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**A STUDY ON SITE RECORDS  
MAINTAINED BY THE  
CONSTRUCTION CONTRACTORS**

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**THIS THESIS IS SUBMITTED TO  
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## SUMMARY

The recognized goal of maintaining site records is to provide the right information to the right person at the right time at the lowest possible cost. This goal can only be successfully achieved and sustained through application of a systematic and thorough approach. Keeping site records is a daily practice on all the building & the civil Engineering projects and these records are maintained for different reasons. These range from providing a means of monitoring construction activities to performing a fundamental role in resolving any disputes.

From the literature survey and the informal pilot survey involving interviews with several senior engineers, construction managers and the site in charges that may need to be used to prepare the questionnaire survey for the thesis. Major construction contractors who work in the city of Colombo participated to answer the questionnaire survey. All the data were collected walk in interviews were conducted with the local construction contractors. The questionnaire requested respondents to indicate on a "Yes" or "No" basis answers to the questionnaire. All the questionnaires inquire in general items to be maintained by the local construction contractors, work in the construction industry to improve the productivity & the legal activities.

The questionnaires were categorized in to 8 project management principles to analysis the average documents maintained by the local construction contractors of the construction industry in Sri lanka. The results were indicated in the histogram form in each project management principle.

The analysis was further extended to study the level of record keeping practice by the construction contractors.

Further all the construction activities were separated with considering time duration of the project. Initial, construction and the final stages are the main divisions of the project activities. The results of the highest and the lowest level of the documents usage in each stage were selected and presented in the histogram form.



# **A STUDY ON SITE RECORDS MAINTAINED BY THE CONSTRUCTION CONTRACTORS**

## **CHAPTER 1: INTRODUCTION**

### **1.1 Background of the record practice.**

The purpose of chronicle compiling records is to provide reliable; factual information for future use. In a quality system records are required in order to demonstrate that the system is functioning satisfactorily & that the required standards are being achieved. They supply objective evidence to enable a manufacturer or contractor to exercise and control operations and they provide verification to a purchaser that the goods or services he is buying will comply with his requirements. Records supply alarm signals to warn of dangers of adverse trends. They supply the factual information needed for statistical quality control. They provide input for cost control. They provide proof of compliance with specification. Whether presented on paper or on more exotic media such as microfilm, magnetic tape, floppy disks or compacted disk, they provide the facts and information on without which, no system can operate, considering two categories of records.



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1. Records whose primary purpose is to control future actions.
2. Records whose primary function is to provide factual information.

It is necessary to insert the word "primary" into both these category descriptions since many records fulfill both functions to a greater or lesser extent. Compare the construction details of a multi-storeyed commercial building. The life span of such a structure may be a hundred years or more and it is likely to undergo many changes of use during this period. Suppose it is decided to install a communications dish antenna on the roof, or an air - conditioning unit. The original designer couldn't possibly have contemplated such an eventuality and the structure may be quite unable to support the additional loads without being strengthened. In case, as-built records are invaluable to the user of the building. Although not compiled with specific control purposes in mixed, they are worth all the effort of preparation and storage, even though those who prepared them could not have imagined the eventual use to which they would be put. Clients, consultants and contractors are subject to varying influences, which

determine their policies in respects of the maintenance of records. Contractors keep records to substantiate requests for additional payments or extensions of time and to guard against claims for compensation by clients or other arising from alleged defective work. Consultants too, require records for defensive purpose and they need data to enable them to deal 'justly with contractor's claims. They also have a need for records, which preserve knowledge of designs and techniques, which may be applied on future projects. Client needs records, which will correctly identify the "as-built" condition of the structure for retention during its lifetime. If specific information is required for operational or maintenance purposes, this should be defined in advance by the client or his advisers. So the appropriate manuals can be compiled as work proceeds. Records may also be necessary in order to gain the approval of regulatory authorities.

Let us consider first the records maintained by contractor's agents and resident engineer to support or adjudicate on claims for additional payment or extensions of time. Procedures for dealing with such claims are outlined in standard conditions of contract.



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Records kept for claims purposes include:

- a). Daily diaries
- b). Start & finish date of each activity
- c). Allocation of staff labour, plant & other resources
- d). Normal hours worked and resources working abnormal hours
- e). Weather affecting the work
- f). Causes & extent of delays
- g). Investigations, tests and inspections
- h). Contents & permits
- i). Date of dispatch and receipt of drawing
- j). Issue & processing of requests for variations.

These documents may be discarded once final payment is made.

A second category of records is, those, which may be required to substantiate a case in court. They include-

- a). Original contract documents
- b). Sub-contracts
- c). Sub-contractor warranties.
- d). Orders on suppliers
- e). Site meeting minutes
- f). Site manager's diary
- g). Resident Engineer's diary
- h). Correspondence between contractor & Architect.  
/Engineer
- i). Correspondence between client & Architect/Engineer



- j). Correspondence between client & contractor
- k). Sectional & final certificate of partial completion
- l). Certificate of making good defects
- m). Documents confirming concessionary acceptances.
- n). Final issues of construction drawings.
- o). Final certificate of completion.

All the above should be retained for at least 16 years by the contractor or consultant as the case may be and should then be destroyed only after consideration of any potential litigation, which might require their subsequent production in court.  
( J. L .Ashford, 1989)

Finally, let us consider the records generated during course of the work to verify compliance with specification.

These will include;

- a. Materials conformance certificates.
- b. Inspection reports.
- c. Laboratory test results.
- d. Piling records.
- e. Concrete placing records

These all contribute to the issue by the Architect /Engineer of a final completion or maintenance certificate at the end of the contractual maintenance period. Once this has been issued, it effectively supersedes the quality control records, which thereby become redundant and could, in theory at least be destroyed. The archive storage of documentation should be considered at the start of a project and filing systems established to select material for long-term storage as it is generated. If this is done, all that is needed at the end of the contract is to compile a register scheduling the content and location of each file. Storage facilities should be secure, dry and fireproof and protected from vermin. To reduce the volume of archive records documents may be microfilmed. (Barry Fryer) Most documents are needed within the first few years after a project is completed. However, due to space constraints, those documents often need to be housed away from the employees. A record management programme helps to determine the best location for those documents, available for future requests.  
(Dennis O. Hamilton, 1991)

## **1.2 Research problem**

Reference to the literature I reviewed and the discussion with my senior engineers and my own experience I found large number of documents needed to be maintained at the construction sites for receiving maximum benefit to the contractors.

I needed to find whether the local construction contractors maintained or not the relevant documents at their sites properly throughout the project duration.

## **1.3 Research Objectives**

- a) To identify the types of site records maintained by the local construction contractors.
- b) To study the level of record keeping practiced by the contractors.

Reference to the research objectives author can study which type of site records are being maintained at the sites by most of the local contractors. By analyzing the results of the questionnaire survey, it can be decided that the contractors maintain or not the essential documents. If the contractors answer is "No" during the questionnaire survey, it will indicate that he does not maintain the records in detail due to the less importance it carry.

During the three stages of the project duration each item of the records will be analysed with the level of the record keeping practiced by the contractors. So we can select several items of records which will be maintained by the highest number of contractors & the documents which are being maintained by the lowest number of contractors within the three stages of the project duration.

## 1.4 Research methodology

After the research problems were identified as stated in section 1.2, the available literature was reviewed and the knowledge gained from the site experience was applied by the author to develop the questionnaire.

The questionnaires were developed under 8 areas of the project management principle such as scope management, cost management, time management, quality management, human resource management, communication management, risk management & procurement management.

Considering the large number of activities in the construction sites, the questions were again categorized into three stages considering the project duration.

They are;

- a). Initial stage
- b). Construction stage
- c). Final (commissioning) stage

To meet the Research Objectives stated in the section 1.3, author carried out the questionnaire survey among the local construction contractors. The questionnaire survey was distributed among 50 contractors in the construction industry. In order to compare the construction contractors' work, mainly Colombo district construction sites were selected to proceed with the survey. Most of them were in the grade 1 to 4 categories according to the ICTAD grading. Author visited contractors at their construction sites personally & got the response for the questionnaires. In addition to the reply of the questionnaires author received the forms, formats and checklist used in most of the construction sites. Although the contractors filled the questionnaires some of them refused to issue forms and formats used at their sites. Author was compelled to make frequent visit to meet them at their sites to get the actual information.

Detail of the questionnaire survey has been developed in the Section 3.2

## CHAPTER 2: LITERATURE REVIEW

Literature review is needed to prepare the questionnaires for survey. Reference to the details of literature with the past research and result of the data analysis, is the base to build up the report for maintaining the site records by the local construction contractors.

The cabinet appointed tender committee in 1988 identified poor construction management in the domestic construction industry as an area needing attendance ( ICTAD, 2005 ). To meet the above requirement author need to scrutiny analyse whether the contractors maintain or not the site records in the construction projects.

Construction activities which are in the projects would be categorized into 3 stages with considering duration of the project.

The site records are maintained at the;

- a) Initial stage
- b) Construction stage
- c) Final stage (commissioning stage)

The contractor should record all the data used for filling the tender documents at the tendering stage. (R.K.Loraine, 1992)

### 2.1 Initial stage

Loraine (1992) stated that the contractors would maintain the checklists for the project surround at the tendering stage. All the information and records at the tendering stage will be effected to plan the project minimizing the construction difficulties.

### **2.1.1 Bidding stage**

At the bidding stage, the contractor can maintain the check list of typical considerations in deciding to bid. That record should contain the type of contract, location of the site, liquidity of the company, availability of finance and other resources to undertake the particular project, financial status of the client, availability of funds for the project, conditions of the contract, details of nominated sub-contractors & suppliers and the environmental and social considerations. (ICTAD, 2005)

If the contractor decided to bid, he intend to use the relevant checklist for achieving a realistic bid. Before starting the bidding process, contractor needs to attend the following activities.

1. Programming the bidding process.
2. Studying the bidding documents such as project specifications, drawings, instructions to bidders, conditions of contract, bonds, checking BOQ with drawings & specifications and the detail of site inspection.
3. Recording the clarification of bidding documents and details of pre-bid meetings.
4. After collecting & calculating the cost information, prepare the estimate and forecast the approximately cash flow.
5. Giving due consideration to the estimator's report and analyzing the risk and mark up, bid document can be submitted after final checking.

After issuing the bidding documents to the contractors, the client/ consultant arrange a pre bid site visit for all the bidders. Pre bid site visit checklist & report is very important in the analysis of the condition of the project (See Appendix 3 – A). The climatic condition of the site premises would be analysed, considering the previous data of the rainfall pattern throughout the year. Temperature and seasons, natural occurrences such as storm conditions, tides and flood incidence are considered with receiving site information. Geometry of the site premises (specially, inundation of low – lying), land topography and geology (rock level etc), availability of filling soil, hydrology would be checked to calculate the additional expenditure.

Access and proximity of services are the other information to be analysed at the proposed site. Postal, telephone, telegram, fax, E- mail and the radio VHF/UHF are the communication media to be selected wherever necessary. Electricity and water availability & reliability and tariff portability, sewage disposal methods are some of the utilities included in the check list to be considered at the tendering stage. When calculating the site overheads the contractor would consider the labour and local staff availability & their location, labour & staff rates, importation of labour & work permits, working hours including holidays & over time, duration of the project, site clearing, back gangs for loading & unloading materials at site, communication stationary & other expenses for the office, statutory charges and inspection cost, site accommodation (staff & labour ) analyzing the risk, investigation & traffic diversion, health & safety regulations & welfare, medical facilities available, tribal & political restrictions, accommodation & feeding, material availability, delivery facilities & local construction plant available for hire are the resources to be considered before filling the bidding documents.



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In addition to the detail of site conditions, the head office overhead is also recorded for maintaining the checklist. The record should include the cost of office rent with maintenance, services (Electricity, water etc.), transport expenses, postage, telephone, telex, e- mail and other facilities, bank charges, including interest & over draft charges, payment for staff, consultant, health and other fringe benefits schemes, training cost and the annual subscription including local authorities tax.

Facilities for sub contractors are the other important factor to be considered. Type of subcontracting such as subcontract with material, labour only, special, plant hire; receive local subcontract items & conditions, client interference on selection of subcontractors. The contractor should get quotations for the various trades of the subcontract items (Aluminum doors and windows, Anti -termite treatment, roofing work etc) before the rate is confirmed. The economic & commercial factors such as record of inflation, escalation, provisions, currency & rate of exchange are the other major factors to evaluate before tendering.



Contractor will maintain the check list for risk management. If the probability of making a loss is great, then risk analysis may be carried out considering the type and size of the project.

The expected risk factors can be listed as below.

1. Financial risk – Associated for the length of construction
2. Escalation of price of material, labour and the method of reimbursement of price fluctuations.
3. Type of contract – For the lump sum contract cannot exceed the contract sum during the construction period.
4. Uncertainties – Flood or earth slip causing damage to temporary or permanent work completed.
5. Project Area – Due to the present ethnic problem in the country some contractors cannot bid for the projects situated in some provinces. Although the contractors win the bid in the said areas it is risk to start & continue the projects smoothly.
6. The consultant risk factor- Ability, reputation, accuracy of bidding documents & BOQ with their terms & conditions will be badly effect to the contractor income wise (such as the actual quantities are fewer than the tendered quantities).
7. Availability of details at the time of tender - Additional bore-hole detail, deep excavation for the foundations to meet hard soil, depth of the rock appears.
8. Client's financial standing & funds availability.
9. Weather – In some areas rainfall intensity is high & it will cause additional expenditure for remedial measures (usage of additional pumps at site)
10. Any other difficulties likely to be encountered at the site.
11. Limiting engineer's powers and responsibilities
12. Special security arrangement of the client
13. Political stability – If the government changes in a shorter duration, funds for the projects are some time withdrawn (Specially government projects if the investors have no confidence about their investment they withdraw the funds due to unstable political situations)



14. Payment in foreign currency (currency fluctuation) – cost of some material or product purchase from the foreign countries, will increase ( eg : steel, DI pipes & fittings etc. )
15. Activities on which experience is not available – Due to the unavailability of skilled persons for some trades cost will increase with repetitive work.
16. Special construction plant & equipment, materials and methodology.

After analyzing the above risk factors, increase the rates or mark up to minimize the financial losses to the contractors. Finally the contractor should prepare the checklist for final submission of bid that should include the record of carrying out arithmetic checks of basic pricing of items, adjusted rate, extensions, subtotals & grand total, checking the prices of material & labour wages including special remark wish to re dust, possible errors (in the bar chart, bid bond, tender sum indicated in form of bid etc. ), call final meeting to check the document of addenda & corrigenda taken into account, special condition of contract/ data, form of bid & bid bond with Power of Attorney corresponding to authorized signature, & check inclusions of relevant document to the correct envelope.



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The contractor should prepare the documents of pre-bid method statement (including the method of execution the job with plant/ labour / material usage within the specified duration), preliminary construction programme and the pre-bid cash flow forecast to submit with bidding documents.

Some contractors use the soft ware packages for tendering purpose. They update the current prices of material and analyze the quantities with adding mark up to receive the BOQ price for tender. All the data related to the submission, open and selection of the tender documents should be recorded for future requirement.



### **2.1.2 Operational planning**

After winning the contract, the contractor should receive the awarding letter & sign the agreement of the contract. The contractor should record the starting and completion dates of the project and person involves to sign the contract & the contact telephone numbers. The form of construction method statement and the Bar Chart formats can be directly used by the contractor in preparing the general programme. To produce realistic and other relevant information, use the software packages of MS Project, Line of Balance method (for the repetitive type of work such as housing projects, pipe laying etc.), for preparing the master programme.

The general programme and the cash flow forecast will be submitted before commencing the construction work to get approval from the client / consultant. Total time consumed for each activity will be effected to the duration of the project. Contractors use computer software to present the programme through a bar chart (Ms Project, Primavera). The programme should be prepared considering the allocated duration of the project. Critical Path Analysis is very important to the project, if the project has to be completed considering a tight duration. If the critical activities consume extra time than estimated, all the precedent activities will be delayed and thereby delaying the completion date of the project and will result in paying liquidated damages to the client.

Moreover the contractors prepare the following programmes in addition to the master programme.

1. Construction programme for individual unit
2. Detail programme use in weekly
3. Weekly programme for execution of works.
4. Steps in critical path scheduling.
5. Line of balance format ( if any )
6. Format for planned bill value curve.

After receiving the awarding letter, contractor can take over the site for starting the construction activities. Before taking over the site contractor & the client/ consultant jointly fill the check list to identify the initial status of the project.

### **2.1.2.1 Check list for taking over the site.**

The contractor must record all the relevant details while taking over the site. They are;

1. Control points (Co-ordinate values & tie measurements) – Confirm the boundary line of the project with co-ordinate & trace in the site plan properly later.
2. TBM, PBMs or PGMs values (to be verified for the accuracy from National Grid Stations) & tie measurements.
3. Existing services such as electricity, telecom, potable water, gas, storm water, waste water & sewerage disposal arrangement at over and under ground.
4. Existing structures within and adjoining the site (Buildings, wells foundations, roads, fence )
5. Existing water ways & rock out crops
6. Recorded flood levels(details can be received from the neighbours)
7. Trees and other removable items.
8. Inquiring from neighbours about the project and its effect for their lives and properties.
9. Properties which can be inundated due to the project activities.



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### **2.1.3 Resource scheduling**

Before initiate the construction work, contractor should arrange the resource schedule for completion of the contract on time. The main resources used in the project are the labour, material, plant and machineries. With reference to the work norms the contractor should prepare resource work sheet for skilled & unskilled manpower. To calculate the man days and the gang strengths quantities & duration of each activity is given in the bar chart. Similarly, work sheet for resource histogram for local material can be used to calculate material requirements per day or week for given activities. Using these and the bar charts, labour & material schedules for different categories of labour and material can be prepared. Organization chart with Curriculum Vitae of each will be submitted to present the work force at the site.

This can be easily done by using the following forms & formats.

1. Resource work sheet – skilled and unskilled manpower.
2. Work sheet for resource histogram (Local materials)
3. Labour schedule (See Appendix 3- B)
4. Labour histogram – Daily requirements
5. Material histogram – weekly requirement (See Appendix 3- C)
6. Equipment use schedule
7. Plant requirement – Bar chart form
8. Plant histogram
9. Short term resource forecast (See Appendix 3- D)

Plant and equipment can be prepared by using formats in table form, histogram form & bar chart forms. Short term resources forecast form would be useful for communicating with the head office which will also serve as a monthly record. The detail of subcontractors expect to work at site should be recorded by using the forms & formats.

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#### 2.1.4 Financial planning

All the project activities mainly depend on the contractor's financial resource planning. After preparing the general programme for the project, contractor can calculate the expected expenditure for each month. The conditions of payment are given as per the contract and the company's purchase procedure. Using the form of planned cash – out flow or expenditure the approximate value of expenditure can be calculated (cumulative). Cash flow forecast form allows the contractor to calculate the planned cash inflow (receipts from the client) and knowing the planned expenditure (cash out flow) form & it will be able to calculate the cumulative or net cash flow.

All the above can be represented in the form of graphs using the following formats.

1. Calculation of expenditure ( cash – out flow )
2. Cash flow forecast ( See Appendix 3-E )
3. Cash flow forecast chart

The date of releasing the bid bond, deposit the performance bond and the relevant extensions after the time extension received, advance payment bond for receiving the mobilization advance, insurance payments are the other dates to be recorded for financial securities deposited at the initial stage of the project.

### **2.1.5 Site planning**

The checklist can be prepared for planning out the site facilities. Contractor's responsibility is to provide sample site layouts to the client to explain how the site layout will be planned out & planning & locating the temporary site facilities with access safety and security measures.

As stated earlier, in the operational planning co-ordinates of the site boundary and the future structures are located in the site plan. On the other hand balance area can be utilized for contractor's temporary facilities.

List of the commonly provide site facilities are given as below. (Since site facilities required in terms of a contract must be in reference to a specific set of conditions, the ICTAD Standard Bidding Documents (SBDD) has been used.)

1. **Mandatory site facilities** - The facilities should be provided to avoid disturbance to the public, water ways, road or foot path, lighting & watching will be provided for protection of the works & for safety & convenience of the public. Water supply system, sewerage, storm water & drainage system, health, safety and first aid & system for keeping site "tidiness" are the other mandatory facilities to be provided to the site.
2. **Other site facilities** - It is included the supply of electricity, telecommunication, resident camps & facilities for staff & labour, site offices & workshops, pre cast yard, plant & equipment maintenance system, sign & notice, viewing platforms, lockers, showers, changing rooms, canteen recreation, protective measures for existing trees, gardens, transport for staff labour & the quarries for aggregate & rubble.

3. Check list of sign boards and notice - The contractor should notice the name of the project with the name of Contractor, Employer, Engineer and other involved with the works, to warn off trespassers, indicate parking area, to warn of danger, indicate safety switches, and indicate fire alarms, to warn of the need to wear hard hats in certain areas & to warn of unsafe plant or machinery.

The above facilities would be maintained by the contractor using the relevant forms, formats & the check list currently use by the contractors (ICTAD, 2005)

#### **2.1.5.1 Site mobilization and start up temporary works**

A basic temporary works set-up will be required at site to support the commencement of operations. A temporary work arrangements and minimum stores & workshop should be set up. Initially site documentation should be boxed and carried in one of the containers. Site offices including the services are best built by local means, of either timber or block work depending on availability and local culture. (R.K.Loraine, 1992)



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Moreover the contractor would record the expenditure of material, labour, plant & machineries use for the temporary work to claim as preliminaries. Before starting the demolition & site clearing, record the existing status of the site using a suitable method. Existing buildings, valuable trees, pipe lines, cables etc. would be recorded and take some photographs to show the initial status wherever necessary for claim purposes. If the site access road goes through a residential area maintaining the road in good condition is necessary throughout the construction period to minimize the inconvenience to the public.

### **2.1.6 Security plan**

Security arrangement of the site is very important to the contractor to protect the material & product from the thieves. So the security plan is essential at site to minimize the losses. Project manager should arrange the own security service considering the locations of security points around the site. The contractor forwards the site layout plan to the client/ consultant to get approval where the contractor would occupy in the site premises. Specially, layout of buildings and works with the storage areas would be produced with shop drawings or sketches. In addition, the contractor can get the services from external security organization instead of their own security services. (R. K. Loraine, 1992)

The project manager should delegate responsibility to a security manager for routine security matters. Security standing orders should be included and clear instructions given to security guards on the types of incident to be reported, whether they should be reported immediately or at the end of shift and to whom. A daybook (Information book), attendance of guards, roster for the month should be maintained by C.S.O. in which all incidents; unusual occurrence or suspicious circumstances are reported. The security manager should inspect this book regularly. The above records are very important to maintain cost reduction & if some incident happen (theft, accident etc.) it useful for legal matters.

As stated earlier, the site layout plan is very important to indicate the location of the important buildings / structures at the site. Free access to the site should be provided and security fencing and adequate lighting to view the buildings/site in the night should also be provided. Specially, those of a sensitive nature such as high – value stores, and the Cashier's room where the safe/cash is kept and the counter where payments are made should be considered. Location of site stores & storage areas especially fuel and explosives, location of plant & vehicle parks are the other main locations to be recorded and maintained according to the client / consultant approved drawings. In addition the contractor should provide the proper security equipment to the security personal. Record of the attendance of security guard / watchers & maintaining information book is very useful. The gate passes are used for vehicles & materials transported from the site to out side & this will limit the losses of material at



the site. All the forms & formats are prepared at site to maintain proper security services.

## **2.2 Construction stage**

### **2.2.1 Site organization**

After recording all the preliminary details such as existing utilities, buildings, trees, levels of the ground, site boundaries, initial photographs of the site etc. contractor could start the construction work by providing approved method statement & inspection request form to the client/ consultant.

The forms under the site organization are self explanatory for contractors use. There are checklists, sample formats, specimens or forms to be directly use & some of the forms could be used as requests for consultant' s approval or other communication with the consultant. There are other forms which could be used for record keeping at site or communication with the contractor's head office or higher management.

#### **2.2.1.1 Checklist & typical records maintained by contractor's site agent.**

The contractor's site agent should maintain the following records at the construction stage such as; all the correspondence between the contractor and the Engineer including variation orders, approved forms, minutes of every formal meeting, plant and labour returns, measurement records ( including dimension books, time sheets, delivery notes, day records, interim statements with all supporting particulars & interim certificates, level & survey books, converging both checks on setting out and completed work, laboratory results & any other testing data), progress photographs, construction drawings supplied by the client, administrative records such as leave and sickness returns, accident reports, site diaries, summary sheet for activity, commencement and completion date etc .

During the construction stage contractor should maintain the following formats also for the monthly bill, measurement sheet, taking off sheet, site organization chart specimen job description, site drawing register, daily task sheet request / approval to

open new work site (for the water supply, roads, irrigation projects etc.), inspection test plan, concreting approval request, daily attendance of the casual workers, daily labour returns, day works- daily sheet, daily labour return, daily site report, daily hauling report, weather data records, service data records, request for confirmation of verbal instructions, data / detail for claims & forms for piling work.

### **2.2.1.2 Meeting with Client, Engineer & RE.**

An initial meeting (Pre contract brief meeting) should be arranged in the project with the representatives of contractor, client & the Engineer. Top management of each party should participate at this meeting at the venue which would be decided by the client. Each party should hand over the general programme & the other construction details at this meeting. Agenda for the initial meeting should include the introduction, communicate correspondence, copies, address and issue of contract documents. Notice should be given regarding the starting date and meeting programme including returns, reports & records of measurements, submissions, and certification & payment procedures. Following matters should be discussed at the meeting office & accommodation with services & supplies to client & Engineer's representatives. Preparation of contract programme local labour recruitment & use of sub contractors are the other matters to be discussed.

Moreover routine meetings should be established after this initial meeting. Initial survey of boundaries, ground levels, site photographs, occupation of the site and relationships with local and land owners, agreement on methods of survey & setting out quarries & borrow pit would be discussed during the site meeting. Agreement on concrete mix design & testing, local labour recruitment, ascertainment of the Resident Engineer's recruitment for routine returns and agreement (methods of site measurement, site instructions, procedure for variation of price, day work procedure, new rate procedure, including summary of on costs & labour costs) would be discussed during the site meeting. All this should be achieved through specific meetings. For the series of meetings at regular intervals, the project manager should provide a report covering the progress, operating performance & end forecasts. It would be included the personnel with health & safety and client relations with security arrangement and resource deficiencies.



The contractor should record every important minute, during the construction, as the minutes of meetings are more advantages than verbal instructions.

### **2.2.1.3 Check list for meetings – by contractor**

Before the commencement of the meeting contractor should forward the list of matters to be discussed at the meeting, study the minutes of last meeting, study the agenda and collect details for the information necessary for discussion.

The contractor should take down the minutes & highlight the important minutes during the meeting. After receiving the client/ consultant's minutes of the meeting, check with the contractor's own minutes & seek clarification from the consultant.

### **2.2.1.4 Special site meeting and routine site inspection**

The Engineer/ consultant may arrange a special meeting with the contractor especially in order to clarify design detail or help to solve urgent construction problems, which need immediate attention.



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The contractor should record the following data during the routine site inspection. They are sample & testing, correspondence, site instructions Architect's instructions, drawn information (drawings / revised drawings amplified or clarified details of how certain items of work should be executed) defective work.

Further the contractor should record the details of documents received from the client / consultant from initial stage to final handing over. The dates on which the documents from the client are received and its reference number is very important to prepare the contractor's claims. Additionally contractor should record all the letters forwarded to the client throughout the construction period. The client's documents containing the construction drawings, sketches, site log note book, letters of site design changes, etc. Delaying the issue of construction drawings and the variation orders, the contractor can claim for time extensions.



Variation of some items will be paid in the day work basis. The contractor should fill the day work sheets (including labour, material & plant and machineries use for the day) and certified by placing the signature of the client / consultant. If the contractor fails to maintain recording the day work sheets regularly he will not be able to make any claims.

The consultant also maintains the forms, checklists & formats as records at the construction site for their own use.

These documents are listed as below

1. Check list – typical record maintained by Engineer (See Appendix 3 - F)
2. Specimen structure for records & report
3. Check list for meeting – by consultant
4. Pre – construction meeting
5. Format for minutes of project meeting
6. Site organization chart of the Engineer
7. Authority to do the concreting
8. Interim payment certificate
9. Final payment certificate
- 10 Certificate of completion/ taking over certificate
11. Certificate of completion by stages/ taking over certificate by stages
12. Performance certificate
13. Final statement
14. Site instruction
15. Daily site report
16. Variation order
17. Variation order – Day work sheet
18. Query sheet

The contractor should maintain the records which would be received from consultant throughout the construction period. The documents which are maintained by the consultant are very useful for the purpose of claims.

### **2.2.2 Material management**

Procurement of material, plant & subcontractors are the major factors in the construction industry. Materials and equipment account for 50 - 60 % of the project cost, and the most common cause of delays in construction is lack of materials (Construction Industry Institute, 1987). Effective material management systems will result in a 6-8% improvement in labour productivity, improved cash-flow, reduced bulk materials surplus, reduced materials management human resource, improved vendor performance, reduced requirement for physical ware house facilities, quantity purchasing discounts, minimized cost impact of change orders & fewer project delays. Computerized material management system is useful for maintaining the site properly. Supplying good quality material is essential for all the projects. If the supplier can provide test reports for the material, it would be useful to select suitable material with lower rate to the project.

Price variation of the raw material is one of the major problems in the construction industry. If the client pay money for the price fluctuation of the material, it would be recorded and claimed when he forward the interim bill. As a result of the steel price is increased rapidly in the world contractors should forward the new price list and get approval for construction.

Suitable suppliers for material, product (ready mix concrete, asphalt, etc) will be selected by calling tenders for the specified duration. The contractor requests quotations for cheapest, reliable and good quality material/ product. Maintaining the list of entire material supplier's quotations for the tender will make matters easy to select another supplier, in the event the present supplier fails to deliver.

### **2.2.3 Plant management**

Daily monitoring the record for machinery /plants is a very important requirement at the construction site. Contractor could use machinery owned by the company & machinery on hire basis and the payments would be released periodically. The recording of working hours, idling hours and break down (repair) hours are essential to settle their payments and calculating the cost monthly.

The forms may be used by the contractor for plant selection, organizing the plant distribution, plant use records and cost records. Contractor should maintain the following documents for the machinery used at the site.

1. Plant distribution record.
2. Sample flow chart of earth moving equipment selection.
3. Machine history folder.
4. Plant/ machinery requisition form.
5. Daily check of machinery (operator's guide).
6. Service check list.
- 7 Vehicle daily running record
8. Machine utilization statement.
9. Utilization of plant and machinery for the month.
10. Plant / vehicle daily running record.
11. Daily plant return.
12. Weekly cost report
13. Monthly cost records (ICTAD 2005)

#### **2.2.4 Management of subcontractors**

The current trend in the construction industry sub contractor's contribution is very much higher than the previous. The major contractors in the construction industry joining to do sub contract work in the major projects. Most of the documents are similar to the main contractor's documents, but all the documents should be signed by the main contractor's site agent. When the contractor calls for subcontract work, contractor should give description of work clearly in the documents to enable them to decide whether they could apply or not for the job. Programme for subcontract work including starting and completion date & the payment terms would be analysed before offering the sub contract work. Provisions of contractors' free issues and facilities are the other economic factors, which enable sub contractors to submit lowest rates in their application. All the subcontractors pay their attention to issue bond & insurance policy under the local regulation. The past experience is another factor to select the subcontractor to maintain the quality of work. Analyzing the submitted records (past performance and the expected rates) would enable the selection of suitable

subcontractors for the project. Main contractor maintains the forms for organizing sub contractor's work in a systematic manner.

The following records are maintained by the sub contractor during his construction period.

1. Sub contractor's work programme
2. Weekly programme
3. Working sheets for resources
4. Labour, plant & material histogram

Sub contractor should submit the above records to the contractor before the commencement of construction work. Generally the contractor should arrange meeting with the subcontractors to discuss the progress, payments, extra work etc. Contractor should prepare check list for the meetings with subcontractors. Day work sheets are also maintained by the subcontractor to claim for the extra work, those items not included in the BOQ. (For the variation orders)

Some contractors issue payment for the supply & installation of machineries as soon as they do so. If there is no agreement signed with the subcontractors, they will not take any risk where the construction activities are concerned.

Sub contractor will issue his interim payment claim to the contractor for the completed construction activities monthly. The contractor's responsibility is to release the bill payments to the subcontractor, maintaining proper records. Recording the date of submission of the bills and date of releasing the payments to subcontractors are very important to minimize the disputes between contractors and the subcontractors. Because some subcontractors will go to labour courts for their claims, the contractors should maintain the proper records for each subcontractor employed under them. Holding percentage payment or retention money is useful to minimize incurring additional money due to rectification of the bad quality workmanship of the items

Forms for the site instructions are maintained by the sub contractor to receive instructions from the Engineer & this should be submitted to the contractor before implementing the activities. If there are any doubts in the construction work subcontractor should maintain the form under the request for information. This form should also be submitted to the contractor after obtaining the Engineer's signature. (ICTAD, 2005)

## **2.2.5 Stores management**

### **2.2.5.1 Stock recording system**

Each item in the stores or in site storage should have a stock record card. The storekeeper's duties include the checking and safe custody of all materials received & recorded for permanent works at the site, or in the Engineer's store; or repair operating & maintenance of engineering works and being looked after by an engineer. The store- keeper has to work hand-in-hand with the engineering staff for proper receipts and technical check of special stores and to distribute the goods on the work sites as they are received from the suppliers. He must check all tools & plant received in stores and issues these for consumption or loan, as the case may be for specific engineering works.

(O.N. Walchlu, 1978)

On some works the storekeeper is also responsible for maintaining the log book or register of plant, dealing with transfers from and to other works, keeping records of tools repairs, salvage recoveries, and sales of stock disposal off, and other matters required for costing or details of accounts. Budget for the annual stores requirement should be prepared with the same care as the financial budget, supported by a stores purchase programme, presented before the purchase committee and passed, before any orders are placed. In urgent situations the project manager may procure goods at short notice for which he should be vested with such powers. Although Walchlu (1978) stated the procedure as above, the purchase unit is allowed to buy on basis of the normal consumption for a given period, say three months or so.



Cement, sand, metal, steel, brick/block, etc are some of the essential building materials used in the project. Maintaining the proper record system including all the relevant details is useful to contractor to forecast his activities in future constructions. Supplier's rates, duration of supplied material is very important to the contractor to plan his project activities properly. According to programme the contractor can calculate the consumption of raw materials and place the orders to receive it in time. Authorized officer should check the required material and the received material with reference to the stores record.

After completion of some activities in the construction work the excess material which is unutilized should be returned to the stores from the site. These will be two-types of such returned stores.

1. New stores, which remained un-utilized on completion of work.
2. Used stores, which were salvaged from works.

Such articles are returned to the stores for their proper utilization in a planned manner on other works. A proper stores returned note prepared in triplicate, one copy being retained by the returning officer and two copies given to the store - keeper to whom the goods are delivered. The storekeeper signs the two copies & returns one to the officer returning the goods & keeps the other to accompany the "stores received book".

These are prepared monthly for "stocks" and "tools & plant" separately. The monthly return shows the variation in stock balances during the month. Only those articles, which have been either received or issued during the month, need to be entered in this statement. Balance from last return will be written up from previous return. The total of "receipts" & "issues" for a month is separately posted and the totals obtained are entered into this form. Specially prepared ledger cards (for material) and bin cards (for tools) are mostly used in the public sector organizations. The reconciliation of receipts, issues and balance of stock by its sub-heads is very essential for proper stock accounting. It is preferable to carryout the financial reconciliation of the stock account for one or two stock sub-heads each month, so that the entire work does not pile up at the end of half- year or yearly period. The storekeeper issues cost statement for issued

materials of the construction work at the end of every month. Some time detached store sub -divisions are maintained under the central stores.

### **2.2.5.2 Stores accounting & disposal**

The receipts of stores should generally be received along with the invoices. If a representative collects stores from a local dealer, these should be delivered to the store section accompanied by a delivery note. The consignment should be opened in the presence of a competent authority and the storekeeper, and properly inspected. The spares should be checked with the relevant supply order, challan & packing note received inside the packages. (Richard Fellows, 1983)

All stores should be accounted for centrally on the prescribed account card (ledger card or bin card). On the account card only one item should be accounted. The account card is an auditable document, which at any time shows receipts, issues and balance stock of spare parts and must therefore be kept under safe custody. A master account card control register should be maintained in which control serial number of all the account cards should be entered. In addition to the control number the part number and name of the parent equipment should be available in the account card.

Annual stock taking of all stores should be completed at the close of the financial year or as per instructions issued by the competent authority. Any discrepancy or surplus should be regularized as per procedure in vogue. Whenever stores become unserviceable in stock, these should be produced before a survey board convinced under the orders of competent authority for condemnation of such spares and assemblies. The survey board proceedings should be sent to the relevant authority for approval of the competent authority. Separate out and record the disposal of unserviceable stocks and it would be produced before the survey board for approval to dispose.

Forms and formats would be useful to the contractor in various store transactions and records. The documents maintained at the stores are;

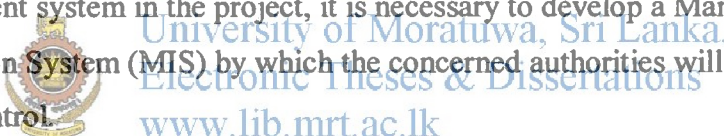
1. Flow chart for purchasing, purchase requisition.
2. Purchase order, supplier's delivery note



3. Good received note (GRN)
4. Material transfer note, material return note
5. Stock ledger/ bin card (See Appendix 3 - H)
6. Material build up sheet
7. Record of material suppliers
8. Material requirement schedule
9. Stores debit note
10. Stores ledger account
11. Store requisition note
12. Petty cash (local purchase)

### **2.2.5.3 Management information system to the store**

Unlike the previous years, now most of the contractors use the computers at the stores to maintain the records properly. In order to evaluate the effective functioning of the management system in the project, it is necessary to develop a Management Information System (MIS) by which the concerned authorities will be able to exercise proper control.



The following records have to be submitted by the project Manager regularly.

1. Monthly statement showing vital items out of stock.
2. Quarterly statement showing coverage of indents by purchase order.
3. Annual statement showing the position of non-moving or surplus stores.
4. Annual statement of spares transactions

### **2.2.6 Management information system & use of computers at site**

With rapid development in technology and management techniques it has become necessary to build up a proper Management Information System (MIS) to cater to needs of the managers to continuously monitor and control the performance of projects effectively. For the construction project in particular, with increasingly complex problems quick and timely management information and reporting system can help the higher management in its control function. It can help in updating the knowledge of the job status & physical and financial progress and in applying

remedial measures, if required, in good time. Thus the MIS can prove helpful in effective control and co-ordination of works under execution.

The information system can be handled either manually or through a computer depending upon the complexity and nature of individual organizational requirements and the method of working. However knowledge of handling the programming required for the job and knowledge of electronic processing of the information could prove most helpful. The use of computers particularly helps in speeding communication in the construction industry. Because of its very nature time factor is of prime importance. One of the latest additions in the communication system is computer conferencing a new technology for more effective management development. This is quite predominant in the advanced world since the seventies. Unlike in the previous decades, now the client / consultant issue not only the hard copies the soft copies with the designed drawings of the project to the contractor for easy reference. Computerising the work in the construction site is very important to maintain progress effectively. Preparation of shop drawings, sketches, documents & report, recording the data, bill preparation, etc are some of the major tasks at site. The management information system should provide accurate and relevant information to enable managers to identify potential problems and deal with regularly, so that action can be taken on the basis of the latest data input. (Derek Miles)

## **2.2.7 Construction, supervision and control**

### **2.2.7.1 Site layout plan**

Presentation of the site layout plan as stated early involves a study, plan and the organization of the unused areas of site around the proposed development to accommodate the contractor's construction equipment, materials and buildings for use in the execution of the construction works. When the contractor arranges temporary buildings, plant and so forth, the method of construction envisaged according to the type of project (Low/ high rise structure). The size and shape of the area to be covered and the position of existing obstructions (eg : existing services and structures) and hazards such as gas mains and under ground or overhead electrical cables are the other main utilities to be considered at the planning stage. The accessibility and restrictions within the site and the type and size of construction plant and equipment

planned for use with the proximity of site boundary to the existing buildings would be recorded before planning the site layout activities.

A site layout may be worked out using a plan of the site, showing an outline of the proposed buildings, roads, paths, paving and the like. The proposed route of main service runs is usually marked to avoid placing temporary building or plant over this route. Existing buildings, services, trees & other obstructions on site should be noted & they should be contracted for details and location of any services that cross the site but have not been shown on the site plan. (A. A. Kwakye, 1997)

The contractor should maintain the record of expenditure for the services utilized at the site. Electricity, telephone, water supply, refundable deposits for temporary service connections etc. are the essential services consumed by the contractor.

The contractor records the number, type and size of the temporary buildings extent to the construction project at the site layout plan. Selection of the temporary buildings should aim at provision of a proper working environment, and privacy to reflect the status of occupant. Temporary buildings can be hired or purchased and contractors normally consider factors such as size, easy mode of erection and dismantling, adaptability, weather tightness, life expectancy, thermal conductivity and ease/ cost of transporting to and from site. Money is allocated to provide office and other facilities to the client/ consultant. Record the expenditure for temporary constructions and rented building for the project as it could be claimed under the preliminaries.

Material storage & work areas for site operations has to be marked out at the site plan clearly for the various materials and operations. Storage or a secure store is necessary for valuable items, which may be stolen if not adequately stored away and protected. Furthermore a weather - proof store will be needed for materials such as timber, cement, lime, drainage goods etc. Records should be maintained of the quantities of all the material, before placing in the specified storage spaces. It must be clearly recorded the location of plant in the site layout plan. Major items of static plant such as hoists, tower cranes, batching plant or the space for parking mobile plant are given careful consideration. The storage compound for tower cranes for example, are so

arranged that its radius cover the maximum area of the site. This arrangement enables to be used for unloading items from delivery Lorries into storage areas as well as hoisting items from store onto workplaces or the structure particular regard is also paid to erection and dismantling of the tower crane. In addition, rights of air spaces and over- rail agreements are considered in relation to site boundaries where necessary. The provision of the parking space for the vehicle and the temporary roads for the movement of plant & material is an important issue. (A. A. Kwakye, 1997)

### **2.2.7.2 Project administration**

The administration of project is the collective responsibility of the project team, made up of the architect, quantity surveyor, structural engineer, service engineer & the contractor. The quality control manager usually appointed by the contractor, with his main duty of ensuring compliance with the contract in regard to the quality of materials/ components & workman ship, expended in the construction process. Ideally, an officer for clerk of works should be appointed sufficiently early to enable him or her to become familiarized with the contract documentation & procedures before site construction commences. Among the responsibilities checking & recording the site grid & setting out, inspecting materials/ components upon delivery & testing or submitting for testing any materials to be used in the works. The quality control manager's work also endorses day work sheets, assists the client's QS with site measurement, and keeps records of progress of the project, working conditions and weather, delays verbal instruction of the architect, site labour employed & visitors to the site.

Recruitment of the labour employees is the essential requirement of the site. Information on local condition of employment should be obtained from the appropriate ministry. Moreover, it is usual for the client, who will also be a large employer, to wish to confirm general acceptability of such conditions. The working hours, minimum wages, allowances and traveling time, (especially if being collected/ returned by site transport) would be prepared as a site record. Overtime rates at the Sunday & equivalents, public holidays etc. including annual and public holidays would be confirmed by the administrative officers. Workman's compensation state

pension / provident fund and allowable deductions from pay including taxation would be recorded at the site. Importing labour from outside the territory will still involve government regulations. These will undoubtedly relate to import quotas, residence & work permits (e.g.:- Middle-east countries all the labour force is imported.)

As analyzed in the bidding stage the contractor's responsibility is to record the expenditure of the unforeseen risk. Rock/ very hard soil appears during the excavation and unexpected shortage of raw material in the country and flood or storm damages the properties and the time etc. are some of the unforeseen risks in the project. The contractor should record the expenditure for delaying the project due to bad weather, strikes, curfew imposed by the government, unexpected holidays, accidents at the site etc for receiving time extensions. Daily record of weather pattern is also important to calculate the loss of time for the project due to unusual rain / bad weather / floods.

### **2.2.7.3 Progress monitoring & control**

The contractor & the consultant can use the relevant forms & formats for monitoring progress effectively against physical program, financial programme (planned bill value, cash flow, etc.), and time targets.

For monitoring progress, forms may be used as appropriate. (ICTAD, 2005)

1. Minutes of progress review meeting
2. Weekly progress report
3. Daily work output
4. Physical percentage of completion
5. Monthly project report
6. Fortnightly progress review report.

### **2.2.7.4 Cost control & payments.**

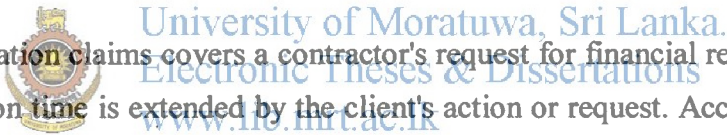
The responsibility for managing the authorized project cost is shared between the client's & the contractor's QS, but for varied objectives. The quantity surveyor's responsibility is to establish of budgetary control procedures before commencement of constructions. The report on financial implications of proposed variations before the issues of formal instruction and interim valuations would be prepared to the progress payment. Preparation of periodic cost reports (e.g. financial statement, cost

value reconciliation) and the regular comparison of actual cost or cash flow against the planned should be recorded at the documents.

During the progress of the works, the contractor's Site Manager requires periodic cost information in order to manage the project efficiently. This must be clearly recorded by the site manager to maintain profit throughout the project duration. The quantity surveyor monthly issues the progress report for varied work, design changes, price escalation etc. to the Client/ Consultant.

The project manager must update the progress with respect to the programmed and the preparation of cash flow forecasting and maintaining physical progress with respect to "S" curve and check the reasons for delay & how to overcome the delays in future to complete the project on time.

#### **2.2.7.5 Prolongation & acceleration claims**

A prolongation claims covers a contractor's request for financial reimbursement when construction time is extended by the client's action or request. Acceleration claims on the other hand, refers to a contractor's request for reimbursement of cost incurred when he or she consents to double productive efforts in order to reduce the time - scale of programmed activities and/or prevent delay. It follows, therefore that if a client's action causes, construction delay, he or she can either accept or revised completion date & pay for prolongation claims or ask the contractor to accelerate construction & there by pay for the acceleration cost. The maintenance of adequate records is a major pre request to compilation of a successful financial claim, and in order to carry out the above functions effectively the contractors quantity surveyor may need to examine and /or refer the necessary documentations.(A. A. Kwakye, 1997)

Under the construction contracts, acceleration means to expedite the construction phase to meet the original or revised contract completion date. If the project is running late the client may require a contractor to take steps to complete it within the original programme. Alternatively, the contractor may unilaterally decide to take



measures to avoid delays and payment of liquidated damages. Usually, the increased productivity obtained from the acceleration is achieved by either the introduction of additional site resources (manpower / plant) or prolonged working hours achieved by overtime and/or shift working arrangements. The above moves aimed at saving construction time are expensive to implement and the record of the above cost, of any acceleration would be assessed by the contractor's QS for inclusion in the contractor's financial claim. The alternative approach to the calculation of this financial claim is the identification of the heads of cost & agreement on a method of calculating the extra cost of the acceleration. For example , it may be agreed that the contractor submits daily labour returns for assessment of the amount of labour on site, O.T. hours worked and so on; and that periodic cost calculating and payment should flow from the information/ records provided.

Although A.A.Kwakye stated that the quantity surveyor needs to examine all the correspondence including minutes of project meetings, site manager involve distributing all the information to the QS. It is important to analyze consultant's instructions and directives issued in writing including site instructions delivered by the consultant. Contract /working drawings, updated and new drawings and other drawn information, site diaries and daily weather reports, showing overall weather pattern for duration of the project are important for analyzing claim purpose. Because the daily labour allocation sheets showing daily labour utilization on all sections of the works and it can be utilized for day work also. The quantity surveyor must analyse the contractor's tender built- up showing break- down of unit rates into labour, plant, materials, and profit & so on. The authorized day work records/sheets comply by the contractor during the progress of the works. The original construction programme and the updated construction programme due to extra work or any changes given by the client are the other factors to be considered.

Material schedules indicating amount and time of incorporation into the works and plant and scaffolding records showing hire & use of plant for the contractor. Specially, quantity surveyor must check the list of invoices received and payments made to sub-contractors & suppliers to check the expenditure. After assembly and



examination of the above records, the contractor's QS progress the preparation of a contractor's financial claim.

#### **2.2.7.6 Contract particulars and point of claims**

The point of claim comprise a list of causes of the claim in respect of delay, description and extra costs upon which the contractor is seeking recompense under the express and implied terms of a particular contract. It is very important to record that the issued variations caused disruptions to the regular progress and sequence of the construction work. Failure of the consultant to approve drawings submitted by nominated specialist subcontractors/ suppliers on time to enable the works to make a steady progress as planned. The issued variations/ instructions / construction information will be some time too late to allow their easy incorporation within the programmed sequence of the works. During the construction period the useful records are very important for claim purpose. The preliminaries such as site staff salaries, attendance of the labour, plant & standing, scaffolding, small tool, site huts, watching & lighting, telephone & electricity costs are the time related matters to record for claim purpose. It reduces the working hours due to rainy seasons (incur due to additional cost), productivity stoppage through bad weather, drying out & other costs. Claims for interest on outstanding monies (retention) which, a contractor has been prevented from utilizing due to the prolongation. How ever, these costs come under the definition of direct loss/ expenses only when a contractor had submitted the right notices. If the cost of construction resources (e.g.-labour & material) increase as the construction period prolongs, calculate the actual increases on resources due to inflationary pressures & include them under this heading of the financial claim. Prolongation of the contract period leads to extension of attendance (general or special) that a contractor normally provides on nominated sub-contractors under a contract, actual cost of the extra period of attendance calculated and included in the claim. The demand for the profit is to earn from other work had the prolongation not occurred.

As stated in the bidding stage, analyse the cost due to the head office personnel & equipment (e.g.; head office building, office m/c, Office running, maintenance &

staffing costs) required for the contractor's business. This overhead calculated annually for the coming year & expressed as a percentage on the anticipated turnover for that trading year in claiming for the additional overhead cost, resulting from a prolongation. The QS has to prove the contractor's annual turnover & expected return on turnover & the percentage of the return required to cover the Head office overhead. All the overheads at the head office should be recorded to analyze the annual turnover of the company.

The contractor may use the following forms for maintaining the cost records and for controlling the actual cost by comparing with planned cost.

1. Unit cost sheet (weekly)
2. Weekly statement of direct labour cost
3. Weekly statement of Machine hire cost
4. Weekly statement of Material hire cost
5. Weekly statement of labour sub contractor's payments
6. Monthly statement of overhead costs
7. Monthly cost summary
8. Weekly statement of out put of work ( Value of work )
9. Contractor's monthly cost control / table
10. Contractor's Monthly cost control / chart.

#### **2.2.7.7 Resolution of construction disputes**

Construction projects are generally complex and this reason, delay and disputes are always present. Although the client has a desire to acquire the right building, at the right time and at the right price, he or she is always exposed to possible delays and / or additional costs for which there may be no compensation. Disputes may arise on a construction projects for a number of reasons. The contractor's responsibility is to record the necessary data for future requirements. Shortcoming, omissions and errors in contract documents, delay the supply of general construction information with late issue of instructions in varying some sections of the works would be recorded at the earliest time possible. Some time client/ consultant increase in scope of work such as changes, extra and errors without proper consideration for extension of construction

time. Issuing variation instruction untimely will cause to disrupt the contractor's progress & programme of works and failure of contractor to construct the works, diligently and to programme.

The disputes will appear due to poor workmanship and failure to use specified materials, skilled operatives and recognized methods and failure to inspect works in progress regularly and condemning only when works are completed. Inaccurate valuation of variations and works in progress and the cost for acceleration to complete within the original programme are the other requirements to be analysed to avoid construction disputes. Late payments or non-payment for the work completed satisfactorily is the other cause to arise disputes between the contractor and the consultant.


#### **2.2.7.8 Employment and workplace labour relations.**

Although the contract of employment can be oral or in writing, most contracts these days are in writing stating the names of the employer, employees & the dates on which employment began; and if any previous employment counts towards continuous service, the date on which the continuous period of employment began. It would include the title of the job, wages rate or pay scale, or methodology of calculating pay, the intervals at which the employee is to be paid. ( e.g. Monthly, weekly), details of working hours, holiday entitlement, including public holidays & holiday pay, details of any risk pay & pension rights the length of notice the employee is entitled to receive and obliged the give, to end the contract and whether there is a contracting out certificate for the state pension scheme or provident fund scheme. Instead of supplying a written statement, the employer can refer to a document containing these details, but it must be accessible. Usually, this document will be an agreement arrived at by collective bargaining and this is the case for construction workers covered by national working rules.

### **2.2.7.9 Administration & records**

Construction firms whose personnel procedures are well developed will have reliable records, providing information for planning purposes and for employee administration.

Most firms need records of personnel information about employees (such as experience, qualifications, health and the name of a person to contact in the event of illness or accident). Daily record of attendance is needed to prepare their wages including overtime payment. Special payments for sickness and accidents are very important to pay compensation to the employee. Especially the payment will be paid if the accident or illness happens during the working hours. Personnel staff will be responsible for developing and implementing suitable methods of data collection, storage and retrieval, including the use of computers. They will have to interpret and present information in the way it best facilitates decision – making & control.

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There are several ways in which a contract of employment may end, without it amounting to a dismissal. Resignation or constructive resignation (the employee acts in a way which shows that he no longer intends to be bound by his contract.) is the two methods to terminate the employment. Frustration of contract and the consensual termination, project termination is the other method to terminate the work. If the project is reach termination automatically terminate the employment of the employee (A. D.Austen & R.H.Neale, 1984). When we record the dismissal / termination of contract of employee, it must be clearly noticed the way of dismissal or terminate of him and detail of the dismissal or termination.

### **2.2.8 Communication**

The communication is one of the main requirements of the construction industry. Poor communication has long been a problem in the construction. Contractor should communicate with client / consultant, suppliers, subcontractors etc through the telephone, fax, e- mail etc. about the project related matters. In small organizations communication is often good as there is more face-to-face contact & if people don't

understand what is being said, they say so and the problem is cleaned up straight away and communication is more direct. (Barry Fryer) Larger firms more rely on the written word. This puts the message on record, but misunderstandings cannot easily be cleaned up. Every important messages passes to the employees would be recorded for the benefit of both parties.

### **2.2.8.1 Communication methods**

People communicate through language & pictures. Language is conveyed through speech & writing, and pictures are communicated by graphical means, such as drawings & photographs, sign boards etc. Spoken communication is important to distribute instructions & information to the employees. Individual directives, such as a work instructions or verbal instructions and one-to-one discussion, are useful for staff appraisal.

It is the responsibility of the project manager to send a report to the top management periodically, describing the progress of project & the causes of delays & his proposals to overcome the problems. Top management will also communicate with the project manager to give solution for financial or other resources to minimize the delays. Some time the major decisions are taken by the top management and the site staff & workers should abide by their decisions.

Meetings are the other important communication method. At the project meetings and the site meetings communication matters are aroused in the project. Written communication is one of the powerful methods to communicate matters with each other such as notices and reports. All the important matters would be recorded during the meeting in progress. On site they give feed back on costs, progress and other aspects of performance. To minimize the future problems the site staff should record this head office information.

## **2.2.9 Safety and health**

### **2.2.9.1 Safety**

Safety precautions are very important at the construction sites. In spite of new safety legislation and the efforts of employers and trade unions, the safety statistics still give cause for concern. Some trades are more risky than the others. Not surprisingly, steel erection and demolition account for many fatalities & serious accidents. Painting & decorating is also hazardous, because the painters often have poor access to work places & use inadequate working platforms. Many site injuries result from people falling from structures like roofs & scaffolds, or being hit by falling objects. Many others are caused by the misuse of mechanical plant & site transport including hoists. Safety officer should involve recording the risk activities & he wants to prepare the plan including checklist to avoid any incident in the site & he should provide written instructions to foreman level officer to get attention during the construction period.

The safety officer, a full time employee of the construction is responsible for carrying out and regulating the contractor's safety policy. He advises to management on any legislative and legal requirements affecting safety in construction and any subsequent changes. He has to maintain good recording system to inspect safety during the construction period

In the event any accident happens in the site, treatment should be given to the person as soon as possible and record the incident in detail for future reference. The contractor should pay compensation to the person who accident at the site and record his overall expenditure. If the accident results in a death, labour department would call explanations from the contractor & he should explain the reasons for accident and the events which lead to the accident. Compensation should be released to the victim by the contractor and safety precautions tightened at the site to minimize accidents.

The prevention of an accident is essential at site, as the accident will cause loss of property, life of the workers & wastage of time.



### 2.2.9.2 High-risk activities

The safety officer in the site would maintain a record of safety precautions to each activity before starting the work. When the steel erection operation is on at site, the arrangement of safety precautions & remedial measures are very important to avoid any damages / injury happening in the site due to fall from the structure or from access ladders. The safety officer should record the activities of each location and prepare his arrangement in consultation with the engineers or officer in charge for each activity to minimize the damages. Not only the safety officer but the engineer / officer in charge should be held responsible to protect people & property from any damage. It would be advisable to give verbal or written instructions periodically to the workers who work in unstable or partially erected structures. Before construction work commence daily, safety measures should be taken (display the safety sign boards, mobile sign boards and wearing safety helmets, gum boots, goggles, safety belts etc). Safety audit should be held monthly at the site & the results recorded should be forwarded to be reviewed at the progress meetings.



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Although the safety helmets are available, workers in the site do not wish to wear same and as a result workmen are prone to accidents. Forms in this section can be used by the contractor to record accidents and injuries and checklists are used for prevention of accidents

The documents can be summarized as

1. Accident record (general register of accident )
2. Monthly injury summary
3. Monthly damage summary
4. Supervisor's injury analysis (See Appendix 3 – I )
5. Summary checklist of most common types of accidents
6. Check list of prevention of accidents
7. Inspection, maintenance & recharging of fire extinguishers.



### **2.2.9.3 Check list for prevention of accidents**

The contractor's main responsibility should be to avoid accidents at site during the construction period. The following activities should be monitored closely and a check list maintained to prevent accidents. (ICTAD, 2005)

1. Site planning & layout – locate the dangerous area clearly
2. Excavations - careful when deep excavations & night work
3. Erecting of scaffoldings – proper supporting is needed
4. Placing of ladders - keep suitable angle and protection cover
5. Roofing work – Protection against sliding & falling
6. Steel erection – Usage of safety belts, wearing helmets are essential
7. Work over the water –Boat for life guard & protection net against falling person
8. Working at the confined spaces – Safety measures take before starting the work
9. During the transportation – Use proper access & be careful about the existing utilities
10. Using the cranes – Use on the firm ground and periodically check the cables
11. Goods or platform hoists- Display warning boards for workmen not use goods hoists.
12. Usage of hand tools – Safety goggles & wearing safety cloths
13. Handling steel form work – As the weight is on the high side, be mindful about the lifting equipment.
14. Usage electricity- Proper insulations need to take safety measures
15. Fire protection- Use fire extinguishers, water & take action to use appropriate material to resist fire.
16. Noise
17. Usage of hazardous substances
18. Need welfare facilities. – Good water, meals, fresh air is needed for the workers at site.



#### **2.2.9.4 Health**

Safety hazards have overshadowed the health risks to construction workers. This is partly because employers and employees have not been fully aware of the health risks & partly because of an attitude among some employers that health is the worker's own responsibility.

Moreover health hazards are difficult to control because site conditions are so variable. The project manager's responsibilities are to provide proper facilities to the workers to take maximum output. Records of the given facilities and expenditure for purchasing or supplying it to the site are important to provide health facilities of the employees at site.

The officer in-charge should get involved in providing all facilities such as to avoid contamination of toxic fumes, radiations & any vibration & noises to disturb the employees. If the employees suffer the above health hazard record the names of the employees who have taken treatment and all the other details for claims insurance.



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#### **2.2.10 Quality control**

As a rule, in construction contracts, it is convenient for the contractor to under take and complete construction works to the expected standard of quality specified at a price the client expects to pay. Therefore, a client will only be satisfied if the contractor is able to provide a finished product to quality standard.

While the construction work is in progress the material testing, concrete product testing, dimension & pressure testing for the pipes, and the Megger testing etc should be done to maintain quality of the material & product. If the tests fail, purchase suitable material or take remedial measures to maintain the quality.

Taking photographs of the construction activities are the most essential requirement in the project. When the contractor prepares monthly report the photographs of the construction activities should be forwarded to client with monthly report to confirm the completed work done is correct. Photographs are taken before the project start to

show the pre construction status of the project. Some time the client/ consultant request the video record of the ground to confirm the initial status.

### **2.2.10.1 Supervision**

Close supervision of a construction project during its construction phase is important to achieve specified standards relating to quality. When the contractor maintain quality of product he may pay attention to reduce construction of sub-standard works condemnation & additional remedial costs with non payment for defective work failure to properly control & coordinate sub contractor's work and maintenance of poor site records. To maintain good quality product the contractor should recruit competent qualified personnel to be in-charge of supervision on site. If the contractor finds some bad quality workman ship he should re-do that work & record the item and the expenditure for rectifying the objects.

### **2.2.10.2 Internal auditing**

In large projects, internal control may be so complex that a separate group of internal auditors may be required to maintain effective control. Internal auditors should maintain the records of necessary activities. They should check the accounting system, carry out the plans & policies of the management & check the accuracy. While auditing they should check whether managers at various levels function properly & whether it functions or not as in Investigating & appraising the internal control system. Auditors record their observations during the auditing process and they prepare their report to change the process if it is in the incorrect path to put in to the correct path.

The forms under the quality control are self explanatory and the contractor or client could use same where relevant. The documents generally used at the site are as follows. (ICTAD, 2005)

1. Check list for demolishing, clearing & leveling
2. Bar bending schedule
3. Concreting approval request

4. Inspection test plan
5. check list for concrete placing record
6. Concrete cube test results – typical site records
7. Concreting inspection – In situ concrete
8. Concreting inspection – Ready mix concreting
9. Report of mix proportions of ready mix concrete
10. Concrete placement card
11. Post concreting check
12. finishing schedule
13. Defects list
14. Check list for buildings – Walling (brick/ block/ rubble), carpentry work, floor finishes, wall finishes, ceiling finishes etc.
15. Check list for sewerage contract- measurement sheet, weather record, incident report, day work record, testing pumping mains, pressure testing, close circuit television inspection report, approval for concreting, daily report, opening a new work site, handing over sites
16. Water supply contract Pressure testing report, daily report, backfilling & compaction record, checklist for coupling/adapters before placing, check list for large diameter pipe Bends/Reducers/Tees/ Valves/ Couplings for acceptance, Request for information, material inspection form, inspection request form, field order form, daily rock excavation monitoring sheet, confirmation of verbal instruction, concrete pour record sheet for structures, accident reporting form, checklist for transmission main & the electrical installation.

### **2.2.10.3 Quality records**

Records must be maintained, safely stored and be accessible for verification that work has been carried out complying to quality standards. The degree of documentation and retention times of records shall be that agreed with the client or defined with the quality system. The following important areas should be covered during maintaining the site records. (Terry Hughes & Trefor Williams, 1991)

#### 2.2.10.4 Purchasing

Procedures, graded in stringency to the importance of the purchased item ensure that bought in resources comply with the specified requirements and those providing them are competent such compliance may be judged by assessment of their formal quality system, in – house records of previous achievement, formal internal assessment procedure for examination of physical or documentary evidence of past performance and provision for higher level of main contractor supervision and support of their quality standards.

The procedures should also be included for the continual re-assessment of bought – in resources based upon performance. Procedures must be included to ensure that client supplied services or products, including information, also comply with the appropriate quality standards.

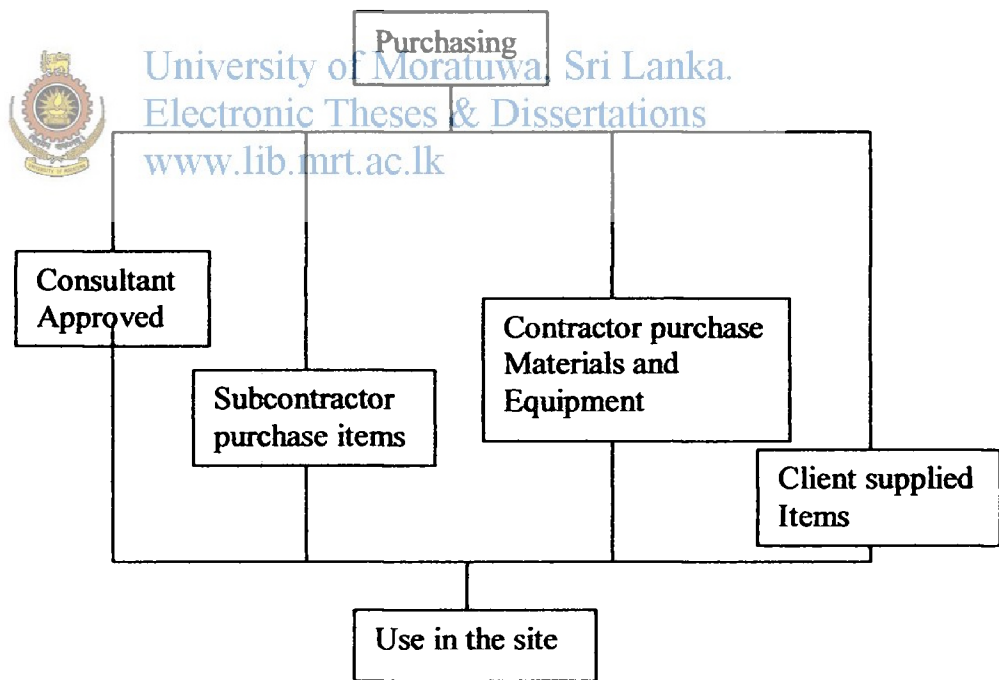


Figure 2.1 Quality records for purchasing

### 2.2.10.5 Inspection and testing

Procedures must be included for the verification of compliance with specification. These must be produced at each of the following stages such as upon receipt, during construction, at completion. In addition the routine checking and documentation of measuring and test equipment, the prevention of defective materials or workmanship being finally incorporated into the works through a system of instructions and regards and the control of non- conforming products, the implementation by management of corrective in the event of non- conformance, the use of statistical techniques in establishing conformance.

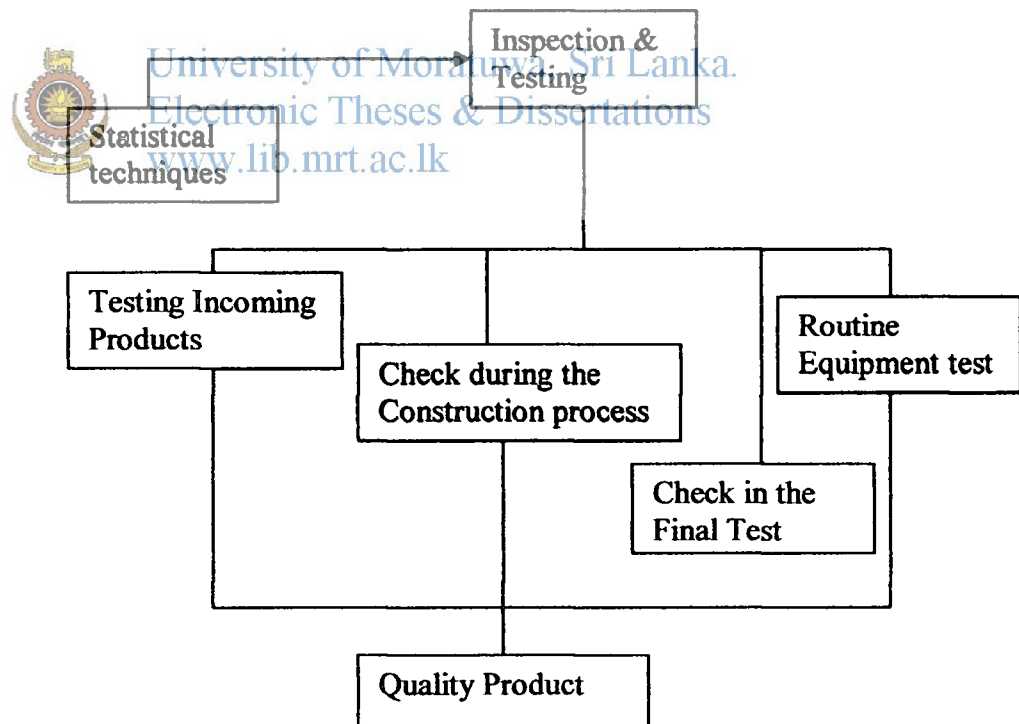


Figure 2.2 Quality records for inspection and testing

### 2.2.10.6 Handling & storage

Procedures must be included for the receipt of materials, identification of materials, inspection of materials, handling & storage of materials in accordance with the manufacturer's recommendations to ensure protection from damage or deterioration, protection of completed work until hand over.

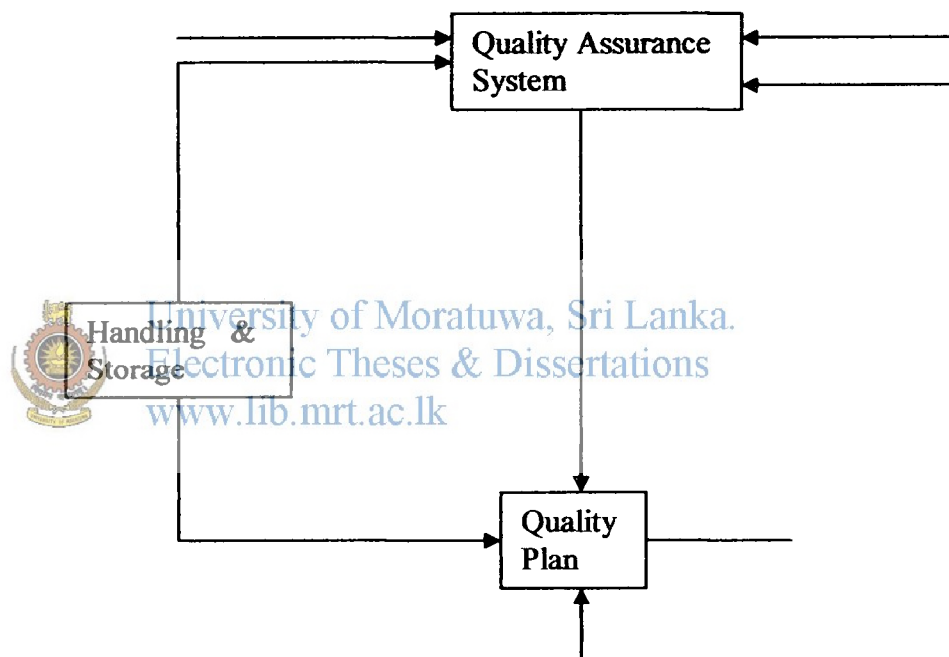
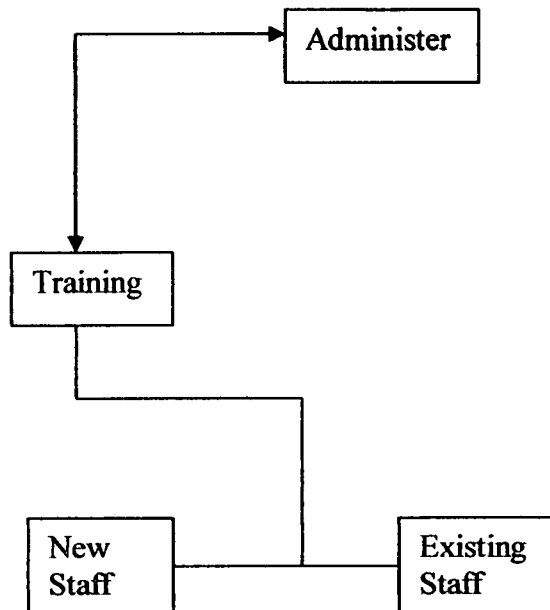


Figure 2.3 Quality records for handling and storage

### 2.2.10.7 Training

The training procedure must be included in the personnel records available to confirm that staff or operators requiring particular skills have been trained, tested or otherwise checked. It could be identified the general or specified need for additional training requirement of the staff & this provision is made for quality awareness training. In addition to the staff working in the company the attention is given to new personnel to be trained.





**Figure 2.4** Quality records for training



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### 2.2.10.8 Document control procedure


The purpose of this procedure is to increase the traceability of every significant piece of information issued during a project. At the commencement of each project, files should be established with the following sections.

(a). Head office

1. Record section
2. Incoming correspondence
3. out going correspondence
4. Internal correspondence

A master copy of all documents should be kept in these files and not removed under any circumstances. These should either be originals or a certified copy. It should be ensured that photocopies contain all the relevant information. (Eg. Small point on the back of quotations)

**(b). Site**

1. Correspondence to and from Architect in separate sections and minutes of meetings to be filed in a separate section.
2. Correspondence to and from subcontractors in alphabetical order & instructions to subcontractors filed in separate sections.
3. Correspondence to and from material suppliers in alphabetical order.
4. Correspondence to and from plant suppliers in alphabetical order.
5. Architects Instructions, clerk of works directions and confirmation of verbal instructions in separate sections.
6. Requests for information & replies.
7. Quotations from possible future subcontractors and suppliers or plant hirers.
8. Records (a copy of records to be retained on site).
9. Tender make up and costing information.
10. Applications valuations and certificates.
11. Internal correspondence and safety.
12. Contract documents files, (a single copy of all contract documents should be kept in this file) noted the contents are only to be listed in the Quality plan file.  University of Moratuwa, Sri Lanka.  
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13. Quality file, (refer to the Quality plan procedures for contents)
14. Master Index files.

The face of the file/ files should be marked with the contract number, project name and contents in accordance with the above. Continuation files should be numbered sequentially dated \* from and to\* completed files should be marked as continued on file No. "Which is the next files".

### **2.2.10.9 Quality plan procedures**

The quality plan is drawn up to help the site manager firstly define and subsequently control the quality requirements of the project. Its production requires analysis of the work and the abstraction of imposed quality requirements from the project documentation. In addition the project management team must establish and define their own (and company's) requirements for the inspection and control of quality.

The quality plan is formulated in two stages.

- The general overall plan called the general plan and
- Detailed plans, which follow the broad outline on the general plan.

The general plan shall be prepared prior to the commencement of building operations. On completion of the general plan, a copy shall be forwarded to the Quality Control Manager. The site manager is responsible for the quality plan through its preparation may be delegated. The quality control manager is responsible for implementation & monitoring of the quality plan.

The quality plan is first prepared in general terms. Detailed plans are then prepared, in sections, with the first priority given to the early operators or operations with a long lead in. The detailed sub-programmes for these early operations must be prepared to enable a clear examination of the precise work involved. As the first task is to draft a complete schedule of the drawings, specifications and other documents from which the plan is prepared. This schedule of documents, together with own requirements and any subcontractor's plans which may be available, from the data source from which the plan is prepared. The contract programme then tells you when and where to enable the completion of the general quality plan.

Having prepared the quality plan, items such as hold points should then be marked on the construction programme. This act is as a visual aid in monitoring their compliance relative to progress. This process should it possible be completed during the mobilization/ it may also span the construction period it self. In addition it is almost certain that further detailed quality plans or amended quality plans will be prepared at intervals during constructions.

## 2.3 Commissioning stage

The main purpose of the commissioning stage is to ensure that the building has been completed as specified in the contract documents and that all the facilities work properly and provide a record of the actual construction, together with facilities provided. Difficulties may arise due to change the original design at the construction stage. Records of these changes will be kept during the construction, mainly for financial reasons. These must be brought together to make a complete record of the actual construction.

The activities are as below

- a). Prepare “As-Built” records
- b). Inspect the building thoroughly and have defects remedied.
- c). Test for water tightness
- d). Start up, test and adjust all services.
- e). Prepare operating instructions and maintenance manual.
- f). Train staff



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The test for water tightness is important in areas where rain occurs and water flows (Bath rooms, Balconies and toilets). Failure to test at the commissioning stage might result in leaks not being discovered until rainfall occurred- perhaps many months or even a year later. The commissioning stage is the transition period between the construction & the occupation and use of the building. For large and complicated buildings, or groups of buildings, it is not uncommon for the commissioning to be done in several stages. Commissioning must be planned well in advance so that the recruitment and training of staff and deliveries of furniture and equipment can be co-ordinate with the commissioning schedule.

The following forms will be maintained as an inventory for handing over of varies items and fittings in the completed work. (ICTAD, 2005) They are;

1. Handing over note – General
2. Handing over note – Electrical fittings
3. Handing over note – Mechanical fittings & plant

4. Operational & Maintenance manual- Operational maintenance manual consists of Test report, Manuals, Warranties, Spare parts list.

During the practical completion stage, the contractor should record all the letters of handing over and keep copies in the site and the head office. Contractor, client & consultant visit the site and prepare the defects list and give the target dates to rectify the defects. At the time of handing over the project, the contractor should submit the As- built drawings. There are number of changes being done at the construction stage with respect to tender documents. Include all the changes at the construction stage in the preparation of the as built drawings / documents and submit to the client. Location of the pipe lines electrical wiring & cable trenches are required if new construction work start in the future at the same ground.

Generally the defect liability period is considered as one year. The contractor should record the defects liability period. After this period elapse the contractor can claim all the retention money of the contract. Performance bond and the insurance bond generally expire on the initial date of completion of the project. But due to various valid reasons the contractor can request to extend the date of completion & renew the performance bond & insurance to the new date of completion of the project.

As stated earlier, when the project is handed over, the contractor should submit the warranty certificates to client for specified material or product & services such as water proofing, electrical equipment, sanitary fittings, anti termite treatment services etc. Contractor also should record the details of companies, which gave the warranty for their material or product. Handing over the inventory report is the main task of the contract or during the handing over of the project. The copy of inventory report should be kept in the site records files for further requirement when defects are rectified.

At the initial stage client / consultant confirm the date of completion of the project. The contractor prepares the general programme with reference to the given period. Due to various valid reasons the date of completion the project would be extended. If the contractor can finish the project within the extended duration he will not be liable

to pay the liquidated damages. If the contractor is unable to complete the project, he is liable to pay the liquidated damage for the extended dates. The contractor should record the expenditure for liquidated damages if it is paid.

Demobilizing plan must be carefully prepared and rehearsed well in advance. The factors to be taken into consideration are;

1. Reduction in the expatriate staff
2. Pay off the labour force
3. Allocation of work to subcontractors
4. Discharge of fiscal & legal obligations
5. Re-export of construction plant
6. Settlement of final account with the client

### **2.3.1 Discharge of fiscal & legal obligations**

Legal & fiscal matters that have to be dealt with during the close-down period include

1. Individual expatriate tax clearances
2. Company tax clearance
3. Discharge of all obligations as a local employer
4. Payment of duty on plant & materials retained in the territory or obtainment of release of bonds posted against the re- export of such items. (If the contract is fully duty – paid, these matters are not relevant)
5. Determination of all contracts with local parties.
6. Termination of insurance
7. Obtainment of return of bonds.

The settlement of final account with the client is normally the last activity on a contract.

## **CHAPTER 3: RESEARCH METHODOLOGY**

### **3.1 Introduction**

Chapter 1 identified objectives of the study and chapter 2 established the theoretical background of the study. This chapter illustrates the research methodology used in the study.

As stated in the section 1.4, the questionnaire has prepared according to the project management principles used in the construction industry. Details of the development of questionnaires were given in the section 3.2

All the questionnaires were prepared with considering the time factor of the project. As a result, the questionnaires were separated in to initial stage, construction stage & the handing over stage in the project for easy reference to the contractors. Results of the questionnaire survey were included in the Appendix – 1.

### **3.2 Development of the questionnaire**

The available literatures were reviewed to collect the data in the construction projects and additionally I did a pilot study to identify the views of the senior engineers, construction managers and the site in-charges about the record keep in practice in their projects.

Furthermore I used my long term site experience to abstract the necessary details for development of the questionnaires.

In addition to the information received from the literature review & the pilot study, it was further categorized into project management principles used in the construction industry and the details were included in the following sections.



### 3.2.1 Scope management

All the documentary related activities were included in the scope management. The questionnaires were developed reference to the following records maintained at the site.

- A). The following records of security arrangements should be maintained at the site.
- a. Monthly prepare a roster for the security personnel to schedule their duties.
  - b. Any incident of importance at the site should be recorded in the Information book. (I.B)
  - c. All the vehicles in the company should maintain the running chart book in each vehicle to record the daily activities.
  - d. A gate pass is necessary for all the vehicles leaving the site.
- B). It is necessary to prepare the general construction programme with bar chart arrangement or similar method before commencement of the construction work.
- C). Risk Management during the construction period is very important.
- a. Separate file should be used to record the risk during the project period.
- D). It is required to record the important minutes of the progress meeting. Important activities are to be completed according to the priority.
- E). It is necessary to take photographs at the construction site from the initial stage to final handing over.
- F). All the letters of handing over should be recorded.
- G). Record the As- built drawings to be submitted to the client.
- H). During handing over the site, inventory report / lists are to be submitted to the client.

### 3.2.2 Cost management

All the contractors maintained the cost related documents at their sites as all the construction activities were mainly depended on the contractors' financial facilities. The management principle was developed to prepare the questionnaires as below.

- A). Existing status within the site premises should be recorded before commencement of the construction work. e.g. Buildings, trees, pipelines, cables, access roads etc.
- B). Expenditure for the following site overheads should be recorded for preparation of the interim bill.
- a. Record all the temporary constructions to be completed at site.
  - b. Record all the existing buildings to be demolished before commencement of the construction work.
  - c. Record the expenditure of the houses rented to the site staff.
- C). Monthly expenditure can be calculated by analyzing the activities with quantities in the BOQ. The cash flow diagram should be submitted to the client before commencement of the construction to prior notice of cash requirement of the project.
- D). Record the cost of services utilized from initial stage to final handing over. The services are described as follows.
- a. Record the initial and monthly cost of the electricity used in the site.
  - b. Record the initial cost and the monthly cost for the telephone facility consumed at the site.
  - c. Record the water consumed for drinking & construction purpose throughout the project duration.
  - d. Record the refundable deposits for all the temporary service connections used at the site.

E). Monthly site expenditure is recorded to purchase materials & tools including the payments of sub contract work within the limitations given by the company.

- a. Petty cash is used for purchasing stationary, material and for services with price limitations.
- b. Purchase imprest is used for purchase of materials, tools within the limitation of price.
- c. Record the expenditure of sub contract advance payments paid to the sub contractors.

F). Monthly expenditure for the payment of salaries & wages to the workmen employed at the site.

- a. Monthly expenditure for the salaries and other payments of the permanent, contract basis or casual officers work in the site.
- b. Monthly record the salaries, wages or other expenditure of the. Labour grades
- c. Sub contractors
  - i. Record the payments made for the labour sub contractors.
  - ii. Record the payments made for the full sub contractors



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G). If the client / consultant decide to make payments for the additional work in a day work basis, the contractor should maintain the day work sheets throughout the period of additional work is carried out.

H). All the contractors prepare their monthly interim bills and submit same to client before the agreed date.

- a. The submitted monthly bill value is recorded together with the client certified bill value for information of the top management.
- b. According to the contract, the payments should be released on scheduled date after submission of the interim bill. In this regard recording the date of submission of the bill is very important.
- c. Recording the date of releasing the payment for interim bills is very important. Any delay on the part of the client to release the payment on or before the due date will hinder the progress.

I).To maintain progress of the project effectively; the contractor should pay the subcontractor's payments on time and contractor should record the date and amount of the payments are made.

J).Price increases of the essential raw materials during the construction period cause one of the major problems in the construction industry. If the client pays price escalation for the raw material, the contractor should record it. The following lists of raw materials constitute the major materials used in the construction sites.

- a. Cement
- b. Sand
- c. Metal
- d. Steel
- e. Bricks
- f. Electrical wire

K). If the contractor fail to handover the project on the scheduled date he should pay liquidated damages to the client for the extended dates. If the client deducts money for the liquidated damages, the contractor should record the amount in each month.

### **3.2.3 Time management**

Generally all the contractors should handover their sites in the scheduled date & extend the project duration due to various reasons. If the contractor can complete the project on time it can be saved the time and cost of the project. The list of questionnaires was to be developed at the site as given below.

A). Starting date of the project is very important to the contractor & he should record the date of taking over the site. When extending the insurance coverage or renewing the performance bond the starting date & the finishing date of the project are very useful.

- B). If the contractor agreed to complete the project on time, he should analyse the critical path of the project. If the critical activities are delayed, the project automatically will be delayed.
- C). Maintaining daily weather report throughout the construction period is necessary to receive time extensions for the contract for unusual weather, which disrupts work.
- D). The contractor should update the progress with respect to the programme. He should submit the “S” curve for the physical progress at the monthly progress meeting.
- E). When the contractor hires the machineries he should pay charges on hourly basis. Following machinery hours should be recorded at the site.
- a. Working hours
  - b. Idling hours
  - c. Repair hours
- F). A register is maintained at the site office to record the details of the following documents / written instructions such as issuing date, receiving date and reference number.
- a. Construction Drawings
  - b. Sketches
  - c. Specifications
  - d. Site logbook
- G). Computer is used for maintaining the records and preparing the shop drawings at site.
- H). Computer is used to prepare the bills and develop the photographs taken from the digital camera.



I). Recording the following dates are very important to the contractor for releasing the retention payment and renewing the bonds and insurance on time.

- a. Defects liability period
- b. Date of expiry of the performance bond
- c. Date of expiry of the insurance bond

J). After handing over of the project, 50% of the retention payment is released in the final bill. The balance 50% will be released after the defects liability period. The contractor should record the dates of receiving of all the retention money of the contract.

### **3.2.4 Quality management**

The contractors' main aim should be finishing the contract on time, within the budget & the specified quality requirement. So the management of quality requirement is important to handover the good quality product to the client. Otherwise re - work/ testing is consumed additional cost for the contractor & loss his profit. Contractors maintain the documents which are mainly effect to maintain the quality of the project activities which is listed as bellows.

A).All the construction materials & products used for the construction activities should be tested before / after the construction to maintain the quality. The material / products are given as below.

- a. Sand (sieve analysis test)
- b. Cement (setting time test, finesse test)
- c. Metal (Sieve test / water absorption test)
- d. Slump test
- e. Concrete cube test
- f. Pressure test (water supply)
- g. Megger test (electrical wiring)

B).While the construction is ongoing, the contractor should check the quality of workmen ship. If the quality control manager or other authorized person rejects

the bad quality construction work, these activities should be re-done. Expenditure for all the rectification work should be recorded.

C). Before handing over the project, list out the defects to be rectified.

D). At the time of handing over of the project, the contractor should hand over the warranty certificates for the specified material/ product to the client. The following materials or equipment will be used with warranty and the supplier will issue the warranty certificate indicating the warranty period.

- a. Water proofing
- b. Electrical equipment
- c. Sanitary fittings
- d. Water pumps



### **3.2.5 Human resource management**

Human resource management is the essential requirement of the project as all the activities are handled by the employees work in the project. As a result of the high expenditure for the employees, it would be maintained the records correctly throughout the project duration. The questionnaires to be developed are given as below.

- A). Security personnel's (security guards/ watchers) attendance is recorded on their attendance book.
- B). When the site is taken over by the contractor, he should record all the details of persons in the parties involved in signing the contract.
- C). Client / consultant request to submit the organization chart to analysis the staff engaged in the project.



D). Attendance of the following employees working at the site should be recorded / displayed in the site office and submitted daily to the client/consultant.

- a. Administrative officers
- b. Supervisors
- c. Labour (Skilled & Unskilled)
- d. Subcontractor's staff
- e. Security staff

### **3.2.6 Communication management**

After won the project, the contractor's site agent continuously communicate with the client, consultant and their top management at the head office for the matters arise in the project. Questionnaires were developed as given in below.

A).For the communication purpose the contractor should record the contact telephone numbers of the persons involved for taking over of the site.

B). Site manager should send the progress report to top management, periodically for identifying the shortage of resources and the method of accelerating the project.

C). In response the top management will issue instructions verbally or in writing to the site staff. Site manager should record all the information received from the top management including dates.

### 3.2.7. Risk management

As stated in the bidding stage the contractor should manage the risk factors during the construction period. Documents were maintained by the contractors for claiming the additional cost incurred. The questionnaires were developed under the following activities.

A). Following security bonds & guarantees from the relevant companies to be submitted to the contractor.

- a. Performance bond.
- b. Bid bond.
- c. Advance payment bond

B). While the construction work is in progress the surrounding properties may get damage. In this respect the contractor should maintain the record of all complains made by the public.

C). Contractor should record the expenditure for the unforeseen activities at the site.

- a. It may find the rock/ very hard soil during the excavations at the site. Cost for breaking the rock or excavating the hard soil is consuming much time and costly when compared to excavation under normal conditions.
- b. Shortage of raw materials locally will badly affect the progress, due to the cost and time factor in the event the materials have to be imported.
- c. Unexpected floods or storms may hinder the site activities. Specially, the soil near the excavated foundation pits may collapse. Although the contractor has all the resources, he may have to face unexpected risky situations at the site as a result.

D). Contractor should record expenditure for any delays in the project due to the following reasons.

- a. Change in the weather pattern & bad weather, climatic condition, lightening etc. may cause the project to delay.

- b. Strikes may result in due to problems between the employer & employees for paying low salaries / wages, dismissals, unfair conditions implemented at the site etc.
- c. Construction will stop when the government imposes curfew.
- d. Unexpected holidays announced by the government will cause in delays in the project.
- e. If the site is situated in the high security zones, there may be restrictions for vehicle movements or the working hours being restricted.
- f. Construction work will delay if a major accident happens at the site.

E).Events pertaining to safety should be recorded by the safety officer & arrangements should be made to pay compensation through the insurance company.

### **3.2.8 Procurement management**

Procurement of the resources is mainly effect to the progress of the project. The labour, material & plant resources utilize according to the general programme of the project. The contractor should maintain the records of procurement of resource continuously throughout the project period to meet the time target. The questionnaires were prepared according to the data analysis in the following areas.

- A). The contractor should prepare the records of resources needed to complete the project with respect to the programme submitted. List of skilled labour, unskilled labour, machineries etc are the main resources to be submitted, using the resource histograms.
- B). The contractor should maintain the following records at the stores.
  - a. Purchase Requisition (order material or tools for the construction work)
  - b. Goods Received Notes (G.R.N.)
  - c. Material Requisition Notes (materials issued for the site construction)
  - d. Transfer Notes (material transferred from site to other sites)
  - e. Return Notes (excess material returned back to the stores.)
  - f. Gate passes needed for transporting material / tools from site to other sites.

- g. All the vehicles coming in and going out of site are recorded by the security guards at the gate. When the vehicles / machineries leave the site a gate pass should be produced by the drivers / operators and these should be signed by a responsible officer.
  - h. Tools are recorded on the bin cards in the stores.
  - i. Consumable items should be recorded on the ledger cards at the stores.
  - j. All the non-consumable items issued to the site are recorded on the personnel issue register. (Under the authority of specified officer)
  - k. Tools issued to the site are recorded on the bin card register
- C). The contractor should maintain enough stocks of building materials for the construction work. He should check the material periodically with submitted general programme to minimise the delays due to material shortage.

The following building material stocks are very important to be recorded weekly to minimize delays in the construction activities.

- a. Cement
- b. Sand
- c. Metal
- d. Steel
- e. Brick/Block
- f. Lime

- D). When procurement of material or machineries, the contractor should maintain the list of suppliers including all the detail such as rates, discount, name, address with contact telephone numbers etc. Following are the main procurement of material and services to the site to be recorded by all the contractors.
- a. Building materials (cement, Sand....)
  - b. Machines hired
  - c. Subcontractors
  - d. Ready mix concrete

### **3.3 Data collection from the contractors**

Section 3.2 identified the questionnaires to initiate the survey. It was responded only 17 numbers of contractors out of 50. I spent 4 -5 months of duration to collect data from the contractors.

### **3.4 Analysis the data received from the contractors**

The results of the questionnaire survey were received by “Yes” or “No” answer. It was further analysed the results to identify the type of site records maintained at the construction sites. The results were again categorized in to eight project management principles (116 numbers of questions were included in each questionnaire form).

The total answers (“Yes” And “No”) were received with respect to the total number of interviewed contractors. The total number of “Yes” answer compared to the total answers in each project management principle was calculated and presented in the percentage values.

The results of the average documents maintained at the sites in each project management principles were presented in the form of histogram.

The analysis was extended to study the level of record keeping practice by the construction contractors. Out of 116 questionnaires (documents) I identified the document the documents which were maintained by the most of the contractors and the documents which were maintained by the minimum number of contractors in the initial, construction & the final stages of the construction period.

The results of the highest and lowest level of the documents usage (Percentage wise) were selected and presented in the histogram form in each stages of the construction project.

### 3.5 Summary

This chapter summarized the methodology of the research study. It highlighted the method adopted for identifying the site records maintained by the construction contractors. This chapter also highlighted how to develop the questionnaires for the questionnaire survey. Furthermore, it highlighted the method of analyzing the data received.



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## **CHAPTER 4: DATA ANALYSIS & INTERPRETATION OF THE RESULTS**

### **4.1 Introduction**

Based on the research methodology described in the chapter 3, questionnaire survey was carried out to identify the types of site records maintained by the construction contractors. Response to the questionnaire survey was received from the construction contractors and the details were given in the Appendix -1

Based on the results obtained from the data analysis, author was able to make certain observations about the site records maintained by the contractors & these were illustrated in sections 4.2.1, 4.2.2 & 4.2.3.

### **4.2 Details of the data analysis**

#### **4.2.1 Average of documents maintained at the sites.**

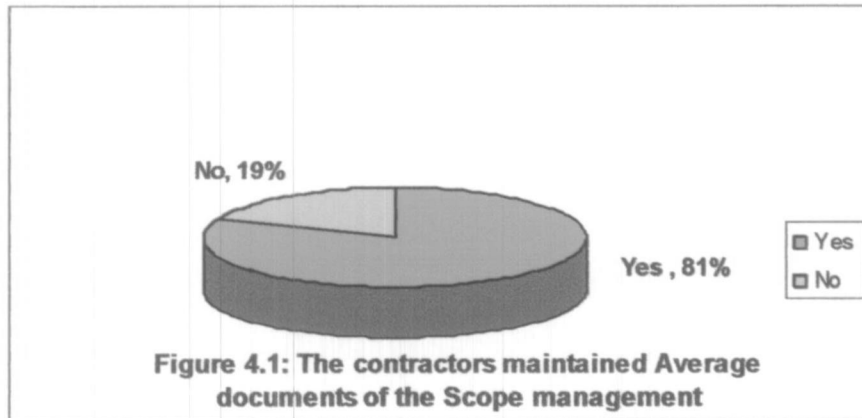
As stated in the section 3.2 the number of records (out of 116 numbers) was maintained under the eight categories of project management principles. Results of the percentage of average documents maintained at the sites were given in each project management principle in figure 4.1, 4.2, 4.3, 4.4, 4.5, 4.6, 4.7 & 4.8.

As a summary the average of documents maintained at the site was tabulated in the table 4.1. The relevant histograms were given in figure 4.9. The details of the research data were presented in the table 1 in the Appendix 2.



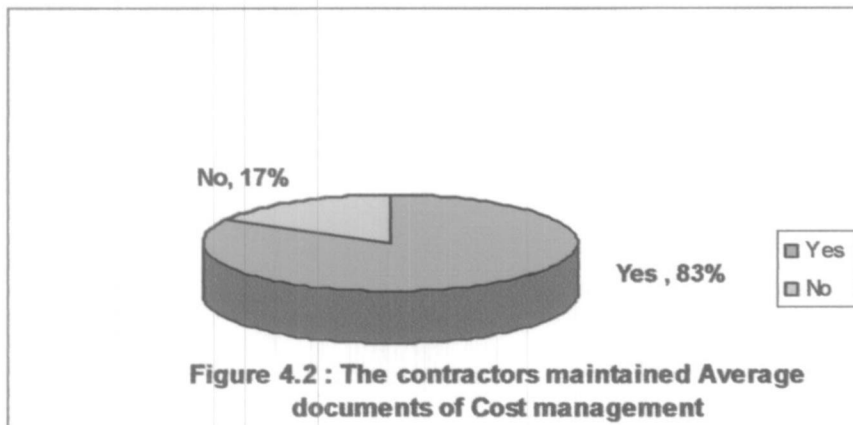
#### 4.2.1.1 Scope management

There were 11 numbers of documents to be maintained under the scope management by the 17 number of contractors. Reference to the reply of the questionnaire survey 152 “Yes” answers received out of 187 documents.



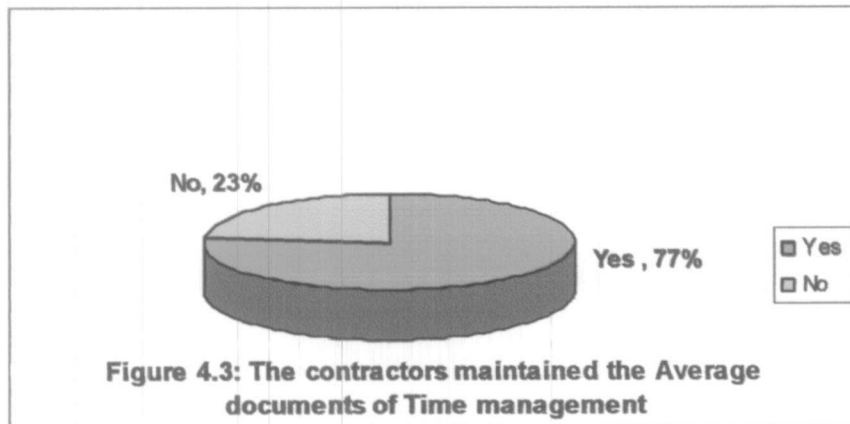
#### 4.2.1.2 Cost management

There were 11 numbers of documents maintained at the sites under the cost management. The questionnaire survey results indicated 394 answers “Yes” out of 476 documents within the 17 numbers of contractors.



#### 4.2.1.3 Time management

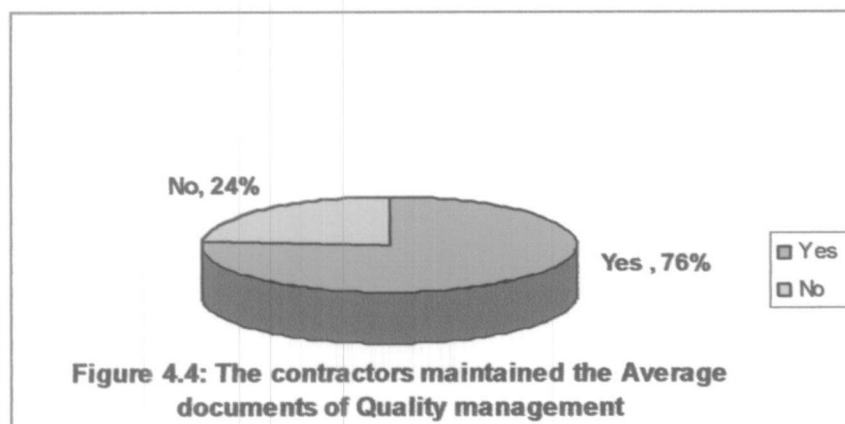
Reference to the table 4.1 in the section 4.2.1 & the table 1 in the Appendix -2, there were 17 numbers of documents maintained at the sites in time management. Results of the questionnaire survey indicated 223 numbers of “Yes” answer out of 289 documents, totally used by the 17 contractors.



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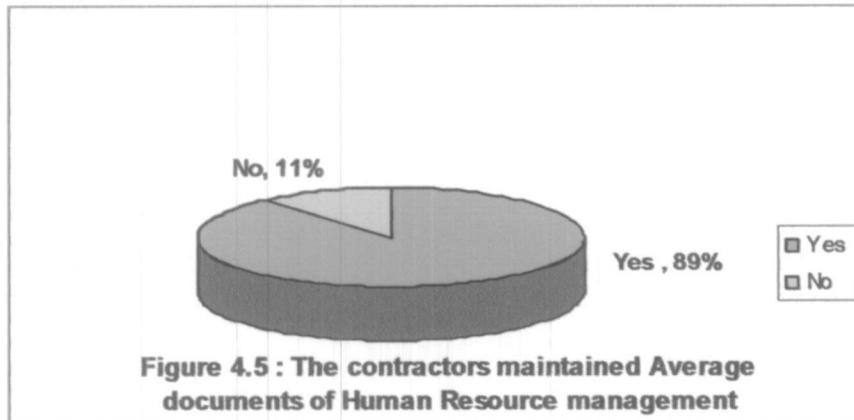
#### 4.2.1.4 Quality management

Each of 17 numbers of contractors maintained or not the 13 number of documents of the quality management. Results of the questionnaire indicated 168 documents were maintained at the sites out of 221 total documents relevant to the quality management.



#### 4.2.1.5 Human Resource management

The results of the questionnaire survey indicated that 121 documents were maintained out of 136 total numbers of documents. The total number of documents were to be maintained by the 17 numbers of contractors were 8 numbers.

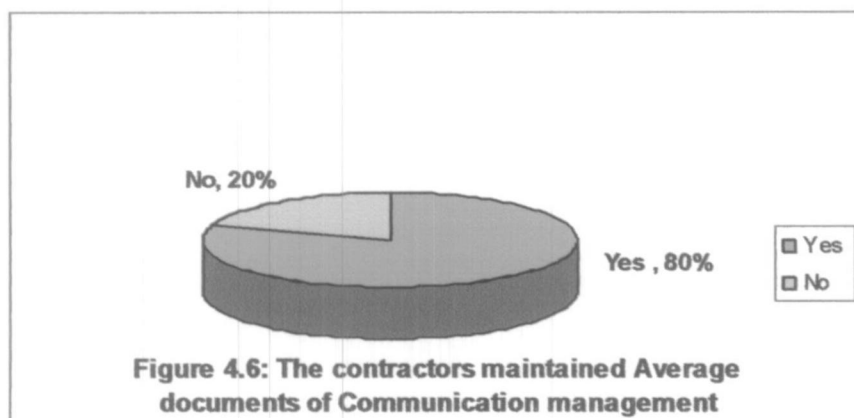


#### 4.2.1.6 Communication management



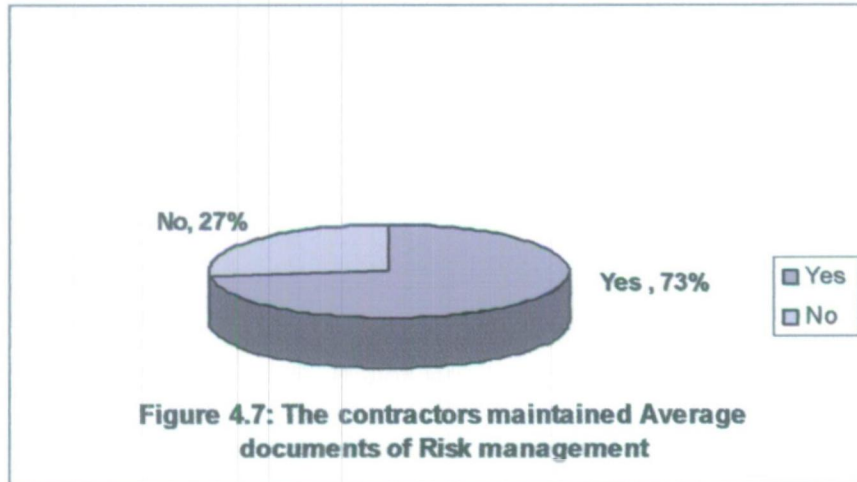
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The number of questions in the communication management is 3 out of total documents after distributed among 17 numbers of contractors. The results of the questionnaire survey were clearly indicated the total documents maintained are 41 out of 51 total documents.



#### 4.2.1.7 Risk management

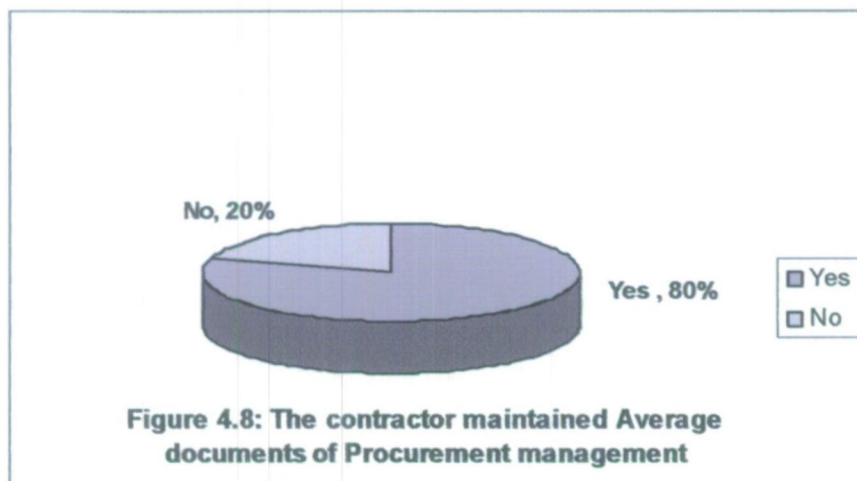
The questionnaires were prepared under the risk management was 14 numbers. While the questionnaires were distributed among 17 numbers of contractors, the total reply from the contractors were 238 numbers. Reference to the results of questionnaire survey the total documents maintained was 174 numbers.



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#### 4.2.1.8 Procurement management

There were 22 numbers of documents maintained at the sites under the procurement management. The results of the questionnaire survey indicated 300 numbers of answers "Yes" out of 374 documents within the 17 numbers of contractors.



**Table 4.1 Average of documents maintained at the site**

	<b>Categories of the documents</b>	<b>Number of documents Identified in each category</b>	<b>Answer "Yes" %</b>
1	Scope Management ( Scope M.)	11	81
2	Cost Management ( Cost M.)	28	83
3	Time Management (Time M.)	17	77
4	Quality Management (Quality M.)	13	76
5	Human Resource Management ( H.R.M.)	8	89
6	Communication Management ( Com. M.)	3	80
7	Risk Management (Risk M.)	14	73
8	Procurement Management (Pro. M. )	22	80



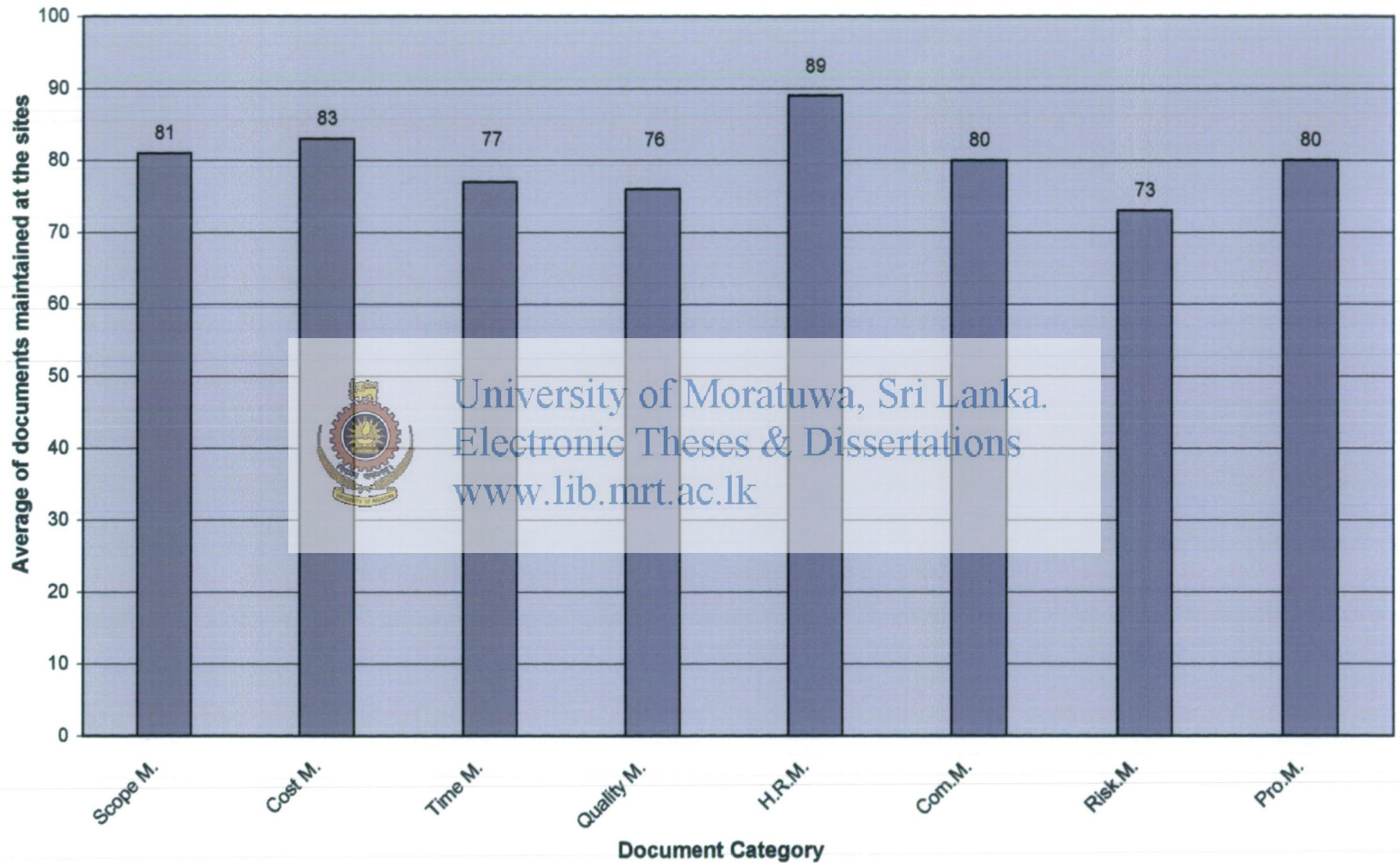


Figure 4.9 Average of documents maintained at the sites.

#### 4.2.1.9 Discussion

Based on the results obtained from the data analysis in each category of the documents maintained at the sites (See Table 4.1), the highest percentage of documents maintained at site was Human Resource Management. Employees formed a very important part in the project and contractors should have paid their salaries, overtime, bata, bonus etc on time. Generally all the contractors should have maintained the records of each employee attached to the project.

Although the documents under the human resource management were maintained by most of the contractors, this section had no more documents to be maintained at the sites. Reference to the documents in the cost management, percentage of the documents maintained was lesser than the human resource management. Although the cost management included 28 numbers of documents, the human resource management included only 8 numbers of documents. Compared to the large number of documents maintained by the contractors under the cost management, it was also considered the cost management had maintained the average of more documents at the sites. As a result of the lesser documents were followed by more contractors under the category of human resource management, it become highest value of eighty nine percent (89%) of the average value.

The lowest number of documents maintained at the site is under the risk management. As a result of negligence of the risk at the project activities, some contractors do not maintain the records relevant to the risk management. Some time the client may not spend money for unforeseen risk at the site, as the condition would have not been included in their specification. Main reason for maintaining the lower level of documents for the risk management is that most of contractors will not spend money for maintaining the risk management related activities. Safety measures including safety equipment, sign boards, safely erecting the scaffoldings etc and the safety officer are not maintained in some contracts.





## **4.2.2 The level of record keeping practice by the contractors**

Results of the questionnaire survey indicated the numbers of documents were maintained at the sites by each of the contractors. The maximum usage & the minimum usage of the documents were analysed in percentage values in three stages of the project duration was calculated with referred to the results of Appendix -1.

Usage of documents at the site in maximum level or minimum level was described with respect to the project duration as given in the section 4.2.2.1, 4.2.2.2 & 4.2.2.3,

### **4.2.2.1. Initial stage**

#### **(A). Documents with highest level of usage at the site**

After winning the tender in competitive bidding or negotiation, contractors took over the site to start the construction activities. At the initial stage, all the contractors recorded the dates & persons involved in taking over the site. At the time of taking over the site, they have signed in the special format supplied by the client or consultant. Contractor's representative (senior officer) involved in taking over the site and signed the agreement & the taking over sheet before starting the construction activities at the site.

Most of the contractors recorded the existing status before starting the construction work at their sites. For the purpose of claims the contractors recorded the existing status using photographs & video pictures of the buildings, trees, pipelines, CEB or telephone posts etc which were to be removed or replaced before the construction start. The contractors recorded the temporary construction for calculating the overheads as they have claimed it under the preliminary item of the BOQ. Temporary construction included the construction of site office & other facilities to the client/consultant.

Under the area of scope management, the programme should be prepared by most of the contractors in a bar chart form using relevant software package (M S Project). An engineer or technically qualified person has to be involved in the preparation of the programme and monitoring the progress continuously. Most of the contractors

recorded the details of performance bond at their sites, because the contractor's bill payments were tied up with valid performance bond.

The documents with highest usage out of 17 contractors at the initial stage of the project as described above was given in the Table 4.2 and the relevant histogram was shown in the Figure-4.10

**Table 4.2 Documents with highest level of usage at the initial stage**

Item Number	Type of records	Answer "Yes" %
1.01(a)	Record the Dates when taking over the site	100
1.01(b)	Record the Person involve when taking over the site	94
1.02	Record the Existing status before starting the construction	94
1.04(a)	Record the Temporary construction for calculating overheads	94
1.05(a)	Prepare the programme including Bar chart before commencement of the construction	94
1.06(a)	Record the Details of the performance bond	94

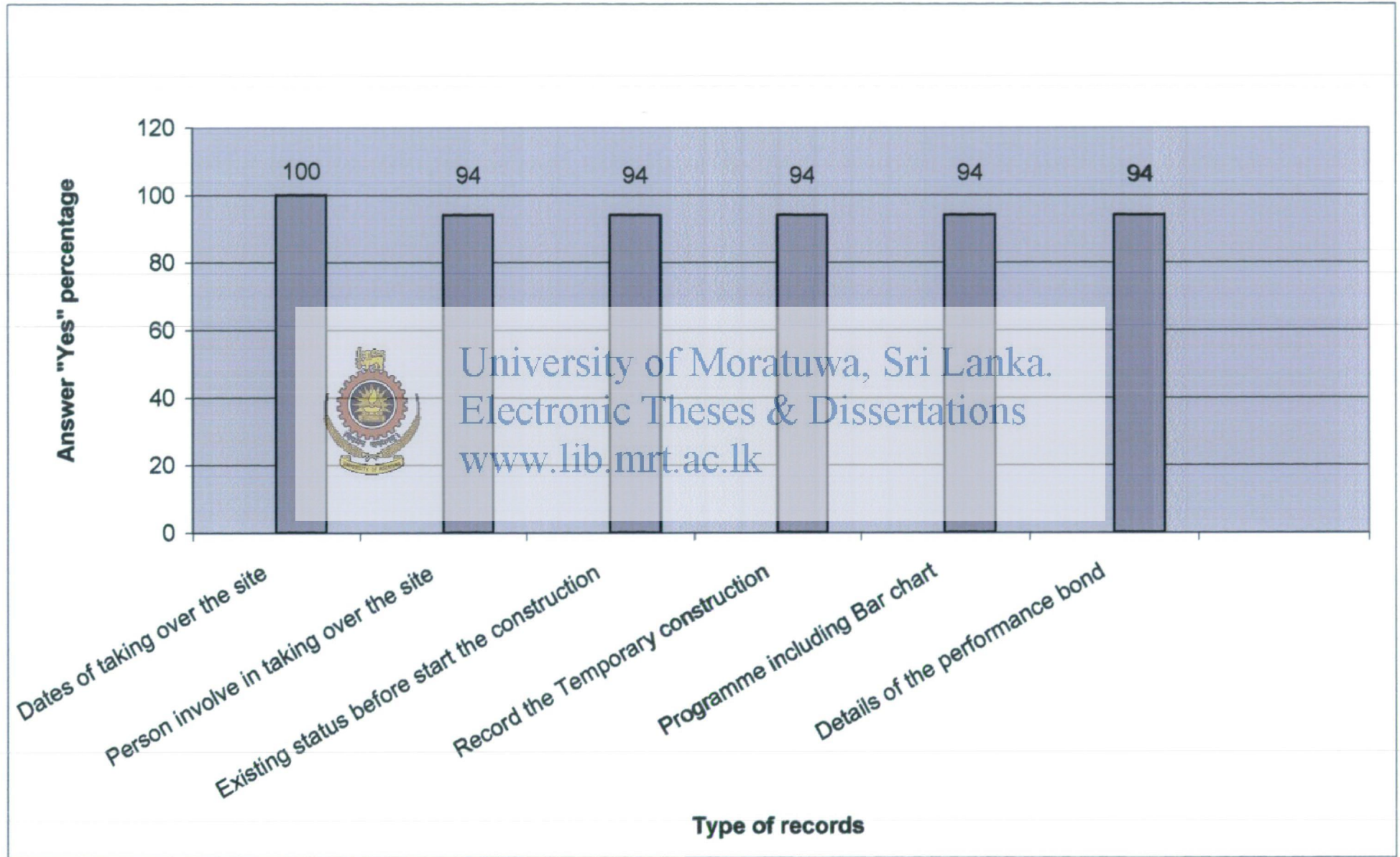


Figure 4.10 Documents with highest level of usage at the initial stage of the project.

### **( B ). Documents with lowest level of usage at the site**

By analyzing the result of the questionnaire survey it was observed that the several items were maintained at lowest level in the sites. At the initial stage of the project several documents were not recorded effectively by some contractors due to the lack of facilities available at site. As a result of some security companies were recruited at the site, the contractors' own security team would not have maintained the documents such as rosters, personal data etc properly at the site.

All the vehicles leaving & entering the project premises should have to be recorded at the security office at the entrance. Although the vehicle running chart books were maintained at the major projects and the government projects some contractors didn't maintain it. If the project was to be handed over on the scheduled date, the contractor should have followed the critical path analysis. If the contractor failed to complete critical activities on time he would have failed to handover the project on time. If the contractors have enough time to complete the project and due to impose lower restrictions from the client they would not follow the critical activities & the critical path.



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Resource allocation was very important in the major projects. Skilled/unskilled labour, machinery etc were the major resources have to be allocated effectively. Resource histograms were one of the important methods of presentation of resource allocation of the project. But the contractors did not prepare the resource histograms at their projects due to unavailability of the actual resources for each item at their company.

There were only few contractors who maintained the records for public complains. Vibrations or other side effects would have caused damages to public property as a result of rock blasting, pile driving or any other similar major operation in the site. Specially, before the project start, the actual condition of the neighbours' property should have been recorded and their complains should be recorded periodically to give solutions to them through the insurance company. If the contractor did not pay attention to the neighbours' complains they will go to courts to stop those harmful operations. If there is any damage to public property, compensation would be paid by

the contractor through the relevant insurance company. Public relation officer engage at the major projects, to solve the problems with the public. He should have maintained the records of public complains and intervene to solve their problems. If the project was situated in a remote area, the contractors did not maintain public complain records and if they maintained at least the access roads, drains and other common utilities properly no complains came from the public.

The documents with lowest usage out of 17 contractors at the initial stage of the project was given in the Table 4.3 and the relevant histogram was given in the Figure 4.11

**Table 4.3 Documents with lowest level of usage at the initial stage of the project**

Item Number	Type of records	Answer "Yes" %
1.03(b)	Record the preparation of Roster for each month	65
1.03(d)	Record the Vehicle running chart book	65
1.05(b)	Prepare the Programme including Critical Path Analysis	53
1.05(d)	Prepare the Histograms for (skill/ unskilled -labour, m/c)	65
1.07	Maintain record of Public Inquires for outsiders	35



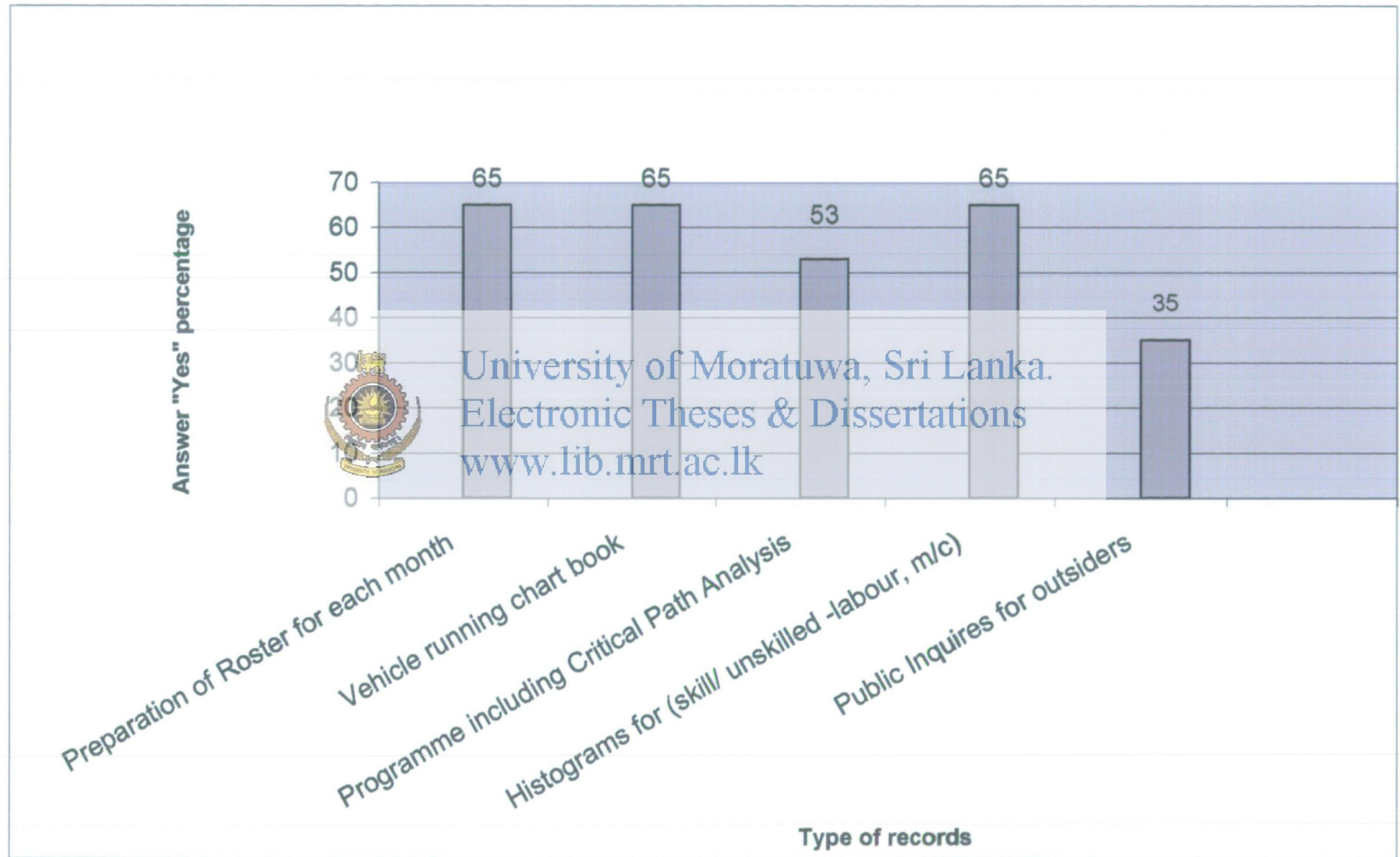


Figure 4.11 Documents with lowest level of usage at the initial stage of the project

#### **4.2.2.2 Construction stage**

##### **(A). Documents with highest level of usage at the site**

All the contractors who participated to the questionnaire survey maintained separate record files for analyzing the cost of electricity, telephone etc throughout the construction period. Initial cost of the connection charges and the refundable deposits were also included in the cost analysis of the services.

All the contractors updated the progress with respect to the programme scheduled and monitored the progress weekly to check whether it was delayed or not.

When the progress meeting was held, client/ consultant and the contractors, recorded the important minutes and they have taken action considering the urgency of the activities. Whichever the activities should be completed in a shorter duration, it should have highlighted to take action immediately by the contractor.

Before procurement of building materials, most of the contractors selected the suppliers who were short listed with the details to contact them. The lowest rated high quality materials were expected to be used by the contractors during the purchasing. Most of the contractors obtain quotations from the subcontractors for subcontract work. They short listed the subcontractors and recorded the name and details of the work they were expected to carry out.

All the contractors recorded the cumulative bill values for the interim payments and they deducted the previous cumulative bill payments paid & receive only the balance amount for the current monthly bill. Interim bill payment was the main resource to the contractors to function the project effectively.

Contractors recorded the subcontractors' bill payment separately to avoid over payment & the legal problems with them.



According to the result of questionnaire survey, the documents with highest usage out of 17 contractors at the construction stage of the project as described above was given in the Table 4.4 and the relevant histogram was given in the Figure 4.12.

**Table 4.4 Documents with highest level of usage at the construction stage**

Item Number	Type of records	Answer "Yes" %
2.01(a)	Maintain separate record files for analyzing the Cost of Electricity	100
2.01(b)	Maintain separate record files for analyzing the Cost of Telephone	100
2.11	Update the progress with respect to the programme.	100
2.13	Record the important minutes of the progress meeting	100
2.21(a)	Record the received quotation for procurement of building materials	100
2.21( c )	Record the received quotation for procurement of Subcontractors	100
2.22(a)	Record the cumulative bill value for interim payments	100
2.24	Record the sub contractors' bill payment	100

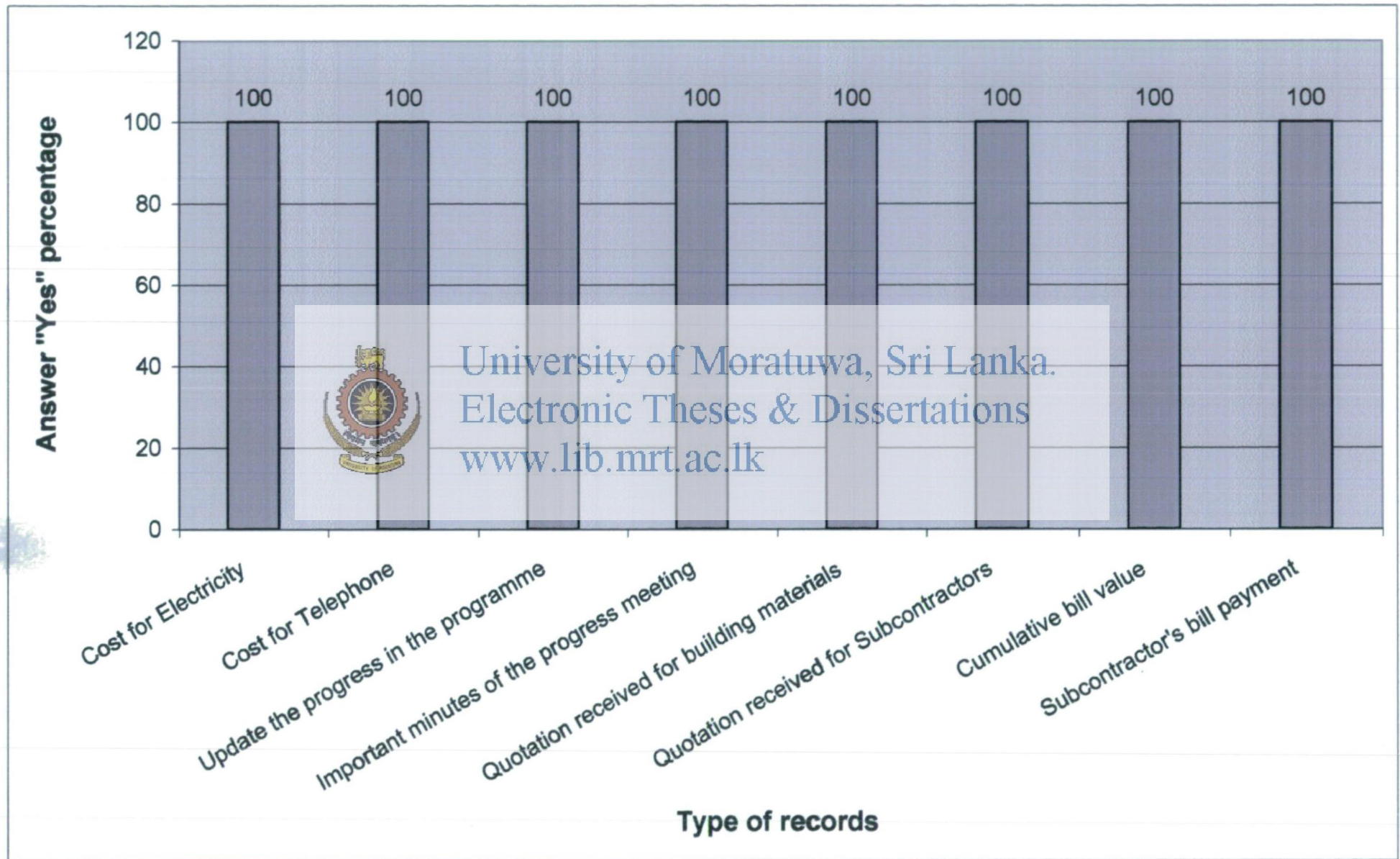


Figure 4.12 Documents with highest level of usage at the construction stage of the project

**( B ). Documents with lowest level of usage at the site**

Contractors recorded the expenditure for unforeseen risk of the shortage of construction material or product in the country. Calculation of the extra cost for material purchased from the other countries or purchased for higher price within the country was caused to loss of the profit to the contractor. Those records should have maintained properly to minimize the additional cost to the contractor as the contractor could have claimed it under the variations. Based on the questionnaire survey it was found only few contractors followed the above records. Some contractors discussed with the client / consultant and replaced the material with other to recover the shortage of the above material at the country.

Records were maintained at the stores were very important as receiving and issuing of the material & tools, mainly effect to change the productivity of the project. The ledger card (for consumable items) & bin cards (for tools) were used to maintain stores records systematically at the government organizations. Generally major contractors did not follow this system and they used their own format to record the transactions of stores items to their site or other site in the same company.

At the time of the questionnaire survey started most of the contractors did not use the computers for preparation of the monthly bill and the store records. Later the contractors used the computers for all the necessary work including accelerating the billing work, maintaining stores records, planning the programme, preparation of drawings and for other construction activities as well.

At the initial stage of the project, the contractor submitted the test report for construction material to the client/ consultant with reference to their specification. For the specified grade concrete work cement and sand should have been checked to meet the special requirement. Sieve analysis test, specific gravity test, absorption test, clay lump test etc were some of the special test reports for sand to be submitted before commencing the construction. Generally most of the contractors did not maintain the above test records for the sand due to high expenditure for testing. If the consultant requested the contractors would have done only sieve analysis test. Generally the

contractors check whether the properties of cement, sand & the metal were met with the specifications before start the concrete work. In addition to the manufacturers test report, the contractor checked the properties of cement at the laboratory. Most of the contractors used the reputed supplier's best quality cement for the concrete work with receiving their test report. As a result most of the contractors did not maintain the test records of cement.

According to the result of questionnaire survey, the documents with lowest usage out of 17 contractors at the construction stage of the project was given in the Table 4.5 and the relevant histogram was given in the Figure 4.13

**Table 4.5 Documents with lowest level of usage at the construction stage of the project**

Item Number	Type of records	Answer "Yes"%
2.02(b)	Record the shortage of raw materials or product in the country	35
2.09(i)	Maintain Ledger cards at the stores	35
2.2	Use the computer for bill preparation at the site	35
2.23(a)	Maintain test records for sand	41
2.23(b)	Maintain test records for cement	41



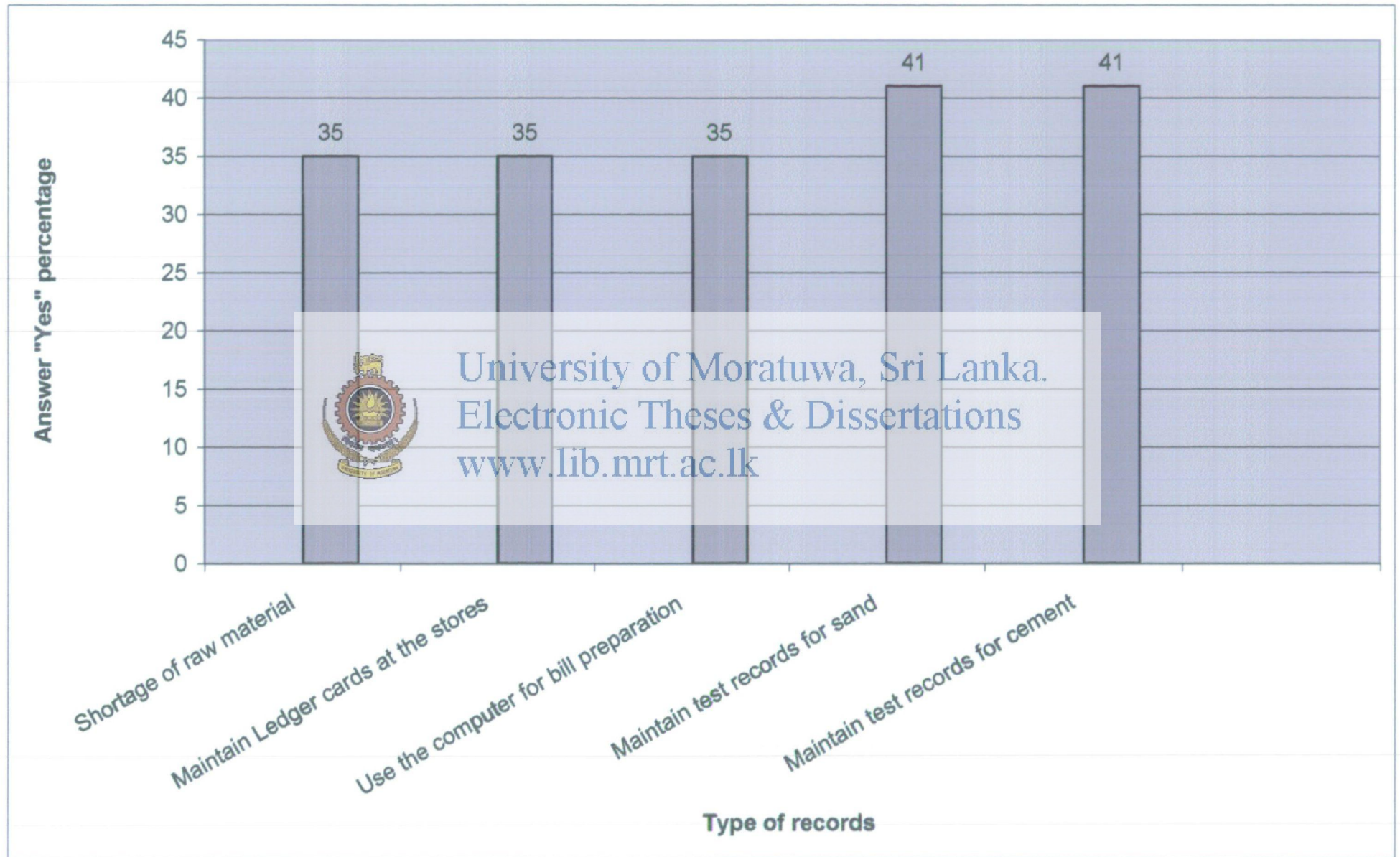


Figure 4.13 Documents with lowest level of usage at the construction stage of the project

### 4.2.2.3 Final stage

#### (A). Documents with highest level of usage at the site

Contractors recorded all the letters of handing over to the client in every project. Most of the contractors list out the defects has to be rectified to complete the project successfully. Generally within a reasonable duration they completed the defects and got the certificate of the final completion.

Although the record of submitted all the As- built drawings were very important, few contractors did not maintain it as the client/ consultant did not request them. More contractors recorded the handing over warranty certificates for water proofing, sanitary fittings, water pumps etc as the client needed to contact the suppliers or subcontractors after completion the project. Most of the contractors recorded the inventory report/ list but few contractors did not provide the list because they constructed only the reservoir type structures..

According to the result of questionnaire survey, the documents with highest usage out of 17 contractors at the final stage of the project were given in the Table 4.6 and the relevant histogram was given in the Figure 4.14.

**Table 4.6 Documents with highest level of usage at the final stage**

Item Number	Type of records	Answer "Yes"%
3.01	Record all the letters of handing over	100
3.02	List out the defects to be rectified	88
3.03	Keep a record of the as- built drawings submitted	88
3.06(a)	Record the handed over warranty certificates for water proofing	94
3.06(c)	Record the handed over warranty certificates for sanitary fittings	88
3.06(d)	Record the handed over warranty certificates for water pumps	88
3.07	Record the inventory report/ list	94

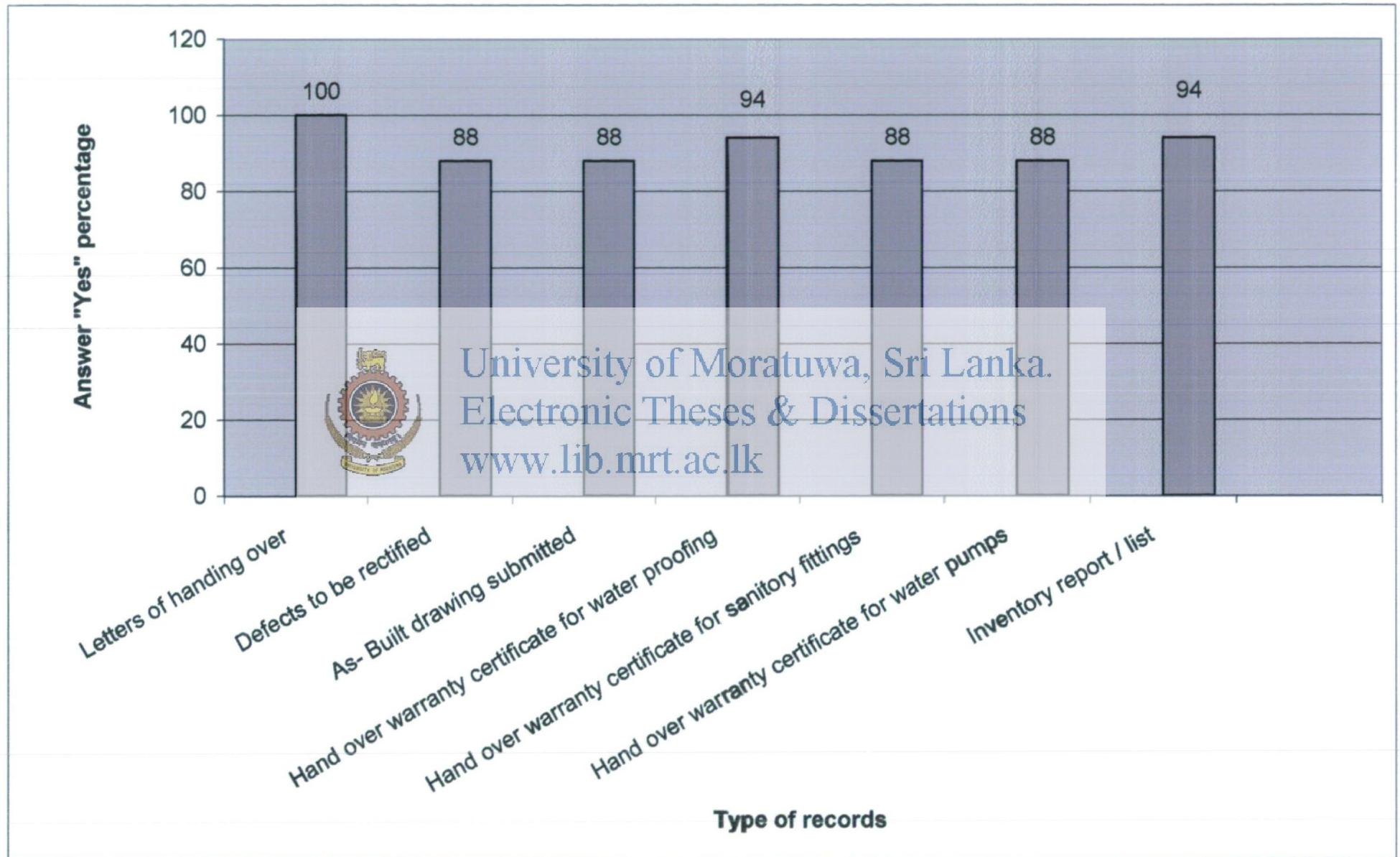


Figure 4.14 Documents with highest level of usage at the final stage of the project.



**.( B ). Documents with lowest level of usage at the site**

The date of expiry of performance bond was very important to the contractors, as the bill payments were not be paid on expiry of the bond. To avoid such difficulties contractors maintained the record of the dates of performance bond valid and renewed if it was needed. For the contract period was less than one year, the contractors did not renew the performance bond.

Insurance coverage was the other major requirement before starting construction. Some contractors did not obtain the insurance coverage for construction activities due to the high cost of payments to the insurance company. To renew the insurance coverage periodically, the date of expire of the insurance should have to be recorded. Generally, after receiving the retention payments the contract could have been finished. So the contractors recorded the date of releasing the retention payment. According to the questionnaire survey some contractors did not maintain the above documents at their sites.



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When the project was completed, mostly the stipulated duration of the project would have expired due to various reasons and the client enforced liquidated damages for the contract. The contractors submitted the reports including the reasons for delay during the construction period. Given additional work, unusual bad weather, strikes, curfews, unexpected holidays, restrictions for vehicle movement and accident in the site etc. were the causes to delay the projects. These records should have to be maintained in separate files describing the reasons & losses due to stoppage of work and these could be considered to extend the completion date of the project.

According to the result of questionnaire survey, the documents with lowest usage out of 17 contractors at the final stage of the project was given in the Table 4.7 and the relevant histogram was given in the Figure 4.15

**Table 4.7 Documents with lowest level of usage at the final stage of the project**

Item Number	Type of records	Answer "Yes" %
3.04(b)	Record the Dates for expiry of Performance bond	77
3.04(c)	Record the Dates for expiry of Insurance	77
3.05	Record the Dates for releasing retention payments	77
3.08	Record the Expenditure for Liquidated damages	65



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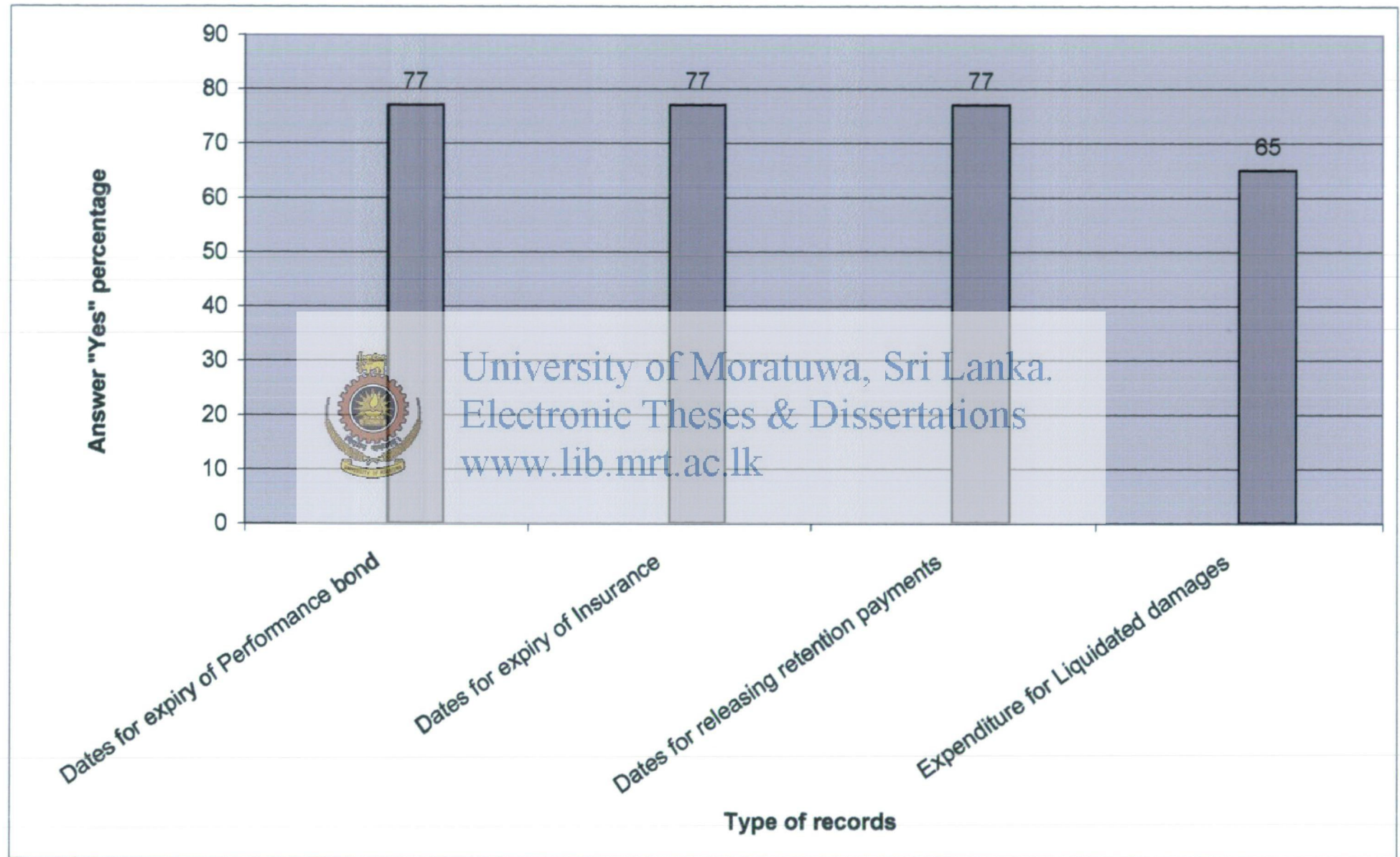


Figure 4.15 Documents with lowest level of usage at the final stage of the project.

#### **4.2.2.4 Discussion**

Reference to my selection of questionnaires in the construction activities I found mostly usage of documents and the lesser usage of documents at the initial, construction and the final stages as given in the section 4.2.2.1, 4.2.2.2 & 4.2.2.3.

At the initial stage all the contractors I interviewed maintained the record of commencing date of the project as all the duration of activities and the commissioning date based on the starting date. All the security bonds and releasing the advance payments were the several items depended on the starting date of the project. So the contractors properly maintained the documents with recorded starting date of the project.

The minimum numbers of contractors have maintained the documents under the public inquire for outsiders. For the projects at the remote areas the above record was not essential but at the town areas that document was essential. With considering the above matters and the contractor's negligence lesser number of contractors maintained that documents.



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The following documents were maintained by most of the contractors during the construction stage. The records related to the indirect cost of the services such as electricity & the telephone were maintained by all the contractors. In addition to that it was recorded the important minutes of the progress meeting, quotations for procurement of building materials & the sub contractors, the cumulative bill values of interim payments & the sub contractors' bill payments were the documents maintained by the most contractors at the sites. Contractors maintained the documents properly to minimize the additional cost.

Reference to my selection of the questionnaires one of the lowest levels of documents was maintained at the sites was the records of shortage of raw material in the country. Some contractors negotiate with the client/ consultant to replace the raw material which was not available in the country with local material.

The ledger cards were maintained only few contractors and the government organizations.

Maintaining the ledger cards at the stores was the other document used by the lowest number of contractors at the sites. More contractors used their own method to record the purchased material to the stores instead of used ledger cards.

More documents were maintained by the contractors during the commissioning stage. All the contractors I interviewed recorded all the letters of handing over to the client at their sites. If the contractors couldn't hand over the material or product with the relevant documents, legally the contractor liable to rectify the defects appearing after the defects liability period.

The documents with lowest level usage at the site were the record of expenditure for liquidated damages. Some contractors completed the contract on time and some others negotiated with the client/consultant to get releasing from the liquidated damages. Most of the government department, corporation or any other government organization most of the time exempted to pay liquidated damages & as a result they neglect to maintain the relevant documents.



## **CHAPTER 5: CONCLUSIONS AND RECOMMENDATIONS**

### **5.1 Conclusions**

The primary purpose of maintaining site records is to control future actions providing factual information. In order to make it a more profitable contract, the contractor needs to claim every additional item & get time extensions for the items not specified in the BOQ and the other external causes such as unusual bad weather, curfews imposed, special holidays etc.

Furthermore the legal documents needed with the client, consultant or subcontractors and sometime the client may stop the construction work of the project due to financial crisis of their respective organizations. The contractor should prove the losses due to stoppage of the construction work by forwarding the site records maintained by them.

As stated in the chapter 2, the cabinet appointed tender committee had identified the poor construction management methods used in the construction industry in Sri Lanka. In this respect remedial actions have been taken by several established engineering organizations to distribute their know how to the construction industry.



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Due to the rapid economic growth and industrialization in Sri Lanka the construction of the buildings & structures in the city and the suburbs are coming up during the past few decades. The involvement of foreign contractors is also a significant factor in the construction industry in Sri Lanka. Their new construction technology also needs to be adapted in the local construction industry for the rapid development of the country.

The results of the questionnaire survey reflect that the essential documents were maintained by most number of contractors & the less important documents were maintained by only handful.

If certain information is to be extracted for some purpose from these site records, a considerable effort has to be made in searching. Accessing useful information kept in the site records in most cases is a time consuming process. The accessibility of site records is affected by several factors including, their legibility, lack of well-defined categorization, and complexity. The accessibility is also affected by the fact that some

records do not provide actual information and simply redirect the search. Due to the inaccessibility of these records, it is not easy to gain useful information that will help to develop a complete “as built” picture of what happened on individual construction activities, once the work is completed. It is exactly such a record which is needed to assist in dealing with delay claims.

The storage space for the completed contract investigated, quality procedure for dealing with archiving the records were being followed and these required that all project – related records be stored for at least 16 years. In addition adequate safety provisions must be made to ensure that such records are held securely and all of these factors have cost implications. Specially the soft copies of the As- Built drawings are in compact disks and submitted to client for future reference.

## **5.2 Limitations of the research**

One limitation of this research study is the degree of reliability of the data gathered. However this research data was gathered from the construction contractors registered (Grade 1 to 4) in the ICTAD under the general building.



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Therefore this study excluded the contractors under the lower grades (below Grade 4). Consequently the data gathered might not be a true representation of all the construction contractors operating in the local construction industry.

This research was limited to the local construction contractors engaged in the country. As a result of increased number of funded projects being implemented in the country there is a significant increase in the foreign contractors involved in the construction and the higher grade contractors work in the foreign funded projects as subcontractors. The local sub contractors’ contribution for the foreign contracts is much higher than the previous decade as a result the above sub contractors’ involvement should be scrutinized in the analysis.



### 5.3 Future research

Future studies could be carried out to modify the questionnaire survey with the foreign contractors and local sub contractors' involvement in the construction activities in the country. Majority of the documents used in the foreign construction industry should be analysed with the local contractors' documents already analysed in the local construction industry and check the relevant forms, formats, checklists and other documents compared with the local one. During the research the emphasis was on the site records identified as essential & most important for the construction contractors

Further research study may also be carried out to explore the management of the site records of the local construction contractors. The engineering contractors have records similar to other kinds of contractors, but they have several unique types of records. These unique types include the drawings, specifications, project files, shop drawings etc and the space for storage for retrieval would be an important factor.

### 5.4 Recommendations

By combining the knowledge gained from the site experience and the literature review and the discussions with other experienced construction engineers, recommendations are provided to maintain the site records by the local construction contractors.

The recommended contractors should go to the bench mark with other contractors and overcome their short comings with respect to the maintenance of the site records.

Quality procedures should be prepared addressing the maintenance of site progress records and in particular personnel diary records to cover the detail of recorded documents, accepted format and categorization, regular audit of diary records. It is believed that many organizations will have lists/ checklists dealing with what should be recorded, but only by regular audits can sensible control be exercised to ensure that good records in an acceptable format and adequate coverage are produced.

It is particularly important to ensure that proper guidance is given to young, inexperienced engineers to help them understand the importance of site records and also to help them recognize the events essential to be recorded.

During the absence of a member of site staff, it is very important to ensure that records be kept in the absentee's diary by a substituted person to avoid discontinuity. It is important to keep an "As – built" daily record of exactly when the activities of the contractor's program took place and the period of influence of delays. The links between activities should also be recorded to identify exactly the time when subsequent dependent activities could begin. It is only with such a record that a picture of what actually happened on site can be built up.

National Construction Association of Sri Lanka should guide the local construction contractors to maintain the site records at their sites effectively by introducing regular seminars, workshops, site visits etc.

Consideration should be given to computerizing record – keeping procedures. The era of computers that can recognize handwriting and human speech has begun and the construction industry should benefit from such advanced technology. Much more is possible and a greater use of computers in this area would certainly make the site records a good deal more accessible and eventually allow them to minimize storage space.



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## REFERENCE

1. S. Scott and S.Assadi, The Quality of Site Records, First International Conference on Construction Project Management, Singapore, P.P. 437-43, 1995.
2. Abrahamson M.W, Engineering law & the ICE contracts, 4<sup>th</sup> edition Applied Science Publishers, England, 1979.
3. Jackson, M.J., Computer in construction Planning & control, Allen and Unwin, England, 1986.
4. Scott.S, Keeping Better Site Records, Journal of International Project Management, Butter worth – Heinemann Ltd 8( 4 ) 243 – 249, 1990.
5. Steve Scott and Sami Assadi, A Survey of the site records kept by construction supervisors, Construction Management and Economics, 17, 375 – 382,1999.
6. Alan D Russel, Computerized Daily site Reporting, Journal of Construction Engineering & Management. Vol. 119, No 2 June, 1993.
7. Dennis O Hamilton, Records Management in Engineering firms, Journal of Management in Engineering Vol. 7 No 4, Oct, 1991.
8. A.A. Kwakye, Construction Project Administration in Practice, Harlow, Addison Wesley Longman, 1997.
9. Barry Fryer, Practice of Construction Management.
10. J. L. Ashford, The management of quality in construction, London, E & F.N. Spon, 1989.
11. Richard Fellows, David Langford, Robert New combe & Sydney Urry, Construction Management in practice, London, Construction press, 1983.
12. P.P.Dharwadker, Construction Management.- N. D. : Oxford & IBH publishing co,1989.
13. A.D Austen & R.H.Neale, Managing Construction Projects, Geneva International Labour office,1984.
14. O.N.Wakhlu, Civil Engineering Management, Light & Life Publishers, New Delhi, 1978.

15. R.K.Loraine, Construction management in developing countries, 1992.
16. Derek Miles, Construction Change Managing International Technology Transfer.
17. Darshi de Saram and Syed M. Ahmed, member ASCE, Construction Coordination Activities, what is important and what consumes time, Journal of Management in Engineering, October, 2001.
18. Terry Hughes & Trefor Williams, Oxford BSP Professional books, 1991.
19. N.D.Gunawardena & G.W.T.C. Kandamby, Quality Management in Building Construction practice of site level, Journal of the Institute of Engineers Sri Lanka Vol:XXXV No 03, September, 2002.
20. Laksman Alwis, Guidelines for Effective Construction Management, Institute for Construction Training and Development (ICTAD), August, 2005.



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# APPENDIX 1

## Questionnaire survey

### Number of companies (out of 17 companies) maintain the records



#### 1.1 Initial stage of a project.

1.01 Do you record the followings in taking over the site.?

1.01(a) Dates

1.01(b) Person involved (Name & designation).

1.01(c) Contact telephone number of 1.012

\*\* Please forward the format you use.\*\*

1.02 Do you record the existing status within the premises before starting the construction work. e.g. Buildings, trees, pipelines, cables, access roads

1.03 Do you record the following security arrangements of the site.?

1.03(a) Attendance book for security guards /watchers.

1.03(b) Register for the each month.

1.03(c) Information book

1.03(d) Mile running chart book

1.03(e) Gate pass.

\*\* Please forward the format you use.\*\*

1.04 Do you record the followings for calculating overheads?

1.04(a) Temporary constructions.

1.04(b) Demolishing records.

1.04(c) Rents.

1.04(d) Others ...

.....

1.05 Do you prepare the followings before commencement of the construction work.?

The Programme including,

1.05(a) Bar chart

1.05(b) Critical Path Analysis

1.05(c) Cash Flow Diagram.

1.05(d) Histograms (Skill/ unskilled - labour, machines. etc. )

1.05(e) Organisation chart.

1.05(f) Others.....

	Yes	No
	17	0
	16	1
	12	5
	16	1
	15	2
	11	6
	13	4
	11	6
	14	3
	16	1
	15	2
	15	2
	16	1
	9	8
	13	4
	11	6
	13	4

- 1.06 Do you record the details (dates & amount) of the following Bonds & Guarantees.?
- 1.06(a) Performance bond.
- 1.06(b) Bid bond.
- 1.06(c) Advance payment bond
- 1.06(d) Others (please specify).....
- .....
- 1.07 Do you maintain a record for the public inquires.? eg. Out side people.

**1.2 Construction stage of the project.**

- 2.01 Do you maintain separate record files for analyzing the cost of services at site.?

- 2.01(a) Electricity
- 2.01(b) Telephone
- 2.01(c) Water supply
- 2.01(d) Refundable deposits for temporary service connections.
- 2.01(e) Others (please specify)
- .....

- 2.02 Do you record the expenditure for the unforeseen risk?

- 2.02(a) Rock/ Very hard soil appear during the excavations
- 2.02(b) Shortage of raw materials in the country.
- 2.02(c) Flood or storm damaged the site work.
- 2.02(d) Other (please specify)....
- .....

- 2.03 Do you record the expenditure for delaying the project due to ?

- 2.03(a) Unusual bad weather
- 2.03(b) Strikes
- 2.03(c) Curfews
- 2.03(d) Unexpected holidays
- 2.03(e) Restrictions for vehicle movement
- 2.03(f) Accidents at site
- 2.03(g) Other (please specify)....
- .....

- 2.04 Do you record the above " 2.03 " data in ;

- 2.04(a) Separate file

Yes	No
16	1
14	3
14	3
6	11
17	0
17	0
16	1
13	4
13	4
6	11
10	7
16	1
13	4
15	2
14	3
12	5
12	5
9	8





2.05 Do you maintain a weather chart throughout the construction period?

\*\* If yes please forward your format\*\*

2.06 Do you record the monthly expenditure of the following?

2.06(a) Petty cash

2.06(b) Purchase Imprest

2.06(c) Labour sub contractor's advance payment.(upto a percentage)

2.06(d) Other (please specify)....

.....

2.07 Do you keep records of the monthly expenditure for emoluments of ,

2.07(a) Officers

2.07(b) Labour grades

Sub contractors

2.07(c) Labour

2.07(d) Full

2.08 Do you record / display the daily attendance of the following?

2.08(a) Administrative officers

2.08(b) Supervisors

2.08(c) Labour (Skilled & Unskilled)

2.08(d) Subcontractor's staff

2.08(e) Security staff

2.08(f) Others.

.....\*\* Please forward the format you use.\*\*

2.09 Do you maintain the following stores records?

2.09(a) Purchase Requisition (P.R.)

2.09(b) Goods Received Notes (G.R.N.)

2.09(c) Material Requisition Notes (M.R.)

2.09(d) Transfer Notes

2.09(e) Return Notes

Gate pass.

2.09(f) For items (e.g.. Materials, tools. etc.)

2.09(g) For vehicles

2.09(h) Bin cards( for tools.etc.)

2.09(i) Ledger cards ( for consumable item )

2.09(j) Personal issue register

2.09(k) Bin Card Register

\*\* Please forward the format you use.\*\*

Yes	No
15	2
15	2
15	2
15	2
14	3
14	3
15	2
14	3
15	2
15	2
16	1
16	1
15	2
15	2
14	3
14	3
14	3
13	4
15	2
14	3
11	6
6	11
10	7
8	9



2.10 Do you keep record of the following building materials weekly?

2.10(a) Cement

2.10(b) Sand

2.10(c) Metal

2.10(d) Steel

2.10(e) Brick/Block

2.10(f) Lime

2.10(g) Others....

2.11 Do you update the progress with respect to the programme?

2.12 Do you record the details of the following Machinery hours?

2.12(a) Working hours

2.12(b) Idling

2.12(c) Repairs

**\*\* Please forward the format you use.\*\***

2.13 Do you record the important minutes of the progress meeting?



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2.14 Do you send weekly / fortnightly progress report to top management?

2.15 Do you record the information forward by the top management?

eg. Verbally or in writing.

2.16 Do you record in a register with respect to receiving date, issue date and reference number the following documents?

2.16(a) Construction Drawings

2.16(b) Sketches

2.16(c) Specifications

2.16(d) Site log book

2.16(e) Others (please specify)...

**\*\* Please forward your format \*\***

.....

2.17 Do you maintain records for day work sheets?

**\*\* Please forward your format \*\***

2.18 Do you take photographs for the works carried out from initial to final handing over?

Yes	No
15	2
15	2
15	2
15	2
15	2
15	2
15	2
17	0
15	2
13	4
13	4
17	0
14	3
15	2
15	2
14	3
13	4
16	1
12	5
13	4

- 2.19 Do you use the computer at site for maintaining records?
- 2.20 Do you use the computer at site for site for billing work?
- 2.21 Do you record the received quotations for procurement of the followings?  
 2.21(a) Building materials (e.g.. Cement, sand..... etc)  
 2.21(b) Machines hired  
 2.21(c) Subcontractors  
 2.21(d) Ready mix concrete  
 2.21(e) Others (please specify)  
 .....
- \*\* Please forward your format \*\*
- 2.22 Do you record the followings for interim payments?  
 2.22(a) Cumulative bill value  
 2.22(b) Date of submission of the bill  
 2.22(c) Date of receiving payment  
 2.22(d) Other ( please specify )
- 2.23 Do you maintain test records for the following material or product?  
 2.23(a) Sand (sieve test )  
 2.23(b) Cement  
 2.23(c) Metal  
 2.23(d) Slump test  
 2.23(e) Concrete cube test  
 2.23(f) Pressure test ( water supply )  
 2.23(g) Megger test (electrical wiring )  
 2.23(h) Others.....
- 2.24 Do you record the sub contractor's bill payment?
- 2.25 Do you record the price fluctuations of the following material/ product?  
 2.25(a) Cement  
 2.25(b) Sand  
 2.25(c) Metal  
 2.25(d) Steel  
 2.25(e) Brick  
 2.25(f) Electrical wire  
 2.25(g) Others.....

Yes	No
7	10
6	11
17	0
16	1
17	0
15	2
17	0
16	1
16	1
7	10
7	10
10	7
14	3
15	2
14	3
14	3
17	0
12	5
10	7
10	7
11	6
11	6
11	6
11	6

2.26 Do you record the accidents in the site and expenditure for the compensation?

2.27 Do you record the bad quality workmanships & the expenditure?

**1.3 Final stage**

3.01 Do you record all the letters of handing over?

**\*\* Please forward your format \*\***

3.02 Do you list out the defects to be rectified?

3.03 Do you keep a record of the as- built drawings submitted?

3.04 Do you record the following dates?

3.04(a) Defects liability period

3.04(b) Date of expiry of the performance bond

3.04(c) Date of expiry of the insurance

3.05 Do you record the dates for releasing retention payment of the main bill?

3.06 Do you record the handed over warranty certificates for each material & products?

3.06(a) Water proofing

3.06(b) Electrical equipments

3.06(c) Sanitary fittings

3.06(d) Water pumps

3.07 Do you record the inventory report / list?

3.08 Do you record the expenditure of the Liquidated Damages?


Yes	No
13	4
12	5
17	0
15	2
15	2
14	3
13	4
13	4
13	4
16	1
14	3
15	2
15	2
16	1
11	6

## APPENDIX-2

**Table 1 : Responses of the contractors**

	Categories of documents	Total number said Answer "Yes"	Documents maintained Under the question
1	Scope Management	11 13 11 14 16 9 17 13 17 15 16 <b>152</b>	Prepare a Roster Maintain Information Book Running Chart Book Gate Pass General Programme Separate File for Risk Management Important Minutes of Progress Meeting Photograph Letters handed over As-Built Drawing Inventory report to be submitted
2	Cost Management	16 16 15 15 13 17 17 16 13 15 15 15 14 14 15 14 12 17 16 16 17 12 10 10 11 11 11 11 <b>394</b>	Existing Status before construction start Temporary Construction Existing Buildings to be Demolished Expenditure for Hired/ Rented house Cash Flow Diagram Cost of Services of Electricity Cost for Telephone Water Consumption Refundable Deposits for temporary services Petty Cash Purchase Imprest Subcontract Advance Payments Expenditure of Recruited Officers Expenditure of Labours Expenditure for the Labour Sub contractors Expenditure for the Full Sub Contractors Maintain Day Work Sheets Submitted Monthly Bill Value Bill Submission Date Payment Release Date Subcontractors Bill Payments Price Increase of cement Price Increase of Sand Price Increase of Metal Price Increase of Steel Price Increase of Bricks Price Increase of Electrical wire Deducted Liquidated Damages

3	Time Management	17 9 15 17 15 13 13 15 14 13 16 7 6 14 13 13 13 223	Date of Take over the site Analyze the Critical Path Maintain Daily Weather Report Update the Progress Machinery Working Hours Machinery Idling Hours Machinery Repairing Hours Record the Received Construction drawings Record the Received Sketches Record the Received Specifications Record the Received Site Log Book Computer Usage at site Computer Usage for Bill Preparation Record the Defect Liability Period Date of expiry of Performance Bond Date of expiry of Insurance Bond Date of receiving Retention Money
4	Quality Management	7 7 10 14 15 14 14 12 15 16 14 15 15 168	Testing Sand Testing Cement Testing Metal Slump Test Concrete Cube Test Pressure Test Megger Test Bad Quality Workmanship and Expenditure Defects to be Rectified Warranty Certificate for Water proofing Warranty Certificate for electrical equipment Warranty Certificate for Sanitary fittings Warranty Certificate for Water pumps
5	Human Resource Management	16 15 13 15 15 16 16 15 121	Attendance of the security personnel Parties involve to Sign the Contract Organization Chart Attendance of Administrative Officers Attendance of Supervisors Attendance of Skill/ Unskilled Labours Attendance of Subcontractor's Staff Attendance of Security Staff
6	Communication Management	12 14 15 41	Detail of the persons involved to take over site Progress Report to top Management Instructions from Top Management

7	Risk Management	16 14 14 6 13 6 10 16 13 15 14 12 12 13 <b>174</b>	Detail of Performance Bond Detail of Bid Bond Detail of Advance Payment Bond Public Inquires Unforeseen due to rock/ hard soil appear at site Unforeseen due to Shortage of Raw Material Unexpected Foods or Storms record the Unusual Bad Weather Strikes Curfew Unexpected Holidays Restriction for Vehicle Movement Accident at site Accidents & the paid Compensation
8	Procurement Management 	11 15 14 14 14 13 15 14 11 6 10 8 15 15 15 15 15 15 17 16 17 15 <b>300</b>	Prepare the Resource Histograms Purchase Requisition Good Receiving Note Material Requisition Note Transfer Notes Return Note Gate Passes needed for Transporting Material Gate Passes needed for Vehicles go outside Bin card for tools Ledger Card for consumable Items Personnel Issue Register Bin Card Register Weekly Record the Stock of Cement Weekly Record the Stock of Sand Weekly Record the Stock of Metal Weekly Record the Stock of Steel Weekly Record the Stock of Brick/Block Weekly Record the Stock of Lime Quotation for Building Materials Quotation for MachinerieS hired Quotation for Subcontractors Quotation of Ready Mix Concrete



## APPENDIX 3

### 3 –(A). PRE BID SITE VISIT CHECK LIST & REPORT

Project:..... Date:.....  
Address: .....  
Distance from the Head office: .....

1. Nearest town and distance from site:.....
2. Nearest railway station, police station, hospital and distance from site:.....
3. Details of public transport serving the site :.....
4. Local authority  
Give name and special statutory requirements to be complied with ( if any )
5. General description of site:  
Give details of topography, wood lands, hedges, low lying areas, and surface water. Ascertain from local sources if site is liable to flooding and if so frequencies. It is Recorded general flood levels, rock out- crops, and existing buildings on the site. Can they be used for offices, stores, etc.
- 6 Demolition of existing structures ( if any )
- 7 Shoring and / or underpinning for protection of adjacent buildings and liability for possible damages due to construction activities.
- 8 Accessibility to site:  
Give details of existing or adjacent road ways on site or adjacent to site, give their widths and if considered capacity of sustaining normal site transport:  
Give details of temporary roadways required  
Any special difficulties such as congested site:  
Conditions of culverts & bridges and restrictions on loads.
9. Ground conditions:  
Investigate strata to be found during excavation:  
Is bore hole information available or are trial holes considered necessary?  
Effect of adverse climatic conditions on site operations.  
Surface water or water table, Is water tidal?  
Any existing foundations, roots, rock or any other material likely to be found in ground:  
Any water springs?  
Will pumping be required?  
Stability of excavations, timbering required?
- 10 Disposal of spoil  
Details of local tips, distance from site?
- 11 Services:  
Are existing services on site, if not, how far from site;  
Sewerage  
Surface water drainage:  
Water supply (drinking & construction purposes):

**Electricity supply:**

What voltage?

Is a 3 – phase supply available?

If so, distance from the existing transformer to site.

Weather a new line required to site?

Telephone: Land and mobile

**12 Labour:**

Local rates

Craftsman:

Labourers:

Details of local labour strength:

Projected availability during the project;

Details of other major work in the neighbourhood:

Will it be necessary to transport labour daily or build a labour camp?

Report on local lodging facilities.

**13 Security**

Is site fenced?

Will watchmen be required?

Any site storage proposals?

Any protection or barricades necessary?

**14. Details of local suppliers, production capacity and cost:**

General materials such as bricks, metal, sand, rubble, timber, etc:

Plant:

Transport

Projected availability during the project.

**15. Local weather conditions**

Report of Met. Office if possible

**16. Social problems:**

Squatters, encroachment to the site, trespass

**17. Environmental issues:**

Noise, vibration, dust, restrictions on working hours.

**18. Any other useful information:**

Site Inspected by:.....

Signature

.....

Name

.....

Designation

**3 – (B). Labour schedule**

Category	Year	2007																											
	Month	1				2				3				4				5				6							
week		1	2	3	4	1	2	3	4	1	2	3	4	1	2	3	4	1	2	3	4	1	2	3	4				
<b>U/S Labour</b>																													
<b>Masons</b>																													
<b>Carpenters</b>																													
<b>Mechanics</b>																													
<b>Painters</b>																													
.....																													
.....																													
.....																													
.....																													
<b>Total</b>																													

**Note : The value indicated is the daily requirement of the particular week**



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### 3- ( C ). Material Histogram – Weekly Requirements

Project:

(Cement 50 kg bags / Metal m<sup>3</sup> / Sand m<sup>3</sup> / Bricks in thousands)

Sheet No :



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2      3      4      5      6      7      8      9      10      11      12  
Weeks      →

### 3- (D). Short term resource forecast

Projects: ..... Date.....

#### Financial

Cumulative Bill Value up to last bill (Bill No ..... ) = Rs.

Cumulative Amount received (Bill No ..... ) = Rs.

Cash in hand for the project = Rs.

Cash required for Next Month = Rs.

Materials	Stock at site	Additional requirement for next month
Cement		
Sand		
Metal (25 mm)		
Bricks		
Rubble		
Steel		
Timber		
.....		
.....		

Labour	Available At present	Requirement For next month	Excess	Shortage	Transfer in/ out
Unskilled Labours					
Masons					
Carpenters					
Bar benders					
Sub contractors					
Masonry Reinforcement					
Formwork					
Electrical					
Plumbing					

Plant	Available at present	Additional requirement	Excess at site	Transfer in/ out
Concrete mixer				
Vibrator				
Excavator				
Generator				
.....				
.....				

Note : This chart can be discussed and filled at the fortnight / monthly site meeting.

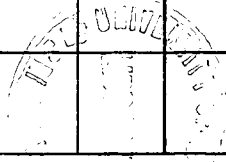
### 3 - ( E ). Cash Flow Forecast

Project.....

Contract Period	Month												Maintenance period					
	1	2	3	4	5	6	7	8	9	10	11	12	1	2	3	4	5	6
Monthly Bill Value																		
Cumulative Bill Value																		
DEDUCTIONS: (i) 20% Advance																		
(ii) 10% Retention <5%																		
(iii) Amount Previously Certified																		
ADD: Material at site...%																		
Certificate for Month																		
Deduct : Taxes																		
Receipts( include advance)																		
Cum Receipts																		
Monthly Expenditure ( from chart 4.1 )																		
Cum Expenditure																		
Cumulative Cash flow ( Cum receipts – Cum Expenditure )																		



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AX



### **3- (F). Check list**

#### **Typical Records Maintained by Engineer at site.**

1. Contract Documents
2. Site Investigating Reports
3. Surveying and leveling record books, covering both checks on setting out and completed work.
4. Construction drawings and Drawing Register
5. Method Statement
6. Programme and Progress Report as submitted and as corrected, progress photographs.
7. All correspondence between the Engineer and the Contractor, including variation orders, approval form, etc.
8. All correspondence between the Engineer, Employer and third parties
9. Administrative records such as leave and sickness returns, accident reports etc.
10. Site diaries
11. The minutes or notes of every formal meeting
12. Day work records, as submitted and as corrected
13. Records required for checking future claims
14. Plant and labour returns, as submitted and as corrected
15. Measurement records, including dimension books, time sheets, delivery notes etc.
16. Weather records
17. Laboratory test results and any other testing data
18. Interim statements, as submitted and as corrected, with copies of all supporting, particulars, and interim certificates
19. Safety records
20. Details prepare As – built drawings/ maintenance manual
21. Commencement and Completion date of each activity and any of the discontinuation of any activity etc.

**3- (G). SUB – CONTRACTORS INTERIM PAYMENT CERTIFICATE**

**Certificate No** :.....  
**Contract Title** :.....  
**Engineer** :.....  
**Title of Subcontract Work** :.....  
**Sub contractor’s Name & Address:**.....  
.....  
.....  
.....  
.....

1.0 Value of work done upto ..... Rs.....

2.0 Add : Assessed value of materials/ goods at site Rs .....

-----

Rs .....  
3.0 Less: 3.1 Retention .....% of 1.0 Rs.....

3.2 Advance recovery.....% of 1.0 Rs.....

3.3 Value of materials issued to Sub- contractor Rs. ....

3.4 ..... Rs.....

3.5 ..... Rs.....



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Rs. .... Rs.....

Total amount payable to date Rs.....

Less :  
Total amount previously certified. Rs.....

Amount certified for payment by this certificate Rs.....

IT IS CERTIFIED THAT THE AMOUNT NOW PAYABLE TO THE  
SUB – CONTRACTOR BY THE MAIN CONTRACTOR IS RUPEES ... ..  
(RS .....)

Date.....

.....  
On behalf of the Contractor

**3 – ( H ). Stock ledger / Bin card**

**Bin card No:**.....

**Time code:**.....

**Month:**.....

Received					Issued						Cumulative Issues		Balance		
Date	Ref. No.	Qty	Price	Value	Date	Ref. No.	Job No.	Qty	Price	Value	Qty	Value	Qty	Price	Value



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XVIII

**Description :**.....

**Unit:**.....

### 3 – (I). Supervisors Injury Analysis

1. Project Number .....
2. Date of injury .....
3. Project location .....

Last Name		First		Initial	
Medical only	Lost Time	Fatal	Previous claim in this job	Job Number	Time of Injury AM/PM
<p>5. Give a brief description of the circumstances leading to the injury, including distances, weights, heights, speed, etc.</p> <p>.....</p> <p>.....</p> <p>Employee ..... Witness.....</p>					
Circle Appropriate Letters					
<p>6. Craft :</p> <p>A. Mason</p> <p>B. Carpenter</p> <p>C. Electrician</p> <p>D. Bar bender</p> <p>E. Painter</p> <p>F. Unskilled Labour</p> <p>G. Other, Specify</p>		<p>7. Age Group</p> <p>A. 18 - 20</p> <p>B. 21 - 25</p> <p>C. 26 - 30</p> <p>D. 31 - 35</p> <p>E. 36 - 40</p> <p>F. 41 - 45</p> <p>G. 46 - 50</p> <p>H. 51 - 55</p> <p>I. 56 - 60</p> <p>J. 61 - 65.</p> <p>K. 66 - 70</p> <p>L. 71+</p>			
<p>8. Nature of injury</p> <p>a. Abrasion, Scratch</p> <p>b. Amputation</p> <p>c. Burn</p> <p>d. Concussion</p> <p>e. Conjunctivitis(Eye irritation)</p> <p>f. Crushing, Bruise</p> <p>g. Cut, Laceration, Puncture</p> <p>h. Dermatitis, Rash</p> <p>i. Electric Shock, Electrocutation</p> <p>j. Flash bum ( Eye )</p> <p>k. Foreign body</p> <p>l. Fracture</p> <p>M. Sprain, Strains</p> <p>N. Any other.</p>			<p>9. Part of body</p> <p>a. Head ( not face, eyes, internal ears)</p> <p>b. Ears internal ( including hearing )</p> <p>c. Eyes</p> <p>d. Face (nose, mouth, lips, teeth, etc.)</p> <p>e. Neck</p> <p>f. Arm ( s ) ( including wrist )</p> <p>g. Hand( s) and / or finger( s)</p> <p>h. Abdomen (including internal organs)</p> <p>i. Back ( including muscles, spine, spinal code )</p> <p>j. Chest ( including ribs, internal organs )</p> <p>k. Hips ( including pelvis, buttocks, internal organs )</p> <p>l. Shoulders</p> <p>m. Legs</p> <p>n. other specify</p>		

Supervisors Injury Analysis	
Circle Appropriate Letters	
<p><b>10. Source of Injury</b></p> <ul style="list-style-type: none"> <li>a. Burning or Welding operation</li> <li>b. Hand tools</li> <li>c. Power hand tools ( except grinder )</li> <li>d. Grinder</li> <li>e. Material, Equipment being handled worked</li> <li>f. Ladder</li> <li>g. Scaffold</li> <li>h. Object improperly placed, Located</li> <li>i. Work surface, Floor, Ground floor</li> <li>j. Failing, Flying, moving objects.</li> <li>k. Building, structure, installed equipment</li> <li>l. Construction equipment, vehicle</li> <li>m. Electrical equipment</li> <li>n. Irritants (chemicals, dusts, fumes, etc.)</li> <li>o. Insects, Plants, (wasp string, etc.)</li> <li>p. Fire</li> <li>q. Wind</li> <li>r. Other, specify</li> </ul>	<p><b>11. Accident Type</b></p> <ul style="list-style-type: none"> <li>a. Struck Against</li> <li>b. Struck by</li> <li>c. Fall from elevation</li> <li>d. Fall from same level</li> <li>e. Caught In, Under, Between</li> <li>f. Overexertion (Lifting, throwing, pulling, pushing )</li> <li>g. Contact with Electric current</li> <li>h. contact with Temperature Extremes</li> <li>i. Contact with Chemicals, Dust, Smoke</li> <li>j. Other specify.</li> </ul> <p><b>12. Unsafe Condition</b></p> <ul style="list-style-type: none"> <li>a. No unsafe condition</li> <li>b. Defect of Source of injury (dull, rough, sharp, slippery, broken, etc.)</li> <li>c. improper or inadequate clothing</li> <li>d. Unsafe Method of storage</li> <li>e. Unsafe Placement of Storage</li> <li>f. Inadequate guarding</li> <li>g. Inadequate illumination</li> <li>h. Inadequate Ventilation</li> <li>I. Other, Specify</li> </ul>
<p><b>13. Unsafe act</b></p> <ul style="list-style-type: none"> <li>a. No unsafe Act</li> <li>b. Working on Moving, Energized, pressurized equipment</li> <li>c. Failure to Wear protective equipment (hard hat, safety glasses, rubber goods, foot guards, etc.)</li> <li>d. Operating without Authority</li> <li>e. Failure to Secure or Warn</li> <li>f. Improper use of equipment</li> </ul>	<ul style="list-style-type: none"> <li>h. Taking an Unsafe position or posture</li> <li>i. Inattention to footing or Surroundings</li> <li>j. Making safety devices inoperative</li> <li>k. Undue haste</li> <li>l. Driving error by equipment / Vehicle operator</li> <li>m. Unsafe loading, Placing, mixing, etc.</li> <li>n. Using unsafe equipment</li> <li>o. Other, Specify</li> </ul>

14. Corrective Action Taken: .....

.....

.....

.....  
Foreman  
Superintendent

.....  
Safety Engineer

.....  
Office Manager

