International Journal of Structural and Civil Engineering Research

ISSN 2319 – 6009 www.ijscer.com
Vol. 1, No. 1, November 2012

Research Paper

EVALUATION AND COMPARISON OF BUILDING CONSTRUCTION TECHNOLOGIES IN TWO MAJOR CITIES OF BANGLADESH

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The study considers the building construction technologies available in Bangladesh. It has been carried out to evaluate the existing situation of construction projects in the country and its aim to evaluate the current situation and make a comparison between the cities, i.e., Dhaka, the capital city and Sylhet, the fast rising city but located at the periphery of the country. The projects investigated in this study include both residential and commercial buildings and the survey works were done by visiting different construction sites and collected all possible and related information through interviews and questionnaires of the workers and engineers. Since technology is important in contrast of time, cost and quality, it is urgent need to evaluate the condition which will help for the respective authorities to take initiative for introducing modern technologies in construction industries. Study shows that periphery areas are far away from modern construction technologies compare to that of capital city, although the capital city also has so many deficiencies to use automation technology compare to that of modern word. Thus proper mechanization and implementation of modern building construction techniques would bring significant impact in building construction by improving its quality with reducing time and cost.

Keywords: Building construction, Modern technology, Questionnaires, Dhaka

INTRODUCTION

Building construction is the process of adding structure to real property. The vast majority of building construction jobs is small renovations, such as addition of a room, or renovation of a bathroom. Often, the owner of the property acts as laborer, paymaster, and design team for the entire project. However, all building construction projects include some elements in common-design, financial, estimating and legal considerations. (Tucker, 1991).

Salam *et al*. (1999) studied that in Bangladesh, all types of civil engineering works, including infrastructure, low and high-rise buildings, defense installations such as fire protection and earthquake resistant, environment protection and local/domestic construction are being constructed to use

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traditional and modern technology. Bangladesh is a densely populated developing country. To meet the continuous housing demand, construction works are rising firstly. Developments in building construction and in construction industries have a significant role in the overall development of a country. So construction industry of any country requires serious attention for further improvement.

In common with other developing countries, demographic changes in Bangladesh are resulting in massive migrations of people from villages to urban areas. The capital city of Dhaka, Bangladesh is facing severe overpopulation. However, even though government spending is increasing, it is not nearly enough to solve the housing problems and, therefore, over the last 10-12 years, private companies have stepped in to initiate real estate business through the construction and sale of middle to high-rise apartment buildings. The main reasons for high-rise rather than low-rise construction are scarcity of land and land prices (Salam *et al*., 1999).

Photios and Robert (1988) performed a study to assist the construction and manufacturing industries in becoming more efficient and cost effective through the introduction and broad use of new technologies. They found that approximately 50% of construction costs in light industrial and commercial building construction are related directly to enclosure and structural systems. Since these systems are common among industrial buildings, the identification and adoption of effective and efficient technologies in these areas is a major step toward improving quality, reducing costs, and expediting schedules.

The cost of building construction has risen dramatically in recent years worldwide. Excessive construction costs have eroded the competitive position of the US construction industry and are having a similar impact on the manufacturing industry by preventing it from building new plants and modernizing existing ones. A large number of projects have been abandoned because the cost of construction is a large component of a corporation's cash flow. The decline will continue until construction firms lower costs and improve techniques to the point where growth is worth the risk and investment. An effective solution to these problems is the introduction of new technologies that enhance the quality of the building product, increase construction efficiency, and decrease costs. For new technologies to be incorporated in building construction, however, they must first be identified and evaluated during the project design phase and the construction planning phase (http://en.wikipedia.org/wiki/Construction# Building_construction).

Anthony C Webster (1993) reported that "the modern technologies available in construction arena like as the elevator system which is operated by one worker stationed at the ground floor, keeping him more comfortable and safe than he would be inside the lift. His only jobs are to tell the lift's computer control system which floor to take a given load of material to, and to direct the lift to pick up any materials that are ready to be sent to the ground floor. The system is fully automated where work is performed at a computer terminal, which displays an animated picture of the lift's current location, the load inside it, and the status of the stacking area at each floor.

There is a television screen next to the terminal displays the interior and doors of the lift and if there is no room on a given floor to stack pallets, the computer terminal displays a blue box on the floor next to the elevator and will refuse to load any more pallets designated for the floor. Boxes waiting to be picked up from higher floors are shown in red". Such type of technologies are available in developed countries where construction works are dominated by machine rather than man and which increases the construction productivity, quality and reduces the time which rarely available in Bangladesh.

In addition there are many construction robots is used in Japan (Levy, 1990), for automated concrete finishers, steel welding machines, and facade inspection systems. Besides for floor finishing robots are used in Japan but the effectiveness for example, is reportedly similar to American walk-behind systems, and are "an order of magnitude" less effective than American riding trowels (Tucker, 1991). Tucker (1991) reports that generally the equipment "has not been successful," at least to increase productivity.

PROBLEM STATEMENT AND AIMS

Extreme a large number of limitations exist for developing and improving the building construction management in Bangladesh due to technology constrains. The construction practice no doubt can be improved by adopting advanced technology and changing over to mechanized system for construction and give to efficient management. However, considering the resource constrains and conditions of available resources and adoption of appropriate of technology, in this content, the objectives of present works are to study the present status of building construction technologies in Sylhet and Dhaka city of Bangladesh, and to make a comparison between the cities for finding the technology lag of peripheral cities of the country. Besides, the study will show the capabilities of Bangladeshi construction organizations working in the country depending on construction equipments and technologies.

METHODOLOGY

This study includes all the details survey related to building construction techniques and technologies such as the process performed, equipments used, techniques followed in construction sites, etc. There are many ways to get information and collect data for any research work. Surveys are one of the major tools for getting the information. The most common survey methods are: Literature Search, Talking with Responsible People, Focus Group Discussion, Telephone Survey, Post Mail Survey, and Preparation of Questionnaire. A literature search involves reviewing all readily available materials. These materials can include internal company information, relevant trade publications, newspapers, magazines, annual reports, company literature, on-line data bases, and any other published materials. Talking with responsible people is a good way to get information during the initial stages of a research project that can be used to gather information that is not publicly available, or that is too new to be found in the literature. A focus group is used as a preliminary research technique to explore people's ideas and

attitudes. A group of 6 to 10 people meet in a conference-room-like setting with a trained moderator. Their disadvantage is that the sample is small and may not be representative of the population in general. Telephone surveys are the fastest method of gathering information from a relatively large sample (100-400 respondents). The interviewer follows a prepared script through that telephone call is essentially the same as a written questionnaire. Mail surveys are a cost effective method of gathering information. Because there is no interviewer, there is no possibility of interviewer bias. The main disadvantage is the inability to probe respondents for more detailed information. Preparation of questionnaire includes the question types, reliability and validity, strength and weakness of the questions, etc. Questionnaires are printed lists of questions used to find out what people think or feel about an issue, product or service. They can be filled in away from the researcher in the form of a self-administered, group-administered or postal questionnaire. Questionnaires can provide quantitative data using close (or fixed-response) questions, where the respondent is presented with a number of alternative responses to a question and asked to mark the one that they feel is most appropriate (Oppenheim, 1992). Qualitative data can be gathered using open (or free-response) questions to which respondents are asked to write their own answer (Oppenheim, 1992). However, closed questions are more specific than open ones, communicate the same frame of reference to all respondents, and well designed response categories can more accurately detect differences among respondents (Converse and Presser, 1986). Postal questionnaires can be a cheap and effective method for gathering data from a large number of widely dispersed people (Oppenheim, 1992). Strength is that, because the researcher is not present while the respondents make their answers, data collected using questionnaires is free of any investigator effects (Oppenheim, 1992). The weaknesses of postal questionnaires are related to the fact that they may be filled in away from the researcher. There has been much argument over whether text should be left and right justified (all lines are made an equal length by varying the spacing between words) or just left justified (word spacing is consistent and line endings are ragged). It seems that there is little difference between fully justified and left justified text in terms of legibility, reading speed or comprehension (Hartley, 1994). However, Hartley (1994) argues that there are indications that left justified text might be more helpful for less able readers, be they young children or elderly people. Questionnaires are versatile, allowing the collection of both subjective and objective data through the use of open or closed format questions. Modern computers have only made the task of collecting and extracting valuable material more efficient. However, a questionnaire is only as good as the questions it contains. The majority deal with making the questionnaire understandable and free of bias. Mindful review and testing is necessary to weed out minor mistakes that can cause great changes in meaning and interpretation. When these guidelines are followed, the questionnaire becomes a powerful and economic evaluation tool. Most of the mentioned characteristics and principles of questionnaire design were

followed during the design of selected questionnaires for the study. After survey, it is very important task how to tabulate and then analyzed the collected data. In this study data was firstly tabulated in a easy tabular form and then analysis by percentage to make it easy to understand and perception of real field condition. In addition, data also presented graphically like bar chart and discussed in details. Finally, a brief conclusion was made to evaluate the present scenario of Bangladeshi construction arena.

RESULTS AND DISCUSSION

Analysis of survey data and interpretation is these is the most important task of the thesis. The main objective of the thesis work was totally depends on the accuracy of the data, analysis and interpretation. To analyze the data tabular, graphical representation and method of percentage were adopted. Survey data includes three types of data, i.e., site information, construction procedure, and quality control. These data are collected by survey from 12 different building construction sites in Sylhet and 14 different building construction sites in Dhaka city. The surveyed sites were selected by using simple random sampling technique. All the data were interpreted by numerical value and graphical representations are made with the help of Microsoft Excel. To realize the general practice in the field of construction, there was no alternative of field survey. Total 26 construction sites are visited in Sylhet and Dhaka city. Those sites includes the residential, commercial and both the combina-tion of residential and commercial buildings, low rise and high rise buildings, the building having the frame system of beam slab or flat plate system in various construction areas.

Table 1 shows what type of building construction sites were surveyed and visited in both sampling areas. In capital city Dhaka, there were eight residential, five commercial and one multipurpose ongoing building construction sites were surveyed in which thirteen are high rise means above six storied and one low rise means up to six storied. Besides, in peripheral city Sylhet, there were three residential, seven commercial and two multipurpose ongoing building construction sites were surveyed in which seven were high rise and five were low rise.

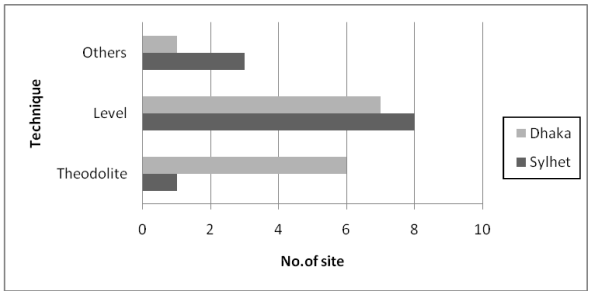
If the construction sites are classified according to percentage, 58% high rise building is covered in Sylhet and 93% that of in Dhaka city. In other words, it can be said that the construction of high rise building is more than the construction of low rise building.

Table 1: Types of Building Surveyed in Dhaka and Sylhet City

City	Type of Building				
	Residential	Commercial	Multipurpose	High-rise	Low-rise
Dhaka	8	5	1	13	1
Sylhet	3	7	2	7	5

The first step of the construction work is to set the perpendicular line for the trenching and excavate the site perpendicular to the ground level. To achieve these objectives the layout technique has been adopted to do the task accurately. There are various methods for the layout technique. From Figure 1, it indicates that use of the traditional method of layout technique is practiced rather than using the modern method. It may be for the inadequacy of the equipment as well as shortage of technical personnel. Recently the construction works became more machine related; the use of the theodolite is increasing in Dhaka area for the layout technique.

Figure 1: Layout Techniques of Building Construction Sites



Water logging problem is a common problem in construction site. Mainly for deep excavation the water logging problem arises. Study shows that, among 12 different building construction sites in Sylhet, only 2 sites were not faced water logging problem and in Dhaka city, only 3 sites were not faced water logging problem. Most of the construction sites are faced these problems in those areas. The whole assembly was submerged in the fluid to be pumped. Submersible pumps were easily primed (removing air from the suction line) compared to other alternatives. Table 2, indicates how popular the pumping method of dewatering in our country. Most of the construction site in Dhaka uses this method for dewatering where in Sylhet, fewer construction site used this pump for dewatering.

Table 2 also shows that the excavation work is mainly done by manpower all over the country. It actually depends on the construction area of work. For small area, manpower is suitable rather than machine. But for large area of construction, machine is used for excavation to save the time and money. In case of soil compaction the backfilling is also most of the case done by manpower rather than machine. Since, manpower is available and cheap, it is quite good but in terms of time it is the drawback of Bangladeshi construction. Table 2, indicates traditional method of manpower is using in both areas and only one site of Sylhet and 3 sites of Dhaka are using machine equipment for backfilling.

Aggregate crushing is generally done by machine for stone chips and brick chips. But for small and economic construction, brick chips are produced by crushing the brick with the help of daily labor. The crushing of stone

Table 2: Technology Used in Foundation Works

City	Dewatering Tech.		Earth Excavation		Backfilling Tech.	
	Pump Use	Manpower	Machine	Manpower	Machine	Manpower
Dhaka	12	02	04	10	03	11
Sylhet	07	05	01	11	01	11

aggregate is mainly done at aggregate crushing plant where the brick chips are crushed by the crusher at site from bricks. A few small farms still use day-labor for crushing brick chips which is cheaper but time consuming. For rapid construction, mechanical crushing facility is necessary. Mechanical crushing of aggregate is increased day by day as in Table 3, 83% sites crushed the aggregate by mechanical means where only 17% by day-labor in Sylhet city but Dhaka is clearly ahead and 100% sites are using machines. In addition, the table also represents that no sites were used mechanical screener for producing well graded aggregate at site in Sylhet city. They ordered the specific size and type of aggregates which was screened at the plant and only 10% sites at Dhaka screened the aggregate at their site by revolving method. Regarding aggregate washing which is very much important for gaining strength by removing foreign materials, it is evident that in our survey sites, most of them used manually washed aggregate.

Type of Concrete Use

There are two types of concrete was available in Bangladesh. Ready mixed concrete is suitable for large concreting and the mixed at site concrete was suitable for small volume of concrete. During the slab and beam casting for medium to large construction site, ready mixed concrete is used; while for column and lintel casting mixed-at-site concrete was used. From Figure 2, it represents that among 26 different building construction sites, 24 of them used the concrete mixed at on site in Sylhet and Dhaka city, and only 2 of the sites were used ready mixed concrete for large volume of concreting which are located in Dhaka. The whole scenario represents the warning sign of how far away the Bangladeshi constructions from modern world.

The use of admixture was important for the water proofing and workability properties of the concrete. Normally the admixture was used for these two reasons. Though the use of admixture was not governed but the situation is progressing day by day. As the water cement (w/c) ratio was not maintained correctly the use of admixture was important for gaining the adequate strength of the concrete. From Table 4, it shows that 100% projects of Dhaka city

Figure 2: Type of Concrete Used in Construction Sites

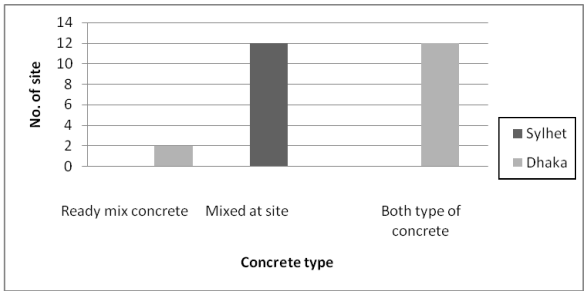


Table 3: Preparation of Aggregate

City	Stone Crashing Tech.		Screening Machine		Washing Tech.	
	Mechanically (%)	Manually (%)	Use at Site (%)	Not Use at Site (%)	Mechanically (%)	Manually (%)
Dhaka	100	00	10	90	07	93
Sylhet	83	17	00	100	00	100

Table 4: Concrete Preparation and Use

City	Admixture Use		Concrete Mixing Tech.		Concrete Compaction Tech.	
	Yes (%)	No (%)	Automatically (%)	Manually Driving Machine (%)	Mechanically (%)	Manually (%)
Dhaka	100	0	70	30	100	0
Sylhet	17	83	20	80	100	0

used admixture for concreting which indicates whenever the w/c ratio is not maintained accurately, use of admixture is needed but 83% sites do not use admixture in Sylhet. The table also depicts that the rate of using automatic concrete mixture machine is increasing in Dhaka, i.e., 70% of the projects produced concrete through auto machine but in Sylhet the situation is not at satisfactory level because they depends on manually driven mixture machine (i.e., 80% case). However, for compacting concrete after placing into formwork all the projects of both cities are using vibrator which is really good sign.

Lifting device was used for material raising or cumbersome objects. Sometimes concrete buckets were used with the roof hoist and tower hoist. They are specially designed for mass placement of concrete in large projects. From Table 5, it is clear that 80% transporting of materials was done by mechanical means in Dhaka city and 100% is done by manually in Sylhet city. It shows the use of machine was increasing day by day in building construction works in Dhaka areas. The table also illustrates, the concrete pumping machine is used all sites of Dhaka but only 20% sites at Sylhet was used the technology. Passenger lift has their stable performance, reliable, safety, easy transportation and strong adaptability can enhance work efficiently and reduce works labor intensity. It is suitable for the vertical transport of people and construction equipment. Above table, shows among 26 different building construction sites in Sylhet and Dhaka city, only 3 sites used the passenger lift in Dhaka city and 23 sites did not use these equipment which means regarding technology based construction the capital city is introducing modern techniques but at periphery areas construction is actually depends on the ancient means.

It is used for removing or displacing mortar or concrete from steel sheet. The use of

Table 5: Technology Use in Different Purposes

City	Materials Lifting Tech.		Concrete Lifting Machine		Passenger Lift	
	Mechanically (%)	Manually (%)	Pumping Machine Use (%)	Other means (%)	Use at site (%)	Not use (%)
Dhaka	20	80	100	00	80	20
Sylhet	00	100	20	80	00	100

grinding machine is more popular Dhaka than Sylhet. Table 6 depicts, all the projects of Dhaka used grinding machine to smooth surface but in Sylhet its use was very limited to only single project. In case of using welding machine, among 26 building construction sites, 8 sites used the welding equipment in Dhaka city and all sites of Sylhet used the machine. The cutting of reinforcement was necessary due to erect in right place after formwork was done. The mechanical cutting wass common where the bending of the reinforcement was done by manually. The table above shows the evidence of 100% sites cutting the steel by mechanical means in Dhaka city and 92% that of Sylhet city. It shows the use of such machine is increasing day by day in building construction works in our country.

Table 7 shows that steel boards for formwork was used at all the projects of Dhaka which represents the sign of quality construction regarding shape and size of structure. But construction sites in Sylhet city, only 8% they were used the steel shutter and 75% sites used the wooden board. The table also depicts that for scaffolding our construction sectors still depends on bamboo specifically the remote cities like Sylhet totally depends on bamboo (92%). However, the capital city more advance than Sylhet for using metal scaffolding rather than bamboo and 57% projects used metal scaffolding.

Curing system

The traditional method of curing in Bangladesh for beam and slab is ponding, for column it is the wet gunny bag and for the plastered surface, spraying which was done by pipes or other equipments. Figure 3, represents that among 26 different building construction sites, most of the sites were practicing ponding, spraying and wet gunny bag method but the method of fogging was not practicing.

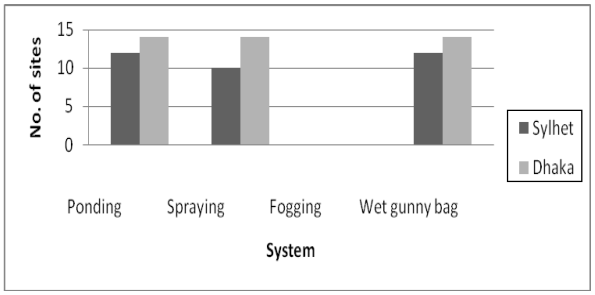
Table 6: Equipment use in Grinding, Welding, Fabricating

City	Grinding Machine		Welding Machine		Steel Fabricating Machine	
	Use at Sites	Not use at Sites	Use at Sites	Not use at Sites	Use at Site	Not use (Manually)
Dhaka	14	0	8	6	14	0
Sylhet	1	11	12	0	11	1

Table 7: Materials Used in Formworks and Scaffolding

City	Formworks			Scaffolding		
	Steel board (%)	Wooden board (%)	Both (%)	Metal (%)	Bamboo (%)	Both (%)
Dhaka	100	00	00	57	29	14
Sylhet	08	75	17	00	92	08

Figure 3: Type of Curing System Available in Construction Sites



CONCLUSION

The study has been conducted by collecting information through field study from various building construction farms and craftsman engaged in various construction works. Some owners of the construction companies have an opinion that cost of mechanized construction and modern construction techniques in building construction will be more in a country of cheap manpower like Bangladesh. Through a field survey covering construction technology, state of construction techniques and construction equipment being used, these construction technologies are revealed to be smooth and efficient building construction practice. The study concluded that the overall constructions in Bangladesh is yet beyond the modern technology, although the capital city are introduced some of the modern facilities but remote but vastly growing city like Sylhet is absolutely rising under tradition methods of construction. In addition, the mechanization for construction has not yet reached at satisfactory level like steel fabricating, bending, concrete mixing, placing, compacting, curing, etc., should be fully mechanized for saving time, ensuring quality and serving economic construction. Planned utilization of equipment at different stages of construction is a necessity for faster and quality construction. However, these equipments should be owned by specialized organization and provided to builders through a back system of manner to minimize the idle time. Construction methods, techniques and safety being practiced have a vast scope for modernization and improvement.

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