The Prefabricated House in the Twenty-First Century: What Can We Learn from Japan?  
A Case Study of the KST-Hokkaido House

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ABSTRACT

The use of wood in architecture is often linked with ideologies that address environmental sustainability, building material appropriateness, and climatically responsive design. As well, the wood industry is concerned about mass production, global markets, and resource management. Where does prefabricated housing fit into this picture? Prefabrication takes advantage of mass production with its promise of global markets, yet as a housing strategy it is often considered unresponsive to local climates and conditions. Since World War II, prefabrication has been extensively explored as a method of constructing houses in Canada and the United States as well as Japan, but with very different acceptance rates. In North America, the prefabricated house is often perceived as a less durable and less desirable form of housing. Somewhat ironically, this negative perception partly stems from the success of the low-cost, manufactured-mobile home market in the United States. In contrast, the prefabricated house in Japan represents a large percentage of new housing starts for all income levels.

Why then are prefabricated houses considered so desirable in Japan? What can North Americans learn from the Japanese design and construction of prefabricated housing? And can a prefabricated wood-frame house be durable as well as responsive to local conditions? This case study looks at these questions by examining a prefabricated house from Japan’s northern prefecture of Hokkaido: the KST-Hokkaido House.

CANADA AND THE UNITED STATES

Prefabrication of manufactured and modular homes

To say that a house is “prefabricated” means that part or all of its construction is completed off-site in a factory. The term covers manufactured, modular, panelized, and precut or preengineered systems, with a myriad of hybrid forms. In practice, the definitions of these terms vary in the United States and Canada. In the United States, “manufactured housing” is defined by having an integral steel chassis. (Its predecessor was the mobile home.) In Canada, manufactured housing simply means that 85 percent or more of the construction is completed in a factory. Moreover, the Canadian Manufactured Housing Institute does not differentiate between manufactured and modular homes based on the inclusion of a steel chassis.

But more than just a difference in definitions exists between the United States and Canada. There are also differences in cost, market share, regulatory codes, and manufacturing processes. Manufactured or mobile housing is the fastest-growing segment of the American market due to its comparatively low purchase price. In fact, 24 percent of new housing starts in 1996 were manufactured-mobile houses; only 2 percent to 3 percent were other prefabricated styles (such as modular housing). In the same year in Canada, all styles of prefabricated homes represented only 7.5 percent of the market, with two-thirds of these homes being single modules.

In the United States, the production cost of such factory-built homes is low due to the cost-effective manufacturing process and lack of regional building code restrictions. Since 1976, manufactured housing in the United States has been governed by a single federal building code (known as the “HUD Code”) administered by the Department of Housing and Urban Development. This performance-based code preempts all building codes. Because manufactured homes are portable, they are often situated on leased or rented sites, further reducing their purchase price. The Code requires that the chassis be permanent so that the units can be relocated, but the wheels and the trailer hitch can be removed once on site. With the wheels and hitch removed, manufactured units have similar flexibility to modular units. They are no longer

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preferred construction method within the town site. Many of the post-and-beam timber-frame homes are thought to have been prefabricated in Boston or New York and then shipped to Halifax.

As the population moved westward, the advent of the railroad meant that building materials manufactured in the east could be shared by all. For example, at the end of the nineteenth century, a customer could order a precut house from a department-store catalogue. A Victorian-style home from Eaton’s or Sears, Roebuck and Co. would roll up in a boxcar, with all its components ready for assembly. Panelized housing was also available. For example, a “large three-room portable ready made cottage” cost $258 in the 1910 Sears, Roebuck and Co. Home Builder’s catalogue. The sixteen-by-twenty-foot house was wrapped on two sides with a porch. Called a “Simplex Portable,” the house could be erected by “anyone with a wrench, hammer and screwdriver ... in a few hours.” Easily dismantled, it was purportedly found twenty-foot house was wrapped on two sides with a porch. Called a “Simplex Portable,” the house could be erected by anyone with a wrench, hammer and screwdriver ... in a few hours.” Easily dismantled, it was purportedly found twenty-foot house was wrapped on two sides with a porch. Called a “Simplex Portable,” the house could be erected by anyone with a wrench, hammer and screwdriver ... in a few hours.” Easily dismantled, it was purportedly found twenty-foot house was wrapped on two sides with a porch. Called a “Simplex Portable,” the house could be erected by anyone with a wrench, hammer and screwdriver ... in a few hours.” Easily dismantled, it was purportedly found twenty-foot house was wrapped on two sides with a porch. Called a “Simplex Portable,” the house could be erected by anyone with a wrench, hammer and screwdriver ... in a few hours.” Easily dismantled, it was purportedly found twenty-four-hour truck to the site and installed by crane on a conventional foundation. Are modular homes visually distinctive? Some modular homes may be recognizable as a result of the low sloping roof required for ease of transport. But many, particularly those homes comprising multiple modules with separate roof units, are indistinguishable from their site-built counterparts. Once installed on the foundation, the only remaining trace is the “marriage line” where the manufactured units meet at the wall or floor; at these points, the structure is doubled in thickness.

Changing methods and materials for housing
The selection of housing building materials has always balanced available natural resources and technologies with the needs and desires of the inhabitants for comfort, style, function, durability, ease of maintenance, and affordability. Wood has been the traditional material for the mass housing of Canadians and Americans since the beginnings of permanent structures. Some exceptions are noteworthy, such as the adobe tradition in the American southwest and the stone houses of Manitoba’s Red River area, but these innovations primarily resulted from the lack or exhaustion of local wood sources. The majority of the New World did and still does make use of its nearly ubiquitous supply of wood for building houses.

The beginning of prefabrication in Canada and the United States is linked with construction needs in new territories coupled with the availability of a transportation system. Some of the first North American houses erected in the early 1600s at Île Sainte-Croix in Acadia were of sawn timber, cut and milled in France (essentially, an early version of precuts). The winter of 1604–1605 proved the island a poor choice for habitation, so those same homes were dismantled and reassembled at Port Royal in present-day Nova Scotia. Later, when a town called Halifax was laid out to accommodate some 2,500 British settlers, one of the first tasks was to construct houses. Although building log houses in the Acadian tradition was expedient and necessary for defense, frame construction was the preferred construction method within the town site. Many of the post-and-beam timber-frame homes are thought to have been prefabricated in Boston or New York and then shipped to Halifax.

By the end of the nineteenth century, post-and-beam timber-frames had been replaced with balloon framing using standardized lumber that unskilled workers could assemble. Early in the twentieth century, balloon framing was in turn replaced by western platform framing or what is called in Japan “two-by-four” construction. The traditional prefabrication of the timber frame, essentially precuts, was being replaced by site assemblage of factory-produced studs.

In North America, prefabrication was the solution for many architects and builders exploring technical innovation to address the shortage of housing after World War II. Different systems were investigated, from the Monsanto House (made with fiberglass matting impregnated with synthetic resin) to the Lustron (an all-steel, porcelain-enameled mass-produced house). However, only wood proved economically affordable in mass-produced housing. Promoted by industry and government, most affordable prefabricated housing was not stylistically inventive or distinctive. Focusing on the repetition

confined to the single or double-wide form. For example, although they must be delivered to the site on their own wheels, this restriction does not preclude manufactured units from being stacked to create multilevel housing. Such practice does not appear to have been anticipated by the HUD Code, which contains no regulatory provisions for stairs.

Modular homes are also built in a factory, but they must comply with local building codes where they will be located. (All prefabricated housing in Canada, whether manufactured or modular, must meet or exceed the requirements of the National Building Code and sometimes provincial codes, depending on the jurisdiction.) Lacking a permanent chassis, modular units must be trucked to the site and installed by crane on a conventional foundation. Are modular homes visually distinctive? Some modular homes may be recognizable as a result of the low sloping roof required for ease of transport. But many, particularly those homes comprising multiple modules with separate roof units, are indistinguishable from their site-built counterparts. Once installed on the foundation, the only remaining trace is the “marriage line” where the manufactured units meet at the wall or floor; at these points, the structure is doubled in thickness.

Other manufacturing systems involve prefabricating parts of the house (by precutting structural members or panelizing walls, for example). As well, all contemporary homes, whether prefabricated or site-built, use a number of prefabricated items, from prehung doors and window units to precut studs and engineered sheathing and trusses.

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of form to lower the manufacturing cost, the housing was not widely accepted by the growing middle class. Far more popular was the “site-built” house, even though hundreds if not thousands of identical units were built, often in the same neighborhood. The Levitt House is a good example of this building strategy.

Immediately after World War II, William J. Levitt was the most successful developer of mass housing in the United States. Given the task of building affordable housing as expeditiously as possible for returning veterans and their families, Levitt turned the entire building site into a factory. Several complete units would be built at the outset to determine labor costs and the most effective use of materials. Any item that could be prefabricated was. Stairs, for example, were built in one location then trucked to individual houses. All studs, joists, and rafters were precut to size in a central location. Although perceived as site-built houses, the Levitt House reduced construction costs by minimizing the design and materials options and prefabricating as many components as possible.

Today, modular wood-frame construction in Canada and the United States produces highly engineered homes constructed in a climate-controlled environment. The efficient building process and material usage, coupled with consistent quality and speed of construction, make for durable, long-lasting homes to meet the stylistic and functional demands of clients. However, site-built construction remains the preferred construction method and, with the exception of manufactured housing, is often more affordable as well. In North America, the efficiencies of the factory don’t seem to result in a product that is popular with middle-class families nor a product that is competitively priced. Reservations resulting from the marginal quality of many manufactured-mobile homes, as well as the desire for a distinctive house designed for a specific site, have sustained the preference for site-built housing. This preference holds, even though few mass-produced site-built houses take advantage of their sites, and most are no more distinctive than modular homes.

What then is different in Japan? Why are the Japanese willing to pay a premium for prefabricated homes?

**JAPAN**

The impact of social change on housing materials and forms

Historically, wood has also been the material of choice for the detached house in Japan. But this is not the case with factory-built housing. Prefabricated home shows in Japan exhibit houses made from diverse materials: precast concrete, structural steel, and light-gauge steel, as well as timber-framed and two-by-four wood-frame construction. The Japanese display houses at these permanent home shows just as North Americans display the newest models of cars. And prospective Japanese homeowners are happy to choose a home from a display of models. But North American purchasers still want to see their houses being constructed.

What contributes to this difference? The prefabricated home in Japan has many advantages over a site-built house. It is erected more speedily, is generally of quality construction that is long lasting, and often includes the highest-tech gadgets as part of the package. But the same advantages could and, in some cases, are realized in North America. What is vital to understanding the Japanese acceptance of prefabrication in housing is the ability of Japanese culture to seemingly transform itself. A brief summary of a few key events in Japanese history will prove useful here. To maintain its power as an independent state, Japan quickly changed itself into a modern industrial nation after its opening to the West in 1867 at the beginning of the Meiji Period. This ability to transform was further tested at the end of World War II. During that war, close to 30 percent of Japan’s housing had been destroyed, creating a dramatic housing shortage that required the immediate development of shelter. The resulting housing – much of it prefabricated and characterized by poor quality, resulting in uncomfortable living conditions – dominated Japan for much of the postwar era. After the initial demand for shelter was met, the Japanese government tried to improve the quality of the housing stock, with the responsibility for this task resting principally with the Ministry of International Trade and Industry (MITI) and the Ministry of Construction. Their mandate was to improve the Japanese standard of living through the development of safer, longer-lasting houses. (For example, a plan completed in the mid-1980s experimented with a “hundred year house.”) One of the answers to the problem of durability was prefabrication. (Despite these efforts, however, the average life of a house in Japan today remains much shorter than its counterpart in Canada or the United States.)

After the reconstruction of the 1950s, Japan prospered in the 1960s and 1970s. During these decades, the nuclear family became increasingly prevalent, and the tradition of three generations of a family living in one home began to erode. The idea of “my home” became popular, resulting in an explosion of two-story detached homes for the burgeoning “salaryman” and his family. “My home” was idealized as “a detached house with gateway, gable and garden within commuting distance of the husband’s workplace.” As a result of realizing this new dream of detached houses, available land became scarce. When Japan entered the 1980s as an economic power, the price of land skyrocketed. In turn, the
Today, mats determine the size and function of a room, including the height of the ceiling. Roughly three feet by six feet, although the exact dimensions vary from region to region. As a result, the spacing of the columns began to conform to the measure of a tatami mat; that is, the idea of ken, the proportion in which wood members are arranged in sections. The section is based on the diameter of a column of one ken. The size of the wood members can be determined by proportionately reducing the column’s sectional size. By doing so, it is possible to standardize woodcutting techniques, providing an efficient and economical means of producing buildings.

The ken thus determined the grid in which the carpenter planned the house. With the development of the tatami module and kiwari, building practices became even more systematized. To a large degree, guesswork was eliminated in housing design: the carpenter did not have to know about structure or make decisions about what materials to use, and the wood

With the rise of a global economy, housing and its importance to culture have been further put to the test in Japan. Western influences have become fashionable, with a growing impact on the construction and style of the Japanese home. But what appears to be modernization and to a lesser extent westernization of the Japanese home is just that—appearance. The modern Japanese home is still deeply rooted in tradition, and this fact is critical in understanding how a house can be factory-made yet retain its traditional sociocultural significance.

For the Japanese people, the house is not only shelter but also a marker of stability. The social significance of the house determines much of the physical form of its design. For example, in Japanese history many forms bear social and personal meanings beyond their physical function. Such forms have entered into Japanese language and culture, providing a link between the social and physical needs of the society. Two of these forms—the pillar and the measuring system—are of particular significance in Japanese housing.

Japanese house forms: cultural and physical
In Japan, the pillar symbolizes the stability of the house and thus the stability of the family and its structure. From ancient Japan to modern day, the pillar is the archetypal building form. (Indeed, as Atusushi Ueda writes, the history of Japanese architecture is the history of the struggle with the pillar.) As Shintoism became established in Japan as a way to consolidate power among competing groups, this form became symbolic, with the use of three posts being established and the center post being invested with important symbolic meaning. This post is called the “heart” post (shin no mihashira). But the pillar is more than a structural form allowing a particular type of construction for the Japanese; it also represents a link to the spiritual world. Semantically, the pillar or hashira means both the head of the household and the means by which the gods descended to earth. Although the importance of the heart pole has diminished as a structural device in Japanese construction, its cultural importance remains strong.

The subsequent history of Japan reflects this mix of symbolism and physical function. For example, after the introduction of Buddhist and Confucian beliefs from China in the seventh and eighth centuries, Japan became established as a nation, with the state growing powerful and hierarchical. To control building practices, the state established a system of measurement using the pillar as the starting point. This system and others allowed the state to exert strict control over the form and structure of the Japanese house, and they reflected the belief that standardization was important in maintaining the structure of the society. The initial system of measurement was based on the ken, meaning a distance or interval, and its development was primarily based on an economic rather than a philosophical model. By using ken, carpenters could more accurately define space when planning a house, with the space between two columns from center to center used as the strict carpentry-related definition of ken.

With the evolution of the tatami mat, the ken as a strict measurement between columns disappeared. The tatami mat had to be standardized, because it was moved from house to house and room to room, whereas the spacing of the columns might differ from house to house. As a result, the spacing of the columns began to conform to the measure of a tatami mat; that is, roughly three feet by six feet, although the exact dimensions vary from region to region. A combination of individual mats determines the size and function of a room, including the height of the ceiling.

Today, ken is used more as a design tool rather than as a precise measurement. Tied to the interval of ken is the idea of kiwari. This word literally means the “proportion of wood allotment.” Kiwari is the proportion in which wood members are arranged in sections. The section is based on the diameter of a column of one ken. The size of the wood members can be determined by proportionately reducing the column’s sectional size. By doing so, it is possible to standardize woodcutting techniques, providing an efficient and economical means of producing buildings.

The ken thus determined the grid in which the carpenter planned the house. With the development of the tatami module and kiwari, building practices became even more systematized. To a large degree, guesswork was eliminated in housing design: the carpenter did not have to know about structure or make decisions about what materials to use, and the wood
members were prefabricated in the master carpenter’s shop, with the highly complex joints designed for easy on-site erection of the frame.

Tied to the importance of stability and permanence in social structures is the complementary force of impermanence within the physical and political sphere. For much of Japan’s history, cities were either destroyed by fire or earthquakes or moved for political reasons. The ability to quickly move and relocate entire cities was crucial for ancient Japan’s stability. The development of an effective system of measurement and the sophistication of a prefabricated frame helped make this versatility possible. Major governmental and religious buildings were prefabricated using standardized designs as early as the Nara Period (A.D. 710–794). Later, prefabrication became even more sophisticated through the adaptation of industrialized methods. Although the ability to easily relocate buildings is no longer important, the potential for natural disasters and subsequent reconstruction still exists. Here, philosophy and construction methods come together in an interesting fashion. Philosophically, Buddhism allows for disastrous occurrences to be placed within a larger context of natural cycles. To move a building or change its form in the West suggests a loss in the original meaning of the building, resulting in an air of impermanence. For example, it has been difficult in the West to consider moving a historically significant building. Conversely in Japan, the “spirit of the place is rooted in the forms which compose it.” Because the “spirit of the place” is rooted in the structure of the building, there is no philosophical conflict with off-site prefabrication of a structure.

Design and construction of the KST-Hokkaido house
The KST-Hokkaido House is a prefabricated house that is nonetheless uniquely designed for a specific region and culture. Hokkaido has 20 percent of Japan’s land mass but only 5 percent of its population. This lower density makes the production of larger, detached family houses more viable. The KST-Hokkaido House averages 200 square meters, and it more easily accommodates a multigenerational family in a single dwelling. The building is a hybrid of structural precuts, panelized walls, and on-site construction. All the interiors, exterior cladding, and roofing are installed on site.

Unlike most of Japan, Hokkaido is characterized by cold winters with heavy snowfalls. The removing and disposing of snow is a constant concern. In this climate, similar to that of much of Canada and the northern United States, KST-Hokkaido successfully designed a prefabricated house that performs well in a harsh environment while satisfying its clients’ needs for a comfortable and “modern” house. The style of the house is very different from the traditional Japanese home, but the Japanese culture of form and building practices are retained.

The KST-Hokkaido House can be easily distinguished from the more traditional or western-styled houses of Hokkaido by its form. (One also sees a number of KST-style houses in Hokkaido.) The first story is the foundation, an aboveground, reinforced concrete box containing the garage and utility spaces. The concrete box offers protection from moisture problems created by the deep snows that often cover the ground floor. On top of the concrete box sits the two-story wooden section of the house proper, consisting of prefabricated panels that fit within a precut post-and-beam structure. The third distinguishing feature is the snowslide-free roof. This roof is covered with inverted metal that slopes downward to a large interior duct or drain. Its design allows for the containment and slow melting of the snow. The Petchka, a centrally located kerosene stove in a Russian-type fireplace, provides heating. Other notable aspects of the house include walls that breath, five-layered windows, and an open floor plan to facilitate the heat circulation.

The design of this simple house is the culmination of over forty years of experimentation by the KST-Hokkaido founder and owner, Mr. Akira Yamaguchi. Although the KST-Hokkaido House has attracted the interest of researchers from around the globe, the house is not even exported to northern regions of Honshu, which has a similar climate. It is designed specifically to meet the environmental and social needs of Hokkaido residents. An overview of the life of Yamaguchi helps in understanding the origins of the KST-Hokkaido House.

Growing up in the isolated small fishing village of Chiyoshibetsu on the Sea of Japan, Yamaguchi started his construction career at age eighteen as an apprentice to a temple and shrine carpenter. He was especially “impressed with the spirit of shrine carpentry, which applied the minutest care to the part that was to be hidden when the building was completed.”
Yamaguchi used this experience when constructing a house for his mother in 1951, respecting both how the wood is used and how the home is put together. This project also began his interest in design innovation using a three-layered window/shutter system to mediate the harsh winds off the Sea of Japan.

Several years of working as an apprentice and later operating his own construction firm led Yamaguchi to a number of concerns about housing in Hokkaido. Snow buildup on roofs caused many problems and resulted in several deaths a year. The heavy snow often unexpectedly slid off the steeply pitched roofs. To avoid this danger and roof collapses, people repeatedly shoveled the snow off the roofs. Yamaguchi put his research efforts into developing a roof that would mitigate these problems. In 1961, with Hokkaido architect Mr. Toshio Maeda, he designed and constructed the first “snowslip-free roof” with a snow duct. The two men built full-size mockups to test their ideas, and the system was close to ideal by 1969. Today, this system is frequently copied in Hokkaido – it is patented in Japan – because it has solved many of the problems associated with deep, heavy snows and satisfies clients’ needs. For example, in an interview with a grandmother who had recently purchased a KST-Hokkaido House for herself and her son’s family, she stated she chose the house because of its “durability.” She also added: “I am too old to shovel snow off the roof, and the younger generation isn’t interested.”

Because Yamaguchi felt strongly that the multigenerational family is important to the sustainability of Hokkaido’s society, he developed a housing form to support this family relationship. The typical KST-Hokkaido House is designed with two separate kitchens and living areas, an open stairwell connecting both floors of the wooden section, and a communal bath shared by all three generations. As well, the concrete first floor provides space for a small home business or office.

As a result of the harsh winters, construction often stops for up to six months of the year in Hokkaido. Yamaguchi believed that the year-round construction of houses was important for the community. He noted that the highly specialized temple carpenter – who stressed quality and respect for materials – could never meet the production needs for housing. One of his early projects was building a cow barn using two-by-four construction. He noticed at that time the benefits of using modular pieces that can easily be assembled by unskilled workers. He also recognized that poor-quality housing was a major problem in Hokkaido as in the rest of Japan. To keep costs down and still maintain quality, he started prefabricating parts in a factory. The approach would maintain high quality, and the use of materials, particularly wood, could be maximized if a worker performed only a few tasks using precision equipment in an assembly-line fashion. This approach led to the policy of prefabricating as much of the KST-Hokkaido House as possible.

Perhaps Yamaguchi’s greatest concern was a respect for the natural environment. In Hokkaido, this concern translates into a focus on wood. Yamaguchi remarked that his “mind was always on wood and winter in Hokkaido.” And, as stated in one of its brochures, “KST-Hokkaido works with nature, not against it.” For example, the idea of honoring the tree by letting it live – a kind of second life in its constructed form – is deeply entrenched in Japanese culture. In “Learn from Trees,” the master temple carpenter Tsunekaza Nishioka says, “The master carpenter is one who, perceiving a piece of wood’s peculiarities, uses the appropriate material in the appropriate place.” In following this philosophy, Yamaguchi has tried to use only wood from Hokkaido for the construction of his houses. He takes small, warped pieces of wood and laminates the pieces together, combining ancient wisdom with high-tech methods. The KST-Hokkaido House is thus part of a “total system” designed as a sustainable model for living and working on the island of Hokkaido. The house is designed to last two hundred years, honoring and sustaining the wood used in its construction. This combination of modern industrial house-building techniques and traditional values makes KST-Hokkaido distinct.

**The modern house and traditional wisdom**

For KST-Hokkaido, a link with the past is crucial in defining its function as a builder of modern housing. The company uses examples of ancient wooden temples in Japan as a reference point for design. From a western perspective, many KST practices may appear inefficient. For example, although the house uses extensive prefabrication, it is still a post-and-beam structure with a wood-frame infill that uses two to three times the amount of wood required for conventional western construction. However, the house is possibly four times as durable as its western counterpart. As well, the connection of the post to the beam reflects traditional Japanese joinery; that is, complex wooden joints using few metal fasteners. These joints are not fashioned by a skilled carpenter using hand tools but rather by highly specialized machinery that requires few skills to operate. And, like the first temple Yamaguchi worked on as an apprentice, the joints are hidden once construction is complete. This feature is among other hidden details shown to potential customers in marketing-related tours of the KST-Hokkaido factory.

As discussed, the history of building practices in Japan is closely linked to the development of the pillar and the subsequent development of the systems of measurement. These developments can be seen in the form of the KST-
Hokkaido House. The post-and-beam structure rests on the concrete box much like the pillar rests on the foundation. For the pillar to disappear would be more than a technological change: it would also necessitate cultural change. Symbolically, the centrally located Petchka stove is the heart or pillar of the home. Although usually only one room is designated as a “tatami room,” the module is used throughout the house. The extensive amount of wood refers back to the Shinto belief in the importance of wood as both construction material and embodiment of the spirits. The assembly-line process of prefabrication is similar to the model used by ancient temple carpenters who would prefabricate all pieces in their shop with only erection occurring on site.

Perhaps KST-Hokkaido’s closest link with traditional wisdom is the model of sustainability or living in harmony with nature. The attempt to use only locally available renewable materials, coupled with an emphasis on durability, promotes sustainability. But for the company, sustainability is measured not only in the ability to conserve resources but also in the importance of conserving the stability of the traditional multigenerational Japanese family and the social structure of the region. (Tradition is clearly very important in Japan. Consider that the Japanese word for house also means family. To say you have a house thus also means you have a family. 

The form and use of the house is intrinsically linked with the culture and region where it was developed, which is why Yamaguchi has refused to export the KST-Hokkaido House.

**PREFABRICATION AT THE CROSSROADS**

The KST-Hokkaido House is one of many different models of prefabrication that have been successful in Japan. Yamaguchi does not consider his house prefabricated but rather as comprising high-quality factory-made components based on traditional Japanese carpentry. However, many companies in Japan that produce fully modular homes have also been successful. By contrast, North American companies, for example, producing wall-panel components have problems with public acceptance. Factory-built homes in Japan are unarguably more publicly accepted than in Canada and the United States.

This difference is primarily historical and sociocultural. Prefabrication is tied to the history and culture of Japan in a way that simply does not exist in North America. Japanese culture, including language, is intimately linked with the traditional craft of post-and-beam construction. People have learned to think of houses as constructed of post-and-beam frames with infill walls. These frames have always been prefabricated, just as they were earlier in North American history. Post-and-beam timber-frames are still available in North America as precut packages, but they are not price-competitive with western platform framing as a method of construction. North Americans had no problem in accepting the switch from post-and-beam framing to light wood-framing, because site-built houses could be constructed more economically and expediently. From one perspective, western platform framing could be considered a method of prefabrication: the studs are precut to length in a factory, and walls are prefabricated, albeit on site, using the floor or platform for the work area. Roof trusses are fabricated in a factory as are many other components including door and window units, which often arrive on site with their hardware installed and finishes complete. Whether North American site-built houses have made the best use of prefabrication techniques for our culture and conditions remains an open question.

William H. Coaldrake, who has written extensively on housing in Japan, identifies a lack of collaboration among government, industry, and the architectural research sector as the major reason for the failure of prefabricated housing in the United States. Architects such as Walter Gropius were out of touch with market demands. Moreover, the government did not have adequate incentives to influence the thousands of small homebuilders or to change the direction of housing construction.

As well, the National Association of Home Builders is a powerful lobby in Washington D.C., principally supporting the individual builder. The collaborative working ability of the participants in the housing construction industry has fewer historical precedents in North America than in Japan. The construction of houses occurs under the direction of many small homebuilders and a few larger companies. Although government may dictate policy through building and zoning codes and through subsidized housing, the decisions are primarily made in the market, with distinctive design getting the highest marks and drawing the strongest consumer interest.

As shown, standardization of the housing industry is more readily accepted within the Japanese culture. The government plays a much stronger role in determining methods of construction, with standardization being linked to maintaining the structure of the society. By comparison, the large North American middle class tends to devalue the standardized house. (Yet, ironically, the typical North American house may be no more distinct from its neighbor than is the typical Japanese house.) Despite this tendency, manufactured-mobile housing has been very popular in the United States, primarily because of its low purchase price. The proliferation of manufactured-mobile homes, often relegated to less desirable locations as a result of zoning regulations, has led to a perception that the prefabricated house is a less durable and less preferred form of housing. While the Japanese government was able to guide the efforts of the large housing manufacturers in the 1960s and
1970s to move beyond the substandard models of the postwar era, low-cost manufactured-mobile housing in North America has not developed under similar guidance.²⁸

This fact, however, should not mean that prefabrication of durable housing for the middle class has a limited future in Canada and the United States. Fabrication in a factory has many advantages, including increasing the quality or durability of the house as well as cutting down construction waste. Modular houses must be rigid enough to sustain being trucked down the highway and then lifted off the trailer onto the foundation with a crane. As one manufacturer stated, its modular homes are consequently already wind-tunnel tested when they arrive on site. (One could add that they are seismically tested on an impromptu “shake table.”) It may therefore be easier for factory-built houses or components to address issues of climatic and environmentally responsive design.

The cue we might take from the KST-Hokkaido House is to acknowledge that cultural influences are as important as construction methods in determining whether prefabrication will be accepted. In North America, we also need to recognize our desire for homes made, if not entirely at least sufficiently, by hand so as to sustain or restore a sense of tradition or belonging. Another cue may be our desire for the unique, a house designed specifically to meet our needs. The challenge we now face is how to match the inherent strengths of prefabrication with a region’s economic, social, and environmental requirements for affordable and desirable housing.

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¹ In Japan, prefabricated housing starts had already reached one million units by 1983, representing over 12 percent of the housing market. In Canada, prefabricated housing starts in 1991 amounted to only 6.2 percent of the market.
² All units with a permanent steel chassis will be called “manufactured housing” in this article. Units without a chassis will be referred to as “modular.”
³ Data obtained from the National Association of Home Builders
⁴ Data obtained from the Canadian Manufactured Housing Institute
¹⁰ Ibid., 66
¹¹ Ibid., 65
¹⁴ Ueda
¹⁶ Ibid.
²⁰ Akira Yamaguchi, Mottainai: Waste Not, Want Not (Sapporo, Japan: International Ecodevelopment Institute, 1995), 45
²¹ Ibid., 96.
²² Personal interview by author Linda Brock, August 1996.
²³ Yamaguchi, 3.
Coald rake, “Manufactured Housing,” *Japan Architect* 1 (1987): 58. This fact helps to explain the acceptance of the steel-framed prefabricated house in Japan. The popularity of the two-by-four house may be only a desire for the perceived higher quality of western construction methods or the desire for a “modern” style rather than a preference for a construction method.