Study on Mongolian Yurt Features and Its Environmentally Friendly Design

Xin-Hong ZHANG\textsuperscript{a,*} and Yu-Tong BAI\textsuperscript{b}

College of Wood Science and Art Design, Inner Mongolian Agriculture University, 306 Zhaowuda Rd, Saihan District, Hohhot, China

\textsuperscript{a}zxh@imau.edu.cn, \textsuperscript{b}18247165989@163.com

*Corresponding Author

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Abstract. Mongolian yurt, used for nomadic life, has the traditional Mongolian housing construction. Yurt is made of wooden framing structures, felt coverings and straps. Yurt has four features: biologic materials, disassembly and assembly system, modular building unit, moving on the wheels. There are several systems correlated with yurt, ventilation, drainage, day lighting, wind prevention, etc. These systems could fulfill the nomadic needs by the yurt components or facilities the yurt affiliated. From the view of the structure and the features of the yurt, this traditional housing style is suitable for the grassland environmentally sustainable development.

Introduction

Inner Mongolia is mainly located in the temperate Continental Monsoon Climate zone, which is strong wind in spring, less rainfall and uneven in summer, polar outbreak extended most of winter. Mongolians got used to live in the yurt in this kind of nature conditions. The nomadic lifestyle is to move along the river and fresh grass, so herdsmen camp in different area during four seasons of the year.

Yurt is the traditional housing style for Mongolian people; it has a round shape which is formed by the wooden frame. As the skeleton, the wooden frame is a self-supporting system. The felt coverings or reed screen coverings are the coat of the yurt. A set of straps, could connect the frame sections and fasten the coverings onto the wooden supporting frame [1]. With the yurt, nomadic life seems comfortable and convenient. So in contemporary society, living in the yurt still is looked as the best choice herding in grassland. In present days, some other building styles, such as fixed concrete yurt and plastic-steel yurt, imitate the shape and structures of traditional yurt could be found in scenario places serving for travelers. These kinds of yurts partly retain the features of the traditional ones, but the function is no longer meeting the nomadic needs.

Features of the Traditional Yurt

With three portions: wooden framing structures, felt coverings and straps, the traditional yurt is made by biologic materials and no single metal material. The wooden parts of yurt are the walls, rafters and roof ring. In Mongolian language, the wall of yurt is called Khana, the rafter is called Honea, and the roof ring called Tono. These portions and parts could be disassembled and assembled easily. The wall of the yurt Khana could be counted as a building unit. If the herdsmen need a larger yurt, they just add the pieces of Khana to the desired size, and make some changes on other parts and portions.

Biologic Material

The traditional yurt is made by some local biologic materials, mainly are wooden materials, felt, leather thongs, fur ropes, reed screen and so forth. Employing these kinds of materials during the
construction process, could reduce the carbon emissions to minimum. Some modern buildings are made of steel and canvas, concrete and bricks, which are called yurts only because of the round shape appearance, not belonging to the traditional yurt types.

The wooden frame structure includes Tono, Honea, Khana, and other parts such as door and pillar. The local wooden materials include elm, white birch, black birch, polar, pine, salix mongolica, Chinese tamarisk. Polar, Elm, white birch or black birch are used to make parts of Tono. Chinese tamarisk (very common in grassland) or pine is cut to make Khana and Honea. (Refer with Table 1)

### Table 1. Materials of the wooden frame.

<table>
<thead>
<tr>
<th>Prats of the wooden frame</th>
<th>Wooden materials</th>
</tr>
</thead>
<tbody>
<tr>
<td>Tono</td>
<td>Polar, Elm, white birch or black birch</td>
</tr>
<tr>
<td>Honea</td>
<td>Chinese tamarisk, pine</td>
</tr>
<tr>
<td>Khana</td>
<td>Chinese tamarisk, pine</td>
</tr>
<tr>
<td>Door &amp; pillar</td>
<td>white birch or black birch, pine, Polar, Elm</td>
</tr>
</tbody>
</table>

Felt is the covering of yurt, made of wool, cut or made in different size and shape, which to cover Tono, Honea and Khana respectively. The shape of top covering is square, the Honea coverings’ shape is circular sector, and the Khana coverings’ is rectangle. In north of Inner Mongolia, the reed (local material) screen is used to cover the wooden skeleton of yurt by local people. The thickness of the coverings in winter is thicker than that in summer. Sometimes people use cloth to cover the yurt instead of the felt in hot weather.

The straps are two types, leather thongs and hair ropes; they all come from the livestock [2]. The width of leather thongs, which made of camel or cow, is cut to 1cm or so, is used as joints, to connect the wooden stuffs. The hair ropes (refer with fig.1) are braided by the longer hair from horse such as the mane and the tail, or the hair from camel neck and knee, used to fasten the coverings and wooden support structures.

![Figure 1. Hair ropes.](image)

Hair ropes have two shapes, round shape and flat shape. The left one is the round one, braided in two nature color hairs, using to fasten the felt in rain days.

The right rope is a flat type. Mongols sew up two or three flat rope together to get a broader flat rope.

The function of strap system similar to cement of a concrete building does. As the bolts, the leather thongs fit into the holes of the crossed point on the Khana, and are in harmony with the wooden parts. This makes the structure less worn and more durable than the metal joints.

**Dis-assembly and Assembly System**

The wooden structure could be assembled and disassembled repeatedly. The herdsmen disassemble the yurt into parts packing on the back of camels [3] or in the oxcarts, called Lele vehicle [4], when they moving to another grassland. A set of Honea (refer with Fig.2), fastened with Tono,
like the skeleton of an umbrella, is folded up setting on the Lele vehicle (refer with Fig.2). Another type of Tono (domed roof ring), packing on the camel’s back, with a door frame underneath and a set of stovepipe on its top (refer with fig. 3 domed roof ring on the camel back. This type of Tono has six crossing bent branches up to the ring, looked like a domed-shape in the distance. ). One yurt has several pieces of Khana. Every piece of Khana has criss-crossed lattices which could open out or fold flat. Khana could be folded one by one and be tied up on the sides of camel’s body (refer with Fig.3. The large size yurt with a bigger Tono, has separated Honea and more number of Honea rafters to tie up together, which is not the same structure as showed in these two figures.).

Assembling a yurt is in a converse process compared with disassembly. The first step is to stand up and connect the latticed Khana pieces and attach the door at the two ends of the Khana wall.

The second step is to hold up the Tono attached with Khana on the center of the closed wall space. As to a medium or small size yurt, the diameter of Tono is usually not beyond the control of an adult male’s arms. So it is easier to hold by one man. As to the large yurt, Tono is big and heavy, should be tied with the Honea rafters before they are raised up by pillars. When the Tono and Honea rafter are raised above to the height of the Khana, the other side of the Honea rafter should be tied with the top crossing of the Khana wall. After these two steps, wooden structure assembling is finished. The last thing is to cover and tie the felt coat and the water resist clothe on to the wooden structure.

Table 2. Parameters of the building unit and the yurt size.

<table>
<thead>
<tr>
<th>Yurt Type</th>
<th>Khana Numbers</th>
<th>Pillar Numbers</th>
<th>Tono Average Diameter [cm]</th>
<th>Yurt Average Diameter [cm]</th>
</tr>
</thead>
<tbody>
<tr>
<td>Small</td>
<td>4</td>
<td>0</td>
<td>117</td>
<td>468</td>
</tr>
<tr>
<td>Medium</td>
<td>6</td>
<td>2</td>
<td>153</td>
<td>612</td>
</tr>
<tr>
<td>Large</td>
<td>8 or more</td>
<td>4</td>
<td>200-</td>
<td>800-</td>
</tr>
</tbody>
</table>

**Modular Building Unit**

Khana is one of the building units. In Inner Mongolia around the year of 1949, a yurt with four pieces of Khana is popular for a common Mongol family. A yurt with 6-8 pieces of Khana was usually used by a rich family, and 12-Khana-yurt used by Lama or social high levels [3]. Nowadays, Mongols using different numbers of Khana build the yurt at the desired diameters (refer with Table 2). The more quantities of the Khana load, the larger volume of the yurt occupy. From this point, the Khana is a basic modular building unit, and also a terminology to reference the size of the yurt. In some modern style yurt, the wooden structures are replaced by metal material. The metal Khana still is used as the
building unit, but couldn’t fold flat. When Mongols construct a large size yurt, the pillars are necessary to hold the weight of the Tono, Honea and coatings, refer with Table 2. From the parameters of Table 2, the diameter of yurt is 4 times of that of the Tono, the ratio is followed to build winter yurt.

Moving on the Wheels

The yurt (abbreviated by style 1), could be disassembled by several parts and easy packing on the cart wheeling by ox when move along the rivers. Another type of yurt built on the wheels (abbreviated by style II), could pull by oxen wherever the Mongols wanted. This yurt (style II) was recorded on Mongolian history document, and popular on the ancient war fields. The structure of pattern II was similar as the style I; the only difference was that the body of style II connected with the war cart together as a whole building. Some researchers think that the time of repeatedly disassembling, delivering and rebuilding should be shorted by using a new style, which fixing the yurt on a 4-wheel-base [5]. This style learns from the idea of pattern II. No matter which yurt style, the building and its affiliated stuffs could moving by vehicles on a whole or into parts easily.

Needs of Mongol Herdsmen and the Structure of Yurt

Ecological Balance

One-tenth Rule is a rule of ecological system sustainable development, which Mongols comply with for generations. Mongols believe that nature resources could recover and renew themselves on one precondition, that is the nature resource was consumed only one tenth. This is called One-tenth Rule. Mongols love grassland, what is their living basis. They keep moving along the river as herding their domestic animals, to let the meadow recovery after graze.

Mongols construct yurt on a place they selected, on which flat, grass plump and near the river. They set the yurt directly on this flat place, some Mongol families pile the timber floor; most people are willing to let the grass grown inside the yurt. The grass under and around the yurt will grow up again when they leave. The ground under the yurt is original nature.

Daily Life

Yurt could fulfill their basic living needs. Inside the yurt, Mongols could cook, sleeping, storing stuffs, recreation and planning the daily routine. Two double beds are placed at east and west side separately along the Khana [6]. There is still enough space to let storage furniture setting beside the beds. Herding stuffs and cupboard are hanging or stand aside the door. In the middle, the enclosed space among the furniture has functions as living room and dining room. Mongols have applied the wind power or solar power facilities to supply power for the lamps and TV.

Stove, the important thing for Mongol, is set in the center of the yurt, smoke come from the stove outside yurt along the stovepipe which stretches out of the Tono (refer with fig.4). The fire could use to boil the milk tea or cook meat, and also to heat the space [7].

Because of the dome shaped appearance, there is a low pressure area outside the top of the yurt [3]. This is an advantage to cook inside the yurt, for the cooking steam and the smoke is easy to be pumped out of the space. In summer, herdsmen roll the felt covering at the bottom of the yurt, to let the cool wind in, then the warm air flow out of the Tono (refer with Fig.4). This is an auto ventilation system.

The Tono is not only an air-vent, also a window and a timer of yurt. The day-lighting shine in the Tono, let the interior space warm and bright. Mongols has a tradition method to record the time [8]. They can estimate the time from the sunlight positions inside yurt to carry out the herding affairs.
Figure 4. Yurt in summer.

Yurt is built on flat grassland. In summer, herdsmen roll the bottom felt up to let the cool fresh air blow through the Khana into yurt, and the rose warm air goes out from the Tono (half covered with the top felt). There is a small metallic ring fixed on the Tono to set the stovepipe which stretches out of yurt.

**Resisting Nature Disaster**

The climate in Inner Mongolia is strong wind accompanied by sand storm during fall, and heavy snowfall in winter, some rain falls in summer and spring. The sand storm and heavy snowfall are frequently occurred. Mongols call the heavy snowfall white disaster. Yurt is designed to survive during the disasters.

The flexible wooden structure skeleton, especially the Khana’s opening out at different size, could make the yurt a slight higher or lower height. In spring and autumn the yurt is constructed low to reduce the wind drag. The wooden structure with the leather bolts could lateral sway a bit to relief the wind power, the ropes tied outside the covering pull back yurt at the same time. In summer the yurt is built a little bit higher than autumn to lighten the rainwater damages. The felt coverings have the functions to keep warm and keep water out of yurt. Snow could easily creep down the dome-shaped top of yurt. That’s why yurt still standing straight after the strong wind and heavy snow.

**Conclusion**

Yurt is a traditional nomadic building. Mongols live in yurts, which set on the sunny slope with river nearby. One-tenth rule is a traditional rule followed by Mongols for generations. Herdsmen wheel their dwellings frequently, using local biologic materials to build their yurts to balance the relationship between nature and human beings. From this article, the design idea shows that the traditional yurt should fulfill the Mongols needs, such as the needs of daily life: clothing, eating, sleeping and herding. As the development of the economics, some new styles are emerging, with different materials and structures. But the contemporary needs and the design idea should be complied on the yurt design.

**References**


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