

IMPIEGO DEL LATERIZIO NELLA COSTRUZIONE FACILITATA  
THE USE OF TILES IN SIMPLIFIED CONSTRUCTION METHODS

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**SOMMARIO** Una ricerca, attualmente in corso, si prefigge di analizzare le prospettive d'impiego del laterizio in presenza di talune condizioni socio-economiche e di mercato (scarsità di risorse finanziarie, esiguità e diluizione degli interventi, dequalificazione della mano d'opera) tali da rendere appropriato il ricorso a tecnologie di "costruzione semplificata", cioè a processi che usino manodopera non particolarmente addestrata ed attrezzature di facile impiego, senza diminuire la qualità dei prodotti edilizi.

**ABSTRACT** A research project currently under way aims to analyse the utilization prospects for brickwork under particular socio-economic and market conditions (scarcity of financial resources, few and small-scale activities, unskilled labour) which call for simplified production technologies, that is, methods employing workers with little training and easy to use construction equipment, without detracting from the quality of finished products.

## 1. PREMISE

The construction methods currently used in the building sector tend to take on a number of features which stress the need of envisaging new "production lines" for building products and components specially tailored to the requirements of users.

In several segments of construction activities, in fact, not only in the so-called "Third World" countries but in the industrialized nations as well, whilst ever greater emphasis is being laid on the need to cut down costs, we witness a gradual loss of traditional labour expertise, as workers tend to become unskilled. All this leads to the need of adopting greatly simplified construction methods in order to prevent a drop in the quality of the finished building objects. On the other hand, it can be observed that the Italian market tends to break up into a series of small-scale activities, ranging from the construction of low few-storey buildings (often for single-family homes) to the rehabilitation and extension of existing structures. This fragmentation brings brickwork back to the fore, as a material with a considerable potential for development in interesting applications, and as a material that adapts easily to a variety of environmental situations.

Finally, it should not be overlooked that a culture of "appropriation" or "re-appropriation of one's surroundings" is now emerging, which applies to many aspects of life, but in particular to those aspects linked with the utilization of building objects, to the point that quite a few users have engaged in building their own single-family homes by themselves or become involved in partial restructuring activities (not to mention special instances of particular interest, where people handle and build by themselves community housing and facilities).



In view of these characteristics of the Italian market, which in some cases also apply at worldwide level, we are confronted with the problem of simplifying the construction process in order to meet the following objectives:

- a) make the construction process more economical,
- b) allow a massive use of unskilled workers,
- c) facilitate the task of people who engage in building their homes by themselves, whether they are driven by economic or cultural motivations.

On the basis of these premises, a research project has begun, promoted by the "Associazione Nazionale degli Industriali dei Laterizi Italiani" (A.N.D.I.L. - National Association of Italian Brick Manufacturers), to analyse the possibilities of using bricks in simplified building processes.

## 2. SHORT SUMMARY OF THE CURRENT PHASES OF RESEARCH

As a first step, the investigation focussed on the characteristics of the potential users of simplified processes and products, arriving at a rather important distinction between unskilled labourers who still belong to the building sector and the users who engage in building activities.

The salient difference resides in the fact that the latter (whom we shall term "self-builders") may very well be people not accustomed to heavy labour and hence require products that are easy to handle, easy to stack and not too heavy, products which may be placed with simple tools and with easily manoeuvrable machinery (as well as not too expensive, especially in the case of people who undertake small-scale rehabilitation work). Labourers who are not skilled but still are part of the building sector may not require these features and be ready to accept the utilization of heavy products provided they can be handled with suitable equipment and construction site machines.

This distinction must be kept in mind throughout the report in order to identify the destination of the proposed building products which may be intended either for "self-building" proper or for simplified construction activities in general.

### 2.1 COLLECTION OF DATA AND DEFINITION OF AN APPROACH

The analysis and study of specific reference material and of the environmental situations of interest from the viewpoint of simplified construction has brought out a marked convergence of attention, in Italy, on curtain walls, greatly enhanced, for obvious reasons, by the urgency of the energy problem.

In view of this state of affairs (which is also confirmed by the literature produced abroad, in Europe as well as outside Europe), it was deemed wise to stress and anticipate the phase of brickwork design-proposals for the remaining elements of the building object (other than curtain walls), deferring a systematic and critical analysis to a subsequent phase of checking and optimization to be carried out in collaboration with the manufacturers.

Together with this choice, also prompted by the need of developing studies and proposals concerning other parts of the building whose application methodology is not undergoing a thorough review (as is the case with external walls), it seems worthwhile to briefly mention other significant trends emerging nowadays, observed at the early phase of the research, which are seen to concentrate on



three main lines, namely, working methods, types and characteristics of the elements:

- a) As for working methods, the data collected so far highlight the tendency to simplify assembling operations, both by improving the dimensional characteristics of brickwork elements and by introducing new, specially designed equipment and tools or modifying the existing ones.
- b) As concerns the type of elements, it seems that special attention is being devoted to a number of geometrical and functional issues, such as the development of pieces ensuring "technological homogeneity" in the building activities: elements which may facilitate integration with other parts of the technological system (plants is a typical case); large size panels; components which may reduce or even eliminate the need of finishing operations.
- c) When we come to the characteristics and performance offered by brickwork elements, we can identify two different approaches: the first is based on the consideration that brickwork is a material with a not yet fully tapped performance potential and therefore we should increase its performance levels and at the same time develop more complex products (which should in turn translate into "added value" from the performance viewpoint); the second line of thought instead feels that brickwork offers an unrequested performance "surplus" (at least vis-à-vis its current building applications) and therefore it would be best to reduce the range of performances offered so as to be achieved through the ensuing "pauperization" of the material and/or the elements produced a cut-down in unnecessary costs, whilst still maintaining sufficiently high quality levels.

On the basis of the emerging trends discussed above, it can be logically argued that a correct company policy should pay the greatest attention to simplified construction methods and to an increase in quality, relying above all on an improvement in the overall quality of its product. There are, however, some lines focussing on the needs of self-building practice and a "Third World" perspective which calls for rigorous savings.

To conclude the observations made in this chapter, we may recall that research at world level can follow many alternative paths and that the identification of new working methods and new products may be achieved out of an extremely wide spectrum of possibilities.

## 2.2 THE ELABORATION OF PROPOSALS

Taking into account the current situation and the context and market prospects mentioned above, the research moved on to the elaboration of immediate proposals considering a vast range of products, either existing or conceivable, and thinking that in such a varied market there is room for considerable diversification.

At this stage of the elaboration of proposals, the investigation covered the following series of building elements, arranged in such a way as to begin with the elements of lesser performance complexity but greater versatility with respect to their potential users (self-builders and unskilled workers) and to end up with elements intended for specific categories of users:



- A) Interior flooring,
- B) Exterior paving,
- C) Interior walls,
- D) Complementary elements,
- E) Surface finish,
- F) Vertical bearing structures,
- G) Horizontal bearing structures: beams,
- H) Horizontal bearing structures: ceilings and vaults.

For each group of building elements comprised in this list the research project then went on to formulate some exemplifying indications of new brickwork products, which are proposed so that they may undergo a series of theoretical verifications, along appropriate " design itineraries", in order to check their qualitative response levels, and a series of experimental checks intended to assess the degrees of feasibility and efficiency which may be reached. These indications are illustrated in the chapters that follow.

### 2.2.1 EXEMPLIFYING INDICATIONS FOR INTERIOR FLOORING

- A1) Bricks or tiles embedded in self-levelling mortar, joined through simple vertical restraints, and involving the use of a sealing product to join the elements together and glaze the overall flooring surface.
- A2) Large size tiles with stiffening ribs to serve as supporting legs on the floor's extrados and form a cavity for the passage of ducts; supplied with sealable joints set flush at the edges.
- A3) Grids of brickwork elements with vertical holes, to be fixed to the floor ring extrados with a semirigid waterproof blanket cast through the holes and completed above with a layer of paving plywood with restrained elements, or another material consisting of sheets strong and stiff enough to remain plain under service loading.
- A4) Thin grids formed with bricks arranged into a modular mesh with prior insertion of raceways and ducts for the building's systems (with the possibility of filling them up with insulating materials.) These grids will serve as support for a wearing course consisting of permanent rigid slabs.
- A5) Brickwork blocks, to be arranged with the holes set horizontally, placed closed to one another and sealed with mortar cast from above till the level of the upper surface. The blocks will provide a supporting surface for moquette or similar covering material, with no further finishing. The horizontal holes may also be filled with different substances during production at the factory to provide calibrated properties of sound insulation at various frequencies.

In these exemplifying proposals one can discern the attempt to "hybridize" such a traditional material as brickwork with additives that are totally different, in terms of type of commodity and application techniques, and to make use of bricks in situations and for integration purposes that are very far from the usual ones. An attempt at "hybridization" which, from the standpoint of production, could open up stimulating opportunities for the utilization of novel filling techniques (foam producing substances, etc.) and a very significant proposal for "self-building" activities, thanks to the possibility of fitting system



ducts with the greatest ease and simplifying all placing operations.

### 2.2.2 EXEMPLIFYING INDICATIONS FOR EXTERIOR PAVINGS

- B1) Hollow clay blocks with one face to serve as walking floor (obtained by making the outer block sector thicker and by treating the surface with sandblasting or similar finishing techniques in order to provide sufficient resistance against wear) embedded in a concrete layer and sealed with bituminous products in special slots built into the thicker edges.
- B2) Hollow clay blocks, stiffened as at B1), but set at an appropriate slope and with the end pieces kept slightly apart so as to form (through the inner holes) a draining plane for surfaces exposed to bad weather (paving of sidewalks).
- B3) Brickwork blocks with small size holes set upright, resting on a roadbed and a sublayer of gravel and compacted sand so as to provide a partially drained paving (or the support for additional surface paving).
- B4) Profiled brickwork elements with suitable shapes to form water collecting troughs or else a protected inspection facility for sundry ducts and conduits.

Starting from the assumption that the intrinsic characteristics of brickwork can also prove valuable for external utilization, it can be noticed that the guiding concept of the above exemplifications consists in meeting the requested performance levels through a carefully calibrated indication of a qualitative nature.

### 2.2.3 EXEMPLIFYING INDICATIONS OF INTERIOR WALLS

- C1) Brickwork elements in the form of hollow clay blocks with increased thickness, fitted with sealable restraints on all four sides and with incorporated wooden strips to facilitate the application of alternative types of surface finishing (such as fabric covering) and to simplify the addition of wall fittings.
- C2) Brickwork elements in the form of hollow clay blocks with sealable restraints on all four sides, produced with a thicker sector (characterized by two or three series of holes), fitted with slots and marks for the insertion of system components and ducts. In this case, the finish would be traditional, with plaster.
- C3) Brickwork elements, with L or C shaped profiles for the formation of composite non-bearing partitions made up of staves stacked up and fixed one into the other with an insulating layer in between (for instance, a mineral wool mattress).
- C4) Brickwork elements with inclined holes to form a grid type wall that might ensure a certain degree of privacy and at the same time serve as a partial subdivision of interior space. These walls may also be viewed as permanent fixtures to be equipped as a function of the users' needs. Given the considerable amount of empty volumes, these elements can also be formed as large size panels with sealable restraint joints.

As can be observed, in this summary of possible proposals, the emerging trend is the simultaneous presence of diversified functional assignments, alongside



the traditional function of providing a visual barrier. A simultaneous presence that facilitates and suboptimizes the ratio between quality and costs, and at times may even eliminate the need of installing other specific building elements.

#### 2.2.4 EXEMPLIFYING INDICATIONS OF COMPLEMENTARY ELEMENTS

- D1) Brickwork elements for fences, transennae, and breastwork, supported by other brick elements profiled to form uprights, cross members, handrails and sills. The design and size of these elements, as well as the colour and type of surface finish (sandblasting, etc.) should be selected with a view to replacing the concrete element solutions in current use.
- D2) Glazed surface containers which may be stacked and fixed to one another to form permanent fixtures and pieces of furniture in the home. We should just think of the potential of a material that would introduce new shapes and dimensions into interior design as an alternative to wood, not only as a lining material, but as an essential component of interior space and fittings: closets, shelves, containers, etc. Moreover, it would be crucial to exploit as fully as possible its specific assets: ease of washing, durability, brightness, colours, etc.
- D3) Elements conceived much like the above, but unglazed, in order to provide self-builders with raw technical volumes and leave it up to them to finish the units' surfaces according to specific functional needs, varying the type of finishing (water-repellent, polished, dull, granular, etc.) and the colour.  
In this way, the brickwork, combined with the finishing products, is turned into a new material that differs from all existing ones, especially if additives are used for the surface of the mixture so as to modify its characteristics and behaviour.

In this category of building elements, therefore, the proposals are inspired by a principal line of research that tends to identify and gain new market outlets in a sector where brickwork has always played a minor role: interior (and exterior) home furnishing.

#### 2.2.5 EXEMPLIFYING INDICATIONS OF EXTERNAL FINISH

- E1) Tile elements with ceramic or opus incertum patterns, prepared on provisional boards to facilitate placing, applied with open joints or metal covering joints set between the boards.
- E2) Modular tile elements of considerable size (60 x 60 cm), set on metal frames to be fixed either to the wall or to other supporting structures, with the possibility of leaving a cavity to be filled up with insulating materials. This would simplify placing operations and would make it possible to combine different decoration or surface finish compositions.
- E3) Big contoured tiles with raised edges (reinforced with metal blades for fixing the units to the support by means of bolts) to be used to create external facade coverings (of new or existing buildings) and to facilitate the introduction of insulating materials in the cavity obtained between the supporting structure and the tiles (as in the case of cladding "coats"), or



form ventilated facades for application under particular climatic conditions.

- E4) Surface finish elements for the decoration and fitting up of interior room surfaces, such as walls and ceilings, to be formed with layers of raw clay stabilized with additives so that it may acquire enough rigidity in relation to its intended application.
- E5) Profiled elements, in very long sections, for the realization of vertical and horizontal matchboarding to be applied, for instance, in lieu of similar wooden elements, exploiting the greater durability of brickwork and wider choice of shapes and colours to be combined.

The basic idea of the examples mentioned above is the attempt to fulfill specific requirements, at times quite sophisticated ones, of users - including self-builders - who care for their home and are sensitive to the problem of the appropriation of space, by introducing, amongst other materials, raw stabilized clay (whose utilization is compatible with the climatic conditions of interior spaces).

#### 2.2.6 EXEMPLIFYING INDICATIONS OF VERTICAL BEARING STRUCTURES

- F1) Brickwork blocks with different size holes (big holes at the centre and small ones round the perimeter) conceived for use as non recoverable formwork for the casting of concrete walls and columns (or for the realization of technical compartments for the passage of system ducts and flues).
- F2) Blocks (possibly made with a lightweight mixture, considering that strength prerequisites are often limited) with modular dimensions (to facilitate their integration with modularly coordinated building components) provided with eyelets or vertical slots at the edges for the introduction of vertical reinforcing bars and guides for easy placing on site.

In this case, only two indications have been illustrated since the sector is at present involved in the study of the specific problems of reinforced masonry walls and their resistance to seismic effects. Therefore, the reader is referred to the extensive research that is being carried out in this direction.

#### 2.2.7 EXEMPLIFYING INDICATIONS OF HORIZONTAL BEARING STRUCTURES: BEAMS

- G1) Thin-walled hollow bricks, with the outer surface suitable for facing work, with L or C shaped profile specially designed for use as non recoverable formwork for the surface finish of beams projecting underneath the ceiling (or at ceiling level). These elements, whose shape should also facilitate their interconnection and stability during surface casting, may also ensure some slight advantages in terms of thermal insulation.
- G2) Special brickwork elements, conceived to eliminate the need of temporary supporting reinforcement during the casting of structural elements (lintels and the like) by developing a shape consisting of mutually supporting parts where the lintel components may rest and react starting from the abutment pieces in the walls.
- G3) Hollow brickwork elements, suitably arranged for the insertion of prestressing tendons (to be tensioned manually through simple screwing action) for the formation of limited span beams to be precast on site and completed with



a concrete casting to make them integral with the ceiling.

As can be seen, the above indications tend to outline the possibility of employing brickwork in a rather unusual sector, outside the range of the material's customary applications, relying on the one hand on its properties as a "lining" material for structural elements of reinforced concrete, and, on the other, on its aptitude for the functional integration of steel reinforcement (a possibility obviously based on its great compressive strength).

#### 2.2.8 EXEMPLIFYING INDICATIONS OF HORIZONTAL BEARING STRUCTURES: CEILINGS AND VAULTS

- H1) Hollow clay block type elements with increased thickness and a high percentage of hollow space, produced with the injection of insulating materials inside the holes in order to enhance the blocks' heat and sound insulating characteristics. These elements may be applied for the execution of non habitable garret ceilings or false ceilings, by the insertion of special reinforcing bars along longitudinal joints.
- H2) Elements similar to the ones illustrated at para. G1), but shaped so as to provide the stiffening ribs for ceilings (joists) serving as supports for additional lightweight members to be placed between the joists.
- H3) Hollow brickwork elements with a profile specially designed for the execution of double curvature lightly reinforced vaults to be precast on site by means of a square fabric sheet, fixed at the four corners, on which the brickwork elements should be placed before the casting of lightweight concrete (making sure all joints are fully saturated with concrete). These small-size vaults whose shape would obviously be determined by the weight exerted on the cloth by the bricks and thin concrete casting (and which would be turned upside down and placed, needless to say, with the curve pointing upwards) may find application as roofing of rooms or as intermediate ceilings by supporting their edges on reinforced concrete joists or steel sections. As an alternative, the vaults may be executed without inserting the brickwork elements, by casting a suitably reinforced, thin slab of expanded clay concrete.

In this last category of building elements, it can be observed that the first two examples belong to a sector where brickwork has been amply exploited and where new proposals for simplified construction must concentrate mostly on the solution of joint details and execution methods; as to the last proposal, instead, that is, small vaults, it can be seen that it introduces a new construction element perfectly in tune with the basic idea of simplified construction and of great interest, both in architectural terms and from the viewpoint of building technology.

### 3. CONCLUSIONS

At the end of this rapid survey of "design ideas" inspired by the requirements of simplified construction and "self-building", it seems worthwhile to underscore that, over and beyond the specific techniques that will ensure the greatest ease of execution and construction, the research currently under way also



identifies the desired "simplification" with the greater value ascribable to the ratio between the "quality offered by a building object" and the "costs incurred for its realization".

When this value is higher, in fact, it is probable that the proposed product has become functionally richer, to the point of doing away with other building elements and hence reducing the complexity of the building operations.

This approach of the investigation (which is merely one of the possible research paths, not the only one) is consistent with many production needs observed in Italy (and probably prevailing in many other countries too), although not much has been done towards a "direct pauperization" solution entailing a qualitative decrease of the products themselves and of their methods of utilization. It is felt, in fact, that we should still regard as "appropriate", that is non consumistic, a production that fulfills the actual needs of the users in an economically advantageous fashion, especially if the users can play an active role in the building process and thus obtain further reductions in costs.