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# Between Memory and Reason: The Brick Wall

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**Abstract**

Architecture responds to the social dynamics of uses, articulating the nature of the environment in which it is projected with the complex nature of human needs. In the present case, the culture handed down is based on the tectonic ingenuity and creativity of the designer who interprets and merges the concept of resistance (effective) with that of enveloping (affective) in the case study. The *embrici* we find on the domes of Vietri (Italy), or the architectural completion elements mentioned in this article, are examples that demonstrate the adaptation of brickwork. The result is an unprecedented correlation between space, form and matter. describes the path from the survey of the Solimene factory façade to the governing of some acquired parameters. The pair of Vitruvian memory *decor/distributio* proposes a methodological approach for the geometric-compositional reconfiguration of the same typological family of brick infill walls. In continuity with the development of local tradition, the modification of the wall texture is managed to meet local needs and provide customised functional and aesthetic solutions.

**Keywords**: bricks, wall textures, parametric change management, HBIM typological families, generative design

## 1. Introduction

Working with terracotta satisfies basic needs such as drinking or eating but simultaneously demonstrates man's ability to invent himself by renewing his culture. The continuity of the invention process is a reality that the history and landscape of Vietri make evident. Vietri sul Mare is a small town at the beginning of the rocky spur that divides the Gulf of Salerno from the Gulf of Naples (Italy). Renowned for its natural beauty, it was famous for producing artistic pottery, sold in fashionable department stores during the so-called "economic miracle".

The characteristic assortment of multicoloured terracotta pottery exposed in Vietri's shop dialogues with the glazed *embrici* covering the dome of the parish church and the polychrome tiles of benches, votive shrines, and murales (Fig. 1).

Along the road from Salerno to Sorrento, passing through the small town of Vietri, it is not difficult to be blinded by the light that reverberates from the terminals of the proto-Baroque bell towers at midday (Fig. 2). With simple, double, or variable curvature, the *peri carmosini* multiply the lighting effects at this latitude, evoking the flame that burned at the top of the mythical Lighthouse of Alexandria. The embers (*imber*, rain), slippery to water, are an example of a successful adaptation of the original forms: the shaped "bricks" at the arched base are superimposed in a "herringbone" pattern.

Bibliographic sources from the Swabian and Angevin periods refer to importing a skilled workforce for qualified labor for the implementation of *"scientes facere mattuncello"* [1]. Aragonese cedulas attest to the importation from Valencia of *"rajoletes pintados"*, later translated in Naples' slang into *"rigiole-rizole"*, hence *"riggiolaro"* (*tiler)*, namely [2]. During the seventeenth century, the clay biscottis were tin-plated and glazed twice to be more resistant to the rain that falls here copiously, as Cristofaro Mennella (1967) remarked. The lead-silicate mixture that vitrifies at a high temperature makes the colours [3] used to decorate the exteriors

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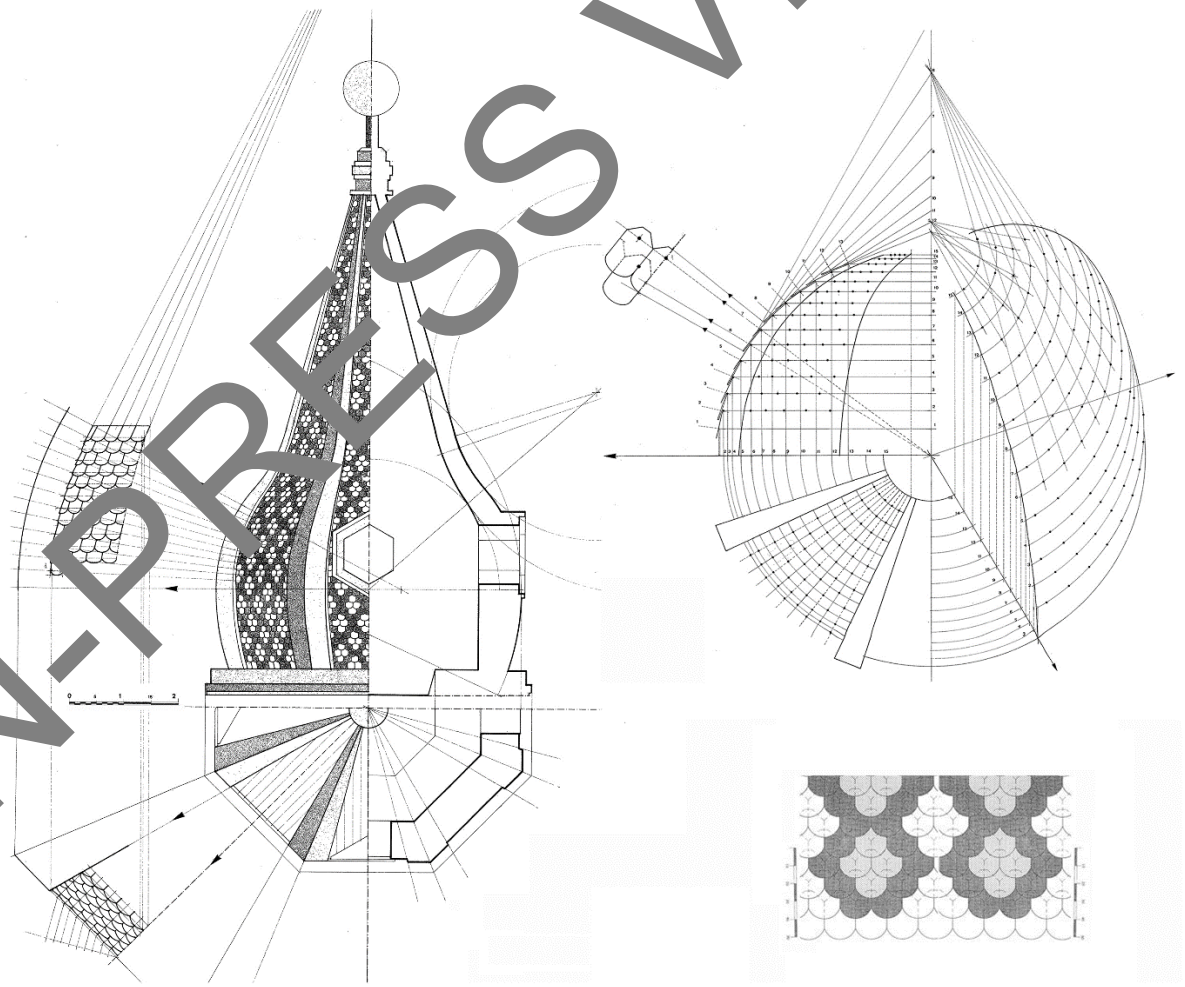
brilliant. Indeed, the four-part cells composed of Phyto morphic motifs soon came to rival the richness of marble [4].

[Figure 1 – Vietri sul Mare From left to right: view of the dom[illegible]; be[illegible]n Via M[illegible]donna degli Angeli; detail of the multicoloured glazed tiles; from inside the Solimene factory; Vi[illegible]w of t[illegible] stre[illegible]and from outside (authors' photos)].



[Figure 2 – Theoretical models. The geometries of the cusps and domes of the Early Baroque can be classified according to their horizontal cross-section and elevation developments. Representation of glazed *embrices* executed in pencil, black and coloured. Indian ink on velum paper by A. Rossi 1991]

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The size of the polychrome tiles allows for the display of original and particularly interesting solutions. The small mosaic tiles were suitable for covering the curved shapes of the end proto-baroque cusps of the bell towers, guaranteeing the continuity necessary to prevent infiltration and subsequent degradation. Surface treatment optimised the waterproofing of the covering. In this way the production of ceramics revitalised a market in crisis. Among the reasons was the low-cost labor caused by the demographic increase at the end of the 16th century.

Skilled craftsmen combined the characteristics of glazed and twice-fired clay with construction needs and aesthetic research. bricks suitable for building self-supporting walls were therefore. Emblematic examples are the small colorful "wedge" bricks used in Sicily [5]. In line with the architectural needs that guided the indigenous experimentation of the Sicilian region, the elements that structure the facade of the "Solimene" factory appear, a factory built between 1953 and 1955 in Campania. Adopting "the aesthetic canons codified by Vasari's masters" [6] the designers used small amphorae instead of perforated bricks to economically and effectively resolve the apparent geometric complexity of the main façade of the factory [7]. They were used to fill the "kidneys" of the small vaults celebrated by Le Corbusier (1923, Vers une Architecture) and subsequently to lighten the inter-storeys [8].

## 2. The brick walls case study

After completing an apprenticeship at Frank Lloyd Wright's studio, Paolo Soleri (Turin 1919 - Cosanti 2013) returned home and started a long journey across southern Italy in a unique caravan used as a home studio. He stopped in Vietri for a few years, fascinated by the art of lathing clay. In the early thirties, he met Vincenzo Solimene. The enlightened ceramist (*faenzaro)* commissioned him to design a new factory built on the Vetreria Ricciardi land [8].

The terracing is carved into the cliff of the Costiera. It extends for more than one kilometre so that the ribbon façade, designed by the architect from Turin to conceal the bulk of the building, is modulated by eleven opaque bodies alternating with almost full-height windows.

The nine central bodies circumscribe the interior of the production hall. The project echoes the attributes of the old *Pinto* factory, built at Marina di Vietri, where Vincenzo Solimene was a lathe turner before taking over the premises and becoming the entrepreneur of CAS (Ceramiche Artistiche Solimene). The production cycle is organised along a pathway facing an airy hollow lit from above. The workstations follow one another, causing the increasing convexity of the various projecting bodies on the façade [9].

The courses of rows recalled as «ceramic plates of different colours» [10] are not claddings but the bases of small amphorae, called *mummarelle* in local slang, used to keep the water cool. They are of medium capacity, about 2 litres, resting horizontally on the slabs cast with the pillars and the connecting ramp. More than 17,000 amphorae were forged by CAS employees to be used directly on-site. Crushed on the belly before baking, the bases of the *mummarelle* jut out a few centimetres from the front, while the necks, turned inwards, are used to hold a steel wire so that the resulting net would facilitate the internal finishing of the plastered and painted wall [11].

On the outside the opaque bodies, apparently conical [6] and about 15 m high from the ground, appear as gigantic vases supporting the roof garden: a manifesto for what is produced and sold inside.

The pair *decor/distributio*, announces the *raison d'être* of this work. Starting from the reinterpretation of Vitruvian categories, the French academy anticipates and addresses some of the priorities that will be of the "masters" of the Modern Movement.

As Gianfranco Caniggia and Gian Luigi Maffei (1979) explained in the previous century, tectonic necessities are subordinated to *utilitas*. Even for Paolo Soleri, working in the early post-war period, it is impossible to separate life from the place, the who from where, and existence from original residence [11].

## 3. State of the art.

Although it does not have a strictly load-bearing function, the characteristic wall made of amphorae contributes to the stability of the whole, guaranteeing the necessary climatic, acoustic, and luminous comfort. A datum that the metric survey unveils and the analysis of the components describes. These components are identified in shape and colour, configuration and language, geometric and technical, and equipment and processing of the raw materials used.

On the data acquired by capturing the point cloud with Terrestrial Laser Scanning (TLS - Fig.3) [12], the accuracy of the "unstructured" model [13] was based and reconstructed (Fig 4). Reliable values, in terms of accuracy and precision, represent the complexity of the existing heritage in BIM applications [14]. The urgency to share a few outcomes led to the development of advanced forms of accessibility for survey documents and their thematic processing.

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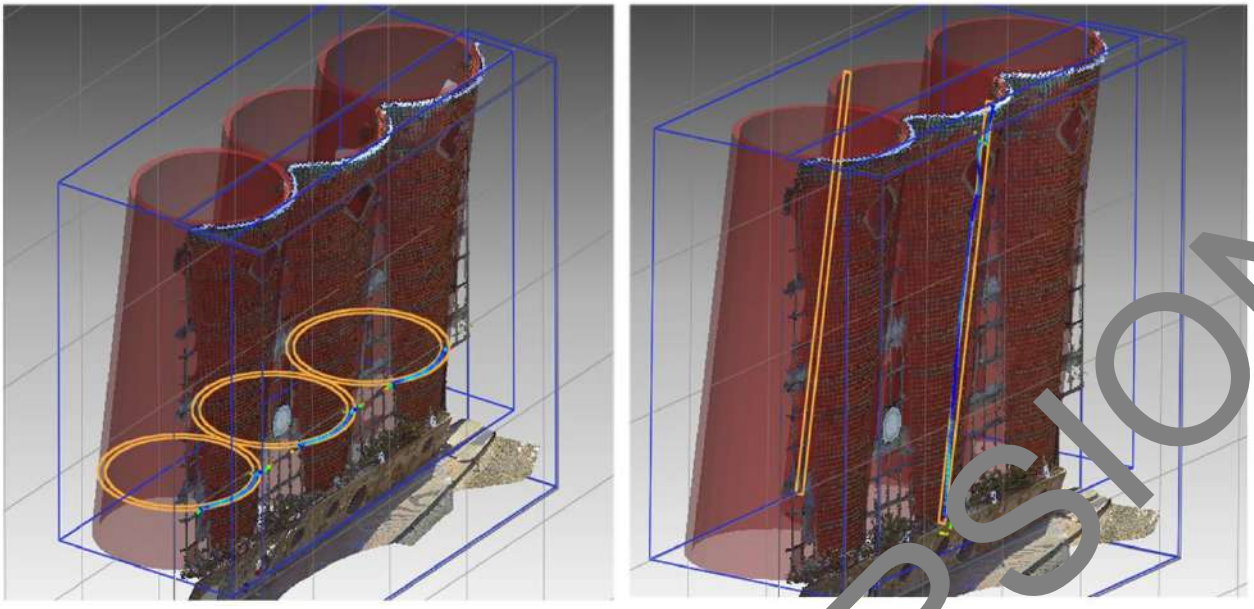

124 [Figure 3 – Processing of the survey Faro laser scanner [Karmann-Rossi 2017, p..]

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126 [Figure 4 – Information modelling of the Solimene factory by Umberto Palmieri, Post-PhD V:alere 2019, supervisor
127 A. Rossi – from the 3D point cloud to an informative model]

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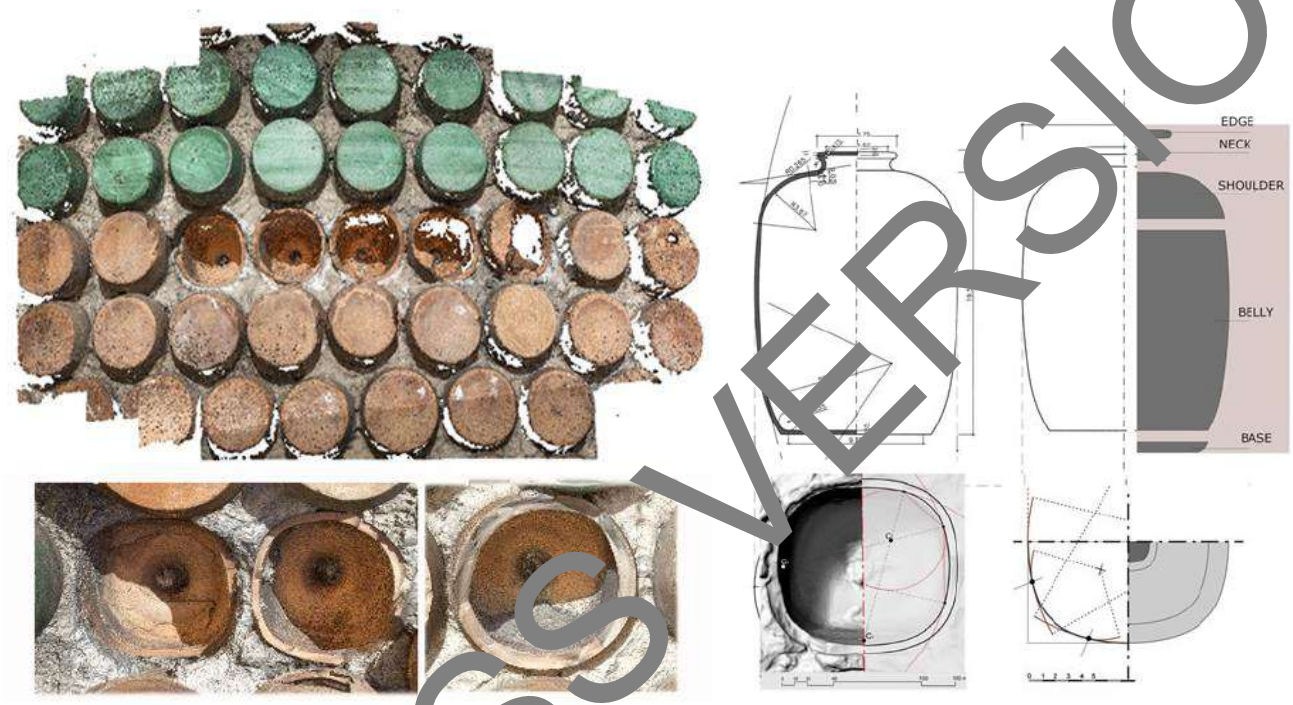
## 4. Data Analysis and First Results

To advance a more intimate understanding of the construction methods of the "wall component", the survey was integrated with a photogrammetric acquisition carried out at close range [15]. The bottoms of some amphorae, detached in the façade at eye level, allowed the capture of the single internal configuration with a Structure from Motion (SfM) technique. A Canon 60D APSC camera with a 60mm lens (focal length 5, ISO 200) was used for this purpose. Parameters were set, considering the light of the day and avoiding blurring, out-of-focus and overexposed images. Post-processing allowed for immediate data development with Agisoft Metashape software. Keeping the alignment and dense cloud creation parameters high ensured the good level accuracy of the model, which was scaled using the values acquired with the direct survey. (Fig 5).




[Figure 5 – The survey and the point cloud obtained from photogrammetry – survey and processing by the authors].

Further studies allowed the physical and mechanical information of a single amphora and wall samples to be derived using FEM (Finite Element Method) techniques [16]. The data led to a greater definition of the geometric Level Of Detail (LOD) and Information Level (LOI) of details.

While respecting the topology of the overall geometric form, the arrangement of the constituent elements aims to achieve greater levels of interoperability (Fig 6). To breathe new life into the surveyed data by transforming them into design opportunities, adopting the retrofitting strategy requires transcribing the acquired data into spacuse and databases extracted from as-found models. For this purpose, graphical forms derived from meshes furnished with Basic-Spline geometries offered reliable and valuable support to control the modifications around remarkable points, lines, and surfaces [17].

## 5. Towards the design of species

The rationalisation of design activities in the digital site to restore historic buildings calls for an operational and conceptual inversion of activities. The state-of-the-art survey anticipates and reflects on the project's quality and the current status of existing buildings. However, degrees of accuracy architectural (GOA) and specific generation geometric (GOG) are necessary to interact and support the technical-executive description of the typological families [18].

Although different from each other, the handcrafted amphorae have some common characteristics. The bases are approximately 12 cm, the thickness required by the craft, while the length is around 20-22 cm. The interpretation of the formal structure is essential for the representation of a species' design. In our case, the definition of the parts is base, belly, neck, and rim (fig. 6b). The identification of the geometric locations guides the selection of the "frontiers", The boundaries between the parts direct the definition of the constraints within which the algebraic fields of existence of the intervals can vary without composing the (invariant) attributes that

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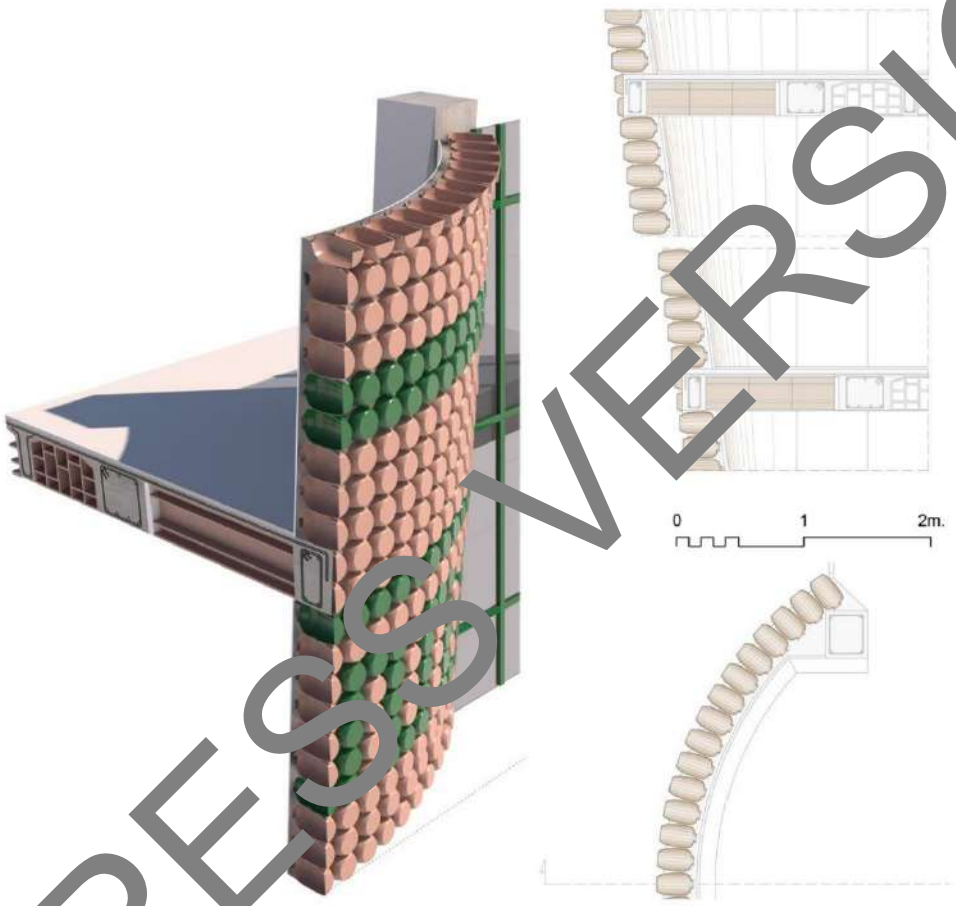
characterize a specific design occasion. The decimal classification system, compatible with its function of using, guides the organisation of a hypothetical process of generating the geometric form of the wall [19].

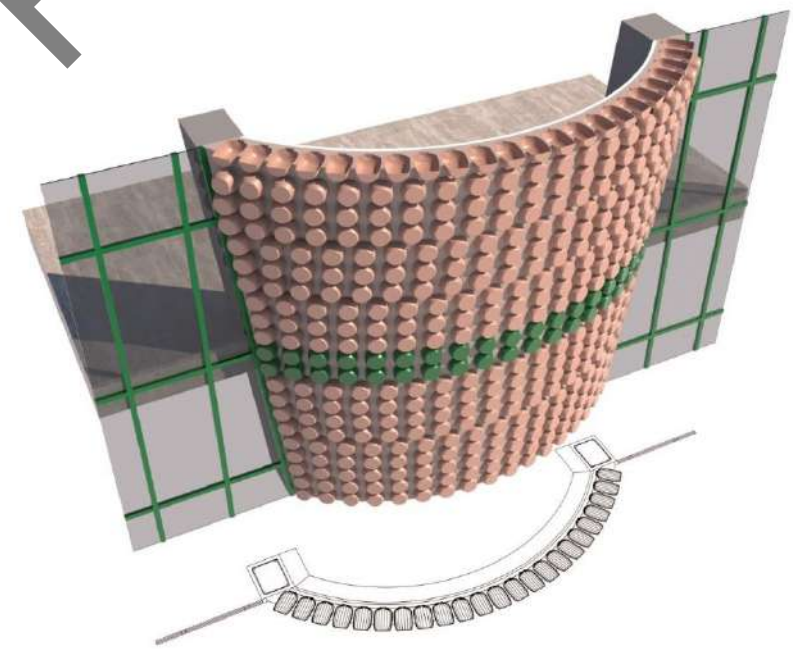
The modifications dictated by a hypothetical circumstantial paradigm capable of parametrically modifying the possible syntactic combinations of the parts configuring the Vietrese amphora are then discussed.

The base of the pitcher/bottle can be approximated to a closed ring. The line is constrained at the initial and final points, and the programmed strategy uses a geometric grid to populate the reference database with variables.

In order to generate a logical architecture to support the generative design, the direct survey data were tabulated and then used to articulate relationships according to three different orders of primary choices [...]: (a) the variation of the geometry of the descriptors in plan and elevation; (b) the variation of the paths alternatively considered as guiding and generating lines, or (c) varying the sections along the path [19].




[Figure 6 – HBIM as-found model level of interoperability – elaboration by the authors]



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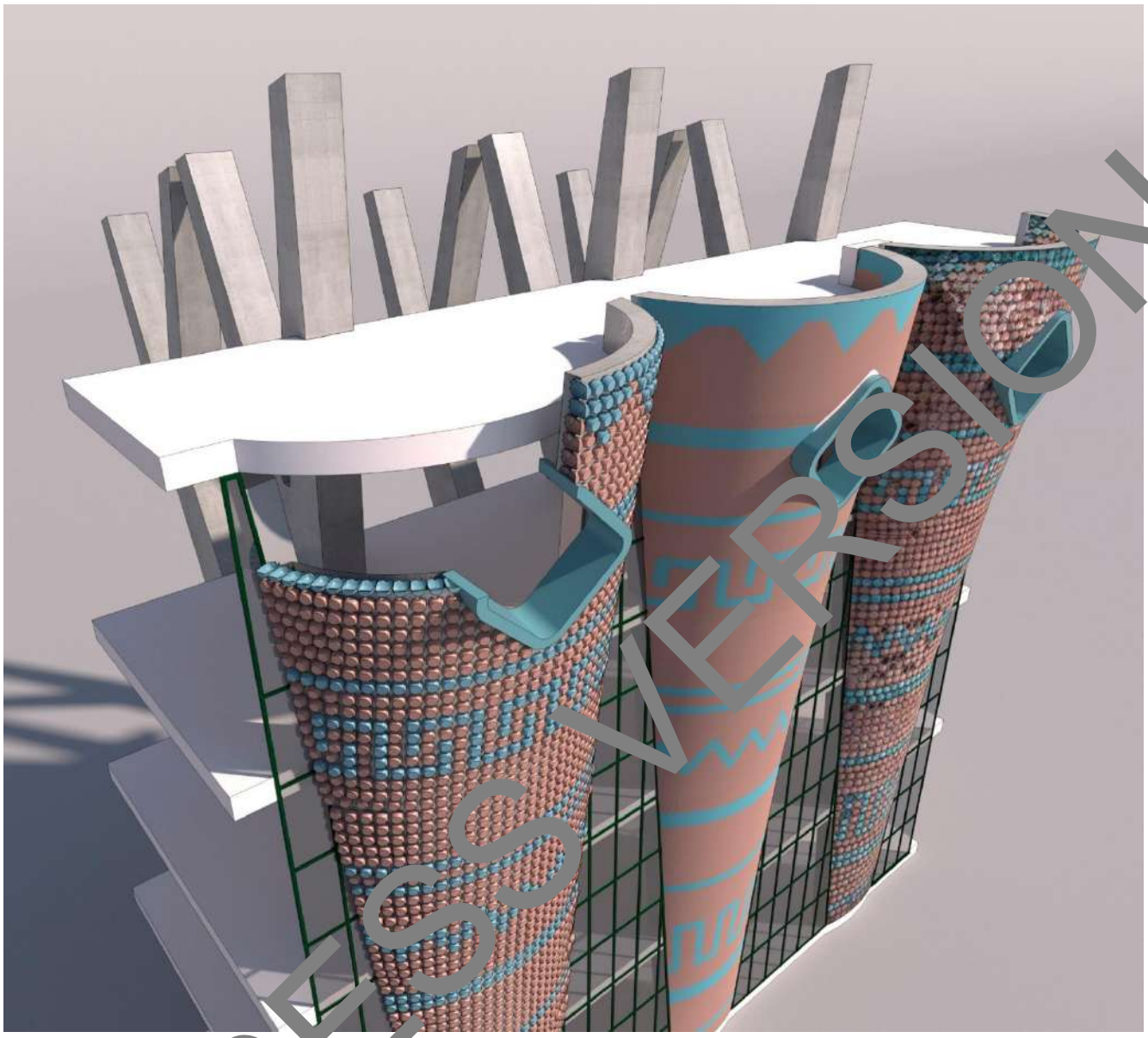

[Figure 7 – From the point cloud, [illegible]mated and cleaned, towards 'as-built' virtualization. Elaboration by the authors]

These qualities [illegible]ally considered can be processed by a generative algorithm according to pre-programmed strategies. Thus, there is a need to compare the discrete parts of similar objects. PET bottle bases, which are widely marketed, proved to be functional for the purpose: their design respects operational and static needs (they must store water, be manageable, stand stable, and, not least, characterise the manufacturer). The variations studied in the plan have been related to each other and in relation to vertical development (fig. 8).

Procedural parametric algorithms (Rhinoceros and Grasshopper) for geometric-spatial analysis and control (fig.9) describe the procedure for digitally prototyping a newly conceived modular amphora. This model can adapt shape and size to design patterns (Fig.10) of simple or inclined surfaces, such as those of the opaque bodies in the Solimene façade and, more generally, free-form configurations with variable curvature. Structural solutions, if "isomorphic" to the intended uses-functions, highlight and validate potential applications.

Consolidated in the free-form methodology [20], BIM applications in visual programming algorithms support experimentation. Modifiable forms in relation to initial data and programmed transformations can be interactively controlled via plug-ins [21]. Thus, accessibility and sharing facilitate multidimensional work.

Becoming a collector of surveys and elaborations, the model allows for incorporating their disciplinary peculiarities to advance knowledge or defining projects for use, maintenance, restoration, and renovation over the life of the artefact and successively in its "future memory".

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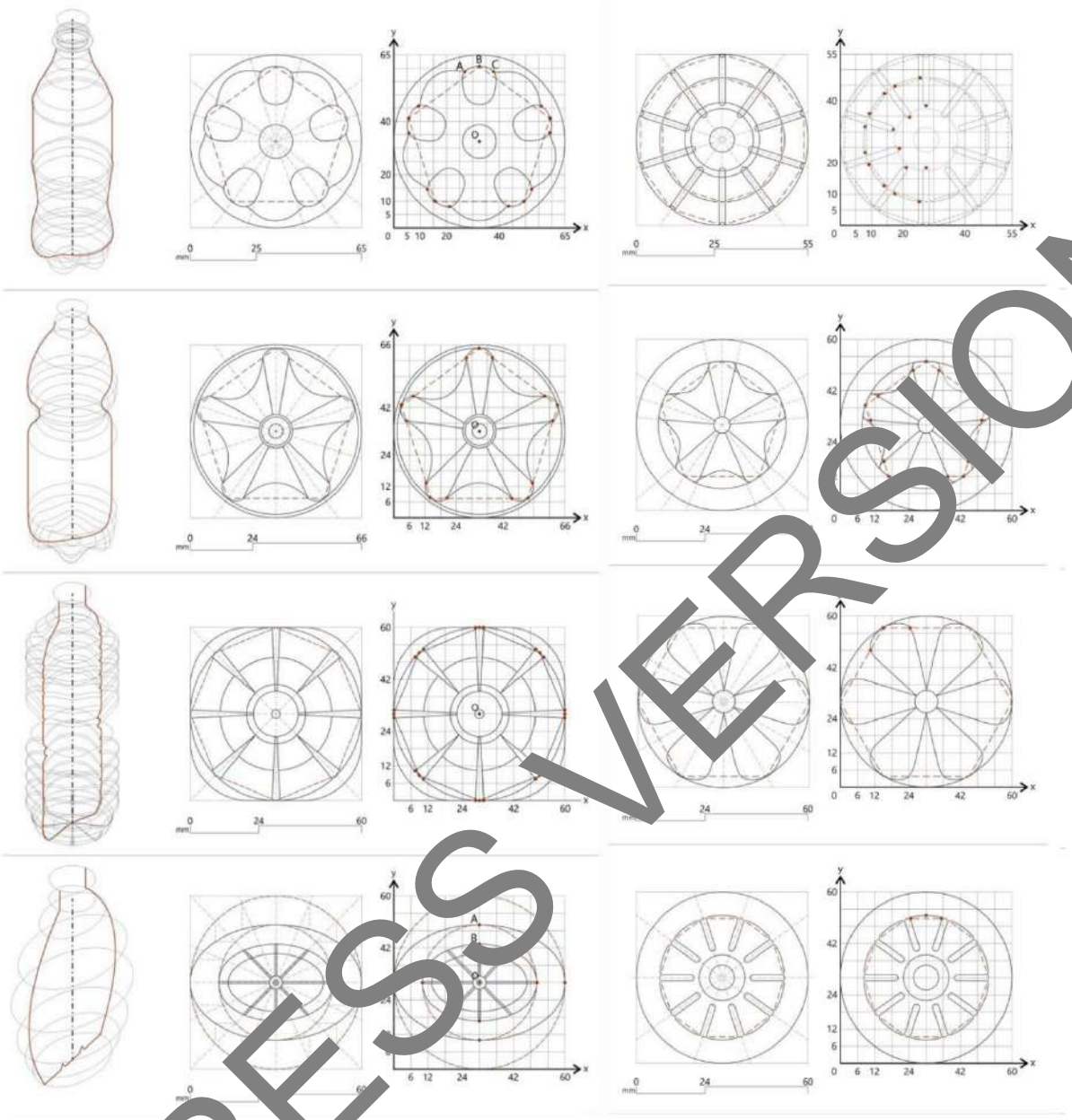

[Figure 8 – Survey of specimens: plans of PET bottles in relation to vertical development – from the course Laboratory of Advanced Techniques of Representation, A. Rossi a.y. 2019-2020]

## 6. Discussion

These latest developments find BIM platforms an excellent support to site management for new constructions [22]. Principles and criteria have been adapted to the digital construction of surveyed artefacts. The digital twins support the preventive conservation of historic assets through awareness of the significance of the heritage [23]. Starting with the 2021 version, Autodesk's Revit, the software used for this project, provides dialogue boxes that the user applies to optimise the design details in 3D.

Constraints, inputs and outputs follow criteria identified and defined based on customised studies [24]. It is, therefore, possible to evaluate alternative solutions using an open-source visual design programming environment (e.g., Dynamo).

Thanks to the creation of new cloud-based platforms, Revit API Docs, it is, on the other hand, possible to develop an add-in for Autodesk Revit to automate and improve the generative process of as-built digital models by reusing the extracted abstract code.

There is not just a path but a sequence to follow. Both the scalability of the method and the advanced levels of interoperability achieved through a series of APIs (Application Program Interfaces), SDKs (Software Development Kits), protocols and BIM applications related to free-form modelling software support the digitisation process of the built heritage. The development of a live app shows how different types of users (professionals and non-experts) can interact with information and eXtended Reality (XR) ecosystems [25].

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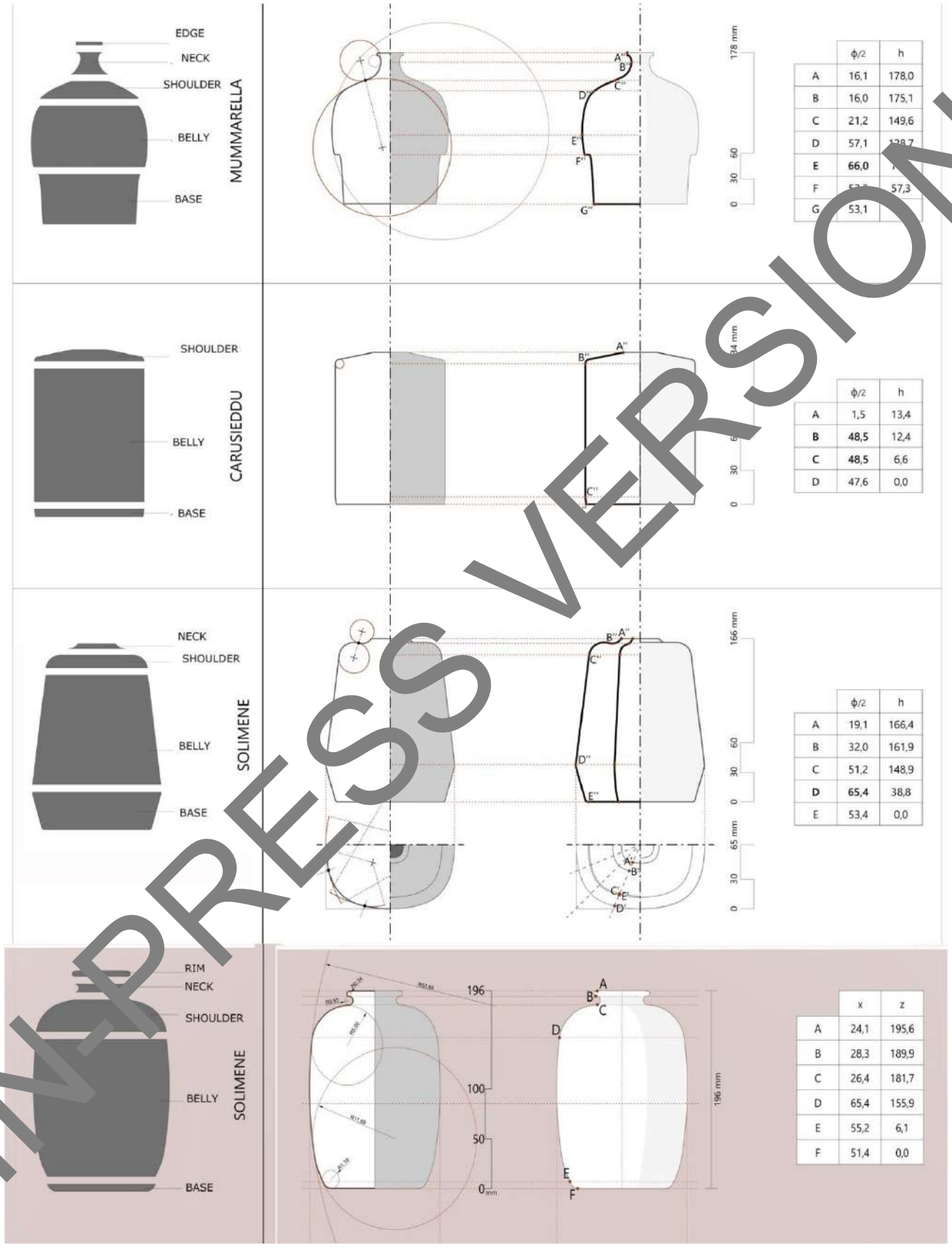


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225 [Figure 9 – Digital prototyping of a newly conceived modular amphora – from the Laboratory of Advanced
226 Techniques of Representation course, A. Rossi a.y. 2019-2020]

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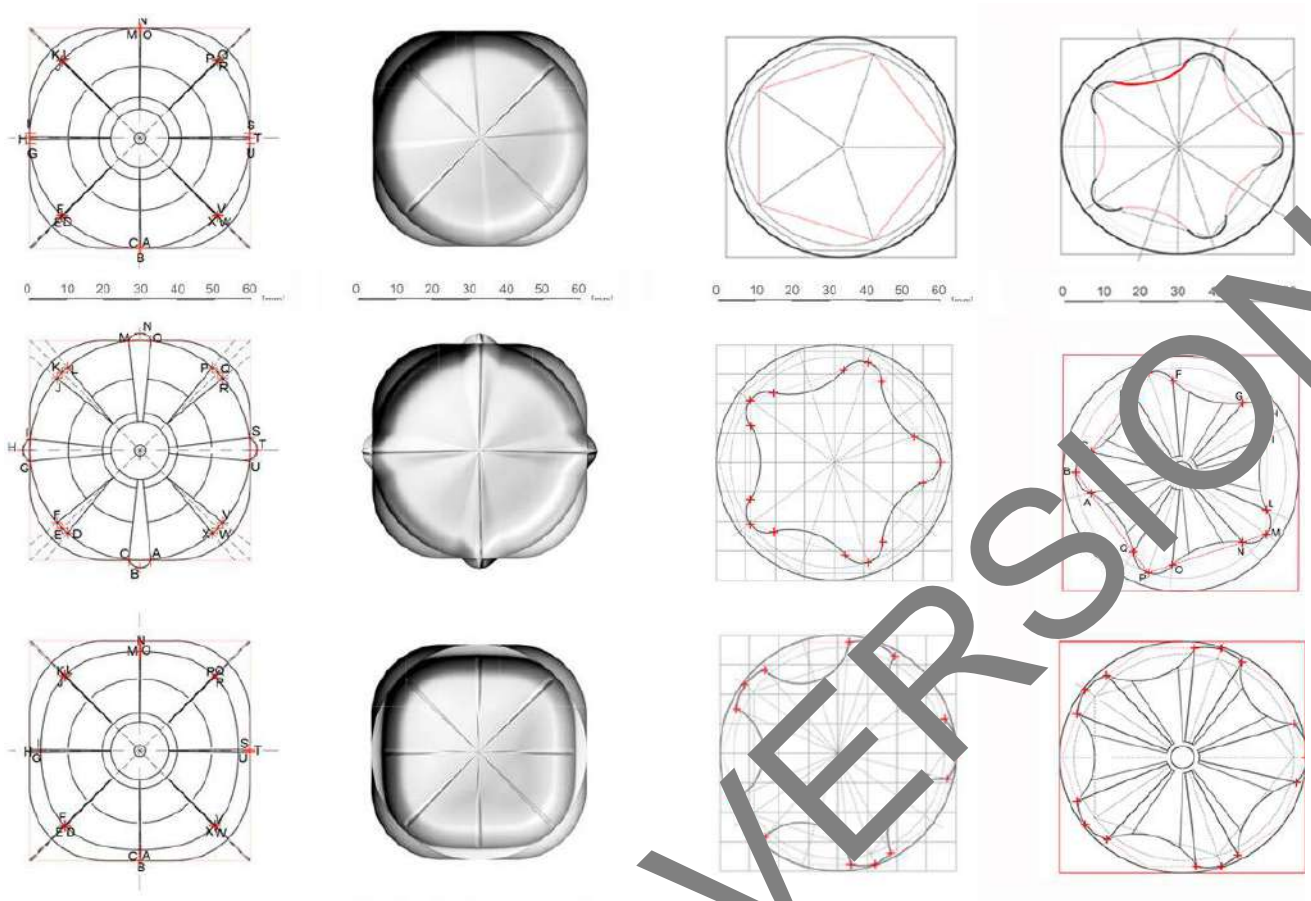

[Figure 10 – Digital prototyping of a newly conceived modular amphora – from the Laboratory of Advanced Techniques of Representation course, A. Rossi a.y. 2019-2020]

## 7. Conclusions

If consumed within it, language use always leaves degrees of freedom to express new ways of thinking and acting. An illustrative example is the brick façade of the Solimene factory, which, in continuity with the Mediterranean tradition, interprets and develops the aesthetic and stylistic canons of the Vasari masters. The designer's creativity merges utility, strength, and aesthetic research in the proposed solution.

The typical *mu marel* wall self-supporting, improves thermal-acoustic insulation, controls dispersion, and declines in artistic shapes and polychromes. Flexible grids guide the descriptive logic of the surveyed elements, guiding the control of the geometric relationships between features that make up the structure of the wall.

The computer is a powerful aid for applying numerical laws, a synthesis of operational strategies that can generate solutions of design interest.

To date, the algebraic existence fields of the detected intervals have been experimented with to derive rows of variable shape and size. Implicit in the computer system's algorithmic structure is the clue paradigm's potential for a new approach based on sequences of aids. The certified survey-based workflows and generative design criteria related to the services offered by the network allow experts in the field, not only them, to customise the generative process by interacting with augmented, virtual and mixed reality experiences.

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