SEVENTEENTH-CENTURY BUILDING ENGINEERING IN THE CENTRAL MEDITERRANEAN: A CASE STUDY FROM MALTA

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Abstract. *Masonry and architecture are synonymous in built heritage which is erected in local stone. The Maltese archipelago, located in the central Mediterranean, is no exception. Malta is geo-culturally rich in architectural heritage dating back to the Neolithic Period and reaching a peak during the rule of the Hospitaller Order of St John. This paper studies the engineering and construction of seventeenth-century residential architecture in Malta through a representative case-study of the period: Casa Ippolito, an aristocratic country residence erected in local limestone. The limestone walls were roofed by slabs laid on masonry arches or timber beams. These slabs had an overlying layer of fill and flagstones to uniformly distribute the loading. The parts of the roof exposed to the elements were finished in an impervious layer.*
Keywords: *building engineering*, *construction*, *architecture*, *Central Mediterranean*, *Malta*, *Casa Ippolito*.

Introduction

Since time immemorial the Central Mediterranean has been a cradle of civilisation. It was the basin where the main trading empires fought for dominance. It provided major routes for military expansion, trade and commerce. As in other parts of the world, the history of building engineering and construction in the Mediterranean is a source for design solutions for the region.[1] Building materials are notoriously heavy and bulky, and consequently transport over long distances was virtually impossible; thus, until the twentieth century, locally available materials prevailed. The island of Malta, the largest in the Maltese archipelago, lies at the centre of this maritime basin, at the cross-routes between the European, African and Asian continents (**fig. 1**, left). Its building tradition and its history of architecture are shaped by its geology and weather and the cultural interaction with nearby countries. The built heritage of this island was erected in local limestone. The selection of this medium for use in the construction industry as building stones was conditioned by availability and the means of extraction. Neolithic builders differentiated between the outcropping lithostratigraphical formations, as

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[1] Bianco 2016.

testified to by the outstanding megalithic temples, most of which are included in the UNESCO World Heritage List.[2]

Following the advent of the Hospitaller Order of St John in 1530, a number of prominent foreign military engineers and other building experts gave their learned input to the development of local architecture and building engineering practices and construction.[3] Francesco Laparelli da Cortona, the military engineer commissioned to design the new capital Valletta, recommended that the quarrying season in Malta should be restricted to summer, when building works were halted as the hot dry months dried the mortar and thus rendered the construction less durable. This former assistant of Michelangelo Buonarroti argued that "in these months when actual construction was not possible stone could, however, be cut and other materials stockpiled so that work could start immediately the weather was favourable."[4] Geocultural, building-related activities commissioned by the Knights continued during the seventeenth and eighteenth centuries.[5] By the eighteenth century, the Order had members who were experts in geology, notably the "celebrated" French naturalist Déodat de Dolomieu.[6]

A classic representative of the built heritage of seventeenth-century rural Malta is Casa Ippolito, an exemplar of Maltese rural residential architecture associated with the aristocracy (**fig. 1**, right). Art and architectural historian Mario Buhagiar considered this building, which is finished in ashlar masonry, as the "most interesting example of seventeenth-century Maltese rural architecture."[7] Such a stonework system was normally utilised in monumental architecture.[8] More unassuming buildings were erected in irregularly shaped stones, often minimally worked or selected to a similar size or both. Left abandoned since 1919, Casa Ippolito is now in a dilapidated state, with dimension blocks deteriorating and a significant part of the structure reduced to ruins due to natural deterioration, but also due to vandalism ranging from graffiti to arson.[9]

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[2] http://whc.unesco.org/en/list/132, accessed 30 March 2020.

[3] During the period when Malta was ruled by the Hospitaller Order (1530–1798) building experts from Europe were brought over by the wealthy and influential organisation who could afford them. Indeed, the architecture of local villages was a vernacular imposition of the building design and techniques introduced by the Order. The popularity of Baroque elements in ecclesiastical architecture was a typical example.

[4] Hoppen 1999, p. 235.

[5] Bianco 1999.

[6] Schermerhorn 1929, p. 285, 296–298.

[7] Buhagiar 1978, p. 260.

[8] https://www.britannica.com/topic/architecture/Techniques#ref405530, accessed 26 January 2020.

[9] At the National Museum of Archaeology there is an entry on Casa Ippolito under *The Protective Inventory of the European Cultural Heritage Card of the Council of Europe* (CoE).

The aim of this paper is to address building engineering practices at the time when the Casa was built, by focusing on the following three questions:

1) What was the status of building engineering as a profession (although the term occupation may be more fitting) in seventeenth-century Malta?

2) What building engineering and construction techniques were used in its erection?

3) What were the building materials utilised in the construction of traditional residential architecture?

Fig. 1. Location: (left) of the Maltese archipelago and (right) of Casa Ippolito on mainland Malta circled in red (© Google Earth)

A prime source in the history of building engineering is the site itself. Thus, Casa Ippolito was surveyed and architectural drawings of the layout and sections, which do not exist in the extant literature, were drawn up. The initial survey was supplemented by drone technology to obtain photographic images to complement the dimensions and thereby position those elements of the building which were otherwise inaccessible due to the dangerous state of the structure. Although written primary historical references were not readily available, secondary sources on the history of the building and other authoritative scientific publications on the general history of building engineering and construction in Malta were utilised to interpret the survey's findings. The authors also consulted the case file on Casa Ippolito at Heritage Malta, Valletta, available at the reserve collection of the National Museum of Archaeology (NMA).

Information was inputted by Mario Buhagiar, the same author of Buhagiar 1978, in January 1968 (NMA, *Council of Europe Monument Number*). The input on the state of preservation of the following aspects was required to be filled in: main fabric, subsidiary portions to same, roof, interior and dampness. Each had to be classified in terms of one of the following categories: satisfactory, poor or bad. All aspects were classified as bad except for dampness which was left unmarked.

Residential architectural heritage: Casa Ippolito

The country house Casa Ippolito, translated into English as "The House of Ippolito," is generally known by its Maltese name, "Id-Dar ta' Pultu." A document at the photographic archive of the NMA referred to it as a *palazzo*.[10] In legal documents[11] and in the literature[12] there are also references to this house as "Ir-Razzett ta` Pultu" which translates as "The Farmhouse of Ippolito" (**fig. 2**, left).

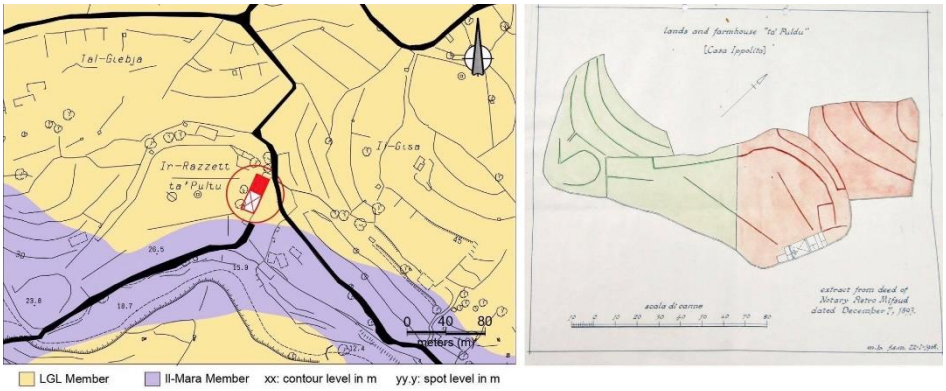

Fig. 2. Site plan: (left) Casa Ippolito is circled (© Planning Authority, Malta); the outcrops of the Lower Globigerina Limestone (LGL) Member and Il-Mara Member are indicated in yellow and in purple respectively (based on Office of the Prime Minister 1993)[13] and (right) Casa Ippolito and the adjacent agrarian land forming part of the same property (NMA: *Extract from Deed of Notary Pietro Mifsud, 7th December 1893*) (© Heritage Malta)

Although it is rural in character, the building is not the traditional unassuming farmer's residence. The site plan of the house and the surrounding agrarian lands which formed part of the same property was attached to a deed dated 1893 (**fig. 2**, right). The layout plan of Casa Ippolito is along an axis, a design principle associated with grandeur rather than the humbleness characterised by peasant farmhouse architecture.[14] The typology

[10] NMA, *Note on roots of title to ownership of Casa Ippolito*, p. 5 [In Italian]. A free translation of this term is "palace." This is incorrect. *Palazzo* is an Italian word for a building, although frequently residential. It was definitely not a palace in the English meaning of the word.
[11] DOI 1998, p. 2969.
[12] https://parlament.mt/media/101022/pq10424.pdf, accessed 22 March 2020; DOS 1973; PA 1988. DOS 1973 was based on aerial photos taken by Hunting Surveys Ltd in August 1968 and on additional information furnished by the Office of the Public Works, Malta, in October 1972. The digitised map of Malta was based on 1988 aerial photographs.
[13] The basemap of the Planning Authority and the geological map (OPM 1993) were plotted at scale 1:2,500 and 1:25,000, respectively.
[14] Jaccarini 1998.

is also different, as is the massing (**fig. 3**, left); both are located in an agrarian setting but the farmhouse is in the vernacular style.[15]

Fig. 3. Casa Ippolito: (left) drone image from the west; access to the yard from the country road is indicated by the red marker (© Joe Fenech); and (right) southeast-facing elevation with main entrance to residence; position of *remissa* is shown by yellow marker

Casa Ippolito is clearly aristocratic, with only the south-west facing fringe of the building bounding the yard, in contrast with the traditional farmhouse which had a courtyard surrounded by rooms along at least two sides of its perimeter. Moreover, the spaces are larger than those of the vernacular farmhouse. The Casa was included in an early twentieth-century publication addressing old towers in Malta, as it represented *case forti non costruite a semplice grandezza e sontuosita` ma anche per sicurta personale e difesa* (fortified houses not erected solely for magnitude and splendour but also for personal safety and defence).[16] Unlike other country residences, Casa Ippolito did not qualify as fortified. In terms of Section 46 of the *Development Planning Act*,[17] this house was designated by the Planning Authority in 1998 as a Grade 1 listed building as per Structure Plan Policy UCO 7.[18] In terms of this policy,

[15] See De Lucca 1993; Tonna 1997. The farmhouse was vernacular in the sense that there was minimal pretence at formal architectural design. Village architecture was vernacular albeit the church/s and other key buildings attempted to follow the proportions included in the treatise of the sixteenth century Mannerist architect Giacomo Barozzi da Vignola (Vignola 1562).

[16] Mifsud 1920, p. 77. This extract is included in a typewritten archival document at Heritage Malta, written by Mario Buhagiar in 1967 (NMA: *Extract from 'La Milizia e Le Torri Antiche di Malta' by Mgr. A. Mifsud*). It was attached to the CoE card. The description of Casa Ippolito as included in this card reads: "A fortified country house with a basement and two floors, consisting of a large courtyard, a mill, stables, a cow manger divided in two parts, four rooms and a kitchen' (NMA, *Council of Europe Monument Number*).

[17] LM 1992.

[18] DOI 1998, p. 2969.

the building cannot be altered except for structural interventions to safeguard its existing state.[19]

Located west of Roman ruins and on the verge of the picturesque Żembaq Valley at Ta' Kaccatura, which lies at the limits of the coastal town of Birzebbuga, this large rural tenement was erected by Ippolito Novantieri, a nobleman from Syracuse, hence its name.[20] Individuals of such standing characteristically demonstrated their status through the architecture of their residences. Urban dwellings in the old capital city of Mdina, the main seat of the local aristocracy, were modelled on similar ones located in Syracuse, Catania and Palermo.[21]

Almost entirely illegible due to atmospheric erosion, the date 1664 was inscribed above the main door. It is reported that it was still distinguishable in the first decades of the twentieth century.[22] This date indicates that the building was completed in the latter part of the seventeenth century.[23] The house, together with the surrounding agrarian land, occupied an area measuring over 0.037 square kilometres.[24] The main entrance to the residence was from a public country road running along the southeast-facing elevation. The dwelling is rectangular in plan and the yard, set at a lower level following the natural gradient of the terrain, had an independent access from the public road via a doorway through a 0.5 m thick boundary wall (**fig. 3**, left). This access ran through the yard and led to the opposite side, at a lower level, to enter the agrarian grounds which formed part of the property. The paving stones of the path through the yard have a unique profile whereby round stones alternate with flat ones, thus facilitating wheel-based transport by halting movement in either direction (**fig. 4**).

The remnants of the house are characterised by the absence of ornamentation both on the exterior and, especially, on the interior. It occupies two floors, with a mezzanine and a lower level (**fig. 5**). The layout

[19] PSD 1990, p. 88.

[20] Buhagiar 1978, p. 258.

[21] Mahoney 1996, p. 82.

[22] NMA, *Note on roots of title to ownership of Casa Ippolito*, p. 1 [In Italian].

[23] Mifsud claimed that the date of completion of the house was 1626 (Mifsud 1920, p. 76). On the typewritten copy of Mifsud's text at NMA, Buhagiar introduced a footnote with his personal observation. It states that the year 1626 did not correspond to that on the inscription on the main entrance to the house which read, namely 1664 (NMA, *Extract from 'La Milizia e Le Torri Antiche di Malta' by Mgr. A. Mifsud*). He further remarked that Mifsud's date was certainly wrong as Novantieri died in 1727. This point was reiterated by Mario Buhagiar (Buhagiar 1978, p. 259).

[24] NMA, *Extract from the Deed of Notary Pietro Mifsud, dated 7 December 1893*. This deed stated that the house and surrounding lands forming part of the same property had a superficial area of 36 tumoli, 4 mondelli and 2 misure.

is typical of seventeenth-century Malta.[25] Until the turn of the nineteenth century, town and country houses of people of higher social standing had an intermediate level, a mezzanine, between the ground and the *piano nobile* on the first floor.[26] The *piano nobile* was the main floor of the house, characteristically higher than the other floors. This level at Casa Ippolito – accessed via the roof of the ground floor, with internal dimensions of 9.5 m by 4.4 m and roofed over at 3.7 m – did not comply with the typical *piano nobile* model (**fig. 6**).

Fig. 4. Yard: exit to road (left) and detail of paving (right) (NMA: *Courtyard - Exit to road*) (© Heritage Malta)

The following is the earliest historical description of Casa Ippolito and the lands forming part of the same property:[27]

> […] the space occupied by the house consists of fourteen fields with walls – a cistern – and a house containing a large courtyard with two doors, one facing the road and the other on the ground – a cow byre divided into two – one uncovered staircase leading to a room on part of the said byre – a horse mill – two stables – a flight of uncovered stairs leading to the floor at road level, which becomes the ground floor, and a warehouse that has ingress from the said ground.
>
> The ground floor, which is above the aforementioned amenities, contains an entrance with a door onto the street – two side bedrooms – a kitchen – a staircase leading to a room above the horse mill – and a continuation of the staircase to the terraces – and from these you go to two rooms, and to an

[25] Mahoney 1996; Camilleri 2019.
[26] Mahoney 1996, p. 85.
[27] NMA, *Extract from the Deed of Notary Pietro Mifsud, dated 7 December 1893*. Fig. 2 (right) was attached to this deed.

open loggia, overlying the ground floor – plus a *remissa*[28] with a door to the street – and a stable with entrance from the fields; […].[29]

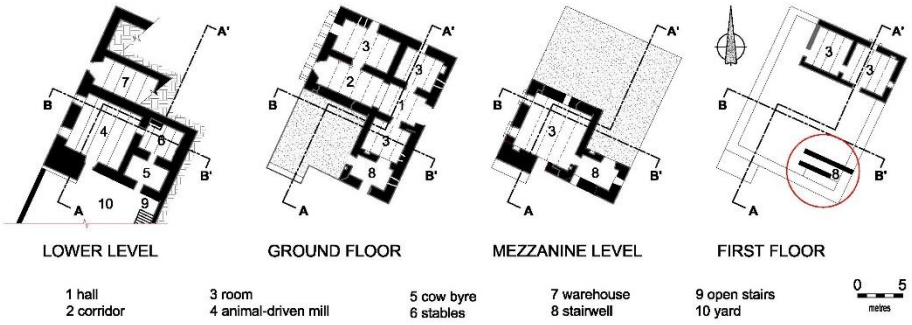

Fig. 5. Plans of the various levels of Casa Ippolito[30]

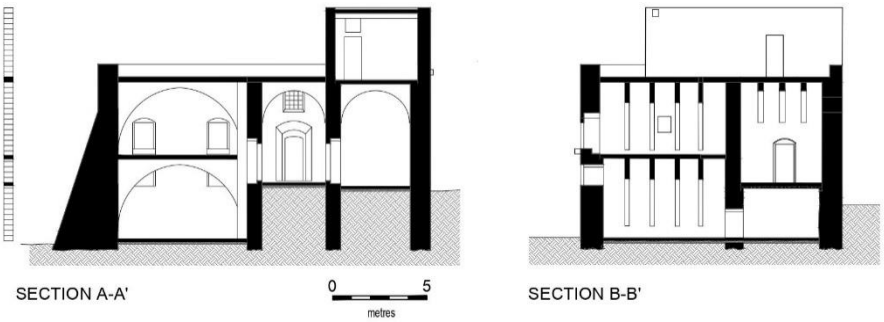

Fig. 6. Sections through of Casa Ippolito; for location of section, see **fig. 5**

The main entrance led to a corridor ending with an open balcony along the northwest elevation and overlooking agrarian land (**fig. 7**). This corridor,

[28] The *remissa* was the structure (**fig. 3**, right), now in ruins, located along the northeastern side of Casa Ippolito.

[29] Free translation by the author. The original reads: "… conpreso la spazio occupato del ricetto, consiste in quattordici lenze con scontri di muro - in una cisterna - e in un ricetto contenente un ampio cortile con due porte l'una mette sulla strada e l'altra sul terreno - un bovile diviso in due - una scala scoperta che conduce ad una camera soprapposta ad una porzione del detto bovile - una camera de centimolo - due stalle - una branca di scale scoperta che conduce ad un piano al pari della strada, che viene ad essere il piano terreno, ed un magazzino che ha ingresso dal detto terreno. Il piano terreno, il quale é sopraposto alle summenzionate comodita' contiene un'entrata con porta sulla strada - due camera laterali - una cucina - una scala conducente ad un stanza soprapposta e quella da centimolo - e centinuazione della scala fino i terrazzi - e da questi si va a due stanze, e ad un loggiato, sovrastanti ad alcune comodita' del piano terreno - piu' una remessa con porta per la strada - ed una stalla con ingresso dal terreno; …"

[30] The layout circled in red could not be established with certainty.

which measured about 3.4 m by 12.0 m, with a ceiling height of 5.2 m, included the entrance hall, which measured 3.4 m by 4.4 m (**fig. 5**). Two rooms, each measuring circa 3.7 m by 4.4 m, were located on either side of the hall. Adjacent to the room on the right there was another room, measuring circa 3.7 m by 6.7 m, which served as a kitchen, as evidenced by the inbuilt chimney running up to the roof. A large room measuring circa 6.4 m by 6.7 m, overlying the centimolo, or animal-driven mill (which itself measured circa 6.4 m by 6.5 m) was accessed from the room on the left of the entrance hall via a short flight of stairs.

The mill was accessed directly from the yard, and adjacent to it there were two interconnected rooms, one with direct access to the yard and the other to the mill, presumably used to stable cows and horses respectively. At the lower level, underlying part of the corridor at ground-floor level, between the hall and the balcony, there was a room that could be accessed directly from the northwest-facing elevation.

Fig. 7. Views of Casa Ippolito as in 1967: (left) southeast (NMA*: Façade to East*) and (right) northwest (NMA*: Façade to West, closer*) (© Heritage Malta)

The different levels of the house were linked through a stairwell which overlaid the cow-shed. It ran from ground level to the room over the mill and ended at the ground floor's roof. An uncovered flight of stairs ran from the yard to the stairwell (**fig. 8**). Rainwater from the roof of the first floor drained onto the roof of the ground floor through clay water pipes, and through masonry water spouts onto the agrarian land along the northwestern elevation. Based on the geometry and stereotomy of the remaining elegant elevations, including the positioning of the apertures, we can assert that the architectural composition of Casa Ippolito was the creation of a person/persons well versed in the art and science of building, most probably a local architect-engineer/skilled mason. In contrast, local vernacular

architecture was a manifestation of architecture without architects, in Rudofsky's sense.[31]

Building engineering as a profession

Following the foundation of Valletta, the occupation of *perit* emerged,[32] the precursor of the current profession of architect-engineer known locally by the same appellation.[33] A *perito*, as referred to in the literature at the time, was versed in various skills and was considered a technical expert. An architect-engineer was engaged in the design and construction of military and public buildings. He was not a *perito agrimensore* (the latter term being derived from the Roman *agrimensor*, one who practiced the art of mensuration or land surveying). A *perito agrimensore* was often engaged in quantification and surveying.

Fig. 8. Southwest facing elevation of Casa Ippolito: (left) uncovered flight of stairs from the yard to the ground floor, as in 1967 (NMA, *Staircase leading from courtyard to centimoli*) (© Heritage Malta) and (right) the remains after the collapse of a section of this wall

[31] Rudofsky 1964.

[32] De Lucca 1975, p. 431.

[33] The 1919 Architects' Ordinance promulgated by the British Colonial Government paved the way for the Maltese architect-engineer, the *perit*, being granted professional status (Degiorgio 1969, p. 22; De Lucca 1975, p. 435).

Most often, in cases of non-military or civil projects, the architect-engineer who designed the building was called *capo maestro* (master-builder). However, normally he would also be the person who then worked on-site, overseeing the construction works and directing the builders. This was also the case in early modern Italian states such as the Kingdom of Naples. A comprehensive study on the organisation of these professions and their respective responsibilities from the mid-seventeenth century to the end of the eighteenth century was undertaken by Spiteri and Borg.[34]

In 1530, Malta was granted as a perpetual fiefdom to the Hospitaller Order of St John by the Spanish Emperor Charles V, and it was ruled by the Order as a vassal state of the Kingdom of Sicily. From 1646 to 1714, the *Capi maestri dell' Opere* (Master-builders of Works) were appointed by the Grandmaster, the Head of the Order, following nominations by:

1) the Commissioners of Works,
2) the officials responsible for the fortifications, and
3) the preceding master-builder.

Dell' Opere was the forerunner of what nowadays is referred to as public works. Thus, the *capi maestri* were appointed on a long-term basis by the *Dell' Opere* officers. Evidently, there are other *capi maestri* employed elsewhere. The 1724 publication, *Leggi e Costituzioni Prammaticali*,[35] also known as the *Codice de Vilhena*, noted that *periti agrimensori* (plural of *perito agrimensore*) were "those who completed surveys and valuation of urban as well as rural properties and reported on matters of property litigations."[36] They drafted plans and reports of immovable property for notarial deeds,[37] such as the lands belonging to the Abbazia di San Antonio.[38]

In Malta there was no formal educational training available for these occupations during the rule of the Order. The first school specialising in design, painting, sculpture and architecture was set up in the early nineteenth century under British rule which, *de facto*, commenced in the year 1800. By the mid-seventeenth century, the Order had recognised mathematics as a primary discipline for the training of a *perito agrimensore*. Thus, persons engaged as *periti*, *agrimensori* and *capi maestri* (singular: *capo maestro*) or *maestri muratori* (master masons) were expected to be qualified and skilled. The terms *capi maestri* and *maestri muratori* were used interchangeably and the respective skills of the main trades in the building industry, including licences to operate, were listed in the *Codice de Vilhena*.[39] The master-builder, as the local architect-engineer was

[34] Spiteri, Borg 2015.
[35] de Vilhena 1724.
[36] Spiteri, Borg 2015, p. 131–132.
[37] De Lucca 1975, p. 434.
[38] Bianco 2017.
[39] Spiteri 2019.

commonly known in historical sources, drew unsophisticated designs for building urban and rural dwellings. Most of the *periti agrimensori* were masons and sculptors who gained practical knowledge while training as an architect-engineer.[40] Various master-builders trained as apprentices under foreign engineers brought over by the Order. Many of them then furthered their knowledge abroad, most notably in Naples and Rome.

Architects, *capi maestri*, *periti agrimensori*[41]	***Capi maestri dell' Opere* and fortification (term in office)**	**Grandmasters (term in office)[42]**
Nardo (?) Tommaso Dingli[43] Lorenzo Gafa Francesco Sammut Salvatore Borg Michele Agius Giuseppe Azzopardo Francesco Bonnici Domenico Tonna Vincenzo Casanova Carlo Gimach Giuseppe Bonavia Alesandro Pulis	Clemente Muscat (1646–1681) Giovanni Barbara (1681-1715)	Jean-Paul Lascaris Castellar (1636–1657) Martino de Redin (1657–1660) Annet de Clermont-Gessan (1660–1660) Raphael Cotoner (1660–1663) Nicolas Cotoner (1663–1680) Gregoire Carafa (1680–1690) Adrien de Wignacourt (1690–1697) Ramon Perellos y Roccaful (1697–1720)

Table 1. Grandmasters, practicing architects, *periti agrimensori* and *capi maestri* during the period 1650–1700

The preferred institution at which to further their education was the Academia di San Luca in Rome. Those who studied at this institution

[40] Spiteri, Borg 2015, p. 131–132.
[41] Ibid., p. 157.
[42] Hughes 1967, p. 200.
[43] Dingli is a personality that had been studied extensively over the past half a century. L. Mahoney notes that early seventeenth century documents refer to him as *scalpellino* (a stone carver), freely translated as sculptor (Mahoney 1996, p. 149). As per contract dated 1615, the administrators of the Attard Parish owed him and Giovanni Attard money for work as *scalpellini* (singular: *scalpellino*) undertaken at the new parish church (ibid., p. 206, n. 27). Dingli is also referred to as *scalpellino* in work undertaken in 1626 at the Mdina Cathedral (ibid., p. 206, n. 29). The first mention of Dingli as an architect was in two independent pleas by clerics for his release from prison to continue his work on the Attard church and on St Mary Parish Church in Birkirkara. The priest from Attard stated that Dingli "*fa arte di scalpellino et architetto* ..." (works as a sculptor and architect) (ibid., p. 149–150). Over the period 1610–1615 Giovanni Attard, engaged by the Grand Master Alof de Wignacourt as *capo maestro* on the erection of the aqueduct (ibid., p. 307), was Dingli's tutor (Hughes 1967, p. 201. *Apud* Calleja 1865, p. 5). L. Mahoney acknowledged that for most documents which he cited are based on Zammit's work (Mahoney 1996, p. 206 n. 31; Zammit 1977).

included Giovanni Barbara and Lorenzo Gafa. Carlo Gimach studied at the Roman College, the forerunner of the Gregorian University, but also frequented the Academia.[44] The only other foreign architects enlisted to erect important buildings during the rule of the Order were Filippo Bonamici and Stefano Ittar, who practiced in the eighteenth century.[45] The architect-engineers, *periti agrimensori* and *capi maestri* who thrived in the second half of the seventeenth century, when Casa Ippolito was constructed, together with the contemporary ruling Grandmasters, are listed in **table 1**. The resident engineers employed in Malta by the Order were Bonamici (from 1635 to 1659) and Mederico Blondel (from 1659 to 1698), from Italy and France respectively.[46]

References in archival sources to the term architect, as used in local parlance, are limited. Spiteri discussed two cases: one which presented a distinction between architect and *capo maestro*, in reference to Giovanni Bonavia, and another in which the terms architect and *maestro muratore* were used interchangeably, in reference to Francesco Zerafa, Barbara's successor as *Capo maestro dell' Opere*.[47]

The Order, as the State, regulated these professions in line with provisions in force on mainland Europe, with the first decree issued in 1646.[48] In terms of this ordinance, new buildings had to be erected by master-builders who were licenced by the *Commissarii delle Case* (Commissioners for Housing) who were responsible for urban dwellings within the fortified cities, namely, Valletta, Birgu and Isla. In the seventeenth century, the Order required that construction be undertaken according to good practice, tradition and the art of building, else the buildings would be demolished.[49] By the early eighteenth century, a candidate aspiring to qualify as a *perit* could only fill a post after it became vacant following the death of the previous holder, since the *Codice de Vilhena* limited the number of *periti* to twelve.

Building engineering and construction techniques

Traditional building construction techniques at the time of the construction of Casa Ippolito can be traced back to Medieval Malta. The structure of the house is an authentic load-bearing masonry construction with no evidence of

[44] Gimach is credited with the design of Palazzo Carneiro (now the Auberge de Bavière), the renovation of the Monastery of Arouca and the restoration of the Basilica of St Anastasia in Malta, Portugal and Rome, respectively.
[45] Hughes 1967, p. 199.
[46] Hoppen 1999, p. 289. For a complete list of military engineers and architects who worked on the fortifications of the Order, see Spiteri 2001, p. 368.
[47] Spiteri 2018.
[48] Spiteri 2019.
[49] Spiteri, Borg 2015.

later additional building materials introduced after its erection.[50] The foundations were directly set on the bedrock; typically, they were "almost invariably formed by the solid rock, cushioned with a little soil and mortar to get an even surface."[51] The location of the site is just above the transition from the Il-Mara Member of the Lower Coralline Limestone formation to the Lower Globigerina Limestone (LGL), a homogeneous limestone able to withstand the load-bearing stresses of the structure (**fig. 2**, left).

Fig. 9. (Left) damp-resistant layer of Coralline Limestone - for location of photo see **fig. 13** (left); a €2 coin is used for scale, (middle) section through collapsed internal wall, and (right) detail of section; marker is 500 mm in length

The absence of a damp-proofing course or its bridging has caused rising damp, which can be inferred from the LGL dimension stones which are immediately above ground level.[52] These stones exhibit characteristics congruent with the ingress of water that has carried soluble salts present in the ground into the fabric. Historical empirical evidence indicates that, given the absorption properties of LGL, dampness can rise to circa 1.2 m above the agent causing it. Use of a damp-proof course became mandatory in local construction in 1854 under the *Code of Police Laws*.[53] Previously, the more

[50] From site inspection undertaken by the authors it transpired that concrete was introduced in the northwest and southwest elevations to make good for deteriorated dimension stones. Some steel reinforcement is visible along the former (**fig. 11**, left). Such remedial works had been undertaken in the latter part of the twentieth century as such mode of repair was not used earlier.

[51] Hughes 1967, p. 195.

[52] LGL building block for ashlar masonry has several limitations: low compressive strength, very high porosity, low density and low shear strength. In many cases the absence of other building materials rendered it impossible to design features to mitigate these limitations.

[53] LM 1854. This Code was enacted by Order-in-Council of the 30 January 1854 and promulgated by Proclamation I of the 10 March 1854. Several ordinances amended this code. The Ordinance, published in 1880, regulated building practices to protect public health, but

compact Coralline Limestone formations were used to limit rising damp from the ground; foundation stones cut from this formation were utilised in the lower level of Casa Ippolito's structure (**fig. 9**, left).

The external walls of the house, which have an average overall thickness of 1.2 m, have weathered well except for the walls of the mill and the overlying room and the stairwell. They consist of a double-leaf ashlar wall with stone rubble infill and soil as a binder.

The use of such walls in masonry construction, although not always ashlar, was common throughout Europe. Although as a norm internal walls were single-leaf, circa 0.2 m to 0.3 m in thickness, the internal walls in Casa Ippolito were twice as wide – up to 0.8 m thick – to carry the thrust generated by the masonry ribs. The collapsed internal wall located between the corridor and the mill room was 1.2 m in thickness (**fig. 9**, middle and right). The buttress along the southwest-facing elevation was introduced to take the side thrust of the semicircular stone arches spanning the 6.4 m mill room (**fig. 10**).

Fig. 10. (Right) the buttress on part of the southwest-facing elevation and (left) the position of the arches is indicated by a red marker

The thickness of the first-floor walls is less than that of the ground floor.[54] Masonry lintels, of standard course height of 270 mm, were used for apertures up to 0.9 m in span. For a span less than 1.1 m, either the dimension

it recommended using lead sheeting as a damp-proof course, which is not a good solution.

[54] The horizontally positioned timber beams used to roof this floor did not generate side thrust.

stone located directly above the lintel was notched or the depth of the lintel increased by 50% to 400 mm; for larger spans, an arch was introduced (**fig. 11**).

Flat-roofed construction styles are typical of the southern side of the Mediterranean and in the Maltese archipelago while low-pitched roofs are more common on the northern side. The flat roofs at Casa Ippolito were constructed in LGL slabs, locally known as *xorok* (singular: *xriek*). These slabs spanned the semicircular masonry arches of the lower floors and the timber beams of the first floor (**fig. 12**).

Fig. 11. Spanning openings over 0.9 m: (left) lintels with notched dimension stone, (middle) lintel depth increased from the standard 270 mm course height to 400 mm, and (right) arches introduced for spans over 1.1 m

Masonry arches were used to avoid the use of timber beams, which were simpler and more effective, as this material was less readily available. The significant advantages of stone arches over timber beams include:

1) greater strength (although timber beams were adequate to carry the dead and live loads of the roofs)

2) not vulnerable to biological attack and

3) not combustible.[55]

The thickness of the *xorok* was circa 75 mm. At ground and lower levels, masonry arches were used at circa 1.2 m intervals with *xorok* spanning from one arch to the other, whereas on the first floor the *xorok* spanned from one timber beam to the next. The edges of the *xorok* were bevelled and they were laid next to each other across the masonry arches or timber beams, with limestone wedges driven tightly between the ends of the slabs. Small wet stone chippings were placed in the groove formed between the adjacent edges of the *xorok* in a 1:1 mix of lime to LGL powder.[56] Prior to placing the mix,

[55] The risk of fire in such a heritage building was negligible as the fire loads present where commonly insignificant. Rotting of timber beams was a problem especially when exposed to continuous moisture.

[56] Hughes 1967, p. 196–197.

wet chippings were gently hammered in between the bevelled edges approximately every 100 mm. The fact that the slabs were wedged tightly against each other on all sides allowed for the transfer of load from one slab to another. When a point load was imposed on one of the slabs, the wedging allowed for the transfer of this load across a larger area and the slab would not fail. Lime was introduced for two purposes: (i) to provide a fat mix, that is, a mix which was easy to lay and still permitted adjustment of the slab, and (ii) as a cementing agent, although its curing period is much longer than, say, Portland Cement. These *xorok* were covered with well-compacted stone chippings, locally referred to as *torba*, to ensure uniform distribution of the overlying dead and live loads, and LGL flagstones were placed on top. These square flagstones, which were 520 x 520 mm in size[57] and 75 mm thick, were used at the ground and lower levels, as can be deduced from damaged ones located in the first room on the right as one enters the building.

Fig. 12. Roof: (left) of entrance hall, (middle and right) of the first room to the right of the entrance with part of the collapsed roof of the first floor also visible; (right) failed masonry slabs are circled in red

The parts of the roof that were exposed to the elements were finished with *deffun*, a 6 mm impervious layer composed of small chippings of earthenware, lime and water beaten to a paste. The *deffun* was laid over a 150 mm bed of well-compacted layer of dry *torba*, laid to falls, to ensure uniform distribution of the overlying dead and live loads.[58] The *deffun* functioned as a

[57] The standard dimension of flagstone was 2 *palmi* by 2 *palmi* where by 1 *palma* (plural: *palmi*) was equivalent to 520 mm.

[58] The *deffun* was placed during spring or autumn when the weather is neither too hot nor too cold. Once laid, loose straw was placed on it for two to three weeks. During this period the straw was regularly sprinkled with water to cool the roof and prevent cracking on hardening (Hughes 1967, p. 197–198).

high-performance hydraulic mortar and a waterproof layer, protecting the structure against the action of rain and rainwater.

Building materials: composition and properties

Although there were abundant supplies of limestone, the construction industry in seventeenth-century Malta required other materials which had to be imported, most notably pozzolana, timber and iron, which were often in short supply and less accessible. In contrast, LGL was easily available and the labour costs involved in quarrying it were low. The context of architecture of Malta, as elsewhere when the geology permitted, was to have "a quarry and building site *en-suite*."[59] Quarries on site were subsequently utilised either as water cisterns for storing rain to use in drier seasons, or, if located off site often reclaimed for agrarian uses. A cistern hewn into the rock and roofed over with *xorok* supported by masonry arches lies adjacent to the southern boundary of Casa Ippolito's yard. It has been indicated that this was the site where limestone utilised for building the house was quarried.[60] Although there is no evidence that the stone was cut from this cistern, it was the norm to extract stone in the vicinity of the building site, thus eliminating the cost of transportation.

In selecting the limestone used to erect Casa Ippolito, the builders deliberately differentiated not only between limestone formations but also distinguished between the different beds within the LGL member.[61] The lower level, exposed by the collapse of part of the corridor, was erected in Coralline Limestone which is dense and difficult to dress. More compact and less porous than the LGL, this limestone prevented damp from rising to ground-floor level, as a result of which the internal walls constructed in LGL are in an optimal state of repair (**fig. 13**, left). The distinguishable weathered limestone above the main entrance which once bore the date inscription, together with the surrounding deteriorating fabric, both exhibit features typical of failure associated with a carving that took place years after the dimension stones were placed in position (**fig. 13**, right). This kind of carving destroys the hard crust which gradually forms during the first years post-

[59] Buhagiar 2005, p. 6.

[60] D'Amato 1998, p. 77.

[61] The uniaxial compressive strength of LGL in its dry and saturated state varies between 15 N/mm² and 32.9 N/mm² and 9.1 N/mm² and 16.3 N/mm,² respectively (Cachia 1985). Inferior LGL characteristically has higher mean dry compressive strength (f_k) and lower porosity (Bianco 1993). As per the Centre Technique de Matériaux Naturels de Construction (Camilleri 2019. *Apud* CTMNC 2015), LGL is definitely not a hard stone (f_k>40 N/mm²); some lithostratigrahic beds qualify as a compact (10 N/mm²≤f_k≤40 N/mm²) rather than as a soft stone (f_k<10 N/mm²).

construction, resulting in rapid damage to the blocks themselves and to the surrounding fabric:

> On exposure to the air, the stone slowly forms a hard crust so that any carving has to be carried out soon after the stone has been placed in position. […] Otherwise, once the hard surface is broken the stone becomes very friable and powders away. If this occurs, the damage will spread rapidly to the adjoining stones.[62]

Lime-based mortar was used to level and fill in the spaces between the masonry blocks. It was used as a cushion rather than as a cementing joint.

Fig. 13. (Left) the wall at the lower level erected in Coralline Limestone: detail indicated in red is shown in **fig. 9** (left); (right) position of the inscription is indicated in red

The relative bulk density and the 'free lime' content are two important properties which effect the performance of mortars.[63] Lime improves workability, water retention and bonding properties. It is not only softer and less rigid than cement, but is compatible with LGL. Due to its permeable character, lime does not hinder the movement of moisture, thereby allowing

[62] Hughes 1967, p. 199. Buhagiar notes that the inscription of the main entrance, which was readable until some years earlier, read: "Questa è la casa/Di Ippolito Novantieri/Che Fece oggi quell/ Che dovea far ieri" (This is the house of Ippolito Novantieri who did today what he had to do yesterday). Following Hughes observation, this could be read that a time lapse of over four years had passed between the placing of the dimension stones for the inscription and the carving taking place on it (Buhagiar 1978, p. 260).
[63] Snow, Torney 2014, p. 14.

the LGL stones of Casa Ippolito to 'breathe'. It regulates humidity through the absorption and subsequent evaporation of the moisture through the limestone fabric. These characteristics limited the impacts of rising damp, which was typically restricted to 0.9/1.0 m above ground level. Lime was also used as a whitewash in Casa Ippolito. Seasonal rainfall was, however, an important factor. Accelerated damage to the limestone along the southern part of the northwestern elevation and the now-collapsed section of the southwest-facing elevation was caused by the later introduction of sand-cement mortar and plaster, which was used as rendering during repairs in the latter part of the twentieth century.[64]

In the seventeenth century, the interior walls of such residences were smoothed down and a lime wash then applied. Two coats of *xahx* wash, based on fine LGL paste, were applied to the exterior of the building. The porous LGL and even more porous joints absorbed the *xahx* wash. Subsequently, most of this wash was removed during rainfall, giving a uniform, slightly yellowish appearance to the wall.

Timber was used for structural beams, apertures and fittings. Most of the beams have been lost. None of the apertures are left either due to vandalism or severe weathering. Larch (*Larix decidua*) and oak (*Quercus petraea*) were the woods most commonly used in historic roof structures.[65] Although olive and chestnut timber was also imported by the Order,[66] the structure of the Sacra Infermeria, erected in Valletta in 1574, made use of larch.[67] It would be worth testing the remaining beams at Casa Ippolito but, although they are still supporting masonry slabs, their deterioration is at an advance stage thus rendering material testing a health and safety hazard. Larch is a strong, medium density softwood but it is not easy to work. In dry conditions it resembles pine and chestnut. The colour of the resinous heartwood is reddish.[68] The higher the density, the greater the strength, although the size and location of knots and other deficiencies have a bearing on the strength of a given beam.[69]

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[64] This implies that the first quality, compact to soft LGL, left untreated over 350 years, weathers well in the natural environs.

[65] Galliani, Mor 2006.

[66] Hoppen 1999, p. 234.

[67] Amanda-Jane De Giovanni, the architect responsible for the restoration works of the structure of the Sacra Infermeria on behalf of the Restoration Directorate (Malta), had established that larch had been used in the building (Amanda-Jane De Giovanni, personal communication). The question arises whether this was the original or a replacement.

[68] Bergstedt, Lyck 2007, p. 36.

[69] Experiments on 20 mm x 20 mm samples yielded the following results: density 512 kg/m^3, modulus of elasticity 9.7 GPa, bending strength 63 MPa, compression strength 50 MPa and hardness 3.1kN (BRE 1977).

Typical of timber doors at the time, a ledged and braced door was probably used at the entrance. This was a customary form of planked construction used where strength and durability were required. Given the width of the aperture, which stood at 2.1 m, the door would have been double leaf. Furthermore, given this width, the door was unlikely to have had a wicket gate (a door within a door) as it was not large enough to require access via a smaller opening. Prior to the advent of hinges, doors were hung on vertical posts which formed part of the aperture and were rebated into sockets at the top and the bottom. The main entrance door was probably locked by means of a bar, likely a timber plank, as evidenced by the groves cut into the stone at same height on either side of the door jamb. Looking outwards, these grooves vary in depth along their length: the one on the right is 0 mm at the top and 40 mm at its bottom; the one on the left ranges from 0 mm at the bottom to 80 mm at the top; they appear to mark the outer edges of a circle. This implies they accommodated the clockwise motion of the bar which revolved around a pivot set into the inside of the door. Evidence of such a bolting system is sparse in Malta.[70]

To provide further security against intrusion, iron grills were anchored in the limestone to secure all windows. Although its close proximity to the sea could have been an issue, at the time of Casa Ippolito's construction there was minimal likelihood of Ottoman fighters or pirates landing in nearby coves – such threats were receding in the Mediterranean by the late seventeenth century.[71] Only two grills survive, but the remaining apertures exhibit corrosion-related cracks and/or anchoring holes.

Conclusions

Although reduced to a ruin, Casa Ippolito is a statement in the traditional residential architectural heritage of Malta. It is an essay in seventeenth-century building engineering techniques with respect to the three key aspects addressed by our research questions: professional practice, building construction and building materials. We address these issues in turn below.

Professional practice. Unlike vernacular architecture, civic aristocratic country residences were erected by a *capo maestro*, the precursor of the contemporary profession of *perit*. The knowledge of seventeenth-century architect-engineers and master masons included structural engineering solutions and the stereotomy of ashlar masonry respectively. They had an

[70] The official residence of the President of Malta, a building dating back to the early part of the seventeenth century, has the entrance door of the Kitchen Garden along St Anthony Street, Attard, bolted in this manner (Brincat 2019, vol. 2, p. 180–186).

[71] Cassar 2000, p. 135. Yet, J. Q. Hughes notes that after the fall of Candia in 1670, the fear of an invasion increased (Hughes 1967, p. 32).

excellent understanding of the structural dynamics of static structures and the nature and properties of building construction materials.

Building construction. The structure was built directly on the bedrock. No natural geophysical movements occur on the site. The thickness of the external and internal solid walls, both of which are double-leaf, is 1.2 m and 0.8 m respectively. The external walls had to carry the stress of the semicircular masonry arches. Such walls were thinner on the upper level, which was roofed over by horizontal timber beams. Masonry lintels were used in apertures not larger than 0.9 m; for spans up to 1.1 m either the dimension stone located precisely above the lintel was notched or the depth of lintel was increased by 50% of the standard height; for larger spans, arches were used. Masonry arches at 1.2 m intervals supported the masonry roofing slabs, which were covered with an overlying layer of well-compacted *torba* and flagstones to uniformly distribute the dead and live loads of the otherwise weak tensile slabs. The arches were replaced by timber beams at the first-floor level, set at the same intervals and roofed over in a manner similar to the arched ribs. The *xorok* were bevelled and a mix of lime, LGL powder and wet fine stone chippings was introduced to infill the resulting v-profile prior to the laying of the *torba*.

Building materials. The builders differentiated between the various lithostratigraphic formations of the local geology. They were knowledgeable about the properties of different types of limestone. Long before sanitary regulations on damp proofing were introduced in the mid-nineteenth century, these builders were making use of the more compact Coralline Limestone in the lower level buildings such as Casa Ippolito, thus restricting movement of moisture and salts to the ground level. Lime, which is compatible with LGL, was used as the primary component of the mortar when laying the dimension stones. It was not only workable when fresh, but acted as a cushion rather than a cementing joint. Lime mortar allows the movement of moisture when hardened, thereby allowing the porous LGL limestone to 'breathe'. A lime wash was applied to the interior and a *xahx* wash was applied to external walls.

Casa Ippolito has stood the test of time. Although now reduced to a ruin due to vandalism and almost a century of neglect, the high-quality LGL has weathered well in the natural environs over a span of 350 years.

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LISTA ABREVIERILOR DE PERIODICE

AAASH	– Acta Archaeologica Academiae Scientiarum Hungaricae. Budapesta.
AAS	– Archaeological and Anthropological Sciences.
ActaMN	– Acta Musei Napocensis. Muzeul de Istorie a Transilvaniei. Cluj-Napoca.
ActaMP	– Acta Musei Porolissensis. Muzeul Judeţean de Istorie şi Artă Zalău.
ActaMT	– Acta Musei Tutovensis. Muzeul „Vasile Pârvan". Bârlad.
AEM	– Archäologisch-epigraphische Mitteilungen aus Österreich-Ungarn.
AÉ	– Archaeologiai Értesitö a Magyar régészeti, müvésytörténeti és éremtani társulat tudományos folyóirata. Budapest.
AIIAI/AIIX	– Anuarul Institutului de Istorie şi Arheologie „A. D. Xenopol" Iaşi (din 1990 Anuarul Institutului de Istorie „A. D. Xenopol" Iaşi).
AIIGB	– Anuarul Institutului de Istorie „George Barițiu". Series Historica. Institutul de Istorie „George Barițiu" Cluj-Napoca.
AM	– Archivum Melitense. Malta Historical and Scientific Society. Valleta.
AMEM	– Anuarul Muzeului Etnografic al Moldovei. Complexul Muzeal Naţional „Moldova". Iaşi.
ArhMold	– Arheologia Moldovei. Institutul de Istorie şi Arheologie „A. D. Xenopol" Iaşi.
AMET	– Anuarul Muzeului Etnografic al Transilvaniei. Muzeul Etnografic al Transilvaniei. Cluj-Napoca.
ANAL LETT	– Analytical Letters. Philadelphia.
AnB	– Analele Banatului (serie nouă). Muzeul Naţional al Banatului. Timişoara.
Antaues	– Antaeus. Communicationes ex Instituto Archaeologico Academiae Scientiarum Hungaricae. Budapest.
AO	– Arhivele Olteniei (serie nouă). Institutul de Cercetări Socio-Umane. Craiova.
APPB	– L'Arte Periodico Patrio-Bimensile. Malta.
Appl. Phys.	– Applied Physics A. Materials Science and Processing. Springer Verlag. Germany.
Apulum	– Apulum. Acta Musei Apulensis. Muzeul Naţional al Unirii Alba Iulia.

ArchBulg – Archaeologia Bulgarica. Sofia.

ArhSom – Arhiva Someşană. Revistă istorică-culturală. Năsăud.

ASSEHR – Advances in Social Science, Education and Humanities Research. Atlantis Press. Amsterdam.

Astra – Astra. Literatură, arte şi idei. Biblioteca Judeţeană „George Bariţiu" – Casa „Baiulescu". Braşov.

Astra Sabesiensis – Astra Sabesiensis. Astra Sabesiensis. Despărţământul Astra „Vasile Moga" Sebeş.

Astra Salvensis – Astra Salvensis. Cercul Salva al ASTRA. Salva.

ATS – Acta Terrae Septemcastrensis. Institutul pentru Cercetarea Patrimoniului Cultural Transilvanean în Context European. Sibiu.

AUASH – Annales Universitatis Apulensis. Series Historica. Universitatea „1 Decembrie 1918" din Alba Iulia.

BA – Biblioteca de arheologie. Institutul de Arheologie din Bucureşti. Bucureşti.

Banatica – Banatica. Muzeul de Istorie al Judeţului Caraş-Severin. Reşiţa.

BAR – British Archaeological Reports (International Series). Oxford.

BB – Bibliotheca Brukenthal. Muzeul Naţional Brukenthal. Sibiu.

BC – Biblioteca şi cercetarea. Cluj-Napoca.

BCŞS – Buletinul Cercurilor Ştiinţifice Studenţeşti. Universitatea „1 Decembrie 1918" din Alba Iulia.

Be-JA – Bulgarian e-Journal of Archaeology.

BEN – Bibliotheca Ephemeris Napocensis. Institutul de Arheologie şi Istoria Artei. Cluj-Napoca.

BerRGK – Bericht der Römisch-Germanischen Kommission des Deutschen Archäologischen Instituts. Frankfurt am Main.

BerWissGesch – Berichte zur Wissenschaftsgeschichte. Wiley-VCH. Weinheim, Germania.

BGB – Berichte der Geologischen Bundesanstalt. Wien Geologische Bundesanstalt. Viena.

Biharea – Biharea. Muzeul Ţării Crişurilor. Oradea.

BHAB – Bibliotheca Historica et Archaeologica Banatica. Muzeul Banatului Timişoara.

BM – Berlinische Monatsschrift. Berlin.

BMA – Bibliotheca Musei Apulensis. Muzeul Naţional al Unirii Alba Iulia. Alba Iulia.

BMJT – Buletinul Muzeului Judeţean Teleorman – seria Arheologie. Alexandria.

BMMSA – Bibliotheca Musei Marisiensis. Seria Archaeologica, Târgu Mureş.

BMN – Bibliotheca Musei Napocensis. Muzeul de Istorie a Transilvaniei. Cluj-Napoca.

BMS – Bibliotheca Musei Sabesiensis. Muzeul Municipal „Ioan Raica". Sebeş.

BNES – Beiträge zur naturwissenschaftlichen Erforschung Siebenbürgens. Oberösterreichisches Landesmuseum, Biologiezentrum/OÖ LANDES-KULTUR GMBH Linz.

Boabe de grâu – Boabe de grâu. Revistă de cultură. Bucureşti.

BR – Budapest Régiségei, Budapesti Történeti Múzeum. Budapest.

Brukenthal – Brukenthal. Acta Musei. Muzeul Național Brukenthal. Sibiu.

BS – Bibliotheca Septemcastrensis. Institutul pentru Cercetarea Patrimoniului Cultural Transilvanean în Context European. Sibiu.

BUA – Bibliotheca Universitatis Apulensis. Universitatea „1 Decembrie 1918" din Alba Iulia.

Buridava – Buridava. Muzeul Judeţean de Istorie Vâlcea. Râmnicu-Vâlcea.

CA – Cercetări arheologice. Bucureşti.

CAC – Central Asia and the Caucasus. CA&C Press AB. Sweden.

Carpica – Carpica. Complexul Muzeal „Iulian Antonescu" Bacău.

CBAstra – Conferințele Bibliotecii Astra. Biblioteca Județeană Astra. Sibiu.

CCA – Cronica cercetărilor arheologice. cIMeC. Bucureşti.

CI – Cercetări istorice. Muzeul de Istorie a Moldovei. Iaşi.

Contimporanul – Contimporanul. Revistă de avangardă, cu program constructivist. Bucureşti.

Corviniana – Corviniana. Acta Musei Corvinensis. Muzeul Castelului Corvineştilor.

Crisia – Crisia. Culegere de materiale şi studii. Muzeul Ţării Crişurilor. Oradea.

Cumidava – Cumidava. Muzeul Judeţean de Istorie Braşov.

Cultura Vâlceană – Cultura Vâlceană. Bilunar de informație cultură. Râmnicu Vâlcea.

Dacia – Dacia. Recherches et découvertes archéologiques en Roumanie. Bucureşti, I, (1924)-XII (1948). Nouvelle série: Revue d'archéologie et d'historie ancienne. Bucureşti.

Dacoromania – Dacoromania. Fundația „Alba Iulia 1918, pentru unitatea şi integritatea României". Alba Iulia.

Danubius – Danubius. Muzeul de Istorie. Galați.

DAJÖ – Das Achtzehnte Jahrhundert und Österreich. Österreichischen Gesellschaft zur Erforschung des Achtzehnten Jahrhunderts. Viena.

DD – Detskiy Dom. Avtonomnaya nekommercheskaya organizatsiya "Detskiy dom". Moskva.

Der Unterwald – Der Unterwald. Asociaţia Evelyne. Sebeş.

Dolgozatok – Dolgozatok az Erdély Nemzeti Múzeum Érem – és Régiségtárából. Kolosvár (Cluj).

Drobeta – Drobeta. Seria Etnografie. Muzeul Regiunii Porţilor de Fier. Drobeta-Turnu Severin.

EphNap – Ephemeris Napocensis. Institutul de Arheologie şi Istoria Artei Cluj-Napoca. Cluj-Napoca.

ER – Ekonomika regiona. Institut ekonomiki Ural'skogo Otdeleniya Rossiyskoy Akademii Nauk. Ekaterinburg.

EMúz – Erdélyi Múzeum. Erdélyi Múzeum az Erdélyi Múzeum-Egyesület, Kolozsvár, 1, 1874-1948, 1991 şi urm.

Ethos – Ethos. Muzeul Satului Dimitrie Gusti. Bucureşti.

ESHR – The European Sports History Review. Frank Cass Publishers. London.

Familia – Familia (seria I: 1865-1906). Oradea.

FMI – Filosofskaya mysl' v Islame. obshchestvo s ogranichennoy otvetstvennost'yu. Izdatel'skiy dom: Medina. Moskva.

Francia – Francia. Forschungen zur westeuropäischen Geschichte. Deutsches Historisches Institut Paris.

FVL – Forschungen zur Volks -und Landeskunde, Sibiu.

Germania – Germania, Römisch-Germanischen Kommission des Deutschen Archäologischen Instituts. Frankfurt am Main.

GeoJournal – GeoJournal. Spatially Integrated Social Sciences and Humanities. Springer Science and Business Media. Netherlands.

GT – Geographia Technica. Geographia Technica Association. Cluj University Press. Cluj-Napoca.

GuG – Geschichte und Gesellschaft. Zeitschrift für Historische Sozialwissenschaft. Berlin.

GNFC – Gumanitarniye nauki, filosofiya i comparativistika. Sankt-Peterburgskiy gosudarstvennyy universitet. Sankt-Petersburg.

Godišnjak – Godišnjak. Jahrbuch Knjiga. Sarajevo-Heidelberg.

GYI – Gumanitarniye i yuuridicheskiye issledovaniya. Severo-Kavkazskiy federal'nyy universitet. Stavropol'.

Helinium – Helinium: revue consacrée à l'archéologie des Pays-Bas, de la Belgique et du Grand-Duché de Luxembourg.

HHR – Hungarian Historical Review. Institute of History, Research Centre for the Humanities. Hungarian Academy of Sciences. Budapest.

Hierasus – Hierasus. Muzeul Judeţean Botoşani.

HSR – Historical Social Research. Leibniz Institute for Social Sciences. Leibniz.

IASL – Internationales Archiv für Sozialgeschichte der deutschen Literatur. Universität Bielefeld. Fakultät für Linguistik und Literaturwissenschaft. Berlin.

IEA – Issues in Ethnology Anthropology. Facultatea de Filosofie. Universitatea din Belgrad. Belgrad.

IGP – Istoriya gosudarstva i prava. Izdatel'skaya gruppa Yurist. Moskva.

Izvestiya Altaysko – Izvestiya Altayskogo gosudarstvennogo universiteta. Altayskiy gosudarstvennyy universitet. Barnaul.

Izvestya ANKSSR – Izvestia Akademii Nauk SSSR. Seriya Literatury I yazyka. Rossiyskaya Akademiya Nauk. Moskva.

Îndrumător bisericesc – Îndrumător bisericesc misionar şi patriotic. Episcopia Aradului. Arad.

JAHA – Journal of Ancient History and Archaeology. Institutul de Arheologie şi Istoria Artei, Universitatea Tehnică. Cluj-Napoca.

JAMT – Journal of Archaeological Method and Theory.

JAS – Journal of Archaeological Science, Academic Press. United States.

JBS – The Journal of Baroque Studies. International Institute for Baroque Studies at the University of Malta.

JCH – Journal of Contemporary History. SAGE Publications Ltd. Thousand Oaks. California.

JLS – The Journal of Legal Studies. The University of Chicago.

JLSt – Journal of Lithic Studies. Edinburgh.

JSCS – Journal of the Serbian Chemical Society. Beograd.

JSH – Journal of Sport History. University of Illinois Press. Champaign.

JSKV – Jahrbuch des Siebenbürgischen Karpatenvereins. Sibiu.

JSPS – The Journal of Social Policy Studies. National Research University Higher School of Economics. Moscow.

JTCA – Journal of Thermal Analysis and Calorimetry.

Khirurgiya – Khirurgiya. Zurnal imeni N. I. Pirogova. Media Sfera Moskva.

Karpatenrundschau – Karpatenrundschau. Braşov.

Les Nouvelles	– Les Nouvelles de l'Archéologie. Fondation Maison des sciences de l'homme.
MAA	– Mediterranean Archaeology and Archaeometry. The University of the Aegean, Greece.
MCA	– Materiale şi cercetări arheologice. Bucureşti.
MemEthn	– Memoria Ethnologica. Revistă de patrimoniu ethnologic şi memorie culturală. Centrul Judeţean Pentru Conservarea şi Promovarea Culturii Tradiţionale Maramureş. Baia Mare.
MH	– Melita Historica. Malta Historical Society. Floriana.
MI	– Man in India. Serials Publications Pvt. Ltd. New Delhi.
MInt	– Masonry International. International Masonry Society. Shermanbury (UK).
Museikon	– Museikon. Muzeul Naţional al Unirii din Alba Iulia.
Muzeum	– Muzeum. Muzejní a vlastivedná práce. National Museum. Prague.
MWM.MöGW	Mensch, Wissenschaft, Magie. Mitteilungen der österreichischen Gesellschaft für Wissenschaftsgeschichte. Österreichische Gesellschaft für Wissenschaftsgeschichte. Viena
NBFI	– NB: Filologicheskiye issledovaniya. Akademiya nauk SSSR. Moskva.
Neo-Lithics	– Neo-Lithics. The Newsletter of Southwest Asian Neolithic Research.
Noesis	– Noesis. Academia Română. Bucureşti.
OI	– Otechestvennaia istoriia. Nauka. Moskva.
Opción	– Opción. Universidad del Zulia. Maracaibo.
Orizont aviatic	– Orizont aviatic. Publicaţie pentru propaganda Aviaţiei. Arad.
PA	– Patrimonium Apulense. Direcţia Judeţeană pentru Cultură Alba. Alba Iulia.
Plural	– Plural. Revista Departamentului de Istorie şi Geografie a Universităţii Pedagogice de Stat „Ion Creangă". Chişinău.
Pontica	– Pontica. Muzeul de Istorie Naţională şi Arheologie. Constanţa.
Povestea Vorbii 21	– Povestea Vorbii 21. Asociaţia Oamenilor de Ştiinţă şi Artă.
PS	– Prosveshcheniye v Sibiri. Sibirskoye regional'noye upravleniye narodnogo obrazovaniya. Novosibirsk.
PZ	– Prähistorische Zeitschrift. Deutsche Gesellschaft fuer Anthropologie, Ethnologie und Urgeschichte, Institut für Prähistorische Archäologie. Berlin.
Rabotnitsa	– Rabotnitsa. Pravda. Moskva.

Radiocarbon – Radiocarbon. University of Arizona. Department of Geosciences.

RAIA – Revista de Artă şi Istoria Artei. Muzeul Municipiului Bucureşti. Bucureşti.

Răsăritul nostru – Răsăritul nostru. Organ pedagogic cultural şi social al surdo-muţilor din România (1932-1949).

RBNR – Revista Bibliotecii Naţionale a României. Biblioteca Naţională a României. Bucureşti.

ReDIVA – ReDIVA. Revista Doctoranzilor în Istorie Veche şi Arheologie. Universitatea „Babeş-Bolyai" din Cluj-Napoca.

Renaşterea – Renaşterea. Organ Oficial al Eparhiei Ortodoxe Române a Vadului, Feleacului, Geoagiului şi Clujului. Cluj.

RdHPh – Revue d'Histoire de la Pharmacie. Société d'histoire de la pharmacie. Paris.

Res montanarum – Res montanarum : Zeitschrift des Montanhistorischen Vereins für Österreich. Montanuniversität Leoben.

RevBibl – Revista Bibliotecilor. Bucureşti.

Revista CICSA – Revista CICSA. Centrul de Istorie Comparată a Societăţilor Antice. Bucureşti.

RHSEE/RESEE – Revue historique du sud-est européen. Academia Română. Bucureşti, Paris (din 1963 Revue des études sud-est européennes).

RI – Revista de Istorie (din 1990 Revista istorică). Academia Română. Bucureşti.

RIP – Romanian Journal of Physics. Academia Română. Bucureşti.

RM – Revista Muzeelor. Bucureşti.

RMI – Revista Monumentelor istorice. Institutul Naţional al Patrimoniului. Bucureşti.

RMMM – Revista Muzeelor şi Monumentelor, Muzee. Bucureşti.

RRH – Revue Roumaine d'Histoire. Academia Română. Bucureşti.

RT – Revista Teologică (între anii 1956 şi 1991 a apărut sub denumirea de Mitropolia Ardealului). Mitropolia Ardealului. Sibiu.

Sargetia – Sargetia. Acta Musei Devensis. Muzeul Civilizaţiei Dacice şi Romane. Deva.

Science – Science. American Association for the Advancement of Science. Washington D.C.

SCIATMC – Studii şi Cercet. Ist. Art., Teatru, Muzică, Cinematografie. Institutul de Istoria Artei „G. Oprescu". Bucureşti.

SCICPR – Studii şi comunicări de istorie a civilizaţiei populare din România. Sibiu.

SCIV(A) – Studii şi cercetări de istoria veche (din 1974, Studii şi cercetări de istorie veche şi arheologie). Bucureşti.

SCN – Studii şi cercetări de numismatică. Institutul de Arheologie Bucureşti. Bucureşti.

SIB – Studii de istorie a Banatului. Timişoara.

SMIM – Studii şi materiale de istorie medie. Institutul de Istorie „Nicolae Iorga" al Academiei Române. Bucureşti.

SP Suplementum – Studii de Preistorie Suplementum, Bucureşti.

Studii vâlcene – Studii vâlcene. Societatea Prietenii Muzeului Bălcescu, în colaborare cu Arhivele Statului Râmnicu Vâlcea. Râmnicu Vâlcea.

SZ – Soiuz Zhenshchin. Soiuz ravnopraviia zhenshchin. Sankt Petersburg.

SP – Studii de Preistorie. Asociaţia Română de Arheologie. Bucureşti.

St.Com.Etn – Studii şi Comunicări de Etnologie. Institutul de Cercetări Socio-Umane Sibiu.

StComSibiu – Studii şi Comunicări. Arheologie-Istorie. Muzeul Brukenthal. Sibiu.

StComSibiu-ŞN – Studii şi comunicări. Ştiinţele Naturii. Muzeul Brukenthal. Sibiu.

Studii – Studii. Revistă de istorie (din 1974 Revista de istorie şi din 1990 Revista istorică). Academia Română. Bucureşti.

SUBBC – Studia Universitatis „Babeş-Bolyai", series Chemia. Universitatea „Babeş-Bolyai". Cluj-Napoca.

SUCSH – Studia Universitatis Cibiniensis. Series Historica. Universitatea „Lucian Blaga" Sibiu. Sibiu.

SV – Siebenbürgische Vierteljahrschrift. Sibiu.

SQ – Siebenbürgische Quartalschrift. Sibiu.

Terra Sebus – Terra Sebus. Acta Musei Sabesiensis. Muzeul Municipal „Ioan Raica" Sebeş.

Transilvania – Transilvania. Centrul Cultural Interetnic Transilvania. Sibiu.

TSUJ – Tomsk State University Journal. Tomsk.

Tyragetia (International) – Tyragetia. Muzeul Naţional de Arheologie şi Istorie a Moldovei. Chişinău.

Utopia – Utopia. Revistă de cultură generală. Cluj.

VAH – Varia Archaeologica Hungarica. Budapest.

Vestnik Moscovskoy – Vestnik Moscovskoy shkoly politicheskikh issledovaniy. ANK Moskovskaya shkola grazhdanskogo prosveshcheniya. Moskva.

Viaţa românească – Viaţa Românească. Revistă literară şi ştiinţifică. Iaşi.

VPU	– Vestnik Permskogo universiteta. Permskiy Gosudarstvennyi Universitet. Perm.
ZfB	– Zeitschrift für Balkanologie. Balkanologenverband e.V. Jena.
Ziridava	– Ziridava. Muzeul Judeţean Arad.
ZV	– Zhenskii Vestnik. Sankt Petersburg.
ZRO	– Zhenshchina v rossiiskom obshchestve. Ivanovskiy Gosudarstvennyi Universitet. Ivanovo.
ZS	– Zhizn' Sibiri. Sibirskiy revolyutsionnyy komitet. Novonikolayevsk.
WMQ	– The William and Mary Quarterly. Omohundro Institute of Early American History and Culture.