

Chapter 3

Unpaved Roads Play as a Natural Air Conditioner

I have recently come to think that people in the olden days did not pebble roads in order to keep off the summer heat. Unpaved roads act as a natural air conditioner helping to keep surrounding temperatures cooler than pebbled or asphalt roads.

You may think it strange that it is cooler with unpaved roads but it is not so peculiar. Experientially, many people feel that under the blazing summer sun it is cooler walking along an earth track than along an asphalt-paved road. Data shows that on a fine summer's day in the year 2000, when the atmospheric temperature was 30 degrees Celsius, the surface temperature of fully dried soil was 45 degrees Celsius. The area covered with grass was 40 degrees Celsius, which could fall into the 30s quickly if cooled down with water. The surface of an asphalt paved road recorded temperatures no less than 55 degrees Celsius, which was 10 degrees higher than the dry soil, and 25 degrees higher than the air. It is, therefore, not our imagination but a natural fact that air becomes hotter where there are many paved roads.

Big cities in Japan have been suffering from, the so-called, "heat-island" effect in summer. The name "heat-island" comes from the graphical dimension of temperature distribution that the inner part of a big city features. The inner city shows much higher temperatures during the daytime compared to the surrounding areas. This phenomenon extends into the night as the temperature does not easily fall. When the inner city is embossed on a temperature distribution graph it looks like an island on a sea.

The high temperatures in urban areas result partly from the large number of vehicles and air-conditioning units. They are known as heat sources. Mainly, the temperatures are derived from the many concrete buildings and roads paved with asphalt or pebbles. Concrete, stone and asphalt do not easily heat up but once they are hot they take considerable time to cool off. In the height of summer, the characteristics of these materials cause the surrounding air hotter with radiant heat and the temperature cannot cool down easily during the night.

A long time ago, people burned stones in a bonfire then wrapped them with rags and put them inside of their clothes to use as portable body warmers. In Japanese they are named “onjaku”, which literally meaning “warm stones”. People knew that onjaku do not easily cool down. The heat-island effect turns a whole city into an enormous onjaku and is the root cause of successive tropical nights during which temperatures do not fall below 25 degrees Celsius.

In the past when there were many wooden buildings and less paved areas in a city, the temperature did not rise high enough to create the heat-island effect. Though, it did get hot in the summer during the daytime, lumber and soil helped prevent tropical nights. These materials warm less easily than concrete and stone, and do cool off during the night.

Specific heat stands for the heat quantity required to increase the temperature of a material with the same volume by one degree Celsius. The specific heat of lumber is about 50 to 60 percent higher than that of stone. In other words, additional heat is required to increase the temperature to the same level. Lumber, therefore, needs much more heat at a much quicker rate to increase its temperature to the same levels as concrete and stone. In short, lumber has no effect in keeping surrounding temperatures hot as it hardly heats up during the daytime and quickly becomes cold once the sun sets.

Though this phenomenon should apply everywhere in the world some lovers of foreign culture may try to contradict this by arguing that the roads in London were neatly paved with stones in the same years as the Edo Period and had lower summer temperatures. In fact, the climate in London was entirely different from that of Edo (today's Tokyo). The temperature in summer in London was lower than in Edo as it is today. “Science Chronological Table”, published by the Nation Astronomical Observatory of Japan, shows that in London the average temperature of July and August in recent years is less than 17 degrees Celsius, which is 10 degrees lower than that in Tokyo, where the average varies from 25 to 27 degrees Celsius. Therefore the pebbled roads in London produced more benefit than loss in those days.

Some critics may say that the Japanese authorities in the Edo Period left the unpaved roads as they were because the country was still underdeveloped. This notion, however, is nothing less than the extravagant viewpoint of modern people who ungratefully

consume enormous amounts of energy for air-conditioning. In 1987 every household in Japan owned an air conditioner, while in 1970 the ownership ratio was 5 units for every 100 households. They were considered luxury goods. In those days air conditioners and the electricity to operate them cost too much for the ordinary person to easily afford. During the Edo Period the Emperors and Shoguns had nothing and asked someone to fan them or they had to seek out breezy sites in their residences. Thus, neither the noble nor the common folk had the same effective options in dealing with the summer heat.

To ease the summer heat and to suppress the rise in temperatures they would sprinkle cold water on the hot ground. This not only lowers the temperature by the coldness of the water but also by evaporation. Though we sometimes see people sprinkling water on the paved road in front of their house, it does not help much as the water dries up in an instant – like a drop of water on a burnt stone. In contrast, sprinkling adequate water on unpaved soil is effective in lowering temperatures. This is because the sprinkled water can go into the soil and its evaporation takes off the heat from inside of the soil as well as its surface. Of course the fact that the temperature of the soil does not rise as high as that of the paved roads helps this cooling system. The surface temperature of the soil soon goes down by about 10 degrees Celsius; reducing the number of sweltering nights. Thus one can live utilizing solar energy, not depending too much upon artificially generated energy sources.

When you step out on a paved road from an unpaved one under the sun, you suddenly feel hotter with the heat reflecting from the concrete surface. One can easily experience that unpaved roads obviously alleviate the heat of midsummer once one visits an area with uncovered roads.

There is no clear evidence that states roads were left unpaved during Edo Period in order to keep off the summer heat. However, it is a big mistake and quite farfetched to conclude that Edo, then the biggest city in the world with its paving technology, owned almost no paved roads because it was culturally underdeveloped or poverty-stricken. Instead, it may be more natural to think that the city utilized unpaved roads to prevent the blazing heat; which they had experienced with pebbled roads.

If we take the optimal conditions for a life utilizing only solar energy, saved for a year or two in advance, we should endure various immediate inconveniences we would not

imagine in our present modern ways. Of course we would hardly find anything in this kind of lifestyle better than those we do today. As we were not satisfied with the former style of life we have strived to make ours more convenient. But, the more convenient our life becomes the more we suffer from disadvantages that underlie the convenient life. Some might insist that living in wooden houses and putting up with muddy roads helps alleviate the midsummer heat – including infamous sweltering nights in urban areas. However, I would firmly oppose to the idea of tearing the pavement from the roads as I still remember how uncomfortable the muddy roads were in the former Musashino area. Besides, it would impractical to pull down all the buildings in Japan and to return to unpaved roads.

Since 1940 I have lived in the northern part of Nakano Ward, which is close to the center of Tokyo. I remember that the small streets off the main roads, even in my ward, had been muddy until the 1950s. As winter used to be much colder in those days the muddy roads, which had almost no gravel, became frosted over during the night and would become muddier in the late morning when the frost melted. When we traveled such roads with our bicycles, the gluey mud twined around the tires and jammed into the mud flaps eventually halting it. We then had to carry the bicycle by ourselves to the paved roads. What made matters worse, the mud stuck to the wooden clogs we wore in those days. We could not walk without dropping mud every two or three steps. Now it might be hard for people to imagine how awful those muddy roads became in winter.

In the early spring, when it became warm and the frosty days were over, Nakano and Nerima Wards in Tokyo had another problem. The large parts of these wards were farmland and in May there were still no crops growing. Then during a long spell of fine weather the strong north wind blew up so much red clay that the sun would get hazy and everything in the houses were covered with dust. Most uncomfortably, the sand got into our mouths and would make a crunchy noise.

Even to prevent the heat-island effect in the midsummer, I would not like to endure the disadvantages that came with the muddy roads. Still, the muddy roads teach a lot in terms of how they functioned as a natural air conditioner.