Sources and Cause of Poor Performances on Residential Building Projects – Case Study of the Republic of Mauritius

Asish Seeboo 1, Viren Proag 2
1 Open University of Mauritius, Reduit
2 Civil Engineering Department, Faculty of Engineering, University of Mauritius, Reduit
a.seeboo@uom.ac.mu

Abstract. In this particular study the intent was to determine the sources and causes of poor performances on residential projects. The methodology adopted was through observation of the construction (from start to end) of 18 houses, and to be part of the study the houses needed to satisfy specific requirements such as (i) floor area of residence not exceeding 1615 square feet; (ii) the residence has ground floor only; (iii) the residence will be made of reinforced concrete elements and cladded with cellular blocks; (iv) acceptance of the client to be part of the survey; (v) acceptance of the client to give access to the site during the execution of works; (vi) acceptance of the client to give access to the plans and financial information; (vii) construction will be executed by a team of masons or small to medium labour contractors; (viii) the team of masons or the labour contractor will supply labour only; (ix) the client will be the sole party to deal with the different suppliers throughout the project; and (x) construction will start in the coming weeks. Miscommunication, improper planning and absence of internal supervision of works lead to some reworks which add to the overall cost of the project as well as increases the duration. In many cases, the end product was not of standard quality, and there was nobody to flag these issues. To bridge the gap between the client and the contractor, it is primordial to have the third stakeholder (consultant) into the picture. The proposed consultant’s scope of works will have to be precisely defined and the fees charged will have to be rational.

1. Introduction

Construction is defined by Hillebrandt [1] as a multifaceted sector of the national economy. A study by Park [2] identified the strong linkages existing between the construction industry and the different parts of the economy of developing countries. Furthermore, the national economic growth of a nation is influenced by its construction industry. And, in turn, is an indication of how wealthy the nation is [3, 4, 5, 6, 7, 8, 9, 10, 11, 12, 13]. The building industry has dramatically evolved regarding project size and complexity [14] making each construction project unique, involving some interrelated tasks and work packages [15] in the last fifty years. For any nation, the construction industry plays an integral part in its physical development (construction of buildings, roads and bridges), which is used as a measure of its economic evolution [16]. A nation’s economic well-being is dependent on the following:

(i) the building industry’s aid to the Gross Domestic Product (GDP),
(ii) its capacity to create jobs and
(iii) provision of the market for the latter’s materials and products (produced by another sector of the economy) [17], the success of such a venture is more than necessary for the stakeholders [18].

Buildings are considered successful when they are completed on the project’s proposed end date, within the allocated cost and to the approval of the stakeholders [18, 19, 20, 21, 22, 23]. However, many construction projects worldwide suffer from poor performance [24]. Examples are; (i) delays in meeting...
construction deadlines, (ii) cost overruns, quality defects [25] and (iii) low to inferior productivity with negative customer feedback [26, 27, 28]. A few decades back, despite the advances made in project management theories and methods towards enhancing the performance of construction projects, the results are still not convincing [29]. Following an investigation by the Construction Industry Institute (CII) back in 2012 on 975 construction projects only 5.4 % performed satisfactorily. The barriers to the inefficiency of these projects remain the very complex and dynamic environments of the construction industry, which are difficult to capture [30, 31]. However, the need to enhance project performance within the construction sector worldwide is essential. It is in line with reports by Latham [32] and Egan [26] from the British construction industry. According to publications by Hwang et al. [33] and CII [34], the United States experiences unfinished works which amount to 5 % of the total construction cost. In India, it has been reported that time overruns have been observed on 40 % of construction projects [35]. In Ghana’s construction sector, the poor performance has been attributed to issues relating to project management, intricate and long-lasting claims processing, resulting in delays in paying [36]. In emerging SIDS countries, the problems linked to the performance of construction projects are fuelled by inadequate to limited means to tackle them.

The intent of this particular research project is to identify the sources as well as the causes for the poor performances with respect to the iron triangle witnessed in the construction of residential buildings with specific attributes.

2. Methodology

The proposed methodology is as described in this specific section. The Republic of Mauritius comprises of nine districts, figure 1. For each district, the local planning department was contacted in order to get a list of people who had recently been awarded the building and land use permit (BLUP) also referred to as the construction permit, for the construction of a residence with the following attributes.

- Floor area of residence not exceeding 1615 square feet.
- The residence has ground floor only.
- The residence will be made of reinforced concrete elements and cladded with cellular blocks.

| #  | District              | Abbreviation |
|----|----------------------|--------------|
| 1  | Port-Louis           | PL           |
| 2  | Pamplemousses        | PP           |
| 3  | Riviere Du Rempart   | RDR          |
| 4  | Black River          | BR           |
| 5  | Plaines Wilhems      | PW           |
| 6  | Moka                 | M            |
| 7  | Flacq                | F            |
| 8  | Savanne              | S            |
| 9  | Grand Port           | GP           |

Figure 1. Districts of Mauritius.

A list of potential clients was established with an average of 4 people per district. Each of them was contacted and only those meeting the following criteria were selected:

- Acceptance of the client to be part of the survey
- Acceptance of the client to give access to the site during the execution of works
- Acceptance of the client to give access to the plans and financial information
- Construction will be executed by a team of masons or small to medium labour contractors.
- The team of masons or the labour contractor will supply labour only
- The client will be the sole party to deal with the different suppliers throughout the project
- Construction will start in the coming weeks
The number of clients who were eligible for the study is illustrated in figure 2.

![Bar chart of participants by districts](image)

**Figure 2.** Participants to observational survey.

The construction of residential buildings was studied thoroughly, and three different phases were identified as (i) sub-structure (the structure of the building located below natural ground level); (ii) super-structure (part of the building above the natural ground level); and (iii) finishing works that will make the dwellings aesthetically pleasing to see. The main tasks or activities that any contractor or sub-contractor will have to execute during such constructions are illustrated in table 1.

3. **Observations and discussions**

**Documents for construction** – consisted of approved plans from the respective municipal or district councils, which include both architectural and structural drawings, and the building and land use permit with terms and conditions to be followed.

*Observation*: Both the architectural as well as the structural plans lack some construction details, dimensions and information regarding floor levels.

**Selection of team of masons/labour contractor** – the above construction documents are handed over to potential builders (team of workers/labour contractor) for them to quote their best price.

*Observation*: Quotes obtained from the builders were a price per square foot with no concise detail on the scope of the works, and the payment schedule was not clear.

**Materials** – once the client has selected a particular builder, before the start of the construction, the client was provided with a list of materials required for the different phases of the development (sub-structure and super-structure).

*Observation*: The initial list of materials handed over by the contractor to the client had to be amended on all of the construction sites during the construction phase as the contractors failed to calculate the required amount of materials. The inaccuracy in the calculation of the materials necessary was in the range of 10-18%. This led to an increase in the frequency of procurement, for a specific material, which resulted in issues such as delays in procurement and an increase in the cost of transportation.

**Site clearance** – before working on any particular plot of land, the latter is cleared of debris, shrubs and trees.

*Observation*: This particular task was done on all the sites.

**Topsoil** – the first layer of natural soil (300 mm) on any plot of land should be removed as it contains organic materials such as roots, which will decay in time and as a consequence results in a settlement, hence inducing cracks within the constructed building.
Observation: On 90% of the residential projects the topsoil is never removed.

Setting Out – executed by the contractor using the plans provided by the client. 
Observation: No third party ensures that the setting out is correct. 75% of the projects followed had no setting out plans and had missing dimensions. In 90% of the setting out, errors of the order of 5-10% were observed implying that the resulting residence would differ from the planned and approved one.

The depth of Foundation – the depth of foundation, that is, the depth at which stiff soil is observed was never indicated on any plan.
Observation: Depth of foundation, as excavated by the team of workers or small contractors, varied between 600 to 900 mm below natural ground level. No tests are done in the excavated foundation trenches before casting of the blinding layer.

Excavation works – the client takes the responsibility to rent the excavators together with its operator.
Observation: Excavators rented by the client are paid either an hourly rate or a lump sum at the end of the task. It was seen that very often the equipment broke down. The excavation works were not controlled and on many sites over excavation was noticed. Roots and debris in trenches are seldom removed.

Blinding layer – all the plans specify a blinding layer of 50 mm.
Observation: The builders either misinterpreted or misunderstood the thickness and purpose of the blinding layers. The aim with a blinding layer is to have a level surface on which the foundation could be built and the “50 mm” blinding layer means that on average, the blinding should be 50 mm thick. Blinding layers also protect the rebars against corrosive soils as well as water and/or other contaminants. Figure 3 illustrates the way the blinding layer is put in place, which is wrong.

![Figure 3. Placing of blinding layer.](image_url)

Foundation reinforcement – reinforcement to the foundation were provided in the plans.
Observation: All the plans had rebar details for the foundation, and on 50% of the residences under study, the reinforcement bars, the spacing of the bars, the lapping, spacers and the cover block thicknesses were as per plan. However, on the remaining residences under study, the following deviations were witnessed.

- Reinforcement bar diameter was not according to plans, for example, the reinforcement to strip footing were shown on a plan to be 3T10+T10-225. However, 3T08+R06-150 was used instead. [T: high tensile steel of characteristic strength of 460 MPa, R: mild steel of inherent strength of 250 MPa]
- Rebar spacing in the bases was not consistent, that is if the rebars were spaced at 150 mm centre to centre, then on site after fixing, the spacing varied and ranged from 145 mm to 175 mm.
Lapping of rebars was not as per standard practice, in some cases, lap lengths between T10 bars did not even exceed 300 mm.

Use of rebars, R06 which is mild steel of a diameter 6mm, in strip footing posed to be a problem especially after fixing when people walked on the reinforcement. These bars, under the weight of the workers, are easily deformed, which decreases the cover to the reinforcement, and as a consequence, the durability of the footing is put at stake.

Cover blocks are not correctly placed, and as a consequence, the durability of the footing is at stake.

Concrete to foundation – three scenarios were witnessed for the casting of the foundation.

Observation:
Scenario # 1- the client buys all the materials, rent a concrete mixer and an elevator with the casting done by the team of workers or labour contractor. This particular option was adopted by clients who had enough space to stockpile the required materials. However, where space was an issue, then either one of the following scenarios was adopted.

Either
Scenario # 2 – Client orders ready-mix concrete from the concrete supplier and fixing is done by the team of workers

Or
Scenario # 3 – Client orders ready mix concrete which is fixed by the supplier itself.

It was observed that on 95% of the dwellings under study, scenario # 3 was implemented by clients. Neither the clients nor the working teams were bothered with the concrete compressive strength of the cast concrete, and it was not possible to ascertain whether the resulting concrete had the required strength.

Curing of concrete to the foundation – there was no specification regarding curing of foundation in any of the documents handed over to the contractor/team of workers.

Observation: Curing was not done at all. Furthermore, most of the casting was done early morning, and the block laying was initiated just after casting.

Construction of block walls – block walls were erected up to the plinth level.

Observation: The different rows of blocks, within the wall, were not horizontal but defined a wavy pattern, block joints were not consistent and uniform, many of the walls, within the sub-structure, were not vertical, walls more than six rows high did not have any wall ties. There was no internal quality control at all entertained by either team of workers or labour contractor.

Columns to sub-structure – all the plans had the required details to enable the workers to proceed with the columns.

Observation: Formwork utilised were, in 75 % of the cases, not adequately fixed and resulted in bulging of the concrete. The quality control is quasi-inexistent. When questioned, the workers had similar answers “the sub-structure will be buried in the ground. Hence all defects will be hidden”. Reinforcement to columns are never inspected by third parties; it was observed that the reinforcement of many columns was altered from 4T12 to 4T10. The casting of these columns was done by site batching as the volume of concrete required was small. Here also, no testing of the concrete cast was done.

Engineering fills – details were not available to the contractor on 65 % of the projects under investigation.

Observation: All the contractors/workers did not follow the details concerning engineering fills. Primarily they used the excavated materials as engineering fill. Compaction is carried out using a whacker, but no compaction test is done to assess the degree of compaction.
Surface bed – on all plans, some details of the size and reinforcement to be used for the slab were provided.

**Observation:** The contractors/workers did not execute the surface bed as per plans as they either did not understand or misinterpreted the information provided.

- Anti-termite treatment was not done on 75% of the residences
- The damp proof course was utilised on 40% of the sites
- Reinforcement – top mesh - was not fixed in the required position
- Reinforcement specified on drawings was A142 top mesh, however, on 80% of the sites, the latter was replaced with mild steel of diameter 6 mm, which got distorted under the weight of the workers after fixing on site.
- When the concrete was ordered, the workers/labour contractor requested the client to order for concrete grade 25 instead of grade 30 as specified on the plans.
- Curing was done after casting of the slab using water; however, this caused much inconvenience in starting the block wall of the superstructure.

Walls – will be made of cellular concrete blocks with thickness, position and height as per plans provided to the constructor.

**Observation:** On all the residential sites under investigation no internal or even external quality control was in place, and as a result, the following were witnessed:

- Individual blocks are placed without proper levelling, which resulted in a wavy pattern of the row when observed in the horizontal plane
- Resulting walls were not vertical
- An assessment of the amount of rendering that would be required to make the walls look vertical ranged between 20-35 mm, which could have been avoided if there was proper quality control in place.
- Block joints are not uniform and consistent
- Wall ties are seldom used
- Door jambs are rarely used
- Cills are not reinforced

Columns to super-structure – all the plans had the required details to enable the workers to proceed with the columns.

**Observation:** Formwork utilised were, in 75% of the cases, not adequately fixed and resulted in bulging of the concrete. The quality control was inexistent. Reinforcement to columns was never inspected by third parties; it was observed that the reinforcement of many columns was altered from 4T12 to 4T10. The rebars, if exposed for a more extended period, will rust and in many cases, especially those constructions near the sea, the degree of rusting was not assessed before casting of the columns. The lap lengths were not as per standard (Figure 4) and it was also observed that too many laps were used in some of the columns. Improper lapping resulted in a reduction in the cover thickness. The casting of these columns was done by site batching as the volume of concrete required was small. Here also no testing of the concrete cast was done. Columns, on many sites, were cast in more than one pour and the concrete stuck on the rebars, due to the previous pour, was never cleaned before the next pour.

Beams to super-structure – plans provided to the builders had beam details concerning the geometry as well as the reinforcement, but it was not possible to know the exact position of the laps, top bars’ features, and the reinforcement details at the end of the beams. All this information are generally provided on beam elevations, which were not found on any of the structural drawings.

**Observation:** Formwork utilized were, in 55% of the cases, not adequately fixed and resulted in bulging of the concrete during casting. Carpenters tend to cut out the required piece of formwork out of new boards instead of using old ones. This practice enhances the amount of wastage on these residential building sites. Scaffolding were erected using timber posts and on 90% of the residences observed, the scaffoldings were not properly tied to the wall and stability was questionable. Access to the
scaffolding was not safe. The quality control was inexistent. Reinforcement to beams was never inspected by third parties, it was observed that the reinforcement of many beams was altered from 4T12 to 4T10 with the exception of simply supported beams. Since no details pertaining to laps and their position were provided on the plans, it was observed that laps were even done in the middle of the beams, which is contrary to industry standard. The reinforcement at the intersection of the column rebars and beams were not appropriate, resulting in reduced cover on one side of the beam (Figure 5). Casting of these beams was done by site batching as the volume of concrete required was less than 3 cubic metres. Here also no testing of the concrete cast was carried out. Beams of the whole residence were never cast at one go, contractors did the casting in at least 2 pours to save on the formwork.

Figure 4. Lapping details for columns.  Figure 5. Rebar position at column/beam junction.

Slab to super-structure – plans had reinforcement details for the slab. 
Observation: On all the residential projects observed in this specific study, steel formwork was utilised. The formwork was, in 90% of the cases, in a bad state. Deformation of the steel formwork was the primary issue. When put in place, it was difficult to obtain a level surface, and the soffit of the resulting slab defined a wavy pattern. Props were, in many cases, set up on unstable features, some were even placed on loose soil/excavated soil. Reinforcement was cut and fixed according to the contractor’s experience. The details provided on the plans were seldom followed. Bottom bars B1 and B2 were interchanged on many slabs. Top bars were not cut according to norms, and insufficient chairs resulted in the top bars merging with the bottom layers of rebars. The spacing of the bars was not constant, and the different bars were not correctly tied with binding wire. The degree of rusting of rebars was never checked. Cover blocks were on average 20 mm, which is less than the diameter of coarse aggregate used in the concrete. For all of the residences observed, the slab was cast on a supply and fix basis. Curing was done using either curing compound (in a region where there are shortages of water or in areas where the temperature is quite high) or water.

Finishes – no details concerning finishes were provided on any plans to the builders.
Observation: Rendering was not defined anywhere and, in many cases, the clients were unaware of which type of rendering they would like; hence they stay guided by the workers/builders. Most of the houses had sponge finishes to the ceiling and exterior of their residences while the internal walls were rendered with a very smooth finish. The overall quality of the resulting finishes was not to standard. Rendering thicknesses, on both the interior and exterior walls/facades, were in the range of 20 mm to 30 mm. De-bonding of the rendering was frequently observed on many walls as well as ceilings. Corners of adjacent walls, walls and ceiling junctions, edges of isolated columns and beams are done by hand and define a wavy pattern which is aesthetically an eyesore. Sides of isolated columns and beams tend to break.

Electricity and Plumbing – no details concerning electrical and plumbing installation were provided on any plans to the builders.
Observation: In all of the houses under investigation, the electrical and plumbing installations were carried out after the completion of the core structure inclusive of all rendering and screed works.

3.1. Observed stakeholders’ behaviour during the construction process

3.1.1. Clients. They tend to control the construction process despite the fact that they possess little to no experience in this specific field and as a consequence, the following was observed:

- Difficulties to have materials delivered to sites on time,
- Plant and equipment are required on site for particular works on specific dates. The owners have many issues in hiring these resources on time,
- It is only during the execution and progress of the tasks that the clients get a concise picture of what is being constructed regarding geometry. Hence, changes are inevitable on such projects. Some of the main changes observed were (i) units were either too small/ significant and had to be increased/decreased as per clients’ requirements; (ii) position of the said units were found not to the taste of the owners and had to be relocated; and (iii) position and size of openings were altered to owners’ specifications.
- Since the payment schedule is not specific to when and how much money will be paid to the workers, the owners tend to delay payments to workers.

The inexperience of the owners impacts negatively on the overall performance of the construction, namely;

(i) inability to have materials delivered on time on site,
(ii) delays accrued in hiring plants and equipment, and
(iii) making changes to the works during the execution of the contract

All of the above lead to increase in the duration and cost of the projects. Delays in payments for works done have been observed to impede on the workers’ commitment to work, which in turn results in a decreased efficiency and an increase in the poor quality of works. There is an urgent need to educate and sensitize future owners on the consequences of their actions during the execution of residential projects otherwise these ventures will continue to perform poorly.

3.1.2. Contractors/team of workers. The followings were noted during this specific observational study concerning the labour contractors/team of masons.

- 90% of the contractors followed during this study could not interpret drawings properly. Furthermore the drawings are divided into two sections, namely architectural and structural, however, on 100% of the construction sites only structural drawings were used during the construction.
- The works were not adequately planned; execution of the different tasks was merely based on an ad-hoc basis.
- Internal quality control was inexistent on all of the construction sites observed.
- In general, the skillsets claimed by the workers were questionable. For example, block layers did not follow the standard principle for block laying, a phenomenon witnessed on all sites.
- Variation works, as a result of changes made by the clients, were not adequately assessed regarding duration and cost.
- On 80% of the houses constructed, the quality of works was below industry standard and required reworks, due to shoddy workmanship. The value of the reworks ranged between 5-15% of the project value.
- Lack of motivation (illustrated by a high rate of absenteeism) among the workers were evident and proved to be a significant factor that labour contractors will have to work on if they intend to increase work efficiency on their projects.
All of the observations mentioned above contribute directly to the poor performance of the projects concerning cost, time and quality. Hence, the pressing need for the contractors/team of workers to work on their deficiencies before start a project anew. Some of the identified areas of improvement are:

(i) plan interpretation;
(ii) detailed methodology/sequence in which the different tasks will be executed;
(iii) training of staffs for better efficiency;
(iv) internal quality control system; and
(v) coming up with realistic variation costs and durations.

3.2. Problems identified and recommendations

In this section, the numerous problems identified during the observational study are discussed, and the recommendations provided are geared towards enhancing the overall project performance.

3.2.1. Contract Agreement. On all of the projects under investigation, there was no formal contract signed. The only document that linked both the clients and the team of workers/labour contractor was a one-page document that stipulated the price charged per square foot only. 90% of the papers did not even have the total footprint of the residence being constructed. This document, legally, does not tie both parties and breach of contract can occur at any moment during the execution of the works, without any proper legal action being possible or enforceable.

Recommendations – A proper, concise and shorter version of standard construction contract could be adapted for the construction of residential buildings whereby the different parties are tied in their respective responsibilities concerning the following, namely:

- The scope of works,
- Quality of works,
- Financial standing and disbursement,
- Retention monies among others.

Furthermore, the contract could also contain a simple, tailor-made Bill Of Quantities (BOQ) for residential buildings under investigation.

3.2.2. The inexperience of Owner/workers. As previously discussed in the above sections of this chapter, the inexperience of both clients and workers are factors that lead to poor performance of the project.

Recommendations – Clients should be briefed or explained by a competent person in the field on;

(i) the type of residence being constructed;
(ii) the position and dimensions of every unit within the house;
(iii) the consequences associated with making changes during the execution of works;
(iv) delays in making payments to the workers; and
(v) delays in having materials delivered on-site or in hiring plants and equipment.

Contractors should be briefed or explained by a competent person in the field on;

(i) the type of residence being constructed;
(ii) the position and dimensions of every unit within the home;
(iii) the method of construction;
(iv) the need for an internal quality system;
(v) the need/importance of a detailed Programme of Works (POW);
(vi) the importance of keeping the team together;
(vii) how to increase the efficiency of his worker through motivation and
(viii) the way to deal with variation works.

3.2.3. Quality Control. Currently is inexistent on all of the projects monitored.
**Recommendations** – There is a pressing need to have a simple but effective internal quality control system put in place to ensure that the works being done by the workers are to industry standard. Once such a system is in place, defective works could easily be detected at an early stage and the appropriate actions taken in order to mitigate the financial losses. Furthermore, third-party supervision is a must and appointment of a consultant is being recommended. The latter will need to ensure that works are being executed according to prevailing norms.

3.2.4. **Absenteeism.** All construction sites worked from Monday to Saturday. Working time during weekdays is from 7:30 am to 4:30 p.m. and on Saturdays from 07:30 a.m. until noon. However, on 84% of the residential building sites, it was observed that on Mondays the workforce was reduced to 1/5th of its capacity. Sometimes, it was found that the whole team would be on leave without prior notification to the clients. Furthermore, when the project is nearing completion, the rate of absenteeism shoots up considerably, and the reason for such hike is attributed to the team has started a new project to ensure continuous work throughout the year.

**Recommendations** – There should be a firm commitment of the workers to their respective projects. The workers should be motivated to complete the construction on time, if not before time. When taking such a job finishing before time implies a higher profit share; hence, client and consultant should ensure that materials, plants and equipment are provided on time to ensure that the works are executed without issues.

3.2.5. **Productivity/efficiency.** Teams were mostly composed of at least two masons, one of whom was the leader and two to three helpers. Team members remained unchanged on only 85% of the projects. However, most of the helpers did not show any interest in the job or in learning how to execute the task properly so that later they could practice and be promoted to the rank of a mason or skilled labour.

**Recommendations** – Team members should work in unity with shared responsibility. The willingness to learn more should be encouraged by the skilled workers and consultants. Within the team, there should be some internal training given to the unskilled workers to progress into a skilled one.

3.2.6. **Health and Safety.** No risk assessment were done before the start of any construction works on any one of the construction sites. Personal Protection Equipment (PPE) was limited to gloves and rubber boots. Significant accidents were not reported on any of the sites. However, minor accidents such as cuts and minor fall into shallow trenches were noted.

**Recommendations** – Before the start of any construction tasks, a risk assessment should be carried out. Proper PPE equipment should be provided to all workers and should not be limited to hard hats, safety shoes, gloves, reflective jackets among others. Proper signage should be provided on the site. Health and Safety training should be provided. A First Aid kit should always be present on site, and essential phone numbers are at hand.

3.2.7. **House Keeping.** All sites were messy with minimal cleaning done. Cement bags were thrown next to where the concrete was being mixed. Debris was left everywhere around the site. All of the sites did not have a proper housekeeping plan in place.

**Recommendations** – Proper housekeeping makes the environment conducive to work. Hence a proper housekeeping plan is a must on every site.

3.2.8. **Wastage.** Observed from start to completion of construction. Concrete, in surplus, during casting is stacked on site, which later requires additional resources to break and discard. While making timber formwork for specific elements, it was noticed that workers tend to cut the required piece from new timber boards instead of looking for the same piece from the stack of used boards. While rendering walls, the cement mortar falling to the ground is left in place, and later these hardened mortar require
resources to break the hardened mass and cart away. These are some of the actions observed on site that increase wastage on site.

**Recommendations** – A proper system should be put in place whereby some dedicated helpers are assigned to the cleaning up of sites before leaving the site. Instead of wasting the materials, the foreman will have to identify places where the remaining concrete and mortar could be used on site. For the formwork required, pieces could be cut from existing used boards. It is recommended that the site be organized in such a way that specific spaces are identified for particular items. For example, there should be a particular spot for storing materials such as coarse and fine aggregates, timber (new as well as used ones), waste/used materials (items that can be used back identified and stored accordingly) among others.

4. Conclusions
Miscommunication, improper planning and absence of internal supervision of works lead to some reworks which add to the overall cost of the project as well as increases the duration. In many cases, the end product was not of standard quality, and there was nobody to flag these issues. To bridge the gap between the client and the contractor, it is primordial to have the third stakeholder (consultant) into the picture. The proposed consultant’s scope of works will have to be precisely defined and the fees charged will have to be rational.

**About the researcher** – Asish Seeboo has a first degree in Civil Engineering from the University of Mauritius and a master’s degree in Civil Engineering with specialisation in Construction Engineering and Management from the Iowa State University of Science and Technology, Iowa, USA. He has more than 14 years of experience in the design, detailing and construction supervision of residences around the island.

**Involvement of researcher during construction** – The researcher only observed the different construction processes without interfering. His presence during all the concrete castings was required in order to be able to measure the excess concrete. Furthermore, it was also agreed that debris could only be discarded from site after inspection by researcher.

**Acknowledgment(s)**
The authors acknowledge the contribution by both the clients and contractors who accepted to be part of the study.

**References**
[1] P. Hillebrandt, “Analysis of the British Construction Industry”, Macmillan, London, 1985.
[2] S.H. Park, “Linkages between industry and services and their implications for urban employment generation in developing countries”, Journal of Development Economics, 30, pp.359–79, 1989.
[3] D.A. Turin, “Construction Industry, based on the Proceedings of the International Symposium on Industrial Development” held in Athens in Nov-Dec 1967, New York, Monograph no. 2, 1969.
[4] J. Wells, “The Construction Industry in Developing Countries: Alternate Strategies for Development”, Croom Helm Ltd, London, 1986.
[5] B. Field and G. Ofori, “Construction and economic development – a case study”, Third World Planning Review, 10, 41–50, 1988.
[6] R. Bon, and R. Pietroforte, “Historical Comparison of Construction Sectors in the United States, Japan, Italy and Finland Using Input-Output Tables”, Construction Management and Economics, 8, pp.233-247, 1990.
[7] R. Bon, “The future of international construction: secular patterns of growth and decline”, Habitat International”, 16, pp. 119-28, 1992.
[8] R.K. Green, “Follow the leader: how changes in residential and non-residential investment predict changes in GDP”, Real Estate Economics, 25, 253–70, 1997.
[9] P.M. Hillebrandt, “Economic Theory and the Construction Industry”, Third Edition. London: Macmillan Press LTD, 2000.
[10] S.C. Lean, “Empirical tests to discern linkages between construction and other economic sectors in Singapore”, Construction Management and Economics, 13, 253-262, 2001.
[11] R. Rameezdeen, “Image of the construction industry”, Department of Building Economics, University of Moratuwa, Sri Lanka, 2007.
[12] D. Myers, “Construction Economics”, Second Edition ed. London and New York: Taylor & Francis, 2008.
[13] S. Dlamini, “Relationship of the construction sector to economic growth”, School of Construction Management and Engineering, University of Reading, UK, 2011.
[14] W.S. Alaloul, M.S. Liew, and Z. NAWA, “Identification of coordination factors affecting building project performance”, Alexandria Engineering Journal, 55, pp. 2689-2698, 2016.
[15] A. Akintoye, G. McIntosh, and E. Fitzgerald, “A Survey of supply chain collaboration and management in the UK construction industry”, European Journal of Purchasing and Supply Chain Management, 6, pp. 159-168, 2000.
[16] J.I Alzahrani, and M.W. Emsley, “The impact of contractors’ attributes on construction project success: A post-construction evaluation”, International Journal of Project Management, 31, pp. 313-322, 2012.
[17] ILO, “The Construction Industry in the Twenty First Century: Its Image, Employment Prospects and Skills requirements”, International Labour Office, Geneva, 2001.
[18] J. Ye, C.D. Carter, and L. Kemp, “Stakeholders requirements analysis for a demand-driven construction industry”, Available at http://www.itcon.org, 2009.
[19] D.K. Chua, Y.C. Kog, and P.K. Loh, “Contract success factors for different project objectives”, Journal of Construction Engineering and Management, 125(3): pp.142-150, 1999.
[20] D.R. Ogunsemi, “Predicting the Final Cost of Construction in Nigeria”, The Quantity Surveyor, 54(4):3-6, 2006.
[21] H. Yaman, “A building cost estimation model based on functional elements”, Publication of Istanbul technical University, A/2(4):73-87, 2007.
[22] M.Y. Cheng, H.C. Tsai, and E. Sudjono, “Evolutionary Fuzzy Hybrid Neural Network for Conceptual Cost Estimates in Construction Projects”, 26th International Symposium on Automation and Robotics in Construction (ISARC2009): pp.512-519, 2009.
[23] M.Y. Cheng, H.C. Tsai, and E. Sudjono, “Evaluating Subcontractors Performance Using Evolutionary Fuzzy Hybrid Neural network”, International Journal of Project Management, 29(2011):pp.249-356, 2011.
[24] X. Meng, “The effect of relationship management on project performance in construction,” International Journal of Project Management, 30, 188-198, 2011.
[25] T.Y. Lo, I.W.H. Fung, and K.C.F. Tung, “Construction delays in Hong Kong Civil engineering projects”, Journal of Construction Engineering and Management, 132,636-649, 2006.
[26] J. Egan, “Rethinking construction”, Construction Task Force, HMSO, London, 1998.
[27] F. Yasamis, D. Arditi, and J. Mohammadi, “Assessing contractor quality performance”, Construction Management and Economics, 20(3), 211–223, 2002.
[28] A. Chan, D. Chan, and K. Ho, “An empirical study of the benefits of construction partnering in Hong Kong”, Construction Management and Economics 21 (5), pp. 523–533, 2003.
[29] J. Zhu, and A. Mostafavi, “Discovering complexity and emergent properties in project systems: A new approach to understanding project performance”, International Journal of Project Management, 35, 1-12, 2017.
[30] A.J. Shenhar, “One size does not fit all projects: exploring classical contingency domains”, Manag. Sci. 47, 394-414. http://dx.doi.org/10.1287/mnsc.47.3.394.9772, 2001.
[31] Q. He, W. Jiang, Y. Li, and Y. Le, “The study on paradigm shift of project management based on complexity science — project management innovations in Shanghai 2010 EXPO construction program”, IEEE International Conference on Industrial Engineering and Engineering Management. IEEE, Beijing, China, pp. 603–607 http://dx.doi.org/10.1109/IEEM.2009.5373265, 2009.
[32] Latham Report, “Constructing the Team”, HMSO, London, 1994.
[33] B. Hwang, S.R. Thomas, C.T. Haas, and C.H. Caldas, “Measuring the Impact of Rework on Construction Cost Performance”, Journal of Construction Engineering and Management, Vol. 135, No.3, 187-198, 2009.
[34] Construction Industry Institute (CII), “Making zero rework A reality”, RS 203-1 (Nov.), Univ. of Texas at Austin, Austin, Tex, 2005.
[35] K. Iyer, and K. Jha, “Critical factors affecting schedule performance: Evidence from Indian construction projects”, Journal of construction engineering and management, 132(8), 871-881, 2006.
[36] W. Gyadu – Asiedu, “Assessing construction project performance in Ghana: modeling practitioners’ and clients’ perspectives”. (PhD thesis, of Technology Universiteit, Eindhoven, Holland). [Online]. Available at: www.tue.nl/en/publication/ep/pld/ep-uid/234018/ (Accessed: 13 February 2018), 2009.