The Transition from Pit Structures to Surface Structures — Comparing Japan with other Pit Dwelling Societies

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Introduction

Pit structures are one of the most common archaeological features found in Japan and were used as dwellings in the archipelago for over 10,000 years. Pit houses are notable for their ability to moderate extreme temperatures (Hill & Woodland, 2003, pp. 31–34) and for having relatively low construction costs (McGuire & Schiffer, 1983, pp. 292–294). Perhaps as a result of these advantages, pit houses began to be built by a multitude of societies across the world after the end of the Last Glacial Period. In much of Eurasia, and in parts of America, pit dwellings were eventually phased out in favor of surface dwellings as complex societies developed. Japan is an exception to this trend, as pit houses continued to be used well after the development of intensive agriculture, sedentism, social hierarchy, and the birth of a state society. This raises two fundamental questions: why do societies build pit structures? and why are they eventually abandoned in favor of surface structures?

There has been extensive discourse on this phenomenon in the American Southwest, where the transition from pit structures to surface structures has been attributed to a multitude of factors. Whalen (1981) saw the transition as being the result of increased agricultural intensification, population growth, and the specialization of labor. Gilman (1987) echoed these ideas, using ethnographic data to suggest that the change was the result of increased agricultural intensity, increased sedentism, and an increased need for household food storage. However, subsequent authors (Wilshusen, 1989; Rocek, 1995; Wills, 2001) criticized this hypothesis, pointing out that the evidence of increased agricultural intensity during the transition is scant. Wills (2001) saw the transition as representing a change in labor organization, shifting the burden of food processing on women. Flannery (1972, 2002) also posited that change in household organization can be seen in the evolution of dwelling form, arguing that the transition from circular to rectangular dwellings seen across the world represents a shift towards nuclear or extended households. However, these discussions rarely take into consideration the archaeology of East Asia, in particular the archaeology of Korea and Japan. Pit structures continued to be used as dwellings in this region long after the entrenchment of intensive agriculture, sedentism, and social hierarchy. It is necessary to reevaluate the characteristics of pit dwelling societies in order to better understand the reasons why they transition towards using surface structures.

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In this paper, I attempt to explain the factors which cause the use and abandonment of pit structures, expanding on Gilman's (1987) middle range theory of architecture. In Section 1, I assess the spatiotemporal distribution of pit structures, noting where and when they appear in the archaeological record in order to better understand the context behind their use and abandonment. In Section 2, I replicate Gilman's methodology and reassess the ethnographic data using an updated version of the *Ethnographic Atlas* (Murdock et al., 2023), and compare the social characteristics seen in the ethnographic record with the archaeological record. In Section 3, I examine the history of pit structures in the Japanese archipelago and attempt to explain the reasons behind their use and abandonment.

1. Spatiotemporal Distribution of Pit Structures

1.1 Terminology

There are a multitude of terms by which pit structures are referred to in English literature, and the lack of unified terminology has led to an underestimation of the true extent of their usage. The terms used include but are not limited to:

1) pithouse; pit-house; pit house; house-pit; pit dwelling; pit-dwelling; dwelling pit; pit building

2) subterranean building / dwelling / house; semi-subterranean building / dwelling / house

3) sunken building; sunken-featured building; sunken-floor building / feature / house

4) dug-out; dugout shelter; earth-house; earthlodge; earth lodge

5) burdei; bordei; grubenhaus; fogou; souterrain; poluzemlianki; zemlianka

I am referring to the above archaeological features when I use the term "pit structure", which I define as any building whose floor is primarily below the ground surface (excluding caves and basements). While this term refers to a multitude of building forms with a variety of typological characteristics, I am attempting to assess the usage of subterranean archaeological features in the broadest sense. I use the term "surface structure" to refer to any building whose floor is primarily on or above the ground surface and reserve the terms "house" and "dwelling" for structures whose function was primarily residential.

1.2 Objectives

It is necessary to clarify the spatiotemporal distribution of pit structures in order to gain a better understanding of the contexts in which they were used. To the author's knowledge, there has not been a comprehensive assessment of worldwide pit structure usage since Gilman (1987). Applying Lewis Binford's concept of middle range theory, Gilman used Murdock's (1967) *Ethnographic Atlas* to identify the factors which cause pit house usage and the characteristics of pit dwelling societies. She identified three requirements for pit house usage:

1) a non-tropical climate during the season of pit house habitation

2) a minimally bi-seasonal settlement pattern

3) a reliance on food stored in the pit house during the period of occupation

Although Gilman underestimated the worldwide distribution of pit structure usage[2], the first of her three requirements appears to be broadly true as pit structures tend not to be used below 23.5 degrees latitude, with a few exceptions (see Figure 1). The latter two requirements are based on comparison with ethnographic data (Murdock, 1967), which is a valuable source of information but represents a limited sample. Pre-modern societies where pit structures were eventually replaced by surface structures are naturally excluded from the ethnographic record and it is therefore necessary to conduct a survey of pit structure usage in archaeological cultures.

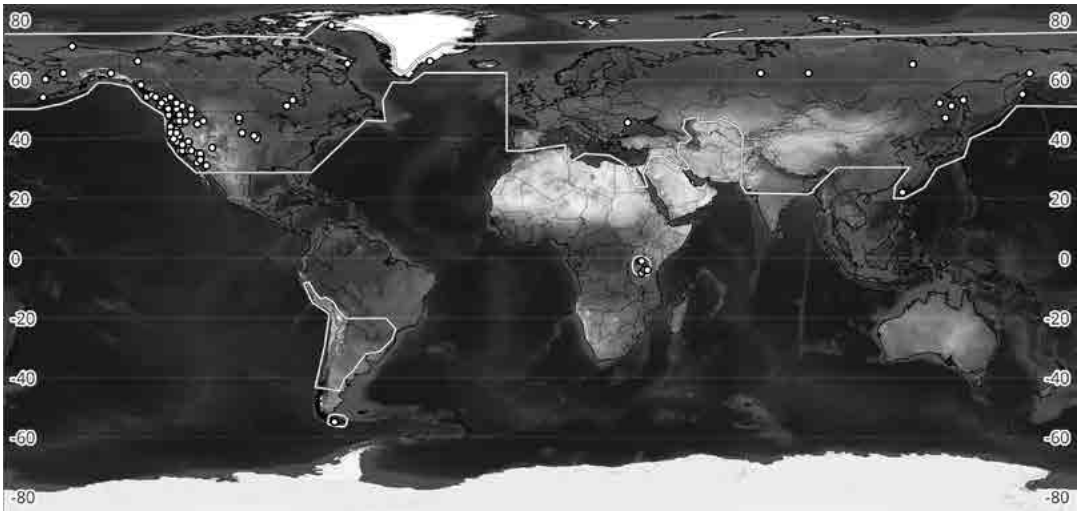

Figure 1: Extent of pit structure usage.
Points represent societies in the *Ethnographic Atlas* (Murdock et al., 2023) that have a primary or secondary subterranean residence. The red line represents the furthest extent of pit structure distribution, based on the ethnographic and archaeological data presented in Section 1. Basemap: Esri World Imagery.

1.3 Eurasia

1.3.1 East Asia

Pit structure usage in the Japanese archipelago will be discussed in detail in Section 3 but a brief summary is provided here. The earliest pit structures date to the Paleolithic period (45,000–14,000 cal BC) but they are relatively rare (Ishino, 1975). Throughout the Jomon period (14,000–300 cal BC), Yayoi period

[2] Gilman did not recognize the use of pit structures in western Europe, the Near East, Egypt, India, China, Korea, the Amur Basin, the Ryukyu Islands, the Andes, northeastern Canada, Greenland, and Iceland. Compare Figure 1 with Gilman (1987: Figure 1).

(965 cal BC–250 AD), and Kofun period (250–710 AD), pit houses were the primary dwelling form used in mainland Japan (the islands of Kyushu, Shikoku, and Honshu). Surface structures were also used in each of these periods, but pit structures are far more prominent in the archaeological record. During the Nara period (710–794 AD), pit structures were almost entirely replaced by surface structures in western Japan but continued to be used in parts of eastern Japan until the end of the Heian period (794–1185 AD) (Ishino, 1975; Agency for Cultural Affairs, 2010). Pit structures continued to be used for non-residential purposes (e.g., storage) during the Kamakura period (1185–1333) and Muromachi period (1336–1573 AD) (Suzuki, 2013).

Pit houses were used in Hokkaido by the Jomon, Epi-Jomon (340 BC–700 AD), and Satsumon (700–1200 AD) cultures. The Ainu, who succeeded the Satsumon and Okhotsk cultures, stopped using pit houses in Hokkaido between the 12th and 13th centuries AD, although they continued to be used by the Kamchatka Ainu until the 18th century, and were used as winter residences by the Sakhalin Ainu until the 20th century (Takase, 2018, p. 29). In the Ryukyu islands, pit houses were used alongside surface dwellings throughout the Shell Mound period (7000 BC–1050 AD) but were gradually replaced by surface dwellings towards the end of the period and stopped being used in the 12th century AD, during the Gusuku period (1050–1429 AD) (Pearson, 2013, pp. 69, 92, 154, 266).

In Korea, pit houses began to be used during the Chulmun period (8000–1500 BC) (Kim et al., 2015) and were the main residential structure used at settlements during the Mumun period (1500–300 BC) (Bale, 2012). Pit houses continued to be used throughout the peninsula during the Proto-Three Kingdoms and Three Kingdoms periods (300 BC–668 AD) (Korean Archaeological Society, 2010) and their usage was attested to by contemporary Chinese historical records (Nakanishi, 1989, pp. 7–9). During the Unified Silla period (668–935 AD) pit houses were absent at the Seorabeol capital, but they were still used at provincial town and settlement sites (Korean Archaeological Society, 2010, p. 416). Pit houses continued to be the main dwelling type in rural settlements after the unification of the peninsula by Goryeo (935–1392 AD) (p. 471) and pit houses continued to be used in the 16th and 17th centuries during the Joseon period (p. 483). Semi-subterranean folk homes are still used in rural areas in modern times (Shin & Kim, 2005).

There were several cultures that used pit structures in the territory of modern China, especially during the Neolithic period. The earliest examples include the Peligang (7000–5000 BC), Houli (6500–5500 BC), and Laoguantai (6000–5000 BC) cultures where they were the primary dwelling type (Lu et al., 2021; Liu, 2004). Subsequent cultures, such as the Yangshao (5000–3000 BC) and Dawenkou (4100–2600 BC), used both pit houses and surface houses (Lu et al., 2021), although the Yangshao transitioned to using mostly ground-level houses by the Late Yangshao period (3500–3000 BC) (Lu al., 2021; Liu, 2004). After 3000 BC there was a diversification in dwelling forms with a trend towards the usage of surface dwellings, though pit houses continued to be used by the Longshan (3000–2000 BC), Mijiayao (3000–2000 BC), Yueshi (1900–1500 BC),

Qijia (2400–1600 BC), and Erlitou / Xia-Shang (2000–1000 BC) (Lu al., 2021; Liu, 2004). Pit houses were also used in the Tibetan Plateau at the Karuo site (3950–2050 cal BC) (D'Alpoim Guedes, 2020), though the extent of their distribution is unclear. Subterranean dwellings were used in Taiwan by the Tao (Murdock et al., 2023) and Atayal peoples, and in the nearby Batan Islands by the Yami (Oliver, 1997, p. 1233).

1.3.2 Northeast Asia

Pit houses were the primary dwelling type in much of northeast Asia during the Neolithic period (6000/5000–2000 BC) and shallow pit structures date back to the Pleistocene in the Lower Amur River Basin (Onuki, 1998, pp. 250–261). Archaeologically, pit houses disappeared from northern China and the Liao River Basin around the 1st century BC to 1st century AD, and their usage declined in the Lower Amur River Basin by the 12th century AD (pp. 236, 252, 258). The decline in pit house usage seen from the 12th century onward coincides with the rise of the Jin dynasty, and Onuki suggests that the abandonment of pit houses in northeastern Japan and Hokkaido at the same time may be related (pp. 236, 258). While this time period represents the end of archaeological evidence of pit houses, historical records and ethnographies attest to the continued use of pit dwellings in the region (p. 258). Murdock et al. (2023) records subterranean dwelling usage in the region by the Udihe, Oroch, Negidal, Nivkh, Yakut, Koryak, and Itelmen peoples.

1.3.3 South Asia

Pit structures are found at settlement sites during the Neolithic period in Kashmir (Shinde et al., 2020), but there is debate about whether these structures were dwellings or storage pits (Coningham & Sutherland, 1998; Fuller, 2006). At Burzahom, one of the main settlement sites of Neolithic Kashmir, pit structures were used between 3000 BC and 2000 BC, after which the inhabitants transitioned to using surface structures (Bhat & Dubey, 2019). Pit dwellings were also used at the Bhirrana site in Punjab during the Hakra Ware culture phase (3500/3300–2800 BC) (Singh, 2008). Pit house usage extends as far south as Malwa during the Chalcolithic Malwa culture phase (1600–1300 BC), and semi-subterranean dwellings are still used by impoverished peoples in the region in modern times (Shinde et al., 2020). In Bangladesh, where the preservation of archaeological features is poor, Hu et al. (2020) uncovered a pit dwelling at the Wari-Bateshwar site dating to 290 ± 30 cal BC, which indicates that pit houses may have been used in the Ganges Delta during the Indian Iron Age.

1.3.4 West Asia

Semi-subterranean dwellings have a long history in the Levant, and the oldest known example comes from the Ohalo II site, dating to 23,000 cal BP (Nadel, 2003). The settlements of the Epipaleolithic Natufian

and Harifian cultures (12,300–10,500 cal BC) are made up of clusters of semi-subterranean pit houses (Bar-Yosef, 1998; Grosman, 2022). Similar circular pit structures are used at settlements throughout Mesopotamia during the Pre-Pottery Neolithic (10,500–9200/8600 cal BC) (Iamoni & Baldi, 2023). Such pit dwellings can be found as far south as the Sinai Peninsula during the Pre-Pottery Neolithic (Hershkovitz et al., 1994, p. 61). Pit house usage in the Levant continues until the Early Bronze Age I period (3300–3000) (Sebag & Deborah, 2005).

In Anatolia, round semi-subterranean dwellings were used between the 9th and early 6th millennia BC and were later phased out in favor of rectangular mud-brick surface houses (Cilingiroglu & Helwing, 2023). In Transcaucasia, semi-subterranean dwellings were used during the 6th millennium BC and likewise subsequently phased out in favor of surface structures (Baudouin, 2019; Cilingiroglu & Helwing, 2023).

1.3.5 Central Eurasia

Pit houses were used by several cultures inhabiting the Eurasian steppe during the Paleolithic, Neolithic, and Chalcolithic. The earliest pit dwellings on the East European Plain belong to the Upper Paleolithic Kostenki-Avdeevo culture (27,000–24,000 cal BC), and pit houses reappear in the region between 8300 and 6000 BC (Pavlov et al., 2023, pp. 666–669). Pit houses were also used by the Middle Don Neolithic Culture (5500–4500 BC) (Kotova et al., 2023, p. 776) and at the Mikhailovka site cluster on the Lower Danube by a culture related to the Dereivka and Gumelnița cultures (4150–3650 BC) (p. 780). Pit houses continued to be used at the Mikhailovka site during the early Yamnaya period (3400–3000 BC) (Anthony, 2010, p. 320). Pits found at settlement sites of the Cucuteni–Trypillia culture (5000–2800 cal BC) were initially thought to be pit houses, but recent scholarship has rejected this notion (Burdo et al., 2012, p. 97). Pit dwellings were also used during the Chalcolithic by the Botai culture (3700–3100 BC), located in modern Kazakhstan (Pleshakov, 2023, p. 371).

The earliest pit houses in Western Siberia date to the Neolithic and have been found at the Tartas-1 site (6400–6200 BC) (Piezonka, 2023, p. 4) in the Baraba Steppe. Pit house use continued in Western Siberia until the Early Modern period (p. 8), and ethnographic examples in the region include the Ostyak and Ket peoples (Murdock et al., 2023).

1.3.6 Europe

Some of the earliest pit structures in Europe have been found in Norway, dating to the Middle to Late Mesolithic period (8000–4000 BC) (Fretheim, 2023). Pit houses were one among many dwelling types used during the Neolithic and Chalcolithic by the Funnel Beaker culture (Hadevik, 2010) and during the Bronze Age by the Bell Beaker culture (Sarauw, 2007; Abegg et al., 2022), with pit dwelling sites ranging from Denmark and Sweden in the north, to France, Italy, and Spain in the south. Pit house distribution was

particularly dense in Fennoscandia and in northwestern Russia during the Neolithic (Mökkönen, 2008, 2011) and pit houses continued to be used in the region until the Early Metal Period (Petro, 2002) but were largely absent in the Baltic States (Nordqvist, 2023, p. 679). Pit houses were also used during the Neolithic period in Greece (Kloukinas, 2018) and were found at the Archaic period Greek colony of Metapontum in southern Italy (Tsetskhladze, 2023, p. 1054). Neolithic pits in the British Isles were interpreted as being dwellings by early scholarship, but later scholars arrived at the consensus that they were primarily storage structures (Coningham & Sutherland, 1998).

During the Early Middle Ages (500–1000 AD), pit structures[3] were a common building form and used for both residential and non-residential purposes (e.g., crafting, storage) (Brather, 2023), and many are thought to have been used by women for weaving (Milek, 2012; Wallace, 2005). In the west, non-residential usage was more common, and cellars began to replace pit structures by the High Middle Ages (1000–1250 AD), but their usage has continued in eastern Europe to the present day (Brather, 2023; Oliver, 1997, p. 1325). Pit houses were the main dwelling type used by Slavic peoples, who settled eastern and central Europe between the 6th and 10th centuries AD (Curta, 2001; Herold, 2012; Oliver, 1997, p. 1306), and they were also used by the subjects of the Avar Khaganate between the 7th and 9th centuries AD (Herold, 2018).

Entirely subterranean pit structures (*souterrains*) were used in the British Isles between the 5th and 12th centuries AD, both for non-residential purposes (e.g., storage) and as residential structures for semisedentary pastoralists in Ireland (Crawford, 1979). Buildings that meet the definition of a pit structure were also used by impoverished peoples between the 17th and early 20th centuries in Sweden (Svensson et al., 2020). Murdock et al. (2023) records the Gagauz people in the Balkans as having used subterranean secondary houses.

1.4 The Americas

1.4.1 North America

North America is home to many indigenous peoples that are recorded by ethnographies as having used pit structures, both as dwellings and for other purposes, and these societies make up the majority of samples in the *Ethnographic Atlas* (Murdock et al., 2023). The examples are too numerous to list in full, but range from the Aleut in Alaska, the Inuit peoples of the Arctic Circle and Greenland, the people of the Northwest Pacific coast (e.g., the Haida), the people of the American Southwest (e.g., O'odham), and the people of the Great Plains (e.g., the Pawnee). Pit structures were also used by the Dorset (Fitzhugh, 2023, p. 353) and by Norse settlers in Newfoundland at the L'Anse aux Meadow site (990–1050 cal AD), where two pit

[3] In European literature they are referred to as "Grubenhaus", "sunken-featured buildings", or "sunken-floor features".

structures were excavated and are thought to have served as either residences or workshops (Wallace, 2005).

Perhaps the most well-known pit houses come from the American Southwest, where they were used by the Ancestral Pueblo, Hohokam, and Mogollon cultures (Sedig et al., 2023). Pit house usage began during the Basketmaker II period (800/500 BC–500 AD), accompanying the spread of maize agriculture and a more sedentary lifestyle, and by the Basketmaker III period (500–750 AD) pit houses had grown in size and agricultural subsistence had become more entrenched (Lekson, 2023, p. 426; Reed & Throgmorton, 2023, p. 456). The Ancestral Pueblo primarily resided in pit houses until the start of the Pueblo I period (750–1150 AD), after which *pueblo* surface structures[4] became the main form of housing (Lekson, 2023). However, pit structures and surface structures continued to be used alongside each other, and room blocks became larger as pit structures became deeper (Wilshusen, 1989). Some pit structures came to be used as *kiva*, ritual spaces for communal gatherings, a tradition continued by modern Pueblo peoples. The Mogollon used pit houses as their main residential structure during the Pithouse period (200–1000 AD) until *pueblo* surface structures became their main house type during the Pueblo period (1000–1450 AD) (Sedig, 2023, p. 445). Pit houses were also the primary dwelling of the Hohokam culture (1700 BC–1450 AD) until the Classic Period (1125/1150–1450 AD), during which *pueblo* surface structures became the primary dwellings (Caseldine, 2023). After the collapse of the Hohokam cultural complex, pit houses once again became the main residential structure and were used by the O'odham, their modern descendants (Caseldine, 2023; Murdock et al., 2023).

1.4.2 South America

Pit houses were used in the Andes during the Preceramic period at sites such as Jiskairumoko in Peru (3050–1500 cal BC) (Craig, 2011). At Jiskairumoko, pit structures became deeper over time until eventually evolving into a semi-subterranean dwelling form shortly before the site was abandoned. Other Andean sites where semi-subterranean pit structures have been found include Chilca I (4400–3900 BC) (Malpass & Stothert, 1992; Oyuela-Caycedo, 2023), Pernil Alto (3800–3000 cal BC) (Gorbahn & Reindel, 2020), Culebras, Los Chinos, Huaca Prieta, and Huaca Negra (Malpass & Stothert, 1992). In Chile, pit dwellings are also found during the Preceramic period between 4800–1675 BC, at sites ranging from Tarapacá in the north to Isla Grande de Chiloé in the south, and there is a notable shift away from subterranean dwellings towards semi-subterranean dwellings over the period (Malpass & Stothert, 1992). Pit houses are also attested to in pre-Columbian Argentina (Gonzalez, 1953, p.272), and extremely large (>20m) pit houses have been found in the Brazilian highlands between 1395 and 1650 cal AD (Gregorio de Souza et al., 2016). Gonzalez (1953) and Murdock et al. (2023) report the Yahgan people of Tierra del Fuego as having used pit houses.

[4] The term *pueblo* also refers to the architectural style of the Pueblo people, that is above-ground room blocks that were made of rammed earth or stone and sometimes formed contiguous, multi-story structures.

1.5 Africa

Pit structures are uncommon in Africa, and the only archaeological examples that I was able to identify are from Egypt. In Upper Egypt, a rectangular semi-subterranean pit structure associated with the Naqada I period (4000–3650 BC) was found, and in Lower Egypt several circular subterranean pit structures were excavated at Maadi, the type-site for the Buto-Maadi culture (4000–3300 BC) (Newman & Wendrich, 2023, pp. 63–67). Subterranean dwellings, including both vertical pit structures and cliff dwellings, were used by Berber people at Matmata in southern Tunisia from the 12th century AD to the mid-20th century, where they helped to moderate the extreme temperatures of the desert (Hill & Woodland, 2003). The *Ethnographic Atlas* (Murdock et al., 2023) records the Turu, Luo, Goroa, and Iraqw peoples near Lake Victoria as having used subterranean dwellings. Gilman (1987) discusses pit house usage among the Konso people of Ethiopia, citing Murdock (1967), but later versions of the *Ethnographic Atlas* (Murdock et al., 1999, 2023) record that the Konso used surface dwellings.

1.6 Discussion

Pit structures first appear in northern Eurasia towards the end of the Paleolithic period and become used across the world as Neolithic cultures develop and sedentism increases. While ethnographic data would seem to suggest that pit houses are associated with non-agrarian cultures, a seminomadic or semisedentary settlement pattern, and a lack of social hierarchy (see Section 2), I have shown in this section that there are several examples of agrarian, sedentary, stratified societies where pit dwellings continued to be used. In particular, the longevity of pit structures in Korea and Japan is noteworthy, as they continued to be the primary dwelling type long after the development of agriculture, sedentism and social hierarchy, and even persisted after the development of state society.

Pit structures are primarily distributed within the temperate zone of the northern hemisphere, (23.5°–66.5° N), suggesting that environmental factors strongly influence pit structure usage. Pit structures have the ability to regulate extreme temperatures, making them an advantageous architectural form in climates that experience a high degree of seasonal temperature variation (i.e., non-tropical climates). This observation was originally made by Gilman (1987), who further posited that a non-tropical climate is a requirement of pit house use. While it is true that pit houses are uncommon in tropical climates, Gilman underestimated the actual distribution of pit structures, overlooking examples from subtropical climates (Egypt, the Levant, northern India, the Ryukyus) and tropical climates (central India). Considering the distribution of pit structures in environments where their ability to regulate temperatures is of lesser importance, we must conclude that that there are non-environmental factors, both economic and cultural, which also encourage pit structure usage. This must be the case, as pit house abandonment occurs even in cold climates where their usage should be

incentivized (e.g. northern Europe, northeast Asia).

There has been extensive debate regarding the economic advantages and disadvantages of pit house architecture, especially with regards to the American Southwest (Gilman, 1987, p. 540). While Gilman did not consider economic cost to be a significant factor in determining pit structure usage, I argue that economic factors must have had some influence, otherwise the use of pit structures by impoverished communities in the Early Modern period (see Svensson et al., 2020) cannot be understood. McGuire & Schiffer (1983) argued that one of the advantages of a pit house, besides the ability to regulate temperatures, is the relatively low labor and material cost required to construct one, and that the main disadvantage of the architectural form is its susceptibility to decay and infestation, which results in a short use-life and higher maintenance costs.

Labor cost estimates suggest that making a pit house was a substantial investment, but not beyond the capabilities of an individual or small family. A Pueblo pit house (45m², 2m deep) would take between 34.6 and 64.3 person-days to excavate (McGuire & Schiffer, 1983, p.294), a Slavic pit house (19.32m², 80cm deep) could be dug, walled, and roofed in 107.5 person-days (Curta, 2001, p.283), and a small Jomon pit house (3.14m², 50cm deep) can be built by two people in 30 days (60 person-days) (Shumatsu Jomonjin, 2023, p. 112). While these labor cost generalizations cannot be applied to all types of pit structures, they suggest that pit house architecture is likely beyond the means of a fully nomadic people, but well within the means of semisedentary and sedentary peoples.

In other words, McGuire & Schiffer argue that pit houses generally have a lower manufacturing cost and a higher maintenance cost, while some forms of surface structures (e.g., *pueblos*) have a higher manufacturing cost and a lower maintenance cost. If this is accurate, then it explains why pit houses are rarely seen in urban settlements, as building longevity is prioritized over manufacturing cost. McGuire & Schiffer also predict that social inequality will lead to more variety in architectural forms, as elites are capable of investing more resources into construction and will seek ways to express their social status. The archaeological record seems to support this hypothesis, as elites in societies where pit structures are the main form of housing (e.g., Yayoi–Kofun period Japan) seem to have a preference towards residing in surface structures.

2. Pit Structures in Ethnography

2.1 Ethnographic Data

In this section I replicate the methodology employed by Gilman (1987), using data from an updated version of the *Ethnographic Atlas* (Murdock et al., 2023; database by Kirby et al. 2015). Bahrami-Rad et al. (2021) tested the validity of the *Ethnographic Atlas* and found it to be consistent with self-reported data from subject communities. However, the *Ethnographic Atlas* is merely a collection of ethnographic data, not an exhaustive database of all human societies, and as such does not represent the societal characteristics of

many prehistoric and historic societies that used pit dwellings. In particular, the dataset is heavily skewed towards representing the indigenous peoples of the Americas. This is an issue with the middle range theory of architecture presented by Gilman, which was primarily based on ethnographic data. Below I will reevaluate Gilman's conclusions by comparing ethnographic data with examples from archaeology.

2.2 Subsistence Strategy

Data from the *Ethnographic Atlas* (Murdock et al., 2023) suggests that pit house usage is more frequent amongst non-agricultural societies (Figure 2, 3). However, the archaeological record demonstrates that there are many cultures that engaged in intensive agriculture and also used pit houses. Gilman likewise concluded that the use of pit houses is not linked to the presence or absence of agriculture, noting that agriculture was practiced during the period in which pit houses were used in the American southwest. Therefore, despite what the ethnographic data would suggest, we must conclude that the practice of agriculture does not necessarily correlate with the abandonment of pit dwellings. However, intensive agriculture can allow for the creation of urban settlements and the development of social elites, which may indirectly cause the abandonment of pit house architecture.

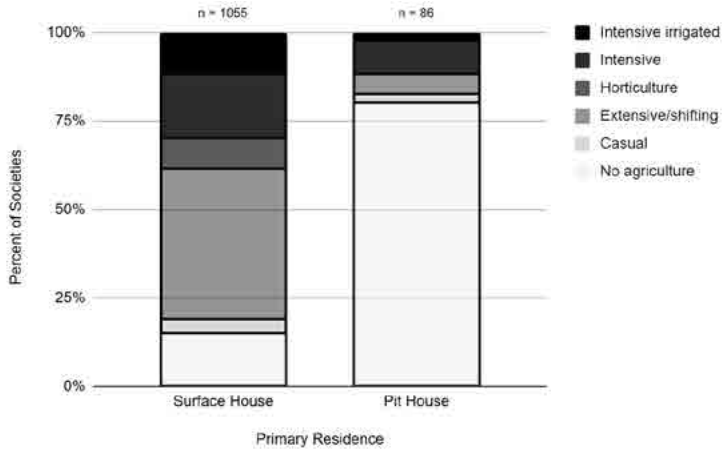

Figure 2: Intensity of agriculture by primary residence type.
Based on data derived from the Ethnographic Atlas (Murdock et al., 2023).

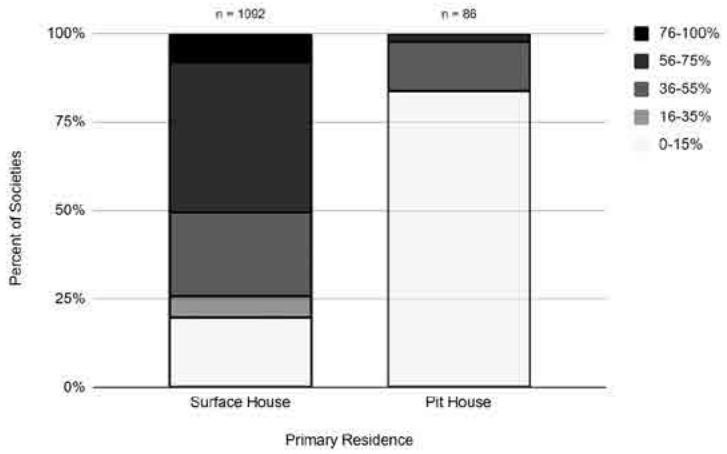

Figure 3: Dependence on agriculture by primary residence type.
Based on data derived from the Ethnographic Atlas (Murdock et al., 2023).

2.3 Settlement Pattern

Gilman associated pit house usage with seminomadic and semisedentary settlement patterns, citing Murdock's (1967) *Ethnographic Atlas*, and suggested that pit dwellers are likely to be sedentary during winter and mobile in other seasons, while recognizing that sedentism is possible if an abundant food source is available (e.g., agricultural fields). Data from the current *Ethnographic Atlas* (Murdock et al., 2023) shows that most ethnographic examples of pit dwelling societies are seminomadic or semisedentary, but it also records the use of pit houses by sedentary communities in villages and towns (Figure 5). Examples of pit house usage at complex permanent settlements (i.e., cities) are not found in the ethnographic record.

Archaeology attests to several examples of cultures with a sedentary settlement pattern using pit houses (e.g., Neolithic and Bronze Age China, Central and Eastern Europe during the Middle Ages, post-Mumun period Korea, post-Yayoi period Japan). There are comparatively fewer examples of pit houses being used in urban contexts. In state societies where both pit dwellings and surface dwellings were used, such as Unified Silla–Goryeo period Korea, and Nara–Heian period Japan, pit houses were often relegated to rural settlements and the urban capital sites used surface structures. While pit houses were used at the Xia-Shang capital sites of Erlitou, Zhengzhou (Lu et al., 2021), and Yinxu (Barnes, 2015, p.217), elites resided in palaces that were built on the surface. If we consider both the ethnographic and archaeological data, then it is clear that pit houses cannot be associated with any single settlement pattern. However, we can note that pit houses are typically not used by fully nomadic peoples, and they are also infrequently used in cities.

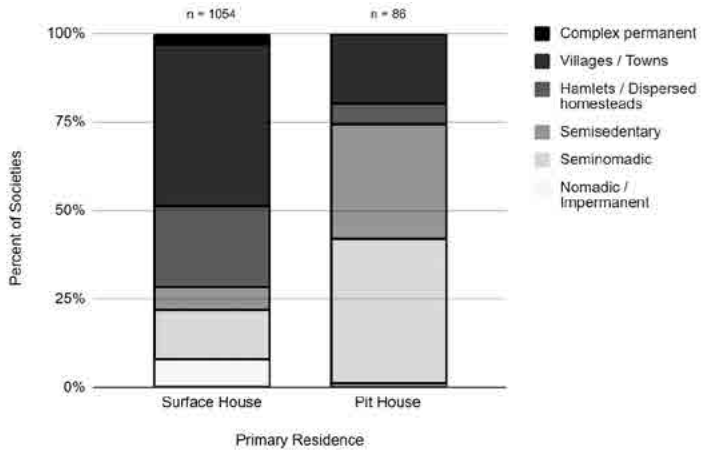

Figure 4: Settlement pattern by primary residence type.
Based on data derived from the Ethnographic Atlas (Murdock et al., 2023).

2.4 Population Density

Gilman noted that pit dwelling societies tend to have low population density, citing Murdock (1967), and this is still the case in the current *Ethnographic Atlas* (Murdock et al., 2023) (Figure 4). The *Ethnographic Atlas* reports the "mean size of local communities", interpreted here as meaning the average population size of a settlement. Making a direct comparison with archaeological data is difficult but population estimates of the Japanese archipelago performed by Koyama (1978) allow for a rough comparison. By Koyama's estimates, the average number of people per site was approximately 8.5 in the Initial Jomon period (9000–5000 cal BC), 24.3 from the Early Jomon period to the Final Jomon period (5000–300 cal BC), 56.7 in the Yayoi period (950 cal BC–250 AD), and 170 during the "Haji period" (250–1150 AD)[5]. Koyama (1978) based these figures on 8th century historical population estimates, using ratios comparing the average number of dwellings at sites in the Kanto region, where pit dwellings were used until the end of the Heian period. These figures fall on the low side of the settlement population density shown in Figure 4. An argument could be made that during the Nara and Heian periods a "local community" would be an administrative village (*kori* 郷里), which had an average population of about 1000 people (50 households of 20 people), but these were merely an administrative unit and not representative of actual settlements.

Setting aside the average size of local communities, let us consider the maximum size of settlements in both pit dwelling and non-pit dwelling societies. In Japan, the most densely populated settlement site composed primarily of pit houses was the Yoshinogari site, dating to the Yayoi period, and had a peak population estimated to be between 1000 and 1500 people (Hudson & Barnes, 1991, p.233). By the Nara period

[5] Calculated by the author, using Koyama's (1978) estimate of "Haji period" site population (170) and the ratios provided.

(8th century AD), when pit structures began to be phased out in favor of surface structures in western Japan, the Heijo capital (100,000–200,000 people; Wada, 2020) was able to achieve a population that was 100 times greater than that seen at Yoshinogari. In China, there are examples of pit dwellings being used at the relatively populous capital sites of the Xia-Shang period, such as at Erlitou (18,000–30,000 people), Zhengzhou (78,000–130,000), and Yinxu (Barnes, 2015, p.211). But at Yinxu, the last of these capitals, the pit houses all date to the earliest phase of the site and are associated with non-local pottery (Jing et al., 2013, p. 361), suggesting they were abandoned as the capital urbanized and became more homogenous. It would seem that pit house architecture is abandoned as settlements become more urban and this may be a consequence of their short use-life.

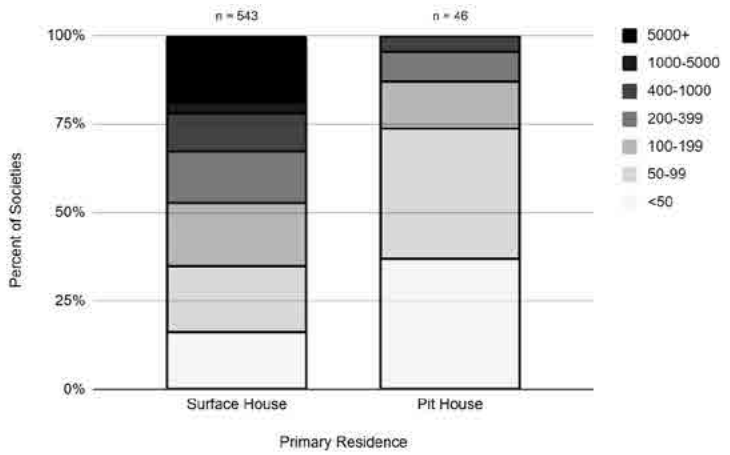

Figure 5: Mean size of local communities by primary residence type.
Based on data derived from the Ethnographic Atlas (Murdock et al., 2023).

2.5 Social Complexity

Gilman noted that pit dwelling societies tend to have lower degrees of political complexity and attributed this to their lower overall population density, though she concluded that political organization is not directly linked with pit house usage. The data from the *Ethnographic Atlas* (Murdock et al., 2023) shows that pit dwelling societies have varying levels of political complexity and class distinction (Figure 6, 7), but that there are no examples of state level societies or societies with "complex stratification". However, ethnographic data only represents societies which continued to use pit houses into modern times, and therefore fails to represent the societies of the past which later transitioned to using surface structures.

Archaeology attests to several examples of state societies using pit structures, including Xia-Shang period China, Nara–Heian period Japan, and Unified Silla–Goryeo period Korea. In each of these state societies, elite residences were always surface structures and there was a clear hierarchy among residential forms, with pit dwellings falling to the bottom of that hierarchy. In Japan, this hierarchy was already well established by the

Kofun period (250–710 AD) and elite residences at sites like Mitsudera I were usually raised-floor buildings. This is in line with McGuire and Schiffer's theory of architectural design, which speculates that architectural variation increases with social stratification as elites are capable of investing greater resources into increasingly elaborate architectural forms.

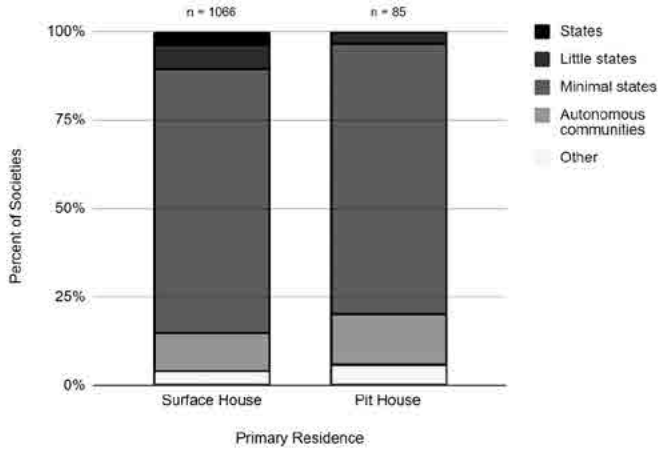

Figure 6: Political integration by primary residence type.
Based on data derived from the Ethnographic Atlas (Murdock et al., 2023).

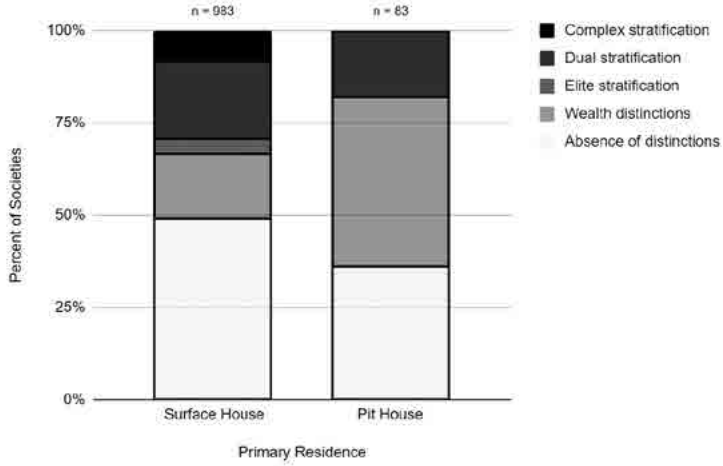

Figure 7: Primary class differentiation by primary residence type.
Based on data derived from the Ethnographic Atlas (Murdock et al., 2023).

3. Case Study: The Japanese Archipelago

3.1 Pit Structures in The Japanese Archipelago

In this section, I examine how pit structures changed over time in the Japanese archipelago, how they came to be used, and why they were eventually abandoned. I consider the utility of the factors proposed

by Gilman (1987) and suggest alternative use and abandonment factors that can explain the transition from pit structures to surface structures in the Japanese archipelago.

In mainland Japan (Honshu, Kyushu and Shikoku), pit structures typically have one or more of the following components: 1) a thatch or sod roof supported by posts; 2) storage pits dug into the floor; 3) wood-reinforced retaining walls; 4) drainage ditches on the inside or outside of the structure; 5) a hearth dug into the earth (replaced by a stove in the late 5th century AD). Not all of these elements are present in every pit structure, and structures that lack features necessary for everyday life are thought to be used for non-residential purposes. These archaeological features are typically referred to as a "pit house" (*tateana jukyo* *竪穴住居*), a term that has been criticized as being inaccurate, as not all pit houses were used as dwellings. "Pit building" (*tateana tatemono* 竪穴建物) has been suggested as an alternative term (Agency for Cultural Affairs, 2010; Kiriu, 2015). The most common surface structures in Japanese archaeology are pillared-buildings (*hottate-bashira tatemono* 掘立柱建物), subdivided into raised-floor buildings (*takayuka-shiki tatemono* 高床式建物) and ground-level buildings (*heichi-shiki tatemono* 平地式建物).

In the Paleolithic period (45,000–14,000 BC), simple pit structures (both round and rectangular) are found in the Japanese archipelago but are relatively uncommon (Ishino, 1975). In the subsequent Jomon period (14,000–300 cal BC)[6], a Neolithic hunter-gatherer way of life spread throughout the archipelago, accompanied by the use of pit houses. Both rectangular pit houses and round pit houses are used throughout the period, with the predominant form varying over time and from region to region (Ishino, 1975). From the Middle Jomon period onwards, there was substantial variation in subsistence strategy, settlement pattern, and social complexity across the archipelago and northeastern Japan was the region with the highest degree of sedentism and social complexity. Despite this, pit structures remain the dominant dwelling type in the Japanese archipelago throughout the Jomon period.

During the Yayoi period (950 cal BC–250 AD)[7] intensive rice agriculture and sedentism became firmly established throughout the Japanese archipelago, except in the Ryukyu Islands and Hokkaido. Bronze ritual implements and iron tools also spread throughout the archipelago during the Middle Yayoi (350 cal BC–50 AD) and Late Yayoi (50–250 AD) periods. Despite these revolutionary changes in subsistence, settlement pattern, and material culture, pit structures continued to be the most common dwelling type throughout the period. Raised-floor buildings are built at many settlement sites, and most are thought to have been used as granaries. But in the Middle and Late Yayoi period, large raised-floor buildings start to be built at political

6 The transition from the Jomon period to the Yayoi period in mainland Japan occurred gradually and there is overlap between the two periods. Northern Kyushu was the first region to adopt the Yayoi culture in 950 cal BC, and the Chubu region was the last place to adopt around 300 BC (Fujio, 2009a).

7 The start date of the Yayoi period is a topic of ongoing debate. Here, I am using the dates provided by Fujio (2009a).

centers, such as the Makimuku site in Nara prefecture and the Ikegami Sone site in Osaka, and likely were used as residences by elites or for ritual functions. This accompanies an increase in the social stratification of mortuary culture, and large burial mounds begin to be constructed for elites. The Late Yayoi period also sees a decline in round pit structures as rectangular pit structures become more common.

By the Kofun period (250-710 AD), rectangular pit structures became the dominant type and by the 5th century, round pit structures were completely phased out (Ishino, 1975). In the latter half of the 5th century, migration from the Korean peninsula led to the adoption of stoves (*kamado*) in pit dwellings, which were typically built along the walls of a house rather than in the center. By the late 6th century, kilns for iron smelting began to be installed in pit structures that were used as workshops. Pit structures remain the most common feature at settlement sites while elite residences are usually raised-floor buildings, such as those seen at the Mitsudera I site. But at the Kuromine site, a settlement that was preserved by volcanic ash, surface structures were more numerous than pit structures, which suggests either that a transition away from pit structures was underway by the 6th century (Ishino, 1975), or that pit structures are generally overrepresented in the archaeological record. The late 6th century is also when elites began to be influenced by Buddhism and commission the construction of Buddhist temples (e.g., Asuka-dera) with the help of artisans who migrated from the Korean peninsula.

During the Asuka period (538–710 AD), the Yamato court began constructing palace complexes in the Nara basin, which would frequently be disassembled, moved, and reconstructed across the Nara plain, eventually culminating in the construction of the Fujiwara capital (694 AD). At the start of the Nara period (710–794 AD), the Yamato court created the Heijo capital (710 AD) and reorganized their government in the image of the Tang dynasty, becoming the Ritsuryo state. They constructed provincial capitals (*kokufu* 国府) and governmental offices (*kanga* 官衙) across the country, which almost exclusively use surface structures as their architectural unit. Pit dwellings in western Japan decreased in size and eventually disappeared between the late 7th century and early 8th century AD (Ishino, 1975, p.159). But in eastern Japan, pit structures continue being used as dwellings until the end of the 12th century, and at some sites pit structures become merged with surface buildings (Takahashi, 2015).

The persistence of pit structures in eastern Japan during the Nara period may explain why there are significantly fewer Nara period settlement sites in western Japan (378) than there are in eastern Japan (1434)[8], despite the population of western Japan (2,344,000) being higher than that of eastern Japan[9] (2,046,100)

[8] These site counts were calculated by filtering the National Research Institute for Cultural Properties site database for Nara period settlement sites (code 5101), removing duplicates, geolocating their coordinates, and selecting sites within each region in QGIS.

[9] In this section I define western Japan as encompassing the Kinai, Nankaido, Sanyodo, Sanindo, Nankaido regions, and eastern Japan as encompassing the Hokurikudo, Tosando, and Tokaido regions.

(Kito, 1996). This may be the result of preservation bias, as pit structures leave a relatively large stratigraphic impression while surface structures only leave behind postholes. This disparity could also be the result of a difference in the use-life of pit structures and surface structures. If pit structures have a relatively short use-life and surface structures have a comparatively longer use-life, then we would logically see fewer surface structures in the archaeological record. An individual pit structure may have had an average occupation span as short as 10 years in the Jomon period (Kobayashi, 2009) and 20 years in the Yayoi period (Fujio, 2009b).

Pit structures continue to be built in the Kamakura period (1185–1333 AD) (Ishino, 1975), as evidenced by the many pit buildings found at the Kamakura capital site (Suzuki, 2013). However, these pit structures are thought to be used for non-residential functions, such as storage. Some scholars argue that residential pit structures also existed during this period, but they are in the minority (Suzuki, 2013). Pit structures continue to be used in a similar way during the Muromachi period (1336–1573 AD) (Suzuki, 2013).

In Hokkaido, pit houses were used throughout the Jomon and Epi-Jomon (340 BC–700 AD) periods. During the Satsumon period (700–1200 AD), pit dwellings adopted the same cooking stove (*kamado*) technology that had spread through mainland Japan a few centuries earlier (Agency for Cultural Affairs, 2010, p.42). Pit houses were also the primary residential structure of the Okhotsk culture of Sakhalin and in northern Hokkaido. The Ainu culture originally used pit dwellings as winter residences (*toj cise*) and surface dwellings as summer homes (*sax cise*) (Oliver, 1997, p. 993) but pit dwellings were abandoned in Hokkaido between the 12th and 13th centuries AD. The Kamchatka Ainu continued to use pit dwellings until the 18th century, and they continued to be used as winter residences by the Sakhalin Ainu into the 20th century (Takase, 2018).

In the Ryukyus, pit houses are used throughout the Shell Mound period (7000 BC–1050 AD) alongside surface dwellings (Pearson, 2013, pp. 69, 92). A shift towards surface dwellings began during the Late Shellmound period (300 BC–1050 AD), and by the 12th century AD pit houses were replaced by surface dwellings at village sites (pp. 69, 266). This transition occurred during the Gusuku period (1050–1429 AD), when intensive agriculture spread throughout Okinawa, and walled sites with elite residences (*gusuku*) began to be constructed (pp. 154).

3.2 Factors Affecting Use and Abandonment

Two of the three requirements for pit house usage that were posited by Gilman (1987) are challenged by Japanese archaeology. Requirement 1 (a non-tropical climate during the season of pit house habitation) is challenged by the usage of pit houses in the Ryukyus, which have a sub-tropical and humid environment. Requirement 3 (a reliance on stored food during the period of pit house occupation) is challenged by the fact that both pit structures and raised-floor structures were used for food storage from the Yayoi period onwards. As the factors posited by Gilman are not able to explain the pattern of pit house use and abandonment in Japan,

I propose the following use and abandonment factors.

Use factors: 1) environmental necessity; 2) economic necessity; and 3) cultural inertia.

Abandonment factors: 1) urbanization; 2) technological advancement; and 3) cultural influence.

The spatiotemporal distribution pattern of pit house usage in the Japanese archipelago can be explained by considering these factors. Paleolithic and Incipient Jomon peoples likely built their dwellings as pit structures out of economic and environmental necessity (Use Factors 1 and 2), as the low material cost and high thermal efficiency of pit houses was advantageous. However, even after moving south into warmer climates where it was no longer environmentally necessary (i.e., the Ryukyus), pit houses continued to be used due to cultural inertia (Use Factor 3). Surface structures were occasionally used as dwellings, especially after social stratification increased in the Yayoi and Kofun periods and elites came to use raised-floor buildings, but there was little reason to abandon pit style architecture entirely.

In mainland Japan, the transition to surface structures did not occur until the late 7th to early 8th century AD, when the state increased their authority and ordered the construction of palatial complexes and urbanized capital cities (Abandonment Factor 1). At the time, there was a diffusion of new architectural tools and knowledge from continental Asia brought by migrants from the Korean peninsula (Miyamoto, 2015), and this technology allowed for the construction of new architectural forms (Abandonment Factor 2). The Nara period Japanese state was heavily influenced by Tang China and sought to emulate their governmental organization and architecture (Abandonment Factor 3), leading to the construction of an urban capital and government offices across the country.

As commoners became exposed to the architectural style used at government offices and at the capital, they may have sought to emulate it (Abandonment Factor 3), except in regions where pit dwelling usage would have been encouraged by environmental and economic necessity (Use Factors 1 and 2). The diffusion of architectural technology would have also made surface structures relatively less costly to build than in previous times (Abandonment Factor 2), and craftsmen would have gained experience building these architectural forms by participating in the construction of the capital sites and regional offices (Abandonment Factor 3). Cultural influence from mainland Japan led to the development of new architectural forms in Hokkaido (Oliver, 1997, p. 993) and the Ryukyus (Pearson, 2013, p. 153–154) in the 12th century, and this may be the reason why pit structures were abandoned in both regions at the same time (Abandonment Factor 3). While pit structures stopped being used as dwellings in mainland Japan after the 12th century, they continued to be used as storehouses in the Kamakura and Muromachi periods throughout the archipelago, possibly due to Use Factors 1 and 2.

Conclusion

In this paper, I have attempted to explain the factors which cause the usage and abandonment of pit structures by taking into consideration both archaeological and ethnographic data. In my survey of worldwide pit structure distribution (Section 1), I established that pit structures are used by a wide range of societies, from seminomadic hunter-gatherers to sedentary agricultural state societies. I have tried to be as thorough as possible, but I have doubtless failed to include some time periods and regions where pit structures were used. The variety of social characteristics exhibited by societies which use pit dwellings must be kept in mind when we attempt to interpret the meaning of pit structures in the archaeological record. However, some general trends regarding the use and abandonment of pit structures can be identified, and these are related to the advantages (low construction cost, the ability to regulate extreme temperatures) and disadvantages (short use-life, limited utility in urban environments) of pit house architecture.

Using the Japanese archipelago as a case study, I have shown how the pattern of pit dwelling use can be explained by considering: 1) environmental necessity; 2) economic necessity; and 3) cultural inertia. Likewise, I have argued that there are three factors that can lead to the abandonment of pit dwellings: 1) urbanization; 2) technological advancement; and 3) external cultural influence. A transition from pit structures to surface structures occurs when the factors encouraging abandonment outweigh the factors encouraging use. This list should not be taken as being exhaustive, and there are certainly other factors which may encourage pit structure use or lead to pit structure abandonment.

Figures

Figures 1–7 were created by the author, using data from the *Ethnographic Atlas* (Murdock et al., 2023; based on Murdock et al., 1999) provided by the D-Place database (Kirby et al., 2015). Figure 1 is based in part on the map of pit structure distribution in Gilman (1987: Figure 1).

References

Abegg, C., Carloni, D., Cousseau, F., Derenne, E., & Ryan-Despraz, J. (2022). The bell beaker culture in all its forms: *Proceedings of the 22nd meeting of 'archéologie et gobelets' 2021 (Geneva, Switzerland)*. Archaeopress Publishing Ltd.

Agency for Cultural Affairs. (2010). 発掘調査のてびき ―集落遺跡発掘編― [*Hakkutsuchosa no tebiki: Shūraku iseki hakkustu hen*]. Doseisha.

Anthony, D. W. (2010). *The Horse, the Wheel, and Language: How Bronze-Age Riders from the Eurasian Steppes Shaped the Modern World*. Princeton University Press.

Bahrami-Rad, D., Becker, A., & Henrich, J. (2021). Tabulated nonsense? Testing the validity of the

Ethnographic Atlas. *Economics Letters*, 204, 109880. https://doi.org/10.1016/j.econlet.2021.109880

Barnes, G. L. (2015). *Archaeology of East Asia: The Rise of Civilization in China, Korea and Japan*. Oxbow Books.

Bar-Yosef, O. (1998). The Natufian culture in the Levant, threshold to the origins of agriculture. *Evolutionary Anthropology: Issues, News, and Reviews*, 6(5), 159–177. https://doi.org/10.1002/(sici)1520-6505(1998)6:5<159::aid-evan4>3.0.co;2-7

Baudouin, E. (2019). Rethinking architectural techniques of the Southern Caucasus in the 6th millennium BC: A re-examination of former data and new insights. *Paléorient*, 45(1), 115–150. https://doi.org/10.4000/paleorient.602

Bale, M.T. (2012). *Storage Practices, Intensive Agriculture, and Social Change in Mumun Pottery Period Korea, 2903–2450 Calibrated Years B.P.* [Doctoral dissertation, University of Toronto]. TSpace. https://hdl.handle.net/1807/31685

Bhat, S. A., & Dubey, M. C. (2019). Burzahom (Burzohama) a Neolithic Site in Kashmir. *International Journal of Trend in Scientific Research and Development*, 3(2), 583–585. https://doi.org/10.31142/ijtsrd21440

Brather, S. (2023). The Medieval Period of Temperate Europe. In T. Rehren & E. Nikita (Eds.), *Encyclopedia of Archaeology* (2nd ed., Vol 4). Academic Press.

Burdo, N., Videiko, M., Chapman, J., & Gaydarska, B. (2012). Houses in the archaeology of the Tripillia—cucuteni groups. In *One World Archaeology* (pp. 95–115). Springer New York. http://dx.doi.org/10.1007/978-1-4614-5289-8_5

Caseldine, C. R. (2023). North America, Southwest: Hohokam. In T. Rehren & E. Nikita (Eds.), *Encyclopedia of Archaeology* (2nd ed., Vol 4). Academic Press.

Cilingiroglu, C., & Helwing, B. (2023). The Neolithic and Chalcolithic of West Asia. In T. Rehren & E. Nikita (Eds.), *Encyclopedia of Archaeology* (2nd ed., Vol. 4). Academic Press.

Coningham, R. A. E., & Sutherland, T. (1998). Dwellings or granaries? The pit phenomenon of the kashmir-swat neolithic. *Man & Environment*, 22, 29–34.

Craig, N. (2011). Cultural dynamics, climate, and landscape in the South-Central Andes during the mid-late holocene: A consideration of two socio-natural perspectives. Chungará (Arica), 43(1), 367–391. https://doi.org/10.4067/S0717-73562011000300004

Curta, F. (2001). *The Making of the Slavs: History and Archaeology of the Lower Danube Region, c.500–700*. Cambridge University Press.

Crawford, R. B. (1979). The Irish souterrains and their background. In H. E. W. Crawford (Ed.), *Subterranean Britain: Aspects of underground archaeology*. 100–144. St. Martin's Press.

D'Alpoim Guedes, Jade & Aldenderfer, Mark. (2020). The Archaeology of the Early Tibetan Plateau: New

Research on the Initial Peopling through the Early Bronze Age. Journal of Archaeological Research. 28. https://doi.org/10.1007/s10814-019-09137-6

Fitzhugh, W. W. (2023). Archaeology of the North American Arctic. In T. Rehren & E. Nikita (Eds.), *Encyclopedia of Archaeology* (2nd ed., Vol. 3). Academic Press.

Flannery, K. V., & Schwerdtfeger, F. W. (1972). *The origins of the village as a settlement type in Mesoamerica and the Near East: a comparative study*. Duckworth.

Flannery, K. V. (2002). The Origins of the Village Revisited: From nuclear to extended households. *American Antiquity*, 67(3), 417–433. https://doi.org/10.2307/1593820

Fuller, D. Q. (2006). Agricultural origins and frontiers in South Asia: A working synthesis. *Journal of World Prehistory*, 20(1), 1–86. https://doi.org/10.1007/s10963-006-9006-8

Fretheim, S. E. (2023). From Tents to Pit Houses: A Quantitative Study of Dwelling Trends in Mesolithic Norway, 9500–4000 BC. *European Journal of Archaeology*, 27(1), 3–22. https://doi.org/10.1017/eaa.2023.35

Fujio, S. (2009a). Details of the Research, the Results and Issues. *Bulletin of the National Museum of Japanese History, 149*, 1–30. https://doi.org/10.15024/00001671

Fujio, S. (2009b). Yayoi Settlement Theory Using Calibrated Dates (Research Papers I The Settlement Theory of the Yayoi Period). *Bulletin of the National Museum of Japanese History, 149*, 135–161. https://doi.org/10.15024/00001676

Gilman, P. A. (1987). Architecture as Artifact: Pit Structures and Pueblos in the American Southwest. *American Antiquity*, 52(3), 538–564. https://doi.org/10.2307/281598

Gonzalez, A. R. (1953). Concerning the Existence of the Pit House in South America. American Antiquity, 18(3), 271–272. https://doi.org/10.2307/277052

Gorbahn, H., & Reindel, M. (2020). Early Agriculture in Southern Peru. In J. Müller & A. Ricci (Eds.), *Past Societies. Human Development in Landscape* (pp. 51–68). Sidestone Press.

Gregorio de Souza, J., Robinson, M., Corteletti, R., Cárdenas, M. L., Wolf, S., Iriarte, J., Mayle, F., & DeBlasis, P. (2016). Understanding the chronology and occupation dynamics of oversized pit houses in the southern Brazilian highlands. *PLOS ONE*, 11(7). https://doi.org/10.1371/journal.pone.0158127

Grosman, L. (2022). The Natufian Chronological Scheme – New Insights and their Implications. In *Natufian Foragers in the Levant*, 622–637. Berghahn Books. http://dx.doi.org/10.1515/9781789201574-039

Hadevik, C. (2010). Sunken Floor Houses of the Funnel Beaker Culture: A Methodological Problem. *Lund Archaeological Review*, *16*, 5–15.

Herold, H. (2012). Fortified Settlements of the 9th and 10th Centuries AD in Central Europe: Structure, Function and Symbolism. *Medieval Archaeology*, 56(1), 60–84. https://doi.org/10.1179/0076609712z.0000000003

Herold, H. (2018). Settlements of the Avar Khaganate. *Antaeus*, 35–36, 187–203. https://doi.org/10.62149/antaeus.35-36.2018_08

Hershkovitz, I., Bar-Yosef, O., & Arensburg, B. (1994). The Pre-Pottery Neolithic populations of South Sinai and their relations to other circum-mediterranean groups : An anthropological study. *Paléorient*, 20(2), 59–84. https://doi.org/10.3406/paleo.1994.961

Hill, J., & Woodland, W. (2003). Subterranean settlements in southern Tunisia: Environmental and cultural controls on morphology, community dynamics and sustainability. *Geography*, *88*(1), 23–39. https://www.jstor.org/stable/40573794

Hu, G., Wang, P., Rahman, S.M., Li, D., Alam, M.M., Zhang, J., Jin, Z., Fan, A., Chen, J., Zhang, A. and Yang, W. (2020), Vicissitudes experienced by the oldest urban center in Bangladesh in relation to the migration of the Brahmaputra River. J. *Quaternary Sci*, 35: 1089-1099. https://doi.org/10.1002/jqs.3240

Iamoni, M., & Baldi, J. S. (2023). Asia, Southwest: Neolithic Onset of Modern Societies. In T. Rehren & E. Nikita (Eds.), *Encyclopedia of Archaeology* (2nd ed., Vol. 4). Academic Press.

Hudson, M., & Barnes, G. L. (1991). Yoshinogari. A Yayoi Settlement in Northern Kyushu. *Monumenta Nipponica, 46*(2), 235–211. https://doi.org/10.2307/2385402

Ishino, H. (1975). 考古学から見た古代日本の住居 [Kōkogaku kara mita kodai Nihon no jūkyo]. 『家』日本古代文化の探究 [*"Ie" nihon kodai bunka no tankyū*]. 社会思想社 [Shakai Sou-sha]. 77–192.

Jing, Z., Tang, J., Rapp, G., & Stoltman, J. (2013). Recent Discoveries and Some Thoughts on Early Urbanization at Anyang. In A. P. Underhill (Ed.), *A Companion to Chinese Archaeology* (pp. 333–366). John Wiley & Sons.

Kirby, K.R., Gray, R. D., Greenhill, S. J., Jordan, F. M., Gomes-Ng, S., Bibiko, H-J, et al. (2016). D-PLACE: A Global Database of Cultural, Linguistic and Environmental Diversity. *PLoS ONE*, 11(7): e0158391. https://doi.org/10.1371/journal.pone.0158391

Kim, M., Shin, H.-N., Kim, S., Lim, D., Jo, K., Ryu, A., Won, H., Oh, S., & Noh, H. (2015). Population and social aggregation in the Neolithic Chulmun villages of Korea. *Journal of Anthropological Archaeology*, 40, 160–182. https://doi.org/10.1016/j.jaa.2015.08.002

Kiriu, N. (2015). From "Pit dwellings" to "Pit buildings". *Archaeology Quarterly*, 131, 14-16.

Kito, H. (1996). 明治以前日本の地域人口 [Meiji izen Nippon no chiiki jinkō]. *Sophia Economic Review*, *41*(1–2), 65–79.

Kloukinas, D. (2018). Pictures of home: Regional perspectives into the neolithic building technology of northern Greece. In *Communities, Landscapes, and Interaction in Neolithic Greece* (pp. 167–186). Berghahn Books. http://dx.doi.org/10.1515/9781789201468-015

Kobayashi, K. (2009). Understanding Pit Dwellings from Middle Jomon Using 14C Dates (Research Papers

I The Settlement Theory of the Yayoi Period). *Bulletin of the National Museum of Japanese History*, 149, 113–133. https://doi.org/10.15024/00001675

Korean Archaeological Society. (2013). 概説韓国考古学 [*Gaisetsu Kankoku kōkogaku*] (J. Takesue, S. Shōda, & T. Yamamoto, Trans.). 同成社 [Doseisha].

Kotova, N., Vybornov, A., & Morgunovac, N. (2023). The Neolithic and Eneolithic in the Western Steppe Zone. In T. Rehren & E. Nikita (Eds.), *Encyclopedia of Archaeology* (2nd ed., Vol. 4). Academic Press.

Koyama, S. (1978). Jomon Subsistence and Population. *Senri Ethnological Studies*, *2*, 1–65. https://doi.org/10.15021/00003473

Lekson, S. H. (2023). North America, Southwest: Anasazi / Ancestral Pueblo. In T. Rehren & E. Nikita (Eds.), *Encyclopedia of Archaeology* (2nd ed., Vol 3). Academic Press.

Liu, L. (2005). *The Chinese Neolithic: Trajectories to Early States*. Cambridge University Press.

Lu, P., Tian, Y., Storozum, M., Chen, P., Wang, H., Wang, X., Xu, J., Jing, L., Yan, L., Zhang, L., & Mo, D. (2021). Shifting patterns of house structures during the neolithic-bronze age in the Yellow River Basin: An environmental perspective. Land, 10(6), 574. https://doi.org/10.3390/land10060574

Malpass, M. A., & Stothert, K. (1992). Evidence for Preceramic Houses and Household Organization in Western South America. Andean Past, 3(12).

McGuire, R. H., & Schiffer, M. B. (1983). A theory of architectural design. Journal of Anthropological Archaeology, 2(3), 277–303. https://doi.org/10.1016/0278-4165(83)90002-8

Milek, Karen. (2012). The Roles of Pit Houses and Gendered Spaces on Viking-Age Farmsteads in Iceland. *Medieval Archaeology*, 56. https://doi.org/10.1179/0076609712Z.0000000004

Miyamoto, N. (2015). Perspectives of Pit buildings in the History of Architecture. *Archaeology Quarterly*, 131. 93–94.

Mökkönen, T. (2008). A review of neolithic multi-room housepits as seen from the Meskäärtty site in virolahti parish, extreme south-eastern Finland. *Estonian Journal of Archaeology*, 12(2), 114. https://doi.org/10.3176/arch.2008.2.02

Mökkönen, T. (2011). *Studies on Stone Age Housepits in Fennoscandia (4000-2000 Cal BC): Changes in Ground Plan, Site Location, and Degree of Sedentism* [Doctoral dissertation, University of Helsinki]. http://hdl.handle.net/10138/26492

Murdock, G. P. (1967). *Ethnographic Atlas*. University of Pittsburgh Press.

Murdock, G. P., R. Textor, H. Barry, III, D. R. White, J. P. Gray, and W. T. Divale. (1999). *Ethnographic Atlas*. World Cultures 10:24-136 (codebook).

Murdock, G. P., R. Textor, H. Barry, I., D. R. White, J. P. Gray, & W. T. Divale. (2023). D-PLACE dataset derived from Murdock et al. 1999 'Ethnographic Atlas' (v3.0) [Data set]. Zenodo. https://doi.org/10.5281/

zenodo.10177061

Nadel, D. (2003). The Ohalo II brush huts and the dwelling structures of the Natufian and PPNA sites in the Jordan valley. *Archaeology Ethnology and Anthropology of Eurasia*, 1, 34–48.

Nakanishi, A. (1989). 朝鮮半島の建築 [*Chōsenhantō no kenchiku*]. 理工学社 [Rikogakusha Publishing Co.].

Newman, J., & Wendrich, W. (2023). Africa, North: Neolithic and Predynastic Egypt. In T. Rehren & E. Nikita (Eds.), *Encyclopedia of Archaeology* (2nd ed., Vol. 3). Academic Press.

Nordqvist, K. (2023). The Late Stone Age Western Forest Zone, 7th–3rd Millennium BCE. In E. Nikita & T. Rehren (Eds.), *Encyclopedia of Archaeology* (2nd ed., Vol 4). Academic Press.

Oliver, P. (1997). *Encyclopedia of Vernacular Architecture of the World*. Cambridge University Press.

Onuki, S. (1998). 東北アジアの考古学 [*Tōhoku Asia no kōkogaku*]. 同成社 [Doseisha].

Oyuela-Caycedo, A. (2023). Americas, South: Andean Complexity. In T. Rehren & E. Nikita (Eds.), *Encyclopedia of Archaeology* (2nd ed., Vol 4). Academic Press.

Pavlov, P., Besudnov, A., & Lisitsyn, S. (2023). The Paleolithic and Mesolithic Western Steppe and Forest Zone. In T. Rehren & E. Nikita (Eds.), *Encyclopedia of Archaeology* (2nd ed., Vol. 4). Academic Press.

Pearson, R. (2013). *Ancient Ryukyu: An Archaeological Study of Island Communities*. University of Hawai'i Press.

Petro, P. (2002). Semisubterranean houses in Finland - a Review. In P. Paula & H. Ranta (Eds.), *Huts and houses: Stone age and early metal age buildings in Finland*. National Board of Antiquities.

Piezonka, H. (2023). Between the Ural Mountains and Lena River: The Post-Glacial Stone Age in Northern Asia. In E. Nikita & T. Rehren (Eds.), *Encyclopedia of Archaeology* (2nd ed., Vol 4). Academic Press.

Pleshakov, A. A. (2023). Asia, Steppe, East: Neolithic and Chalcolithic Kazakhstan. In T. Rehren & E. Nikita (Eds.), *Encyclopedia of Archaeology* (2nd ed., Vol. 4). Academic Press.

Reed, P. F., & Throgmorton, K. (2023). North America, Southwest: Ancient Peoples of the Four Corners Region. In E. Nikita & T. Rehren (Eds.), *Encyclopedia of Archaeology* (2nd ed., Vol 4). Academic Press.

Rocek, T. R. (1995). Sedentarization and Agricultural Dependence: Perspectives from the Pithouse-to-Pueblo Transition in the American Southwest. *American Antiquity*, 60(2), 218–239. https://doi.org/10.2307/282138

Sarauw, T. (2007). On the outskirts of the European bell beaker phenomenon – the Danish case. *Journal of Neolithic Archaeology*. https://doi.org/10.12766/jna.2007.23

Sebag, & Deborah. (2005). The Early Bronze Age Dwellings in the Southern Levant. *Bulletin Du Centre de Recherche Français à Jérusalem*, 16, 222–235.

Sedig, J. (2023). North America, Southwest: The Mogollon. In T. Rehren & E. Nikita (Eds.), *Encyclopedia of Archaeology* (2nd ed., Vol 3). Academic Press.

Sedig, J., Caseldine, C., & Lekson, S. (2023). North America, Southwest. In T. Rehren & E. Nikita (Eds.),

Encyclopedia of Archaeology (2nd ed., Vol 3). Academic Press.

Singh, U. (2008). *A History of Ancient and Early Medieval India: From the Stone Age to the 12th Century*. Pearson Education India.

Shin, Y., & Kim, D. (2005). 韓国の民家 [*Kankoku no minka*] (Y. Nishigaki, J. Yi, & J. Ichioka, Trans.). 法政大学出版局 [Hosei University Press].

Shinde, V., Deshpande, S. S., & Sarkar, A. (2020). *Chalcolithic South Asia: Aspects of Crafts and Technologies*. Infinity Foundation.

Shumatsu Jomonjin. (2023). *週末の縄文人 [Shumatsu Jomonjin]*. 産業編集センター [Sangyō Henshū Senta-].

Suzuki, K. 2013. 中世鎌倉の都市構造と竪穴建物 [*Chūsei Kamakura no toshi kōzō to tateana tatemono*].同成社 [Doseisha].

Svensson, E., Hansson, M., & Nilsson, P. (2020). 'As far below as you can come'? Historical archaeology on vulnerability and marginalization of life at the bottom of the social ladder. *Post-Medieval Archaeology*, 54(2), 165–185. https://doi.org/10.1080/00794236.2020.1812291

Takahashi, M. (2015). Combined buildings a Pit building and a Flat building. *Archaeology Quarterly*, 131. 77–79.

Takase, K. (2018). Pit dwellings of the Nalychevo Culture in Southern Kamchatka and the Northern Kuril Islands. *Journal of the Graduate School of Letters, Hokkaido University*, 13, 11–33. https://doi.org/10.14943/jgsl.13.11.

Tsetskhladze, G. R. (2023). Mediterranean: Greek Colonies. In T. Rehren & E. Nikita (Eds.), *Encyclopedia of Archaeology* (2nd ed., Vol 4). Academic Press.

Wada, K. (2020). 平城京に住まう人びと：貴族と役人の生活 [Heijōkyō ni sumau hitobito : kizoku to yakunin no seikatsu]. In: Watanabe, A. (Eds.), 奈良の都の暮らしぶり 平城京の生活誌 [*Nara no to no kurashiburi Heijōkyō no seikatsushi*]. 独立行政法人国立文化財機構奈良文化財研究所 [Dokuritsu gyōsei hōjin kokuritsu bunkazai kikō Nara bunkazai kenkyūjo].

Wallace, B. (2005). The Norse in Newfoundland: L'Anse aux Meadows and Vinland. *Newfoundland & Labrador Studies*, 19(1).

Wills, W. H. (2001). Pithouse Architecture and the Economics of Household Formation in the Prehistoric American Southwest. *Human Ecology*, 29(4), 477–500. https://doi.org/10.1023/a:1013198022095

Wilshusen, R. H. (1989). Architecture as Artifact—Part II: A Comment on Gilman. *American Antiquity*, 54(4), 826–833. https://doi.org/10.2307/280688

Whalen, M. E. (1981). Cultural-Ecological Aspects of the Pithouse-to-Pueblo Transition in a Portion of the *Southwest. American Antiquity*, 46(1), 75–92. https://doi.org/10.2307/279988