Construction of Russian Wooden Buildings of the 17th – 18th Centuries

on the Example of St. Dmitry Solunsky’s Church in Verchnaya Uftuga in the Krasnoborski District of the Archangelsk Region

Alexandr Popov

Once in the autumn evening in 1979 or 1980 (I don’t remember exactly) I had tea with my new friends: Innokentiy Alexandrovich Korovin and his pupil Sasha Popov. Of course, we were talking about our famous monasteries which were museums now. Korovin was speaking a lot and it was he who led his silent pupil to restore wooden monuments and make discoveries.

Popov being forced by Korovin told us about interesting things which seemed improbable at that time...

It turned out that technologies of woodworking by 20th century were lost, and thus many wood-working tools were lost as well. Without knowing technologies and having tools you can’t start scientific restoration of wooden buildings. Popov assured us that he would restore the wooden church in the Archangelsk region using the same tools as the architects used in the 17th century. And when we asked him where he would take them, he said: “We will make them”. He also told us that they would put birch bark under the planked roofs for damp course and so on. I was listening to him and thought: it was wonderful, it was the way how all monuments should be restored, but as a rule nobody did it. And besides, it was difficult to believe that a man from Moscow would go to the Archangelsk backwoods to do such remarkable things.

But he went and since 1981 till 1988 he restored the tent-shaped St. Dmitry Solunsky’s church in Uftuga which was 42 meters high. During these 7 years he had to work hard: the graduate of the prestigious Moscow Institute for electronic machine-building, the certified architect (in 1981 he graduated from the Moscow Institute of Architecture) had to become a feller, a carpenter, a smith. He suffered from hunger and cold weather in one log house together with the workers who were former prisoners. But the most difficult was that whose who were considered to be specialists didn’t accept his discoveries and everything he had done.

Only in 1991 he won recognition after he had become laureate of the State Award for the restoration of the Dmitry Solunsky’s church in Uftuga.

Work in Uftuga and before it in the museum-estate of the painter V.D. Polenov in the Tula region made him think that it was necessary to teach specialists for restoration and that training should go together with the working process. In 1988 he created his own restoration workshop where he tried to combine training and restoration of the wooden buildings in the village Nenoksa of the Archangelsk region.

The years of perestroika destroyed the Soviet restoration and didn’t assist private enterprises to survive. They had to leave Nenoksa because there were no money and the Ministry of Culture didn’t want to pay for the work which had already been done.

Then he worked in Moscow and in the places near it restoring very famous monuments: the house of architect Konstantin Melnikov, the main house with the wing in the museum-estate of Morozov (in Odintsovo), the Moscow Institute of Architecture.

Since 2000 Popov resumed his work in the North, in the Vologda region and since 2005 he opened his enterprise “Restoration center – Architecture, Work, Training” there.
With the support of the governor of the Vologda region he created the restoration school in Kirillov where he trains carpenters, realizing his dreams to combine all the stages of restoration in one single process.

Everything in his life is subordinated to his work and his only serious hobby – drawing – is directly connected with his profession. “An architect can draw, drawing is his language”, he says.

He draws with great pleasure, easily and quickly, immediately understanding the most important thing in the subject which has drawn his attention. As for the subject it can be an artificial flower on the terrace of the restaurant, a sculpture in the church, the head of his neighbor in the train. His head is full of people’s faces, real and invented which are quickly drawn.

He never thought about public display of his works. It was the idea of the people who worked in the museum. Having seen piles of the drawings which hadn’t been given away yet, they decided to show them. Thus the exhibition was born.

Galina Ivanova

In 1981-1988 restoration of the St. Dmitry Solunsky’s church constructed in the 18th century in Uftuga was undertaken. One of the tasks set to the restores was restoration of the monument using tools and technology of the carpenter’s skill of that time when it was built (drawing 1).

A lot was written about good craftsmanship of Russian carpenters, but the building culture as the most important side of the folk architecture was out of the researchers’ field of vision. The tools which the Russian architects used were known, but their original form and technology of their use were forgotten among architects and carpenters. In Russian restoration science little attention is paid to these issues, but we may not begin restoration without knowledge of the peculiarities of professional skill and
Though the author of the restoration project had specialized education and nine-year old experience he had to start the restoration work in 1981 from nothing. While disassembling the St. Dmitry Solunsky’s church the constructions of the framework were studied, and then during six-year old work almost all the tools of the 18th century were reconstructed, carpenter’s methods and technology of ancient craftsmen’s work were revived. All this gave an opportunity to understand the way of thinking of the creators of the folk architecture in its heyday.

A quite natural question arises: how it could happen that study of the tools, constructions and technology of the wooden architecture was left aside from the research of the folk architecture almost till the end of the 20th century. There are several reasons for it.

First, brick architecture had penetrated in the Russian North by the end of the 18th – beginning of the 19th centuries. Wooden architecture was replaced by stone architecture very quickly. As the number of commissions for the building of wooden churches decreases, teams of carpenters broke up and the carpenter’s building culture started disappearing. Of course, wooden architecture still existed in the North, but with time it was limited by the construction of dwelling houses and service buildings, and though religious buildings were constructed, they lost features characteristic to the folk architecture. By the end of the 19th – beginning of the 20th century “Northern modern(ist) style” dominates in the wooden architecture under the influence of which experience gained during erection of wooden towns, fortresses, churches, was gradually forgotten.

As the second reason why not only carpenter’s skill but also carpenter’s way of thinking of the 17th – 18th centuries were lost, we can name active use of sawn materials in the construction of the North in the 19th century as well as in the construction of the dwelling buildings.

With the appearance of the saw (to saw up logs on boards, blocks and plates) came new methods of working traditional construction material. The saw tore grains of the wood that’s why sawn boards were sensitive to moisture and started to rot very quickly. For serving longer they were planed. After the appearance of the smooth surface sawn on the plumb (perpendicularly) and then planed, a new epoch of carpenter’s art – epoch of new esthetics started. A graphic example of it in the building art is the church in the village Gorbachiha on the Kenozero, where walls of the church were assembled from the sawn plates, and then lagged with boards which were planed with a filister.

Penetration of the professional architecture to the North and its confluence with traditional carpenter’s handicraft and rapidly developing carpenter’s skill can be called the third reason. An example of this confluence is the church in the village Zachachiye of the Archangelsk region. The church was designed of logs, but the meaning of this word was different among the craftsmen of the 17th – 18th centuries. The log in the folk architecture is a unique element of the building which has diameter of the top, diameter of the butt-end, curvature, structure of the wood (wave-grown timber is used for the framework, straight-grown timber – for boards, blocks, plates, beams and so on). For the
builders of the village Zachachiye the log is a unified element: all logs have the same length and diameter, they are taken "in a ring" and they don't have their individuality. This unified element can be placed in the wall in accordance with the draft made beforehand, what couldn't be made before. In contrast to the traditional wooden architecture where form dictates material, here a pen dictates form completely. In the folk architecture the craftsman – creator is like a sculptor; in the 19th – 20th centuries the carpenter was a craftsman who doesn’t reflect upon how and what log to place in the framework but he points on its definite place like a stonemason puts a brick in the wall, keeping only to the designing documents. There is no necessity for him to select a log: having taken any log from the pile, he puts it in the framework.

The records for the commission of building churches in the 17th – 18th centuries are full of phrases which show the type of the church and the cost of its construction. As for all the rest the architects were free to do what they wanted. A striking example is the Trinity Church of the Nenokotski Pogost which was considered to have 3 hipped roofs. But the architect decided to make not only 3 mentioned in the record, but to add two more, and that's why the team created a five-tent-shaped church1.

The folk architecture was created as peculiar sculpture, where the framework “modeled” all the forms: a quadrangle, an octagonal base, a plan of 20 walls (an octagon with 4 quadrangles attached to it), enlargement of the wall upwards, a hipped roof, a barrel-shaped top of the quadrangle and a dome. Wood is a material giving each church unique appearance. Wood in the framework of the carpenters – craftsmen in the 19th – 20th century loses its individuality, taking away unique plasticity of the folk architecture. It is replaced by the imitative wooden and brick architecture in the “Russian style”.

During a long time it was considered that the carpenter’s handicraft didn’t change since the 17th till the 19th century, that’s why when restoring wooden buildings, the culture of erecting buildings of logs was automatically transferred on the buildings of the 17th – 18th centuries.

Beginning from the 19th century many researches studied folk architecture, but the efforts of the majority of them were directed to the archeology, typology, proportioning, study of the metric system, imagery, and only some of them touched upon constructions, tooling, technology and organization of folk architects’ work. Among them we can name colonel Dementiev and engineer Roshefor who wrote about the modern state of carpenter’s skill2. The first steps in the comprehension of wooden constructions were made by Suslov (construction of the framework without nails) 3. But it was the end of the research of the construction in the 19th century.

In 1950-s M.G. Miloslavski did a great job extracting archival information on constructions, tools and technology of the work of the old Russian architects4. He delimited time, but his research lacked observation on location and he didn’t differentiate between town and village architecture. In the 18th century professional architecture set the fashion in the town, as for the North it was the heyday of the folk architecture. The church in Martsialniye Vodi near Petrozavods (construction of Peter’s I time) is an example of the influence of the secular architecture on the ecclesiastical architecture and the church in Uftuga (the end of the 18th century) is a vivid example of the traditional folk architecture. It will be right to say that in his work Miloslavski studied not folk, but town architecture of the 17th – 18th century.

A.V. Opolovnikov continued to lift the veil of later development5. He tried to substantiate theoretically restoration methods. But speaking about restoration the author remained on the level of building culture of the 1950-s and he didn’t go further than imagery of the architectural monument.

It’s worth mentioning one more circumstance. The gap between designing and constructing which emerged in the 18th century and which continues till nowadays in the building and restoration can’t be justified. The architect and restorer cannot forget that each wooden building has not only its look, but its own constructing manner as well. After the Second World War a lot of monuments were restored and transported to the open-air museums. Restoration and transportation were made with full disassembling and assembling of the buildings. But the fact that the theory of architecture during this period didn’t receive any new information about the building culture of the monuments in
the North, tells a lot. Not a single research contained information about constructions, technology of their erection and tools of that time. Each transported or restored on the spot monument has its own secrets, without study and reconstruction of which it turns into a plaster cast and ceases being unique.

**Heated and unheated framework**

We will consider varieties of the framework on the example of the St. Dmitry Solunsky’s church. In this church we meet if not all, than most of the known methods of joining in the framework.

The framework is a wooden construction in which logs are laid on horizontally one on another. They are joined in the corners in a certain way and there is a slot along the log thanks to which the logs adjoin each other closely. The framework can be rectangular, hexahedral and octahedral in the plan. It can take any shape in space. Depending on the fact whether the framework is heated inside or not, it can be summer (unheated) and winter (heated). The heated framework is erected with moss; the unheated is assembled without it.

The Dmitry Solunsky’s church in the Uftuga village is unheated as well as the majority of the grandiose religious buildings in the North. The unheated framework was erected of logs as closely as possible, so that there was no clearance between the cup and the log and so that the slot of the upper log covered the lower one as tightly as possible. The cups in the Dmitry Solunsky’s church are cut with bend inwards. It is done in order that the upper log fitted in the middle of the cup freely. Only the joining line of two logs is adjusted to the “line tool” (according to the edge of the cup of the lower log).

The line (drawing 2) is a tool used to adjust one log in the framework to another one. It leaves marks on the log for the cup and slot and then in accordance with this marking you can make a wooden construction with the axe (slot and joints in the corners of the framework).

If you make a horizontal section in the middle of the cup (drawing 3), the intersection of it with the cup will look almost like a circumference with four inflections (abcd).

The slot in the logs of the Uftuga church is not wide; it is obtuse angle (drawing 4). It was made in order that the upper log fitted more tightly along the full length to the lower log, unlike the heated framework where the slot in the log was cut wider and not on the angle, but on the arc which covered the lower log (after the assemblage of the framework on the moss the slots and cups are caulked).

The cup of the heated framework is also cut wider than the upper log so that the clearance between the cup and the log was about 1.5-3 centimeters (drawing 5, 6). If you don’t do this it will be impossible to caulk the corners of the heated framework. The heated frameworks of this type are found in the dwelling houses of the 19th century. Owning to the stability of methods of “heated” and “unheated” construction we can make a conclusion that the heated log house appeared earlier than the houses
In the dwelling houses of the 19th – 20th centuries we find the slot in the logs both from above and from below of one and the same log. There are plenty of such buildings near Moscow (Sergiev Possad) and in the North (along the Onega River) and so on. The upper slot often goes till the cup and then after the cup it passes to the upper log. But sometimes the slot on the top of the log goes till the middle of it. It can be explained by the fact that when the wood is tapering (the butt-end of the log is thicker than its top), you have to cut the larger part of the log in the top. That’s why in such cases it turned out to be more efficient to cut a slot in the butt-end.

Construction of the unheated framework has come down to us in many service buildings of the 19th – 20th centuries. The chapels were also built in the same way. It is more difficult to make the cup of the unheated framework than of the heated one, that’s why the following words were told about the carpenters cutting them: “The axe is bending in their hands”.
**Structure of the corners of the framework**

The walls I and II in the Dmitry Solunsky’s church are cut as it shown on the drawings 8, 9. In the sanctuary and in the octagonal base the logs are joined at the angle of 135° (as for the rest, erection of the framework is the same, as the above mentioned way of construction).

It is necessary to note that the octagonal base and the sanctuary pentagon were made without outside scaffolding only from one side – from the side of the framework. The carpenter was sitting on the log of the framework and was cutting the cup through: from the inside out. It is indicated by the marks of inside cutting of blocks in the octagon and basement level of the sanctuary. More careless cutting of the cup in comparison with the first rows of the sanctuary and octagon also shows it. Sometimes the adze is used. Marks of this tool are found in the western and northwestern walls of the octagon. In our opinion the adze was used to lighten the cutting of complicated cups of the octagonal base.

The sanctuary with the quadrangle (above the floor level in the sanctuary) and
The walls in the quadrangle (prayer house) are joined as on the drawing 12. This joining was widespread in the religious buildings of the 17th – 18th centuries (heated and unheated). It is also found in the dwelling houses. For example, the house at III International Street in Kargopol (it hasn’t come down to us). It had a heated framework erected apparently in the 18th century.

In this type of construction the adjacent walls in the interior are joined at right angles (drawing 14). We can suppose that the walls erected in such a way are more durable. But in Zaostrovye in the church of the 17th century three walls in the quadrangle (northern, western and southern) are joined as on the drawing 12 and the eastern wall – as on the drawing 8, 9. It means that the first way of joining is tribute to fashion, imitation to the brick right angles in the interior in comparison with the round corners in the log house when we use the second type of joining and then hew the walls.
One more variety of joining is found in the church of Zaostrovye and shown on the drawing 13.

Constructive peculiarities and methods of cutting were also used in the hipped roof (drawing 15). The hipped roof of the Uftuga church was about 19 metres high and it was a crib.

The crib construction was used in the folk architecture for cutting hipped roofs, domes, a barrel-shaped top of the quadrangle, retaining walls, bases for the windmills and so on. The crib construction is a framework, but the logs in it are laid with clearance, the cup is cut into about one third of the diameter of the log. The crib construction is convenient when you need to erect a huge building and a complicated form of the framework. The effort reduced, materials were saved on; additional durability was provided owing to the use of splines in the construction.

The hipped roof in the Dmitry Solunsky’s church is an octagon and a crib. As the hipped roof carries large wind loads, for durability it is joined with the splines (5-7 metres long) in turn from each four sides – North, South, West, East, North-West, South-West, North-East and South-East. The hipped roof has four levels of splines. The splines of the adjacent levels are overlapped. It is done in order that the hipped roof worked like a homogeneous pyramid.
So that the logs in the crib construction didn’t turn (because of vertical loads, in particular), three logs in the crib are sometimes joined with wooden pegs (drawing 16). In the Dmitry Solunsky’s church the cross-piece under the cross is a crib, but the logs in which crossing is set, are joined with pegs (wooden birch pegs).

As it was mentioned above, the sanctuary is joined with the quadrangle as on the drawing 10. In the interior of the quadrangle without iconostasis the butt-end of the logs of the sanctuary are visible. So that the upper logs of the sanctuary framework didn’t go out of the cups of the quadrangle because of the deformations in the foundation (the foundation is made of piles 75-90 centimeters long which are sunk in 20-30 centimeters), two rows of the sanctuary are dovetailed (in the prayer house). To put it more precisely, this joint is a something in the middle between the joining as on the drawing 10 and dovetail. Outwardly the joint of these two rows doesn’t differ from the rest of the sanctuary rows.

The church was erected of fresh wood (1784 – the charter for assigning lands to build a church, and in 1786 the iconostasis was painted by Ivan Sloev, it was signed), to avoid cracking of the dovetailed joints the wedge was driven in the butt-end.

The upper end of the enlargement of the wall upwards has an interesting joint (drawing 17). The purpose of this row is to avoid difference of the half the log in the framework of the enlargement of the wall upwards. One end of the planked roof is laid on the logs of the hipped roof (crib construction), and the second one – on the stud of blocks which in its turn lies on the upper row of the enlargement of the wall upwards.

The upper row of the enlargement of the wall upwards is cut into the last but one, as it has difference of the half the log, the upper row is cut only into scaracement of the log. That’s why the following happens: from 8 logs of the upper row not all logs of the upper stud are cut, but next nearest. As for the log which is cut into the last but one row, it is cut in from two sides: butt-end and top. The adjoining log of the upper stud only leans on the previous row. Though which such cutting of the corners the log is weakened by half, but owing to the fact that the moment is not big (the arm is about 50 centimeters), this construction is reliable. In Uftuga not a single log of the upper stud was broken over 200 years.

The upper stud of the ambulatories in the church is dovetailed (drawing 18). It is the easiest way of cutting. Both heated and unheated constructions were dovetailed in the 17th – 18th centuries. The dovetailed joint has its own peculiarities.
One of them was found when the roadside chapel near the Gorbachiha village on the Kenozero in the Archangelsk region was restored. The joint is straight, not dovetailed, but it has a tenon which joins the framework and not let it shrink in the corners. The chapel in the Gorbachiha village dates back to the 19th century, but under the sheathing there was an ancient framework belonging probably to the chapel which had stood earlier on the same place. When reconstructing the old framework was preserved, two new rows, the floor, ambulatories and roofing were added and the framework was sheathed. Probably, this old framework dates back to the end of the 18th century or to the very beginning of the 19th century.
Walls of the framework

Walls in the interior can be of two types: hewn and not hewn. Besides, they differ according to the types of corners – with right and round angles. For a long time we couldn’t solve the problem how to work the walls in the Dmitry Solunsky’s church. When everything became clear, we also found confirmation in the records.

The walls in the prayer house were hewn with an axe and then planed with an adze (drawing 20). Since the saw was used in the construction the adze began to play the role of the plane. The eastern wall of the quadrangle in the prayer house was hewn. The same method of hewing was found on the ceiling in the octagon (T-beams and plates). The rest of the walls in the quadrangle have a different method of working and we can’t see axe marks on them. It was also difficult to solve this problem because of the fact that according to the traditions the walls in the log houses and churches were rubbed with gruss (fine comminuted stone) and washed with hot water. This tradition begins with houses heated by a chimneyless stove which were covered with soot during winter. That’s why during more than 100 years the manner of working suffered a lot. But in the rays of light, especially in the corners, the adze marks are visible at the sharp angle. The recording for the commission of the church in Sheksna Pogost of 1672 settled all the doubts. Practical work confirmed the manner of working.

In the basement level of the sanctuary, quadrangle and ambulatories the walls were not hewn (drawing 21). In the sanctuary the walls are hewn and planed with the adze. In the interior they have round angle.

The church in Uftuga has some peculiarities in the walls of the quadrangle (drawing 22). The first one is that the walls of the quadrangle were hewn without the help of a lace (one tightens a lace, puts soot on it and hammers off mark on the log). Hewing of walls, blocks, plates with the help of the lace is a widespread method in the 19th - 20th centuries. In Uftuga the walls of the quadrangle have an internal bend of about 5 centimeters on 10,5 running meters. This fact couldn’t be explained for a long
time, until it was supposed that the bend was because of the large length of the logs (the first row – 11.7 meters). It is well known that the logs are laid in the wall hump upwards so that water didn’t reach the middle of the framework along the slot.

That’s why if the lower log in the framework slopes more than the upper one, the slot in the upper log will be wider in the middle of it than in the edges. And in case if the hump itself is smaller in the lower row than in the upper one, the slot of the upper log will be wider in the edges. The craftsmen who built the church in Uftuga tried to make the slot as smaller as possible (the construction was unheated, and it was demanded to be high). The butt-ends of the logs must have a slot, otherwise the log will sway. If the lower log has smaller hump than the upper one, the middle of the log may have no slot at all, because the upper rows will press it down by its own weight. And in this case it turns out that the slot in the middle of the log is wider than in the edges.
When the walls are being hewn, hewing goes as closer to the slot as possible, but you can’t hew on the slot: there will be cracks in the interior and redistribution of loads in the wall. In this case there will be bending into the interior on the wall.

When the walls don’t have such length there is no bending and the wall is hewn with the help of the lace (the walls of the sanctuary).

The second peculiarity of the walls in the quadrangle is their slope inwards (drawing 19). The height of the quadrangle is a little bit less than 10 meters, the first row is 11,7 meters and the upper row - 11,45 meters. Each wall has slope inwards by 12,5 centimeters. Taking into account than the eastern wall of the quadrangle has 27 rows and the western one – 28, it turns out that each log has slope inwards of about 0,5 centimeters. The aim of this slope is to create grandiose appearance directed high into the air. It’s interesting to note that the octagon placed on the quadrangle doesn’t slope. It is 4 meters high. Surprisingly, not a single inspection of the building till the 1980-s didn’t mention it. But it is the originality of the church in Uftuga. Besides, if we take away this peculiarity the monument will die.

**Joining of the framework**

One of the problems in the construction of the framework is increase of the length of the log and space of the room (drawing 25). In the history of the Russian wooden architecture increase of the air-space was achieved by replacing the log house with a hexagon and an octagon with 4 quadrangles attached to it (a plan of 20 walls). There were also attempts to increase the length of the log house: erection of one framework near another one under one roof, joining of the logs in the framework in the cup and so on. All this was described by Maksimov and other researchers. Here we will consider some constructive peculiarities of joining the logs in the quadrangle.

The ambulatories have the framework with several attachments. The cantilevered elongation of the quadrangle turns into the upper stud of the ambulatories. The joining which is found here is well known. Such joints were already registered in the 12th century during the archeological digs in Novgorod.

For better attaching the log A (drawing 24) a tooth is cut in it for the log B on the level of the log C. It is similar to the cutting in the butt-end when the logs were joined as on the drawing 10.

In Uftuga to join two logs on the butt-ends an M-shaped and L-shaped tooth was
used (drawing 23). Such joint is used in the top of the quadrangle where begins the roof under the corners of it. As usually the framework ends on the half log, one wall of the quadrangle is higher than the other one. To level the framework an interesting method is used: a short log is cut under the roof, one end of it is cut into the perpendicular log as on the drawing 10, and another end is joined by the butt-ends with the first log of the octagon. The joint of the butt-end to the butt-end was used very seldom (carefully).

At first sight it seems to be difficult to cut in such a tooth. But you need a chisel to cut a pocket for the Π-shaped tooth and as for the M-shaped and Л-shaped teeth you can use only the axe. To make jambs of the window and door openings in Uftuga the chisel was used, but they were set separately from the erection of the framework. To build the framework the craftsman used only the axe and the line tool. It turns out that the M-shaped and Л-shaped teeth which have come down to us in the Dmitry Solunsky’s church were typical for the building traditions of the 16th – 17th centuries but for its time they were archaic.

Floors and ceilings
Floors in the Dmitry Solunsky’s church in Uftuga are made of blocks (drawing 26). Blocks are logs with the diameter of more than 30 centimeters in the top which are trimmed from the upper side by about one third. Then these blocks are laid on the sleepers. After that they are adjusted to each other with the line tool.

The floors of the Uftuga church were made in the following way: they were made only after the walls had been erected till the floor level. And then they continued with the walls. Joining of the floor with the walls and cross walls of the building are shown on the drawings 27-30.

The floors in the church in front of the sanctuary have a solea; it is a step in the eastern side of the quadrangle. The solea is placed on the floor and squeezed by the logs of the northern and southern walls of the quadrangle. From the eastern side the floor battens of the sanctuary are cut into it. The method of squeezing the floors with walls of the building is typical both for religious and dwelling wooden constructions.

For ceilings there are two T-beams in the quadrangle and sanctuary and between them plates are laid (drawing 31). From above the plates are squeezed by wooden birch wedges.

The bay in the quadrangle is 10 meters; it is much for the wooden beams. The ceiling construction of the quadrangle is the following (drawing 32): in the middle from the north to the south go three logs cut one over another one and joined with a metal forged stud. The butts of the beam are squeezed in the southern and northern walls. The joint of the ceiling with the quadrangle looks like on the drawing on the previous page.
Соединение половых плах со стеной четверика

Экспликация
1. Фризовая балка;
2. Западная стена четверика
3. Перегородка;
4. Половая лада;
5. Восточная стена апсиды

Соединение фризовой балки с половыхыми плахами.
Jambs of the window openings and doorways

Constructions of the window and door openings look traditionally (drawing 33-34). Singularity of this construction lies in the fact that it is made of a round log with the axe, adze, line tool and chisel. It is like a wooden sculpture carved out from the timber block.

Another peculiarity is that all the jambs of windows and doors are different (drawing 37). Two windows of the second row on the southern side of the quadrangle are identical from the front. But construction of the inside joints is different. One window had tenons between window-sill and vertical jambs and the second one didn't have them. For a modern man it seems strange, but from the point of view of the architects of this church it can be easily explained.

In 1784 when the Dmitry Solunsky's church in Verchnaya Uftuga was built, these places according to one document were “full of robbers and dissidents”. Nobody studied with text-books, knowledge of handicrafts were handed over from grandfather to father and grandson orally. But for all that only that person who added some new methods to the grandfathers’ ones could become a craftsman. Two craftsmen met building this church: one was taught by his father to made jambs with the tenon and the second one – without it. Thus everything was built. Both windows stood 200 years; the jamb with the tenon rotted in it, but the jamb without it remained intact (drawing 35-36).

And one more thing which is worth mentioning: windows of the first row in the quadrangle and sanctuary have different construction: some of them have a window-sill, the others don’t have it. There can be only one explanation: all windows were cut at once on one level. Then it turned out that the windows in the quadrangle to the east of the solea and sanctuary were too low from the floor, that’s why they decided to raise them.
Дверные проемы

двери подклета четверика

Экспликация:
1. Косак
2. Перег
3. „Брешинъ“
An 18th century axe and work with it

For a long time there was such an opinion that technology of the work with an axe didn’t change over centuries. Carpentry was considered to be conservative and invariable in the course of time. But it was not true: the axe itself changed with time and at the same time changed technology of working wood and timber constructions.

Already in the second half of the 20th century it became clear for the specialists that the carpenter’s technologies of the 12th – 18th centuries differ fundamentally from the work technique with the axe in the 19th - 20th centuries. The Vikings’ boats built in the 9th century which I studied in Norway had the same work technique like the Russian buildings of the 12th – 18th centuries.

Restoring the Dmitry Solunsky’s church in Verchnaya Uftuga I paid attention to the peculiarities of woodworking which we didn’t manage to reconstruct with the tools of the 19th - 20th centuries. Search for the bearers of old technologies among the inhabitants of the neighboring villages was unsuccessful. Then we had to apply to the materials of the archeological researches in Zashivirka and Mangazey. The axes found by the archeologists differed from the modern ones. But even after making the axes according to the measurement of the archeological axes we couldn’t reconstruct historical technologies. More that three years had passed before we managed to receive hewing traces which were similar to the traces found in the church.
Medieval hewing was executed with the narrow-bladed axe (drawing 39-41). The craftsman stood from one side of the log. The blade was about 9-10 centimeters wide. The axe was wedge-shaped and the axe-handle can be from round to heart-shaped or triangular.

The hewn surface looked like a washing board (drawing 42). Depending on the width of the blade and log the craftsman hewed it several times (3-5 times). The carpenter was looking from the direction of the axe, it means that he saw the working surface from one side. It can be seen on the Norwegian engravings of the 14th century. And with all this going on the axe blow was struck not parallel to the log like later, but it was similar to a crescent-shaped blow. The axe blow can be divided into two stages. At the first stage the blow was delivered a little bit from the side of the log, but when the axe went into the log, the carpenter pressed the axe-head to the log and the axe began to go out of the log. The mark was double: short entrance into the wood and long going out. Such a method gave an opportunity to close wood pores and not to leave notches on the hewn surface, thus the water didn’t stayed too long on the wood surface worked with the axe.

Notes:
1 Gosudarstveniy arhiv Archangelskoy oblasty, f. 191, op. 1, l. 1691, l. 13.
3 Suslov V.V. O derevnyakh derevnyannych postroykach severnykh okrain Rossii. – Trudi VI arheologicheskogo syeza. Odessa, 1886.
4 Miloslavski M.G. Tehnika derevyanogo zdchestva na Rusi XVI-XVII vv. – Trudi instituta istoriy estestvoznaniya i tehniki, Tom 6, Moskva, 1956.

The above mentioned material only begins to study the Northern carpenter’s construction culture. The author doesn’t lay claims to the wide coverage of this topic. It is only the part of that material which was gathered during the restoration of the Dmitry Solunsky’s church. Here there are drawings which don’t have explanations yet.