

VENETIAN SPOLIA BETWEEN ARCHAEOLOGY AND ARCHITECTURE

Luigi Sperti¹, Myriam Pilutti Namer²

1: Ca' Foscari University of Venice
sperti@unive.it

2: Ca' Foscari University of Venice
myriam.piluttinamer@unive.it

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Abstract *This paper examines a project implementing an integrated digital workflow for the study of Venetian spolia. The research employed non-invasive digital measurement to record precise metric data from reused sculptures incorporated into façades, churches, and bell towers. Rather than being an end, measurement serves as the foundation for systematic documentation. The collected data were organised into a structured digital catalogue, including attributes such as material, chronology, provenance, and bibliographical references. All artefacts were georeferenced within a GIS-based platform, facilitating spatial analysis of their distribution within the urban fabric. The workflow was further enhanced through integration with photogrammetry, allowing the creation of metrically accurate three-dimensional models based on reliable local control networks. By linking measurement, 3D modelling, cataloguing, and geospatial mapping, the project provides a comprehensive research framework.*

1. VENETIAN SPOLIA¹

1.1. Introductory Observations

The testimony of an anonymous fifteenth-century chronicle recounts, with reference to the construction of the Basilica of St Mark during the eleventh century, that «... many noblemen and common people sent [men] to fetch marbles from Aquileia and Ravenna, and many sent [them] to Constantinople ...» (SPERTI 1996, 122; FORTINI BROWN 1996, p. 29). This account places the acquisition, transport, and reuse of marbles at the very origins of the city's monumental history and at the same time outlines the principal geographical areas from which such materials were obtained: on the one hand the Roman cities of the mainland, and on the other the eastern Mediterranean.

Reliefs, statues in the round, and architectural elements of classical and medieval date thus became characteristic components of the Venetian monumental landscape. They aroused the curiosity of travellers (SPERTI, ZINATO 2017) and, in the full climate of Renaissance humanism, inspired the first attempts to give tangible form to the names of the great Greek artists known from literary sources (BESCHI 1986).

¹ Please note that paragraph 1 was written by Luigi Sperti, and paragraphs 2 and 3 were written by Myriam Pilutti Namer.

Expanded over the centuries, the corpus of the *stones of Venice* became the object of systematic scholarly investigation especially from the period following the Second World War onwards: the statue of *Tóدارo* was recognised as an assemblage of ancient sculptures (SARTORIO 1947); the typology and chronology of the heterogeneous corpus of the capitals of St Mark's were defined (DEICHMANN 1981); and the first comprehensive syntheses were attempted concerning the lagoon's spolia and their relationship with proto-Renaissance architectural culture (POLACCO 1972-1973; SPERTI 1996).

In the last decade the theme of the Venetian reuse of ancient sculpture has attracted scholarly attention (for an updated general overview see SPERTI 2018; ID. 2019; LAZZARINI, PILUTTI NAMER, SPERTI 2025). The Procuratoria of St Mark devoted a conference to the Tetrarchs, in which the well-known group was examined both within the monumental context of the Basilica of St Mark and in relation to its Constantinopolitan origins (*Enigma dei Tetrarchi* 2013). The conference entitled *Le pietre di Venezia: spolia in se, spolia in re* explicitly set out, already in its title, to address the most diverse cases of Venetian reuse from this dual perspective – not only sculpture, but also inscriptions, architectural elements, and building materials – while at the same time exploring the archaeological resonances reflected in contemporary art (*Pietre di Venezia* 2015).

In March 2015 the German Centre for Venetian Studies organised a study day devoted to the roundel depicting a Byzantine emperor reused in Campiello Angaran, and to the almost identical example preserved in the Dumbarton Oaks Museum in Washington. Regardless of the results – stimulating and rich in suggestions (*Tondi di Venezia e Dumbarton Oaks* 2019) – it is important to emphasise the concern that lay at the origin of this initiative, explicitly stated by the editors in the introduction to the conference proceedings: the need to safeguard the artefact, long exposed to atmospheric pollution and in a state of preservation that recommended its urgent removal to a protected environment. It is important to stress this point because the tondo is by no means isolated, and the protection of Venice's stone furnishings has in recent decades become an unavoidable priority (indeed, to this day the Byzantine roundel still remains *in situ*).

For reasons that need not be emphasised here, St Mark's Area constitutes the urban nucleus that houses the oldest and most representative spolia. The Basilica of St Mark offers the most striking example of an architectural organism in which reused elements contribute decisively to defining both decoration and structure. The bibliography on the monument – on the extent, typology, chronology, provenance, and ideological function of the reused materials – is vast. I therefore limit myself to referring to a recent three-volume publication (*Basilica di Venezia* 2019), which provides an updated bibliography and essays that range – within the scope relevant to our discussion – from the political role of the proto-Byzantine columns of the ciborium (Th. WEIGEL) to a chronological reassessment of the arrival in the lagoon of the trophies of the Fourth Crusade (G. TIGLER), from the restoration of the façade horses (M. MARABELLI) to the symbolic value of the group of the Tetrarchs (P. SCHREINER).

While research on the bronze quadriga has essentially remained at the stage reached with the Venetian exhibition of the late 1970s – where the hypothesis already proposed earlier of a date in the later Imperial period was confirmed (see *Cavalli di San Marco* 1977) – and with the monograph by M. JACOFF (1993), which interpreted the group as a *quadriga domini*, the conference mentioned above and several other contributions published in the same period have brought a number of new insights concerning the group of the Tetrarchs. The identification of the figures, based more on the typological analysis of clothing and attributes than on physiognomic features, points to the context of the First Tetrarchy (GEHN 2012). I shall only briefly mention the complex history of the group in *Asia Minor*. For historical

reasons, scholars have hypothesised an original placement in an imperial residence, probably at Nicomedia, followed by a transfer to Byzantium under Constantine – or in any case during the fourth century – to a location which later sources identify with the area of the *Philadelphion*. The discovery, during excavations carried out in 1966 near the church of the *Myrelaion*, of a fragment of the base with part of the foot of one of the statues demonstrated that by the time of Venetian rule the monument was already damaged. Scholarly opinion, however, diverges concerning the Constantinopolitan history of the monument. The manner in which it was displayed at the *Philadelphion* remains unknown (for some it stood at ground level, for others it was placed in an elevated position); likewise uncertain are the exact location in which the monument stood when the Venetians decided to transport it to the lagoon and its state of preservation at that time. For an overview of the principal hypotheses see, at least, NIEWÖHNER PESCHLOW 2012, EFFENBERGER 2013, *Enigma dei Tetrarchi* 2013 (A. EFFENBERGER), and *Basilica di Venezia* 2019, II (P. SCHREINER).

The columns of Mark (Fig. 1) and ‘Tódaro’ (Fig. 2), erected during the thirteenth century near the Molo, mark the monumental entrance to the city and at the same time constitute a remarkable example of how ancient elements heterogeneous in material, typology, date, and function can be combined into a unified monument, most probably inspired by earlier precedents erected on the Bosphorus. A Constantinopolitan origin has also been hypothesised – without any foundation – for the two colossal shafts, that of Mark in Troad granite and the other in syenite, both measuring forty Roman feet in height. The provenance of the Egyptian granite shaft is unknown; however, for a series of both archaeological and historical reasons, the Marcian monolith may derive from the same quarries of *marmor troadense* or from the nearby site of *Alexandria Troas*, close to the island of Tenedos, along a route frequently travelled by Venetian convoys. Numerous shafts comparable in size and technical characteristics are still present today both in the quarries and in the harbour of Alexandria (SPERTI, ZINATO 2017; SPERTI 2018).

Far better known and more extensively studied are the statues placed atop the columns. The origin and dating of the bronze lion on the eastern column have been the subject of the most varied – and often highly imaginative – hypotheses, spanning a chronological range from the ancient Near Eastern protohistoric period to the local Middle Ages, and an equally vast geographical area. Many aspects of this problematic and eclectic monument remain obscure; nevertheless, it is at least plausible to suggest a provenance from some region of the eastern Mediterranean (perhaps *Cilicia*) and a date between the Late Classical period and the early Hellenistic age (*Leone di Venezia* 1990).

The statue of *Tódaro* on the companion column is a pastiche fashioned by an anonymous Gothic sculptor from the torso of a cuirassed marble statue of Hadrianic date and an ancient head long identified as the portrait of some Hellenistic ruler. As the oak crown – the only surviving element of the original sculpture – demonstrates, it is a portrait of the Constantinian period, perhaps even of Constantine himself, probably originating from Byzantium and extensively reworked on the occasion of its Venetian reuse (SPERTI 2015).

It goes without saying that, in terms of ideological significance, monumental impact, and self-representational value, the spolia in St Mark’s area are unparalleled by any other comparable ensemble in the city. A single, partial, and relatively late exception is the late seventeenth-century arrangement of the monumental entrance to the Arsenale, where Francesco Morosini, returning from his brief conquest of Athens, placed lions on either side of the Renaissance gate (SACCONI 1991). This, moreover, was marked by the deliberate reuse of a pair of Byzantine capitals.

Beyond these two monumental nodes, the presence of spolia within the Venetian urban fabric is nevertheless pervasive and significant, characterising public buildings, churches, aristocratic residences, and popular contexts alike. The corner of the sixteenth-century Palazzo dei Dieci Savi overlooking the Rialto Bridge displays, on a corbel, a composite statuette of Hellenistic and Roman date, reinterpreted – consistent with the function of the magistrates housed in the building – as a representation of ‘Justice’ (TRAVERSARI 1991). Not far from there, in Campo S. Polo, the eponymous church preserves a marble image of St Paul, produced through a fifteenth-century integration of an ancient statue which recent research attributes to Cypriot production of the Hellenistic period (LAZZARINI, PILUTTI NAMER 2020). Like the ‘Tódaro’, it bears witness to a phenomenon attested with some frequency: the transformation of ancient statues into images of saints. Within religious buildings more broadly, attention is drawn by the recently noted presence of Byzantine capitals reused for structural purposes in Gothic constructions. This is the case with proto-Byzantine examples incorporated into the niches of the Basilica of St Maria Assunta dei Frari (PILUTTI NAMER 2008), but most striking is the mid-nave reuse in the Basilica of Sts Giovanni e Paolo of a group of six capitals originating from the Constantinopolitan church of St Polieucto – the same source as the so-called ‘Pilastrì Acritani’ later reused along the south side of St Mark’s Basilica (BARSANTI, PILUTTI NAMER 2009). Byzantine capitals, and local imitations from various periods, also characterise some of the oldest noble residences along the Grand Canal (BARSANTI 2002) (Fig. 3), as well as Romanesque churches (PILUTTI NAMER 2015) (Fig. 4) and commercial buildings such as the Fondaco dei Turchi, though the latter has been extensively altered by nineteenth-century restorations (PILUTTI NAMER 2016).

A kind of narrative through reuse, intended to glorify the commercial exploits of a merchant family, unfolds in Campo dei Mori and the nearby Palazzo Mastelli, known as the ‘Palace of the Camel’, in the *sestiere* of Cannaregio. Here, a series of statues of merchants – distinguished as ‘Oriental’ by marble turbans taken from Muslim funerary stelae – a Gothic bas-relief depicting a merchant leading a camel (from which the palace takes its name), the incorporation into a corner bifora of the same palace of a cylindrical altar adorned with garlands from the mid-Hellenistic period, originating in the Cyclades, and the emphasis on the waterline through a sequence of Byzantine vine-scroll cornices, all combine to celebrate, through exotic – and therefore rare and precious – objects, the family’s wealth and the scope of its commercial enterprises (SPERTI 1996; SPERTI 2018).

1.2. Methodological Observations

The study of reuse in Venice presents both methodological and practical challenges. Without claiming to be exhaustive, I shall outline the most significant points of concern, particularly those that relate directly to the relationship between spolia and the urban fabric:

1. Venice’s architectural history is long, complex, and highly stratified. Both the most important and well-known monumental contexts and lesser-known urban sites have undergone, over time, additions, demolitions, and alterations, sometimes of a radical nature. Archival documentation rarely allows for the reconstruction of the original arrangement of reused elements: a little-known but illustrative example is Campo dei Mori and the Mastelli Palace or ‘of the Camel’ in the *sestiere* of Cannaregio, where the original placement of the statues that give the name to the Campo remains unknown.

2. The phenomenon of dispersal – which intensified with the fall of the Republic and continued vigorously into shamefully recent times – affects not only painting, sculpture, architectural elements, and furnishings, but also spolia. One still little-studied area concerns ancient artefacts reused as wellheads. Indeed, the dispersal of Venetian wellheads, many of which have ended up abroad, is estimated at several hundred examples; among these, the number of wellheads derived from ancient marble remains uncertain.
3. The reworking of ancient material was a common practice and, in certain cases, makes it impossible to reconstruct the original appearance of a piece. For example, *paterae* – those round decorative discs, typically featuring zoomorphic motifs and dated between the tenth and thirteenth centuries – were often made from column drums cut into segments of suitable thickness, or more rarely from sculptures. In one such piece preserved at the Ca' d'Oro, the reverse still retains part of the original statue from which it was taken. Another class of monumental elements frequently adapted to the decorative logic of the period of reuse is that of monolithic column shafts, most of which are in Proconnesian marble: research conducted by Lorenzo Lazzarini has identified at least 1,800 examples, reused in churches, palaces, or private houses from the Veneto-Byzantine period up to the nineteenth century. Columns and other suitably sized artefacts were often converted into slabs: the marble cladding of the interior and exterior facades of St Mark's Basilica, though poorly integrated, particularly on the north side, consists largely of Proconnesian and coloured marbles of ancient origin.
4. The placement of many pieces – for instance, Byzantine capitals in palaces overlooking the Grand Canal or other waterfront façades – makes autopsy particularly difficult in certain cases.

2. MEASUREMENT, CATALOGUING, MAPPING AND GOREFERENCING

2.1. Measurement and Cataloguing

Within the framework of research carried out at the Venice unit (Ca' Foscari) of Spoke 8, “Sustainability and Resilience of Tangible Cultural Heritage” (project leaders: Professors Carlo Bianchini and Paolo Carafa, Sapienza University of Rome), as part of the project *CHANGES – Cultural Heritage Active Innovation for Nex-Gen Sustainable Society* (01/01/2022–30/11/2025) funded under the National Recovery and Resilience Plan (PNRR), it has been possible to extensively implement the pilot project *The Stones of Venice. A Digital Landscape*. This initiative was developed between 2018 and 2022 thanks to two separate grants awarded to the Department of Humanities at Ca' Foscari University of Venice: the Coordination & Support Action (CSA) promoted by the Time Machine consortium (<https://www.timemachine.eu/csa-information>) and the ministerial fund for Departments of Excellence, which enabled the creation of the Venice Centre for Digital and Public Humanities (<https://www.unive.it/vedph>).

For the first time in the history of Venetian archaeology, this research aimed to test the innovative potential of applying a non-invasive digital technique for the extensive measurement of reused sculpture preserved in Venice and its lagoon. Sample measurements were carried out to obtain precise digital information on elements of archaeological and epigraphic significance – such as ancient columns,

capitals, or inscriptions – reused on the façades of palaces along the Grand Canal, as well as inside and outside Venetian churches and bell towers. In most of the cases considered, these measurements were taken for the first time, providing essential data for the census and analysis of these artefacts (CALVELLI, SPERTI, PILUTTI NAMER, DELPOZZO 2021, p. 84).

The technical characteristics of the instrument also ensured effective measurement at considerable distances (tested over 50 m), thereby allowing the recovery of metric information from artefacts that are otherwise difficult to access. Measurements were conducted using a digital laser distance meter equipped with an inclination sensor for angle measurement (Leica Disto S910). By combining these two technologies, the instrument can measure point-to-point distances (P2P technology) – a function that proved particularly crucial for surveying elements integrated into architectural contexts, often positioned in inaccessible locations and therefore impossible to measure manually.

This instrument offers several advantages over other commercial products, as it is a traditional distance meter enhanced with an inclination sensor for angle measurement. By combining these technologies, it can record P2P distances. The device also allows data acquisition in the AutoCAD DXF exchange format: in this mode, the measurements are saved on the device in a DXF file, which can contain up to 30 points positioned in three-dimensional space within a local reference system, and can be associated with their respective photographs where available. Another significant feature of the Leica Disto S910 is its ability to connect to devices such as tablets or laptops via Bluetooth or Wi-Fi. The Bluetooth connection, in particular, allows the instrument to interface – through the ‘App’ mode – with applications specifically developed for the product, such as Leica DISTO Plan, which enables real-time visualisation of floor plans while measurements are being taken. Equally useful is the WLAN connection function, through which the instrument acts as a hotspot for Wi-Fi linkage with other devices. The connection was tested using the Disto Transfer software for PC and its AutoCAD plugin, making it possible to display, in real time on the computer screen, the three-dimensional drawing of the object being surveyed, including any associated photographs. It is important to note that this setup supports station changes: in complex contexts, the instrument can be moved, and work can continue using previously established points as reference.

2.2. Measurement and Georeferencing

Within the project, the integration of the Leica Disto S910 functions with photogrammetric survey techniques was also tested: the instrument, in fact, allows the easy creation of a local reference network, enabling the generation of metrically accurate three-dimensional models. The advantages provided by measurements taken with the Leica Disto S910 have been evident both in terms of the instrument’s non-invasiveness – which minimises the risks associated with handling ancient artefacts – and in terms of time and cost efficiency. For example, measuring the diameters of the ten reused columns in the church of Madonna dell’Orto required only twelve minutes. The ability to carry out numerous measurements in a short time allows for methodological innovation in the study of architectural sculpture, whether reused or original, particularly when the focus is on series of elements for comparative analysis (primarily capitals and columns, but also friezes, cornices, and the like) or, more generally, on architectural composition.

The case study of the Fondaco dei Turchi, measured from the opposite side of the canal – from Campo San Marcuola, at a distance of 58 m – provides a striking example: sample measurements effectively demonstrate the potential for future studies on design phases and construction processes of semi- or

entirely inaccessible buildings, such as palaces facing the Grand Canal or other city waterways. The same argument regarding time and cost efficiency – with added research value due to access to information on portions of the archaeological heritage otherwise known only through difficult reproductions – applies equally to sculpture, whether reused or original, located in semi- or completely inaccessible positions, or in highly frequented areas that prevent convenient working conditions, as is the case with the previously mentioned ‘Justice’ of Rialto.

Moreover, within the project, the integration of this instrument with photogrammetric survey was further explored to quickly establish an accurate local reference network for the creation of metrically precise three-dimensional models.

The data collected within the project, along with the relevant scientific literature, are currently available open access via a dedicated website (<https://www.unive.it/display>) and a digital map accessible through the same site, indicating all contexts and artefacts surveyed and studied (Fig. 5). In addition, 3D models of the most significant spolia are available online on the Sketchfab platform, which allows browser-based visualisation.

The map, developed in a GIS environment and subsequently adapted for online use, enables the visualisation and consultation of all data relating to the Venetian spolia examined in the project, alongside other examples documented in the scientific literature.

For the creation of the webGIS, following research and analysis of available tools as of April 2024, the decision was made to use the UMap service (<http://umap.openstreetmap.fr/en/>), which is sufficiently flexible and based on OpenStreetMap. Data collection and processing were carried out using the open exchange format GeoJSON and, where possible, by reusing geographic data already present in OpenStreetMap (downloaded and modified in accordance with the Open Data Commons Open Database License v1.0).

The information is mapped across two point-based geographic layers, which describe the types of objects considered and are also subdivided to facilitate easier consultation (Fig. 6). The “Reused Artifacts” layer (in green) refers to archaeological artefacts and inscriptions that have been reused as independent sculptures and/or for a public function, but not necessarily architectural. This layer includes the following attributes: name, type, material, dimensions, brief description, chronology, provenance, bibliography, and media.

The “Reused Architectural Sculpture” layer (in pink), by contrast, refers to artefacts reused for an architectural function and includes name, number of artefacts, type, brief description, chronology, provenance, bibliography, and media. In this second layer, point geometries represent the centroids of buildings containing one or more spolia. In the “media” field of both layers, reference images of the building and/or the artefact are included, as well as links to the corresponding three-dimensional models uploaded to Sketchfab, where available.

The map has been designed and structured as an effective tool for collecting and organising data on a significant phenomenon such as the reuse of materials in Venice, highlighting its geographic and spatial dimensions – an essential aspect in the highly distinctive lagoon context. It is intended as an open-access resource that can be continually updated and expanded.

3. CONCLUSIONS

The investigations carried out within the project have highlighted not only the effectiveness of the digital tools employed but, above all, their potential applications for the study of archaeology and

architecture. More than in the metric data itself, the principal innovation lies in the ability to rapidly integrate the information collected into a comprehensive analytical system, capable of linking survey, three-dimensional modelling, historical-artistic interpretation, and reading of the urban context. From this perspective, the interaction between digital measurement and photogrammetric survey has proven particularly fruitful (Fig. 7). The creation of metrically reliable local reference networks makes it possible to produce accurate three-dimensional models, on which morphological, proportional, and comparative analyses can be conducted with a level of precision rarely achievable through traditional techniques. The integration of point-based metric data with photogrammetric models also allows for a more effective investigation of construction processes, design phases, compositional logics, and reuse practices, providing concrete tools for studies in architectural archaeology, for the analysis of series (capitals, columns, cornices, friezes), and for understanding the circulation dynamics of ancient artefacts. A central role in this framework is played by georeferenced mapping. The implementation of a GIS system and its online deployment allow the spatial dimension of material reuse to be fully represented – a dimension that is essential in the highly distinctive Venetian context. The synoptic visualisation of artefacts, organised by type and function, makes it possible to identify distributions, concentrations, and relationships between monumental contexts and the urban fabric, opening the way to diachronic and thematic analyses that have hitherto only been partially explored. Georeferencing thus represents not merely a cartographic aid, but an interpretative tool capable of integrating material, bibliographic, and iconographic data within a dynamic and continuously expandable environment.

At the same time, conducting research in a city that remains inhabited and intensely lived-in, such as Venice, imposes specific practical, legal, and ethical constraints. The presence of economic activities, tourist flows, religious functions, and residential uses affects the timing and methods of access to artefacts, requires complex authorisations, and demands a constant balance between research needs, heritage protection, and respect for the everyday life of the community. In many cases, private property restrictions or institutional considerations limit the possibility of close-range or long-duration surveys; likewise, conservation and safety concerns necessitate the adoption of non-invasive methods and minimally intrusive interventions.

It is precisely in this context that an integrated digital approach – based on the combination of metric survey, photogrammetry, and georeferenced mapping – emerges as a methodologically appropriate and sustainable solution. This approach allows work to be carried out quickly and accurately, minimising interference with ongoing activities and conservation requirements, while simultaneously creating a solid and shareable database capable of supporting further research. In this sense, the project goes beyond a mere technical advancement, outlining an operational model for the study of archaeological and architectural heritage in complex, fully active urban contexts.



Fig. 1. The bronze lion on the top of one of the two columns in St Mark's Piazzetta in Venice (*Leone di San Marco* 1990, fig. 72, p. 61).

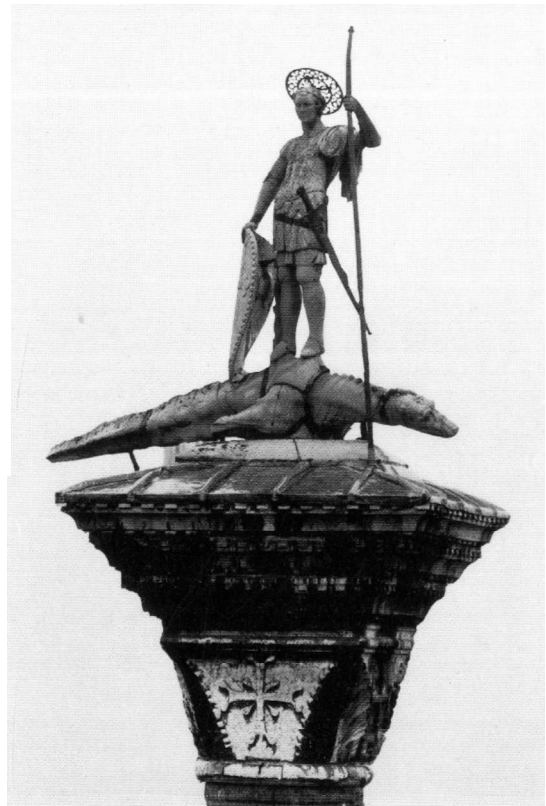


Fig. 3. Statue of St. Theodore on one of the two columns in St. Mark's Piazzetta before the substitution with a replica (Photo: Luigi Sperti).



Fig. 2. Polyphora at the first floor (piano nobile) of Ca' Loredan with reused columns and capitals (Photo: Myriam Pilutti Namer)



Fig. 4. The interior of the church of St. Giacomo at Rialto, Venice, with reused columns and capitals (Photo by O. Böhm, Creative Commons Licence).

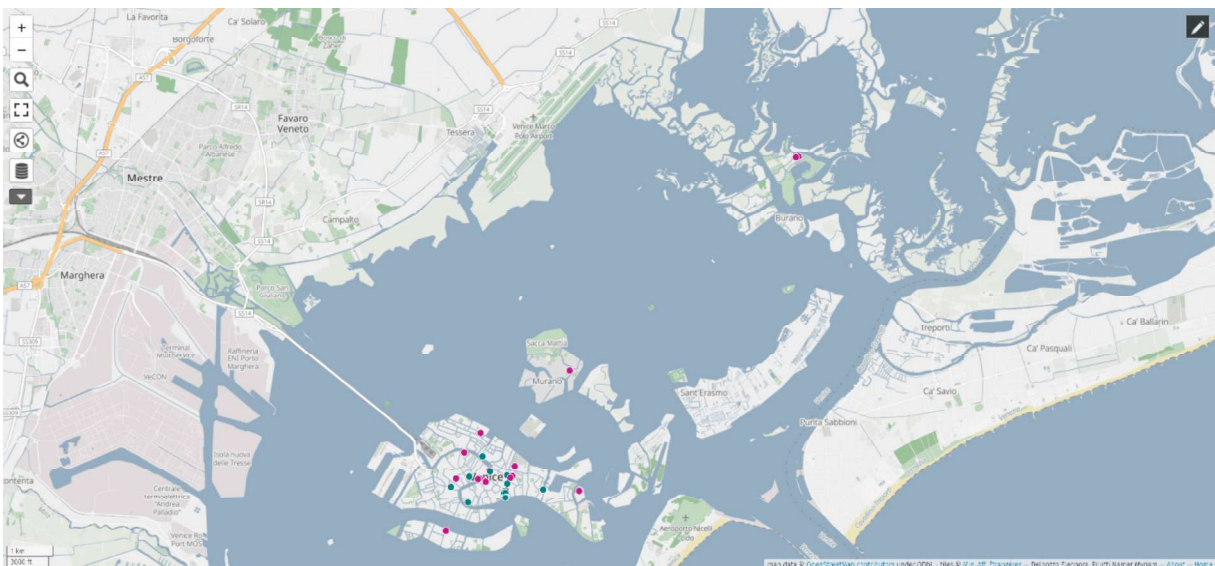


Fig. 5. OpenStreet map displaying the location of *spolia* in Venice and in the islands of the lagoon.
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Fig. 6. Detail from the homepage of the website www.unive.it/display with a digital elaboration of the Tetrarchs now in St. Mark's Piazzetta, Venice. © DiSpLay_Eleonora Delpozzi.



Fig. 7. Ortofoto of the façade of the Fondaco dei Turchi on the Grand Canal in Venice.
Elaboration: Caterina Balletti, IUAV Venice.

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