To analyze the wear of stairs, it is essential to study how the force acts on the stairs when a person walks on them. Based on previous studies, we establish the Step Load Interaction Model (SLIM) to analyze the way forces act on stairs when a person walks on them.

When a person walks on the stairs, the shoe is the only part that directly contacts the ground. Based on assumption n, without considering footwear such as high-heeled shoes, which significantly change the way the force acts, and neglecting the mass of the shoe itself, we can consider the force of the shoe on the ground to be equivalent to the force of the foot on the shoe. That is, under this simplified condition, the shoe does not affect the magnitude and distribution of the force.

By reviewing the literature, we obtained an Infrared pressure distribution diagram of the force on the foot when a person is walking up and down stairs[1]. The blue part of this map indicates the minimum pressure and the orange and red parts indicate the maximum pressure. The parts with the highest pressure correspond to three parts of the foot, i.e. the Hallux region (first metatarsal), the Metatarsals two and three& the Metatarsals four and five regions, as well as the Medical and Lateral Calcaneus regions, which are defined as the main force-bearing areas. To further study the area of the main force-bearing areas and its relationship with the total area of the foot, we first outlined the projection profile of the foot with a black line on the infrared distribution map. Subsequently, the grid method was used to process the images: when a certain grid was covered by one-half or more of the image area, it was counted as one grid, otherwise, it was ignored.

Then, we counted 32 grids covered by the main force-bearing areas and 118 grids covered by the total projection of the foot, with the area share of the main stress portion being about 0.2712. Based on the average foot area of a U.S. citizen (approximately 245 %square centimeters%), we calculated the average area of the main force-bearing areas to be 66.44 %square centimeters%, taking 66 %square centimeters% to simplify the problem.

Thus, we can abstract the force of the foot on the stairs to the action of the main force area. According to the assumption n, **the force exerted by a person walking on the stairs can be further simplified into the model shown in Figure n.**

Figure n shows that a countertop of stairs can be divided into two parts: the actual footprint section and the weathering section. To simplify the model, we assume that all stepping occurs in the actual footprint section and analyze the wear only in this section in the formal modeling.