ENGINEER’S ESTIMATE
makes or breaks the construction industry

Application of
COMPOSITE MATERIALS

- Eng Frank Kweronda
  The need to enforce effluent discharge regulations

8M Technical Team
- How to harness Sipi Falls potential without ‘touching’ it

- Angella Naluwenda
  Timber form works in construction
Uganda, the Pearl of Africa
Located along the Equator, the Pearl of Africa is a country that boasts of a warm climate all year round, attracting visitors from each and every corner of the planet who flock in for an experience of a lifetime laden with pure pleasure. With the diversity of culture and different ethnic groups, Ugandans are friendly and very welcoming people. Currently, Uganda is experiencing massive infrastructural developments making it a hub for potential investment projects in various areas of construction.

Activities
The session will be graced with lots of exciting but educative activities including; a welcome cocktail, a gala dinner, local colour night and the conference.

Who should attend
- Contractors
- Government officials
- Government entities
- Funding agencies
- Consulting engineers
- Public sector investors & stakeholders
- Construction equipment & materials suppliers
- Private sector investors & stakeholders

Exhibition
Stalls will be available to all firms willing to showcase their services at a fee that will be communicated in due course.
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   Choosing the perfect generator
Having jogged your memory in the last issue about Uganda’s civil engineering history, we assume at 8M Construction Digest that our readers in the construction industry have done the needful, i.e., rebooted, about issues like the prefabricating system.

Now rebooting in today’s dot.com age language is not as plain as remembering what happened. To borrow a parallel from the medical profession, the neural centre especially the brain must ‘awake’ and begin anew. If it doesn’t, the one to whom it belongs is as good as dead and no use to him/herself or those around! And the engineering fraternity, to say the least, are the neural centre of infrastructure and development. When they reboot and begin anew, the impact is multi-dimensional!

One way of rebooting with impact is innovation. At 8M Construction Digest we have the eightfold interconnected parameter of mindset, markets, methods, management, money, materials, manpower, and machinery. Let’s suppose we are right in believing that someone has an innovative mind. Then s/he will look for materials, raw or not, and find some manpower, and use certain methods, money, and so on and so forth, and create something ‘out of nothing’ even if s/he will not be re-inventing the wheel! It is not an easy road, we know; but the journey of a thousand miles for Uganda must begin with the single step, in raw materials – the iron ore, the sand, the rocks, the soil, the plants, the water, the wind (moving air), the oil, the gas, etc.

Hence there are articles in this issue where some students have dared step out, just like Kiira Motors and some other individuals did in their own way. Kyambogo University Engineering Society students have invented a “wheelchair staircase on rack-and-pinion-mechanism” for the disabled and the elderly, besides “the multimedia filter” for rural water purification. And Konstantin Gorchakov, general manager in Uganda of MRG-Composites (which are laying claim to being an alternative to steel), explains out the third part of his article on the materials. Three electrical engineers – JE Ongodia, HE Mutikanga and D. Kalumba would be happy to see Ugandans go back to underground tunnel construction at a sophisticated and dot.com-era level. (Remember the underground tunnels at Kilembe Mines?)

You will find regular articles such as Angella Naluwenda’s cost of materials and indices in construction, Mama Fundi baring her teeth and growling over soil, and so forth.

Have a good read. Cheerio.

Samuel Hadido
Editor
Our Mission
To research and communicate construction and engineering information for Uganda’s grassroots development.

Our Strategic Goal
To research for information, compile and store it, package and design it into magazines and documentaries, and spread it using the print and electronic media, music, dance and drama.

Our Strategic Objective
To expand everyone’s business in the engineering and construction industry using innovative and professional technical journalism, thus causing Uganda’s grassroots development.

USE SCIENCE AND TECHNOLOGY TO INNOVATE LOCAL PRODUCTS!

In this issue, we bring you several upcoming products innovatively and locally made by using science and technology. Some are still in form of dreams needing researchers, scholars and the business community to complete the jig-saw puzzle and get rich. And that is the way to go if Ugandans want to modernize and add value to products using locally available resources for fundamental social, economic and technological development! At 8M, we pride ourselves in availing this INFORMATION for our readers’ IMAGINATION and INNOVATION!

By showing where, when and why to replace steel reinforcement bars with the more cost-effective fibre reinforcement bars (FRB), the MRG Composites team led by Konstantin Gorchakov is showing how the construction industry can cut costs while retaining value and quality. Let us use the information. The Hilton Hotel project came to Uganda and disappeared mysteriously: in its place arose a Pearl Africa Hotel. But a local entrepreneur, Dr Dan Twebaze, has innovatively brought it back along with lots of ‘local content’ in the form of consultants, builders and service providers on Kyadondo Road, Kampala. We hope to bring to you continuously the construction story of this local product that is recognized by the ‘Hilton Hotel’ international brand.

Bravo to the student leaders Angel Nagawa (third-year Mechanical Engineering) and Edwin Muramuzi (fourth-year Civil Engineering), both of Kyambogo University. They led conquerors to a Nairobi international students science and technology conference, where two of the Ugandan exhibitors won the first and second prizes for using science and technology to innovate: a ‘mobile application for hostels’ location’ and a ‘local-resources-made water filter’.

But the idea explosion of “How to harness the Sipi Falls potential without ‘touching’ it!” by Kenneth Kacondoozi, the 8M Technical dreamer-writer, challenges the minds of policymakers and a combination of the old and experienced civil and structural engineers, dam designers and hydropower construction specialists, as well as professionals and specialists of various shades to change the Kacondoozi dream into a reality! Consider cottages built right on site and boosting the tourism industry. The Ministers of Tourism, Wildlife and Antiquities and Science, Technology and Innovation need to fund a completion! We are willing to coordinate the efforts.

Till the next issue.
**GOOD NEWS: HILTON HOTEL IS BACK!**

The Hilton Hotel project was launched by the Minister of State for Finance (General Duties) Hon Gabriel Ajedra on 22nd March 2019 at TWED Towers in Kampala.

The hotel will be part of the mixed-use scheme on plots 18 Kyadondo Road, and 16 Lourdel Road, Kampala.

At the cocktail at TWED Towers, the Permanent Secretary in the Ministry of Tourism, Mrs Doreen Katusiime, said that while in Nairobi, a Hilton Hotel key staff told her why they had left Kampala when they were supposed to run the present Pearl of Africa Hotel at Nakasero, without revealing the details.

Dr Dan Twebaze, the managing director and owner of TWED Property Development Company Ltd thanked Government, the Hilton Hotels and Resorts Worldwide management, his Board members, staff, suppliers, financiers and others for their contribution in various ways.

He pledged that the TWED Management would strive to deliver the hotel in about four years to the expectation of the public and Hilton Hotel Management.

The Hilton Senior Vice President, Mr. Patrick Fitzborne, said the mixed-use scheme and hotel project is estimated to deliver 65,000 sqm of space within four years at a cost of USD135 million. He further said the location is ideal for a five-star hotel and will create about 350 direct jobs and about 1000 to 2000 indirect jobs.

Hon Ajedra pledged government support to ensure the project is delivered because he knows it will create jobs, pay taxes and spur the economy.

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From left in front row is the Senior Vice President Hilton Hotels, Mr Patrick Fitzborne (Ugandan-born whose parents taught at Mbarara High School and Ntare School); Mrs Doreen Katusime (PS Ministry of Tourism, Wildlife and Antiquities); the Minister of State for General Duties, Hon Gabriel Ajedra Gadison Ariidru (in red tie shaking hands with Dr Dan Twebaze, the TWED Group managing director and hotel developer); Samantha Muna (the Hilton East Africa Region business development manager). Behind from right is the G4S Managing Director; then Ms Brigite Koehler (in pink T-shirt) who is the Roko Construction manager; Mr Amos Wekesa (the managing director of Great Lakes Safaris); Hilton Africa Business Development Manager, Mr Michael Colline; Eng Joseph Kabanga (a TWED Board member); Ms Lilian Ajovaro (CEO of the Uganda Tourism Board); the Hilton Africa Execution and Construction Director, Mr Paul Blackman; and Mr Solomon Rubondo, a TWED Board member.

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Hilton Hotel construction at second floor stage 8M Photo March 2019
HON. ELIOIDA TUMWESIGYE SIGNS MOU WITH RUSSIAN GOVERNMENT

Memorandum of Understanding (MoU) between the Ministry of Science, Technology and Innovation of the Republic of Uganda and the Ministry of Science and Higher Education of the Russian Federation on Scientific, Technical and Innovation Cooperation was signed on 22 February 2019 in Moscow.

Hon Elioda Tumwesigye, the Minister of Science, Technology and Innovation, signed the memorandum on behalf of the Government of Uganda while Hon. Mikhail Kotyukov, Minister of Science and Higher Education of the Russian Federation signed on behalf of the Government of Russia.

The purpose of this MoU is to contribute to the development and realization of mutually beneficial cooperation in the field of science, technology and innovation. Within the scope of their competence, both parties will contribute to the development and realization of cooperation in technologies for the exploration and development of mineral resources; and research in ecology, agriculture, biotechnology and chemistry. Both parties identified areas of cooperation and agreed that implementation should begin by July 2019.

INTERNATIONAL ENGINEERING STUDENTS CONFERENCE (IESC)

By Angel Nagawa, March 2019

The Engineering Students’ Association (ESA) of the University of Nairobi held the 2nd International Engineering Students Conference (IESC) on 21st and 22nd February 2019 in the University of Nairobi at the Chandaria Centre of Performing Arts Auditorium. The conference theme was, “Young engineers’ role and space in the big four agenda: affordable housing, affordable health care for all, food security, and manufacturing.”

IESC, a student-based programme, was initiated by the engineering students of the universities of Nairobi and Kyambogo in 2017 when the first conference was held at Kyambogo. The major reason for this programme was to inspire the culture of research and innovation among the engineering students around the East African countries.

During this conference, ten universities around East Africa participated in the conference: six from Kenya, two from Tanzania and two from Uganda. The Kyambogo University Engineering Society, led by Ms Angel Nagawa, presented three projects in different categories: (1) “The wheelchair on staircases,” currently being manufactured, showcased a wheelchair that moves on stairs by rack-and-pinion mechanism; (2) “My Hostel” showcased a mobile-telephone application which enables incoming fresh students, to book affordable hostels online; and (3) “The Multi-Media Filter” showcased an affordable filter which purifies pond and run-off water for the communities.

The mobile application and the multimedia filter emerged the best and second best projects, respectively, in the male category, winning prizes of KShs50,000 and KShs30,000!

It was a wonderful experience spearheading winning teams. From the exhibition in this conference, it can be seen that it is only through creativity, research and innovation that the engineering sector can contribute to the technological development of our nation and humanity at large.

ISIMBA HYDROPOWER DAM COMMISSIONED

Isimba Hydropower Dam, one of the largest electricity plants and one of the country’s biggest power projects was finally completed and commissioned by President Yoweri Museveni on 18th March, 2019 in Kayunga District.

The dam is expected to bridge the deficit in electricity production and bring down the exorbitant power costs and boost the acceleration of the local economy.

The 183MW Isimba Hydro Power Project (HPP) is located 4km downstream of Isimba Falls on the River Nile, approximately 50km downstream of the Source of the Nile. The project site is about 21km from Kayunga Town as the nearest town and about 65km from Jinja Town. The power station will be installed with four vertical Kaplan turbine generator units with a capacity for 45.8MW per unit, thereby providing a combined installed capacity of 183.2MW.

Construction works on the project were launched by President Museveni on October 5, 2013.
UIPE President Eng Vincent Ochwo

UIPE TA Team Leader Dr Anton Olivier

The Uganda Institution of Professional Engineers benefits from a 2-year European Union Technical Assistance Project

Dr Anton Olivier is the team leader of the European Union’s TA to the Local Construction Industry that is working with UIPE over the next two years.

UIPE is the organisation that vets engineers before they are registered with the government’s Engineers Registration Board. But as Dr Olivier points out, the TA is focussed on increasing UIPE’s relevance to the entire engineering sector, and so hopes to benefit technicians and technologists as well as university graduates.

The overall purpose of the TA is to help Ugandans in the engineering profession become more competitive. At the moment there is an imbalance in the market: although around 2,000 home-grown engineers, technicians and technologists emerge from colleges and universities each year, the industry still finds it hard to recruit staff with the right kind of experience and skills. The aim of the TA is to find ways to address that gap.

By the end of the two-year project, UIPE should be in a better position to give member engineers, technologists and technicians a helping hand from the time they start this specialised study to the time they get their first job and become established. The TA team’s Professional Career Development Specialist, Jim Clarke, says, “We’re making the link between industry and the big pool of engineering professionals so that through UIPE they find the support they need to respond to what the industry is looking for.”

The TA to UIPE is funded to the tune of €1.3m, and is one of four such institutional development projects the EU supports. According to the EU Project Manager in Uganda, Simon Muliisa, taken together the four projects make up a €12 million intervention. This includes technical assistance to the Ministry of Works and Transport, the Uganda National Roads Authority and the Uganda Road Fund.

Mrs Immaculate Makwo Akello is UIPE’s executive secretary. She runs the small team that makes it all happen for UIPE members. She is looking forward to big improvements to the services that UIPE can offer its members.

She says: “Our Secretariat is the first point of contact for our 4000+ members, but we realise that there are many more professionals out there that could benefit from what UIPE offers. So we are hoping that the new strategy and business plan that the TA team is helping us develop will further strengthen UIPE so that everyone in the engineering profession finds us relevant.”

Thanks to the TA Project, Mrs Akello is also expecting changes in the
The EU Support to the Local Construction Industry project will help young engineering professionals on their career paths

Infrastructure projects need engineers, technicians and technologists with the right skills and experience

UIPE President, Eng Vincent Ochwo, sums it all up: “Thanks to the TA Project, UIPE is increasing its relevance to all professionals working in engineering. As the only member organisation for the entire profession in Uganda, we have a responsibility to help build careers. We are hoping that the TA Project will lift UIPE to a new level, so that we can play our part in ensuring home-grown talent is ready and able to contribute to Uganda’s future.”

THE NEED TO ENFORCE EFFLUENT DISCHARGE REGULATIONS

By Eng Frank Kweronda
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Lake Victoria chokes under pollution discharge and the water hyacinth
Water pollution is a severe worldwide problem that urgently requires plans for monitoring and implementation as well as solutions. A significant number of emerging pollutants resulting from the point and diffuse pollution are present in the aquatic environment.

Recently while having a boat ride within the inner Murchison Bay of Lake Victoria from Munyonyo to Luzira, I realized that our fresh water body has continuously been polluted by untreated effluent from the surrounding environment. This could be observed from the visible algae spread all over, and the bad smell around. All this affects the aquatic environment and its organisms like fish. Secondly, it has been observed that utilities like NWSC, the umbrella authorities for the operation and maintenance of our water supply systems will face high pumping and treatment costs while extracting water from such polluted water bodies in order to make it potable.

Effluent is defined generally as “wastewater treated or untreated that flows out of a treatment plant, sewer, or industrial outfall. Generally it refers to wastes discharged into surface waters”. Cleaning up the nation’s largest source of water pollution is a priority. In Uganda, millions of litres of untreated and undertreated wastewater (sewage) are dumped into our waterways every year. This is an environmental, human health and economic issue. Wastewater effluents have been shown to contain a variety of anthropogenic compounds, many of which have endocrine-disrupting properties.

Effluent Guidelines are national regulatory standards for the wastewater discharged to surface waters and municipal sewage treatment plants. Municipal wastewater is one of the principal causes of water pollution in the world. Since stringent effluent limitations set by regulatory authorities can have a major impact on the local communities, a prudent regulatory decision on the needed levels of wastewater treatment is vital to countries where wastewater treatment may not be economically affordable. This goal can only be achieved through enforcement of the basic principles, ground rules and management framework. The basic principles provide the broad reference framework or direction within which to develop specific ground rules for the discharge of land-based effluent to the environment, as well as its management. The objectives of the regulatory requirements must be clearly defined and implementable.

The need for effluent discharge regulation can be looked at as mainly to strengthen the management of all current and future point-source discharges to water. Effluent disposal standards have played a key role in controlling pollution discharges since the early 1970s in developed countries. Strict regulations of wastewater disposal will lead us to a stage with only limited conventional water pollution problems. On the other hand, in order to control toxic chemicals entering municipal wastewater treatment plants from industrial facilities, an effective and enforceable industrial pre-treatment programme must be implemented.

In addition, pollution prevention or a cleaner production programme should be an integral part of these industries. Adequate sanitation is vital to a healthy society. To protect public health and the environment, human wastes must be properly collected, treated and disposed of. The level of wastewater treatment needed depends on the method of disposal which can be broadly classified into two categories, namely, surface-water discharge and land application. Disposal to surface water-bodies such as rivers, lakes, estuaries and oceans is by far the most common approach in the world. A land application system refers to wastewater applied to land, draining naturally to groundwater or surface waters.

Although effluent disposal standards may vary from country to country, some of those not in existence may even be established by the jurisdiction of local regulatory agencies, the basic conventional pollutants are the same which include suspended solids, organic matter, bacteria, and nutrients. Their quantities in the water-bodies indicate the degrees of pollution. Unfortunately, sometimes it is not economically feasible to simultaneously address all pollutants of concern because the costs of removal of these pollutants increase as the treatment level increases (e.g. primary, secondary, tertiary treatment, etc.). In our country, for example, this problem could be addressed through plant upgrading in phases with a compliance schedule. The first phase could be the primary treatment, which removes some organic matter and suspended solids. The second phase could be secondary treatment, which removes most of the organic matter and suspended solids. The final phase could be advanced treatment, which removes nutrients and toxic chemicals.

Obstacles to effective wastewater management could include, poor legislation or even lack of it, inappropriate institutional structures, fragmentation of jurisdiction between agencies, ministries, departments, boards, authorities, utilities, and other stakeholders.

On the other hand, lack of implementation can also be due to lack of staff capacity, lack of enforcement and lack of adequate long-term funding, among others. Discharges must take into account the ability of the receiving environment to assimilate the wastewater.

Finally, it should always be noted that wetlands, on top of acting as homes for different living organisms, also act as a filter and store of water before it reaches lakes and rivers. Therefore they should be protected and managed very well.

Eng Frank Kweronda is a civil engineer and Ag. Assistant Commissioner at the Directorate of Water Development, Ministry of Water and Environment. He is a Member of ERB
APPLICATION OF COMPOSITE MATERIALS

PART III

By Konstantin Gorchakov, General Manager, MRG-Composites

In the first article, we described the main and most common technologies for the production of products made of composite materials. The second article proposed a technology and description of an innovative product for construction in East Africa: FRP-Bars as a replacement for traditional steel rebars.

In this article we will talk about wider applications of composite materials in industrial construction.

As we mentioned in earlier articles, structural elements made of composite materials have become firmly established in international construction experience and have shown themselves as a noteworthy product with excellent performance characteristics. In the modern manufacture of products made of composites for construction, the main application is found in the technology of pultrusion, winding, manual forming and pressing (for a description of the technology, see the article in the December 2018-January 2019 issue).

Next, we consider the most popular applications for different areas of construction.

Since composite materials have high strength characteristics along with a low weight and excellent corrosion resistance, even under aggressively strong chemical environments, the following products are most common:

- Stairs
- Grating
- Railings
- Communication crossings
One of the important advantages of this kind of products and designs is their high degree of prefabrication. All products are initially designed according to construction plans and are manufactured with engineering precision. All processing and preparation of components takes place at the enterprise. Therefore, assembly on construction sites requires minimal time and virtually eliminates any errors during the process, which significantly saves the customer’s funds.

More complex technically and with specific properties are products for the chemical industry, including extractive. These products can be:

**Tanks for chemically active substances**

Due to the excellent chemical resistance, composites are widely used in the chemical industry. With the help of composites, you can achieve high durability and relatively low cost of concrete tanks.

**Elements of structures**

Recently, block-modular construction has been increasingly used in the construction of enterprises. Structure elements can be the profiles made of composite material four times lighter than structural steel. The use of composites significantly reduces the stress on foundations, allowing them to be made less massive and expensive.
In the above cases, the composite material is developed strictly on the basis of the conditions of further exploitation. Both reinforcing agents and binders with the necessary level of resistance to aggressive media are selected.

Another of the most promising areas for the use of composites is road infrastructure. These are widely used as protective structures, and prefabricated pedestrian or communication crossings. For road construction, safety, maintainability and resistance to moisture and ultraviolet rays are important. Since composite materials are painted in mass, even if the surface layer is damaged, there is no loss of appearance. Also for these products corrosion is not terrible and external aesthetics last many years.

The following are the most common uses for composite materials:

**Dampers and separation structures**
An important element of the road device combining information and passive safety of road users.

**Fencing and noise protection structures**
Often, the major highways pass through closely located settlements. Such constructions serve not only for sound insulation, but also prevent harmful substances from entering the living area when motor fuels are burning.
Drainage systems
The system for collecting and draining water from road is dense. Due to their low weight and the tongue and groove system, they are easily mounted without special equipment and connections.

Pedestrian crossings
In residential and densely populated areas, fast-built pedestrian crossings play a particularly important role. On the one hand, they increase the safety of pedestrians, on the other, they increase the traffic flow on highways. At the same time, the relative low cost significantly reduces the burden on the budget.

It is known that products made out of polymers are subject to aging caused by solar radiation. Composites are no exception. Even with the addition of special protective components, the resins in composites are subject to degradation or erosion under the influence of ultraviolet radiation. Therefore the service life of such products is limited to 15-20 years with a gradual loss of strength.

It is important to note that the production of modern composite materials has low energy consumption, and with each year increasing environmental safety. The main chemical components released during production processes have low stability and disintegrate into environmentally-friendly substances almost immediately within a few minutes.

Also, the manufacture of products made of composite materials allows the use of specialists of different skill levels, thereby creating an excellent base for employment and professional growth. There are now quite many technical specialists due to the rapid introduction and widespread use of new technologies in the production and processing of products, leading to more overall technical literacy and personnel development.

Thus, the production and use of composite materials in modern construction and economy meets all modern requirements of a civilized economy: environmental friendliness, efficiency, high technology, economical efficiency, and maximum use of the labour of personnel at different technical levels, which is especially important for rapidly developing countries.
ENGINEER’S ESTIMATE
MAKES OR BREAKS THE CONSTRUCTION INDUSTRY

This article explains what the engineer’s estimate means and how, when, and why a wrong one may drastically affect the employers, the construction industry and the country’s economy. The article also proposes a way forward, which should be to discuss the topic further in a symposium of stakeholders in the construction industry. Resolutions therefrom should be forwarded to the relevant authorities to be used in reviewing the existing construction laws and regulations or enacting new ones.

Background

It is widely known that many public construction projects register massive variations, cost overruns and cost claims during or after the expiry of the project cycle. There are often administrative reviews that ‘eat’ into the project time and cost emanating from flawed procurement processes. Often, the so-called “lowest evaluated bidder” may return too low or too high a figure, thereby forcing the employer to engage him/her at the employer’s peril! The procurement regulations do not assist the employer, if there is no engineer’s estimate or if it was poorly derived.

The common public view backed by the law is that the lowest evaluated bidder takes the job, assuming he/she is below the engineer’s estimate! However, once such a procurement is awarded and started using a wrong engineer’s estimate, chances of variations exceeding 15% and 25% abound, with the attendant time overruns and loss of earnings due to late utilization of the project products or services.

To our knowledge, Uganda and many countries lose billions of money in variations, claims or litigations concerning failed procurements thus negatively affecting employers, the construction industry and the economy. There are several factors attributed to this problem. A major one is the “Engineer’s Estimate (EE)” which breaks the construction industry, if it has not been derived professionally and kept as a top secret from bidders and their interested associates.

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Eng Hans JWB Mwesigwa,
(Tel 0772431465, h.mwesigwa@8mconstruction.com) is a registered civil engineer, a project manager/Managing Director, 8M Construction Digest Ltd and a part-time lecturer in project management and structural engineering for students of architecture at Makerere University, Kampala.
**What is the Engineer’s Estimate?**

The **Engineer’s Estimate (EE)** is the estimated market cost of the construction project, derived as the total amount the constructor/contractor ought to ask for, in order to fulfill the employer’s desire on the project time, scope, cost and quality. All the four result in a value for money, project, even if the contractor walks off with the market profit.

But why do we call it the Engineer’s Estimate when a quantity surveyor or any other professional in the construction industry can derive it? This is a question for another day.

There are several massive projects in irrigation, urban water supply, water for production, roads and highways, energy and facilities, buildings and related structures. These projects need professionals for the design and supervision, and contractors for implementing the works. For a cost-effective procurement, the caring employer’s wish is to have a project that has the **4Es of effectiveness, efficiency, economy and equity**. In other words, the project should show Value for Money. If the engineer’s estimate is lower or higher than the just-right value, the project will either be underfunded or vice versa, thereby losing value for money.

**Why is the Engineer’s Estimate (EE) important?**

The just-right EE assists in the fulfilment of the project time, scope, cost and quality. The correct procedure of soliciting and awarding infrastructure contracts strengthens the competitive bidding process towards value-for-money projects. A competitive contracting environment therefore needs an effective procurement programme that ensures fairness in the pre-bid solicitation process and post-award review of construction bids. A reliable EE is critical to the success of such a procurement. When the EE is just right, it enables a procurement that attains value for money.

**How is the EE derived?**

The stages of implementing a typical traditional project, say an office block, are:

a) The inception and planning stage, when the project feasibility and needs are assessed by consultants and approved by the employer complete with an estimate that forms the working budget estimate;

b) The scheme design stage by consultants, when specifications and design concepts are derived and approved, complete with a more refined project cost estimate that should be within the budget. If the cost estimate is higher than the budget estimate, then either the budget or scheme’s design estimates will have to be adjusted.

c) The working, detailed drawings and bid documents’ stage entails production of all architectural, civil and structural, electro-mechanical and information communication technology (ICT) working drawings for approval, complete with detailed drawings to derive the EE and bid documents. Firstly, the key professionals provide specifications and the working and detailed drawings to the quantity surveyor (QS). The QS then uses the documents to prepare a bill of quantities (BoQ), which shows columns of the scope of works for each item to be covered together with the rates for doing the work. The BoQ also includes preliminaries such as cost of insurances, plant and equipment and dayworks. The BoQs are then costed to arrive at a just-right EE. The **EE SHOULD STRICTLY REMAIN CONFIDENTIAL** for obvious reasons. The critical review of any bid depends on the reliability of the EE if it is being compared to.

Therefore procurement departments and the relevant consultants should pay sufficient attention to prepare the engineer’s estimate using the same or a better level of detail as the contracting industry. In addition, the EE is the benchmark for analyzing bids and is an essential element in the project approval process. The EE should reflect the amount that the contracting agency considers fair and reasonable and is willing to pay for the work, allowing for a fair contractor’s profit. Under-estimating causes project delays as additional funding is sought. On the other hand, over-estimating causes inefficient use of funds that could be used for other projects.

d) The contract procurement stage goes through prequalification, qualification and selection of a contractor;

e) The contract administration/supervision stage goes through the supervision of works by the consultants to achieve the project time, scope, cost and quality;

f) The post-contract and closure stage goes through correcting defects and closing the project. Here, contracts agreements of both consultants and contractor are ended as the employer effectively takes over the completed project.

**Methods of deriving the EE**

Three basic approaches are used to derive the EE: actual cost, historical data, and a combination of both. One of the most important factors in obtaining a good EE is the experience of the estimator, the time and the INTEGRITY he or she devotes to the exercise.

**Actual cost approach**

Here the estimator considers the market or current cost of every product, material and service needed to actually perform the work (i.e. the cost of money, materials, manpower and machinery). He must consider the sequence of operations, production rates and a reasonable value of overheads and profit.

This approach requires the estimator to have a good working knowledge of construction methods and equipment. An unreliable EE may be made if the estimator does not have adequate resources to determine production rates from actual outgone and current works, construction methods and equipment as performed by the contracting industry on similar types of projects. This method produces a more reliable estimate that will aid review processes and decisions to award the contract or reject the bids altogether. The method is however more time consuming.

**Historic data approach**

The estimator relies on historical data from recently awarded contracts. For example, the recent rates used by best evaluated bidders on similar projects may be used to develop the EE. Though this is a cost-effective method to develop the EE, solely relying on historical data may not be appropriate when the data is based on a non-competitive bidding environment. A file of previous unit bid prices should be maintained according to type, size, and location of the project. Upcoming projects should be matched to the most recent projects to develop base prices for estimating the value of the unit prices. Under this approach, bid data are summarized and adjusted for project conditions (i.e. project location, size, quantities, etc.) and the general market conditions.
This approach requires the least amount of time and personnel to develop and produce an adequate estimate for use in budgeting/programming as long as competitive bid prices are used to build the estimate. Non-competitive bidding and unbalanced practices are the least recognizable using the historical data approach to estimating. Further adjustment of the base prices should be considered based upon the ages of the similar projects. Past inflation rates should not be projected into the future unless based on circumstances which can be reasonably expected to occur, such as labour-rate increases through labour negotiations and known material price increases. Where the magnitude and timing of future increases are uncertain and would have a major effect on critical unit prices, price adjustment clauses may be a better alternative.

Combination approach

This approach combines the use of historical bid data with actual cost data methods.

The confidentiality of the EE should be a matter of policy even after the project has been commissioned for use! One advantage of keeping the EE confidential is that it eliminates the possibility of only one or some of the bidders knowing what the procurement entity believes as the worth of the project, thus removing any pressure from its employees to secretly release the estimate to bidders. One disadvantage of making the EE public is that those desiring to rig bids can form an insider-dealing gang and use it to force for their preferred low-bid amount. This is especially important in cases where the contracting agency anticipates minimal competition and/or a single bid for construction.

If a just-right EE is made, it could be the basis for a procurement option, where specifications, design and a range for the estimated project cost could be provided and included in the bid proposal. The bids are then evaluated against time and cost!

Accuracy of the EE

The EE must be credible enough to effectively guide the bid review process. Its accuracy should be judged by comparing it against the lowest bid (%). Although preparation of the EE is not an exact science, the estimate should however be within ±10% of the lowest bid for at least 50% of the projects.

With confidence in the art of determining a just-right EE, the contracting entity should reject those low bids that are not within a reasonable percentage above the EE.

What is the situation on the ground?

The situation on the ground in Uganda and East Africa seems to be bleak. There are ever cases of variations, cost overruns and administrative reviews on several projects. Litigations on why the lowest bidder was not chosen are many. The Public Procurement and Disposal of Public Assets (PPDPA) has time and again approved variations in excess of 15% and 25%. Many of these cases fundamentally rely on a poorly derived EE that therefore failed to guide on the way forward. Where the EE is too low and the contract was awarded at a lower cost, cost overruns and variations are bound to occur.

There is a wrong practice by some consultants, who either by omission or commission do not advise the employer on the importance of the EE. There are instances when it is done using documents with missing information! A vivid example is when design engineers fail or refuse to provide all detailed design information, claiming that the contractor will provide the same! Bulk works unnecessarily left as prime sums often cause untold variations. They are commonly left for the contractor to break them down and price them, often to the detriment of the project.

An engineer’s estimate of cost without time is equally lame! A project time that is left to be estimated by the bidder may overshoot by twice the time. This escalates insurance and preliminary costs. It may also cause other related costs such as loss of earnings from renting the building.

How does a just-right EE affect the project?

During the pre-bid considerations/prequalification

The potential bidder’s resources, financial assets, work experience and staffing capability must be identified for it to become prequalified. Under consideration should also be the quantity, type of work and cost the bidder can undertake.

If a fair EE is in place, it can be used to evaluate and compare the cost of jobs a potential bidder has handled.

More-than-one bid preference

There may be cases when only one bid is returned. There is evidence (with the Auditor General’s reports) that in those cases where only one contractor was interested in a project and more-than-one bid requirement was desirable, the bidder actually contacted another contractor to submit a complementary but higher bid so that he got the award as the lowest evaluated bidder. In such a case, if the bid far exceeded the just-right EE, it could be rejected. But if it is at or below the EE, it should be considered for award.

Bid analysis and contract award

There are reliable reports of poorly derived EEs, whereby the EEs were overstated. Even when they were not within plus or minus 10% of the low bid for at least 50% of the projects awarded, there was no procurement law to reject the bids based on poorly derived EEs.

Review of the preparation of the EE

What if the engineer’s estimate is not just-right? Are there procurement regulations regarding release or protection of the EE? Do we have a procurement regulation or law that guides on when a contract award is null and void if it is based on an unrealistic EE, so that the estimate overruns, unfair competition and other factors are eliminated?

There is need to review the preparation of the engineer’s estimate and decide when it can be rejected or approved, depending on its comparison with the returned bids. There is a further need to make the EE officer(s) answerable for unprofessional conduct through omission, neglect of failure. The rejection or approval of an EE should be based on the documentation and database the estimator used, in the event that it is questioned.

Conclusion

A fairly derived EE makes the proper procurement of projects by giving value for money and ensuring that they are done in accordance with the desired time, scope, cost and quality. A poorly derived EE breaks the employer’s back and the construction industry.

Editor’s note:

We request for readers’ views and comments on the article. We hope to have a symposium of stakeholders to discuss the topic and formulate a way forward.

Contact us on digest@8mconstruction.com. Tel/Whatsapp 0772431465. Plot 8 Wamala Avenue, Bukoto
Uganda’s reputable supplier of quality generators, construction equipment, specialized materials and chemicals backed up by a highly professional and efficient after sales services.

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If you are running or managing a company or business and you have decided to buy a generator, then you deserve to be congratulated for providing your employees, clients, and yourself with peace of mind in the event of a power blackout.

Of course, now that you have chosen to buy a generator, you will be curious as to how to choose the best one. No matter what industry or business you are in, these tips will help you choose a generator that meets the needs of your company or business.

Well, you have come to the right place. By asking yourself the following questions and considering the following tips, you should not have any issues choosing a generator that is perfect for your business.

Consider Your Needs: If you’re going to be relying on your generator as a backup to your regular power source during a blackout, you are going to want to take into account different factors than if you are planning to use your generator to keep your servers running during stressful use scenarios. Consider which components are most essential to your business and then plan to have the generator power those things.

Think About Your Voltage

Requirements: A lot of companies are already set up for what’s called a three-phase power solution. Some aren’t. It’s best to get a generator that already matches your business’ incoming utility voltage. You’ll also want to look and see what your needs are in terms of turning on your backup power source. Will someone be manually starting up the generator or will you install a transfer switch for seamless power in the event of a power outage?

Think About Your Generator’s Fuel Source: More often than not, generators are powered by either diesel fuel or natural gas. You should determine which is most readily apparent in your community and then weigh that information against the cost of keeping your generator running. You’ll also want to look at your fuel storage needs. Will you need additional fuel storage beyond your generator’s tank? How much space will you need for fuel storage? Is there any zoning requirements you need to assess before purchasing your extra fuel? These are a few basic questions you’ll want to think about before your generator set is delivered.

Size Is Important: How big is your business? What are the ramifications for losing power? Be sure to consider how big your generator should be to power all your essential equipment and go from there. You’ll also want to consider how long the power may be out. Over your time in the industry, you’ve probably witnessed a few blackouts. How long do they typically last? You’re going to need to plan your generator needs to anticipate these outages.

Lastly, you are going to need a location for your generator to sit on the property. Whether you’re placing your generator set indoors or outdoors, you’ll need to consider noise implications, ventilation, and accessibility for routine maintenance. You don’t want to shove your generator set into a confined or ill-equipped location. That could cause more concerns down the road.

There Is No One-Size-Fits-All Solution: Honestly, those are just the basics. Every company’s needs are different, which can make choosing a generator a complicated process. A lot goes into deciding which generator is right for you, so it’s a good idea to enlist an expert like the team at Terrain Plant Limited.

Terrain Plant Limited has supplies a variety of quality generators from which you can choose a generator for your business or company.
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SE2700 Honda Powered Petrol Generator

SE2700 Honda Powered Petrol Generator
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SE3400LR Honda Powered Petrol Generator

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AJ Power 7 Series. 715 - 3350 kVA

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**Introduction**

By definition, a tunnel is a horizontal civil or mining engineering structure whose length is longer than twice the diameter of the structure (International Tunnelling Association, 2009).

Tunnels can be built underground, on the surface or submerged. Underground tunnels are common where construction on the surface is not feasible (Beaver, 1972). For instance, where cities are populated, other land uses exist or legal restrictions hinder surface construction. Underground construction provides a means to optimize land and water resources sustainably especially in critical ecosystems comprising wildlife UNESCO heritage sites (Ghimire & Reddy, 2013). Thus, possible adverse environmental impacts are mitigated whilst generating electricity concurrently (Tshering, 2012; Poff & Hart, 2002). Further benefits of underground structures include a better earthquake tolerance which makes them favourable in earthquake prone regions such as Tokyo (Sousa, 2010).

Underground tunnel construction is increasing at a fast rate globally. In the Ugandan context, tunnels have been used at the Kilembe mines; hydro tunnels are under construction at the Karuma project for electricity generation; and other potential uses for tunnels include utilities, access and transportation of wildlife and traffic. Though an old art on a global scale, tunnel engineering is not very well-known compared to other engineering fields (Road Tunnel Manual, 2009).

Tunnel structures are generally high hazard risk structures which cause tremendous losses including human life. Up to US$100 million in financial losses are registered in catastrophic tunnel failures and average project delays of 6 months (Sousa, 2010). Moreover, tunnel structures are very expensive to construct and are very capital-intensive ranging over millions of dollars (Spackova, 2012). Therefore, understanding the field of tunnelling is very important to avoid disastrous catastrophes and losses. Specifically, underground construction involves high risks and each undertaking is unique necessitating sharing of experiences which can only be built on a good appreciation of the subject. According to Greer (2012), identified potential failures can be mitigated to minimize the escalating record of tunnel failures. Figure 1 shows examples of failed tunnel cases. Figure 2 shows how tunnel failures resulting from works were stopped following an investigation or remedial incident affect economics of resources (Konstantis, Konstantis, & Spyridis, 2016).
History

According to Prior (2016), the actual origin of tunnels is uncertain but Beaver (1972) writes that in Europe and North America active tunnelling started in the 18th century. Before then, ancient Siberians, Babylonians, Egyptians, ancient Greeks and Romans built tunnels for mining, water transport, military and access (Sousa, 2010; Beaver, 1972). The purposes for which tunnels are built today are similar to former uses. Additional uses of tunnels include utility lines, storage, irrigation and passages of wind and wildlife (Sousa, 2010; Yi, 2006). Traditionally, miner gangs dug out the ground to create tunnel caverns until the advent of mechanical methods. The most remarkable event in the history of tunnelling was the invention of a tunnelling shield and drill.

A main characteristic of the industrialisation era was the need for less congested transportation routes in the 18th century during which attempts were made to tunnel under the navigable River Thames. Initially, manual hand excavation was futile without much progress until the first tunnelling shield was invented by Brunel in 1825 (Prior, 2016; Beaver, 1972). Brunel’s shield was rectangular-shaped and robust although tedious to use since parts had to be reassembled as the excavation advanced.

Later around 1864 Barlow invented the price excavator which was a more superior circular shield (Beaver, 1972). Barlow’s shield was used to construct the Gotthard Tunnel where a fast rate of tunnelling progress was achieved. Both inventions by Brunel and Barlow were unique and patented. Barlow’s shield was not an improvement to the Brunel shield.

Barlow’s shield was eventually modified significantly into the Greathead shield (Sousa, 2010; Beaver 1972). Greathead’s shield was first tested in the construction of the London railway and it earmarked modern tunnelling shields (Transport and Road Research Laboratory, 1973). Figure 3 illustrates the evolution of the tunnelling shields before the drilling age from (a) Brunel to (b) Barlow and eventually to (c) Greathead shield.

In 1953, further advancement included the rotary machinery developed by Robbins Company from which the model of most popular modern tunnel boring machines (TBMs) originated (Sousa, 2010). Figure 4 shows examples of TBM machine varieties. Machines reduce construction risks, are suitable for soft and water-logged conditions and they support and balance the weight of the surrounding ground and pressures (Hoek, Kaiser & Bawden, 1995), they give faster tunnelling progress rates and lower costs in hard ground (Blake, 1989).

Drilling started in 1876 when Brandt invented a pressurized rotary water-driven hydraulic rock drill during construction of the Simplon tunnel. However, its unsatisfactory application led to further research and eventually in 1970, manufacturers developed hydraulic oil percussive drills which earmarked modern drilling (West, 2005). Usually, drilling precedes blasting and both processes together are called the drilling and blasting (D&B) method of excavation. Small diameter holes up to 6 m deep are drilled into the ground following an expert-designed blasting pattern. Explosives are placed in the holes then the area is evacuated to a safe distance away from the excavation for safety purposes before the explosives are detonated to break the ground thereby creating the excavation.

After blasting, the area is scarified and cleared of muck. Figure 4 illustrates the D&B method which is used at the Karuma (600MW) hydropower construction project.
Types of tunnels

Tunnel types vary depending on their purpose, ground material properties, service function and design life. A tunnel name concisely describes it because it usually encompasses the construction method, material, geometry, purpose and method of support. Based on the method of construction, types include mined or bored tunnels, cut-and-cover tunnels, immersed or submerged tunnels, jacked-box tunnels and inverted arch tunnels (RTM, 2009). Cut-and-cover tunnels include top-down and bottom-up tunnels though the latter causes more surface disruptions. Mined tunnels are excavated at depth without unearthing the ground (soil, rock or mixed face) above.

Mixed face is a ground condition which involves combinations of different material types thereby making construction difficult. Based on the earth material out of which they are constructed, tunnel types include soft-ground and rock tunnels.

Tunnels are also differentiated based on their cross-sectional shapes (Figure 6) and method of support generally as either lined or unlined. Tunnel support improves overall stability which ensures functionality over its average design life of 100-150 years.

Cut-and-cover tunnels

Where surface disruptions should be limited, top-down construction is preferred. It involves construction of permanent structural slurry support walls from the ground surface. The tunnel roof is tied into the support walls then it is either cast in-situ or built using precast beams and the surface is restored while tunnel construction progresses underneath the roof. After excavation is completed, the floor is constructed in the same way as the roof. Figure 7 illustrates the construction process for cut-and-cover top-bottom tunnels (RTM, 2009).

Bottom-up cut-and-cover tunnels are a suitable option when it is not critical to limit surface disruptions. The vertical sides of the ground aligning the tunnel sidewalls are supported with lateral earth supports and the ground in-between is excavated while piling the muck at the surface. The tunnel is then constructed in-situ, the trench is backfilled and the surface restored. Figure 8 illustrates the steps taken for construction (RTM, 2009).
Immersed or submerged tunnels

These tunnels are immersed or submerged in water and they are used as sea water crossings. Submerged floating tunnels (SFTs) are a variation of immersed tunnels used for deeper sea crossings where ship traffic exists (Ingerslev, 2003). Immersed tunnel elements are constructed from prefabricated structural steel, reinforced concrete or concrete-filled steel elements on shipways, dry docks or improvised floodable basins; then they are floated and carefully installed in a dredged trench (Sousa, 2010; Ingerslev, 2003). They are connected to cut-and-cover tunnels, linked to the surface and covered with backfill to protect them from water traffic. Figure 9 shows how an immersed tunnel is installed in position.

Jacked-box tunnels

Jacked-box tunnels are constructed when surface disruptions are not acceptable and tunnels should be constructed at shallow depths near the surface. Construction is achieved by jacking a large precast reinforced concrete box horizontally through the ground thereby excavating the enclosed earth prism (Viggiani, 2012) and finally the excavation is supported. Figure 10 shows the construction process illustrating the launch slab along which the jacked box is driven into the ground to construct the tunnel shown in (b).

Inverted-arch tunnels

An invert is the bottom floor of a tunnel. Inverted-arch tunnels are constructed with a curved floor in order to limit deformation at the bottom of the tunnel. According to Zhongming (2015), inverting the arch increases a tunnel’s structural load-bearing capacity. Kawata et al (2014) explain that the increased structural load-bearing capacity is due to formation of a ring structure which causes the bending moment to be altered into an axial compressive force.

Soft ground tunnels

The term ‘soft ground’ refers to earth material of low-bearing strength generally less than 25 MPa (Ongodia et al, 2016). Challenges associated with tunnelling in soft ground include face collapse, flowing ground, squeezing and swelling ground, loose material and limited stand-up times. Therefore, great precaution is required including balancing the excavation by using tunnelling shields or the TBM which support the ground during the excavation process. Tunnelling in soft ground is usually done in stages depending on the stand-up time of the unsupported excavation according to a chosen sequential excavation method (SEM). Figure 11 illustrates examples of SEM construction sequences.

Figure 10: (a) Launch slab & (b) Jacked box tunnel (Lynn, 2006)

Figure 11: Typical excavation sequences (ITA, 2009)

Rock tunnels

Rock varies in degree of strength and hardness. For softer rock, mechanized excavators are used whereas the TBM, SEM and the D&B methods are used to excavate hard rock. The TBM is most popular because it is fast and has a fairly controlled tunnelling ability despite it being an expensive high technology machine comprising a cutter head, gripper, shield, thrust cylinder, conveyor and rock reinforcement equipment (RTM, 2009). Figure 12 shows cutters with (a) grinding ability for hard intact rock, (b) less teeth for fairly hard rocks and (c) smoother cutters for jointed rocks (Blake, 1989).

Figure 12: Rock tunnelling machine cutters (Blake, 1989)

Editor’s note:

The article is running in two parts. The first covers a brief history of underground tunnels as well as the types of tunnels engineers commonly use. The second part in the next issue (June–July) will cover the process of tunnel construction itself and the insights gained from previous tunnel experiences.
or the fourth time in four years, I visited Sipi Falls and stayed in the expensive hotel across the falls. The whole evening it rained and I had nothing to do. I sat on the verandah drinking some beer and sipping cupfuls of the Mbale coffee. And I drank in the magnificent sight of the falls, a masterpiece of an extravaganza. I gazed in wonder as the tiny streak of water lingered in falling the thousands of millimetres down below. There was so much love with nature that the water turned into cold steam. I could see a great open cave behind where the falls land, needing cover. I painted a picture of the falls acting as a cloth that won’t cover the nakedness of a beautiful woman. And I chuckled at my stupidity or rich imagination. I felt that this stupefied beautiful daze should continue endlessly.

Suddenly, I realized that a bitter quarrel was in earnest progress. The sponsors were seated on the table next to mine! A huge man with a white moustache, seething with anger, shouted, “There is no way you so-called engineer can harness this Sipi Falls for hydropower without ‘killing the goose that lays the egg. You will kill this place as a tourist attraction spot!”

The engineer, thoroughly agitated and hurt at this belittlement, bellowed: “Using science, technology and innovation, it can be done, you nitwit! You have blindly lived here and failed to tame nature and im-
prove your livelihood. Now keep quiet and I explain!"

As he rumbled some stuff that his colleague-in-arms was rubbishing, something tickled my brain, that this engineer was right. My mind of a journalist moved my brain into a higher gear of tank-thinking on the what, where, when, why and how to harness the Sipi Falls potential without touching it. Trained to listen and write, I paid the utmost attention to the short engineer as he battled to gain audience with the shouting huge man. And I heard him say:

“The Sipi Falls EXTRAVAGANZA idea needs the minds of a combination of the old and experienced civil and structural engineers, dam designers and specialists of all kinds, let alone to concretize the dream”.

Suddenly my mind clicked and I saw it all.

There was a signpost reading, “Sipi Falls Extravaganza”. There were the big umbrellas and revellers sitting, sipping and sightseeing the falls right above. But then I beheld! More of them were looking down at another man-made falls that had been created a distance below. There was a signpost reading, “Sipi Falls Extravaganza”.

It was a marvel to behold, a ninth world wonder! I asked the engineer to take me for a walk down to the falls and explain the wonder.

The slab of the cosy open restaurant was built at the foot of the falls using a high grade of class 60. Beneath the slab was a massive vessel that was supported by both valleys and the concrete structure. The vessel contained enough water to pour out and create two times the volume of the original Sipi Falls for eight hours! “What is the magic with the figure 8!” I asked the engineer. He said that 8 times 3 was 24 and 24 was the number of hours in one night. He explained further that for eight hours when Kapchorwa and its environs needed power most, a hydropower station which was innovatively located between the falls below and the water vessel generated twice the amount of electricity as would have been generated by the old Sipi Falls above.

At first, I failed to understand the logic. Then the good engineer slowly but surely explained how the Sipi Falls potential was harnessed to produce both power and a better tourism site! In sheer excitement, I banged my forehead. And then I woken up to find the quarrelling party were actually fighting. A thrown bottle had locked onto my head and by force it had woke me up. Bleeding, I left to piece down this story.
RATIONALE FOR THE WATER FILTER

Access to running water by the majority of Ugandans living in rural areas is still a dream. As a result, these natives rely on unsafe water from ponds and streams. Unfortunately, some users even share the same water sources with animals. This exposes them to several health hazards.

Typically, most regions in Uganda receive heavy rainfalls but the storm water (run-off water) is poorly recovered and harvested. Those who attempt to harvest and utilize the storm water dig ditches where it is trapped and cleared by sedimentation. The quality of the water obtained is low thus minimizing its application in addition to the process being slow.

Using scientific and technological knowledge of filtration and adsorption, I came up with an innovation in which such dirty water could be treated. Designed from locally available materials of plastics, clean sand, charcoal and gravel, the unit can be used to filter and provide safe water from the different unreliable sources. With this innovation, the water harvesting system is improved.

HOW IT WORKS

The unit has a simple operation system. Dirty/unsafe water is poured on the top of multimedia bed filter. The water first penetrates the gravel layer before perforating through the charcoal layer and lastly the sand. Water flows at a decreasing flow rate through the different layers with fastest speed in the gravel layer, leading to the accumulation of the water in the charcoal layer. This is desired because charcoal is the natural purifier adsorbing heavy metals and ions as well as reducing the microbial load. By the time water percolates through the last layer, it is cleaner and safer.

THE PROJECT STATUS

The project is at prototype/incubation level. Research work started in October 2019 and is still on going. I recently presented the project at the International Engineering Students’ Conference at the University of Nairobi. Representatives from different universities in East Africa including Makerere and Kyambogo made presentations. By the grace of God, this project presentation emerged as the second best.

Some of the pictures taken while presenting the project in Nairobi

Working on this project has changed my life and perspectives. Among the concepts developed is ‘localized self-sufficiency’. As a chemical-engineering student, I now realize how science, technology and innovation can assist communities to meet their needs by providing solutions that are based on locally available resources. I seek finance to developing the project to its full potential, so that it can be used to improve the livelihood of our people.

Editor’s Note:

The author and researcher of this innovation, Mark Wilson Kirumira (0787 342 121/0701 774 069 mark06wils@gmail.com), is a third-year student at Kyambogo University studying Chemical Engineering. In belief of using appropriate science and technology to innovate solutions that improve communities’ livelihood, we commend the student-researcher for financial support to complete the project. We however advise Mark to look around, say to the Directorate of Water Development (DWD) and elsewhere, to discover if such technology does not already exist. It’s not good to duplicate effort. However, there is always a chance to improve and add value to existing filtration systems. Bravo, Mark Wilson Kirumira!

We welcome researchers of other products, which we will publish for free.
FERTILISING THE URBAN TOOKE WITH URINE

By 8M Reporter

Caption on the magpie: “Camera on the move” captured this huge ‘tooke’ growing by the perimeter wall in an engineer’s home in Kampala City. As an “urban farming scheme” he has nominatively used the science and technology of mixing one portion of urine with three of water to produce a wonderful natural nutrient/fertilizer for the banana. Simple: He and all males under his roof urinate in a 20 litre jerry can instead of the WC. With the jerrycan one-third (1/3) full, they fill it with water. They then sprinkle the urine-water fertilizer sparingly around the banana stem and wait for sweet results: a big bunch of bananas for the livelihood of the family!

8M photos, March 2019

BEAM POWER TECHNOLOGY TO PRODUCE ELECTRICITY FROM GRAVITY

Is there a way of producing electricity using gravity or mechanical energy? Mr John Bwengye will tell you yes.

A few years ago the 8M Technical team met and liaised with Mr John Bwengye, a mechanical engineer who is in advanced stages of producing electricity from mechanical energy using gravity.

He explained the concept of his innovation briefly as below:

The technology provides a single and a three-phase electricity-generating systems using the ever available gravity. “I made use of gravity and a see-saw device to establish different forces moving up and down under gravity and a system of springs. In this way, I invented a system that perpetually stays in motion, thus producing mechanical energy, which I can transform into electricity,” Bwengye said. He added that he devised another system which uses and transforms the mechanical energy into electrical energy.

“As simple as that?” I asked. “No”, he replied, “it has taken me six solid years of research and juggling with systems and engineering!” Bwengye is currently looking for a partner to develop the idea to a commercial level. He has a workshop and a garage. “I have personally used lathe machines and all other tools, equipment and machinery in developing the idea. All I need is a partner, with whom to polish the technology,” he ended.

Mr Bwengye can be contacted through: The Editor, 8M Construction Digest, Plot 8 Wamala Avenue, Bukoto, Kampala. +256772431465 digest@8mconstruction.com. www.8mconstruction.com
In our Volume 4 April/May 2017 of the 8M Construction Digest, page 17 under the topic, “How Ugandans lose value for money in infrastructure development”, we reported on the ‘forgotten’ pedestrians’ access in form of a staircase.

This March 2019 photo shows the pedestrian footway on the left has been constructed alongside the old footway.

As at 26 March 2019, there is what the locals call a “Stairway to Heaven” which is very steep. It is next to the old muddy steps that are ‘preferably’ used.

A public voice reaching the 8M Information Forum wrote, “Even myself anytime I use here, I avoid these steps that seems to be heading to ‘heaven’.

They simply didn’t follow the terrain in making the steps. It seems unnatural and difficult to climb from the user perspective. However, if they had seamlessly understood the flow of terrain in their execution it would have been pleasant to use as seen on the right.

UNRA found their road-demarcation post inside someone’s house on the Northern By Pass, Kampala. 8M Photo March 2019.

Our camera caught him/her red-handed hiding the UNRA boundary demarcation post in his house.
Qn: Dear Mama Fundi!

I have often seen murram and rubble being poured onto good top soil or swamps, in preparation for future construction. But the good top soil for plants is lost! Is there any regulation against this practice?

A The agriculture teacher in my school in the 1960s, the late Fabius Tadeo Rwakana, always started the first lesson with the question, “What is the most important thing in the world?” His answer was SOIL. If ever anyone failed this question, the pupil would have at least six strokes of the cane from Rwakana!

Now to the answer. The Department for Environment, Food and Rural Affairs in Great Britain, www.defra.gov.uk has a publication, “Construction Code of Practice for the sustainable use of soils on construction sites.”

It deals with, among others, soil management during construction and comprehensive soil care. The rule is that SOIL SHOULD NOT BE BURIED UNDER CONSTRUCTION AS THIS RESOURCE WOULD THEN BE LOST! It states: “Soil is a fundamental and ultimately finite resource that fulfils a number of functions and services for society which are central to sustainability. Some of the most significant impacts on this resource occur as a result of activities associated with construction activity, yet it appears that there is a general lack of awareness and understanding of this need within the construction industry. A Code of Practice has therefore been developed to assist anyone involved in the construction sector to better protect the soil resources with which they work. By following the guidance in the Code you will not only be able to help protect and enhance the soil resources on site but you may also achieve cost savings for your business.”

I have not found a similar code of practice or regulations by the National Environmental Management Authority (NEMA). While I will seek NEMA’s guidance for the next issue, I want to categorically state that it should be a crime to cover good arable soil, whether on hills or in valleys or swamps in the name of construction. Lost soil is a lost resource that is impossible to recover!
I was reading random things on the Internet last night and stumbled upon some things about Albert Einstein’s wife. Some people say she was as brilliant as Einstein, if not better. But what happened to her? Marie Curie was the first woman to win a Nobel Prize, the first person and only woman to win it twice and the only person to win a Nobel Prize in two different sciences, physics and chemistry; and that Mileva Mari-Einstein was Albert Einstein’s wife, the only woman in the Physics department at Zurich Polytechnic where Albert Einstein studied and the only person to score higher than Einstein in mathematics in the entrance exam!

What was the difference between these two brilliant women? Why did one go down in history as a great scientist with two Nobel Prizes and the other as just Albert Einstein’s wife?

Their husbands! Mileva Mari-Einstein got married to Einstein and helped him in writing some of the most profound papers that changed science but Einstein never cited her in his works. But Maria Curie married Pierre Curie, a gentleman who understood partnership. When the Nobel Prize committee wrote to Pierre Curie in 1903 informing him that he had won the Nobel Prize, Pierre asked if his wife was also going to be honoured but he was told only him and Henri Becquerel would be honoured. Pierre wrote to the Nobel Prize committee acknowledging the honour but rejecting it if his wife would not be honoured. He said the papers had a heavy input from his wife.

The committee bugged and Marie Currie became the first woman to win a Nobel Prize. Albert Einstein, on the other hand, was too consumed with personal recognition to even consider to put Marie’s name on publications. Such actions would later cause controversy in the scientific world where till today, there are debates on Marie’s contributions. In conclusion, the right marriage will reinforce your legacy. The wrong marriage will diminish it.

Selfish Einstein!

Promotion of engineering in primary schools today - badges given out depending on pupil achievement. One of my little ones was testing structural strength of chocolate by putting heavy weights on it whilst the other was testing how fast a car can go on different materials and why. My team was involved in the above, including myself. Something for the Ministry of Education to think about! <https://www.yearofengineering.gov.uk/about>

Can someone guess what that info signifies? I mean the info on a stone plaque at Amber House, an old but elegant building that was opened (around 1952?) and the building belongs to the former Uganda Electricity Board. It shows that the Lake Victoria level in 1907 was 3,905.40 feet (1,190.36 metres) above sea level. What a precision! Hon Onek should know. I need confirmation. Admin

Is the puzzle about the years 1907 on the stone and year of opening the building 1952?

Should be a survey benchmark for Kampala. Therefore, should not be destroyed.
On another note, where is this or a similar vernacular home in Uganda? What materials are used for walling and roofing?

Houses like this are protected in the UK. Any owner has to maintain the structure in its [original] form — although you may add electrics and plumbing or similar.

Members, please welcome Dr Dan Twebaze, a medical doctor who is doing wonders in real estate development! “Good News, Hilton Hotel is back!” Courtesy of Dan and his Board of Directors, who launched the project on 22 March! Dan, on this forum, we share views on engineering and construction-related info for social and economic development. Admin

Dr Dan Twebaze, TWED Towers: Many thanks, Admin. Kindly introduce or encourage members on this Forum to introduce themselves so that I know whom I’m chatting with.

Eridda Nyanzi: When you go to group info you will see most of us, otherwise we are more than 250! But you are most welcome to the group.

Dr John Muhumuza Kakkitha, QS Min Educ: On the 26th March 2019, the Institution of Surveyors of Uganda (ISU) had a clinic at the Constitutional Square. The rebranded ISU will be shared with the public together with the USSD code *284*20# that verifies both registered and assistant surveyors. Kindly share broadly and feel free to participate.

Breaking sad news: Eng Paulo Ssebbowa, formerly PS/Engineer-in-Chief of Ministry of Works, passed away after a long illness at around 8pm on 24th March 2019 at Nakasero Hospital. More info about this gallant engineer may be shared by those who worked with him or were nurtured by him like Engineers Samson Bagonza, Ben Kimeze, Sebanakitta, Robert Kibuuka, etc. The likes of Patrick Batumbya, Dr Katahoire, etc, may also well know him. 8M Construction Digest reported about him in lengthy articles. You may send in eulogies to be passed on to the bereaved family.

The passing of a great personality in his advanced age is to me a blessing. We mourn him but we let him go to his deserved resting place with the Almighty. I recall that his senior, Eng Alfred Luba, formerly Kampala City Engineer and Surveyor for donkey years, passed away in similar advanced age. Eng Paul Ssebbowa, rest in eternal peace.
Leisure & Jokes

THE EGG IN A PAKWACH HOTEL!
A prominent well-to-do Ugandan with a friend from Australia recently stopped over to sleep in Pakwach. At breakfast, Charles the Ugandan picked 2 eggs from the self-help breakfast-table. A lady-waiter politely tells him, “Sir, management here allows only one egg per person.” Charles, feeling insulted and alarmed, says, “No way. If you want, I’ll pay separately for it.” “No sir!” the young lady insists, going in to pick the second egg from Charles’ plate: “Sorry, it is the hotel order!” And here, Charles blows his top: “Look lady, if you can’t let me buy the second egg, I will buy the hotel, destroy it and make sure you lose your job!” At the height of chaos, another lady steps in and begs the first lady to allow Charles have the second egg. Surprised at the good deed, Charles learns that the second lady was on internship, being trained by the first!

WHO IS FOOLING WHO?
A supply contractor promised the boss of a public company that he would give a handsome bribe if a major supply-contract was approved. Believing him, the boss wrote on the file, “Approved”. Even after two days, the bribe money was not given. Boss felt cheated. The boss’s office boy said, “No problem, sir. I will bring the file & you write “Not” before “Approved”. So it became “Not Approved”. Two days later the supplier “became wise” and bribed the boss according to what was agreed earlier. Boss was worried as to what to do next. The office boy again came to the rescue and brought the file back and said, “Write “e” after “Not” and put colon “:” So it ultimately became “Note: Approved”.

MURDER OF ENGLISH
1. Pick up the paper and fall in the dustbin
2. Both of you stand together separately
3. Why are you looking at the monkeys outside when I am inside
4. Will you hang the calendar or else I will hang myself
5. I have two daughters both are girls
6. Give me a blue pen of any color
7. The principal is revolving in the corridor
8. All of us stand in a straight circle
9. Open the window, let the Air force come in

Interesting confusion
1. Can you cry under water?
2. Do fishes ever get thirsty?
3. Why do birds fall off trees when they sleep?
4. Why is it called building when it’s already built?
5. When they say dogs food is new and improved, who tastes it?
6. If money doesn’t grow on trees, why do banks have branches?
7. Why does round pizza come in a square box?
8. Why does glue stick to its bottle?

A woman in labor suddenly shouted, “Shouldn’t! Wouldn’t! Couldn’t! Didn’t! Can’t!”

“Don’t worry,” said the Doc. Those are just contractions.”

Dear Phone,
Maybe if you didn’t light up so many damn times telling me you had a low battery, you wouldn’t have died so quickly!

My boss told me to have a good day.. so I went home.

Conflict resolution training CANCELLED due to disagreement over Venue.

I TOLD MY WIFE SHE WAS DRAWING HER EYEBROWS TOO HIGH. SHE LOOKED SURPRISED.
Precise knowledge of the properties is essential for the consumer to achieve the desired and anticipated value of the tile.

Certain tiles are better suited for some installations than others.

Various surface designs to suit your needs are available.

### Reasons to use Ceramic Tiles

- Natural product and are environmentally friendly
- They are impermeable to water
- Easy to clean (surface prevents anything from sticking, and grease may be eliminated easily)
- Hygienic and anti-allergenic
- Maintenance-free (except normal cleaning) their incombustibility also helps to prevent the spread of fires.

### CHARACTERISTICS

<table>
<thead>
<tr>
<th>CHARACTERISTIC</th>
<th>Dimension and Surface Quality</th>
<th>Deviation in Thickness</th>
<th>Straightness of Sides</th>
<th>Rectangularity</th>
<th>Surface Flatness</th>
<th>Surface Quality</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>Dimension and Surface Quality</td>
<td>±0.5%</td>
<td>±0.6mm</td>
<td>±0.3%</td>
<td>±0.5%</td>
<td>Min 95%</td>
</tr>
<tr>
<td>2</td>
<td>Deviation in Thickness</td>
<td>±0.2%</td>
<td>±0.2mm</td>
<td>±0.2%</td>
<td>±0.3%</td>
<td>Min 96%</td>
</tr>
<tr>
<td>3</td>
<td>Straightness of Sides</td>
<td>±0.2%</td>
<td>±0.2mm</td>
<td>±0.2%</td>
<td>±0.3%</td>
<td>Min 95%</td>
</tr>
<tr>
<td>4</td>
<td>Rectangularity</td>
<td>±0.3%</td>
<td>±0.3mm</td>
<td>±0.3%</td>
<td>±0.3%</td>
<td>Min 95%</td>
</tr>
<tr>
<td>5</td>
<td>Surface Flatness</td>
<td>±0.3%</td>
<td>±0.3mm</td>
<td>±0.3%</td>
<td>±0.3%</td>
<td>Min 95%</td>
</tr>
<tr>
<td>6</td>
<td>Surface Quality</td>
<td>Min 95%</td>
<td>Min 96%</td>
<td>Min 95%</td>
<td>Min 96%</td>
<td>Min 95%</td>
</tr>
</tbody>
</table>

### Physical properties

<table>
<thead>
<tr>
<th>CHARACTERISTIC</th>
<th>Physical properties</th>
</tr>
</thead>
<tbody>
<tr>
<td>1 Water Absorption</td>
<td>&gt; 10%</td>
</tr>
<tr>
<td>2 Bending Strength</td>
<td>&gt; 150 Kg/ cm²</td>
</tr>
<tr>
<td>3 Scratch Hardness (Mohs)</td>
<td>Min 3</td>
</tr>
<tr>
<td>4 Crazing</td>
<td>1 Cycle</td>
</tr>
<tr>
<td></td>
<td>2 Cycle</td>
</tr>
</tbody>
</table>

### Chemical properties

<table>
<thead>
<tr>
<th>CHARACTERISTIC</th>
<th>Chemical properties</th>
</tr>
</thead>
<tbody>
<tr>
<td>1 Staining Resistance</td>
<td>min class 2</td>
</tr>
<tr>
<td>2 Household Chemical</td>
<td>min class b</td>
</tr>
<tr>
<td></td>
<td>Resistance to all Acids and Alkaline &amp; Household Chemicals, except Hydro Flouric acid</td>
</tr>
</tbody>
</table>

### Thermal properties

<table>
<thead>
<tr>
<th>CHARACTERISTIC</th>
<th>Thermal properties</th>
</tr>
</thead>
<tbody>
<tr>
<td>1 Thermal Shock</td>
<td>Resistant to 10 Cycles</td>
</tr>
<tr>
<td>2 Thermal Expansion</td>
<td>Max-9e-06</td>
</tr>
</tbody>
</table>
**TIMBER FORMWORK IN CONSTRUCTION**

By Angella Naluwenda, a quantity surveyor, Email: aluwenda@gmail.com

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**Formwork** is a mould or open-box-like container into which fresh concrete is poured and compacted. When the concrete is set, the formwork is removed and a solid mass is produced in the shape of the inner face of the formwork. The top of the formwork is normally left open. False-work is the necessary support system that holds the formwork in the correct position. Formwork materials can be classified as: timber, metals, plastics.

The timber formwork is one of the mostly used in the construction industry, fabricated on site using timber. Timber shuttering is the most flexible type as it can be used for any shape and size. Timber formwork takes the form of a structure of boards surrounding an open cavity, and offers several advantages over other formwork types as shown below.

**Advantages of using timber formwork**

- It is easy to construct for any shape, size and height.
- It is economical for small projects.
- It can easily be made into any shape or size.
- It can be constructed using locally available timber.
- It is lightweight when compared to metal shuttering.
- It is easy to disassemble.

**Disadvantages of using timber forms**

- Cannot be used for long.
- Timber forms have limited usage. So, they cannot be useful for more times.
- Wet concrete will shrink round timber which has high moisture content (more than 20% moisture content) and cup. This leads to open joints and leakage of grout.
- Dry timber may absorb water from wet concrete which results in the reduction of strength in the concrete structure.

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**Types of formwork based on structural member**

- **Wall formwork**: Wall formwork used for concreting of shear or RCC walls in dams, wing walls, basement RCC walls, etc. Wall shuttering made of vertically arranged upright timbers (bearers) to which plywood sheeting boards are nailed at the inner side. The upright timbers are diagonally braced with the help of boards at both sides.
- **Beam formwork**: Beam is the most important member in an RCC-framed structure. Beam formwork has prefabricated formwork includes sheeting bottom and side sheeting panels. The individual parts of formwork are manufactured based on the beam size. For prefabrication of the sheeting parts, a table for fabrication must be manufactured on site.
- **Slab formwork**: Floors require a large area of formwork to be provided usually from beam to beam. Timber floor formwork consists of timber boards or plywood sheets supported on a framework and resting on a series of timber joists. Again timber props can be used for vertical supports. Adjustable props are needed for levelling purposes.
- **Column formwork**: Formwork arrangement for columns may differ on the basis of column outline like rectangular, circular, hexagonal or any other shape. The sheeting of column shuttering is constructed according to the column dimensions. The panels are placed in a foot rim, anchored in soil with the help of bolts.

**A good formwork should satisfy the following requirements**

- It should be strong enough to withstand all types of dead and live loads.
- It should be rigidly constructed and efficiently propped and braced both horizontally and vertically so as to retain its shape without undue deformation.
- The joints in the formwork should be tight against leakage of cement grout.
- Construction of formwork should permit removal of various parts in desired sequences without damage to the concrete.
- The material of the formwork should be cheap, easily available, and suitable for reuse.
- The formwork should be set accurately to the desired line and levels should have plane surface.
- It should be as light as possible.
- The material of the formwork should not warp or get distorted when exposed to the elements.
- It should rest on firm base.

**Economy in formwork**

The following points are to be kept in view to effect economy in the cost of formwork for concrete structures:

- Design the formwork to provide adequate but not excessive strength and rigidity.
- Fabricate the forms into modular sizes to provide more reuses without refabricating when practical.
- Prepare working drawings prior to fabricating the forms.
- Prefabricate form sections on the ground rather than on the scaffolding.
- Timber used for shuttering for exposed concrete work should have a smooth and even surface on all faces which come in contact with concrete.

**Order and method of removing formwork**

The sequence of orders and methods of removal of formwork are as follows:

- The shuttering forming the vertical faces of walls, beams and column sides should be removed first as they bear no load but only retain the concrete.
- Shuttering forming soffit of slabs should be removed next.
- Shuttering forming soffit of beams, girders or other heavily loaded shuttering should be removed in the end.
- Rapid-hardening cement, warm weather and light-loading conditions allow early removal of formwork.

**Table: Period of Removal of Formwork**

<table>
<thead>
<tr>
<th>No.</th>
<th>Description of structural member</th>
<th>Time period</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>Walls, columns and vertical sides of beams</td>
<td>1 to 2 days</td>
</tr>
<tr>
<td>2</td>
<td>Slabs (props left under)</td>
<td>3 days</td>
</tr>
<tr>
<td>3</td>
<td>Beam soffits (props left under)</td>
<td>7 days</td>
</tr>
<tr>
<td>4</td>
<td>Removal of props to slabs</td>
<td>11 days</td>
</tr>
<tr>
<td>5</td>
<td>Removal of props to beams and arches</td>
<td>15 days</td>
</tr>
</tbody>
</table>

A safe practice for formwork during design of formwork and construction at site is important for safety of workmen. Improper erection of formwork can cause damage to structural element as well as pose a threat to the safety of workmen. A formwork expert is highly recommended.

**AVERAGE COST OF TIMBER FOR FORMWORK IN KAMPALA, MARCH, 2019**

Prices vary from one seller to another and most items will be cheaper if bought in bulk or bought directly from the specific timber market.

<table>
<thead>
<tr>
<th>Item</th>
<th>Description</th>
<th>Unit</th>
<th>Quantity</th>
<th>Average Price (UGX)</th>
</tr>
</thead>
<tbody>
<tr>
<td>A</td>
<td>Kirundi 10x1x10ft</td>
<td>pcs</td>
<td>1</td>
<td>7,000</td>
</tr>
<tr>
<td>B</td>
<td>Eucalyptus poles (big size)</td>
<td>pcs</td>
<td>1</td>
<td>4,000</td>
</tr>
<tr>
<td>C</td>
<td>Eucalyptus poles (small size)</td>
<td>pcs</td>
<td>1</td>
<td>3,500</td>
</tr>
<tr>
<td>D</td>
<td>4x2x10ft</td>
<td>pcs</td>
<td>1</td>
<td>4,000</td>
</tr>
</tbody>
</table>
Daywork is a means by which a contractor is paid for specifically instructed work on the basis of the cost of labour, materials and plant plus a mark-up for overheads and profit. It is generally used when work cannot be priced in the normal way. Examples of when daywork may be applied are when unforeseen obstructions are encountered during groundworks or when work is instructed for which there are no comparative rates in a bill of quantities.

### DAYWORKS IN CONSTRUCTION, MARCH 2019

**Daywork is a means by which a contractor is paid for specifically instructed work on the basis of the cost of labour, materials and plant plus a mark-up for overheads and profit. It is generally used when work cannot be priced in the normal way. Examples of when daywork may be applied are when unforeseen obstructions are encountered during groundworks or when work is instructed for which there are no comparative rates in a bill of quantities.**

<table>
<thead>
<tr>
<th>ITEM</th>
<th>DESCRIPTION</th>
<th>UNIT</th>
<th>QTY</th>
<th>AVERAGE RATE (USHS)</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Daywork</strong></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td><strong>Labour</strong></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Net amount of wages per day (8 hours)</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>A</td>
<td>Working ganger</td>
<td>day</td>
<td>1</td>
<td>40,000</td>
</tr>
<tr>
<td>B</td>
<td>Semi-skilled</td>
<td>day</td>
<td>1</td>
<td>30,000</td>
</tr>
<tr>
<td>C</td>
<td>Unskilled</td>
<td>day</td>
<td>1</td>
<td>15,000</td>
</tr>
<tr>
<td>D</td>
<td>Artisan</td>
<td>day</td>
<td>1</td>
<td>40,000</td>
</tr>
<tr>
<td>E</td>
<td>Driver for light vehicle</td>
<td>day</td>
<td>1</td>
<td>30,000</td>
</tr>
<tr>
<td>F</td>
<td>Driver for heavy vehicle</td>
<td>day</td>
<td>1</td>
<td>50,000</td>
</tr>
<tr>
<td>G</td>
<td>Operator for heavy equipment</td>
<td>day</td>
<td>1</td>
<td>50,000</td>
</tr>
<tr>
<td><strong>Materials</strong></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>A</td>
<td>Ordinary Portland cement in 50 kg bags</td>
<td>ton</td>
<td>1.0</td>
<td>700,000</td>
</tr>
<tr>
<td>B</td>
<td>Coarse aggregate for concrete</td>
<td>m³</td>
<td>1.0</td>
<td>165,000</td>
</tr>
<tr>
<td>C</td>
<td>Fine aggregate for concrete</td>
<td>m³</td>
<td>1.0</td>
<td>70,000</td>
</tr>
<tr>
<td>D</td>
<td>Water for concrete</td>
<td>lit</td>
<td>1.0</td>
<td>100</td>
</tr>
<tr>
<td>E</td>
<td>Sand for building</td>
<td>m³</td>
<td>1.0</td>
<td>70,000</td>
</tr>
<tr>
<td>F</td>
<td>Sand for plaster</td>
<td>m³</td>
<td>1.0</td>
<td>70,000</td>
</tr>
<tr>
<td>G</td>
<td>Bricks for building</td>
<td>no.</td>
<td>1.0</td>
<td>350</td>
</tr>
<tr>
<td>H</td>
<td>Concrete blocks for building, 225mm x 150mm thick</td>
<td>m²</td>
<td>1.0</td>
<td>80,000</td>
</tr>
<tr>
<td>I</td>
<td>Concrete blocks for building, 150 mm thick</td>
<td>m²</td>
<td>1.0</td>
<td>65,000</td>
</tr>
<tr>
<td>J</td>
<td>Hydrated lime for building 150 mm thick</td>
<td>kg</td>
<td>1.0</td>
<td>2,000</td>
</tr>
<tr>
<td>K</td>
<td>Timber formwork</td>
<td>m²</td>
<td>1.0</td>
<td>18,000</td>
</tr>
<tr>
<td>L</td>
<td>High yield steel reinforcement: 8-10 mm dia</td>
<td>kg</td>
<td>1.0</td>
<td>4,500</td>
</tr>
<tr>
<td>M</td>
<td>High yield steel reinforcement: 12-16 mm dia</td>
<td>kg</td>
<td>1.0</td>
<td>4,500</td>
</tr>
<tr>
<td>N</td>
<td>High yield steel reinforcement: 20-25 mm dia</td>
<td>kg</td>
<td>1.0</td>
<td>4,500</td>
</tr>
<tr>
<td>O</td>
<td>Steel reinforcement fabric S reference: A252</td>
<td>m²</td>
<td>1.0</td>
<td>18,000</td>
</tr>
<tr>
<td>P</td>
<td>Hardcore filling</td>
<td>m³</td>
<td>1.0</td>
<td>80,000</td>
</tr>
<tr>
<td>Q</td>
<td>Topsoil delivered to site</td>
<td>m³</td>
<td>1.0</td>
<td>40,000</td>
</tr>
<tr>
<td><strong>Plant</strong></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Net amount of wages per day (8 hours)</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>A</td>
<td>3-ton tipper lorry</td>
<td>hr</td>
<td>1</td>
<td>100,000</td>
</tr>
<tr>
<td>B</td>
<td>5-ton tipper lorry</td>
<td>hr</td>
<td>1</td>
<td>150,000</td>
</tr>
<tr>
<td>C</td>
<td>9-ton tipper lorry</td>
<td>hr</td>
<td>1</td>
<td>180,000</td>
</tr>
<tr>
<td>D</td>
<td>Motor grader Caterpillar 14 with scarifier</td>
<td>hr</td>
<td>1</td>
<td>100,000</td>
</tr>
<tr>
<td>E</td>
<td>D4 tractor or equivalent</td>
<td>hr</td>
<td>1</td>
<td>150,000</td>
</tr>
<tr>
<td>F</td>
<td>D7 tractor or equivalent</td>
<td>hr</td>
<td>1</td>
<td>150,000</td>
</tr>
<tr>
<td>G</td>
<td>10 - 12 Ton pneumatic self-propelled roller</td>
<td>hr</td>
<td>1</td>
<td>80,000</td>
</tr>
<tr>
<td>H</td>
<td>Small hand-propelled vibrating roller</td>
<td>hr</td>
<td>1</td>
<td>50,000</td>
</tr>
<tr>
<td>I</td>
<td>2 1/4 cu. Yd. Tractor excavator with loader attachment</td>
<td>hr</td>
<td>1</td>
<td>100,000</td>
</tr>
<tr>
<td>J</td>
<td>Mechanical excavator with 22 cu. Ft bucket capacity or equivalent</td>
<td>hr</td>
<td>1</td>
<td>100,000</td>
</tr>
<tr>
<td>K</td>
<td>Compressor (250 c.v.m) complete with all tools, hoses, steel etc.</td>
<td>hr</td>
<td>1</td>
<td>120,000</td>
</tr>
<tr>
<td>L</td>
<td>Concrete vibrator (Pocker type)</td>
<td>hr</td>
<td>1</td>
<td>50,000</td>
</tr>
<tr>
<td>M</td>
<td>Concrete mixer 14/10</td>
<td>hr</td>
<td>1</td>
<td>70,000</td>
</tr>
<tr>
<td>N</td>
<td>Concrete mixer 11/7</td>
<td>hr</td>
<td>1</td>
<td>70,000</td>
</tr>
</tbody>
</table>

**QUOTE**

“It is not the beauty of a building you should look at: It’s the construction of the foundation that will stand the test of Time”

David Allan Coe
**AVERAGE MARKET CONSTRUCTION PRICES AND COST INDICES FOR SELECTED TILES: MARCH, 2019**

Construction prices and cost indices are published quarterly, or at agreed intervals, which are used for estimating, cost checking and fee negotiations on public sector construction projects. The collection of data and calculation of indices is let to the Uganda Bureau of Statistics (UBOS) and there is also a requirement to develop and improve the indices methodology. These are vital in the construction industry and are used by the relevant parties in the industry.

<table>
<thead>
<tr>
<th>Item</th>
<th>Description</th>
<th>Unit</th>
<th>Quantity</th>
<th>Average Rate (USD)</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>1US Dollar = 3701 Uganda shillings</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Sawn formwork to:</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>A</td>
<td>Vertical sides of blinding concrete</td>
<td>SM</td>
<td>1</td>
<td>4</td>
</tr>
<tr>
<td>B</td>
<td>Vertical sides of columns</td>
<td>SM</td>
<td>1</td>
<td>4</td>
</tr>
<tr>
<td>C</td>
<td>Vertical sides of strip concrete</td>
<td>SM</td>
<td>1</td>
<td>4</td>
</tr>
<tr>
<td>D</td>
<td>Vertical sides of ground beams and tie beams</td>
<td>SM</td>
<td>1</td>
<td>4</td>
</tr>
<tr>
<td>E</td>
<td>Vertical sides of retaining walls</td>
<td>SM</td>
<td>1</td>
<td>4</td>
</tr>
<tr>
<td>F</td>
<td>Horizontal soffits of suspended slabs, cantilevers, canopies, lofts.</td>
<td>SM</td>
<td>1</td>
<td>4</td>
</tr>
<tr>
<td>G</td>
<td>Edges of grade slab up to 150mm</td>
<td>LM</td>
<td>1</td>
<td>0.6</td>
</tr>
<tr>
<td>H</td>
<td>Vertical sides and soffits of beams, lintels</td>
<td>SM</td>
<td>1</td>
<td>4</td>
</tr>
<tr>
<td>I</td>
<td>Vertical sides of columns</td>
<td>SM</td>
<td>1</td>
<td>4</td>
</tr>
<tr>
<td>J</td>
<td>Edges of slabs over 150 but not exceeding 225mm girth</td>
<td>LM</td>
<td>1</td>
<td>0.9</td>
</tr>
<tr>
<td>K</td>
<td>Soffits of suspended landings and midlandings</td>
<td>SM</td>
<td>1</td>
<td>4</td>
</tr>
<tr>
<td>L</td>
<td>Sloping soffits of staircase waist slabs</td>
<td>SM</td>
<td>1</td>
<td>4</td>
</tr>
<tr>
<td>M</td>
<td>Sides of steps and upstands up to 150mm high</td>
<td>LM</td>
<td>1</td>
<td>0.6</td>
</tr>
</tbody>
</table>

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Cabinet sat on 25th March, 2019 at the Office of the President. A decision taken on science, technology and innovations was as follows:

- Approved the National Research and Innovation Programme framework and its objectives include:
  - i. To promote science, research and Innovation in Uganda;
  - ii. To promote the implementation of innovative projects with the aim of facilitating the realization of new or improved products, processes or services designed to raise the economic efficiency;
  - iii. To Improve the innovation potential and technological level of enterprises;
  - iv. To increase private investment and enhance the dynamics of innovation processes in Uganda.

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(With effect from 1st November, 2018)

<table>
<thead>
<tr>
<th>Type</th>
<th>Dimensions (mm)</th>
<th>Cost (Ugx)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Full page</td>
<td>255 X 170</td>
<td>3,000,000</td>
</tr>
<tr>
<td>1/2 page advert</td>
<td>170 X 125</td>
<td>1,600,000</td>
</tr>
<tr>
<td>1/4 page advert</td>
<td>125 X 84</td>
<td>900,000</td>
</tr>
<tr>
<td>1/8 page advert</td>
<td>84 X 61</td>
<td>480,000</td>
</tr>
<tr>
<td>Full strip column</td>
<td>170 X 42</td>
<td>550,000</td>
</tr>
<tr>
<td>Logo size (on front page)</td>
<td>40 X 30</td>
<td>550,000</td>
</tr>
<tr>
<td>Company logo on 8M website</td>
<td>Per issue</td>
<td>770,000</td>
</tr>
<tr>
<td>Classified listing</td>
<td>Max. 30 words</td>
<td>50,000</td>
</tr>
<tr>
<td>Full page advertorial or sponsored articles</td>
<td>255 X 170</td>
<td>2,500,000</td>
</tr>
<tr>
<td>Inside front cover or inside back cover advert</td>
<td>255 X 170</td>
<td>3,700,000</td>
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<tr>
<td>Back page cover advert</td>
<td>255 X 170</td>
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<tr>
<td>Centre spread advert/article</td>
<td>380 X 170</td>
<td>5,600,000</td>
</tr>
<tr>
<td>Advert designing</td>
<td></td>
<td>200,000</td>
</tr>
</tbody>
</table>

---

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YMR operating in the region since 1985
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- Worked with clients across the public and private sectors
- Construction consultancy services from project and cost planning to quantity surveying and building economics.
- Project experience in Kenya, Uganda, Tanzania, Rwanda, Burundi, Sudan, Ethiopia, Mauritius, Somalia, DRC, Congo, Djibouti and Seychelles.

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- Working in Kenya since 2014.
- International experience is coupled with local knowledge, delivering projects for global clients.
- Delivering complex and challenging projects for multinational clients
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- Microsoft offices in Nairobi & Lagos
- Project and programme management of the portfolio rationalisation for Nokia Siemens Networks across Sub-Saharan Africa
- BG Mtwara Port Refurbishment Phase II in Tanzania

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**Benefits for our clients:**
- Certainty of delivery, no matter the complexity or amount of change
- The best people, every step of the way
- World-class systems and processes
- Knowledge gained from diverse sectors and projects

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