A classification of types of the Italian archaeological heritage is presented. The classification is centred on the structural behaviour and is the basis for subsequent studies on seismic vulnerability and risk. Twenty-two types are considered which comprehend the heritage of prehistoric, Etruscan, Greek and Roman Ages. For each type, there are given a description of the structural elements and a list of sites where specimens of the type are present.

INTRODUCTION

Recent Italian destructive earthquakes (Friuli 1976, Irpinia 1980 and Umbria-Marche 1997) had a heavy impact on the historical and monumental heritage. In particular, the archaeological heritage was recognized to exhibit a high degree of risk because of its state of decay.

In 1998 the Italian National Group for the Defence against Earthquakes started a research activity on archaeological heritage. The first phase of the activity was aimed at establishing a classification of types and studying the response of common elements under seismic actions. The vulnerability evaluation of the types and the design of restoration interventions, purposely conceived to respect the original conception of the works and their historical testimony, will be the subject of subsequent phases of the research.

The classification of types, centred on the structural behaviour, is presented in this study. Twenty-two types are considered which comprehend the heritage of prehistoric, Etruscan, Greek and Roman Ages. For each type, there are given a description of the structural elements and a list of sites —unavoidably non-exhaustive— where specimens of the type are present which are clearly recognizable, in the sense that they are not included in later buildings. The list does not include those sites where the presence of ancient constructions is documented by historical or literary sources only. Some types, like the Doric temple, are subdivided into sub-types depending on the different behaviour of the remains under earthquake.

PREHISTORIC AGE

Menhirs

_Bari, Otranto, Giurdignano._

Menhirs are megaliths of lengthened shape made of a stone block, generally raw or irregularly hewn out, driven into the soil like a coarse obelisk, sometimes pierced. It is conjectured that menhirs precede dolmens. Menhirs may be of different shape (cylindrical, obelisk-like, prismatic, irregular) and their height is generally below 5 m.
**Dolmens**

*Bisceglie, Giovinazzo, Corato, Melendugno, Minervino di Lecce, Mazzarino, Cava dei Servi*

Dolmens are made of one or more horizontal plates supported by rocks driven vertically into the soil. The surface of the vertical rocks is raw or slightly hewn out, so that only point contacts are present between them and the horizontal plate. The basic type consists of four plates, three driven into the soil and the fourth for roofing, forming a square cella. More complex shapes are exhibited by some dolmens found in South-Eastern Sicily during recent archaeological campaigns; for instance, the dolmen found in Cava dei Servi (Ragusa) is made of big calcareous plates forming a cella with circular plan.

**Megalithic walls**

*Regione molisana, Beneventano, Frosinone*

The earlier type is the Cyclopean fabric, a continuous structure made of big rocks, with size 1 m or larger, raw or roughly hewn out, forming a dry wall.

The later type is the polygonal fabric (Fig. 1), made of blocks hewn out to form a polygonal shape, with the surfaces at the joints roughly smoothed, resulting in a facing consisting of an assembly of irregular polygons.

**ETRUSCAN AGE**

![Figure 1](image)

Wall in polygonal fabric, Alba Fucens

**Etruscan town walls**

*Volterra, Roselle, Vetulonia, Fiesole, Chiusi, Arezzo, Tarquinia, Tuscania, Roma, Cerveteri, Veio, Vulci, Palestrina, Civita Castellana, Arpino*

Etruscan walls and arch gates are always imposing: big blocks of calcareous rock, basalt or tuff assembled without interposition of mortar, to form a polygonal fabric or an *opus quadratum*. The stone is local and differs from zone to zone of Etruria: in Southern Tuscia — comprised between present Tuscany and the Tiber — the stone is always volcanic tuff cut in parallelepiped blocks with length 1.20 m and height 0.60 m, forming a two leaves wall filled by rough stones and mortar; in Volterra the walls are made of blocks in sandstone arranged according to the polygonal fabric or the *opus quasi quadratum*; in Roselle the walls consist of horizontal courses of irregular blocks 2–3 m long and 1–2 m high, and smaller stones filling the interstices; in Fiesole the walls are made of stones hewn out in a rough parallelepiped shape and arranged in horizontal courses with stones cut into wedges interposed between different blocks; in Arezzo the town walls are made of big green clay bricks.

**Etruscan and Greek arch gates**

*Volterra, Perugia, Velia*

The early Etruscan arch gates have a horizontal monolithic architrave, as those of the Mycenaean Age. The late gates have a round arch with three patroness godheads. The Etruscans built round arches since the 6th century B.C., as proved by the Cloaca Maxima in Rome which dates back to Tarquinus Priscus.

The unique example of arch in the Magna Graecia is the Porta Rosa in the town wall of Velia (the early Elea), made of two piers in sandstone supporting a round arch made of radial sandstone voussoirs, with a discharge arch above.

**Corbelled vaults**

*Volterra, Quinto Fiorentino, Montefortini, Vetulonia, Tivoli*

Corbelled vaults are found in monumental tombs, and consist of squared stone blocks projecting inwards closer and closer to each other until they meet.
Sometimes, a pillar supports the central block at the top (Fig. 2). The equilibrium of the corbelled vault is provided by the outer dry-stone wall which acts as a counterfort. The plan is often circular, but square and sometimes rectangular plans are present as well.

Corbelled vaults are only present in Northern Etruria. Often, they are covered by a soil tumulus which is enclosed by stones or a tambour.

GREEK AGE

Town walls of the Hellenistic Age
Pompeii, Velia, Paestum, Cefalù, Agrigento, Siracusa, Lentini, Megara Hyblaea, Tindari, Selinunte, Gela, Eraclea Minoa, Nasso, Erice

The walls of the Hellenistic Age result from the assembly of large blocks of sandstone, marble, tuff and sometimes green bricks, arranged to form dry walls according to the polygonal fabric or the *opus quadratum*.

The *opus quadratum* consists of squared blocks. The fabrics are essentially three. The first fabric consists of a sequence of two or more blocks arranged in the longitudinal direction—the orthostats—alternated with a block arranged in the transverse direction—the diaton. The second fabric consists of a sequence of two or three courses of orthostats alternated with a course of orthostats of different size, lower and penetrating into the wall. The third fabric consists of all diatons, i.e. blocks arranged in the transverse direction.

The *opus quadratum*, broadly used by the Greeks in the classical age, was laborious because of the necessity to square, transport and position the blocks. In the Roman world, it was initially adopted to build the leaves for the *opus caementicum*, and subsequently abandoned.

The resistance of the wall is increased by cramps or dogs. Originally, dogs were simple swallow-tailed dowels in oak wood. Subsequently, cramps in bronze or iron were used with Z, I, C or double swallow-tailed shape.

The material is usually stone, but examples are present of green clay bricks as well.

Doric temples: basements
Caulonia, Imera, Agrigento

The colonnade of the Doric temple rests on a basement with three or more steps, the highest of which (stylobate) is the floor of the temple. The basements consists of courses of big parallelepiped blocks in local stone (sandstone, alluvial conglomerate, travertine, volcanic tuff), usually porous and cracked.

Doric temples: free standing columns
Capo Colonna, Agrigento, Selinunte

The Doric column is made of local stone, has no plinth and rests directly on the stylobate. The shaft, channelled during the finishing, is monolithic only in early temples (7th–6th century B.C.). Since the second half of the 6th century B.C., the shaft is formed by drums, usually 4 to 9, is tapered and has a swelling
(entasis) at approximately one third of the height. The aspect ratio of the shaft — i.e. the ratio between the diameter at the base, or the average diameter, divided by the height — is equal to 1:4 in early temples, and decreases to 1:6, showing the trend to make the column more and more slender. The top of the shaft is a single block with the capital, with truncate conic or basin shape (echinus), surmounted by a parallelepiped with square base (abacus). Each drum has at its centre a square hole for the insertion of a pin.

Presently, Doric columns show significant decay: crumbling, more or less superficial crazing and macrocracks originated by atmospheric agents. Damage is also present: thin vertical cracks along the shaft and large fractures at the perimeter of the interface between drums originated by impacts induced by earthquakes.

Doric temples: columns with architraves

Metaponto, Paestum, Agrigento, Selinunte

The architrave (epistyle) consists of elements in local stone which join on the axes of the columns. The distance between columns is small in early temples (approximately 1.50 m in the 6th century B.C.), and increases during the maturity of Doric order (2.40 m in the 5th century B.C.). The columns of the façade are placed at a larger distance, so as to emphasize the longitudinal axis of the temple.

The preservation of intact architraves can be explained by the presence of cramps which induce a global motion of the colonnade.

Decay phenomena are present in abaci or architraves, in a way similar to columns. Typical remedies are confinement or reinforcement through iron bars.

Doric temples: colonnades, architraves, friezes, frontons

Agrigento, Paestum, Segesta

The temples better preserved have friezes and frontons.

The frieze, resting on the architrave, consists of triglyphs and metopes and is made of two rows of blocks, inner and outer, in local stone.

The fronton is the triangular wall (tympanum) enclosed by a horizontal cornice and two inclined cornices under the slope of the roof. The tympanum and the inclined cornices often show large cracks and partial collapses originated by atmospheric agents, pollution, wrong interventions and earthquakes.

Doric temples: double tier of columns

Paestum

In some temples (e.g. the temple of Poseidon in Paestum) the cella is subdivided into three naves through two rows of columns with double tier supporting the roof.

Roman age

Substructiones

Otricoli, Tivoli, Roma, Todi, Pierre Taillée.

Substructiones are structures supporting a horizontal plane in a slope through masonry walls, sometimes connected each other through orthogonal walls, with interposed soil.

Vitruvius proves that the problem of the thrust of the soil on the substructiones was well known and states the rules for this type of structures: «The thickness of the masonry shall correspond to that of the soil which is put behind. Then the retaining walls (anterides) and the counterforts (erismae) shall be built simultaneously. The distance between the counterforts shall be equal to the height of the substructiones and their thickness to the thickness of those». Vitruvius only deals with «full» substructiones, where the main element is the soil, more or less restrained by masonry walls, connected on the front and without an autonomous covering.

A different type, as much as common, is represented by «hollow» substructiones, whose resistance is provided by a set of rooms vaulted in opus caementicum.

Thermae

Roma, Albano, Baia, Pompei, Ercolano, Saturnia, Ravenna, Catania

The typical element of thermal architecture is the vault, used to cover different rooms (apodyterium,
The Italian archaeological heritage

The Italian archaeological heritage

*laconicum, frigidarium, tepidarium, caldarium*). The barrel vault is the type most frequently used. Cross vaults are frequent as well and are present in grand size in the Thermae of Titus, Caracalla, Diocletian, in the hall of the Market of Trajan and in the Basilica of Maxentius. Cloister vaults are rather uncommon.

The development of the vault coincides with the achievement of the *opus caementicum*. Frequently, the vault has brick ribs. Several expedients were used to lighten the vault: light inerts for the higher part of the vault, or empty amphorae purposely made and inserted one into the other to form rows incorporated into the casting. Frequently, the heated rooms were covered by a double vault: the countervault was suspended to hooks clamped into the vault forming a hollow space for the passage of heated air.

The problem of the thrust was solved in several ways. Apart from the simplest remedy to enlarge the piers, counterforts were used for both barrel vault and cross vaults. Another remedy was to build smaller vaults near the main vault, so that they counterfort each other. For the domes, the thrust was usually carried by inner counterforts formed by thick walls with large niches. Another way to carry the thrust of domes was to surround the impost by an annular barrel vault.

Frequent types of damage are the collapse of the whole vault or a portion of it, and cracking at the intrados along the meridians of domes. Usually, the degree of damage increases from barrel vaults to cross vaults and domes.

**Aqueducts**

*Roma, Acqui Terme, Tortona, Albenga, Minturno, Spello, Napoli, Termini Imerese*

The importance ascribed by the Romans to water supply is documented by the treatise *De acquae ductu urbis Romae* written by Frontinus in 98 A.C. which contains the experience of four centuries. Aqueducts usually tapped springs, even at the cost of lengthening their course. Water flowed inside a channel (*specus*) with plane or vaulted cover, and size such as to be easily accessible for cleaning and repairs. At regular intervals, air intakes restored the atmospheric pressure. The channel, in ashlar or brick masonry, was waterproofed through a thick plaster of *opus Signinum*, a mix of lime, sand, hard stones of small size.

Initially, aqueducts were underground for the whole course (*Aqua Appia*, 312 B.C.). However, when the channel had to cross a valley or cover a plain, it was necessary to support it by arches (*Anio Vetus*, 272 B.C.). The first Roman aqueduct on arches is the *Aqua Marcia*, 144 B.C.: built in *opus quadratum*, it runs on voussoir arches with span 5.10–5.35 m.

The arches are always round and discharge on piers of large cross section with core in *opus caementicium* within masonry leaves. Aqueducts had to be very stiff at the level of the channel, where even small cracks undermined their functionality. However, unavoidably they faced inhomogeneities of the soil which made necessary structural restorations consisting of arches and piers.

**Triumphal arches**

*Roma, Aosta, Susa, Torino, Ravenna, Verona, Trieste, Rimini, Ancona, Ascoli Piceno, Fano, Malborghetto, Spoleto, Spello, Benevento, Pompei, Sepino*

The elements of the triumphal arch are: vault, piers and upper block, usually with the shape of an attic, which is the base of the statues. The arch is usually round. The fabric is the *opus quadratum*. For two-faced monuments, placed across a road, the type with single barrel vault is the most common. However, for works of major importance, the type with three vaults is used, with the central vault larger and higher than the side vaults.

Almost never two-faced arches are free standing: they join other buildings like town walls, stadia or aqueducts.

On the contrary, four-faced arches are always free standing. They are complex monuments dating back to the most developed age of Roman architecture (3rd and 4th centuries A.C.). They are located at the crossing of two roads which intersect at right angle, and have cross vaults or domes.

Architects usually have an odd number of vousoirs, with the keystone. There are three types of arches: a) extradossed, i.e. with the extradosses concentric to the intrados; b) with pentagonal vousoirs; c) with hammer shaped vousoirs. The connection between different vousoirs is sometimes improved through cramps.
Piers are massive, according to Vitruvius: «When arches are made of wedge shaped voussoirs, piers shall have a larger width so as to be strong and resist when the voussoirs, pressed downward by the weight of masonry, because of their connections, tend to fall at the centre, while at the impost they thrust outward. Therefore, piers of large size will be able to restrain the thrust and provide stability to the building».

**Roman temples**
*Roma, Tivoli, Terracina, Palestrina, Cori, Pompei, Baia, Assisi, Brescia*

From the typological point of view, Roman temples are derived from the Etruscan-Italic models; they are «frontal» buildings, resting on a basement and surrounded by columns on three sides.

The characteristic element of the Roman temple, which distinguishes it from the Greek temple, is the plataband, assimilable to the architrave from the point of view of shape, and to the arch from the point of view of structure. However, the plataband cannot be used for long spans because its considerable thrust. Platabands may have wedge, hammer or bayonet shaped voussoirs.

A developed version of the plataband is reinforced: slots were made in the pulvinos to fit two or three iron bars which carried the tensions at the intrados.

The walls of the cella are made of opus quadratum or opus latericium, the vaults of opus caementicium. The drums of the columns and the elements of the trabeation are made of travertine or marble and are usually connected each other through dogs or cramps inserted in slots purposely made and filled with cast lead.

**Bridges**
*Roma, Rimini, Verona, Padova, Narni, Ascoli Piceno, Spoleto, Vulci, Ferento, Blera, Benevento*

The original contribution of the Romans is the arch bridge with multiple spans. The arches are made of voussoirs or masonry. The most frequent shape is the round arch, followed by the flat arch. The spandrels are made of block or brick masonry. The fill of vaults and piers is in opus caementicium. The foundation consists of a single plataband made of blocks or a bed in opus caementicium. Sometimes, the piers are skewed to follow the current, as in the bridge of Rimini and Ponte Milvio in Rome, and provided with breakwater. Typical spans are:

- Ponte Salario, 3 arches, spans: 4.12, 22.76, 4.12 m;
- Ponte Elio, 5 arches, spans: 7.00, 18.33, 18.33, 18.33, 7.00 m;
- Ponte Fabricio, 2 arches, spans: 24.25, 24.50 m;
- Ponte Cestio, 3 arches, spans: 5.80, 23.65, 5.80 m.

The width of bridges is not greater than 7–8 m. The ratio between the thickness of the arch at the key and the span does not follow a precise rule: according to Leger, it ranges from 0.045 (bridge of Narni) to 0.133 (Ponte Fabricio) with average 0.086, calculated on 20 cases studied.

Since the beginning of the 3rd century B.C., the achievement of concrete posed problems of detachment between the leaves and the inner core. Therefore, the voussoirs at the intrados were connected each other by cramps, and the concrete fill was subdivided by inner walls forming several cells (Fig. 3).
Roman theatres


The elements of the Roman theatre derive from those of the Greek theatre, but with significant innovations: the theatre becomes a building, free from soil morphology. Before reaching a complete independence from orographic conditions, since the second half of the 2nd century B.C. up to the first half of the 1st century B.C., the theatre goes through the so-called Greek-Roman phase (Fig. 4).

The Roman theatre has its origin in 55 B.C. with the erection of the theatre of Pompeii. The gradin for the audience (cavea), has semicircular shape, consists of ima, media and summa cavea, is subdivided in several areas (maeniana) and is supported by two or three tiers of arches and pillars. The audience entered through stairs flowing into the centre of each block of seats through purposely made vomitoria. Often the cavea is surrounded by a sheltered gallery (porticus in summa cavea). The orchestra of the Greek theatre, which lodged the chorus, reduces itself to a semicircular area. The stage (pulpitum) is raised 1.0–1.5 m above the level of the orchestra. The scene (scenae frons) is a structure with two or more storeys, as much high as the cavea, with which it forms a single building. The cavea is closed at both sides by retaining walls (analemmita) parallel to the stage and separated from this by entrance aisles vaulted in opus caementicium. Therefore, the Roman theatre is a closed building which only lacks the roof: it could be temporarily sheltered by large sheets (velaria).

The elements of the theatres are now in different states: in Roman theatres, the substructiones below the cavea are preserved, but the latter lacks the gradin; in the Greek theatres of Southern Italy and Sicily, the cavea is deprived of the steps, but the shape is clearly preserved. The scene is generally in bad state.

Amphitheatres


Amphitheatres are typically Roman buildings, born to lodge gladiatorial performances.

There are two types of amphitheatres. The former type, on embankment (Pompeii), similarly to the Greek theatre, fits itself to soil morphology, and the gradins rest on the soil retained by walls. An aisle, vaulted in masonry, runs below the first row of seats. The latter type is more strictly architectural and has radial walls with facings in opus quadratum or opus latericium and concrete fill, connected each other through inclined barrel vaults supporting the cavea (Fig. 5). Generally, amphitheatres have two tiers of arcades, sometimes surmounted by an attic with rectangular or arched windows. Few amphitheatres have three tiers of arcades, as the Amphitheatre of Capua and the Flavian Amphitheatre (Coliseum) in Rome.

Often, amphitheatres had to be restored. Restorations were carried out under the Emperors Julius, Claudius, Trajan and Hadrian. Regulations were issued by Tiberius in consequence of the collapse of the amphitheatre near Fidenae. Sometimes, the reason of strengthening was the increase of the audience. Typically, interventions consist of jacketing the annular wall supporting the media cavea.
Dwelling types

Roma, Tivoli, Albano, Viterbo, S. Maria Capua Vetere, Pompei, Ercolano, Baia, Pozzuoli, Capri, Piazza Armerina

The *casa insula* is a block of dwelling houses up to three storeys in brick masonry or other cheap technique. It has arches and vaults at ground floor and cantilever balconies.

The *domus* and *villa* are houses with rich and wide illustration of curvilinear architecture.

The masonry types used in dwelling houses, as well as public buildings, can be organized into different classes, based on the characteristics of the stone, initially used for the whole thickness of the walls, and subsequently only for the leaves.

The earliest type is the *opus quadratum*, made of parallelepipided stones. This technique was supplanted by the *opus caementicum*: since the end of the Republic masonry consists of two leaves (*crustae*) and an inner core (*structura caementicia*). The *opus caementicum* was made of scraps of stone or brick mixed with lime, sand and water; therefore, *caementicum* means: «made of caementum». This component of the mix had not the modern meaning of binder — taken by the word cement only at the end of the 18th century — but the meaning of «scraps of stones», since the word *caementum* derives from the Latin verb *caedo*, that is «to cut into pieces».

In hydraulic works, sand was replaced, all or partly, by volcanic pozzolan from Baia or Cuma: the property of concrete made of lime and pozzolan to harden under water was well-known, as testified by Vitruvius who provides the instructions for the correct choice of the components and their proportion in the mix. Pliny the Elder and Vitruvius himself recommend to tamp the cast. Roman concrete was similar to modern concrete; the major differences, besides the obvious differences of mix, transport and tamping, regard the type of inerts and binder. In the *opus caementicum*, the role of binder, played in modern concrete by cement, was committed to lime, alone or with pozzolan; the inerts are sand and scraps of stone or bricks, not larger than a hand, as suggested by Vitruvius.

The earliest type of leaf is the *opus incertum*, consisting of stones embedded into the core, with an irregular surface in sight. Alignments on the vertical were avoided, with the aim to prevent cracking. When the leaf was made of cobblestones, it was necessary to insert frequent levellings aimed at smearing the loads on the section. Therefore, since the Augustan Age, horizontal brick belts were inserted into the wall.

At the beginning of the 1st century B.C., the stones become more and more regular (*opus quasi reticulatum*). The subsequent *opus reticulatum* is made of small truncated pyramid-shaped elements (*cubilia*) with square base (side 5–7 cm) made of different materials, forming a net inclined at an angle of 45°. The advantage of the *opus reticulatum* was the standardization of the material. However, Vitruvius trusted the *opus incertum* more than the *opus reticulatum* because the latter required more mortar in the core and was in consequence more compressible, making easier the detachment of the leaves.

The *opus mixtum*, lasting since 50 B.C. up to the end of the 2nd century A.C., is an *opus reticulatum*, with levellings made of horizontal courses of bricks. The subsequent scheme, the *opus vittatum*, initially used in the peripheral regions of Italy, replaces the *opus reticulatum* in Central Italy since the 3rd century.
A.C., becomes the most common type during the late Empire, and continues to be used in the early Middle Ages. The leaves are made of square stone tiles arranged in horizontal courses—like bandages, «vittae» in Latin— or, in the opus vittatum mixtum, alternating stone tiles with courses of bricks.

Brick masonry may be of two types: the opus latericium, wholly made of baked bricks, and the opus testaceum, with only the leaves in baked bricks. The bricks baked in kiln are the great innovation of Roman building technique. They were made of clay mixed with water and sometimes with sand, straw or fine pozzolan in small amount: the mix was compressed in a square wooden mould with side 20 cm (2/3 of Roman foot or «bessal»), 30 cm (Roman foot or «pedal»), 45 cm (1.5 Roman feet or «sesquipedal») or 60 cm (2 Roman feet or «bipedal»). The thickness ranges from 4 to 2.8 cm, decreasing from the Flavian Age to the Severian Age. The bricks were initially put to dry in the sun, then in a sheltered and ventilated place, and finally baked in a kiln at 800 °C. The porous and lightly rough surface improved the bond with the mortar in bed joints; sometimes, furrows of different shape were made on their surface.

The opus latericium was employed for the whole thickness of the wall when high compressive strength was required. A small amount of mortar was used in both bed joints and head joints.

In the opus testaceum bricks are cut diagonally to form two triangles, and placed with the diagonal face in sight and the right angle embedded into the inner opus caementicium with the aim to improve the connection between leaves and core. A further improvement of the connection was provided by the insertion of bipedals.

Bricks were employed in arches, vaults and discharge arches. The latter are structural, i.e. have the same thickness of the wall, up to two Roman feet. When the wall is thicker, they are limited to the leaves and do not penetrate into the core.

The first example of opus testaceum is the House of Tiberius on the Palatine. Since then, it gradually replaces the opus reticulatum in urban houses.

Another type of masonry is the opus Africanum, employed in Southern Italy and Sicily. It consists of big stone blocks, arranged in the horizontal and vertical directions, with the empty spaces filled by material of small size (Fig. 6).
disliked this technique because of its vulnerability to fire, moisture, and cracking at the interface between timber and masonry, but justified it for reasons of rapidity or small carrying capacity of the soil.

**Columns with winding staircase**

*Roma*

The Column of Trajan, completed in 113 A.C., inaugurates the monumental type of the free standing column, decorated with a spiral frieze, with an inner winding staircase (Fig. 8). The column is one hundred Roman feet high (29.78 m). The shaft consists of 17 huge drums in Carrara marble, with diameter 3.83 m and height 1.56 m. At approximately one third of the height, the column presents the traditional entasis aimed at improving the optical effect. The spiral frieze was made after the column had been assembled. The decision to make the column accessible through the inner staircase was probably taken after the completion. The connection between the drums is provided, besides the large contact surface, by pins driven into holes purposely made.

On the model of the Column of Trajan, the Column of Marcus Aurelius was erected by 193 A.C. It is one hundred Roman feet high as well, has diameter at the base 3.80 m and at the top 3.66 m, without entasis. The shaft consists of 19 drums. The third column of the Roman Forum is the Column of Foca, rebuilt in 608 A.C. with earlier materials, probably dating back to the 2nd century A.C.

Columns with winding staircase are different from Doric columns with regard to material (marble instead of porous rock) and size (columns with winding staircase have both larger base and larger slenderness). Presently, they show damage originated by earthquakes, as shown by slidings of the friezes.

**CONCLUSIONS**

A classification of types of the Italian archaeological heritage is presented. The classification is centred on the structural behaviour and is the basis for subsequent studies on seismic vulnerability and risk. The study only deals with the types located in earthquake prone regions of Italy, and therefore excludes some types (stone huts and terraced buildings in Lecce area, vault structures in the Salento peninsula, prehistoric nuraghi and holy wells of Sardinia).

Seismic vulnerability is strongly dependent—besides the obvious factors of shape, material and boundaries—on the decay of the materials, hydrogeologic instability, meteorological and climatic conditions, damage induced by earthquakes, work of man.

This study is the summary of the extensive literature on the subject and represents a synthetic reference for further studies aimed at a systematic evaluation of vulnerability.

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