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STRUCTURAL RECOVERY AND PROJECT MANAGEMENT: THE DESIGN DRAWS CONTRIBUTION

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ABSTRACT

This study illustrates how the role of project design doesn’t end with the prefiguration of the finished object. On the contrary, the purpose of drawings is to illustrate how work must be carried out on site in order to explain the construction phase: the aim is to accompany the work from its conception to the final delivery.

Keywords: design, project, process, innovation.

INTRODUCTION

We can see how considerable progress in terms of quality of building products has been made in the construction sector over the years. Nevertheless, there hasn’t been an equally satisfying increase in the quality of the finished product. On the contrary. The aim is to take the improvements introduced by the industry, producing higher-performance construction materials, and incorporate them into the construction of buildings. This activity is often carried out by poorly qualified people and is characterised particularly by a problematic fragmentation of those involved. As a result, project design is increasingly required to describe not only the elements used in construction but also the activities to be carried out.

THE DIFFICULT MEASURE OF CONSTRUCTION QUALITY

For the above reasons, on contemporary construction sites, the simple transposition of consolidated design practices can cause difficulties. Sometimes, executive project designs provide the information required by the customer but fail to completely and analytically support the specific indications relating to the performance and entry into operation of the construction elements. Quality is now absolutely essential in various areas. The word project is becoming more and more closely linked to concepts of management and organisation, and the combination of the terms *project* and *management* seems to have become a guarantee of quality of the results obtainable, so much so that, if considered according to an apodictic approach - the quality of a project could be paradoxically made to coincide with the possibility to efficiently manage all the problems inherent in it (Campioli, 1997) - creating a confusion with regard to the tools and motivations applied to it.

The construction system can be likened to a system with several variables, which do not always help solve the problem in stable terms. At a first glance, they can be divided into two categories. The first concerns the intrinsic design quality, regarding the correctness of the general design choices made, according to a vision in which forecasting and the transformation of reality, as described by Carlo Giulio Argan in *Progetto e destino*, take precedence over managerial aspects. The second is related to specific accomplishment. In turn, two distinct attitudes still coexist within the sphere of design. On one hand, there is still a situation of intellectual detachment, based on sustaining a vision of design which makes no tangible attempt to transform the built-up environment. Within this sphere, there is no trace of the desire to influence reality, merely an observation of the paradox of drawings which are perhaps tools for criticism of reality and opportunities to describe imaginary worlds that would be hard to accomplish or, worse again, paper architectures: drawings in which the project is developed as a mere exercise in composition, avoiding every form of confrontation with technical accomplishment. In this case, design becomes the aim rather than the method (Coppo, 1983). On the other hand, there is the position which is necessarily attentive to the cultural category of the utilitarian approach. It looks at several different aspects, from the culture of creating to the culture of engineering. The spirit of the culture of creating, while taking a withdrawn stance, linked to the artisanal nature of construction, highlights the importance of considering the entire process of design/construction as a unitary act. Often, construction drawings are created by a single professional or a team capable of individually managing the complexity of the project. When the complexity of the various aspects of the project and professional specialisations required to tackle them increase, experience teaches us that the culture of engineering takes on a priority role. This is based on the conviction that the project can be tackled in two separate phases: the first, which concentrates on the function and formal aspects of the subject, and the second, which looks at engineering, accompanying the previously established idea of space and shape with the technical information that enables construction: we could say, paraphrasing the subtitle of a text written by Margherita De Simone (De Simone, 1990) that the passage is “from the design to the idea to the project of the object”, but, alas, with a jump that marks its discontinuity.

In order to overcome this operational dichotomy, the culture of *project management* is now taking hold. In this case, the general quality of a building/architecture is measured by compliance with the needs for which it was built. Several levels of design are involved. Typological and environmental quality are related to the specific phases of the economic and definite feasibility project, while technological quality concerns definitive and, above all executive design. To complete the process, the procedures of *project management* have introduced the principle of effective quality, which can be pursued during the operational design phase. This is the fourth level, after the executive design phase, and its aim is to achieve correspondence of final quality to the levels expressed in the previous design phases. Operational quality can be described as “a product’s capacity to meet the expected levels of a performance programme referred to the reduction of the resources and times necessary, from arrival on site to transformation or installation” (Allodi, 2008).

The intention here is to analyse the importance of drawing during the operational phase, paying attention to system quality (see UNI EN ISO 9001) in terms of working methods and design procedures.

DETAILED DRAWINGS FOR THE DESIGN OF TECHNOLOGICAL QUALITY

On-site activity currently presents problems relating partly to the difficulty in combining high-performance technological materials and partly to the use of unqualified labour, without thinking of the fragmentation that characterises the production of construction elements and the production process as a whole. The current scenario requires particular attention to detailed drawings, even more so than in the recent past, so much so as to reflect the contents of the manual skills applied at the beginning of the last century, without it being possible to re-propose their universal values.

Several years ago, before the exasperated specialisation, linked to the rationalisation of the production process characteristic of the industrial age, invested the construction sector, the *state of the art* definition generated a series of operations left to the responsibility of the executor, of which the designer already knew the final outcome. Today, in the climate that has developed within the technical world and as a result of the fragmentation of the production system, which has witnessed the disappearance of the construction skills once possessed by the construction firms, the relationship between designer and builders is completely different to the way it was in the past. This is attributable to the introduction of prefabricated components and to the fact that some of the executors (in relation to their lack of knowledge of the legal aspects of operational dexterity) are increasingly less able to control construction in its entirety. In construction, while the term artisan was once synonymous with professionalism and ability, nowadays it is increasingly associable with the mere performance of work contracted out to various companies.

There is also an increasing spread of evolved versions of traditional techniques which while retaining their artisan origin with regard to conception and method of assembly, have evolved through a slow process of transformation, attributable largely to the replacement of traditional materials (Mangiarotti, 2005) with materials the installation of which, increasingly without the use of adhesives, is mediated by production systems different to those used in the construction sector. In this context, the architectural detail elaborated by the designer takes on the didactic function of training qualified operators. The mind goes to the more specific technical construction manuals written between the 19^{th} and 20^{th} centuries, when the arrival on the scene of new construction practices and the widespread use of operators from other sector (especially farming) imposed the need for simple and effective formative references. We can look at construction details from a systematic approach, on the basis of which to present messages from the designer to the executor, in compliance with the principle not only of what to do but also how to do it, all aimed at production.

Within the framework above, we can agree that the “detail becomes constructive when the executive detail is destined directly an exclusively to production” (Mezzetti, 2006). To this end, the scales of representation (usually large), the systems of projection (often axonometries and the related blow-ups), and the graphic codes used become extremely important. The same reasoning can be used when it comes to passing from the construction of products on-site to a disjointing implementation of prefabricated components.

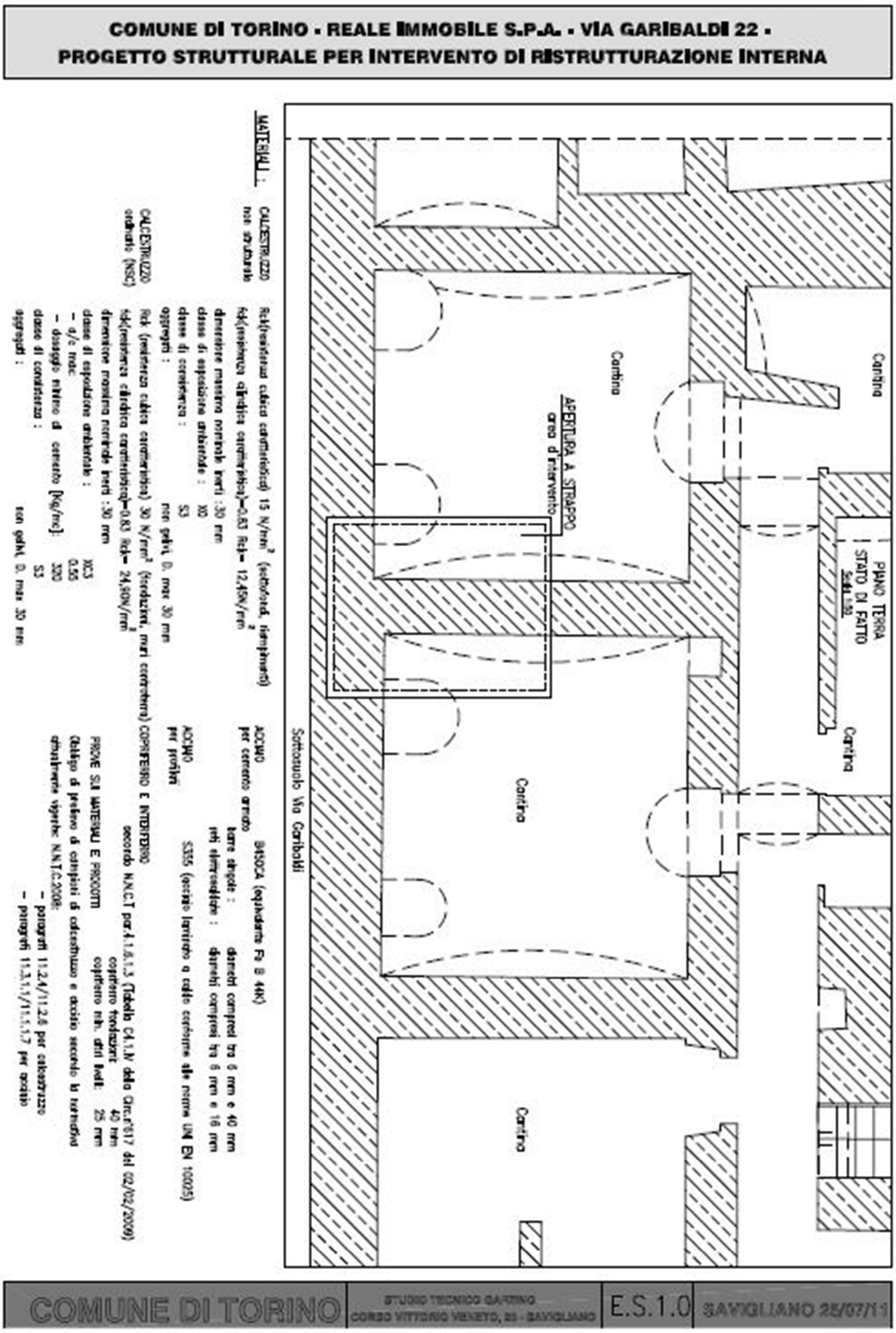
THE REPRESENTATION OF CONSTRUCTION PHASES: OPERATIONAL PROJECT DOCUMENTS

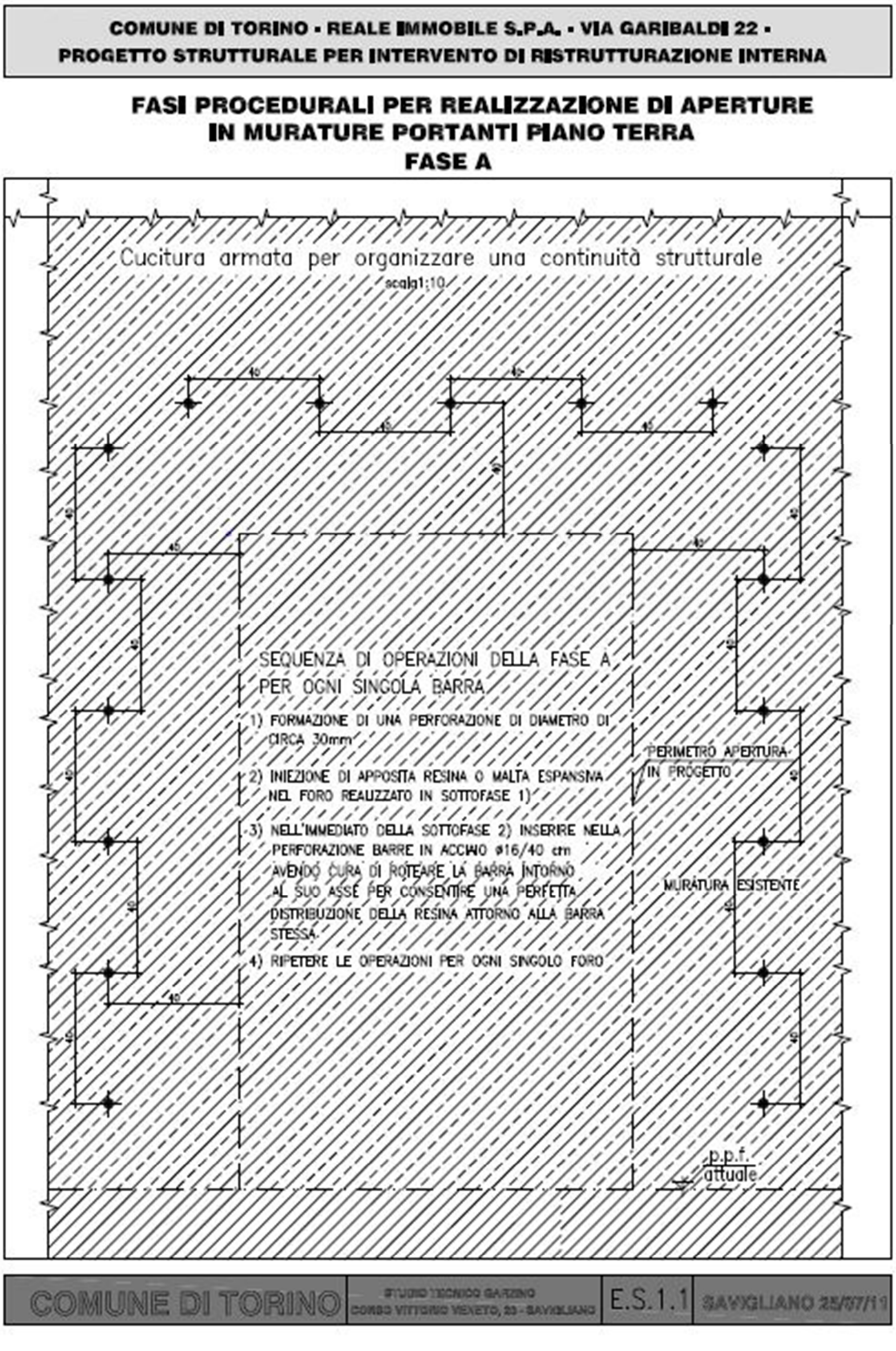
Operational quality can be recognised as a product's or an element's capacity to meet the functional and performance levels expected from it.

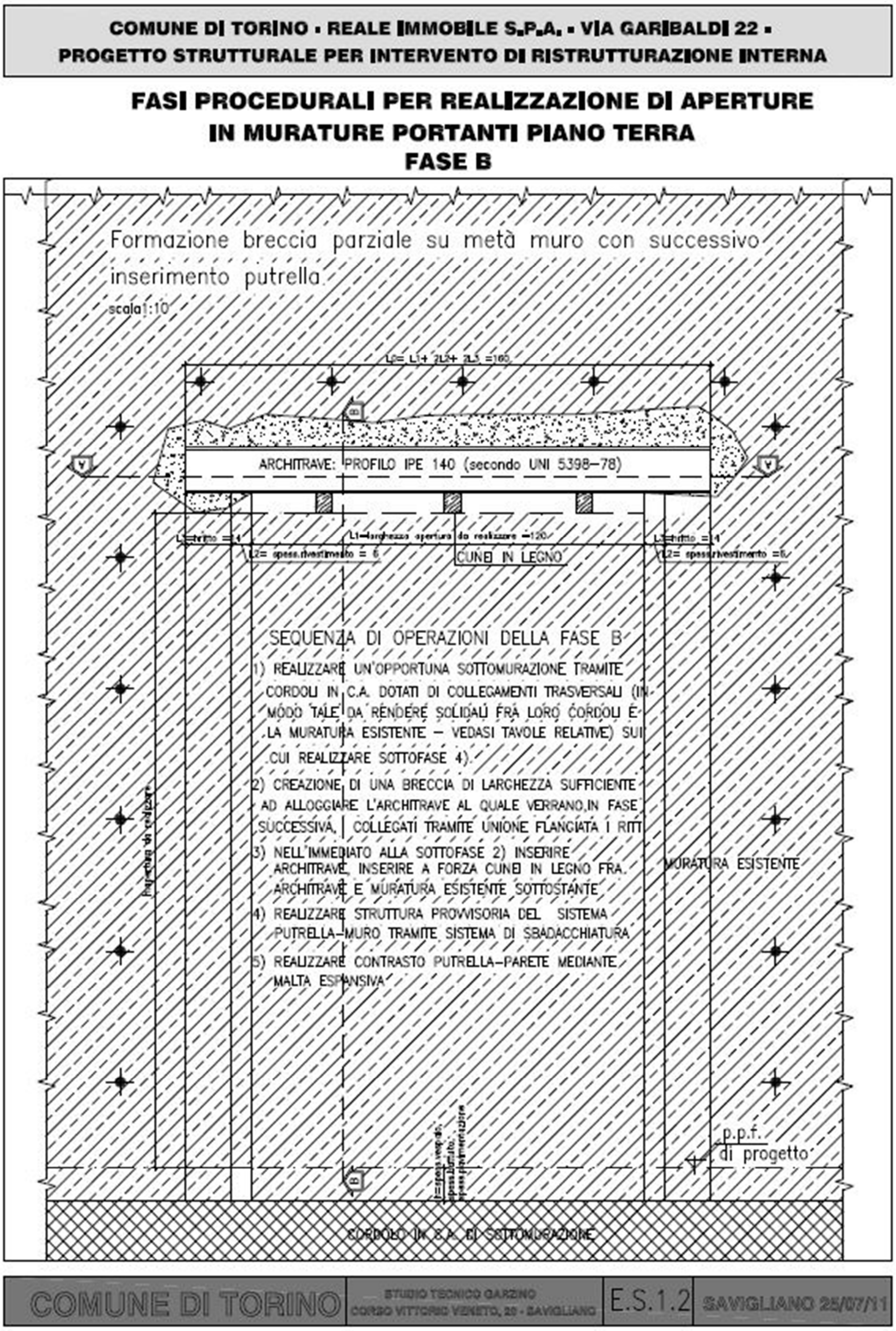
According to a consolidated practice within the scope of representational disciplines, the next moment in the design procedure following the perfection of the design for implementation on site is the operational design phase. The aim is to stipulate a series of operations with which we progress from the elaboration of the design of the aims to their accomplishment. It turns out that this is one of the main causes of multiple conflicts during the launch of the site phase, where the executive design directions are adapted to the skills, abilities and technical habits of the site operators. The graphic and descriptive documents, being drawn up with the executive design (before the tender) are often general and fail to consider the plans of execution drawn up by the company for the implementation of the fabrication sequences.

In specific terms, the operational design plays the role of bringing eh various technological subsystems together, coordinating them on the basis of the overall executive planning of the operation (Garzino, 2009). Every operational plan, containing the instructions and details on the components, must also be integrated with indications on the measures and devices capable of guaranteeing, in safe conditions, the regular performance of the various activities. Every technological subsystem is subject to the formulation of a special operational plan, articulated into basic plans (prefabrication, connection, assembly, and technical and organisational interface, etc.). In this sense, the graphic elaborates are created to contain additional pertinent content. This operationality not only regards *how to do* something (an approach with which, thanks to recurrent appointments, the history of design has given designers the habit of organising design tables every time they use an innovative technology, as in the case of constructions made of iron, reinforced concrete, etc.) but above all *what to do and when to do it.* Project design also becomes a tool for the regulation of site organisation and construction activity. In the industrial world, more so now than ever before, the innovation of greatest economic importance, is related to the organisation of production systems, even before the relative production technique itself. In the same way, we can see how the most significant aspect in terms of business resources for construction is the regulation on on-site activity. It is necessary to think of an operational project design which shows operators grouped together into teams which are not directly related to one another what to do and when, even more so than how. This need corresponds in two ways to the legislative framework that increasingly imposes bureaucratic control over operations and assigns professionals specific responsibilities.

In order to make the contents of the operational design as clear as possible, the design tables must highlight not only the safety instructions for the operations in question but also the details of how they have to be implemented, for each work phase. Alongside typological and functional metric indications and descriptions of the elements (illustrated file with objects / capitolato figurato a oggetti - CFO), the representation of the most frequent construction dynamics with also appear.

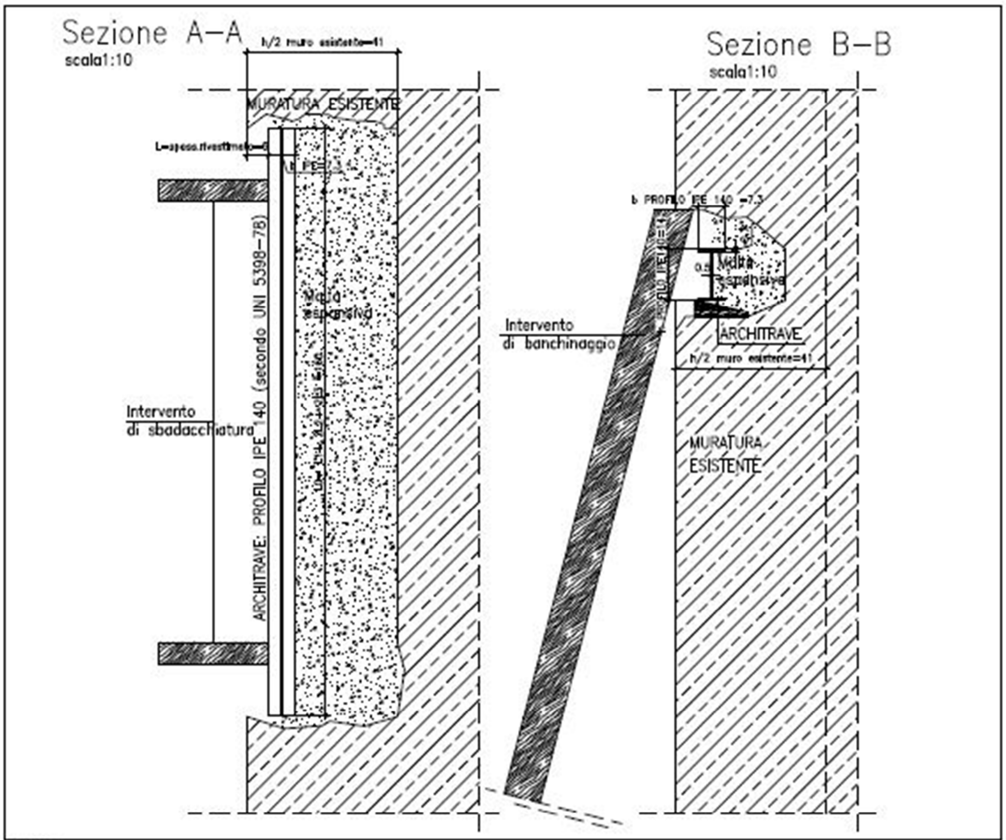

COMUNE DI TORINO - REALE IMMOBILE S.P.A. - VIA GARIBALDI 22 -
PROGETTO STRUTTURALE PER INTERVENTO DI RISTRUTTURAZIONE INTERNA
Cantina
APERTURA A STRAPPO
area d'intervento
PIANO TERRA
STATO DI FATTO
Sottosuolo Via Garibaldi
MATERIALI :
COMUNE DI TORINO
E.S.1.0
SAVIGLIANO 25/07/11


COMUNE DI TORINO - REALE IMMOBILE S.P.A. - VIA GARIBALDI 22 -
PROGETTO STRUTTURALE PER INTERVENTO DI RISTRUTTURAZIONE INTERNA
FASI PROCEDURALI PER REALIZZAZIONE DI APERTURE
IN MURATURE PORTANTI PIANO TERRA
FASE A
Cucitura armata per organizzare una continuità strutturale
scala1:10
SEQUENZA DI OPERAZIONI DELLA FASE A
PER OGNI SINGOLA BARRA
1) FORMAZIONE DI UNA PERFORAZIONE DI DIAMETRO DI CIRCA 30mm
2) INIEZIONE DI APPOSITA RESINA O MALTA ESPANSIVA NEL FORO REALIZZATO IN SOTTOFASE 1)
3) NELL'IMMEDIATO DELLA SOTTOFASE 2) INSERIRE NELLA PERFORAZIONE BARRE IN ACCIAIO ø16/40 cm AVENDO CURA DI ROTEARE LA BARRA INTORNO AL SUO ASSE PER CONSENTIRE UNA PERFETTA DISTRIBUZIONE DELLA RESINA ATTORNO ALLA BARRA STESSA
4) RIPETERE LE OPERAZIONI PER OGNI SINGOLO FORO
PERIMETRO APERTURA IN PROGETTO
MURATURA ESISTENTE
p.p.f. attuale
COMUNE DI TORINO
E.S.1.1
SAVIGLIANO 25/07/11


COMUNE DI TORINO - REALE IMMOBILE S.P.A. - VIA GARIBALDI 22 -
PROGETTO STRUTTURALE PER INTERVENTO DI RISTRUTTURAZIONE INTERNA
FASI PROCEDURALI PER REALIZZAZIONE DI APERTURE
IN MURATURE PORTANTI PIANO TERRA
FASE B
Formazione breccia parziale su metà muro con successivo inserimento putrella
scala1:10
ARCHITRAVE: PROFILO IPE 140 (secondo UNI 5398-78)
CUNEI IN LEGNO
SEQUENZA DI OPERAZIONI DELLA FASE B
1) REALIZZARE UN'OPPORTUNA SOTTOMURAZIONE TRAMITE CORDOLI IN C.A. DOTATI DI COLLEGAMENTI TRASVERSALI (IN MODO TALE DA RENDERE SOLIDALI FRA LORO CORDOLI E LA MURATURA ESISTENTE – VEDASI TAVOLE RELATIVE) SUI CUI REALIZZARE SOTTOFASE 4).
2) CREAZIONE DI UNA BRECCIA DI LARGHEZZA SUFFICIENTE AD ALLOGGIARE L'ARCHITRAVE AL QUALE VERRANO, IN FASE SUCCESSIVA, COLLEGATI TRAMITE UNIONE FLANGIATA I RITTI
3) NELL'IMMEDIATO ALLA SOTTOFASE 2) INSERIRE ARCHITRAVE, INSERIRE A FORZA CUNEI IN LEGNO FRA ARCHITRAVE E MURATURA ESISTENTE SOTTOSTANTE
4) REALIZZARE STRUTTURA PROVVISORIA DEL SISTEMA PUTRELLA-MURO TRAMITE SISTEMA DI SBADACCHIATURA
5) REALIZZARE CONTRASTO PUTRELLA-PARETE MEDIANTE MALTA ESPANSIVA
MURATURA ESISTENTE
p.p.f. di progetto
CORDOLO IN C.A. DI SOTTOMURAZIONE
COMUNE DI TORINO
STUDIO TECNICO GARZINO
CORSO VITTORIO VENETO, 20 - SAVIGLIANO
E.S.1.2
SAVIGLIANO 25/07/11

COMUNE DI TORINO - REALE IMMOBILE S.P.A. - VIA GARIBALDI 22 -
PROGETTO STRUTTURALE PER INTERVENTO DI RISTRUTTURAZIONE INTERNA

FASI PROCEDURALI PER REALIZZAZIONE DI APERTURE IN MURATURE PORTANTI PIANO TERRA
FASE B



MATERIALI :

CALCESTRUZZO non strutturale
- Rck(resistenza cubica caratteristica) 15 N/mm² (sottofondi, riempimenti)
- fck(resistenza cilindrica caratteristica)=0.83 Rck= 12,45N/mm²
- dimensione massima nominale inerti : 30 mm
- classe di esposizione ambientale : X0
- classe di consistenza : S3
- aggregati : non gelivi, D. max 30 mm

CALCESTRUZZO ordinario (NSC)
- Rck (resistenza cubica caratteristica) 30 N/mm² (fondazioni, muri controterra)
- fck(resistenza cilindrica caratteristica)=0.83 Rck= 24,90N/mm²
- dimensione massima nominale inerti : 30 mm
- classe di esposizione ambientale : XC3
  - a/c max: 0.55
  - dosaggio minimo di cemento [Kg/mc]: 320
- classe di consistenza : S3
- aggregati : non gelivi, D. max 30 mm

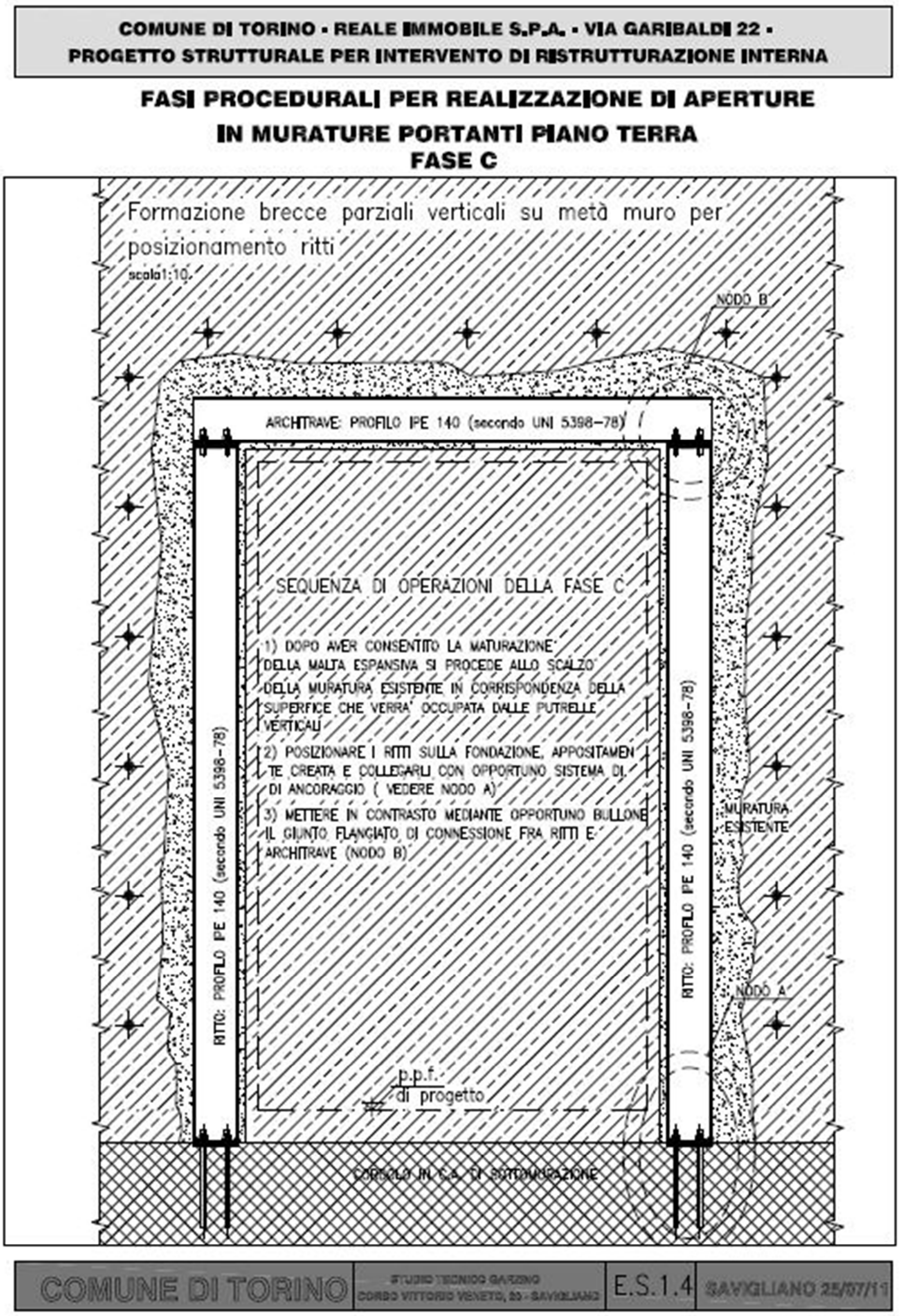
ACCIAIO per cemento armato: B450CA (equivalente Fe B 44K)
- barre singole : diametri compresi tra 6 mm e 40 mm
- reti elettrosaldate : diametri compresi tra 6 mm e 16 mm

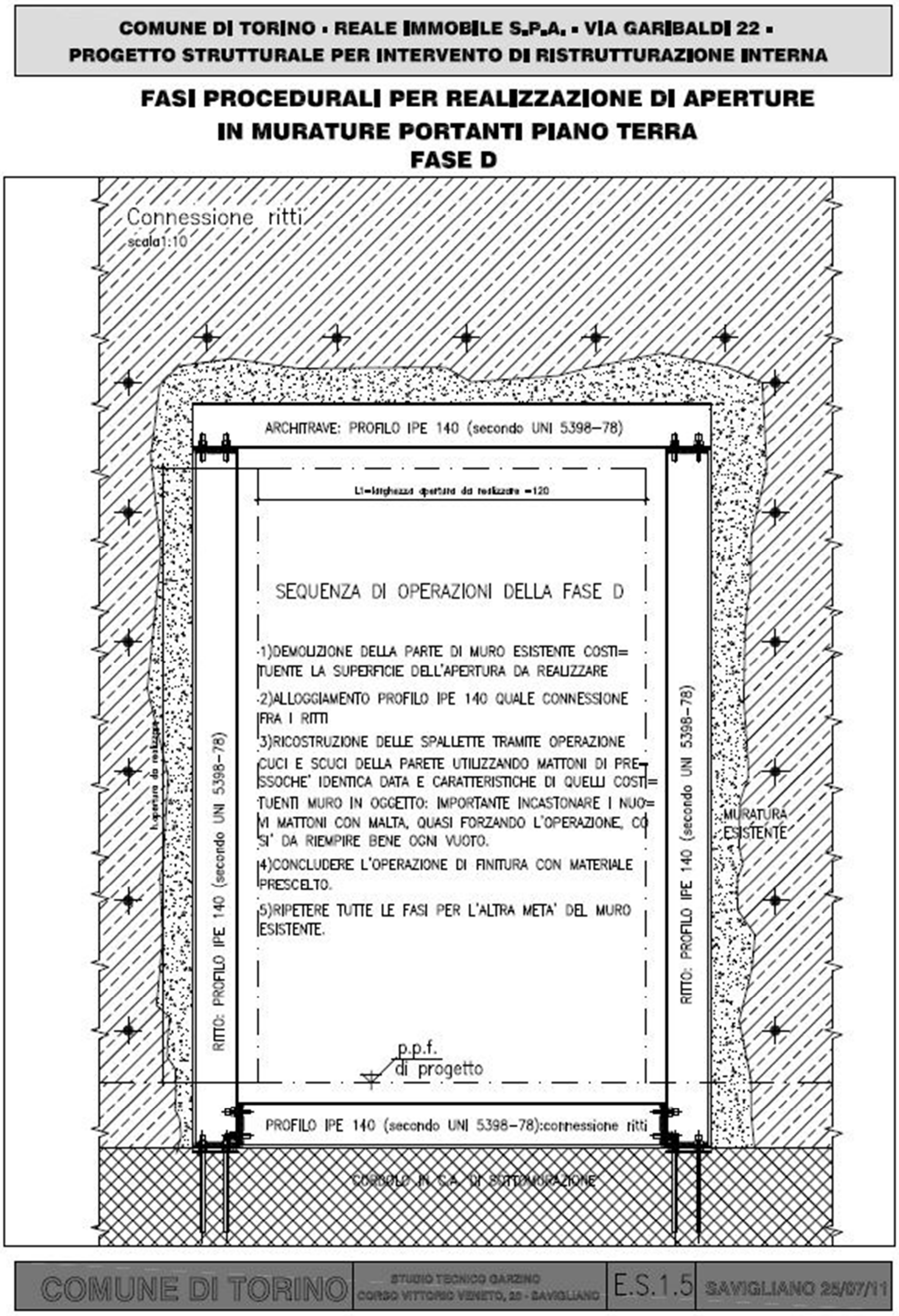
ACCIAIO per profilati: S355 (acciaio laminato a caldo conforme alle norme UNI EN 10025)

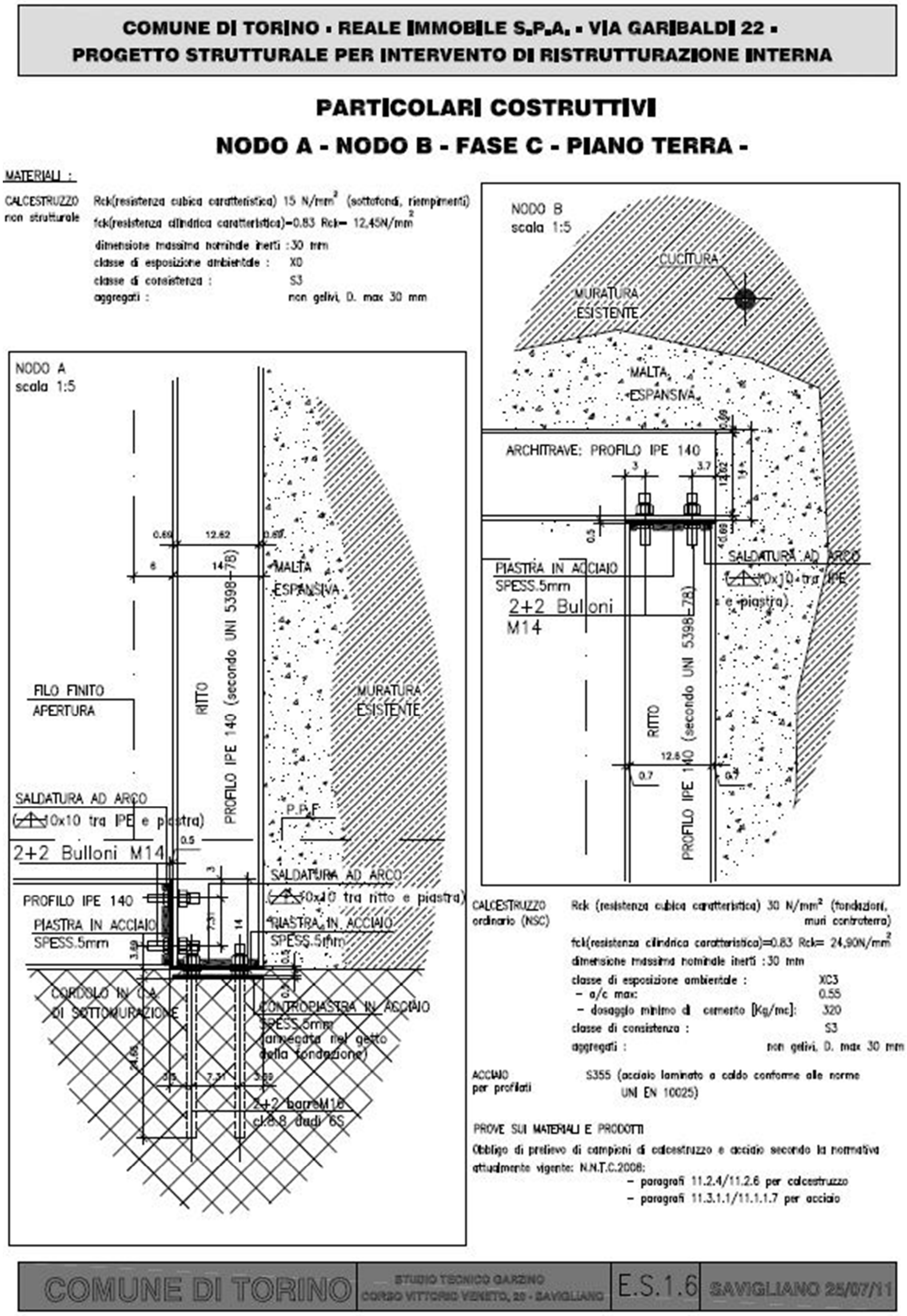
COPRIFERRO E INTERFERRO
secondo N.N.C.T par.4.1.6.1.3 (Tabella C4.1.IV della Circ.n°617 del 02/02/2009)
- copriferro fondazioni: 40 mm
- copriferro min. altri livelli: 25 mm

PROVE SUI MATERIALI E PRODOTTI
Obbligo di prelievo di campioni di calcestruzzo e acciaio secondo la normativa attualmente vigente: N.N.T.C.2008:
- paragrafi 11.2.4/11.2.6 per calcestruzzo
- paragrafi 11.3.1.1/11.1.1.7 per acciaio

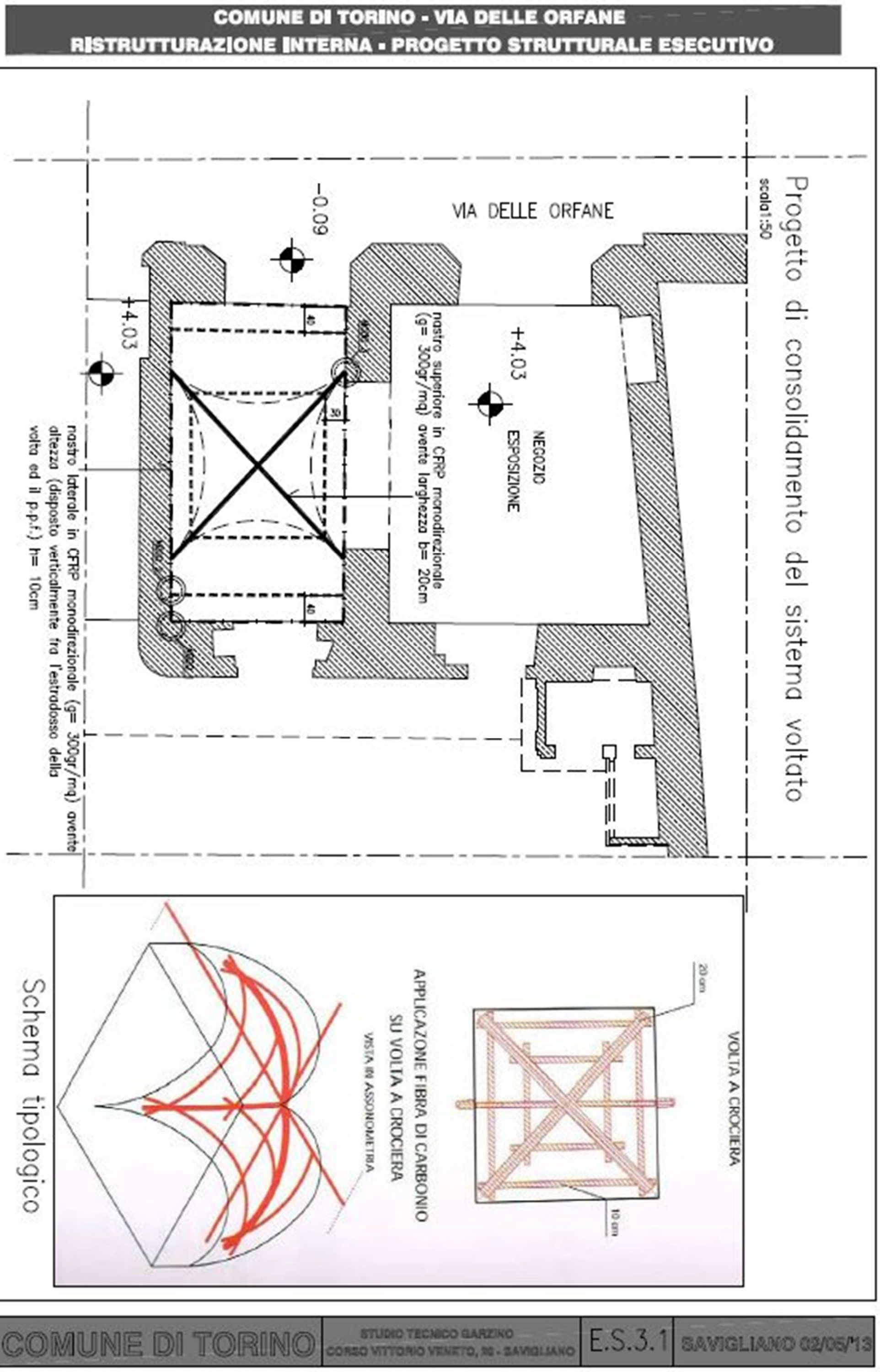
COMUNE DI TORINO	STUDIO TECNICO GARZINO CORSO VITTORIO VENETO, 20 - SAVIGLIANO	E.S.1.3	SAVIGLIANO 25/07/11


COMUNE DI TORINO - REALE IMMOBILE S.P.A. - VIA GARIBALDI 22 -
PROGETTO STRUTTURALE PER INTERVENTO DI RISTRUTTURAZIONE INTERNA
FASI PROCEDURALI PER REALIZZAZIONE DI APERTURE
IN MURATURE PORTANTI PIANO TERRA
FASE C
Formazione brecce parziali verticali su metà muro per posizionamento ritti
scala1:10
NODO B
ARCHITRAVE: PROFILO IPE 140 (secondo UNI 5398-78)
SEQUENZA DI OPERAZIONI DELLA FASE C
1) DOPO AVER CONSENTITO LA MATURAZIONE DELLA MALTA ESPANSIVA SI PROCEDE ALLO SCALZO DELLA MURATURA ESISTENTE IN CORRISPONDENZA DELLA SUPERFICE CHE VERRA' OCCUPATA DALLE PUTRELLE VERTICALI
2) POSIZIONARE I RITTI SULLA FONDAZIONE, APPOSITAMENTE CREATA E COLLEGARLI CON OPPORTUNO SISTEMA DI DI ANCORAGGIO (VEDERE NODO A)
3) METTERE IN CONTRASTO MEDIANTE OPPORTUNO BULLONE IL GIUNTO FLANGIATO DI CONNESSIONE FRA RITTI E ARCHITRAVE (NODO B)
RITTO: PROFILO IPE 140 (secondo UNI 5398-78)
RITTO: PROFILO IPE 140 (secondo UNI 5398-78)
MURATURA ESISTENTE
NODO A
p.p.f. di progetto
CORDOLO IN C.A. DI SOTTOMURAZIONE
COMUNE DI TORINO
E.S.1.4
SAVIGLIANO 25/07/11


COMUNE DI TORINO - REALE IMMOBILE S.P.A. - VIA GARIBALDI 22 -
PROGETTO STRUTTURALE PER INTERVENTO DI RISTRUTTURAZIONE INTERNA
FASI PROCEDURALI PER REALIZZAZIONE DI APERTURE
IN MURATURE PORTANTI PIANO TERRA
FASE D
Connessione ritti
scala1:10
ARCHITRAVE: PROFILO IPE 140 (secondo UNI 5398–78)
SEQUENZA DI OPERAZIONI DELLA FASE D
1)DEMOLIZIONE DELLA PARTE DI MURO ESISTENTE COSTI= TUENTE LA SUPERFICIE DELL'APERTURA DA REALIZZARE
2)ALLOGGIAMENTO PROFILO IPE 140 QUALE CONNESSIONE FRA I RITTI
3)RICOSTRUZIONE DELLE SPALLETTE TRAMITE OPERAZIONE CUCI E SCUCI DELLA PARETE UTILIZZANDO MATTONI DI PRE- SSOCHE' IDENTICA DATA E CARATTERISTICHE DI QUELLI COSTI= TUENTI MURO IN OGGETTO: IMPORTANTE INCASTONARE I NUO= VI MATTONI CON MALTA, QUASI FORZANDO L'OPERAZIONE, CO SI' DA RIEMPIRE BENE OGNI VUOTO.
4)CONCLUDERE L'OPERAZIONE DI FINITURA CON MATERIALE PRESCELTO.
5)RIPETERE TUTTE LE FASI PER L'ALTRA META' DEL MURO ESISTENTE.
RITTO: PROFILO IPE 140 (secondo UNI 5398–78)
RITTO: PROFILO IPE 140 (secondo UNI 5398–78)
MURATURA ESISTENTE
p.p.f. di progetto
PROFILO IPE 140 (secondo UNI 5398–78):connessione ritti
COMUNE DI TORINO
STUDIO TECNICO GARZINO
E.S.1.5
SAVIGLIANO 25/07/11



Figs. 1/7 - Representation of construction phases: operational project documents


COMUNE DI TORINO - VIA DELLE ORFANE
RISTRUTTURAZIONE INTERNA - PROGETTO STRUTTURALE ESECUTIVO
Progetto di consolidamento del sistema voltato
scala1:50
VIA DELLE ORFANE
-0.09
+4.03
+4.03
NEGOZIO
ESPOSIZIONE
nastro superiore in CFRP monodirezionale (g= 300gr/mq) avente larghezza b= 20cm
nastro laterale in CFRP monodirezionale (g= 300gr/mq) avente altezza (disposto verticalmente fra l'estradosso della volta ed il p.p.f.) h= 10cm
VOLTA A CROCIERA
20 cm
10 cm
APPLICAZONE FIBRA DI CARBONIO
SU VOLTA A CROCIERA
VISTA IN ASSONOMETRIA
Schema tipologico
COMUNE DI TORINO
STUDIO TECNICO GARZINO
E.S.3.1
SAVIGLIANO 02/05/13

COMUNE DI TORINO - VIA DELLE ORFANE
RISTRUTTURAZIONE INTERNA - PROGETTO STRUTTURALE ESECUTIVO

Sequenza delle fasi temporali di esecuzione delle opere edili

1) Puntellamento dei sistemi voltati costituenti solai del P.1° oltre che dell'arco che mette in collegamento i due ambienti al P.T.
2) Consolidamento delle murature al P.T. e al P.1° con la tecnica cuci-scuci e modifica vani porta al P.1°.
3) Consolidamento estradossale del sistema voltato non interessato da interventi di demolizione mediante realizzazione di cappa armata strutturalmente collegata ai muri perimetrali e consolidamento intradossale delle lunette del sistema voltato del P.2° mediante connessioni con FRC.
4) Realizzazione di opere provvisionali mediante travature reticolari incrociate da realizzare al piano primo in posizione soprastante alla volta da demolire.
5) Demolizione del sistema voltato lato Nord.
6) Consolidamento dell'arco al P.T. mediante interventi di ripristino dei conci in mattoni e placcaggio con FRC.
7) Completamento del consolidamento del sistema voltato a Sud mediante la realizzazione di frenelli, tavolato e cappa armata collegata ai muri perimetrali.
8) Modifica e riduzione di un paramento murario lato cortile.
9) Realizzazione del nuovo solaio ligneo e rimozione delle travature reticolari provvisionali.

COMUNE DI TORINO	STUDIO TECNICO GARZINO CORSO VITTORIO VENETO, 20 - SAVIGLIANO	E.S.4.0	SAVIGLIANO 18/04/'13

Figs. 8/9 - Representation of consolidation works and operating instructions

RESULTS AND CONCLUSIONS

The research carried out shows how, in the construction sector, in the case of renovation and conversion operations, it is necessary to be aware of the fact that the project has two components. The first consists of the combination of technical elaborates, drawings and reports that describe the work and indicate its physicality. This knowledge must be joined by a combination of know-hows relating to the effective organisation of the procedures for the creation of the element, known as process activities, which can be acquired mostly only when the site is open and which form the second component. It must be remembered that, in the case of operations involving existing buildings, the construction sphere is characterised by little repetition of procedures, activities that are similar but never the same, and unpredictable variables which can be traced back to the unveiling of the building as work progresses. Moreover, particularly within the spheres of agglomerates that are already built, every site is different in terms of environmental conditions or type of building, with phases that are affected by uncontrollable external conditionings. Within this framework, it is obvious how the technical project, in engineering terms, characterised by dimensions as well as the analysis of deformations to which the resistant sections are subject, has to be accompanied by procedural documents which, in the case of construction, are made up of graphic elaborates which show the methods used to accomplish the parts of the construction operation within each technological subsystem.

The graphic language used for the project design must meet the quality expectations expressed in every phase of the construction process, from the moment of conception to that of completion. It must illustrate in geometric and quantitative terms the elements and, at the same time, describe the construction phases also in terms of optimisation of human resources, paying attention to correctness and constructive safety, as well as the economy of resources.

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