SPECIAL LECTURES

On the Oldest Aseismic Iron Bridge in Japan

by Yutaka TANAKA

Mr. President, Ladies and Gentlemen:

It is my greatest pleasure, as an aged member of the Japan Soceity of Civil Engineers, to have an opportunity to speak a few words at this memorable meeting.

As you know well, Japan is a country of cherry-blossoms and a country of Mt. Fuji, while on the other hand, Japan is situated on the main thoroughfare of the typhoon and Japan is a well-known country affected by the predominant earthquakes which shook at times around the Pacific, and it goes without saying that the study of seismology and earthquake engineering is of paramount importance.

The conference is now opened with the distinguished delegates from various countries of the world, in an effort to achieve and promote the hope for better future with a determined will, for which I should like to pay my respect to everyone who is here today.

Please let me take this opportunity to express my sincere appreciation of what the Local Arrangement Committee has accomplished under the chairmanship of Prof. Kiyoshi MUTO in connection with the many details necessary for the planning and execution of the Conference.

Now, may I take the liberty to give a nominated lecture: "On the oldest aseismic iron bridge in Japan and stonewalls of the Imperial Palace in Tokyo". Later, if we have enough time, a brief talking will be made about "On a new big caisson for bridge building".

In the traveler's guidebook of Tokyo, you will find a picture of the main gateway to the Imperial Palace. There stand two bridges, one is masonry arch bridge and the other is an iron arch. Both bridges were built some seventy years ago. They experienced the violent Kanto Earthquake of 1923 with no appreciable damage.

The foresaid iron bridge is known as Nijubashi, that literally means double bridge and is a wrought iron arch with three hinges. The arch was fabricated in Germany - by Hacourt A.G., Duisburg - and was built in 1888. The bridge consists of five solid ribs and has a span length of 24.4 m and a width of 10.7 m and it was erected, having a height of 14.3 m above water level of the moat.

In 1949, I obtained a nominated permission for inspection of this bridge, and in 1959, we measured the dimension of the supersturcture and made the complete drawings. In the meantime, we could refer to an official document which had been well preserved by the Imperial Household Agency, and we could obtain the following information.

As for the type of bridge, after the careful aseismic considerations, they came to a conclusion that the three hinged arch would be the best type to be adopted.

As for the substructure, they also made the utmost efforts. At each end of the bridge, they built a rigid tapered strut of brick-work in the directions of the arch thrust, which was 8 m long and embedded in the thick concrete foundation. This is the bridge now still in existence as the oldest beloved quakeproof metallic bridge in Japan, and if it is allowed to comment in this bridge, I will not hesitate to express my admiration for the prudential planning and procedures of execution.

From this actual example, the following two reasonings may be really recognized that a light metallic span is preferable to a heavy masonry bridge in such a case as this, and that arch bridge is generally aseismic, so far as it is built on the reliable foundation.

It was also reported that the responsible contractor who erected the bridge, guaranteed life of the bridge of one hundred and fifty years. However, as a result of our inspections, it was disclosed that the bridge already reached the age-limit, and the loading is now limited.

Next, I wonder if you may take notice of the interesting stone walls which stand near the bridge and along the moat of the Imperial Palace Castle.

In Japan, although there is no masonry wall so big as the well-known Great-Wall in China, still we have the stone walls of special construction around the old castles. The design and the method of execution of these walls are quite ingenious. They used pyramidal stones as the facing stones, and broken stones as packing and back filling materials. The facing stones have irregular polygonal faces but with nearly equal depths.

It is reported that the oldest stone wall was built at the Nijo Castle in Kyoto in 1569, since then, the walls had been built everywhere as the important parts of the castles through the feudal age. The wall of the castle of Kumamoto in Kyushu is well-known in its height of 18.6 m.

The present wall of the Imperial Palace is believed as built early in the seventeenth century (in 1628 ?).

The wall of this type claims the following merits: Good interior drainage, conformability with an appreciable yielding of foundation, and the aseismic feature, owing to the reasonable battering and effective back filling, in addition to the foregoing two characteristics.

In the present age, the construction of a big stone wall as this, is too expensive and it might be out of date, while, as a Japanese civil engineering structure of historic existence, the stone wall mentioned above might be noteworthy.

Allow me to continue my brief talking "On a new big caisson for bridge building".

After the extensive investigations on the damage of the bridges due to the Kanto Earthquake of 1923, we learned that the failures of the substructures might be the causes in high percentage.

The Reconstruction Bureau, which was established in 1923, soon after the violent quake, adopted the method of pneumatic caisson in order to build the deep reliable foundations of the bridges over the Sumida River in Tokyo.

The works were performed very successfully under supervisions of American Foundation Co., New York.

Since then, the foundation of bridges and buildings and even the underground railway tunnels have been and are being built by this method. The number of caissons sunk to the present time, is numbered not less than one thousand.

In this year, two big caissons, which measure 40 m x 17 m, have been sunk down to 20 m and 24.5 m under water level, as the foundations of the main towers of the Wakato Bridge, which is now under construction in Kyushu.

The Wakato Bridge is located over the gulf-mouth between Wakamatsu City and Tobata City. The bridge will be of a suspension type and the channel span will measure 375 m effective which will be the longest in the Far East. On the aseismic study of this bridge, the results of investigations will be disclosed later by Prof. K. KUBO.

One of the two caissons has been sunk by tHe Shiraishi Foundation CCo Co., Tokyo, and the other at the Wakamatsu side, by the Taisei Construction Co., Tokyo. The latter contractor sank a caisson of a new improved type, which was invented by Mr. Hiroshi UCHIDA, Vice President of Taiho Construction Co., Tokyo, who obtained a patent in 1951. The new caisson has double chambers, the lower is for working and the upper smaller is for air-locking.

In America, they use a steel man-lock of boiler shape for a big caisson, while the present new caisson dispenses with the steel lock, and the air chamber will be built in any size as required. For the big caisson the spacious air-lock is advantageous, because many workers will be able to be decompressed at one time.

In America, owing to the higher labor cost, the pneumatic methods are remarkably replaced by the other process, while, in the present, Japan is to be sorted as a country of pneumatic caisson, and I should like express our heart-felt gratitude to three American engineers of American Foundation Co., from whom we learned how to sink the pneumatic caisson in our country after the great earthquake of 1923.

Thank you.