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MOUNTAIN CITIES[1]

Like the previous two chapters, this essay was previously published in a reprint of *Shin Kenchiku*, issues 3 and 4, 1946, as “Sangaku toshi ron” [On Mountain Cities], and was the final essay in a set of three entitled “The New National Construction” [*Atarashiki kokudo kensetsu*]. It was a proposal to build cities by utilizing steeply sloping terrain that makes up a large portion of Japan’s land.

During the war, I looked on while excellent tracts of arable land were indiscriminately and steadily demolished for the expansion of structures such as munitions factories, simply because the land was easy to procure, but severe food shortages hit Japan when the war was over. When lasting world peace was established, food self-sufficiency was not necessarily essential because of rational international specialization; but assessing arable land as yielding meager profits based purely on the economics and productivity of capitalist economic mechanisms, is no reason to destroy it. There are magnificent views of verdant undulating rice paddies spreading across the alluvial plains as far as the foothills of distant mountains, or the glow of insect light traps on summer evenings glistening everywhere. What about moving cities into the hills onto steeply sloping land, rather than dispersing them through the alluvial plains? With this in mind, this chapter is the slightly expanded version of an amateurish suggestion I sent in to “Our Words”—*Watashitachi no kotoba*, the radio program that invited listeners’ participation NHK began to broadcast weekly after the war—entitled “A proposal for mountain cities,” which put together housing construction methods to use land more efficiently for high density living.

Naturally, when it comes to using land, the combining and placement of various industries must be considered. Japanese territory is a combination of the flat land of Holland and the steeply sloping terrain of Switzerland, and it is said there are few gently sloping hillsides suitable for raising livestock. Rice paddy cultivation was developed on flat land that accounts for merely one quarter of the total, and since the Meiji era arable land located on the urban periphery has been squandered through the development of capitalist cities. However, cities don’t necessarily need to be built on flat land, residential areas in particular. What if some other place was put forward as more desirable than flat land; how about relocating cities into the mountains? In this sense, the expression "mountain city" is a little too narrow. Of course, the issue of disaster prevention must be considered when making use of precipitous slopes, and considerable fabricated construction work is needed. Therefore, high-density, compact, comprehensive and concentrated development is in fact preferable. And then there is the reasoning that disasters must also be prevented, but if we're going that far, we might also establish a rationale that it is preferable to consider large-scale national land reformation using advanced building equipment, regardless of whether it applies to existing mountains. Indeed, in Kobe after the war, mountains behind the city were shaved and the sea was filled, and "flat" land was constructed from the mountains and the sea simultaneously. Also, although high-density housing was suggested, it was considered important to guarantee openness to the outside for every household, an important condition to ensure public health and security; but when high-density and concentration was pushed for even more, some indicated that the fabricated installation of multi-story housing as a substitute for local conditions was perhaps more favorable. However, immediately after Japan's defeat the design did not progress this far, because the proposal emerged at a time when the nation was barely surviving on soybean pulp and sweet potato vines. Many articles now discuss this issue, and emphasize the need to use steeply sloping land since "overpopulation" and "food self-sufficiency" are practically no longer problematic due to changes in the international environment, and to production methods and lifestyles; but this was one of many issues that people immediately after the war tussled with. Furthermore, great importance is placed on factors such as sunlight and ventilation when laying out housing, but despite strong opposition housing alignment until that time ignored these; to set this as a basic condition of urban construction could arguably be seen today as shortsighted. To discuss the future based on predictions made 20-odd years ago is diverting because from today's perspective they missed the mark considerably. This proposal is nothing more than an unadulterated and simple one-sided view, because with the purposes discussed above it was written during the war by quickly gathering together things that occurred to me at odd times; but it is included here as one perspective on utilization design for national space.

(Originally published as "Sangaku toshi ron" [On Mountain Cities], Part 3 of "Atarashiki kokudo kensetsu" [The New National Construction], in *Shin Kenchiku*, June 1946.)

1. Preface: The Case for Mountain Cities

When you gaze out at the passing scenery from the window of a car or a suburban train, what catches the eye are factories dotted throughout the splendid farmlands on the alluvial plains, and moreover they are surrounded by tall fences. Throughout the China Incident and the Pacific War, views like this were to be found everywhere. Today, now that the war is over, within these tightly enclosed walls there are mere glimpses of unfinished buildings, and many barely completed factories lay dormant; just like a war-torn battlefield the vast expanses are piled up with building materials and such, and apart from being unsightly, they are not being put to any positive use at all. Due to food shortages, these days people are calling for undeveloped land to be cleared from deep within the forests and plains, but in doing so, should we just abandon even better land that until yesterday was fertile and productive?

The lands occupied by these virtually abandoned factories must be put to use to boost food production.

Generally speaking, factories were probably built on "the plains" because of prerequisites like convenient access to transport and the need for level ground; however, disparities in the relative value structure for types of land including urbanized, agricultural, and mountains and forests, were exploited—a condition for locating industry under liberal economics—with the aim to seek maximum profit from each enterprise, and this in the end resulted in wasting good quality arable land despite wartime efforts to expand it, and must be viewed as having heightened the distress of food shortages today. Considered from the point of view of the overall benefit to the people, many of these factories do not make use of this arable land, or would be better relocated to land with a low degree of utilization. Moreover, at the present time there is a pressing need internally and externally to arrange for our maximum self-sufficiency in food. Every piece of our nation's limited and precious land must be used and developed, employing methods that on the whole are becoming more efficient. Viewed from this perspective, low-lying marshlands must in principle be secured for use as arable paddy fields.

In our nation, cities generally grew around locations such as feudal-era commercial centers and castle towns that were trading posts for agricultural produce and key strategic points for transport (although this is not necessarily so in all cases due to historical development conditions). But many of them are in the heart of the alluvial plains close to rivers, so there is a tendency to believe that building cities on flat land is inherently predetermined. Moreover, capitalist development produces a swelling snowball effect around these former feudal towns, and before long the plains that make up their hinterland are completely destroyed; difficulties in supplying food from adjacent lands become obvious, and result in today's problem of overcrowded cities.

When thinking about the construction of the most ideal configuration for our nation, we need to completely abandon all that has happened in the past and reconsider matters. By so doing, we will obviously consider locating many of the facilities that make up so-called urbanized spaces, whether they be factories or housing, to steeply sloping land in mountains and forests that are difficult to use for arable farming, or sometimes even below ground.

This means building cities in the mountains, in valleys, on mountainsides, and on mountain tops.

Of course, it isn't possible to do this for all cities. Some cities probably can't be moved for historical and geographical reasons, and the nation as a whole needs several general manufacturing bases, so these must be located in the heart of the great plains at key transport points. However, the construction of most cities, in particular medium- and small-sized cities over which there is now a great clamor for eliminating the adverse effects of overcrowding, ought to be decisively moved into the mountains.

During the war, plans taking air defense into consideration were enacted to transfer many factories into the mountains, valleys and underground, or simply into the countryside. Some of these were of course just a way to ride out the crisis, and there were probably many that from an overall national planning perspective placed things in inappropriate locations. However, there is no need to give up the locations themselves, as they were presented here. We should dispose of their current sorry state of abandonment, or thoughts of tearing them down, and positively consider their reexamination and use.

The penetration of cities into the mountains and the use of steeply sloping land have the edge on current city construction methods that merely spread urban sprawl. Vertical transportation becomes mechanized, and high-rise buildings are built intensively. This is a benefit for land usage, and for engineering works. If advancements in designs of engineering machinery and facilities for use in construction work on steeply sloping land are tailored to Japanese conditions, then difficulties presented by such work will not be of concern. Also, if south-facing slopes are used, it will be possible to build the sort of high-density housing that would be inconceivable on the plains, and secure the maximum amount of arable land even in the narrowest of spaces; furthermore, urbanized land coverage will become denser and it will be possible to fully deliver high-quality life facilities economically.

Let's say the typical urban landscape of traditional Japan is the view of temples and shrines such as Kurodani, Gion and Kiyomizu standing out against the blanketed slumbering form of purplish Higashiyama rising above a sea of tiled roofs spreading out across the plains; then I envisage the shape of a new Japan, where healthful fireproof high-rise residential areas are built like white horizontal lines etched into the foothills to halfway up the purplish green mountains encircling the rolling golden plains that stretch out all around, and where electrified factories, subway exits and other features are visible in the lowest areas adjoining the plains, with rapid transit facilities darting swiftly between them.

Rather than farming all the way to the mountains, people will live in these areas instead.

Although much effort will be needed to resolve the food shortage crisis, I hope we can take the time to make sufficient allowances within the various emergency measures to accommodate 100-year plans like these.

I recommend here that the building of mountain cities be actively pursued as an important direction for our nation's urban construction.

Submitted with the title "A proposal for mountain cities."

Broadcast on "Our Words"—*Watashitachi no kotoba*—on the morning of December 9, 1945.

2. An Appeal for the Effective Use of Land

The greatest problem facing Japan at present and into the future with regards to our people can be summed up by the term "overpopulation." Any mistakes made in steps to resolve this runs the risk of forcing Japan to face the worst possible outcomes.

In general, in most cases people refer to overpopulation when a population is out of proportion in relation to other factors, but problems to do with overpopulation indicate a "surplus" in a condition that is hard to alter (perhaps not an absolute condition), namely a country's natural resource. Moreover, studies in demography refer to relative overpopulation as an increase in population that leads to a decline in living standards, and among these cases that where existence can no longer be sustained is called absolute overpopulation. Since the ability to provide a population with a certain standard of living is called population sustainability, in the former case this means that in parallel with absolute increases in population there is no proportional increase in population sustainability, while in the latter, further declines in living standards to offset insufficient increases in sustainability are not possible.

Of course, "population sustainability" is an abstract concept, and varies according to the structure of the national economy. Factors determining declines in living standards, or threats to a country's existence, are not concepts like supra-historical "sustainability"; in many instances, "over" population arises due to barriers for boosting productivity based on contradictions in production relationships, or unfair distribution (in part, wastages, and in part, shortages). However, if for instance we consider sustainability in its entirety, including its social and economic contradictions, as a determining criterion for "overpopulation," what comes to mind and attracts the most attention is land, a natural resource that features in every aspect of life: it is a crucial condition, and an element of production for life's essentials; food in particular but also things such as raw materials. Land has its spatial limits, whether it is on a global or national scale; and its use under certain production relationships and technological conditions is an important and fundamental condition that limits production of the essential goods of life it supports.

Due to the law of diminishing returns, in general we cannot expect sustainability to increase in response to population growth the more intensively land is used, so there is a strong risk of overpopulation in countries that are unable to expand their territory. Although Japan has a population of around 70 million, it has a limited land area and high population density. Also, comparing arable land used in direct food production as a part of total national land across countries, this disparity becomes even greater. (See Table 10.1.)

For the most part, Japan is made up of mountains, forests, and steeply sloping land with little leeway for expanding arable land as in other countries. (See Table 10.2.) Therefore, all other factors being equal, Japan has a much greater risk of succumbing to what we call "overpopulation."

Table 10.1 Population and land (including arable) for key countries

Country	*Land per person (ha)*	*Arable land per person (ha)*	*Arable land per farmer (ha)*	*Ditto, ratio when Japan = 1*
Japan	.55	.087	.42	1.0
China	2.2	.26	1.1	2.6
India	1.32	.32	1.2	3.0
Holland	.40	.11	1.4	3.3
Italy	.73	.30	1.5	3.6
Belgium	.36	.13	1.7	4.0
Poland	1.13	.55	1.8	4.3
Germany	.70	.29	2.1	5.0
England	.52	.09	2.7	6.4
France	1.32	.51	2.7	6.5
Sweden	7.15	.59	3.6	8.6
Denmark	1.16	.72	4.8	11.5
U.S.	6.25	1.07	12.8	30.0
Canada	87.00	2.12	19.6	42.0
Australia	114.0	1.75	20.7	50.0

Note: Figures obtained separately from each country.
Source: Juitsu Kitaoka, "Population Policy" [*Jinkō seisaku*], p. 123.

Table 10.2 How land is used

Country	*Total acreage (ha)*	*Arable land (%)*	*Permanent grazing land and pasture (%)*	*Forests (%)*	*Other (%)*
Japan	38,225	15.8	8.7	51.5	21.0
Manchuria	130,314	14.1	…	16.8	69.0
India	269,869	46.6	…	13.4	45.0
Holland	3,293	29.2	39.2	7.4	23.8
Italy	31,019	41.7	18.8	17.9	21.6
Belgium	3,051	34.8	23.2	42.0	42.0
Poland	38,863	47.7	16.7	21.4	14.2
Germany	47,071	41.2	18.2	27.4	13.2
England	9,307	60.4	17.5	11.8	10.3
France	55,099	38.3	20.7	19.5	21.3
Sweden	41,024	9.1	2.7	54.2	34.0
Denmark	4,293	61.9	9.9	28.2	28.2
U.S.	770,213	16.8	…	…	…
Canada	897,821	2.6	…	…	…
Australia	122,388	6.0	…	…	…

Source: 57th "Statistical Yearbook of the Empire of Japan" [*Teikoku tokei nenkan*]

Naturally, a nation's ability to sustain its population is not influenced solely by the land resources it possesses; that sustainability also depends on things other than land such as commerce, industry and trade. However, to maintain settlements in a [favorable] direction, securing this sustainability is to a considerable extent dependent upon trends in public opinion in other countries, and must also be predicated on lasting peace in international relations, therefore securing absolute sustainability cannot necessarily be taken for granted.

Furthermore, as a defeated country under the occupation of Allied troops, our nation at present cannot trade freely, and faces a situation where it must be anticipated there will be perpetually more trouble maintaining even the lowest standards of living. Moreover, while our nation is now facing the extraordinary situation of its worst crop failure in three decades, it is also confronted by absolute shortages of food, and faces the unprecedented crisis of difficulties in maintaining even minimum levels for the people's livelihood and national economic activity. On top of this, as far as the future is concerned, Japan must also bear in mind that the population will also continue to increase year on year.

For our nation to curb a tendency towards overpopulation that is limiting expansion of the people's economy, what will become issues of utmost urgency are the production relationships that determine population sustainability; in other words, striving for a more rational structure for the people's economy, while making maximum use of limited national lands to maintain and secure it, and establishing a direction in national development over the long term that realizes much better utilization.

The issue I would like to emphasize here is that of the relationship between the people and land, in particular the latter. Today 70 million people are crammed onto four main islands and must find ways to support themselves; consequently, it will be necessary to provisionally examine how these two corresponding conditions—population and land—may transform in the future.

Since before the second Sino-Japanese War [1937] many analysts have discussed trends in Japan's population growth. While their conclusions are not completely in accord, there is general agreement that Japan, from estimates based on the precedents of many developed nations, is at the end of the second stage of demographic change.

Reviewing population trends in modern civilized nations over roughly the last 125 years, four stages can be identified. In stage one, birth rates tend to rise slightly while death rates tend to stall or slightly decline, and the rate of natural population growth increases. In stage two, birth rates begin to decline but death rates drop faster than this, and natural population growth continues to rise. Following this, in stage three birth rates drop rapidly, but there is a gradual decline in death rates until it levels off, and natural population growth steeply decreases. The decline in birth and death rates continues, and birth rates can drop to zero. However, there is a limit to how far death rates can decline since all men are mortal; when birth rates drop below death rates, natural population growth can turn negative as a result. This is known as stage four.

The fact that our nation's population is [only] in the beginning of stage three, the first step of this shrinking, is because despite the difficult

Table 10.3 Population forecasts for Japan (Unit = 1,000 persons)

Year	*1. Statistics Bureau of the Cabinet (1927)*	*2. Shimojo (1931)*	*3. Sayuda (1931)*	*4. Ueda (1933)*	*5. Nakagawa, series 1*	*6. Nakagawa, series 2*	*7. Institute for Population Research (1941)*	*8. Kawakami & Kubo (1941)*	*9. Kitaoka*
1935	66,533	68,527	66,860	68,016			69,254		
1940	71,681	72,626	71,123	71,123	74,027	73,939	74,035	73,156	73,528
1945	76,144	76,298	75,667	75,261	79,202	78,985	79,291	80,110	77,972
1950	80,768	79,454	80,437	78,355	85,124	84,336	85,170	87,678	83,856
1955	86,563	82,014	85,292	81,144	91,544	90,107	91,589	93,264	90,276
1960		83,912	90,351	83,582	98,278	95,955	98,312	100,044	96,891
1965		85,099		85,776	105,193	101,608	105,231		
1970		85,542		87,723	112,356	106,857	112,408		
1975					119,963	111,453	120,005		
1980					128,161	115,379	128,190		
1985					137,001	118,554	137,018		
1990						120,914			
1995						122,528			
2000						122,741			

Source: Kaizo Noma, “Population and Economy of Japan” [*Nihon no jinkō to keizai*], p. 368. Nakagawa series 1 assumes death and birth rates will persist at 1935 levels; Nakagawa series 2, that both birth and death rates will gradually decline following recent trends. Ueda has constant death rates, by age, and constant birth rates (2.1 million); Kitaoka sets the natural growth rate at the 1941 level, or 14.4%.

circumstances of the unfolding of the second Sino-Japanese War, the government of the day succeeded to a certain extent in bringing about various public policies to boost the population. Population trends cannot necessarily be expected to unfold according to established patterns simply by implementing such population policies; however, based on assumptions regarding the aforementioned precedents related to advanced nations, we can draw various predictions concerning trends in Japan's population growth. See Table 10.3 for some of these predictions.

If we take a general look at these predictions, let us assume that over the long term the various factors that determine demographic changes remain constant; if we optimistically (regarding growth) set an upper limit where the rate of growth is kept steady at present levels, and allow for various pessimistic views that predict declining birth rates, then regardless of hypothetical conditions and excluding the primary premise that growth will continue forever, it is predicted that the absolute volume of population will reach its maximum rate of growth in any case in 30 years at the earliest, or roughly 80 years at the latest. And this maximum population will be of a magnitude between 90 million and 120 million.

The Japanese people's living conditions and the nation's population sustainability have declined significantly due to our defeat in the recent war, the reduction of Japan's lebensraum or living space because of our acceptance of the Potsdam Proclamation, and moreover the exhaustion of past reserves due to the war; at the same time, many people were killed in action, or died as victims of the war (said to be around 750,000), and it is predicted the population will decline as a result of the economic collapse that brought the subsequent food crisis to a head. Also, restricting births is being advocated to resolve this difficult situation.

These circumstances include factors that fundamentally overturn pre-war forecasts of population trends, even the optimistic ones among them, and as a result it is suddenly difficult to predict the shape of future demographic trends in our nation. However, even if, for instance, this inclination to expand suffers a large setback, we should still expect our population to "grow" for the time being; the result will be that we should probably anticipate the emergence of a situation where over 100 million people inhabit these four [main] islands, even if this takes place somewhat later than expected.

On the other hand, from a mathematical perspective, what about our nation's natural resources and land?

With regards to land as a production factor for foodstuffs, fuel, and raw materials, expanding acreage used for producing food is most difficult.

The amount of arable land in the main island of Honshu since the middle of the Taisho era [1912–1926] has fluctuated around the vicinity of 6 million hectares (of which, half consists of rice paddies), and has seen little growth. Of course a considerable amount of land has been reclaimed; nevertheless, this has been used for little more than expanding urban areas, or appropriated as landfill for non-arable land for sociocultural facilities such as factories, buildings, roads, railways, and upgraded rivers.

As a result of our defeat in the war, large-scale land reclamation projects to boost food self-sufficiency systems have been set up (a 5-year plan beginning from 1946: land clearing, 1.55 million hectares, of which Honshu, 850,000 and Hokkaido, 750,000; drained land, 100,000 hectares, of which from lakes, 75,000 and shoreline, 25,000; land improvement, 2.10 million hectares; conversion to rice over three-year period, increased production of 20 million *koku* [102.4 million bushels]—Source: *Nihon Sangyō Keizai,* Nov. 11, 1945). However, this probably represents the upper limit to the expansion of the amount of arable land in our nation. Therefore, upon completion of this expansion project the volume of arable land in our nation will be 7.7 million hectares. Tentatively, this is the upper threshold for the total amount of our arable land.

In which case, what happens to the relationship between arable land and population if, for instance, we examine only the aspect of "food self-sufficiency"?

In order to proceed with this examination, let us look at two forecasts for population growth: A) those from the Institute for Population Research [*Jinkō mondai kenkyūjo*]; and B) forecasts based on a simple geometric growth rate (1.35% per annum).

Next, with regards to food allowances, if the amount of rice consumed per person is an average of 1.10 *koku* [5.63 bushels], or between 1.00 and 1.15 *koku* per person per annum from the middle of the Taisho period to the present day, then the volume of food allowances corresponding to these population changes appears in Table 10.4, columns 3 and 4.

If, for example, we supply this through total national production, the amount of arable land needed is shown in columns 7 and 8. However, it would be fatalistic to expect absolutely no change in the food productivity of arable land, so if we assume factors such as land improvement (based on the rising yield per *tan* [0.2451 acres] of 0.14 *koku* per decade, since 1884) and that advances in agricultural technology will continue in future, forecasts for changes in yields per *tan* are shown in column 5.

And to simplify matters, if we assume 60% of total arable land is used as paddy fields (for rice cultivation), then yields per *tan* for total arable land is shown in column 6.

When we compare the totals in columns 7 and 8 with the maximum arable land volume of 7.7 million hectares, food self-sufficiency is possible for the time being if we realize the aforementioned land reclamation project. However, in 1965, 20 years from now, self-sufficiency will clearly no longer be possible. But if continued growth in yields per *tan* is guaranteed, and furthermore if our population growth tends to stagnate as predicted by A), the amount of required arable land will peak at around 8.13 million hectares in the period 1975–1985, and demands on arable land will tend to decline. Even under this scenario, we must still expect a period where there is a shortfall of arable land of around 400,000 hectares.

Table 10.4 Volume of arable land acreage required for future food self-sufficiency

Year	*Forecast population*		*Volume of food required (million* koku*)*		*5. Volume of rice produced per* tan	*6. 60% of col. 5.*	*Arable land required (million ha)*	
	1. Institute for Population Research (1941)	*2. Simple geometric calculation*	*3. Using col. 1.*	*4. Using col. 2.*			*7. Using col. 1.*	*8. Using col. 2.*
1945	78,985,589	78,200,000	86.8	86.0	2.10	1.26	6.88	6.92
1950	84,336,487	83,607,530	92.6	92.5	2.17	1.30	7.12	7.11
1955	90,107,431	89,388,856	99.0	98.3	2.24	1.34	7.38	7.33
1960	95,955,701	95,569,784	105.4	105.1	2.31	1.39	7.59	7.57
1965	101,608,567	102,178,466	111.7	112.4	2.38	1.43	7.81	7.87
1970	106,857,962	109,243,836	117.3	120.2	2.45	1.47	7.97	8.17
1975	111,453,360	116,797,596	122.6	128.5	2.52	1.51	8.11	8.50
1980	115,379,596		126.9		2.59	1.56	8.13	
1985	118,554,200	133,509,296	130.2	146.9	2.66	1.60	8.13	9.18
1990	120,914,016		133.0		2.73	1.64	8.11	
1995	122,328,494	152,611,992	134.6	167.9	2.80	1.68	8.00	10.00
2000	122,741,777		135.0		2.87	1.72		
2005	122,186,682		134.4		2.94	1.76		
2010	120,737,750		132.8		3.01	1.81		
2015	118,492,685		130.3		3.08	1.85		
2020	115,465,386		127.0		3.15	1.89		
2025	111,776,766	199,407,654	123.0	219.4	3.21	1.93	6.37	11.47

Note:
For population forecasts in col. 1, see the Institute's 1941 "Guide to Population Issues" [*Jinkō mondai no shiori*], p. 55; for col. 2., see my "Housing Construction in New Japan" [*Shin Nihon no jūtaku kensetsu*], *Collected Works*, vol. 1, chapter 24, for population forecasts (annual growth rate of 1.35%).

Table 10.5 Required acreage for new urbanized areas

Year	*Population growth*		*Required acreage (km^2)*	
	A	*B*	*A*	*B*
1950	5,350,898	5,407,530	535	541
1955	11,121,842	11,188,856	1,112	1,119
1960	16,970,112	17,369,784	1,697	1,737
1965	22,622,978	23,978,466	2,262	2,398
1970	27,882,373	31,043,836	2,788	3,104
1975	23,477,771	38,597,956	3,248	3,860
1980	36,404,007		3,640	
1985	39,568,611	55,309,296	3,957	5,531
1990	41,928,421		4,193	
1995	43,342,905	74,411,992	4,334	7,441
2000	43,756,188		4,376	
2025	32,791,177	121,207,654	3,279	12,121

Nevertheless, the above comparisons do not in any way take into account cultural destruction of arable land brought about by population growth or other factors, and this is unlikely. Population growth naturally necessitates the use of arable land for cultural facilities. How much land will this be?

For instance, if 1 km^2 of urbanized land (or residential land) is needed per 10,000 people, the required amount of additional urbanized land—or land for cultural facilities—for population growth after 1945 will be 3,957 km^2 according to calculations by A), and 5,531 km^2 according to B); in other words, 400,000 hectares and 557,000 hectares respectively.

How we obtain this will determine key changes to our nation's food self-sufficiency system.

That is, if this is supplied by destroying flat arable land, even with population growth forecasts calculated by A), in 1985 there will be an arable land shortfall of 800,000 hectares (8,000 km^2), or approximately 10% of the total. But if this is obtained by using steeply sloping land in mountains and forests that cannot be used as arable land, the shortfall will be reduced by half (or approximately 5% of the total); if the use of steeply sloping mountain and forest land is doubled—in other words, if we can relocate twice the number of people from our growing population into steeply sloping regions—then as far as food production alone is concerned, it is possible for the time being to establish a system of food self-sufficiency.

However, if demographic changes do not trend downwards in this way, the system of self-sufficiency described here[2] will be more difficult to attain. This can only further increase the importance of using steeply sloping land in mountains and forests to build cities. Since it is risky to make hypothetical arguments about the distant future, let us tentatively adopt estimates about our nation's population growth trends comparable to those of the Institute for

Population Research; from indications that a system of food self-sufficiency can be secured based on this, it is possible to attain the target of relocating twice as many people every year to mountain regions.

3. Technological Measures for High-Density Housing

In order to sustain a high-density population on scarce land resources, we must first do our utmost to locate cities on steeply sloping land in mountains and forests that are difficult to use as arable land; in this way, we must plan the most efficient use of the nation's land overall, and this will make it clear that establishing a system of food self-sufficiency is not necessarily out of the question.

What must be considered next is that cities built in this manner will make high-density housing a reality.

The realization of high-density housing is clearly significant in two positive ways. First, by engineering such buildings to be compact, the property is improved and the cost of urban facilities is relatively reduced. Second, by decreasing the area occupied, on plains the amount of wasted arable land is reduced; and in mountains and forests, on certain suitable sites the relocation and incorporation of people who were living on the plains is increased because ever more people can be accommodated, and this contributes to securing and expanding productive arable land.

This effort is a matter that must be taken seriously, not only in the mountain cities examined here, but likewise for the reconstruction of existing cities located on the plains. Of course, what we here call high-density housing cannot be built at the expense of protecting the public health and security of residences, nor the openness and other features of living areas in particular. On this point, we must not adopt construction methods for high-density concentrated [housing] that ignore certain minimum conditions, for example guaranteeing a specific number of daylight hours in living areas when arraying buildings, or ensuring transversal ventilation, etc.

This being the case, what methods can be considered when guaranteeing these conditions, while improving residential density? The following three suggestions can be made: highrisification; lifts; and using south-facing slopes.

3.1. Adopting High-Rise Buildings

The following notions have already been clarified: aligning the open side of every dwelling unit north–south, and arraying dwelling units in east–west rows is the method best suited to our nation's climatic and topographical conditions; in these cases, the interval between rows is the determining factor for a residential space's openness and healthfulness; in order to guarantee an identical openness factor (sky angle), the more floors are stacked up in building rows, the less acreage is required, etc. (See my *Collected Works*, volume 1, chapter 24, "Housing Construction in New Japan" [*Shin Nihon no jūtaku* *kensetsu*]). However, in high-rise housing, above a certain level, usually above at least five floors, vertical traffic (traffic between floors) must be mechanized; this mechanization makes it necessary for corridor-type residences because of maintenance service and operating needs, and as a result, because building acreage per dwelling rises and the ratio of living space falls, relative dwelling density cannot be expected to increase on savings of land area from reducing the interval between rows. Therefore, although stacking floors on top of each other naturally increases dwelling density the taller the high-rise becomes, when constructing on flat land a building of around four floors where a staircase-type form can be adopted does not present the difficulties from mechanization of floor traffic; one conclusion which may be drawn is that this is a rather ideal number of floors.

3.2. "Buildings" with Lifts

Factors determining the intervals separating, and the spaces between, rows of housing, are related to the horizontal and vertical distances between the northernmost edge of the front (southernmost) row of buildings and the southernmost edge of the rear (northernmost) row of buildings; no matter how far the front (southernmost) row of buildings sticks out below the line connecting these two edges, there will be no effect upon the openness of the rear buildings. This fact has little significance in the case of single-story houses, but in two-story houses how far the depth of the upper floor is reduced relative to the depth of the lower floor depends on the positioning of the upper floor, and buildings with identical floor space can give rise to different intervals between buildings. (See Figure 76, 2.) For this reason, with respect to normal building methods,

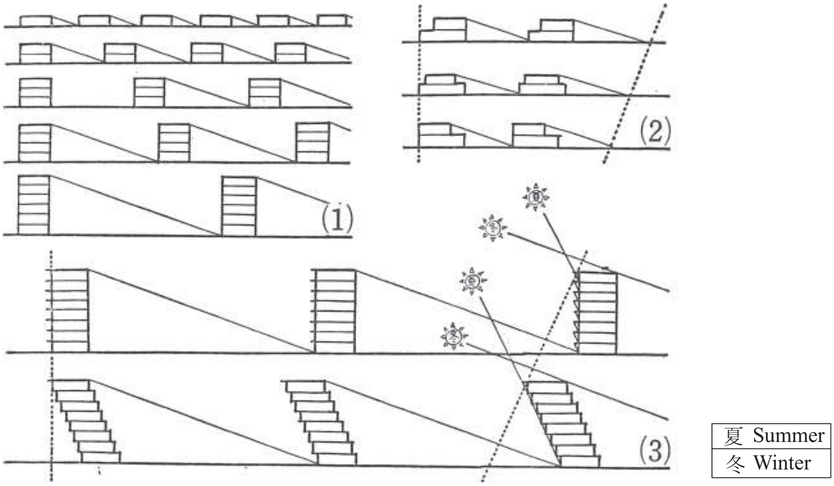


Figure 76 Diagram of intervals between residential buildings the best method for two-story houses is to align the southern (front) side in order to increase housing density. This is why, when seeking a standard model for two-story dwelling units, this format is adopted as a rule.

Is there no way to apply this approach also to high-rise structures?

Generally speaking, identical dwelling units are stacked on top of each other, so it is impossible to vary the depth of the building by its floors. Therefore a solution like that adopted for two-story buildings cannot be applied. But as shown in Figure 76, 3, a possible solution could be to project the upper floor with *hisashi* (covered walkway) southwards.

On the whole, the nation's climate tends towards heavy rain, and during the rainy season in particular rain pours down continually. Also, it is hot and humid in summer, and as much as possible the summer sun must be prevented from penetrating indoors. These two considerations led to the development of the deep *hisashi*, and the *hisashi* and the related *engawa* (verandah) were indispensable elements at south-facing openings in particular. Incidentally, as long as the *hisashi* provided cover from rain and sun, how the area above it was used presented no problem to the opening side or the residential space for which it was intended. By projecting the upstairs residential space out onto this *hisashi*, this alone increases the perpendicular distance between the uppermost northern edge of the upper floor and the rear of the row of buildings (northern edge). Therefore, if identical openness is maintained, this alone reduces the interval between buildings, so building density and consequently residential density are raised.

Let us calculate the extent of this.

i. *Hisashi* protrusion.

The nation's key cities are located between latitudes 31° 36' (Kagoshima) and 43° 49' (Sapporo), with most between 35° and 36°. The angle of projection during the summer solstice when the sun is highest in the sky is the latitude minus 23° 47', producing the range of 7° 49' and 19° 17' (and a modal value of around 12°). If we now assume a national standard (model) using Tokyo's 35° 39', the angle of projection is 11° 52', and the projection of *hisashi* required to obstruct this is the height multiplied by tan 11° 52' = 0.210. If floor height is 2.7 m, the *hisashi* may protrude by 0.565 m.

However, midsummer is the period during which *hisashi* must obstruct incident sunshine: from mid-August initially, the sun gets lower by the end of August, and the height of the sun's meridian passage is approximately 64°; cot 64° = 0.488, so if floor height is 2.7 m, the *hisashi* needs to protrude by 1.317 m. Traditionally, many of the nation's typical dwellings were built with *hisashi* that protruded between 0.6 and 1.0 m.

With this point in mind, let us assume the average protrusion of *hisashi* as 1.0 m (1 unit).

In this instance, the distance of incident sunshine during the winter solstice is tan 59° 26' = 1.693, so if floor height (interior measurement) is 2.4 m, it is

Table 10.6 Ratio of rising residential density, due to protruding construction

Housing format	*Building height, h (m)*	*Row intervals, normal case (Sm)*		*Row intervals, protruding construction (S'm)*		*Residential density, normal case*		*Ditto, protruding construction*		*Ratio of row interval reduction*	
		4 h (of sunlight)	*6 h*	*4 h*	*6 h*	*4 h*	*6 h*	*4 h*	*6 h*	*4 h*	*6 h*
1 C	3.90	14.80	16.36	14.80	16.36	203.33	182.15			100.00	100.00
2 C	6.60	18.20	20.84	17.20	19.84	203.33	182.15			105.81	105.04
3 D	9.30	25.60	29.32	23.60	27.32	297.64	259.85	322.85	278.87	108.47	107.32
4 D	12.00	31.00	35.80	28.60	32.80	327.72	283.85	362.82	309.76	110.71	109.15
5 EF	14.70	37.40	43.28	33.40	39.28	302.81	261.56	339.09	288.29	111.98	110.18
6 EF	17.40	42.80	49.76	37.80	44.76	317.53	273.08	359.54	303.58	113.23	111.17
7 EF	20.10	48.20	56.24	42.40	50.24	328.94	281.93	375.72	315.59	114.22	111.94
7 (3D4E)						334.76	286.91	382.36	321.17		
7 (4D3E)						336.69	288.57	384.57	323.03		
8 EF	22.80	51.60	62.72	44.60	55.72	351.17	288.91	406.30	325.20	115.70	112.56
8 (3D5E)						356.61	293.36	412.60	330.21		
8 (4D4E)						358.41	294.83	414.68	331.86		

Note: For housing formats C, D, E and F, see *Collected Works*, volume 1, chapter 24.

(1.693 X 2.4 – 1.0 m) = 3.23 m. In other words, even with a *hisashi* of 1.0 m, 76.4% of a total incident surface of 4.23 m will reach indoors, and this is feasible.

ii. Interval between rows.

In the case where the *hisashi* protrudes 1.0 m, and floor height is 2.7 m (therefore $\tan \beta = 0.370$), then the space between rows, α, is:

$\alpha = ha (\tan \alpha - \tan \beta) + 1.0$ m.

However, the + 1.0 m is an adjustment, because a 1.0 m *hisashi* protrusion on the highest floor does not help reduce the interval between rows.

Regarding $\tan \alpha$, if we assume during Tokyo's winter solstice four hours of sunshine (2.0), or six hours of sunshine (2.4), then,

$l_6 = 2.05\ h + 1$ m (six hours of sunshine);

$l_4 = 1.65\ h + 1$ m (four hours of sunshine).

The interval between rows includes the depth of the highest floor in the row of buildings.

iii. Residential density.

Residential density varies according to housing format (number of floors, and dwelling unit style). If we now make calculations based on examples of standard housing proposals in the aforementioned study (*Shin Nihon no jūtaku kensetsu)*, Table 10.6 shows there is no variation in the case of single-story homes, but in two-story houses we see residential density is 5.8% higher than those constructed in the standard way (or 5.0% when there are six hours of sunshine), and a rise in this ratio with the increase in the number of floors. In other words, there is a 10.7% (9.1%) rise for four-story buildings; 14.2% (11.9%) rise for seven-story buildings; and 15.7% (12.6%) rise for eight-story buildings. Generally, it is slightly more than 10% in mid-rise formats, and slightly more than 15% in high-rise formats.

As a result, in standard housing proposals for the mid-rise format (four-story buildings) with four hours of sunshine, the usual population density of 327.7 persons per hectare rises to 362.8 persons per hectare, while in the eight-story high-rise format, it rises from 358.4 persons per hectare to 414 persons per hectare.

Nevertheless, this construction method involves complications in ways to support southward projections during building construction. For high-rise formats in particular, the larger the projection the greater the complications in eliminating instability in the entire building structure. This is probably the reason why there are such difficulties in using this on a large scale.

3.3. Using South-Facing Slopes

If building sites are on south-facing sloping land, the construction base of the front row rises as far as the back row of buildings; so when the openness factor (sky angle) is uniformly implemented across the southern aspect, the steeper

Gradient (S/hd)		10.0	8.0	7.0	6.0	5.0	4.5	4.0	3.5	3.0	2.5	2.0	1.5	1.0
Housing density multiple	4 h of sunlight	1.20	1.25	1.29	1.33	1.40	1.44	1.50	1.57	1.67	1.80	2.00	2.33	3.00
	6 h of sunlight	1.24	1.30	1.34	1.40	1.48	1.53	1.60	1.69	1.80	1.96	2.20	2.60	3.40

the slope the narrower the gap between buildings. Therefore, using south-facing slopes not only has the benefit of locating cities in mountain regions that are hard to use as arable land, it makes very high-density housing feasible, and yields the advantage of making the construction of compact cities possible.

Reducing the interval between buildings, and how far the resultant housing density can be raised, is shown as follows in the following calculations, assuming certain sloping conditions.

First, the shrinkage ratio (and resultant rate of increase of housing density) for north-rising slopes (relative to building row intervals on flat ground), according to various slope angles of sloping land, is shown in the following table by slope angle, through the ratio of vertical distance to horizontal distance. (See Figure 79.)

Using these ratios we obtain two values for building row intervals, for four hours of sunshine and for six hours of sunshine, respectively; calculating intervals between buildings and (revised) population densities results in Table 10.7. However, there are two things that must be noted about these calculations.

First, on very steep slopes row intervals become narrower for housing formats with a small number of stories, and not only is there no space to build things like roads in between buildings, in extreme cases based on [theoretical] calculations, row intervals even become shorter than the depth of buildings, and buildings appear to sit atop each other. This is unreasonable, so minimum row intervals are set at the depth of buildings, and also minimum road widths are set at 6 m.

Second, various housing shapes are conceivable such as Format A or Format C, but the detached types of A, B, and C are unsuitable when taking into account difficulties with construction work on sloping sites.[3] Therefore only multi-story types of Format D and below can be considered, but external transport is determined by the placement of housing on slopes and involves a lot of vertical traffic, while internal transport and its corresponding vertical traffic increases greatly. Priority must be given to the location of housing units in order to reduce this vertical traffic as much as possible. It is conceivable that one method for doing this is to mechanize vertical traffic wherever possible, both externally and internally. To do so, it will of course be necessary to coordinate this with the housing format. Therefore, to calculate residential density, in terms of housing type this study mainly considers Formats E and F, where traffic between floors is assumed to be mechanized, while Formats C and D are also considered as a reference point.

Table 10.7 Gradient, row interval, and housing density, on south-facing slopes

Housing format		*4 h of sunlight*					*6 h of sunlight*				
		Level ground	*1:3.0*	*1:2.5*	*1:2.0*	*1:1.5*	*Level ground*	*1:3.0*	*1:2.5*	*1:2.0*	*1:1.5*
Row interval (Sm)	1 C	14.80	13.00	13.00	13.00	13.00	16.36	13.00	13.00	13.00	13.00
	2 C	18.20	13.00	13.00	13.00	13.00	20.84	13.58	13.99	13.00	13.00
	3 D	25.60	15.36	14.22	13.00	13.00	29.32	16.29	14.96	13.33	13.00
	4 D	31.00	18.60	17.22	15.50	13.29	35.80	19.89	18.27	16.27	13.77
	2 EF	22.20	14.00	14.00	14.00	14.00	23.84	14.00	14.00	14.00	14.00
	3 EF	25.60	16.36	15.22	14.00	14.00	30.32	16.84	15.47	14.00	14.00
	4 EF	31.00	19.60	18.22	16.50	14.29	36.80	20.44	18.78	16.72	14.15
	5 EF	37.40	22.44	20.78	18.70	16.03	43.28	24.04	22.08	19.67	16.65
	6 EF	42.80	25.68	23.78	21.40	18.34	49.76	27.64	25.39	22.62	19.14
	7 EF	48.20	28.92	26.78	24.10	20.66	56.24	31.24	28.69	25.56	21.63
	8 EF	51.60	32.16	29.78	26.80	22.97	62.72	34.84	32.00	28.51	24.12
Housing density (persons/ha)	1,2 C	203.33	244.01	244.01	244.01	244.01	182.15	244.01	244.01	244.01	244.01
	3 D	297.64	495.07	535.75	586.12	586.12	259.85	467.73	509.31	571.67	586.12
	4 D	327.72	546.20	589.90	655.44	764.68	283.79	510.82	556.23	624.34	737.85
	2 EF	213.69	312.37	312.37	312.37	312.37	190.02	312.37	312.37	312.37	312.37
	3 EF	255.45	425.75	459.81	468.54	468.54	224.51	403.40	430.26	468.54	468.54
	4 EF	283.13	471.88	509.63	566.26	600.65	246.20	443.16	482.55	541.64	640.12
	5 EF	302.81	504.68	545.06	605.62	706.56	261.65	470.07	512.83	575.63	680.20
	6 EF	317.53	529.22	571.55	635.06	740.90	273.08	491.54	535.24	600.78	710.01
	7 EF	328.94	548.23	592.09	657.88	767.53	281.93	507.47	552.38	625.25	733.02
	8 EF	351.17	585.28	632.11	702.34	819.41	288.91	520.04	566.26	625.60	751.17

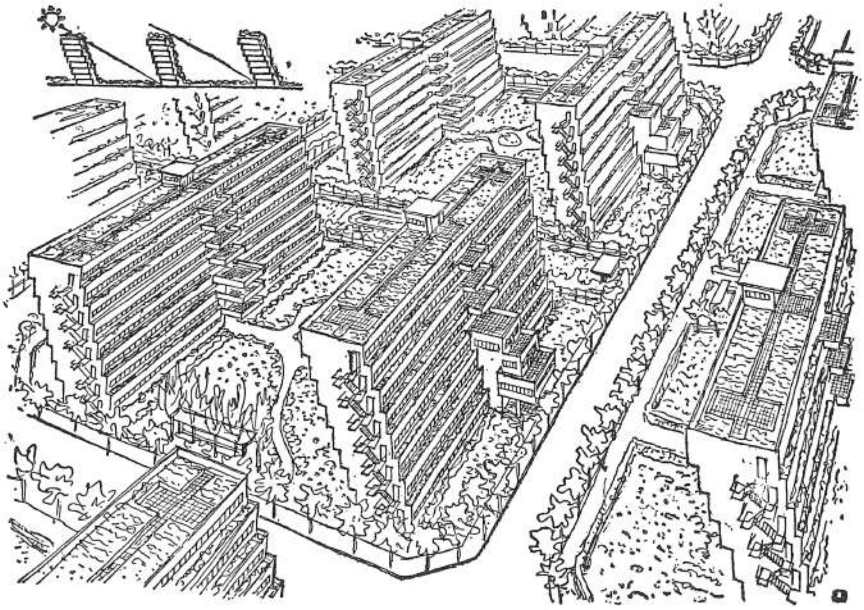


Figure 77 High-rise residential area with protruding construction

If we look at this in the case of four hours of sunshine, on level ground Format 4D allows 328 people per hectare, and Format 8EF 351 people; on a 1:3 gradient surface this rises by approximately slightly more than 60%, or 546 and 585 respectively; on a 1:2 gradient surface, a residential density of approximately double, or 655 and 702 respectively, can be secured. Naturally when using sloping land, this will usually include valleys and ridges, and because of the lay of the land it is hard to locate buildings as freely as one would on a level surface; this makes it difficult to realize according to plan the high-density arrangements shown here. However, with skillful placements, it should be possible to achieve something approaching these. Much of the nation's mountainous areas, in other words mountains and forests on steeply-sloping and unusable land, lie in the approximate gradient range of between 1:3 and 1:1.5; therefore if we construct cities on south-facing slopes in this gradient range, we can see that for housing only around half the acreage is needed compared to level ground.

As the previous table clearly shows, shrinking of row intervals (due to slope) for one- and two-story house formats, and three-story housing formats on steeply sloping land, cannot be effectively applied when the minimum gap between buildings is limited to 6 m. Therefore there is little expectation of a rise in residential density. From this perspective also, we can see that housing for residential estates on steeply sloping land has no advantage if mid- and high-rise formats are not adopted.

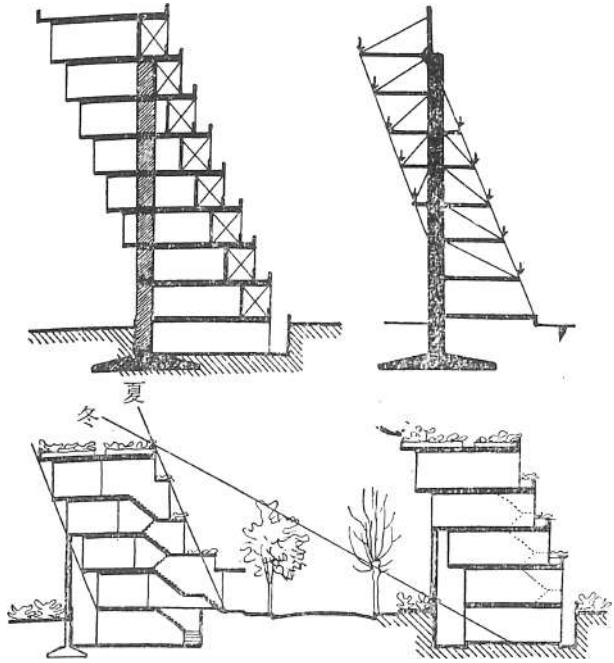
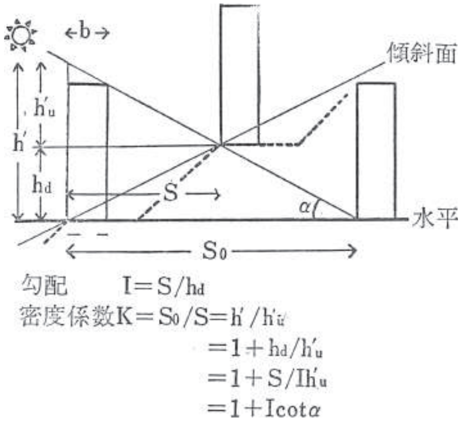


Figure 78 Protruding construction formats



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Sloping surface
Level
Incline
Density coefficient

Figure 79 Residential building row intervals, for slopes facing due south

In cases where the sloped surface of sloping land is not south-facing, conditions are not that advantageous. For the placement of buildings in such instances, issues include insisting that rows at least be placed in an east–west orientation, or perpendicular to contour lines. (See Figure 80.)

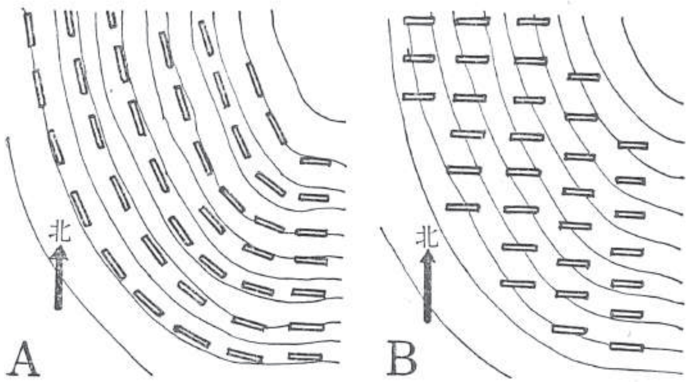


Figure 80 Slope contour lines and residential building placement

To improve dwelling unit daylight conditions the former solution is preferable, in which case building row foundations will have a slope and sloping-type corridors will be used, or multi-level floor buildings will have to be constructed where the flooring of each dwelling unit gradually changes. This creates disadvantages during building construction. The latter solution has drawbacks regarding daylight conditions, but the construction methods are much more sustainable. However, regardless of which solution is used, it will become an important issue as to what extent the direction of the slope deviates from south will be tolerated, in particular in the latter case.

Detailed examinations will be omitted here, but if placements are made using the latter solution, then generally speaking any deviation from due south within a range of 45° either east or west can in fact be considered as not so very different from a south-facing slope, and due east and due west should be considered to be upper limits of deviation.

Conditions determining row intervals in this case will vary according to the direction of the sloping surface, the degree of slope, and the number of daylight hours, but these detailed calculations will not be made here. However, for the most plentiful sloping surfaces with gradient range between 1:3 and 1:1.5, if the condition of four hours of daylight is applied, then even rows facing due east or due west can be arrayed more tightly than those on level ground.

As this examination has made clear, when adopting these construction methods to improve residential density, surfaces sloping due south are the most advantageous topographically, those sloping due east or due west are at the limit [of feasibility], and those sloping north are unfeasible. Therefore, places where these construction methods can be applied are limited. An important condition for applying these methods is to choose the most suitable location.

3.4. Sloping Land Use and Projecting Construction

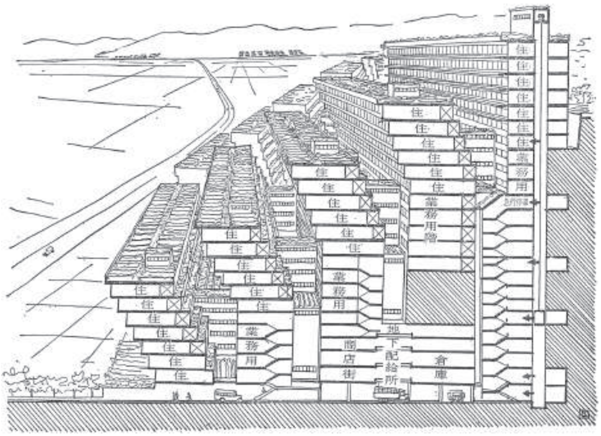
Methods found in 2 and 3 above are used at the same time.

It is possible to reduce the space between building rows to their smallest interval such that they can be used merely for air circulation and roads, and [still] make it possible to realize maximum residential density. Moreover, if rooftops and north-facing terraces on each floor are used as small productive green spaces (domestic vegetable plots, etc.), it is probably possible to create the maximum ground surface usage profile also from the viewpoint of using sloping land as productive green space. (See Figure 81.)

All the construction methods above have only been proposed with the view to boost residential density, but we must uncover even greater meaning contained within them, and strive to expand them. In other words, we must manage our residential sphere on the surface of the earth where the land meets the sky, but transform this contact area into a three-dimensional, optimally rich environment; without wastage, use all the blessings provided from the sky (especially the emission of solar energy) and natural resources from the ground; and create the best residential configuration on the earth's surface. Every "building" must be developed as part of the continued construction and development of an "earth's surface" imbued with this meaning.

4. Designing Mountain Cities

In order to rationally satisfy the two demands clarified above—namely, calls for where to locate cities in our nation in future, and the need to realize high-density housing—it is proposed that actively adopting mountain cities that exploit south-facing slopes as an important format for housing and the city henceforward is essential.



Text: from left to right

住	Residential
住	Residential
業務用	Business use
住	Residential
業務用	Business use
商店街	Shopping area
地下配給所	Underground supply center
住	Residential
業務用階	Business floor
倉庫	Warehouse
住	Residential
業務用	Business use
急行停車	Express train stop

Figure 81 Example of highly concentrated residences, using south-facing slope

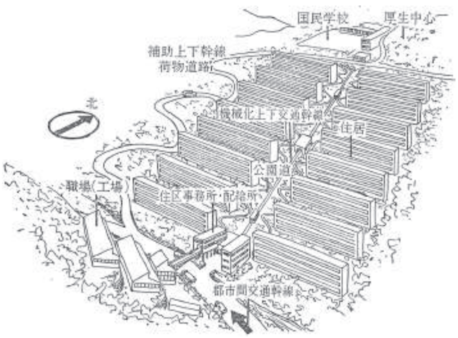
Below, let us examine my thoughts on what the mountain city is, and give two or three specific design examples.

4.1. *The Character of the City*

i. The scale of the city is limited by restrictions based on topographical conditions.

   When looking for suitable south-facing slopes throughout the nation, most will be slopes and valleys from mountains that have been eroded by flowing rivers. In many instances, these locations have an irregular terrain. Therefore, even if ideal topographical conditions exist the acreage is usually small and narrow, making it difficult to permanently settle hundreds of thousands of people. So scale precludes large- and medium-sized cities, and probably small cities of at most one collective, around 50,000, will account for the majority. However, as in the case of Kobe, which has south-sloping Mt. Rokko and the Maya Range behind it, there are rare instances where it is possible to construct a large mountain city (although issues to do with geological features require serious examination).

ii. As for the functional nature of the city, it is likely to be a small unitary single-function city (small industrial city) with its own places of employment and residential areas—apart from those in valleys where main rail trunk lines pass through, there will probably be many places where heavy traffic is inconvenient due to terrain issues, so the industry will by nature mainly be precision processing requiring a relatively small volume of raw materials. As in the case of large cities or general industrial complexes, it is conceivable there will be special cases involving outlying residential cities (or social welfare cities) connected to a hub city unable to provide residential areas for all workers in proximity to their place of employment.



Text: from top

国民学校	Public school
厚生中心	Public welfare center
補助上下幹線荷物道路	Supplementary two-way main line freight road
機械化上下交通幹線	Mechanized two-way traffic trunk line
住居	Housing
公園道	Park road
職場（工場）	Place of employment (factory)
住区事務所・配給所	Residential zone office, supply center
都市間交通幹線	Intercity transport trunk line

Text: arrow

North

Figure 82 Model for mountain city

iii. In contrast to cities built on the plains, the overall city must be completely equipped with public facilities (primarily transport). This is why the city cannot be constructed such that it is completed gradually in a piecemeal manner. At the very least, those sections that constitute the core must be completed all at once, and within a fixed construction period. Therefore, it is necessary to transfer in the industry that carries out the core function, and also construct satellite towns ("new towns") connected to the new build.

On the way to constructing the new Japan, we must build urban housing for 600,000 households a year over the next 30 years; if we consider locating one-third of these in mountain cities, this will mean building 20 mountain cities per year if one of these can accommodate an average of 50,000 people (or 10,000 households). In order to realize this, we cannot rely on private construction activities. For the key components of investment to construct this housing in the people's economy, it will be necessary to establish political and economic support solely dedicated to the construction of mountain cities.

4.2. Suitable Location and Terrain for Cities

i. For public heath requirements, housing zones must be located on south-facing slopes, or at the very least on southeast- or southwest-facing slopes. However, it is impossible to find mountain regions consisting of large unbroken expanses of south-facing slopes. Therefore when keeping in mind housing format and housing zone location, areas with high ratios of high-utility south-facing slopes must be selected. Considerable differences in construction cost can arise from how this selection is made, so the choice of suitable location is important.

ii. In terms of both terrain and connecting intercity transport, the most suitable locations are either green fringes of mountainous regions on the broad plains (residential towns for small industrial cities or large hub cities on the plains); or valley areas in mountainous regions where large transport lines pass through, or secondary valley areas (small industrial cities adjacent to transport lines).

iii. Housing can be built on ridges below sloping surfaces. Ridge intervals of 100–150 m are ideal. It is thought that slopes of 1:3 and 1:2 are the most plentiful, but sloping surfaces of 1:1 may also be used. It doesn't matter how long the sloping surface is, but in many cases the vertical height of valley areas is at most around 150 m.

iv. By studying topographical maps, it is probably possible to find suitable locations meeting the above criteria, but one other key factor that must be focused on is the geological situation. Obviously terrain weakened by weathering must be avoided, but in addition, places that topographically or geologically have a risk of landslides, subsidence, or flooding must not be selected.

4.3. Constructing the City

i. As previously discussed, the scale of the city depends on terrain conditions, and cannot be expected to be very large. However, it needs to be at least as large as a primary school residential zone. In other words, it must assume a minimum threshold of around 10,000 people.
ii. One city comprises several primary school residential zone units. Each residential zone has a public welfare facility center that combines primary school, park and rest areas, etc.; and an office facility center that combines housing office, shops, medical facilities, and administrative offices, etc.; these two centers are built in the form of a tightly knit hub. It is recommended that the former, the public welfare center, is constructed at the top of the slope (mountain top), while the latter, the administrative center (in the case of an industrial city, to be connected to the industrial belt), is located in a suitable lower area close to main transport lines, or at the lowest point in the valley (here, in the case of an industrial city, factories may be set up on lower or other regions of north-facing slopes opposite). (See Figure 82.)
iii. The city is built on sloping surfaces.

Transport between cities would consist of main transport lines passing through the cities' lowest points, areas in the valleys, and green fringes on the plains. Therefore the main transport routes inside the city are vertical transport lines. However, vertical transport is inconvenient, so it will be mechanized in various ways to be discussed later; and foot traffic along contour lines where possible will become the mode of horizontal traffic.

In the case of industrial cities, factory complexes will be built in places along the lowermost main transport lines.

4.4. Housing Format

i. High-rise buildings are preferred, with the largest number of floors a foundation can support, to reduce the weight of building site construction work, and also to realize high-density housing. If high-rise buildings are chosen, then of course vertical traffic must be mechanized. The mechanization of this traffic between floors inside the building is closely related to vertical traffic methods used in the city as a whole, which in any case must provide the mechanical power. This is discussed in the point below.
ii. To eliminate mechanization of vertical traffic inside buildings all housing can be limited to four-story buildings; or each residential building can be six-stories high with a traffic floor constructed at the midpoint of each building, while the vertical transport to this floor is mechanized as a city service and entrusted to a vertical transport authority. If this method is selected, Format D may be used.

However, in order to make this mountain city livable on the many different elevations along the slope, attention must be paid to mechanizing all vertical transport wherever possible; to do this, Formats E and F should mostly be used.

4.5. Vertical Transport

i. Mechanization is necessary for vertical transport. However, the extent of mechanization is connected to issues such as volume of traffic (general and commuting traffic), fluctuations over time, and maintenance and servicing; determining the most suitable format is an issue for future study.

ii. The following methods for mechanization are conceivable:

   a. Perpendicular hoisting device (elevator);
   b. Sloping hoisting device (cable car);
   c. Bus; and
   d. Escalator.

   Escalators (d) can handle the greatest volume of traffic, but beyond specific places their use is problematic due to maintenance and servicing issues. The bus (c) option has the highest degree of flexibility, but its use is greatly limited by topographical conditions, and transport volume is not large. Therefore it is not possible to rely solely on these for vertical traffic, but they are suitable, and indeed essential, as supplementary transport modes.

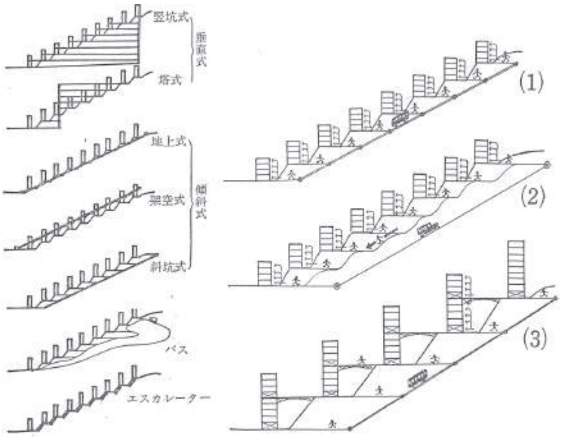
   Ultimately, hoisting devices (a and b) are the methods from which the most can be expected.

   The construction of track for sloping elevators is simple when suitable terrain is used, and it is possible to raise transport efficiency by increasing the number of passenger platforms. However, if the line becomes long, there is the disadvantage of operation becoming sluggish. On the other hand, for perpendicular hoisting devices, the hoisting column can be made from either an in-ground track system, or a transport path with frame construction; in both cases, complex methods must be adopted, and places where they can be used are limited.

iii. If mechanization is selected, the question of how far apart (different elevations) stops are installed is related to maintenance and servicing issues, and is an important matter. Frequent stops, for instance stopping at each floor, are possible in perpendicular hoisting devices that travel short distances, but are not feasible in other devices.

   In order to ensure each resident can travel to their dwelling using the minimum of vertical transport, various methods to do with housing format can be conceived.

   If vertical foot traffic is limited to a maximum of 10 m (perpendicular distance), this is equivalent to 3.5 floors; therefore passenger stops must be installed every 7 floors (20 m) at most.



Text: from top to bottom

垂直式	Perpendicular system
竪坑式	Vertical shaft method
塔式	Tower method
傾斜式	Sloping system
地上式	Above ground method
架空式	Overhead method
斜坑式	Inclined shaft method
バス	Bus
エスカレーター	Escalator

Figure 83 Transport systems for residential areas on slopes
In order to cut down on the trouble of maintenance and servicing, the three examples shown here in (1) through (3) do not use hoisting devices in their apartment buildings, but provide mechanized transport facilities through the middle of the residential zone. (1) is an example of providing stops for mechanized transport facilities at the ground floor level of each apartment building. (2) is an example of the simplest of vertical transport in such residential zones: stops are provided at the highest and lowest levels, and points in between are reached by foot traffic; however, to conserve pedestrian energy traffic is in one direction, downwards.

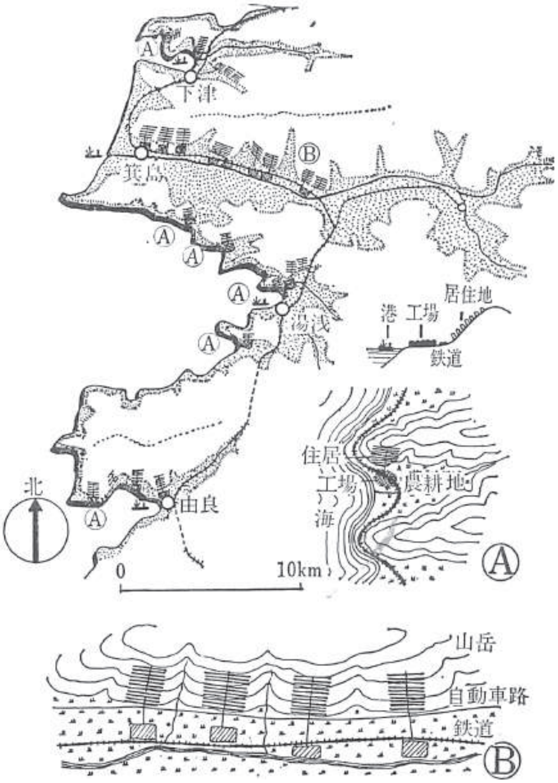
In these two examples ground level is designated as the traffic floor where one enters the residential building from the street, but clever use of sloping surfaces makes it possible to designate intermediate floors, such as the second or third, as the point of entry. This way, five- or six-story structures are possible without utilizing lifts within the apartment building.

Taking this format a step further, (3) shows how overhead walkways are provided to maximize the number of floors. By so doing, the interval between stops for residential zone vertical transport facilities can be made larger than that in (1).

However, of the various methods for vertical traffic, if strict limits are eliminated for downward traffic, and one-way traffic flows are adopted, in the extreme case it is entirely possible to set up passenger stops only at the highest and lowest points of the housing zone.

iv. Figure 83 shows the various types of vertical traffic systems that are conceivable, according to the analysis above; of these, the most viable probably entails the following system of methods, namely:

1. Using sloping hoisting devices as the main vertical transport service;
2. Using road vehicles (the type to be determined by traffic volume) as a supplementary service; and
3. In principle, foot traffic is to be on level surfaces; each residential floor is to be within a maximum perpendicular distance of 10 m. (See Figure 83, 1–3.)



Text: from top to bottom

下津	Shimotsu
箕島	Minoshima
湯浅	Yuasa
港	Harbor
工場	Factory
居住区	Residential area
鉄道	Railway
由良	Yura
住居	Residences
工場	Factory
海	Sea
農耕地	Arable land
山岳	Mountains
自動車路	Motor vehicle road
鉄道	Railway

Text: arrow

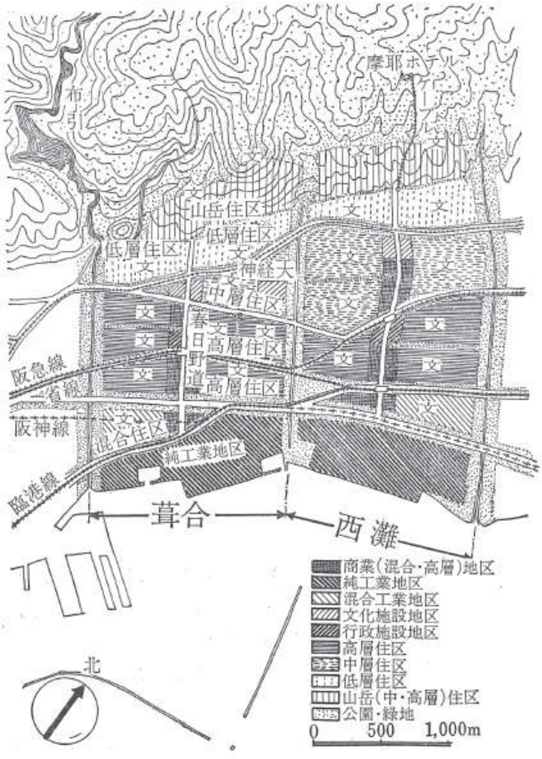
North

Figure 84 Layout example for mountain city (Wakayama)
The example of the Kishu coast is presented here to try to show the structure for the layout of a mountain city that has, for instance, places where mountains rise sharply from the sea (A), and places where transport trunk lines pass beneath the foothills of mountains that run east to west (B). However, this region is the home of the *Kishū mikan* or cherry orange, so due consideration must be taken as to which is more useful to the nation as a whole: the cultivation of *mikan*, or housing for the population.

It is conceivable that the simplest system (eliminating mechanization) is to have only road vehicles, and to restrict foot traffic to the downhill direction. (See Figure 83, 2.)

4.6. Residential Zone Structure

i. As previously noted the structure of residential zones, the unitary zones that make up the city, in principle takes the form of a public welfare center in the upper region and a business (place of employment) center in the lower region; their precise configuration depends greatly on several factors, such as overall location issues, as well as vertical transport



Text: from top

摩耶ホテルケーブル	Maya Hotel cable car
文	Elementary or junior high school
山岳住区	Mountain housing zone
低層住区	Lowrise housing zone
神経大	Kobe University of Economics
中層住区	Midrise housing zone
阪急線	Hankyu line
省線	Government run railway line
阪神線	Hanshin line
春日野道	Kasuganomichi Station
高層住区	Highrise housing zone
高層住区	Highrise housing zone
文	Elementary or junior high school
臨港線	Kobe Rinko Line
混合住区	Mixed housing zone
純工業地区	Semi-industrial area
葺合	Fukiai
西灘	Nishinada

Text: key, from top

Commercial (mixed, highrise) area
Semi-industrial area
Mixed industrial area
Cultural facilities area
Administrative facilities area
Highrise housing zone
Midrise housing zone
Lowrise housing zone
Mountain (mid-, highrise) housing zone
Park, green area

Text: arrow

North

Figure 85 Design proposal for Kobe city alliance (1945)
Each unitary zone is separated by rivers and is marked off by green areas.

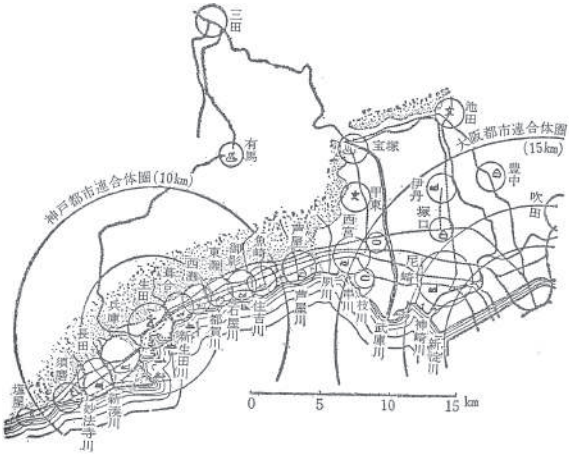
The unitary cities that make up the Kobe city alliance all have mountains behind them to the north, and their foothills have been used to build many mountain residential areas. The diagram shows the local structure of some of these, such as the two zones of Fukiai and Nishinada, which have the character of unitary industrial cities.

The use of sloping land is limited to around one housing zone per lower region, and in this design the two zones accommodate a population of around 70,000. However, this allows for urban greening where ample space is given to each residential building, and each housing zone. Zones housing around 100,000 are possible, if the use of sloping land is expanded and efficient consolidation of space is carried out. The south-facing slopes of the Rokko mountain range are often the scene of natural disasters, but can't this disintegration be completely prevented by investing heavily in the construction of mountain residential zones?

> modes to be utilized throughout the city, and housing formats and vertical transport methods to be used inside residential buildings.

See Figure 82 for what are considered the most common patterns of the various configurations for residential zones.

From the above, I think the various forms into which the mountain city can be constructed have been largely clarified. To rectify any shortcoming in the



Text: Kobe circle

神戸都市連合体圏 （１０km）	Kobe city alliance zone (10 km)
須磨	Suma
長田	Nagata
兵庫	Hyogo
生田	Ikuta
葺合	Fukiai
西灘	Nishinada
東灘	Higashinada
御影	Mikage
魚崎	Uozaki
妙法寺川	Myohojigawa
新湊川	Shinminatogawa
新生田川	Shinikutagawa
都賀川	Togagawa
石屋川	Ishiyagawa
住吉川	Sumiyoshigawa

Text: Osaka circle

大阪都市連合体圏 （１５ km）	Osaka city alliance zone (15 km)
伊丹	Itami
塚口	Tsukaguchi
豊中	Toyonaka
尼崎	Amagasaki
吹田	Suita
串川	Kushikawa
枝川	Edagawa
武庫川	Mukogawa
神崎川	Kanzakigawa
神淀川	Kanyodogawa

Text: other place names

三田	Sanda
有馬	Arima
宝塚	Takarazuka
池田	Ikeda
甲東	Koto
西宮	Nishinomiya
芦屋	Ashiya
芦屋川	Ashiyagawa
夙川	Shukugawa
塩屋	Shioya
♨	Hot springs symbol

Figure 86 Diagram of the Kobe city alliance zone

explanation, let us select several sites and present concrete examples of mountain cities that were planned.

First, let us take a part of the west coast of the Kii Peninsula, and show various configurations for mountain city placement. (See Figure 84.)

Second, the residential city (pop. 20,000) that was built on both sides of steeply sloping Haratoge (slope gradient approx. 1:3), which extends from Hiragino, in the northern suburbs of Kyoto, to Nikenchaya on the Kurama line.

Third, an example of a small industrial city (pop. 10,000), built in a branch valley near the same Nikenchaya mentioned above.

These have all adopted the simplest method for vertical transport.

Fourth, a small industrial mountain city built in a designated part of the Obata Gawa valley, which extends from Rakusai/Katsura, also in the suburbs of Kyoto, and Kameoka (Tottori Prefecture). Here, as a trial, the most concentrated housing formats and mechanized vertical transport have been attempted. (All the above [descriptions] have been abridged.)

The fifth example is the case of a mountain city that is part of a unitary city, itself a component of a large city; it shows an example of a unitary residential zone, part of a private proposal for the remodeling of Kobe City. (See Figures 85 and 86.)

Notes

1 Translated from *Nishiyama Uzō chosakushū 3* [The collected works of Uzō Nishiyama, volume 3], *Chiiki Kūkan Ron* [Reflections on Urban, Regional and National Space] (Tokyo: Keisō Shobō, 1968). "Dai 10 shō, Sangaku toshi" [Chapter 10, Mountain Cities], pp. 267–295.

2 Nishiyama's note: Things like advancements in the use of nuclear energy, or innovation in industrial production methods for food, etc., may thoroughly revolutionize the population sustainability limits examined here. However, I have resumed this discussion without including projections of that sort.

3 Translator's note: Formats A through H refer to examples of housing described by Nishiyama in his *Collected Works*, volume 1, chapter 24, pp. 523–525.

A = Single-story house;
B = Two-story house;
C = Row houses;
D = Staircase type;
E = Single-floor corridor type;
F = Multiple-floor corridor type;
G = Single-floor central-corridor type;
H = Mezzanine corridor type.