

THE EDAIF TOWER

Investigation Report (Final)

By A Technical Committee Constituted By The
Accra Metropolitan Assembly

PARTIAL COLLAPSE OF MEZZANINE FLOOR OF EDAIF TOWER – REQUEST FOR STRUCTURAL INVESTIGATION

December 2015

Following the partial collapse of the Mezzanine floor of the EDAIF Tower during the casting of the floor on Sunday, 22nd November 2015, the Accra Metropolitan Assembly acting through its Metro Works Department constituted a multi-disciplinary Technical Committee to among other things, determine the cause of the collapse.

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o. EXECUTIVE SUMMARY

This report presents the findings of the Technical Committee constituted by the Accra Metropolitan Assembly to investigate the partial collapse of a section of the mezzanine floor of the Export Development and Agricultural Investment Fund (EDAIF) Tower presently under construction in the Ambassadorial Enclave, Ridge, a suburb of Accra, belonging to the Ministry of Trade and Industry.

During placement of concrete on a section of the Mezzanine floor on Sunday, November 22nd 2015, at 1:15pm an incident occurred where the section being worked on collapsed causing one fatality and other casualties.

Utilizing both destructive and non-destructive testing techniques, properties of the building materials were determined as part of the investigations. Concrete cores taken from the building were sent to laboratory for compressive strength testing. The results were found to be satisfactory.

The investigations established that coordinating both supply of concrete with the supply and fixing of props and jacks was a challenge. When the concrete was finally supplied to site and was being poured, works on fixing the props and jacks was still on-going.

Various design criteria were used to depict the behaviours of the building materials and falsework, including the slender steel props. It was established that the propping system was not properly installed. The following were observed on the propping system in areas where concrete had already been cast and areas prepared for casting:

- Non-verticality of the props – inclined up to an angle of 5°;
- Inadequate and improper bracing of the props;
- Irregular spacing of props ranging from 600mm to 1,300mm;
- Joists placed outside the centre of the top plate of the props (eccentric loading); and
- Visibly bent and/or buckled slender props, even without concrete loads.

Findings from the investigations are outlined as follows:

- i. The partial collapse of a section of the mezzanine floor during the concrete casting was as a result of failure of the props supporting the formwork. The slender steel props buckled (bent) under excessive loads from the poured concrete triggering a state of progressive collapse;

- ii. The applied load imposed on the prop by the concrete varies according to the spacing of the props. It was established that a spacing of 900mm × 900mm adopted on site imposes a load of 7.776kN which is in excess of the critical buckling load of 6.86kN at a prop height of 4.5m;
- iii. The 1.5tonnes as a capacity for the props to be used at 5.2m height with a diameter of 64mm is misleading. A column of 5.2m height and 64mm diameter should be analysed as a slender column which fails in buckling. Buckling should have been used to determine the capacity of the props. The Supplier, providing a 1.5tonnes (15kN) as the capacity for the props; indicated to the Contractor that the props will buckle under a load of 1.5tonnes. Computations from the Committee show that the props of height, 5.2m of the same diameter, at spacing 900mm x 900mm have buckling load of 0.514tonnes. The partial collapse of the mezzanine floor of the EDAIF Tower was found to be as a result of buckling of the steel props.
- iv. Timber joists secured by binding wire were used to brace the props. This was a poor attempt at bracing the props and offered very little resistance to the progressive collapse. Certain props were supported off other timber joists that were themselves supported on props. The rigidity of the system was diminished as soon as the state of equilibrium was lost;
- v. The contractor went ahead to pour concrete without the sign-offs of the Request for Site Inspection (RSI), disregarding best practice and professional advice;
- vi. It was established that there was laxity in the professional relationship between the Monitoring Structural Engineering Consultant and the Contractor. This resulted in the issue raised in point iv above;
- vii. There was only one safety officer on site on the said Sunday, and at the time of the accident, he was directing traffic outside the site. He was, therefore, unavailable to ensure safety of the workers;

The following are recommendations based on our findings:

- i. Health, safety and environment issues on site should be improved considerably to reflect the Company's own policy;
- ii. There needs to be an audit of the site management by an external entity to help improve on processes. This should be monitored by the Accra Metropolitan Assembly
- iii. As an International Contractor, it is recommended that Amandi, brings the best global industry practices to Ghana because there are equally good alternative construction methods;

- iv. All engineering structures, whether buildings, props, or formwork etc. regardless of origin of supplier or production, should be certified by a professional engineer of good standing with the Ghana Institution of Engineers;
- v. The Engineering Council Act 2011, Act 819, should be enforced to the letter by all Metropolitan, Municipal and District Assemblies (MMDA). This is the key to minimising or avoiding incidents of this nature;
- vi. Ghana Standards Authority should develop stringent standards in conjunction with the Ghana Institution of Engineers for the certification of formwork and props and similar items and approval of promotional literature.
- vii. The AMA and other Assemblies should make it a requirement for designs done outside Ghana to be reviewed by Professionals within Ghana so that local peculiarities such as earthquake and wind loadings are properly addressed.

The Accra Metropolitan Assembly ought to be commended greatly for the pace at which they responded to this incident. They are encouraged to continue with their supervisory role to instil best practice in the construction industry in the metropolis and Ghana at large.

Ing. Joshua Allotey
Committee Chairman

Ing. Dr. Desmond Aryee-Boi
Project Director

Ing. (Mrs.) Florence Sam Mensah
Committee Secretary

Ing. Nii Armah Tagoe
Asst. Committee Secretary

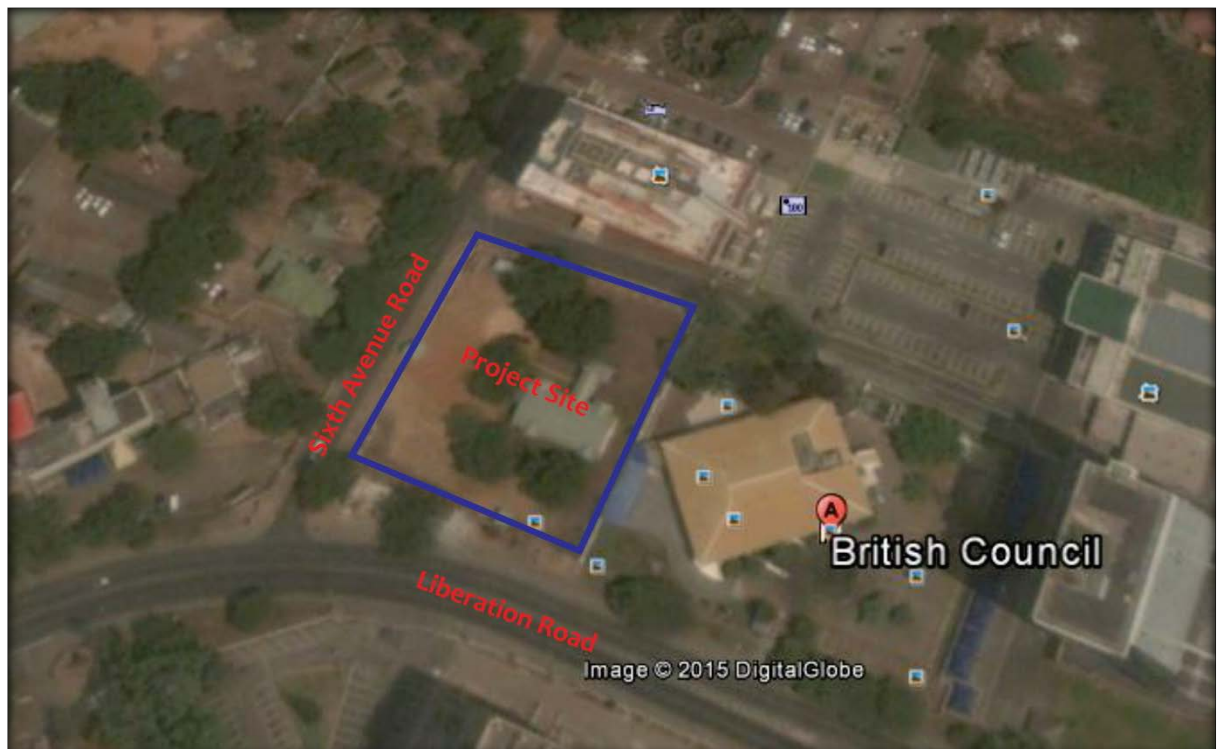
1. INTRODUCTION

1.1 BACKGROUND INFORMATION

The Export Development and Agricultural Investment Fund (EDAIF), is an agency of the Ministry of Trade and Industry (MOTI) of the Government of Ghana. EDAIF contracted Amandi Holdings Ltd, under a Design-Build Contract to plan and construct a 16-storey building with a 2-level basement parking facility in Accra, Ghana.

The project site is bounded by the Liberia Road, the 6th Avenue Road and the British Council building. The EDAIF building project which commenced in October, 2014 is scheduled to be completed in May, 2017. The building skeleton will be constructed with reinforced concrete and will include flat structural slabs, reinforced concrete beams, columns, walls and curtain walls. The location of the project site is shown in Figure 1-1.

Figure 1-1: Project Location Map



During placement of concrete on a section of the Mezzanine floor on Sunday, November 22nd 2015, at 1:15pm an incident occurred where the section being worked on collapsed causing one fatality and other casualties. This incident recorded ten (10) persons injured and one (1) person dead with damage to other properties and materials on site. Figure 1-2 shows the completed works to date and the collapsed section.

Figure 1-1: View of Work to date

1.2 OBJECTIVE

The Accra Metropolitan Assembly, in exercising its oversight responsibility in the construction of building structures within the metropolitan area, constituted a multi-disciplinary Technical Committee to investigate the cause(s) of the partial collapse, among other things.

1.3 SCOPE OF ASSIGNMENT

The scope of the investigation into the partial collapse of the section of the Mezzanine floor as defined in the letter of engagement was as follows:

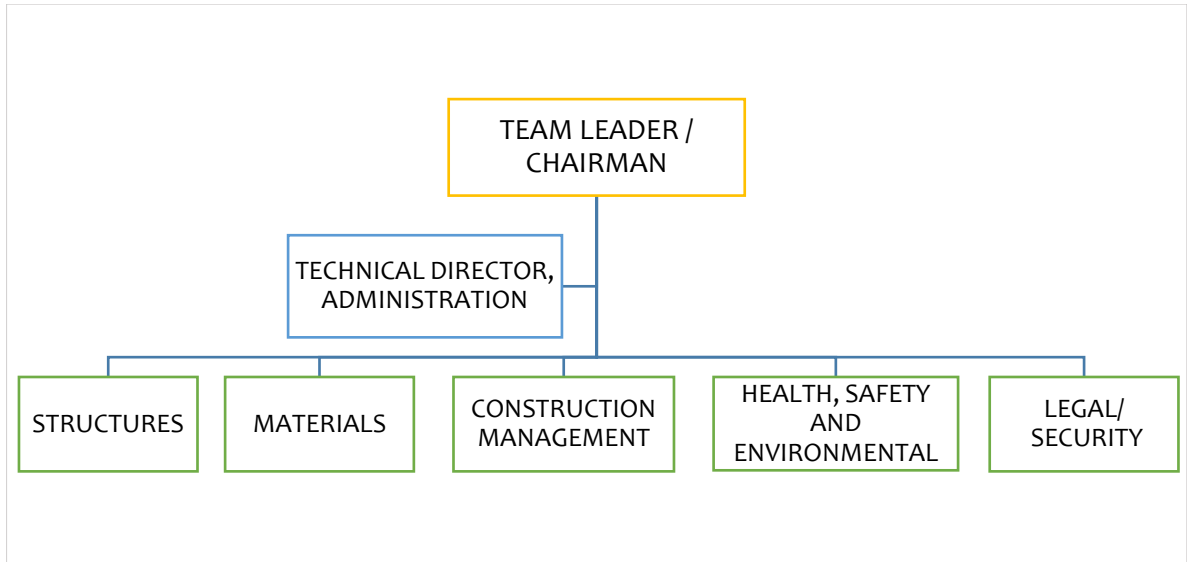
- Identify the cause(s) of the collapse; and
- Recommend appropriate measures to guide future construction activities of the EDAIF Tower.

This report presents the Technical Committee's approach and methodology for carrying out the investigations, findings of the investigation and the proposed recommendations to guide this and future construction.

2. METHODOLOGY

As part of the approach to fulfilling the objectives of the assignment, the Technical Committee was divided into six teams as depicted in Figure 2-1 to enable effective conducting of the investigations.

Figure 2-1: Structure of Technical Committee



The list of the Technical Committee members and their respective teams are shown in Table 2-1.

Table 2-1: Composition of Technical Committee

Sub-Teams	Names	Designation
Committee Chairman	Ing. Joshua Allotey	Engineer, MGhIE
Structural	Dr. Cyprain Wenyonu (Leader)	Engineer, MGhIE
	Ing. Robert Owoo	Engineer, MGhIE
	Ing. Nii Armah Tagoe	Engineer, MGhIE
	Ing. Florence D. S. Mensah	Engineer, MGhIE
	Ing. Richard Ofori-Addo	Engineer, MGhIE
	Ing. Beverly N. A. Okai	Monitoring Consultant's Rep. & Engineer, MGhIE
	Ing. Carlien Bou-Chedid	NADMO Rep. & Engineer, FGhIE
Materials	Ing. Bonne Acquah (Leader)	Engineer, MGhIE
	Ing. Joseph Oddei	Engineer, MGhIE
	Ing. Fiifi Yawson	Engineer, MGhIE
Construction Management	Kobina Baidoo (Leader)	Management Consultant
	Ing. Joshua Allotey	Engineer, MGhIE
	Ing. Fiifi Yawson	Engineer, MGhIE
	Frank Adjei	National Security
	ACP Sabina Osei-Bonsu	Divisional Police Commander
	DSP Reuben Dugah	Ghana Police Service

Sub-Teams	Names	Designation
Health, Safety and Environment (HSE)	Jonathan Antwi (Leader)	HSE, NADMO
	Dr. D. Aryee Boi	Engineer, MGhIE
	Kobina Baidoo	Management Consultant
	ACP Sabina Osei-Bonsu	Divisional Police Commander
	Frank Adjei	National Security
	DSP Reuben Dugah	Ghana Police Service
Legal / Security	Nana Asmah (Leader)	Lawyer
	ACP Sabina Osei-Bonsu	Divisional Police Commander
	DSP Reuben Dugah	Ghana Police Service
Administration	Dr. Aryee Boi (Leader)	Engineer, MGhIE
	Ing. Florence D. Sam Mensah	Engineer, MGhIE
	Allan Kyekye	Photographer
	Security Officers	Ghana Police
	Felix Tetteh	AMA Representative

Prior to commencement of the assignment, the Contractor, Amandi Holdings Ltd., was issued with a check list of documents required aid in the investigations. The list of documents provided by the Contractor is attached as Appendix A.

The various teams provided a work schedule of activities to be undertaken throughout the investigations. During the period of the investigations, meetings were also held by the Technical Committees to discuss progress and methods for carrying out the investigations. Minutes of meetings are attached as Appendix B.

Activities carried out by each Team are discussed under the following sub-headings.

- Material Investigations;
- Structural Investigations;
- Construction Management;
- Health, Safety and Environment; and
- Legal and Security.

2.1 MATERIAL INVESTIGATIONS

The material assessment was carried out to provide quality control and quality assurance information required for the investigation and evaluation of the as-built works.

2.1.1 Scope

The scope for the material investigations is as follows:

- Site visit/reconnaissance;

- Desk Study;
- Fieldwork;
- Laboratory testing; and
- Submission of technical report.

2.1.1.1 *Site Visit/Reconnaissance*

The material team had its initial site visit on 23rd November 2015. The visit offered the team the opportunity to assess prevailing site conditions after the partial collapse, which will influence its field activities. The Team had access to the ground floor columns and mezzanine floor area and obtained the following from the site visit:

- Concrete core samples from the mezzanine floor;
- Schmidt hammer readings from the mezzanine floor and the ground floor columns;
- Steel prop, plywood and timber joist samples;
- Steel bars (reinforcements) samples – un-used and used batches within the collapsed section.

2.1.1.2 *Desk Study*

As part of the investigation into the probable cause of the partial collapse, a desk study was carried out on the contractor's general quality control/quality assurance scheme and documentation. The material testing sub-committee assessed the quality and mechanical properties of the following materials:

- Placed Concrete;
- Reinforcement (sizes available on site);
- Formwork plywood;
- Timber joist; and
- Shoring (props).

The following information received from the contractor were also reviewed:

- Steel bar (reinforcements) test results;
- Certification for plywood board;
- Concrete test results;
- Geotechnical report;
- Props test results; and
- Project quality plan.

2.1.1.3 Fieldwork

In order to verify the quality and mechanical properties of construction materials, the team relied on the use of both destructive and non-destructive testing methods.

The tests undertaken to assess concrete compressive strength were a combination of crushing of in-situ concrete core samples and Schmidt hammer testing. Three concrete core samples were obtained within the mezzanine floor slab. Five sets of Schmidt hammer recordings on the mezzanine floor slab and ten sets of Schmidt hammer recordings on randomly selected ground floor columns were taken.

2.1.1.4 Laboratory Test

Laboratory tests comprised:

- Tensile strength test on steel reinforcements (39No in total) - it comprised both used and un-used samples;
- Compressive strength test on concrete core samples;
- Strength tests on formwork plywood, I-section timber joist and props.

The tests were to assist the structures team in the evaluation of the contractor's formwork system design.

2.2 STRUCTURAL INVESTIGATIONS

The methodology adopted for the assessment was as listed below:

- Site survey to check formwork arrangement such as alignment; spacing, bracings and method of fixing;
- Review of prop calculation report submitted by the contractor;
- Discussion of report with contractor;
- Determination capacity of the props;
- Review of prop arrangement;
- Exploration of the possible causes of the collapse including:
 - o Poor design;
 - o Adequate design, but poor construction; and
 - o Adequate design, adequate construction but poor usage.

2.3 CONSTRUCTION MANAGEMENT

The scope of the Construction Management team's work was as follows:

- To investigate the defined management structure of the project site team;

- Establish roles and responsibilities of project site team prior to and during concreting;
- Investigate project site controls;
- Establish existing communication protocols;
- Identify elements of project and construction management likely to give rise to disputes and claims, i.e. pay policy, overtime policy, workers compensation policy as per the labour laws of Ghana and staff Welfare.

To achieve the above, the team set out to look for the Contractor's policies in the following areas:

- Project Management Planning;
- Cost Management;
- Time Management;
- Quality Management;
- Contract Administration; and
- Safety Management.

The team reviewed literature provided by the Contractor and conducted interviews with selected staff members.

2.4 HEALTH, SAFETY AND ENVIRONMENT

The scope of works for the team was to look for answers to the following:

- What happened?
- Who got injured?
- Was the injured doing the right thing? If not who was responsible for the mishap?
- Who, besides the injured, was involved?
- What was the extent of the injury?
- What materials were destroyed?
- Does it need repairs before being put to service again?
- The culpability must be established where necessary.

Based on the above, the team assessed the Contractor's:

- Environmental awareness training programs carried out to sensitize workers on the need to follow laid down procedures at the construction site;

- Provision of appropriate Personal Protective Equipment (PPE);
- Provision of well-stocked first aid kit for minor injuries that may occur on site; and
- Measures to ensure the use of the crane does not pose any threat or nuisance to neighbours.

2.4.1 Thematic Areas of Assessment/Inspection

The Assessment/Inspection of defective site was in ten (10) thematic areas:

- Good Housekeeping procedures;
- Environmental conditions;
- Manual handling;
- Welfare Facilities;
- First Aid Facilities;
- Safety Signage/ Colour Code;
- Working with hazardous Substances;
- Personal Protective Equipment (PPEs);
- Emergency/Evacuation Response Plan and Procedures; and
- Documentation and Procedures.

The team sighted ten (10) documents relevant to the entire operations of Amandi/EDAIF projects. These guided the incident investigation. The documents included:

- Traffic Impact Assessment;
- Health and Safety Report;
- Fire Permit;
- Health & Safety and Environment Policy Manual;
- Safety Pocket Guide;
- Risk Assessment;
- Environmental Report;
- Insurance Policy;
- Organogram; and
- Time-Table for HSE training.

Questionnaires and inspections forms used for the investigations are attached as Appendix C.

2.5 LEGAL AND SECURITY

A Technical Committee was instituted to investigate the cause of the accident. The role of the Security and Legal Team was:

- To ensure that evidence at the construction site (hereinafter called "the Site") was secured: this was achieved by:
 - o the Ghana Police Service cordoning off the Site to prevent movement of material from the Site,
 - o the Technical Committee halting all work at the Site, including preventing the removal of debris from the Site, to enable the various technical sub-committees to fully collect evidence;
- To follow the progress of the investigations of the various technical teams in order to gain a better understanding of the probable cause of the collapse.
- Another aspect of the Security and Legal Team's work was to ensure that the integrity of the investigations is maintained in an atmosphere where Amandi is offered an opportunity to witness aspects of the investigation. This was intended to provide a fair and candid fact-finding process within which Amandi would be offered an opportunity to respond to any questions that may arise.

3. FINDINGS / DISCUSSION OF RESULTS

After the procedure listed in the previous section had been completed, the teams made some observations and analysis based on their findings. These observations are enumerated in this section.

3.1 MATERIAL

3.1.1 Interview Response

The interview conducted and responses received are collated and presented in Table 3-1.

Table 3-1: Interviews and Responses

ID	Questions	Responses
1	Cement type and class used	Ghacem Ordinary Portland Cement and 42.5N strength class
2	Strength specification for concrete structural members	walls/columns (37MPa), slabs (30MPa), Beams (30MPa)
3	Steel reinforcement information	High tensile grade; sources: B5 in Ghana and Arcelor Mittal in Ukraine
4	Testing laboratories for steel reinforcement and concrete cubes	Ghana Standard Authority and Amandi's laboratory respectively. Monitoring Consultant observes concrete cube testing
5	Admixture used	Masterpozzolith R132, a retarder and glenium 27, a plasticizer which increases workability
6	Any trial mix activity for concrete works	Yes, trial mix carried out to estimate mix design ratios
7	Any concrete curing activity	Yes, curing done using a composite geomaterial. The last curing of the completed section of the mezzanine floor slab was before the collapse.
8	Is concrete batching in situ or otherwise	Concrete batching was not in-situ. Amandi Ltd batch site at Dunkonah, near West-Hills shopping Mall produces concrete
9	Poker vibrator used during concrete placement	Yes
10	Quarry construction materials	Coarse aggregates for concrete works from a quarry at Shai Hills
11	Foundation type and depth	Raft at 8.50m below existing ground levels

3.1.2 Desk Study

The desk study revealed the following information:

- SUMEC International Technology Co. Ltd from China tested the plywood. The report reference number is 15 - 1208, and test conducted between 3/8/2015 and 15/8/2015. The test result indicated that *bending strength in the longitudinal and cross grain directions are 43MPa and 31MPa respectively. Moduli of elasticity are 4326MPa and 5821MPa in the respective directions.*
- ISOTOP Ltd tested the shoring prop for two different heights. The heights are 3.0m and 3.5m. Three samples were tested for each length. Maximum loads recorded at the 3.0m height are 25.9kN, 23.8kN and 26.2kN. Similarly, maximum loads recorded at the 3.50m height are 19.3kN, 24.9kN and 21.7kN.
- Amandi Ltd tested the concrete samples in their laboratory. Test results inspected include retaining walls, foundation footing and ground floor columns among others. The test results inspected indicated strength values that satisfy design specifications.
- Other tests conducted included some physical and mechanical properties of coarse and fine aggregates.
- The project quality plan was inspected. The plan states procedures to follow to ensure compliance to quality control performance.
- Geotechnical report for the project was assessed. Foundation depth and type followed the recommendation in the report.

3.1.3 Fieldwork

Results of the Schmidt Hammer test are shown in Appendix D. Field test indicated the following results: For estimating concrete quality, the rebound values recorded in conjunction with the table below is used as a guide.

Table 3-2: Rebound Values vs Quality of Concrete

Average Rebound	Quality of Concrete
>40	Very good
30 – 40	Good
20 – 30	Fair
<20	Poor and / or delaminated
0	Very poor and/or delaminated/ full of void

The representative rebound value “ R_a ” per test point was obtained from taking the average of ten (10No) localized individual rebound readings. A calibration factor, in this case 1.18, multiplied

by the average rebound hammer values gives the corrected values. From the average of the recorded rebound values i.e. $R_a = 46$, for concrete with age in excess of 28-days (ground floor columns), and with reference to the table above, it was the opinion of the materials team that the quality of the contractors' concrete can be considered as **“very good”**.

Schmidt hammer tests were performed to estimate concrete compressive strength.

- Schmidt hammer test results on ground floor columns indicated strength values between 51MPa and 55MPa. Average and standard deviation values are, approximately, 54MPa and 1.4MPa respectively. The coefficient of variation for the values is 2.6%. This means the level of variation in concrete strength for the columns is insignificant. Therefore, average strength value is appropriate for any structural assessment. The concrete age was more than 28-days at the time of testing.
- The corridor section, of the mezzanine floor slab - 200mm thick, indicated 18.5MPa for a ten-day strength using the Schmidt hammer. Again, the mezzanine floor slab - 400mm thick indicated strength values between 17.0MPa and 20.0MPa. The average value was, approximately, 18.5MPa. The average value indicates that the level of strength development was satisfactory and the concrete is likely to attain the required 28-day cube crushing strength.

3.1.4 Laboratory Testing

Laboratory test indicated the following results:

Three concrete core samples from sections of the mezzanine floor slab were tested for compressive strength. The diameter of the cores was 95mm. The trimmed length for testing was 195mm. The length correction factor of 1.11 multiplies the laboratory strength values to obtain the standard strength. Further, a factor of 1.25 multiplies the standard strength in order to obtain equivalent cube strength. The concrete age of the cored samples was thirteen (13) days; thus, the corresponding assessed equivalent cube strengths were 12.72MPa, 15.66MPa and 16.64MPa. Average value is 15.01MPa. It should however be noted that, generally, in-situ concrete strength test results are expected to be approximately 80% of the compressive strength of its equivalent cube sample cured under ideal conditions. In this case, for the characteristic design strength of 30MPa slab mix, the theoretically expected in-situ compressive strength at thirteen (13) days was approximately 16.8MPa; thus, the average compressive strength value i.e. 15.01MPa is within acceptable limits of our expectations. Laboratory test results for concrete core samples are attached as Appendix E.

The various sizes of steel reinforcement bars used within the collapsed mezzanine floor section, after tensile testing, gave the following results at yield point presented in Table 3-3.

Table 3-3: Used Rebars Sizes and Strength

Size	Strength
10mm	567.21 - 577.30MPa
12mm	587.26 - 588.32MPa
14mm	522.34 - 529.03MPa
16mm	516.11 - 517.23MPa

The various sizes of un-used steel reinforcement bars, after tensile test, gave the following results at yield point presented in Table 3-4.

Table 3-4: Un-used Rebar Sizes and Strength

Size	Strength
8mm	410.95 - 430.09MPa
10mm	580.48 - 582.27MPa
12mm	586.37 - 605.09MPa
14mm	671.47 - 678.32MPa)
16mm	512.03 - 513.48MPa
18mm	515.53 - 520.15MPa
20mm	556.46 - 558.73MPa
22mm	595.00 - 610.05MPa
25mm	595.31 - 507.45MPa

With the exception of the 8mm sizes, all other steel reinforcement bars exceeded the minimum required yield strength (460MPa) for high tensile grade reinforcement. Thus the 8mm sizes bars were consequently considered to be mild steel (yield strength < 460MPa). Laboratory Test results are for steel reinforcement are attached in Appendix E.

3.2 STRUCTURAL INVESTIGATIONS

Based on the work programme provided, the Structures team explore all the possible causes of the partial collapse, namely:

- Poor design;
- Adequate design, but poor construction; and
- Adequate design, adequate construction but poor usage.

After the work of the Structures Team, the following results were obtained.

- On the basis of poor design – there exists a peer review report of the design which was reviewed and suggested that the design of the structure was competently done.

- On the basis of Adequate design, but poor construction – the team’s investigation showed that an over-dependence on the word of a product supplier without further independent checks and a failure to properly fix and brace the props for the formwork, contributed to the collapse of the props and subsequently the section of the floor that was still under construction.
- On the basis of Adequate design, adequate construction, but poor usage –there was no basis to consider or comment on this point, since the building was still under construction.

The section of the mezzanine floor that collapsed is bounded by gridlines 6, D, 10 & G. The thickness of the slab at this section is 400mm with total volume of concrete being approximately 111.91m³, constituting a concrete weight of 2,685.78kN. The partial collapse was as a result of the failure of the props supporting the formwork at the soffit of the slab.

The Structures Team reviewed the calculations submitted by the supplier of the steel props. The supplier of the props made a presentation of his calculations to the Technical Committee. One of the results of the calculations presented showed a vertical displacement of 206.1mm. The Prop Supplier was however, unable to explain what accounted for that huge displacement. He also did not state the standard to which his company’s props were manufactured.

The Steel Prop Supplier promised to revert to the committee at a later date with justification for this anomaly but failed to do so. However, he submitted a new calculation report, which has been reviewed by the Technical Committee, and found not acceptable (see Appendix F for reports).

Generally design standards for steel props include tables that show a relationship between the safe working loads for props and the length of props for various loading and support conditions. This facilitates the specification of the spacing of the joists and the props to achieve an optimal propping configuration.

Using Euler’s Column Formula (Equation 1) for the buckling of columns under axial loads, the critical buckling loads for the steel props were calculated for various heights of props.

Equation 1: Euler’s Column Formula

$$f_b = \frac{n\pi^2 EI}{l^2}, l = \text{length of the prop (m)};$$

f_b = buckling load (kN); n = end conditions factor;
 E = modulus of elasticity(kN); and I = moment of inertia;

With the support or end conditions of the pipes, the section properties (sectional area, radius of gyration, moment of inertia), and the Young's modulus of elasticity remain constant, a simple relation between the buckling load and the height of prop was established.

Equation 2: Simple relation between the buckling load and the height of prop

$$f_b = \frac{139}{l^2}, l \text{ is the length of the prop in metres and}$$

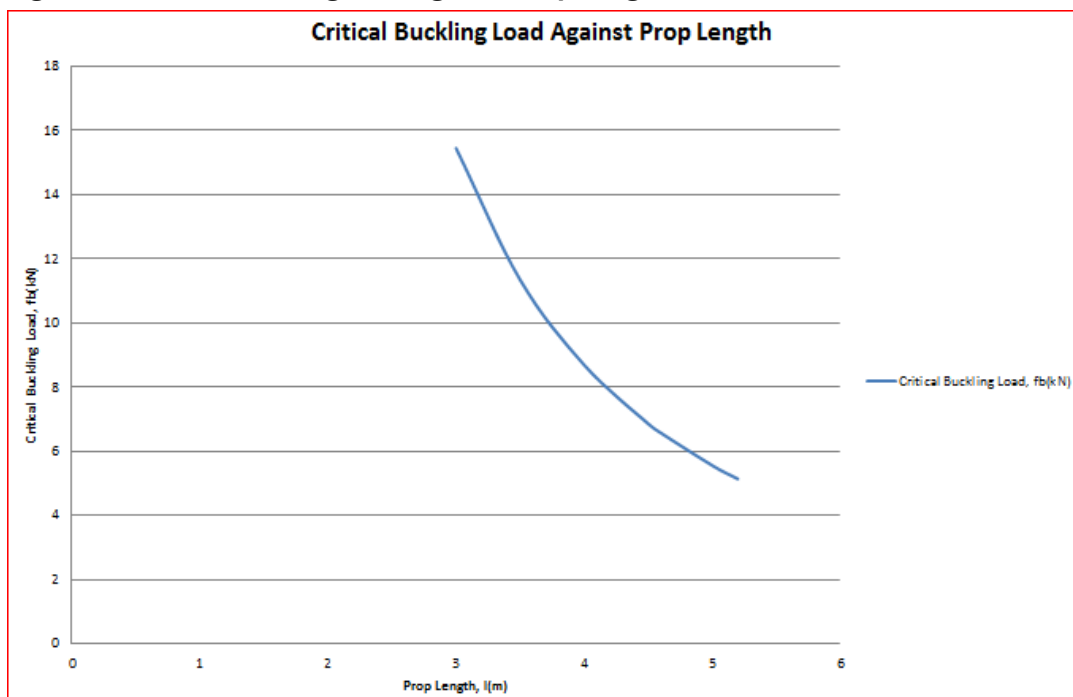
f_b is the buckling load in KiloNewton.

Table 3-5: Critical Buckling Load against Prop Length

Prop Length, l(m)	5.2	5.0	4.6	4.5	4.0	3.5	3.0
Critical Buckling Load, f_b (kN)	5.14	5.56	6.57	6.86	8.69	11.34	15.44

Figure 3-1 is a graph showing the relationship between the critical buckling load and the length of the steel prop. The graph is based on data from **Error! Reference source not found..** The relationship is an inversely proportional one and as such, the load carrying capability of the prop reduced rapidly from 1.5tonnes stated by the supplier once the height of the prop increased. For normal construction where the floor-to-floor heights rarely exceed 3.5m, 3m lengths of props can easily be used to support the quoted load of the prop.

Figure 3-1: Critical Buckling Load against Prop Length



The Structures team also noted that the props were not properly fixed in place: non-verticality, inadequate and improper bracing and irregular spacing. It was instructive to note that the use of timber joists secured by binding wire was a poor attempt at bracing the falsework and offered very little resistance to the collapse of falsework. Certain props were supported off other timber joists that were themselves supported on props.

The original arrangement of the props resulted in the base being considered fixed and the top being free. This particular arrangement of props with props supported on joists constituted a hinge that presents a condition that was not allowed for in the original design of the prop.

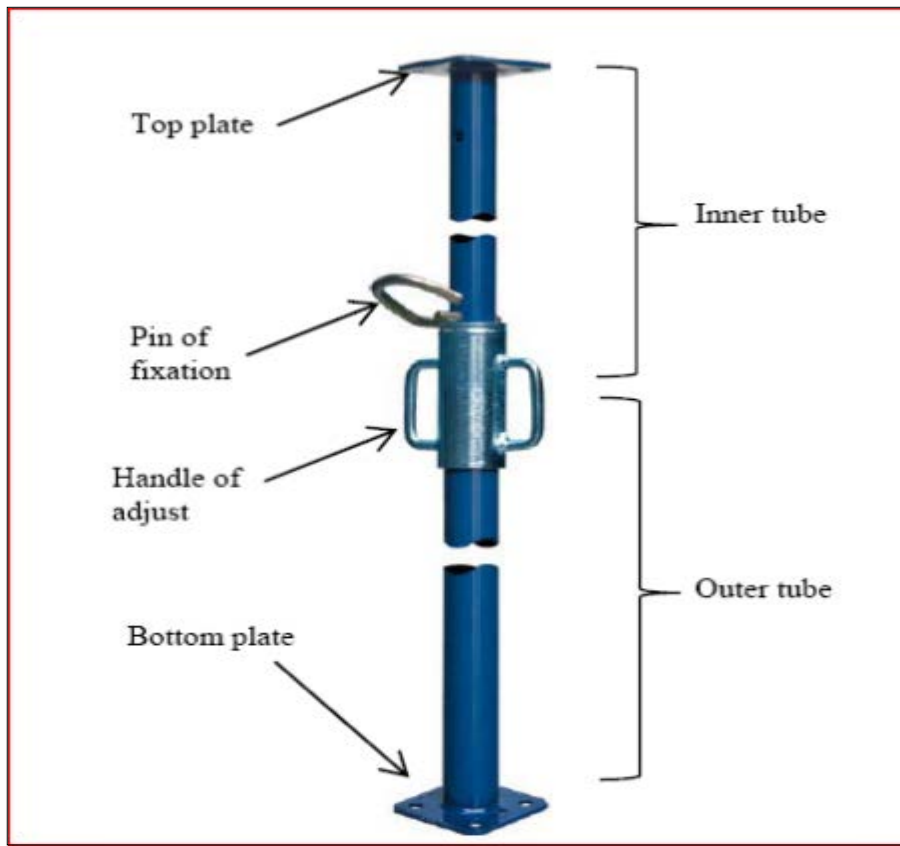
After relating the critical buckling load to the length of prop, the team calculated the applied load that the supported concrete imposes on each prop assuming certain prop spacing. The parameters used to calculate this applied load on the props assumed the unit weight of cured reinforced concrete instead of the unit weight of green concrete. No construction load was applied though in reality, a construction load of 0.75kN/m^2 plus 10% of the self-weight of the slab should have been added to account for the periodic short-term heaping of concrete during casting.

It is clear from assumptions made by the Structures Team that loads obtained on each prop would be lower than the large construction load that in all likelihood exists during the construction. Nonetheless, the calculations of the Structures Team shows that a spacing of $900\text{mm} \times 900\text{mm}$ imposes a load of 7.776kN which is in excess of the critical buckling load of 6.86kN which relates to a prop height of 4.5m . In reality, the load that would have been imposed on the prop would have been higher than stated here. Also, by the principles of limit state design, the critical buckling loads of the props should be reduced by the use of a suitable factor of safety to make for a safe design.

Figure 3-2 is a picture of a typical adjustable steel prop with the various parts well labelled. When fixing adjustable steel props, it was the expectation of the members of the Structures Team that the props would first be adjusted to a height reasonably close to the fixing height. The *pin of fixation* would then be slotted into the appropriate opening to lock the two parts of the prop together. The prop would then be positioned properly and steps taken to ensure that the prop is not out of plumb, i.e. truly vertical. Subsequently, the *handle of adjustment* would be turned to adjust the height of the prop till the top plate is at the correct level. In cases where the height of the props exceeds 3m , it is conventional to brace the props adequately to ensure safety.

Figure 3-2: Parts of a Steel Prop

(Source: IACSIT International Journal of Engineering and Technology)



In the case of the EDAIF Tower, it was observed that the bracing was virtually non-existent. Figure 3-7Figure 3-8 are pictures that show the various attempts to brace the props. Several props were out of plumb by more than 1.5° . The prop spacing was also not uniform.

Figure 3-3: Props severely out of Plumb



Sample of Adequately braced Falsework



Figure 3-4: Props with Clearly Defined Handle of Adjustment



Figure 3-5: Different type of Pin of Fixation



Figure 3-6: Props supported off Joists



Figure 3-7: 'Bracing' of Props



Figure 3-9: 'Bracing of Props – Another view



3.3 CONSTRUCTION MANAGEMENT

3.3.1 Preliminary Observations/Findings

The team's findings were qualitative. The findings were based on site visits and interviews conducted with selected staff, guided by the literature provided by the Site Administrator (see Appendix G for list of relevant policy documents). The team's findings were in two folds, namely, general and incident related.

3.3.1.1 General

- Documentation – Human Resource policy documents such as the Health, Safety and Environment Policy and the Risk Assessment Document were available;
- There was a big disconnect between the group human resource manager and the management of this site;
- Two groups of staff were identified, casual and permanent staff;
- The site has a workman's compensation policy provided by Vanguard Assurance;
- Pay Policy is well defined. This is based on the particular day a worker reports for work in a week and also takes account of staff who work on statutory holidays and weekends;
- According to both staff and workers interviewed, overtime is non-obligatory;
- Starting times and closing times were well defined and any extended time after closing has a well-defined compensation regime;
- There were visible health and safety signage at the entrance of the site.

3.3.1.2 Accident Related

- There is no clarity about what exactly the deceased was doing under the area where concrete was being poured. The following were collated from various group of worker:
 - One narration is that he was hiding there to have a meal;
 - Another is that he was helping check if the platform above was leaking ;
 - Another says he was actually detailed to be downstairs in the basement but was skiving;
- There were inadequate props and jacks which necessitated a day's delay in hoisting them.
- The Request for Site Inspection for the day of the accident, was not signed because the representative of the monitoring structural engineering consultant was not on site at the time of casting. He claimed he requested that he should be called before casting of the concrete began.

- Notably, none of the supervising officers (Project Manager, Site Engineer, Masons' Foreman, and Carpenters' Foreman) were within the immediate vicinity of the accident scene when it occurred except the Site Manager.

3.3.2 Analysis of Findings

- In the matter of the site management team's act of omission or commission, potentially leading to the accident, our investigation cannot be conclusive. However, it appeared that there was laxity on the part of the structural engineering site consultant in responding to the Request for Site Inspection (RSI). In some cases Request for Site Inspection is signed off-site which is not within the Construction industry's best practice;
- The findings seem to suggest that there was delay in the supply of the remaining props and jacks, which led to a short lead-time to commence the pouring of concrete;
- Looking at the program of work, there is a delay in delivery time. However, we did not see a revised Work Program to accommodate the lag time;
- There is no evidence of staff dissatisfaction over pay delays or non-payment for work done;
- Site documentation covers quality management, risk control, health, safety and environment policy and project management policy.

3.4 HEALTH, SAFETY AND ENVIRONMENT

Incidents of this nature can rarely be attributed to just one cause. The following are some of the factors in this instance:

- Work environment (inadequate space resulting in the haphazard arrangement of materials in the yard etc).
- Supply constraints (untimely supply of materials for the falsework resulting in a hasty approach to the fixing of the falsework and formwork).
- Inadequate supervision of work (Inexperienced safety officer on duty).

3.4.1 Incident Analysis

Generally, determining the risk level of EDAIF Project, several factors were taken into consideration. These were:

- The location of the project;
- Usage of the structure;
- Number of persons that will be found in the building at any given time; and
- The kind of materials being used during and after construction.

The location of the project within the Ambassadorial Enclave by default is of high risk. This is due to the nature of building facilities and activities around the project premises. However, the impact of the EDAIF project on the environment is of **moderate risk** level.

Risk is the likelihood of harm occurring together with an indication of how serious that harm could be to either the people or facility under investigation. Table 3-6 below shows the levels of risk and action description in the health and safety impact analysis.

Table 3-6: Risk level and the appropriate actions needed.

Risk Level	Description
Very Low risk	Local investigation where appropriate
Low risk	Contributory factor(s) to be identified; discuss with local management the need for any changes in practice, policies, procedures, education or training.
Moderate risk	Identify contributory factors. Discuss at the local governance meeting. Action plans to be monitored centrally.
High risk	Report incident immediately to manager/head of department. Inform risk manager. Full investigation to be undertaken including interview with staff and identification of root causes. Action plans to be monitored centrally.

The likelihood of the incident (fatalities and injuries) recurring is very low taking into account feedback received from site visits, questionnaire, interviews and documents reviewed from Amandi in respect of health, safety and environment. With reference to the Incident Investigation Form, Workplace Health & Safety Inspection Form and Questionnaire, Amandi had largely adhered to best practice procedures on health, safety and environment on the site. The risk level, therefore, is generally low.

3.4.2 Challenges

Challenges on projects, may be identified before, during and after execution. Per the analysis, the following were noted on the EDAIF project:

- Inadequate space within the project enclave, to ease movement of persons and materials;
- Only one safety officer was on the project site;
- Unavailability of Incident Investigation Files;
- Some medical examination records/file could not be produced;
- Signage were inadequate and sparsely posted on the site;
- The First Aid Kit was unkempt and had inadequate medications;
- The basement of the crane had no caution tape to serve as warning to persons working around it; and

- Absence of emergency response plan and procedures.

4. CONCLUSIONS AND RECOMMENDATIONS

4.1 MATERIAL INVESTIGATIONS

4.1.1 Conclusions

The compressive strengths of the concrete tests were satisfactory. With the exception of the 8mm sizes, all other steel reinforcement bars exceeded the minimum required yield strength (460MPa) for high tensile grade reinforcement.

4.1.2 Recommendations

- For concrete cube strength test, confirmation by an independent laboratory is important.
- Template for concrete cube test is not consistent. Therefore, all concrete cube tests should be on a standard template.

4.2 STRUCTURAL INVESTIGATIONS

4.2.1 Conclusion

The investigations revealed that the adjustable steel props used for the construction of the mezzanine floor of the EDAIF Tower were improperly fixed. The props were out of plumb, not properly braced and irregularly spaced. This implies that there were varying loads on each prop. Safe Working Load tables provided by many manufacturers and formwork standards show the maximum load that should be imposed on each prop.

Several calculations have been advanced that established that due to the length of the props, failure by buckling was inevitable. The 1.5tonnes as a capacity for the props to be used at 5.2m height with a diameter of 64mm is misleading. A column of 5.2m height and 64mm diameter should be analysed as a slender column which fails in buckling. Buckling should therefore be used to determine the capacity of the props.

The Supplier, providing a 1.5tonnes (15kN) as the capacity for the props; indicated to the Contractor that the props will buckle under a load of 1.5tonnes. Computations from the Committee show that the props of height, 5.2m of the same diameter, at spacing 900mm x 900mm have buckling load of 0.514tonnes. The partial collapse of the mezzanine floor of the EDAIF Tower was found to be as a result of buckling of the steel props.

4.2.2 Recommendations

- The monitoring or supervising consultants should enforce approval of design of formwork and falsework and subsequent fixing on site;

- Authenticated Reports of the monitoring or supervising consultants should form part of the evaluation processes leading to the issuance of a building permit certificate for public buildings, school buildings, hospitals, places of worship and buildings where large crowds congregate;
- All engineering structures, whether buildings, props, or formwork etc. regardless of origin of supplier or production, should be certified by a professional engineer of good standing with the Ghana Institution of Engineers;
- The Engineering Council Act 2011, Act 819, should be enforced to the letter by all Metropolitan, Municipal and District Assemblies (MMDA). This is the key to minimising or avoiding incidents of this nature;
- A traceability system should be established for all construction materials; and
- Ghana Standards Authority should develop stringent standards in conjunction with the Ghana Institution of Engineers for the certification of formwork and props and similar items and approval of promotional literature.
- The AMA and other Assemblies should make it a requirement for designs done outside Ghana to be reviewed by Professionals within Ghana so that local peculiarities such as earthquake and wind loadings are properly addressed.

4.3 CONSTRUCTION MANAGEMENT

4.3.1 Conclusions

- The site's policies are well documented but the legal department is advised to ensure that headings, wordings and addresses conform to legal entity's details as outlined in the project management document and also the billboards as displayed for the avoidance of doubt;
- Staff welfare is being met progressively and do not seem to have contributed to the incident;
- The site conforms to the PNDC Law 187 on Workers Compensation and have a policy with Vanguard Assurance which is presently valid, thus it is envisaged that the affected workers shall be duly compensated.
- Management informed us that the family of James Quashigah, the deceased, has formally been informed of his death. The Human resource manager informed us that the family has been advised to present a funeral expense for consideration.

4.3.2 Recommendation

- It is recommended that a further investigation be conducted into how completed phases of work are signed off;
- It is also recommended that health and safety issues should go beyond PPEs and include improvement in health messages and signage. Particular need is a designated area for smoking as per the health and safety policy document of Amandi Holdings to stem passive smoking;
- It is recommended that storage of potential hazardous materials such as sharp edged materials (e.g. iron rods) around exits should have visible warning signs and where possible sealed to avoid falls and cuts;
- Human Resource Manager – It is recommended that the human resource manager should have a physical working presence with the site to answer worker/management issues, explain policy, raise morale albeit periodically and to formulate a site specific sub-policy driven by the expectations of all stakeholders;
- Adequate data of ALL persons who have at least a day's relationship with the site should be captured; and
- Social Security and National Insurance contributions should be **Compulsory**. It should not be left to the discretion of the workers, especially the casual or contract workers.

4.4 HEALTH, SAFETY AND ENVIRONMENT (HSE)

4.4.1 Conclusion

Documentary investigations and interviews conducted on site showed that, the EDAIF project has a low risk level in respect of health, safety and environment. The incident could be classified as an accident and not a disaster.

4.4.2 Recommendations

The Technical Committee recommends that Amandi as a contractor for the above-mentioned project takes note of the following:

- Consider Post Emergency Rapid Assessment on project site;
- Have at least two qualified HSE officers to take responsibilities of Health & Safety and Environment Issues;
- Have an Emergency Response Plan and Procedures to handle any possible emergencies that may arise on the site;

- Have well stocked first aid medications available for emergencies;
- Have bi-annual general trainings on Occupational Health and Safety Management for both permanent and contract staff; and
- Have simulation exercises and drills to test the level of preparedness of workers on site.

APPENDICES

APPENDIX A

LIST OF DOCUMENTS PROVIDED BY CONTRACTOR

**STRUCTURAL ENGINEERING INVESTIGATIONS INTO THE COLLAPSE OF THE MEZZANINE FLOOR OF THE EDAIF 16-STOREY
TOWER UNDER CONSTRUCTION**

Status of Items Required from the Contractor

ID	Items	Received (✓) / Not Received (-)		
		Soft Copy	Hard Copy	Remarks
1	Architectural drawings	✓	✓	
2	Structural drawings	✓	✓	
3	Project Management Plan	-	-	Yet to be received. Contractor needed clarification on the document required
4	Work Programme	✓	✓	
5	Project Register	✓	✓	
6	Risk assesment/analysis and proposed risk response report/plan	✓	✓	
7	Quality plan, Quality Assurance and Control plan	✓	✓	
8	Attendance book	✓	✓	
9	Visitors book	-	✓	Hard copies only
10	Construction album (Pictures)	✓	✓	
11	Accident registration book / register	✓	✓	
12	Insurance certificate of staff/workers	✓	✓	
13	Status/progress report (weekly/periodic)	✓	✓	
14	List of Construction Engineers (qualifications, contacts, Country of origin)	✓	✓	
15	List of Consulting Engineers & Architects - qualification, contacts, country of origin	✓	✓	
16	List of Project Management	✓	✓	
17	List of Technicians - qualifications, contacts, country of origin	✓	✓	
18	List of Workers (foremen, artisans, carpenters, steel benders, helpers, mason, etc.)	✓	✓	
19	Material Test Certificates - concrete	✓	✓	
20	Material Test Certificates - iron rods, bending wire, etc	✓	✓	
21	Material Test Certificates - timber , formwork-beams, formwork plates, scantlings, etc.)	✓	✓	Specs and Certificate received
22	Material Test Certificates - metal props	✓	✓	Specs and Certificate received
23	Authorizaiton Certificate to Work - from HSE	✓	✓	
24	Saftey and Health procedure/manual	✓	✓	
25	Saftey and Health training certificate	✓	✓	
26	Technical training of workforce (certificate)	✓	✓	Training document receieved, with no certificates
27	Fire Drill certificate	✓	✓	
28	Cubes prepared for the collapsed floor	✓	✓	
29	Structural Design calculation	✓	✓	
30	Soil report	✓	✓	
31	Request for Information from Contractor	✓	✓	
32	Formwork drawings	✓	✓	
33	Structural Analysis Reports and Certificate	✓	✓	
34	Additives for concrete	✓	✓	
35	Contract Document	-	✓	Hard copies only
36	Peer Review report	-	✓	Hard copies only
37	Soil/Geotech report	✓	✓	
38	Site/block plan	-	✓	
39	Formwork plan	✓	✓	

APPENDIX B

MINUTES OF TECHNICAL COMMITTEE MEETINGS

Project Name: EDAIF Tower, Accra-Ghana

Technical Committee, Undertaking the Investigation of the Collapse of the Mezzanine Floor of the EDAIF 16-Storey Tower Under Construction

Subject: Meeting No. 1

Time: 10:00am

Date: 24th November, 2015

Venue: Meeting Room 3; Movempic Hotel, Accra

01.10	ATTENDANCE				
	ID	NAME	DESIGNATION	Telephone	Email
	1.	Joshua Allotey	Team Leader TC	0244241295	jnmallotey@hotmail.com
	2.	Dr. Aryee-Boi Desmond	Technical C'ttee	0269840291	daryeeboi@yahoo.com
	3.	ACP Sabina Osei-Bonsu	Divisional Police Commander	0208199365	sabbons@yahoo.com
	4.	DSP Reuben Dugah	Div. Crime Officer	0244815688	kluyaodugah@gmail.com
	5.	Robert Owoo	Technical C'ttee	0244269789	rob_owoo@yahoo.com
	6.	Nana Asmah	Legal / HBAB	0244273130	nana.asmah@hayfronaddobarry.net
	7.	Nii Armah Tagoe	Technical C'ttee	0246258166	niiarmahtagoe@gmail.com
	8.	Joseph Oddei	Technical C'ttee	0244726164	joddei@outlook.com
	9.	E. N. Bonne Acquah	Technical C'ttee	0208120613	bonneakwa@yahoo.com
	10.	Fiifi Yawson	Technical C'ttee	0272588788	fiifi.yawson@gmail.com
	11.	Kobina Baidoo	Technical C'ttee	0267046666	kobdem@gmail.com
	12.	Reuben Ayite	Technical C'ttee	0548273145	reubenayiti@.com
	13.	Felix Tetteh	AMA - MWD	0244658586	flexb2006@yahoo.com
	14.	Frank Adjei	National Security	0277112751	henryaddo2020@yahoo.com
	15.	Jonathan Antwi	NADMO-HQ	0242975091	antwijonathan@ymail.com
	16.	Beverly N. A. Okai	Monitoring Stuct. Eng. Rep.- ADP	0202845271	narvelyb@yahoo.co.uk
	17.	Allan Kyekye	Photographer	0277447413	
	18.	Richard Ofori-Addo	Technical C'ttee	024352849	roforiaddo@espco-gh.com
	19.	Florence D. Sam Mensah	Technical C'ttee	0207504987	florrydoh@gmail.com
Contractor					
ID	NAME	ORGANISATION	DESIGNATION	CONTACT	
1.	E. Nussbacher	Amandi	02540108730	ernestnu@amandi.com	
2.	Ehud Rotman	Amandi	0246946637	ehudro@amandico.net	
3.	David Benayan	Amandi	0244336623	dudu@amandico.net	

Project Name: EDAIF Tower, Accra-Ghana	
Technical Committee, Undertaking the Investigation of the Collapse of the Mezzanine Floor of the EDAIF 16-Storey Tower Under Construction	
Subject: Meeting No. 1	Time: 10:00am
Date: 24 th November, 2015	Venue: Meeting Room 3; Movempic Hotel, Accra

ITEM	SUBJECT	ACTION	DATE						
01.20	Opening Prayer								
	The opening prayer was said by Mrs. Florence D. Sam Mensah								
01.30	Recap of Commencement Meeting								
	The Chairman, Ing Allotey indicated that the Technical Committee has been grouped into various sub-committees to handle different aspect of the committee’s task. - The Sub-committees and their compositions are as follow: <table><tr><td><u>Structures Team</u> - Dr. Cyprain Wenyonu (Leader) - Ing. Robert Owo - Ing. Nii Armah Tagoe - Ing. Florence D. S. Mensah - Richard Ofori-Addo - Beverly N. A. Okai - NADMO Rep. </td><td><u>Materials Team</u> - Ing. Bonne Acquah (Leader) - Ing. Joseph Oddei - Mr. Fiifi Yawson </td></tr><tr><td><u>Health, Safety and Environment</u> - Razak Abdullai (Leader) - Dr. Aryee Boi - Kobina Baidoo - Jonathan Antwi - Allan Kyekye - ACP and DSP </td><td><u>Construction Management</u> - Kobina Baidoo (Leader) - Ing. Allotey - Fiifi Yawson - ACP Sabina Osei-Bonsu </td></tr><tr><td></td><td><u>Legal / Security</u> - Nana Asmah (Leader) - ACP Sabina Osei-Bonsu - Frank Adjei </td></tr></table> - It was agreed that each Sub-committees should furnish the Secretary with a Work programme for carryout their assignments. - Contractor advised to provide a representative for the Technical Committee. - Contractor was also furnished with a checklist of items required by the Committee.	<u>Structures Team</u> - Dr. Cyprain Wenyonu (Leader) - Ing. Robert Owo - Ing. Nii Armah Tagoe - Ing. Florence D. S. Mensah - Richard Ofori-Addo - Beverly N. A. Okai - NADMO Rep.	<u>Materials Team</u> - Ing. Bonne Acquah (Leader) - Ing. Joseph Oddei - Mr. Fiifi Yawson	<u>Health, Safety and Environment</u> - Razak Abdullai (Leader) - Dr. Aryee Boi - Kobina Baidoo - Jonathan Antwi - Allan Kyekye - ACP and DSP	<u>Construction Management</u> - Kobina Baidoo (Leader) - Ing. Allotey - Fiifi Yawson - ACP Sabina Osei-Bonsu		<u>Legal / Security</u> - Nana Asmah (Leader) - ACP Sabina Osei-Bonsu - Frank Adjei		
<u>Structures Team</u> - Dr. Cyprain Wenyonu (Leader) - Ing. Robert Owo - Ing. Nii Armah Tagoe - Ing. Florence D. S. Mensah - Richard Ofori-Addo - Beverly N. A. Okai - NADMO Rep.	<u>Materials Team</u> - Ing. Bonne Acquah (Leader) - Ing. Joseph Oddei - Mr. Fiifi Yawson								
<u>Health, Safety and Environment</u> - Razak Abdullai (Leader) - Dr. Aryee Boi - Kobina Baidoo - Jonathan Antwi - Allan Kyekye - ACP and DSP	<u>Construction Management</u> - Kobina Baidoo (Leader) - Ing. Allotey - Fiifi Yawson - ACP Sabina Osei-Bonsu								
	<u>Legal / Security</u> - Nana Asmah (Leader) - ACP Sabina Osei-Bonsu - Frank Adjei								
01.40	Status of Checklist								
	- The Secretary confirmed the soft copies of some of the items on the checklist was received from the Contractor yesterday. Outstanding documents were to be submitted at the meeting (both hard and soft copies). - The Secretary was advised to liaise with the Contractor and check status of submission after the meeting.	Engineer Secretary	24/11						
01.50	Work Programme								
	- At the commencement meeting on 23/11/2015, the various Teams were tasked to provide a schedule of their work activities and deliverables with timelines. - A draft work programme has been provided showing commencement and duration of each team’s activities								

Project Name: EDAIF Tower, Accra-Ghana	
Technical Committee, Undertaking the Investigation of the Collapse of the Mezzanine Floor of the EDAIF 16-Storey Tower Under Construction	
Subject: Meeting No. 1	Time: 10:00am
Date: 24 th November, 2015	Venue: Meeting Room 3; Movempic Hotel, Accra

ITEM	SUBJECT	ACTION	DATE
01.51	Update from Team Leaders are as follows: Structures Team - Documents required have been received; - Structural Analysis software also received; - Document review will take 3-days as per the draft work programme; and - Report preparation will follow. <u>Responses</u> The Team has been advised to include the following as part of their task: - Information on Contractor's sequence of concrete placement; - Liaise with the Material Team and review material test results; - Explore all the possible causes of the collapse: - Poor design; - Adequate design, but poor construction; and - Adequate design, adequate construction but poor usage - Consider and explore post design stage construction phase; - Concentration should not be only on the collapse but also on the quality of as built works; and - Check bracing of formwork and props.	Structures Team	
01.52	Update from Material Team - In-situ test to start today; - Coring to commence today, coring equipment is presently on site; - Sampling of construction materials to start after meeting; - Steel pipes used as prop and timber formwork would be sampled for testing; - Testing to be done at AESL; <u>Responses</u> - The team was advised to make available testing results for circulation to other members. - Scope of works for the team was outline by Dr. Aryee Boi as: - Investigation on the as built works; - Processes carried out for then as built works; - Conduct both destructive and non-destructive test on as built works; - Conduct rebar test, insitu testing and laboratory tests on as built works; - Review in-situ tests carried out by the Contractor; - Review Contractor's method statement or working procedures; - Review Contractor's sequence in carrying out the works, esp concrete placement; - Check prop's strength, rigidity, stability and verticality; - Load carrying capacity of props should be conducted; - Estimate loads transmitted unto the props; - Check strength and capacity of composite beams; and - Bracing provided for the props should be checked;	Material Team Material Team	

Project Name: EDAIF Tower, Accra-Ghana

Technical Committee, Undertaking the Investigation of the Collapse of the Mezzanine Floor of the EDAIF 16-Storey Tower Under Construction

Subject: Meeting No. 1

Time: 10:00am

Date: 24th November, 2015

Venue: Meeting Room 3; Movempic Hotel, Accra

ITEM	SUBJECT	ACTION	DATE
	- Contractor requested to participate in tests conduction; - Team agreed with the Contractor's request.		
01.53	<u>Health, Safety and Environment</u> - Members will commence review of available documents after meeting, and proceed to site. - Formulate questionnaires for interview; - Check Contractor's HSE implantation processes; - Accident data and procedure employed when accidents do occur; - Review Contractor's processes for carrying out health and safety issues; - Recommendations and corrective measures for non-adherence to safety and health issues; - Contractor's Policy Regulations, Health and Safety Policy and employment processes to be reviewed will include: - Medical examinations records; - Employment records; - Information on casual and regular staff; - Records of treatment of injuries on site; - On-site injury insurance policy; and - Emergency response plan document (components include hydrology, fire, earthquake, etc.); <u>Response</u> Information required should be outlined for transmission to the Contractor if not on the check list.	Kobina Baidon and Team	24.11.15
01.54	<u>Legal and Security</u> Legal aspect will depend on: - Work will be based on findings from sub-committee; - Contractual obligations; - Insurance for worker - Statutory Regulations; - Compensation for injury of workers; and - Health and safety training for casual workers; Nana Asmah, added that he would provide a comprehensive activities to be carried out by the legal team which are to be include the outlined work programme.	Nana Asmah	
01.55	<u>Construction Management</u> Items to review will include: - Contractor's organogram for Site management - Written out job descriptions; - Procurement strategy/Policy; - Recruitment policy;	Nana Asmah	

Project Name: EDAIF Tower, Accra-Ghana	
Technical Committee, Undertaking the Investigation of the Collapse of the Mezzanine Floor of the EDAIF 16-Storey Tower Under Construction	
Subject: Meeting No. 1	Time: 10:00am
Date: 24 th November, 2015	Venue: Meeting Room 3; Movempic Hotel, Accra

ITEM	SUBJECT	ACTION	DATE
	• Compensation for workers and instruments used in measurement; • Working shift policy; • Defined roles and responsibilities; • Formwork system policy; • Concrete approval; • Project plan documentations. Others to be carried out to assess the Contractor's project management plan would include: • Interviews would be conducted on site; • Instruments used for measurements would be checked; • Who does the sign-offs for work items such as formwork, etc. • Formworks system policy would be reviewed.	Fiifi Yawson	
01.60	Other Matters		
	• Sub-committees were advised to make prepare their reports along with the activities in order to meet the deadline. • Members advised to observe utmost confidentiality in our work and handling of documents; • Photos should be taken of the 3-segments of the building: – Completed segment (concreting works done); – Partially completed segment (work completed up to rebars stage); and – Collapsed segment. • Contractor requested to carrying out the following activities on site: – Curing of concrete works on site – Provided supporting props for basement slabs, and – Clear the site of debris as result of the collapse In response to the Contractors request: • After several deliberations it was concluded that the Contract should documents on the method of curing for the structural team to review for approval or otherwise. • Contractor was instructed to proceed with fixing of props for the suspended basement slab; • With regards to clearing of the debris, the Contactor has been asked to hold on with this activities until the teams have concluded with site investigations.		
	Recorded By:		
	Secretary		

Project Name: EDAIF Tower, Accra-Ghana

Title: Technical Committee, Undertaking the Investigation into the Partial Collapse of the Mezzanine Floor of the EDAIF Tower Under Construction

Subject: Meeting No. 2

Time: 10:00am

Date: 26th November, 2015

Venue: Meeting Room 4; Movempic Hotel, Accra

02.1	ATTENDANCE				
	ID	NAME	DESIGNATION	Telephone	Email
	1.	Ing. Joshua Allotey	Committee Chair	0244241295	jnmallotey@hotmail.com
	2.	Ing. Dr. Aryee-Boi Desmond	Technical C'ttee	0269840291	daryeeboi@yahoo.com
	3.	ACP Sabina Osei-Bonsu	Divisional Police Commander	0208199365	sabbons@yahoo.com
	4.	DSP Reuben Dugah	Ghana Police Service	0244815688	kluyaodugah@gmail.com
	5.	Ing. Robert Owoo	Technical C'ttee	0244269789	rob_owoo@yahoo.com
	6.	Nana Asmah	Legal / HBAB	0244273130	nana.asmah@hayfronaddobarry.net
	7.	Ing. Nii Armah Tagoe	Technical C'ttee	0246258166	niiarmahtagoe@gmail.com
	8.	Ing. Joseph K. Oddei	Technical C'ttee	0244726164	joddei@outlook.com
	9.	Ing. Carlien Bou-Chedid	NADMO Rep	0244372980	carlienbc@gmail.com
	10.	Ing. Fiifi Yawson	Technical C'ttee	0272588788	fiifi.yawson@gmail.com
	11.	Kobina Baidoo	Technical C'ttee	0267046666	kobdem@gmail.com
	12.	Reuben Ayiti	Technical C'ttee	0548273145	reubenayiti@com
	13.	Felix Tetteh	AMA - MWD	0244658586	flexb2006@yahoo.com
	14.	Frank Adjei	National Security	0277112751	henryaddo2020@yahoo.com
	15.	Jonathan Antwi	NADMO-HQ	0242975091	antwijonathan@ymail.com
	16.	Ing. Beverly Okai	Monitoring Stuct. Eng. Rep.-ADP	0202845271	narvelyb@yahoo.co.uk
	17.	Allan Kyekye	Photographer	0277447413	
	18.	Ing. Richard Ofori-Addo	Technical C'ttee	024352849	roforiaddo@espco-gh.com
	19.	Florence D. Sam Mensah	Technical C'ttee	0207504987	florrydoh@gmail.com
	Contractor				
	ID	NAME	ORGANISATION	DESIGNATION	CONTACT
	1.	Ernest Nussbacher	Amandi	0540108730	ernestnu@amandi.com
	2.	Ehud Rotman	Amandi	0246946637	ehydro@amandico.net
	3.	David Benayun	Amandi	0244336623	dudu@amandico.net
	Apologies				
	ID	NAME	ORGANISATION	DESIGNATION	CONTACT
	1.	Ing. E. N. Bonne Acquah	Technical C'ttee	0208120613	bonneakwa@yahoo.com
	2.	Dr. Cyprian Wenyonu	Technical C'ttee	0266420047	cwenyonu@yahoo.com

Project Name: EDAIF Tower, Accra-Ghana	
Title: Technical Committee, Undertaking the Investigation into the Partial Collapse of the Mezzanine Floor of the EDAIF Tower Under Construction	
Subject: Meeting No. 2	Time: 10:00am
Date: 26 th November, 2015	Venue: Meeting Room 4; Movempic Hotel, Accra

02.2	AGENDA
	1. Opening Prayer 2. Introduction of Members 3. Review of Previous minutes 4. Current state of affairs 5. Status of Tests Conducted to date - Material's - Structures - Construction Management - Health and Safety 6. Progress to date: - Material's - Structures - Construction Management - Health and Safety - Legal and Security 7. Any Other Business (AOB)

Project Name: EDAIF Tower, Accra-Ghana	
Title: Technical Committee, Undertaking the Investigation into the Partial Collapse of the Mezzanine Floor of the EDAIF Tower Under Construction	
Subject: Meeting No. 2	Time: 10:00am
Date: 26 th November, 2015	Venue: Meeting Room 4; Movempic Hotel, Accra

ITEM	SUBJECT	ACTION	DATE
02.3	Opening Prayer		
	The opening prayer was said by Ing. Robert Owoo		
02.4	Introduction of Members		
	Members introduced themselves indicating the institutions they represented.		
02.5	Review of Previous Minutes		
02.5.1	Corrections/Omissions		
	- The name 'David Benayan' was corrected to read 'David Benayun' - Dr. Aryee-Boi was added to the Legal/Security Team - Frank Adjei was added to Health, Safety and Environment Team - item 01.53, bullet no. 3, 'Implantation' was corrected to read 'Implementation' - Item 01.53, Action Column 'Kobina Baidon' was corrected to 'Kobina Baidoo' - Both ACP Sabina Osei-Bonsu and DSP Reuben Dugah are members of the Construction Mgt, Legal/Security and Health, Safety and Environment Teams		
02.5.2	Acceptance of Previous Minutes		
	In the absence of any comments the minutes was accepted by members of the Technical Committee		
02.60	Matters Arising		
	a) The secretary updates members on the status of the checklist. Additions to the checklist include: - Visitors' book; - Contract Documents; - Test Certificates for Timber and Formworks; and - Peer review document. b) <u>Materials Team</u> Circulation of available material test results is yet to be done by the Material Team. c) <u>Health, Safety and Environment</u> The proposed leader for HSE, Razak Abdullahi has still not turned up, thus the HSE Team has nominated the NADMO rep., Jonathan Antwi as their leader. d) <u>Legal/Security</u> As part of the programme to be submitted, the following are being prepared by the Legal team. - Non-disclosure, Confidentiality undertaking is ready; - Memorandum is yet to be provided. Will be forwarded to the secretary by close of day.	Nana Asmah	26.11.15

Project Name: EDAIF Tower, Accra-Ghana	
Title: Technical Committee, Undertaking the Investigation into the Partial Collapse of the Mezzanine Floor of the EDAIF Tower Under Construction	
Subject: Meeting No. 2	Time: 10:00am
Date: 26 th November, 2015	Venue: Meeting Room 4; Movempic Hotel, Accra

ITEM	SUBJECT	ACTION	DATE
02.70	Progress of Activities		
02.7.1	<i>Update from Material Team</i>		
	a) Meeting was held with a rep from the Contractor and that from the Monitoring Consultant's. Information required was collated. b) Coring of as built concrete works was carried out on Wednesday, 25.11.2015, testing is outstanding; c) Smith Hammer test on constructed concrete work is completed and results are ready; d) Used rebar samples were taken from the collapsed area for testing. Unused samples were also taken for testing; e) Props have been sent to Standard Boards. Test to start on Monday, 30.11.2015. <u>Comments from Members</u> - When asked about the review of Contractor's concrete test results, the Materials Team indicated that the review of Cube test results were yet to be carried out; Cube test results for the collapsed are yet to be ready. - Results of completed Concrete floor would be reviewed as part of the desk study today; - Concerning the Props: - Lab results for props should be communicated to the Structure team; - Apart from the dimension in the specs, dimensions of the props are to be measured on site after the meeting. It was agreed this was to be done by the Structure Team	Material Team Ing. Nii Tagoe	26.11.15 26.11.15
02.7.2	<i>Update from Structure Team</i>		
	As previously discussed the following step are currently being undertaking: a) Review of the structural analysis done by the Design Engineers. The following are being review: - Midas file received from the Contractor; - Loading system used for the analysis; - Structural Frame system adopted; - Earthquake parameters adopted; etc b) Cross sectional properties of the prop used for the construction have been calculated and is yet to be discussed. <u>Comments from Members</u> - Design criteria being used, whether the Ultimate State or the Near Collapse state? In response the Structural Team indicated that the design engineer's adopted design criteria was what is being reviewed		

Project Name: EDAIF Tower, Accra-Ghana	
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Subject: Meeting No. 2	Time: 10:00am
Date: 26 th November, 2015	Venue: Meeting Room 4; Movempic Hotel, Accra

ITEM	SUBJECT	ACTION	DATE
	Member to Note: A presentation on the Structural Analysis would be held by the Contractor and Structural Engineering Team in the meeting room at 4:00 pm after the meeting.		
02.7.2	Construction Management		
	Scope of works has been defined in terms of the document review carried out to date. The document reviewed include: - Project management; - Quality management; - Safety management; - Professional management; - Time management; - Contract administration; - Cost management; and - Professional practice. Based on the review, 8-staff members are currently on stand by for interview, after which the report preparation would commence.	Construction Mgt. Team	26.11.15
02.7.3	Health, Safety and Environment		
	a) In addition to interactions with workers on site, an initial rapid assessment was conducted yesterday; b) As a result, a template has been formulated for the evaluation of the works; c) A request has also be made to meet cross section of the staff, both permanent and casual for further interrogations on matters concerning health and safety on site; d) A document was also prepared to define the core objectives of the assessment. This has been circulated to members for comments. The core objectives of the final assessment will focus on areas outlined as follows: - Housekeeping procedure; - Welfare facilities; - Manual handling; - Frist aid facilities; - Work with hazardous substances; - Emergency response plan and procedure; - Safety signage; - Colour coddging; - PPEs; - Documentations and procedures. e) Preliminary report would be prepared based on the outcome of the final assessment.		

Project Name: EDAIF Tower, Accra-Ghana	
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ITEM	SUBJECT	ACTION	DATE
02.7.4	<i>Legal and Security</i>		
	a) Legal team work will mainly depend on the outcome of the various reports provided by the other Teams. b) The Contactor's professional practices would also be reviewed in line with approved practices. Thus they would wait for the report from the other teams in order to present their report. c) A non-disclosure, confidentiality undertaking which is available would be circulated to members for endorsement. The content which was explained by the Nana Asmah, head of the Legal team indicated that members are to maintain a professional approach to the investigations and execute their task in a fair and confidential manner. Documents provided for the investigations are to be kept confidential. d) It was explained that members are bound by the undertaking to keep all information and findings of the Committee confidential. The undertaking takes effect from Monday 23.11.2015	Nana Asmah & Florence	
02.7.5	<i>Invoicing</i>		
	a) Members were reminded to submit their invoices to the Chairman. The invoices should be divided into two areas, namely: - Reimbursable; - Professional allowance. b) Members to note that amounts submitted would be reviewed for approval prior payment. c) The chairman was informed that some institutions would require payment to be made before test results are made available to the team. Contractor suggested to facilitate payment for the test results, however this submission was rejected by the Technical Director. d) The Technical Director suggested that members should provide estimates for the tests being conducted in order for funds to be made available; e) Estimates for the reimbursable should be made available as soon as possible to enable the Chairman secure money for the tests being conducted. f) Following deliberation, Ing. Carlien was appointed head of the Finance for the Technical Team. Concerning allowance for Committee Members, Felix was asked to check with AMA's structure for payment on assignment of similar nature. This information should be shared with the Committee	Felix	
01.60	Other Matters		
	a) The Contractor was concerned with the Title of the Minutes. He indicated that the Title did not reflect the incident on site, and requested for the title to be revised. <u>Response</u> After several deliberation, it was agreed that the Title should conform to title in AMA's letter of engagement to the Technical Committee. However, if the		

Project Name: EDAIF Tower, Accra-Ghana	
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ITEM	SUBJECT	ACTION	DATE
	Contractor is not comfortable with the title in the letter of engagement, then a formal request should be made to AMA with copy to the Technical Committee. b) <u>Reporting Format</u> It was agreed that Ing. Tagoe should provide the format for the report. The report should also focus on : - Possible Causes of the collapse; - Preventive measure (What could have been done); and - Recommendations. ACP Sabina Osei-Bonsu, indicated that the Police on duty at the site are required for other assignment, thus members were urged to complete data collation as soon as possible in order for the site to be handed over. Chairman advised members to complete all data collection by close of day, 26.11.15 for the site to be handed over to AMA for onward transfer to the Construction Team.	Nii Tagoe	
	Recorded By:		
	Engineer Secretary		

APPENDIX C

HEALTH, SAFETY AND ENVIRONMENT INVESTIGATION FORMS

Safety and Health & Environment Evaluation Questionnaire

The following questions are designed to help you evaluate the effectiveness of your current safety and health & environment program.

Agency/Institution: _____

Location: _____

Written Safety and Health Written Program

- 1) Does your agency/institution have a current written safety and health program that addresses the following elements?
- a) Management commitment and leadership? Yes _____
No _____
 - b) Safety performance standards for managers and supervisors? Yes _____
No _____
 - c) Employee involvement/safety committees? Yes _____
No _____
 - d) Written safety rules/procedures? Yes _____
No _____
 - e) Safety inspections/hazard assessments? Yes _____
No _____
 - f) Loss prevention and control techniques? Yes _____
No _____
 - g) Regulatory compliance activities? Yes _____
No _____
 - h) Safety and health training? Yes _____
No _____
 - i) Accident reporting and investigation? Yes _____
No _____
 - j) Safety and health promotion activities? Yes _____
No _____
 - k) Return to Work Policy? Yes _____
No _____
- 2) Are all managers, supervisors and employees aware of the program? Yes _____
No _____

Comments/Action Steps:

Managers

Do Managers:

- 1) Periodically conduct or attend department safety meetings? Yes____
No____
- 2) Personally review all serious accidents and near misses? Yes____
No____
- 3) Insure that all supervisors are held accountable for safety? Yes____
No____
- 4) Make at least one safety inspection/planned safety observation of their department or employees per quarter? Yes____
No____
- 5) Recognize outstanding safety performance? Yes____
No____
- 6) Periodically attend safety training sessions? Yes____
No____
- 7) Talk to their employees about safety and health issues? Yes____
No____
- 8) Follow all safety rules and procedures? Yes____
No____
- 9) Require supervisors to complete at least one safety project per year? Yes____
No____
- 10) Encourage their supervisors to attend outside safety training programs? Yes____
No____
- 11) Provide adequate resources for accident prevention? Yes____
No____
- 12) Include safety in each supervisor's job description/performance standard? Yes____
No____

13) Review the quality of accident investigation reports?

Yes_____

No_____

Comments/Action Steps:

Supervisors

Do supervisors:

1) Conduct safety meetings with their employees?

Yes_____ No_____

2) Perform periodic safety inspections of their department?

Yes_____

No_____

3) Take appropriate action(s) to correct safety rule violations?

Yes_____ No_____

4) Talk to their employees at least once a quarter regarding safety and health issues?

Yes_____

No_____

5) Promptly complete and submit accident investigation reports?

Yes_____

No_____

6) Conduct job specific safety training for their new employees?

Yes_____

No_____

7) Attend supervisory safety training programs?

Yes_____ No_____

8) Conduct periodic planned safety observations of their employees?

Yes_____

No_____

9) Identify and complete at least one safety project annually?

Yes_____

No_____

10) Review and respond promptly to employee safety suggestions?

Yes_____ No_____

11) Initiate immediate action(s) to correct unsafe conditions/acts?

Yes_____ No_____

Comments/Action Steps:

Safety Manager/Coordinator

Does the Safety Manager/Coordinator for your organization:

- 1) Conduct formal safety and health inspections? Yes____
No____
- 2) Encourage employees to submit safety suggestions? Yes____
No____
- 3) Attend at least one departmental safety meeting each quarter? Yes____
No____
- 4) Participate in the investigation of serious injuries and near misses? Yes____ No____
- 5) Coordinate regulatory compliance activities? Yes____
No____
- 6) Conduct/coordinate safety training for current employees/supervisors? Yes____
No____
- 7) Conduct/coordinate new employee safety orientation training? Yes____
No____
- 8) Attend 1-2 professional development courses annually? Yes____
No____
- 9) Review accident statistics and Worker's Compensation costs? Yes____
No____
- 10) Serve as the Chairperson or member of the Safety Committee? Yes____
No____

Comments/Action Steps:

Employees

Do employees:

- 1) Follow all established safety rules and procedures? Yes____
No____
- 2) Report unsafe conditions and accidents to their supervisor? Yes____
No____
- 3) Attend all required safety training programs? Yes____

No _____

4) Submit safety suggestions?

Yes _____

No _____

5) Maintain proper housekeeping within their work area?

Yes _____

No _____

Comments/Action Steps:

Safety Committees

1) Does your agency/institution have an active Safety Committee?

Yes _____

No _____

2) If yes, does the Safety Committee:

a) Perform periodic safety inspections?

Yes _____

No _____

b) Meet at least quarterly?

Yes _____

No _____

c) Review all serious accidents?

Yes _____

No _____

d) Recommend safety program improvements?

Yes _____

No _____

e) Monitor safety program effectiveness?

Yes _____

No _____

f) Take timely action on safety suggestions?

Yes _____

No _____

g) Maintain and publish minutes of each meeting?

Yes _____

No _____

Comments/Action Steps:

Safety and Health Inspections

- 1) Does your agency/institution conduct formal safety and health inspections? Yes_____ No_____
- 2) Have all persons on the inspection team been trained in hazard recognition and assessment techniques? Yes_____ No_____
- 3) Does the team establish time limits for correcting deficiencies? Yes_____ No_____
- 4) Does the team observe and record both positive and negative work conditions and actions of employees? Yes_____ No_____
- 5) Does the program include inspections of the following?
- a) Employee work areas? Yes_____ No_____
 - b) Machines/power tools? Yes_____ No_____
 - c) Parking lots/sidewalks? Yes_____ No_____
 - d) Powered industrial trucks? Yes_____ No_____
 - e) Ventilation systems? Yes_____ No_____
 - f) Emergency eye wash units/showers? Yes_____ No_____
 - g) Chemical storage areas? Yes_____ No_____
 - h) Electrical panels/wiring? Yes_____ No_____
 - i) Loading docks? Yes_____ No_____
 - j) Fire extinguishers? Yes_____ No_____
 - k) Ladders? Yes_____ No_____

Comments:

Regulatory Compliance

- 1) Does your agency/institution have a current written program/policy pertaining to the following areas?

◆ Bloodborne Pathogens	Yes_____ No_____ NA_____
◆ Confined Space Entry	Yes_____ No_____ NA_____
◆ Personal Protective Equipment	Yes_____ No_____ NA_____
◆ Hazard Communication	Yes_____ No_____ NA_____
◆ Electrical Safety	Yes_____ No_____ NA_____
◆ Lab Safety	Yes_____ No_____ NA_____
◆ Lockout/Tagout	Yes_____ No_____ NA_____
◆ Respiratory Protection	Yes_____ No_____ NA_____
◆ Hearing Conservation`	Yes_____ No_____ NA_____
◆ Powered Industrial Trucks	Yes_____ No_____ NA_____

- 2) Are employee exposure and medical records maintained for the duration of employment, plus 30 years? Yes_____ No_____
- 3) Does your organization provide personal protective equipment (PPE) where needed based upon a written hazard assessment? Yes_____ No_____
- 4) Does your organization conduct exposure monitoring when required by a particular OSHA Standard or when requested by employees? Yes_____ No_____
- 5) Does your organization conduct/provide medical examinations when required? Yes_____ No _____ NA_____

Comments/Action Steps:

Safety and Health Training

- 1) Which of the following receive safety and health training?
- a) Managers? _____
 - b) Supervisors? _____
 - c) Safety Committee members? _____
 - d) Employees? _____
- 2) Is attendance mandatory? Yes_____ No_____
- 3) Is all health and safety training documented? Yes_____ No_____
- 4) Is your agency /institution currently conducting training on the following subjects?
- ◆ Accident Investigation Yes_____ No_____ NA_____
 - ◆ Confined Space Entry Yes_____ No_____ NA_____
 - ◆ Personal Protective Equipment Yes_____ No_____ NA_____
 - ◆ Hazard Communication Yes_____ No_____ NA_____
 - ◆ Powered Industrial Trucks Yes_____ No_____ NA_____
 - ◆ Electrical Safety Yes_____ No_____ NA_____
 - ◆ Lab Safety Yes_____ No_____ NA_____
 - ◆ Lockout/Tagout Yes_____ No_____ NA_____
 - ◆ Back Injury Prevention Yes_____ No_____ NA_____
 - ◆ Office Safety Yes_____ No_____ NA_____
 - ◆ Ergonomics/Body Mechanics Yes_____ No_____ NA_____
 - ◆ Respiratory Protection Yes_____ No_____ NA_____
 - ◆ Safety Fundamentals for Supervisors Yes_____ No_____ NA_____
 - ◆ Bloodborne Pathogens Yes_____ No_____ NA_____
 - ◆ Hearing Conservation Yes_____ No_____ NA_____
 - ◆ Fall Protection Yes_____ No_____ NA_____
 - ◆ Workplace Violence Yes_____ No_____ NA_____
 - ◆ Emergency Response Procedures Yes_____ No_____ NA_____
 - ◆ First Aid/CPR Yes_____ No_____ NA_____
- 5) Do employees receive annual and/or refresher training when required by a particular OSHA standard? Yes_____ No_____

Comments/Actions Steps:

OSHA Injury and Illness Log

- 1) Does your organization maintain a current OSHA 200 log? Yes_____ No_____
- 2) Is the annual summary posted each February? Yes_____ No_____
- 3) Has the person responsible for the log received training on how to maintain the log? Yes_____ No_____
- 4) Are occupational illnesses, lost workday and restricted day cases properly recorded on the OSHA log? Yes_____ No_____

Comments/Actions Steps:

Injury/Illness Prevention Activities

- 1) Does your organization use engineering controls (i.e. adjustable workstations, mechanical lifting devices, ventilation systems, etc.) and/or administrative controls (i.e. job rotation) to prevent or control workplace injuries and illnesses? Yes_____ No_____
- 2) Does your organization use safety posters, health fairs, etc. to promote health and safety? Yes_____ No_____
- 3) Has a Job Safety Analysis (JSA) been completed for each hazardous job? Yes_____ No_____
- 4) Has your organization developed an effective ergonomics program that includes hazard assessments and supervisory and employee training? Yes_____ No_____
- 5) Are safety and health requirements and concerns considered when purchasing new machines, equipment and chemical products? Yes_____ No_____

Comments/Actions Steps:

Accident Reporting and Investigation

- 1) Are all workplace injuries and illnesses reported and investigated?
Yes _____ No _____
- 2) Are near misses and vehicle-related accidents reported and investigated? Yes _____ No _____
- 3) Have all supervisors and managers been trained in accident investigation procedures? Yes _____ No _____
- 4) Are supervisors required to complete a separate Accident Investigation Report? Yes _____ No _____
- 5) Is the Safety Coordinator promptly notified when a serious accident occurs? Yes _____ No _____
- 6) Are incomplete reports returned to the appropriate supervisor? Yes _____ No _____
- 7) Are accident prevention programs and activities based upon an analysis of accident reports and injury and illness rates? Yes _____ No _____

Comments/Actions Steps:

Emergency Preparedness

- 1) Does your organization have a current Emergency Response Plan? Yes____ No____
- 2) Are emergency phone numbers and building maps posted? Yes____ No____
- 3) Do all personnel know how to respond to an emergency such as a fire? Yes____
No____
- 4) Does your organization conduct periodic disaster drills? Yes____ No____
- 5) Are alarms tested at least once per month? Yes____ No____

Comments/Action Steps:

Name of**Reviewer:** _____**Title:** _____ **Date:** _____

****Reference to Ghana Labour Act 2003, Part XV, Article 118 - 121,

Workplace Health & Safety Inspection Form

Note – only items with the potential to affect health and safety should be recorded on this form, non-safety maintenance items should be recorded separately.

Date:.....

Location/Area:.....

Region:.....

Country:.....

Health and safety issue	Indicate if satisfactory or note defects	Action by whom & when	Completed Date/initials
1. Housekeeping			
Are workplaces tidy well maintained and materials safely stored? Consider..... Storage of materials (avoid storage in gangways and fire evacuation routes; heavy items and liquids should not be stored above shoulder height) Condition of traffic routes and entrances / exits Are pedestrian routes clear? Avoid tripping or slip hazards (such as trailing cables, frayed carpets, loose tiles, spilt liquids)?			

Health and safety issue	Indicate if satisfactory or note defects	Action by whom & when	Completed Date/initials
2. Environmental Conditions			
Are conditions satisfactory?			
Lighting ☐			
Ventilation ☐			
Noise ☐			
Vibration ☐			
3. Manual Handling			
Identify any hazardous manual handling activities.			
Have risks been assessed? Y / N			
Have regular handlers been trained in safe lifting? Y / N			
How can risks be reduced further?			

Health and safety issue	Indicate if satisfactory or note defects	Action by whom & when	Completed Date/initials
5. Welfare Facilities			
Are welfare facilities suitable and sufficient? Kitchens / canteen / rest areas			
Toilets			
Washing / changing facilities			
6. First Aid Facilities			
Are numbers of Trained First Aiders adequate?			
Are there sufficient First Aid Kits?			
Are they well stocked and their location known? (who inspects?)			
7. Safety Signs			
Are safety and fire signs adequate and in good condition? Can signage be improved? As well as colour coding			
8. Work with Hazardous Substances (where applicable)			
Have COSHH Assessments been produced and updated? Y / N Are controls implemented? Storage			
Handling / use			
Dust or fume extraction – tested?			
9. Personal Protective Equipment – PPE (where applicable)			
Have employees been provided with appropriate PPE that is well fitting and adequate?			
Is it being used, when appropriate?			
Is it properly maintained & stored?			

Health and safety issue	Indicate if satisfactory or note defects	Action by whom & when	Completed Date/initials
10. Fire Safety			
Has a Fire Risk Assessment been carried out? Is Fire equipment adequate and properly maintained? Is there an evacuation procedure & are fire notices provided? Are fire drills conducted regularly? (date of last 2 drills?)			
11. Machinery & Equipment			
Is all machinery properly guarded? Have portable electrical appliances been regularly inspected & labelled?			
12. Vehicles on site			
Are vehicles and pedestrians clearly separated on site? If not, have the risks been assessed and controls put in place to prevent accidents?			
13. Off site visits			
Are off site visits planned and arranged in accordance with EPA Outdoor Education code? Are risk assessments reviewed after each trip?			
14. Documentation and Procedures			
Has School H&S Code / Policy been issued to all staff? (has it been reviewed in the last 12 months?) Is there a system for accident /work related ill health/ near miss reporting (to H&S Team)? Are incidents investigated by Head H&S Advisers? Have Risk Assessments been completed and a Register maintained? Are there written safe systems of work for high risk activities?			

****Reference to Ghana Labour Act 2003, Part XV, Article 118 - 121,

APPENDIX D

SCHMIDT HAMMER TEST RESULTS

CONCRETE REBOUND HAMMER TEST RESULTS

Title: Partial Collapse of Mezzanine Floor-EDAIF Tower

Project activity: Schmidt Hammer Test on Structural Members for EDAIF Building

Client: Accra Metropolitan Assembly

Location: Ridge, Gt. Accra

Hammer system: W-M-250

Date: 24/11/15

Sheet

Date of cast	Date of Test	Hammer Rebound Values R	Ave. R μ	Stand Dev σ	CoV %	X'ter R	Corr R	Ave. In situ conc. strength (N/mm ²)	Age days	Direction of Test	Reference	Pos in works
14/11/15	24/11/2015	20 16 22 20 20 20 22 22 20 24	21	2	10	20	23	18.5	10	VD	1st Floor (200mm thick)	Slab
""	""	20 22 20 20 24 24 20 18 20 22	21	2	9	20	24	20.0	""	""	1st Floor (400mm thick)	
""	""	18 22 20 18 22 24 20 18 20 20	20	2	10	19	23	18.5	""	""		
""	""	18 22 18 20 18 20 20 20 20 20	20	1	6	19	22	17.0	""	""		
""	""	20 22 22 20 18 22 20 20 22 18	20	2	8	20	23	18.5	""	""		
	""	38 40 40 40 38 38 40 40 38 40	39	1	3	39	46	53.0	>28	H	Ground floor	Column
	""	40 38 36 40 40 36 40 40 40 40	39	2	4	38	45	51.0	""	""		""
	""	40 38 42 40 40 42 40 36 38 42	40	2	5	39	46	53.0	""	""		""
	""	40 42 42 40 38 40 40 40 42 40	40	1	3	40	47	55.0	""	""		""
	""	40 44 40 38 40 40 42 40 40 40	40	2	4	40	47	55.0	""	""		""
	""	42 38 38 40 40 40 42 40 40 40	40	1	3	39	46	53.0	""	""		""
	""	44 40 40 42 40 42 40 38 40 40	41	2	4	40	47	55.0	""	""		""
	""	40 42 44 40 42 40 40 42 38 40	41	2	4	40	47	55.0	""	""		""
	""	42 44 40 40 38 40 40 40 40 36	40	2	5	39	46	53.0	""	""		""
	""	40 38 40 42 44 40 44 42 40 40	41	2	5	40	47	55.0	""	""		""

Notes:

1. H - Horizontal; VD - vertical down; VU - vertical up
2. CoV - represents coefficient of variations (values less than 15% are observed as insignificant variations); it's the ratio of standard dev to average
3. Column 7 - represents characteristic value (X'ter R = $\mu - 0.5\sigma$) in hammer reading, which is used to estimate concrete strength

APPENDIX E

CONCRETE CORE AND REBAR TEST RESULTS

CONCRETE CYLINDER STRENGTH TESTING

Project: Partial Collapse of Mezzanine Floor - EDAIF Tower - Request for Structural Integrity

Client: Accra Metropolitan Assembly

Contractor: AMANDI Co. Ltd

Location: Ambassadorial Enclave, Ridge, Gt. Accra

Serial No	Date of casting	Date of Testing	Average Dimension, mm			Cross Sec. Area, mm ²	Age days	Load kN	Compressive strength, N/mm ²	Mass (kg)	Mix Proportion	Density kg/m ³	Position in works/Remarks
			<i>dia</i>	<i>l</i>	<i>h</i>								
1	14/11/2015	27/11/2015	95	195	-	7089.138	13	80	15.66	3410		2466.76	Mezzanine Floor Slab
2	"	"	95	195	-	7089.138	"	85	16.64	3357		2428.42	
3	"	"	95	195	-	7089.138	"	65	12.72	3466		2507.27	

Factors

height 1.11

cube shape 1.25

TENSILE STRENGTH OF STEEL BARS

Project: Partial Collapse of Mezzanine Floor - EDIAF Tower

Location: Ambassadorial Enclave, Ridge, Gt. Accra

Client: Accra Metropolitan Assembly

Contractor: AMANDI Co. Ltd

Date: 25/11/2015

AESL Official: DK

NOTE: SAMPLE TAKEN FROM UN-USED STEEL REINFORCEMENT BATCHES

Serial No	Cal. Size of Bar mm (dia)	size of bar after test mm	Cross Section Area mm ²	Mark Ref No	Elongation %	Yield Point Load (KN)	Ultimate Load (KN)	Tensile Strength N/mm ²	
								Yield Point N/mm ²	Ultimate Strength N/mm ²
1	8.14		52.09		20	22.40	40.73	430.09	781.99
2	8.14		52.04		20	21.38	39.71	410.95	763.20
3	8.14		52.09		20	21.38	39.71	410.54	762.44
4	10.01		78.70		26	45.82	66.19	582.27	841.06
5	10.01		78.70		24	45.82	67.21	582.27	854.00
6	10.02		78.94		24	45.82	66.19	580.48	838.47
7	11.89		111.07		26	67.21	89.61	605.09	806.78
8	11.90		111.14		26	65.17	91.65	586.37	824.58
9	11.89		111.07		26	66.19	90.63	595.92	815.95
10	13.76		148.62		29	99.79	120.16	671.47	808.50
11	13.76		148.62		28	99.79	120.16	671.47	808.50
12	13.76		148.62		29	100.81	122.20	678.32	822.21

REMARKS: Test was carried out as per BS 4449: 1988, Specification for Carbon Steel for reinforcement of concrete.Minimum specification for mild and high tensile steel are 250N/mm² and 460N/mm² respectively for characteristic yield point strength

checked by: Ing J.K. Oddei (Senior Eng)

Engineer in-charge

TENSILE STRENGTH OF STEEL BARS

Project: Partial Collapse of Mezzanine Floor - EDIAF Tower

Location: Ambassadorial Enclave, Ridge, Gt. Accra

Client: Accra Metropolitan Assembly

Contractor: AMANDI Co. Ltd

Date: 25/11/2015
AESL Official: DK
NOTE: SAMPLE TAKEN FROM COLLAPSE SLAB

Serial No	Cal. Size of Bar mm (dia)	size of bar after test mm	Cross Section Area mm ²	Mark Ref No	Elongation %	Yield Point Load (KN)	Ultimate Load (KN)	Tensile Strength N/mm ²	
								Yield Point N/mm ²	Ultimate Strength N/mm ²
1	10.03		78.99		24	44.81	67.21	567.21	850.82
2	10.05		79.37		23	45.82	66.19	577.30	833.88
3	10.00		78.52		24	44.81	66.19	570.65	843.00
4	11.97		112.51		25	66.19	90.63	588.32	805.55
5	11.89		110.98		26	65.17	89.61	587.26	807.48
6	11.97		112.51		25	66.19	90.63	588.32	805.55
7	13.90		151.84		27	79.43	121.18	523.11	798.08
8	13.91		152.06		26	80.45	122.20	529.03	803.60
9	13.91		152.06		26	79.43	122.20	522.34	803.60
10	15.67		192.90		28	99.79	137.47	517.33	712.64
11	15.77		195.33		28	100.81	136.45	516.11	698.58
12	15.77		195.33		28	100.81	137.47	516.11	703.79

REMARKS: Test was carried out as per BS 4449: 1988, Specification for Carbon Steel for reinforcement of concrete.

 Minimum specification for mild and high tensile steel are 250N/mm² and 460N/mm² respectively for characteristic yield point strength

* Bold size diameters represent high tensile

checked by: Ing J.K. Oddei (Senior Eng)

Engineer in-charge

TENSILE STRENGTH OF STEEL BARS

Project: Partial Collapse of Mezzanine Floor - EDIAF Tower

Location: Ambassadorial Enclave, Ridge, Gt. Accra

Client: Accra Metropolitan Assembly

Contractor: AMANDI Co. Ltd

Date: 25/11/2015

AESL Official: DK

NOTE: SAMPLE TAKEN FROM UN-USED STEEL REINFORCEMENT BATCHES

Serial No	Cal. Size of Bar mm (dia)	size of bar after test mm	Cross Section Area mm ²	Mark Ref No	Elongation %	Yield Point Load (KN)	Ultimate Load (KN)	Tensile Strength N/mm ²	
								Yield Point N/mm ²	Ultimate Strength N/mm ²
1	15.73		194.35		28	99.79	135.43	513.48	696.87
2	15.75		194.90		27	99.79	137.47	512.03	705.35
3	15.73		194.35		28	99.79	134.42	513.48	691.63
4	17.58		242.75		29	126.27	155.80	520.15	641.80
5	17.58		242.75		29	126.27	156.82	520.15	646.00
6	17.66		244.93		28	126.27	156.82	515.53	640.25
7	19.68		304.36		29	170.06	200.61	558.73	659.10
8	19.78		307.43		27	171.07	200.61	556.46	652.52
9	19.78		307.43		28	171.07	202.64	556.46	659.15
10	21.84		374.81		26	223.01	254.58	595.00	679.22
11	21.62		367.23		28	224.03	257.63	610.05	701.55
12	21.80		373.15		27	224.03	255.59	600.37	684.97
13	24.60		475.53		28	283.09	351.31	595.31	738.79
14	24.60		475.53		28	284.11	352.33	597.45	740.93
15	24.60		475.53		29	284.11	354.37	597.45	745.21

REMARKS: Test was carried out as per BS 4449: 1988, Specification for Carbon Steel for reinforcement of concrete.Minimum specification for mild and high tensile steel are 250N/mm² and 460N/mm² respectively for characteristic yield point strength

checked by: Ing J.K. Oddei (Senior Eng)

Engineer in-charge

APPENDIX F

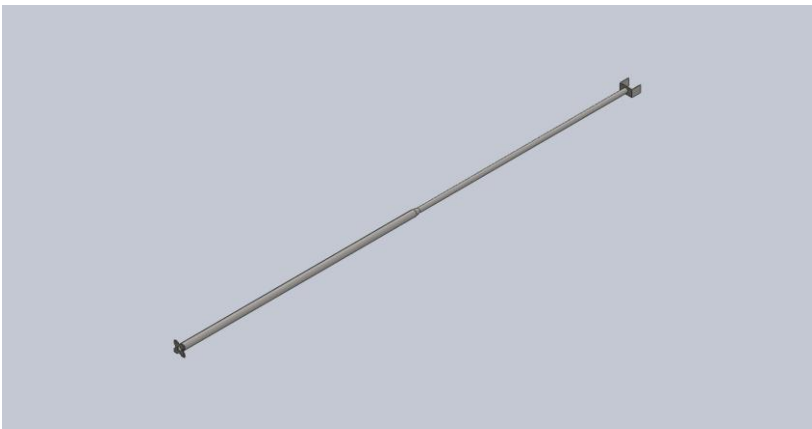
RESPONSES FROM SUPPLIER OF PROPS

Simulation of base

Date: 09 2015، أيلول
Designer: Solidworks
Study name: Static 2
Analysis type: Static

Table of Contents

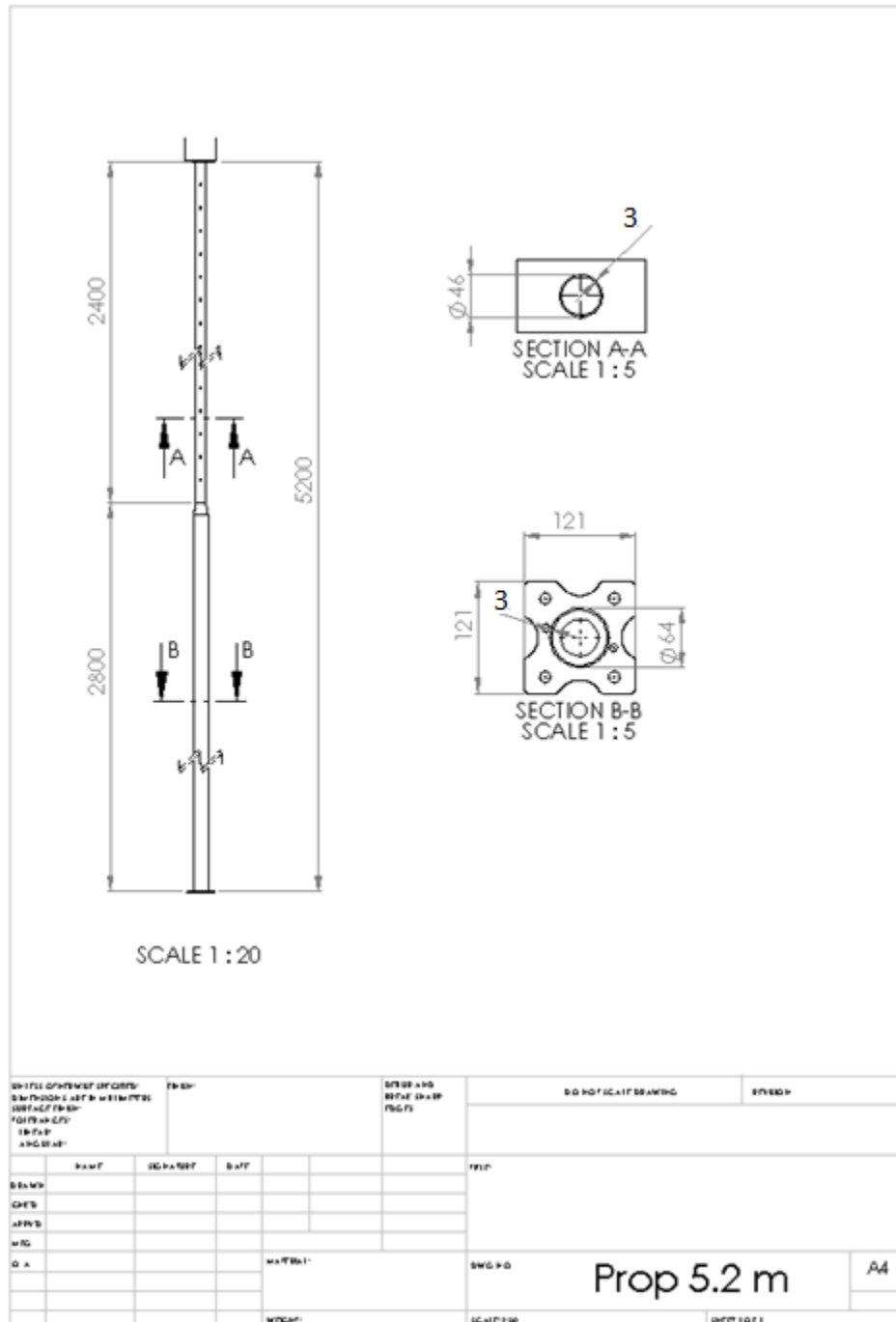
Description.....	1
Assumptions	2
Model Information	3
Study Properties	4
Units	4
Material Properties	5
Loads and Fixtures.....	5
Connector Definitions.....	6
Contact Information.....	6
Mesh Information	7
Sensor Details	8
Resultant Forces	8
Beams.....	8
Study Results	9
Conclusion	11



Description

No Data

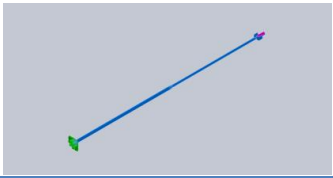
Dimensions:



Model Information



Model name: base
Current Configuration: Default

Solid Bodies			
Document Name and Reference	Treated As	Volumetric Properties	Document Path/Date Modified
Boss-Extrude5 	Solid Body	Mass:21.1113 kg Volume:0.00270658 m^3 Density:7800 kg/m^3 Weight:206.891 N	C:\Users\Service Centre\Desktop\study 20 Kn\base.SLDPRT Sep 09 16:32:25 2015

Study Properties

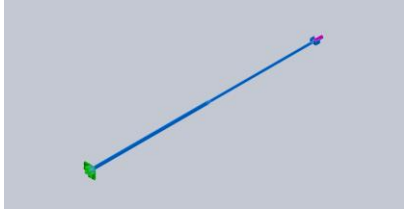
Study name	Static 2
Analysis type	Static
Mesh type	Solid Mesh
Thermal Effect:	On
Thermal option	Include temperature loads
Zero strain temperature	298 Kelvin
Include fluid pressure effects from SolidWorks Flow Simulation	Off
Solver type	FFEPlus
Inplane Effect:	Off
Soft Spring:	Off
Inertial Relief:	Off
Incompatible bonding options	Automatic
Large displacement	Off
Compute free body forces	On
Friction	Off
Use Adaptive Method:	Off
Result folder	SolidWorks document (C:\Users\Service Centre\Desktop\study 20 Kn)

Units

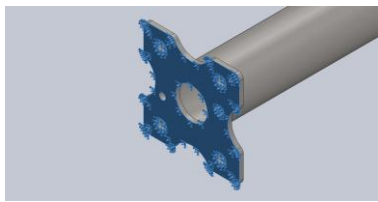
Unit system:	SI (MKS)
Length/Displacement	mm
Temperature	Kelvin
Angular velocity	Rad/sec
Pressure/Stress	N/m ²

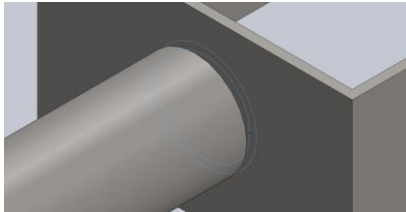


Material Properties

Model Reference	Properties	Components
	Name: Plain Carbon Steel Model type: Linear Elastic Isotropic Default failure criterion: Unknown Yield strength: 2.20594e+008 N/m ² Tensile strength: 3.99826e+008 N/m ² Elastic modulus: 2.1e+011 N/m ² Poisson's ratio: 0.28 Mass density: 7800 kg/m ³ Shear modulus: 7.9e+010 N/m ² Thermal expansion coefficient: 1.3e-005 /Kelvin	SolidBody 1(Boss-Extrude5)(base)
Curve Data:N/A		

Loads and Fixtures

Fixture name	Fixture Image	Fixture Details		
Fixed-1		Entities: 1 face(s) Type: Fixed Geometry		
Resultant Forces				
Components	X	Y	Z	Resultant
Reaction force(N)	-162.167	-149.693	-14495.4	14497.1
Reaction Moment(N.m)	0	0	0	0

Load name	Load Image	Load Details
Force-1		Entities: 1 face(s) Type: Apply normal force Value: 15000 N Phase Angle: 0 Units: deg



Connector Definitions

No Data

Contact Information

No Data

Mesh Information

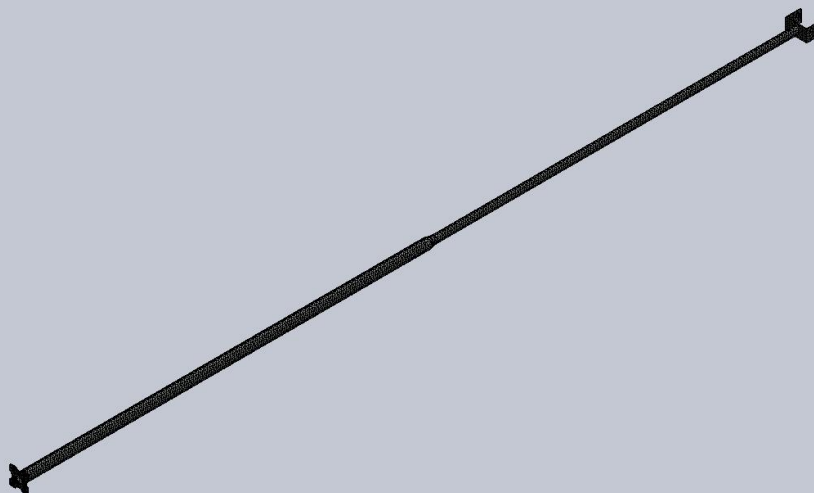
Mesh type	Solid Mesh
Mesher Used:	Standard mesh
Automatic Transition:	Off
Include Mesh Auto Loops:	Off
Jacobian points	4 Points
Element Size	15.1348 mm
Tolerance	0.756742 mm
Mesh Quality	High

Mesh Information - Details

Total Nodes	47085
Total Elements	23387
Maximum Aspect Ratio	28.172
% of elements with Aspect Ratio < 3	2.86
% of elements with Aspect Ratio > 10	0.235
% of distorted elements(Jacobian)	0
Time to complete mesh(hh:mm:ss):	00:00:06
Computer name:	SERVICE-CENTRE



Model name: base
Study name: Static 2 (Default)
Mesh type: Solid mesh



Sensor Details

No Data

Resultant Forces

Reaction Forces

Selection set	Units	Sum X	Sum Y	Sum Z	Resultant
Entire Model	N	-162.167	-149.693	-14495.4	14497.1

Reaction Moments

Selection set	Units	Sum X	Sum Y	Sum Z	Resultant
Entire Model	N.m	0	0	0	0

Beams

No Data



Study Results

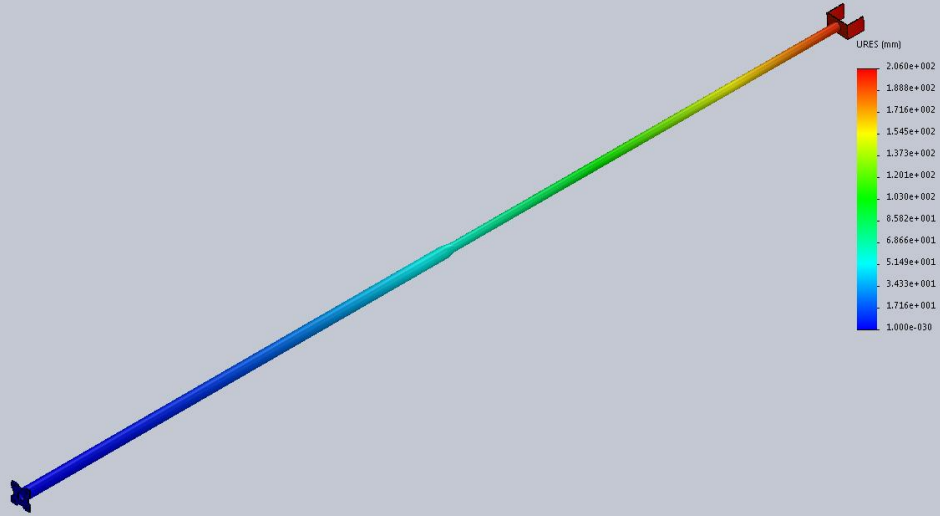
Name	Type	Min	Max
Stress1	VON: von Mises Stress	1421 N/m^2 Node: 12424	1.61096e+008 N/m^2 Node: 1189



base-Static 2-Stress-Stress1

Name	Type	Min	Max
Displacement1	URES: Resultant Displacement	0 mm Node: 4421	205.97 mm Node: 7699

Model name: base
Study name: Static 2(Default)
Plot type: Static displacement Displacement1
Deformation scale: 1



base-Static 2-Displacement-Displacement1

Name	Type	Min	Max
Strain1	ESTRN: Equivalent Strain	3.69052e-009 Element: 15545	0.000612184 Element: 20067

Model name: base
Study name: Static 2(Default)
Plot type: Static strain Strain1
Deformation scale: 1



base-Static 2-Strain-Strain1

Name	Type	Min	Max
Factor of Safety1	Automatic	1.36933 Node: 1189	155238 Node: 12424



Conclusion



Description
No Data

Simulation of STAND

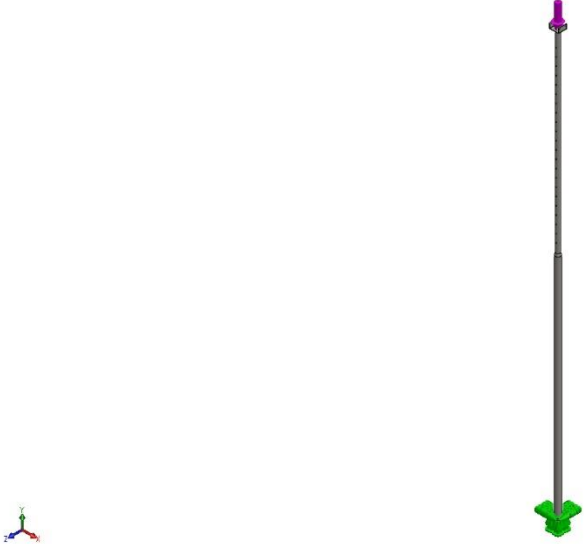
Date: Tuesday, December 08, 2015
Designer: Design office
Study name: Static 2
Analysis type: Static

Table of Contents

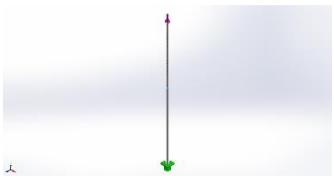
Description.....	1
Assumptions	2
Model Information	2
Study Properties	4
Units	4
Material Properties	5
Loads and Fixtures.....	6
Connector Definitions.....	6
Contact Information.....	7
Mesh information	8
Sensor Details	9
Resultant Forces	9
Beams.....	10
Study Results	11
Conclusion	14

Assumptions

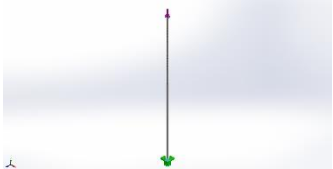
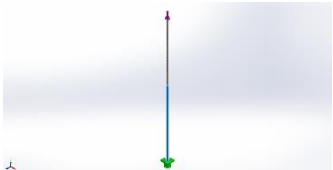
Model Information



Model name: STAND
Current Configuration: Default

Solid Bodies			
Document Name and Reference	Treated As	Volumetric Properties	Document Path/Date Modified
Revolve1 	Solid Body	Mass:0.121729 kg Volume:1.56062e-005 m ³ Density:7800 kg/m ³ Weight:1.19294 N	O:\Work Files\Desktop Projects\Probs\type 02\study 20 Kn\Conical.SLDPRT Dec 07 16:44:40 2015



Cut-Extrude1 	Solid Body	Mass:7.8579 kg Volume:0.00100742 m³ Density:7800 kg/m³ Weight:77.0074 N	O:\Work Files\Desktop Projects\Probs\type 02\study 20 Kn\INSIDE- GUIDE.SLDPRT Dec 07 16:42:58 2015
Boss-Extrude1 	Solid Body	Mass:0.42359 kg Volume:5.43065e-005 m³ Density:7800 kg/m³ Weight:4.15119 N	O:\Work Files\Desktop Projects\Probs\type 02\study 20 Kn\base.SLDPRT Dec 07 16:42:57 2015
Extrude-Thin1 	Solid Body	Mass:12.9677 kg Volume:0.00166253 m³ Density:7800 kg/m³ Weight:127.084 N	O:\Work Files\Desktop Projects\Probs\type 02\study 20 Kn\stand- base.SLDPRT Dec 07 16:42:58 2015

Study Properties

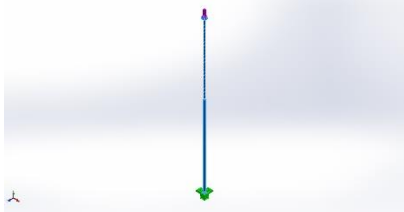
Study name	Static 2
Analysis type	Static
Mesh type	Mixed Mesh
Thermal Effect:	On
Thermal option	Include temperature loads
Zero strain temperature	298 Kelvin
Include fluid pressure effects from SOLIDWORKS Flow Simulation	Off
Solver type	FFEPlus
Inplane Effect:	Off
Soft Spring:	Off
Inertial Relief:	Off
Incompatible bonding options	Automatic
Large displacement	Off
Compute free body forces	On
Friction	Off
Use Adaptive Method:	Off
Result folder	SOLIDWORKS document (O:\Work Files\Desktop Projects\Probs\type 02\study 20 Kn)

Units

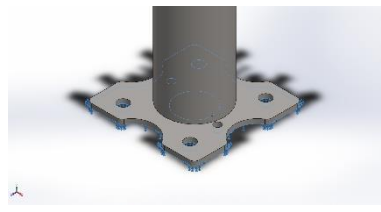
Unit system:	SI (MKS)
Length/Displacement	mm
Temperature	Kelvin
Angular velocity	Rad/sec
Pressure/Stress	N/m ²

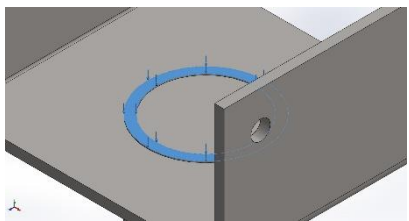


Material Properties

Model Reference	Properties	Components
	Name: Plain Carbon Steel Model type: Linear Elastic Isotropic Default failure criterion: Unknown Yield strength: 2.20594e+008 N/m² Tensile strength: 3.99826e+008 N/m² Elastic modulus: 2.1e+011 N/m² Poisson's ratio: 0.28 Mass density: 7800 kg/m³ Shear modulus: 7.9e+010 N/m² Thermal expansion coefficient: 1.3e-005 / Kelvin	SolidBody 1 (Revolve1)(Conical-1), SolidBody 1 (Cut-Extrude1)(INSIDE-GUIDE-1), SolidBody 1 (Boss-Extrude1)(Top part-1), SolidBody 1 (Boss-Extrude1)(base-1), SolidBody 1 (Extrude-Thin1)(stand- base-1)
Curve Data:N/A		

Loads and Fixtures

Fixture name	Fixture Image	Fixture Details		
Fixed-1		Entities: 1 face(s) Type: Fixed Geometry		
Resultant Forces				
Components	X	Y	Z	Resultant
Reaction force(N)	0.0918039	7999.79	0.141564	7999.79
Reaction Moment(N.m)	0	0	0	1e-033

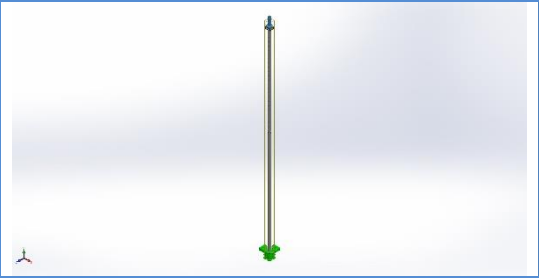
Load name	Load Image	Load Details
Force-1		Entities: 1 face(s) Type: Apply normal force Value: 8000 N

Connector Definitions

No Data



Contact Information

Contact	Contact Image	Contact Properties
Global Contact		Type: Bonded Components: 1 component(s) Options: Compatible mesh



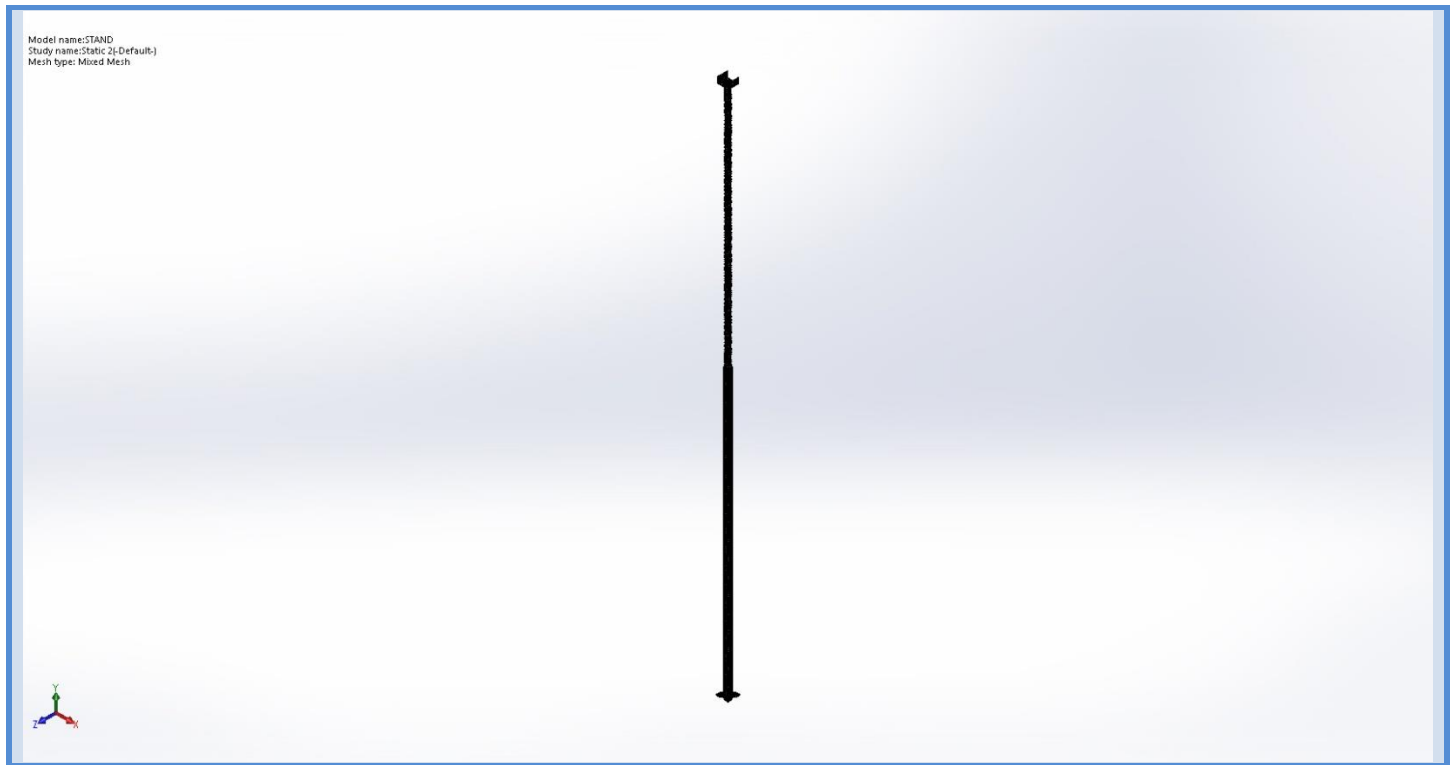
Mesh information

Mesh type	Mixed Mesh
Mesher Used:	Standard mesh
Automatic Transition:	Off
Include Mesh Auto Loops:	Off
Jacobian points	4 Points
Jacobian check for shell	On
Element Size	15.2911 mm
Tolerance	0.764557 mm
Mesh Quality	High
Remesh failed parts with incompatible mesh	Off

Mesh information - Details

Total Nodes	59781
Total Elements	29579
Time to complete mesh(hh:mm:ss):	00:00:14
Computer name:	HASSAN-PC





Sensor Details

No Data

Resultant Forces

Reaction forces

Selection set	Units	Sum X	Sum Y	Sum Z	Resultant
Entire Model	N	0.0918039	7999.79	0.141564	7999.79

Reaction Moments

Selection set	Units	Sum X	Sum Y	Sum Z	Resultant
Entire Model	N.m	0	0	0	1e-033



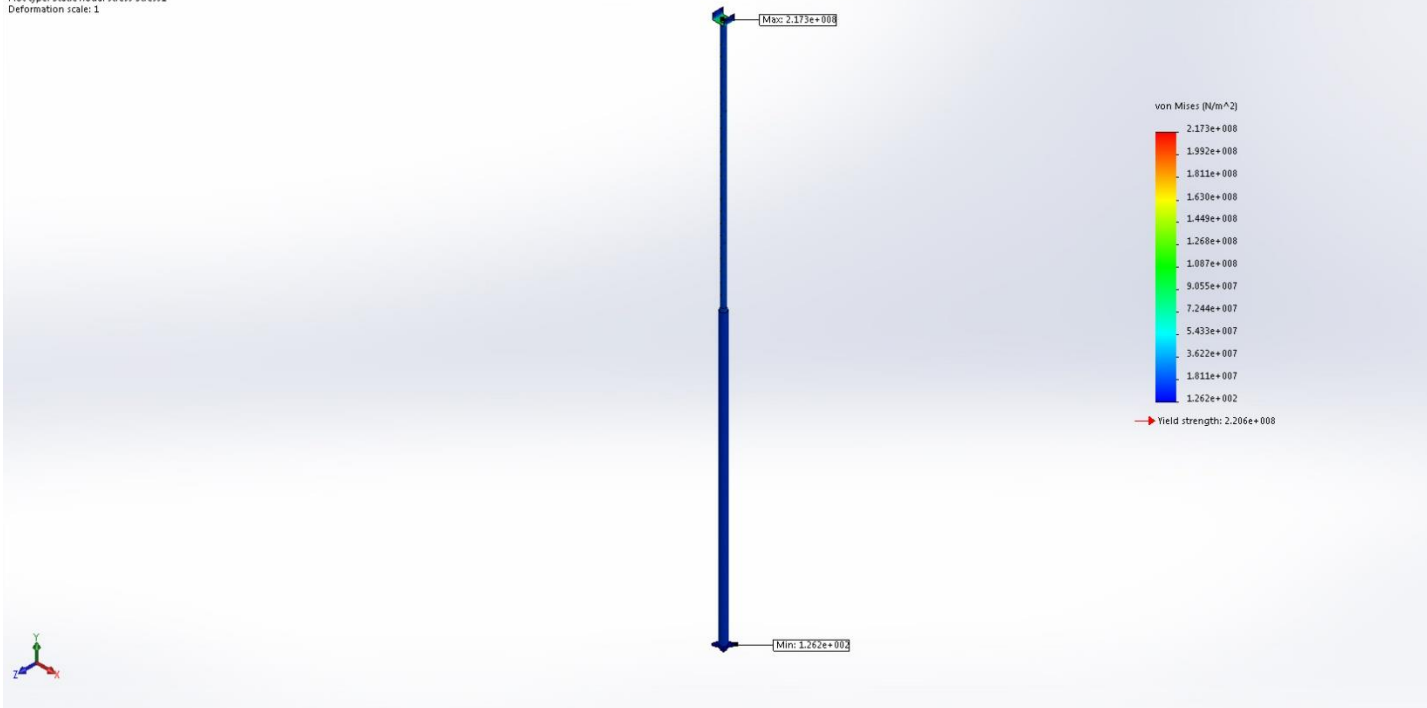
Beams

No Data

Study Results

Name	Type	Min	Max
Stress1	VON: von Mises Stress	126.224 N/m ² Node: 26871	2.17331e+008 N/m ² Node: 59011

Model name: STAND
Study name: Static 2(Default)
Plot type: Static nodal stress Stress1
Deformation scale: 1



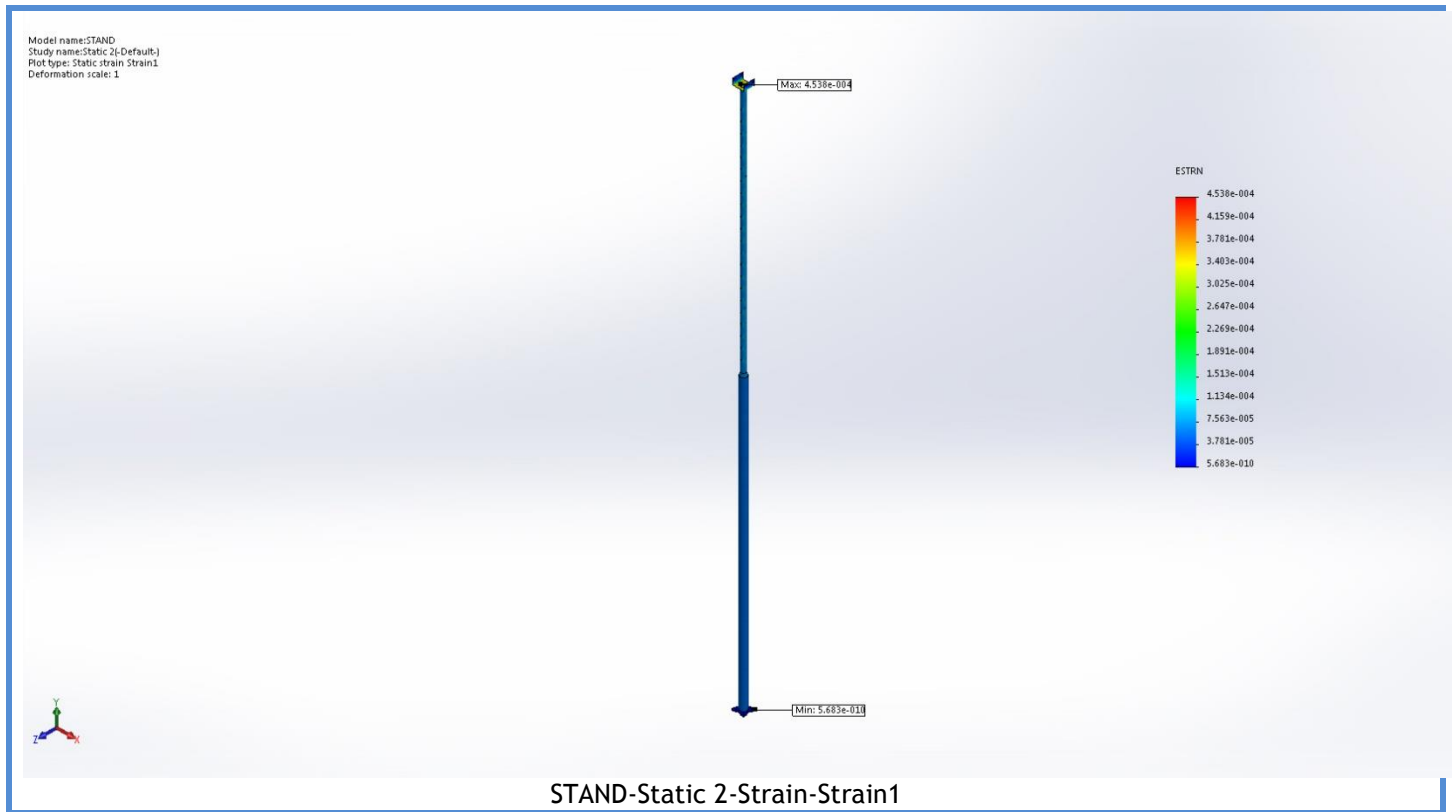
STAND-Static 2-Stress-Stress1

Name	Type	Min	Max
Displacement1	URES: Resultant Displacement	0 mm Node: 26378	1.03259 mm Node: 58916

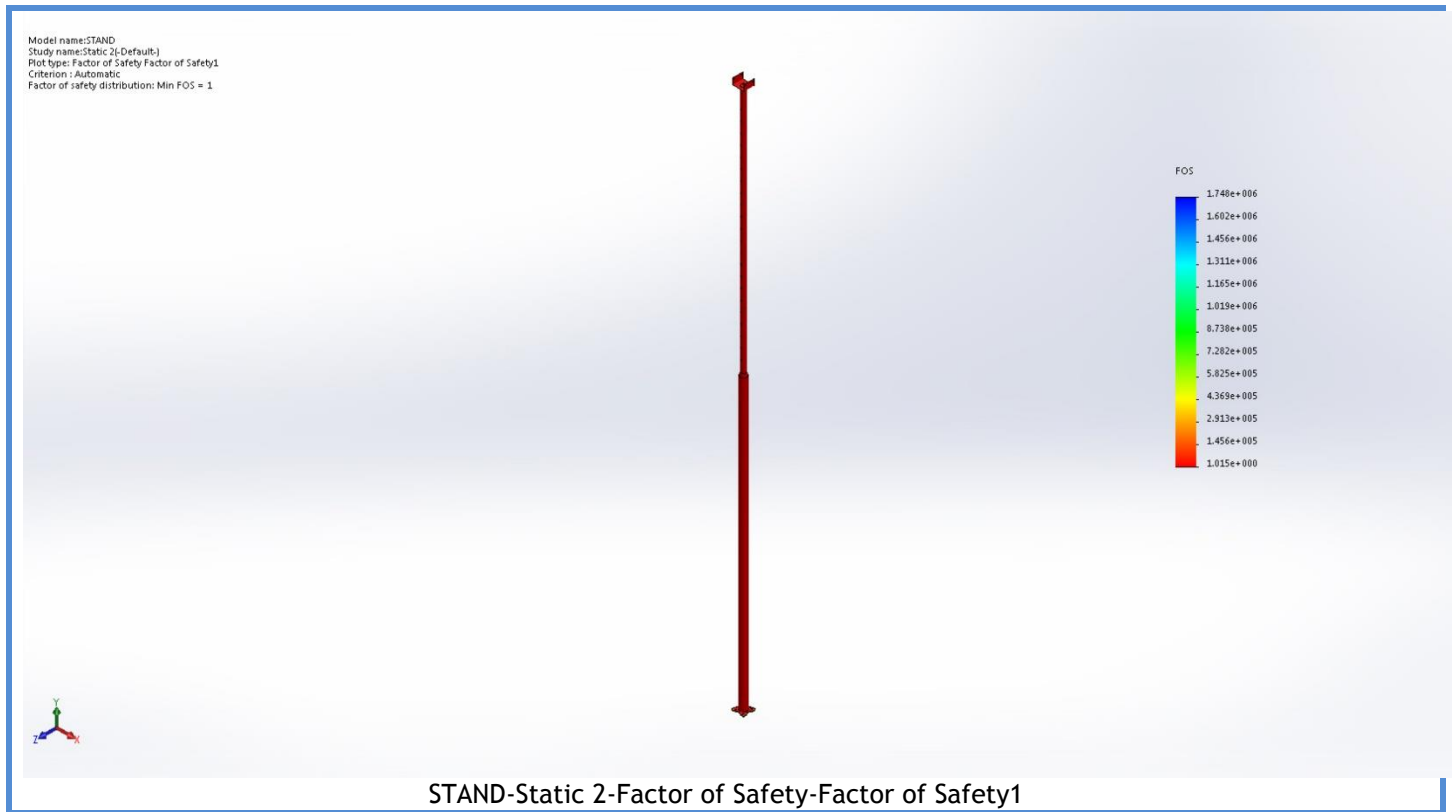




Name	Type	Min	Max
Strain1	ESTRN: Equivalent Strain	5.68278e-010 Element: 13371	0.000453761 Element: 29339



Name	Type	Min	Max
Factor of Safety1	Automatic	1.01501 Node: 59011	1.74764e+006 Node: 26871

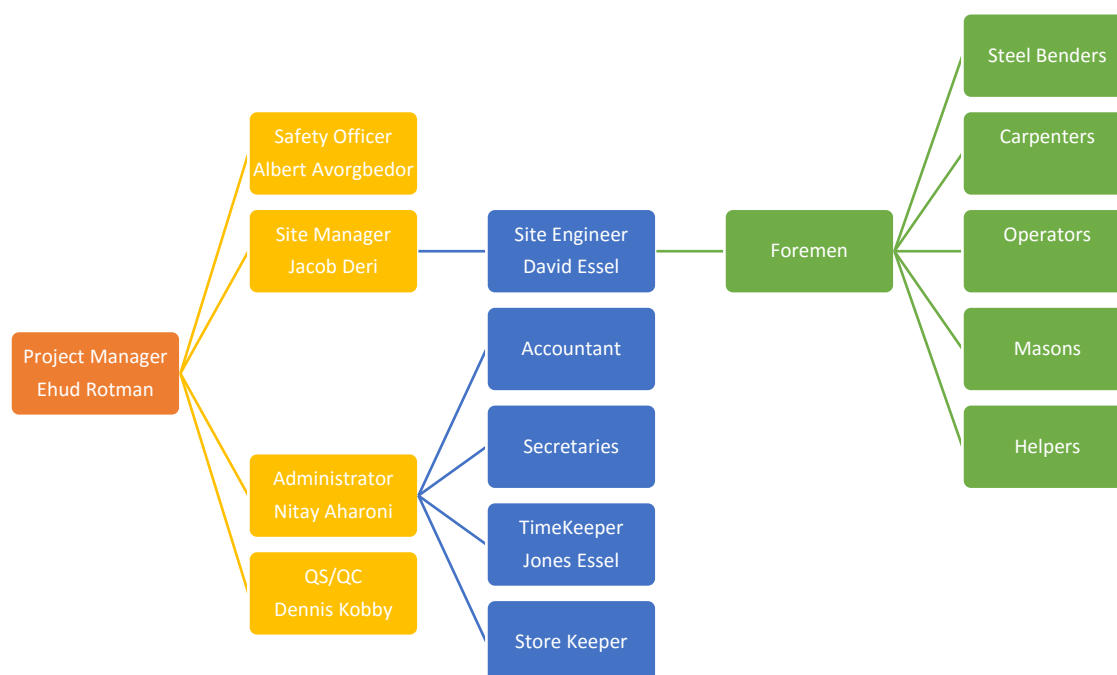


Conclusion

APPENDIX G

LIST OF POLICY DOCUMENTS

1. Figure 1- Organizational Structure on EDAIF Site



Source: AMANDI/EDAIF PMP

2. List of documents Provided by Site Administrator

- I. Accident registration
- II. Attendance book
- III. Authorization certificate to work
- IV. Insurance certificates
- V. List of construction engineers
- VI. List of project management
- VII. List of technicians
- VIII. List of workers
- IX. List of workers (foremen, masons, etc.)
- X. Progress report (Weekly/Monthly)
- XI. Quality plan, quality assessment
- XII. Risk Assessment, proposed risk response report
- XIII. Visitors books
- XIV. Technical training of workforce certificate
- XV. Work program
- XVI. HSE Policy Manual

THE PARTIAL COLLAPSE OF THE MEZZANINE FLOOR OF EDAIF TOWERS

**MONITORING AND EVALUATION OF
POST-INVESTIGATION ACTIVITIES
– FINAL REPORT**

ING. DR. D. ARYEE-BOI AND ING. J. ALLOTEY

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After the investigation of the partial collapse of the Mezzanine floor of the EDAIF TOWERS, under construction in November, 2015, recommendations were made to prevent any future occurrence of the accident and also to better the working conditions of the Contractor and his employees. This exercise of Monitoring and Evaluation is to ensure that the Contractor is adhering to the recommendations made in the final report of the investigation into the partial collapse of the Mezzanine floor. It is also the objective of this exercise to provide enough information to the city authorities and the Accra Metropolitan Authority to enable them make good judgment, when the client applies for HABITATION PERMIT.

EXECUTIVE SUMMARY

This post monitoring and evaluation report on the 16-Storey Block of offices for the Export House, (Export Trade, Agriculture and Industrial Development Fund) EDAIF, (Ghana Export Promotion Authority) GEPA and other Trade Agencies at the Ambassadorial enclave still under construction in Accra, Ghana, was done to investigate whether the recommendations drafted for the Contractor following the partial collapse of the Mezzanine floor of the EDAIF Tower during the casting of the floor on Sunday, 22nd November 2015, which took one employee's life was being adhered to. This report also intends to know whether other measures have been instituted by the Contractor to avert any future occurrence of that unfortunate incidence.

To accomplish this investigation, two (2) methods were essentially adopted.

- a) Interviewing of all groups (contractors employees and Consultant's representative) involve in the construction of the building.
- b) Personal Observations of the entire building by the engineers involved in the investigation.

The monitoring and evaluation team realized from their findings that, the Contractor and the Consultant have eventually instituted the following measures to achieve the recommendations of the Technical Committee Constituted by the Accra Metropolitan Assembly after the partial collapse of the Mezzanine floor.

- The Resident Engineers on the project supervise and certify design of formwork, false work, fixing on site and all other engineering work done by the Contractor. They enforce these measures by vigorously inspecting every aspect of the engineering work accomplished by the contractor and appending their signatures on a request for

inspection sheet provided by the Contractor if only they are satisfied with the work executed.

- The Resident Engineers also inspect every material and engineering tests delivered or performed by the Contractor on site and sometimes recheck the information by doing further tests to confirm and affirm the results.
- Two (2) Permanent Safety Officers and a General Safety Manager are employed on the project by the Contractor to enforce safety measures.
- The First Aid Kits on the site were adequately equipped with medical materials and tools to care for construction accident victims before professional assistance arrives if necessary.
- A pick-up truck provided by the contractor on the project site, is used to transport injured workers to a nearby clinic or hospital in case first Aid is not enough for the victim.
- Yearly, Monthly, Weekly and Daily Safety report are prepared by the safety Officer for the management of the construction company in order to record and keep track of every safety issue arising on the project site.
- The emergency response plan for the company includes, accessing the Emergency situation, providing first Aid for the victim and Transporting the victim to a nearby clinic or hospital for a professional care if the situation is beyond just first Aid.
- The contractor has provided a well organised store room where construction materials, supplies and equipment are kept and protected from damage from rain or temperature extremes on the construction site.
- The Employees are trained twice a week, on Monday's and Friday's on Occupational, health and safety issues on the construction site.

- Safety signs have been posted all around the construction site to remind workers and possible trespassers of hazardous conditions and precautionary measures they have to take to protect themselves from injuries.
- The Contractor has four (4) site engineers on the project. These engineers are divided into four (4) major areas of the construction. There is an Engineer responsible for Stone facing, a materials Engineer who verifies and record construction materials delivered on site and makes sure they meet the project specifications, the Engineer who liaise with the Resident Engineer to solve issues raised by the consultant during inspection of work and the General site Engineer who coordinates and supervise all technical aspect of the construction project.
- Every employee on the project is enrolled on the National Health Insurance Scheme by the Contractor.
- Every Employee is enrolled on the Vanguard life Insurance Policy to help them receive extra compensations in case of any site related injuries.
- The social security of every employee on the project is paid perpetually by the Contractor.

The Monitoring and Evaluation team also made the following significant notes after touring the entire building and its environs.

- Floor holes and Edges where workers might accidentally fall were well guided with fabricated steel rods.
- Guardrails in the form of fabricated steel rods have been provided around the staircase as an interim solution to prevent falling.
- There were caution and warning tapes wrapped around the fabricated steel rods but not all as a visual warning to further inform the workers of the possible danger.

- The Floors were clean and dry as possible to prevent slippage.
- The workers were provided with the required Personal Protective Equipment (PPE's) like safety boots, helmets and reflectors for their respective works.
- The scaffolds were properly equipped with mid-rail to prevent falling.
- The construction scaffolding steel props were in good condition and well secured.
- The Elevator on the site was well protected and in good functional state.
- The construction store room was well managed and materials orderly arranged.
- There were four bathrooms and three unit water closet for the workers. Two of the four bathrooms were not functional. The water closets were not hygienic enough with leakages and wet floors.
- There were no urinals for the workers. They urinate on a wall close to the toilet
- There was no suitable canteen available on site for the workers.

CONCLUSION

The Contractor has adhered to almost all the recommendations provided by the Technical Committee constituted by the Accra Metropolitan Assembly after the partial collapse of the Mezzanine floor of the EDAIF Towers during the casting of the floor on Sunday, 22nd November 2015. The contractor still needs to regularly improve on the implemented measures used to reach these objectives and develop other plans to achieve the other recommendations yet to be attained. This will further help to enhance the Health, safety and the general well-being of the workers on the project. **In all the Contractor has done excellently well in acting on the recommendations of the final report of the investigations in to the partial collapse of the building during construction in November 2015.**

RECOMMENDATIONS

There were other areas that needed to be improved on the construction site to further strengthen the good works done by the Contractor. The following are the recommendations of the monitoring and evaluation team.

- The Toilet Facility for the workers should be upgraded to improve hygiene and the floor should be kept dried always to prevent slippage.
- A proper Urinal facility should be built for the workers.
- A suitable canteen should be built for the workers on site.
- Caution and warning tapes should be wrapped around all fabricated steel rods used as protective barriers around the staircase, floor edges and floor holes to serve as a visual warning to further inform the workers of the possible dangers.
- A simulation exercise and drills to test the level of preparedness of the workers on site was conducted at the end of January 2017. However there was the need to continue to conduct more often such exercises, since it became clear during the exercise that the workers are not prepared to act correctly, if there should be an accident.

Ing. Joshua Allotey
Committee Chairman

Ing. Dr. Desmond Aryee-Boi
Project Director

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1.0 INTRODUCTION

The Export Development and Agricultural Investment Fund (EDAIF), is an agency of the Ministry of Trade and Industry (MOTI) of the Government of Ghana whereas The Ghana Export Promotion Authority (GEPA) is the National Export Trade Support Institution of the Ministry of Trade and Industry (MOTI) responsible for the facilitation, development and promotion of Ghanaian exports.

This report presents the findings of the Post Monitoring and Evaluation investigation into the cause of partial collapse of the mezzanine floor of the EDAIF Tower, a proposed office tower with underground parking for EDAIF and GEPA (the clients) in the Ambassadorial Enclave, Ridge, Accra – Ghana.

1.1 *Background Information*

The Export Development and Agricultural Investment Fund (EDAIF), is an agency of the Ministry of Trade and Industry (MOTI) of the Government of Ghana. EDAIF contracted Amandi Holdings Ltd, under a Design-Build Contract to plan and construct a 16-storey building with a 2-level basement parking facility in Accra, Ghana. The project site is bounded by the Liberia Road, the 6th Avenue Road and the British Council building. The EDAIF building project which commenced in October, 2014 is scheduled to be completed in May, 2017. The building skeleton will be constructed with reinforced concrete and will include flat structural slabs, reinforced concrete beams, columns, walls and curtain walls. The location of the project site is shown in Figure 1-1.

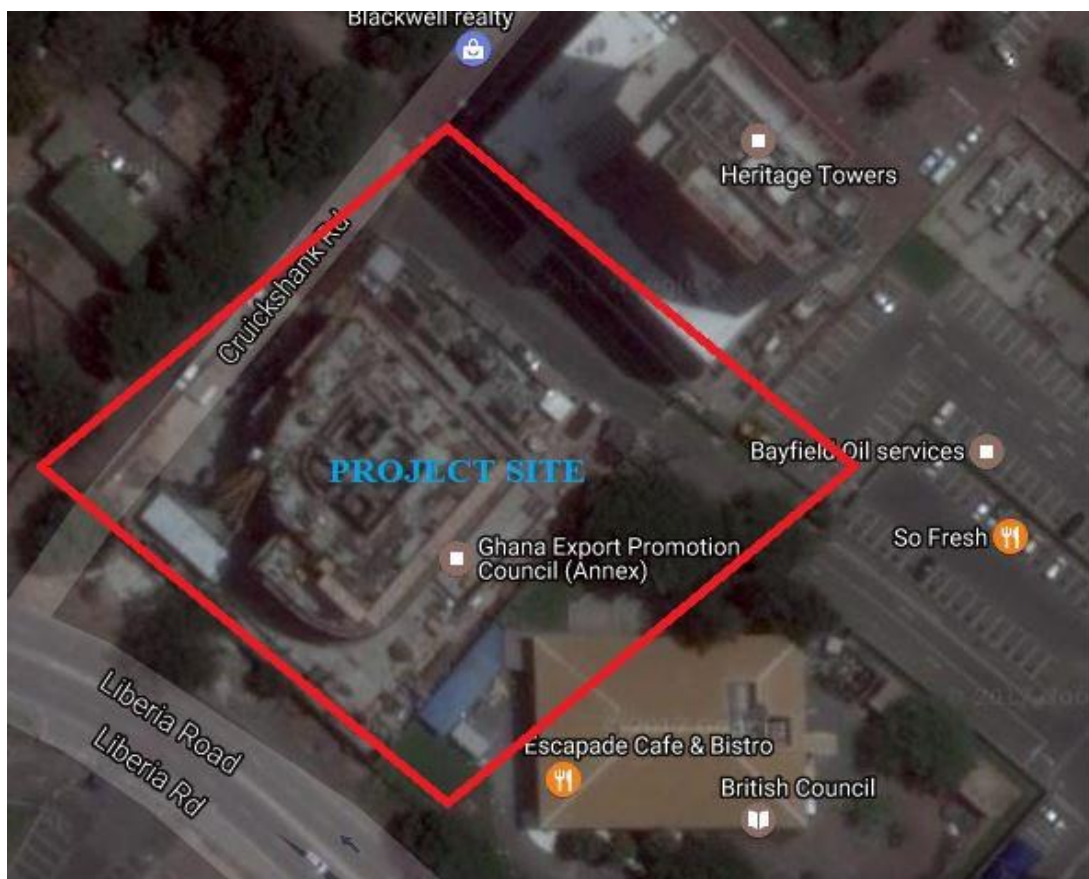


Figure 12-1 Project Location Map

1.2 *Scope of Work*

The following is the scope of works for the Post Monitoring and Evaluation investigation into the collapse of uncompleted building as defined by the request for engineering services submitted to the technical committee:

- a) Monitoring the strict adherence to the recommendations made after the investigations into the partial collapse of the mezzanine floor in November 2015.
- b) Evaluation of methods implemented by the Contractor in keeping to the recommendations made in the final report of the investigations into the partial collapse of the mezzanine floor
- c) Recommendations, if necessary, to better the working conditions on site

1.3 *Objective*

The main objective of the Monitoring and Evaluation Exercise was to ensure that the recommendations drafted for AMANDI Holdings (the Contractor) on December 2015, following the partial collapse of the Mezzanine floor of the EDAIF Tower during the casting of the floor on Sunday, 22nd November 2015, are being adhered to.

This investigation also intends to know whether other measures have been instituted by the Contractor to avert any future occurrence of that unfortunate incidence, and to make the working conditions, in terms of Health, Safety and Environment is made better than it was before the accident.

1.4 *Team*

The Metro Works Department of the Accra Metropolitan Assembly, in exercising its oversight responsibility in the Constructions of building structures within the metropolitan area, recommended JUKESS CONSULTANCY AND SERVICES LTD, a consulting civil & structural firm, to the clients, to act as consultants for the Monitoring and Evaluation Exercise.

2.0 METHODOLOGY

To accomplish the above outlined objectives, two main methods were essentially adopted.

a) Interviewing of all groups (Contractors employees and Consultant's representative) involved in the construction of the building.

b) Personal Observations of the entire building by the engineers involved in the investigation.

The questioning of all the groups (Contractors employees and Consultant's representative) involved in the building process was done to amass information on construction practices implemented on the site, to ensure safe environment for the workers. This was also done to enquire whether the recommendations provided by the Technical Committee Constituted by the Accra Metropolitan Assembly after the partial collapse of the Mezzanine floor are being followed extensively.

The personal observation of the entire building by the engineers involved in the investigation was thoroughly done to confirm the information compiled from the questioning of all party's involved the construction.

3.0 FINDINGS AND DISCUSSIONS

3.1 1ST QUARTER

There were six visits conducted in the first quarter of the year 2016, in order to monitor and evaluate the works of the Contractor. The visits took place on the following dates: 15th January, 29th January, 12th February, 26th February, 11th March and 25th March.

The following observations, among many others, were made:

- Two Permanent Safety Officers and a General Safety Manager are employed on the project to enforce safety measures.
- The First Aid Kits on the site were adequately equipped with medical materials and tools to care for construction accident victims before professional assistance arrives if necessary.
- A pick-up truck provided by the contractor on the project site is used to transport injured workers to a nearby clinic or hospital in case first Aid is not enough for the victim.
- Floor holes and Edges where workers might accidentally fall were well guided with fabricated steel rods.
- Guardrails in the form of fabricated steel rods have been provided around the staircase as an interim solution to prevent falling.
- There were caution and warning tapes wrapped around the fabricated steel rods but not all, as a visual warning to further inform the workers of the possible danger.

3.2 2ND QUARTER

There were six visits conducted in the second quarter of the year 2016, in order to monitor and evaluate the works of the Contractor. The visits took place on the following dates: 8th April, 22nd April, 13th May, 27th May, 10th June and 24th June.

The following observations, among many others, were made:

- Two Permanent Safety Officers and a General Safety Manager are employed on the project to enforce safety measures.
- The First Aid Kits on the site were adequately equipped with medical materials and tools to care for construction accident victims before professional assistance arrives if necessary.
- A pick-up truck provided by the contractor on the project site is used to transport injured workers to a nearby clinic or hospital in case first Aid is not enough for the victim.
- Floor holes and Edges where workers might accidentally fall were well guided with fabricated steel rods.
- Guardrails in the form of fabricated steel rods have been provided around the staircase as an interim solution to prevent falling.
- There were caution and warning tapes wrapped around the fabricated steel rods but not all, as a visual warning to further inform the workers of the possible danger.
- The Floors were clean and dry as possible to prevent slippage.
- The workers were provided with the required Personal Protective Equipment (PPE's) like safety boots, helmets and reflectors for their respective works.
- The scaffolds were properly equipped with mid-rails to prevent falling.
- The construction scaffolding steel props were in good condition and well secured.
- The Elevator on the site was well protected and in good functional state.

- The construction store room was well managed and materials orderly arranged.

3.3 3RD QUARTER

There were six visits conducted in the third quarter of the year 2016, in order to monitor and evaluate the works of the Contractor. The visits took place on the following dates: 8th July, 22nd July, 12th August, 26th August, 16th September, and 30th September.

The following observations, among many others, were made:

- Two Permanent Safety Officers and a General Safety Manager are employed on the project to enforce safety measures.
- The First Aid Kits on the site were adequately equipped with medical materials and tools to care for construction accident victims before professional assistance arrives if necessary.
- A pick-up truck provided by the contractor on the project site is used to transport injured workers to a nearby clinic or hospital in case first Aid is not enough for the victim.
- Floor holes and Edges where workers might accidentally fall were well guided with fabricated steel rods.
- Guardrails in the form of fabricated steel rods have been provided around the staircase as an interim solution to prevent falling.
- There were caution and warning tapes wrapped around the fabricated steel rods but not all, as a visual warning to further inform the workers of the possible danger.
- The Floors were clean and dry as possible to prevent slippage.
- The workers were provided with the required Personal Protective Equipment (PPE's) like safety boots, helmets and reflectors for their respective works.

- The scaffolds were properly equipped with mid-rails to prevent falling.
- The construction scaffolding steel props were in good condition and well secured.
- The Elevator on the site was well protected and in good functional state.
- The construction store room was well managed and materials orderly arranged.
- Yearly, Monthly, Weekly and Daily Safety reports are prepared by the safety Officers for the management of the construction company in order to record and keep track of every safety issue arising on the project site.
- The May to December 2016 safety reports indicate there has been 0.0% accident recorded on the project.
- The emergency response plan for the company includes, accessing the Emergency situation, providing first Aid for the victim and Transporting the victim to a nearby clinic or hospital for a professional care if the situation is beyond just first Aid.
- The contractor has provided a well organised store room where construction materials, supplies and equipment are kept and protected from damage from rain or temperature extremes on the construction site.

3.4 4th QUARTER

The 4th Quarter Monitoring and Evaluation exercise was very detailed and concise. Unlike the other period of the year, where the visits were short and frequent, in the 4th Quarter, more engineers were engaged in the exercise to ensure more strictness in the adherence of all recommendations made in the final report of the investigations after the partial collapse in November 2015. The enhancement of the exercise this time was also due to the fact that, the construction of the building is nearing its completion. **The total adherence of all recommendations made may help the city authorities to make good judgement when assessing the building for the HABITATION PERMIT.**

The Evaluation and Monitoring process started with a general meeting on the premises of the construction site on Wednesday 21st December 2016, to inform all groups involved in the construction of the 16-Storey building of the fact-finding process to be done by the two Investigative Engineers appointed by the project director of the Evaluation and Monitoring team. The project director also pleaded with the groups to cooperate with the Engineers for a smooth process.

The meeting was chaired by ING. Joshua Allotey, the committee chairman and ING. Dr. Aryee-Boi, the project Director for the Monitoring and Evaluation Team. Mr. Muli Semo, the Administrator for AMANDI Holdings Ltd, Mr. Jonathan Antwi, the General Safety Manager for AMANDI Holdings Ltd, Mr. Albert Avorgbedor, the site Safety Officer, Mr. Joseph Dodzi, 1st Investigative Engineer and Mr. Emmanuel Aidoo, 2nd Investigative Engineer for the monitoring and evaluation team were all present at the meeting.

The main objective of the evaluation and monitoring team was to check whether the recommendations drafted for AMANDI Holdings Ltd (the Contractor) on December 2015, following the partial collapse of the Mezzanine floor of the EDAIF Tower during the casting of the floor on Sunday, 22nd November 2015, was being adhered to.

The recommendations provided by the Technical Committee Constituted by the Accra Metropolitan Assembly after the partial collapse of the Mezzanine floor of the EDAIF Tower are briefly outlined below;

- The monitoring or supervising consultants should enforce approval of design of formwork and false work and subsequent fixing on site.

- All engineering structures, whether buildings, props or formwork etc. regardless of origin of supplier or production, should be certified by a professional engineer of good standing with the Ghana Institution of Engineers.
- A traceability system should be established for all construction materials.
- Consider Post Emergency rapid Assessment on project site.
- The Contractor should have at least two qualified Health, Safety and Environmental (HSE) Officers to take responsibilities of Health and Safety and Environment Issues.
- The Contractor should have an Emergency Response Plan and procedures to handle any possible emergencies that may arise on the site.
- The Contractor should have bi-annual general trainings on Occupational, Health and Safety Management for both permanent and contract staff.
- The Contractor should have a simulation exercises and drills to test the level of preparedness of workers on site.
- It is also recommended that health and safety issues should go beyond Personal Protective Equipment (PPE) and include improvement in health messages and signage. Particular need is a designated area for smoking as per the health and safety policy document of Amandi Holdings to stem passive smoking.
- It is recommended that storage of potential hazardous materials such as sharp edged materials around exists should have visible warning signs and where possible sealed to avoid falls and cuts.
- It is recommended that further investigation be conducted into how completed phases of work are signed off.
- Adequate data of all persons who have at least a day's relationship with the site should be captured.

- Social Security and National Insurance contributions should be compulsory. It should not be left to the discretion of the workers, especially the casual or contract workers.

3.4.1 Interaction With The Consultant

The investigation process commenced with a face to face discussion with Mr. Eddie Mills, the structural Resident Engineer on the site. The information we acquired from him was that, there were two main personnel from the Consultant (Architectural Design Partnership (ADP)) representing on the project, namely Mr. Alex Owusu, the Lead Architect and himself, the lead structural Engineer.

There were other representative from electrical, material and mechanical department of the consultancy firm on the project as well, who visits the site occasionally to make sure things are done according to plan.

The Resident Engineer's basic objective on the project is to supervise and certify design of formwork, false work, fixing on site and all other engineering work done by the Contractor. The Resident Engineers on the site enforce these measures by vigorously inspecting every aspect of the engineering work accomplished by the contractor and appending their signatures on a request for inspection sheet provided by the Contractor if only they are satisfied with the work executed. This is done before any further work can be performed by the Contractor and also to ensure all services/works are adequately performed and in accordance with the best practices and standards to fulfil the objective of the project.

The Resident Engineers also inspect every material and engineering tests delivered or performed by the Contractor on site and sometimes recheck the information by doing further tests to confirm and affirm the results.

These appropriate measures have been implemented by the consultant to ensure that, the recommendations provided by the Technical Committee Constituted by the Accra Metropolitan Assemble team after the 9th November 2015 incidence are being adhered to by the Contractor.

3.4.2 Health, Safety And Environmental (HSE) Issues

The Health, Safety and Environmental (HSE) Issues concerning the project were highly recommended by the Technical Committee Constituted by the Accra Metropolitan Assembly in the previous Investigation, to be at the highest quality standard.

To know whether the enforcement of quality Health, Safety and Environmental practices recommended by the Technical Committee are being adhered to by the Contractor, Personal observations and a direct discussion with the safety team on the project was done. There were two permanent safety officers on the project and a General Safety Manager for the Contractor, who oversees all projects being handled by the Contractor and ensures that quality safety measures are being implemented by his junior safety officers. The Safety officers were Mr. Jonathan Antwi, the General Safety Manager, Mr. Albert Avorgbedor, the Project Safety Officer and Mr. Isaac Anku, the Assistant Project Officer.

The following were the information was gathered from the Health, Safety and Environmental Team on the Project.

- Two Permanent Safety Officers and a General Safety Manager are employed on the project to enforce safety measures.

- The First Aid Kits on the site were adequately equipped with medical materials and tools to care for construction accident victims before professional assistance arrives if necessary.
- A pick-up truck provided by the contractor on the project site is used to transport injured workers to a nearby clinic or hospital in case first Aid is not enough for the victim.
- Yearly, Monthly, Weekly and Daily Safety reports are prepared by the safety Officers for the management of the construction company in order to record and keep track of every safety issue arising on the project site.
- The May to December 2016 safety reports indicate there has been 0.0% accident recorded on the project.
- The emergency response plan for the company includes, accessing the Emergency situation, providing first Aid for the victim and Transporting the victim to a nearby clinic or hospital for a professional care if the situation is beyond just first Aid.
- The contractor has provided a well organised store room where construction materials, supplies and equipment are kept and protected from damage from rain or temperature extremes on the construction site.
- The Employees are trained twice a week, on Monday's and Friday's on Occupational, health and safety issues on the construction site.
- The Safety Team on the project has not organised any simulation exercise and drills to alert the workers on how to escape in case of any emergency or imminent danger.
- Safety signs have been posted all around the construction site to remind workers and possible trespassers of hazardous conditions and precautionary measures they have to take to protect themselves from injuries.

3.4.3 Interaction With Site Engineers

Issues related to supervision of engineering works on the site were discussed with the General Site Engineer. It was discovered that the Contractor has four site engineers on the project. These engineers are divided into four (4) major areas of the construction. There is an Engineer responsible for Stone facing, a materials Engineer who verifies and record construction materials delivered on site and makes sure they meet the project specifications, the Engineer who liaise with the Resident Engineer to solve issues raised by the consultant during inspection of work and the General site Engineer who coordinates and supervise all technical aspect of the construction project.

The Contractor does not have a specific material schedule on site. The materials Engineer inspects and make sure every construction material delivered on site comes with its own certificates and test results from the manufacturer. A further test is performed by the contractor on the materials delivered on site if there is any doubt with the certificates and test results provided by the manufacturer. All these precautionary measures are taken to ensure all construction materials are according to project specifications and can be traced back to its source.

3.4.4 Project Manager And The Administrator

The Project Manager and the Administrator for the Contractor briefed us on the company's policy on health, which has forced every employee on the project to be enrolled on the National Health Insurance Scheme. The Contractor also renews every employee's National Health Insurance when they expire. The social security of every worker on the project is been paid by the Contractor constantly. The company has also registered every Employee on the Vanguard Insurance Policy to help them receive extra compensations in case of any site related injuries.

Some of the workers on the project justified these information provided by the Project Manager during our personal conversation with them.

The Evaluation and Monitoring process was closed on Thursday 5th January 2017 with a general meeting on the premises of the construction site.

All documents supplied by the Health, Safety and Environmental team, the Project Manager and the Administrator for the Contractor are provided in the appendixes to support the information they provided.

3.4.5 Observations By Monitoring and Evaluation Engineering Team

The Monitoring and Evaluation team also made the following significant notes after touring the entire building and its environs.

- Floor holes and Edges where workers might accidentally fall were well guided with fabricated steel rods.

- Guardrails in the form of fabricated steel rods have been provided around the staircase as an interim solution to prevent falling.
- There were caution and warning tapes wrapped around the fabricated steel rods but not all, as a visual warning to further inform the workers of the possible danger.
- The Floors were clean and dry as possible to prevent slippage.
- The workers were provided with the required Personal Protective Equipment (PPE's) like safety boots, helmets and reflectors for their respective works.
- The scaffolds were properly equipped with mid-rails to prevent falling.
- The construction scaffolding steel props were in good condition and well secured.
- The Elevator on the site was well protected and in good functional state.
- The construction store room was well managed and materials orderly arranged.
- There were four bathrooms and three unit water closet for the workers. Two of the four bathrooms were not functional. The water closets were not hygienic enough with leakages and wet floors.
- There were no urinals for the workers. They urinate on a wall close to the toilet
- There was no suitable canteen available on site for the workers

4.0 CONCLUSIONS

The Contractor has adhered to almost all the recommendations provided by the Technical Committee Constituted by the Accra Metropolitan Assembly after the partial collapse of the Mezzanine floor of the EDAIF Tower during the casting of the floor on Sunday, 22nd November 2015. The contractor still needs to regularly improve on the implemented measures used to reach these objectives and develop other plans to achieve the other recommendations yet to be attained. This will further help to enhance the Health, safety and the general well-being of the workers on the project.

In all the Contractor has done excellently well in acting on the recommendations of the final report of the investigations in to the partial collapse of the building during construction in November 2015.

5.0 RECOMMENDATIONS

The Monitoring and Evaluation team has realised from its findings that, the general Health and Safety on the project site can be further improved when the Contractor adhere to the following recommendation.

- The Toilet Facility for the workers should be upgraded to improve hygiene and the floor should be kept dried always to prevent slippage.
- A proper Urinal facility should be built for the workers.
- A suitable canteen should be built for the workers on site.
- Caution and warning tapes should be wrapped around all fabricated steel rods used as protective barriers around the staircase, floor edges and floor holes to serve as a visual warning to further inform the workers of the possible dangers.
- A simulation exercise and drills to test the level of preparedness of the workers on site was conducted at the end of January 2017. However there was the need to continue to conduct more often such exercises, since it became clear during the exercise that the workers are prepared to act correctly, if there should be an accident.

APPENDICES

APPENDIX A:**MINUTES OF POST EVALUATION AND MONITORING MEETINGS**MONITORING AND EVALUATION (POST INVESTIGATION) OF EDAIF TOWERSMINUTES OF THE SITE MEETING HELD AT EDAIF TOWERS ON 21ST DECEMBER,2016**Location:** EDAIF Towers, Accra**Date:** Wednesday 21st December 2016**Time:** 10:15 a.m.**CALL TO ORDER**

The meeting began at 10:15 a.m. with a prayer from Mr. Albert Avorgbedor of AMANDI Holdings, and was presided by Dr. Ing Desmond Aryee-Boi with Joseph Dodzi as secretary. Dr. Ing Desmond Aryee-Boi gave his welcome speech and allowed every attendee to introduce himself.

ATTENDEES

- | | |
|------------------------------|---------|
| 1. Ing Joshua Allotey | JUKESS |
| 2. Dr. Ing Desmond Aryee-Boi | JUKESS |
| 3. Dodzi Joseph | JUKESS. |
| 4. Emmanuel Aidoo | JUKESS. |
| 5. Jonathan Antwi | AMANDI |
| 6. Albert Avorgbedor | AMANDI |

7. Muli Semo

AMANDI

8. Eddie Mills

ADP

AGENDA, DECISIONS AND ISSUES

A brief history of the project and the principal aim for the meeting was outlined by Dr. Ing Desmond Aryee-Boi, the Project Director for the Monitoring and Evaluation Team.

The aims of the meeting as outlined by the director are as follows:

- a) To know the measures implemented by the Contractor to adhere to the recommendations drafted by the Technical Committee Constituted by the Accra Metropolitan Assembly after the partial collapse of the Mezzanine floor on 22nd November 2015.
- b) To inform all members of a new monitoring and evaluation team that has been formed by the Technical Committee to further investigate whether the Contractor is adhering to the recommendations.

Mr. Emmanuel Aidoo and Mr. Joseph Dodzi were introduced by the project Director as the engineers to do a 2-day monitoring and Evaluation of the project site to further check whether the Contractor is adhering to the recommendations.

The table below summarizes all the questions asked by the chairman and the project director and the answers given by the contractor's representatives during the meeting.

NO.	RECOMMENDATIONS (QUESTIONS)	ACTIONS & RESPONSIBILITY (ANSWERS)
1	The monitoring or supervising consultants should enforce approval of design of formwork and false-work and subsequent fixing	Mr. Muli Semo, the administrator for AMANDI Holdings (Contractor) explained that, every engineering work on the project site is thoroughly checked by Mr. Eddie Mills (the Consultant) before any progress can be made by the Contractor.
2	All engineering structures, whether buildings, props, or formwork etc. regardless of origin of supplier or production, should be certified by a professional engineer of good standing with the Ghana Institute Of Engineers	The Contractor has 4 qualified professional Engineers, who check all engineering work on the site to confirm whether they meet the project requirements. This was explained by Mr. Muli Semo.
3	Traceability system should be established for all constructional materials.	Every constructional Material received on site comes with a manufacturer's certificate and test results to make traceability simple. This was clarified by Mr. Muli Semo.
4	Consider post emergency Rapid Assessment on project site and emergency respond plan and Procedures to handle any possible emergencies that may arise on site	Mr. Jonathan Antwi explained that, Measures have been implemented by the safety department of the company (AMANDI Holdings) to cater for post emergency issues on the site. This include

		a well equip first Aid kit and a standby pickup to transport the injured to a nearby hospital if necessary.
5	Have at least two qualified HSE Officers to take responsibilities of Health ,Safety and Environment issues	The contractor has two qualified safety officers on the project and a general safety manager for the company, who are responsible for Health, Safety and Environmental issues on the site. This was elucidated by Mr. Jonathan Antwi.
6	Have well stocked first aid medications available for emergencies	Mr. Jonathan Antwi, the safety manager for the Contractor confirmed the provision of well stocked first aid box on site.
7	Have bi-annual general trainings on occupational health and safety management for both permanent and contract staff	Training is done twice a week, on Monday's and Friday's on Occupational, health and safety issues on the construction site. This was explained by Mr. Jonathan Antwi
8	Have simulation exercises and drills to test the level of preparedness of workers on site.	Yet to be considered

CLOSING

Dr. Ing Desmond Aryee-Boi moved for the closure of the meeting in the absence of any further issues for deliberation and this was agreed upon at 12:00 p.m.

MONITORING AND EVALUATION (POST INVESTIGATION) OF EDAIF TOWERS

MINUTES OF THE SITE MEETING HELD AT EDAIF TOWERS ON 5TH

JANUARY, 2017

Location: EDAIF Towers, Accra

Date: Thursday 5th January 2017

Time: 10:00 a.m.

CALL TO ORDER

The meeting began at 10:00 a.m with a prayer from Mr. Albert Avorgbedor of AMANDI Holdings, and was presided by Dr. Ing Desmond Aryee-Boi with Joseph Dodzi as secretary.

ATTENDEES

9. Ing Joshua Allotey	JUKESS
10. Dr. Ing Desmond Aryee-Boi	JUKESS
11. Arc. Victor T. Mensah	A. M. A
12. Dodzi Joseph	JUKESS.
13. Emmanuel Aidoo	JUKESS.
14. Jonathan Antwi	AMANDI
15. Albert Avorgbedor	AMANDI
16. Ehud Rotman	AMANDI
17. Eddie Mills	ADP
18. Abraham Fiscian	ADP

AGENDA, DECISIONS AND ISSUES

The meeting started at 10:00 a.m. with a welcome address from Dr. Ing Desmond Aryee-Boi of BONADES Limited. He wished all members present at the meeting a great year filled with immense happiness and luck.

Dr. Ing Desmond Aryee-Boi then allowed Mr. Victor T. Mensah some time to share his views on the EDAIF project and the progress made by the Contractor so far.

Arc. Victor T. Mensah, the Director of works at Accra Metropolitan Assembly (A.M.A), was highly impressed with the progress made on the EDAIF project after the partial collapse of the Mezzanine floor on Sunday 22nd November 2015. He then advised all the members present on the importance of acquiring the right building documentation from A.M.A before the start of any project in Accra.

Mr. Emmanuel Aidoo, one of the two engineers tasked to further do a 2-day monitoring and evaluation of the site during the initial meeting on 21st December 2016, was subsequently called by Dr. Ing Desmond Aryee-Boi to briefly enlighten the members of their findings.

Mr. Emmanuel Aidoo first thanked the Consultant and the Contractor for being candid with the 2-man monitoring and evaluation team. He then proceeded with the team's findings.

The following were the findings made clear by Mr. Emmanuel Aidoo.

- The Resident Engineer supervise and certify all engineering work on site, appends his signature on a request for inspection sheet before any other work can proceed.
- Two Permanent Safety Officers and a General Safety Manager are employed on the project to enforce safety measures.

- The First Aid Kits on the site were adequately equipped with medical materials and tools to care for construction accident victims before professional assistance arrives if necessary.
- Yearly, Monthly, Weekly and Daily Safety report are prepared by the safety Officer for the management of the construction company in order to record and keep track of every safety issue arising on the project site. The May to December 2016 safety reports indicate there has been 0.0% accident recorded on the project.
- The Employees are trained twice a week, on Monday's and Friday's on Occupational, health and safety issues on the construction site.
- The Safety Team on the project has not organised any simulation exercise and drills to alert the workers on how to escape in case of any emergency or imminent danger.
- Safety signs have been posted all around the construction site to remind workers and possible trespassers of hazardous conditions and precautionary measures they have to take to protect themselves from injuries.
- The Contractor has four site engineers on the project who supervise all engineering work before the consultant does his final check.
- Every Employee is enrolled on the Vanguard life Insurance Policy.
- The social security of every employee on the project is been paid perpetually by the Contractor
- Floor holes and Edges where workers might accidentally fall were well guided with fabricated steel rods.
- Guardrails in the form of fabricated steel rods have been provided around the staircase as an interim solution to prevent falling.
- There were caution and warning tapes wrapped around the fabricated steel rods but not all as a visual warning to further inform the workers of the possible danger.

- The Floors were clean and dry as possible to prevent slippage.
- The workers were provided with the required Personal Protective Equipment (PPE's) like safety boots, helmets and reflectors for their respective works.
- The scaffolds were properly equipped with mid-rail to prevent falling.
- The construction scaffolding steel props were in good condition and well secured.
- There was anomaly in the sample compressive test results the monitoring and evaluation team received from the Contractor; The Strength of concrete after 7 and 28 days of curing was higher than the project specifications.

Mr. Ehud Rotman the project Manager for the EDAIF Towers, was granted the opportunity by Dr. Ing Desmond Aryee-Boi to explain some of the issues raised by Mr. Emmanuel Aidoo during his briefing.

He explained that, the Vanguard Insurance provided for the workers on the project is to help them earn extra compensation in case of any site related injuries.

Mr. Ehud Rotman explained that the anomaly in the compressive strength of concrete usually happens during and after raining days. During these days, the water content of the sand increases, making the sand heavier than it should be. Therefore the concrete mixer accepts less sand but same weight for the mix ratio. This is one of the causes of the anomalies in the compressive strength of the concrete.

He also confirmed that, they usually target compressive strength above the project specification during concrete mixing in order to achieve the best of results.

The members were also briefed by Mr. Ehud Rotman on the extra test the contractor sometimes perform on materials they receive on site in order to confirm the test results received from the manufacturer.

Mr. Eddie Mills, the Resident Engineer, confirmed the reasons specified by the project manager for the anomalies in the compressive test results and further elaborated on the issue. He disclosed that, the Consultant has had series of meetings with the Contractor on the same issue. The Consultant even went to the extent of testing their own concrete cubes to confirm the compressive test results from the Contractor and the results were always equivalent to the initial results.

Mr. Jonathan Antwi, the Health, Safety and Environment manager for the Contractor, revealed to the members, the new health, safety & Environment manual with pictorial illustration his department will publish and distribute to all workers by the end of 2017 and how the book will further help workers understand safety issues adequately.

Eventually the Chairman advised the Contractor to have a simulation exercise on the project site by the end of January 2017. Final words were taken from all the members present at the meeting on the issues discussed.

CLOSING

Dr. Ing Desmond Aryee-Boi moved for the closure of the meeting in the absence of any further issues for deliberation and this was agreed upon at 12:00 p.m.

APPENDIX B: PICTURES OF ESSENTIAL THINGS IN AND AROUND THE SITE

Figure 13: Fabricated steel rods painted red and white, used as barriers on the edge of the floor slab with red net around them to protect workers from falling



Figure 14: Fabricated steel rods used as barriers around floor holes to protect workers from falling



Figure 15: Fabricated steel rods used as handrail and barrier for the staircase to protect workers from falling



Figure 16: Caution and warning tape wrapped around a floor hole to warn workers of the possible danger.



Figure 17: Slab formwork adequately supported by solid steel props.



Figure 18: First Aid box with medical tools and medicine in it located in the store room



Figure 19: First Aid box with the appropriate materials and tools located in one of the working areas of the site.



Figure 20: A well-equipped First Aid Kit on the project site



Figure 21: Signages posted on the entrance gate to remind workers to wear their personal protective equipment always on site.



Figure 22: Signages posted on a crane stand to restrain workers from running on site and how to prevent falling from heights.

APPENDIX C: SAMPLE CONCRETE COMPRESSIVE TEST RESULTS

PROJECT:		BATCHING PLANT:		CONCRETE SAMPLE RECORD															
EDAIF PROJECT		AMANDI ACCRA BATCHING PLANT		Concrete Order No:		19111603		Casting Date:		19-11-16		Volume:		21.00					
EMPLOYER:		SUPERVISION:		CONTRACTOR:		Location:		Elements:		Slump Class:		S4		Strength: C25/30		Max Aggregate: 20mm		Cube: 150X150X150	
Architectural Design Partnership		AMANDI LIMITED																	
Truck	Delivery Note	Time		Volume	Bulk Density	W/C	Slump	Cement Content	Temp	Air Content	Cube Tag	Compression Test				Elements/Location For Sample			
No	No	In	Out	m ³	Kg/m ³	-	mm	Kg/m ³	°C	%	No	7 Days		28 Days					
												Crushing Date	Mpa	Crushing Date	Mpa				
MDM-19	6155	9:56	11:49	8.50	2,401	0.537	200	349.4	36.70		ACBP161803	26-11-16	24.15	17-12-16	31.16				
												26-11-16	24.55	17-12-16	31.05				
MDM-22	6161	11:58	14:01	8.50	2,387	0.540	200	348.8	37.60		ACBP161807	26-11-16	24.88	17-12-16	31.55				
												26-11-16	26.03	17-12-16	32.34				
MDM-21	6167	14:02	15:09	4.00	2,350	0.514	200	350.0	38.20		ACBP161809	26-11-16	25.68	17-12-16	31.65				
												26-11-16	23.53	17-12-16	30.90				
Average/Quantity					2,380	0.530	200	349	37.5			6	24.80	6	31.44				
Requirements					-	-	160-210	-	≤45	-		3	-	3	≥30				
Meets? Y/N					-	-	Y	-	Y	-		Y	-	Y	Y				
Conclusion: Meets		Project Manager Approval:										Approved By Engineer:							
Comments:		Laboratory Technician:										Signature:							
Date:	17-12-16	Signature:										Date:							
Name:	Sarman Noufi	Name:										Name:							

APPENDIX D: SAMPLE MANUFACTURER'S CERTIFICATE FOR STEEL REBARS



INSPECTION CERTIFICATE № 151610358 date 09.11.2016

EN 10204-3.1

MILL: PUBLIC JOINT STOCK COMPANY
"ArcelorMittal Kyivskyi Ribi"
UKRAINE

-TO WHOM IT MAY CONCERN-

Material description:

REINFORCING STEEL REBARS
CLASS: A500S

STANDARD: DSTU 3760:2006

REFERENCE NO.: B97222015

PACKING: EXPORT, IN BUNDLES WEIGHING UP TO 5 MT MAX. EACH BUNDLE SHALL HAVE LIFTING SLINGS AND NOT LESS THAN FIVE BINDINGS, WITH TWO EXPORT TAGS IN ENGLISH

Heat №	Chemical properties, %																	Physical properties					
	C	Mn	Si	S	P	Cr	Ni	Cu	N	Al	As	B	Al	Mo	V	W	Ceq	Yield point, N/mm2	Tensile strength, N/mm2	Elongation, %	Bend test		
	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	19	20	21	22	23	
SIZE/DIAMETER, MM												NUMBER OF BUNDLES											
8.0												112											
*214656/16	0.209	0.52	0.072	0.027	0.027	0.028	0.018	0.025	0.0056	<0.005	<0.005	0.0004	0.008	<0.010	<0.005	<0.020	0.31	647/657	707/727	22.0/22.8	ok		
*214660/16	0.186	0.453	0.047	0.029	0.018	0.018	0.013	0.020	0.0054	<0.005	<0.005	0.0004	0.003	<0.010	<0.005	-	0.27	652/637	712/697	23.3/21.3	ok		
*224595/16	0.185	0.54	0.071	0.031	0.010	0.019	0.010	0.015	0.0054	<0.005	<0.005	0.0004	<0.002	<0.010	<0.005	-	0.28	677/677	717/771	24.3/21.3	ok		
*214656/16	0.210	0.52	0.067	0.026	0.030	0.029	0.019	0.025	0.0055	<0.005	<0.005	0.0004	-	<0.010	<0.005	<0.020	0.31	682/662	771/761	20.5/22.0	ok		
*214660/16	0.186	0.453	0.047	0.029	0.018	0.018	0.013	0.020	0.0054	<0.005	<0.005	0.0004	0.003	<0.010	<0.005	-	0.27	682/677	771/766	21.3/19.8	ok		
*214659/16	0.184	0.51	0.066	0.024	0.013	0.011	0.022	0.036	0.0058	<0.005	<0.005	0.0004	0.006	<0.010	<0.005	0.027	0.28	582/592	642/667	22.0/22.5	ok		
*10-2748/16	0.195	0.91	0.038	0.015	0.031	0.014	0.010	0.017	0.0059	<0.005	<0.005	0.0004	<0.002	<0.010	<0.005	-	0.35	612/612	677/687	27.0/26.5	ok		
*214660/16	0.186	0.453	0.047	0.029	0.018	0.018	0.013	0.020	0.0054	<0.005	<0.005	0.0004	0.003	<0.010	<0.005	-	0.27	682/677	771/766	21.3/19.8	ok		
*214659/16	0.184	0.51	0.066	0.024	0.013	0.011	0.022	0.036	0.0058	<0.005	<0.005	0.0004	0.006	<0.010	<0.005	0.027	0.28	582/592	642/667	22.0/22.5	ok		
*214660/16	0.186	0.453	0.047	0.029	0.018	0.018	0.013	0.020	0.0054	<0.005	<0.005	0.0004	0.003	<0.010	<0.005	-	0.27	682/677	771/697	23.3/21.3	ok		
*224593/16	0.196	0.56	0.054	0.030	0.013	0.017	0.010	0.018	0.0055	<0.005	<0.005	0.0004	<0.002	<0.010	<0.005	-	0.3	602/652	682/712	22.8/24.0	ok		
*214646/16	0.223	0.559	0.045	0.016	0.011	0.016	0.010	0.015	0.0055	<0.005	<0.005	0.0004	0.029	<0.010	<0.005	-	0.31	597/637	672/697	21.8/23.3	ok		
*214651/16	0.195	1.15	0.016	0.025	0.021	0.022	0.019	0.019	0.0056	<0.005	<0.005	0.0004	<0.002	<0.010	<0.005	0.027	0.4	652/662	761/771	22.5/22.0	ok		
*10-2748/16	0.195	0.91	0.038	0.015	0.031	0.014	0.010	0.017	0.0059	<0.005	<0.005	0.0004	<0.002	<0.010	<0.005	-	0.35	607/597	677/677	26.0/24.3	ok		
*214651/16	0.195	1.15	0.016	0.025	0.021	0.022	0.019	0.019	0.0056	<0.005	<0.005	0.0004	<0.002	<0.010	<0.005	0.027	0.4	652/662	761/771	22.5/22.0	ok		
*214622/16	0.195	0.96	0.023	0.016	0.020	0.015	0.011	0.018	0.0057	<0.005	<0.005	0.0004	0.005	<0.010	<0.005	-	0.36	597/617	687/707	18.2/18.5	ok		
*264842/16	0.172	0.487	0.061	0.029	0.009	0.037	0.023	0.047	0.0055	<0.005	<0.005	0.0004	0.005	<0.010	<0.005	-	0.27	612/607	707/702	18.8/18.0	ok		
*10-2750/16	0.214	0.58	0.102	0.028	0.043	0.016	0.013	0.018	0.0058	<0.005	<0.005	0.0004	<0.002	<0.010	<0.005	-	0.32	607/617	707/702	18.8/18.0	ok		
*214674/16	0.176	0.493	0.050	0.034	0.014	0.022	0.031	0.052	0.0056	<0.005	<0.005	0.0004	0.004	<0.010	<0.005	<0.020	0.27	607/617	707/717	19.5/19.8	ok		
*10-2754/16	0.204	0.461	0.063	0.034	0.020	0.012	0.010	0.010	0.0061	<0.005	<0.005	0.0004	<0.002	<0.010	<0.005	-	0.29	657/657	746/756	19.5/19.0	ok		
*10-2752/16	0.212	0.57	0.068	0.039	0.028	0.015	0.010	0.010	0.0056	<0.005	<0.005	0.0004	<0.002	<0.010	<0.005	-	0.31	670/654	742/734	19.3/20.0	ok		
*214674/16	0.176	0.493	0.050	0.034	0.014	0.022	0.031	0.052	0.0056	<0.005	<0.005	0.0004	0.004	<0.010	<0.005	<0.020	0.27	653/663	741/742	19.3/20.0	ok		
*264842/16	0.172	0.487	0.061	0.029	0.009	0.037	0.023	0.047	0.0055	<0.005	<0.005	0.0004	0.005	<0.010	<0.005	-	0.27	612/607	707/702	18.8/18.0	ok		
*9-2753/16	0.201	0.96	0.035	0.012	0.032	0.010	0.010	0.015	0.0060	<0.005	<0.005	0.0004	<0.002	<0.010	<0.005	-	0.37	667/677	736/746	18.8/19.5	ok		
*214641/16	0.174	0.75	0.013	0.042	0.013	0.021	0.012	0.023	0.0050	<0.005	<0.005	0.0004	0.003	<0.010	<0.005	-	0.31	660/658	737/740	19.5/20.3	ok		
*214487/16	0.174	0.93	0.021	0.033	0.021	0.016	0.029	0.031	0.0056	<0.005	<0.005	0.0004	0.004	<0.010	<0.005	0.057	0.34	657/677	717/746	19.5/19.8	ok		
*9-2753/16	0.201	0.96	0.035	0.012	0.032	0.010	0.010	0.015	0.0060	<0.005	<0.005	0.0004	<0.002	<0.010	<0.005	-	0.37	667/677	736/746	18.8/19.5	ok		
*214641/16	0.174	0.75	0.013	0.042	0.013	0.021	0.012	0.023	0.0050	<0.005	<0.005	0.0004	0.003	<0.010	<0.005	-	0.31	660/658	737/740	19.5/20.3	ok		
*10-2750/16	0.214	0.58	0.102	0.028	0.043	0.016	0.013	0.018	0.0058	<0.005	<0.005	0.0004	<0.002	<0.010	<0.005	-	0.32	607/617	707/717	19.5/19.8	ok		
SIZE/DIAMETER, MM												NUMBER OF BUNDLES											
10.0												145											
*264759/16	0.192	1.05	0.027	0.022	0.015	0.013	0.015	0.015	0.0056	<0.005	0.006	0.0006	0.006	<0.010	<0.005	0.064	0.37	628/646	708/724	17.4/17.0	ok		
*235088/16	0.190	0.95	0.027	0.025	0.016	0.018	0.015	0.027	0.0055	<0.005	<0.005	0.0004	0.005	<0.010	<0.005	-	0.36	625/644	705/726	16.4/16.0	ok		
*264759/16	0.192	1.05	0.027	0.022	0.015	0.013	0.015	0.015	0.0056	<0.005	0.006	0.0006	0.006	<0.010	<0.005	0.064	0.37	634/631	716/722	16.4/16.4	ok		
*264759/16	0.192	1.05	0.027	0.022	0.015	0.013	0.015	0.015	0.0056	<0.005	0.006	0.0006	0.006	<0.010	<0.005	0.064	0.37	628/646	708/724	17.4/17.0	ok		
*214574/16	0.192	0.497	0.062	0.012	0.010	0.019	0.011	0.020	0.0055	<0.005	<0.005	0.0004	<0.002	<0.010	<0.005	-	0.28	623/619	699/694	18.4/18.8	ok		
*235070/16	0.306	1.21	0.30	0.033	0.020	0.079	0.013	0.027	0.0053	<0.005	<0.005	0.0004	0.003	<0.010	<0.005	-	0.52	620/621	697/695	18.6/19.0	ok		
*214574/16	0.192	0.497	0.062	0.012	0.010	0.019	0.011	0.020	0.0055	<0.005	<0.005	0.0004	<0.002	<0.010	<0.005	-	0.28	623/619	699/694	18.4/18.8	ok		

INSPECTION CERTIFICATE № 151610358 date 09.11.2016

We hereby confirm that the material meets the requirement of the order



Українська Крайова
Адміністрація
по маркетингу
та збуту

APPENDIX E: SAMPLE TENSILE TEST RESULT

TENSILE TEST - ASTM A370 / EN 10002

Client: AMANDI INVESTMENT
 Test Organisation: GHANA STANDARDS AUTHORITY
 Test location: ACCRA

SPECIMEN DESCRIPTION:

Test date: 2016-11-18 Date/time received: 2016-11-18

Position/direction of sample:

Label: 2357 ENG2 16A

Sample: TEST SAMPLE

Steel type: STEEL BAR (14mm)

Type of specimen ROUND

☐ Plain ☒ deformed

L (mm): 490.0

Weight (Kg): 0.571

Mass (Kg/m): 1.165

Area (mm²): 148.4

Dia. (mm): 13.7

Lo (mm): 160.0

Machined: ☐ Yes ☒ No

Proportional/Not proportional specimen ☐

ELONGATION MEAS. APPARATUS Encoder

TEST END TEST RESULTS:

Fm (kN): 104.90

ReH (N/mm²): 628.4

ReL (N/mm²): 628.4

Ae (%): 5.01

A (%): 20.00

Rm (N/mm²): 706.6

Lu (mm): 84.00

Notes: QE

TECHNICAL RESPONSIBILITY:

Responsible person Name: B N ANANG

Position: CTK

Signature:

CERTIFICATE IDENTIFICATION:

Certificate number: CERT

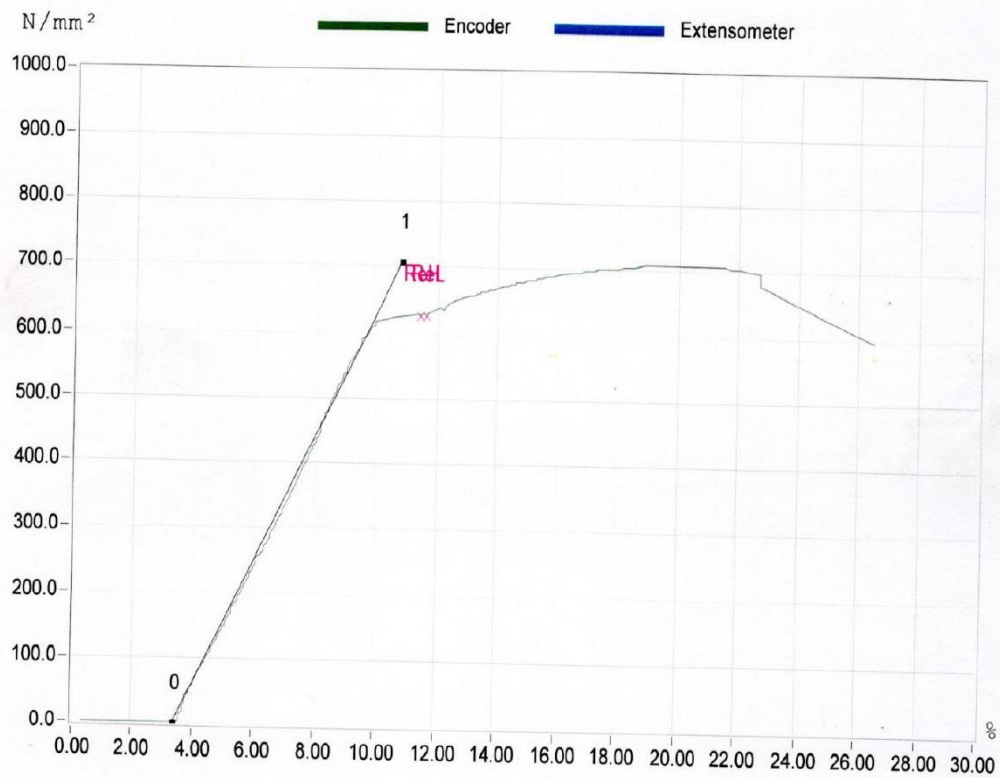
Certificate date: 2016-11-18

TENSILE TEST - ASTM A370 / EN 10002 - STRESS/STRAIN GRAPH

Client: AMANDI INVESTMENT

Label: 2357 ENG2 16A

Test date: 2016-11-18



Notes: QE

TECHNICAL RESPONSIBILITY:

Responsible person Name: B N ANANG

Position: CTK

Signature:

CERTIFICATE IDENTIFICATION:

Certificate number: CERT

Certificate date: 2016-11-18

TENSILE TEST - ASTM A370 / EN 10002

Client: AMANDI INVESTMENT
Test Organisation: GHANA STANDARDS AUTHORITY
Test location: ACCRA

SPECIMEN DESCRIPTION:

Test date: 2016-11-18

Date/time received: 2016-11-18

Position/direction of sample:

Label: 2357 ENG2 16B

Sample: TEST SAMPLE

Steel type: STEEL BAR (14mm)

Type of specimen ROUND

☐ Plain ☒ deformed

L (mm): 498.0

Weight (Kg): 0.562

Mass (Kg/m): 1.129

Area (mm²): 143.8

Dia. (mm): 13.5

Lo (mm): 160.0

Machined: ☐ Yes ☒ NoProportional/Not proportional specimen ☐

ELONGATION MEAS. APPARATUS Encoder

TEST END TEST RESULTS:

Fm (kN): 86.72

ReH (N/mm²): 552.9ReL (N/mm²): 552.9

Ae (%):

6.18

A (%):

21.43

Rm (N/mm²): 603.2

Lu (mm): 85.00

Notes: QE

TECHNICAL RESPONSIBILITY:

Responsible person

Name: B N ANANG

Position: CTK

Signature:

CERTIFICATE IDENTIFICATION:

Certificate number: CERT

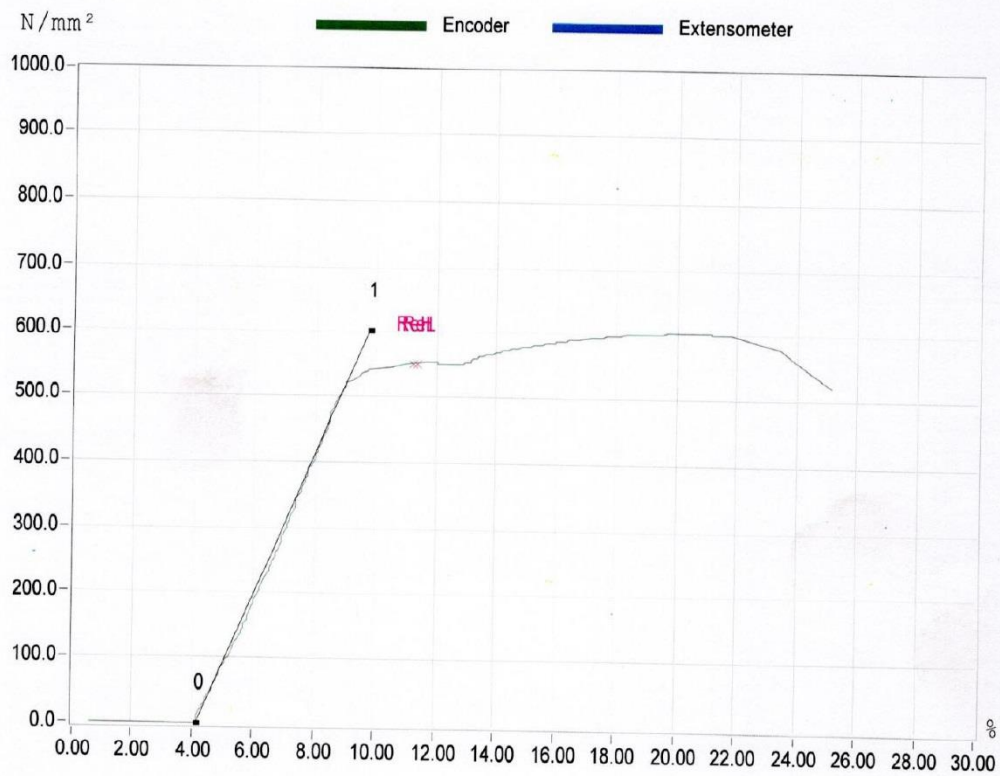
Certificate date: 2016-11-18

TENSILE TEST - ASTM A370 / EN 10002 - STRESS/STRAIN GRAPH

Client: AMANDI INVESTMENT

Label: 2357 ENG2 16B

Test date: 2016-11-18



Notes: QE

TECHNICAL RESPONSIBILITY:

Responsible person Name: B N ANANG

Position: CTK

Signature:

CERTIFICATE IDENTIFICATION:

Certificate number: CERT

Certificate date: 2016-11-18

APPENDIX F: SAMPLE REQUEST FOR INSPECTION SHEET

PROJECT: EDAIF PROJECT		POSTAL CORRESPONDENCE: P.O. Box KIA 30408 Accra 226 Osibisa Close Airport Rd Airport - Accra Ghana		RSI No: 666 Rev: Date: 16/9/16	
EMPLOYER:  EDAIF		ENGINEER:  Architectural Design Partnership		CONTRACTOR:  AMAND	

REQUEST FOR SITE INSPECTION							
Structure	Finish works	Electrical	Plumbing				
Fire	Blinding	Formwork	Miscellaneous				
Setting out	Backfilling	Concreting	Levels				
Excavation	Reinforcement	Blockwork	Utilities				
Leveling and Compacting	Waterproofing	Civil Works	Curing				

Date of Inspection: **16/9/16** Time of Inspection: **7:00am**
 Location: **Level C(+47.95)** Dwg Reference: **1431-0-10-02**
 Description of task: **Re - inspection request for City of Concrete for core areas only at level C(+47.95) located between gridpoint C13-6 at the westside, J/C-E at the northside E12-6 at the eastside and 6/E-C at the southside.**
Please find location of Concrete on the attached drawing.

Submitted by Contractor: Date: 16/9/16 Name: Joseph Ojo	Signature: _____ Received by Engineer: Date: 16/09/16 Name: Edie Mills
---	---

Engineer's Comments:

The works are:	Approved	✓ Approved as noted	Revise and Resubmit	Rejected
----------------	----------	---------------------	---------------------	----------

- FINAL INSPECTIONS CONDUCTED, YOU MAY PROCEED WITH CONCRETE WORK.
 - CHECKING SUPPORTING PROPS OF UNDERLYING AREAS SHOULD BE CHECKED FOR VERTICALITY & STABILITY PRIOR TO CONCRETE WORKS.

Issued by Engineer: Date: 17/09/16 Name: Edie Mills	Signature: _____ Received by Contractor: Date: 17/9/16 Name: Joseph Ojo
---	--

PROJECT: EDAIF PROJECT		POSTAL CORRESPONDENCE: P.O. Box KIA 30408 Accra 226 Osibisa Close Airport Rd Airport - Accra Ghana		RSI	
EMPLOYER  EDAIF		ENGINEER:  Architectural Design Partnership		CONTRACTOR:  AMAND	
				No: 666 Rev: Date: 8/9/16	

REQUEST FOR SITE INSPECTION					
Structure		Finish works		Electrical	
Fire		Blinding		Formwork	Plumbing
Setting out		Backfilling		Concreting	Miscellaneous
Excavation		Reinforcement		Blockwork	Levels
Leveling and Compacting		Waterproofing		Civil Works	Utilities
					Curing

Date of Inspection: 17/9/16	Time of Inspection: 7:00am
Location: Level (+4.95)	Dwg Reference: 1476-0-140-02
Description of task: Inspection request for casting of Concrete for Core over only at Level (+4.7m) located between gridpoints C/3-6 at the westside, 3/C-5 at the Northside, E/3-6 at the eastside and 6/5-C at the Southside. Please find location of Concrete on the attached drawing.	

Submitted by Contractor: Signature: [Signature] Date: 8/9/16 Name: Joseph Ojan	Received by Engineer: Signature: [Signature] Date: 08/09/16 Name: EDDIE MILLS
---	--

Engineer's Comments:				
The works are:	☐ Approved	☐ Approved as noted	☒ Revise and Resubmit	☐ Rejected
PLEASE EFFECT CORRECTIONS AS DIRECTED FOR FINAL INSPECTION PRIOR TO CASTING OF SUB.				

Issued by Engineer: Signature: [Signature] Date: 16/09/16 Name: EDDIE MILLS	Received by Contractor: Signature: [Signature] Date: Name:
--	---

APPENDIX G: SAFETY STATISTICAL REPORT ON KPIs FOR NOVEMBER 2016



AMANDI INVESTMENT LIMITED

SAFETY STATISTICAL MONTHLY REPORT ON KPIs

PROJECT: EDAIF OFFICE COMPLEX, GT. ACCRA, ACCRA CENTRAL
NOVEMBER, 2016

INTRODUCTION:

1. Total Number of project site: 1
2. Total Number of project site regions: 1
3. Total Number of personnel on Site:
 - Amandi Employees = **256**
 - Subcontractors:
 - Including:
 - ✓ Fox Cooling
 - ✓ Aluglass
 - Total = 10
- Total Number of man-hours:
- Frequency Rate (TAFR) Target: **0.00%**
- Frequency Rate (FR): **0%**

HSE ACTIVITIES

Lead Indicator	Month: November, 2016	YTD
Man – hours	66,560	66,560
External Work permit issued	0	0
Internal work Permit issued	0	0
HSE Inductions Conducted	0	40
HSE Committee Meeting	0	0
Consultant HSE Audits Conducted	4	8
Internal HSE Inspection Conducted	28	126
HSE Training Conducted	0	0
Risk Assessment Conducted	0	0
PSI & Toolbox Meetings	28	225

Lagging Indicator	Month: November, 2016	YTD
<i>Health & Safety</i>		
Near Miss (NM) in severity	0	66
Lost Time Injury (LTI)	0	49
Recordable Incident Rate (RIR)	0	0
Number of Accident Rate (NAR)	0	0
Number of Safety Violation on site	0	0
Restricted Work Day Case (RWDC)	0	41
Medical First Aid (FA)	2	67
Property Damage (PD)	0	0
Environmental Incident (EI)	0	0
Security Incident	0	0

1. SAFETY

DSL Toolbox Topics :

- **Weekly HSE inspection:** Internal inspection on work safety practices of the project is ongoing and the new safety culture gradually understood by all.
 - **Daily PSI /Toolbox talk meeting:** Workers toolbox discussions has been a regular practice.
 - **General housekeeping:** Good housekeeping is in good practice.
1. **ENVIRONMENT:** The working environment still remains calm, conducive and acceptable since, the area continue to serves as a central business location.
 2. **SECURITY INCIDENT:** Security matters regards to workers, environment and equipment safety are secured.

Among the various project sites, EDAIF has been the site with more near-misses but this very month there was no record of such and only (2) first aid/medical treatment cases (minor-medium injuries). Indeed site now under control in regards to risk and hazards . More of the toolbox discussions and safety meetings must be conducted to keep reducing the rate to zero injury. Management must empower ther safety officers to do their work diligently and devoid of any additional duties on site.

Prepared by:

JONATHAN ANTWI

(Safety Department, AMANDI HOFF)

APPENDIX H: SAMPLE WEEKLY HOUSE PERFORMANCE REPORT

AMANDI INVESTMENT LTD		WEEKLY HSE PERFORMANCE REPORT		RELATED DOCUMENT				
 AMANDI INVESTMENT LTD		Revision date 31/10/2016-6/11/2016	Version: 001	Ref Number: 027				
* Mandatory reporting fields								
*Business Area/Project Name (Specify):		*Month of: NOVEMBER Year: 2016						
ACCRA CENTRAL (MINISTRIES/ RIDGE)								
Operation / Project:		EDAIF						
*CONTRACT COMPANY: Prime Contractor? ☐ Yes ☐ No		AMANDI HOLDINGS LIMITED						
SUB – CONTRACTOR COMPANIES:		FOX COOLING/ HANS SYSTEMS/ ALU GLASS						
Contacts:		Name		Contact Number				
Project Manager		EHUD ROTMAN		0246946637				
Health & Safety Officer		ALBERT AVORGBEDOR COLLINS YEBOAH		0242384585 0540950639				
Site Administrator:		MULI SEMO		0540114249				
Sub-Contractor Owner's Representative (If any):		SHEHED MMRAD SIMON MENSAH		0244836596 0244682671				
Site manager:		YOCOV DERA		0244341941				
HS&E PERFORMANCE								
LAGGING INDICATORS By Business Area		Weekly Total	Monthly Total	Year to Date	LEADING INDICATORS By Business Area	Weekly Total	Monthly Total	Year to Date
*Near Misses (#)		0	0					
*First Aids (#)		0	0		Toolbox Talks	1	1	
*Medical Treatments (#)		0	0		Safety Meetings	6	6	
*Lost Time (#)		0	0		Orientations			
*Waste Disposal(#)		1	1		Inspections/Observations	7	7	
*Lost Work Days		1			Corrective Actions Completed	2		
*Restricted / Modified Work Days		0	0		Total Work force	256		
*Reportable Environmental Incidents (#)		0	0		General Cleaning:	1	1	
*Hours Worked (Regular)		52	52					
*Hours Worked (Overtime)		22	22					
*Total Exposure Hours worked		74	74					
Total Recordable Injury Frequency								
MAN HOURS BREAKDOWN Hours Worked Regular = 52 Hours Worked Overtime = 22 Average Workforce = 210 Average Workforce = 115 Man hours = 10920 Man hours = 2530 TOTAL MAN HOURS FOR WEEK= 13450								

Reports are to be submitted to the Project Manager, Site Engineer and copied to the Company Safety Manager (Department) by 1st day of a new week.

Injury Statistic Definitions

Near Miss – An incident that could have, but did not, result in unintended harm or damage.

First Aid Injury – An Occupational Injury/Illness that requires first aid treatment only and does not result in loss of time from work or Restricted Work.

First Aid Injuries include:

- a) Use of non-prescription medications at a non-prescription strength, including antiseptics;
- b) Administration of tetanus or diphtheria shot(s) or booster(s). Other immunizations such as Hepatitis B vaccine or rabies vaccine related to an injury are considered medical treatment;
- c) Cleaning, flushing or soaking wounds on skin surface;
- d) Use of wound coverings such as bandages including liquid bandages, gauze pads, steristrips or butterfly bandages, etc. Wound closing devices such as staples, sutures and skin glue are considered medical treatment;
- e) Use of any hot/cold therapy (e.g., compresses, soaking, whirlpools, non-prescription skin creams / lotions for local relief, etc.);
- f) Use of any totally non-rigid, non-immobilization means of support (e.g., elastic bandages, wraps);
- g) Use of temporary immobilization devices while transporting an accident victim;
- h) Drilling of a nail to relieve pressure or to drain fluid from a blister;
- i) Use of eye patches;
- j) Removal of foreign bodies not embedded in the eye if only irrigation or removal with a cotton swab is required;
- k) Removal of splinters or foreign material from areas other than eyes by irrigation, tweezers, cotton swabs or other simple means;
- l) Use of finger guards;
- m) Use of massages; and,
- n) Drinking of fluids for relief of heat stress.

Medical Treatment – A classification of Occupational Injury/Illness for Medical Treatment beyond First Aid Injury where there has been no Lost Days.

The following are not considered Medical Treatment Injuries:

- a) Visit(s) to a health care provider limited to observation or counseling or prescribed Restricted Work;
- b) Diagnostic procedures (e.g., X-rays, blood tests), including the use of prescription medications solely for diagnostic purposes (e.g., eye drops to dilate pupils).

Lost-Time Injury – An injury/illness resulting in Lost Days beyond the date of injury as a direct result of an Occupational Injury/Illness incident.

Other Recordable Injury/Illness

Restricted Work – When an employee, due to a work-related injury/illness, is medically determined to be unable to perform one or more routine functions or unable to work the normal time period of their pre-injury/illness work day, they are working in a "restricted" capacity. Routine functions are the work activities that employee regularly performs at least once a week.

Significant Occupational Injury/Illness – Any injury/illness, that is not recorded as a Fatality, Lost-Time Injury, Medical Treatment Injury or Restricted Work case, but has been medically diagnosed and determined to be work-related and the cause is a verified trauma or workplace exposure that has extended to be within the current reporting period. Injury examples include: punctured eardrums and fractured or cracked bones. Illness examples might be hearing loss, or respiratory disease.

Loss of Consciousness – Is a work-related, altered state of consciousness that can vary from disorientation to time, place or person, to coma. For reporting purposes, the Loss of Consciousness must be witnessed or medically substantiated as related to a work activity or exposure.

Recordable Injury – Any Occupational Injury/Illness that results in an employee experiencing:

- a) Fatality;
- b) Lost-Time Injury;
- c) Medical Treatment Injury; or
- d) Other Recordable injury/illness (not captured above), which has:
 - i) Restricted Work; or
 - ii) Significant Occupational Injury/Illness; or
 - iii) Loss of Consciousness.

Lost Days – The number of calendar days that the employee is unable to work beyond the day of injury/illness recommended by a physician or other health care professional. Lost time ends as of the date that the employee is deemed fit to work either full or Restricted Work or to a maximum of 180 calendar days for any individual case. For cases where the disability will continue beyond the closing date, Lost Days and Restricted Days shall be estimated on the basis of medical opinion as to probable ultimate disability and included in the data submission. Lost Days are only recorded for the period that the injured person is in the employ of the company.

Restricted Days – The number of calendar days to a maximum of 180 days during which the employee is subject to Restricted Work, based on the recommendation of a physician or licensed health care professional, for an individual case. For cases where the disability will continue beyond the closing date, Lost Days and Restricted Days shall be estimated on the basis of medical opinion as to probable ultimate disability and included in the data submission. Restricted Days are only recorded for the period that the injured person is in the employ of the company.

Exposure Hours – Exposure to injuries shall be measured by the total number of hours of employment (i.e., the actual worked hours) of all employees for each contractor and sub-contractor companies for the reporting period.

$$\text{Total Recordable Injury Frequency Rate} = \frac{\text{Number of Recordable Injuries} \times 200,000}{\text{Total Exposure Hours}}$$

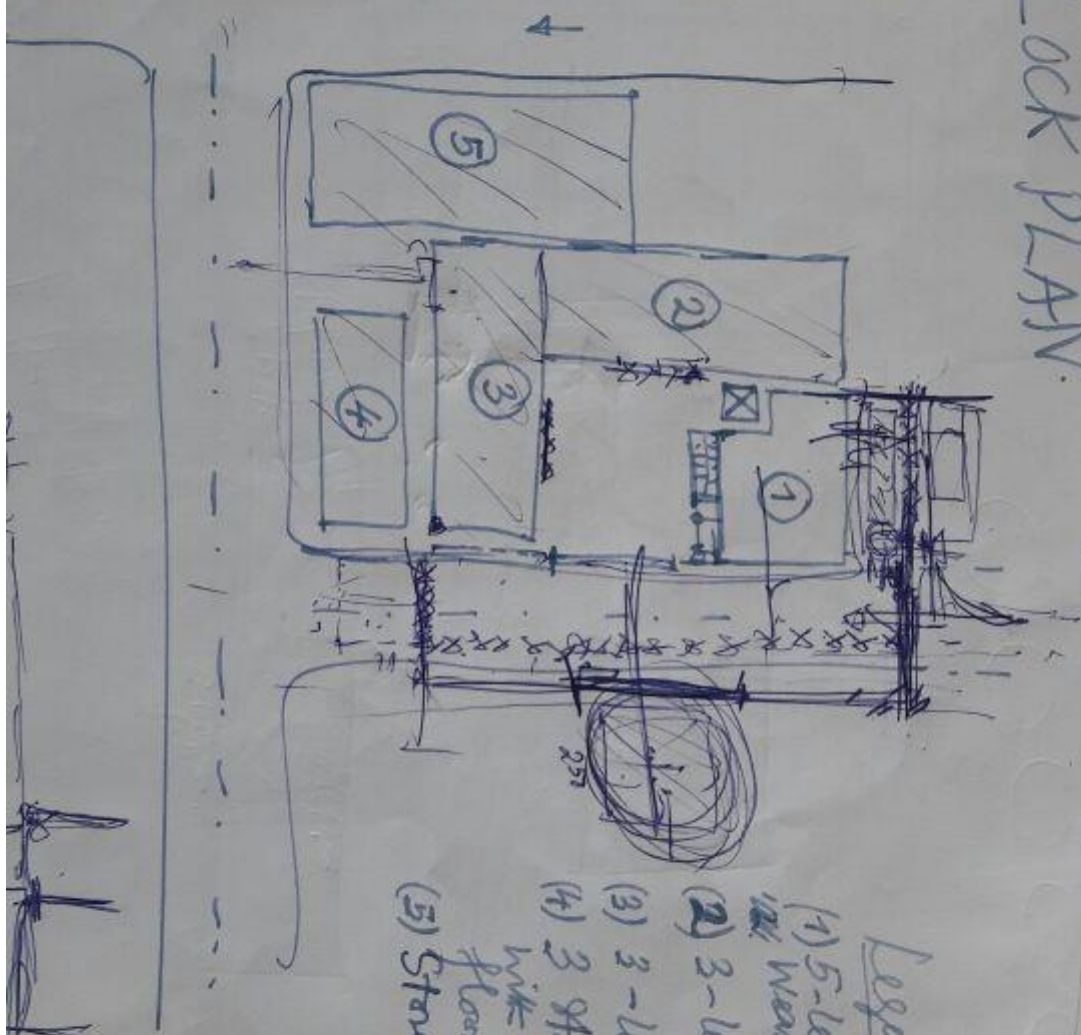
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APPENDIX I: RAW FIELD REPORT

Nonnah
Interchange.

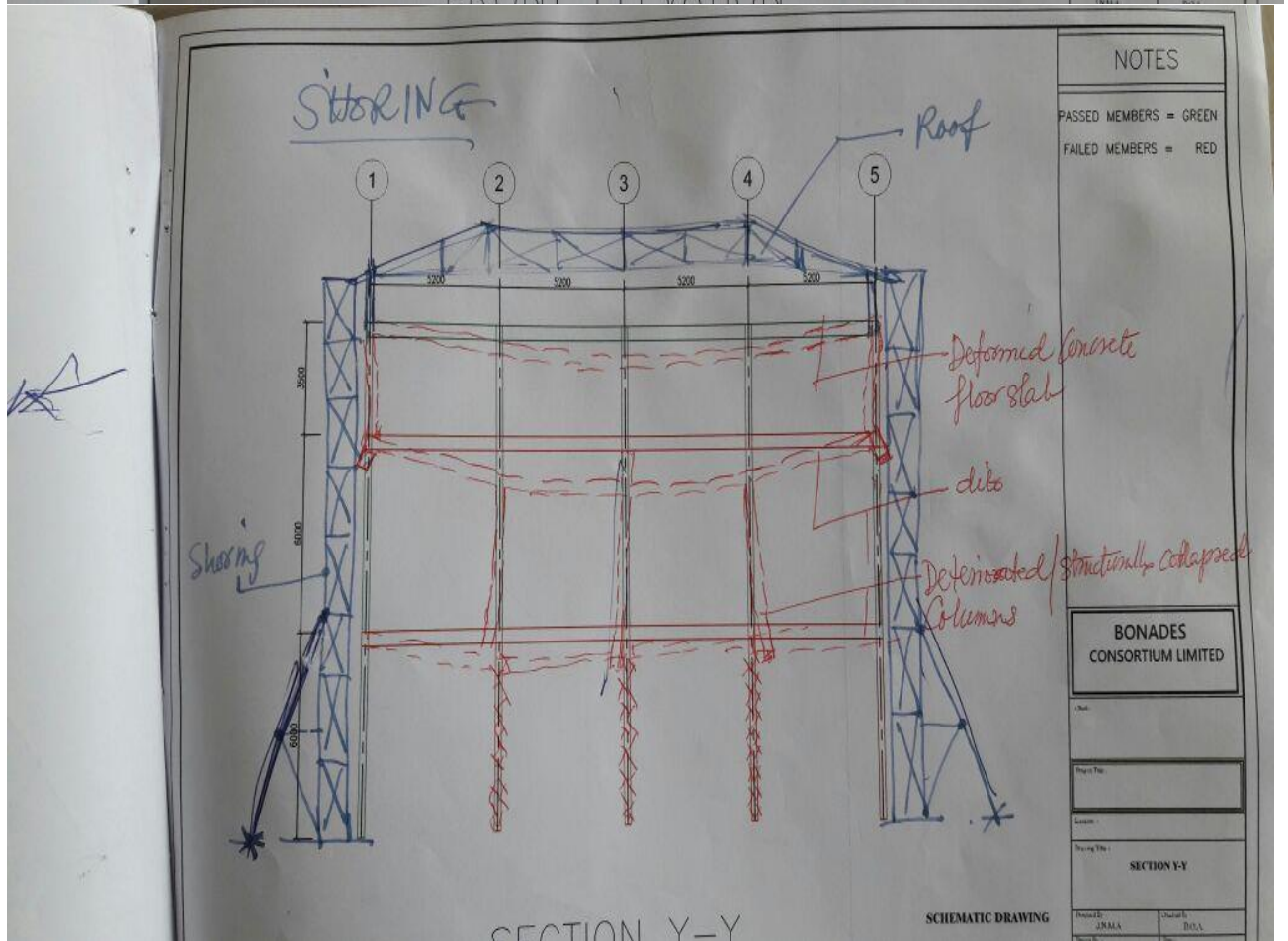
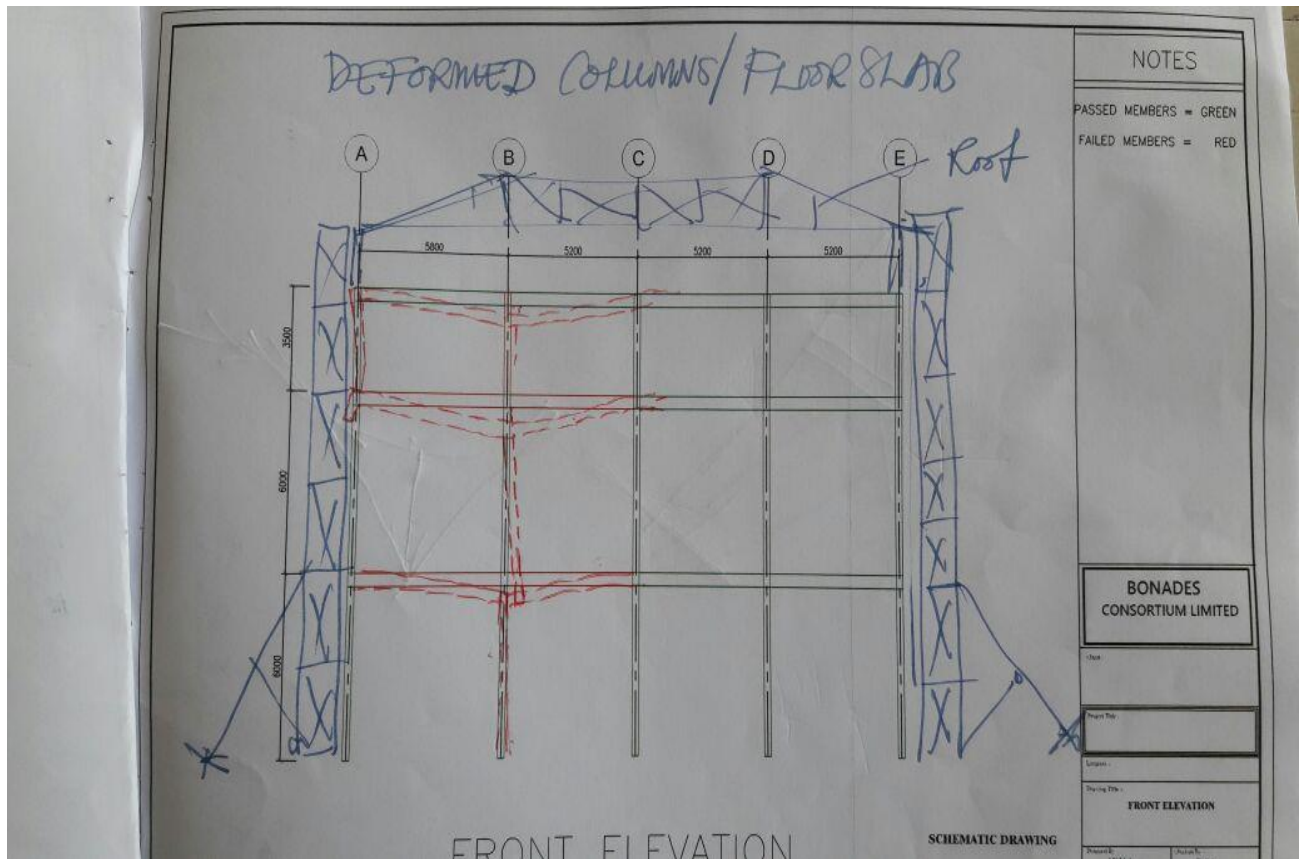
Koju Thompson Road

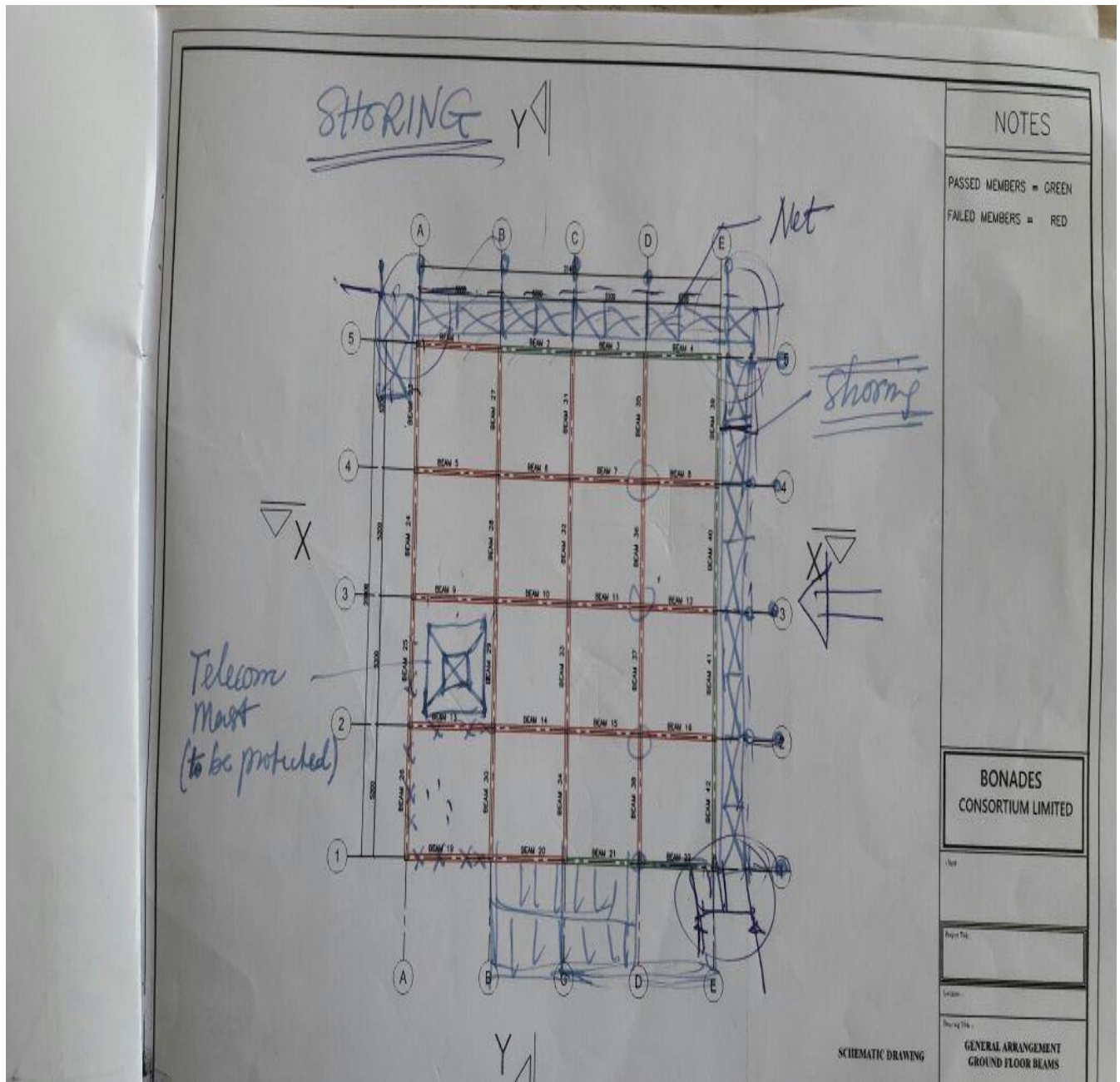
BLOCK PLAN

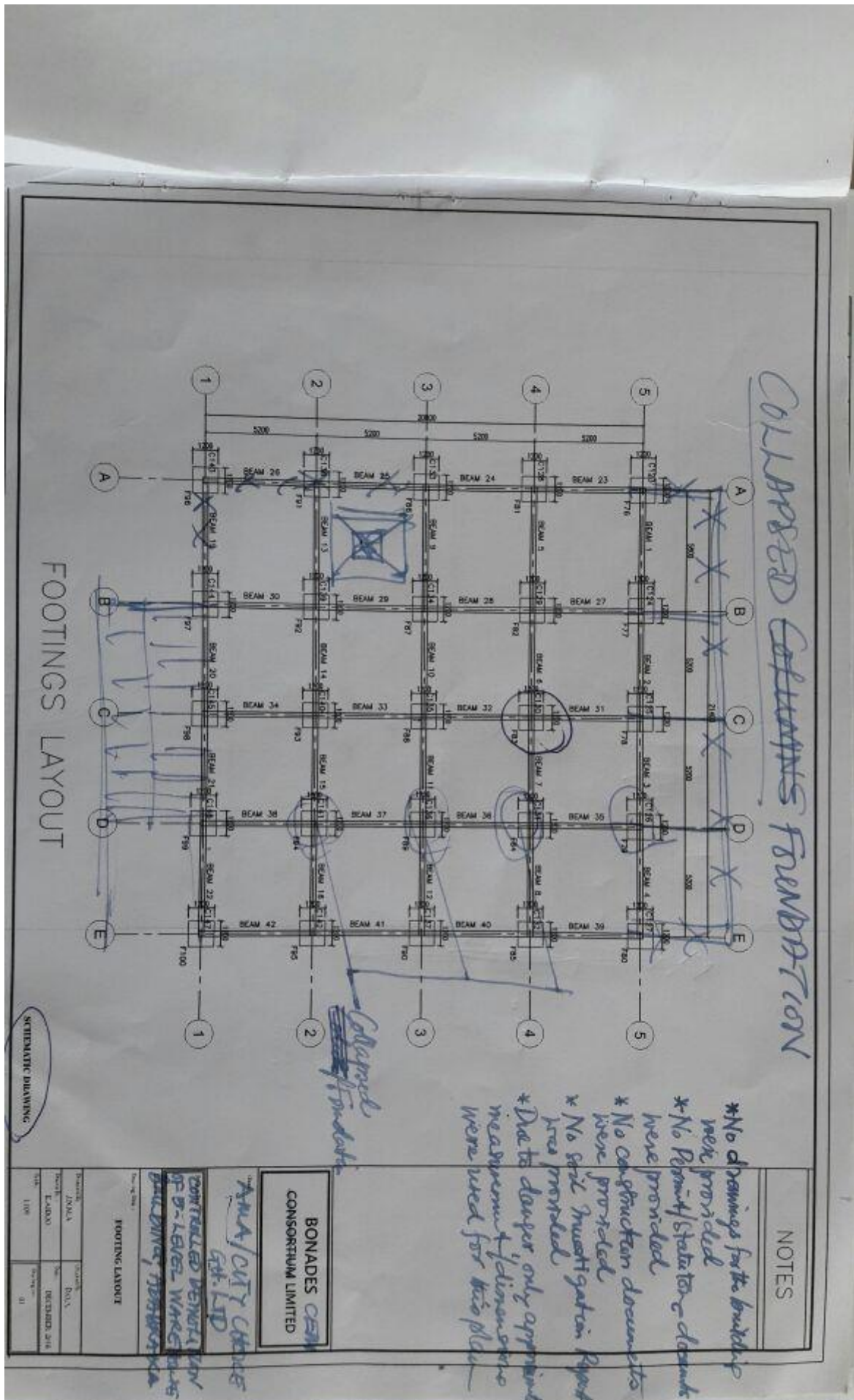


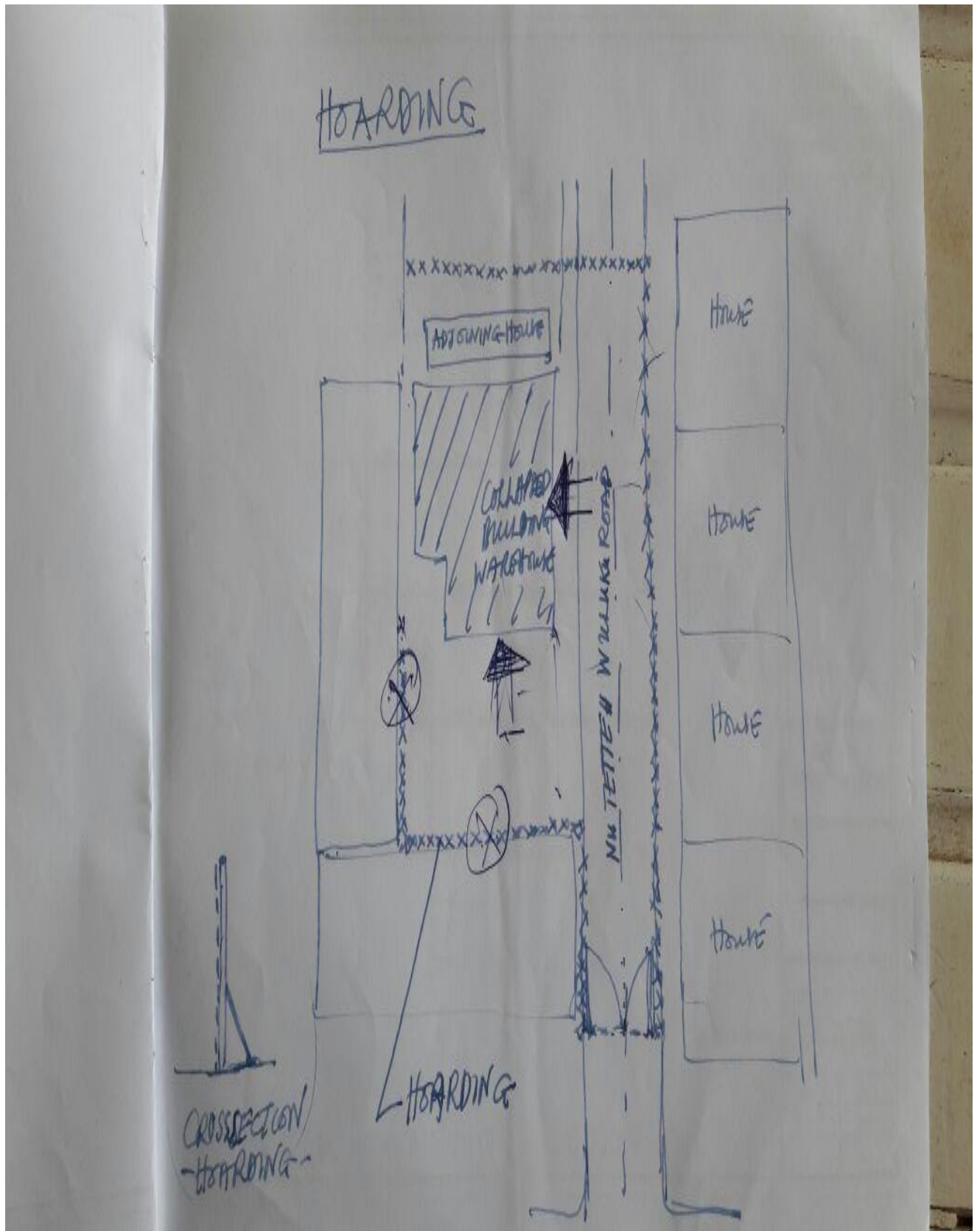
Legend

- (1) 5-level Cottaged Warehouse
- (2) 3-level Warehouse
- (3) 3-level Warehouse
- (4) 3 Storey Resident with Stores in Ground floor
- (5) Stores (2-3 storey)









REPORT FORM		BONADES	
From:	NATHANIEL KLIMUNDA AUMEN	Date:	24/12/2016
Subject:	SITE PROGRESS REPORT	Current Version:	v.
Project/Task:	DEMOLISHING OF 4-STORY WAREHOUSE BUILDING AT ADABRAH		
To:	THE CONSULTANT		
By:			
Reference:	Previous Subject	Prev. Date	Prev. Version

Action Taken/ Achievement
1. The project was initiated in the month of March 2018.
2. The project was completed in the month of April 2018.
3. The project was completed in the month of May 2018.
4. The project was completed in the month of June 2018.
5. The project was completed in the month of July 2018.
6. The project was completed in the month of August 2018.
7. The project was completed in the month of September 2018.
8. The project was completed in the month of October 2018.
9. The project was completed in the month of November 2018.
10. The project was completed in the month of December 2018.

Remarks

No.	Description	Action Taken/Achievement
10	The Chinese men salvaging and at loading trucks with their salvage goods to be taken off the site. They hired more men so work is moving faster and will be finished very soon. Maximum of two (2) days.	

Challenges/ Risk Issues

Remarks

No major challenge was encountered.

Recommendation

Remarks

Signature: [Signature]

Management's Remarks

Signature: _____

Date:

PROJECT REPORT FORM		BONADES b	
From:	NATHANIEL KLINGMAN ANUMEN	Date:	25/12/2016
Subject:	SITE PROGRESS REPORT	Current Version:	V.
Project/Task:	DEMOLISHING OF 4-STORY WAREHOUSE BUILDING AT ADABBAKA		
To:	THE CONSULTANT		
Reference:	Previous Subject	Prev. Date	Prev. Version
Action Taken/ Achievement		Remarks	
Salvaging at loading of the chinese goods continued today. All the chinese goods were loaded off the site today. So now the chinese men have no business on the site.			
Challenges/ Risk Issues		Remarks	
No challenge was encountered			
Recommendation		Remarks	
Signature: 		Management's Remarks	
Signature: 		Date:	

From:	NATHANIEL KLIMMAN DRUMEN	Date:	26/12/2016
Subject:	SITE PROGRESS REPORT	Current Version:	v.
Project/Task:	DEMOLISHING OF 4-STORY WAREHOUSE BUILDING AT ADABARA		
To:	THE CONSULTANT		
By:			
Reference:	Previous Subject	Prev. Date	Prev. Version

Signature: 

Management's Remarks

Signature: Elvira Date: _____

Signature: 

Management's Remarks

Signature: _____

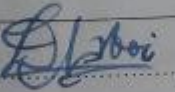
Date:

REPORT FORM		BONADES	
From:	NATHANIEL KLIMSMAN ANUMEN	Date:	23/12/2016
Subject:	SITE PROGRESS REPORT	Current Version:	V.
Project/Task:	DEMOLISHING OF 4-STORY WAREHOUSE BUILDING AT ADABAKA		
To:	THE CONSULTANT.		
Co:			
Reference:	Previous Subject	Prev. Date	Prev. Version

Signature: 

Signature: DL Noor

Date:.....

PROJECT REPORT FORM		BONADES 	
From:	NATHANIEL KLUMSMAN AYUMEH	Date:	20/12/2016
Subject:	SITE PROGRESS REPORT	Current Version:	V.
Project/Task:	DEMOLISHING OF 4-STOREY WAREHOUSE BUILDING AT ADABRAKA.		
To:	THE CONSULTANT.		
Reference:	Previous Subject	Prev. Date	Prev. Version
Action Taken/Achievement		Remarks	
Dismantling of the Glo network must continued as well as the hoarding of the site. The direction of the hoarding was changed to create access for the residents of the house opposite the warehouse and hoarding works were completed. The crane operator and his team came to do their Possibility Studies to know how to carry out the demolishing exercise successfully.			
Challenges/ Risk Issues		Remarks	
Recommendation		Remarks	
Signature: 			
Management's Remarks			
Signature: 			
Date:			

From:	NATHANIEL KLIMSMAN ANUMEH		Date:	22/12/2016
Subject:	SITE PROGRESS REPORT		Current Version:	v.
Project/ Task:	DEMOLISHING OF 4-STOREY WAREHOUSE BUILDING AT ADABRABA			
To:	THE CONSULTANT			
CC:				
Reference:	Previous Subject		Prev. Date	Prev. Version

Signature: 

Signature: _____

Date:.....

PROJECT REPORT FORM		BONADES b	
From:	NATHANIEL KUMSIAN BUNMEN	Date:	17/12/2016
Subject:	B SITE PROGRESS REPORT	Current Version:	v.
Project/Task:	DEMOLISHING OF 4-STORY WAREHOUSE BUILDING AT ADARAWA		
To:	THE CONSULTANT		
Co:			
Reference:	Previous Subject	Prev. Date	Prev. Version
Action Taken/ Achievement			Remarks
Taking delivery of the remaining timber members and boards and the auxiliary materials to carry out the hoisting exercise. We also took measurement from the house which was disconnected to the next available power supply to buy electrical cables for reconnection.			The activities for the day was successfully executed.
Challenges/ Risk Issues			Remarks
The residents (some few) got angry they have been disconnected the previous day and tore the caution tapes restricting access to the site and parked car tyres in front of the warehouse to burn to exhibit their frustration and anger.			
Recommendation			Remarks
Reconnecting to be done for the disconnected as soon as possible since some of the residents food refrigerated was going bad.			
Signature: 			
Management's Remarks			
Signature:  Date:			

PROJECT REPORT FORM		BONADES b	
From:	NATHANIEL KLIMSMAN AVUMEH	Date:	18/12/2016
Subject:	SITE PROGRESS REPORT	Current Version:	V.
Project/Task:	DEMOLISHING OF 4-STORY WAREHOUSE BUILDING AT ADABRAKA		
To:	THE CONSULTANT		
Co:			
Reference:	Previous Subject	Prev. Date	Prev. Version

Action Taken/Achievement	Remarks
Reconnection was done to the house which was disconnected. Hoarding works also started with the roofing of the adjoining being projected with the plywood and 50mm x 150mm and 50mm x 100mm timber members. The hoarding also commenced.	Work started and commenced smoothly and would be continued the next day.
Technical men from GLO Ghana came to dismantle their network mast sited right beside the warehouse to be demolished. The residents of the building behind the warehouse were given money (400 cedis each) for relocation from the house.	

Challenges/Risk Issues	Remarks
Access to the house opposite the warehouse will be blocked when the hoarding is completed restricting its residents from moving to and fro.	

Recommendation	Remarks
The hoarding must be done to create access for the residents of the opposite house but restricting them of access to the site.	

Signature: 

Management's Remarks

Signature: 

Date:

PROJECT REPORT FORM		BONADES b	
From:	NATHANIEL KLISMAM ANUMEN	Date:	16/12/2016
Subject:	SITE PROGRESS REPORT	Current Version	V.
Project/ Task:	DEMOLISHING OF 4-STORY WAREHOUSE BUILDING		
To:	ITE CONSULTANT		
Cc:			
Reference:	Previous Subject	Prev. Date	Prev. Version

Action Taken/ Achievement	Remarks
Disconnection of electrical cables running in front of the warehouse by Technical men from the Electricity Company of Ghana to prevent any electrical shock to the technical members who will be working on the Project stated above and prevent any damages which might occur to the electrical cables. He took also delivery of the timber members and boards which will be used board the roof of the adjoining building and the site at whole/large.	disconnection was successfully done without any damage or life lost.
Challenges/ Risk Issues	Remarks
Disconnecting of the electrical cables cut power supply to some of the buildings around since they take their power from the electrical cable running.	
Recommendation	Remarks
Reconnecting the power to the houses which will be affected from a different source because the electrical cables needs to be disconnected.	

Signature: 

Management's Remarks

Signature:

Date:

PROJECT REPORT FORM		BONADES b	
From:	NATHANIEL KLIMSMA AVUMEN	Date:	21/12/2016
Subject:	SITE PROGRESS REPORT	Current Version:	V.
Project/Task:	DEMOLISHING OF 4-STORY WAREHOUSE BUILDING AT ADABRAKA.		
To:			
Ref:			
Reference:	Previous Subject	Prev. Date	Prev. Version

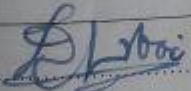
Action Taken/ Achievement	Remarks
Demolishing exercise started in the morning and in a maximum of Two (2) hours, the 4-story warehouse was down with all its contents with all technical men on site. Thus, the fire service reps, police men, supervisors from A.M.A and other engineers and consultant. No casualty was recorded.	Operation was Successful.

Challenges/ Risk Issues	Remarks
The gate to the adjoining house must be removed and column demolished to make way for the crane to enter the house to continue the demolishing works. Part of the house wall and windows were broken as a result of the impact from the demolished ware.	

Recommendation	Remarks
The column must be constructed with the fixed to the entrance of the house and also reconstruct the broken wall behind of the house and replace the damaged part of the windows and roofing sheets.	

Signature: 

Management's Remarks

Signature: 

Date:

Signature: 

Signature: DL 2601

Date:.....

Action Taken/ Achievement	Remarks
① Disconnection of the electrical cables in front of the warehouse by representatives from the E.C.G. This exercise was done to ensure that in demolishing of the it will not affect the electrical cables connecting to the opposite houses and other house adjoining the building	Disconnection was done successfully
Challenges/ Risk Issues	Remarks
① The opposite house was disconnected and needs to be reconnected. ② The opposite house, the power supply cable was not long enough to reach the pole.	
Recommendation	Remarks
① measure of the cable from the house to the pole was taken, to provide another one for reconnection.	

Signature: 

Management's Remarks

Signature: DLHoi

Date:

PROJECT REPORT FORM			BONADES b	
From:	SAMUEL MIAIYI ARIEETET	Date:	27/12/2016	
Subject:	SITE PROGRESS REPORT	Current Version:	V.	
Project/ Task:	DEMOLISHING OF FOUR(4) STOREY WAREHOUSE AT AABRAKA			
To:	THE CONSULTANT			
Cc:				
Reference:	Previous Subject	Prev. Date	Prev. Version	
Action Taken/ Achievement			Remarks	
The contractors and labourers are on site breaking the columns and beams with the concrete breaker. As at now, there are only <u>two</u> labourers on site which is <u>not making work move faster</u>.				
Challenges/ Risk Issues			Remarks	
No challenge encountered just that work is <u>not moving faster</u> due to the shortage of labourers				
Recommendation			Remarks	
More labourers and more machines must be hired to speed up work.				
Signature:				
Management's Remarks				
Signature: <i>DL Naci</i> Date:				

Action Taken/ Achievement	Remarks
① Hoarding of site, both ends of the road ② Removal of mast (Glo telecommunication mast)	
Both ends of the road was hoarded to prevent people from entering except the engineers and other representatives.	Activities was carried out well.
Challenges/ Risk Issues	Remarks
There was delay in putting sign boards and other restricted boards to prevent other pedestrians from entering the site. There was short of the materials (plywood, 2x4)	
Recommendation	Remarks
Restricted boards and sign board must be provided early to prevent pedestrians and other residents from entering the site without notice	

Management's Remarks	
1. The company has a strong track record of growth and profitability, with a consistent increase in revenue and a solid margin. 2. The company has a strong market position and a competitive advantage, with a strong brand and a loyal customer base. 3. The company has a strong management team and a clear vision for the future, with a focus on innovation and growth. 4. The company has a strong financial position and a solid balance sheet, with a strong cash flow and a low debt-to-equity ratio. 5. The company has a strong environmental, social, and governance (ESG) record, with a strong commitment to sustainability and social responsibility.	

Signature: _____ Date: _____

PROJECT REPORT FORM

BONADES 

From:	SAMUEL NIAYI ARYEGIE-I		Date:	24/12/2016
Subject:	SIC PROGRESS REPORT		Current Version	V.
Project/ Task:	DEMOLISHING OF FOUR (4) STOREY WAREHOUSE			
To:	CONSULTANTS			
Co:				
Reference:	Previous Subject		Prev. Date	Prev. Version

Action Taken/ Achievement	Remarks
The Chinese owners salvaging the goods on the site and administrators brought more men (labourers) to speed up work. This exercise went faster than taught, due to the availability of more hands at work.	

Challenges/ Risk Issues	Remarks
No challenge occurred	

[illegible]

Signature:



Management's Remarks

Signature: _____

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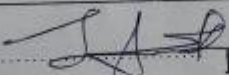
Date: _____

PROJECT REPORT FORM			BONADES b	
From:	SAMUEL NIIANI ARTECIE-T	Date:	21/12/2018	
Subject:	SITE PROGRESS REPORT	Current Version:	V.	
Project/ Task:	DEMOLITION OF FOUR (4) STOREY WAREHOUSE			
To:	CONSULTANT			
Co:				
Reference:	Previous Subject	Prev. Date	Prev. Version	

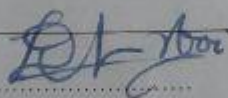
Action Taken/ Achievement	Remarks
Demolishing of the warehouse started very early with the engineers and other representatives and the media all present at the site. For the crane operators to time to study on which direction is to break first for the building to come down safely without any injury. So after the visibility study the operation began.	All operation was successfully carried out without injury.

Challenges/ Risk Issues	Remarks
The middle column of the big gate of the adjoin house was also demolish for the crane to move into the adjoin house for demolishing.	

Recommendation	Remarks
The big gate was to be demolish for the crane to enter the adjoin house to break from the back, which was the perfect way to prevent injury and other damage properties	

Signature: 

Management's Remarks

Signature: 

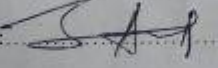
Date:

PROJECT REPORT FORM		BONADES b	
From:	SAMUEL MIIAYI ARYEETAY	Date:	18-Dec-2018
Subject:	SITE PROGRESS REPORT	Current Version	V.
Project/Task:	DEMOLITION OF FOURCY STOREY WAREHOUSE		
To:	CONSULTANT		
Co:			
Reference:	Previous Subject	Prev. Date	Prev. Version

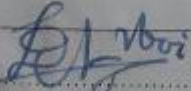
Action Taken/ Achievement	Remarks
(i) Hoarding of Site	
(ii) Hoarding of roof next to the warehouse to prevent damage of roof in the demolishing process.	
The roofs adjoining to the next was heard by the Carpenter to prevent severe and minimize risk of damage to the Ceiling and other properties.	
(iii) The crane operator was on site to see the warehouse before demolition	

Challenges/ Risk Issues	Remarks
Residents must vacate for engineers to commence work.	

Recommendation	Remarks
Residents must find a new place to relocate in the mean time to prevent injuries to anyone.	

Signature: 

Management's Remarks

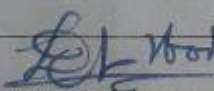
Signature:  Date:

PROJECT REPORT FORM		BONADES	
From:	SAMUEL NWAJI ARYEETAY	Date:	23/12/2016
Subject:	SITE PROGRESS REPORT	Current Version:	V.
Project/Task:	DEMOLITION OF FOUR (4) STOREY WARE HOUSE		
To:	THE CONSULTANT		
Ref:		Prev. Date:	Prev. Version:
Reference:	Previous Subject		

Action Taken/ Achievement	Remarks
The Chinese owner of the Goods in the Second and third floor were present to Salvage their goods. They came along with some hired labourers and trucks to carry the goods. The Accra metropolitan representative was around and gave them the permission to carry their goods away.	
Challenges/ Risk Issues	Remarks
The only challenge was that the labourers and the hired trucks was not enough to speed up work.	
Recommendation	Remarks
more labourers and trucks must be hired to speed up work.	

Signature: 

Management's Remarks

Signature: 

Date:

PROJECT REPORT FORM		BONADES b	
From:	SAMUEL NIAYI ARYEETIY	Date:	17-Dec-2018
Subject:	PROGRESS REPORT	Current Version:	V.
Project/ Task:	DEMOLISHING 4 STOREY WAREHOUSE		
To:	CONSULTANT		
Cc:			
Reference:	Previous Subject	Prev. Date	Prev. Version

Action Taken/ Achievement	Remarks
1) Delivery of hoarding materials such as the plywood, 2x4, 2x6 and nails and other carpentry equipment.	All activities was carried out perfect.
2) measurement taken from opposite house to the nearest electricity power supply, for connection ~~due to~~ results of disconnection when the electrical cables were being remove from the warehouse.	
Challenges/ Risk Issues	Remarks
Some of the opposite residents got angry, due to the disconnection of their light. They also complain that their food stuff are getting spoiled due to the disconnection of their light.	
Recommendation	Remarks
Reconnection was suppose to be done for peace to prevail.	

Signature: *[Signature]*

Management's Remarks

Signature: *[Signature]*

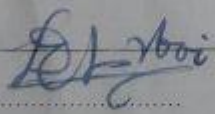
Date:

PROJECT REPORT FORM		BONADES b	
From:	SAMUEL NIINIMARTTIE	Date:	20/10/2016
Subject:	SITE PROGRESS REPORT	Current Version:	V.
Project/ Task:	DEMOLITION OF FOUR (4) STOREY WAREHOUSE		
To:	CONSULTANT		
Cc:			
Reference:	Previous Subject	Prev. Date	Prev. Version

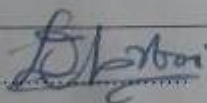
Action Taken/ Achievement	Remarks
(a) Handing of Site and (For demolishing)	
(b) Removal of mast (Glo telecommunication mast)	
The engineer on board called the Glo Communication team to come to the site for inspection. From the outcome it was brought on board that the telecommunication mast must be removed for easy demolishing, because the direction of the building was taken into consideration, and also minimize risk of the mast falling on other part of the building adjoining the warehouse.	All activities was carried out as required
Challenges/ Risk Issues	Remarks
The telecommunication team was not on site early, so there was slow in some of the activities, the crane operator was not there early to meet the Consultants	
Recommendation	Remarks
The meeting between the Consultant and the crane operator was scheduled on the next day to finalise everything for demolishing to commence.	

Signature: 

Management's Remarks

Signature: 

Date:

PROJECT REPORT FORM			BONADES b	
From:	SAMUEL KIMUCCI PROJECT	Date:	25/12/2016	
Subject:	SITE PROGRESS REPORT	Current Version	V.	
Project/ Task:	DEMOLISHING OF FOUR(4) STORE/ WAREHOUSE			
To:	THE CORPORATION			
Cc:				
Reference:	Previous Subject	Prev. Date	Prev. Version	
Action Taken/ Achievement				Remarks
The salvaging and loading of the goods on site continued but ended on that day due to rain at which the labourers and others hands were help to speed work.				
Challenges/ Risk Issues				Remarks
No challenge encountered.				
Recommendation				Remarks
Signature: 				
Management's Remarks				
Signature:  Date:				