

# Characteristic Parameters Analysis on Breast Shape for Moulded Bra Cup and Bra Structure Design

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## Abstract

At present, bra enterprises usually use under bust girth and bust differences to design bra pattern. These kind of bras do not consider the differences of breast shapes and therefore cannot not satisfy the demands of fit and comfort of different breasts. This paper firstly elaborates on the effect analysis of bra wearing to discover the differences then verifies the importance of breast characteristic parameters. Then a three dimensional laser scanner is used to measure the size of 75B of young female breast shape to collect data. In order to analyze breast shape change rule for moulded bra cup and bra structure design, basic statistics analysis, factor analysis and cluster analysis were conducted for breast data. Finally, six major characteristic parameters on breast height, bust external side slope, breast depth, under bust depth, biacromial breadth and center front point-bust inner point length were extracted for bra structure design. Also, cluster analysis was used to divided breast shapes into three shapes. The results of the paper can be used for providing technical parameters and theoretical basis for further study of bra structure design. It also explores a new direction of the development of tailored moulded bra cup and bra structure design.

*Keywords:* Breast Shape; Characteristic Parameters; Bra; Structure Design

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## 1 Introduction

There are many variations of female breast shapes. Although different people may have the same bust girth and bust difference, the same size and style of bra may bring discomfort while wearing. Wearing these bras would result in a mismatch between cup and breast, leading to inappropriate pressures and discomfort for breasts. Finally it cannot achieve the requirements of the tailored bras varieties, nor provide the perfect based data for scientific and rational bra pattern design. It is known that China's current bra standard follows a generic bra size industry standard. The classification of bra size and pattern design might only depend on the national standard in the bust and under bust girth [1]. However, these two data just reflect the laws of bust girth dimensional

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change. It is necessary to conduct a more detailed study for suitable moulded bra cup and bra structure design on female breast shape.

It is very important for moulded bra cup and bra structure design to reflect the proportions features on different breast shape and body to achieve the common pursuit of aesthetic effect. For example, in order to beautify the disc type breast, bra structure design should increase its breast height; In order to have enhanced beauty affect for disc type breasts, the bra structure design should raise and collapse its cups. When dealing with sagging breasts, folding methods and other more forceful ways are used to ensure that the breast is situated in an ideal location. A comfortable and suitable bra is crucial in ensuring the best position for the breast to enhance its attractiveness [2]. However, there are many women that are categorized in between the two breast shapes. More anthropometric research and detailed study are necessary for moulded bra cup and bra structure design.

Currently, anthropometric measurements and body analysis has attracted more and more attention. There was a measurement report which disclosed that 75.8% of measuring bra shape were different from actual sizes in North service-love Ergonomic Institute recorded in August 2002 [3]. 1,742 individuals were enrolled as subjects to try bra in anthropometric survey of Duan XJ investigation. It was discovered that the standard bra size only accounted for 27.9% of the consumer with an inconsistency of 72.1% for the other users [3]. The analysis of the data including bust girth, breast pitch, bust height from Wang JP showed that the results reflects 30 young women bust structural features to achieve young females bust structural features, varied laws and relative values according to ergonomic principles [4]. It was believed by Rong Z that the series of breast segmentation should not be based on the bust and bust girth. As a consequence, he introduced a new series of breast shapes by switching under bust girth and breast deep wide ratio as segment parameters [5]. Qi J considered that the breast data from girls wearing the same size bra showed larger differences. Suggestions were given for further improvements in girls bra size specifications, such as the division into age groups of statistical data analysis, new classification of the breast, and refined grading values [6]. The measurement of transverse thoracic sagittal diameter ratio RB (refer bust line bust and bust thick horizontal length ratio) of 197 women aged 18-50 from Wang HE. She divided the bust shape into high breast shape, flat breast shape and normal breast shape after cluster analysis, which included high breast shape accounting for 32%, flat breast shape accounting for 17.3%, normal breast shape accounting for 50.7% [7]. Ying BA presented a parametric study on the relationships of feature points and feature curves of moulded bra cups and model shape by analyzing modeling of digital moulded bra cup [8]. Liang SZ sliced, chosen point and computed relative bust key part about 10 breast basic shape by measuring 254 female undergraduates in Western China. The results divided basic shapes of breasts into 9 classes [9]. Moreover, a report from Jia JJ and her collaborators showed that they applied K-means Cluster analysis to classify the girls' breast shapes into 9 types [10]. In addition, previous experimental researches [11-14] have concentrated on the assessment of the emotion space of bra and the analysis of the function of the shoulder strap, verifying the effect of sports bras on thermal regulation of the breast by exercise.

In many research fields of the moulded bra cup and bra structure design, a mapping method was put forward to construct blouse's body block with just-fit design by Ning GH, basing on true female body sizes [10]. Chen XP proposed that bra structure design should be in conformity with the size and body shape and shoulder strap position should be in conformity with body structure characteristic. After collection of data, comparison and classification of the existing bra prototypes at home and abroad were carried out. Last but not least, bra specification should have larger coverage and suitability of the crowd, especially in the moulded bra cup and bra structure