The paper focuses particularly on the employment of thermal insulating materials (Eraclit and Celbes) in the Italian colonies in 20s and 30s. The main sources are handbooks and reviews, which give an overall view of the experimentation of light prefab. building solutions, providing also a guideline to tracing the development of building techniques, and lastly to determining the effects of aforesaid experimentation on the Italian market, even in the post-war years.

Abstract

Italian colonial settlements (1870-1940) have provided the territories in which to experiment modern materials and construction techniques, in particular ready-built and standardized solutions, in African difficult climatic and logistic settings. This work focuses on the experimental employment of insulating (Eraclit, Cel-Bes) materials on light metal-frames in Italian colonies. Its object is to trace back the development of such construction techniques through case studies published in contemporary technical reviews and handbooks, underlining the mutual relationship between experimentation and industrialization, between theory and construction practice.

Keywords

Insulating materials, Eraclit, Cel-Bes, Modernity, Industrialization, Italian construction

1. INTRODUCTION

In the twenties and thirties Italian colonies saw a sizable building activity resulting from Fascist colonial policies, prompted both by the desire to boost prestige and by the need to provide new opportunities for the Italian construction sector, sorely impaired by the 1929 economic slump. Such policies – climaxing in the campaign of Ethiopia and the foundation of the Empire – led to the transformation of the existing local urban settlements and to the foundation of new towns and rural centres in Eritrea, Somalia, Libya and, lastly, Ethiopia.

Oversea territories provided the opportunity to test Italian urban and architectural theories, as well as to experiment modern materials and construction techniques – in the difficult African geographic and logistic conditions. Coming to terms with utterly different environments and climates
meant devising not only a style suiting ‘colonial’ architecture, but also choosing the techniques and materials suitable for countries with a different approach to construction. At the same time, it also afforded the opportunity to widen scientific speculation regarding the inter-dependence between climates and buildings, from the point of view of comfort, resulting from the different climatic conditions of African colonies [1].

The development of insulating materials in Italy and their employment in the colonies stems directly from the choice of a functional approach to building, which led to abandoning the original curtain wall in favour of two separate – as regards structure and construction - elements: the weight-bearing structural framework and the multi-layered envelope meant to protect the inside of the building. As far as thermal insulating is concerned, the roots of such rapid development are to be led back to the progress of the ice-producing industry, which resulted from the preservation and transformation of foodstuffs; such progress stemmed from both the scientific contribution in determining the thermal conductivity of the materials and the construction of refrigerating buildings. As regards this, the experience gained during World War 1 thanks to the building of large military refrigerating stores contributed to devising materials and implementing construction techniques that after the war were applied to the large factories in Parma, Udine, Verona and Milan. The construction typology prevailing in these specialized buildings consisted in a reinforced-concrete framework with extremely thick infills, their inside surfaces being entirely lined with standardized panels consisting in granulated cork with casein or tar as binders.

The need to overcome the shortcomings of such materials (scarce resistance to humidity and noisome smells respectively) led to experimenting with new vegetal-fibre and cement based materials with which to make highly-insulating, odourless, fire-proof and humidity-resistant panels. These proved suitable even for residential buildings, being capable of protecting the inside from extreme temperature variations. On the Italian market soon were available both Italian and foreign materials: either aerated vegetable panels (Eraclit, Carpilite, Tekton), straw panels (Solomit) and wood fibre ones (Celotex, Populit, Insulite, Masonite, Faesite, Tenlok, Mantex). These joined aerated concrete insulating blocks and hollow blocks when raising multi-layered insulating walls supported by structural frameworks.

The paper focuses particularly on the employment of thermal insulating materials (such as Eraclit and Celbes) in the colonies, providing an overall view of the experimentation of light prefab. building solutions carried out starting from the early thirties, whose results were evident during the Ethiopian War.
The approach to construction in overseas lands in the thirties is strictly connected to Fascist colonial policies, being dependent on its issues. Architects were deeply involved in colonial events and policies [2], as witnessed in the articles of the reviews. In the twenties – when the Italian presence was asserting itself – only scanty articles either regarding individual representative buildings in the chief towns can be found (i.e. banks and government seats in Massaua, Mogadiscio, Tripoli) or infrastructure facilities connected with territorial expansion, such as bridges, railway viaducts and roads [3]. On the other hand, when the regime urged the development and enlargement of the overseas territories, also reviews paid more attention to colonial events.

As regards technical handbooks, instead, there are not any articles specifically dealing with building in the colonies; at the early stages, pragmatism was the rule. The buildings in the colonies were simple structures featuring weight-bearing stone walls with horizontal floorings and wooden roofs mainly covered with corrugated sheeting. Reinforced concrete was reserved for infrastructures and for the structures of the most representative buildings. It is then to be concluded that typologies and construction techniques were made suitable to meet local requirements (materials and manpower), the main target being reducing costs rather than developing solutions specifically meant for

2. BUILDING IN THE COLONIES: THE CONTRIBUTION OF ITALIAN TECHNICAL HANDBOOKS

The paper focuses in particular on the contribution of technical handbooks in the thirties to developing building solutions suitable to meet local requirements (materials and manpower), the main target being reducing costs rather than developing solutions specifically meant for the Italian market.
colonies. Following the 1929 economic slump, the regime policy of public investments in the sector of construction reached the colonies, where the vast number of settlers in Cyrenaica and in the innermost areas of Somalia required local urban centres to be enlarged and new towns and rural villages to be set up. Such emphasis on construction aroused a new interest in colonial themes: the resulting architectural debate involved the features of the “colonial style” of the new buildings, of the urban planning of the new settlements, the typologies of residential housing and, at last, the technicalities regarding colonial construction methods and techniques. Architects and engineers directly involved in planning colonial buildings applied themselves to defining such technicalities; however, several people were – even if indirectly – involved in advancing a modern and rational approach to construction, regarding colonies as suitable testing grounds for ideas and experiences stemming from environments more in keeping with European avant-gardes. Enrico A. Griffini and Gaetano Minnucci should be mentioned among these.

In Griffini’s handbook [3] the subject of how to insulate a building - depending on where it is placed and on its latitude – is dealt with. Insulation, to which also Alexander Klein addressed his attention, was to find in colonies interesting testing grounds: it was to undergo Gaetano Vinaccia’s thorough and systematic enquiry in the late thirties [4].

To this a fundamental contribution regarding insulating materials is to be added: starting from 1931, when his handbook was first published, Griffini devoted a section to the new industrial products; there insulating materials were widely dealt with. This section, which in 1934 was shifted to the volume “Elementi costruttivi nell’Edilizia” owing to lack of space, contains suggestions about employing insulating materials in the new colonial buildings; when the two textbooks were published later, the author underlined their increasingly widespread employment, especially as far as Eracit and Celbes were concerned [5].

Gaetano Minnucci’s contribution, on the other hand, mainly focuses on industrialized construction and on the employment of standardized metal profiles in structures and panels of insulating materials in infills. Since the twenties the Roman architect had in fact been focusing on Dutch and German experiences, dealing with prefab. housing and industrial production. In the January and March 1930 «L’Ingegnere» issues, within the section “Tecnologia Edilizia” written by Minucci between 1927 and 1932, two articles dealing with prefab. and new insulating materials can be found. The information provided by such articles evidence Minucci’s preference for light
metal structures with standardized profiles and light insulating (Eraclit or Tekton) panels infills, to be used not only Italy, but also in Italian African colonies [6].

Figure 1. Colonial house built in Mogadiscio by military authorities and project of steel-and- Eraclit prefabricated. house, to be built in the colonies. From «L’Ingegnere», 4 (1930), n. 1, p. 50.

After the end of World War, the steels availability for the civilian market favoured the use of metal structures in housing construction. Their spread led to study the need to replace the traditional building materials (such stone and brick), both to reduce the weight on the structure and the construction times. For the metal structures the reduction of perimeter walls thickness, required to use insulating materials to ensuring a sufficient insulation thickness. The possibility of using standardized slabs of Eraclit, Celotex, Solomite or Tekton – manufactured on the European market since the late ‘20s – allowed a dry building, faster and safer because it avoided the attack of the metal structure by the moisture. Light weight, ease of assembly of the structure and the ability to control the environmental comfort by insulating slabs, favoured the use even in the colony, where the economic and climatic issues were fundamental, as explained about the prefabricated house made of Somalia [7]. The possibility of using lightweight materials, easy to transport and can be fitted quickly create the bases for the national patents success for prefabricated houses, initially designed for leisure and free time, but later adapted for the colony needs [8].

The attention focused on typological and functional aspects of architecture, rather than to those constructive, and pragmatism that characterized building activity in the colony settlements, reduced the handbooks specialized in very few cases involving particularly Ethiopia [9].

A text which nevertheless tries to offer a general overview on the building in Italian East Africa - and the use of insulating materials - is the Serrazanetti manual, published in Bologna in 1936. The book, though limited by the intention encyclopaedic allows outline the masonry techniques employable and employed, in a turning point as the Campaign of Ethiopia to reopen the
constructive technical debate into new cultural references [10]. Here the climatic factors (environmental, geographic and climatic) and land resources (materials and workers) come together in the design and construction of walls of new homes. Regarding the walls, the main requirements were: heat-insulating power suitable for the climatic conditions, good resistance of materials (moisture, action of the winds, thermal expansions, insects). Focusing the difference between hot weather and no-night breezes of East Africa and the dry one with strong Libyan swings between day and night, it is considered necessary to have not too insulating walls in the first case and insulating walls of great depth in second, where the coefficient of transmittance recommended is 1.30, corresponding to a brick wall with three heads of 38 cm, or in stones of 70 cm [11].


For housing in the colony, that rarely exceeded two floors, the manual recommended the use of hollow bricks elements, with robust ribs enough to support the modest relative loads (2-2.5 kg/cm). The solution for permanent buildings was that of coupling elements and cables of cementitious blocks (cellular concrete or pumice), coupled with plates of insulation materials (conglomerated or pressed fibres) so as to reduce the problem of the conductivity of these elements. Externally it recommended the use of plaster to protect the insulating materials from insolation and the washing away of the rains (thermal and mechanical protection of the wall). The foundation curb was to be adequately protected from rising moisture of the soil with tar or bitumen sheets, or alternatively with tarred canvas bags, while for the interior floors is recommended the use of insulating material with suspended ceilings [12].

The types of masonry work mentioned in the handbook are essentially two.
First of all, wall structures provided with air space, in which the gap prevents the stabilization of the temperature both inside and outside. Said air space must be no more than 8-10 cm. wide in order to forestall any convective motion and must present no openings either on the inside or the outside to avoid any access to insects. Otherwise, highly insulating compact wall structures can be employed: they may consist of stones, normal or hollow bricks, porous or pumice concrete blocks, hollow concrete blocks. Both types of masonry posed difficulties of construction to unskilled labourers, but - for the second type- building solutions meant to slight such problem have been devised. A first system of construction for very thick and highly insulating walls (suitable for the Libyan climate) had been devised by Luigi Piccinato at Milan Triennale in his “Casa Coloniale”. Here high temperatures were held at bay resorting to a particular typology of building (the house around a courtyard), to its morphology (orientation and positioning of windows) as well as to its construction: the building in fact consisted in reinforced concrete framework and Lipari pumice stone wall work, so as to obtain the highest thermal insulation [13]. Another construction system based on the employment of insulating blocks was the Cierre System. The patent devised raising a strong external framework made up of special large concrete elements (ten elements were employed for a 30cm. thick, 1square metre wall); the inside surface consisted in light insulating panels (Eraclit), at a certain distance from the wall behind to allow an air gap. Such concrete blocks could be manufactured in the building yard by means of special either manual or mechanical block-making machines; the scanty amount of iron in the framework (about 1 Kg. of iron rod for 1 square metre of wall), together with the highly- insulating performance of the masonry made this system particularly suitable for «buildings that were meant to last» [14].

The handbook also illustrates prefabricated solutions for temporary buildings, in which wall structures consisted in «different materials that modern technique has been successfully employing for some years. We announce a great future for the employment of these new materials in the buildings of Italian Africa, not only owing to the fact they generally afford a higher thermal insulation, but also because their being simply and rapidly manufactured – though a precious factor everywhere – is especially so in colonies» [15].

Just the difference between temporary and long-lasting buildings marked the dividing line between massive (either prefab. or not) and light – generally consisting of mass-produced elements – solutions, which was to prove decisive on the occasion of the Ethiopian campaign and furthered their commercial success.
3. TWO MATERIALS FOR THE EMPIRE: ERACLIT AND CEL-BES

The beginning of the Ethiopian Campaign and later the founding of the Empire marked a crucial turning point in Fascist colonial policies. The sector of construction, as well as the whole Italian society, was involved in the effort to provide materials and expertise for the building up of the Empire, where the construction choices and the materials employed in Eastern Africa from 1935 on were deeply marked by an ideologically highly-charged military confrontation [16].

The rapid success of light metal frames with insulating panels infills, which had already been employed in the colonies since the early thirties, was determined by political choices agreeing with economic opportunities. This kind of light prefab. proved to be best suited to meet the demand for temporary buildings – such as houses, store-rooms, hospitals – supporting the war effort and later colonial work. At the same time, the political implications of Italian expansion in Ethiopia required a different approach to construction: stylistic mimicry and employment of local materials was superseded by the deployment of modern materials and techniques, meant as evidence of an intended civilizing action in the African country [17]. The materials that had a relevant “political” role, being enthusiastically advertised in contemporary reviews were Eraclit and Cel-Bes.

The former, produced by Portomarghera-based Eraclit S.A. from 1925 on, was one of the first-employed insulating materials. Initially devised for insulating walls from humidity, it very soon proved fit for producing insulating and phono-absorbing panels. This material – also known as wood-magnesite – consisted in wool of plant origin made fire-proof, antiseptic and rot-resistant through an impregnation treatment, and later hardened with concrete. It resulted in a light, compact and reasonably resistant material that could be produced in large panes whose sizes and thicknesses varied depending on their lengths [18].

Its features and the fact that panels could be dry-laid made it suitable for employment in the colonies. During the war, in fact, it was widely used for building war barracks, hospital wards, bungalows and houses, especially in Somalia. Such frequent employment led to defining building systems meant specifically for colonies that allowed some shortcomings of the material (for example its durability in adverse weather conditions) to be overcome. The structure employed was generally made of metal with double T elements to which could be applied 2,5cm.- thick Eraclit-lined panes on the outside e nuovi materiali noi vediamo un grande avvenire per le costruzioni nell’Africa Italiana non solo perché in genere – assicurano un più elevato isolamento termico, ma anche perché la semplicità di rapidità di esecuzione sono coefficienti preziosi in ogni luogo, ma specialmente in colonie [15]. Proprio la differenza tra edifici temporanei ed edifici duraturi segnava il confine tra soluzioni massive, prefabbricate o meno, e soluzioni leggere, generalmente costituite da elementi prodotti in serie, cosa che si rivelerà decisiva in occasione della campagna d’Etiopia e per la loro fortuna commerciale.

3. DUE MATERIALI PER L’IMPERO: L’ERACLIT E IL CEL-BES

L’inizio della campagna d’Etiopia e la successiva fondazione dell’Impero segnarono una svolta decisiva nella politica coloniale del Fascismo. Il settore delle costruzioni, e conoscenza per la costruzione dell’Impero, dove le scelte costruttive e i materiali impiegati in Africa Orientale a partire dal 1933 furono profondamente segnati dalla carica ideologica del conflitto [16]. Il rapido successo delle strutture leggere metalliche con tamponamento in pannelli di materiale coibente, già impiegati in colonia a partire dall’inizio degli anni ’30, fu dovuto alla convergenza di ragioni politiche e di opportunità economiche. Questo tipo di prefabbricazione leggera si rivelò ideale per soddisfare la forte richiesta di edifici temporanei (abitazioni, magazzini ospedali) a supporto dello sforzo bellico e successivamente all’opera di colonizzazione. Allo stesso tempo le esigenze politiche dell’impresa etiopica, richiedevano un approccio differente dell’attività costruttiva: al mimetismo stilistico e all’impiego dei materiali locali si sostituì il dispiegare di materiali e tecniche moderne, simbolo della presa azione civilizzatrice nel paese africano [17]. I materiali che svolsero un importante ruolo ‘politico’, godendo di una grande visibilità sulla rivista dell’epoca furono l’Eraclit e il Cel-Bes.

Il primo, prodotto dalla Eraclit S.A. di Portomarghera a partire dal 1925, è stato uno dei primi materiali coibenti impiegati. Inizialmente pensato per isolarne le murature dall’umidità, si rivelerà ben presto adatto per ottenere pannelli isolanti e fonoassorbenti. Il materiale, chiamato anche legno-magnesite, era costituito da lana vegetale resa incombustibile, antivettovaglia e imputrescibile mediante un processo di impregnazione e successivo indurimento con il cemento. Il risultato era un materiale leggero, compatto e sufficientemente resistente, che poteva essere preparato in grandi lastre di dimensione e spessore variabili in funzione della lunghezza [18].

Le sue proprietà e la possibilità di montare a secco i pannelli lo resero il materiale adatto per l’uso in colonia. Durante la guerra infatti venne largamente utilizzato per la costruzione di baracchi militari, padiglioni ospedali, bungalow e abitazioni, specialmente...
and Eternit panes on the inside. Alternatively, 5cm.- thick panes plastered on both sides could be used, as they were in Ospedale “De Martino”, built in Mogadiscio by the Somali Capital Municipal Authority. As for houses, the construction system changed: a wooden framework was placed between two 2,5cm.-thick panels, so that it was protected from termite attacks and its insulating features were improved. This system was employed in several armed-force-staff and government- officials houses in Merca, Addis Abeba and Kisimajo.

The resort to insulating panels also prompted several patents regarding prefab. houses, which were quite successful in Eastern Africa between 1935 and 1940; among them the “L’Invulnerabile” patent, owned by the Bologna firm of the same name, marketed by the Bergamo F.E.R.V.E.T. firm, which enjoyed a wide success above all thanks to public customers [19]. According to this patent, the weight-bearing framework consisted of special laminated and cold-drawn steel profiles, their section being such as to allow the double panels-walls to be simply snapped into place. The external walls (designed to withstand high temperatures) consisted of special high-thermal- insulating agglomerate panels lined on the outside by fibre-cement panes, whereas internal perimeter-walls consisted in insulating material coupled with plywood-panes panels [20].
Figure 4. “L’Invulnerabile”, a house that could be mounted on site, exhibited at the Bari Fiera del Levante (1937) and being built in Eastern Africa. (A.S. INA).

The roofs had a 30% slant: they consisted of fibre-cement panes fastened to wooden boards and protected by tarred cardboard and insulating panes coupled with wood made up ceilings [21]. The widespread employment of the above patent made the commercial success of a system devised for colonies but also introduced at home, thanks to its flexibility and contained costs, obtained thanks to prefabrication and the coupling of two standardized systems, i.e. framework and panels [22].

The second material that played a primary role in Eastern Africa was Cel-Bes, produced by the Milan firm of the same name starting from 1934 on and marketed under the patent of the Milan S.A. L’Infrangibile firm. The material had been specifically devised to be used in the colonies and was widely employed in raising temporary structures - houses, barracks, storehouses and hangars – as required by the Ethiopian campaign. Even in this case the reasons of its success lay in its being light and allowing on-site fitting, which reduced times and costs, not to mention the fact that – if compared with Eraclit – it was a “wholly Italian” material [23].

Cel-Bes consisted of modular panels based on homogeneous wooden fibres made waterproof and antiseptic by means of impregnating varnish [24]. Though lighter and better performing from the point of view of thermal insulation than Eraclit, Cel-Bes lacked the rigidity necessary to be employed on its own. That is why it was devised to couple it with Eternit panes, as according with the “L’Infrangibile” patent: it contemplated the employment of one or two Cel-Bes 0.12cm.-thick panes, with 0.04cm.-thick Eternit sheets. If the resulting multi-layered panel was 20cm. thick, it was guaranteed to offer a λ amounting to 0.0425 at a 50° C temperature: though at a very slightly lower conductivity coefficient, much greater rigidity and resistance could be secured.

The panels could be employed on different types of structures, ranging from brick-block walls, to metal or wooden structures. As for the former, a structure...
of wooden battens on which to nail the panels was required, whereas for the latter, the panels could be fastened directly by means of screws and fastening straps. One advantage of these panels (which reduced the time and the cost of setting them into place) was that their surfaces could be left exposed, being smooth, waterproof and perfectly washable, though they could be topped with plaster, finishing varnishes or thin reflecting aluminium sheets [25] if required. The surface smoothness and its needing to be clamped on wooden battens, even suggested resorting to Cel-Bes to set up the first ventilated walls on brick-walls. The traditional thickness of brick-walls was not capable of affording a suitable insulation, and providing settlements in Africa with air conditioning was out of the question. The channels between the vertical joists and the employment of Cel-Bes allowed the thermal resistance of the walls – and consequently the comfort inside the building – to be increased.

The employment of this material during and after the Ethiopian campaign, its being widely advertised in the reviews and in the exhibitions featuring home-made materials, determined the success of Cel-Bes even after the end of World War II, when it competed with other materials and came to be extensively used during reconstruction.

Figure 5. Construction details for buildings employing Cel-Bes to be raised in the colonies.

From «Casabella», (1936), n. 105, p.34-35.

4. CONCLUSIONS

From the above survey regarding the employment of insulating materials in oversea territories, some of their features can be highlighted accurately:

- the results obtained out of the widespread resort to Eraclit and Cel-Bes in Eastern Africa suggest they should be used to some extent differently: for
both of them the trend has been their employment in multi-layered panels, in which the insulating material was coupled either with Eternit panes in external walls, or wooden panes in internal walls. This allowed the performances of insulating materials to be kept almost unaltered, though markedly improving their resistance to bending and shocks, not to mention their durability to weather conditions, the latter being an absolute must in quite extreme climatic and environmental conditions;

- a further improvement stemming from colonial construction experience, which resulted from joining aforesaid panes to fibre-concrete panes, was resorting to larger – up to 125x250 cm and 100x300 cm – panels, which allowed to save on their positioning even more, since it was possible to operate on the areas distancing two floors (about 270 cm);

- the value of thermal conductivity reached by Eraclit, and even more so by Cel-Bes – when used in multi-layered panels – evidences the results obtained by experimenting with insulating materials: such value roughly amounts to the performance of insulating panels employed today.

Notwithstanding their clear fact-based and media-boosted successes, the widespread resort to mainly metal light frame-works coupled with insulating panels, was more due to their cheapness (taking the time required and building costs into account) than to a convinced faith in prefab. construction in Italy.

This surfaced when the conquest of those territories was set on more permanent bases: prefabricated construction in fact did not become the Italian tradition of vast wall-works that the authoritarian bent of the regime had sponsored as the hallmark of its new imperial architecture. The flimsy quality of metal frame-works, their being mass produced and temporary could by no means convey the long-lasting features the new buildings meant for the Empire required.

However, the Italian experience acquired in the late thirties about light prefabrication in construction did not get lost; it surfaced usefully later on. After Second World War II, standard-sized multi-layered panels were widely employed during reconstruction, when the savings they afforded in terms of times and costs proved advantageous for a country beset by post-war logistic and economic problems. The benefits of those experiences, anyway, reached even further, when, from the seventies on, industrialization and prefabrication became essential in Italian construction: standardized solutions both applied to frame-works and – even more so – to multi-layered panels were widely resorted to.

5. REFERENCES


- un altro miglioramento effettuato sulla scorta di tale esperienze, e verso possibile dall’abbinamento con lastre di fibrocemento, fu l’adozione di formati standard più grandi, fino a 125x250 cm e 100x300 cm, che consentivano di ridurne ulteriormente i tempi di posa, potendo lavorare sulla dimensione dell’interpiano (270 cm circa).

- un indicatore della qualità raggiunta in questa sperimentazione nel campo dei materiali coibenti è il valore di conduttività termica che si raggiunse per l’Eraclit, ma soprattutto per il Cel-Bes nella sua applicazione in pannelli multistrato, valore che è paragonabile a quello dei pannelli isolanti che si usano oggi.

Nonostante gli evidenti successi concreti e mediatici, l’affermazione delle strutture leggere per lo più metalliche abbinate a pannelli di materiale coibente fu dovuta più alla loro economia in relazione ai tempi e ai costi di costruzione, che ad un effettivo convincimento sull’utilizzo prefabbricato nella cultura costruttiva italiana. Questo emerse nel momento in cui si iniziò il consolidamento dei territori conquistati: l’edilizia prefabbricata infatti non si addivenne alla tradizione italiana delle grandi masse murarie che la svolta autoritaria del Regime aveva individuato come caratteristica della nuova architettura imperiale. L’esitività delle costruzioni metalliche, la serialità e il loro carattere temporaneo non potevano duale rappresentare il carattere duraturo che era invece richiesto ai nuovi edifici progettati per l’Impero.

L’esperienza messa a punto nella seconda metà degli anni ’30 in Italia sulla prefabbricazione leggera per l’edilizia non andò tuttavia perduta, ma ritornò utile anche successivamente. Nel secondo dopoguerra l’utilizzo dei pannelli multistrato con formati standard vedrà un largo impiego durante la ricostruzione, quando la loro rapidità ed economia torneranno utili per un paese nelle difficili soluzioni logistiche ed economiche postbelliche. Ma gli effetti di questa sperimentazione si girarono anche oltre, quando a partire dagli anni ’70 l’industrializzazione e la prefabbricazione diventarono centrali anche nella costruzione italiana che vide il vasto impiego di soluzioni standardizzate tanto per la struttura quanto, e soprattutto, per l’utilizzo di pannelli multistrato.


[8] The first prefababricated building were exhibited by Legnami Pasotti and Carpenteria Cittera at “Mostra di Edilizia Moderna” during the Turin 1922”I Esposizione Internazionale Campionaria”.


[11] When employing stones, it was necessary to examine the features of such stones, since A.O.I. rocks afforded poor insulation, being compact with high specific weight, such as basalt, granite and hard limestones. Serrazanetti A., op. cit., p. 108-109.


[13] Even later on Piccinato was to deal with this subject, submitting his project for colonial Nervacciaio buildings in 1935. Marconi, P., Costruzioni e padiglioni nel parco della Triennale, «Architettura», (1933), n. 12, p. 52-53.


[18] Eraclit panes were 2-5cm. thick and their standard sizes ranged between 100x33 cm. and 200x50. Specific weight was 330-400 kg/cubic metre and the thermal conductivity coefficient was $\lambda= 0,07-0,08$. Griffini E. A., La costruzione razionale della casa, op. cit., p.70-71; Minnucci, G., Materiali edilizi speciali, op. cit., p. 49-50.


[22] The patented “L’Invulnerabile” system, thanks to its having been widely employed in colonies, could be exhibited at the Bari 1937 VIII Fiera del Levante, and so be made available in the Italian market.


[24] Celbes panels were between 0,12 and 0,06cm. thick and their standard sizes were 120x300cm. or 120x300cm. Their specific weight was 270 kg/ cubic metre and the thermal conductivity coefficient $\lambda= 0.04$. Pasquali A., Il “Cel-Bes”, «Casabella», (1936), n. 107, p. 36-37.

[25] Coating with aluminium sheets – which had already been tested in Eastern Africa – led to patenting and marketing AL-Bes, a panel substituting the external Eternit sheet with an Anticorodal one. Griffini E. A., La costruzione razionale della casa, op. cit., p. 43.