

China's ancient water pipe networks show they were a communal effort with no evidence of a centralized state authority

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Photo of in situ water pipes leading to a drainage ditch near Pingliangtai's southern gate. Credit: Yanpeng Cao

A system of ancient ceramic water pipes, the oldest ever unearthed in China, shows that neolithic people were capable of complex engineering feats without the need for a centralized state authority, finds a new study by University College London researchers.

In a study published in *Nature Water*, the [archaeological team](#) describe a network of ceramic water pipes and drainage ditches at the Chinese walled site of Pingliangtai dating back 4,000 years to a time known as the Longshan period. The network shows cooperation among the community to build and maintain the [drainage system](#), though no evidence of a centralized power or authority.

Dr. Yijie Zhuang (UCL Institute of Archaeology), senior and corresponding author on the paper, said, "The discovery of this ceramic water pipe network is remarkable because the people of Pingliangtai were able to build and maintain this advanced water management system with stone age tools and without the organization of a central power structure. This system would have required a significant level of community-wide planning and coordination, and it was all done communally."

The ceramic water pipes make up a drainage system which is the oldest complete system ever discovered in China. Made by interconnecting individual segments, the water pipes run along roads and walls to divert rainwater and show an advanced level of central planning at the neolithic site.



Closeup photo of water pipe segments fitted together in situ at Pingliangtai.
Credit: Yanpeng Cao

What's surprising to researchers is that the settlement of Pingliangtai shows little evidence of social hierarchy. Its houses were uniformly small and show no signs of social stratification or significant inequality among the population. Excavations at the town's cemetery likewise found no evidence of a social hierarchy in burials, a marked difference from excavations at other nearby towns of the same era.

But, despite the apparent lack of a centralized authority, the town's population came together and undertook the careful coordination needed to produce the ceramic pipes, plan their layout, install and maintain them, a project which likely took a great deal of effort from much of the community.

The level of complexity associated with these pipes refutes an earlier understanding in archaeological fields that holds that only a centralized state power with governing elites would be able to muster the organization and resources to build a complex water management system. While other ancient societies with advanced water systems tended to have a stronger, more centralized governance, or even despotism, Pingliangtai demonstrates that was not always needed, and more egalitarian and communal societies were capable of these kinds of engineering feats as well.



Segment of ceramic water pipe excavated from Pingliangtai, now at Henan Provincial Institute of Cultural Relics and Archaeology in Huaiyang. Credit: Yanpeng Cao

Co-author Dr. Hai Zhang of Peking University said, "Pingliangtai is an extraordinary site. The network of water pipes shows an advanced understanding of engineering and hydrology that was previously only thought possible in more hierarchical societies."

Pingliangtai is located in what is now the Huaiyang District of Zhoukou City in central China. During neolithic times, the town was home to about 500 people with protective earthen walls and a surrounding moat. Situated on the Upper Huai River Plain on the vast Huanghuaihai Plain,

the area's climate 4,000 years ago was marked by big seasonal climate shifts, where summer monsoons would commonly dump half a meter of rain on the region monthly.

Managing these deluges was important to prevent floodwaters from overwhelming the region's communities. To help mitigate the excessive rainwater during the rainy seasons, the people of Pingliangtai built and operated a two-tier drainage system that was unlike any other seen at the time. They built simple but coordinated lines of [drainage ditches](#) that ran parallel to their rows of houses in order to divert water from the residential area to a series of ceramic water pipes that carried the water into the surrounding moat, and away from the village.



Segment of ceramic water pipe excavated from Pingliangtai, now at Henan Provincial Institute of Cultural Relics and Archaeology in Huaiyang. Credit: Yanpeng Cao

These ceramic water pipes represented an advanced level of technology for the time. While there was some variety in decoration and styles, each [pipe](#) segment was about 20 to 30 centimeters in diameter and about 30 to 40 centimeters long. Numerous segments were slotted into each other to transport water over long distances.

Researchers cannot say specifically how the people of Pingliangtai organized and divided the labor among themselves to build and maintain this type of infrastructure. This kind of communal coordination would also have been necessary to build the earthen walls and moat surrounding the village as well.

The Pingliangtai drainage system is unique from water systems elsewhere in the world at the time. Its purpose to drain rain and [flood water](#) from monsoons differs from other neolithic systems in the world, many of which were used for sewerage water drainage or other purposes.

More information: Hai Zhang, Earliest ceramic drainage system and the formation of hydro-sociality in monsoonal East Asia, *Nature Water* (2023). [DOI: 10.1038/s44221-023-00114-4](https://doi.org/10.1038/s44221-023-00114-4).
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