THESIS INFORMATION

Title:	**RESEARCH STABILITY OF HAU RIVERBANKS IN AN GIANG PROVINCE AND PROPOSING APPROPRIATE PROTECTION SOLUTIONS**
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Riverbank instability in the Mekong Delta has been happening very complicatedly on the soft ground of Quaternary sediments. In recent years, the instability of the Hau riverbanks through An Giang province has been occurring with increasing intensity and scale. Some sections of the Hau riverbanks have been recorded seriously landslide, such as Binh Duc Ward, Binh Khanh Ward in 2012, in My Hoi Dong Commune in 2017, at the Highway 91 in 2010. This phenomenon has been repeated in the years of 2019 and 2020. In order to minimize the severe damage caused by riverbank landslide, erosion and collapse in An Giang Province, the riverbank instability and riverbank protection have been studied and proposed scientifically and systematically. Therefore, the PhD thesis title **" Research stability of Hau riverbanks in An Giang province and proposing appropriate protection solutions "** was selected.

The research methods used in this thesis were literature review; geological structures, Quaternary geology, hydrogeology engineering geology in order to divide the soft ground types of the river banks; theoretical and experimental methods of soil mechanics; numerical models such as GeoSlope / W, Mike, Plaxis and Auto Cad to analyze and simulate the process of riverbank instability.

The results of the thesis can be summarized as following:

- River bank stability study is a complicated research direction. There are many influencing factors causing the instability of the riverbank. Therefore, when studying riverbank stability, it is not possible to study a single direction, but it is

necessary to research multidisciplinary - interdisciplinary to assess the overall process of destruction, causing instability of riverbanks.

- The soft ground structures on Hau riverbanks in the section flowing through An Giang province have been divided into 2 main types (Type I, Type II) corresponding to 5 subtypes (subtypes IA, IB, IC, IIA, IIB). These types of structures are the main cause of riverbank instability. The IA structure was found in the destabilized areas such as Chau Doc City, Long Xuyen City. The IB structure was found in the instable and landslide areas such as Binh My Commune, Binh Duc Ward, Binh Khanh Ward. With the structure type IIA, IIB causing instability and erosion at the islets on Hau river in the study area.
- Hydrodynamic conditions - The morphology of Hau river which flows through An Giang province has been influenced from Tien river through Vam Nao river caused high velocity. The areas of Binh My commune, Binh Duc ward, Binh Thanh islet, My Hoa Hung is directly affected by hydrodynamic flow and flow direction is the main factor causing the instability of the riverbanks. In addition, river flows impact directly on the riverbanks because of the curvature causing instability like Binh My commune. Some areas tend to expand the riverbank causing instability of riverbanks such as: Binh My commune, Binh Duc ward, Binh Khanh. The increase in volume, scale and frequency of boats on the Hau River has continuously created vessel waves and wind waves with a height of more than 0.3m, directly affecting the riverbank bedrock has a large shrinkage and swelling, have impacted on the riverbank directly and severely, promoting erosion and destabilizing riverbank at the tip of the isle Binh Thanh and My Hoa Hung isle.
- The research results of the thesis have also found three mechanisms: the erosion mechanism, the collapse mechanism, and the landslide mechanism. The landslide mechanism demonstrates the areas of riverbank instability such as: Binh My commune, Binh Duc ward, Binh Khanh ward. Collapse mechanism, erosion mechanism for Hau river bank appeared at the tip of Binh Thanh isle and My Hoa Hung isle.
- A zoning map for predicting stability of the Hau riverbanks in An Giang province also was established. This map was based on the principle of superposition of data

layers from the stable and unstable zoning maps. Factors affecting the stability of the Hau riverbanks were divided into 3 main regions: region of instability, region of instability risk and region of stability. Unstable areas in Chau Doc city, Binh My commune, Binh Thanh islet, My Hoa Hung islet and stable areas in An Chau town, Binh Long commune have been discovered.

- Appropriate proposed solutions for riverbank protection have been chosen and designed. Soil cement piles to cohesive sand traps can be used for the unstable riverbanks in Binh My Commune. A groyne to adjust the flow direction can be applied in Binh My commune. Gabions to reduce or eliminate the impact of flow and wave energy can be used in Binh Thanh isle and My Hoa Hung isle. In My Hoa Hung isle, it is possible to use larsen piles for areas with geological structure of type IA, soil cement piles of areas with geological structure of type IB to protect the riverbanks. Around My Hoa Hung islet, sand mining can be carried out to clear the flow of An Thanh Trung isle, or at the beginning of Pho Ba isle.

These research results can be used as a reference for the study feasibility and effective solutions for protecting riverbanks in the Mekong Delta and other regions.

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