出國報告（出國類別：國際會議）

出席 ICCEMS2016 國際學術研討會公務
出國報告

服務機關：國立嘉義大學土木與水資源工程學系
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派赴國家：新加坡
出國期間：2016.04.28-2016.05.04
報告日期：2016.05.10

摘要

藉由此次國際會議的參與不但能了解國際間的現況，也從口頭發表場次中，增進自己視野與未來研究發展能力，有助於提供日後進行相關研究之本質學能與精進研究技巧及國際研討會務的參與。此次參予發表研究評估崩塌與堰塞湖形成之條件與特性，來到新加坡南洋理工大學校內的南洋執行中心所舉辦的研討會。也體驗到新加坡對其環境綠美化的成效及環境安全衛生的重視。

目次

一、參加國際會議之目的

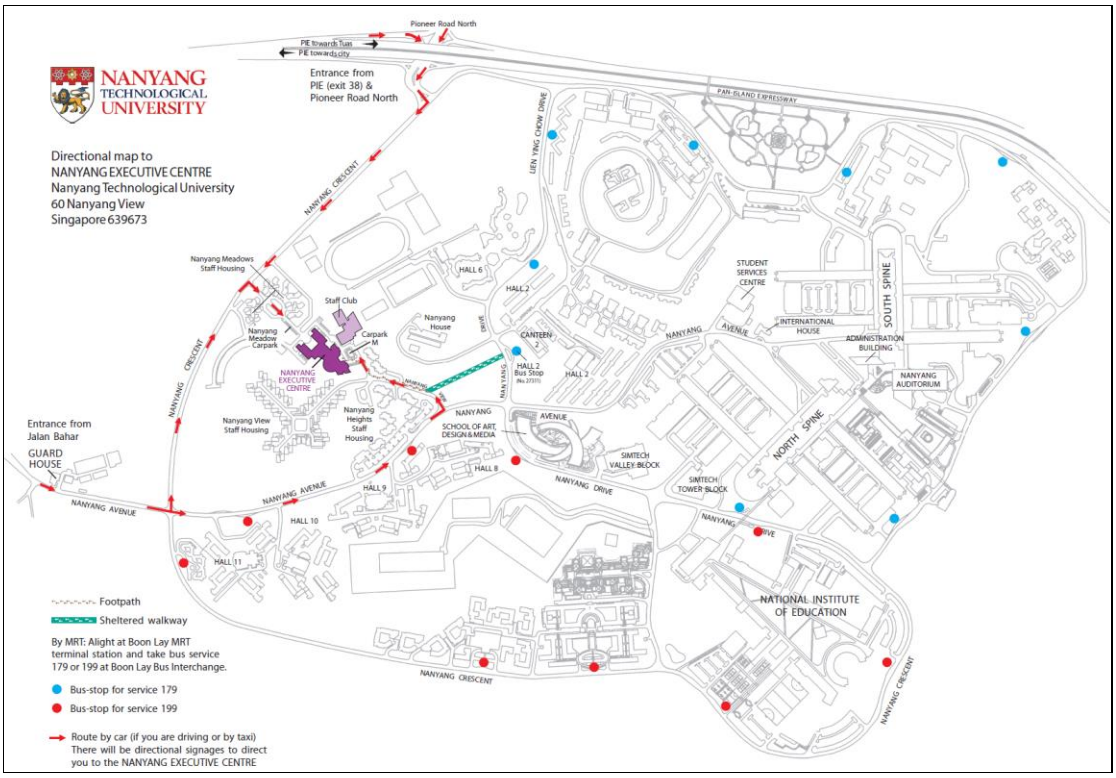
參加本次國際研討會之目的為研究論文口頭發表。本次出席發表學術口頭報告題目為「Riverbank Landslides and the Probability Analysis of Landslide Dams」。近年來全球氣候異常，各地災形頻傳，而過度的開發坡地使臺灣的邊坡災害頻繁，危害人民生命財產安全，所以山坡地的使用及保護為重要課題之一。其中最著名為九十八年八月八日莫拉克颱風，帶來的超大豪雨引發南部山區大量崩塌，使旗山溪流域的小林村邊坡獻肚山走山，楠梓仙溪河道被大量土石擋住形成大型堰塞湖，而後潰堤造成小林村滅村事件發生。

本研究評估崩塌與堰塞湖形成之條件與特性，判斷兩者之間的發生機率關係，藉由形成機率來判釋其可能形成地點與危害度，並以荖濃溪流域作為研究區域，目的為劃定集水區河岸不穩定區段，分析崩塌形成堰塞湖之機率，並以荖濃溪流域災情案例進行案例探討與模式驗證，利用機率模式評估形成堰塞湖之潛勢，來預估堰塞湖可能發生之區域，作為堰塞湖潛在形成地點風險評估的依據。

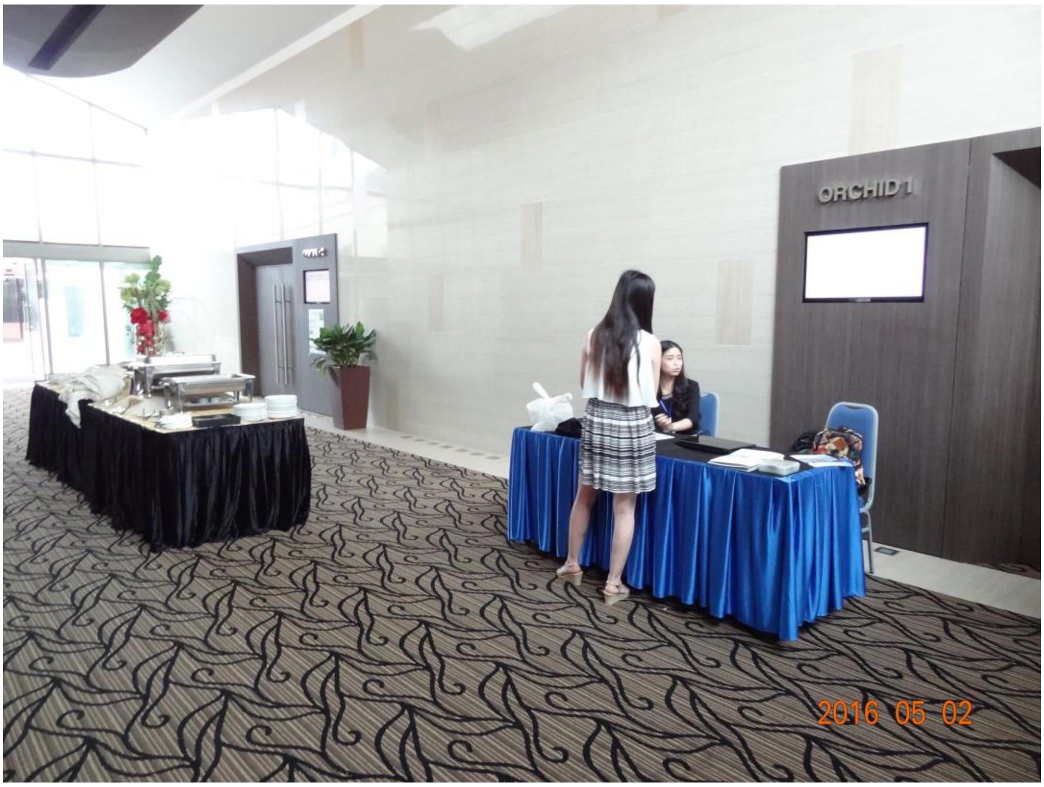
二、參加國際會議之過程

會議時間與地點

本會議於 2016 年 5 月 1-2 日於新加坡南洋理工大學校內南洋執行中心舉行(圖一)，並於 3 日辦理現地參觀。研討會場距離新加坡樟宜國際機場約 20-30 公里遠，到達機場後轉搭地鐵至市區約需 0.5 小時才可到達市區，再由市區搭乘捷運約 1 小時可至研討會地點南洋理工大學。圖二為研討會報到櫃台，圖三為研討會會場。



圖一、研討會場南洋執行中心位置圖(摘自研討會網頁)



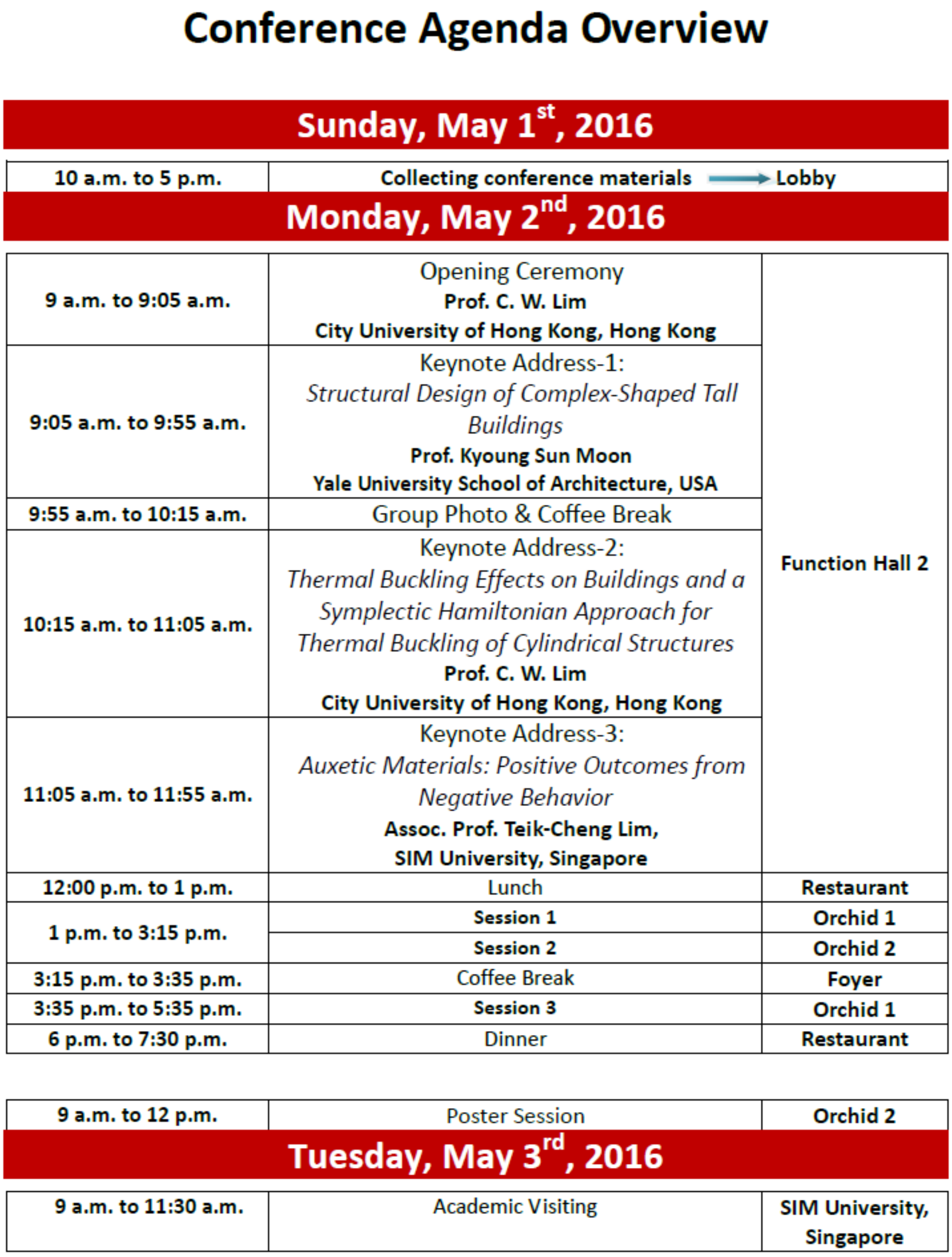
圖二、研討會報到櫃台

圖三、研討會會場

會議議程

本次會議議程如下(表一)，表二為研討會發表場次議程表：

表一、研討會議程表



Conference Agenda Overview

Sunday, May 1st, 2016		
10 a.m. to 5 p.m.	**Collecting conference materials → Lobby**	
Monday, May 2nd, 2016		
9 a.m. to 9:05 a.m.	Opening Ceremony **Prof. C. W. Lim** **City University of Hong Kong, Hong Kong**	**Function Hall 2**
9:05 a.m. to 9:55 a.m.	Keynote Address-1: *Structural Design of Complex-Shaped Tall Buildings* **Prof. Kyoung Sun Moon** **Yale University School of Architecture, USA**	
9:55 a.m. to 10:15 a.m.	Group Photo & Coffee Break	
10:15 a.m. to 11:05 a.m.	Keynote Address-2: *Thermal Buckling Effects on Buildings and a Symplectic Hamiltonian Approach for Thermal Buckling of Cylindrical Structures* **Prof. C. W. Lim** **City University of Hong Kong, Hong Kong**	
11:05 a.m. to 11:55 a.m.	Keynote Address-3: *Auxetic Materials: Positive Outcomes from Negative Behavior* **Assoc. Prof. Teik-Cheng Lim,** **SIM University, Singapore**	
12:00 p.m. to 1 p.m.	Lunch	**Restaurant**
1 p.m. to 3:15 p.m.	**Session 1**	**Orchid 1**
	Session 2	**Orchid 2**
3:15 p.m. to 3:35 p.m.	Coffee Break	**Foyer**
3:35 p.m. to 5:35 p.m.	**Session 3**	**Orchid 1**
6 p.m. to 7:30 p.m.	Dinner	**Restaurant**
9 a.m. to 12 p.m.	Poster Session	**Orchid 2**
Tuesday, May 3rd, 2016		
9 a.m. to 11:30 a.m.	Academic Visiting	**SIM University, Singapore**

表二、研討會部分議程表

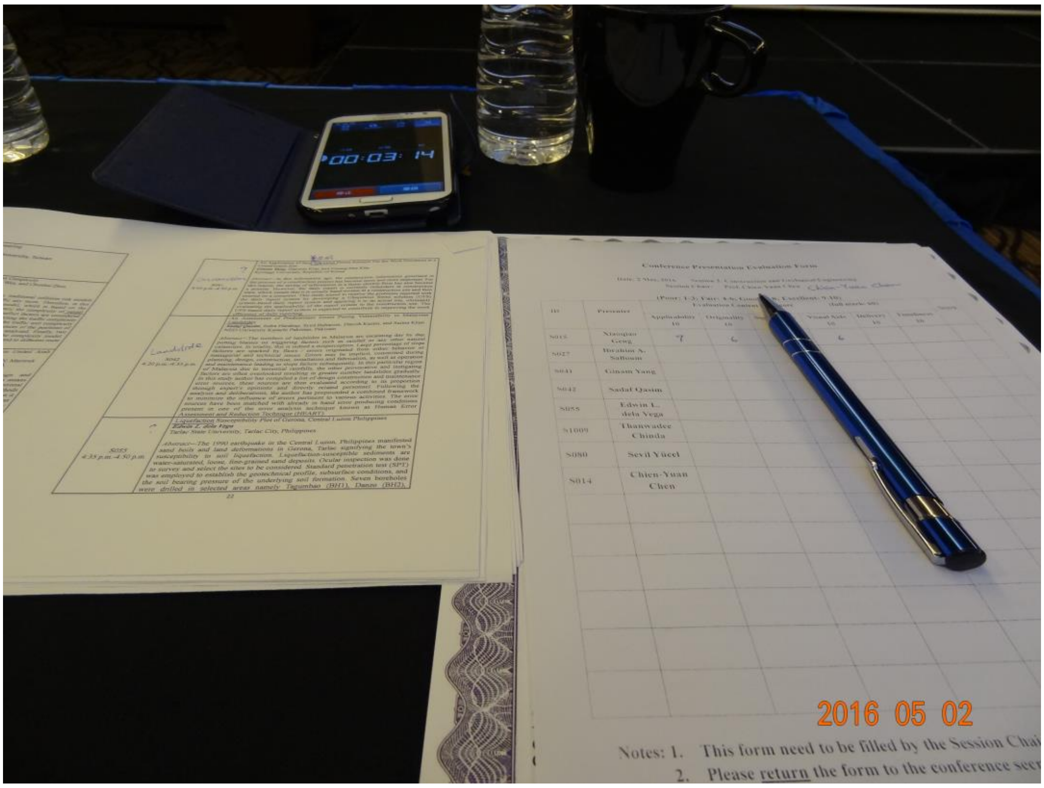
Session 3: Construction and Geological Engineering **Chair: Prof. Chien-Yuan Chen, National Chiayi University, Taiwan** **8 presentations** **Time: 3:35 p.m. -- 5:35 p.m.** **Venue: Orchid 1**	
S015 3:35 p.m.-3:50 p.m.	Modeling of the Marine Traffic Situation Complexity ***Xiaoqiao Geng***, Liang Huang, Yuanqiao Wen, and Chunhui Zhou Wuhan University of Technology, China *Abstract*—With the growth of traffic density, traditional collision risk models cannot thoroughly describe the complex traffic any more. Therefore, in this paper, a marine traffic situation complexity model, which is based on the relationship between ships, is introduced to metric the complexity of vessel traffic. Firstly, traffic density factor and traffic conflict factors are considered to construct the traffic unit complexity model, reflecting the traffic complexity and traffic characteristics; Secondly, by extending the traffic unit complexity model into the own-ship complexity model, the influences of the positions of other ship on the complexity spatial distribution are analyzed; Finally, two scenarios are imported to validate the availability of the complexity model. The verification results show that the complexity can respond to different route structures and traffic situations sensitively.
S027 3:50 p.m.-4:05 p.m.	Assessment on the Usage of Insulated Concrete Forms in United Arab Emirates Construction Industry Syed W. Ather, Saud AbdelAziz, ***Ibrahim A. Salloum***, Abdullah N. Marzouk American University of Sharjah, United Arab Emirates *Abstract*—Recently, the UAE government endorsed the design and implementation of green buildings to increase energy efficiency. This means that construction fraternity would need to move from the conventional construction, i.e. Concrete Masonry Unit (CMU), towards sustainable methods such as Insulated Concrete Forms (ICF). However, the cost is an issue when it comes to green buildings. Therefore, this paper looks into a green construction method, i.e. insulated concrete form, and determines problems faced by construction industry for its implementation with the help of a survey. It was found out that changes in codes and regulations are necessary to integrate and encourage the use of insulated concrete formwork. Moreover, results also depict that less proportion of people had previous experiences with insulated concrete forms. Regardless, all respondents have strongly agreed that the increase in publicity of insulated concrete formwork, and encouraging the use of green materials in the United Arab Emirate (UAE) are essential to convince construction society to adopt such methods. Future research can be done on the Life Cycle Cost Analysis of an insulated concrete formed villa to determine the overall cost. This will include factors such as initial cost, maintenance cost, and salvage value.

表二、研討會部分議程表(續)

	magnesium silica aerogel.
S014 5:20 p.m.-5:35 p.m.	Riverbank Landslides and the Probability Analysis of Landslide Dams ***Chien-Yuan Chen*** and Wei-Ting Lee National Chiayi University, Taiwan *Abstract*—Climate change induced slopeland hazards have become an issue in recent years worldwide, especially the landslide dams-induced. The probability of landslide dam formation in the Laonong River basin during Typhoon Morakot in 2009 is analyzed using Geographic Information System (GIS) spatial analysis, topographic features (elevation, slope, aspect, and geology), hydrological factors and use of the Shallow Slope Stability (SHALSTAB) model to simulate potential landslide areas. Landslide area, cumulative frequency distribution, and cumulative probability distribution are used to determine the potential of landslide dam formation and for further risk assessment. The results show that topographic factors interact with each other, the elevation factor being the most seriously affected. Landslides and landslide dams are located in the mid to high potential areas in the SHALSTAB analysis. Landslide frequency-area distribution in the basin shows a power-law relationship. The main landslide area is between 10^3 to 10^4 m^2. Landslide probability for an area larger than 10^3 m^2 is about 86% while areas greater than 10^4 m^2 have about a 19% landslide probability. A minimum landslide area of 2×10^4 m^2 was found sufficient to block the river in the study area.

與會過程

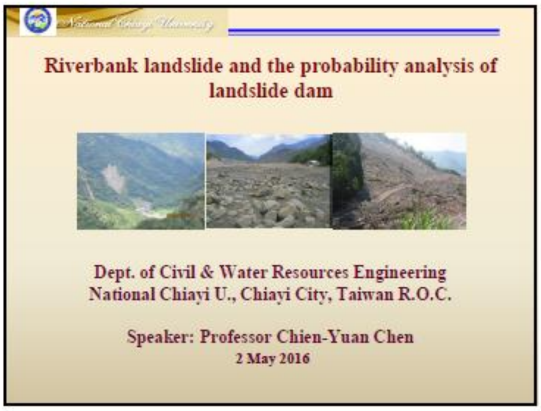
本研討會主要會議期間共有三天，主要論文發表日期為5月2日，5月3日則為現地參觀。除專題演講外，論文發表共分成3個場次(session)。經審查錄取之文章修改後將發表在期刊上，本人除擔任場次會議主持人外，發表的文章則被安排在5月2日下午16:30場次的最後一位，圖四及圖五為研討會口頭發表情形。



圖四、研討會作者口頭發表會場(一)

圖五、研討會作者口頭發表會場(二)

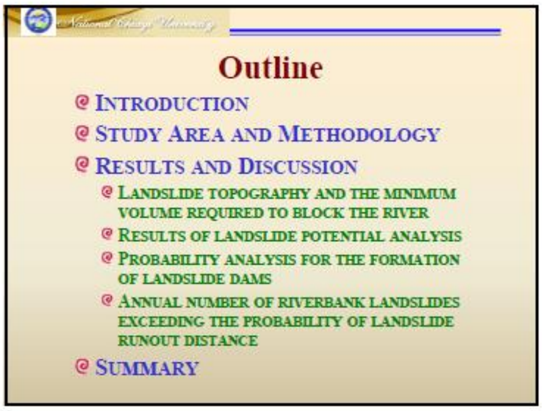
由於此次研討會由大陸與新加坡方面主辦，本校嘉義大學協辦，相關接受文章審查後並將刊載於國際期刊上。本場次共有 8 篇文章發表，本人已有甚多次口頭發表經驗，因此在發表上相當順利。簡報檔資料如下(圖六)。



Riverbank landslide and the probability analysis of landslide dam

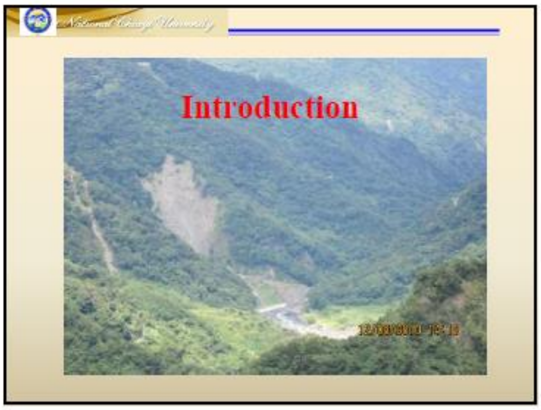
Dept. of Civil & Water Resources Engineering
National Chiayi U., Chiayi City, Taiwan R.O.C.

Speaker: Professor Chien-Yuan Chen
2 May 2016

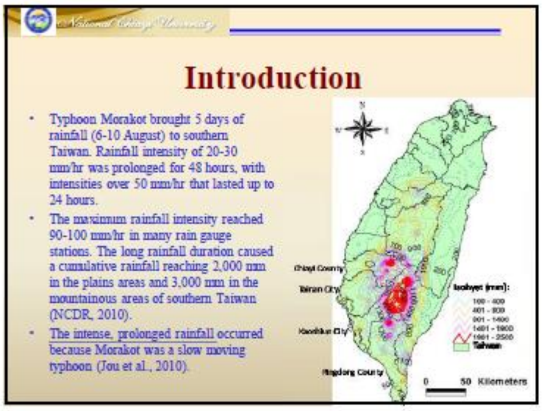


Outline

- INTRODUCTION
- STUDY AREA AND METHODOLOGY
- RESULTS AND DISCUSSION
  - LANDSLIDE TOPOGRAPHY AND THE MINIMUM VOLUME REQUIRED TO BLOCK THE RIVER
  - RESULTS OF LANDSLIDE POTENTIAL ANALYSIS
  - PROBABILITY ANALYSIS FOR THE FORMATION OF LANDSLIDE DAMS
  - ANNUAL NUMBER OF RIVERBANK LANDSLIDES EXCEEDING THE PROBABILITY OF LANDSLIDE RUNOUT DISTANCE
- SUMMARY



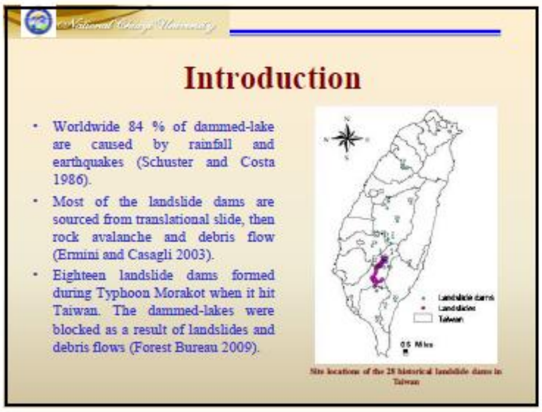
Introduction



Introduction

- Typhoon Morakot brought 5 days of rainfall (6-10 August) to southern Taiwan. Rainfall intensity of 20-30 mm/hr was prolonged for 48 hours, with intensities over 50 mm/hr that lasted up to 24 hours.
- The maximum rainfall intensity reached 90-100 mm/hr in many rain gauge stations. The long rainfall duration caused a cumulative rainfall reaching 2,000 mm in the plains areas and 3,000 mm in the mountainous areas of southern Taiwan (NCDR, 2010).
- The intense, prolonged rainfall occurred because Morakot was a slow moving typhoon (Jou et al., 2010).

Typhoon Morakot

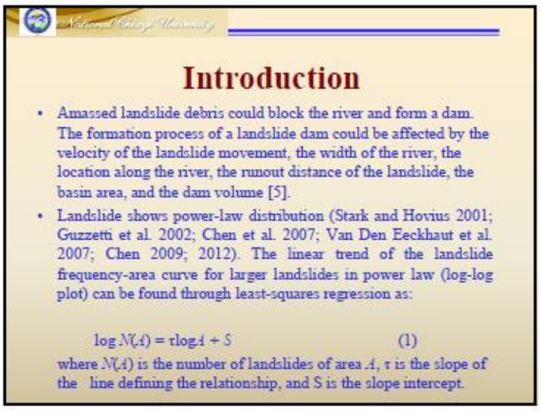


Introduction

- Worldwide 84 % of dammed-lake are caused by rainfall and earthquakes (Schuster and Costa 1986).
- Most of the landslide dams are sourced from translational slide, then rock avalanche and debris flow (Ermini and Casagli 2003).
- Eighteen landslide dams formed during Typhoon Morakot when it hit Taiwan. The dammed-lakes were blocked as a result of landslides and debris flows (Forest Bureau 2009).

Site locations of the 28 historical landslide dams in Taiwan

圖六、作者口頭報告簡報檔

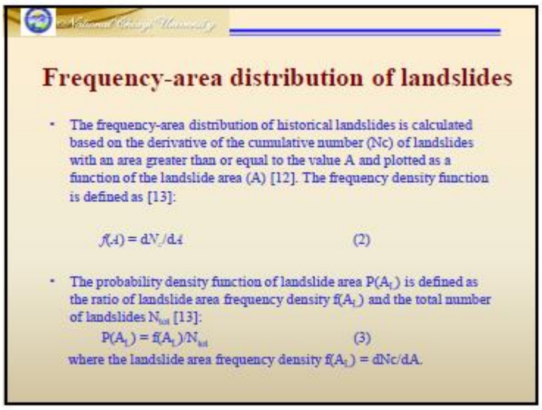


Introduction

- Amassed landslide debris could block the river and form a dam. The formation process of a landslide dam could be affected by the velocity of the landslide movement, the width of the river, the location along the river, the runout distance of the landslide, the basin area, and the dam volume [5].
- Landslide shows power-law distribution (Stark and Hovius 2001; Guzzetti et al. 2002; Chen et al. 2007; Van Den Eeckhaut et al. 2007; Chen 2009; 2012). The linear trend of the landslide frequency-area curve for larger landslides in power law (log-log plot) can be found through least-squares regression as:

$$\log N(A) = \tau \log A + S \qquad (1)$$

where $N(A)$ is the number of landslides of area A, τ is the slope of the line defining the relationship, and S is the slope intercept.



Frequency-area distribution of landslides

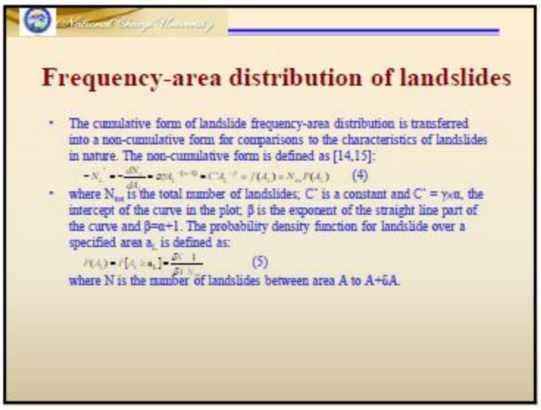
- The frequency-area distribution of historical landslides is calculated based on the derivative of the cumulative number (Nc) of landslides with an area greater than or equal to the value A and plotted as a function of the landslide area (A) [12]. The frequency density function is defined as [13]:

$$f(A) = dN_c/dA \qquad (2)$$

- The probability density function of landslide area $P(A_L)$ is defined as the ratio of landslide area frequency density $f(A_L)$ and the total number of landslides N_{tot} [13]:

$$P(A_L) = f(A_L)/N_{tot} \qquad (3)$$

where the landslide area frequency density $f(A_L) = dNc/dA$.



Frequency-area distribution of landslides

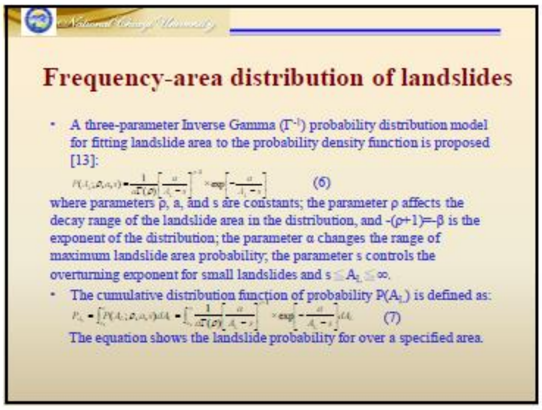
- The cumulative form of landslide frequency-area distribution is transferred into a non-cumulative form for comparisons to the characteristics of landslides in nature. The non-cumulative form is defined as [14,15]:

$$-N_L' = -\frac{dN_L}{dA_L} = \alpha\gamma A_L^{-(\alpha+1)} = C' A_L^{-\beta} = f(A_L) = N_{tot}P(A_L) \qquad (4)$$

- where N_{tot} is the total number of landslides; C' is a constant and $C' = \gamma\times\alpha$, the intercept of the curve in the plot; β is the exponent of the straight line part of the curve and $\beta=\alpha+1$. The probability density function for landslide over a specified area a_L is defined as:

$$P(A_L) = P[A_L \ge a_L] = \frac{\delta N}{\delta A}\frac{1}{N_{tot}} \qquad (5)$$

where N is the number of landslides between area A to A+δA.



Frequency-area distribution of landslides

- A three-parameter Inverse Gamma (Γ^{-1}) probability distribution model for fitting landslide area to the probability density function is proposed [13]:

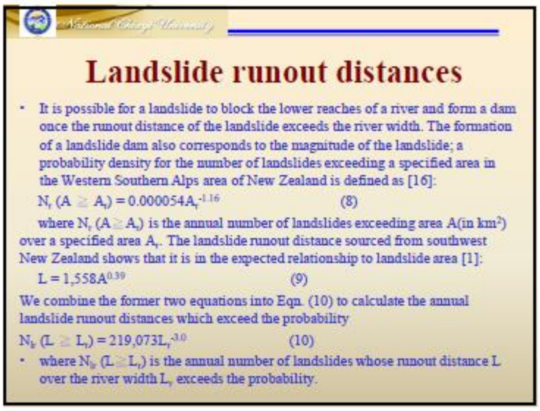
$$P(A_L;\rho,a,s) = \frac{1}{a\Gamma(\rho)}\left[\frac{a}{A_L - s}\right]^{\rho+1}\times\exp\left[-\frac{a}{A_L - s}\right] \qquad (6)$$

where parameters ρ, a, and s are constants; the parameter ρ affects the decay range of the landslide area in the distribution, and $-(\rho+1)=-\beta$ is the exponent of the distribution; the parameter α changes the range of maximum landslide area probability; the parameter s controls the overturning exponent for small landslides and $s \leq A_L \leq \infty$.

- The cumulative distribution function of probability $P(A_L)$ is defined as:

$$P_{A_L} = \int_{A_L}^{\infty} P(A_L;\rho,a,s)\,dA_L = \int_{A_L}^{\infty}\frac{1}{a\Gamma(\rho)}\left[\frac{a}{A_L - s}\right]^{\rho+1}\times\exp\left[-\frac{a}{A_L - s}\right]dA_L \qquad (7)$$

The equation shows the landslide probability for over a specified area.



Landslide runout distances

- It is possible for a landslide to block the lower reaches of a river and form a dam once the runout distance of the landslide exceeds the river width. The formation of a landslide dam also corresponds to the magnitude of the landslide; a probability density for the number of landslides exceeding a specified area in the Western Southern Alps area of New Zealand is defined as [16]:

$$N_r\,(A \geq A_r) = 0.000054A_r^{-1.16} \qquad (8)$$

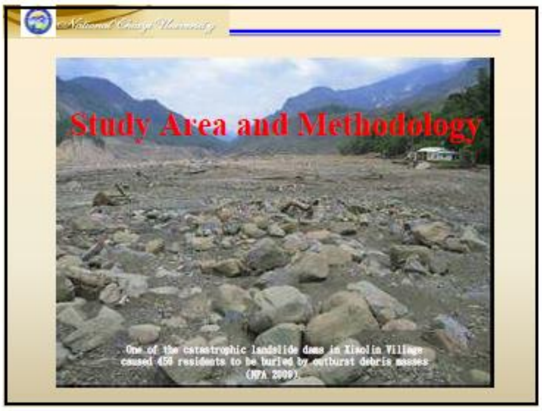
where $N_r\,(A \geq A_r)$ is the annual number of landslides exceeding area A(in km^2) over a specified area A_r. The landslide runout distance sourced from southwest New Zealand shows that it is in the expected relationship to landslide area [1]:

$$L = 1{,}558A^{0.39} \qquad (9)$$

We combine the former two equations into Eqn. (10) to calculate the annual landslide runout distances which exceed the probability

$$N_{lr}\,(L \geq L_r) = 219{,}073L_r^{-3.0} \qquad (10)$$

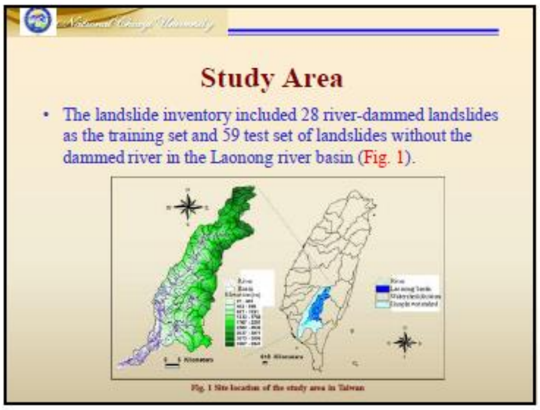
- where $N_{lr}\,(L \geq L_r)$ is the annual number of landslides whose runout distance L over the river width L_r exceeds the probability.



Study Area and Methodology

One of the catastrophic landslide dams in Xiaolin Village caused 458 residents to be buried by outburst debris masses (NPA 2009).

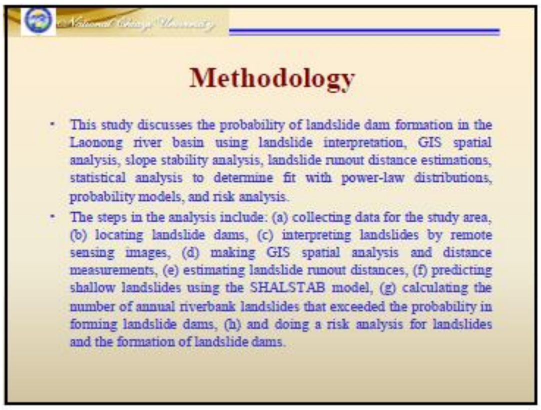
圖六、作者口頭報告簡報檔（續）



Study Area

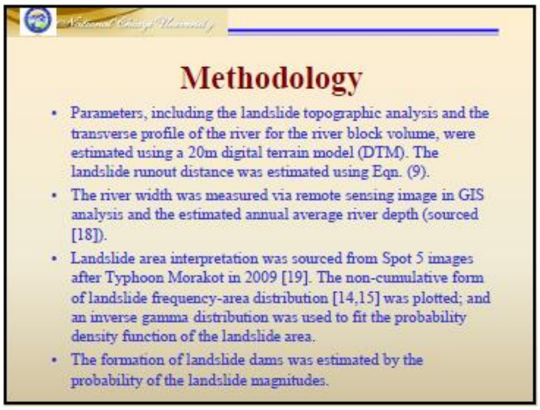
- The landslide inventory included 28 river-dammed landslides as the training set and 59 test set of landslides without the dammed river in the Laonong river basin (Fig. 1).

Fig. 1 Site location of the study area in Taiwan



Methodology

- This study discusses the probability of landslide dam formation in the Laonong river basin using landslide interpretation, GIS spatial analysis, slope stability analysis, landslide runout distance estimations, statistical analysis to determine fit with power-law distributions, probability models, and risk analysis.
- The steps in the analysis include: (a) collecting data for the study area, (b) locating landslide dams, (c) interpreting landslides by remote sensing images, (d) making GIS spatial analysis and distance measurements, (e) estimating landslide runout distances, (f) predicting shallow landslides using the SHALSTAB model, (g) calculating the number of annual riverbank landslides that exceeded the probability in forming landslide dams, (h) and doing a risk analysis for landslides and the formation of landslide dams.

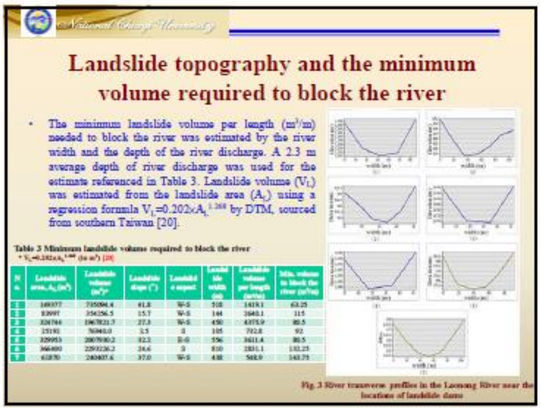


Methodology

- Parameters, including the landslide topographic analysis and the transverse profile of the river for the river block volume, were estimated using a 20m digital terrain model (DTM). The landslide runout distance was estimated using Eqn. (9).
- The river width was measured via remote sensing image in GIS analysis and the estimated annual average river depth (sourced [18]).
- Landslide area interpretation was sourced from Spot 5 images after Typhoon Morakot in 2009 [19]. The non-cumulative form of landslide frequency-area distribution [14,15] was plotted; and an inverse gamma distribution was used to fit the probability density function of the landslide area.
- The formation of landslide dams was estimated by the probability of the landslide magnitudes.

Results and Discussion

Results



Landslide topography and the minimum volume required to block the river

- The minimum landslide volume per length (m^3/m) needed to block the river was estimated by the river width and the depth of the river discharge. A 2.3 m average depth of river discharge was used for the estimate referenced in Table 3. Landslide volume (V_L) was estimated from the landslide area (A_L) using a regression formula $V_L=0.202\times A_L^{1.268}$ by DTM, sourced from southern Taiwan [20].

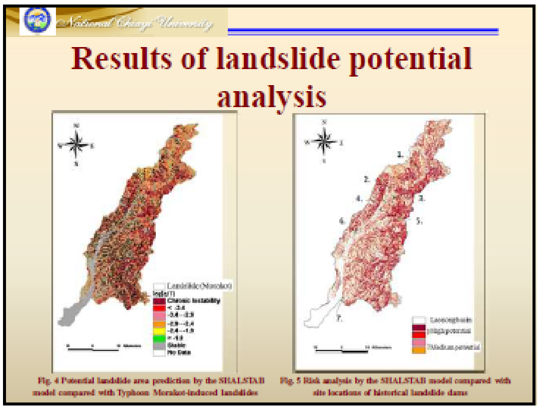
Table 3 Minimum landslide volume required to block the river

* $V_L=0.202\times A_L^{1.268}$ (in m^3) [20]

No.	Landslide area, A_L (m^2)	Landslide volume (m^3)*	Landslide slope (°)	Landslide aspect	Landslide width (m)	Landslide volume per length (m³/m)	Min. volume to block the river (m³/m)
1	169377	735094.4	41.8	W-S	518	1419.1	63.25
2	83097	354256.5	15.7	W-S	144	2460.1	115
3	324744	1967821.7	27.3	W-S	450	4375.9	80.5
4	25191	76940.0	3.5	S	105	732.8	92
5	329953	2007930.2	12.2	E-S	556	3611.4	80.5
6	366480	2293236.2	24.6	S	810	2831.1	132.25
7	61870	240407.6	37.0	W-S	408	588.9	143.75

Fig. 3 River transverse profiles in the Laonong River near the locations of landslide dams

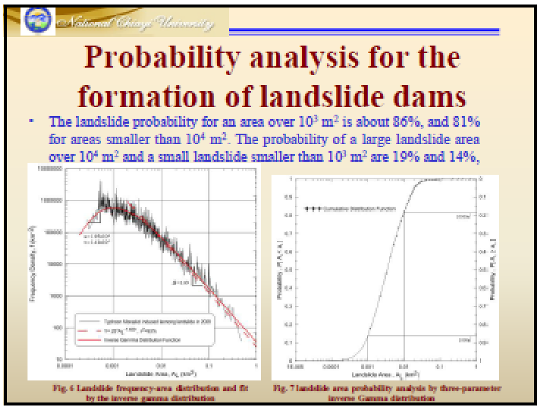
圖六、作者口頭報告簡報檔(續)



Results of landslide potential analysis

Fig. 4 Potential landslide area prediction by the SHALSTAB model compared with Typhoon Morakot-induced landslides

Fig. 5 Risk analysis by the SHALSTAB model compared with site locations of historical landslide dams

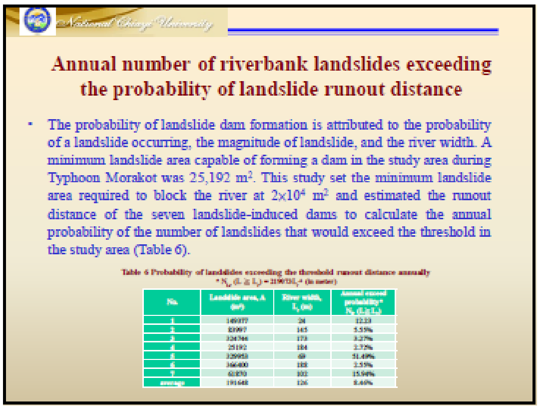


Probability analysis for the formation of landslide dams

- The landslide probability for an area over 10^3 m^2 is about 86%, and 81% for areas smaller than 10^4 m^2. The probability of a large landslide area over 10^4 m^2 and a small landslide smaller than 10^3 m^2 are 19% and 14%,

Fig. 6 Landslide frequency-area distribution and fit by the inverse gamma distribution

Fig. 7 landslide area probability analysis by three-parameter inverse Gamma distribution



Annual number of riverbank landslides exceeding the probability of landslide runout distance

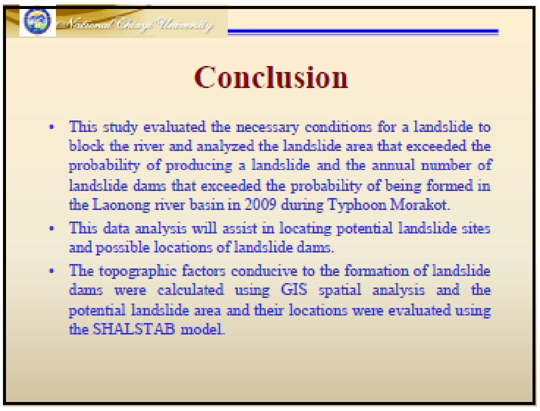
- The probability of landslide dam formation is attributed to the probability of a landslide occurring, the magnitude of landslide, and the river width. A minimum landslide area capable of forming a dam in the study area during Typhoon Morakot was 25,192 m^2. This study set the minimum landslide area required to block the river at 2×10^4 m^2 and estimated the runout distance of the seven landslide-induced dams to calculate the annual probability of the number of landslides that would exceed the threshold in the study area (Table 6).

Table 6 Probability of landslides exceeding the threshold runout distance annually

* N_{L_r} ($L \geq L_r$) = [illegible] L_r^{-4} (in meter)

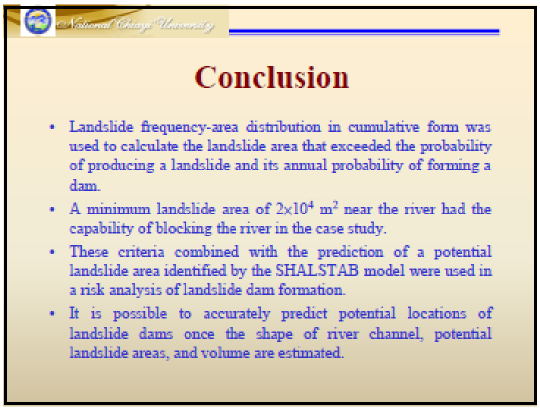
No.	Landslide area, A (m²)	River width, L_r (m)	Annual exceed probability* N_{L_r} ($L \geq L_r$)
1	149377	28	12.23
2	83997	165	5.55%
3	324744	173	3.27%
4	25192	184	2.72%
5	329953	69	51.49%
6	366400	183	2.55%
7	62870	102	15.94%
average	191648	126	8.46%

Conclusion



Conclusion

- This study evaluated the necessary conditions for a landslide to block the river and analyzed the landslide area that exceeded the probability of producing a landslide and the annual number of landslide dams that exceeded the probability of being formed in the Laonong river basin in 2009 during Typhoon Morakot.
- This data analysis will assist in locating potential landslide sites and possible locations of landslide dams.
- The topographic factors conducive to the formation of landslide dams were calculated using GIS spatial analysis and the potential landslide area and their locations were evaluated using the SHALSTAB model.



Conclusion

- Landslide frequency-area distribution in cumulative form was used to calculate the landslide area that exceeded the probability of producing a landslide and its annual probability of forming a dam.
- A minimum landslide area of 2×10^4 m^2 near the river had the capability of blocking the river in the case study.
- These criteria combined with the prediction of a potential landslide area identified by the SHALSTAB model were used in a risk analysis of landslide dam formation.
- It is possible to accurately predict potential locations of landslide dams once the shape of river channel, potential landslide areas, and volume are estimated.

圖六、作者口頭報告簡報檔(續)

本次研討會攜回資料包括:

(一) 期刊論文集點子檔光碟

(二) 研討會會議手冊，

(三) 研討會參加(口頭報告)及場次主持人證明，

（四）研討會手提包及場次主持人紀念品。

考察參觀活動

研討會於 5 月 3 日舉辦 1 日南洋理工大學校園及明曜大學校園參觀行程，本人主要參加南洋理工大學校園行程，並於往來會議期間順便參訪經過的新加坡市區。研討會議舉辦地點-南洋理工大學位於新加坡郊區，從市區搭捷運約需 1 小時，出捷運站後須改搭公車或約需步行 30 分鐘(圖七)。在市區的參觀本人體驗到新加坡的一個城市即一個國家，及其對環境綠美化的成效與環境安全衛生的重視。

圖七、研討會現地參觀-南洋理工大學

三、心得及建議

新加坡在國際競爭力上排名上數一數二，在亞太地區更是居翹首。一個城市即是一個國家，是新加坡的寫照。個中的原因是舉世探討的對象。在研討會停留期間，本人觀察新加坡有下列幾點特點:

（一）以英語為官方語言，與國際無縫接軌。

（二）華人、印度人、馬來人、印尼人及其他外國人士族群融合度高。

（三）市區任何告示牌皆有四種語言，促進族群融合與社會和諧，無形中將國界無限延伸。

（四）交通捷運便捷，誠如一個進步已開發城市。

（五）尊重各族群宗教信仰，各種族教堂寺廟林立。

（六）市面流動的紙幣居然都是新的無舊幣。

在市區的參觀讓人體驗到新加坡的繁華與進步，與進一步如何容納各族群，各族群為在地小的土地上生存，必須互相融合協調。如果一個城市能像國家一樣治理且有競爭性，那必能帶動整體國家的進步。