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## Programme Outcomes Assessment for Civil & Structural Engineering Courses at Universiti Kebangsaan Malaysia

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### Abstract

Programme Outcomes (PO) is the expected achievement of the level of knowledge, skills and abilities essential to each student after their graduation. The Department of Civil & Structural Engineering, Faculty of Engineering and Built Environment, UKM has established 10 POs, PO1 to PO10 for all undergraduate courses from Year 1 to Year 4. Measurements of the POs are made through several assessments such as tutorials, quizzes, laboratory works, projects, mid-semester examinations and final examinations. This study presents the results from calculations based on the POs of the final examinations for two semesters (semester 1 and semester 2) of session 2010/2011 Civil & Structural and Civil & Environmental Engineering undergraduate programmes. It was made using the average marks for the sample of five excellent students, five moderate students and five weak students for all courses which have final examinations. The results showed an average overall marks for the PO4 is the highest around 78% followed by PO3 and PO10 which are about 68% and 63% respectively, while PO1 and PO2 have the lowest values which are around 56%-59%.

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**Keywords:** Outcome-Based Education (OBE); Programme Outcomes (PO); assessment using examination; student evaluation: high quality graduates; three categories of students

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### 1. Introduction

Faculty of Engineering and Built Environment UKM has started using the concept of Outcome-Based Education (OBE) since 2005. This concept is in line with the requirements for all engineering programmes in implementing OBE curriculum at public higher education institutions (Shahrir et al., 2008). OBE is a teaching method that emphasizes what students can actually do after they completed their training or their courses (Faizah, 2008). OBE implementation is to ensure the academic programmes, the delivery systems and methods of valuation will produce capable and high quality graduates. There are three main objectives needed to be achieved in the implementation of the OBE. The objectives are the results of the Course Outcomes (CO), the Programme Outcomes (PO) and the

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Programme Educational Objectives (PEO). The objectives should be measured to determine the level of knowledge, skills and abilities of all students after completing their courses.

The basis for the assessment of PO is to use the marks of final exams, mid-semester exams, tests, quizzes, laboratory works, course works and projects. The accounted final exam marks are between 40% and 70% of the overall course marks and it is the largest component. However, the examination can only be used to assess the performance of PO1, 2, 3, 4 and 10. The rest of the POs can be evaluated using other methods as mentioned above. Table 1 shows the list of PO1 to PO10 used by the Civil & Structural and Civil & Environmental Engineering undergraduate programmes for the 2010/2011 session.

Table 1. List of Programme Outcomes (PO) (Universiti Kebangsaan Malaysia, 2010)

PO	Knowledge Components
PO1	Has adequate background knowledge and able to apply it.
PO2	Has the ability to undertake engineering problem identification and provide solutions.
PO3	Has the ability to design a Civil and Structural or Environmental Engineering project within social and environmental.
PO4	Is able to behave professionally and practice moral ethics.
PO5	Has the ability to design and conduct experiments, as well as to analyze and interpret data.
PO6	Has the ability to use the techniques, skills and modern engineering tools necessary for civil engineering practice.
PO7	Has the ability to convey spoken or written ideas not only with engineers but also the community.
PO8	Has the ability to function effectively as individuals and in groups with capacity to be a leader or manager as well effective team member.
PO9	Recognizes the needs of life-long learning.
PO10	Has the ability to adopt elements of the construction project management, asset management, public policy, administration, business and entrepreneurship.

## 2. Methodology

This study has analyzed the information related to the achievement of PO using 15 samples of students' final exam answer sheets for each course of the programmes. PO matrix of the final examination forms for each course show marks of the tested POs. Marks obtained show the achievement of POs by 15 students representing three different categories for each course. PO results for all courses were then averaged to indicate overall performance of PO. PO values for each category of the excellent, moderate and weak students were also evaluated. A total of 37 courses of Civil & Structural Engineering and the Civil & Environmental Engineering were offered for the 2010/2011 session. However, only 22 courses were involved in the evaluation of these POs while the other 15 courses could not be assessed due to lack of data, or did not have final examinations. List of courses involved in this study is given in Table 2.

Table 2. List of courses

No.	Course Code	Course Name	No.	Course Code	Course Name
1.	KH1044	Static and Dynamic	12.	KH4033	River Engineering
2.	KH1124	Engineering Survey	13.	KH4073	Engineering of Water Supply and Sewerage system
3.	KH2124	Strength of Materials	14.	KH4193	Project Management
4.	KH2134	Fluid Mechanic for Civil Engineering	15.	KH4223	Geotechnical Engineering Practice
5.	KH2174	Introduction to Environmental Engineering	16.	KH4283	Sustainable Town Planning
6.	KH2254	Geotechnics I	17.	KH4323	Structural Design II
7.	KH2264	Material Technology	18.	KH4573	Structure Stabilisation and Dynamic
8.	KH3224	Structural Analysis	19.	KW1104	Principle of Chemical Processes
9.	KH3234	Engineering Hydrology	20.	KW3214	Chemical and Biological Processes
10.	KH3244	Road Engineering	21.	KW4023	Pollution Control
11.	KH4023	Advanced Structural Analysis	22.	KW4113	Bioreactor System

### 3. PO evaluation

Ratings are based on the PO matrix set by lecturers during preparation of final exam questions. In this study only PO1, PO2, PO3, PO4 and PO10 can be evaluated while the other POs cannot be assessed through final examination. Figure 1 (a) and (b) below shows the achievement of PO1, PO2, PO3, PO4 and PO10 for both undergraduate programmes during 2010/2011 session. Evaluation shows that the average percentage of each PO is at satisfactory level (more than 60%) especially PO3, PO4 and PO10. The average for both PO1 and PO2 are above 56%. There are several courses such as KH2124 and KH4023 that show very poor achievement of both PO1 and PO2 where the values are less than 40%. These courses affect the total average of both POs. For KH4573, KW3214 and KW4113, PO2 values are less than 40%. Therefore it is recommended that respective lecturers of these courses should pay more attention on PO1 and PO2 because they involved fundamental knowledge of the taught courses.

Values of PO1, PO2, PO3, PO4 and PO10 for the three categories of the excellent, moderate and weak students are displayed in Figure 2. The three categories are determined using the final exam marks where five highest marks were chosen to represent excellent category, five middle marks in moderate category and five lowest marks in weak category. Results show that all POs for excellent students have the highest values (76-94%), followed by moderate students (57-73%) and weak students (37-65%). All categories of students show the highest values in PO3 and PO4. Comparing the overall values of all POs, this study found that PO2 has the lowest value followed by PO1, with value between 37% and 77%. It was found that the differences in all the POs between excellent and moderate students were within 13%-20%. However, the differences in all the POs between excellent and weak students were within 28%-40%. The largest percentage difference of POs between excellent and weak students is PO2 (40%), followed by PO3 (38%) and PO1 (37%). This result indicated that most of weak students could not achieve PO1 and PO2 targets. It is recommended for PO1, that the academic staff should focus on improving the ability of students to acquire and use fundamental knowledge of mathematics, science and engineering. As for PO2, the lecturers should give more exercises to enhance student ability in identifying and solving engineering problems, in their respective courses. However, the overall percentages of POs are at satisfactory level.

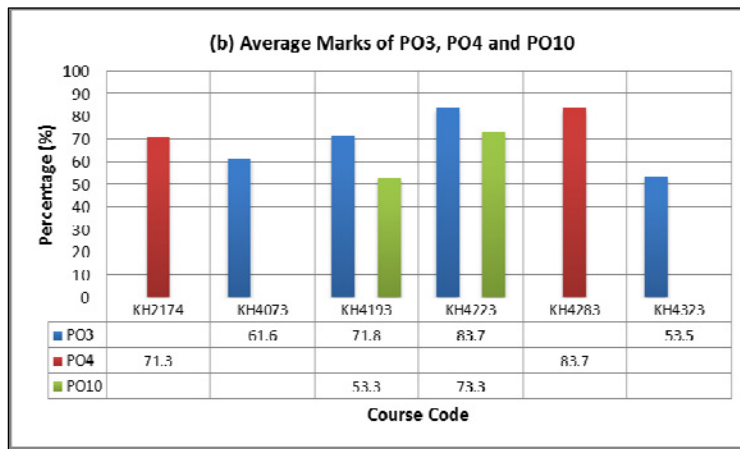
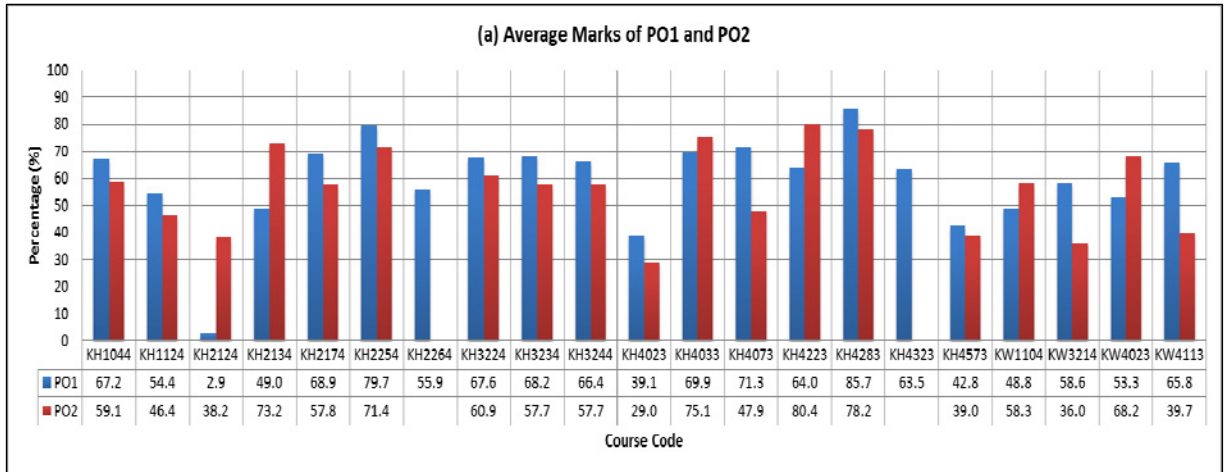


Figure 1. Evaluation of PO1, PO2, PO3, PO4 and PO10 for Civil & Structural and Civil & Environmental Undergraduate Programmes during the 2010/2011 Session

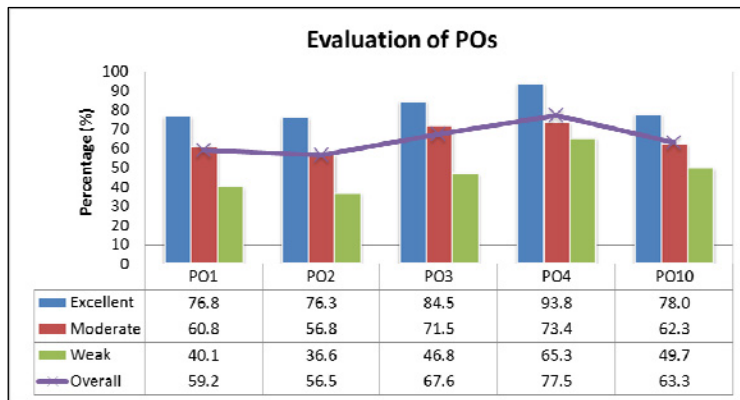


Figure 2. Evaluation of PO for three categories of students and overall marks of PO for all categories.

#### 4. Conclusions

Evaluation of PO1, PO2, PO3, PO4 and PO10 using the final exam marks showed that all the five POs are at satisfactory level. Values of PO3 and PO4 are at the highest level followed by PO10. This result demonstrates achievement of PO3 with assess the ability to design related civil, structural and environmental engineering projects. Achievement of PO4 the ability to behave in professional and ethical responsibilities is very good. The achievement of PO1 and PO2 which are at lower values compare to other POs indicated more emphasis must be given on these two POs. Lecturers are advised to put in more effort in enhancing students' understanding of the basic knowledge and to apply them in solving engineering problems. Among the improvements that can be done is to give students more problem solving on the engineering applications. This can be applied particularly for courses which are considered critical in the evaluation of PO1 and PO2.

#### 5. Recommendations and Improvement

This study should be done from time to time so that the department can evaluate the students' level of knowledge, skills and abilities based on all the POs, in order the teaching and learning aspects can be continuously improved. To achieve better and comprehensive results for the study, it is proposed that the calculation is made for all students and for all courses using final examination marks. It is recommended that the scoring matrix for each PO of all students is prepared to enable a more accurate assessment.

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