Construction methods of ancient earth fills and natural environments in East Asia

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ABSTRACT

In the middle Yellow River basin, the Hanchiku method has started in B.C.3 thousand in order to compact densely the Chinese Loess for the construction of ancient earth fills. In the Chang River basin, the employment of Hanchiku technique was behind the Yellow River Basin because of cohesive property of the Chang River basin soils. Since B.C. 1.1 thousand, in Jiangnan, the lower Chang River basin, burial mounds which are the overground burials have been constructed. However, large burial mounds (after B.C.5 hundred) in the Yellow River basin, are the underground burials and these burial styles propagated to Lelang Commandery (B.C.108~) in the Korean Peninsula. In the mountainous Northeastern region, China, cairns burials using river field stones started in B.C.4 thousand. All burial mounds in Japan including the Yoshinogari burial mound (B.C.150) which was constructed by the Sochiku and Taiciku method and in the Southwest of the Korean Peninsula are the overground burials. These mounds are the same as the Jiangnan’s burial style.

As mentioned, construction methods of ancient earth fills (about B.C.4 thousand to A.D.3 hundred) have strong relations with the regional environments. And burial mounds can be divided into two groups, namely, the underground burials and the overground burials according to the environments.

Keywords: ancient earth fills, construction methods, burial styles, natural environments, East Asia

1 INTRODUCTION

Construction methods of ancient fills such as soil walls, soil foundations, burial mounds which the author had field investigations in East Asia are reviewed on the different regions and eras. The regions are the Yellow River basin, Chang River basin, Northeastern region of China and Northern Korean Peninsula, and Southern Korean Peninsula and Northern Kyushu, Japan as shown in Fig.1. The era is from about B.C.4 thousand to A.D.3 hundred (the end of Yayoi period in Japan).

As the results, it can be clear as follows. Ancient fills construction methods, such as the Hanchiku, Sochiku and Taichiku (in Japanese) were borne, developed and propagated according to the regional and natural environment (climate, topography and geology), earth fills functions and construction era. Especially burial mounds can be divided in two groups from the view of seepage water measurements, such as the underground burials in the Yellow River basin and almost the Korean Peninsula, and the overground burials in the lower Chang River basin, the Southwest of the Korean Peninsula and Japan including Northern Kyushu.

2 NATURAL ENVIRONMENTS AND ANCIENT FILLS CONSTRUCTION METHODS IN THE

YELLOW RIVER BASIN

2.1 Chinese Loess deposit and property

The Yellow River basin is the Chinese Loess deposit region as shown in Fig.2 (Liu 1985). The basin is under a dry and semi-dry climate. The loess generally has a strong cementation, however, a collapse easily occurs by soaking due to a rainfall or rising water table. The collapsible loess distribution is mostly around the middle Yellow River basin and corresponds to the loess highland.

Fig. 1. Regions in East Asia for the research
The loess particle is very small because of an aeolian soil and more than 60% is silts and it belongs to CL. The cohesion is less. The natural water content is 10 to 30% and is close to the optimum water content of the compaction test.

2.2 Ancient fills construction method

The oldest fill by the Hanchiku (a compaction method as explained later, in Japanese) method in the middle Yellow River basin is the Xishan remains. The Chengziya remains (Shandong Province, B.C.2.6 thousand~) are surrounded by soil walls compacted by the Hanchiku method. The soil wall (B.C.2.0 thousand ~B.C.1.5thousand) shows clearly compacted layers by the Hanchiku method as shown in Fig.3. The one layer is 12~14cm in depth and the trace of compaction is 3~4cm in diameter.

Many earth fills including large sized burial mounds were constructed by the Hanchiku method in the Spring and Autumn period to the West Hang period. However the burial mounds’ underground palace and burial matters are set under the ground not in the fill such as the Mausoleum (big burial mound) of the First Qin Emperor. All burial mounds in the Yellow River basin are underground burials where the ground water level is deep. For the construction of soil walls and soil foundations which need a strength and persistence, the Hanchiku method was borne to conquer the weak points of the Chinese loess. It is a dense compaction using a mullet after pouring soils in a space surrounded with confining boards as shown in Fig.4 (Yang 2001).

3 NATURAL ENVIRONMENTS AND ANCIENT EARTH FILLS CONSTRUCTION METHODS IN THE CHANG RIVER BASIN

3.1 Natural environments

The Chang River basin is under a warm and humid climate. The ancient fill such as soil walls and burial mounds have a natural water content of 20~30%, and are classified as CL. Their sand contents are less than 30%. Silt and clay part occupies almost of the soil and these are nearly same proportion.

3.2 Ancient fills construction methods in the Chang River basin

The oldest earth fill in China is the Chengtoushan remains (Hunan Province) soil wall (B.C.3.5 thousand) in the middle Chang River basin. The compacted one layer depth is about 20cm. As shown in Fig.5, much soil was filled without a dense compaction, namely filled by the Taichiku (a compaction method, in Japanese) method.

In the Chang River basin, the Hanchiku technique’s introduction was behind the Yellow River basin because a dense compaction was not need for the cohesive soils in the Chang River basin.
The Sanxingdui remains (Sichuan Province) in Chengdu Plain, in the upper Chang River basin is surrounded by the soil walls. The remained wall (B.C.2.5 thousand ~ B.C.1.6 thousand) partly shows horizontal layers by the Sochiku (an intermediate level’s compaction method between Hanchiku and Taichiku proposed by the author, in Japanese) method.

The burial mounds (Tudunmu in Chinese) in Jiangnan, the lower Chang River basin have been constructed during the Western Zhou period (B.C.1.1 thousand~) and the Warring State period (~B.C. 221). As shown in Fig.6 (Onitsuka et al. 2003), human remains are set on the ground in the earth fill.

The large sized burial mound for aristocrats in Zhejiang Province was compacted politely to horizontal layers using different soils. And each soil layer was compacted in order to mobilize their function. The compacted method can be observed as Sochiku or Hanchiku.

Fig.6. Schematic diagram of Jiangnan burial mound in China

4 NATURAL ENVIRONMENTS AND ANCIENT FILLS CONSTRUCTION METHODS IN THE NORTHEASTERN REGION OF CHINA AND NORTHERN KOREAN PENINSULA

4.1 Natural environments
The Northeastern region of China and Northern Korean Peninsula are mountainous and under a cold and less rainfall climate. It can be easy to get river field stones from the low water level’s river different from the Yellow River basin.

4.2 Ancient fills construction methods
In the late New Stone age (B.C.8 thousand~B.C.2 thousand), cairn (stone mound) burials started, and dolmens and stone coffin burials followed (Higashi and Tanaka 1995). Cairns are filled with river field stones, and human remains or coffins are set in the cairns.

The cairns in Niuheliang remains (Hongshan Culture period, B.C.4 thousand~B.C.3 thousand), Liaoning Province are well known as early cairn burials. The cairn burials appeared in Koguryo in B.C.1 hundred and developed to large sized burials such as the General tomb (early A.D.4 hundred) which has a corridor-style stone chamber in Jilin Province (Saotome 2000).

The burial mounds’ style and compaction method in the Yellow River basin propagated to the Korean Peninsula after setting of the Lelang Commandery (B.C.108~A.D.313) in the West Hang period. Much burial mounds are called as “Lelang burial mounds group” which has wooden or brick compartments under the ground. This underground burial style is affected by the burial style in the Yellow River basin.

5 NATURAL ENVIRONMENTS AND ANCIENT FILLS CONSTRUCTION METHODS IN THE NORTHERN KYUSHU, JAPAN AND SOUTHERN KOREAN PENINSULA

5.1 Environments
Northern Kyushu, Japan and Southern Korean Peninsula are separated by only a narrow strip of water, hence they have a similar warm climate. The hill where the Yoshinogari remains locate in the Northern Kyushu is covered with the volcanic ash (called as Aso 4, about 90 thousand years ago). The soil classification is MH (sandy clay). On the other hand, there are few volcanic ash deposits in the Southern Korean Peninsula.

5.2 Ancient fills construction methods
The oldest and large Yoshinogari burial mound in Japan was constructed by the Sochiku and Taichiku compaction method. Burial jars were laid on the dug hole and back filled very densely as shown in Fig.7 (Onitsuka and Hara 2012). The higher natural water content soil than the optimum water content can be compacted by foot. The overground burial is similar to the Jiangnan’s burial style. The ancient people in Northern Kyushu employed Jiangnan style because of similar environments. However, they utilized large sized burial jars instead of traditional coffins or compartments. This is a new idea to protect burial matters from damages due to the seepage water.

All burial mounds in Japan which followed the Yoshinogari burial mound are the overground burials which are similar to Jiangnan burials. In Sinra of the three Kingdoms of Korea period (late A.D.3 hundred~), many cairns with wooden compartments were constructed. These burials install wooden compartment under the ground. This underground burial style is similar to that in the Yellow River basin and the Lelang Commandery.

It seems that in the Southwest of the Korean Peninsula, jar burials with a mound were constructed in A.D.2 hundred. This is an overground burial style. Like this, the burial style in the Southwest region of the Korean Peninsula is similar to the Yoshinogari remains and other remains in Northern Kyushu, Japan. And similar style’s dolmens were constructed in both regions, hence it can be said that the Southwest region of the Korean Peninsula and the Northern Kyushu have a common burial style.
6 CONCLUSIONS

In the middle Yellow River basin where the Chinese Loess deposits, the *Hanchiku* technique was borne to overcome the weak points of the less in around B.C.3 thousand. In the Chang River basin, the employment of the *Hanchiku* method was behind the Yellow River basin, because it didn’t need to compact the Chang river basin’s cohesive soils so densely due to having some cohesions.

In Jiangnan region, since B.C.1.1 thousand, many burial mounds have been constructed. These are the overground burials. This burial style is a revolutionary change from conventional pit burials under the ground. The same overground burial style appeared in the Yoshinogari burial mound in the Northern Kyushu, Japan.

In the mountainous Northeast region of China, since about B.C.4 thousand, cairns burial using river field stones has started.

The Yoshinogari burial mound and following burial mounds in Japan and in the Southwest region of the Korean Peninsula are the overground burials which are the same as the Jiangnan burials. The ancient people in Japan and Korean Peninsula introduced the Jiangnan’s burial style for the reason of similar natural environments.

As mentioned above, the ancient earth fills construction methods in East Asia were newly borne and were introduced by the ancient people considering the regional and natural environments (climate, topography and geology) and earth fills functions. And burial mounds can be divided into two groups, namely, the underground burials and the overground burials according to the environments.

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