Beam-pillar and blockhouse wooden construction systems in the world: the areas of domination and mixing zones

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Annotation:
At the early time in every world region the both blockhouse and beam-pillar systems of wooden architecture were used. Further the advantage obtained this type that answered better to the local climate and seismic circumstances. There are the global world areas of blockhouse and beam-pillar systems being spread according to climate and seismic-wind vibration criteria: the beam-pillar system suits for regions with hot climate and high vibrations, and the blockhouse system is common for the regions with cold climate and low vibrations. There exist also some zones with mixed and hybridized constructions that appear in the borders of global areas and also in the territories with abnormal climate-seismic factors local dissemination where the criteria suitable for the blockhouse and beam-pillar systems came into contradiction. Here due to mixing and hybridization of wooden building systems the most original wooden architecture usually appears.
Key words: wooden architecture, blockhouse, beam-pillar, climate-seismic criteria, global areas of wooden systems spreading, abnormal climatic dissemination territories, contradictive criteria, mixing and hybridizing of wooden building systems.

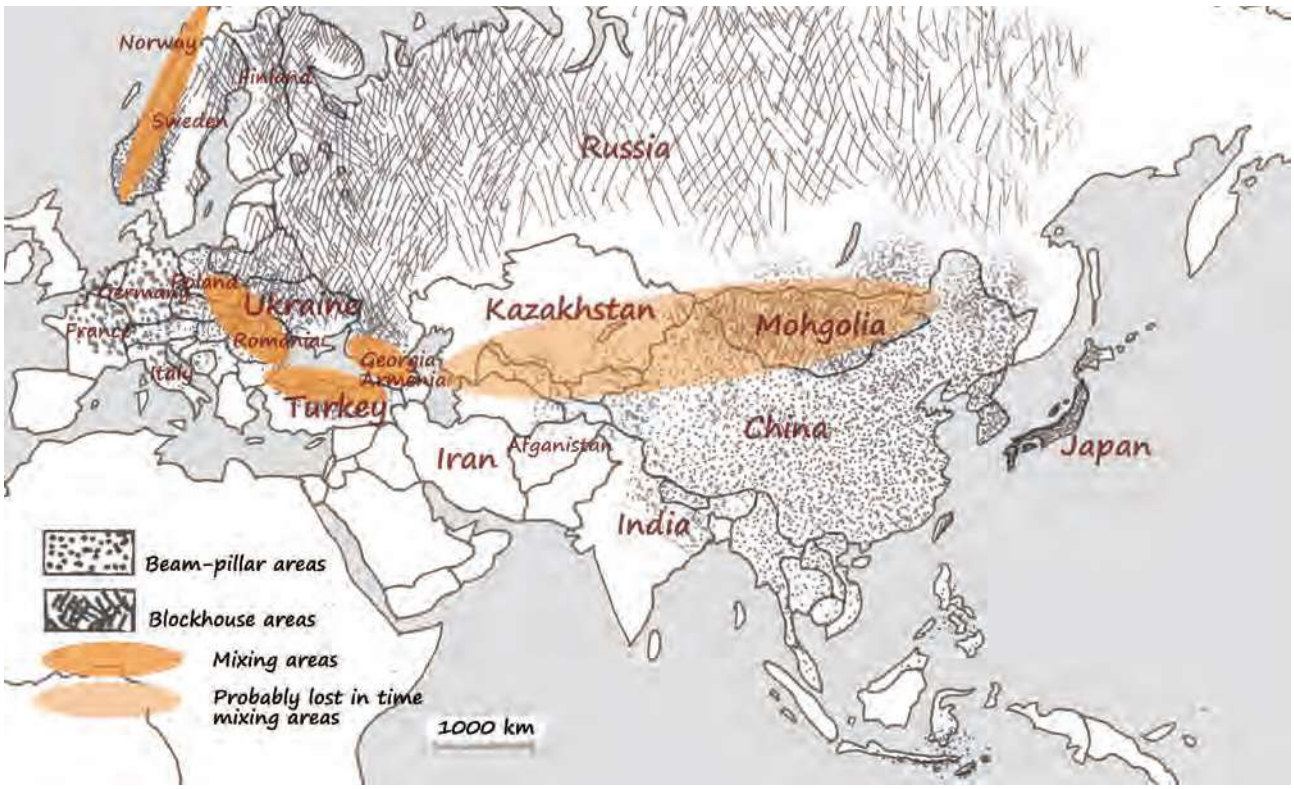
The problem of the global developing processes of blockhouse and beam-pillar constructive systems of wooden architecture is quite unstudied. For the first glance it seems that at each geographic region of the word reigns either blockhouse or beam-pillar system. Marking the territories of blockhouse and beam-pillar spreading on the Eurasian map we can notice that there exist the global areas of blockhouse and beam-pillar systems spreading [1]. It is also can be noticed that beam-pillar system is mostly common for the south-east regions (such as South-East Asia and Far East regions) and the blockhouse system is eventually common for north-west regions (such as Norse Europe, (pic. 1). So it seems logic to suppose that cold-resistant solid blockhouse system was shaped at the North and lighter beam-pillar system origins from South. But due to the comparative study of some ancient clay models and archeological vestiges of wooden architecture coming from different territories excavations we could find that there at early times the both blockhouse and beam-pillar systems were used. Thus we could find some information of the both constructive systems existence at the early times of South-East and Central Asia, Caucasus, Mediterranean, Slavic regions, Northern Europe and so [2-14 and so]. So it is possible to suppose that initially the both systems were developed almost everywhere in the world and finally in certain region the advantage obtained that type of the wooden construction that answered better to the local circumstances.

So, what type of local circumstances could influence in certain region to the process of constructive system choice? It is obviously consists not only of the topic of existence or absence of the wood. It seems naturally that blockhouse that needs a lot of wood could dominate at forest lands and at the forest deficit lands it is better to use economic beam-pillar system. But there are a lot of examples of high forest countries (such as Japan as well) nevertheless using mainly beam-pillar system. The logical analytic of this point leads us to the decision that the basic criteria of blockhouse or beam-pillar system choice in certain geographic territory mostly source from the character of local climate and seismic-wind vibration circumstances than from the quantity of the forests. Simply speaking, each constructive system of wooden architecture has basic technical characteristics suitable or unsuitable for certain climatic factors.

Generally it is possible to point several objective criteria that leads to beam-pillar or blockhouse system domination at the certain rejoin.

Beam-pillar domination criteria are:

Wet and warm climate that suits to such technical peculiarity of beam-pillar system as easiness of buildings inner space's ventilation. From the other hand, in the warm



Pic. 1 World areas of blockhouse and beam-pillar constructive systems.

climate does not matter the beam-pillar system low cold-resistant ability;

High seismic activity or strong winds as beam-pillar construction is quite strong to the vibrations and is able to shape enforced vibration-resistant variations (as for example the famous "nuki" system of Japanese historical architecture). At the same time, in the case of destroying, the beam-pillar system provides minimum danger and is easy to repair.

Blockhouse domination criteria are:

Dry and cold climate that suits to the high cold-resistant peculiarity of the blockhouse construction. In the same time, in cold climate does not matter its low ventilation ability;

Absence of seismic activity or strong winds that makes not important the low resistant ability to the vibrations of blockhouse joints.

So now we could clearly understand why in some geographic regions finally came to domination one or another wooden architecture constructive system: beam-pillar or blockhouse. Precisely speaking, although beam-pillar system can be easily aerated and is strong to the vibrations, it fits to the hot, seismic and windy regions (exactly like South-East Asia and Far East regions). From the other hand, blockhouse is cold resistant but has bad aeration ability and is quite weak to the vibrations, so it is more suitable to the regions with cold but not windy climate with no earthquakes (exactly like Norse Europe). In the same time, we have to mean that in every case the final choice of the constructive system was influenced not only by single certain reason but mostly by their complex. It is also the fact that in most cases "failed" constructive system continued to be used in rudimental forms for some types of wooden buildings having unique function or requiring special maintenance [1]. Let us analyze the details of such proses on the examples of Ukraine and Japan.

Although initially in the territory of Ukraine were tried the both blockhouse and beam-pillar systems [9-10], finally the blockhouse has dominated at the most part of Ukrainian territory(1) as it can be brightly seen at the examples of Ukrainian entire blockhouse rural houses and fascinated wooden churches (pic. 2) [15-17]. This domination is evidentially caused by quite cold Ukrainian climate with absence of strong winds and earthquakes. But in Ukrainian case this domination is quite resent and not absolute. A lot of archeological vestiges whiteness for about the wide variation of beam-pillar constructions at territories of Ukraine at the time of Bronze as well in the Ancient-Russ period (9th-14th cc.) [11-13]. Nowadays we also can see some part of beam-pillar constructions among the household outbuildings and support structures of Ukrainian rural architecture [18-20] (pic. 3). The beam-pillar structure


Rural house of Polissya historical land.


Church from Kisorychi village.


Church from Bronniki village.


Church from Sinyavka village.


Church from Novomoskovsk town.

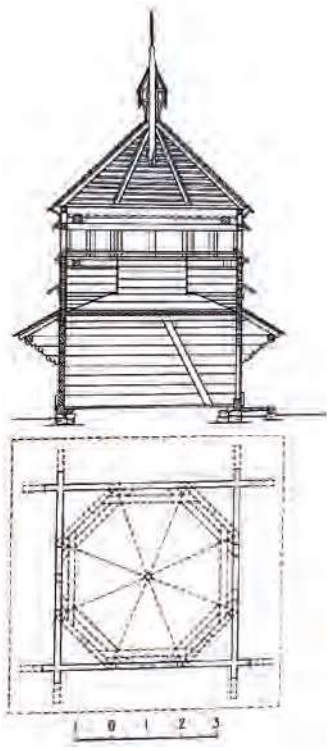

Chapel from Klesiv village

Pic. 2 Ukrainian entire blockhouse rural houses, chapels and churches (17-19th c.).

also is fully or partly used for Ukrainian belfries [21; 22] (pic. 3). All these cases can be explained by some special function of mentioned buildings that for example not need to be heated inside in winter like some types of rural storehouses or requires special construction like belfries. In the case of belfries it is possible to assume that the choice of untypical for Ukraine beam-pillar system is connected here with the peculiarities of this building's function. As a belfry is not supposed for the long people stay, the cold-resistant ability is not needed here, so most economical beam-pillar construction is preferable. In the same time the belfry is usually feeling quite strong vibration caused with bell oscillation as well as by swinging efforts of the ringer so in this case the preference of beam-pillar construction becomes evident.

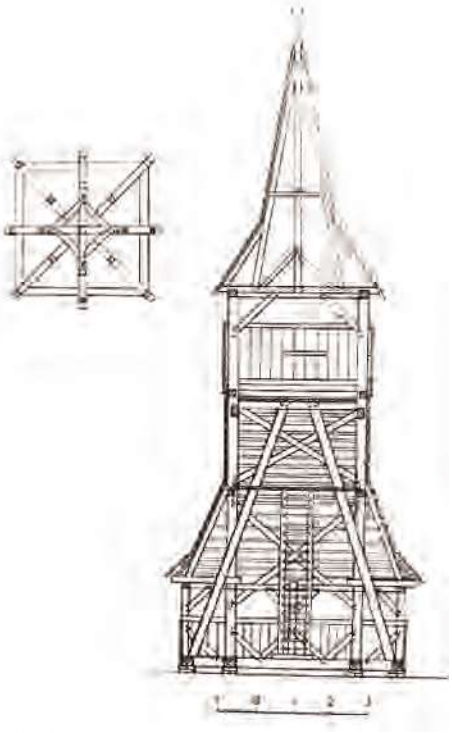
In Japan we can observe reverse phenomena: there finally beam-pillar system has dominated but the rudiments of blockhouse system still can be seen in the household outbuildings and support structures. We also can find the witness of wider blockhouse system spreading there in old times, for example, in the takayuka type granaries of Sannay Maruyama archeological cite excavations and so. But of course in the wet and warm Japanese climate with often earthquakes and typhoons the blockhouse construction is not suitable for the wide using. It is also true that blockhouse system is not convenient for the creation of the buildings with spacious layout [24]. That fact maybe also limited its spreading in Japan at Asuka-Nara times. Of course it is evident that limited with trunk length and unstable in lateral dimension blockhouse is not allow to create so usual for Far East architecture buildings with spacious layout. So it is possible to suppose that partly borrowed from China and Korea, architectural taste of Japan finally leaded to beam-pillar domination of this area(2). But the same it can be supposed that much earlier, generally suitable for Far East climate beam-pillar system dictated the initially shape preference of Far East architecture(3). Nevertheless, as it was mentioned before, in Japan also, the "failed" blockhouse system continued its rudimental existence in some types of additional buildings. The main medium of blockhouse in Japan are storehouse buildings eventually having source from Jomon and Yayoi époques takayuka type granaries and then transformed to a state treasury storehouses and ceremonial regalia storages having their blossoming mostly in 5th-6th cc. [24].

Basing of the excavation materials from Sannay Maruyama archeological sites it can be supposed that in late Jomon period – the time of takayuka granaries formation, they could be beam-pillar or blockhouse system as well. But starting from Yayoi period these two systems became to



Belfry from Yasynya village

Belfry from Kut-Tovste village.



Belfry from Krainikovo village.

Pic. 3 Ukrainian beam-pillar and mixed constructions (17-19th c.).

mix and finally elaborated so called ita-azekura hybrid system that gave a little more shaping freedom to the builders and probably was stronger to the vibrations than blockhouse. Good examples of such granaries now can be seen at Toro archeological site excavations. It is also can be noticed some ita-azekura system influence to early Shinto architecture, mainly in Ise-jingu construction [24]. At Asuka and early Nara times due to political and economic reasons the big state storehouse building type arose. In seems that in 5th-6th cc. in Japan old fashioned ita-azekura storehouses existed synchronically with modern beam-pillar constructions inspired by Korean carpenters [24]. But nevertheless blockhouse survived till nowadays mostly in temple storehouses for ceremonial regalia.

In this point we have a good case to discuss the question of climate influence to the peculiarities of constructive system. Roughly speaking due to local climate, an ordinary beam-pillar of blockhouse system can obtain some unique peculiarities required only for this place specialty. Exact example of this possibility is the original blockhouse system of temple storehouses that was shaped in Japan no later than in Nara times [24] when rudimental for Far East blockhouse system was deeply modified and finally becoming even better suitable for storehouse function that beam-pillar system. Usually the structure of Japanese temple storehouse building consists of one simple square-planned blockhouse cage with slight enlargement to the top that rises on the low pales and is covered with rafter pyramidal roof as we can see at preserved till nowadays Todaiji and Toshodaiji temples' azekura storehouses of Nara period. Inside of such storehouses it is indispensable to keep suitable for the temple regalia temperature and humidity level during all the year. This problem was resolved due to the atypical triangle shape of timbers intersection with their flat side turned inside the building. In lateral dimension the triangle-sectioned timbers are jointed together only with theirs tiny angle sides. In summer, when Japanese climate become extremely humid, the wooden timbers swell allowing the construction to clench together preventing the humid to get inside the buildings. But in winter, when humidity falls down, the triangle-sectioned timbers shrink creating the lateral slits between and thus allowing active aeration inside the building [25].

If we compare Japanese rudimental blockhouse system with elaborated Ukrainian one, we can notice that in Ukrainian case the timber's intersection has more diversity: it can be round or semi-round (with flat side turned inside the building), square or rectangle and even in some cases octagonal or triangle. Ukrainian blockhouse has really wide shape-formation potential jointing several cages in


Pic. 4-a Octagon-on-square space-construction shape, Drogobych town church


Pic. 4-b Zalom space-construction shape on a square cage base, Kisorychi village church.


Pic. 4-c Zalom space-construction shape on an octagonal cage base, Zarubintsy village church.

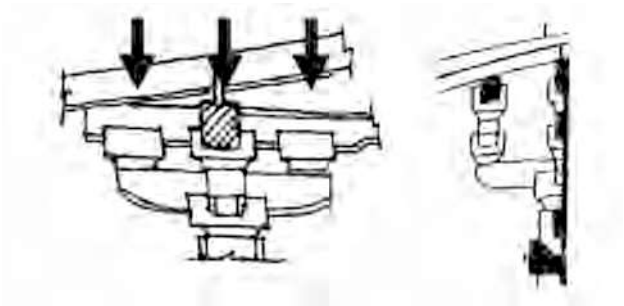

Pic. 4-d Zalom on a base of an octagon-on-square, Novgorod-Siverskii town church.

Pic. 4 The types of blockhouse tower space-constructive shape of Ukrainian churches (16-18th c.).

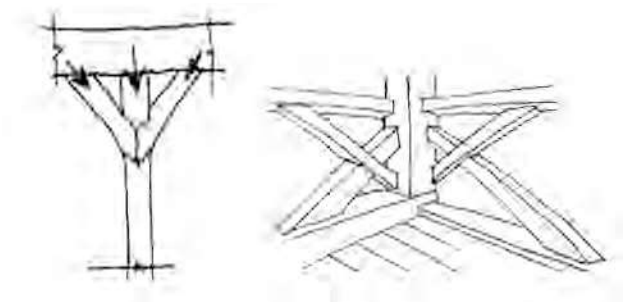
complicated structures. The cage itself also can be not only square or rectangular in layout but also octagonal, hexagonal or trapeze shape. In the church architecture Ukrainian blockhouse can create multiplied narrowed to the top high towers of complicated space-constructive shape that not need interior horizontal support (beams or so) and can show inner space opened and lightened with windows from the top to the bottom of the building. It became possible because of high blockhouse outwork systems creating such space-constructive shapes as so called octagon-on-square and zalom. The octagon-on-square is a space-constructive shape of a church top created with the blockhouse octagonal-plan cage that is posted on the blockhouse square cage base forming massive tower usually covered with pyramidal blockhouse top (pic. 4-a). This outwork method can be observed mostly in Ukraine and Russian wooden churches but obviously have some genetic relations with Caucasus and Iranian architecture [26]. The zalom is a unique Ukrainian space-constructive shape of blockhouse church top where the cage is narrowed with pyramidal inclining covering that is catted in the half and then continued up without inclination (pic. 4-b, 4-c). Zalom top structures can be multiplied in vertical dimension several times shaping high and slim, faulty similar with the pagodas towers. This space-constructive shape can be used in the top of the Ukrainian church substantively or be placed on the octagon-on-square base (pic. 4-d, more detailed explanation see in [15-16, 27-28]). All this is witnessing for about more developed stage of blockhouse in Ukraine than in Japan. But nevertheless, in Ukraine we can't observe Japanese peculiarity of blockhouse's seasonal temperature work changing like it can be seen on the example of Japanese sacral regalia storehouses.

Beam-pillar systems of Japan and Ukraine also are really different and this difference clearly witnessing for about much developed stage of beam-pillar in Japan where it is more elaborated, refined and decorated. Some peculiarities of the both systems also allow to suppose in what type of climate they were formed. In Japan we can see lightness of the walls and their possibility to transformation witnessing to the hot and need to ventilate climate. Also we can see there a lot of special anti-vibration constructions giving mobility to the most Japanese beam-pillar joints (so called nuki system). Also due to developed elbow-bracketing (so called kumimono) systems Japanese beam-pillar is usually works with the principle of only vertical loading transmission, as in Ukraine the beam-pillar has permanently stabled joints with a lot of diagonal supporting elements (so called pidkis) helping to the stability of beam-pillar and transmitting the loading not only in vertical but also in diagonal dimensions [29]. The last phenomena of course could not be possible to exist if Ukraine has earthquakes or another high vibration factors (pic. 5).

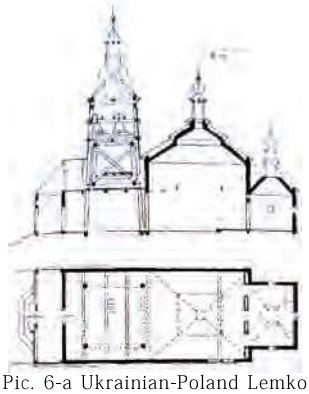
As it was already noticed in the beginning, judging from the Eurasian map of wooden construction systems spreading (see pic. 1), the beam-pillar and blockhouse areas generally answer to the following criteria: beam-pillar system is mostly common for the south-east regions with warm and wet climate. The same is for the regions with high seismic



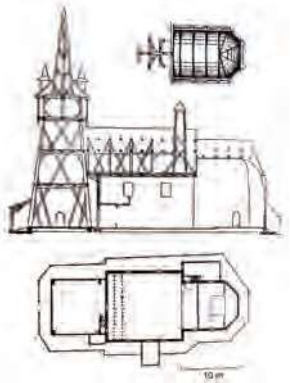
Pic. 5-a Loading transmission way of Japanese beam-pillar constructions.



Pic. 5-b Loading transmission way of Ukrainian beam-pillar constructions.



Pic. 6-a Ukrainian-Poland Lemko type blockhouse churches with beam-pillar narthex belfry. Poland, Mikulashova village (drawings by D. Buxton).



Pic. 6-b Poland wooden churches of mixing construction. Komorowice village (drawings by D. Buxton), Debno village church, 15th c.

Pic. 6-b

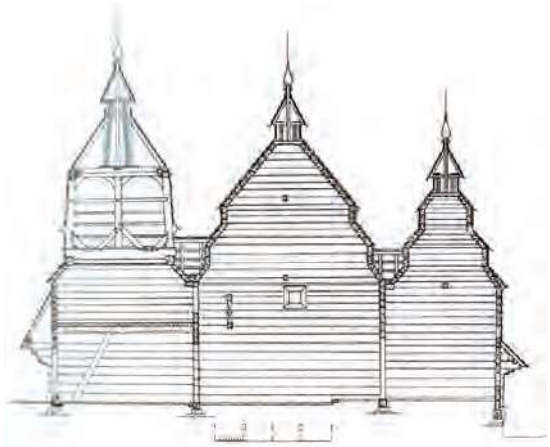
Pic. 6 Lay-out form of beam-pillar and blockhouse systems mixing.

activity or seacoast strong windy lends. For contraire, blockhouse is common for north-west motherland regions without accented seismic activity or strong winds. It also has to be noticed that in most cases the climate factors (south-north vector) and the vibration factors (seismic activities and seacoast-motherland vectors) are not coming in contradiction. Easily speaking, in general seismic and wind activity is usual for hot regions of the world and in the same time cold regions are usually not suffering from the earthquakes, typhoons or hurricanes. But it is also possible to determine some zones with mixed and hybrid blockhouse and beam-pillar constructions that appear at the borders of global areas of two systems spreading as well as at the territories with abnormal local climatic circumstances where the criteria suitable for the blockhouse and beam-pillar systems come into contradiction. Here usually we can observe the most curious and sometimes unique wooden architecture examples that can be just transmission forms between blockhouse and beam-pillar systems as well as creating separated building traditions.

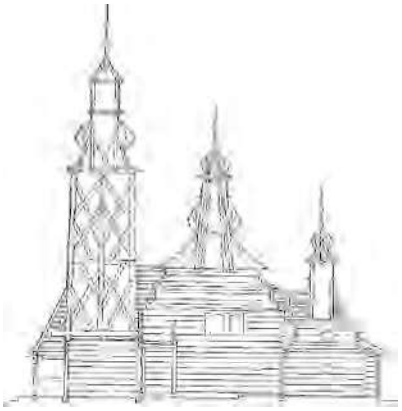
It can be clearly seen from pic. 1 that an accented geographic border of beam-pillar and blockhouse systems spreading concentrating in a rich wooden architecture region lying around the Carpathian mountain ridge. So this territory can be estimated as a very temperature terminator of wooden constructive systems where coming from the South, suitable for beam-pillar climatic zone and coming from the North, suitable for blockhouse zone meet and provoke creating the mixing of wooden building systems. Here also meet the borders of several countries such as Ukraine, Poland, Romania, Hungary and Slovakia. Each of these countries has its original and high developed traditions of wooden architecture concerning not only rural houses and additional household structures but the first of all – the high developed wooden sacral architecture. Wooden churches of these countries are divinely different and mostly have their own genesis but at the point of Carpathian Mountains all of them showing the tendency of beam-pillar and blockhouse mixing. For example generally inclined to the blockhouse system Ukrainian wooden churches of Carpathian region show there some features of mixing with the beam-pillar as it can be seen at the Ukrainian churches of Boyko, Lemko and Transcarpathian types that has beam-pillar construction of western tower [21-23, 27], (pic. 6, pic. 7).

Revising in general the cases of blockhouse and beam-pillar mixing it is possible to determine four types of them.

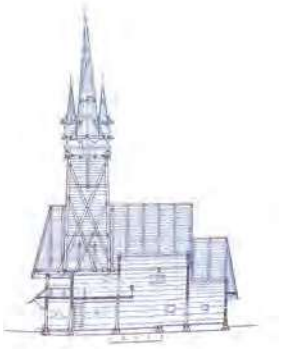
The first one is common in Carpathian region lay-out form



Pic. 7-a Ukrainian Boyko type blockhouse church with upper beam-pillar part of the narthex belfry. Sukhyi and Kryvka villages, 18th c.



Pic. 7-b Ukrainian Lemko type blockhouse church with upper beam-pillar part of the narthex belfry. Kanora village, 18th c.



Pic. 7-c Romanian blockhouse church with upper beam-pillar part of the narthex belfry and rafter roof. Ukrainian Krainikove and Romanian Surdesti villages, 17-18th c.

Pic. 7 Support form of beam-pillar and blockhouse systems mixing .

of beam-pillar and blockhouse systems mixing where some lay-out parts of the building are beam-pillar and the other are blockhouse. For example, the narthexes (western towers) of some Lemko types of Ukrainian wooden churches are beam-pillar, although the nave and altar parts are blockhouse (see pic. 6-a) [22, 23]. The similar point we can observe also in almost all types of Carpathian wooden churches in Romania, Poland and so (pic. 6-b) where blockhouse body of the churches are jointed with beam-pillar narthexes [28].

The second common type of Carpathian is a support form of beam-pillar and blockhouse mixing when the parts of the building with different constructive system are placed on each other. For Carpathian region there are usual the cases when beam-pillar top-part of the building is placed on the blockhouse base-part[4] such it can be seen at the examples of traditional Ukrainian Boyko, Lemko and Transcarpathian type churches as well as at Romanian churches and so[5] (pic. 7). It can be also seen at Carpathian household outbuildings and belfries where base levels are blockhouse and upper ones are beam-pillar [22, 23, 28].

The third type is a hybridized form of beam-pillar and blockhouse where the elements of the both systems are fully merged in creating curious beam-pillar-blockhouse structures. Such merging can be widely seen in some Carpathian rural storehouses where lateral blocks are inserted in the beam-pillar frame[6] [18-20] (pic. 8).

The fourth type can be characterized as a mimicry adaptation form and represents the cases when one wooden building system is changed till strangely that finally obtained some properties of another. In Carpathian Mountains it is possible to see two different examples of such phenomena. One of them can be distinguished widely in many Ukrainian and Romanian Bukovina province ly protruding from the building body to support the long eaves or pent roofs that prevent the church's walls from so common for Carpathians heavy rains. So, it can be concluded that in this case modified according to the local circumstances blockhouse parts have obtained some properties of elbow bracketed pillars becoming able to serve as pointed supports of the eaves (pic. 9-a).

The other example of mimicry adaptation is a modified

Pic. 8 Hybridized form of beam-pillar and blockhouse system mixing. Rural houses and household outbuildings of Carpathian region (18-19th c.).

Pic. 9-a Carpathian wooden churches (Rogatyn town, Beregomet village, 16-18th c., Ukraine).

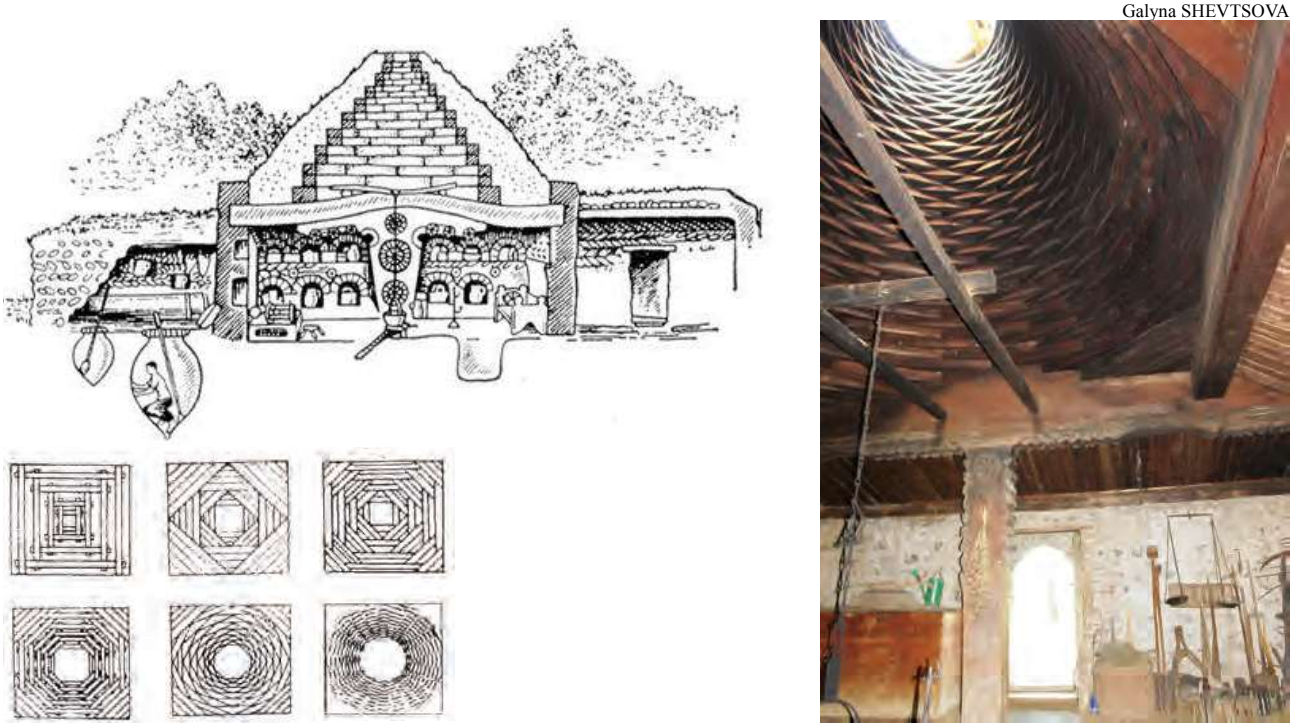
Pic. 9-b Close to the timbers multiplied octagon-on-square structures of beam-pillar framing (Romania, summer altar at Barsana monastery).

Pic. 9 Mimicry adaptation form of beam-pillar and blockhouse system mixing.

multiplied octagon-on-square geometric structures of beam-pillar framing system that can be widely observed in the additional structures of Rumanian Maramuresh province' s churches and monasteries. Mostly it concerns of the light wooden pavilions covering the sources of sacral water or so called summer altars (pic. 9-b). Here we can notice so close placement of lateral elements of the frame that their entire structure became rather close to blockhouse timbers than to the beam-pillar system[7].

As we could see on the upper examples all listed above blockhouse and beam-pillar mixing types are present in Carpathian Mountains region.

We also can find the witnesses of mixed systems' wooden architecture existing in the region of Caucasus [6, 7] that also can be considered like a beam-pillar and blockhouse systems' mixing geographical border that is nowadays not so brightly determined because of wooden architecture's bad preservation of this area. But it is no doubt that there the wooden architecture widely existed before probably giving the source to the some unique shapes of famous Armenia and Georgia stone orthodox churches[8]. The center of mixed wooden system's traditions at Caucasus is a unique type of rural houses that was spread before at Armenia, Georgia and Azerbaijan lands. Longinoz Sumbadze – the main researcher of this question, has pointed them with their Georgian rural term darbaza [6-7][9]. Darbaza is



Pic. 10 Some examples of darbaza type Georgian rural dwellings (drawings by L. Sumbadze [6]).

an interesting type of mountain rural house that is partly deepened in the ground. The main room of darbaza has a fireplace in the center surrounded by square-plan beam-pillar framework[10] serving as the base to so called gvirgvini. Gvirgvini is an opened to the interior blockhouse pyramidal tower that usually is square or octagonal in layout and has an opening for the fume on its top[11] (pic. 10). Gvirgvini can be of several types determined by L. Sumbadze according to the timbers assembling geometry variations (pic. 10). So we can fix here a really curios fact of support form beam-pillar and blockhouse mixing existence where differently from Carpathian example[12], the blockhouse system is placed on the top of beam-pillar frame.

In some meaning it is also can be supposed that mentioned above Carpathian and Caucasian borders of wooden systems' mixing are just two points of ancient general border that trace nowadays is hard to determine due to just fragmental preservation of wooden building traditions of these lands. Recently fulfilled by Turkish specialists investigations fixed in the close to Black Sea lands of Turkey the tradition of mixed blockhouse-beam-pillar wooden mosques erecting that sourced not later than Medieval times [8]. These mosques are of very interesting type of wooden systems mixing having timbers walls and frontons in jointing with interior beam-pillar system and framed verandas [8]. From pic. 1 it can be seen that Turkish territory reposes exactly between mentioned above Carpathian and Caucasus wooden systems mixing regions and in some meaning connecting them. Then it can be supposed to probably prolongation of this eventually mixing zone from Caucasus till Mongolia where also exist some beam-pillar-blockhouse authentic mixing traditions mostly seen at the examples of old Mongolian beam-pillar and blockhouse octagonal dwellings [4] that merging with Chinese influences finally conducted the originality to regional Buddhist architecture [4]. Some echoes of those mixing traditions can be also find in Central and Middle Asia regions between Mongolia and Caucasus [6, 8] (see pic. 1).

To the South from described above mixing border of wooden architecture systems, now it can't be seen many vestiges of wooden architecture but archeological materials witness [4-6] that in the past the traditions of wooden architecture continued from Caucasus through the Middle Asia and Iranian lands till China and South-East Asia and also to India which elaborated temple architecture obviously had wooden roots [3]. It is also curious that some examples of Indian wooden temples are still preserved in Kashmir and Kerala lands [30, 31] (pic. 11-a) and judging from the information found at the materials of 19th centuries researches, before they were much more numerous there [32] (pic. 11-b). At the same time, to the south from Carpathian it is also lying not brightly determined but quite noteworthy region of South European beam-pillar wooden architecture which traces can be found in framing constructions of Middle Ages

Pic. 11-a. Ananthapura-lake-temple at Anthapuram, Kerala province.

Pic. 11-a Vadakkumnathan-temple at Thrissur, Kerala province.

Pic. 11-b. Disappeared wooden temple of Kashmir province (from James Fergusson's materials [32]).

Pic. 11 Indian beam-pillar temples.

Pic. 12-a. Framed church. Poland, Dabcze village, 17-18th c.

Pic. 12-b. Framed Medieval dwellings. Germany, Limburg town.

Pic. 12 Western Europe frame constructions.

town dwelling's architecture as well as in constructions of some framed wooden churches of the region[13] (pic. 12).

To the North from pointed at pic. 1 wooden constructions' mixing border the traditions of wooden architecture are much more visible. They continue directly as well preserved blockhouse buildings' area of Slavic lands (see pic. 1) as it can be seen at the examples of the supported structures, rural houses and wooden churches of Central and Northern Ukraine and then at Russia where to the mentioned above types of wooden buildings also adds civil and fortress blockhouse architecture [14] (pic. 13) [33, 34, 35].

But it is difficult to argue the same for Scandinavia lands where it is possible to observe the most interesting case of beam-pillar and blockhouse wooden systems coexistence (see pic. 1). The reason of atypical mixing zone appearing there is that in Scandinavian seacoast the climatic criteria suitable for the blockhouse and beam-pillar systems come into contradiction. Good example is the ancient wooden architecture of seacoast Norway where the cold climate suitable for blockhouse system is paired with furious sea-storm winds' vibrations could bear only by beam-pillar system. This phenomenon brings there to the life the formation of curious beam-pillar-blockhouse hybridized form construction called stave. Briefly speaking, stave is an elaborated by folk genius shaky framework with inserted inside of it vertical type blockhouse. All the system has additional mobility of the joints resisting to the wind vibrations. Here the frame is a leading element, serving like a bearing construction to confront the winds and blockhouse is just a filler structure to prevent the cold to get inside.

Especially impressive are so called Stave Churches or stavkyrkje – Norwegian Middle Age (11th-13th cc.) wooden churches of stave hybrid construction (pic. 14-b), but the same stave can be widely observed also in the rural barns and dwellings of Norway (pic. 14-a) [37]. The hybrid construction of stavkyrkje is usually working on framework principle due to the big quantity of different shaky joints [14]. The fundament of stavkyrkje is a posed on a stone base square layout made from four huge horizontal logs (that is exactly called stave) crossed with their ends. On the points of these logs' crossing as well as on their

Pic. 13-a Rural dwelling from Onega lake.

Pic. 13-b Kondopoga town church, Karelia land.

Pic. 13-a fortress gate of Nikolo-Karelskiy monastery.

Pic. 13-b Pokrova church at Kizhi Pogost.

Pic. 13 Russian entire blockhouse architecture (17-19th c.).

length there are placed wooden pillars covered with four horizontal upper logs (pic. 15-a). Thus we can observe the creating of initial cubic core-frame system usually covered with triangle rafter roof sometimes with small decorative tower on its top (pic. 15-a). Further this initial core-frame is enforced with a big quantity of additional tiny joints such as for example the belt of crossed elements among the pillars placed on the top level of the frame or semicircle wooden elements among pillars and beams, beams and rafters (pic. 15-a). The space between the pillars of the stavkyrkje is usually filled with vertically placed logs or desks[15] (see pic. 14). It is also a usual case when entire construction of such church was prolonged with small altar part and surrounded with additional gallery covered with pendant roof (see pic. 14-b). More elaborated and rare level of stavkyrkje construction is so called double-nave churches [14, 37] where the initial cubic beam-pillar core-frame was surrounded by the belt of a little lover pillars jointed with the top of the core-frame with inclined rafters and based on the additional horizontal logs reposed on the gabs of the horizontal logs of the core-frame base (see pic. 15-a, 15-b). This innovation not only evidently enforced the construction but also became an excellent method of interior space formation. Thus in this case the high pillars of the core-frame entered inside the church where organized something in the first glance similar with three naves of Western Europe masonry basilicas where two rows of the pillars dividing the interior in three naves and the central nave is


Pic. 14-a Rural barn from Oslo open air popular museum.


Pic. 14-a Rural dwelling from Oslo open air popular museum.

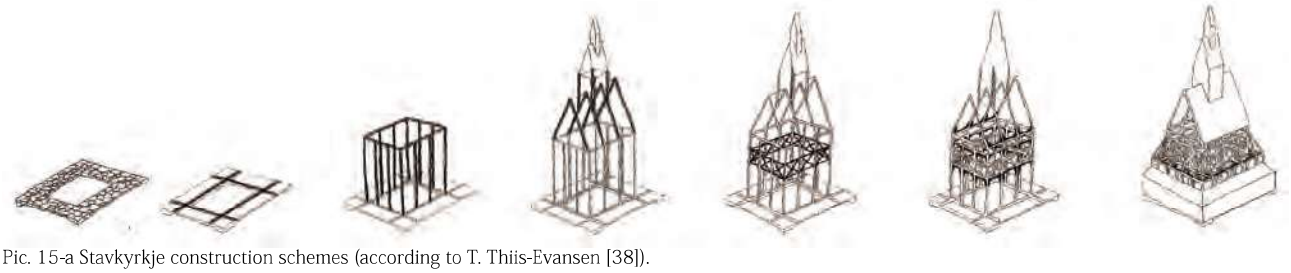

Pic. 14-b Medieval church (stavkyrkje) from Urnes.


Pic. 14-b Medieval church (stavkyrkje)Borgund.

Pic. 14 Norwegian wooden stav construction architecture.

wider and higher than the aisles. So it is not surprising that Norwegian specialist sometimes augmented the relativity of Norwegian stavkyrkje with Middle Age Western Europe masonry church architecture traditions [14]. But truly the space construction of stavkyrkje is not lineal like basilica, but has a centric exaltation formed with square or slightly rectangular in the plan core-frame with higher pillars surrounded by fore-sided aisle parts of lower pillars. This shape is much closer to the Far East Buddhist temples space organization type than to the basilicas.

Nowadays there are only 27 authentic wooden Middle Age (12th-13th cc.) stavkyrkje and 2 a little younger wooden churches (14th-15th cc.) has preserved in Norway [14]. Archeologist also could find the rest of more than 2000 wooden churches of approximately the same time. Later the stavkyrkje were not erected any more maybe because of prayers quantity increasing initiating the bigger church need that stavkyrkje's construction could not provide [14]. It is especially pity that the great deal of Middle Age stavkyrkje were lost quite recently, in the 19th – the beginning of the 20th centuries [14]. But it is notably curious that during the excavations under the bases of Middle Age stavkyrkje often can be found the rests of more ancient, so called pillar wooden churches of slightly different construction that had not a lateral log square frame base (stave) and where the vertical filling elements of the walls were inserted directly in the ground [14]. More ancient vestiges also witnessing for the existence there of a “vertical blockhouse”, or so called palisade churches erected with vertical pile-logs inserted in the ground tightly to each other, but their construction still

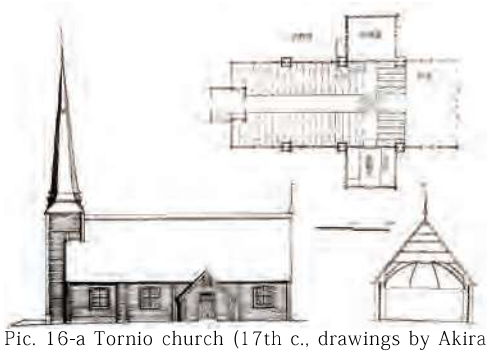


Pic. 15-a Stavkyrkje construction schemes (according to T. Thiis-Evansen [38]).

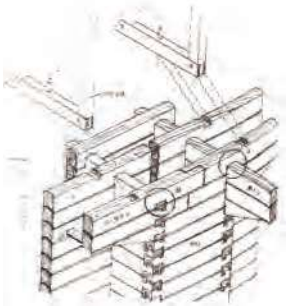
Pic. 15-b Stavkyrkje construction model (Borgund church museum).

Pic. 15-c Greensted palicade church of 9-11th c. Essex, England.

Pic. 15 Stavkyrkje construction and its prototypes.



Pic. 16-a Tornio church (17th c., drawings by Akira Takeuchi [39]).



Pic. 16-b Block-pillar construction (by Akira Takeuchi [39]).

Pic. 16-c Muhos church (17th c.).

Pic. 16 Finnish wooden churches with block-pillars construction.

remains quite doubtful[16] [14].

It is interesting that seemed to be similar with Norwegian, neighbor Finish and Sweden wooden architecture are nevertheless mostly based on blockhouse constructions [28, 39]. So it is possible to assume that situated in less windy lands Finland and Sweden are coming out of wooden building systems mixing anomaly zone and turning to the traditional for the North territories pure blockhouse area. But even at comparatively protected from the wind territory of Finland it can be observed some curious initial process of blockhouse and beam-pillar systems hybridization that can be classified as a case of mimicry adaptation form. As it is possible to notice from the material of David Buxton [28] and Takeuchi Akira [39] research of Finish wooden churches, there was developed so called buttress-pier [28] or box-like pillar [39] system, a unique blockhouse constructive method where wall horizontal timbers of the blockhouse are allowed to prolong with the help of hollow joint of block-pillar which assemble the ends of horizontal wall timbers inside of vertical blockhouse boxes (pic. 16-a, 16-b). This method allows jointing several horizontal logs to one wall and finally creates along the wall's length several pillar-like timber elements[17] (pic. 16-a). The upper parts of the block-pillars are jointed with transverse and longitude beams (pic. 16-b) that makes all block-pillar structure particularly sturdy and allows to incorporate the long walls with high risen vaults[18] (pic. 16-a, 16-c). A. Takeuchi also emphasizing, that box-like pillar system of big and high-roofed Finish wooden churches offers an excellent stabilization of the construction in the event of strong wind [39] that can directly illustrate the thesis of blockhouse and beam-pillar systems initial mixing proses appearing

there due to the climate and vibration factors abnormal dissemination.

At the resume it is possible to assume that the most notable principle of blockhouse and beam-pillar wooden building systems' developing in the world is that at the initial stage in every region the both systems were experimentally used. Further the advantage obtained that type of the wooden construction that answered better to the local circumstances. But "failed" constructive system usually continued to be used at rudimental form for some types of wooden buildings having unique function or requiring special maintenance. Generally blockhouse or beam-pillar systems domination in a certain region is determined by following criteria: cold resistant but having bad aeration ability and quite weak to the vibrations blockhouse is suitable to the regions with cold and dry but not windy climate with no earthquakes; easily aerated and strong to the vibrations beam-pillar fits to the hot, wet, seismic and windy regions. It can be noticed that usually hot and wet climate territories of the world are grouped with strong vibration (earthquakes, typhoons, hurricanes and so) factors the same as cold and dry climate territories usually are not windy or seismic. That is why the spreading of beam-pillar and blockhouse wooden building systems at the territory of Eurasia shows clearly contoured geographical areas. At the borders of global climatic areas of beam-pillar and blockhouse systems spreading as well as at the geographic zones with abnormal climate-seismic factors local dissemination usually appear mixed and hybridized block-beam-pillar constructive traditions. According the information obtained till now, as territories of geographical beam-pillar-blockhouse mixing can be fixed the area from Carpathian till Caucasus Mountains (that probably can be supposed to prolong till Mongolia). As the atypical mixing territory of wooden systems' mixing it is possible now to fix the seacoast Scandinavian lands but it is no doubt that further investigation of whole world wooden architecture is able to add a lot of new examples, aspects and details to this problem.

Endnotes

1. Excluding south and south-west part of Ukraine that comes to the beam-pillar and blockhouse mixing geographical area, see below.
2. Nevertheless we need to mind that in China, Korea and Indo-China region the beam-pillar system is usually used in symbiotic with the massive masonry and ground base that is coming from initial historical China building traditions [2] that is absolutely differs from Japanese case.
3. The same logic also could be applied for North and Eastern Europe wooden architecture formation process where climatic preference of blockhouse system leads to the formation of compact blockhouse cage combinatory architecture most brightly seen at the examples of wooden churches were blockhouse cages obtain vertical tops of multiplied types although vertical tendency of the exterior and inner space is immanent for Christian architecture in general.
4. Further there also will be shown the possibility of vice-versa support form placement where the blockhouse parts of the building are posed on beam-pillar base as it can be observed in the examples of Caucasus rural dwellings (see pic. 10).
5. Precisely speaking, the Ukrainian Transcarpathian type of wooden churches having historical source at Romanian Maramuresh province type of wooden churches so they can be examined like entire phenomena.
6. Here is maybe can be noticed some similarity with Japanese ita-azekura system.
7. So it becomes possible to compare them with blockhouse octagon-on-square outwork shapes of Ukrainian churches' towers (see pic. 4-a).
8. The evidence of this fact was proved in the fundamental work of L. Sumbadze "Architecture of Georgian folk habitation Darbaza" [6].
9. The similar is glhatun for Armenian and karadam for Azerbaijan. There are also witnesses of this type dwelling spreading at Middle and Central Asia regions [6].
10. The walls of darbaza are mostly masonry, but also some examples of old houses with blockhouse walls exist [6].
11. L. Sumbadze argues this shape relativity to the Arian Zoroaster temples traditions finally transmitted also to the Caucasus stone Orthodox churches' shape having central octagonal opened into the interior tower supported by fore pillars of square layout [6]. It can be recognized that his ideas are quite credible. Further it is also possible to suggest the relativity of gvirgvini's shape with mentioned above octagon-on-square blockhouse tower space-constructive shape of Ukrainian wooden church [26, 36].
12. Where beam-pillar is usually placed on the top of blockhouse.
13. It also can be mentioned here the credible possibility of wooden prototypes existing of masonry European Gothic and Mediterranean Classical Antiquity Order systems that also obviously were based on the beam-pillar principles.
14. It is also have to point that nevertheless of some initial relation between Ukrainian and Russian wooden churches, they are principally different not only with their design but also with their space-constructive shape.
15. As it was mentioned above, similar homogeny hybridized form of beam-pillar-blockhouse constructions can be sometimes seen in the wooden buildings all over the world without direct connection of climatic or seismic factors. But in Norway it was shaped a unique extremely strong for shaking hybridized variation of wooden building system where blockhouse filling elements are placed inside the beam-pillar frame in the unusual vertical but not horizontal dimension.
16. Some information about so called palisade churches construction probably can provide the unique preserved example of stumpy Greensted palicade church of 9th-11th c., from Essex, England (pic. 15-c).
17. Directly speaking there we can observe the pillar like working elements created with blockhouse system methods.
18. Reposed to the block-pillars lengthwise beams create an additional basement to the roof-trusses allowing the erection of much higher vaults [39].

Bibliography:

1. Shevtsova G. Blockhouse and beam-pillar construction in wooden architecture: sources and mutual influence, competition for domination (on the examples of Japan and Ukraine). Modern problems of architecture and city planning. Kiev: Kiev National University of Construction and Architecture Publ., 2006, no 14, pp. 152-134. (in Ukrainian). (Шевцова Г.В. Зрубна та каркасна конструктивні системи в дерев'яній архітектурі: витоки та взаємовпливи, змагання за першість (на прикладі Японії і України) / Сучасні проблеми архітектури та містобудування. – К.: КНУБА. – 2006. - № 14. – С. 152-134.)
2. Qinghua Guo. Chinese architecture and planning: ideas, methods, techniques. Stuttgart/London: Edition Axel Menges, 2005.
3. Mortimer Wheeler. Civilization of the Indus valley and beyond. New York: McGraw Hill Book: 1966.
4. Maydar D. Mongolian architecture and city planning. Moskow: Stroiizdat Publ., 1971. (in Russian). (Майдар Д. Архитектура и градостроительство Монголии. – М.: Стройиздат, 1971. – 244 с.)
5. Jimbiev B. To the problem of Siberia and Far East peoples dwelling's evolution. Architectural Heritage. Moskow, 1996. №. 41. pp. 207-214. (in Russian). (Жимбиев Б. Ц. К проблеме эволюции жилища народов Сибири и дальнего Востока // Архитектурное Наследство. – М., 1996. - № 41. – С. 207-214.)
6. Sumbadze L. Architecture of Georgian folk habitation Darbaza. Tbilisi: Metsnierba Publ., 1984. (in Russian). (Сумбадзе Л.З. Архитектура грузинского народного жилища дарбази. – Тбилиси: Мецниерба, 1984. – 369 с.)
7. Sumbadze L. Colchis's dwelling according to Vitruvius. Architectural Heritage. Moscow: Stroyizdat Publ., 1958, no 11, pp. 81-103. (in Russian). (Сумбадзе Л.З. Колхидское жилище по Витрувию // Архитектурное наследство. – М.: Госстройиздат, 1958. - № 11. – С. 81-103.)
8. E. Emine Naza-Dönmez. Wooden mosques of the Samsun Region, Turkey, from the past to the present. Oxford: BAR International series 1820, Hadrian books Ltd, 2008.
9. Videiko M. Cucuteni-Trypillian civilization. Kiev: Akademperiodika Publ., 2003. (in Ukrainian). (Відейко М. Ю. Трипільська цивілізація. – К.: Видавничий дім «Анадемперіодика» НАН України, 2003. – 184 с.)
10. Berezanskaya S. Pustinka: the settlement of the Bronze époque on the Dnieper River. – Kiev: Naukova Dumka Publ., 1974. (in Russian). (Березанская С. С. Пустынка. Поселение эпохи Бронзы на Днепре – К.: Наукова думка, 1974. – 150 с.)
11. Mykhailyna L. The Slavic people of 8th-10th centuries between Dnipro river and Carpathian mountains. Kiev: Archeology Institute of Ukrainian National Academy of Science Publ., 2007. (in Ukrainian). (Михайлина Л. Слов'яни VIII-X ст. між Дніпром і Карпатами. – К.: Ін-т археології НАН України, 2007. – 300 с.)
12. Lisenko T. Rural house from Bessarabia to Galicia. Architectural

heritage. Moscow, 1996, no 41, pp. 182-195. (in Russian). (Лисенко Т.Л. Народное жилище от Бессарабии до Галиции // Архитектурное наследство. – М., 1996. - № 41. – С. 182-195.)
13. Lisenko T. Slavic and Ancient Russ dwelling of Carpathian Ukraine. Architectural heritage. Moscow, 1999, no 39. pp. 157-166. (in Russian). (Лисенко Т.Л. Славянское и древнерусское жилище Карпатской Украины // Архитектурное наследство. – М., 1999. - № 39. – С. 157-166.)
14. Jensenius Jørgen H. Research in Medieval Norwegian wooden Churches, relevance of Available Sources. Nordic Journal of Architectural Research, vol. 13, no. 4, 2000, pp. 7–23.
15. シェフツォバ・ガリーナ、櫻井敏雄「ウクライナ木造教会堂の基礎的研究」近畿大学理工学部研究報告 . 平成 16 年 , 第 40 号 , ページ 18 ― 28.
16. シェフツォバ・ガリーナ、櫻井敏雄「ウクライナ木造教会堂の外観と様式」近畿大学理工学部研究報告 . 平成 16 年 , 第 40 号 , ページ 9 ― 18.
17. シェフツォバ・ガリーナ、櫻井敏雄、五島利兵衛。ウクライナにおける校倉造木造教会堂の内部空間 大同大学紀要 . 2009, 第 45 巻 , ページ 65 ― 71.
18. Danyluk A. Rural architecture of Boyko Ukrainian Land. Lviv: Ukrainian Technology Publ. 2004. (in Ukrainian). (Данилюк А. Народна архітектура Бойківщини. – Львів: НВФ «Українські технології», 2004. – 168 с.)
19. Danyluk A. The treasures of Hutsul Ukrainian land rural architecture. Lviv: Logos Publ., 2000. (in Ukrainian). (Данилюк А. Скарби народної архітектури Гуцульщини. – Львів: Логос, 2000. – 136 с.)
20. Danyluk A. The traditional architecture of the regions of Ukraine: Polissia. Lviv: Lviv National University Publ., 2001. (in Ukrainian). (Данилюк А. Г. Традиційна архітектура регіонів України: Полісся. – Львів: Видавничий центр ЛНУ ім. І. Франка, 2001. – 111 с.)
21. Logvyn G. Wooden architecture of Ukraine. Sketches of Ukrainian republic architecture history. Kiev: State Ukrainian publishing of construction and architecture literature, 1957, vol. 1, pp. 200-231. (in Ukrainian). (Логвин Г. Дерев'яна архітектура України // Нариси історії архітектури Української РСР. – Т. 1. – К.: Держ. вид. літератури з будівництва і архітектури УРСР, 1957. – С. 200-231.)
22. Makushenko P. Rural wooden architecture of Transcarpathia (18th – beginning of 20th c.) – Moskow: Stroiizdat, 1976. (in Russian) (Макушенко П.И. Народное деревянное зодчество Закарпатья (XVIII – начала XX в.). – М.: Стройиздат, 1976. – 160 с.)
23. Mogytych I. Defense buildings. Belfries. Rural architecture of Ukrainian Carpathians 15th-20th centuries. Kiev: Naukova Dumka Publ., 198. pp. 181-194. (in Ukrainian). (Могитич І.Р. Оборонні споруди. Дзвіниці // Народна архітектура українських Карпат XV-XX ст. – К.: Наукова думка, 1987. – С. 181-194.)
24. Watanabe Yasutada. Shinto art: Ise and Izumo shrines. New-York: WEATHERHIL; Tokyo: HEIBONSHA Publ., 1964.
25. Yong D., Kimura M. Introduction to Japanese Architecture. Singapore: PERIPLUS Publ., 2004.
26. Shevtsova G. The spatial design of timber "octagon-on-square": problems of non-converged evolution. Wooden architecture: new materials and discoveries. Vol. 4. Moscow; Sankt Petersburg: Kolo Publ., 2015, pp. 25 – 42. (in Russian) (Шевцова Г.В. Пространственная конструкция срубного восьмерика на четверике: проблемы неконвергентной эволюции // Деревянное зодчество: новые материалы и открытия. - Москва; Санкт-Петербург: Коло, 2015. - Вып. 4. - С. 25 - 42.)
27. Shevtsova G. Wooden churches of Ukraine. Kiev: Grani-T Publ., 2007. (in Ukrainian). (Шевцова Г. В. Дерев'яні церкви України – К.: Грані-Т, 2007. – 376 с.)
28. Buxton D. The wooden churches of Eastern Europe. An introductory survey. London: Cambridge University Press Publ., 2008.
29. Lisenko T. Constructive peculiarities of Carpathian region's wooden churches. Architectural Heritage, no. 34. Moskow: Stroyizdat Publ., 1986. pp. 142-151. (in Russian). (Лисенко Т. Л. Конструктивные особенности деревянных церквей Карпатского региона // Архитектурное наследство. – М.: Стройиздат, 1986. – Вып. 34. – С. 142-151.)
30. George Mishell. The Hindu temple. London: Paul Elek, 1977.
31. Encyclopedia of Indian temple architecture: South India. American Institute of Indian Studies University of Pennsylvania Press, 1983.
32. James Fergusson. History of Indian and Eastern architecture. Delhi: Munshiram Manoharlal oriental Publ., 1876.
33. Opolovnikov A. Russian wooden church architecture. Moscow: Iskusstvo Publ., 1986. (in Rurrian). (Ополовников А. В. Русское деревянное зодчество: Памятники шатрового типа. Памятники клетского типа и малые архитектурные формы. Памятники ярусного, кубоватого и многоглавого типа – М.: Искусство, 1986. – 312 с.)
34. Opolovnikov A. Russian wooden civil architecture. Moskow: Iskusstvo Publ., 1983. (in Russian). (Ополовников А. В. Русское деревянное зодчество: Гражданское зодчество – М.: Искусство, 1983. – 288 с.)
35. Kradin N. Russian wooden fortress architecture. Moscow: Iskusstvo Publ., 1988. (in Russian). (Крадин Н. П. Русское деревянное оборонное зодчество – М.: Искусство, 1988. – 192 с.)
36. Shevtsova G. Space-construction like one of the main markers of the genesis of the wooden temples. Questions of the History of World Architecture, no. 6. Moscow: Nestor-Istoria Publ., 2016, pp. 149–168. (in Russian). (Шевцова Г.В. Пространственная конструкция, как один из ведущих показателей генезиса деревянных храмов // Вопросы всеобщей истории архитектуры. – Вып. 6. – М.; СПб.: Нестор-История, 2016. – С. 149–168.)
37. Bing B., Boe L.H., Christie I.L. and others. Norsk Folkemuseum: the Open-Air Museum. Oslo: the Department of Cultural History Publ., Norsk Folkemuseum, 1996, 156 p.
38. Eva Vallebrokk, Thomas Thiis-Evansen. Norway's Stave Churches. Oslo. Boksenteret Publ., 1993.
39. Takeuchi Akira. The wooden churches of Finland. The construction and history of the block-pillar church in the 17th and 18th centuries. Tokyo: LITHON Publ., 2009. (in Japanese). (竹内晧．フィンランドの木造教会 17，18 世紀における箱柱式教会の構法と歴史．東京：リトン，2009.)