The Construction Process – Girls Hostel, Buruburu Girls School

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Summary

The construction process of the the girls hostel-buruburu girls school is a typical example of the merits and demerits of combining proffessional roles in a building process. The roles of a project manager in the Kenyan construction market is slowly becoming clear to the proffesionals involved in the market but has yet to be appreciated by project financiers.

In many Kenyan construction projects, the client appoints a consultant to manage the project and to be responsible for co-ordinating the various actors in the process. The most usual project manager is one of the consultants in the design team with experience in contracting and designing activity. Structural engineers are very rarely selected in building projects because the Kenyan architects are still being treated as the self-evident project managers. In the building process analysed herein under, the project structural engineer was the project manager. It is my intention to let the reader of this paper see how the engineer performed and how the construction process as a whole was carried out.

Introduction

The aim of this paper is to describe and analyse the construction process of the Girls hostel, Buruburu Girls School, Nairobi

The Project

Buruburu girls school is one of the girls boarding schools located in Nairobi. It is situated on a low-lying fairly flat piece of land on the outskirts of the city of Nairobi within a middle income housing estate. Nairobi is the capital city of Kenya with a population of 1.5M inhabitants.

The school, which has been built mainly through local fund raising efforts, is run by a school board of governors. The school headmistress also doubles up as the secretary to the board and represents the board on the routine running of the school.

Kitololo consultants is an indegenous private engineering consulting firm located in Nairobi. It has been involved in the design and construction supervision of low rise/high rise residential, industrial, commercial and institutional buildings together with their associated civil engineering works. It has undertaken numerous projects both for the government and for private sector developers. Currently Kitololo consultants employes six engineers, one technician engineer, seven draughtsmen and five support staff members in the administration department. The director of the company is also a member of the board of governors of Buruburu girls school. At the time of design of the project the project architect who was acting as an individual was housed in the offices of Kitololo consultants.

The construction of the hostel was concieved when it became necessary to accommodate the more than 390 girls previously housed in wooden dormitories in a permanent structure with better facilities conducive to study. The project involved the design and construction of a double storey hostel block, a laundry block and two clothes drying shelters. The use of natural stone, a locally available construction material from nearby quarries was encouraged by all parties in order to cut down costs.

The Country

The project is located in Kenya, which lies on the equator and enjoys a tropical climate: hot and humid on the coast, temperate inland, and very dry in the north. The temperature range is affected by latitude and varies from 7 degrees celsius to 32 degrees celsius. There are only two seasons in a year i.e. the wet and the dry season and hence construction goes on throughout the year except on some days when the rainfall is particularly heavy as to interfere with the construction work. Insulation of buildings in most parts of Kenya is mainly optional.

Kenya is also a third world economy, which depends on agriculture and tourism for her foreign exchange earnings. The main kenyan exports are tea, coffee, horticultural products, petroleum products, meat and meat products, hides and skins and cement. It imports industrial machinery, crude petroleum, motor vehicles and transport equipment, minerals, chemicals, iron and steel and manufactured goods. It occupies a cross section area of 580 000 square kilometres and is home to a population of 23M increasing by 3.34 percent per year. The country is bordered to the north by Ethiopia, to the northeast by Sudan, north west by Somalia, to the west by Uganda, to the south by Tanzania and to the east by the Indian Ocean.

The main languages spoken in Kenya are Bantu, Nilotic and Cushitic. Kiswahili is the national and cultural language and English is the official and international language. All the correspondence, meetings and verbal conversations during the construction process were in the English language.

The Construction Market

The construction market has at all times been important to the Kenyan society. The degree of activity within the construction industry is usually a very good pointer to the performance of the economy with investments in construction accounting for over half of the countrys gross investment. It is however sad to note that the market is normally ignored by the major actors i.e. politicians, planners, administrators, and others concerned with development issues resulting in very fragmented building operations. The government is the main client of the construction market in Kenya and like in many other developing countries the demand for several categories of output cannot be met by the limited financial resources. On the whole, the construction market is generally affected by deficiencies in adequate and favourable financing mechanisms, which jeopardises construction programmes leading to cost escalations and time overruns.

In Kenya, local authorities control construction activities for the purpose of ensuring safety and health in the built environment by way of building acts, regulations and building codes. There is however a general lack of maintenance and upgrading strategies with an obvious disparity between the importance placed on new construction programmes vis-a-vis repair and upgrading of existing structures and services. Construction of new structures is preferred because it is less challenging and more straightforward than repairs.

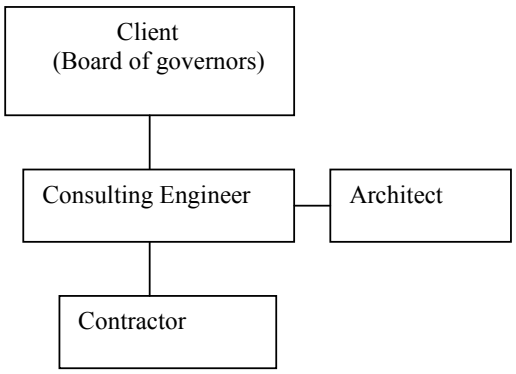
Corruption is a major problem affecting every sector of the Kenyan economy. The construction market has had its share of headaches resulting from the vice. Unlike Swedish contractors, the majority of Kenyan contractors are not trustworthy, as they would not hesitate to compromise on quality in order to maximise on their profits. Quality control therefore cannot be left entirely in the hands of the contractors. Constant supervision of the project by the design team during construction is necessary to ensure adherence to the proposed design, materials and construction standards.

Construction management is a relatively new concept in Kenya. The architect is usually the lead consultant and the natural project manager. Construction management has not been fully accepted due to the obvious fact that it leads to a reduction of architectural fees if the architectural firm does not provide the services. There has also not been a clear-cut definition of the roles of a project manager in the construction process. Many firms are now incorporating the construction management function within their services inorder to continue receiving the full fees. In a nutshell few projects in Kenya have a construction manager. Its not until clients realise that incorporating a project manager who is not part of the design and financing team leads to a more objective look at the construction process that better quality and timely completion of large projects will be archieved.

Design Stage

Project Organisation

At the predesign and design stage, the key players in the project were the client, the project architect and the consulting engineer. The client was represented by the secretary to the board who is also the school headmistress. Below is the project organisation chart.



Procurement

The consulting engineer, a member of the board of governors, was appointed by the board to offer his services as a consulting engineer and to advise the board on the technical and managerial aspects of the project. The consulting engineer offered his services free of charge and invoiced the client only for direct expenses like photocopying.

The appointment of the project architect was done by the consulting engineer on the behalf of the board of governors. The project architect was a friend of the engineer. He did not have a registered company and hence offered his services as an individual. The architect unlike the engineer charged a professional fee for all his services.

During the construction process, the architect was housed in the offices of the consulting engineer. Consultations between the architect and the engineer during the design stage were made easy by the fact that they were both housed in the same offices. There was no quantity surveyor on the project team and all the cost estimates were prepared by the engineer and the architect.

Design Process

At the preliminary design stage, several proposals were submitted to the client by the architect for approval. After several consultations, and revisions, detailed architectural drawings of the double storey hostel block, the laundry block and the drying shelters were prepared and incorporated in the school master plan. The design incorporated the use of locally available building stone from quarries located in the schools neighbourhood. Out of cost considerations, a load bearing structure was preferred in leu of a framed structure. The floors, beams and staircases were made of cast in situ concrete and the roof was made of structural grade cypress timber trusses. Asbestos based roofing tiles manufactured locally were used for roof covering.

The most economical structural design was undertaken. All the designs complied with the requirements of the local authorities in regard to safety and health. The cheapest and most straightforward construction method was given preference and the use of formwork and concrete reduced as much as possible. The design calculations and drawings were prepared to the various British codes of practise requirement for the various structural elements.

The cost estimates were prepared by way of taking off the quantities of the construction materials e.g. concrete and reinforcing steel, timber, mortar etc from the design calculations and drawings and calculation of the total cost done based on the basic rates as determined by the local joint building council. Material manufacturers cost catalogues were also used for cost estimating. There was no computer package for cost estimating. The cost of past and ongoing projects was also used as a general pointer to the expected costs.

Contacts with the engineering and architectural departments of the local authorities were established by the engineer and the architect respectively. All the necessary procedures for scrutiny and approval of the design by the local authorities were put into place i.e. the design calculations and all the structural and architectural drawings were submitted. All the required fees for approval of the designs and supervision of the works by the local authorities were paid for by the client through the consulting engineers office. The agreement and schedule of conditions of contract, a document which was to form part of the contract was also purchased through the offices of the consulting engineer.

It was mainly the engineer who played the role of adviser to the client in deciding the form of contract to adopt. Without a quantity surveyor in the construction process to prepare the bills of quantities, the client was advised to go for a schedule of rates contract. The project architect prepared the schedule of rates.

The engineers estimate of the project cost was 438000 US dollars. After negotiations the contractor agreed to do the works at a reduced cost of 353 000 US dollars. At the negotiation stage, the contractor also, in a bid to ensure that he won the tender, promised the school that he would also undertake the levelling of the schools playing fields as well as upgrading of the 500 metre access road to the school and the parade ground from the existing murrum standard to bitumen standard and provide a comprehensive storm water drainage system for the new road all at no extra cost to the school. The offer was made hastily, without a serious consideration of the cost implications and in writing. It was therefore attached to the contract document and became part of the contract. It was to become a major bone of contention latter on in the project when the contractor realised that inorder to fulfil his promise he had to try and cut corners on the main project to avoid making loses. The source of funding for the project was made clear to the contractor at the negotiation stage and he promised though verbally not to ever stop or delay completion due to delayed payment.

The contractor was a great friend to the school headmistress then having constructed civil works for a subdivision scheme that the school had undertaken on a donated plot and having actually bought some of the plots. There had been no problem with funding for the earlier project since the plot buyers were paying for the construction. The contractor was also a guardian to his niece who was a student at the school then.The client – contractor friendship was not to last long, neither was he to keep his promise of carrying out the construction work at full blast irrespective of delayed payments after he encountered delays in payment on the second interim payment certificate.

Financing

The project was financed through a school building fund but the greater amount of money was sourced through major local fundraising efforts known locally as “HARAMBEES”. Through payment of school fees, every parent contributed to the building fund kitty.

“Harambee” is a well-known term in Kenya which closely means, “let us pull together.” It is a heritage from the founding father of the nation, a call that was made to the citizens during the early days of nation building.

To host the harambees, invitation cards to the occasion were printed by the board of governors, the parents and the teachers of the school and sent out to as many friends to the school as possible. On the card was indicated the date of the harambee, the presiding guest of honour, the assistant guests and the venue of the funds drive. All the funds drives were carried out in the school compound. At the back of the card were tables drawn to assist the recipients collect funds. Names of the people contributing to the fund, the amount given and the date are entered in the tables. On the fund raising day all the people who received invitation cards returned them together with the amount collected coupled with their personal contributions to the harambee. It was through such efforts that three quarters of the finances to the project were sourced. Other sources included donations of cash and kind to the school by local politicians, old parents and friends.

Budget and Budget Control

To avoid cost overruns during the execution of the project, it was observed that a good combination of the contract and payment forms was critical.The client was therefore advised to adopt a fixed price contract with no allowance for variation of prices during the contract period. A clause was included in the contract document to that effect. There were quite a number of variations to the contract which affected the budget.

Applications for interim payment certificates were done by the contractor and submitted to the consulting engineer for certification. To avoid antagonism and suspicions, all the valuations for payment were done by the engineer and the contractor. Payment certificates were prepared by the engineer and submitted to the client for payment. All the extra works were valued separately but included in the interim payment certificates.

To control the budget, the engineer and the architect ensured that the contractor put up all the structures and installed all the services in accordance with the drawings and the specifications. Few variation orders were made by the consultant or the architect. All the variation orders came from the school headmistress. Delays in the completion of the project were occasioned by the numerous variations issued by the client and delays in payment. There was also never a steady supply of finances to the project and the contractor abandoned the works on several occasions siting delayed payment. The contractor also took advantage of the fact that the consulting engineer was a board member to cry foul every time the amount on his application for payment was altered to tarry with the situation on site. He argued that the engineer was being unduly unfair to him and kept questioning the engineers ability to render fair judgement in his combined role of a consultant, project manager and client per se.

Due to the delays in completion, the end of year examinations and hence the clearing of some of the students who had contributed to the building fund was fast approaching without the students being hosted in the new hostel. There was agitation among the final year students as they questioned why they had to pay for a facility that they were seemingly not going to occupy. Due to the demands by the students that they be allowed to occupy the hostel for their last term in school, the contractor was issued with a partial taking over certificate and the final year students accommodated in the hostel. There was a long list of outstanding items of work and defects that was prepared at the taking over date. Unfortunately, After the issue of the taking over certificate, the contractor demanded that the consultant issue him with a certificate releasing five percent of the retention money as stipulated in the contract document. The engineer refused saying that the certificate was issued not because the works were substantially complete but to avoid unnecessary confrontations with the students and parents who had every right to the hostel but were denied by the contractors failure to complete the work on time as per the programme. The contractor could not hear any of it and in protest he refused to attend to any of the defects and abandoned the site.

It was such grievances that led the contractor and the consulting engineer to mistrust each other so much so that they wound up being antagonists rather than team members in the construction process. Accusations and counter accusations became the order of the day and time and energy, which could have been put in the project was wasted as the parties refused to come to a compromise.

Information Technology

The use of computers in the project was limited to the design office and used only for typing the contract documents and correspondences. The structural design of the roof trusses was done by computer. All the other architectural and structural design work and preparation of drawings was undertaken manually both by the architect and the engineer. Neither paper nor computer models were prepared for the project. Drawings and verbal explanations were used to make the client who was represented by the headmistress appreciate the design at the design stage.

When construction started however, and the first floor slab and the staircases cast, the headmistress who had full access to the site during the construction could simply not believe the positioning of the staircases was on the drawings as she saw on site. She immediately asked the contractor to stop work, called the consultants and explained to them where she all along wanted and thought the staircases were and immediately requested that the two middle staircases be replaced with one middle staircase and two smaller staircases at the two extreme ends of the hostel. Work had to stop on site as the design and drawings were revised to the clients requirement.

Design Experiences and Conclusions

It came out as work progressed that the client had not understood the drawings at the design stage. All the variation orders came from the clients office. When the construction of the double decker beds, wardrobes, reading desks and chairs in the sample room that the contractor had been told to prepare was in progress, the client requested for alterations and additions to the works.

She asked the contractor to include dado rails on the walls next to the beds, shoe racks for every student at the top of the wardrobes, additions to the reading desks to allow more students to study at the same time and curtain boxes in every room. She also wanted the contractor to make many other additions which had more to do with her understanding of the behaviour and particular needs of girl students as she had known them over the years than design considerations.

It comes out clearly that many variation orders and the accompanying time and cost overruns could have been avoided had computer models showing the circulation in the building and all the facilities to be included in all the rooms had been prepared for discussion with the client at the design stage. Without these models, it did not really matter for how many hours the design team sat explaining to the client the various aspects of design, they never managed to make themselves clear.

The fact that the client had full access to the site during the construction made it possible for some of the problems to be identified and addressed before it was too late. It becomes difficult to imagine the effect of the clients misconceptions on the project if it was a large project. The " relay race " which is to be found in many projects also featured in this process but was to some degree contained.

The following observations will prove useful in future projects:

- A separation of the offices and roles of the project manager, design team, contractor and client would have led to a more peaceful working relationship between the parties. The engineer in this construction process played three roles, he was a client by virtue of the fact that he was a board member, he was involved in the design process and he was the project manager cordinating the whole process. His involvement in the design process made it difficult for him to look at the construction process objectively in his capacity as the project manager. From what we have learnt in this course the trend which is coming on board in Kenya whereby the engineer or architect incorporates the services of a project manager in their company will only make the role of a project manager more difficult for clients and the general public to appreciate. Project managers should be companies employed by the client to coordinate the construction process. They should not be involved in the design process.
- Procurement of contractors should not be based only on the lowest prices. In the above construction process the contractor offered to do the work at a discount and at the same time promised to do more for the school. The offer was wonderful during negotiations but it brought about many hiccups to the project when the contractor realised that he was going to have to do the work almost at a loss. The consultants cost estimates ought to have been considered at the negotiation stage to avoid going for the lowest price without considering its effect on the project.
- The "relay race" should as much as possible be avoided in the construction process by involving all the parties in the pre-design and design stage. If possible the contractor should also be involved in the design process. Reliability on the part of contractors when they are entrusted with the construction of projects is to be encouraged. This will eliminate the ever present suspicion and believe that contractors are cheats who require close supervision from the engineer or architect because they will readily compromise on quality to increase their profit margins if left unsupervised.
- As much as possible involve the client in the process. This approach has come on board in the Kenyan construction market where the client is represented in the whole construction process and has full access to the construction site. The use of computer models showing three dimensional details of the project at the design stage will increase client understanding and hence participation in the construction process. The use of computer aideed design (CAD) and computer aideed manufacturing (CAM) of structural elements will also help bring down the cost of construction.
- Delegating of responsibilities within the contractors office, good training of craftsmen, and interaction between the site staff and headoffice staff will enhance the flow of information and eliminate antagonism between staff members. The most common problem encountered is diversion of drawings or instructions meant for site staff to the contractors head office which leads to delays in the work as information is awaited and also the use of superseded drawings on site as the updated ones are left lying in the contractors office

Production Stage

Tendering and Contract

The contract was based on the Agreement and Schedule of Conditions of Building Contract (without quantities), a regional document published with the sanction of the Architectural Association of Kenya, the East African Institute of Architects, the East African section of the Institution of Structural engineers, the Kenya Association of Building and Civil Engineering Contractors, the East African Federation of Contractors Association, the Uganda Society of Architects and the Joint Building Council.

The design and preparation of all the contract documents was undertaken by the office of the structural engineer. The tender document was made up of the form of tender, the form of agreement, the form of performance bond, the conditions of contract, particular specifications, the schedule of rates, the schedule of drawings and the general instructions to tenderers. Every tenderer was to comply with the instructions to the tenderers, failure of which was to lead to a rejection of their tenders. The tendering contractors were to submit addresses through

which they were to receive tender correspondence, they were to bear the cost of tendering irrespective of the conduct or outcome of the tendering process, visit the site, examine it and its surroundings and obtain for themselves all necessary information for preparing the tender and entering the contract. They were also required to examine all the instructions, conditions, forms, terms, specifications and drawings and comply with the requirements of tender submission. The details of the tender document were to be treated as private and confidential.

The tender prepared by the tenderer and all the correspondence and documents relating to the tender exchange by the client or the consultant were all written in the English language.

The tender prices were inclusive of the value of work described including all costs and expenses and all general risks and liabilities. The contract sums submitted were deemed to have been calculated on the basis of the schedule of basic rates as determined by the joint building council. The rates and prices quoted by the tenderers were not to be adjusted during the performance of the contract. All duties, taxes, and other levies payable by the contractor under the contract were deemed to have been included in the rates, prices and the total amount of tender submitted by the contractors.

The tenderers were allowed to modify or withdraw the tender after tender submission provided that written notice of the modification or withdrawal was received by the client prior to the prescribed deadline of submission of tenders.

For ease of contract administration during the construction stage, the required amount of the performance bond (ten percent of the contract value), the mobilisation period (fourteen days), the amount of liquidated damages, the maintenance period (six months), the percentage value of listed materials (one hundred percent), the percentage of retention money (ten percent), the limit of retention (ten percent of the contract value), the period of payment after issue of the payment certificates (twenty eight days) and the laws applicable to the contract (the laws of Kenya) were all listed in the appendix to the form of tender.

Prequalification of contractors was done by the consulting engineer in order to eliminate unacceptable contractors and to encourage serious bids and the list submitted to the client for approval. The client did not have any additions or omissions to make to the list. The tendering procedure was administered by the consulting engineer. It was the consulting engineer who on the behalf of the board of governors invited the contractors to tender for the construction, completion and maintenance of the facilities. The cost of tendering was borne by the contractors.

The tender was a fixed price contract with no variation of prices during the contract. It was a schedule of rates contract. There was limited construction time due to the urgent need to house the final year students in the hostel before they cleared school. Completion time was therefore given premium at the tender evaluation stage. With the limited financial supply the best value for money had to also be put in mind. The tender opening ceremony was conducted by the client with the help of the consulting engineer. During the tender opening, the names of all the contractors who had been invited to tender were read out and their tender figures as well as the construction period. A brief check as to whether the contractors had filled the form of tender and the form of performance bond was done to determine how responsive the tenders were. The preparation of the tender analysis and recommendations report was done by the consulting engineer. The tender analysis report was submitted to the client together with copies of the engineers estimates for the works to enable her get into negotiations with one of the contractors. The contract was awarded after negotiations with one of the contractors who was a friend to the client, a guardian to one of the students in the school and who was willing to lower his tender price. The engineer was not involved in the negotiations. The formal award of the tender was done by the consulting engineer again on the behalf of the board of governors. The signing of the contract was done in the clients office. The school headmistress signed the contract on behalf of the board of governors. The contract was registered with the relevant authorities by the contractor and copies of the signed contract documents were retained by both the client and the contractor for future reference.

Upon award of the contract, the contractor was asked to submit to the engineer the necessary insurances against injury to persons and damage to property during the contract period. He was also to submit insurances of the works against loss or damage by fire, earthquake etc. He was to maintain the policies of insurance over the entire contract period.

Quality Assurance

To ensure quality control of the works, detailed specifications in regard to all the materials, which were to be incorporated in the works, were included in the tender document. Specifications for excavation and filling during the construction of the foundations, specifications for reinforced concrete work which formed a big percentage of the construction material, specifications for masonry and blockwork, specifications for timber for structural use, timber roof trusses, roofing sheets and cladding, carpentry, joinery and iron mongery, paving and plastering, glazing, painting, plumbing, and drainage, and external works were prepared in detail and formed the basis of quality control.

As a quality check, all the materials to be used in the works were submitted to the governments testing laboratories and tested at the expense of the contractor and the results submitted to the consultant. This acted as a check against the use of substandard construction material on the project. Quality checks were also done through inspections and supervision of the construction as work progressed. There was no clerk of works on the site and it was the engineer and the architect who carried out all the inspections. It was the contractors responsibility to call the engineer for inspections of the reinforcing steel before any concreting was done. The engineer checked on the quality of formwork, reinforcing steel, timber for structural use etc while the architect checked on the

quality of the architectural components of the construction work. The contractor was not permitted to use materials of less quality than that specified in the specifications. He was however free to source his materials from the any supplier. All the concrete was prepared on site and concrete cubes were taken from the mixing plant, cured on site and submitted to the government laboratories for crushing strength determination. The results were sent directly to the engineers office. If the crushing strength was lower than the specified value, the contractor was asked to demolish the parts cast with the poor concrete and recast with the specified grade of concrete all at his own cost. Masonry blocks delivered on site for use in the construction were picked at random and submitted to the laboratories for crushing strength determination to ensure that the specified strength of materials was maintained. The steel for reinforcement was also tested for yield strength. The contractor also submitted samples of sand and aggregate for grading curves determination.

Quality control was exercised not only through inspections and testing but also through contract review, quality design, up to date technical drawings, proper documentation and by taking necessary corrective action on defects at both the design and the construction stages of the project. Consequential costs arising from delays in the issue of technical drawings or necessary approvals were as much as possible avoided. At no time did the contractor incur any expense resulting from a delay in issuing of drawings or information from the consulting engineer or the client.

A site instructions book was kept at the site office for use by the client, architect and the engineer. As much as possible all the instructions, approvals and any other necessary correspondences were relayed in writing. If instructions were issued verbally, a written confirmation of the same was given to avoid any confusion. Supervision of the works was done with little allowance for the contractor to come up with alternative construction methods those stated in the specifications. This worked for and against the project. Due to the unreliability of some local contractors in matters of quality , the contractor could not be given the freedom to use any construction method other than that specified by the engineer. This was done to avoid the risk of the contractor compromising on quality and the likelihood of the contractor coming up with claims for extra expenses when using a different construction method. The contractor had also not been involved in the pre-design and design stages of the project and it was therefore too late in the process to incorporate his ideas. This kind of arrangement denied the project the extra benefit that would have accrued from giving the contractor a free hand when choosing alternative construction method and material.

Inorder to make the contractor get involved in quality control, he was made to bear all the cost of repairs which were necessitated by defective work. Costs arising from forgotten construction details, misplaced construction elements, wrong measurements, exceeded tolerances, delayed materials and excess consumption of resources were also borne by the contractor.

Production Planning

Immediately after the tender award, the contractor was asked to submit a detailed programme of works showing how he intended to sequence the construction activities. The programme of works was to help all the parties monitor the progress of works. The engineer approved the programme and copies of the same were displayed in the offices of the client and the engineer. A copy of the programme was also pinned up in the site office. The contractor used bar charts for time scheduling. Progress monitoring meetings were held regularly. During such meetings the contractors programme was reviewed and if he was lagging behind his programme, then he was asked to submit a revised programme showing how he intended to make up for lost time.

The progress monitoring meetings were chaired by the engineer who was also responsible for the preparation and distribution of minutes. All the dates for future meetings were set during the previous meeting but either the client or the engineer could call a meeting. The client who was constantly in touch with all the aspects of the construction particularly the rate of progress of the works also occasionally called meetings when dissatisfied with the rate of progress.

It was upon the contractor whose main objective was to achieve the highest possible profit from the project to plan his resources i.e. labour, finances, materials and materials supply in a manner most suited to him. During the construction stage, it was not a requirement for the contractor to submit his materials schedule or the names of his suppliers. As such, guidance of execution of the works on site, allocation of resources, co-ordination of effort on site and motivation of site staff, site organisation, planning for plant and equipment together with all site operations was his responsibility. It was however often difficult for the contractor to carry out a systematic production planning or to realise his materials delivery plans because of delays in payment which characterised the project.

All the daily problems on site which had an effect on the works programme were recorded by the site foreman. Days on which the weather was too poor to allow construction to go on were recorded and used by the contractor when requesting for extension of time.

Economic Control

The fixed sum contract with the schedule of rates method of payment was adopted for the project because it enabled the client to know the total production cost of the project early and helped the board of governors to exercise control early by planning on the methods they were going to adopt to acquire the required finances.

The contractor played a significant role in the economic control during the construction stage. It was his responsibility being the one who was doing all the construction work to bring down the cost of production without compromising on the specifications if he was to make profit in the project. Being the one supplying all the materials for the construction work he was responsible for preparing his material schedule, cutting down on transport

and storage cost, using equipment where necessary and managing his own time. He was responsible for hiring his own labour for all the construction work. It was up to him to arrange for credit with his suppliers if need arose. The roofing tiles specified were to be sourced from particular manufactures. It so happened that the manufactures were not able to supply the roofing tile in time and the contractor was allowed to use different roof tiles.

The contractor prepared and applied for payment certificates at intervals of not less than four weeks. After measurement and verification by the engineer, a certificate of payment was issued within fourteen days from the receipt of the application for payment stating the amount due to the contractor by the client. The contractor was entitled to full payment by the client within fourteen days from the date of presentation of the certificate. The amount stated in the interim payment certificates was the total value of work properly executed together with the value of the construction materials and goods delivered to the site and meant for incorporation in the construction. On all the certificates, a ten-percent retention was exercised.

The prices in the schedule of rates were used to determine the value of all the variations ordered by the client. Measurements of the variations were done by the engineer. The contractor however was always given the opportunity to be present at the time of measurement and to point out all the works that he wanted measured. The value of all variations were added to the contract sum and included in the interim payment certificates. This gave the client the opportunity to see the cash flow and to appreciate the effect of the variations she was making on the final contract figure.

Budget Reviews and Reconciliations

Final budget reviews and reconciliations were done by the consulting engineer and agreed upon by the contractor before submission to the client. The preparation of the final budget was undertaken when the contractor refused to undertake any more extra work after the client failed to pay him on time on several certificates. He was also upset by the fact that whereas he sometimes would carry on with the work even when his payment was delayed, and the fact that he never sued the client for payment of interest on the delayed payments, the engineer was always pushing him and demanding that he completes the work on time. On several occasions, things went quite sour between the contractor and the engineer with each accusing the other of arrogance. The engineer called on the client to terminate the services of the contractor and hire another contractor to complete the work. On hearing that the contractor produced all the records showing how his payments had been disbursed and threatened the client with legal action to make the school pay interest on all delayed payments at the current bank lending rates. He also abandoned work. Neither the engineer, nor the contractor would call the other for dialogue. One correspondence after another was exchanged between the parties and the project suffered greatly during those stand-offs. There were periods when the contract suffered because the contractor was either simply demoralised or out to get back at the rest of the parties. On several occasions the contractor neglected the site after he received payment. He failed to supply the foreman with sufficient construction materials and failed to pay his workers who in turn left the site. This unethical behaviour made the client resort to paying the balances on the certificates directly to the materials suppliers identified with the help of the foreman. The client did not want to resort to the legal mechanism to resolve any disputes during the construction process. She always tried to initiate dialogue with the parties any time the need arose.

The use of information technology and prefabrication was minimal during the construction process. Production of most of the components was done manually. There was no computer aided manufacturing for any of the structural components. Precast units for the two spiral staircases were prepared on site. All the paving slabs for external works were also cast on site.

Experiences to Use in Future Projects

The willingnes of all the parties to work together as a team would have greatly reduced or even eliminated any antagonisms resulting from delays in payment and delays in the completion of the works.

It is evidently clear that the consulting engineers role of the project manager in the construction process was not clearly defined both to him and to the contractor and the client. The fact that he was also a board member and had a role to play as the client complicated matters even more. There was also very little if any financial planning in this project which led to the numerous financial difficulties. It might have been better to wait until a substantial amount of money for the project was collected before construction started but considering the way the project was to be financed, there had to be some work going on at the site to convince the local people to contribute to the building fund.

In future it is recommended that the project manager be an individual or a company that is completely independent of the design and financing team. This is however more easily said than done particularly for small projects and for those projects like this one where financing is a problem.

Property Management

Life-cycle Economy

As stated earlier, the financing of the project was done through local fund raising effort. There was no money borrowed from banks or other lending institutions. As such, there were no loans to be repaid. The client did not have to worry about such things like the conditions of loan, interest rates, repayment time etc. Problems arising from the above mentioned were therefore not taken into consideration at the design stage.

Due to the geographical location of the project, heating and thermal insulation of buildings is not necessary. There is never a time in the year that is too cold or too hot to warrant heating or air conditioning of the building.

Heat energy costs on the project were therefore a negligible part of the total running costs. Ventilation of the buildings was achieved through windows, doors and ventilation blocks. There was no need for mechanical ventilation of the hostel. Electricity was therefore used mainly for lighting and this kept the electricity bills fairly low.

The school matron who was housed in the girls hostel was responsible for controlling the water and electricity consumption levels by the girls. She was to ensure that all the lights were turned off when the students were out of the hostel and at the designated times in the evenings, check that no tap was left running in the ablution areas or in the laundry and report any leakages as soon as she noticed them to the school headmistress. Water consumption in the hostel was in the showers, toilets, laundry and for the general cleaning of the facility.

The daily cleaning and orderliness of the hostel was done by the students under the supervision of the matron. Every student washed their own clothes and ironed them. There were no washing machines or dryers in use in the facility and all the wet clothes were hang out to dry at the clothes drying shelters. This was done to avoid any damp clothes being put in the rooms which would have affected the durability of the timber beds and wardrobes.

All the garbage generated within the hostel was collected by the students and burnt within the school compound.

The school bursar dealt with all the invoices arising from the running costs of the structures i.e. payment of water, telephone and electricity bills.

Maintenance Planning

Due to the lack of a favourable and adequate financing mechanism for the construction process, it was not possible to put aside some lumpsum amount of money for maintenance. Proper maintenance and upgrading strategies could not be formulated. The production of the project was taken more into consideration than the maintenance of the completed works. This is not to say that inferior quality components with shorter lifespans were built instead of those with longer life but in the allocation of the available resources, emphasis was laid on the successful completion of the project.

The maintenance period of the buildings by the contractor was only six months after which the contractor was not liable to the client for any more maintenance or repair. Necessary continuos maintenance during the life of the facilities was to be arranged and paid for by the client. Regular painting of walls, polishing of floors, replacement of broken windows, wardrobes, reading desks and chairs, burnt out bulbs, broken or leaking taps etc was done as the need arose. There was no systematic maintenance planning at the final handing stage over of the hostel.

Connection to the Design Stage – Feedback

The following measures were put into place at the design stage and construction stage as a means of cutting down maintenance costs.

- The floors on the highly trafficked areas of the buildings and those areas which were subject to scratching, kicking and striking like the lobbies, corridors, staircases, ablution areas and the laundry were finished off in polished terrazzo which is more durable than cement screed and needs less maintenance.
- Metal casement windows were used instead of wooden ones as they can withstand rough handling and to avoid the rot and decay that the timber undergoes with age, hence offering a prolonged maintenance free life.
- Pitched roofs were designed and constructed instead of flat ones on all the buildings to reduce maintenance that is occasioned by leakages which invariably accompany flat roofs.
- Gutters and rain water down pipes were installed and eaves constructed on the roofs to provide protection to the external walls and windows from the damage occasioned by contact with rain water.
- All the external walls were made of keyed natural stone which requires very little maintenance.
- All the external doors were solid wooden doors recessed into the building to avoid any contact with rain water or direct sun shine. This was done to eliminate the periodical wetting and effect that direct contact with the elements has on timber, hence prolonging the life of the doors.
- The doors inside the wet core areas were also raised off the floor level to minimise wetting. All the doors in the bathrooms were also solid.
- All the walls in the bathrooms were finished off in polished terrazzo, which is tighter than cement screed and hence reduced ingress of moisture into the floor slab. Adequate slopes were also provided in the bathrooms and the floor in the laundry area to avoid any stagnation of water in the respective areas.
- The water supply and distribution network in the building was done in such a manner that it was possible to access the water stop valves easily and cut off water supply when repairs were needed.