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PROTECTING LIFE FROM GEO-DISASTER AND ENVIRONMENTAL HAZARDS

Editor:
Doni Prakasa Eka Putra
Wahyu Wilopo
PREFACE

The International Symposium and 2nd AUN/Seed-Net Regional Conference on Geo-Disaster Mitigation in ASEAN is done on 25-26 February 2010 at Bali, Indonesia, with a selected theme “Protecting Life From Geo-Disaster and Environmental Hazards”. This event is organized by the Department of Geological Engineering, Faculty of Engineering, Gadjah Mada University in cooperation with the ASEAN Foundation, and AUN/Seed-Net JICA.

The symposium is feature oral and poster presentations, in which conference participants are share their experience on geo-disaster and environmental hazards mitigation including hazard assessment, prediction, reduction of risk and the development of early warning system. In this proceeding, various issues are being analyzed and review, including earthquakes, tsunamis, flooding, typhoons, volcanoes, landslides, disaster mitigation and policies, and groundwater contaminations.

We are indeed most grateful to the conference participants, all of whom promptly send their papers. Without their active collaboration and support, this proceeding simply would not possible. We would also like to express our very special appreciation to all members of organizer committee and organizations, for their support and effort to make this conference successful.

Dr. Doni Prakasa Eka Putra & Dr. Wahyu Wilopo
Editors
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Effects Of Tunnel Excavation On Adjacent Buildings In Ho Chi Minh Urban Area

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ABSTRACT
Prediction on damage to existing buildings due to tunnel excavation is necessary for any tunnelling projects especially in urban area of Ho Chi Minh City where the Ben Thanh-Ba Son Railway Twin-Tunnel alignment underlay difficult subsoil condition of clayey sand, medium dense and presence of groundwater. The 3-storey building located close to the alignment has been focused in this paper.

Both of empirical method and finite element method (FEM) were used in this study. The empirical method so called “Greenfield” that was used for preliminary assessment. In detail evaluation, the Finite element method was applied. In the first simulation, the building was modelled with its equivalent piers; in the second case, the building was modelled with its real piles. According to analysis results, the building was predicted based on the Rankin damage classification (1988).

Analyses of tunnel excavation were carried out with various volume losses of 1.0% to 4.0%. Greenfield pointed out that the settlements were increased significant after each phase of excavation whereas analyses from Finite Element method showed the building settlement was slightly increased. Effects of excavation of Tube 1 on the building are less dangerous than from Tube 2 that were predicted in three approaches. Most analyses from the numerical model in both of two the simulations predicted similar damage categories and less than from the Greenfield. Finally, the building was predicted approximate damage category 3 due to tunnel excavation with occurrence of the volume loss of 3.0%.

Keywords: tunnelling, volume loss, greenfield, FEM, damage.

INTRODUCTION
The Ben Thanh–Ba Son Twin-Tunnel Alignment is a stretch of the Ben Thanh–Suoi Tien Railway project (Route No.1 in Figure 1). It is partially going to be excavated underground by Slurry Shield Machines. The tunnel layout in longitudinal section (Figure 2) and in transverse section (Figure 3) showed the twin-tunnel alignment consists of two tubes, down Tube (Tube 1) and up Tube (Tube 2). The depth of Tube 1 and Tube 2 axes are at 25.0 m and 13.0 m below the ground surface, respectively. The ground surface elevation is at 2.0 m above the sea level. The tunnel mostly underlay the medium dense Clayey sand of the Pleistocene formation. Aim to avoid effects of the down Tube on the up Tube so that the tunnel excavation process is assumed that the Tube 1 will be carried out before the Tube 2.

METHODS OF STUDY
Predicting tunnel induced deformation of such buildings and assessing the damage is an essential part of planning, design and construction of tunnels in an urban environment (Mair et al, 1996). The main factor influences to results of tunnelling prediction that is the volume loss. It is the key in both empirical and numerical analyses. In these analyses, the volume loss (VL) was applied various values in the range 1% to 4%. In this study, the predictions were mainly divided into two stages of preliminary assessment and detail evaluation (Figure 5).

PRELIMINARY ASSESSMENT
In this stage, the Greenfield method is applied for the preliminary analysis. Assuming that building’s structures are completely flexible or without stiffness, and undergo the same deformation as the ground. Surface settlement due to tunnelling is a 3D problem (Fig. 4). In the case of a single tube and a homogeneous medium, the generalized expression is described as:

\[ S_r = \frac{V_r}{\pi t^2} \cdot e^{-\frac{x^2}{2t^2}} \cdot \left[ G \left( y_i - y_0 \right) - G \left( y_i - y_0 \right) \right] \]

Where:
- \( S_r \): Surface vertical settlement at an \((x, y)\) location (m);
- \( x \): Distance of the considered point from the tunnel axis (m);
- \( y \): Longitudinal position of the considered surface point (m);
- \( V_r \): Volume of the settlement trough per meter of tunnel advance (m³/m);
- \( y_0 \): Initial position or starting section of the tunnel (m);
- \( y_1 \): Position of the tunnel face (m);
- \( i \): Trough width parameter, expressed as: \( i = k_{m}(z_0 - z) \), where "k" is a dimensionless constant, depending on soil type, and "z_0" is the depth of the tunnel axis below surface. For clay soils is \( i \approx \)
Figure 1. Ben Thanh-Ba Son railway tunnel Alignment No.1 (Tedisouth, 2007)

Figure 2. Geoengineering profile along the Ben Thanh – Ba Son tunnelling alignment (Modified after Tedisouth, 2007)

\[(0.4\pm0.6)(z_0 - z); \text{ non-cohesive soils is } i \approx (0.25\pm0.45)(z_0 - z)\].
Figure 3. Layout of the tunnels

Figure 4. Three dimensional surface settlements trough (after Attewell et al., 1986)

G: Function defined as:

\[ G(\alpha) = \frac{1}{\sqrt{2\pi}} \cdot \int_{-\infty}^{\alpha} e^{-\frac{x^2}{2}} \, dx \]

(2)

Where:
\[ \alpha = (y - y_0)/i; \quad G(0) = 0.5 \text{ when } y = y_0 \text{ (point above the tunnel face)}; \quad G(1) = 1.0 \text{ when } (y - y_1) \to \infty \]

G can be calculated for different values of \((y - y_1)/i\) and listed in standard probability tables such as given by Attewell & Woodman (1982) or in most statistics text books.

This 3D problem can be interested in evaluating 2D analysis of the transverse settlement trough in a certain section. If the position 'y' of the considered cross-section has the following characteristics: \((y - y_0)/i > 3\) and \((y - y_0)/i < -3\), then \(G[(y - y_1)/i] = 1\) and \(G[(y - y_0)/i] = 0\) (i.e. the cross-section is well behind the tunnel face, then the generalized expression (1) becomes as follows:

\[ S_v(x) = S_{v,\text{max}} \cdot e^{-\frac{x^2}{2\sigma^2}} \]

\[ S_{v,\text{max}} = \frac{V_t}{2\pi i} \]

\(S_{v,\text{max}}\) is the maximum vertical displacement at the transverse distance \(x=0\); \(V_t\) is the volume loss.

Evaluating the settlement of the greenfield, Rankin (1988) provided guidelines of how the maximum settlement \((S_{\text{max}})\) and the maximum slope \((\theta_{\text{max}})\) of a potential building damage (Table 1). Once the maximum slope of more than
1/500 and maximum settlement of more than 10mm the building is damaged and going to the detail evaluation.

DETAIL EVALUATION

In this section, the finite element method is mainly applied for analysis of the interaction between soil and structures. In case of complex building foundation, including large amount of piles under the pile cap these piles can be simulated by an equivalent pier (Poulos & Davis, 1980). The Diameter and Young’s Modulus of the equivalent pier are calculated as:

\[
D_{eq} = \frac{A_{eq}}{2\sqrt{\pi}}
\]

\[
E_{eq} = E_s + (E_p - E_s) \frac{A_{eq}}{A_p}
\]

Where

\(A_p\): The plan area of the pile group as a block; \(E_p\): The Young’s Modulus of the piles; \(E_s\): The average Young’s Modulus of the soil; \(A_{eq}\): The total cross-sectional area of the piles in the pile group.

The maximum slope (\(\theta_{max}\)) and maximum settlement (\(S_{c,\text{max}}\)) are the control parameters for evaluating the building damage. If the damage risk remains high the building has to be considered whether protective methods are necessary. In this study, the settlement control will only be required for the damaged buildings which were after detail evaluation remain in damage category more than 3 (Rankin damage classification, 1988).

RESULTS AND PREDICTION

Greenfield analysis of the building was based on assuming the building's structures are completely flexible or without stiffness, same deformation as
Table 1: Damage Classification established by Rankin (1988)

<table>
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<tr>
<th>Damage Category</th>
<th>Severity Degree</th>
<th>Description of typical damage</th>
<th>Control Parameters</th>
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<tr>
<td></td>
<td></td>
<td></td>
<td>( \theta_{\text{max}} )</td>
</tr>
<tr>
<td>1. Aesthetic</td>
<td>Negligible</td>
<td>Superficial damage unlikely</td>
<td>(&lt; 1/500)</td>
</tr>
<tr>
<td>2. Aesthetic</td>
<td>Slight</td>
<td>Possible superficial damage which is unlikely to have structural significance</td>
<td>(1/500) – (1/200)</td>
</tr>
<tr>
<td>3. Functional</td>
<td>Moderate</td>
<td>Expected superficial damage to buildings and expected damage to rigid pipelines.</td>
<td>(1/200) – (1/50)</td>
</tr>
<tr>
<td>4. Serviceability and structural</td>
<td>High</td>
<td>Expected structural damage to buildings and to rigid pipelines; possible damage to other pipelines.</td>
<td>(&gt; 1/50)</td>
</tr>
</tbody>
</table>

the ground. The settlements of the building due to tunnel excavation were shown in Figures 6-13.

Finite element analysis of the building with its equivalent pier (FEM-equivalent pier) was modeled in the 2D simulation of tunnel excavation that the structure’s stiffness and the weight, as well as the surface loads were cooperated. The interaction between tunnel – soil – pier – building was performed in the same model. The settlements of the building due to tunnel excavation including its initial settlement were presented in the following Figures 6-13.

Finite element analysis of the building with its real piles (FEM-real piles) was modelled in the 2D simulation of tunnel excavation that factors were similarly considered to the previous approach of FEM-equivalent pier. However, in this approach, not only performance of interaction between tunnel – soil – pile – building but also interaction between pile and pile under each the pile cap were simulated in the same model. Therefore, the building settlement was predicted according to this approach is more reality. These results were compared with Greenfield and FEM-equivalent pier approach in Figures 6-13.

![Figure 6: Comparison of building settlements due to excavation of Tube 1 with VL =1.0% between Greenfield and FEM](image-url)
Figure 7: Comparison of building settlements due after excavation of Tube 2 with VL =1.0% between Greenfield and FEM

Figure 10: Comparison of building settlements due to excavation of Tube 1 with VL =3.0% between Greenfield and FEM

Figure 8: Comparison of building settlements due to excavation of Tube 1 with VL =2.0% between Greenfield and FEM

Figure 11: Comparison of building settlements due after excavation of Tube 2 with VL =3.0% between Greenfield and FEM

Figure 9: Comparison of building settlements due to after excavation of Tube 2 with VL =2.0% between Greenfield and FEM

Figure 12: Comparison of building settlements due to excavation of Tube 1 with VL =4.0% between Greenfield and FEM
RECOMMENDATION

After carrying out the Tube 1 the building and the ground were settled and deformed. Most the initial conditions were changed therefore re-investigation is necessary before continue to excavate the Tube 2.

This prediction should be verified with the Plaxis 3D tunnel. It can give the full analysis of not only in transverse settlement but also in longitudinal settlement when driving the tunnel and the need of additional support to be installed ahead of the excavation which the 2D analyses were not capable of predicting the need of the pre-support.

The three-storey building was predicted at category 3 due to tunnel excavation. Therefore, requires controlling the volume loss of less than 3% and monitoring of the building at positions of the first column and second column from the tunnel axis.

Protective methods for the building structure are also necessary. The following typical methods for settlement control were introduced such as:

- Improvement of ground characteristics is used for reinforcement of the ground due to tunnel excavation.
- Structural stiffness improvement of buildings: One way of reducing the sensitivity of existing buildings prior to tunnel excavation.
- Increasing the rate of tunnel advance can be selected for improvement of volume loss.

REFERENCES


Rankin, 1988 “Damage classification”, mechanized tunneling in urban areas, design methodology and construction control, 2007, p.137.

Certificate

Proudly certifies that

Prof. Dwikorita Karnawati

Participated in
International Symposium and The 2nd AUN/Seed-Net Regional Conference on Geo-Disaster Mitigation in ASEAN

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as a Presenter

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