INTRODUCTION

The sandy coast is usually separated by the natural headland. When the dominant wave reaches the shoreline at a certain angle, a special morphology, headland-bay beach is usually formed in the direction of the dominant wave(Silvester R and Hsu JRC,1993). It is a major terrain of the headland-bay sedimented beach, accounting for about 50% of the world's total coastline(Short AD and Masselink G,1999). When the sediment supply of a headland-bay beach ceases over time, the indentation will increase and the shoreline will erode back to a limiting shape, which is termed “static equilibrium”(Hsu et al., 1989b). Under the prevailing erosion of the sandy coast, the shoreline engineering projects for the purpose of shoreline protection and port construction alter the original morphology of the headland-bay beach. Therefore, a stability analysis is usually required before the development and exploitation of headland-bay beach.

In the 1940s, the scientists introduced the empirical function to describe the influence of the coastal structures on the beach. Through the fitting for the existing beaches, the beach stability was analyzed. The logarithmic spiral, hyperbolic and parabolic models are the most commonly used planform model for describing the equilibrium morphology. The parabolic model is a widely used empirical relation for determining the static equilibrium morphology of the headland-bay on the planform(Moreno LJ and Kraus NC,1999;Gonzalez M and Medina R,2001;Klein AHF,et a1,2003). It considers the influence of upstream headland and wave diffraction, and therefore has high engineering value(Yang YX and Zhang JB,2007). Silvester and Hsu (1993) further demonstrated the reasonability of parabolic model, which is later applied in the bay stability analysis on an extensive scale. Li, Chen (2006) and Yu (2010) held the view that the parabolic model is the most ideal of the three. They applied this model to the stability analysis of headland-bay in South China coast and suggested its ability to predict the long-term evolution of the coast. Jackson DWT (2010) used the parabolic model to analyze and predict the conditions of 9 headland-bay beaches in north Ireland.

The parabolic model allows a judgment and prediction on the long-term equilibrium and stability of the arc-shaped shorelines from the perspective of shoreline morphology. This provides good reference and indicative value for the development and protection of the coast. However, judgment and prediction are only qualitative discussions on the long-term evolutionary trends of the beach. With this method, a quantitative analysis of the short-term shoreline changes is impossible. In order the quantitatively determine the stability of the headland-bay sandy coast, DSAS (Digital Shoreline Analysis System, Version 4.3 (Thieler ER, et a1, 2008) recommended by US Geological Survey is used in this study. One of the applications of DSAS is in calculating the shoreline change rate of Accra's coast in Ghana from 1904 to 2002(Addo KA, et a1, 2008). Here the dry-wet boundary line and the mean sea level from the digital aerial images are used to test the stability of the shoreline obtained by different researchers (Limber PW, et a1, 2007). The shoreline evolution since 1884 for the coastal habitats between Ribble and Mersey Estuaries is analyzed (Esteves LS, et a1, 2009).

Typical headland-bay beaches are developed on Zhejiang's coast. Under the double actions of natural and human factors, some parts of the beach become steeper, and sand grains are coarsened and the