

Quality Engineering Design and Construction in Malaysia: A Fast Disappearing and Endangered Commodity?



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CONSTRUCTION AND SITE SUPERVISION

This is the part of the work by the contractor that needs close attention and supervision because the final outcome of the finished product depends on the quality of work produced by the contractor on site. Hence, it is expected that the contract workers will be supervised by the site engineers or clerk of works to ensure there is no compromise in design and actual construction work.

It is the responsibility of the consultants (both the architect and engineer) to carry out periodic, if not regular, inspection on site to ensure that the quality of work done by the contractor is up to par. The standard site inspection usually carried out is to verify the laying of the correct number of steel reinforcing bars in the correct location and also to check on the plumb straightness of erected formwork for walls and column, as well as to ensure that the concrete cover for steel bars to the inner formwork is within acceptable limits.



Figure 7: Urban planning design requires quality engineering input

From an engineering point of view, one conventional method to ensure the strength of the concrete material used is to test the compressive strength of concrete cubes, cast from the batch of concrete mixes delivered by concrete mix trucks from suppliers. In order to be very precise, the engineer may refer to two acceptable standards, *i.e.* BS EN 13791:2007 [1] or BS 6089: 1981 [2].

Both standards provide guidelines on the reasons for testing the concrete used for structural purposes:

- when an existing structure is to be modified or redesigned;
- to assess structure adequacy when doubt arises about the compressive strength in the structure due to defective workmanship or the deterioration of concrete due to fire or other causes;
- when an assessment of the in-situ concrete strength is needed during construction;
- to assess structural adequacy in the case of non-conformity of the compressive strength obtained from standard test specimens;
- assessment of conformity of the in-situ concrete compressive strength when specified in a specification or product standard.

PROJECT MANAGEMENT AND MAINTENANCE

The matter of project management has been briefly addressed earlier on. Nevertheless, it has to be said that quality control can be a set policy, but it is still the implementation side that needs to be addressed. The project manager can provide supervision and some form of control, but it is up to the professionals such as architects, engineers and builders to accept and follow through.

Likewise, in terms of maintenance, adherence to standards and codes of practice is necessary in getting the right quality in the usage and application of materials for engineering design and construction. The adoption and implementation of the Quality Management System such as the ISO 9001:2008, and perhaps even the Environmental Management System as in the ISO 14001:2004, may bring some advantages and head start to those adopting

the prescribed methods. However, the hard part is always the maintenance of such a system, not in attaining such standards.



Figure 8: Concept of the Quality Management System

OTHER ISSUES PERTAINING TO THE QUALITY OF ENGINEERING DESIGN

One important issue that has an impact on the quality of engineering work in design and construction is education and training. This applies not only to designers when they are taught and trained in the basic fundamentals at universities or technical colleges, but also to lower level supervisors and technicians based at the site, including the skilled and unskilled workforce, in labour and handling machinery and equipment on site.

Likewise, well-educated engineers may be well-versed in design work according to the theories and fundamentals learnt, but they are sadly lacking in site supervision experience. Of late, it has also been found that soft skills are also lacking in such graduate engineers, who have problems communicating effectively. This may cause problems in site communications, as well as problems reading and understanding technical details and drawing plans.

The use of automation is also not predominant in the industry. Labour intensive methods of construction work are still the way to go with local contractors and engineering practices, especially with the abundance of cheap foreign labour from Indonesia, Myanmar and Bangladesh. Hence, if these workers are not given a good grounding in the basic work approach, and the skills needed to produce quality work on sites, then the quality of engineering design will be affected.

WHAT IS IN THE INVESTIGATION REPORT ON THE ROOF COLLAPSE OF THE KUALA TERENGGANU SPORTS STADIUM?

As reported by the Malay Mail [3] immediately after the failure, just over a year after it was officially opened by the Yang di-Pertuan Agong Sultan Mizan Zainal Abidin,

the roof of the 50,000-seat capacity stadium named after the latter in Gong Badak, Kuala Terengganu, collapsed on 2 June 2009, damaging a few cars that were parked in the vicinity. BERNAMA [4] reports that 60% of the roof at the stadium, that was built at a cost of RM290 million and opened on 10 May 2008, collapsed, including the area above the royal box at the grand stand.

On 14 January 2010, The Star [5] reported that the Terengganu state government is ready to make public the cause of the Sultan Mizan Zainal Abidin Stadium’s roof collapse. Its Menteri Besar Datuk Ahmad Said said that the state government would disclose all facts about the June 2009 roof collapse once it receives the investigation papers from the Federal Government.

“This incident also tarnished the state government’s integrity and image, and we should not conceal it from the public,” he said.



Figure 9: The damaged portion of the stadium - (Courtesy of NORDIN A. RASIP)



Figure 10: Part of the caved-in structure - (Courtesy of NORDIN A. RASIP)

Datuk Ahmad Said was commenting on news reports that the stadium's key architect Seni Bahri Arkitek had called on the state government to publish a full report on the cause of the stadium's roof collapse.

It cost RM1000 to purchase a set of the investigation report; which comes in four volumes [6-9] from the Terengganu state government. A quick glance at the Executive Summary of the Volume 1 report reveals the following findings on the cause of the collapse:

- The design was inadequate; the designer failed to take into account the full consideration of the support conditions of the roof structure;
- The roof was erected poorly resulting in misaligned geometry;
- There was no quality control at site; and
- Materials and quality of workmanship did not meet specifications.

Further comments made include:

- The complexity and long spans of the roof structure require a more detailed design consideration into second order design analysis, which was not carried out.
- The sensitivity of the space frame roof structure requires consideration for support flexibility in the design mode, which was not done.

Of course, other factors that may have caused the failure were also highlighted, such as:

- Defective welding in steel components, reflecting the poor quality of manufacturing or pre-fabrication work.
- Poorly conceived erection method in installing the roof structural components, and no checks were conducted during the interim stages in erection.
- Inadequate temporary supports used.
- No apparent quality control by the project management team.
- Alternative design proposals provided by main contractor were adopted without integrated checks.
- Preliminary testing of materials used show strengths below design requirements, not meeting specifications.

The above two factors have contributed largely to the collapse by causing a reduction in the safety factor of the structure – which was well below the norms required of such designs.

Hence, it can be observed that the quality checks and control system were not properly planned and implemented, not only at the job sites but also in the design and planning office by the management team. This happens not only with private jobs, but apparently also in government projects such as the Terengganu state stadium. This can result in poor quality design and construction leading to failure and collapse. Fortunately, in the aforementioned case, no lives were lost.

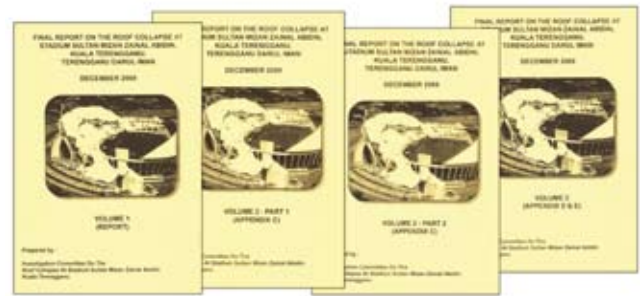


Figure 11: The set of investigation reports on the Kuala Terengganu stadium roof collapse [6-9]

CONCLUSION

The effectiveness of quality engineering design is not easily measurable, as it needs contributions from the many stakeholders involved in all aspects of the work, from planning and design, down to the laborious work on site coupled with site supervision. Nevertheless, if the issues and problems as stated in this paper can be taken into consideration by the proper authorities, then the construction industry may have an opportunity to take effective measures to overcome the problems faced in getting the right quality of work done at all levels. It is time for action by all stakeholders to set right the saying from “First class infrastructure, with third class mentality” to “First class infrastructure, with top class mentality”. ■

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