

**Master of Geotechnical and Geological Engineering Program:
Course Design and Market Survey Analysis**
(Penguasaan Program Kejuruteraan Geoteknikal dan Geologi:
Analisis Reka Bentuk dan Tinjauan Pasaran)

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ABSTRACT

The failure of soil has been a great challenge to geotechnical and geological engineers especially in Malaysia. The landslide and slope failure incidents in Malaysia normally occurred due to the climate and unfavourable nature of weathered materials. Hence, the importance of geological-geotechnical studies as a basis for civil engineering projects is acknowledged. Engineering Faculty in Universiti Putra Malaysia (UPM) has decided to offer a master program in order to produce professionals equipped with expertise and suitable skills in geotechnical and geological engineering. The need of this program in civil engineering fields is a major concern as only few expertises exist in Malaysia. A survey has been carried out on 40 respondents to determine the prospect of conducting the program and its future graduates. 100% of the respondents agreed that the program will produce graduates for labour market. However, there are several modifications of the course design have been made based on the respondents' comments and opinions.

Keywords: Geotechnical and Geological, Master Program, Course Design, Survey, Prospect

ABSTRAK

Kegagalan tanah telah menjadi cabaran hebat kepada jurutera geoteknikal dan geologikal terutama sekali di Malaysia. Kejadian tanah runtuh dan kegagalan cerun di Malaysia selalunya berlaku disebabkan iklim dan keadaan tanah terluluhawa. Oleh yang demikian, kepentingan pelajaran geologikal-geoteknikal sebagai asas bagi projek kejuruteraan awam diakui. Fakulti Kejuruteraan di Universiti Putra Malaysia (UPM) telah memutuskan untuk menawarkan program sarjana bagi menghasilkan profesional yang dilengkapi dengan kepakaran dan kemahiran yang sesuai dalam kejuruteraan geoteknikal dan geologikal. Keperluan program ini di dalam bidang kejuruteraan diberi perhatian yang besar disebabkan terdapat sebilangan kecil sahaja pakar di Malaysia. Kaji-selidik telah dijalankan ke atas 40 responden bagi menentukan prospek dan graduan masa hadapan. 100% daripada responden bersetuju bahawa program ini boleh menghasilkan siswazah untuk pasaran kerja. Walau bagaimanapun, terdapat beberapa pengubahsuaian telah dibuat di dalam reka bentuk kursus berdasarkan komen dan pendapat responden.

Kata Kunci: Geoteknikal dan Geologikal, Program Sarjana, Rekabentuk Kursus, Kaji Selidik, Prospek

INTRODUCTION

Almost all civil engineering projects are constructed on earth or being constructed from earth materials such as embankments and backfills. In Malaysia, with the sets of climatic and geological conditions, landslides are among the most destructive natural disaster forces in Malaysia (Brand 1989; Huat 2010; Komoo 1997; Ooi 2009). Landslides have been reported in Malaysia, involving both cut and natural slopes, resulted in a total loss of lives and properties damaged.

The significance of this program to our situation nowadays is obvious. Geotechnical and geological engineering input are required that allow engineers to understand how subsoil materials behave. As the geology studies provide the necessary information for lithological, structural, hydrogeological behaviour recognition etc;

geotechnics studies provide the tools from a geomechanical point of view. The combination of the two disciplines guarantees an optimal solution to civil engineering problems.

The program has been designed (Table 1) to overcome the situation and fulfill the requirements which have been discussed above. The program consists of three parts which are 1) compulsory course – 22 credits, 2) elective course – 12 credits and 3) project – 6 credits. Students need to fulfill 40 credits throughout the study, 1 year and a half (3 semester), as a requirement for graduation. A part from that, students need to attend seminars or conferences related to the discipline.

TABLE 1. Proposed courses for program of master geotechnical and geological engineering

Compulsory Courses		
Code	Proposed Subject	Credit
ECV 5301	Shear Strength of Soils	3 credits
ECV 5302	Earth Structures	3 credits
ECV 5303	Deep Foundation	3 credits
ECV 5304	Ground Improvements	3 credits
ECV 5305	Environmental Geotechnics	3 credits
ECV 5306	Rock Mechanics	3 credits
ECV 5977	Site Investigation & Field Instrumentations	3 credits
ECV 5988	Independent Study	1 credit
	Project	6 credits
Elective Courses		
ECV 5307	Tropical Residual Soil Engineering	3 credits
ECV 5308	Organic & Peat Soil Engineering	3 credits
ECV 5309	Advanced Engineering Geology	3 credits
ECV 5310	Geotechnical Aspect of Landfill Design	3 credits
ECV 5311	Geospatial technology	3 credits
ECV 5312	Site remediation	3 credits

The purposes of this master program are:

1. To prepare professionals equipped with advanced knowledge in Geotechnical and Geological Engineering
2. To generate an innovative and creative professionals in dealing with global issues
3. To produce competitive professionals with a capability of long life learning
4. To produce professionals equipped with expertise and suitable skill in industry

The main objective of this paper is to evaluate the response from public (companies and industries) regarding to the implementation of Master of Geotechnical and Geological Engineering program as a new program in Engineering Faculty, UPM. It is importance to know the responses and comments from public about the program because from the evaluation, the course design can be adjusted regarding to the public requirements and recent situations. The needs to reform and explore on professional personnel is important as it is related to the basic theories towards the production of new teaching idea (Da 2011). Through the feedbacks from respondents, an extended discussion can be utilized in order to enhance the program and at the same time it could be helpful to the programs to have insights or a systematic process for specific plan of study for technical specialization purposes (Kunberger & O'Neill 2010; Sutterer 2009).

The tools of assessment known as Severity Index level have been choosed to assess the level of acceptance

of Master of Geotechnical and Geological Engineering program by public. The tools have been used widely by several researchers as an evaluation of performance (Abd. Majid et al. 1997; Al-Hammad & Assaf 1996; Hannan et al. 2010; Semsassom 2007). In this paper, the tools will be used to evaluate the relative significant level for each issues identified regarding to the proposed study schemes of the program. Using the level of severity classified by issues in the proposed program, the prospect of the program can be assessed.

METHODOLOGY

In this study, a self-administered questionnaire was used as a data collection tools (Appendix A). 40 respondents work in related discipline were targeted. The questionnaire was sent to foreign and locally owned organizations/ industries (private and government institutions) by post. There are three different parts in the questionnaire; 1) contents of the programme and its relevance to the needs of organisations, 2) career opportunities and 3) others. In part 1) questions focused on the fulfillment of theory and concept of the program. Part 2) emphasized on the future job relevant to the program and part 3) focused on other necessary questions such as sponsorship and outcome of the program (graduates). The companies's responses gathered from the questionnaires were analysed using Severity Index tools (Abd. Majid et al. 1997; Al-Hammad and Assaf 1996; Hannan et al. 2010; Semsassom 2007). Equation 1 was used to calculate the Severity Index of three parts explained previously. Then, the severity level for each part listed in questionnaire was used to evaluate the prospect of Geotechnical and Geological master program in UPM.

$$\text{Severity index} = \frac{\sum a_i x_i}{\sum x_i} \quad (1)$$

Where,

- a_i = index of a class
- x_i = frequency of response
- i = index (1, 2, 3, 4)

Table 2 shows the category of Severity Index used in the study. The level will be divided into four class of index with their specific categories as follows:

TABLE 2. Category for severity index

Severity Level	Severity Index, i	Class of Index, a_i
Strongly Agree	3.5 < Average Index < 4.0	4
Agree	2.5 < Average Index < 3.5	3
Less Agree	1.5 < Average Index < 2.5	2
Disagree	1.0 < Average Index < 1.5	1

RESULTS AND DISCUSSION

ISSUES RELATED TO THE RELEVANCE THEORIES AND CONTENTS OF PROGRAM

Overall recovery of the questionnaire was 33% (13 respondents) and most were sent back by respondents after two weeks by post. The contents of the proposed program and its relevance to the need of organisations were reviewed as shown in Figure 1. Based on the respondents' answers, 61% of the respondents stated that the program fulfilled basic theories required in the related discipline. 77% of the

respondents agreed with the following items; i) the theories used in the program are relevant to the current situation, ii) the proposed program cover all relevant subjects and iii) the length of study which are three semesters is sufficient enough to produce great quality of graduates. The total number of credit for master degree without thesis (by instruction and project) at Universiti Putra Malaysia is 40 credits. Three semesters are sufficient for the students to complete the courses although the minimum duration to complete the program is 2 semesters. 92% of the respondents stated the subjects offered will contribute to the strength of the program.

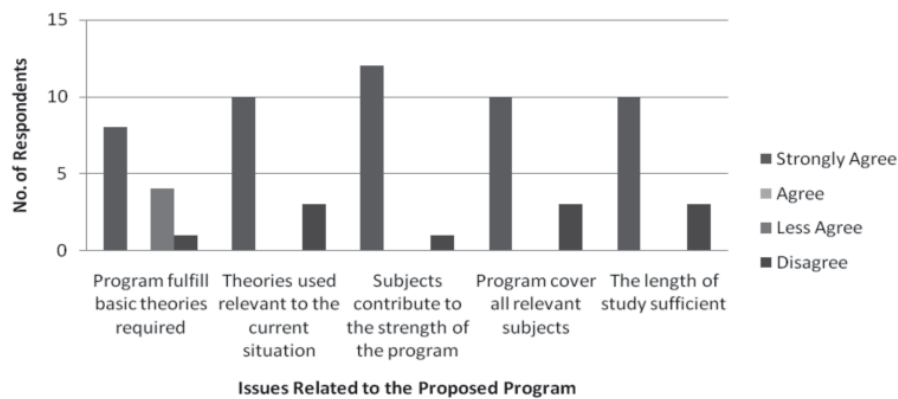


FIGURE 1. Relevance of theories and contents in proposed program

Generally the severity index value of each issue regarding to the theories and contents prepared for the proposed program falls in the range of 'strongly agree' and 'agree' level (Table 1). However there are several comments indicated by respondents regarding the contents of the program. The program needs to consider either including or excluding a few subjects especially in elective courses section as shown in Table 4. Based on respondents' comments, most of the compulsory course remained unchanged except for the 'Site Investigation and Field Instrumentations' subject which is changed to 'Site Investigation'. Five elective subjects were changed

regarding to the public requirements and recent situations occurred in Malaysia such as Slope Engineering and Landslide and Groundwater and Pollution subjects.

CAREER OPPORTUNITIES

Figure 2 shows the results of career opportunities for the graduates of the proposed program in respondents' organization. Based on the respondents' answers, 85% indicated that their organizations provide a suitable area for working in the related discipline. 92% of respondents indicated that their company has relevant jobs for future graduates. However, 54% of respondents stated 'not sure' regarding to the question about number of post available in their company. 46% stated 'slightly yes' regarding to the appropriate income in the range of RM2K to RM2.5K.

From Table 5, generally the severity index value of each issue regarding to the career opportunities of future graduate from the proposed program falls in the range of strongly agree and less agree level. Most of the respondents strongly agree that their company do provide a suitable area and relevant jobs for future graduate of the proposed program. Some of the jobs available in their company are site supervisors, consultants and geotechnical engineers. However, they 'less agrees' with the specified number of posts available in their company since the posts normally depend on the project availability. They 'agree' that the

TABLE 3. Severity index of theories and contents in proposed program

Issues	Severity Index, <i>i</i>	Severity Level
Program fulfill basic theories required	3.15	Agree
Theories used relevant to the current situation	3.31	Agree
Subjects contribute to the strength of the program	3.77	Strongly Agree
Program cover all relevant subjects	3.31	Agree
The length of study sufficient	3.31	Agree

TABLE 4. Modified courses for program of master geotechnical and geological engineering

Code	Compulsory Courses		Credit
	Proposed Subject	Modified Subject	
ECV 5301	Shear Strength of Soils	Unchanged	3 credits
ECV 5302	Earth Structures	Unchanged	3 credits
ECV 5305	Deep Foundation	Unchanged	3 credits
ECV 5311	Ground Improvements	Unchanged	3 credits
ECV 5307	Environmental Geotechnics	Unchanged	3 credits
ECV 4303	Rock Mechanics	Unchanged	3 credits
ECV 5304	Site Investigation & Field Instrumentations	Site Investigation	3 credits
ECV 5977	Independent Study	Unchanged	1 credit
ECV 5989	Project	Unchanged	6 credits
Elective Courses			
ECV 5306	Tropical Residual Soil Engineering	Groundwater and Pollution	3 credits
ECV 5309	Organic & Peat Soil Engineering	Unchanged	3 credits
ECV 5310	Advanced Engineering Geology	Rock Engineering	3 credits
ECV 5312	Geotechnical Aspect of Landfill Design	Offshore Geotechnical Engineering Design	3 credits
ECV 5313	Geospatial technology	Slope Engineering and Landslide	3 credits
ECV 5306	Site remediation	Tunnel Engineering	3 credits

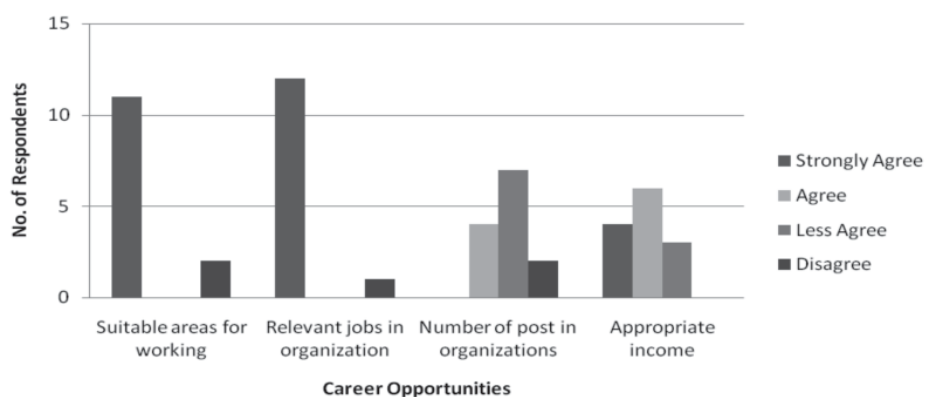


FIGURE 2. Career opportunities for graduate of the proposed program in related organisations

appropriate income should be in the range of RM2K to RM2.5K for fresh graduates depending on their experience and competency.

TABLE 5. Severity index of career opportunities

Issues	Severity Index, <i>i</i>	Severity Level
Suitable areas for working	3.5	Strongly Agree
Relevant jobs in organizations	3.8	Strongly Agree
Number of post in organizations	2.2	Less Agree
Appropriate income	3.1	Agree

OTHER ISSUES

The other issues related to the proposed program were reviewed as shown in Figure 3. Based on the respondents' answers, 15% stated 'yes' that their company do sponsor their staffs to continue study. 85% stated their company always encourage their staff to pursue study and 100% ticked 'yes' that the proposed program can produce graduates for the current market.

The value of the severity index in Table 6 showed that most of the company did not sponsored their staff in pursuing study but most of the respondent strongly agreed that their company did encouraged their staff to continue study in related area.

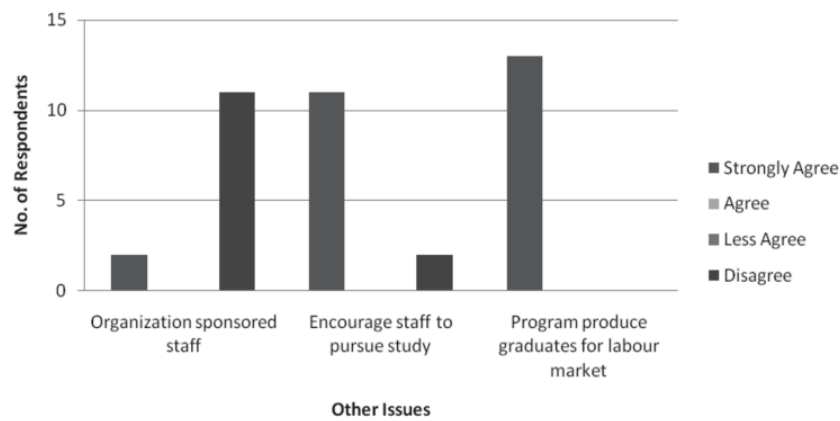


FIGURE 3. Others issues related to the proposed program

TABLE 6. Severity index of other issues related to the proposed program

Issues	Severity Index, <i>i</i>	Severity Level
Organization sponsored staff	1.5	Disagree
Encourage staff to pursue study	3.5	Strongly Agree
Program produce graduates for labour market	4.0	Strongly Agree

Overall, respondents were strongly agreed that the future graduates from proposed program will have a great demand in the labour market. It has been agreed by Liew (2009); geotechnical engineering is a specialised profession and is gradually gaining popularity and acceptance in Malaysia. Several factors were listed by respondents in the Questionnaire: Part iii (Outcome of Programme) such as 1) frequently occurred landslide incidents in Malaysia, 2) the highly requested of specialist with geotechnical skill nowadays, and 3) the critical needs of academics and specialist collaborate in solving problems in related discipline.

Geotechnical engineers need to start off with solid learning of good fundamentals, practical experience and lesson learnt from case studies to convey the design content and proposed solution (Liew 2009). This master course has been design to cover not only fundamental but advanced knowledge in Geotechnical and Geological Engineering, practical and case studies for each subject offered. The increasingly complex nature of the problems encountered has presented challenges to new generation of geotechnical engineers (Chow 2009). Comments from respondents were seriously taking into consideration to make sure the program will produce professionals equipped with expertise and suitable skill in industry also to generate an innovative and creative professionals in dealing with global issues.

CONCLUSION

As conclusions, the proposed program of master’s level for Geotechnical and Geological Engineering (without thesis) is strongly requested when referred to the level of agreements calculated based on the answers collected from respondents with several addition and modification of the course design. The index also showed that most of the companies gave good feedbacks regarding to the career opportunities available and they are strongly agreed that the proposed program can produce graduates with a special skill needed nowadays to encounter several incidents occurred in Malaysia.

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APPENDIX A

KAJIAN PASARAN MENGENAI PROGRAM MS (TANPA TESIS) KEJURUTERAAN GEOTEKNIK DAN GEOLOGY
(MARKET SURVEY FOR PROGRAMME MS (WITHOUT THESIS) GEOTECHNICAL AND GEOLOGICAL ENGINEERING)

Responden:

- I Organisasi / industri milik tempatan (Locally owned organization / industry)
- II Organisasi / industri milik asing (Foreign owned organization / industry)

BAHAGIAN 1: KANDUNGAN PROGRAM DAN KESESUAIAN DENGAN KEPERLUAN ORGANISASI
(PART 1: CONTENTS OF PROGRAMME AND ITS RELEVANCE TO THE NEEDS OF ORGANISATIONS)

Pengisian Konsep Teori (Fulfillment of Theory and Concept)

No.	Soalan	Maklumbalas Responden			Ulasan	
1.	Adakah program yang dicadangkan memenuhi asas-asas teori dalam bidang berkenaan? (Does the programme fulfill the basic theories required in the related discipline?)					
2.	Adakah pemakaian konsep teori sesuai dalam keadaan semasa (Are the theories used relevant to the current situation?)					
3.	Adakah kursus yang dicadangkan ini meliputi semua mata pelajaran/ subjek yang difikirkan perlu? (Does the proposed programme cover all relevant subjects?)					
4.	Adakah kursus yang dicadangkan meliputi subjek yang difikirkan tidak perlu? (Is there any subject that is not relevant in the proposed programme?)					
5.	Sila nyatakan sama ada program yang dicadangkan memenuhi kriteria berikut: (Please state whether the proposed programme fulfils the following criteria:)	Memenuhi Keperluan	Memenuhi Sebahagian	Gagal Memenuhi	Tiada Jawapan	
	a. Teori Asas					
	b. Konsep Semasa					
	c. Perundangan					
	d. Penggunaan ICT					
	e. Penggunaan kaedah Kuantitatif					
	f. Hubung kait dengan Pasaran/Industri					
6.	Adakah anda berpendapat program yang dicadangkan ini mencukupi dari segi jangkamasa pengajian iaitu 3 semester? (Is this programme sufficient in terms of the length of study which is 3 semester?)					

BAHAGIAN 2: PELUANG KERJAYA
(PART 2: CAREER OPPORTUNITIES)

No.	Soalan	Maklumbalas Responden	Ulasan
1.	Adakah graduan program ini sesuai bekerja di organisasi anda? Jika ya, nyatakan bidang yang bersesuaian. (Do you think that graduates of this programme are suitable to work in your organization? If yes, please indicate the suitable areas.)		
2.	Apakah jawatan yang sesuai di organisasi anda bagi graduan program ini? (Please indicate relevant jobs for the graduate of this programme in your organization?)		
3.	Berapa banyak jawatan yang sesuai diisi di dalam organisai anda oleh graduan program ini? (State the number of posts in your organization that can be filled by graduate of this programme?)	<input type="checkbox"/> 1-3 Jawatan (1-3 Posts)	
		<input type="checkbox"/> 4-6 Jawatan (4-6 Posts)	
		<input type="checkbox"/> 7-9 Jawatan (7-9 Posts)	
		<input type="checkbox"/> Lain-lain (Sila Nyatakan: _____)	
		<input type="checkbox"/> Tiada jawapan	
4.	Apakah pendapatan yang bersesuaian yang dapat ditawarkan kepada graduan program ini? (What is the appropriate income for graduates of this programme?)	<input type="checkbox"/> Kurang dari RM1,000 (Less than RM 1,000)	
		<input type="checkbox"/> RM1,001 - RM1,500 (RM 1,001 - RM 1,500)	
		<input type="checkbox"/> RM 1,501 - RM 2,000 (RM 1,501 --RM 2,000)	
		<input type="checkbox"/> RM 2,001 - RM 2,500 (RM 2,001 - RM 2,500)	
		<input type="checkbox"/> Lain-lain (Sila nyatakan: _____)	

BAHAGIAN 3: LAIN-LAIN
(PART 3: OTHERS)

A. Penajaan (Sponsorship)

No.	Soalan	Maklumbalas Responden	Ulasan
1.	Adakah organisasi anda memberi tajaan kepada pelajar di dalam bidang ini? (Has your organization sponsored any students in this field / area?)		
2.	Adakah anda akan menggalakkan kakitangan anda untuk mengikuti program ini? (Would you encourage your staff to undergo this course?)		
B. Kesesuaian Program (Outcome of the Programme)			
1.	Pada pendapat anda, adakah program ini dapat menghasilkan graduan yang diinginkan? (In your opinion, will this programme be able to produce the right graduates for the labour market?)		

