TRAINING REPORT
AND
PROFESSIONAL EXPERIENCES

SEPTEMBER 2012

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DECLARATION

I declare that all informations in this Training Report and Professional Experiences are the result of my own writing based on the working experiences.

Witness

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1. EXECUTIVE SUMMARY

This report is one of the compulsory documents need to be prepared to fulfill the requirement to sit for Professional Interview imposed by Institution of Engineers Malaysia (IEM). It contains detail experiences that have been obtained during working as an academician at Universiti Teknologi Malaysia (UTM) since 1987 till now plus the experience obtained from Industrial Training for two years at construction site in Skudai.

In general, as an academician at higher institution like UTM, I have been involved in Teaching Program for both undergraduate and postgraduate students. Roughly, more than 2000 students have been graduated as Civil Engineer since 1987 till now taking and average of 60 students per class per semester with two semesters per session. The main course taught to the students is Structural Analysis which become the core subject in Civil Engineering Program. During this time, I have engaged with Innovation and Consultancy Bureau (BIP) and Uni-Technologies Sdn Bhd (UTSB) of which both of them are UTM’s subsidiary. Thus, I have opportunity and obtained a lot of experinces in handling some consultancy works through these bodies. Only the important and significant projects that contributed much to the professional experinces are highlighted in this report. They are MRR2 Forensic Engineering Investigation, Jaya Supermarket, Roof Truss of Larkin’s Stadium and Analysis and Design of Billet Bay. The other projects are mostly related to the analysis and design of steel and concrete structures.

In year 2009, I engaged with a consultant namely Perunding ISP for Industrial Training. I took this opportunity to expose myself to construction site in UTM Campus. The title of the project is “Cadangan Membina dan Menyiapkan Projek Bangunan Tambahan Fakulti Kejuruteraan Awam (RMK ke-9) Di Universiti Teknologi Malaysia, 81310 Skudai, Johor”. The construction of new 3-strorey building is a project belongs to UTM, which is one of the projects under Ministry of Higher Education (MOHE). The building is intended to be used for teaching laboratory and lecturer’s room. The total initial cost excluding variation order (VO) is 11.2 millions and the contract period is from 26 August 2008 until 25 November 2009, which is 15 months. Although the project was awarded on 25 August 2008 but the contractor begins one month later. The scope of works for my involvement in this project are i) Assistant to Resident Engineer (RE) for site supervision; ii) Attending site meeting; and iii) Attending technical meeting.

Prepared by
Yusof bin Ahmad
September 2012
2. EXPERIENCES

2.1 Teaching of Undergraduate and Postgraduate

Teaching Responsibilities

I have taught at Faculty of Civil Engineering, Universiti Teknologi Malaysia since July 1987. At that time I was a tutor. At undergraduate level, I teach core and elective subjects. Most of the subjects are related to structural analysis. I also teach design subject especially for steel and timber structures. Some of the core analysis subjects that I have taught are Mechanics – Statics, Applied Mechanic, Technical Drawing, Strength of Materials, Theory of Structures, Theory of Structures II and Structural Analysis. Generally, each semester, two subjects were taught, and there will be one section per each subject. There are about 60 students per section. So far I have taught one elective subject called Finite Element Method. Since, this is a numerical subject, normally the number of student is less than 40. The Structural Analysis and Finite Element Method subject were offered to final year students. I have been teaching the final year students since 1998 till now. Sometimes, the Head of Department appointed me as a subject coordinator. I was also appointed as Head of Analysis Panel.

In addition to the teaching, I also have supervised laboratory classes i.e. Civil Engineering laboratory 1, Civil Engineering laboratory 2, and Civil Engineering laboratory 3. Most of the lab classes are related to the experimental works of structure models and concrete testings. The number of student per class is limited to 50 students (5 students per group). In February 2011, I was appointed as Head of Structures Laboratory.

I also have been appointed by the faculty to organise a compulsory seminar subject called Civil Engineering Seminar, once per semester since 2002 till now. This is 2-day seminar and the purpose of this seminar is to expose the final year students to the talks given by experienced engineers from different discipline in Civil Engineering.

Besides that, I also involved in teaching for part-time student under School of Professional and Continuing Education (SPACE). The number of student per class are varies between 10 to 60. A detailed list of subjects that I have taught can be seen in my Curriculum Vitae (CV). Every semester, I have to supervise between 5 to 10 students which are doing pre-thesis and thesis for undergraduate level. So far, I have supervised about 102 undergraduate students.

At each semester I have allocated my time with the students to monitor their academic progress and personal affairs. The number ranging from 10 to 25 students per semester. Sometimes, few students which are not under my teaching class also come to my office to get discussion on technical advises and I entertained them immediately or ask them to come some other time if I am busy at that time.

I also teach post-graduate students for both full time and part time on Finite Element Method, Bridge Engineering and Advanced Structural Analysis and also be a supervisor and co-supervisor for Masters student pre-project and project. Almost every semester, I was selected to be one of the evaluation panel for the assessment of masters student project, masters proposal and PhD proposal. Until now, I have evaluated 36 post-graduate students with different research projects and proposals.

I involved directly in improving the syllabi and curriculum for both undergraduate and post-graduate program in my faculty. To ensure the quality of teaching and learning is continual, my faculty has appointed me as Internal Auditor for ISO 9000:2001. My responsibility is to monitor the teaching documents or course files are in order where all the academic staff are required to do so.

I spend a lot of time in book writing, book translation, adaptation and thesis writing. So far I have published 5 original books, 3 translations, 3 adaptations, 3 theses and 4 solution manuals. I have written 5 teaching modules for the subject Strength of Materials, Teory of Structure 1, Teory of Structure 2, Structural Analysis and Finite Element Method. I have prepared 3 training notes on STAADPro and LUSAS softwares and 4 compilations of past year questions and solutions. I also involved in writing some articles for “Ensiklopedia Sains & Teknologi”. I have presented and published 26 papers in International and National levels. Details of my publications are shown in my CV.
I ask my student to use my book as a main text book, I also encourage them to refer other books because I believe that each book has their own strength and creativity. Since, a lot of students used my book, I have been awarded “Buku Paling Laris” in 1998.

I also attend related seminar and courses. One of the important short course that I have attended was “Training of Computer Software – STAAD.Pro). Thus, it help me to be expert in using the software before giving training to the student. In addition to that, I have conducted a training on STAAD.Pro to my collegues. This help me a lot to familiarize the use of STAAD.Pro in the teaching programme.

I was appointed to be one of the committee in organising a seminar called Civil Engineering Seminar which actually a compulsory subject to all undergraduate students. The aims of this seminar is to expose the student to the professional talks given by expert engineers from consultants, contractors, government and private sectors.

I have attended two workshops on the Teaching Portfolio. These workshops helped me to produce a teaching portfolio and it was very helpful and benificial to the teaching and learning process. In future, I will try to take video while teaching to evaluate myself.

In 1998, I was selected by the Faculty of Civil Engineering as the Best Lecturer in Teaching. I have been awarded by Peratuan Matematik Malaysia & SIME DARBY on my translation books and other awards.

Almost every semester I was assigned to visit between 10 to 20 students which are doing training at various companies at outside UTM campus such as Perlis, Kedah, Penang, Perak, Wilayah Persekutuan, Negeri Sembilan, Melaka, Johor and Kelantan. The main objective is to ensure that all the students should be exposed to the working environment and to ensure that the student capable to apply the theory that they have learned at university to the site. Till now I have visited and monitored the progress of the industrial training program for 318 students. Typical list of students which completed the training are shown in the CV.

I was appointed as a Committee of Book Panel to assess the new manuscripts from authors. I was also appointed as a substantive editor and pruff reader for 26 entries in Ensiklopedia Sains & Teknologi. The details are shown in the CV.

Beside the teaching work loads, I have involved in many commitees in organising international and national conferences, seminar and short courses. I also actively involved in standardizing the Malaysian Standard of Structural Use of Timber which worked with Malaysian Timber Council (MTC) and SIRIM. Previously, I involved in standardizing the Specification of the Use of Rubber for Dock Fender, also under SIRIM. Until now I have involved in 86 commitees as can be seen in my CV.

Currently I am a Head of Structures Laboratory and Chairman of Family Club, Faculty of Civil Engineering.

2.2 Research Experiences

The first research grant obtained (1991) was a short term research grant from Research Management Centre (RMC), UTM to develop physical models in teaching programme. The models have been used to teach Mechanics – Statics which is a core and basic subject in civil engineering. This research has been carried out after the performance of the student for this subject was not convincing where the Key Performance Index was not achieved. Many students failed in this subject and the other students have obtained moderate mark. From the survey, it shows that most of the student did not understand the subject very well since this subject is the first subject they met in civil engineering program. Thus, in order to get a clear picture in explaining the theory, we have developed some models as a teaching tool.

From year 1996 till now, I obtained 15 research grants from various bodies such as Ministry of Science and Technology (MOSTE), Ministry of Higher Education (MOHE), IRPA, SDAR, FRGS, IRGS, UPP and GUP. The latest grant obtained was Research University Grant (RUG) awarded by MOHE to UTM after UTM was recognised as one of the research universities. I managed to get RM 121,000 to
carry further research on structural timber. The details grant is shown in my CV. Some of the significant research projects are explained here.

I was one of the researchers conducting a contract research project on the use of steel slags to be applied in civil structures especially road construction. This research was funded by a private body i.e. Malaysian Iron & Steel Industry Federation (MISIF) with amount of RM 92,000 for 13 months. The steel slags were collected from five local manufacturer i.e. Antara Steel Sdn Bhd, Amsteel Sdn Bhd, Malayawata Sdn Bhd, Southern Steel Sdn Bhd and Bradken Steel Sdn Bhd. Steel slag was a by product of steel and become wastes material to the steel mills industries. It can be produced by either through blast furnace or electric arc-furnace. The quality of the steel slag produced from blast furnace is better than arc-furnace. Thousand tons of the waste were produced every year and this become a big problem to the limited space for dumping. The first part of this project is to proof that the steel slag is not a hazardous material and should be degazetting from scheduled wastes whilst for the second part, the possibilities to apply the steel slag were studied thoroughly. The research shows that the steel slag was not a hazardous material to the environment if it is manage properly. Also, the steel slag was a good material to be applied in civil structures either to replace coarse and fine aggregate and even to replace some volume of cement of the concrete. It can also be used as a subgrade in road construction. Further study need to be carried out to the effect of steel slag in term of strength, durability, surface roughness, creep and shrinkage, heat transfer and leaching aspect for long exposure. The finding of this research was presented to MISIF and the report was prepared and submitted to them for further action especially for degazetting process by Ministry of Health and Environmental Malaysia.

In 2003, I obtained a research grant from Ministry of Higher Education (MOHE) under Fundamental Research Grant Scheme called FRGS to conduct a research on steel truss structure. The aim of this research is to propose few truss shapes which proven to be the most economic material in roof truss construction. Selecting truss shape either for roof, bridges or others is one of the problems faced by many civil engineers. Normally, the just accept the shape proposed by architect or configure it by themselves randomly. This research was conducted through analytical approach using an engineering computer software called StaadPro which can analyse and design the truss until the optimum sections are obtained. The study was limited to steel tubular section, however the same steps or procedures can be used for other sections. The finding of this research is presented in form of table showing the most economic or optimum section for various span of roof truss.

I did my PhD in the area of timber engineering where the behavior of tropical timber beams strengthened using fiber reinforced polymer rods and plates was studied. In Malaysia, the application of timber structures in construction is still low. Generally, the use of timber mainly focuses on simple structures or structures that can take small loads. Timber has less strength when compared to reinforced concrete or steel. Solid timber beams with bigger size are difficult to be obtained. Therefore the timber beams at factory or existing timber beams that have been built can be strengthened and give equivalent load carrying capacity similar to beams with bigger size. Alternative materials have been studied for the strengthening by reinforcing the timber beams. The attention has been given for the use of fiber reinforced polymer. This research was conducted to investigate the behavior of timber beams (Yellow Meranti) strengthened with glass fiber reinforced polymer (GFRP) bars and carbon fiber reinforced polymer (CFRP) plates using Sikadur-30 as bonding agent. Materials testing were conducted first on timber and fiber reinforced polymer to determine their properties. Twenty eight beams with the dimension of 100 mm × 200 mm × 3000 mm were tested where two of the beams were used as control beam (unstrengthened). The remaining beams were strengthened with different configurations before tested to failure under four-point loading. The bending behavior of the beams was studied based on their load-deflection characteristics. The experimental results were then compared with numerical analysis using finite element method (FEM). The results showed that the strengthened beams performed better than the control beam where the ultimate load, stiffness and ductility were increased as the percentage of GFRP and CFRP used was increased. The use of CFRP plates exhibited better performance of strength, stiffness and ductility over GFRP bars. From the parametric studies, the debonding would not occur if the length of CFRP plate is greater than 2.0 m or two third of beam length. The results showed good agreement
between FEM analysis and the experimental values where the differences are small and acceptable. In conclusion, four major findings were drawn from this research i.e. strengthening of tropical timber beams (Yellow Meranti) using fiber reinforced polymer was developed; bonding technique using spikes between CFRP and timber beams was proposed; modification factors for bending strength and stiffness were proposed for timber beam strengthened using GFRP and CFRP; and efficient technique for testing of GFRP bar was developed which could be used as standard guide line for testing.

2.3 Supervision of Postgraduate Research and Project

Currently, there are three PhD students and three Master students are doing research under my supervision. All students are doing research related to structural timber and the application of fiber reinforced polymer (FRP). The main topics are connection behavior due to seismic, shear strengthening using FRP, effect of groove sizes to the timber strength, effect of surface roughness to the bonding strength of timber strengthened using FRP, strengthening of glulam using FRP and development of durable fiber reinforced polymer grouted splice connection. In addition to that, there are two students who are doing postgraduate project for their masters degree by taught course (MSc).

2.4 Consultancy Works Experience

During my service in UTM, I managed to carry out 29 consultancy works and 26 out of it are related to civil structures and constructions. All of the projects fall under national level except one project was international level which is a colaboration project with a company in Germany called Spelten. Some of the important projects are presented here.

2.4.1 MRR2 Forensic Engineering Investigation

Project name : Projek Jalan Lingkaran Tengah 2 Pakej 11 (MRR2)
Start date of involvement : August 2004
Finish date of involvement : March 2005
Period of involvement : 8 months
Type of involvement : Forensic and Analysis

The Middle Ring Road 2 – Package 11 forms the connection between Package 10 and Package Damansara Puchong, starting at Jalan Selayang Junction and ends at Sri Damansara junction. The route is approximately 4 km long that runs along the existing Jalan Kepong. The Public Works Department (PWD) as a representative of Government of Malaysia has awarded the project to Syarikat Sekretariat Usahasama Kontraktor Melayu-India Malaysia, Bumi Hiway (M) Sdn. Bhd. and Konsortium Kontraktor Melayu (Wilayah) Sdn. Bhd. which is also known as SUKMIN-BUMI HIWAY-KKM (Wilayah) JV, as the turnkey contractor. The initial Consulting Engineer was Perunding Zar Sdn. Bhd but later it was handed over to Maunsell Sharma & Zakaria Sdn. Bhd. The total contract sum was RM 238,828,257.16. The commencement and completion date were 27/05/1999 and 26/05/2001 with construction period of 24 months.

Part of the Middle Ring Road 2 (MRR2) in Kepong - the 1.7 km flyover between the FRIM and the Taman Bukit Maluri interchanges - was ordered closed after experts found it to be a ‘threat to public safety’, when 31 out of 33 pier crossbeams supporting the flyover were found to be defective. Extensive cracks were observed in the affected crossbeams which were visible to the passers-by and the presence of cracks had raised public concern.

Repair work on the defective flyover had been temporarily halted to allow the Anti-Corruption Agency (ACA) to carry out an independent investigation on the bridge structure. The Forensic
Engineering Team from the Universiti Teknologi Malaysia (hereinafter known as the ‘Investigating Team’) was appointed by the ACA to carry out forensic engineering investigation on the MRR2 project. Cawangan Jalan of JKR Malaysia was to be responsible in managing the contract and controlling the design policies and the compliance of the construction works.

The Joint Venture group had appointed Perunding ZAR ‘to carry out all the design works only’ and Maunsell, Sharma & Zakaria (MSZ) ‘to be the supervising consultants’. The Independent Checking Engineer for the structure was Ir. Yaw Jiun Yoong and for the geotechnical works was Ir. Dr. Che Ariffin Hassan. Bumi Hiway would manage this project as well as be the leading contractor for the project on behalf of the Turnkey Contractor.

In original statement as per document studied, Perunding ZAR was appointed for design works only whilst MSZ was appointed as supervising consultant. In another document, MSZ was to be responsible for design and supervision of the viaduct whilst ZAR for design and supervision of the rest of the works which included the piers. Progress Report as per document studied, had mentioned that MSZ’s site supervising team had started on site since June 1999.

The bridge is located between Lebuhraya Damansara – Puchong (LDP) and Package 10 MRR2 Flyover which carries a dual 3-lane elevated carriageway over existing roads. The overall length of the said bridge is about 1.6 km comprising of the superstructure 1.537 km long between the abutments and the remainder consists of abutment structures of reinforced concrete portal frame construction with beams and slab.

The bridge cross-section comprises twin precast segmental concrete single-cell box girders which are about 11.5m between barriers and having an overall depth of 2.5m. The bridge has 34 individual spans each having a length of about 45.2m and was constructed using a span-by-span method. The spans are simply supported with a continuous link slab at the piers to provide a continuous riding surface. The piers are located in the median of an existing road whilst movement joints are provided at every 5th pier. Typical sections (as-built drawings) are shown in the Appendix A.

The 33 piers consist of 2 types of reinforced concrete. Pier 19 and Pier 23 are twin column portal frame structures (sometimes called the pi-shape) supported on pile caps founded on bored cast in-place piles. The remaining piers are of T-shape, a single octagonal column, which is about 3.62m wide, supporting a 7.5m long cantilever crosshead of varying depths from 2.0m at the tip to about 3.5m at the column face. The crosshead has an overall width of about 4m.

The abutments are also of T-shape with 21.24m long rectangular beam by 3m (depth) x 3.8m (width) which is centrally supported on 8m x 6m x 3m deep pile cap. The abutment shelf beam therefore cantilevers about 6.62m each side of the pile cap.

Extensive cracks were observed in 31 out of 33 pier crossheads supporting the bridge which is located between Lebuhraya Damansara – Puchong and Package 10 MRR2 Flyover. Cracks in the affected crossheads were found to follow a certain consistent pattern and were visible to the passers-by and their presence had raised public concern. Repair work on the defective flyover had been temporarily halted to allow the Anti-Corruption Agency (ACA) to carry out an independent investigation on the bridge structure.

Structural investigation reports were submitted earlier to the relevant authority by two consultants appointed by the Contactor (Sukmin-Bumihway-KKM JV) and the JKR (Jabatan Kerja Raya). Contrasting opinion with regard to the safety factor on the capacity of the pier crosshead was provided by the reports. The former report suggested that the ultimate capacity of the crosshead was in the order of 2.6 times the applied nominal loads which far exceeded the required safety factor. The later report however, suggested that the safety factor calculated based on transverse tension was 0.40 for existing dead loads at final stage and the stability of the structure was a serious concern. The report concluded that the structure was not stable and immediate closure and safety measures be taken.

This report has been prepared in response to the request by the Anti Corruption Agency (ACA) that an independent structural and forensic investigation be carried out to determine the cause of the cracking and to check for any discrepancies in the construction of the structure. The forensic investigation into the cracking comprised of field investigation and related laboratory work, design checks and document study.
The primary scope of the investigation was to provide possible evidence which would enable the ACA to establish possible link to the Clause 11(c) of the relevant Act on Falsification of Document.

The field investigation involved visual inspection and crack mapping to verify earlier inspections, covermeter survey, rebound hammer tests, core-drilling for concrete strength sampling and related laboratory testing included core testing, ultrasonic pulse velocity measurement and chemical analysis. The test results indicated that the material used in the construction was in accordance with the specified material properties and strength.

The design check involved load assessment and structural analysis of the crosshead including code assessment, and finite element analysis as well as strut-and-tie analysis as a supplementary method. All the loadings were verified and used in the design check.

Based on the site investigation and design check, a failure hypothesis on the observed cracking was proposed in which it was suggested that the cracking occurred in stages. Early cracking occurred upon striking of formwork was attributed to early thermal expansion. However, longitudinal cracking occurred on top of crosshead was due to inadequate provision of transverse steel which failed to resist tension during erection loading. The longitudinal cracking had caused splitting of the crosshead into 3 parts and consequently reduced its effective width. Inadequate transverse steel was considered as a design error. Further flexural cracking occurred in the crosshead due to combined effect of splitting and bonding failure. The bonding failure was caused by lack of material due to inadequate spacing and lapping of longitudinal steel bars in the middle part of the crosshead (region of maximum bending moment). Inadequate spacing and inappropriate lapping were considered as a detailing error.

Document study revealed that there was an original design of the crosshead submitted by another consultant, the drawing of which contained adequate transverse steel and proper detailing of the reinforcement bars as opposed to the alternative design which was adopted by the contractor. The change in section of crosshead resulted in reduction of overall dimension and reduction in size of transverse steel diameter and their spacing. The original section provided T20@150mm whilst the alternative section provided T16@175mm.

Study of the progress reports revealed that observations on cracks were made during early stage in construction of the viaduct and were reported as non-structural hairline cracks. No clear actions were taken and the construction of other piers continued regardless of the cracks being repeatedly observed with consistent pattern. The consultant had failed to make a thorough assessment on the causes of cracks during construction and the effect of loading from the launcher was overlooked.

The consultant and client had failed to recognize the need to have detailed investigation such as design checks, non-destructive testing etc when cracks appeared during the second period of the crack events. All inspections carried out by the consultant were merely in the form of visual inspection. It is believed that at this stage thorough investigation should have been made especially when at some places cracks were as wide as 4mm.

From the procedural and contractual angle, there was no clear evidence to suggest that the findings contributed directly to the emergence of the defects, which may have been caused by other factors. However, the magnitude and extent of the problems caused by the discovery of the defects could have been mitigated or reduced if best practices were adopted that conform to the chosen procurement system. Best practice in the design and build construction was also questionable. Further findings on this aspect may be supplemented by other additional investigation such as forensic accounting.

Although the evidence gathered in this investigation do not provide a direct causative link to the cracking and the relevance of Clause 11(c) of the Act, major questions related to design and detailing error, change in section, lack of action on observed cracking during construction and other related issues would be of concern to the relevant authority.

The scope of works includes

a) Preliminary Site Visit
b) Initial Desk Study
c) Visual Inspection and Crack Mapping
d) Verification of concrete strength measurement
e) Design check on pier crosshead
   i. Conventional bending theory
   ii. Finite Element Analysis of Pier
   iii. Strut and Tie Model of Crosshead
f) Assessment of Structural Detailing
g) Structural Capacity

2.4.2 Jaya Supermarket

Project name : Demolition Works of Jaya Supermarket at Jalan Semangat,
Seksyen 14, Petaling Jaya, Selangor
Start date of involvement : June 2009
Finish date of involvement : Sept 2009
Period of involvement : 4 months
Type of involvement : Forensic, Analysis and Court Case

An incident at construction site has occurred on 28th May 2009 where almost 70 of a shopping complex
building namely Jaya Mall at Jalan Semangat, Seksyen 14, Petaling Jaya, Selangor has collapsed. The
building was constructed in 1974 using combination of conventional RC structures and post-tensioned
technique using ungrouted tendon. The building was under demolition works when it collapsed. Parts of
the building which collapsed were shopping area and four-storey parking area. It was reported that the
building collapsed during hacking of slab panel at top level. At the time of collapse, five excavators
(hackers) were placed on the roof slab which was also used for parking before this. Seven workers
(suspected from Indonesia) were died in this incident.

Thus, a forensic investigation group has been formed from Civil Engineering Testing Unit (CETU),
Faculty of Civil Engineering, Universiti Teknologi Malaysia, Skudai, Johor, after getting appointment
from Department of Safety and Health (JKKP). The scope was to investigate the causes of the incident
and any other relevant matters. The first site visit was done on 2 – 4 June 2009 and the second was on 25
June 2009. In these visits the collapsed building was investigated thoroughly and all the informations
from the relevant parties incuding documents  were recorded. Samples such as concrete taken from
coring, steel bar, and all other relevant evidences were taken to laboratory for testing.

During preliminary investigation, the layout of drawings was studied. The drawings weres provided
by the contractor who responsible in the demolition works and also by JKKP. The investigation
concentrated on statement method on how the building should be demolished suggested by the
demolishing contractor to the authority. Other important informations given by JKKP were photos taken
before after the incident and discussion conducted by JKKP. The group from CETU has also
conducted on site survey and getting feedback from the workers who were saved from the disaster.

The demolition contractor of the former Jaya Shopping Centre denied starting demolition
work before the building collapsed immediately after the incident. It instead said it was only
planning to carry out work at 6 pm on May 28. That is one hour after the incident occurred.

A spokesman for the construction company, Lawrence Kwok, on the night of the incident
told ‘Malay Mail’ that even until the day of the collapse, no demolition works had taken place.
Kwok was quoted as saying that the company spent the past month putting up safety structures and
testing the stability of the building.

Initial investigations showed that the contractor, Pembinaan C.W Yap Sdn Bhd, did not get
the green light from the Department of Safety and Health (DOSH) to start demolition, although it
did get approval from the Petaling Jaya City Council last year to carry out the work.

An application made to DOSH by the contractor on May 11 was given a no-go as the method
statement submitted was incomplete. The missing details included a detailed survey report and a
detailed calculation of the demolition. Such details are vital for DOSH as it needs to know if a contractor's demolition methods are safe for employees. The method statement also contained the possible risks involved and the listed the ways in which the contractor was planning to demolish the building. Demolition of the building – one part being 10 storeys and the other, four – was to have been done floor by floor and within 122 days.

Nine mini excavators were to be hoisted on the building's two roofs - three at the ninth floor and six at the fourth floor roofs. The contractor had also in its method statement stated that prior structuring of tendons would have to be undertaken by the contractor. And if it were not done, the weight of the excavators and the hacking might pose a risk and that slabs might give way - and that could lead to a cascading effect to the rest of the building. All possible risks of the demolition were also mentioned in detail.

The contractor also did not dismiss the possibility of the building crumbling if the wrong anchors on the building were hit. Despite the risks mentioned, a professional report, which was also submitted by the contractor’s consultant and signed by engineer, stated that the contractor would be able to get the job done safely. The company gave an assurance that safety was its utmost priority.

Couple days before the incident, the Malay Mail managed to contact construction workers who were involved in demolition work of the former Jaya Shopping Centre. They claimed that hacking work had started at least two days prior to the collapse. They also said that they were aware that it was not safe for demolition work to start at the top while supporting works were still under way on the lower floors.

Next the analysis and design checking were carried out based on the gathered information at site and the results obtained from laboratory testing. Finite element computer software-based was implemented in the anlysis to predict the behavior of the structure for comparison with the collapse mechanism. All possibilities of loading were applied to the structure and analysed in order to find the causes of the collapse.

From the investigation the causes of the collapse were identified and some method were proposed to be included in the guide line for demolition works in the next future.

**General Statement of the Building**
This building was first built in 1974, with 3 storeys only, Grid D-N. In was built using prestressed beams and conventional reinforced slab. In 1995, an extension block of 10 storeys was built from Grid A-D using reinforced concrete system. In the same year the 3-storey block was extended for another 2 storeys using 2 different system i.e. bonded and unbonded post-tensioned slab. Some parts of the slab were flat slabs (without beams) and the other parts were common slabs (with beams). Thus the age of the original 3 storey building was more than 35 years old. Thus, the building consists of two interconnected blocks with 10 and 5 storeys. The roof slab of the 5-storey block was used for car parking, whilst the other levels were used for shopping and food courts.

**Hypothesis of Failure**
From the preliminary investigation, some hypotheses have been predicted i.e.

i) The failure might be due to excessive bending moment caused by heavy machinery placed on the roof slab.

ii) The failure might be due punching shear at columns caused by the heavy machinery when placed close to the column.

iii) The failure might be due hacking works at tendon lines which may caused rupture to the tendon.

iv) The failure might be due unproper setting of the scaffolding used to support the slab or it might not be supervised in a good manner.

v) The failure might be due hacking works which caused the anchor beams and columns ruptured.

**Scope and Methodology of Investigation Works**
The scopes are

i) Site investigation.
   Collection of photos
   Dimensioning of structure components
   Determination of structural system used in the building
   Collection of material samples
   Witness interrogation and discussion


iii) Analysis and design checking.
   Determination of structural capacity based on the design load and with the present of extra loads from machinery.

iv) Materials testing.
   Conducting tensile test for steel bars and tendons and concrete core compression test. The results will be used in the design checking.

v) Analysis using computer simulation (Finite Element Software).

vi) Determination of causes of failure.
   Validation of hypothesis

vii) Preparation of final report.

2.4.3 Roof Truss of Larkin’s Stadium

Project name : Structural Investigation of Roof Structure for Larkin Stadium, Johor Bahru

Start date of involvement : July 2009
Finish date of involvement : Jan 2010
Period of involvement : 6 months
Type of involvement : Forensic and Analysis

Larkin’s Stadium was built in 1964 to serve and cater mainly for sport activities in Johor. The stadium was managed by Stadium Board Authority and maintained by Public Work Department (JKR). In 1992 the stadium was upgraded where the roof was installed on top of the grandstand area. The roof was a space truss system.

The whole roof truss structure was treated as a three dimensional roof truss system. The coordinates of each joint of the truss were obtained from survey. The survey was done on 17 Dec 2009. The roof sheeting was made by zincalum which supported by a series of purlins from lipped channel section. From the visual inspection, all purlins were badly attacked by corrosion and loose the material almost more than 60% of its cross section. The size of the roof truss was 94.14 m length, 21.26 m wide and 2.25 height as shown in Figure 1. The structure was symmetry at the mid length. The front portion of the roof truss was cantilever for 13 m whereas the remaining were supported by reinforced concrete columns where the spacing was between 3 – 10 meters. The roof truss was attached to the concrete columns by means of plates and bolts. The truss members were made by tubular steel section where the details mechanical properties were unknown. This structure was built in 1990. All joints use ball and socket system where each member free to rotate. An engineering software called STAADPro (Structural Analysis and Design for Professional) was used to analyze and design this structure. This software was licensed to Department of Structures and Materials, Faculty Civil Engineering, UTM, JB.

In July 2009, the administration staff noticed that two members from the top-chords was splitted from its joints. This alerts JKR for investigation and engaged a consultant from Universiti Teknologi Malaysia to carry out structural engineering assessment on the said roof. Thus, a technical report which presents the structural engineering assessment was prepared by the team. The main objectives of the
structural assessment were to determine the structural integrity and stability of the roof. The methodology of work constitutes of three categories namely visual inspection and surveying works, alignment checking, and structural analysis and design check. The assessment was to look at the condition of all of the members including joints and support base plates. Any weakness such as defect, deterioration, and buckled members were recorded. The alignment survey was done to observe the deflection of the roof truss whilst the analysis and design check was to check the stability of the whole system at its present condition with two defect members can sustain the current loads and compare with undefect system in responding to several loading combination.

Visual inspection found many roof structural members especially those located at the top were not satisfactory in the design point of view. This also happened to some of ball joints. About 59% of the ball joints were found corroded and the paint peeled off from the members. Purlins were the most severe members due to corrosion. There are members that totally lost their section capacity especially at the top chord members. For the bottom chords, only 8% of the members were corroded. Alignment survey shows that the left-hand side of the roof was deflected 30 mm relative to the right-hand side. This finding is close to the value obtained during analysis and design checks. Interestingly, there were several members found to be underdesigned and slender for ultimate load condition. As a conclusion, the roof needs to be repaired immediately. The underdesigned members and the buckled members should be replaced with suitable size. The corroded members need to be cleaned and the new painting should be carried out.

### 2.4.4 Analysis and Design of Billet Bay

**Project name:** Analysis and Design of Billet Bay for Proposed TWP Plant  
At PLO 522, Jalan Keluli, Pasir Gudang  
**Start date of involvement:** July 1996  
**Finish date of involvement:** Sept 1996  
**Period of involvement:** 3 months  
**Type of involvement:** Analysis and Design

This is a two bay steel portal frame structure used for production of steel billets. The owner of this project is Antara Steel Mills, Pasir Gudang, Johor. An analysis and design report was submitted on 9 September 1996. Steel Technology Centre was appointed by Antara Steel Mills to prepare the analysis and design calculations. This is a jointventure project with Spelten Consulting GMBH, Germany. A steel portal frame with two different spacings were analysed. The span of the bay was 26 meters. 2D and 3D models were considered in the analysis using a computer software called QSE. The design works were done manually based on BS 5950: 1990. TWP sections were used for all rafters; UB sections stiffened with steel plates were used for external columns whilst UB combined with double T sections were used for internal column. These bigger sections were used because the structure needs to carry higher loads from cranes. At the vertical end panels and also at the roof end panels, the frame was braced to resist lateral load due to wind. From the computer analysis, three variables i.e. axial force, shear force and bending moment were determined. The rafters and columns were then designed based to satisfy the ultimate limit state and serviceability limit state. Shear and bending capacity were calculated and compared with the applied shear and moment, respectively. Frame stability and formation of plastic hinges were also checked. Other conditions such as local and overall buckling were also considered in the design. Hauch if any was checked for stability.

### 2.4.5 Cracks Investigation of Post-tensioned of Bridge Beams
This project was to investigate the cause of cracks on post-tensioned I-beam at Jalan Kluang-Jemaluang as required by Bakti Insani Sdn. Bhd; the contractor who cast the beams. A total of nine post-tensioned beams were supposed to be cast. Five of the beams were cast on site by using Tenaga Concrete Sdn. Bhd. Mix between 5th to 10th June 1996. Only one mould was used for this purpose. The beams were cast with three stiffeners at equidistant. The following were tests and studies that were carried out on site:

a) NDT tests (Rebound Hammer and Pundit)
b) Cracks width measurement and crack pattern studies
c) Detail drawing checks
d) Supports checks
e) Construction procedures

Consistent readings from both the Rebound Hammer and Pundit has shown that all beams including the uncracked beams have almost the same compressive strength, i.e. 50 N/mm². The crack widths measured using micrometer were up to 1.2 mm. Clause 4.1.3 of BS 8110: Part 1 1985 limits crack width up to 0.2 mm only. Localised horizontal cracks were observed to form in three of the beams along the bottom of the top flange as shown in Figure 2. These horizontal cracks were only located surrounding the stiffeners. All beam supports were in order and no ground settlement occurred. Interviews with the various parties involved in the casting of the beams and lapse of casting have shown that the moulds were removed less than 24 hours of after pouring the concrete. However, the bolts and nuts for prestressing tendon at the stiffeners were removed or loosen four hours after concrete pour. As a results, the green concrete tend to settle due to self weight and caused crack to form at these locations. To confirm the cause of cracks it would be wise to cast beam number six and remove the side moulds at least 24 hours after pouring concrete. It also suggested that the beams with crack width less than 0.2 mm should be injected with epoxy to prevent corrosion to steel reinforcement.

2.4.6 Analysis and Design of Roof Truss for Public Market

The scope of this project was to analyse and design fourteen roof trusses with different shapes and configurations. The task was done by using a structural computer software called Staadpro. Node and member numbering system for each truss was prepared first. The trusses were made using steel tubular section and arranged to form triangulated panel. The trusses were supported by inclined steel tubular sections which transfer the load from roof to the columns. The dead and live loads considered in the analysis were 0.2 kN/m² and 0.3 kN/m², respectively. The loads from the roof were transferred to the truss
through purlins and become point load. The selfweight of the truss was automatically calculated by the software.

2.4.7 Analysis and Design Checking of Substation Erection Platform

Start date of involvement : April 1997
Finish date of involvement : May 1997
Period of involvement : 1 month
Type of involvement : Analysis and Design

This project was a two storey steel frame used for substation erection platform. This frame was designed to transfer a huge load from transformer. The mass of the transformer with oil was 152 tons. The transformer has 4 wheels, thus the mass was then converted to four point loads. Since there were moving loads, it has to be arranged in such a way that creates maximum effect to the bending moment on the beam. This was done using influence line concept where absolute value should be obtained. Works that involved in this project were calculation for section to determine member properties, beams and columns design, design for X-bracings, horizontal bracing and computer modeling using QSE. Double structural steel C-channels were used for column whilst I-beam section was used for beams. Built-up sections were used for secondary beams. The beams were designed based on unrestrained condition as the compression flanges were not prevented from tranverse movement. Shear and bending capacity were two main parameters need to be checked. Lateral torsional buckling was checked for all beams. Columns were checked against axial load and bending. Local and overall buckling check were carried out for this column.

2.4.8 Analysis and Design for Renovation Works

Project name : Analysis and Design Checking for “Cadangan Ubahsuai & Tambahan Rumah Kedai di atas Lot PTB 989 & 990, Jalan Niaga 2, Pusat Perniagaan 2, Kota Tinggi, Johor
Start date of involvement : June 1995
Finish date of involvement : May 2004
Period of involvement : 8 months
Type of involvement : Forensic, Analysis and Court Case

The two storey shop house at Jalan Niaga 2, Business Centre, Kota Tinggi was renovated in 1990. The building was initially designed for two storey and then was extended to four storeys. The ground level was used for restaurant, level one and two were intended for low cost budget hotel, and level four was for office. The building was reinforced concrete structure where the foundation can be considered as raft type. To ensure the stability and strength of the structure, mangroove piles of 125 mm diameter were driven until ‘set limit’. After the renovation works were about to complete, the owner of this building which was also a contractor who did the renovation works received complaints from his neighbour about the crack problems. This matter was then brought into court. Thus the client or owner of the building (defender) has appointed me to investigate the cause of the cracks, reanalyse and redesign the structure. From the visual investigation and the available data obtained from the authority such as Majlis Daerah Kota Tinggi, it was found that the the whole block of the shop houses and the surrounding shop houses were built on dumping area. This dumping area was simply covered by soil and the shop houses were built three years after covered by the soil. Thus the soil was not sufficiently consolidated since the wastes
take longer time to rotten. From the investigation done to other shop houses and adjacent blocks, a lot of cracks were appeared in each lot and some of the cracks were even worst compared to the plaintiff Lot. Some of the soil especially at the aprons were found separated and settled down from the apron for more than twelve inches. Feedback obtained from interview with the current tenants, the cracks started about couple years after the two storey shop houses were constructed. This proved that the soil during that time was unstable. During the monitoring works to the plaintiff building, the crack was classified as live cracks.

Second part of the investigation was carried out on the defender building. Study on drawings for the original and renovated building that have been supplied by the defender was done thoroughly. In addition to that and for confirmation, testing works were carried by UTM and also other parties to determine the soil capacity, the strength of the concrete and other important variables. Monitoring gauges were fixed to the building to measure the settlement. From the construction drawings, it was found that the defender has taken safety precaution for his building by constructing a new foundation for the extended building. The combination of strip and raft foundation were built to the whole area of his lot. From the analysis and design, the foundation was strong enough to carry the extra load. Soil investigation that was carried out by independent party proved that the soil contained a lot of rubbish. Fortunately, the defender building was no cracks although the cracks were also appeared as other lots before the renovation took place. It seems that the new foundations built as an addition to the existing foundation acted effectively to shared the load from the existing and new structure. Finally, after more than 10 years in court case, the defender won the case, with a very comprehensive document to convince the judge.

3. INDUSTRIAL TRAINING – Construction of Teaching Laboratory Blocks

<table>
<thead>
<tr>
<th>Project name</th>
<th>Cadangan Membina dan Menyiapkan Projek Bangunan Tambahan Fakulti Kejuruteraan Awam (RMK ke-9) Di Universiti Teknologi Malaysia, 81310 Skudai, Johor</th>
</tr>
</thead>
<tbody>
<tr>
<td>Start date of involvement</td>
<td>August 2008</td>
</tr>
<tr>
<td>Finish date of involvement</td>
<td>August 2010</td>
</tr>
<tr>
<td>Period of involvement</td>
<td>24 months</td>
</tr>
<tr>
<td>Type of involvement</td>
<td>Supervision</td>
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</tbody>
</table>

Practical training has been conducted at civil and Structures (C&S) Consulting Firm under supervision of a Residence Engineer (RE) and Professional Engineer. The project was a construction of two-block three-storey teaching laboratory building. The main task is to help RE in supervising construction project and to ensure that all activities run in accordance to the work program and follow all C&S drawings and specifications.

3.1 General Informations About the Project

The title of the project is “Cadangan Membina dan Menyiapkan Projek Bangunan Tambahan Fakulti Kejuruteraan Awam (RMK ke-9) Di Universiti Teknologi Malaysia, 81310 Skudai, Johor”. The construction of additional 3-storey building is a project belongs to UTM, which is one of the projects under Ministry of Higher Education (MOHE). The building is intended to be used for teaching laboratory and lecturer’s room. It consists of two blocks namely Block A and B and are connected each other at foyer which is located at the middle part of the building. This foyer becomes the main access to this building. A lift is located at this foyer. A rubble wall was built between fellow house and Block A to protect the slope. A concrete retaining wall of 2.5 heights was built along a river at Block B. The main entrance to this building was located at Block A which is off-road from main road to prevent from traffic jam where this main road was very close to a junction. A one-way road forming close circuit to this building was build. Main parking areas were located at both block and a special area for loading and
unloading materials was available. This project was monitored by Office of Asset & Development (PHB), UTM. PHB has its own unit for architect and landscape, construction, mechanical, electrical etc. All specifications and drawings for this project should refer to JKR standards. The total initial cost excluding variation order (VO) is 11.2 millions and the contract period is from 26 August 2008 until 25 November 2009, which is 15 months. Although the project was awarded on 25 August 2008 but the contractor begins one month later. The followings are groups or individual who involved in this project:-

<table>
<thead>
<tr>
<th>Client</th>
<th>Pejabat Harta Bina (PHB), UTM</th>
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</thead>
<tbody>
<tr>
<td>Civil and Structures (C&amp;S)</td>
<td>Perunding ISP</td>
</tr>
<tr>
<td>Mechanical and Electrical (M&amp;E)</td>
<td>MEC’S Engineer</td>
</tr>
<tr>
<td>Quantity Surveyor</td>
<td>JBB Consultants Sdn. Bhd.</td>
</tr>
<tr>
<td>Contractors</td>
<td>GLR Builders Sdn. Bhd. and MRRB Sdn. Bhd</td>
</tr>
</tbody>
</table>

3.2 Scope of Works

The scope of works for my involvement in this project is
i) Assistant to Resident Engineer (RE) for site supervision
ii) Attending site meeting
iii) Attending technical meeting

3.3 Supervision Works

The supervision works which involve in a building construction are Meeting; Preparation of materials; Equipments; Preliminary works; Site clearing; Earthworks; Silt trap and wash-thru; Safety; Piling and load test; Pile cutting; Carpentry – formwork; Bar bending; Sub-soil drain; Spacer blocks; Pile caps; Concrete testing; Stump; Ground beams; Sanitary plumbing; Downpipes; Gully traps; Ground slabs; Aprons; Lift; TNB room; Retaining wall; Rubble wall; Water tanks; Cold water; Electrical wiring; Telephone wiring; Internet wiring; Columns; Scaffolding; Beams; Slabs, roof slabs and roof aprons; Staircase; Roofing; Handrails and cat ladder; Fire fighting; Airconds; Brick walls, lintels, doors, windows; Plastering; Cabinet; Ceilings; Tiling; Partition; Drains; Sumps; Sewer line; Painting; Louvers; Turfing; Landscape; Parking; Road; Signage; Commissioning.

3.4 Supervision Activities

Preliminary Works

i) Temporary access road
Preparation of temporary access road at main entrance was the first thing done in this project. Crusher run was used for the temporary access road. Since the access road needs to cross an existing drain, temporary drain culvert was installed before the drain was fully covered by the crusher run. The size of the culvert should be sufficient or approximately equivalent area with the existing drain for water to flow especially when heavy rain comes. The culverts should also have a sufficient strength to support heavy vehicles when enter the site. Hence, in order to ensure that the culvert is protected against heavy loads, a steel plate of 2 m wide, 6 m long and 10 mm thick was put on the culvert. A lot of debris due to heavy rain was found which prevent a good water flow to this culvert and the workers have to remove the debris.
frequently. Otherwise, the water from the culvert may enter the site during overflow because the level for the construction site is lower than the existing drain especially at main entrance.

ii) Main entrance door
For the safety of materials at site, a main entrance door was fabricated to prevent unauthorised persons from entering the site especially during holiday. In this project, the fabrication of the door was delayed because there was not much materials brought into the site at that time.

iii) Temporary site office
On the first day of this project, three cabins were brought and used for site office; one for contractor, one for consultants and one for meeting room. It is very important that all representatives from consultant companies be put together in one office for them to discuss. Since the clear space was small for this site, the cabins, which have been arranged inside the premise, were moved to side table of road after getting approval from PHB. Next, all the furnitures such as tables, chairs and other office facilities such as photocopy and fax machine, telephone, computers, internet line, safety helmets, boots, drawings, files and documents were brought into the cabins. The floor of the cabin was not good and some maintenance works should be done to repair it.

iv) Electricity, telephone and water tapping
Before the tapping works of electricity, telephone and water are carried out; the contractor should get approval from the relevant unit at PHB by filling the form. The forms should be submitted together with the drawings. Representative from PHB will come, check the electric, and water meter installed by the contractor before connect it to the existing electric, pipe or telephone lines. A temporary power point was built for electric supply. After one week, the electricity was still not connected and waiting for PHB to check the wiring. PHB asked the contractor to change the electric meter since the meter was wet. Thus, new form should be submitted to PHB by the qualified electric contractor. All electric, water and telephone bills will be paid by the contractor. Sport lights were also fixed for night working.

v) Temporary ground toilet
Two units of temporary ground toilet for workers were built. A temporary septic tank using 4 feet manhole culvert was constructed. However, the capacity of the septic tank was small. Therefore, the depth of the septic tank was raised by mean of brick wall on top of the culvert. During construction, the level of the overflow pipe was too low and the septic tank was fully covered without ventilation or service hole. After receive comment from RE, the contractor (MRRB) has raised the level of outflow pipe and installed 4 inches PVC pipe on the septic tank cover for ventilation.

vi) Signboards
A signboard giving information of the project should be built. A signboard should contain information of client, architect, C&S, M&E, QS, main contractor, start date and finish date. Signboard of “safety first” and warning of “not entering the premise without permission” should be constructed. These signboards should be located at a suitable place and can be seen easily, for example at main entrance.

vii) Shade for workers
A shade for workers adjacent to the cabins was constructed. This would provide a shelter for workers to take rest during break and give protection from hot sun and rain.

viii) Hoarding
The construction of temporary fence surrounding the site was built using wood and zinc, which is called ‘hoarding’. Thus, it is very often that the hoarding was collapsed due to wind. The hording is to protect the equipments, materials, etc and to prevent unauthorized person to enter the site and the main entrance should be used for all purposes.
Site Clearing

This site has some big trees. Before the trees are cut, the contractor should ask the architect which trees should be maintained because some trees are important for landscape and shading. All the trees after cut as well as the root of the tree and the debris were put aside before removed from site. The cut trees should not be buried into ground and this should be monitored by RE. This is to ensure that the logs would not affect the strength of the soil due to decay or disturb the piling works.

Earthworks

After site clearing works were completed, surveying works should be carried out to the determine the level for cut and fill which is called formation level. The levels were marked by using pack showing the depth of the soil need to be cut. Trimming works for slope was also done during cut and fill. Then the slope was protected from erosion by using plastic canvas to prevent mud goes into the river. However, the slopes were not fully covered by the plastic canvas leaving some part of the slope exposed to rain. The contractor should compact the soil properly and do compaction test. The soil should be compacted for every one feet height.

Problem 1
The volume of extra soil is approximately 7000 m$^3$. There is no appropriate area to dump the soil. The extra soil is not allowed to be dumped outside UTM campus to avoid extra cost and no VO is allowed to the contractor for this task. Pejabat Harta Bina (PHB), UTM needs to identify the location to dump the extra soil.

Solution to problem 1
The contractor has submitted a proposal to dump the extra soil. PHB agreed that the extra soil can be dumped to a river side close to Faculty of Mechanical Engineering, FKM (total 3000 m$^3$ out of 7000 m$^3$), UTM. However the removal of soil should be done by stages.

Problem 2
Ground water was appeared on the ground close to the main entrance. During earthworks, ground water level was quite high to some part of block A. This was realised at the beginning stage i.e during the soil investigation works. This water causes a lot of problems in the subsequent tasks.

Solution to problem 2
Discussion was made among consultants and PHB. Subsoil drain was proposed to lower the ground water level. Since this item was not included in the document contract, the consultants need to apply for VO from PHB.

Problem 3
The slope at felo house adjacent to the wash-tru was not shown in the drawing. The slope was more than 45°

Solution to problem 3
Discussion was made among consultants and PHB. A rubble wall of 1.5 m high need to be constructed to prevent the slope at fellow house. Since this item was not included in the document contract, the consultants need to apply for VO from PHB.

**Wash-tru, earth drain and silt trap**

Wash-tru lane or wash basin should be constructed by the contractor as soon as possible. A wash-tru was constructed close to the main entrance to ensure the cleanliness of the existing road. First, the top soil was removed and the crusher run was laid down and compacted. Then the steel bars were erected and concrete of grade 30 was used. The length of wash-tru is 6 m, the width is 3.5 m and the depth at mid-length is one foot. All tyres need to be washed upon leaving the construction site. At the same time the contractor should construct earth drain and silt-trap to prevent silt goes into the river. The earth-drains were constructed in order to collect water from site basin into the silt-trap for sedimentation. The size of the earth and silt-trap should be able to sustain the rain water. For the construction of silt-trap, three culverts of 3 feet in diameter were used. The depth of silt-trap is about 10 feet. The silt-trap consist of two ponds separated by rubbles or crusher run mixed with sand for filtration. The clean water was discharged through culvert into the existing drain but later it was discharged to the river after getting comment from PHB. Rubbles were put at the culvert outlet to reduce the flow speed to prevent erosion at the river slope. Maintainance should be done regularly to remove the mud from the pond. A small silt trap is also required to be constructed to discharge the water from retaining wall.

**Problem 4**

(i) Erosion at slope due to heavy rain at block B, caused overflow to the earth-drain. No proper plastic sheet cover was provided
(ii) Erosion at slope due to heavy rain at block B, caused overflow to the earth-drain. No proper plastic sheet cover was provided
(iii) No proper gradient for the earth-drain to divert the water into the silt-trap pond
(iv) The depth of the earth-drain was not sufficient and too close to the slope

*Solution to problem 4*

Prepare a new earth-drain and demolish the old one.

**Piling Works**

Setting out of piling points for the building and retaining wall was prepared by surveyor. “Total Station” levelling equipment was used for the surveying works. Piling points were marked using small steel rod of 5” length. Piling works for retaining wall were started first. According to document contract, the contractor needs to use jack-in method for the piling works. However, after discussion with RE, the contractor has proposed to use rebound hammer. Thus, the RE asked the contractor to discuss with PHB and get approval from them because it involve with variation order (VO). The main reason to use jack-in method is to get free from noise during piling works because the lecture rooms and other office blocks were located surrounding the site. However, I told and give opinion to the contractor that during the piling works, there will be no lecture as the student will take leave for their semester break. Due to that reason, PHB has agreed to use rebound hammer.

The piling works were carried out by using rebound hammer or hydraulic machine. The mass of the hammer is 2.5 tons with a drop of 500 mm for block A, block B and foyer and 200 mm for the retaining wall. The machine is able to drive piles up to 250 mm diameter.
Reinforced concrete piles were used in this project. The size of the concrete pile for block A and B is 200 mm × 200 mm × 6 m long whereas the size for retaining wall is 150 mm × 150 mm × 6 m long. The concrete grade is 45. Samples for concrete pile should be sent for testing to confirm its strength. After getting the results of cube compressive strength, then the piles are allowed to be used in piling works. The piles were reinforced using 4 bars of 12 mm in diameter and 5 mm shear link. The working load of each pile is 450 kN i.e. the value suggested by geotechnical consulting engineer. From the results of bore-hole, the pile is expected to penetrate approximately 25 m. All piles should be checked by the consultant upon arrival at site.

The pile should be arranged properly to ensure the straightness, thus the ground should be levelled first. Wood spacer should be used intermittently to support the piles especially for long piles. It is very often that the piles when arrived at site were cracked or rupture during handling and storing works. Thus, the SO and RE should monitor regularly.

All piles were marked by the workers at 1 feet interval before driven and the number of blows were recorded for every 1 feet penetration. The piles were jointed using fillet weld. Immediately after the jointing works were completed, the piles were painted to protect it from corrosion. If the rain comes, the welding works should stop immediately for safety. The verticality of the piles should be monitored through out the piling works using bubble. The penetration of the first point of the piling works was 23.5 m. If the penetration is less than 12 mm after 12 blows, the piling works should stop because the pile has set. When the pile is about to achieve its set value, a graph paper is attached to the pile to record the penetration for the next 10 blows. At the end of piling works, the contractor needs to prepare as-built drawing for record keeping. Maximum deviation or eccentricity of pile should less than 75 mm. If the pile deviation is more than the stated value, normally the contractor will propose to solve the problem but the decision should come from RE. One of the methods which is normally done at site is shown at the end of this section.

**Problem 5**
Originally the method for the piling was by using rebound hammer machine as stated in the tender to reduce the cost. After discussion with PHB, they suggested to use jack-in technique to reduce the vibration and noise but PHB should bear the extra cost (VO). This change causes bit delay to this project as the contractor have to wait the decision from PHB.

**Solution to problem 5**
Finally, the hammer machine was chosen since the whole December 2008 was vacation day for the UTM students and does not give much effect to the surrounding.

**Problem 6**
The piles that arrived at site were not in accordance to JKR specifications. The piles were flush end at one end and covered by steel plate of 8 mm at the other end. The pile should be narrow end and the thickness of the steel plate should be 15 mm.

**Solution to problem 6**
After some discussions, the consultant agreed to accept the pile but the contractor should provide a letter of confirmation to use the piles because the price needs to be adjusted by QS (omission).

**Problem 7**
During site clearing and cut and fill works, some of the trees were buried at site. Thus, it disturbs the piling works where the pile cannot penetrate the soil.

*Solution to problem 7*

The RE has given an instruction to the contractor to remove the buried trees from site.

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**Problem 8**

Piles were not arranged properly. It should be supported at the right position to maintain the straightness of the piles.

*Solution to problem 8*

Re-arrange the piles and put proper support.

---

**Problem 9**

The piles age were not 28 days upon arrival at site. Thus, the piling works were stopped due to unmatured piles age.

*Solution to problem 9*

Although the RE has authority to reject the piles, other alternative should be considered. The piles were put aside and have to wait until the matured age is achieved.

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**Problem 10**

i) Pile cannot penetrate at after a penetration of 1.5 m

ii) One of the piles at lift core cannot penetrate after 1 m depth. It is suspected due to hanging boulder

iii) The pile joint for point P13 was broken at early stage during piling.

*Solution to problem 10*

i) Ask the contractor to dig the soil and an overhanging boulder was found. The excavator broke the boulder

ii) Ask the contractor to dig the soil and after the soil was removed, about 1 ton of old steel scrap was found

iii) New piling points and pile cap were proposed by GLR. GLR should provide calculation together with the proposed drawing and endorsed by RE. One extra piling point was proposed. According to JKR, two extra piling point should be done for every broken pile

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**Problem 11**

Two piles were crack which is more than 0.05 mm (0.05 mm is the limiting value mentioned in specification). Two piles were ruptured during piling. One of the pile was cracked at mid length. The other one was ruptured at joint when driven for the third pile.

*Solution to problem 11*

The piles were rejected
**Problem 12**

Few piling points were missing from its position

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**Solution to problem 12**

Survey works were carried out to locate the missing piling points

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**Pile Load Tests**

There is no rule regarding the number of piles need to be tested. In general, if the penetration of pile shows consistence results, one or two piles is sufficient for the test. The working load for one pile or one point is 450 kN.

For static load test, the testing frame made by series of steel beam was setup and the testing procedures should be submitted by contractor (JL piling) to RE for approval. The testing configuration should be checked by RE especially the capacity of the testing frame to sustain the loads. For this project, 33 kentledge blocks were used as loads. Each block has 1.53 m length, 1.02 m width and 1.02 m height and the mass is 3.8 tons. The total mass on the testing frame was 112 tons (i.e.kentledge + steel beams = 99 + 12 tons). The testing frame should be arranged in such a way that the center of the load is exactly on the pile. The loads on the testing frame should be slightly higher than twice of working load (about 10% higher).

The pile to be tested should be cut at 2 feet above the formation level. The surrounding piles need to be cut if the piles disturb the setup of testing frame. All dial gauges and hydraulic jack should be calibrated before used and the contractor should provide data for the calibration and should confirmed by the RE. The serial number of all gauges should be recorded.

For monitoring of load test, reference should be made to the “method statement of load test” given by the sub-con after approved by RE. Load test was carried out for two cycles. For the first cycle, the pile was loaded incrementally according to the schedule until it reaches pile working load. For the second cycle, the pile was loaded incrementally according to the schedule until it reaches twice of pile working load. A graph of load versus settlement was plotted from which the residual settlement can be determined. This value will then compared with the limiting value i.e. 6.5 mm. If the residual settlement is more than 6.5 mm, the pile is assumed fail. If the pile fail, extra pile should be driven and more piles should be tested depending on RE’s decision.

For this project, the results are shown below:-

i) In the first cycle, at working load of 450 kN (45 tons), the deflection is 6.5 mm < 12.5 mm (ok).
   After unloading, the rebound of the pile is 2 mm < 6.5 mm (ok).

ii) In the second cycle, at twice of working load, which is 900 kN (90 tons), the deflection is 17.5 mm < 25.0 mm (ok).
   After unloading, the rebound of the pile is 4 mm < 6.5 mm (ok).

All limiting values mentioned above are referred to ISO specifications. For JKR, the limiting value of 38 mm is used instead of 25 mm

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**Pile Cutting Works**

Pile cutting works can be done immediately after the pile is driven. One important aspect before the pile is cut is the determination of cutting level. Any mistakes to the cutting level yield to under or over digging of soil. This would affects the level of pile cap and the height of stump. The piles were cut using
hacker or hammer to break the concrete and welding set was used to cut the steel reinforcements. The piles were cut 300 mm above lean concrete level and the steel bars were exposed. Sometimes, the space to cut the pile is quite small and thus the cutting works become tedious.

**Carpenting and formworks**

According to JKR’s specifications, the side formworks can be removed 3 days after concreted. The formworks at the bottom part of slab can be removed after 4 days; the floor support and the bottom part of beam can be removed after 10 days; and the beam supports can be removed after 14 days. The removal of formwork at earlier stage is depend on the results of concrete cube test at 7 days. The frequency in using the same formwork is depend on the formwork itself and approval from SO.

**Bar bending works**

The design was based on Code of Practice, BS8110 : Part 1 : 1997 – Structural Use of Concrete. The main steel reinforcement was Grade 460 N/mm$^2$ and the shear reinforcement was Grade 250 N/mm$^2$.

<table>
<thead>
<tr>
<th>Problem 13</th>
<th></th>
</tr>
</thead>
<tbody>
<tr>
<td>When the size of steel bar (used for shear link) is checked, the diameter was 4.2 mm and not 6 mm as mentioned in the BQ.</td>
<td></td>
</tr>
<tr>
<td><strong>Solution to problem 13</strong></td>
<td></td>
</tr>
<tr>
<td>The correct size was sent and arrived at site 2 days later.</td>
<td></td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Problem 14</th>
<th></th>
</tr>
</thead>
<tbody>
<tr>
<td>The steel bars that arrived at site were not in accordance to BS. The steel bar of commercial quality (CQ) type was sent.</td>
<td></td>
</tr>
<tr>
<td><strong>Solution to problem 14</strong></td>
<td></td>
</tr>
<tr>
<td>Hence, the steel bars were rejected by RE.</td>
<td></td>
</tr>
</tbody>
</table>

**Pile caps for buildings**

The next task is to prepare pile caps. Thus, it requires lean concrete, concrete and steel bars. The formworks for pile cap need to be prepared first. At the same time, the soil around the piles should be excavated to the required level. Since the water level is quite high, the C&S consultant has proposed to increase the level to 0.5 m for block A. Thus the pile cap need to be raised up but the stump should be shortened. Ground water also causes problem for pile cap preparation at RW, thus sub-soil drain was proposed by the consultant to discharge the water. The concrete part of the piles were hacked until the level of pile head is about 25 to 50 mm above the top layer of lean concrete. Then concrete was hacked to expose the starter bars as explained before. Then a mobile hand compacter was used to compact the soil before lean concrete (grade 15 – 1:3:6) of 50 mm thick was laid at cutting level of pile. The steel reinforcements that have been fabricated by bar benders were fixed on the lean concrete bed. Then the
formworks were fixed with sufficient gap with the steel reinforcements. The starter bars (300 mm long) were bent to hold the reinforcement of pilecap. Before concreting, the results of tensile test for steel bar should be known first. Steel and formwork should be checked as well. Most of the pile levels were about 1.5 m below the ground slab level. The formworks for pile cap were removed 3 days after concreted.

**Retaining wall**

Six sub-soil drains of 4 to 5 m long were laid at 2 feet below the lean concrete level. After the water was discharge the formation was compacted and then covered by lean concrete. The steel reinforcements were fixed and cleaned before concreted. On site slump test was carried out and 6 cube samples were taken from each lorry (3 for 7 days and 3 for 28 days). The concrete should be tested at batching plant and the consultant should be there as a witness before the concrete is supplied to the site.

The water stopper was laid down along the joint between the horizontal and vertical part of the retaining wall. The water stopper was made by combination of plastic and rubber. The size of water stopper is 200 mm wide and 5 mm thick with two ribs on both sides. About half of its width is embedded in the horizontal and the remaining 100 mm is embedded in vertical part of retaining wall. Special tar was put along the water stopper and at all wall joints.

The effectiveness of the sub-soil drainage and weepholes should be checked. The water flow can be seen clearly from the outlet especially when the rain comes.

**Concrete Tests**

Concreting works should be started in the morning or late afternoon. The concrete should be tested at batching plant and the consultant should be there as a witness before the concrete is supplied to the site. Upon arrival at the site, the concrete samples should be taken again for test. One sample was prepared for slump test where the test should be carried out at site. The slump should be between 55 to 105 mm for good workability. Six samples (3 for 7 days and 3 for 28 days) were prepared for cube crushing test and the samples were cured before tested under compression force. The compressive strength should be more than that of targeted strength.

**Problem 15**
The slump value taken from a lorry has exceeded the limit.

**Solution to problem 15**
The concrete was rejected by RE

**Columns**

The works were started with fixing of main reinforcements, shear links and down pipes then followed by formworks. In order to ease the inspection process, the inspection on steel reinforcement should be done before the formworks are fixed. Other inspection such as the column alignment and verticality after fixing the formworks are also checked before the columns are concreted. The formworks and its bracing or struts should have strong enough to support the column. The tighten components such as formwork ribs should be installed properly in order to prevent from failure during concreting especially at the time of compaction.
**Problem 16**
Three columns were concreted assuming that the columns stopped at first floor. Thus the starter bars were too short for lapping.

**Solution to problem 16**
The top part of the column was hacked to expose the starter bar to a sufficient length for lapping between column at first and second level.

**Problem 17**
RE felt doubt about the quality of the concrete to some of the columns

**Solution to problem 17**
Coring was conducted at some of the selected column and the strength was good.

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**Brickwall**

Brick works could be started after beams, slab and columns are constructed. Lines for brickwall are marked using string and the verticality of the wall will be guided by vertical string set by plumbob. The door frame should be fixed first with the help of strut. In the meantime, the lintel for door and window frames are cast. Some of the brickwall is quite high. Thus, strong lintel should be provided to support the brickwall of more than 3 m, especially at window opening. The ordinary size of lintel is 100 x 100 mm with 4Y8. If the brickwall is considerably high the size of lintel of 100 x 150 mm is suggested. If the span is too long to support the brickwall, a beam instead of lintel should be built. For high and wide brickwall, small column acts as a stiffener should be provided. Wire mesh should be provided for every four layers of brick. Small steel bars with spacing of 1000 mm which embedded into column along its length are used to tie the brickwall and thus hold the brickwall in position. Before plastering work is done, all the electrical wiring, conduit, plumbing should be fixed to the brickwall. In this project, some of the brickwalls and the door frames were wrongly positioned. Thus, the brickwalls were hacked and the door frames were rebuilt.

**Roof Structure**

In this project, cold formed sections are used for roof truss system. The roofing system uses concrete tiles. The roof trusses were assembled on the ground and then lifted by crane to fix on its position. Screws are used for all connections. Sufficient bracings were provided in order to maintain the stability of the trusses. Aluminium foils were laid before purlins for heat protection. During construction, it was found that the cantilever part of the roof was deflected which can be seen clearly by eyes. Thus, a bracing system was introduced to stiffen the cantilever roof. It is very common in construction that the roof tiles were broken due to steps from the workers.

**Drain**
Drains and sumps can be constructed simultaneously i.e. after all the installation of down pipes, gully traps and sewer pipes. The base of the trench should be compacted first. Water level is used to determine the invert level of the drain. Then the crusher run was laid on the trench before drain units were put onto it. After that, the drain risers were constructed on top of the drain unit up to down pipe level. Drain culvert is used when the drain needs to cross the road. Sometimes the drain risers constructed from brick is quite high especially when walkway is required to be higher than road level. Sculper should be constructed under the walkway to allow water to flow from road to the drain.

For steep drain, the staggered drain is preferred to retard the speed of water flow. At retaining wall, drain should be constructed at wall toe and top part of the wall to prevent erosion.

**Sewer lines**

The manhole used in this project is precast unit like culvert. This unit come together with its cover. Before manhole is lowered down into the manhole pit, lean concrete was put to become base of the manhole. The wall of manhole was hacked to prepare for hole so that the sewer culvert could connected to the manhole. Sewer culvert is made by clay with diameter of 250 mm. Crusher run should be laid on a compacted soil along the sewer line to provide support to the sewer culvert. Sewer culvert should be laid in a straight line.

**Problem 18**
High voltage cables of approximately 3 inches diameter were found about 1 m above the ground level at adjacent to the existing manhole when the new manhole was about to attach the existing manhole during tapping works. The sewer pipes should run under the electric cables, thus the level is not suitable to reach the existing manhole.

**Solution to problem 18**
MEC should get information from PHBUTM about the layout of the cables. The contractor was asked to prepare the trial pit for other alternative.

**Road**

Road is the last structural part to be built in construction. Before the road is constructed, the heavy machineries such as crane and excavator should be brought out from site. First, the soil should be levelled and compacted. Then the crusher run was laid down, levelled, compacted and followed by sand. Small roller was used for small area where the ordinary compacter cannot accessed. Samples should be taken for compaction test. All lamp poles if located on the road as well as road curbs should be installed before premixed. Two layers of premix were applied for finishing i.e coarse and fine premix.

**Safety**

Safety is one of the important aspects during construction. Full time safety officer should be provided by the contractor at site for project of more than 20 millions. All workers should undergo safety training and must get green card from CIDB before entering site. All safety equipments such as helmets, boots, safety hardness etc should be provided by the contractor. Even umbrella especially during piling works should be provided.
Briefing on safety awareness should be frequently conducted by safety officer. Safety meeting should be conducted when necessary. The safety officer should check the erection of scaffolding, temporary ladder, safety hardness, safety helmet, boots and rubbish management. The certification of scaffolding system should be check by RE. The contractor should ensure that the construction site clean and free from disease especially dengue. Proper rest area should be provided to the workers. Workers are not allowed to stay in the building being constructed. Ladder should be used for climbing and not the scaffolding. Safety helmets should not be left by the workers at the place where they stop their work.

Problem 19
Safety meeting that has been conducted by PHB found that the use of safety helmets, boots and safety hardness was not properly enforced by the contractor. The crane and piler operator did not wear helmet. Flagman should be provided at site. The contractor need to list down all the activities in the next two weeks time

Solution to problem 19
Safety awareness was conducted by safety officer to all workers.

Meeting
In general, there are two important meetings in any construction projects i.e. site meeting and technical meeting. For this project, site meetings were held once in a month. The meeting is normally chaired by representative from client (PHB) and should be attended by representative from various department of PHB, contractor and consultants. Issues such as status of work progress, status of approval from PHB (in this project, the authority is PHB itself except the approval of fire fighting which should be obtained from BOMBA), problems arise during construction and its solution will be discussed in this meeting.

As for the technical meetings, it’s were held twice in a month which involved contractors and consultants and chaired by Resident Architect. In this meeting, issues such as problems related to drawing from architect and consultants (any amendments to the drawing) will be discussed. Any changes to the drawing should be informed to the client and QS during site meeting.

The coordination between main contractor and sub-contractor was discussed in other separate meeting more frequently, which is once in a week. Re-planning and re-organising works and problems from workers were also discussed.

4. DURATION OF EXPERIENCES AND TRAINING

5. PROFESSIONAL MEMBER

Below is my involvement with professional bodies.

<table>
<thead>
<tr>
<th>No.</th>
<th>Name of Professional Body</th>
<th>Level</th>
<th>Portfolio</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>Board of Engineers Malaysia (BEM)</td>
<td>National</td>
<td>Graduate member</td>
</tr>
<tr>
<td>2</td>
<td>Malaysian Society for Engineering and Technology (mSET)</td>
<td>National</td>
<td>Ordinary Member</td>
</tr>
</tbody>
</table>
6. CONCLUSION

After graduated from Faculty of Civil Engineering, UTM in 1986, I have been involved in academia discipline since 1987 till now. The 25-year experience in teaching and supervising both undergraduate and postgraduate students enable me to apply the knowledge to the real construction industry through consultancy works and industrial training. About 20 projects of civil structures were handled successfully. Two different experiences were gained from the consultancy works which mainly on analysis & design projects and forensic investigation projects. In addition to that, the two year industrial training experience has enhanced the ability to handle the project through supervision works. Proper project planning, management of labor and material, financial flow are important aspects need to be focused in a project to ensure it’s successful. All these experiences enable me to grab the confidence to be more responsible as a professional engineer. I do hope, through this report and the included design report will convince the interview panel to award a place and deserve for corporate member in Institution of Engineers Malaysia.

Thank you.

Prepared by:  
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Approved by:  
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