Stairs are a common architectural element in our daily lives and an indispensable part of architectural history.From modern buildings to ancient temples and churches,stairs are often found and serve as records of human history. However, as time passes, the surface of stairs gradually develops uneven wear due to long-term use. These wears not only reflect how often and how the stairs were used, but also contain information about when they were built and the materials used, providing archaeologists with important clues about the history of the building.

Despite the important research value of stair wear, there are still relatively few targeted and systematic studies. Up to now, most analyses rely on qualitative observations and lack an analytical framework that can quantify wear patterns and their effects. To fill this research gap, there is an urgent need to develop mathematical models that combine the wear characteristics of stairs with information on foot traffic frequency, weight distribution, and environmental factors.

As shown in Fig. n, the wear traces of stairs exhibit complex and diverse patterns. Combining these features, the goal of our article is to provide archaeologists with a feasible measurement method and quantitative analysis of stair wear by building a mathematical model to excavate the historical and cultural information in the wear of stairs.