

## Site Inspection for Construction Projects Using Inspection Test Plan (ITP)

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**Abstract:** Now a days, the current construction projects have become more complex and they consist of diversity of work. Since, construction has become extensive, the problem also exists in each aspect of construction projects. Even though there have been numerous systems developed for controlling the quality, the defects or problems still arise unexpectedly. Furthermore, customers these days have become more focus on the quality of the end products. This study investigates the quality control techniques during site inspection known as Inspection Test Plan (ITP), its implementation and effectiveness for construction projects in Malaysia. To achieve the objective, semi-structured interview was conducted among experienced practitioner in Malaysian construction projects. The interview was supported by 82 survey questionnaires from targeted respondents, namely; project managers, QA and QC managers, construction managers, site engineers and site supervisor. The result showed that the respondents acknowledged the implementation and effectiveness of ITP for Malaysia construction projects. This is to encourage a better implementation for the existing documents in construction projects.

**Key words:** Construction projects, inspection, test plan, site inspection, diversity of work

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### INTRODUCTION

Malaysia's construction projects involve combining all processes with all parties with different work stages (Hasan *et al.*, 2016). This illustrates the complex features of construction projects that involved diverse parties and processes. In addition, Malaysian construction project has been acknowledged as a sector with major productivity since the early.

Quality control deals with the process of carrying out the plan, its specification and its requirement accordingly (Zane, 2005). This can be described as quality control in construction projects as compliance to specification and requirement to meet the satisfaction of end products. The importance of controlling the quality is to ensure that all provided products are at higher standard as well as meet client's expectation and request (Larisa, 2000).

Therefore, one of the methods in quality control is site inspection. Site inspection activities involve examining the materials and components to be in line with design drawing and to abide by regulations (Kamaruddin *et al.*, 2013). The link between quality control and site inspection is to allow the specifications and regulations to be complied by all parties. As such with consistent site inspection assure in minimizing the possible problems before it turns into major problems.

This study aims to conduct deeper investigation about the ITP implementation and its effectiveness during site inspection in Malaysian construction projects. The purpose is to identify the significant purpose of ITP towards site inspection in order to fulfill the demanded quality for construction.

**Inspection Test Plan (ITP):** Inspection Test Plan (ITP) can also be called "Quality Inspection Plan". It was declared that ITP highlighted the critical control points for each construction phase such as scheduled inspection or verification activity by securing the progression of works.

In addition, ITP which was submitted to customers will be review and approve prior to the commencement of work (Silalahi, 2011). It is mandatory for customers to assure the materials or product is compliance with the project standard, specification and requirement.

During construction stages, there were numerous of testing carry out to assure the materials in good condition. The result for entire material's test used in site will be carrying out either at site or laboratory and kept in ITP. This testing is connected with controlling the quality of the building as in specifications. Therefore, during testing construction inspectors are required to present and witness the process. As example, Pile-Dynamic test

(PDA) is carrying out to make sure strength of the pile able penetrates the soil until the hard strata. This test assures the quality of the pile and the building stand straight on the ground.

Meanwhile for concrete test, the usually testing used is cube test or slump test. This test assures the quality of the concrete is practicable and in line with approved grade. Briefly said all of these test are carry out with one purpose which is controlling the quality of construction materials (Silalahi, 2011). The main elements that need to be described and defined are namely:

- Element 1: description of the process to be inspected
- Element 2: description of details activity under the process to be inspected
- Element 3: procedure for the activity
- Element 4: acceptance criteria at which the product or material must meet
- Element 5: number of inspection required
- Element 6: definition of the level of inspection by which involved parties such as contractors or customers

Level of inspection for ITP consists of four stages where the brief definitions are as follow (Silalahi, 2011).

**Spot witness:** It is an activity during construction where the inspection takes place without any formal notification. The customers have the right to hire a third party to inspect the work done by contractor at any time.

**Witness:** Inspection is done at a designated time by customer. If the customer is not able to attend, the inspection is still carried on and the results are documented.

**Hold point:** Inspection must be done with the presence of customer or the third party. If the work done is not approved, it would be held up until the authorization is cleared. Hold point will be released only when contractor has proven the works done are in compliance with specification.

**Review of approval:** The records for the inspection are documented. The essential and required documents inside ITP are namely (Silalahi, 2011):

- Document 1: description of test purposes
- Document 2: standard and specifications
- Document 3: test procedure

ITP is a direct and clear document that points out the materials or work to be inspected or tested by designated parties so as to ensure that the materials or work are in line with the standards provided.

## **MATERIALS AND METHODS**

The method to develop this paper required a mixed method both by quantitative and qualitative approaches. Qualitative methods allow the researchers to develop new techniques, a method which is easy to adapt during collecting reliable information (List, 2012). In this study, the qualitative data is from semi-structured interview conducted among experienced personnel in construction projects.

The semi-structured interview was analysed using content analysis. The techniques may look easier but it contributes to two purposes which are to modify the trends into something simpler and to reduce the subjectivity from summaries (List, 2012).

Quantitative methods is a numerical data, points out the critical point of the study and suitable for a full scale data collection (Denscombe, 2001). Furthermore, due to its reliable and user-friendly criteria, questionnaire was the most preferred method for data collection since it has the ability to collect a wide number of respondents with limited period (Rahman, 2011).

The analysis for the distributed and obtained questionnaire was Kruskal-Wallis test. The test used is to determine the mean difference between the respondent's position in construction projects towards ITP implementation and effectiveness for quality control during site inspection. These mixed methods complement one another and a deeper knowledge regarding this study was acquired (Keng, 2011).

## **RESULTS AND DISCUSSION**

The semi-structured interview was carried out face-to-face since it allowed the process to go smoothly compared to by telephone. The interview was conducted among two project manager and four engineers. The range of respondent's years of experience in construction projects was 6-18 years of working experience. In addition, the period for the interview was between 30-90 min.

Furthermore, the rationale for this interview was proven and justified namely by interviewing the respondents who are registered under Construction Industry Development Board Malaysia (CIDB) and respondent's years of experience in construction projects being >5 years. Content analysis was used to interpret the information from interview process. As such according to interviewee.

"For construction, it is compulsory to carry out the material testing. Its aim is to avoid any problems during construction. Besides, ITP ensure the materials achieve the targeted standard and allowed for construction."

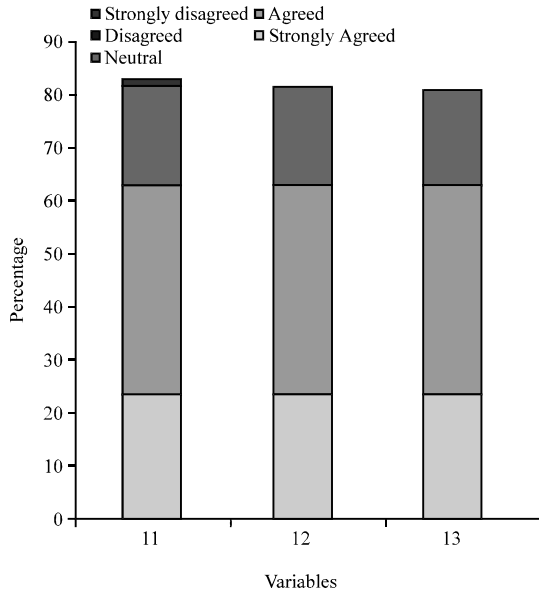


Fig. 1: Frequency analysis on ITP's implementation

The interviewee was a project manager who emphasized the importance of ITP for quality control especially testing on construction materials and components so as to prevent the materials defect during construction projects. Additionally, the interviewee Keng (2011) stated that “test on materials is a crucial quality control, if there were any doubts then ITP helps to erase the doubts. Briefly said, ITP is a guideline for material testing”.

That was an opinion coming from an Engineer. It has proven the importance of ITP contribution towards controlling the quality. As agreed by Silalahi (2011) and ITP helps to point out the important control point during construction phase and the records are compiled prior to commencement of work.

This indicates the importance of material testing for construction projects as part of quality control. Based on the findings, all six respondents agreed that ITP is one of the quality control techniques during site inspection for construction projects (Australian Rail Track Corporation, 2014)

The survey questionnaires were distributed by hand and email to confirm the results of semi-structured interview. The 82 obtained questionnaires were analysed using Frequency Analysis and Kruskal-Wallis test and elaborated. The reason of using this test is to find if there are any different opinions regarding ITP's implementation and effectiveness for quality control during site inspection.

Figure 1 illustrates the frequency analysis on ITP's implementation for quality control during site

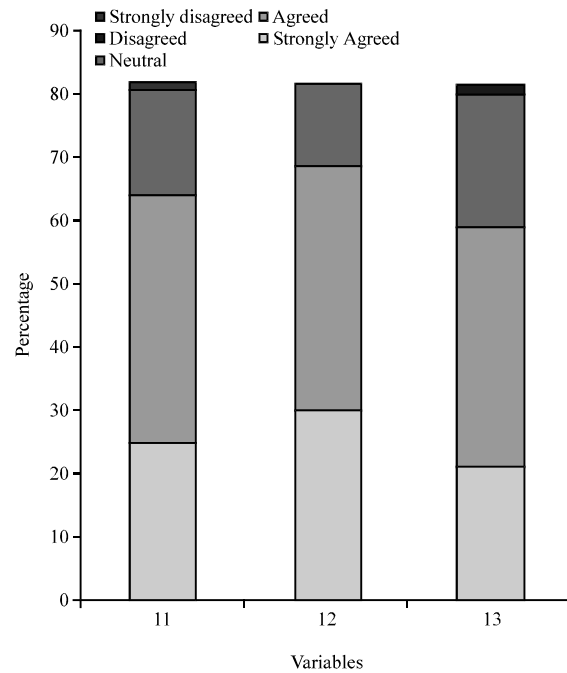


Fig. 2: Frequency analysis on ITP's effectiveness

inspection. Based on the result, I1 known as description of test purposes describes the ITP purposes. Most respondents agreed on the necessity of description of test purposes as required during site inspection with 37%. This is followed by 34% agreed, 10% choosing neutral while only 1 percent chose strongly disagree.

Item I2 known as technical standard and Specifications describes the technical standard and specification for ITP and it is required to be thoroughly understood so as to assure the conducted test is appropriate and reasonable. Respondents choose agree in the implementation of I2 with 49, 30% strongly agree while 3% chose neutral.

Item I3 known as test procedure explained the test procedure or process and with 39% of respondents selected agree and 25% chose strongly agree. Meanwhile, the rest of 18% of respondents selected neutral as the answer. The result showed the agreement from targeted respondents on the ITP's implementation to enhance and upgraded the quality control during site inspection.

Meanwhile, the result for ITP's effectiveness was presented in Fig. 2. This was to determine the documents effectiveness during site inspection since construction site is a huge and complex site and involved many documents which can lead to disorganized construction processes. These documents are necessary as per requisite for construction processes.

**Table 1: Mean value for ITP's implementation**

Documents in ITP	Project manager	QA and QC manager	Construction manager	Site supervisor	Site engineer
Description of test purposes	4.250(3)	3.583(3)	4.545(1)	4.600(1)	4.368(1)
Technical standard and specifications	4.600(1)	4.083(1)	4.182(3)	4.400(2)	4.211(2)
Test procedure	4.400(2)	3.667(2)	4.273(2)	4.100(3)	4.000(3)

**Table 2: Mean value for ITP's effectiveness**

Documents in ITP	Project manager	QA and QC manager	Construction manager	Site supervisor	Site engineer
Description of test purposes	4.250(1)	3.333(3)	4.182(2)	4.150(1)	4.158(2)
Technical standard and specifications	4.250(2)	4.187(1)	4.545(1)	4.050(2)	4.211(1)
Test procedure	4.200(3)	3.833(2)	3.909(3)	3.800(3)	4.000(3)

**Table 3: Kruskal-Wallis result**

Documents in PQP	ITP's implementation		ITP's effectiveness	
	Chi-square	Sig.	Chi-square	Sig.
Description of test purposes	10.700	0.030	9.567	0.048
Technical standard and specifications	10.231	0.037	2.989	0.560
Test procedure	9.248	0.055	3.375	0.497

I1 indicated the effectiveness in test objectives and aims that needs to be explained in details. The results showed 25% was strongly agreed on this effectiveness and 39% agreed. The output displayed the agreeable state for respondents that find its effectiveness. However, there were some respondents who are slightly confused in choosing the answer by selecting neutral and disagree with 17 and 1%, respectively.

Next, I2 specified the effectiveness of technical standard and specification. The result revealed 30% respondents nominated strongly agree, 39% elected agree and 13% decided on neutral.

Meanwhile, I3 pointed out the effectiveness of test procedure or processes. The output presented 21% respondents decided on strongly agree, 38% selected agree, 22% for neutral and only 1% chose disagree.

Comparing both results, it indicated that there were some respondents that found its implementation as important. However, for its effectiveness, it has illustrated a different pattern. It has shown that most respondents preferred to select neutral as the answer on each of ITP's documents for its effectiveness. This is because respondents with different position have different ideas on the meaning of ITP for quality control during site inspection.

Projecting from the results of the Kruskal-Wallis test based on mean value by using respondent's position in construction projects. The respondent's position was among Project Manager, QA and QC manager, construction manager, site engineer and site supervisor who's mainly involved in construction projects.

Table 1 shows the mean value for ITP's implementation based on respondent's position in construction projects included also the ranked for each document. Project manager and QA and QC manager shared the same opinion for ITP's implementation by

ranked the technical standard and specifications as most implemented with 4.600 and 4.083, respectively. However, construction manager together with the site supervisor and site engineer selected the most implemented documents was description of test purposes with 4.545, 4.600 and 4.368 accordingly.

In addition, from the table there is a value below 4.00 by respondents of QA and QC manager with ranging from 3.667 and 3.583. It is still the nearest 4.00 and consider as implemented.

Table 2 presents the mean value for ITP's effectiveness based on respondent's position and its respective ranked. Description of test purposes was ranked as most effective with 4.250 and 4.150 by project manager and site supervisor, respectively. QA and QC manager, construction manager and site engineer selected technical standard and specifications as most effective with mean value of 4.187, 4.545 and 4.211 accordingly. There are four documents with value below 4.00 and labeled as effective.

Based on the discussion above, most respondents agreed on ITP's implementation. It was justified with the mean value for each document above 4.00 and only two of which the value is the nearest to 4.00. The value of 4.00 describes the documents as most implemented for construction projects during site inspection. It was supported that ITP's implementation is part of quality control.

Meanwhile, the effectiveness has a different pattern of result that some documents obtained value below 4.00. Nevertheless, most respondents did acknowledge the effectiveness of ITP for quality control especially during site inspection. This result helps to justify the necessity of the existence of ITP for construction projects. In addition, it is to promote a better future implementation of ITP once its effectiveness has been proven.

Furthermore, Table 3 which represents Kruskal-Wallis result for both ITP's implementation and effectiveness shows there is no significant mean difference that exists among respondents. This means, all respondents agreed on the ITP's implementation and effectiveness for construction projects during site inspection.

### CONCLUSION

A construction project is unique since most of problem hardly identified at early stage. Due to its diversity make it hard to manage since most problems come from low workmanship, lack of understanding of how materials should be worked and foremost poor supervision (Konstantakopoulou *et al.*, 2012). This is the purpose of ITP in controlling the quality of materials and at the same time promotes a better quality control during site inspection.

Materials for construction projects required an appropriate testing before being installed to prevent major problems due to material defects. Therefore, the quality of construction projects can be enhanced by focusing more on the materials testing as in ITP.

It is proved that ITP is not just documents for construction projects but as well as parts of quality control documents during site inspection. The necessity for quality control is to assure the process of construction projects are executed as planned.

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