The Manual Graphic Language as a Propaedeutic and Research Tool. The Drawing of Construction Details as a Singular Case Study

Antonio Estepa Rubio, Jesús Estepa Rubio

Abstract

In this paper, we present a study on the value and relevance of mastering manual graphic language as an essential tool for the development of educational and research processes, especially in contexts related to the performance of technical and creative skills at advanced levels of critical thinking.
In contemporary times, where digital resources have reached a notable level of sophistication, manual drawing continues to hold a significant place due to, among other characteristics, its expressive immediacy in fostering perception, participation, spatial understanding, and creativity.
The design of construction details, as a singular case study, demonstrates that technical drawing remains an irreplaceable universal platform for professions with technical and creative roots. Therefore, the propaedeutic training of architects, engineers, and designers is more necessary today than ever.
The preview capabilities provided by digital tools, including BIM, are fundamental for contemporary professional practice. However, learning to build and manufacture requires rigorous prior training. Drawing, as a scenario where errors are reversible, allows one to anticipate problems that may arise during the execution phases.

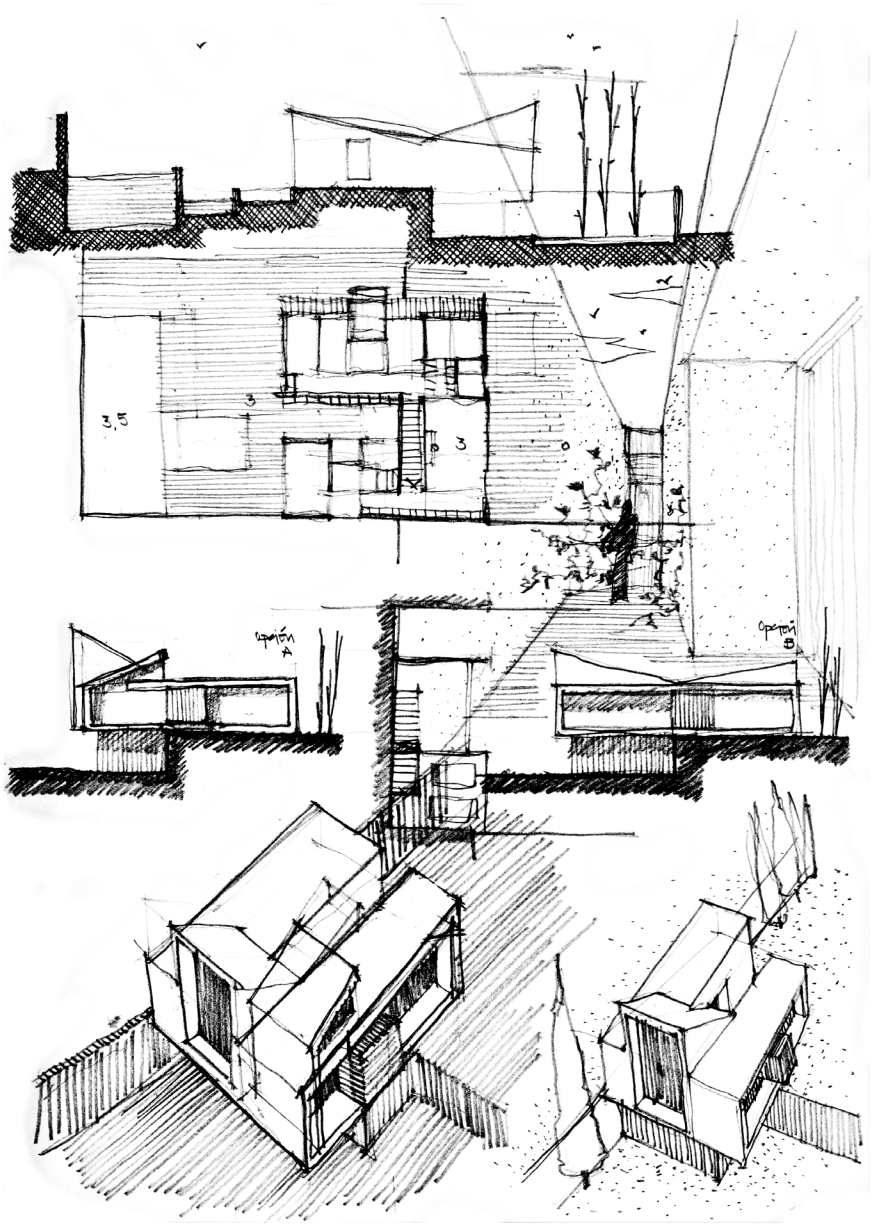
Keywords: graphic language, propaedeutic, research, construction detail, creativity.

Graphic expression as a tool for thought and as a linguistic code for the practice of technical and creative professions

Discursive thinking refers to the ability to reason and express oneself coherently and organizedly in a dialectical exposition or conversation. It is characterized by being a skill derived from the creative intelligence characteristic of human beings [Marina 1994] to organize ideas and arguments clearly and logically, as well as allowing us to understand and respond to the ideas of other interlocutors effectively. This type of thinking involves the ability to use language effectively to communicate with others, whether orally or in writing. It implies the capacity to structure ideas and arguments in a complex yet coherent manner, as well as the ability to establish connections between different related topics or ideas.

Discursive thinking, as an exploratory process inherited from modern thought and art [Argán 1996], is related to the ability to ask critical questions and formulate solid arguments from an intelligible and rational standpoint. Discursive thinkers are often good at critically analyzing information, identifying problems, and formulating practical solutions.
Drawing, understood as a method of discursive interaction, is a highly useful tool for shaping thought and/or structuring communication derived from our intentions [Martín López, Durán López 2020, pp. 38, 39]. In many cases, drawing allows people to visually represent their mental elaborations and ideas (fig. 1), which undoubtedly helps to better understand and more effectively remember what they are trying to convey.

Fig. 1. Discursive graphic iteration in the gestation process of the architectural project (graphic elaboration by the authors).



Additionally, drawing can be a creative and therapeutic tool since, by drawing, people can process their emotions and thoughts in a non-verbal and artistic manner, which can help relieve stress and find new solutions to complex problems [Raposo Grau 2006, pp. 115, 116].
It can also be a fundamental tool for structuring collaboration and communication within a team. By drawing together, team members can share and discuss their ideas visually, which can help them reach agreements and make decisions more effectively.
The ability to process thought visually is always a versatile and valuable strategy for training the intellect, modelling communication, and facilitating collaboration among individuals. By allowing people to represent and share their ideas visually, it can help them better understand and solve problems more effectively.
Drawing and language are two distinct but equally important forms of exchange in the field of communication and representation [De Llano Cabado 1994, p. 26]. Both can be used to express ideas, emotions, and concepts.
Drawing is based on a narrative logic [Chías Navarro 2017, pp. 27, 28] that allows people to represent their thoughts and ideas concretely and tangibly through the intellectual stimulation of the sense of sight, capable of overcoming any intercultural barrier. Unlike language, which is verbal and abstract, drawing is more easily understandable and accessible to those who do not have a deep knowledge of a specific language [Bini 2017, pp. 24, 25].
However, language, whether oral or written, manifests as a more complex and flexible form of communication that allows people to express abstract ideas precisely. Language can also be used to describe and analyse drawing, providing a level of detail and depth that cannot be achieved solely by using drawing. Therefore, it can be concluded that language and drawing form a highly valuable communicative set for the performance of creative, technical, and executive activities.

Architectural graphic expression in its technical and executive aspect: from sketching to drawing construction details

Drawing is a form of representation that uses lines, shapes, and shadows to create an image on a flat surface, such as paper or canvas [Ching 2006]. Since ancient times [Pérez-Gómez 2017, pp. 17, 18], drawing has been used as a form of visual communication and artistic expression

Fig. 2. Axonometry of a vault in the Monastery of Iviron on Mount Athos (Greece) [Choisy 1883, Plate XII]. Source: National Library of France

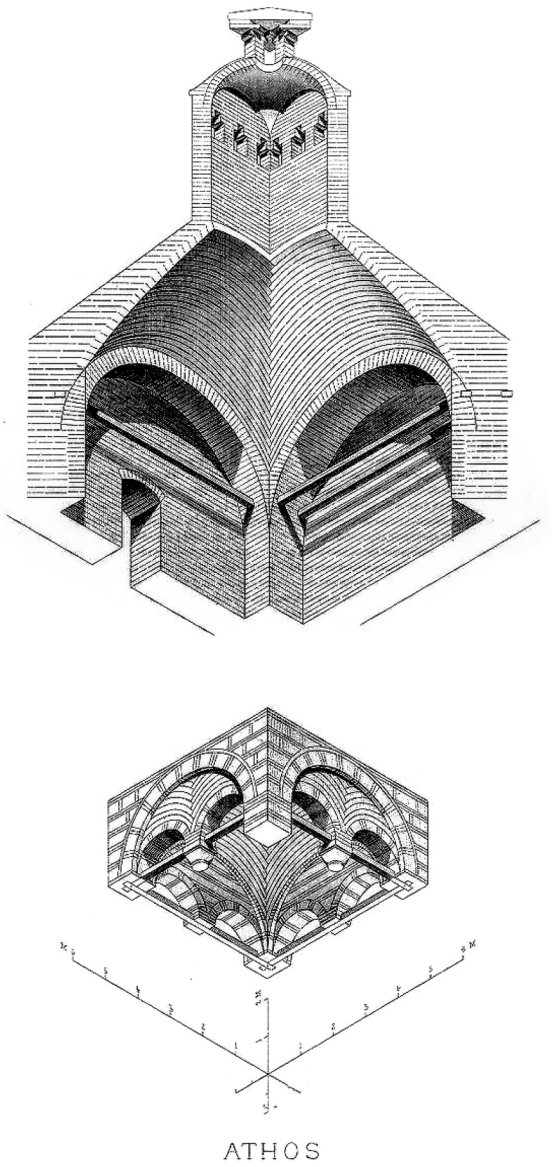
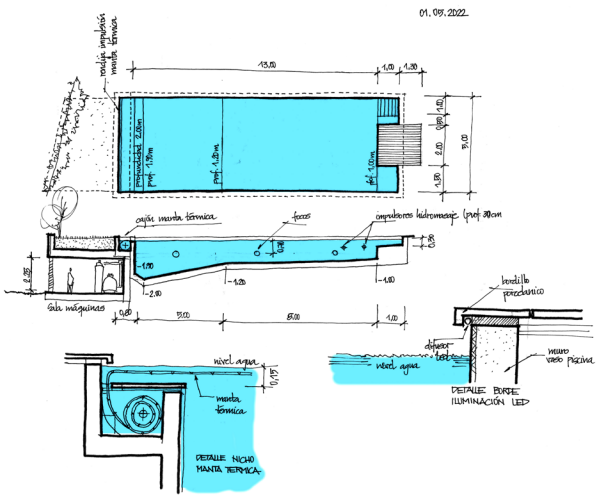


Fig. 3. Example of hand-drawn plans and sections for resolving the execution of a swimming pool (graphic elaboration by the authors).



in the field of Architecture. Thus, masters like Auguste Choisy (fig. 2), among others, have passed down a mode of graphic communication that has allowed, over the years, the development of a unique and highly recognizable way of drawing architecture; in Choisy's case, particularly sensitive to construction-related issues.
Drawing can be a creative and relaxing activity, and it can also be used as a tool to solve problems and improve cognitive skills. Additionally, drawing can be a form of personal and artistic expression, allowing authors to express their emotions, ideas, and visions [Seguí de la Riva, Burgaleta Mezo, Peña Pereda 1986, pp. 5-7].
Graphic-plastic expression and architecture are two fields that are closely related [Baldellou Santolaria 1998]. Graphic expression is a fundamental tool for representing professional ideas and concepts; thus, architects and designers use different graphic representation techniques to communicate their intentions to colleagues, clients, and, in executive phases, to interact with builders.
The exploration of ideas through sketches and drawings based on intuition is also an essential practice in the architectural design process [Melis 2023, pp. 34-36]. Architects and designers use freehand or digital drawings to explore different design options and evaluate the functionality and aesthetics of their projects [Montiel Zacarías 2020, pp. 18, 19].
Architectural Graphic Expression can be categorized as a set of disciplines involving the visual representation of architectural ideas and their communication through drawings, sketches, models, and other visual means, even to represent territory and large scale [Salerno 2019]. This training is essential in the practice of architecture, as it allows for precise instructions to the various agents and entities with whom they must interact to carry out their professional work.
Graphic expression systematically works on several conceptual elements of radical importance for the subsequent practice of the profession, including perspective, scale, proportion, light and shadow, colour, texture, and composition [Viñas Limonchi 2024, pp. 3-5]. These elements are fundamental for creating precise and effective architectural drawings that can clearly and concisely convey the architect's vision, especially when responding to specific problems or resolving conflicts.
There are several types of architectural drawings used in the field of Architectural Graphic Expression; among them, one stands out for its significance and universality: planimetric representation, whose basic foundation lies, as we know, in the development of plans, sections, elevations, perspectives, and, of course, construction details (fig. 3). Each of these types of drawings, typically linked to the development of different technical production phases, has a specific purpose and is used to communicate different aspects [Uría Iglesias 1998, pp. 58-60], both in the preliminary planning phase and in the subsequent implementation phase.

Propaedeutic training in the learning of Architecture and Design

Propaedeutic training is based on a series of pedagogical and theoretical principles aimed at preparing students to assimilate advanced training and, in the case of architecture, to subsequently perform extensive and complex professional practice.
Therefore, one of the most relevant pedagogical approaches for learning any discipline of a creative nature has always been systematic training based on the effective simulation of project development; this allows for a focus on active learning through the execution of practical cases as close as possible to those that occur in reality [Raposo

Fig. 4. Detail drawing to explain on-site how to resolve water drainage at the edge of a terrace (graphic elaboration by the authors).

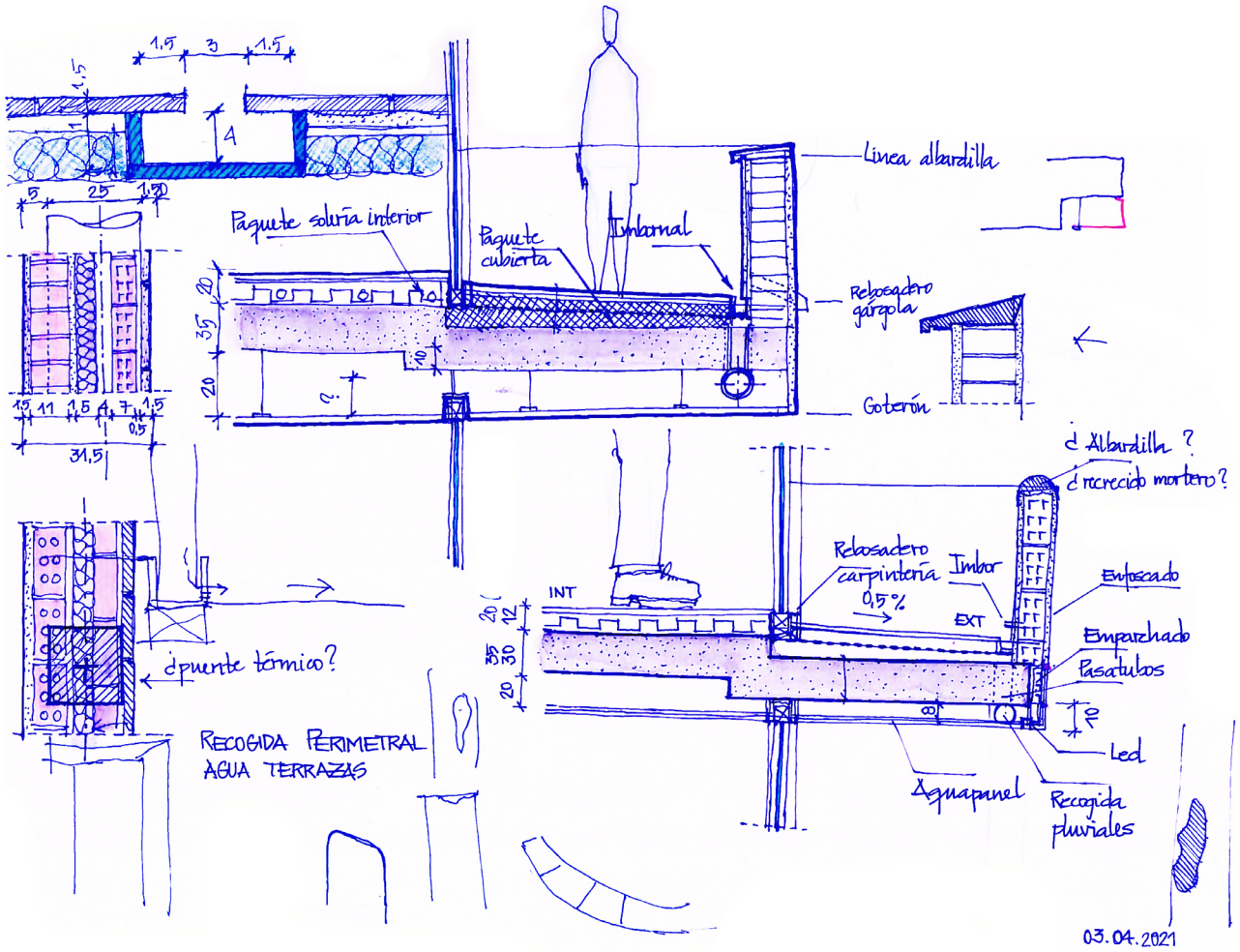
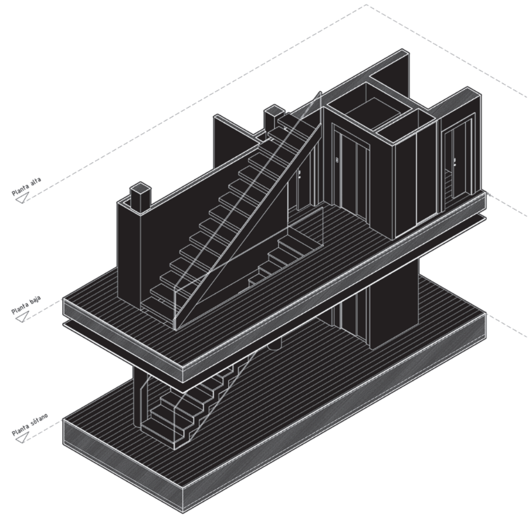
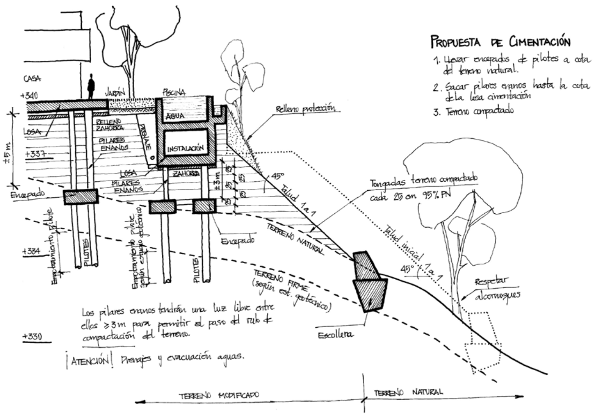


Fig. 5. Sectioned axonometry of the development of a staircase modelled with BIM (graphic elaboration by the authors).

Fig. 6. Detail drawing to explain on-site how to execute the foundation and soil retention (graphic elaboration by the authors).





Grau 2006, pp. 106, 107]. Thus, students apply theoretical knowledge in real or simulated situations, facilitating their understanding and retention of concepts analyzed from theory [Suter Warnholtz 2020, p. 33].

In architectural training, simulation-based learning allows students to develop design skills and spatial mastery where multiple convergent situations must be combined, as this is an interdisciplinary professional activity that combines elements of art, science, technology, and humanities.

Accordingly, it is easy to understand that propaedeutic training must reflect this integration, providing a solid foundation in various areas of knowledge. The juxtaposition of disciplines fosters a holistic understanding of the built environment and prepares students to tackle complex problems from multiple approaches.

For all these reasons, critical thinking is essential for architectural practice, as it allows professionals to evaluate and analyse information objectively and make informed decisions. Propaedeutic training should include activities and exercises that stimulate critical thinking, propositional analysis, and, above all, decision-making from leadership positions.

That is why the practice of architecture requires training in both technical and creative skills; thus, propaedeutic training must balance the development of cognitive competencies, such as logical reasoning and problem-solving, with the promotion of creativity and innovation.

Theoretical foundations provide a solid basis for the propaedeutic training of architects, ensuring that students acquire the necessary competencies to continue their education and subsequently practice the profession competently and ethically.

Within the area of Architectural Graphic Expression, it is worth notably mentioning one of the propaedeutic subjects that, over the years, has served as a springboard for advanced learning of mechanisms that help architects control space, namely, Descriptive Geometry.

Descriptive Geometry, systematized in its current form by Gaspard Monge [Gentil Baldrich 2021, pp. 1207-1209], is a mathematical discipline focused on representing three-dimensional objects on a two-dimensional plane using projective graphic techniques. This science has historically been very important in the fields of engineering, architecture, and industrial design, which is why it has always been part of the curricula of all those careers that deal with manipulating the physical environment, space, and the occupation of objects within it [Bergamo 2022, pp. 112-114].

Precision and attention to detail are fundamental in graphic expression to ensure the effective communication of architectural ideas and the rigorous construction of our works (fig. 4). Therefore, architectural drawings must synthesize and explain, in the best possible way, the spatial distribution of the project, its exterior and interior appearance, construction decisions, and spatial relationships between the different areas of the ensemble.
Thus, propaedeutic initiation into transversal knowledge is essential for the specific knowledge of the discipline to take root as it should. In the context of architecture and design, the integration of disciplines such as history, theory, mathematics, and applied sciences allows professionals to develop a holistic understanding of the built environment. This transversal foundation not only enriches their technical knowledge but also fosters a broader and more critical perspective, essential for addressing the most complex challenges of professional life.

Excellence in digital drawing: CAD and BIM representations through manual graphic discourse

The BIM (Building Information Modeling) methodology allows for efficient and sustainable management of construction and infrastructure projects, improving design quality and informed decision-making. While the CAD (Computer-Aided Design) methodology focuses on creating precise drawings, BIM focuses on collaboration, coordination, and information analysis in all design phases, using a technological and digital role where all project information is contained and programmed [Del Giudice 2018, pp. 122, 123].
On the other hand, it is worth remembering that freehand drawing has historically been a key tool in the conceptualization and communication of architectural ideas; however, with the definitive implementation of contemporary digital technologies that allow the creation of digital twins (fig. 5) with an impressive level of precision, the relevance and necessity of maintaining this traditional skill for professional tasks in our discipline might seem questionable [Borin et al. 2020, pp. 139, 140]. Nevertheless, it is increasingly evident that freehand drawing remains a crucial skill that facilitates the effective handling of digital graphic tools and enhances creativity and precision in the design, ideation, and proposition of architectural solutions of any kind and level (fig. 6).
Manual graphic skills foster a direct connection between the mind and the hand, facilitating the quick and spontaneous

Fig. 7. Construction details of timber frame structures. Drawings by Antonio Cámara [Cámara 1949, p. 86]. Source: Official College of Architects of Madrid.

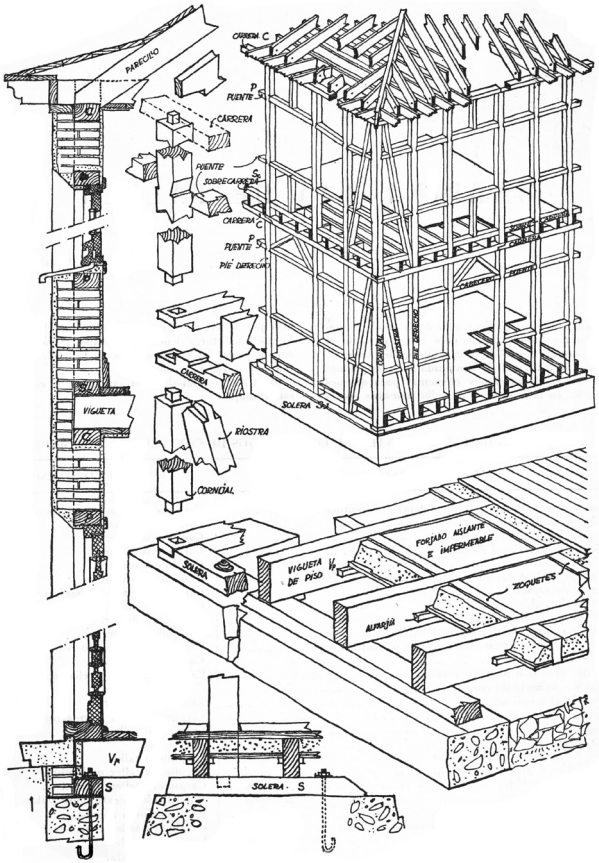
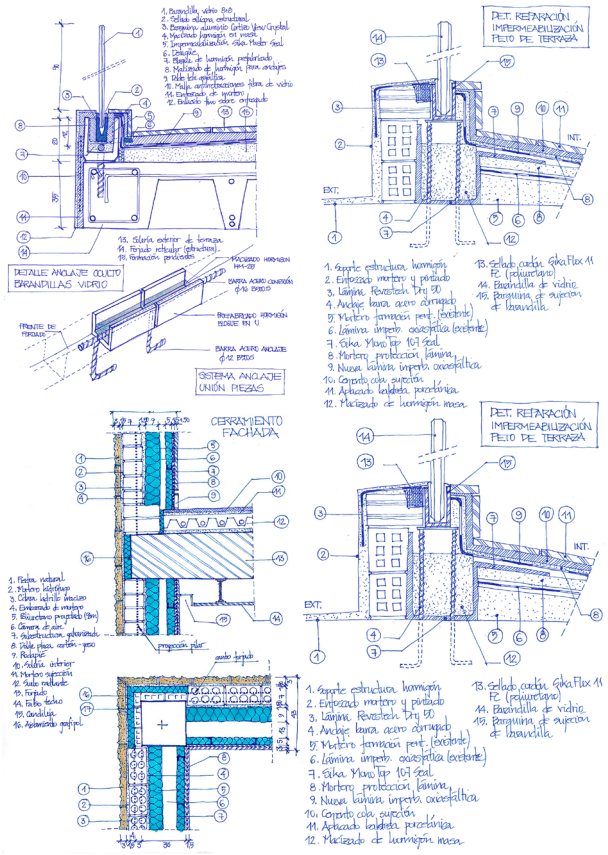


Fig. 8. Construction details of joints and connections on-site (graphic elaboration by the authors).



expression of ideas through conceptual diagrams or basic three-dimensional approximations [Figueroa Rodríguez 2023, pp. 52-54]. Unlike digital tools, which may impose certain technical limitations, freehand drawing offers a creative freedom that is irreplaceable for initiating and structuring decisions in the early stages of design [Graves 1979, p. 32].

Moreover, it can be said without fear of contradiction that freehand drawing serves as a solid foundation for learning and handling digital graphic tools. Architects who master freehand drawing can transfer their observation and representation skills to digital platforms more easily. For example, the ability to quickly visualize and sketch concepts by hand can accelerate the modelling process in BIM and CAD, allowing for a smoother transition between conceptual design and the final technical documentation used for implementation.

Digital tools, such as BIM and CAD, offer significant advantages in terms of precision, efficiency, and collaboration; however, they require a clear understanding of design principles and the ability to think spatially and constructively. It goes without saying that freehand drawing helps develop these competencies, providing a solid foundation upon which more advanced digital skills can be built. In other words, it is quite likely that individuals with good manual graphic expression skills will handle and use digital graphic tools better than those who lack this foundational knowledge.

Additionally, freehand drawing can enhance communication and collaboration in multidisciplinary teams, especially when many agents need to intervene simultaneously on-site. Quick sketches and freehand annotations facilitate discussion, idea exchange, and understanding in executive design or construction management meetings, allowing for a clearer and faster comprehension of proposed concepts. This principle is particularly valuable in collaborative environments where visual communication is key to the project's success [Graves 1979, pp. 35, 36].

Freehand drawing remains an essential skill in the training and practice of architects and designers, complementing and enriching the use of digital graphic tools such as BIM and CAD. The combination of traditional and digital skills allows professionals to approach architectural design with greater creativity, precision, and efficiency. Therefore, it is crucial that educational programs continue to emphasize the importance of freehand drawing as a substantial propaedeutic competence for the training of architects and designers.

The drawing of construction details as a support for mastering construction

Despite technology having changed the way construction projects are carried out, hand-drawing construction details remains important in many cases. Hand-drawn sketches and conceptual diagrams [Puebla Pons, Martínez López 2010, pp. 101-103], often made spontaneously on-site, are very useful for communicating manufacturing processes and determining specific characteristics that can be difficult to convey on a computer screen.
Technical drawing is a form of expression that has always been used to communicate detailed information about how construction processes should be managed and executed (fig. 7). Technical drawings are especially important for construction companies to understand exactly what needs to be done and how tasks should be planned to ensure the material execution of the work aligns with the project's specifications.
Accordingly, developing a set of detailed plans is essential for various trades to understand precisely what is required to construct each unit of work accurately and appropriately. However, we must not fall into the error of thinking that a project document is sufficient to resolve all the problems and conflicts that will arise on-site. In this sense, as it is always necessary to follow up on-site to complete the information in the project's graphic documentation, being able to draw well freehand ensures rapid agility to address and solve any gaps due to the possible lack of graphic information in the execution project.
Additionally, these details are important for budgeting and selecting the most suitable materials and executive systems, which translates into control over the timing and processes of construction and, consequently, parallel cost control during construction. Therefore, in the architectural design process, construction details are always drawn to evaluate different sections where the main construction joints and connections can be studied. It is important that the drawings are precise and detailed so that builders can easily understand how to make connections, joints, or intersections, avoiding errors that could jeopardize any part of the process.
Drawings must be clear and precise so that everyone can understand and follow the instructions correctly. Currently, the drawing of construction details is largely done with digital tools such as CAD and BIM. These tools allow for the creation of precise and detailed drawings, facilitating

Fig. 9. Construction details of floor and roof solutions (graphic elaboration by the authors).

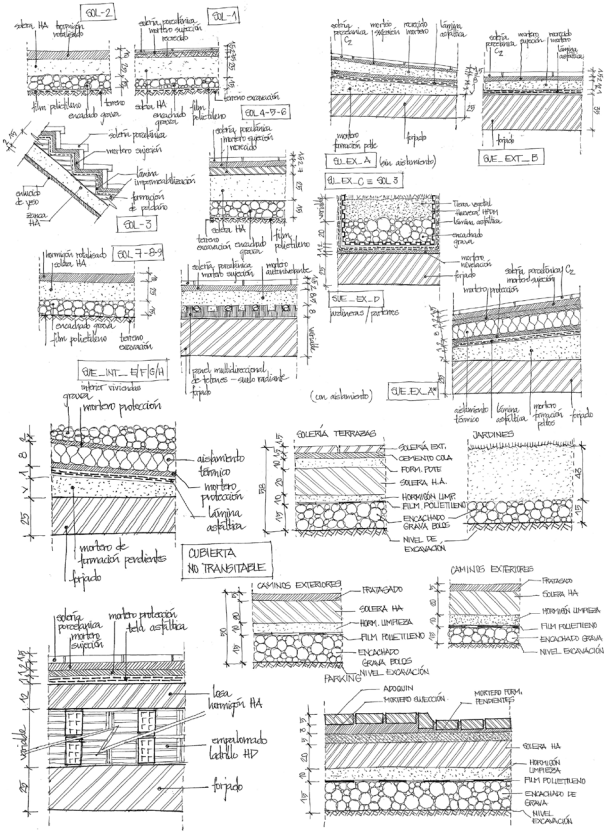
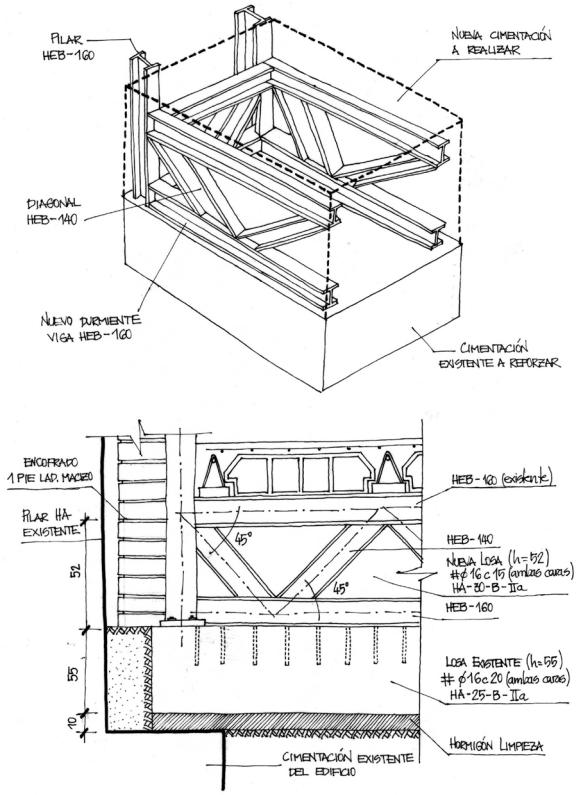


Fig. 10. Construction detail of structural reinforcement (graphic elaboration by the authors).



the management and exchange of information among the different agents involved in the various production phases. However, it is important to highlight that, despite the advantages of digital tools, the ability to draw by hand remains a valuable skill for architects and designers, as it allows for the quick exploration of different solutions and the intuitive and personalized communication of ideas.

Drawing on-site is one of the most valuable skills for an architect or engineer working in construction today (fig. 8). The ability to observe construction systems and record construction details in real-time is fundamental for decision-making and problem-solving on-site, being a differentiating factor that clearly marks the level of excellence among professionals responsible for directing and coordinating building works.

On-site drawing allows construction professionals to capture critical situations in real-time and provide precise and useful information to design and construction teams. Therefore, drawings made on-site help improve the quality of the work and reduce costs associated with subsequent changes and corrections.

In parallel, drawings of construction details that complement the graphic material in the official project documentation allow contractors to visualize the design and better understand the executive requirements.

On-site drawing also helps professionals anticipate problems and avoid errors during task execution (fig. 9). By recording precise details and measurements, site supervisors can identify potential issues before they become major and costly conflicts, enabling early correction and preventing project delays. On-site drawings can also be useful for construction documentation and inspection (fig. 10), and are used to verify the work of contractors and ensure compliance with design requirements. They are also very useful for documenting any changes in design and planning. This improves project efficiency, reduces construction duration, and ensures work quality, which translates into cost control and avoids conflicts arising from poor execution.

Conclusions

In conclusion, it is worth reiterating that manual graphic language, specifically freehand drawing, remains an indispensable tool in the training and practice of contemporary architects and designers. Despite technological advancements and the widespread adoption of digital tools such as

BIM and CAD, manual drawing maintains its relevance for several key reasons.
Firstly, freehand drawing fosters a deep and direct understanding of forms, proportions, and spaces, which is essential in the early stages of design, where creative freedom and the ability to express ideas quickly and spontaneously are crucial. Manual drawing allows designers to explore concepts without the technical limitations sometimes imposed by digital tools.
Additionally, freehand drawing serves as a solid foundation for learning and handling digital graphic tools. Architects who master manual drawing can transfer their observation and representation skills to digital platforms more easily. This smooth transition is particularly evident in the case of drawing construction details, where precision and clarity are fundamental. Manual sketches of construction details allow site supervisors to visualize and effectively solve executive problems before translating them into reality.

Manual graphic language also enhances communication and collaboration in multidisciplinary teams, as quick sketches and freehand annotations facilitate discussion and idea exchange in design meetings, allowing for a clearer and faster understanding of proposed concepts.
In terms of research, freehand drawing allows for a freer and more creative exploration of ideas, which can lead to unique innovations and solutions. The ability to experiment and iterate quickly through manual sketches is a significant advantage in the investigative process.
To conclude, we emphasize our belief that manual graphic language remains an essential propaedeutic and investigative tool for performing advanced technical and creative tasks in contemporary times. In the case of drawing construction details, it is important to note that mastering freehand drawing serves to complement and enrich the use of digital tools, improving precision, creativity, and efficiency in professional practice.

Authors

Antonio Estepa Rubio, School of Architecture and Technology. San Jorge University, aestepa@usj.es
Jesús Estepa Rubio, ER arquitectos, oficina@erarquitectos.com

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