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The Abacus and the Node. Mario Ridolfi's Constructions in Drawing

Abstract
Mario Ridolfi uses drawing to explore constructive themes and also as a hallmark of his personal poetics. The point of convergence between technique and poetics is manifested, in particular, in the use of two tools: the abacus and the node. The abacus concerns the combinatorial variations between quantitative parameters affecting buildings and urban design. The node establishes analogical relationships between building elements of different sizes. The abacus and the node are multiscalar tools that merge architectural design and technical investigation.

Keywords
Abacus — Architectural design — Construction — Handbooks — Node

Italian architectural handbooks published in the first half of the XX century introduced new drawing techniques that intervene in the mediation between construction knowledge and design poetics. However, these drawing techniques have long remained out of the critical spotlight. In 1981, Carlo Guenzi, editor of an important anthology volume devoted to Italian handbooks (1981, p. 14), pointed out that «the way handbooks represent things [...] articulate texts and make use of formats, would deserve specific studies and analysis». Forty years after that warning – and following research undertaken on this topic (Motta et al. 1995; Barucci 1984) – handbooks still appear as fertile and largely unexplored objects, especially for scholars of architectural figuration.

In this essay, I focus particularly on the architectural drawing that Mario Ridolfi (1904-1984) used in his two major handbooks, namely the *Manuale dell'Architetto CNR* (1946) and the *Ciclo delle Marmore* (released posthumously; Ridolfi et al. 1997).

For Ridolfi, the *Manuale dell'Architetto CNR* represented an opportunity to verify the theoretical claims of some of his essays published since the 1940s, supporting the normalization of building elements (Ridolfi 1940) and the revision of architectural drawing techniques (Ridolfi 1943). Indeed, Ridolfi conducted analytical of design practices as early as the 1930s that highlighted the mediating role of drawing between technical knowledge and search for an architectural aesthetics (Cellini and D'Amato 2005).

In this essay, I undertake several reflections on Ridolfi's handbook-oriented architectural drawing, in relation to three theoretical themes, namely: the mediation between architectural knowledge and practice; the investigation of traditional building techniques; and the classification of morpho-

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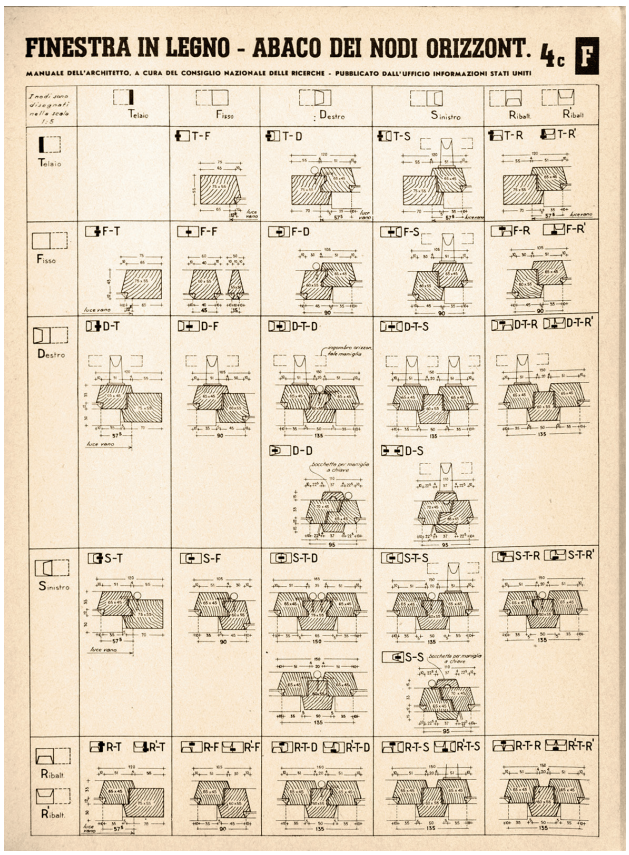

Fig. 1
Mario Ridolfi, «Finestra in legno – Abaco dei nodi orizzontali», tavola 4c F. Source: Manuale dell'Architetto CNR, Rome 1946.

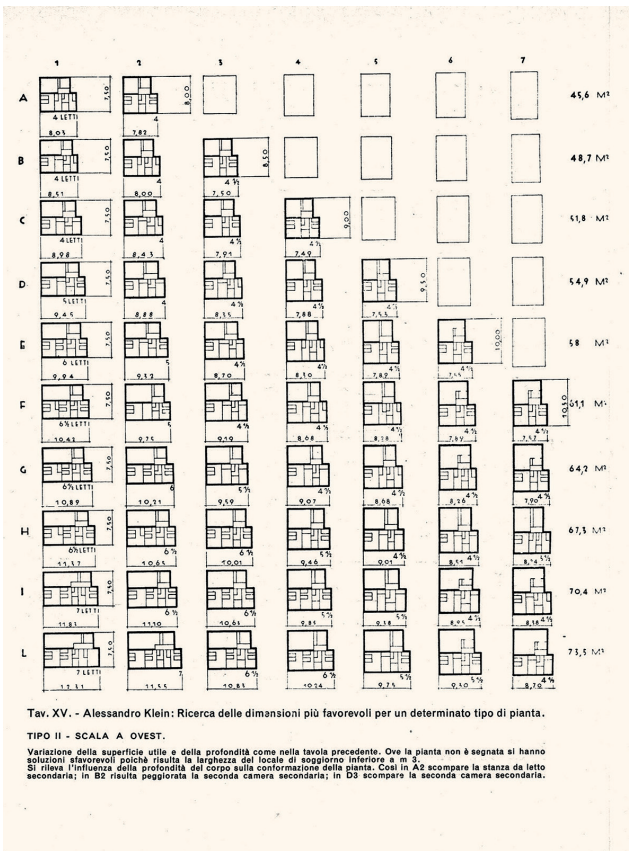

Fig. 2
Alexander Klein, «Ricerca delle dimensioni più favorevoli per un determinato tipo di pianta». Source: E.A. Griffini, Costruzione razionale della casa, Milan 1932.

logical variants of architectural and urban elements. This essay elaborates on the general epistemological hypothesis that Ridolfi's drawing establishes transfers of architectural knowledge between the making of handbooks and the performance of architectural design. More specifically, Ridolfi's handbooks show a mechanism of design thinking that operates behind the prosaic ready-made solution that connotate handbooks as publications for lazy designers. This essay develops this epistemological hypothesis by focusing on two typically handbook-oriented graphic tools employed by Ridolfi, namely: the abacus and the node.

The first section of the essay concerns the abacus featured in the parts of *Manuale dell'Architetto CNR* that are dedicated to windows and door frames. The second section of the essay focuses on the node in relation to *Ciclo delle Marmore* (Ridolfi et al. 1997) that is a handbook to which Ridolfi devoted the last decade of his life in order to document vernacular building techniques of the Umbrian Apennines and also to exemplify design proposals for single-family houses that freely interpret traditional building techniques. Both *Manuale dell'Architetto CNR* and *Ciclo delle Marmore* manifest an existential constraint with Ridolfi's biographical vicissitudes. As stated by Francesco Cellini (1997, p. 10):

> as it had already happened between 1941 and 1943, when the professional and moral consequences of the war and the German occupation had suggested him the extraordinary systematization of the *Manuale*, during the last years of his life Ridolfi fills another void (sentimental, professional, civil) with the translation and sublimation into exempla of his professional experience.

From handbook to design. The abacus

The *Manuale dell'Architetto CNR* was released with the explicit aim of providing architectural designers active in post-conflict reconstruction,

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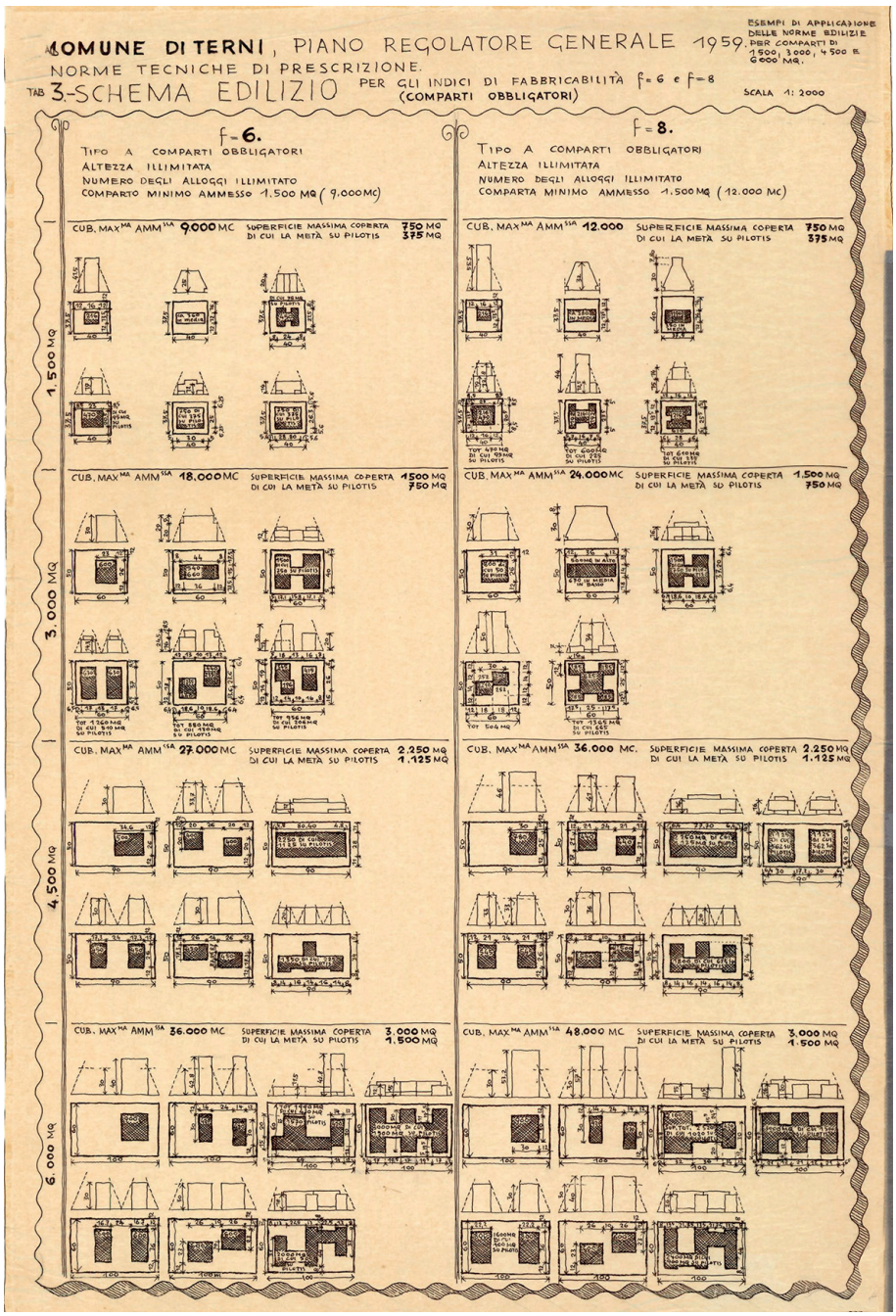

Fig. 3
Mario Ridolfi, Schemi edilizi per il Piano Regolatore Generale di Terni, 1959. Source: Rome, Accademia Nazionale di San Luca. Fondo Ridolfi-Frankl-Malagricci, www.fondoridolfi.org

with an agile tool for consulting technical data and proven building procedures. It illustrated design problems and ready-made solutions for architectural designers and engineers and acted as specific graphic reference for technical drawings. In particular, Ridolfi edited the Section F entitled "Finished Works of Construction" in which he broadly employed abacuses.
Through the abacus, Ridolfi represented the morphological variations of building elements in relation to quantitative parameters. For instance, in the Section F the abacus concerned different ways of designing wooden windows according to materials and assembly configurations (Ridolfi et al. 1946, Table F 4d) (Fig. 1). The abacus illustrated the compositional variations that relate parametric elements such as frames, fixed or movable sashes (scale 1:5). On one hand, the abacus functioned as a repertoire of windows and doors dimensioned and ready-for-use by architectural designers. On the other hand, the abacus resulted of a reflection on the combinatorial mechanisms of the building elements (transom, mullion, hinge),

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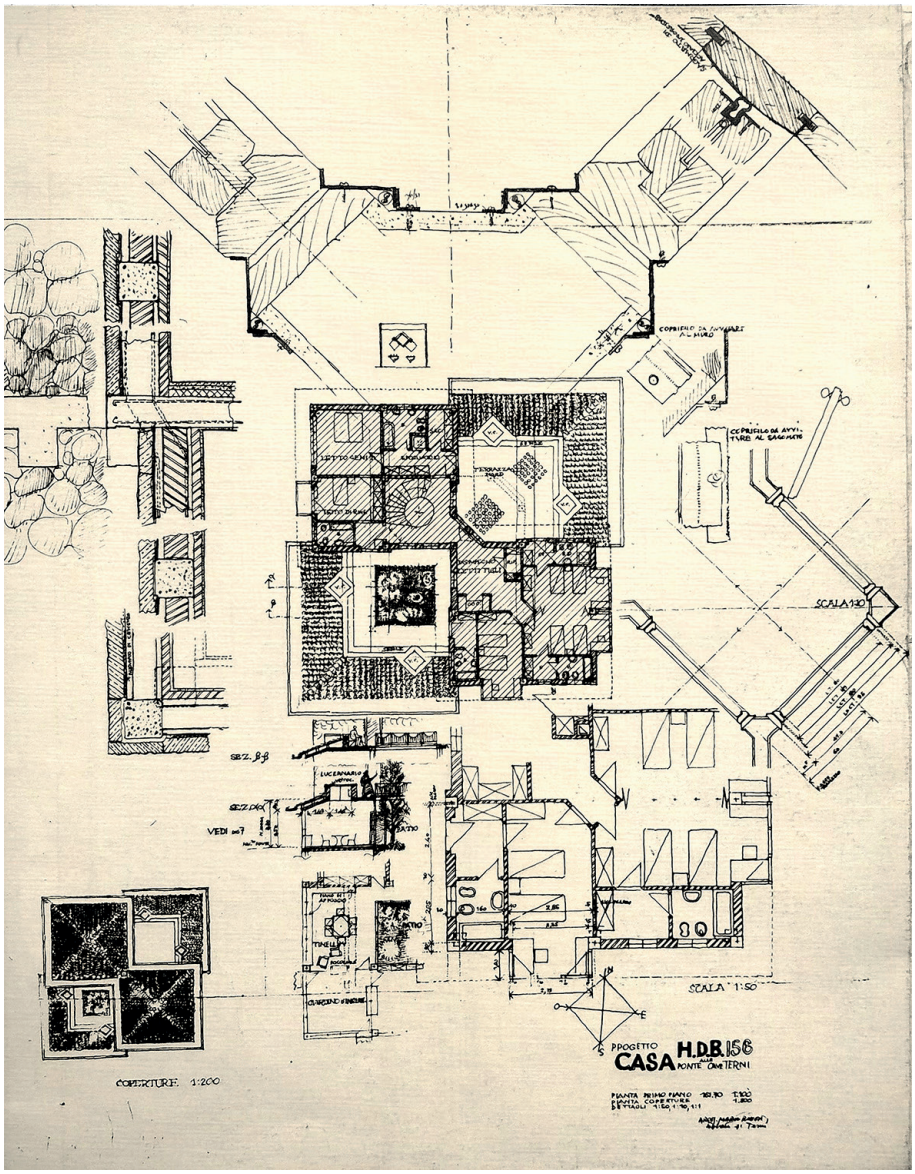

Fig. 4
Mario Ridolfi, Schizzi planimetrici e di dettaglio per Casa De Bonis I, CD 164/I/(2), 1971-74. Source: Rome, Accademia Nazionale di San Luca. Fondo Ridolfi-Frankl-Malagricci, www.fondoridolfi.org.; M. Ridolfi, F. Cellini, C. D'Amato, Manuale delle tecniche tradizionali del costruire. Il ciclo delle Marmore, Milan 1997.

through which Ridolfi attempted to communicate his own problem-solving approach to design issues that exceeded the sole domain of application of fixtures.

It should be noted that the abacus saw diverse applications in handbooks. It occurred in relation to different design issues and scales. For instance, Alexander Klein employed the abacus in his typological studies on the *existenz minimum*, later popularized in Italy by Enrico Agostino Griffini's handbook entitled *Costruzione razionale della casa* (1932). In his typological abacuses Klein showed how to design efficient floorplan variants of a flat. One of his most well-known abacuses displays the relationship between two quantitative variables, namely: the depth of the building (in abscissa) and the floor area (in ordinate) (Fig. 2). This abacus ends up with a number of blank cells (marked with placeholder rectangles) that indicate disadvantageous floorplan arrangements. Blank cells prove that the combinatorial logic of the abacus always exceeds the possible solutions to a design/constructive problem. Therefore, the abacus is not only a classificatory device but rather a combinatorial mechanism that produces figures that can also be irrational, therefore useless to solve specific functional requests.

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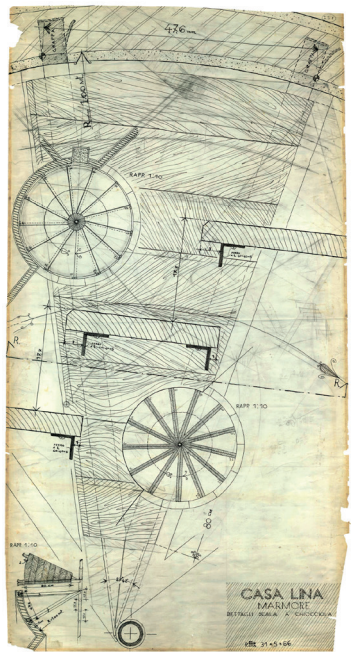

Fig. 5
Mario Ridolfi, Dettagli della scala a chiocciola di Casa Lina a Marmore, Terni, 1964-1967. Source: Rome, Accademia Nazionale di San Luca. Fondo Ridolfi-Frankl-Malagricci, www.fondoridolfi.org.

The abacus performs combinatorial mechanisms that affect also urban design. For instance, Ridolfi employed the abacus in the *Piano Regolatore Generale* of Terni (1950-1959) in order to merge the economic availability of local resources and the dynamics of development and fractionation of a medium-sized urban fabric (Cellini and D'Amato 2005, pp. 76-78). In view of this purpose, the abacus displayed the building ratio (in abscissa) and the parcel surface (in ordinate). The intersection of these two parameters led to solutions of morphologically variable typologies which were represented in the abacus cells (block, multiple blocks, open court and in-line buildings) (Fig. 3). As recalled by Cellini and D'Amato (2005, p. 74): «[the *Piano Regolatore Generale* of Terni] was more than just city planning and, still nowadays, it represents an exemplary normative tool aimed at establishing effective and clear regulations, graphic symbology, synthetic and limpid techniques of representation [...] that are rooted in the generative logic of the *Manuale dell'Architetto CNR*».
In a way, Ridolfi elaborated abacuses that were different from the typological abacuses because they were not aimed at establishing morphological analogies among items. Ridolfi's abacuses were rather sequences of instructions that, like algorithms, allowed the connection between quantitative parameters. Each cell of the abacus implied such an algorithmic procedure. Sometimes the algorithm arrived at an incorrect (or not possible) solution and the respective cell of the abacus was left blank.
In summary, Ridolfi's abacus show two features: one explicit and the other implicit. The explicit feature concerns the abacus as a collection of ready-made solutions according to certain building parameters or construction constraints. The implicit feature is instead the mechanism of rules that underlies the abacus' structure. Moreover, this implicit feature is useful to acknowledge affinities among combinatorial mechanisms that involve different problems of architectural and urban design, namely between abacuses that are explicitly dedicated to different problems.

From design to handbook. The node

Ridolfi employed drawing to undertake transfers of knowledge between construction and design, and this choice rendered his approach to architecture as «ambiguously situated between intellectual and material culture» (Cellini 1983, p. 14). Thirty years after the publication of the *Manuale dell'Architetto CNR*, Ridolfi still aimed at building up «a body of knowledge that is transmissible and separable from individual occasions» (Cellini and D'Amato 2005, p. 33). Therefore, between the 1970s and 1980s he conceived the *Ciclo delle Marmore*, namely: «a building diary in the form of a handbook» (Ridolfi et al. 1997, p. 26) that also referred to his projects of twelve houses in the Apennines of Umbria.
Unlike the drawings elaborated between the 1940s and the 1960s – featuring a strict classificatory system and normalization outcomes – the *Marmore*'s drawings portay a higher level of improvisation due to occasional additions and continuous elaborations (Ridolfi et al. 1997, p. 10). In the *Ciclo delle Marmore*, Ridolfi laid bare his own architectural thought by means of freehand signs that testified his knowledge of constructive details as well as his will to establish a dialectic relationship between geometrical and technical feature of architectural and urban design (Moschini and Rattazzi 1997).
Claudio D'Amato noted that *Ciclo delle Marmore* features: «tectonic nodes arising from the encounter of continuous and discontinuous con-

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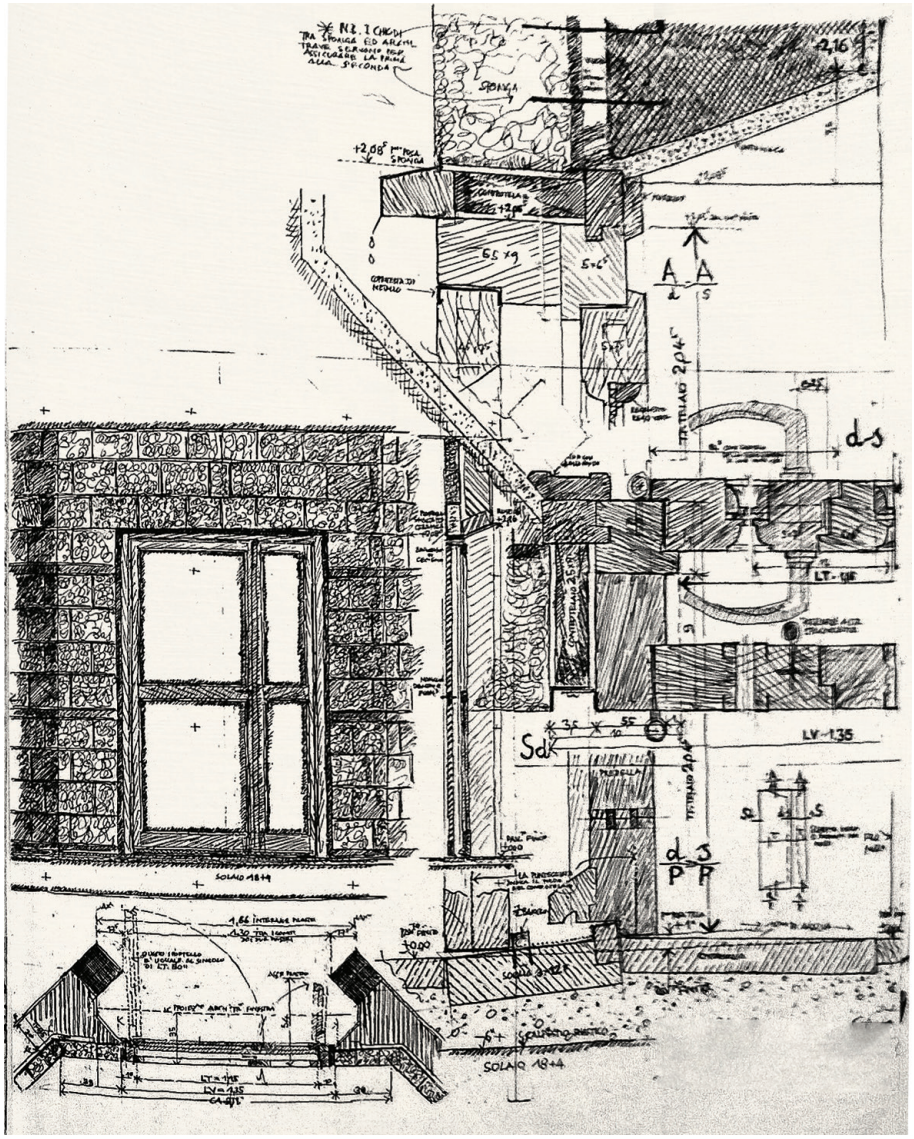

Fig. 6
Mario Ridolfi, Schizzi di dettaglio per Casa Luppattelli, CD 177/III/(14), 1978-84. Source: Rome, Accademia Nazionale di San Luca. Fondo Ridolfi-Frankl-Malagricci, www.fondoridolfi.org.; M. Ridolfi, F. Cellini, C. D'Amato, Manuale delle tecniche tradizionali del costruire. Il ciclo delle Marmore, Milan 1997.

structive elements, [...] between different materials and elements» (Ridolfi et al. 1997, p. 18). The node normally rises from the intensification of signs and the dilation of drawing wherever the technical problem requested an ad-hoc solution.

Ridolfi employed the node whenever he wanted to magnify a constructive problem that concerned multiple elements converging into one cluster. The node itself implied an isomorphic relationship between the procedure of building the details and the procedure of drawing it. This is the reason why several nodes portray a centrifugal shape that expands from the center toward the margins, according to a vortex that progressively involves new elements. The node is also emphasized by the broad use of central plan buildings that characterizes most of the Marmore's designs (Cellini 1983; Cellini and D'Amato 2005, pp. 122-131).

Sometimes the node concerned the manipulation of drawing conventions (the scale and the orientation of orthographic planes) in order to establish constraints among elements of different sizes (from the construction detail to the whole building floorplan). This multi-size relationship concerns variations of either the scale or the arrangement of projection planes.

Variations of scales are well exemplified in the plan of Casa De Bonis I (Fig. 4). Here, the node condenses three different representations of the house, namely: the plan of the second floor, the roof arrangement, and

detailed drawings of windows doors (Ridolfi et al. p. 44-55). The drawing proceeds centrifugally, from large to small scale: the plan (scale 1:100) hinges on the distribution system (stairs and corridors) and gathers some zoomed views in scale 1:50 (the rooms), 1:10 (the hallway between the rooms) and 1:1 (the window and doorframe). Other examples of similar nodes are found in the drawings of Casa Cresta and Casa Lina. One boards of Casa Lina performs a reversed scalar relationship (i.e., from small to large) applied to the spiral staircase; the detail of the step (scale 1:1), drawn at the center of the boards, hinges multiple successive enlargements of the stair structure (scale 1:10) (Fig. 5).
Variations of projection planes occurs when the node combines figures that lay on horizontal, vertical and oblique planes. For example, the drawings for Casa Lupattelli arrange into a single composition the plan and the section that complement each other in the representation of the building levels and the details There is one element of the drawing that acts as the core of the node and at the same time also as a pivot; this pivot element is the window frame (Fig. 6).

Conclusion in problematic form

As we have seen, the abacus and the node constitute a form of graphic translation of Mario Ridolfi's design procedures. Both aim at anticipating and transmitting at once the development of design thinking by the means of drawing.
Nowadays Ridolfi's abacus and node represent ancestors of the algorithmic tools embedded in BIM software in order to empower the interaction between designers and technicians. Anticipating BIM by more than half a century, Ridolfi exemplified a way of designing that does not passively accept technical innovations but, on the contrary, aspires to translate these technical issues into expressive figures or rather into a poetics that assumes technical innovation in drawing as emblematic feature (Bonfanti 1981).

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