Two Porcheddu’s quakeproof buildings in Messina reconstruction

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Highlights

The huge earthquake of 1908 raised many issues about the Italian aseismic regulations. The subsequent State regulations elected any framed building system that can be verified through quick calculations. Steel and concrete were among industry materials those widely available and fully compliant with the mathematic verification. At that time, two building systems were made of steel and concrete: the reinforced concrete and the “ferbeton”. Unpublished drawings and the study of the original files on two housing projects, one in reinforced concrete and the other in ferbeton, sketch out the different performances of the two yards.

Abstract

The Porcheddu Company of Turin (importer in North Italy of the Hennebique building system) was charged of 13 projects in Messina, after the 1908 quake: the study of the unpublished material in the Porcheddu archive, hosted at DISEG in the Turin Polytechnic sketches out two construction sites for quake-proof housings, the economical homes for the “Unione Messinese” in the Orto Botanico district, with a reinforced concrete frame and the Homes for the State Employees with pillars made of a prefabricated steel cage and on site poured concrete. The two different construction systems testify the business and law debate on quake-proof buildings.

Keywords
Quake-proof buildings, Hennebique system, Porcheddu Company, Messina reconstruction, Historical aseismic building techniques

1. SYSTÈME HENNEBIQUE VS. FERBETON: TWO PORCHEDDU’S YARDS

In the application of the ministerial regulations on the reconstruction after 1908 earthquake, frame buildings were preferred, all their projects approved by the Royal Civil Engineers and in some cases directly contract-ed by the State. The survey of the construction plot across the correspondence filed in the Porcheddu Company’s archive, stored at Turin Polytechnic DISEG, is focused on two residential buildings, representing the two different technologies then most in vogue: reinforced concrete (Fig. 1) and ferbeton (Fig. 1). In that time lexicon the two building systems are sometimes assimilated also because they both use steel and concrete. But their conception criteria are
in fact very different as fare as the load bearing frame sizing and the choice of the materials’ mechanical characteristics are concerned. Vincenzo Negro, in 1912 wrote: «There are many assets of ordinary structures in reinforced concrete, but it cannot be denied they require too much delicate care and their final resistance is too intimately linked and dependent on perfect execution. Therefore, it appears better to follow, in cases where it is necessary to achieve the highest degree of static resistance such as in asymmetric structures, to abstract the resistance of the conglomerate, which may be missing or deficient, and rely solely on a complete metal framework suitable for resisting external stresses “by itself”. This is not new and the system is called “ferbeton”». It may be indicative of commercial pressures on ministerial regulation that the exact term “by itself” was present in the first release of the legislation for reconstruction; it only disappeared in the revised law of September 1912. On the other side, the uncertain initial fame of the reinforced concrete in the reconstruction of Messina is witnessed in the study by Ornella Fian-daca who writes [8] «Of the constructions built according to the système Hennebique before 1908, it emerged little has survived the quake, or at least the ones that survived then suffered the usual demolition action».

Figure 1. Example of “Système Hennebique” reinforced concrete structural frame [9].
2. HOUSINGS FOR THE MESSINIAN UNION WITH THE “SYSTÈME HENNEBIQUE”

Today the project mentioned as “lot 198” is encompassed between the streets T. Cannizzaro (under it flows Portalegni stream), Acqua del Conte, Gonzaga and Viale Italia, while Giovanni Pascoli street divides it into two parts (Fig. 2, 12 and 13).

This real estate complex was among those managed directly by the “Messinese Union of owners damaged by the earthquake”: its Technical Department designed the buildings and adopted reinforced concrete frames and slabs which the Tender announced naively as iron-cement). It was preferred a more modern building system, even if by then considered less controllable (Fig. 5). The project by Franklin Colamonico, Messinese Union’s chief engineer, was issued at the end of January 1913, during the first year of the new town planning scheme. Two dissimilar comb shaped blocks were planned. made of two storeys wings with pitched roof on wood structure, partially basement provided.

![Figure 2. Messinian Union Housings, front on Portalegni Street, project drawing [9].](image)

(Asismiche, fare astrazione della resistenza del conglomerato, che può mancare o essere deficiente, ed affidarsi ad una ossatura metallica completa, di per sé stante, ed adatta a resistere da sola agli sforzi esterni. Non è nuovo questo sistema detto del ferbeton). E può essere indice delle pressioni commerciali sulla normativa ministeriale il fatto che l’espressione “di per sé stante” sia stata presente nella prima normativa per la ricostruzione e scompaia solo con la revisione del settembre 1912. L’incerta fama iniziale del calcestruzzo armato nella ricostruzione di Messina è testimoniata da Ornella Fiandaca che scrive [8] “Degli edifici realizzati secondo il système Hennebique prima del 1908 è emerso che poco abbia resistito, o comunque quel che era scampato ha subito la consueta azione demolitrice”.

2. ABITAZIONI DELL’UNIONE MESSINESE CON IL “SYSTÈME HENNEBIQUE”

L’allora intervento denominato lotto 198 è oggi compreso tra le vie T. Cannizzaro (al di sotto della quale scorre il torrente Portalegni), Acqua del Conte, Gonzaga e il viale Italia, ed è diviso in due parti dalla via Giovanni Pascoli (Figg. 2, 12 e 13). Questo complesso immobiliare fu tra quelli gestiti direttamente dalla
All the apartments were directly disengaged by the common staircase; the plastered façades (Fig. 10) were dressed with simple decorative elements and wrought iron gratings (Fig. 3).

After the Royal Civil Engineers’ approval, the private construction tender expired on 28th April 1913. The correspondence between the headquarters of the Porcheddu Company in Torino and the Reggio Calabria-Messina branch revealed the Messina correspondent suggested to focus Porcheddu’s bid on speed execution and contractual timeline compliance rather than on weighty rebates, for which it appeared no margins left. Anyway, the Royal Commissioner appointed for the reconstruction, Comm. Avv. Federico Rejna, would have supported Porcheddu’s application, having said: «I have several millions to spend and I will do every-thing to encourage those who I know as experienced, capable and perfect gentlemen like the members of the Porcheddu Company». Porcheddu Company was the tender winner because of the offered discount and the promised end time. He agreed to complete the first housing block by 26th February 1914 and the other one by 28 March, a couple of months before the mandatory deadline.
The contract was signed on 28 June and Porcheddu was entrusted with the construction site on 1st July 1913: the works would have delivered 204 flats and 7 shops; in the basement a coal boiler would have provided hot water for two rows of laundry sinks of 12 places each and for the common baths consisting of individual shower or tub cabin “en suite” with its dressing room (Fig 4).

Each flat featured a wall container “for the dirty clothes”, a water-closed toilet, kitchen and toilet sinks, and a fresh drinking water supply of 250 liters/day. From the beginning of the construction works, changes are introduced to the foundations, to cope with the varying nature of the soil and to extend the basement to the entire building area, so to improve healthiness and to provide more cellars. Porcheddu’s authority and competence was recognized and appreciated by the Supervisor F. Colamonico, who appeared to be constantly dialoguing with the Company on improvements to the construction process efficiency and on the building functionality (see for example Figs 6 and 11).

In this context, also the perimeter basement walls were modified: instead of the stone listed brickwork demanded by the original project, a much more modern and quick “double wall” was made, consisting of two reinforced concrete layers 10 + 10 cm thick. Moreover, rebars are mainly Porcheddu’s patent-deformed type: they were produced by the Company’s steelworks in Genoa and shipped by sea to Messina.

The floors between the basement and the ground were made of a reinforced concrete slab 8 cm thick with downstand beams, while the upper ones were designed to cope with the trampling noise. In this case, an air chamber slab was adopted, called “cassette slab”: it was made of two reinforced concrete slabs separated by disposable formwork, thus avoiding the expensive and slow laying of the plastered mesh false ceiling: the upper slab is 6 cm thick, the bottom is 3 cm and the interspace is 14 cm, for a total size of 23 cm.

The construction was carried out with great intelligence: the “cassette slab” interspace was formed by custom disposable formworks built on site using the same wooden slats as for orange boxes marketing: the Porcheddu’s technical office unified their size (50 x 100 x 14 cm) and optimized their layout to avoid any special shape, admitting a few halved boxes only. The Company obtained also to replace a large part of the roof with a terracotta tiled terrace made of a “cassette slab” with an increased interspace to improve its heat control and water tightened with 1 cm of asphalt: faster execution, a working load similar to other slabs, increased communal spaces were all reasons leading to these modifications. Similarly they replaced all the sanitary ware, requested in ceramic or enameled steel, with more modern and long lasting
porcelain fittings. This is the sign of a deep collaborative relationship between the Site Supervisor and the Porcheddu Company going beyond the contractual obligations: it faded only concerning the production of concrete, prescribed through the use of machinery (washing machine and kneader): at last, this equipment reached the site on 29th October 1913, after plenty of vehement requests, and was suspiciously activated only two months later, while the cement quality available in the Messina area was still fluctuating as witnessed by Colamonico, who had been Assistant to the Testing Cabinet for Building Materials at the University of Naples and who personally tested several samples. In December, a couple of months before the first delivery of flats (February), the construction site was still far from the end.

The request for an extension time became unavoidable, also because the rising price of bricks (in a few months they increased by 150%) and the loss of some ironworks at sea. On 12 February 1914, just before the first block contractual deadline, Comm. Cagli took over from Comm. Rejna at the helm of the Messinese Union: he was summarized the situation and forwarded the request for an extension that he granted “exceptionally” until July 31st, 1914, for both the lots.

Figure 5. Messinian Union Housings, right block, ground floor plan [9].
In the meantime, Colamonico started the acceptance test on the slabs, asking Porcheddu to provide the fleximeters from Turin because of the deficient equipment in Messina.

The tender requirement was to experimentally verify a sag less than 1/2000 of the span at the 225 daN/m² working load; despite the difficulty in finding quality cements, floors showed to be very good: loaded up to 1.5 times the tender level, they still registered sags much lower than the contractual limit. Porcheddu proved to keep a clear knowledge of the French patent and a deep competence in adapting the system to the recent Italian laws on earthquake-proof constructions, as well as with the construction site. In this way he played the role of coordinator of Hennebique’s dealers for southern Italy: perhaps this is why he often enjoyed great trust by Contracting Stations and his flattering technical results contributed to the emergence of reinforced concrete in the following decades.

The construction site ended without any reserves or penalties.

3. HOUSING IN FERBETON FOR STATE’S EMPLOYEES

The block is between the current streets Fata Morgana, Placida, Nina da Messina, Garibaldi and Piazza Filippo Juvara. The intervention involved the construction of three two storey buildings: the central in the lot has all the flats disengaged from a single staircase, while the two buildings facing the streets Garibaldi and Placida have a more complex shape and these are fitted with a full basement, absent in the central building (Fig. 14). The first one is U shaped and it has three stairs, while the second shows two small courtyard and two stairs (Fig. 16). They featured sloped roofs with flat clay tiles and both the decorative apparatus (Fig. 8) and the equipment are very well looked after: the bathrooms are inside the flats and the ceilings in plastered iron net are connected with a rather wide radius onto the walls, to recall almost a vaulted ceiling. But the intervention is less modern from the point of view of comfort and functionality: for example, there is neither thermal insulation nor interspace between the attic and living rooms below and the attic is not even exploitable due to the absence of a solid floor, replaced by the single plastered suspended false ceiling.

The project is dated 15th February 1913 and it was drawn up directly by the Royal Civil Engineers still on the basis of that pre-existing legislation favoring framework resisting “by itself” to external stresses (see Article No. 7 of R. D. 193/09): the aseismic quality is therefore granted by a steel cage made of prefabricated lattice-work (built in Milan by Officine Meccaniche Giuseppe anche perché i lavori hanno subìtto il rincaro dei laterizi (in pochi mesi sono aumentati del 150%) e la perdita in mare di alcuni trasporti di ferri. Mentre si avvicina il termine per la consegna del primo lotto, il 12 febbraio 1914 il Comm. Gargi subentra al Comm. Rejna alla guida dell’Unione messinese: a lui viene riferitata la situazione ed integrata la richiesta di proroga che egli concede «in via eccezionale» sino al 31 luglio 1914, per entrambi i lotti. Nel frattempo Colamonico prega Porcheddu di procurare i flessimetri da Torino per il collaudo dei solai che, secondo le prescrizioni capitulatori, devono presentare una freccia non superiore a 1/2000 della luce al carico di esercizio pari a 225 daN/ m². Nonostante la difficoltà nel reperire cementi di qualità, i solai si rivelarono assai validi: perché, caricati in collaudo sino ad 1,5 volte il carico di esercizio, registrarono frecce molto inferiori al limite contrattuale. Porcheddu dimostra di avere sicura padronanza del brevetto francese e profonda competenza nell’adeguare il sistema alle recenti leggi italiane sulle costruzioni antisismiche, oltre che con il contesto di cantiere. In questo modo egli viene a svolgere di fatto il ruolo di coordinatore dei concessionari Hennebique per l’Italia meridionale: forse è per questo che gode di grande fiducia presso le Stazioni Appaltanti e i lusingheri risultati tecnici contribuiranno all’affermarsi del calcestruzzo armato nei decenni seguenti. Il cantiere termina senza riserve e senza penali.

3. ABITAZIONI PER IMPIEGATI DELLO STATO IN FERBETON

L’isolato è compreso tra le attuali vie Fata Morgana, Placida, Nina da Messina, Garibaldi e la piazza Filippo Juvara. L’intervento prevede la realizzazione di tre corpi di fabbrica, tutti di due piani fuori terra: uno centrale al lotto, con gli alloggi disimpegnati da un’unica scala e due edifici in fregio alle vie Garibaldi e Placida, il primo con tre scale e pianta a forma di U ed il secondo a blocco in fregio alla via, con due cavedi e due scale (Fig. 16). Il piano cantinato è assente nel corpo centrale (Fig. 14). Le coperture sono a falde con il manto di tegole marsigliesi, ed assai curati sono l’apparato decorativo (Fig. 8) e le dotazioni: i locali per il bagno sono infatti interi agli alloggi ed i controsostituti in lamiera stratificata intonacati sono raccordati con raggio piuttosto ampio alle pareti, a ricordare quasi un orizzontamento volutato. Persò l’intervento è più obbligativo del precedente dal punto di vista del confort e della funzionalità. Ad es. non è previsto alcun isolamento termico tra sottotetto e locali di abitazione ed il primo non è neppure sfruttabile per assenza di solato, sostituito dal solo controsostituto in lamiera stratificata intonacata appena alle travi del tetto. Il progetto è datato 15 febbraio 1913 ed è redatto direttamente dal Genio Civile, ancora sulla base della pre- vigente normativa che privilegiava un’armatura completa «di per sé stante» (cfr. Art. 7 del R. D. 193/09): si affida pertanto alla struttura costruita da tralicci di acciaio prefabbricati (realizzati a Milano).
Arcari and delivered to the construction site with many, many delays), then assembled on site to obtain the designed frame. This lattice frame was next filled with poured concrete (Fig. 15).

This is the so-called “Ferbeton” that the Royal Engineers, less innovative than the designers in the Messinese Union, duly preferred to reinforced concrete. As Porcheddu had soon pointed out, this system was more expensive and complex in its construction, but here any attempt at optimization is rejected by the Supervisor, Eng. Castrogiovanni, a fellow that seems not particularly appreciated by Porcheddu: for example, he proposed, instead of the false ceiling in plastered iron net chamfered to the walls, his “cassette” double slab, but the change is immediately rejected, the same for the use of ordinary concrete also where the contract prescribed the lean concrete and for the proposal of different staircase rebars. The messages between the building site and the Porcheddu’s head office reached the following tenor with reference to the Supervisor’s attitude: «What has been rightly observed with regard to the convenience of increasing the illuminating surface of the windows was...
repeatedly made to be observed by the Supervisor, but, as with any other sensible proposal, without any result. Suffice it to mention that there were balcony windows 1.70 m high and that we have managed to persuade Cav. Ing. Castrogiovanni that if no one exists that reaches him for height of talent, many individuals exceed him in stature, so as to obtain that this height were at least brought to two meters. The shutters are preferred and are desired to be “gelosie” Messina style, expensive and cumbersome. They must have movable slats, and they may even request some opening flaps. Those of the balconies open half-way up to the height of the breastplate, the bottom part opening into a double twin-folded panels, and each of the four parts has slats, for supreme condescension, not movable» (Fig. 7).

The construction site is of considerably smaller size compared to the previous Messinese Union, but proved to be much slower and more conflictual in carrying out the work. The Contract, signed on June 9th, 1913, foresaw the building completion by December 8th, 1914: it was instead extended to July 12th, 1915 following a work variation appraisal. They built 22 flats, but they
took almost two years, a double time in comparison to the Unione Messinese schedule, and this work ended with reserves for over 65 000 Lire, largely rejected by the Supervisor. The final acceptance test was issued in the middle of WWI (19 September 1916): the final amount of the work rised from Lit. 422 972.14 to Lit. 488 917.54 including the damage caused by the conjuncture worsening, with an increase of 15.6 percent.

6. CONCLUSIONS

The reconstruction of Messina after the huge earthquake of 1908 was the occasion to develop the first anti-seismic regulation of the young Kingdom of Italy and for a large scale experimentation of reinforced concrete constructions, whose outcomes had not always been qualitatively significant. In the construction of the two interventions here analyzed, the Porcheddu company used two different types of technologies, one with reinforced concrete frame and floors and the other with a structure of prefabricated steel latticework then covered with concrete (ferbeton): the mechanical and
managerial outcomes testified the improved efficiency and rapidity of the reinforced concrete.

Both the complexes are still existing and much has survived of the original product, proving the durability and quality of the building systems and buildings in general (in fact many of the originals are still in place). From the proof of time it seems clear that the company Porcheddu has attested to be not only a simple concessionaire of an elsewhere-invented patent but a Company really able to manage with efficiency and safety a technology that was still experimental in many aspects: e.g., the abundant dimensioning of the reinforced concrete structural elements allowed one more floor in the Unione Messinese’s buildings, unlike the block in ferbeton, remained in its original consistency. The reading of archive documents also reveals a considerable management and coordination capacity of the yards, these supported by a national and international solid professional reputation, which, when appreciated by the interlocutors on site, has been able to remain current for many decades.

5. REFERENCES