南極の住宅

HOUSING IN THE ANTARCTIC

設計条件

当研究室が初めて「南極の家」に取組むこととなったのは、越冬住宅として居住棟とヘリコプター格納庫の重要な部分を含めるパネル製作を担当することとなったことからです。

この越冬住宅は、文部省の発注により日本大学農学研究室で設計を行い、当方はその本体工事のパネル製作を行うこととなりました。

その結果の設計条件としては、1) 南極まで及びその他の輸送に関する条件、2) 南極における気象条件、3) 現地における建設に関することの条件、4) 現地でそれを使用する条件など大きく4つに分けられます。

1) 輸送条件

基地までの約2ヶ月間の船による運搬、温度・湿度等の変化に耐え、またヘリコプターの空輸に備え形は1.5M×5.0Mを限度とし、重量は100kg前後としなければなりません。

2) 気象条件

最大風速は60M/sec、積雪は建物の風下側にはスノードリフト（吹き替え）が著しい根面面にはなく、また、気温は冬季最低-50℃、夏季平均-15℃～+5℃、湿度はR.H.45～80％です。

3) 建設条件

素人的20名程度の隊員が容易に組立てられるなおかつ所定の強度を維持されなければならない。また、組立に際してクレーン車も使用できますが、万一一の場合は人力でも可能なこととして、約30日間で完成させなければなりません。一方耐地の状態が悪くても可能なこととして、接合方法はできる限り簡便にしていなければなりません。

4) 使用条件

使用目的に応じた機能が完全に発揮され、また、荒涼とした南極で半年の越冬生活を過ごす隊員に人間的かつ快適な空間を提供しなければなりません。なお安全性の問題としては、火災時の延焼に耐えられるようにしなければなりません。

DESIGN CONDITIONS

Specifically, we were charged with the responsibility of manufacturing the panels needed for the construction of these houses and buildings. The members' houses, in order to meet the various climatic requirements, were to be designed by the Saigo Research Institute of Nihon University with a subsidy granted by the Ministry of Education. Misawa Homes then took charge of manufacturing the panels to make the construction of the designed units possible.

Design conditions of such buildings can largely be classified into four categories: 1) Conditions concerning the transportation of materials to the Antarctic. 2) Climatic conditions in the Antarctic. 3) Conditions concerning the erection of buildings in the Antarctic. 4) Conditions in connection with the use of these buildings in the Antarctic.

1) Conditions relating to transportation:

The materials must stand a voyage of about two months, with vibrations, and a great change of temperature and humidity in transit, as well as air transport by helicopter in the Antarctic. To meet these requirements, the maximum size of the panels was limited to 1.5M x 5.0M, with a maximum weight of about 100kg.

2) Climatic conditions:

The maximum wind velocity is 60M/sec. There is thus considerable drifting of snow to the leeward of buildings but no snow accumulation on their roofs. The lowest temperature in winter is -60℃ and the average temperature in summer is between -15℃ and +5℃. Humidity ranges R.H. 45%-80%.

3) Conditions of construction:

The houses must be easily assembled by about 20 members of the research group while still maintaining the necessary strength factors. Mobile cranes are available for use, but basically these houses must be prefabricated so that they can be assembled by manual labor within a period of approximately 30 days. The worst possible site conditions must be taken into account so that connections and joints must be as simple as possible.

4) Conditions of use:

The houses must function so as to meet the needs and requirements of the people living in them, and must provide these people with a humanistic and comfortable space, for the inhabitants are to spend one winter in the desolate Antarctic. For safety, the buildings must be completely fireproof to prevent the spread of flames in case of a blaze.
POLICY AND PLANNING

The principle of prefabricating houses is to provide units of standard specifications and qualify large quantities. However, in order to meet the local customs and climatic conditions of any particular site, the prefab manufacturer must consider all possible site conditions before drawing up his standard specifications for production. He cannot dismiss any single natural phenomenon which may take place, even if only for one short moment over a period of many years, as long as this phenomenon is considered to influence human living in some degree. Thus the ejection of these Mianos units in the Antarctic was seen as a valuable test for the Mianos System as a whole. All the foregoing conditions were carefully studied, and it was decided to adopt complete prefabrication system for the Shou building. The houses for the expedition members were designed to be delivered in a wooden panel system to combat the snow drams. One possibility which was studied was the use of materials other than wood for the floor. Metal is non-flammable, but steel frames have a larger rate of heat transmission that is apt to cause freezing in a building which is exposed to a great interior-exterior temperature difference. Wood materials are highly flammable and, even if treated with a fire-proofing agent, their flame-spread rating cannot be brought to zero. Hence, it has been decided that a non-flammable surface finish is necessary to increase the fire resistance of the wood panels. As for the exterior hangings, they need much more care than usual because there is no need for interior hangings. For this reason, a different system was incorporated using steel frame with a special cover, and the panels are subjected to pressure and are cured. The production of these panels was undertaken by the Matsumoto Plant of Mianos Homes.

The roof panels are laid in the direction of the span with multiple joints, and do not reach the ceiling in the middle. The advantages of this system are:

1. No cumulative error in the direction of the span
2. The height of the ceiling is uniformly level, adding convenience to the use of interior space.
3. More freedom in the use of interior space.
4. A simpler system can be adopted for conduits.
5. With a smaller number of joints, workability improves.

THE METHOD OF CONNEXIONS

The reinforced-concrete foundation must be constructed on-site. Jacks installed in the foundation will telescope into steel frames that comprise the upper foundation and base for construction. After adjustments to assure that the foundation is level, the jacks will be buried in the concrete. Wooden joints of 100 x 50mm each are tightened to the steel frame with bolts and are tied to the joints of the floor panels by means of connectors. In a similar manner, floor to floor, floor to wall, and wall to roof joints are carried out, in that particular order. These joint connectors consist of two parts: one is the female part of “receiving part” which is screwed to the connecting portion of the panel, and the other is the male part of “inserting part” that pulls the “receiving parts” together. Thus, by driving the “inserting part” into the hole created by the “receiving parts” of adjoining panels, all the wooden parts of the panels are held tightly together. The perimeter of each panel has rungs to match the runs on the edges of other panels and, to ensure air-tightness, these runs are filled with a Chloptene Rubber Air-Tightening agent. To prevent rain leakage, the panel to panel joints are also filled with a silicone-type caulkings material.
今後の展望

プレハブ住宅が普及するにつれて、その建設地も拡大していくこととなり、ここでの、その地方の慣習、気象条件等の独自性を、どのように生かしていくかが問題となってきます。

前頁で南極の住宅の設計の概要を述べましたが、これらの技術は、他の開発に役立つものを多く含んでおり、また、このものの構造的なベースとなっているパネルは、実際に得られた実験結果を基に、どのように生かしていくか問題となっています。

FUTURE DEVELOPMENT

In the above, we have outlined the designs of the building in the Antarctic. Many of the techniques involved will also be effec-

tively used in other projects. The panels used here, however, are basically similar to the ones that are widely in use already. In other words, the panels we have been using for conventional prefabricated housing are justifiable, both theoretically and logically. Starting with the supply of buildings for the 9th Antarctic Research Corps, one living unit and one helicopter hangar, Misawa...