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A COMPARATIVE STUDY BETWEEN THE TIMBER FRAME CONSTRUCTION AND THE MASONRY CONSTRUCTION

Orynbek A.D.1
orynbekakmor@gmail.com
1 L.N. Gumilyov ENU, Nur-Sultan,
Kazakhstan; Scientific supervisor: Jumabayev
A.A.

Abstract

The research presented in this article focused on the comparison of masonry and wood frame. There was a comparison in characteristics such as: environmental friendliness, thermal conductivity, energy efficiency, architectural forms, sound insulation. As a result of the analysis, the comparison was proved.

Keywords: fire resistance, air exchange thermal conductivity, wall insulation, durability, strength.

Introduction

This research project focuses the comparison of two structures in construction, namely masonry and timber frame. A battle of materials, thermal balance and quick construction against the conventional solid cavity bricks and mortar. The key difference between timber frame and masonry isn't so much the materials used to make the walls, but the fact that timber frame is usually made in a factory and delivered to site on a lorry. This takes away a lot of the graft and simplifies the process from the builder's point of view.

Timber framed masonry represents a special structural system because of its higher strength than of a timber structure and higher ductility than of an unreinforced masonry structure[1]. Although timber framed masonry buildings are spread all over the world, in some countries being common residential houses, while in others representing important heritage, there is no design standard or published method that can be used to analytically evaluate the capacity of this type of building.

In mass timber construction uses a category of engineered wood products made of huge, solid wood panels, columns, or beams that are often fabricated off-site for load-bearing wall, floor, and roof construction[2]. Like concrete and steel, mass timber is engineered for high strength ratings but is substantially lighter in weight. Mass timber products are thick, compressed layers of wood that may be assembled into panelized components to create strong, structural load-bearing parts. Lamination, fasteners, and adhesives are commonly used to create them. Mass timber is an environmentally acceptable alternative to carbon-intensive materials and building methods that can complement light-frame and hybrid choices.

Masonry is the building of structures from individual units, which are often laid in and bound together by mortar[3].The term masonry can also refer to the units themselves. For masonry construction, the common materials are brick, building stones, etc. Masonry is highly durable form

of construction.

Masonry is often viewed as a facade or cladding material, incapable of supporting an entire structure, but this is a misconception[4]. Structurally engineered masonry provides great physical strength, while being cost-effective.

The purpose of the study is to analyze and compare two structures in different aspects of construction.

Methods

Comparing the two build methods is complex as the structures, procurement models and site operations are different. Masonry construction, in general, consists of separate supply chain members and then on-site assembly of the constituent parts (walls, floors, and roof trusses), whereas timber frame construction typically involves an offsite manufacturer designing, manufacturing, delivering, and erecting the entire structural shell of the home, including the roof structure. In contrast, we studied the utilization of timber and masonry structures in a residential building.

Environmental friendliness

The tree has pores through which it "breathes", which contributes to excellent air exchange. Bricks are made of clay and sand – these are also eco-friendly materials[4]. However, there is no such air exchange as in a tree in a brick. In addition, the finishing of a brick house is often polystyrene, plastic, while a wooden house is decorated exclusively with natural materials.

Thermal conductivity

The thermal conductivity of masonry is higher. Wooden walls keep cool in summer and warm in winter better[5]. If, at the same temperature, a brick wall with a thickness of 0.5 m is compared with a wooden wall with a thickness of 0.2 m, then the heat loss of a brick is 1.5 times higher per 1 than that of a tree.

Such data lead to the conclusion that it is better to build a country cottage out of wood, since it heats up faster and cools down slower. They are filled with moisture; as a result, they will feel damp in the room.

On the subject of energy efficiency

No system is intrinsically more energy efficient in theory; it all depends on the design. In practice, a surprising amount of energy efficiency is determined by the quality of the construction, and factory-built homes usually win out. It is also simpler to install insulation in timber frame walls and leave the space between the two layers unfilled. Masonry dwellings, on the other hand, have an advantage in terms of heat retention, because heat from the sun may be kept in the structure overnight, which is known as thermal mass.

The walls take up to a quarter of all the costs of building a house. The construction of a house needs to take into account the different aspects that the material carries, each design as shown in Table 1 has its own disadvantages and advantages.

Table 1. Advantages and disadvantages of materials

Material	Advantages	Disadvantages
Masonry structures	Reliability; durability; environmental friendliness.	The need for insulation; labor intensity; heavy walls; need a strong foundation.
Timber frame	Speed of construction; lightweight foundation; good thermal insulation.	The durability of the house depends on the technology and quality of construction.

Architectural forms

Between timber or masonry, it should be noted that there are significantly more design and architecture options for masonry buildings. As for architectural solutions, there are no restrictions for masonry structures: it can be at least classical Gothic, at least a semicircular house in the avant-garde style. Timber houses look simpler, as they have uncomplicated architectural forms[6].

Any material is suitable for finishing brick walls: plaster, tile, facing stone. It is enough to

cover the tree with a special paint or varnish.

Sound insulation.

In an article published in Home Building and Renovating magazine[7], Clive Fewins agrees with the previous remark in terms of public impression, stating that the public perception of masonry built is sturdy and enduring. “A masonry structure gives a house a feeling of solidity, as the density of the blocks provides a high level of acoustic mass”.

TRADA state [8] “It’s interesting that even our standard 140mm timber frame walls are 20 per cent more thermally efficient than current building regulations demand. Sound insulation is more efficient too with a timber frame, compared with other methods of construction.”

Results

Table 2 shows the main technical and operational characteristics of masonry, namely stone and brick, and timber materials. Figure 1 shows that a building with a timber frame has a high environmental friendliness coefficient; thermal insulation; clean, untreated timber is less expensive than stone structures, such as masonry structures.

As a result, masonry is more durable, and masonry houses have far higher fire safety and fire resistance than wooden structures.

Table 2. Main technical and operational characteristics

Building materials	Thermal conduc-tivity	Density	Heat capacity	Water absorp-tion	Fire safety	Weight of 1 m2 of wall	Sound insulation
Stone	1,4 W/(m⁰C)	2200 kg/m3	920 J/(kg⁰C)	1,5-8,0%	600-9000C	1000-1300 kg	40-60 Db
Brick	0,67 W/(m⁰C)	1700-2100 kg/m3	840-880 J/(kg⁰C)	14%	700-9000C	1100-1200 kg	50-60 Db
Timber	1,7 W/(m⁰C)	700 kg/m3	2300 J/(kg⁰C)	30%*	250-3000C	100-220 kg	70 Db

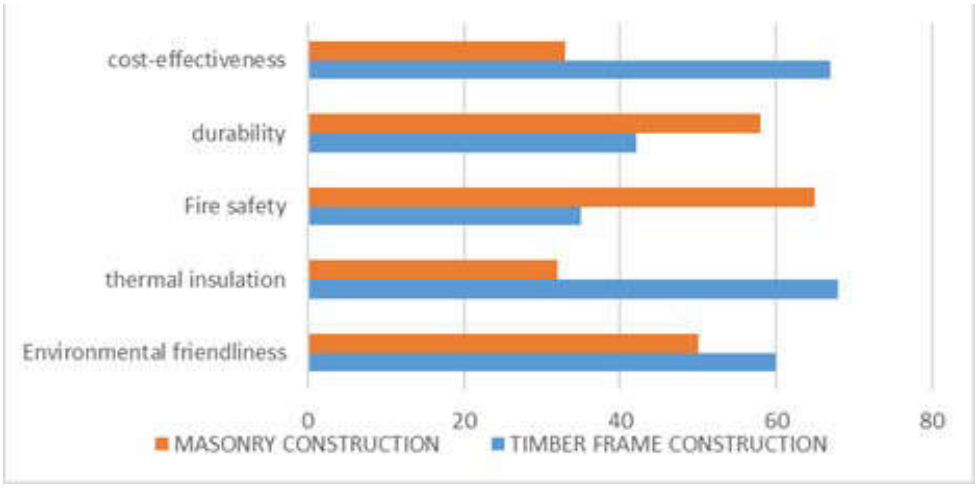

Figure 1. Comparison of the main characteristics of the two designs.

Conclusion

Building timber house is less expensive from a financial standpoint – timber is less expensive, the foundation needs to be shallow-buried, and there is less finishing work. However, this is simply one of several elements that influence the developer's approach toward material selection for a new cottage.

The choice of material is influenced by seismic factors and the geography of the region: it is economically unprofitable to build a brick or stone house in a wooded area if there is always a tree nearby; it is also difficult to choose a material based on the conditions of interior decoration both timber and masonry scan be easily finished with any modern finishing decorative materials.

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ПОДСЕКЦИЯ 11.2. АРХИТЕКТУРА В ГЛОБАЛЬНОМ МИРЕ: ТЕНДЕНЦИИ И ПЕРСПЕКТИВЫ РАЗВИТИЯ

УДК: 721.01

ПРИНЦИПЫ ФОРМИРОВАНИЯ ОБЪЕМНО-ПЛАНИРОВОЧНЫХ РЕШЕНИЙ НА ПРИМЕРЕ ЖИЛОГО КОМПЛЕКСА ТУЛОУ В ПРОВИНЦИИ ФУЦЗЯНЬ

Алимханов Темур Шавкатович
Timuralem1996@gmail.ru
Магистрант 1-го курса ОП 7М07320 – «Архитектура», кафедры "Архитектура",
ЕНУ им. Л. Н. Гумилева, г. Нур-Султан, Республика Казахстан
Научный руководитель – кандидат архитектуры, профессор Чекаева Р. У.

В конце VII века на территории современного Китая произошла масштабная иммиграция из центра империи в его южную часть. Именно эти переселенцы обосновались на юго-востоке провинции Фуцзянь и впоследствии стали народом хокло. Вначале новоприбывшие переселенцы строили дома в соответствии с традиционным ханьским стилем архитектуры. (рис2) Однако в течение некоторого времени общество было нестабильным из-за частых столкновений между этническими группами, и в то же время в стране свирепствовали разбойники и воры. Народы хакка и хокло постепенно улучшали свои дома, так что в конце концов они стали идеальной защитой от нападающих. Эти жилища, похожие на крепости, назывались тулоу.(рис1)