

Architecture of Modern Timber-Framing Houses

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Abstract

The present article characterizes the architecture of timber-framing houses, summarizes the history of genesis and development of the framing construction system, presents construction materials, used in the building of timber-framing houses, describes structural construction technologies, paying closer attention to modern approaches in the renovation of historic buildings and in the construction of new timber-framing houses, reveals reasons for popularity growth of framing in the 20th – beginning 21st centuries in several countries around the world. A massive rising interest to the framing is caused by the entry of new construction technologies and materials, allowing the use of steel, aluminum alloys and even armed concrete instead of wood in a timber framing, as well as building houses with large floor-to-ceiling windows. The 21st century does not predict at least yet to add any new structural versions into timber framing architecture. At the same time there is a possibility to invent solid transparent supporting material for a frame. After inventing such material, building of entirely transparent timber-framing houses would become possible. The article emphasizes that framing achieved the greatest progress in monochrome cultures – Scandinavian and Germanic nations and states that culture (traditions, mentality, mode of life etc.) rather than environmental conditions is determining in the outspread of timber framing architecture. While, for instance, European settlers managed to adjust framing to severe conditions of Canada, Russian timber framing carpentry has not developed up until now. The object of the article is to determine progressive features of timber framing architecture that could be applicable in modern housing. The novelty of the research is in enhancement of approach to the study of timber framing architecture due to the use of new architectural concepts, which came to life in 2014–2015: “architecture of aurality”, “architecture of error”, “architecture as reflection of politics”, precision and accuracy ratio in architecture, designing with regard to cynology and felinology.

Keywords: Architecture, Construction, Construction Ecology, Framing, Material Science, Technology

1. Introduction

Globalization and urbanization processes pose for architects new problems in a most wide range: from ontological to esthetic ones. Timber framing architecture could play a big role in their solution.

Its origins trace back to the ancient architecture. For example, dwellings of neanderthals could be qualified as proto timber framed: framing of mammoth bones and infill made of skins. There were also dwellings made from tree branches similar to the one found on the hillside of Boron Mountain near Nice³.

Early, archeologically confirmed proto timber framing constructions in organized human settlements were found in Turkey during the digging of the ancient settlement

in Çatalhöyük. Timber-framed alike constructions were equally found in the architectonics of Crete and Mycenaean Greece and ancient China. Interestingly enough, classical order system came out of framing-related beam-and-column structure.

Generally, it may be noted that ancient cultures due to the accumulated knowledge in mathematics, geometry, material science managed to put in order wood-and-stone and wood-and-puddle construction in a way that objects of proto timber framing architecture embodied progressive traits reproduced to different extents up until now. By a strange coincidence, these technologies – direct continuation of antiquity – did not decline in the middle ages; on the contrary, they were subject to step-by-step improvement. While technologies of invention of various

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mechanisms, similar to Antikythera mechanism, were lost, framing was perfected during the late middle ages.

The ancients were experienced with construction of building structures with vertical and horizontal beams. Inclined beams appear quite likely later in the middle ages in countries such as Germany, France and the Netherlands. Pile dwellings in Unteruhldingen on the Bodensee represent early framing¹⁰. Gradual accumulation of architectural and building experience, constant excellence in carpentry (development of shipbuilding contributed to it, considerably), unyielding seeking of wood saving, all this lead to the wide spread of timber framing building technology. First full-featured timber framing buildings appear already in the 11th century, the oldest among the remaining - the storehouse of the Knights of the Temple in Cressing²⁵. Timber framing houses, built in the 14th century, also still exist in Germany, one of them in Quedlinburg is dated 1347¹⁶.

In the early modern period timber framing architecture gained widespread in several European countries. In Portugal austere-looking local framing is plastered and then the building is coated with emblazonry azulejos, classical order decorative elements. Carved timber framing barocco remained till the end of 18th century in Czech rural areas. At the same time framing in England, Denmark, the Netherlands, Latvia is commonly laconic and geometrical.

Regional versions of framing and its interpretations are also found in Asia and Africa. In Chinese town Pingyao brick infill of local timber-framed alike buildings was traditionally plastered and ornamented. Other timber framing a like technics of construction are also overspread in China²⁰. Special mention should be made of cylindrical multi-storied buildings Tulou in provinces Guangdong and Fujian; these buildings are framed from the courtyard view and they represent a version of a medieval storied timber-framed town building²¹. Korean timber-framing houses generally resemble the Chinese ones. In Bhutan framing is highly picturesque. In Japan local frame-structured buildings, part of which can be characterized as quasi timber-framed, are even more austere and moderate in decoration. In Turkey, Pakistan, Kashmir and Uzbekistan framing is modest and functional¹⁰.

Settlers from Europe brought framing to the territory of North and South Americas, Australia, and introduced it to colonial settlements on the territory of the old world. Timber framing architecture has become known so far in many countries of the world, but mostly in those with predominance of protestant culture.

2. Literature Review

The study of timber framing architecture dates back to the distant past, to the times of the Roman empire. The treatise of a Roman scientist Marcus Vitruvius Pollio, dated 25 BC, contains the earliest matches to the framing concept – so called “*murus gallicus*” and “*opus craticium*”³⁶.

The work of Tacitus “*Germania*”, dated 98 BC, describes in detail the settlements of ancient Teutons indicating that they carefully paint their homes, made of untooled wood, with “white ground”³³.

The scientific approach to the study of timber framing architecture started in the 17th–18th centuries. The process of study considerably accelerated in the 19th century, after Karl Lachner laid the basis for the study of timber framing architecture. His work, published in 1887, is dedicated to the development of timber framing architecture in Germany¹⁹.

In 1903 Saxon scientist Wilhelm Fiedler systematized scientific knowledge of historic framing of three advanced European countries: Germany, France and England⁴.

In 1904 quite full description of framing as a building construction (so called “checked buildings”) was mentioned in The Brockhaus and Efron Encyclopedic Dictionary³¹.

In the latter half of the 20th century timber framing architecture attracted interest of a quite large number of scientists that is still remaining now.

In 1976 scientific description was given to the regional versions of framing in Poland (or so called “*mur pruski*”)²⁷. In 1978 Karl Klöckner published a magnum opus about the history of framing¹⁷. In 1988 Hans Müller systematized so-called “*Umgebände*” buildings of Sorbs, Czechs and Eastern Germans. These buildings are partly timber-framed, partly made of logs or squared beams²³. In 1994 general knowledge of the architecture of the ancient Roman constructions, including “*opus craticium*”, was introduced to the scientific use¹. Michael Imhof analyzed and structured the development of timber framing architecture of the 19th century in Germany, Austria, Switzerland, France, Great Britain and the United States of America in his research of the end of the 20th century¹⁵.

In 1999 a book by Manfred Gerner was published, which examines social and cultural particularities of the German carpentry community, its history, customs, symbols, holidays⁸.

In 2003 Thomas Herzog, Julius Natterer, Roland Schweizer, Michael Volz and Wolfgang Winter published

a full version of their magnum opus of wooden constructions, where framing took a considerable part¹². In 2007 Jean-Louis Valentin in his work characterized regional versions of framing in France, including the Basque Country³⁴.

The following year Manfred Gerner in his next book described framing trends in the Himalayas, Bhutan, the Philippines, South Europe, and the territory of the former Ottoman Empire¹⁰.

In 2009 Arie van Ziel summed up the modern knowledge of timber framing architecture, placing it within context of the wooden architecture of the Netherlands³⁷. In 2012 the first monograph with scientific description and systematization of timber-framing houses of Russia was published in Germany⁷.

In 2013 at the international research and practice conference in Moscow architectural institute there were set up principles of ecological construction in timber framing architectonics, on which the present research is mainly based³².

The same year Alexander Vsevolodovitch Kuhta pointed out new aspects in the design of a timber-framing building¹⁸.

3. Method

Within the study of the architecture of modern timber-framing houses, the authors of the present article used the following empirical and theoretical methods of research: observation, description, analysis, comparison, forecasting.

3.1 Observation

With the help of this method, first empirical data collection was made, consisting in the directed, systematic perception and registration of timber-framing houses, valuable from the point of view of objects and purposes of the research. The process of observation represented a series of steps: a problem was posed, goal objects and purposes were defined, the objects of the research - timber-framing houses – were described and defined, technical means for fixation of the objects of the research were used, and record of observation results was kept. Two major varieties of observation method were used: standard observation, offering a pre-developed list of timber-framing houses that were up for observation, and non-standard observation, due to which only general

observation directions were determined, and results were recorded directly in the process of observation and later from memory. Based on the used methods, photographs of timber-framing houses were made, photographs and pictures of timber-framing houses from scientific, educational and other literature, internet resources were copied and scanned.

3.2 Description

This method represented a procedure system of primary analysis and material abstracting (gathered data and its characteristics). The procedure looked as follows: valuable and essential features, parameters and characteristics of timber-framing houses were determined, and then the gathered data was organized. Thanks to this method, classification of timber-framing houses by countries and regions of the world and their selection were made, structured database was created in paper form and soft copies.

3.3 Analysis

Due to this method conceptual separation of the object of the research (timber framing architecture) on its components was realized. The process of the analysis allowed to find and identify the features of timber framing architecture, standard models of timber-framing houses, opinions of scientists and architects about framing and its different versions, qualitative characteristics of timber framing architecture - strength, safety, durability, security, environmental friendliness, timber framing architecture styles characteristic to one or another historical period or culture.

3.4 Comparison

The use of the method consisted in juxtaposition of features, parameters and characteristics of timber-framing houses. The process of comparison included several stages: choice of compared objects; choice of the comparison type (historic and modern timber-framing houses, timber-framing buildings in Germany, Canada, Scandinavian countries etc.); choice of the level of significance of similarities and differences; choice of the number of features to compare; choice of the type of characteristics, as well as definition of criteria of their essentiality and inessentiality. Basing on the similarities, authentic characteristics of timber framing architecture were identified, and basing on the differences – the inauthentic ones.

3.5 Forecasting

This method, consisting in the forecast of the future basing on the accumulated experience and the current suppositions, theories, was used together with other methods: expert assessments, extrapolation and simulation. In accordance with the method of expert assessments, the opinion of the authors of the present article, based on their professional, practical and scientific experience, was placed at the bottom of the forecast. Extrapolation method studied the trends of timber framing architecture development, formed both in the past and future, and made it imposition on the future. Due to simulation method, designs of timber-framing houses have been worked out and presented at international forums. The usage of the indicated methods allowed to outline development prospects of timber framing architecture.

4. Results

Within this study the following results were achieved: the concept of framing was articulated, the popularity of framing in the 20th – beginning 21st was found, current trends of timber framing architecture development were defined.

4.1 Concept of Framing

Framing (germ «Fachwerk», from «Fach» – «panel» – and «Werk» – «building», i.e. «building from panels») – is a type of a building structure where the supporting base is a three-axis truss formed by inclined (at different angles) wooden beams. Stone, felt, yelm, fascine inter twisted of willow are used as construction materials. Wooden beams are clearly exposed on the exterior side of the house and they form its creatively different façade. The opening between the beams is fulfilled with puddle clay material, brick, sometimes wood and is plastered. It is the infill between the frames (germ. «Ausfachung»), that is highlighted in the definition of framing. The basic principle of framing is the division of the supporting and walling functions of constructions between the frame and the infill respectively⁶, with regard to environmental protection, timber-framing houses are ecologically friendly.

There are several particularities of framing, defined by different groups of researchers: while German scientists name braces as an essential feature, Russian representatives of architectural science do not emphasize it; at the same time classical carpenters consider special types of joints of wooden elements as distinctive for framing.

4.2 Popularity Growth

For the first time the breakout of framing coincided with the rise of a new architectural style – Art Nouveau in the last decade of the 19th – beginning 20th centuries. In several European countries styles, using timber-framed stylistics as decorative basis, appeared: Jugendstil (Germany), secession (Austria and neighboring countries), Russian modernism (Russia), Glasgow style (Great Britain)²⁶. Framing experienced a renaissance in Europe, thanks to its use as a stylistic base for buildings of the swiss style, stick style, beder, jugend, storybook, Adirondack, as well as national variations of framing in England («framework»), France («colombage»), Spain, Northern Italy, the Balkans.

Major revival of interest to the framing happened in the mid-20th century together with introduction of new construction technologies and materials. In particular, timber framing architecture turned out to be irreplaceable when building houses with big floor-to-ceiling windows. The technology of the construction is quite simple: a wooden frame is taken as a basis for a country house, opening parts are filled with glass panels and the result is a building with a contemporary design. Steel, aluminum alloys and even armed concrete are used occasionally instead of wood in the framed structure in this version of framing.

At present time there is a heavy competition with other construction technologies – panel, monolith, block, logging, and other types of framed construction. While, from the economic point of view, timber-framing houses are not of primary importance, from the social and technical points of view, they represent great interest. As timber-framing buildings do not have structural wall partitions in interior, they are easy for architectural replanning. Even old timber-framing houses are easy to alter due to the requirements of modern amenities. For instance, it is relatively easy to make an avant-garde studio apartment in a timber-framing building dated several centuries. That's why in many European countries architects, artists, designers often inhabit timber-framing houses, considered to be respectable and indicating success. They are also commonly used as municipal buildings²².

4.3 Trends and Prospects

4.3.1 Distinction

The tendency to individual distinction that is now gathering speed will not let post timber framing architecture

disappear. Besides, cities will stand up for individuality preservation at least because people, having high mobility, need a sufficient choice of places corresponding to their needs⁵. Individual approach to house design will last, as well as variety of preferences concerning domestic architecture and their construction technologies. Moreover, retrograde theory of urban locality development, as well as the new antagonistic one – do not exclude the usage of features of timber framing architecture.

Framing in its variety fits architectural styles gaining popularity, which are based on prevailing human modalities. Wide palette of textures of framing is fit for kinesthetics who take the world in a tactile way. The possibility of using different types of wood together with natural materials of mineral origin makes framing attractive to audio digital people – individuals attaching importance to sounds and smells. Taking into consideration the theory of R. Stone, where living of architectural space is made in the language of acoustics³⁰, then the atmosphere created by timber framing architecture is neutral, not different from others.

Over the last years the trend of house design with attention to domestic animals has arisen. Thus, in 2014 in the framework of workshop “Furniture and interior design in a timber-framing style” in Krasnogorsk a project of Nadezhda Kharkina, on designing interior space of a domestic building through felinology, was presented. Small architectural forms for dogs in a timber-framing style are known in Germany.

4.3.2 Historicity

Despite new trends in timber framing architecture, in any country there may be people wishing to build a timber-framed settlement a la historicism. Architects who have not achieved success in “innovation, glory and vitality”², will seek for clients from this environment in order to reproduce architectural techniques from the past times. Contemporary architect S. Rotbard by a quite illustrative example of the Black and White Cities in Tel-Aviv proves the determining influence of city officials on the appearance of one or another part of the city: by their will ultramodern residential area can appear on sand dunes or an existing urban district can be intentionally turned into a museum²⁹. Due to the same reason, on the contrary, technology of concrete-panel construction dominates in Russia to the detriment of post timber-framing technologies.

While modernism in the last 25 years had been developed and faded away, during this period canons of soviet

architecture were being realized in Russia²⁸. This is a unique example of “past in the present”, where framing, probably in the future as well, will be presented in some few houses. In contrast with it – in tropical countries the tradition of ethnic proto timber-framing architectonics and mass-house construction based on it will apparently be preserved.

Some nations, initially having another traditional construction technology, with time turned to framing. This happened, for instance, in Hungary. This example attracted the attention, during the renovation of the lost historical center of Yoshkar-Ola (Russia). As a related Finno-Ugrian nation, having moved to the Central Europe, received a timber-framing style, it was decided to build post-crypto timber-framing houses in the central part of the Mari El capital. “Post-cryptotimber-framing houses” mean modern buildings, designed according to the principles of city architecture of Central and Western Europe, created on the basis of a plastered concealed framing. In addition, while previously the façade of a building was made of stone and other walls were timber-framed, then under current conditions this type of architecture preserves its forms in a new form of technological construction. Another example is a modern tourist quarter of Shanghai, where the features of the old Han architecture were reconstructed in design. In the future similar precedents are quite possible and timber framing architecture as a universal symbol of medieval European cities will revive in its authentic appearance.

4.3.3 Environmental Friendliness

While in the middle 20th century the idea of megapolis, as a basic vector of development of human settlements, was dominant, by the end of the century the concept of ecopolis came to the fore. While the theory, proposed by K.A. Doxiades, suggested the mergence of city buildings into a system, a single inhabited structure, the idea of ecopolis presupposes conservation of open spaces¹¹.

The achievements of constructional ecology and biology might also be expressed in rural architecture. At the present moment experiments with timber framing variations in rural areas are known: while preserving the wooden frame, ones replace the filling by straw bales, the others – by new materials on the plaster (rufalit) basis or of mixture of chaff and clay (harl). Hereafter this trend may be continued. There is a unique example of continuing traditions, when a Russian German Sergey Vladimirovitch

Gurov (Gottman), whose great-grandfather had a timber-framing house outside Mariupol (Ukraine), created a new original timber-framing technology with the frame made of glass magnesium panel and foamed concrete filling.

4.3.4 *Esthetic Qualities*

Timber framing architecture is particularly esthetic. Timber-framing buildings might be called “timber-framing lacework”. Furthermore, these houses look attractive not only in exterior but in interior as well. The problem of esthetic errors, usual for inexperienced architects, starting experimenting with joints of timber-framed elements, will soon be overcome. The invention of architect F. Hughes that “precision” has now nothing to do with «truthfulness»¹⁴, will result in perfectionism.

According to “architectonisation”, designing will be realized on the basis of logical and actual connecting and disconnecting of all forms of objects and phenomena, following the elevation approach (division to upper and lower and of succeeding integration)²⁴. Thus, having a wide range of historical examples of usage and rethinking of framing in architecture as a “basic material”, design engineers or project programs will produce design proposals of numerous interpretations of timber framing architecture, basing on architectonisation principle.

4.3.5 *Universality*

The frame, constructed in accordance with timber framing principles, is statically stable. Sometimes even a totally skewed building turns into a balanced state and does not collapse. This characteristic allows supposing that a timber framing with added hinges and guidance mechanisms might become a basis for a building-transformer, that can easily adjust to a new functional task, which is particularly important under conditions of intensification of life in megapolises. Widely different in form and designation buildings could be constructed, basing on general principles of timber framing architecture. Invention and use of flexible materials for the frame and infill will result in new possibilities of forming in post timber-framing architecture. Such flexible constructions will suit nicely for designing of “buildings-covers”.

Cities, megapolises will be interactive, robotized buildings will make “contact” with people. Parts of timber-framing houses might be quite flexible. Time-proven

beam frame, rack-mounting, cutting and their analogies work fine for the realization of these functions in the best way. According to ideas of architects-futurists, a timber framing (three-axis truss) can be largely used and combine city structure components. As a result, the frontier between buildings, courtyards, streets, squares may easily disappear: large spaces can be covered by translucent sheds, and buildings may discretely maintain their walling function.

Framing in a form close to the authentic one will most probably be used in the architecture of recreational areas. Thus, in the age of minimalistic and austere modernism in Las Vegas, the architecture was different: “Rhythmic frontons, crowning side facades of “Aladdin” building – long, low and timber-framed decorated in the spirit of the English middle ages, – look quite moving, looking from behind the parking, billboards and a gigantic statue, promoting the service station nearby”³⁵. This trend is also proved by Moscow vernacular framing of cafes, restaurants, shopping pavilions in parks or holiday fair markets.

Already in the nearest future human civilization will face the necessity of the moon and mars development. Here we will need framed post timber-framing forms. If approaching the issue from the critical point, the choice of construction technologies, which might be hypothetically used under extreme conditions, framed technologies of construction will obviously come to the fore. The most progressive among them is a timber framing technology due to its particularity of clear division of constructional functions: frame has a supporting function, while the infill – the walling one. A timber-framed three-axis truss has a conditional “proprioceptive” characteristic – so evenly the charges in it are redirected, and so stable it is as a result. This timber framing particularity explains its spread in the regions of high seismic intensity, such as the Caucasus, Asia Minor, Kashmir, the Himalayas etc¹³. On the planet earth framing spreads from the zone of equatorial climate in Singapore to subarctic climate in Fennoscandia and Canada. Besides, a timber framing has successfully adjusted and used new construction materials. Architecture on the timber-framing basis has broad options of structural forming. Thus, framing stands out from general variety of construction technologies by its progressive features and wide adjusting characteristics, and, thereby, with certain improvements is suitable for designing and construction of extra-terrestrial settlements⁷.

5. Discussion

Based on the analyses of the results of the conducted research of the architecture of modern timber-framing houses, we come to the following conclusions:

The characteristics of timber framing architecture both in authentic and modified versions will not come out of architects' use for a long time. It is also probable that timber framing architecture of the present and past times will be reproduced in the world. Timber framing architecture will come in intermutual contact with new architectural tendencies and will result in creation of a large variety of transition forms. These progressive features of timber framing architecture brought to life numerous modifications in different schools of architecture. Experiments with forming change of frame and infill materials to innovative ones resulted in the fact that the principles of timber framing architecture in different variations have become dominant nowadays. Moreover, post timber-framed construction technologies gained widespread both in multi-storied and low-rise construction. Evidently, the tendency to its mass usage will be kept in the future.

While the 20th century brought to architecture, based on the principles of framing, a wide range of various versions of construction, in the current century only minimal alterations may be expected. Nevertheless, not everything has been done yet. As in the middle of the previous century buildings with transparent filling appeared, it will be logical to create solid, transparent material for the frame. This would make possible the concept of construction of public buildings with transparent frame and non-transparent infill. With the help of such materials, construction of fully transparent buildings will become possible.

There is a tendency of uneven development of a timber framing technology in different countries of the world. Framing achieved the biggest progress in monochrome cultures (Scandinavian, Germanic nations), while its complexity is foreign to polychrome cultures, aiming for a quick and short-term result (Eastern European type of culture). It is the mentality rather than natural and climatic conditions that explains the phenomenon that European settlers managed to adjust framing to severe conditions of Canada, while timber framing carpentry were not finally formed in Russia. It is probable that the vector for variable-speed changes in timber framing architecture will preserve in the future. As a subject for discussion we offer several projects, designed in academic institutions of Moscow. Figures 1–3 show reference designs of

constructions, built under timber-framing principles or containing timber-framed elements in decoration. The projects were presented at international forums "Days of timber framing architecture in Moscow" in 2013 – 2015.

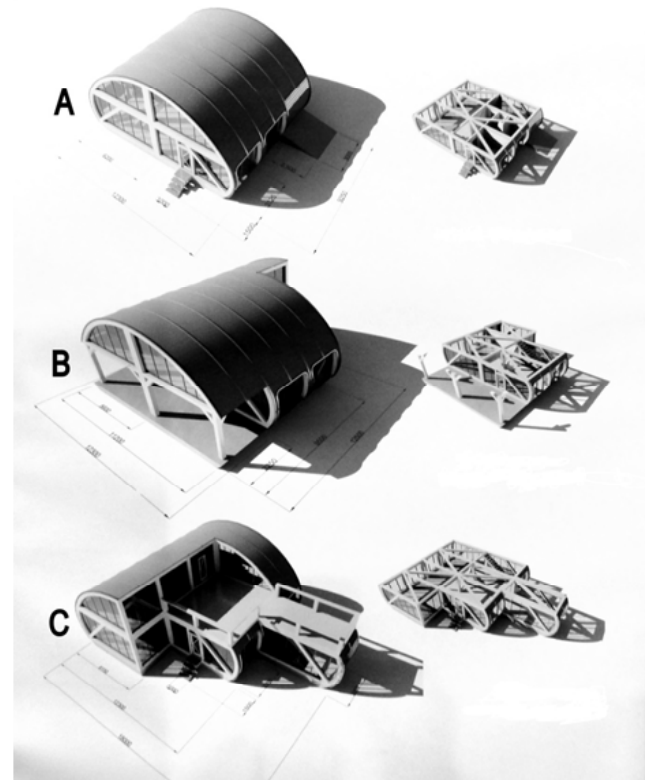


Figure 1. Reference design of a cottage with arched covers and timber framings. Author – Evgeniy Sheludyakov, student of college of construction № 26, Moscow. A – standard view of the cottage. B – modification: cottage with a veranda. C – modification: cottage with balcony.



Figure 2. Reference design of Ecological and Educational Centre with the use of timber-framed elements. Author – Galina Dyomina, student of the National Institute of Design (Moscow).

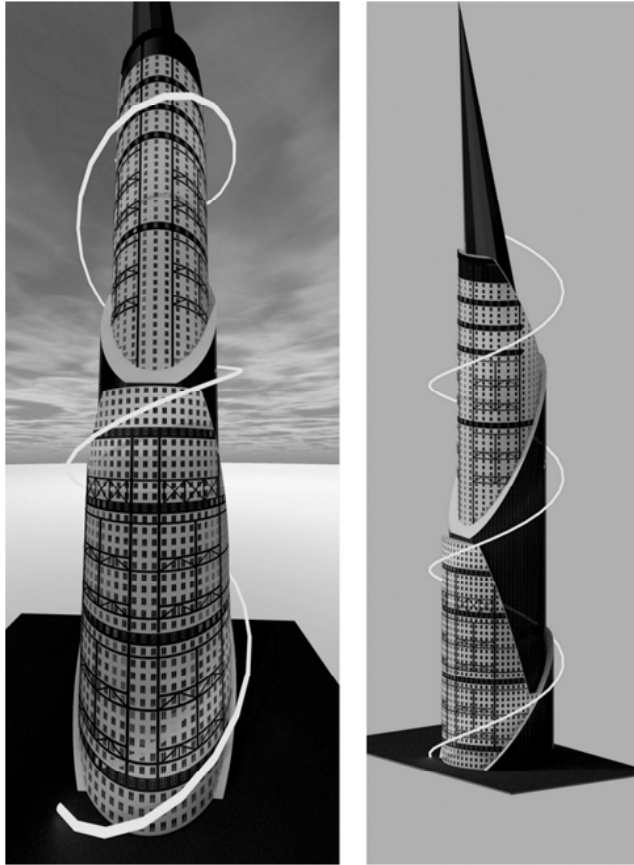


Figure 3. Reference design of a multi-storied building “Außenkante” with the use of timber-framed stylistics in the decoration of facades. Authors: Marina Rozhdestvenskaya and Denis Gavrikov.

6. Conclusion

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