the successive beam, the operation being continuously repeated.
The assembly of curved beams of this type required a temporary scaffolding of simple load supports corresponding to the longitudinal ribbing joints. Straddling these, lengths of added section reinforcements were positioned in order to compensate for the continuation of the metal reinforcement frame of the curved beams while the longitudinal frames were positioned at the ribbing. Moreover, there were then placed chains and lengths of added section reinforcements longer than the springers, whose length was calculated based on the pressure curve for more adverse load conditions. The final laying was carried out beginning from the longitudinal roofing joints and the springers, after the bricks were thoroughly soaked, and there then followed the positioning of the ribbing along the generating lines, filled with plastic sealing, rather than cement mortar, a rib every 10 m so as to create an expansion joint for the structure. Along with the SAP curved prefabricated beams, from the Thirties, different vaulted roofing was constructed following the format of the barrel vault and the SAP vault was cited in the Bollettino Ufficiale del Ministero LL.PP. n° 27 of 21-9-1937 –XV, as being able to be used in state buildings or those subsidized by the state.

In the same years, the R.D.B. Company had been testing in the experimental area of the Pontenure plant (Piacenza), barrel vaults constructed with SAP curved beams of various sizes covering spans of more than 40 m with 20 cm thick bricks, achieving in constructing a large arch, which was the exhibition feature at the Milan Trade Fair of 1938.

Using this vaulted system of the R.D.B. Company, from the design of the engineer, Calastri, the barrel vault was constructed for the roof of the large hall (30x40m) of the soap factory, Saponificio Ambrogio Silva, in Seregno. The vault, with a ratio between the span (30m) and the camber (4.2m) of 7, had a rounded profile and a thickness of 20 m. Horizontal tie bars of Φ 42 mm steel rods were positioned every 2.5 m. The beams of SAP 20 concrete bricks, making up the arch, were constructed on-site with a length of 1/6 of the profile and reinforced with four Φ4mm rods at the four edges of the brick. The temporary support frame was then positioned at the extremes of the curved beams and for the placing of the five longitudinal joint beams reinforced with four Φ5 mm rods. As well, three expansion joints were created, two of which involved only the body of the vault and the third also the springer architraves. The construction of the whole roofing required 30 working days and the formwork removal 27 days after completion.

Another special application of the SAP system was adopted in two drying warehouses of the Azienda Tabacchi Italiani in Piacenza and in Castelsangiovanni, both requiring that the roofing, besides the normal
overloads, also could support the weight of the garlands of tobacco leaves suspended for drying [3]. The roofing of the warehouses was constructed, based on the design of the engineer, Cascione, with two vaults in SAP reinforced bricks with 14m spans, supported by three rows of columns at 5.20m intervals, constructed in R.C. cast in brick formworks and with a recess at half height, in order to achieve a covered surface of 896 mq. As far as the dimensioning is concerned, it was established that each garland of tobacco leaves was made up of 12 rods thus determining the maximum weight which, taking into account the weight of the walkway for the passage of the employees (that of the workers and that of the fresh tobacco), resulted in being 236 kg/mq. Moreover, a length of garlands of about 8m was considered and therefore a height of 10m to the vault springer was established, while the thickness was set at 16cm, foreseeing the elimination of the loads by means of double T, NP8 profiles at 2.60 intervals (half of the column intervals). The tobacco garlands were hung on these to dry and so they were also subject to bending and shearing stresses and were suspended 70 cm at a time with Φ 8mm steel rods. The columns were calculated also taking into account the effect of wind and disymmetrical loads (a load on half of the warehouse) and, as well, the external ones were connected at half height with reinforced cement beams in the Piacenza warehouse, and with brick arches, in the Castelsangiovanni warehouse.

In both cases, the two horizontal elements supported the upper masonry. The SAP16 curvilinear beams were made on-site with a length of 1/4 of the arch so as to obtain three longitudinal joint beams to share more effectively the concentrated loads, while to allow for expansion, a joint at half the length was placed relative to both the vaults and the relevant springers and columns. One of the main problems in the construction of the two ATI warehouses was the construction of the two ATI warehouses in Seregno. The vault, with a span of (30m) and a height (4.26m) was characterized by a circular profile with a thickness of 20cm; at 2.5m intervals horizontal tendons were placed forming the vault, and these were strengthened with Φ42mm steel rods. The SAP16 curvilinear beams were made on-site with a length of 1/6 of the profile and were reinforced with 4 steel rods Φ4mm in the four corners of the brickwork, and these were later strengthened with 2.60 intervals (half of the column intervals). The SAP16 curvilinear beams were hung on these to dry and so they were also subject to bending and shearing stresses and were suspended 70 cm at a time with Φ8mm steel rods. The roof of the warehouses was constructed, based on the design of the engineer, Cascione, with two vaults in SAP reinforced bricks with 14m spans, supported by three rows of columns at 5.20m intervals, constructed in R.C. cast in brick formworks and with a recess at half height, in order to achieve a covered surface of 896 mq. As far as the dimensioning is concerned, it was established that each garland of tobacco leaves was made up of 12 rods thus determining the maximum weight which, taking into account the weight of the walkway for the passage of the employees (that of the workers and that of the fresh tobacco), resulted in being 236 kg/mq. Moreover, a length of garlands of about 8m was considered and therefore a height of 10m to the vault springer was established, while the thickness was set at 16cm, foreseeing the elimination of the loads by means of double T, NP8 profiles at 2.60 intervals (half of the column intervals). The tobacco garlands were hung on these to dry and so they were also subject to bending and shearing stresses and were suspended 70 cm at a time with Φ8mm steel rods. The columns were calculated also taking into account the effect of wind and disymmetrical loads (a load on half of the warehouse) and, as well, the external ones were connected at half height with reinforced cement beams in the Piacenza warehouse, and with brick arches, in the Castelsangiovanni warehouse.

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was to construct the joints and anchoring of the small girders acting as tie bars and, at the same time, support the weight of the tobacco leaves. Where the joints were concerned, two U-shaped rods were soldered on the upper and lower wings of the two extremes of the NPS8 to be joined, at the lintel of the intermediate springer, and a flat-shaped eyelet at the vertical entry at the centre, so that by threading through a simple pin the continuity of the tie rods could be achieved. The anchoring to the border lintels was achieved by bending the girders and with additional reinforced rods passing through the centre.

The SAP system of the R.D.B. quickly spread and was adopted in some particularly interesting projects, even from an architectural point of view.

This is the case of the building of the Nuova Pettinature Riunite in Biella, designed in 1939 by Giuseppe Pagano with the collaboration of the engineer, Gian Giacomo Predaval [4], which is a perfect example of the so-called functionalist architecture.

The building is made up of two parts: one, five floors high, on the road, and the other lower, with a shed roofing, which is built in a rear area. In the multi-story building, the work was carried out, differently to what had occurred in nineteenth-century buildings, from top down. The service parts and the vertical connections were housed in two projecting tower bodies, positioned at the two ends of the facade. Instead, the rear part of the building is markedly characterized by its shed roofing, which is almost a sort of glass ceiling, allowing for a better natural lighting and air circulation. It is actually to achieve the solution that Pagano used the prefabricated SAP curvilinear beams.

The same type of beam was also used by Piero Bottoni for the roofing of a building of the Olivetti Shyntesis plant in Apuania [5], carried out together with Mario Pucci in 1943 and later enlarged by Bottoni alone in 1953. The roofing is made up of six long shed vaults in reinforced bricks, supported by R.C. frames of reticular straight trussing of 19.18m spans, resting on H columns allowing for the shifting of equipment. The vaulted elements do not rest on the trussing, but are connected to it by means of the edge longitudinal beams only at the intersections.

In the building for the indoor Tennis Court of the Agip-Snam sporting complex (Metanopoli) in San Donato Milanese, designed by the architect, M. Bacciocchi, and the engineer, C. Fermi, and built in 1954, the large-sized roofing of 45m was solved by using a circular vault. This was done with curved SAP20 reinforced brick beams, prefabricated in the R.D.B. plant of Pontenure and were 6.50m long, on which an overlaying
4cm reinforced concrete slab was laid. Moreover, the vault was connected to the springer by a trapezoid beam underpinned by a support frames positioned every 5.23 m and resting on load-bearing foundation plinths of concrete sunken piles. Chains, made up of 8 Φ30 bars were positioned at the plinths and arranged in special ducts under the plant flooring. The support ribbing for the brick joists is made of steel tubes, resting on the ground on large wooden platforms thus sharing the ground load. To support the vault, a ribbing of wooden joists was used, positioned on block housings and with wedge thicknesses responding to the exact level, making formwork removal easier. The same SAP brick element was also employed to build the reticular beams used as purlins in the construction of the vaulting, positioning them above the arched structure with different forms (parabolic, round, etc.). Using this method, different paraboloid-shaped roofs were constructed for large warehouses throughout the country. During the same years in which the Nervi hall of the Saline di Stato in Cagliari was built and also the SIR Magazzino in Ravenna, designed by the engineer, Segala, three paraboloid roofing designed by the engineer, A. Minghetti [6] were also built using the same method – the Fabbrica Mantovana Concimi Chimici in Mantua in 1952, the Fabbrica Cooperativa Perfosfati in Cerea (Verona) from 1953 to 1954 and the Consorzio Agrario di Bagnolo Mella (Brescia) from 1953 to 1956. In the first, which is made up of three sections with a total length of 116m and width of 36m, the concrete arches, 30cm thick, are positioned at 6m intervals and support a system of SAP beams. The second is 75m long and 32m wide, and the third 90m long and 34m wide with a maximum height of 13m, resulting in being flatter than the others. All three are characterized by having totally glass caps and the last two by being attached to the ground on the long window sides, appearing to be detached from the earth. Extremely interesting, also from an architectural viewpoint, is the solution adopted by Gaetano Minnucci for the roofing of the large hall of the Fish
Market in Ancona [7] constructed from 1946 to 1949, replacing the old construction of 1928 destroyed during the bombardment.

The roofing structure is made up of eight large arches in R.C. placed parallel to each other at 6.5m intervals and with a variable section of 1.7m to 0.34m. Embedded at the base, the arches are supported, at 5m from the open end, by struts at an angle of 20° to the vertical and attached at the base and the intersection by the arch. SAP8 joists are positioned above, aligned with the vault. The resulting effect of the hall’s space is very impressive, also because of the clever use of natural lighting which, entering from the two opposite sides enhances the curve of the roof.

With SAP elements, also portions of hyperbolic paraboloids were constructed quite easily, such as those used in the building of the small plant of the company, De Senibus e Molinatto, in Turin. To better accommodate the shape of the site, in this case, a structure composed of 4 sloping elements was adopted (a parallelogram shape with 12m sides and 5.5m difference between the diagonals) in an inclined position, which allowed for vertical continuous windows. The sloping elements are shaped into 4 hyperbolic paraboloid segments positioned as a watershed with the lower vertex in the column, a round Φ45cm section, where the descending element was accommodated. The elements are mainly subjected to compression and the upper edge beam, of reticular-shaped elements, absorbs the horizontal components, giving support to the reinforced 4cm thick slab positioned above the SAP joists (prefabricated skew guaranteeing a continuous intrados of varying length in order to obtain a half-span transversal crossbar connection) which increases the thickness up to 25cm near the column.

As the use of prefabrication methods increased and, therefore, the size of the elements to assemble, the R.D.B. produced systems for BISAP vaults, usually in 80-120cm widths, so they could be aligned with both flat and curved skews guaranteeing a continuous intrados of varying length in order to obtain a half-span transversal crossbar connection) which increases the thickness up to 25cm near the column.
profiles.

This system was used in Sigonella to build a warehouse for the military airport where it appears as a large wavy or undulating vault achieved through the use of round surbased arches (7.22m rope and 1.45m arrow) on round arch segments (39.2m chord and 3.84m height). This construction was based on the static proportioning experimented with in the early Seventies in Pontenure by the R.D.B. to build the prototype of a wavy or undulating vault (surfaces achieved by using a non-reticular generatrix on a round or parabolic arched intrados) covering a new furnace. In this case, BISAP reinforced brick panels were used with a thickness of 12cm, width of 80cm and length of 3.25cm. The intrados was built by circle arch with a 30m chord and 4.24m height and the generatrices of a series of round arches with a 4.6m chord, equal to the pillar intervals, and 94cm height.

The panels were placed on temporary longitudinal arch frames, and the following joint between the panels, with R/C curbs at 3.5m intervals, provided the continuity of the vault creating, by means of the reinforcements inside and straddling the curb, a stiffening arch. The connection between the adjoining undulations was entrusted to an R/C 20cm thick flashing. The system required the adoption of 4F28 tie rods positioned corresponding to the columns. In Sigonella, the surfaces of each of the 12 undulations was created with 108 rectilinear BISAP20 panels (0.8m x 3m) stabilized by means of the lateral ribbing and the upper reinforced 3 cm hood and connected to the head of the 30cm thick reinforced concrete arches. For each arch intrados, there is a 30x30cm tie rod in c.a.p. with post-tensioned prestressing tendon cables.

The construction of the roofing with prefabricated elements could be achieved by also using structurally independent curved elements bearing a secondary structure, usually tiles, thus making it very simple, also after the construction of the building, to open up the space to admit light and air. This method used...
SAPAL joists and was employed in the building of the new Telve automated centre in San Martino di Lupari, based on the design of engineer, P. Roncoli. The roofing over a 10m square layout was constructed, without intermediate supports, with a light self-bearing vault with chains embedded in the floor joists. The system was built with 4 hyperbolical paraboloid-shaped roofs (created by a cross section that shifts parallel to one of the horizontal ridge lines and supported on one side, on the horizontal ridge line perpendicular to the first, and on the other, on the inclined perimeter line) and was built using, for the generatrices, precast reinforced concrete joists 10m high, whose end sections were offset from the set angle. 8cm thick blocks were positioned on the joists at 70cm intervals, with stepped ends, which became a formwork to lay a 4cm thick layer of concrete, reinforced with bars placed perpendicular to the diagonals.

An interesting variation which was also based on the idea of constructing, with a limited arch frame support, a load-bearing structure in linear elements on which to overlay the opening elements, is that of the Arco system of Brevetti Morelli which used a grooved brickwork to insert the reinforcing rods with which to shape on-site the straight or curved light beams. In 1941, the engineer, Carlo Morelli, had deposited the patent n°390812 for criss-cross ribbed ceilings or vaults, of triangular, rhomboid or polygonal shape, made of straight or curved load-bearing elements cast on-site. The empty spaces between the joists were filled with brick blocks placed only at the extrados or, in the case of a false ceiling, also at the intrados to create a compression resistant flat or curved surface, which, once mounted, ensured total resistance.

The joints between the load-bearing elements were constructed, so as to achieve an elastic and resistant structure, with a solid connection between the reinforcements.

In particular, the joint was formed by a special rhomboid or square piece in brick or R/C where the converging ribbing reinforcements arrived at the joint, bent and linked together by bolts. The ribbons were constructed by joining the ends of the brick block elements in a U shape arranged opposite each other in order to hold a layer of concrete and the reinforcements. The openings were positioned with one below, the other above, and the two Us were linked by vertical walls and were positioned to accommodate the longitudinal reinforcing rods in specific recesses, established by the ribbing prefabrication. This method was used two times for the roofing of the Osimo market, which, situated in an abandoned urban space in a suburb of historical buildings, was planned as a daily food market and, as well, for the drying of cocoons and grain. The plan of the market involves two adjacent halls and all'interno e a cavallo del cordolo, un arco irrigidente. Il collegamento tra onde contigue era affidato a una conversa in c.c.a. di spessore 20cm. Il sistema, evidentemente spingente, aveva richiesto l'adozione di tiranti costituiti da 4Φ28 disposti in corrispondenza dei pilastri. A Sigonella la superficie di ciascuna delle 12 onde è stata realizzata con 108 pannelli BISAP20 rettilinei (0,8mx3m) resi solidali attraverso le nervature laterali e la cappa armata superiore da 3cm e collegati in testata ad archi in calcestruzzo armato di spessore pari a 30cm. Per ciascun arco direttore è presente un tirante in c.a.p. 30x30cm con cavi di precompressione post-test. La realizzazione delle aperture con elementi prefabbricati poteva essere ottenuta anche utilizzando degli elementi ad arco staticamente indipendenti portanti una struttura secondaria, solitamente tavelle; in questo modo risultava molto semplice, anche in tempi successivi a quello della realizzazione, l’apertura di vani per illuminazione e areazione. Una modalità di questo tipo era quella che utilizzava i travetti SAPAL e che venne impiegata per la costruzione, su progetto dell’ing. P. Roncoli, della nuova centrale automotrice Telve a San Martino di Lupari. La copertura dello spazio a pianta quadra di lato 10m è stata realizzata con senza appoggi intermedii, mediante una volta leggera autoportante con catene annlegate nelle corree della muratura d’ambito: il sistema era costituito da 4 falde configurate a paraboloidi iperbolici (generato da una retta che si sposta parallelamente a una delle linee di colmo orizzontali e poggianti da un lato sulla linea di colmo orizzontale perpendicolaire alla prima e dall’altra sulla linea inclinata di perimetri) fu costruito utilizzando, per le generatrici, travetti in laterizio armato alti 10 cm prefabbricati, le cui sezioni estreme risultavano tra loro ruotate dell’angolo a prefissato. Sui travetti, posti ad interesse di 70cm, erano allaggiati tavello, da 8cm di spessore, con le estremità sagomate a gradino, che costituivano un cassero per il getto di una capsula in calcestruzzo di 4cm di spessore, armata con barre poste perpendicolarmente alle diagonaline di pianta.

Un’interessante variante che si basava sempre sul concetto di realizzare, con un limitato ausilio di centine, una struttura portante in elementi lineari sulla quale sovrapporre degli elementi di chiusura, è quella del sistema Arco dei Brevetti Morelli che utilizzava un laterizio scarico per l’introduzione di ferri di armature con il quale formare a pie d’opera travetti leggeri retti o curvi. Nel 1941 l’ing. Carlo Morelli aveva depositato il brevetto n°390812 per solai o volte a nervature incrociate, di forma triangolare, rhomboidale o poligonale, composti attraverso elementi portanti dritti o curvi prefabbricati a pie d’opera. Gli spazi vuoti tra i travetti erano riempiti con tavelle laterali disposti solo all’estradossa o, nel caso della presenza di un controsoffitto, anche all’intradossa a costituire una superficie piana o curva resistente alla compressione che, una volta montata, garantiva resistenza all’insieme. I giunti tra gli elementi portanti...
the most significant element is the ribbed intrados and segmental vaulted roof designed by the engineer, Carlo Morelli, immediately after the war using his own-patented system.

The warehouse of the Tabacchificio Farina in Battipaglia, constructed in the post-war reconstruction years by A.T.I., also displays a vaulted roofing with depressed profile three barrel vaults positioned in sequence and constructed with crisscross ribbing in brickwork.

A similar quite particular solution is that of the vault in the San Giuseppe Church in the Caleotto area of Lecco, built in 1946, and designed by the architect, Carlo Wilhelm. Here, a sequence of concrete parabolic arches support parabolic profile ribbed vaults using the Morelli system. The 45° grid inclination contributes to providing more stability to the structure which, thus built, to achieve a static equilibrium, had no need of buttresses nor chains. An evolution of Morelli’s system followed with a second patent, which foresaw the use of prefabricated R/C reticular beams, very similar to the Trall Patent for the Formaci Eredi Frazzi in Cremona [8]. This type of joist was used in constructing the vaulted roofing of the large space of the hall which housed the spinning machines of the Ricamificio Automatico in San Giovanni Lupatolo, north-east of Verona.

Also in the case of the Celersap system, the vaults were constructed with very light precast brick arches on which the hollow blocks were placed in line with the curve and then finished off with an upper layer of poured concrete. Later, other systems were developed with precast concrete arches placed parallel to each other on which the brick blocks were laid only on the extrados level, or also on the intrados (Celersapal or Varese type arches).

In 1951, ST’AR blocks were made public resulting from tests carried out in the Pontenure R.D.B. plant, where already for some years tests had been experimenting on a prototype for a ribbed vault in a clay-cement mix where brick blocks were used. This was a particular formation allowing for an easy and quick coupling, both above and below, with the elements previously set in place. The technique of ST’AR roofing was characterized by a very quick formwork removal. The springers were first made in which the brackets and longitudinal tension rod were embedded to block the intrados reinforcement, the protruding rods to be placed over the upper rods anchored in the revetment were later laid and the tie rods to compensate for the thrust of the vaults. The single vault, divided into sections, was built on fixed ribs, of different curvature and about 2m apart, connected by wooden joists positioned in a fan shape at about 1m intervals.

The ST’AR blocks, arch-shaped, were placed on the rib observing a
misalignment both of the joints between the blocks of the adjacent arches and the overlapping between the reinforcement rods of the different arches. The precautions adopted until the vaulted system proved itself to be an actual light-weight concrete shell involved the filling of the casing for the rods and an effective joining of the rods themselves with the brackets protruding from the springer, as well as completely filling with mortar the support bearings between the arches and a light forcing of the blocks of the middle arch.

Often, the ST’AR blocks were used in the building of shed vaulted roofing, typical of buildings used in industry and manufacturing. This is the case of the spinning hall of the Nuovo Cotonificio Siciliano built in Partanna in 1952 and designed by the architect, Pietro Ajroldi, and the engineer, Franco Gioè. The hall had an 80x128m rectangular layout and was divided into two parts by a series of rooms, placed longitudinally in the middle, used to house the general service facilities and ancillary installations. The main problems encountered in the planning stage were those related to the natural lighting of the large work room, the limited number of columns required to allow for the free movement of machines and, at the same time, guarantee visibility for checks, the total elimination of the eventual build-up of dust in the hall and, finally, those involving a good thermal insulation and affordability of the roofing. The spinning hall’s structure was solved by using six series of ST’AR12 shed-inclined depressed vaults, with a north-south of 7.5m x 11.67m and a series of 7.5m x 9.0m, all resting on a frame made up of columns and sloping beams. The six series of large spanned vaults were subdivided into groups of three from the series of smaller spanned vaults, which covered the area to be used for installations and services. The natural lighting was ensured by the wide curved iron window profiles following the line of the two vaults and which in total covered 25% of the hall’s surface, while the change of air and the removal of the dust were ensured by the two segments at the ends, which opened in every window. The internal space, with the overriding feature of
the roof, was especially impressive thanks to the effect produced by the light, which permeated the entire hall.

The same ST’AR block was also used to build easily rib vault roofing, and this is the case of the new graphic arts plant of the company A.G.A in Firenze Peretola, built in 1957 based on the design of the architects, Ponticelli and Gabellini, and the engineer, R. Masini. Here the roofing was constructed with four rib vaults on a 16m square plan. It rested on four corner columns, 35x35cm, on which the R/C large edge arches, 55cm high, were sprung; the 4F30 perimeter tie rods with tensioners of the large arches, which later with the removal of the vault formwork were inserted into a 35m x 35m R/C beam, suspended from the large arch in four points and on which the intermediate floors were laid. The vaults were built using a system of movable arch frames, with ST’AR blocks on which a 3cm thick layer of concrete was laid reinforced with normal bars at the angle bisectors.

The different experimentation in the use of brick blocks in the construction of light-weight vaults has undoubtedly been a feature for decades of the design and construction of many buildings attempting to explore, apart from the economic advantages, the potential of this material involving its structural resistance and possibilities to experiment. Light elements, built with relative ease thanks to prefabrication methods developed by different companies, enhanced the possibilities of structural resistance aspects and resulted in impressive spatial solutions which, experimented with from the beginning by important manufacturing companies, were also later adopted in important and symbolic constructions.

For many years interest in this type of structure dwindled and any further research of this model abandoned, however, recently, there seems to be a new interest growing in the study of reinforced brick block vaulted structures. The hope is that this research, by applying new possibilities of modelling and computation and studying the structural behaviour of this roofing more deeply, may develop and improve on this technique making it usable once presentarono in fase di progettazione furono quelli relativi all’iluminazione diffusa diurna della sala lavorazioni, alla limitazione del numero dei pilastri, necessaria per consentire libertà di movimento alle macchine e contemporaneamente la visibilità per il controllo, alla totale eliminazione di possibili depositi di pulviscolo nella sala e, infine, ad una buona coibenza termica e all’economia della copertura. La struttura del padiglione della filatura fu risolta utilizzando sei serie di volte ribassate, ST’AR12 inclinate a shed, con asse sud-nord da 7,5 x 11,67m in pianta e una serie da 7,5 x 9,0m, tutte poggianti su una intelaiatura composta da pilastri e travi inclinate. Per la copertura venne utilizzata una serie di volte a vela su pianta quadrata di lato 16m, che poggiavano su quattro pilastri d’angolo, 35x35cm, sui quali si impostavano gli arconi di bordo in c.c.a., alti 55cm; i tiranti perimetrali degli arconi, costituiti da 4Φ30 con tenditori, successivamente al disarmo delle volte furono inseriti in una trave di c.c.a., 35x35cm, sospesa all’arcone in quattro punti e su questa furono appoggiati i solai intermedi del capannone. Le volte sono state realizzate, utilizzando un sistema di centine mobili, con laterizi ST’AR sui quali è stata gettata una cappa di calcestruzzo di 3cm di spessore armata con barre normali alle bisettrici in corrispondenza degli angoli.

Figure 6. Shed roofing of the Nuovo Cotonificio Siciliano in Partanna under construction.
again for work on existing constructions and also to come up with new and interesting solutions where brick blocks can be recognized for their structural and aesthetic potential.

REFERENCES


