

# Landslide problems along Highway of Central Vietnam

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Kyoto, 07<sup>th</sup> October 2012



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### 1. Introduction

- ❖ Vietnam has an area of 331.688 km<sup>2</sup> and over one million km<sup>2</sup> of continental shelf.
- ❖ The population in 2011 was estimated at 87.84 million people.
- ❖ Three - quarters area of Vietnam is mountainous.



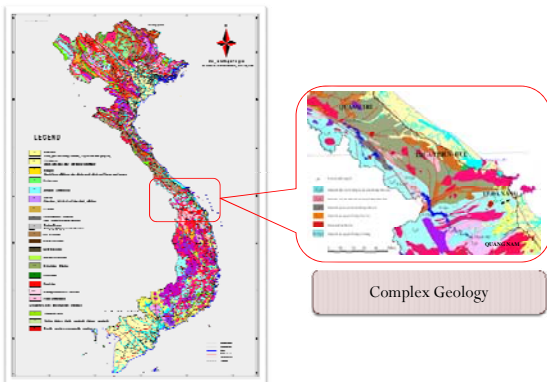
### 2. Highway system in Vietnam

- ❖ The total length of Highways in Vietnam is about 17.500 km, accounting for 8.0% of the total length of the road network.
- ❖ There are only two National Highways from the North through Central to the South of Vietnam.



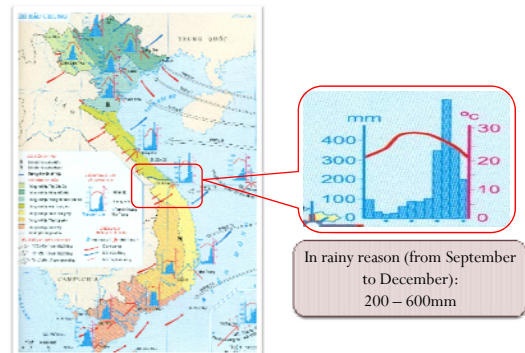
Traffic map of Vietnam

### 3. Geology and rainfall characteristic of Central Vietnam



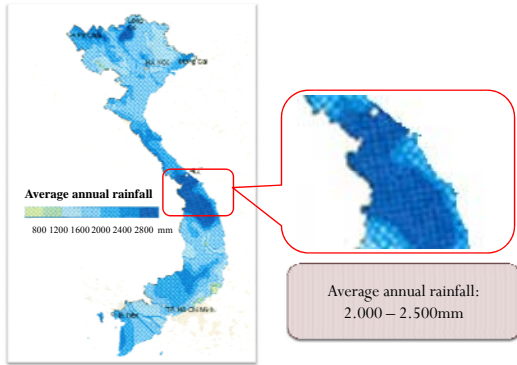
Geological map of Central Vietnam

### 3. Geology and rainfall characteristic of Central Vietnam



Average monthly rainfall map of Central Vietnam

### 3. Geology and rainfall characteristic of Central Vietnam



Average annual rainfall map of Central Vietnam

### 4. Landslides Problem in Central Vietnam

- Landslide is a common geo-disasters caused by natural occurrences and human activities.
- In recent years, landslides occur more and more, and their consequences are growing.
- In Vietnam, landslides mainly occur in mountain area. On 16 February 2012, a landslide occurred on National route No.6 in Hoa Binh city and took two lives.
- Each year landslides occur frequently along the highway in Vietnam, especially in Central Vietnam.
- Landslides cause serious damage to lives and property in Central Vietnam.

### 4. Landslides Problem in Central Vietnam

- There are about more than 200 landslides sites along highways in Central Vietnam every year.
- Estimated number of fatalities per annum due to landslide occurrence is about 30.
- About 15-kilometer highway was affected by the landslides with minimum distance of 100 m.
- Ministry of Transport have cost hundreds of billion VND (equivalent to tens of millions of USD) to repair the highways after landslide occurred in rainy season.

*(According to Institute of Transport Science and Technology  
Ministry of Transport – Vietnam)*

### 4. Landslides Problem in Central Vietnam



Landslide along Ho Chi Minh National Highway

### 4. Landslides Problem in Central Vietnam



Landslide along Ho Chi Minh National Highway

### 4. Landslides Problem in Central Vietnam



Landslide in Ho Chi Minh National Highway, Km399T+000

## 5. Conclusion

In Central Vietnam, there are some problems in landslide as follow

- ❖ Three-quarters of the area is mountainous and the terrain is complex.
- ❖ Geology is complex.
- ❖ Average annual rainfall is high.
- ❖ The landslides were triggered by the combined effect of heavy rainfalls and topographic complexity of the area, which destroyed roads, bridges and tunnels.
- ❖ My country need to develop high technology on risk assessment of landslides along the highway, especially in Central Vietnam.

## 6. Proposal

Analyzing the Impact of Rainfall and Geological Structures to Landslide Hazard on Slope in Central Vietnam

### Research method

- Data collection of rainfall and geological structures in Central Vietnam;
- Laboratory test using portable dynamic undrained ring shear apparatus and direct shear apparatus;
- Model test with different rainfall intensity and geological structures in laboratory;
- Numerical simulation.

### Expected results

- The effect of different geological structure on landslide with the same rainfall intensity;
- The effect of different rainfall intensity on landslide with the same geological structure;
- Obtain landslide hazard maps in Vietnam based on rainfall and geological structure;
- Establish monitoring and early warning system.

## 6. Proposal



Shear ring test apparatus will be in Vietnam

## 6. Proposal



Model slope apparatus will be in Vietnam

The 10<sup>th</sup> International Symposium on Mitigation of Geo-disasters in Asia

Monitoring system image in Son La



Monitoring system will be in Vietnam

