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# Timber framing architecture (pan de bois) in Gaul during the late Iron Age: recent research on a little-known architectural tradition

Pierre Péfau, Andrea Fochesato

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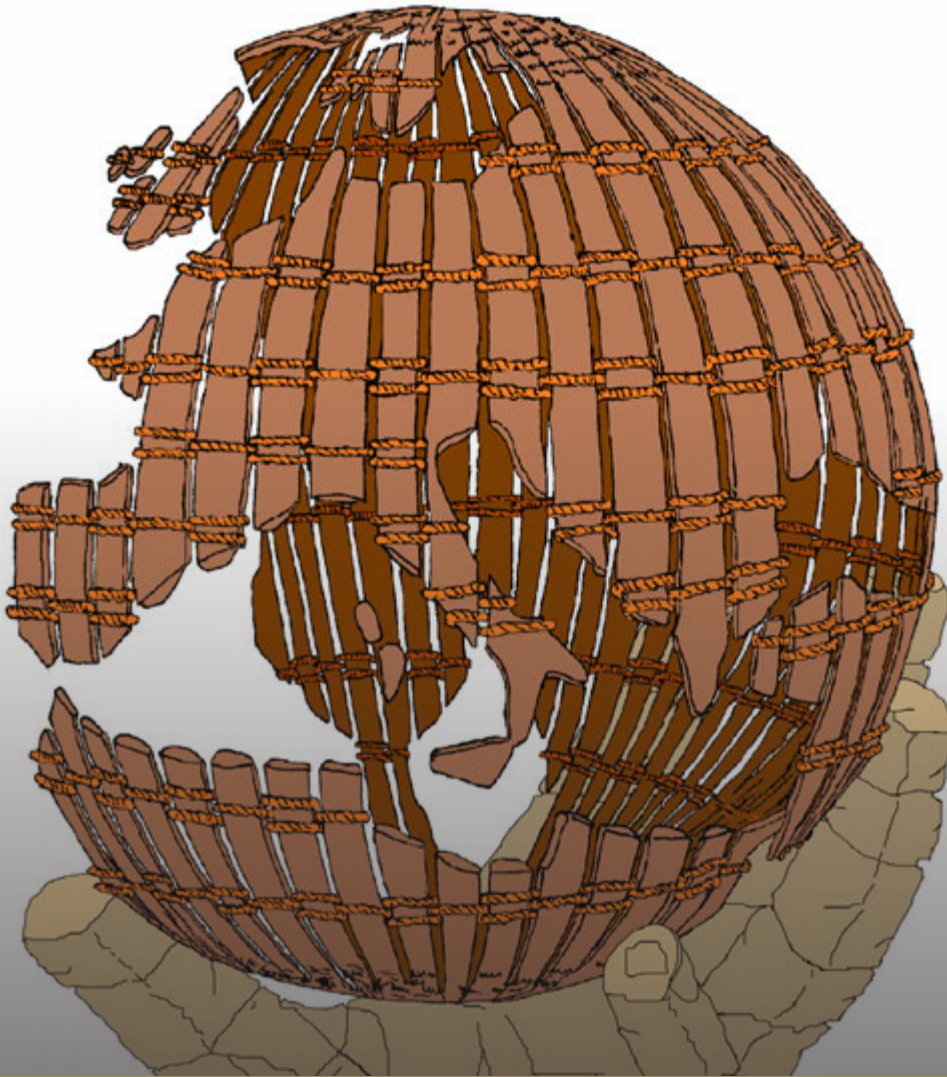
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# Terra, legno e materiali deperibili nell'architettura antica

Estratto

a cura di  
CATERINA PREVIATO  
JACOPO BONETTO



## 1. L'età preromana

ATTI DEL CONVEGNO INTERNAZIONALE DI STUDI  
(PADOVA, 3-5 GIUGNO 2021)

COSTRUIRE NEL MONDO ANTICO 6

ROMA 2023  
EDIZIONI QUASAR

Estratto



*Direzione scientifica/Scientific direction:*

Jacopo Bonetto – Caterina Previato

Università degli Studi di Padova – Dipartimento dei Beni Culturali

Piazza Capitaniato, 7, I-35139 Padova

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COSTRUIRE NEL MONDO ANTICO, 6

Estratto

# Terra, legno e materiali deperibili nell'architettura antica

ATTI DEL CONVEGNO INTERNAZIONALE DI STUDI  
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a cura di  
CATERINA PREVIATO  
JACOPO BONETTO

con la collaborazione scientifica di  
ELIANA BRIDI, CHIARA GIROTTO, BEATRICE MARCHET

## 1. L'età preromana

Roma 2023  
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## ***Timber framing architecture (pan de bois) in Gaul during the late Iron Age: recent research on a little-known architectural tradition***

### **1. Introduction**

The study of earthen and wooden Gallic architecture has been experiencing a rebirth in recent decades<sup>1</sup>, along with many aspects of Late Iron Age archaeology in temperate Europe. The territory corresponding to Gaul, i.e. to the North of the Roman province has, in particular, benefited from this revival, driven by an ever-increasing number of programmed or rescue archaeological operations alongside new university projects.

Until very recently, the Late Iron Age architecture in Gaul was considered to be almost exclusively composed of earthfast posts. Posthole constructions indeed represent the vast majority of the excavated archaeological record for the period<sup>2</sup>. The existence of Gallic timber-framed constructions (*pan de bois*), although acknowledged, was often approached – when the question wasn't simply avoided – from a chronological and evolutionary prospective, rather than a technical or cultural one. Because of the absence of deep foundations, timber-framed buildings are more difficult to find in archaeological field studies than posthole construction. For this reason, it has sometimes been considered to be an innovation originating in the Mediterranean basin and introduced in Gaul only after the Roman conquest (58-51 BC), and therefore unknown – with only few exceptions – by the Gallic populations<sup>3</sup>. This idea is contradicted by recent studies which have identified at least ten different settlements with a large number of timber-framed buildings dated between the 3rd and 1st centuries BC in Gaul (fig. 1). Moreover, several posthole buildings known in the archaeological record in the same period, characterised by closely spaced earthfast posts forming load-bearing walls, employ structural designs closer to timber framing architecture (notably the load-bearing role of the walls) than typical Gallic Late Iron Age posthole architecture. Here the load-bearing role is rather carried out by an internal supporting structure made with earthfast posts and the perimeter walls have either a partial or a non-bearing function (*édifices à module porteur et parois rejetées*<sup>4</sup>; see below, fig. 2).

Two extensive doctoral dissertations completed in 2020<sup>5</sup> and in 2021<sup>6</sup> allowed us to approach these questions at complementary levels of analysis. The first dissertation focussed on the architecture of the emblematic site of Bibracte, on Mont Beuvray, in Burgundy (Nièvre/Saône-et-Loire), a major *oppidum* of the Aedui *civitas* which has yielded exceptional architectural remains over the course of almost eighty years of research. These include several dozen buildings with relatively well-defined plans, mostly dated to the 1st century BC. They are usually well stratified and often associated with floor levels, domestic or craft-type features such as fireplaces and, more occasionally, the burned remains of the walls. This rich archaeological record also includes several dozen waterlogged timbers, generally discovered in a different

1 We would like to thank Max and Jenny Westby for reading and correcting our English text.

2 E.g. Audouze, Buchsenschutz 1989; Buchsenschutz 2005; Buchsenschutz, Mordant 2005; Villard-Le Tiec ed. 2018.

3 Péfau 2017.

4 E.g. Maguer, Robert 2013.

5 Fochesato 2020.

6 Péfau 2021.



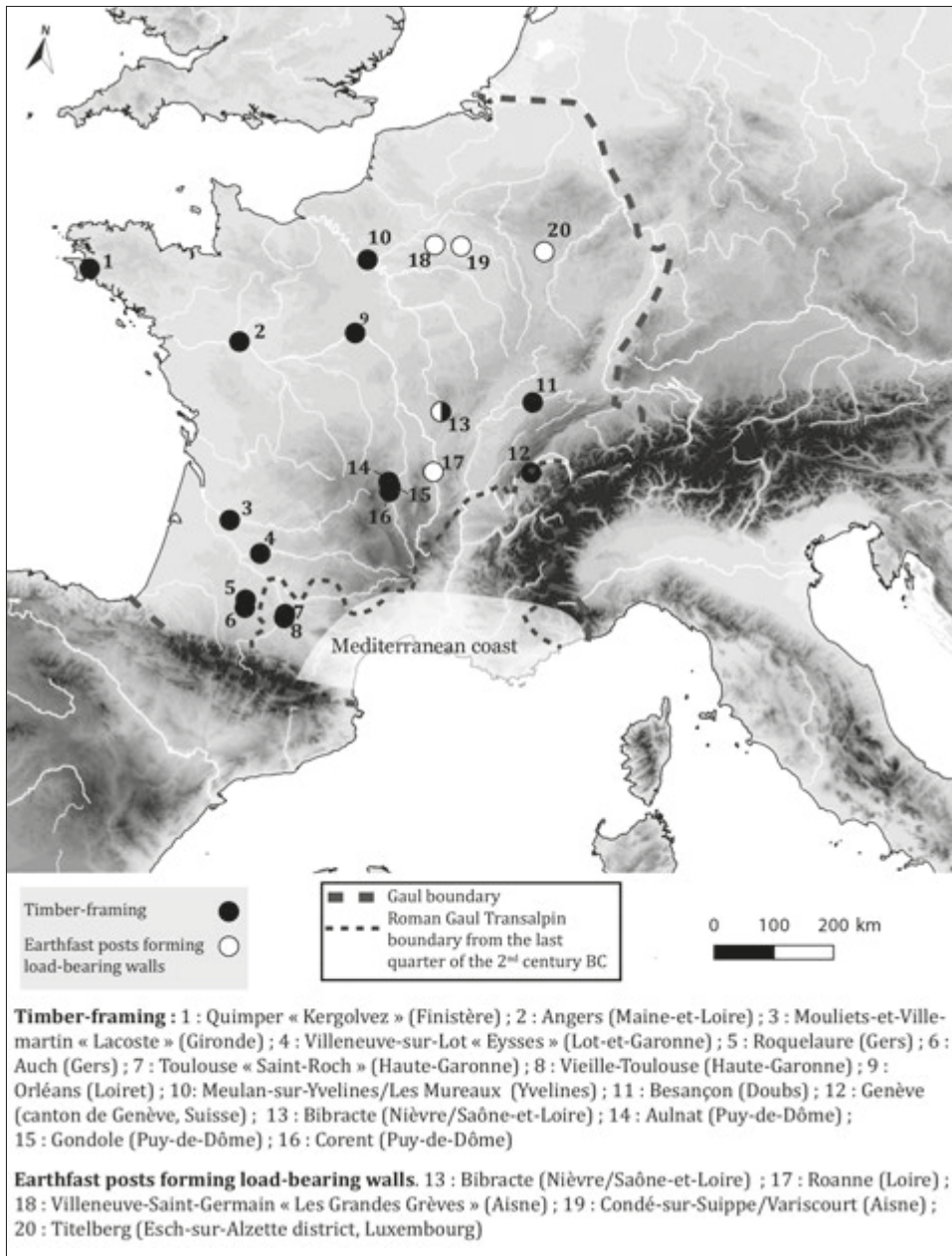


Fig. 1. Location of the main sites (open settlements and *oppida*) associated with timber framed and earthfast posts forming load-bearing walled buildings (drawing by P. Péfau).

context such as at the bottom of wells or reused in the fountains of the *oppidum*. The second dissertation focussed on the architecture characterising the agglomerations of non-Mediterranean Gaul on a larger scale: 330 structures excavated in 39 grouped settlements (both *oppida* and open agglomerations) were identified and analysed. Despite being in a variable state of preservation, the analysis of these buildings now represents, along with the examples from Bibracte, a complete synthesis of the whole range of wooden construction techniques commonly in use between the 3rd and 1st century BC in Gaul, with a large-scale taphonomic and socio-economic approach. Although carried out independently, the two thesis projects lead to completely comparable and convergent results. In particular, they allow us to highlight the prominent – despite until now largely ignored – place occupied by timber framing architecture and its derived techniques within the Gallic architectural tradition during the last three centuries BC, and to

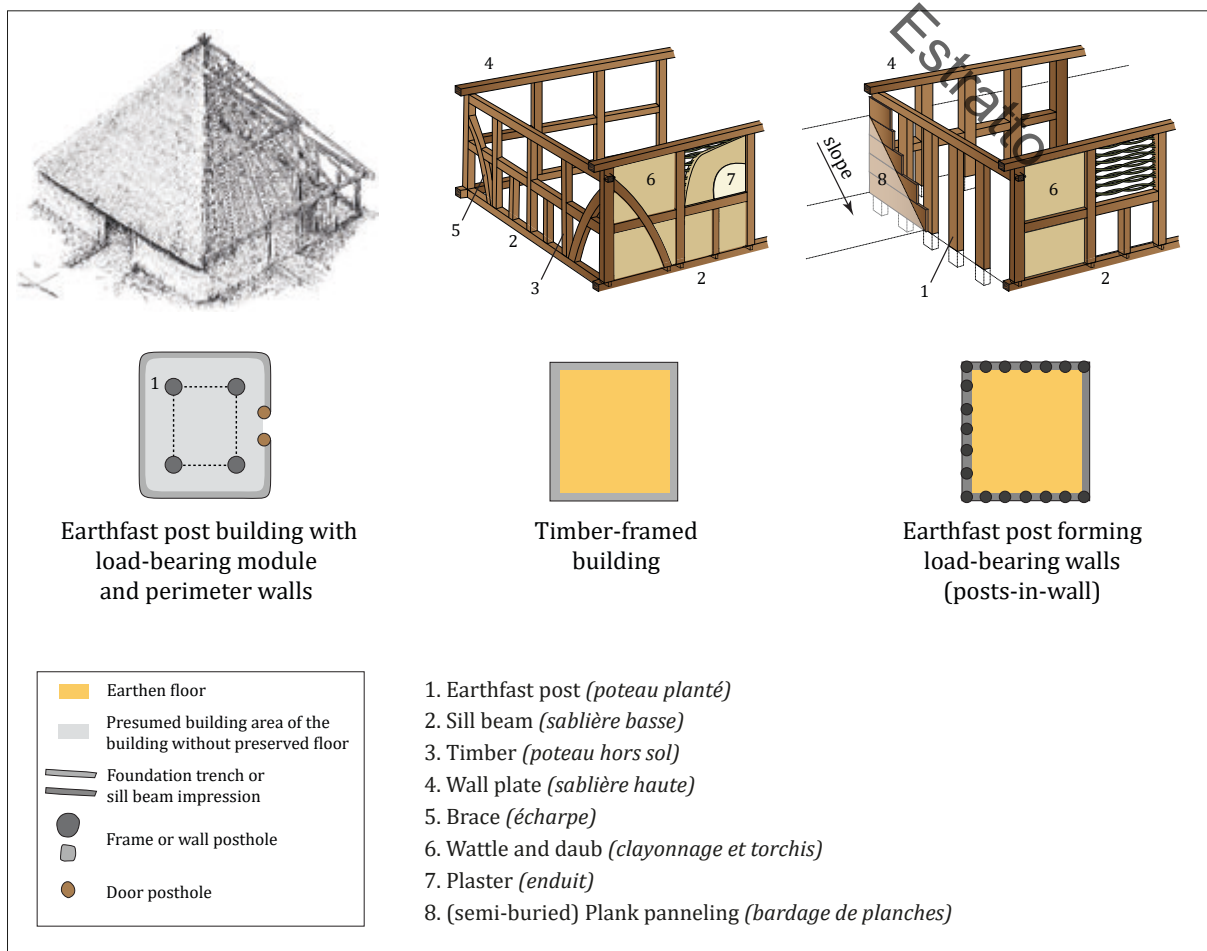


Fig. 2. Main architectural forms discovered in Late Iron Age Gallic settlements: wall construction principles and glossary (after Volmer, Zimmermann 2012) and potential archaeological marks (drawing by P. Péfau and A. Fochesato; Krause, Wieland 1993, fig. 29).

question the socio-economic components linked to its permanence and spread, particularly in the context of grouped habitats, urban settlements and *oppida*.

## 2. Technical background and research method

Before getting into the main aim of this contribution, it is useful to present a short overview on the current understanding of the architectural techniques known in Gaul during the Late Iron Age. We will focus on the housing context (fig. 2), leaving aside both monumental and public/community architecture (for which we refer to a specific bibliography<sup>7</sup>). As seen above, the most frequent and best studied type of construction, with hundreds of examples in the literature, consist of a load-bearing central structure made by earthfast posts – generally four or six posts organized in a quadrangular shape – surrounded by walls (*parois rejetées*) marking the perimeter of the roofed building. These walls are usually built directly on the earth with generally shallow foundations or lying on wooden sill beams<sup>8</sup>. The central supporting posts are, on the other hand, always deeply rooted and often wedged into the ground, which allows for a better understanding of the structures even in the most eroded archaeological records. This easier visibility in

7 E.g. Barral et al. 2018; Fichtl 2018.

8 E.g. Maguer, Robert 2013; Maguer et al. 2018; Maguer, Le Gall 2018.

the field mainly explains the importance – and the variety – of the still growing *corpus* of these building techniques compiled since the 1980s and 1990s.

The main structural difference between these buildings and the ones we discuss below, i.e. timber-framed structures, therefore lies in the load-bearing function of the perimeter walls. In the timber-framed buildings, the sides are made of wooden frames formed by horizontal elements (sill beams, in contact with the ground; wall plates), vertical above-ground timber or posts within the frames and angled parts to ensure the bracing of the building<sup>9</sup>. The sill beam horizontal board may sometimes be interrupted by few earthfast posts. These components however play a limited structural role (bracing or repair mainly), as it is no longer the earthfast post that ensures the stability of the building, but rather the load-bearing framed walls, placed directly on the ground or, from the end of Iron Age onwards, on a dry-stone or masonry base. Deep foundations are therefore absent because of the “above-ground” nature of these structures. Hence, the identification of timber-framed buildings remains difficult in archaeological field studies: it requires very good conservation of the occupation floors, in which the impression of the sill beams can be seen as wall-effect on the floor or the sill-plate of the structure. Evidence of the wall structures may be preserved by carbonisation of wooden components – of beams, planks or posts – or burned earthen elements – such as wattle-and-daub hoarding or plaster fragments. The sole discovery of stone foundation or base walls – without masonry elevation – is difficult to link directly to timber-framed architecture, since they may also have supported adobe or cob walls.

Finally, a technique that can be related to timber-framed architecture, despite the use of earthfast posts, is the one Olivier Buchsenschutz referred to as «*poteaux dans les parois*<sup>10</sup>» i.e. earthfast posts forming load-bearing walls. In contrast to the posthole architecture formed by a load-bearing central structure (see above), where the 4 or 6 posts are most often several metres apart (up to 6 or 7 m) and disconnected from the perimeter walls, in the posts-in-wall architecture numerous posts form the walls. They are more densely organised, less than one meter apart and anchored in common foundation trenches or individual post holes. As we will see below, the post-walls can sometimes be combined with sill beam walls within the same building<sup>11</sup>. The post-walls here have a load-bearing function similar to that of classic timber-framed walls, as it is no longer the post(s) themselves that support the walls and roof, as in the posthole module architecture, but the perimeter walls of the building, either made by horizontal timber frame or earthfast closed posts.

The often poorly conserved remains of these earth-and-wood constructions requires a particular method of analysis, grouping together a multitude of sparse architectural remains that have to be studied jointly as complementary components. In the first instance, it is essential to study all the components found in primary positions in the field, i.e. sill-plates and occupation floors, wall impressions or foundations (post holes or trenches). The observation of the stratigraphical connections between the floor and the wall remains is also essential to define the life of the structure – repairs, upgrades or changes in building techniques – which can often be traced over several decades or even a century. In a second step, other components should be considered, such as preserved wooden pieces – charred or waterlogged, in primary or secondary positions – earthen building components and metal connecting pieces – nails, spikes – etc. The picture which results from the linking of all these details can be further completed by comparative approach, using the best preserved architectural remains from Protohistory to Antiquity and the Middle Ages, over a wide geographical range. Ethnographic documentation also plays a major role, as the analysis of still-standing wooden structures contributes to the discussion about the form and the structural principles of ancient buildings.

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9 Péfau 2017; Péfau 2021.

10 Buchsenschutz 2005, 55.

11 Fochesato 2020; Péfau 2021.

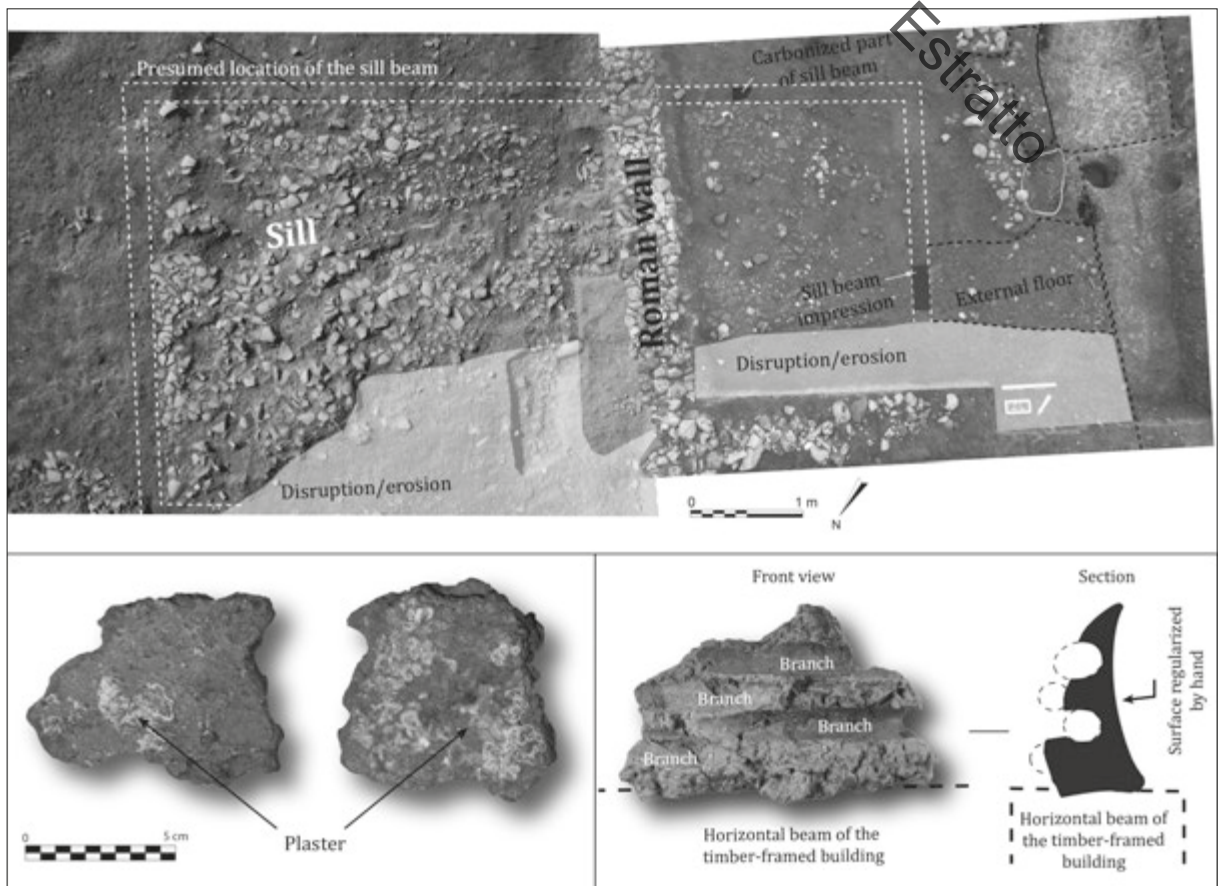


Fig. 3. Overhead photograph of building 3 at Roquelaure (Gers) and fragments of its wattle-and-daub filling (fire damaged) found at the demolition level (drawing by P. Péfau, after Péfau 2017, fig. 2).

### 3. Timber-framed buildings (*pan de bois*) and earthfast posts forming load-bearing walls (*poteaux plantés formant parois porteuses*)

Given the extent of the *corpus* now available on Gallic timber-framed buildings, we will now discuss a small selection of examples that can be considered representative of the building techniques – both of timber framing and posts-in-wall architecture – but also of the diversity of contexts, conservation states and the archaeological interpretation of these buildings discovered and analysed on the field.

#### 3.1 Timber-framed buildings: an overview of Gaul

At least 60 timber-framed buildings are known in Gaul between the 3rd and 1st centuries BC<sup>12</sup> and at least 10 in Bibracte alone<sup>13</sup>. These structures most often consist of a single room, more rarely two or three. Each of them generally measures between 15 and 35 m<sup>2</sup> on the ground, although larger examples exist with buildings that can exceed 100 m<sup>2</sup>, as in the case of Bibracte. However, even in the largest constructions, their width does not generally exceed 6,0 or 6,5 m between the perimeter walls or between these and the inner partition walls, when present. The various case-studies presented below illustrate the diversity of architectural forms in which this type of architecture can be found, as well as the variety of conditions of conservation and observation of their remains.

<sup>12</sup> Péfau 2021.

<sup>13</sup> Fochesato 2020.



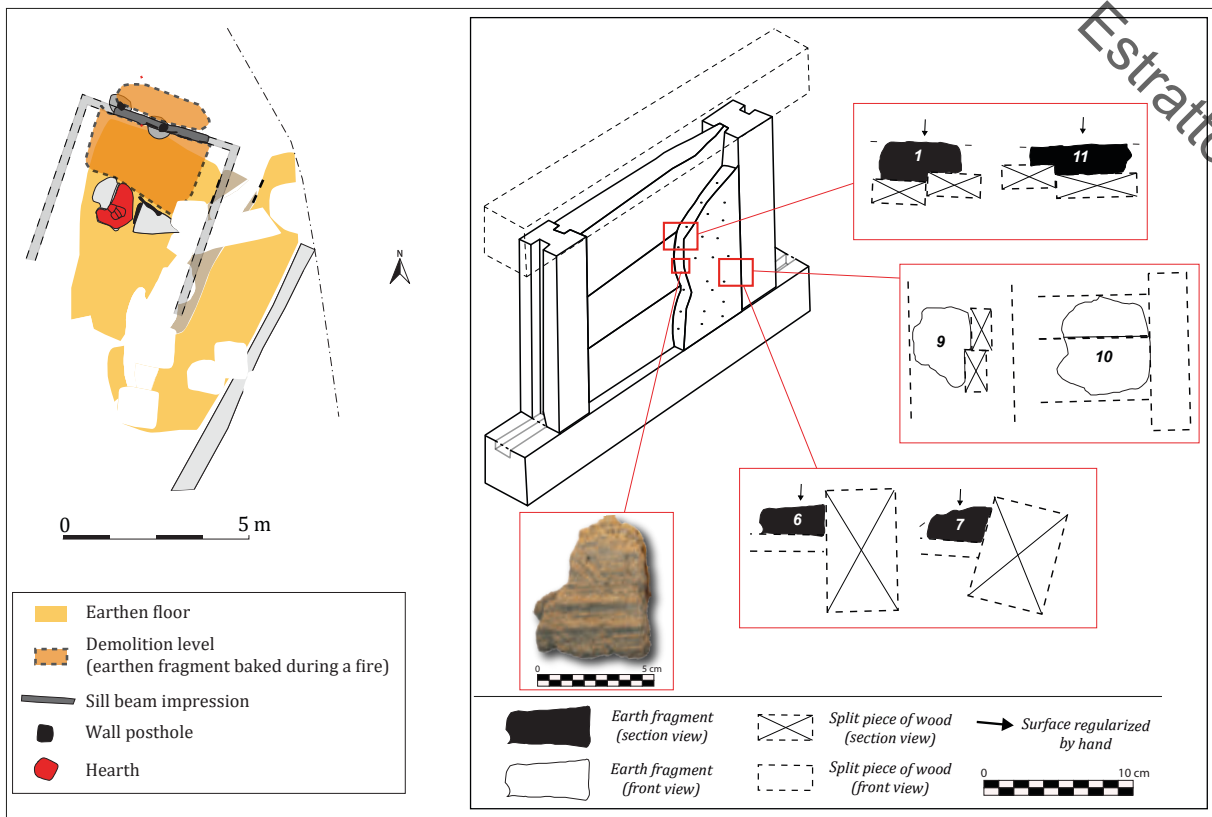


Fig. 4. Plan of building 14 of Vieille-Toulouse and diagrammatic reconstruction of the northern timber framing (drawing by P. Péfau after Robert 2019, figs. 35, 45 and 50 and Péfau 2019, fig. 551).

In the settlement of Roquelaure (Gers, France), several timber-framed buildings dated to 140/130-40/30 BC have been identified<sup>14</sup>. Building no. 3 (fig. 3), built on an amphora sherd sill plate, measures about 24 m<sup>2</sup> (7,6 x 3,2 m). Despite being widely intersected by a later stone base wall dating from the Augustan Age<sup>15</sup>, the rectilinear interruptions of the sill plate observed on its southern and eastern sides allowed us to locate the sill beams on which the entire wooden framed elevation rested. These wall impressions could be clearly identified as negative structures of about 20 cm in width separating the sill and the outside ground. They are never linked to any post holes. In one case, the remains of a charred wooden foundation beam, measuring between 0,20 and 0,25 cm in width, could be observed in connection with the wall impression. Furthermore, some remains of a burned wall collapsed during destruction of the building by fire testify to the use of a wattle-and-daub hoarding between the wooden frames, covered with a fine white plaster.

Another timber-framed building, dated to the end of the 2nd century BC, has recently been studied in the high settlement of Vieille-Toulouse (Haute-Garonne, France). Identified at 9bis, *chemin de la Planho*<sup>16</sup> (fig. 4), its investigation was symptomatic of the usually poor conservation of late Iron Age timber-framed building remains in the archaeological field studies, generally damaged by later constructions. Indeed, only the northern wall of the building could be observed, characterised by a sill beam impression filled with charcoal. Two post holes were also found linked to the wall. This rectilinear northern border delimits the interior floor of the building, consisting of indurated marl on which two structures, including a fire-

<sup>14</sup> E.g. Gardes et al. 2013; Gardes, Péfau 2018.

<sup>15</sup> Péfau 2017.

<sup>16</sup> Robert 2019.

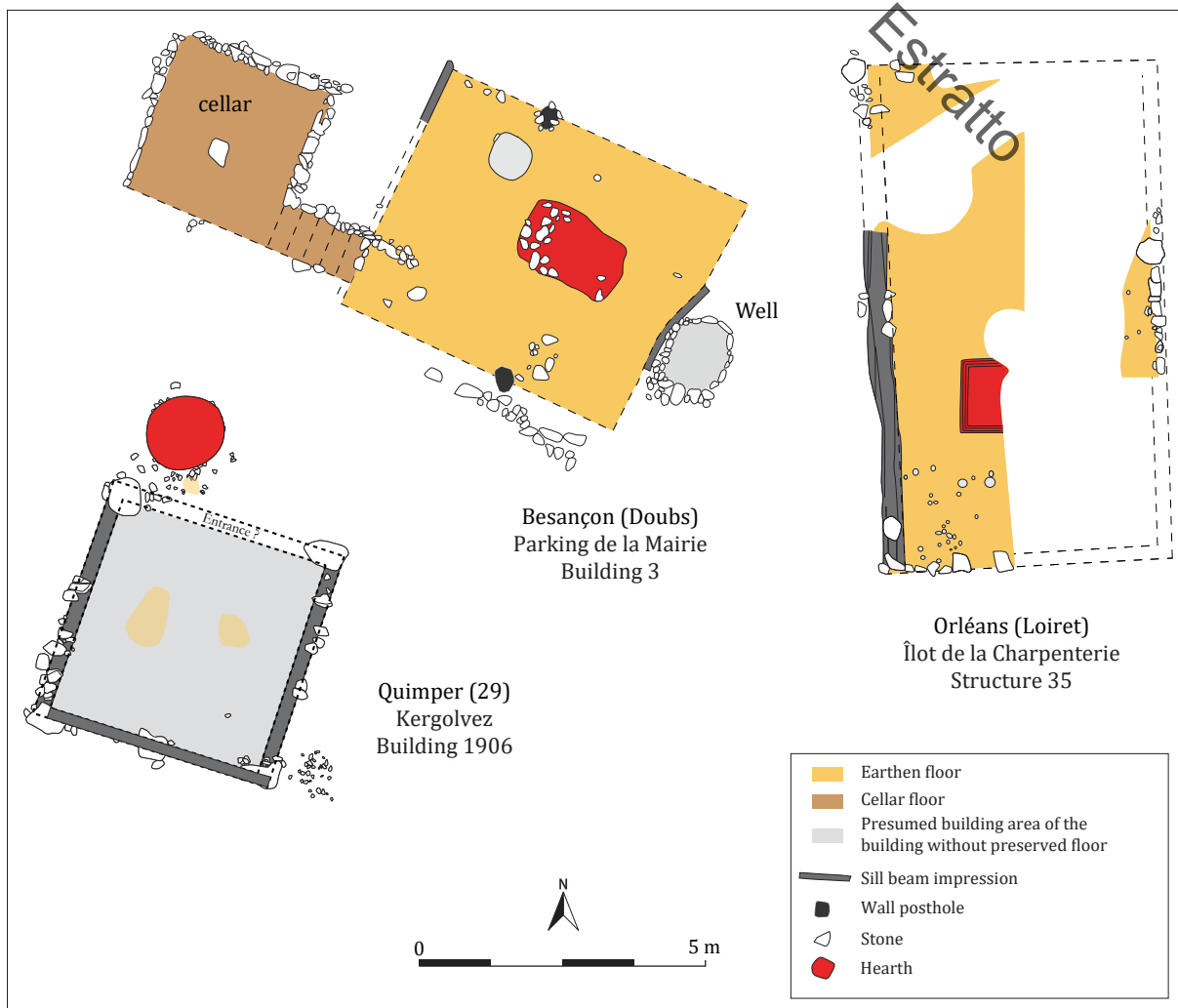


Fig. 5. Examples of buildings in the northern half of France (drawing by P. Péfau, after Goy, Guilhot 1992, fig. 21; Le Goff ed. 2014, fig. 516; Massat, Roux-Capron 2018, fig. 4).

place, were installed. The floor was covered by the remains of the wall, burnt and collapsed towards the interior and exterior of the building following a fire. During excavation, these destruction layers – directly connected to the wall impression and its sill beam – yielded several elements of burnt clay together with many charred wooden remains, including a complete plank. The clay fragments systematically show marks of planks, framed by larger-section timbers. However, no marks or imprint of wattle were observed<sup>17</sup>. It is thus possible to reconstruct a timber-framed structure made by planks placed horizontally between the timbers and then covered with an earthen plaster a few centimetres thick in order to fill remaining gaps as well as protecting and insulating the wooden components. Other buildings discovered in Vieille-Toulouse<sup>18</sup>, with a more complete plan, consistently showed the same shape: the load-bearing framework is formed by sill beams set on the ground and reinforced with few earthfast posts, delimiting rooms generally measuring between 30 and 60 m<sup>2</sup>.

<sup>17</sup> Péfau 2019.

<sup>18</sup> Gardes, Péfau 2018.

Timber-framed buildings are also attested to in some sites in the northern half of France, from the end of the 3rd century or the beginning of the 2nd century BC (fig. 5). This is notably the case of the Kergolvez agglomeration in Quimper in Finistère<sup>19</sup>, where several small-scale buildings, generally not exceeding 16 m<sup>2</sup>, have been discovered. Some of these are built on discontinuous, thin and relatively narrow dry-stone bases, made up of granite blocks and recovered millstones, while others seem to be placed on the ground. Other cases have been found, in the Lacoste agglomeration at Moullets-et-Villemartin (Gironde), from the 3rd century BC. The sill beams appear through imprints at the level of the sill plate formed by a dense assemblage of pebbles and ceramic shards<sup>20</sup>. The presence of powerful construction nails and iron spikes in the immediate vicinity of these structures could confirm that this is indeed a case of *pan de bois*.

Of greater size are the several dozen timber-framed buildings excavated at Orléans (Loiret), the oldest of which date from the middle of the 2nd century BC<sup>21</sup>. Structure 35, in particular, identified on the *Îlot de la Charpenterie* and dated between 40 and 20 BC, measures nearly 43 m<sup>2</sup> (8,7 x 4,9 m). It is built with a floor of crushed and packed limestone, on which a quadrangular hearth is installed. The building, which has been extensively overlaid by later occupations, shows several phases of construction: its sill beams, initially laid directly on the ground, were then raised by a limestone wall base about 30 cm wide. Several buildings dated from 120 BC onwards were also identified at Besançon (Doubs), major Sequani's *oppidum*, during the excavation of the *parking de la Mairie*<sup>22</sup>. Materialised by earthen floors of about 25 m<sup>2</sup> on average and sometimes delimited by slight impressions of sill beams generally 15 cm wide, these structures are generally associated with cellars (*caves*, *celliers* for French authors). These basements, located either inside or outside the building's surface, are built with timber and planks or, more rarely, dry stone walls. Several major sites from the same period, such as the *oppida* of Corent or Bibracte among others, display a very similar building pattern. Furthermore, the discovery of possible shingles in the filling of a well connected with the structure and located directly on the west of building 3, seems to confirm their use for roofing in some buildings.

### 3.2 An exceptional case study: the Bibracte oppidum

In the Bibracte oppidum, on Mont Beuvray, the central areas, characterised by a relatively flat topography in an otherwise quite hilly environment, show the presence of very large timber framed buildings, often equipped with wooden cellars, generally dated from the second half of the 1st century BC. In the *Pâturage du Couvent*, for example, a building with 126 m<sup>2</sup> surface (11,20 x 12,95 m) was excavated in the early 1990s by teams from the University of Madrid. Still largely unpublished<sup>23</sup> (fig. 6), the structure is built on a partially preserved floor of reddish compacted clay, laid out on a rough rubble sill plate. It is delimited on the south and west sides – the other sides having been disturbed by later Augustan occupations – by rectilinear impressions 35/40 cm wide. The fillings of these features yielded small stones and amphora shards used as wedges and insulation system for the wooden sill beams against which the earthen floor of the building was then laid. The charred remains of two 22 cm wide horizontal beams could be recognised in the southern wall, connected on either side to a squared and more deeply buried post. Posts of the same size and depth (25 cm wide and about 30 cm deep) also mark the south-western corner of the building, as well as its western wall, at the junction of a probable partition wall that would have divided the internal space of the house. This construction method combines therefore sill beam foundations with a reduced number of deeper supporting earthfast timbers, located essentially at the intersections of the frame structure (corners, wall intersections). It is in fact the building technique commonly used in the timber-framed architecture of the *oppidum*. The south-eastern quarter of the building is occupied by a cellar of about 16 m<sup>2</sup>, partially excavated, built on a framework of squared oak posts (estimated to be 1,80

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19 Le Goff ed. 2014; Le Goff 2019.

20 Sireix ed. 2012.

21 Jesset et al. 2009; Massat, Roux-Capron 2018.

22 Guilhot, Goy 1992.

23 Fochesato 2018; 2020, 363-368.

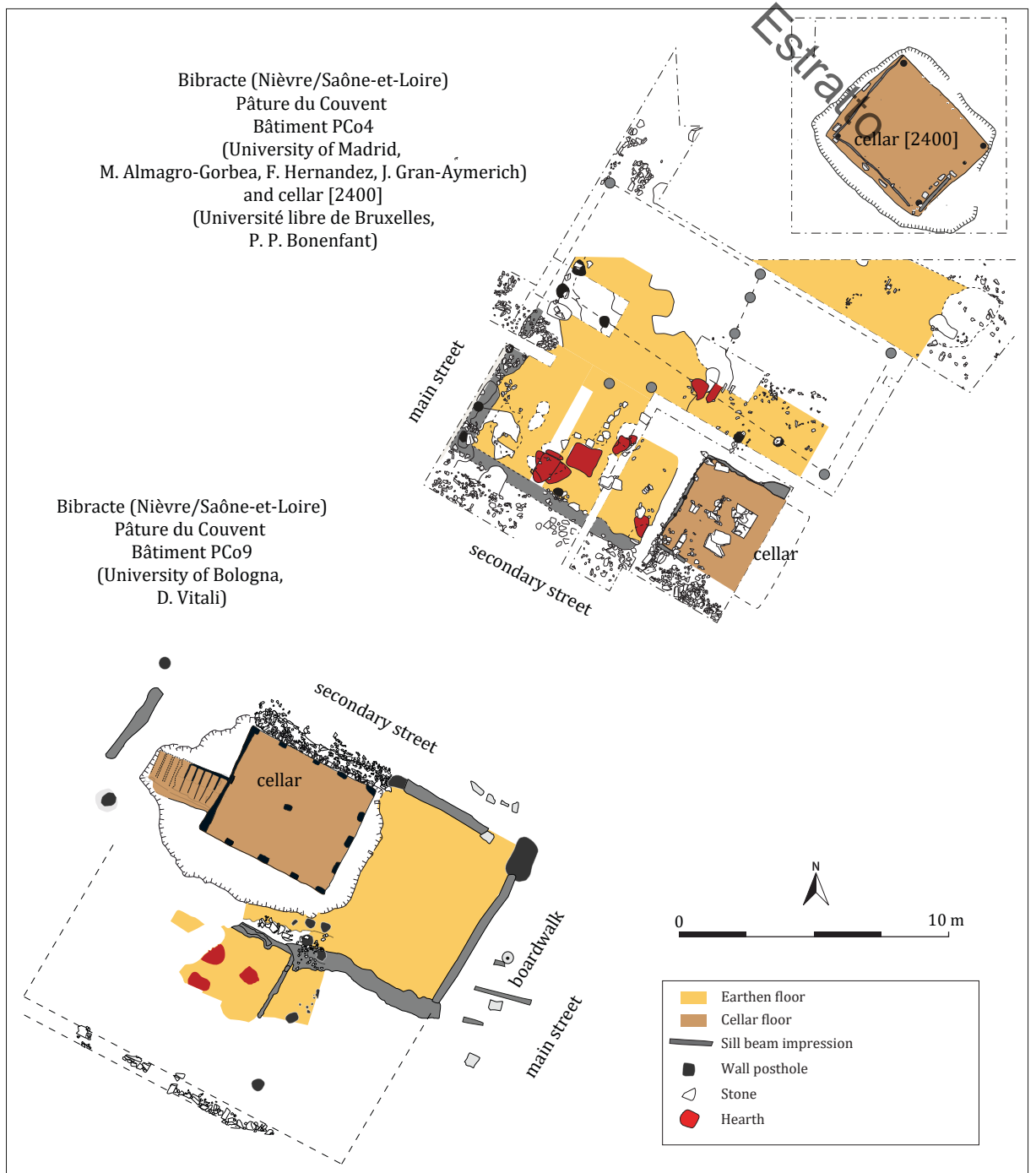


Fig. 6. Examples of timber-framed buildings from *Pâture du Couvent*, in Bibracte (Mont-Beuvray) (drawing by A. Fochesato).

m high) filled by horizontal planks and held on the outside by a half-metre thick backfill installed between the wooden frame and its foundation pit.

Two more similar structures, although far more disturbed by the later Augustan constructions, are located in the immediate vicinity of the building, in a fairly dense settlement pattern. They are known only from the often incomplete remains of their cellars, of which only one has been completely excavated and



published<sup>24</sup>. Better preserved, on the other hand, is the house of some 100 m<sup>2</sup> excavated between 1989 and 1998 by teams from the University of Bologna, under the direction of D. Vitali, in the south-western part of the district<sup>25</sup> (fig. 6). Also dated to the second half of the 1st century BC (its destruction by fire being dated to 15/10 BC) it is part of a rather long stratigraphic sequence covering the whole period of occupation of the *oppidum*. In its northern half, untouched by later construction, the building displayed a compacted earth floor delimited by rectilinear impressions about 30 cm wide, the remains of walls built on sill beams. The eastern facade, facing the central avenue, was fronted by a wooden portico. As in the previous example, the corner of the building is reinforced by an earthfast post on which the sill beams of the walls were assembled. A second post, located in the northern wall at a distance of 1.5 m from the corner, marks the probable access to the building. Several impressions observed in the central and southern portions of the structure can be interpreted as the remains of the dividing walls that organised the space into at least three independent rooms, one of which was marked by the presence of probably artisanal heating structures. The north-west quarter of the building is instead occupied by a large timber-framed cellar with a surface area of 22,5 m<sup>2</sup> (4,27 x 5,25 m). Its floor lay 2,5 m below the ground floor of the house. While the walls of the building were generally built on sill beams placed directly on the ground, as seen above, part of the north wall – the one in line with the cellar – was erected on a stone base wall, probably in order to further insulate the building's structure. The use of stone bases is a real innovation in the architecture of the *oppidum* at that time, as its use only became widespread in Bibracte from the Augustan Age onwards, when the wooden framed cellars are also almost systematically replaced by masonry cellars.

Far from being limited to the *Pâturage du Couvent*, timber framed architecture largely characterises the other central areas of the *oppidum* at the same time, such as the *Parc aux Chevaux*. Here, research over the last twenty years has brought to light several examples of timber framed buildings, many with cellars – in the PC14 sector, for example<sup>26</sup>. This is particularly the case in the occupation horizons prior to the construction of the *domus* PC1 (dated to the Augustan Age), with a timber framed building organised around a central courtyard, i.e. based on a classic Italic plan, dated to the years 50-30 BC (PC1, Period 3<sup>27</sup>). The same technique, although deployed in a more local plan, was used as well in the nearby building also excavated by the Lausanne teams in the opposite side of the avenue from PC1 (in the so-called PC4 area<sup>28</sup>). Here, still from the middle of the 1st century BC, major earthworks were carried out for the installation of an artisanal building consisting of a series of three rooms of 44 m<sup>2</sup> (the central one), 35 and 32 m<sup>2</sup> to the north and south respectively, the latter one only partially excavated. The eastern wall of the complex, opening onto the avenue, was clearly marked by a rectilinear impression 20 cm wide and 10 cm deep (fig. 7). Within its filling, several nodules of rubbed clay mixed with many charcoal fragments attest to the use wattle-and-daub wall. Other impressions of the same dimensions show the perpendicular internal walls, erected on sill beams placed on the ground, sometimes equipped with small wedging structures made of stones and amphora shards. It is only from the Augustan Age onwards that, as in PC1 and in the *Pâturage du Couvent* buildings, these walls were finally raised by the construction of dry-stone or masonry wall bases.

### 3.3 A derived technique: earthfast posts forming load-bearing walls

Unlike the *Pâturage du Couvent* or the *Parc aux Chevaux* which are the only sectors of Bibracte with a relatively flat topography, most of the other densely built-up areas of the *oppidum* have a rather steep topography. This required the adaptation of building techniques to a semi-buried type of architecture appropriate for construction on terraces on the slopes, requiring major earthworks, as seen in many mountain architectural traditions all over the world<sup>29</sup>. Therefore, the builders were forced to develop

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24 Bonenfant 2014, 77-82.

25 Gruel, Vitali 1998, 35-43; Fochesato 2020, 355-363.

26 Fochesato 2020, 368-372.

27 Paunier, Luginbühl 2004, 63-77.

28 Paunier, Luginbühl 2004, 135-155.

29 Fochesato 2018.

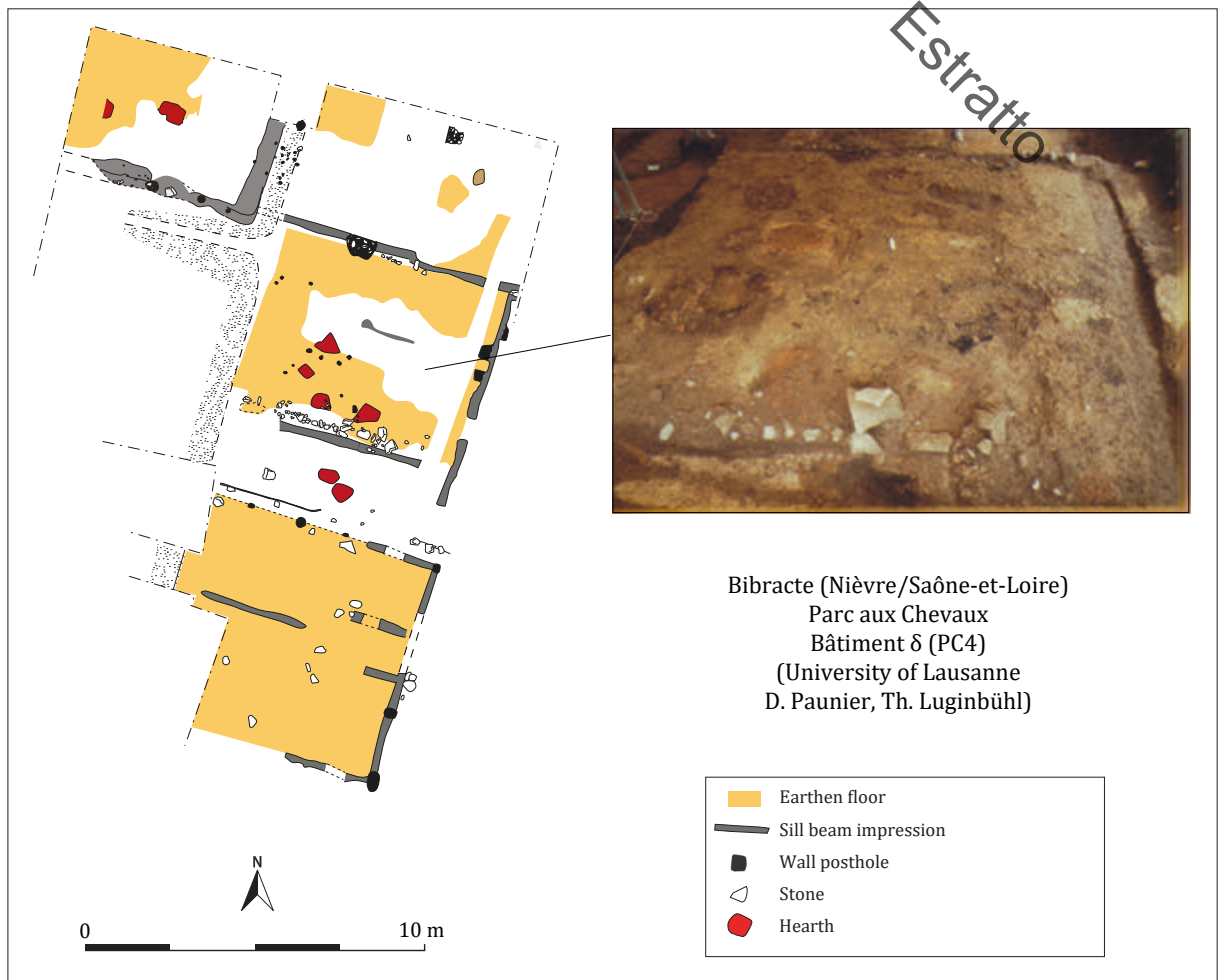


Fig. 7. Plan and photograph of the timber-framed building discovered in *Parc aux Chevaux* (PC4) in Bibracte (Mont-Beuvray) (drawing by A. Fochesato, image: A. Maillier, Bibracte n° 47060).

more resistance and stability by superimposing semi-buried and upper floors and by adapting the timber framing technique to the particular hilly conditions. This resulted in an increase in the number of vertical load-bearing elements in the wall frames and in their direct foundation in the ground or in a foundation trench. Even though these posts replace or, more often, coexist with the sill beams, the load-bearing main function of the walls remains unaltered. Therefore, we can consider this technique as a variant – or an adaptation – of the timber framing architectural design discussed above.

Several dozen examples of buildings on posts forming load-bearing walls are known at Bibracte in the *Côte Chaudron* or *Champlain* sectors, both from research carried out in the nineteenth century and from recent excavations. While during the first half of the 1st century BC these buildings, all of which had an artisanal function, were generally single-room and small (with an average surface area of 17,8 m<sup>2</sup> calculated from the 35 known examples for the period<sup>30</sup>), from the second half of the century onwards their surface area increased and their internal organisation became more complex. Structure [1890-1977] at *Côte Chaudron* (fig. 8), for example, consists of two adjoining rooms of 26,7 and 21,8 m<sup>2</sup> separated by a step of about 40 cm. They are delimited on the downhill side by a façade built on a sill beam, which was intended to guarantee level access from the bottom of the slope. However, the other semi-buried

30 Fochesato 2020, 304-323.

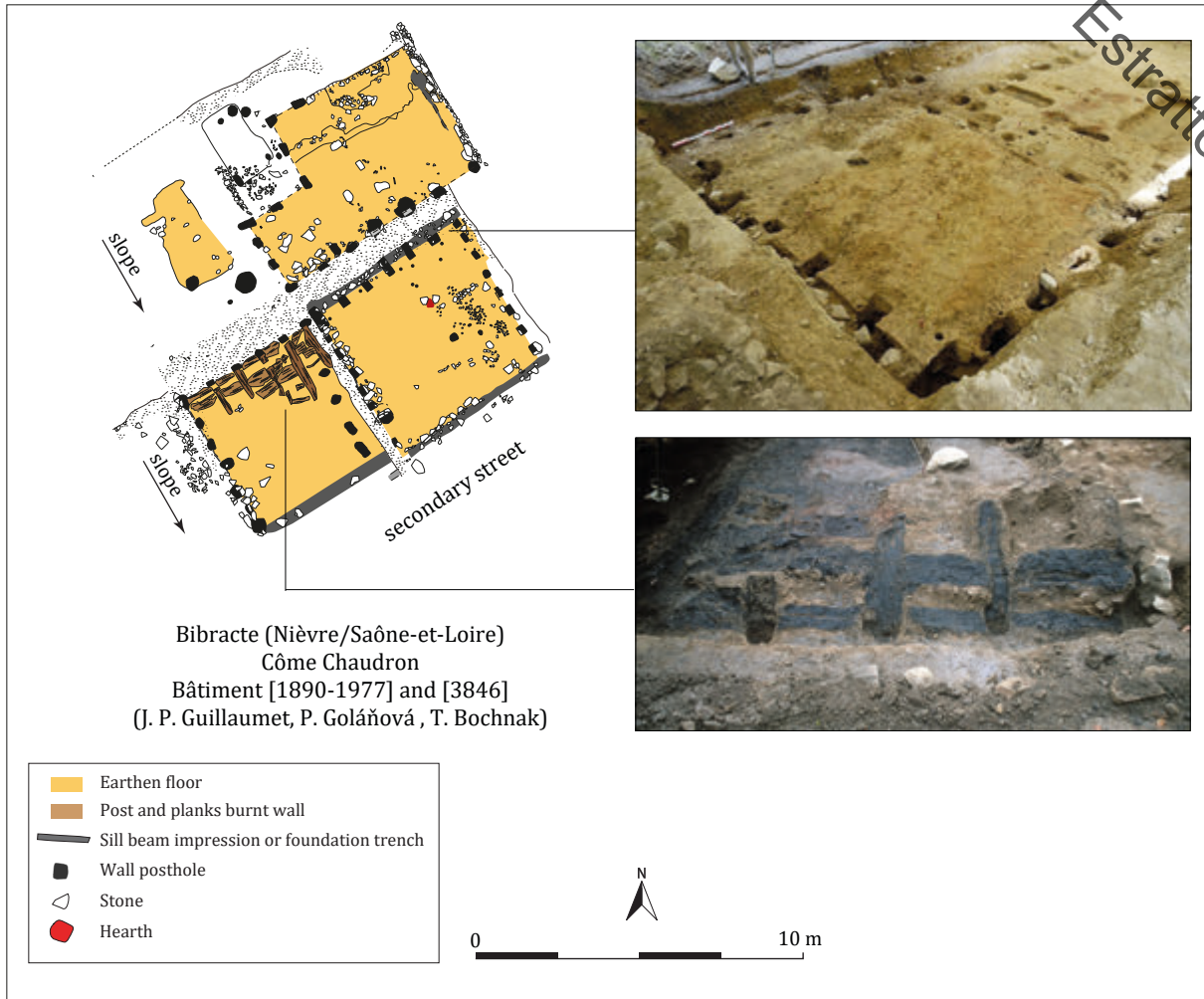


Fig. 8. Plan and photograph of the structure [1890-1977] from Côte Chaudron, in Bibracte (Mont-Beuvray) (drawing by A. Fochesato, image: A. Maillier, Bibracte n° 63535, 92340).

blind walls were built – against the slope – using rows of squared earthfast post, standardised in size (25/30 x 15 cm, for 30 to 40 cm foundation depth) and regularly spaced in foundation trenches which were subsequently infilled with stone wedges. The discovery during the excavation of large sections of the back wall burnt and collapsed towards the inner floor of the western-most room, testifies to the use of horizontal planks, 20 to 30 cm wide, nailed to the outside of the posts and then covered with an earthen plaster that certainly had insulating and thermoregulatory properties, which were indispensable given the partial buried condition of the structure. One can see the practice of the same architectural process elsewhere – e.g. in the *Pâturage du Couvent* or *Parc aux Chevaux* (see above) – deployed here specifically for the construction of cellars within timber framed buildings. That shows a mastery and adaptability of the architectural know-how of the Iron Age carpenters.

Although Bibracte constitutes the best-known *corpus* for this type of architecture, which one can see as derived from the canonic timber framing technique, other sites are also show this tradition, although generally in a much worst state of conservation. These include the settlements of Villeneuve-Saint-Germain<sup>31</sup>

31 E.g. Constantin et al. 1982.

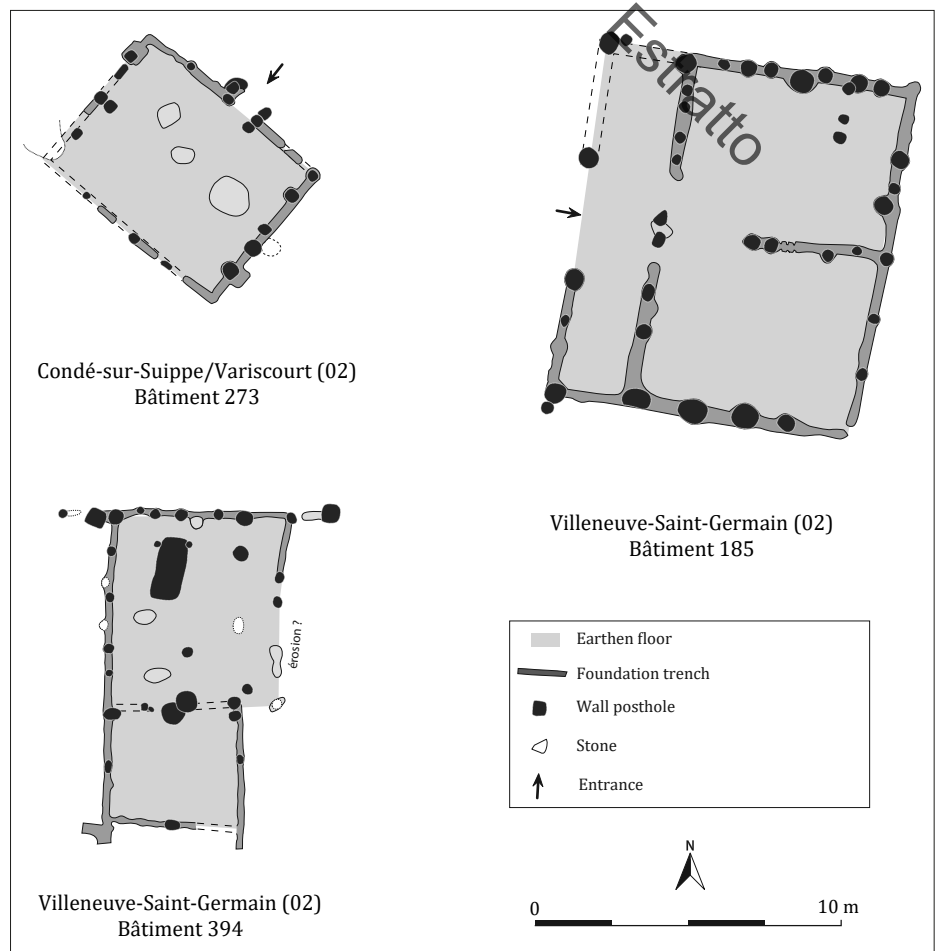


Fig. 9. Examples of buildings with load-bearing walls built on earthfast posts from Northern France (drawing by P. Péfaü after Dubouloz, Coudart 1981, fig. 4, Constantin et al. 1982, fig. 2, Pion 1996, fig. 11).

and Condé-sur-Suippe/Variscourt<sup>32</sup> in Northern France (Aisne), dated respectively to 75-25 and 120/110 to 90/80 BC. Here, several one- or multi-room buildings have foundation trenches associated with post holes or post impressions which can indeed be compared to the known examples on Mont Beuvray (fig. 9).

#### 4. Looking beyond the technical dimension: economy and society

In the light of the examples described above, it is clear that timber-framed architecture and, more generally, load-bearing wall architecture, is far from being a marginal or late aspect of the Gallic wooden building traditions of the Late Iron Age. On the contrary, it is one of the main technical processes commonly used, at least in certain categories of settlements (dense and urbanised ones notably, e.g. *oppida*) and its study allow one to go beyond the more strictly technical analysis to address social and economic questions.

##### 4.1 Timber production, trade and spatial issues

The development of timber framing architecture between the 3rd and 1st century BC is certainly to link to particular social and economic dynamics, related to the Gallic urbanisation process(es) during the Late Iron Age. Indeed, it should be pointed out initially that timber-framed buildings do not seem to be

<sup>32</sup> E.g. Pion 1996; Pion et al. 1997.

systematically present in all settlement contexts<sup>33</sup>. Excavations in grouped settlements such as Moulay<sup>34</sup> in North-western France (Mayenne) or Acy-Romance<sup>35</sup> in the Ardennes, as well as the great majority of dispersed rural settlements, have essentially identified load-bearing central structure, made by earthfast post constructions, and perimeter wall. On the other hand, some urban settlements such as Vieille-Toulouse, Orléans, Quimper “Kergolvez”, Roquelaure, Besançon or Bibracte are mainly characterised by timber framed buildings, with few – or no – posthole structures. The same applies to buildings with load-bearing walls formed by earthfast posts, found in the *oppida* of Bibracte, Villeneuve-Saint-Germain and Condé-sur-Suippe/Variscourt but absent in the surrounding rural settlements. The timber-framing technique and its derivatives thus seems to be in the majority – even exclusively – for certain grouped settlements and little used or not at all for others.

The preference for timber framing architecture in these agglomerations certainly reveals a need for a more rational economy and consumption of the timber resource within these vast Gallic urban settlements, sometimes measuring several dozen or even hundreds of hectares and in which the requirement for building material must have been very high. The regrouping of populations in these sites led to a notable increase in the consumption of wood for construction – both for housing and public infrastructures such as the ramparts, e.g. the *muris gallicus* – as well as domestic or craft activities (carpentry, metalwork, pottery, etc.). While the posts of the load-bearing central module buildings needed to be several metres long and have diameters of 0,40 m on average for their roof load-bearing function, the wooden components of timber framed or posts-in-wall structure can be much smaller, e.g. 15 to 25 cm on average in the examples given above<sup>36</sup>. Hence, the use of this technique has certainly made it possible to better exploit forest resources, with massive production of smaller pieces from more heterogeneously sized trees, most often oak. From oak trunks of different sizes, it is possible indeed to produce 4 or even 8 timbers, whereas only one or two larger load-bearing posts can be produced from the same trunk. Timber production thus frees itself from the constraint of selecting only the most suitable trees, as almost any size and age trunk can be used, even if the resource begins to decline.

Moreover, the existence of such an organised exploitation, production, import and use of building timber in Gallic urban settlements is testified, in Bibracte in particular, by a clear standardisation of the different constituent parts of the buildings (posts, sill beams, etc.) within a precise measurement system<sup>37</sup>. Each post on each building thus uses wooden timbers of the same size, which were therefore mass-produced and available for transport to the site according to a timber trade economy designed to supply the needs of several hundred houses over the period of a century. The use of timber and other wooden architectural products may therefore have been organised and controlled by at least some of these Gallic urban settlements, as is historically and archeologically documented in many urban centres in Antiquity and the Middle Ages.

In addition to these economic aspects, the adoption of timber-framing architecture can be correlated, in some cases at least, to an adaptation to the lack of space which can occur in densely built settlements and/or with unfavourable terrain. Posthole structures with central load bearing structures require larger building areas because the several metre long posts have to be buried and wedged directly on the site. On the contrary, timber framed structures can be pre-assembled in an open space and then transported to the construction site. They can also be transported beam by beam to be pre-assembled or assembled on the intended site, within its spatial constraints. The existence of a pre-assembly process before their erection can be assumed for example in several buildings of Bibracte, where the nailing of the planks to the outside of the timber frame in the semi-buried walls could only be carried out before installation of the wall against the outside slope (see above).

For the same reasons, the very nature of the timber framing technique, which makes it easier to stack floors and thus develop vertical living areas, is an effective response to the lack of space in densely built up and occupied contexts such as some of the Gallic agglomerations during the Late Iron Age.

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33 Péfau 2017; 2021.

34 Le Goff 2016.

35 Lambot 1999; Bocquillon 2012.

36 Péfau 2021.

37 Fochesato 2017; 2018.



#### 4.2 The development of a specialized architecture

Along with the economics, all of these features lead one finally to question the social dimension linked to the presence and diffusion of timber framing architecture in the agglomerations of the late Iron Age Gaul. Firstly, timber framing housing attests to the presence of specialised woodworkers and carpenters, part of a complex and shared network of skills within sites such as the *oppida* of Bibracte, Corent or Manching to name but a few. This is also shown by the discovery within these urban-type settlements of large concentrations of specialised woodworking tools, in proportionately much greater quantities than those found in the surrounding rural settlements<sup>38</sup>. However, unlike the Roman world where the organisation of these builders' guilds is well known<sup>39</sup>, the social framework of these Gallic craftsmen is obviously impossible to characterise due to the absence of written documents. Their mastery is nevertheless reflected in the archaeological record.

In the rare cases where timbers and other architectural wooden elements have survived to the present day, they testify to a complete knowledge of structural principles, quite comparable to that which characterises Antique or Medieval wooden architecture. The aesthetic dimension and the taste for architectural decoration are also not neglected, as shown by the discovery in Bibracte of a waterlogged architectural oak beam – the presence of two mortises indicate its function – about 5 m long, decorated at the top with a sculpted motif alternating with a truncated pyramid and two mouldings. This piece therefore testifies to the existence of an Iron Age carefully crafted and decorated timber framing tradition.

This economic and social background is connected to a process of urbanization in the Late Iron Age in which we witness a sort of rush to build, necessary to supply the needs of an increasingly large population grouped in settlements that can finally number several thousand inhabitants. If we now look at the chronology and stratigraphy, the frequency of construction is further multiplied. In well-stratified sites such as Bibracte, Vieille-Toulouse or Orléans, we observe foundation/abandonment sequences lasting about a generation (20 to 25 years), i.e. on average at least four construction phases over approximately one century of occupation for most of the excavated housing plots. The management of such a building sequence therefore results in a rationalisation of the supply of primary materials, as seen above, but also in a sometimes-strict urban planning. This is very obvious in Bibracte, where the buildings follow, without exception, a standardised construction model in terms of both the framework as well as in ground-plans, in their design and in the respect, generation after generation, of the boundaries of the urban plots<sup>40</sup>.

#### 5. Conclusion: a soft transition to Roman architecture

Given such a high degree of technical, economic and social specialisation, it is not surprising that Gallic timber framing architecture was not merely replaced by new Roman models during the “Romanisation” process from the end of the 1st century BC. While the central module posthole architecture underwent a peculiar development at the beginning of the imperial period – resulting in particular in the possible association of the Gallo-Roman temples with a centred plan<sup>41</sup> – timber framing architecture undergoes a more gradual change. Several similarities of a technical nature (framework organisation, assemblies, etc.) can be observed between the Roman and Gallic timber framing traditions, but also certain differences. These include the more frequent use in Roman structures of masonry bases, earthen (e.g. *adobe*) or stone hoarding, tiled roofs or *opus signinum* floors. These elements were thus integrated into Gallic architecture in a process of hybridization that did not seem to distort the local tradition, at least at first. At Bibracte, for example, the timber framed houses of the *Pâturage du Couvent* were covered from the second half of the 1st century BC by Mediterranean-type tiled roofs. The spread of dry-stone or masonry bases which gradually separated the wooden frames from direct contact with the ground dates from the Augustan Age onwards, in addition to the appearance of the first full stone-built masonry buildings in the private architecture – the use of masonry is attested for the public buildings of the *Pâturage du Couvent* already from the middle of the century

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38 Péfau 2017; 2021.

39 E.g. Ulrich 2007; Diosono 2008.

40 Fochesato 2017; 2018.

41 E.g. Poux, Fichtl 2019.

onwards. Similarly, the replacement of plank-framed wooden cellars by masonry cellars does not imply, in the same period, the disappearance of the timber framed buildings to which they belong. In the end, Gallic timber framed architecture was transformed, or rather hybridised, to give shape to a new tradition which, in parallel with the spread of Roman masonry architecture, would then characterise the upcoming Gallo-Roman world.

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## Riassunto

Lo studio dell'architettura protostorica in legno in Gallia ha conosciuto negli ultimi decenni un nuovo dinamismo, favorito da un numero sempre crescente d'operazioni d'archeologia preventiva, di programmi universitari di ricerca e di sintesi accademiche recenti. Mentre le costruzioni su pali, oggetto di studio e sintesi sin dagli anni Ottanta, sono state spesso considerate come la principale, se non l'unica, espressione architettonica gallica durante la tarda età del ferro, l'architettura detta "a graticcio" (*pan de bois*), più difficile da identificare in scavo, è stata generalmente ritenuta una tradizione marginale o addirittura tardiva, derivata da modelli italici e diffusasi in Gallia solamente dopo la conquista cesariana. Ricerche recenti dimostrano tuttavia che l'architettura a graticcio è in realtà un elemento essenziale, anche se ancora poco conosciuto, delle tradizioni edilizie galliche. In questo articolo esamineremo le conoscenze odierne relative a questa tecnica di costruzione. In primo luogo, discuteremo del metodo con cui queste architetture devono essere analizzate, considerato il precario stato di conservazione in cui, per loro stessa natura, i loro resti sono perlopiù scoperti in scavo. Dotati di fondazioni superficiali o poco profonde, a differenza delle contemporanee e meglio conosciute strutture su pali, gli edifici a graticcio sono generalmente identificati nel record archeologico grazie alla presenza d'impronte murarie spesso evanescenti, resti bruciati di elevati lignei o livelli di distruzione che necessitano d'essere analizzati attraverso un processo che combina deduzione, considerazioni tecniche e confronti. La descrizione di alcuni esempi scoperti in diverse agglomerazioni ed *oppida* dal III al I secolo a.C., selezionati in quanto rappresentativi del *corpus* riunito in due lavori di dottorato recentemente discussi, permetterà non solo di delineare gli aspetti tecnici, ma anche di considerare la problematica della dimensione socio-economica connessa alla diffusione di questo tipo d'architetture, particolarmente adatta a siti protostorici densamente popolati ed a carattere urbano.

**Parole chiave:** Architettura in legno, Architettura a graticcio, Seconda età del ferro, Agglomerazioni urbane, Oppida

## Summary

The study of protohistoric wooden architecture in Gaul has gained fresh impetus in recent decades, supported by a growing number of preventative and programmed archaeological projects and new academic studies. While post-hole constructions have been the subject of analysis since the 1980s, they are often viewed as the major, if not the only, expression of Gallic architecture of the Late Iron Age. Timber-framed architecture (*pan de bois*), which is more difficult to identify in archaeological field studies, has generally been considered as a marginal or even late tradition derived from Roman buildings, and only spread to Gaul after Caesar's conquest. However, recent studies show that timber-framed architecture is indeed an essential, though still largely unknown, element of Gallic building tradition. In this article we will review the current state of knowledge of this construction technique. First, we will discuss how we can approach the study of these buildings which are most often discovered during excavations and therefore in a precarious state of conservation. Because they are poorly rooted in the ground, unlike the more well-known posthole structures of the period, these structures are mostly identified in archaeological records only in the form of shallow wall impressions, the burned remains of framed-elevations or destruction levels that must be analysed through a process combining deduction, technical considerations and comparison. The description of some examples found in different settlements and *oppida* from the 3rd to the 1st century BC, representatives of the *corpus* gathered in two recently completed doctoral studies, will enable us not only to delineate the technical aspects, but also to address the socio-economic dimension related to the spread of this type of architecture, particularly well adapted to densely populated protohistoric urban sites.

**Keywords:** Wooden Architecture, Timber framing, Late Iron Age, Urban settlements, Oppida

Pierre Péfau  
Université Toulouse Jean Jaurès  
TRACES - UMR 5608  
PhD in Archaeology  
pierrepefau@gmail.com

Andrea Fochesato  
BIBRACTE E.P.C.C.  
Université Libre de Bruxelles, Université de Bourgogne  
ARTEHIS - UMR 6298  
PhD in Archaeology  
a.fochesato@bibracte.fr