

Chronology of the Roman Baths of “Indirizzo” in Catania (Sicily)

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Abstract – The Baths of Indirizzo in Catania represent one of the best preserved thermal buildings in the Roman Empire. The goal of this research is twofold and concerns the determination of the date of the monument construction and of its last use. For these purposes, brick samples were collected at specific points of the baths, in order to date them by thermally stimulated luminescence. On this occasion we present some partial results and the study carried out for the optimization of the measurement protocol on historical terracotta.

I. INTRODUCTION

Sicily, in Roman times, was full of thermal complexes, both public and private. Thermal baths had hygiene function and sometimes even of therapy, and were also a popular place for meeting and entertainment, as well as for social and cultural exchange. Catania has some of the richest testimonies of these buildings, among which the most significant are the *Rotonda* and *Indirizzo* thermal baths. The latter represent the best preserved Roman thermal baths anywhere in Sicily and one of the best preserved in the Roman Empire (Figure 1).



Figure 1 – Southeast front of the Indirizzo Baths

The monument is located in *Piazza Currò*, in the historic centre of the city, and were fed by river *Amenano*. The

name is due to the adjacent church of *Santa Maria dell’Indirizzo* and to the near Carmelite convent, now used as a school. The church and the monastery, founded in the seventeenth century, were rebuilt after the earthquake of 1693. During the reconstruction, the thermal baths were partially incorporated into the convent and, thanks to this circumstance, have been preserved in good condition until the present days.

The *Indirizzo* Baths consist of 13 vaulted rooms (Figure 2), which define a complex with a longitudinal axis oriented in a north-south direction. This complex has an irregular shape, as a result of the presence of non-orthogonal walls and the addition of some later chambers (rooms 3, 6, 12 and 13).

The supposed original use of the 13 rooms is indicated in the plan of Figure 2.

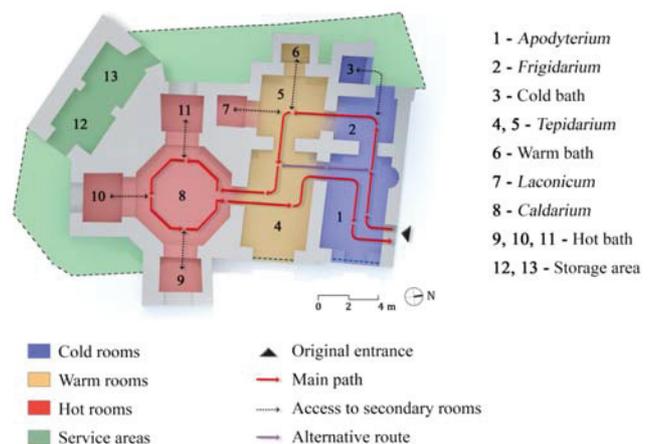


Figure 2 – Schematic plan of thermal complex with supposed bathers’ routes

According to the proposed reconstruction, based on the study of the existing bibliography and on an accurate onsite analysis, the *apodyterium* – an unheated chamber used as dressing room, usually located near the entrance of the baths – corresponded to room 1.

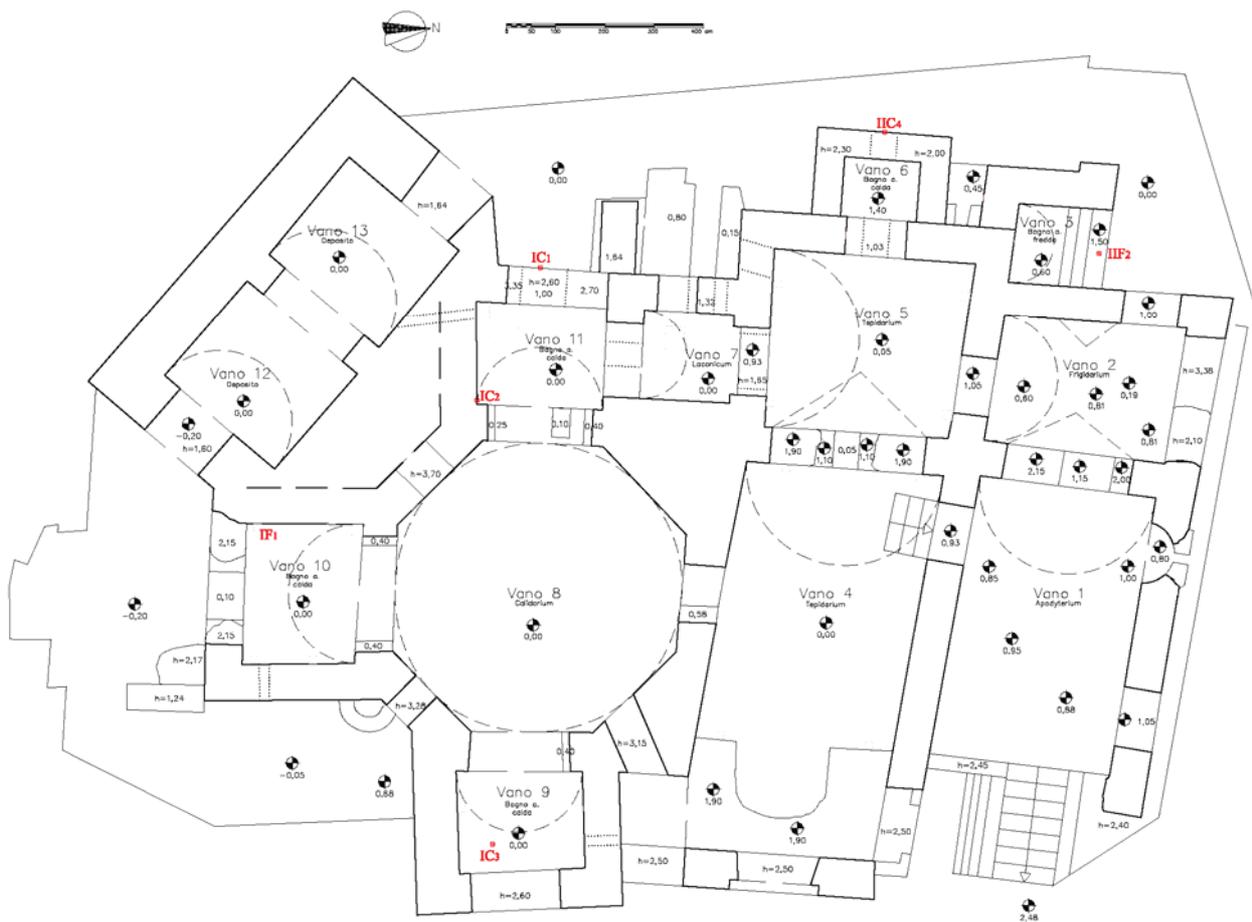


Figure 3 - Planimetry of the Indirizzo Baths with evidence of the collected samples

Hence the bather could proceed directly to the heated rooms (rooms 4-7, 8-11) or head first to the *frigidarium*, located in room 2. This was a place dedicated to cold water ablutions and it was usually close to the *apodyterium*. The adjacent room 3 served as a small cold bath. Rooms 4 and 5, connected with the *apodyterium* and the *frigidarium*, respectively, were probably *tepidaria*. The *tepidaria* were moderately heated rooms, used as transition areas, before entering in the warmest room, the *caldarium* (room 8).

From the bigger *tepidarium* (room 4) the bathers accessed the *caldarium* (room 8), the largest and the most representative room of these baths, covered with a magnificent hemispherical dome (Figure 4).

The three adjacent niches (rooms 9-11) were functional to the *caldarium* and once probably housed pools (*alvea*) for bathing in hot water.

The *Indirizzo* Baths were probably provided also with a small *laconicum* or *sudatorium*, corresponding to room 7. It was used for sweat baths in a dry ambient (sauna) and was bound to be quite hot and therefore located close to the furnaces.

The *sudatorium* can be reached directly from the smaller *tepidarium* (room 5), as recommended by Vitruvius, so that the bather could move gradually from tepid bath, to the sweat chamber and finally to the hot *caldarium*.



Figure 4 – View of the caldarium dome (room 8)

The square hole at its top maybe represented a kind of *lumen*, whose size was regulated by a *clypeus*, a bronze or copper shield that could be lowered or raised through chains to control the outflow of hot steam and, consequently, the temperature and the relative humidity of the chamber [1]. From the smaller *tepidarium* it was possible to reach also another little room (6), which contained an additional *alveus* for bathing in lukewarm water.

As well as rooms 3 and 6, also rooms 12 and 13 are later, since their walls are not bonded to the rest of the fabric. It could be assumed as fuel depots (wood). In fact both were accessible only from the outside, from the service areas where once took place the kilns, to which these depots were therefore perfectly functional.

These furnaces were probably located west of rooms 11, 7 and 6 and south of room 10, at the respective end walls, where are located the *praefurnia*, which are all characterized by the same fabric.

Through the *praefurnia*, the hot gases passed into the subfloor hypocaust to heat the warm and hot rooms. Some of these rooms (7-11) were probably equipped with *concamerationes*, i.e. tile-flues (namely *tubuli*) arranged on the walls to better heat the environment. An imagine of two of these room (rooms 8-10) are represented in a painting dated to XVIII of Houel [2] (Fig.5).

The terracotta exhaust chimneys, observed on the top of many heated rooms, served to improve the draft and to discharge the hot gases.



Figure 5 – Painting of Jean Houel representing rooms 10 and 8 in the late XVIII century [2]

This contribution is part of a wider research work conducted in collaboration between the Department of Physics and Astronomy (DFA) and the Department of Civil Engineering and Architecture (DICAR) of Catania University, and the Faculty of Engineering and Architecture Kore of Enna. The research program involves a multidisciplinary study on the *Indirizzo* Baths aimed to deepen the historical and architectural knowledge, the mode of operation, and the chronological framework. The problem relating to chronology is twofold, as both construction and last use of the complex

are unknown. So far Wilson [3] has attributed the monument to the IV-V cent. CE, while Branciforti [4] to the III-IV cent., but without supporting their dating with excavation evidences or dating. To overcome the aforementioned problem, the application objectives of this work are therefore two and required different methodological approaches in sample preparation and in the measurements protocols. In this paper the results obtained for a first set of terracotta collected samples are presented.

II. MATERIAL AND METHOD

A. Samples

Table I reports the analysed samples with their identification codes and their sampling points.

All samples were collected in strategic points of the monument, from terracotta elements that are supposed to be contemporary with the Roman fabric.

Table I - Code, location and description of analysed samples (see Figure 3)

Samples	Room	Description
IC1	11	<i>praefurnium</i>
IC2	11	<i>tubulus</i>
IC3	9	<i>pila</i>
IF1	10	drainpipe
IIC4	6	<i>praefurnium</i>
IIF2	3	archway

Some of the collected samples (IC1, IC2, IC3, IIC4) can also provide information regarding the last use of the baths, since they were exposed to hot gases (around 125 °C, [5]) that can induce the bleaching of the luminescence signals. In particular, this bleaching was probably total for the *praefurnium* samples (IC1 and IIC4) during last use of the baths, as this samples were directly exposed to the kiln fire. On the contrary, for IIF2 and IF1 we assume that the last heating corresponds to the manufacture of the brick.

B. Protocol and Experimental aspect

The samples were prepared by standard Fine Grain (FG) protocol in order to extract polycrystalline (quartz and feldspars), following the standard PH3DRA laboratories procedure [6-8], which is based on the original work of Zimmermann [9]. *ThermoLuminescence* (TL) glow curves were recorded in the Risø TL-DA-10 detection system using Corning 7-59 and Schott BG-12 optical filters by an EMI 9235QA photomultiplier [10]. For all samples the Added Dose procedure was carried out performing the TL measurements and the calculation of equivalent dose (ED).

Annual dose rate (DR) absorbed by the samples was determined using radioelement concentrations (U, Th, K, Rb), measured from inductively coupled plasma mass spectrometry (ICP-MS) bulk chemical analysis of powder. The values of U, Th, Rb trace elements and the major element K were then converted into the corresponding dose rate contributions using the factors re-evaluated by Liritzis et al. [11]. The environmental dose are obtained using in situ Canberra InSpector 1000 detector.

III. RESULTS AND DISCUSSION

Table II shows the U, Th, K and Rb content of all samples with the corresponding D_α and D_β contributions to the annual dose rate (DR) and the total contribution (gamma and cosmic) of the environment (D_{env}). The ED values with associated standard deviations are reported in Table III. The same table shows also DR total values obtained from contributions after the correction for in situ water content. This correction was calculated by the porosity W values and the saturation F factors experimentally estimated for each sample [12-14].

Table III also shows the annual dose rate DR values obtained from all contributions reported in Table II. The individual dating results (referred to the year of the TL measurements) and the corresponding calendar dates obtained by age equation are also reported.

Table II - Radiochemical composition and dose rate contributions for the examined samples

Sample	U (ppm)	Th (ppm)	K (%)	Rb (ppm)	D_α (mGy/a)	D_β (mGy/a)	D_{env} (mGy/a)
IC1	2,3±0,1	10,5±0,1	2,44±0,01	95±2	14,2±0,3	2,61±0,02	0,95±0,01
IC2	2,5±0,1	9,8±0,1	2,31±0,01	92±2	14,2±0,3	2,52±0,02	0,99±0,01
IC3	2,3±0,1	9,9±0,1	1,72±0,01	83±2	13,7 ±0,3	2,01±0,02	1,00±0,01
IF1	2,8±0,1	10,8±0,1	1,80±0,01	91±2	15,8 ±0,3	2,18±0,02	0,98±0,01
IIC4	3,4±0,1	10,0±0,1	1,48±0,01	53±2	16,9±0,3	1,97±0,02	0,95±0,01
IIF2	3,6±0,1	11,8±0,1	2,10±0,01	81±2	16,81±0,3	2,56±0,02	1,10±0,01

Table III - Individual ages and dates calculated for bricks samples by thermoluminescence dating

Sample	ED (Gy)	W	F	DR (mGy/a)	Age TL/2016 (a)	Date
IC1	6,29±0,16	0,119±0,001	0,562±0,002	4,65±0,13	1352±52	660±50
IC2	7,09±0,35	0,112±0,001	0,231±0,003	4,80±0,14	1479±85	540±80
IC3	6,36±0,25	0,106±0,001	0,250±0,002	4,27±0,14	1489±74	530±70
IF1	1,68±0,18	0,095±0,001	0,125±0,003	4,68±0,16	359±40	1660±90
IIC4	5,82±0,30	0,187±0,001	0,588±0,001	4,13±0,15	1408±88	610±40
IIF2	8,40±0,40	0,153±0,001	0,449±0,001	5,14±0,17	1634±95	380±90

Figure 6 shows the ages obtained for the considered samples: the dates acquired from the *praefurnium* samples (IC1 from room 11 and IIC4 from room 6)

belong to the VII century, while those from both the *tubulus* (IC2 from room 11) and the *pila* (IC3 from room 9) to the VI century. An older phase, dating to the IV century, was obtained for the archway brick in room 3 (IIF2 sample). Finally, a quite recent phase, dating from the end of the XVII century, was individuated from the drainpipe sample in room 10 (IF1).

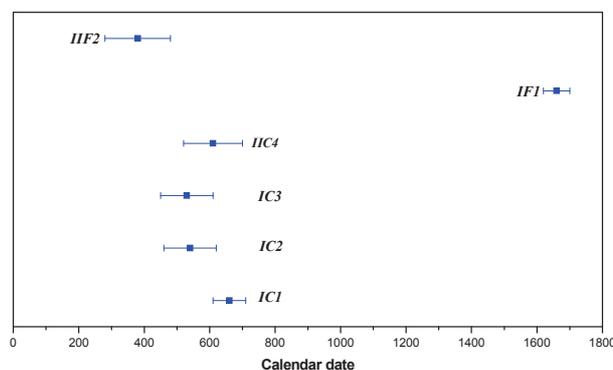


Figure 6 - Calendar dates obtained for each sample

IV. CONCLUSION

In order to determine the construction date of the *Indirizzo* thermal baths and the period of their last use, different brick samples were collected and analyzed.

On the basis of the obtained experimental results, these baths were used till the VII century. In fact, samples IC1 and IIC4, which during their use have been exposed to the high temperature of the furnace ($T \geq 500^\circ\text{C}$), could be subjected to total bleaching of luminescence signals.

According to an architectural interpretation of the monument, samples IC2 and IC3 were contemporary with IC1 but they turned out to be a century older (VI century), since during their use they have been exposed to a lower temperature (around 125°C) that led to a partial bleaching of TL signals.

The analysis of the building fabric has suggested that the baths are characterized by two different phases of construction. Through the measured set of samples, it is currently not possible to date the first phase (rooms 1-2, 4-5, 7-1). The archway sample (IIF 2), which belongs to the second phase (i.e. rooms 3-6, 12-13), gives a dose of the IV century. This data would confirm the hypothesis of Branciforti [3].

Sample IF1, taken in room 10, should belong to the second phase of construction, and could be put in relation with the construction of rooms 12 and 13. However, the data obtained (XVII century) is not compatible with this hypothesis nor with a painting by Houel (fig. 5) of the late XVIII century, where the drainpipe appears already ruined.

Additional measures from a new collection of samples should be provided in order to refine the results. In perspective of a new campaign, we will also carry out a specific study on the influence of humidity of each

sample in the site. In fact, as already mentioned, the data presented in Table III are related to the F factor which is experimentally determined. The age of a sample, determined with routine procedures [11], is strongly influenced by its humidity content and for historical buildings, and especially for thermal baths, this question is fundamental.

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