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Founded 1972

Engineering in KENYA

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Building Services Engineering (BSE)

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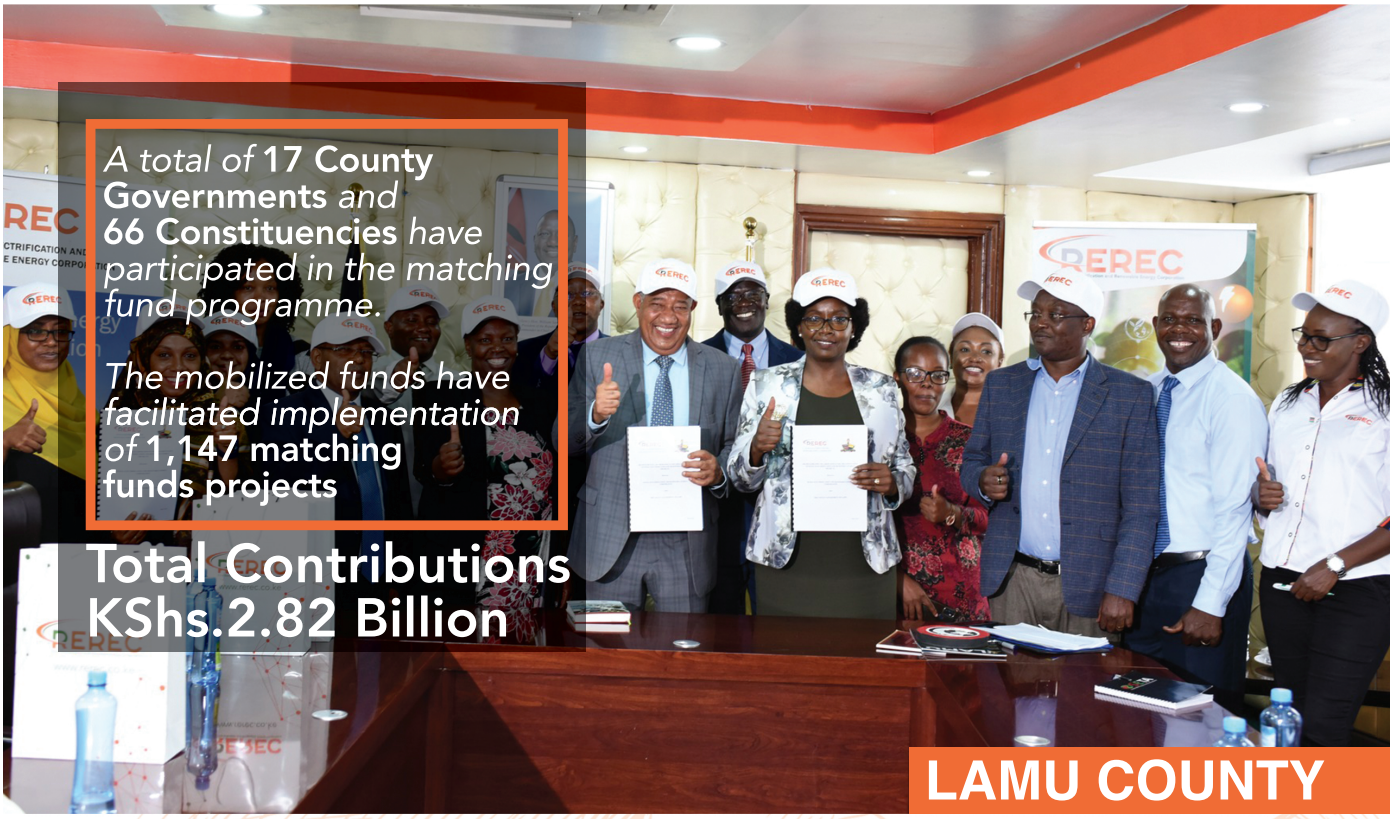
REREC
Rural Electrification and Renewable Energy Corporation

MATCHING FUND PROGRAM

A shilling for a shilling




UASIN GISHU COUNTY


MAKUENI COUNTY


TANA RIVER COUNTY

ABOUT THE MATCHING FUND PROGRAM

The Matching Fund Programme was initiated in 2009/10 financial year with an aim of mobilizing additional resources to supplement the exchequer financing in the implementation of rural electrification programme.

REREC partners with **County Governments** and **National Government Constituency Development Fund (NG-CDF)** under a collaboration framework dubbed "A shilling for a shilling" to implement priority electrification projects.

Contribution from REREC
KShs 1.24 Billion

County Governments and NGCDF
KShs 1.58 Billion

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Engineering in KENYA

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Call for Papers

Engineering in Kenya Magazine - Issue 018

The Institution of Engineers of Kenya (IEK) publishes Engineering in Kenya magazine, whose target audience includes engineering professionals, practitioners, policymakers, researchers, educators and other stakeholders in engineering and related fields. The publication is distributed to its target readers free of charge through hard and soft copies.

IEK invites you to contribute articles for our next and future editions. Articles should reach the Editor not later than 20th July, 2024 for our next issue, whose theme shall be "Engineering Kenya" and related sub-themes, across all engineering disciplines. An article can range from engineering projects to processes, machinery, management, innovation, news and academic research.

The articles must be well researched and written to appeal to our high-end readers in Kenya and beyond. The IEK Editorial Board reserves the right to edit and publish all articles submitted, in line with standing editorial policy. All articles should be in Word document format, 500-700 words, font type Times New Roman and font size 12.

Send your article today, and get a chance to feature in the magazine!

Send your article to:
editor@iekenya.org

Message from the Editor

Eng. Prof. Lawrence Gumbe

Building Services Engineering (BSE) is an engineering discipline concerned with the provision of safe and comfortable building spaces whilst minimising the adverse environmental impacts of buildings. Building Services Engineers are responsible for ensuring that the electrical, mechanical, telecommunications and others systems within buildings work effectively and efficiently.

Building services systems include: Gas; electric and other energy sources; heating and air conditioning; water sources; sewage; drainage and plumbing; lighting; escalators and elevators; ventilation; air filtration; refrigeration; internet and telephone lines; security systems; fire and carbon monoxide detection; and acoustics.

Titles for similar work to **BSE** include **Mechanical, Electrical and Plumbing Engineering (MEP), Technical Building Services, Building Engineering** and **Facilities and Services Planning Engineering.** The term BSE is widely used in Commonwealth countries (including the United Kingdom, Ireland, Canada and Australia), but in the United States of America, Saudi Arabia and Pakistan, the MEP engineers are known as Services Planners.

In some countries, a building services engineer is a senior MEP engineer with experience in the installation of equipment in buildings construction, building maintenance, management, integration of electrical, mechanical, fire, hydraulic, security and communications building services, who manages and delivers the integrated detailed design of multiple disciplines so as to ensure that the building is delivered in a **least cost technically acceptable** manner, with emphasis on both the **construction costs** and the **operational costs**.

The two most notable professional bodies for BSE are:

- The **American Society of Heating, Refrigerating and Air-Conditioning Engineers (ASHRAE)** was founded in 1894.
- The **British Chartered Institution of Building Services Engineers (CIBSE)** was founded in 1976 and received a Royal Charter in the United Kingdom

Building services engineers typically possess an academic degree in civil engineering, architectural engineering, building services engineering, mechanical engineering or electrical engineering. In the United Kingdom, the length of study for such a degree is usually 3– 4 years for a Bachelor of Engineering (B.Eng) or Bachelor of Science (BSc) and 4– 5 years for a Master of Engineering (M.Eng).

In the United Kingdom, the **Chartered Institution of Building Services Engineers (CIBSE)** accredits university degrees in Building Services Engineering. In the United States, the **Accreditation Board of Engineering and Technology, ABET,** accredits degrees.

The global construction market was valued by PR Newswire at US$ 14.4 Tr, accounting for 14% of global GDP. In 2022 the construction industry in Kenya contributed about KES 954 Bn to the GDP. BSE accounts for about 10% of the above values.

Building services engineers ensure that buildings are designed, constructed and operated so as to maximize work and occupation efficiency, comfort, energy and water efficiency, environmental protection and safety.

Issue 4 of this magazine was themed **Engineering Education, Research and Practice.** We noted in this issue that a few years ago country comparison of the number of persons served by an engineer were, in part, as follows: Kenya, 6,300; South Africa, 3,166; Korea, 285; UK; 311; Brazil, 227; and China, 130. The UNESCO recommended figure is 2,000. We see from the figures that the level of industrialisation, economic development and affluence have a direct relationship to the quantity of engineers in a country. Hence Kenya must strive to expeditiously increase its quantity and quality engineers. This is especially true of building service engineers. We need to increase the numbers of engineers, technologists, technicians and artisans.

The new IEK council under the leadership of President Shamma Kiteme has hit the road with urgency and focus. As per the resolution of the last AGM the council organised an SGM which took place on Thursday 16 May 2024 at the Daystar University and also virtually . The meeting was very well attended with good participation. In order to revamp IEK governance and management the meeting focused on constitutional review and elections audit. The meeting resolved that: The council would constitute a **Constitution Review Committee** which shall carry out a participatory process and deliver a new constitution and elections bylaws by November 2024; and the council to procure a competent systems auditor to audit the elections of 2024 and deliver a report by end of July 2024. The recommendations of the elections audit are to feed directly into the constitutional and election bylaws review process.

This issue of **Engineering in Kenya** is dedicated to Building Services Engineering. As a proud member of ASHRAE and one who has used CIBSE publications, I hope that you will find this issue informative, educative and entertaining. We welcome your feedback.

2024 AGM PICTORIAL

The Chair of the Scrutineers, Eng. Dr. Jedidah Maina, during IEK AGM, announcing the results of the 2024/2026 IEK Election which was concluded on 21st March 2024

The New IEK president Eng. Shammah Kiteme, CE, PMP, with the new 2024/2026 IEK Council members during AGM held on 5th April 2024 at Day Star University.

The Inauguration of the new IEK President, Eng. Shammah Kiteme, CE, PMP

The new IEK President, Eng. Shammah Kiteme, CE, PMP delivers his maiden speech to IEK members during 2024 AGM

The IEK outgoing treasurer, Eng. Justus Otwani, presenting his report. Despite 2023 being a challenging year, the institution maintained the upward trajectory in revenue growth up by 21% compared to the year 2022.

The auditor CPA Jeremiah presenting the Financial Statements for the year ended 31st December 2023.

The council Led by Eng. Erick Ohaga 2022-2024 acquired an Institution's Van, which will come in handy in operations of the Secretariat and during IEK functions especially the Annual Convention.

IEK's President, Eng. Erick Ohaga delivering his report highlighting major achievements of the council 2022-2024 to the members present during the 2024 AGM .

Message from the President

Eng. Shammah Kiteme, CE, FIEK

I am pleased to invite you our reader to this 17th Issue of Engineering in Kenya Magazine. This comes at a time when the new IEK council 2024-2026 is settling after being elected into office in March this year. This is an important milestone to our beloved institution as we have now consistently undergone transition every two years.

Our commitment to members is that we will deliver value in offering our services to you. While council runs in perpetuity, the confidence we drew from members is borne of the belief that we have an opportunity to grow from strength to strength. We have continued to enjoy goodwill from our partners globally and locally and so IEK will continue to be a reliable player within the World Federation of Engineering Organisations, Federation of African Engineering Organisations and other players internationally to keep our obligations and pursue interests of our members on that level.

We have already set up the committees of the council and taken on assignments that will ensure that our reach locally and globally is felt.

IEK will position engineers strategically to lead in the conversation about infrastructure. We will take an active role in what is happening in our society and offer reasoned interventions that will educate the public but also that will help define policies that affect us. In this regard, the council has inaugurated the engineering standards and Bottom-Up Economic Transformation Agenda task forces. These task forces have a mandate to help define sound, reasoned positions that IEK can take and so engage in public discourse from an informed position.

Our engagement with the policy makers in both levels of government, National and Counties, will be from this point of view. That positions we take are well researched and geared towards ensuring that our interventions are to the common good of the society which looks upon us to provide leadership in the area of infrastructure development.

Towards this end, we will lead an aggressive conversation on industrialization for economic transformation and employment creation. In this conversation we will align the needs of the members of our fraternity towards spurring an entrepreneurial approach to resolving them. We plan to engage on a conversation that leads to the exploitation of the untapped potential that this country has in terms of manufacturing. It is informed by the understanding that Engineers thrive when an economy is thriving. Engineers have to lead in the conversation of ensuring that our potential in manufacturing is exploited. The aim is that once the country is well positioned to be a leader in production of goods from factories and value addition to agricultural produce, this translates to job creation and spurs economic development.

A robust productive sector will also support a growing service industry. This will be anchored on the need to ensure that goods produced find the market where they are needed. Other supporting services in logistics, transport and communication, banking and insurance among others come in to play to facilitate a healthy economy where production meets demand.

Towards this end, an industrial tour has been organized in September to visit Italy and Germany. This is aimed at benchmarking for members to experience manufacturing from the first world and explore partnerships that would be helpful to our members as we dive into this conversation on industrialization.

Kenya is well positioned in East Africa and globally with the East Africa Community and Africa Continental Free Trade Area (AfCTA) providing a big platform for the country to export to our immediate neighbors and Africa at large.

It is within this context that this issue of EiK focusing on Building Services Engineering acknowledges that our members have a great platform to ply their trade in offering professional services not only locally but also regionally and globally. Indeed, Trade in Services is a critical component of AfCTA and our members are well positioned to practice both locally and regionally. I note that we have Mutual Recognition Agreements (MRA) with Tanzania, Uganda and Rwanda. Efforts are ongoing to ensure that more countries enter into MRAs with us to make it easier for equivalent registration status to be recognized. This will make practicing for our members in the region less complicated.

IEK will take a leading role in ensuring that standards of practice favour our members and through advocacy ensue that the practicing environment enables us to grow professionally to exploit our potential. IEK will create an enabling environment from our members to do joint ventures to win big contracts. We will also ensure that capacity building of our members prepares them to adequately take on regional and global markets to their advantage.

It is understood that there is enough for everyone's need but not for everyone's greed. It is for this reason that we encourage members to ensure that as we offer our engineering services both in the building services and in other sectors, we work within the framework of Engineers Scale of Fees which are the gazzeted guidelines on how to seek compensation for our professional services. Because we operate in a regulated practice, this will go a long way in ensuring that we stop bad practices like undercutting each other in charging professional fees.

Lastly, IEK will strive to ensure that the welfare of our members is a key focus. All disciplines will be effectively represented in ensuring that a full implementation of our strategic plan 2024-2026 will herald effective representation of all the disciplines. In this spirit, and pursuant to the strategic plan goals, two discipline chapters will be launched in the next two months. These will be aimed at ensuring that we continue to grow our membership as we provide a platform for professional development and networking. We also know that our strength is in numbers.

Message from the Honorary Secretary

Eng. Jacton. A. Mwembe, PE, MIEK

I am honoured and delighted to address you for the first time as your newly elected Honorary Secretary of the Institution of Engineers of Kenya (IEK). As we embark on this exciting journey together, I am thrilled to contribute to our vibrant community and to serve on the Editorial Board of our esteemed publication.

Our latest issue, themed "Building Services Engineering," which encompasses the electrical, mechanical and associated engineering disciplines delves into the core of what sustains and enhances our built environment. This theme is not just timely but essential as we continue to push the boundaries of innovation, sustainability, and excellence in our field. Building services engineering is the backbone of modern infrastructure, ensuring our buildings are safe, comfortable, and efficient.

One of our focal points in this 17th Edition of the Engineering in Kenya magazine is the enhancement of quality and sustainability in Kenyan infrastructural development. Innovation remains at the heart of our profession. Hence, the discussions in the subsequent pages of this publication underscore the importance of integrating cutting-edge technology to enhance efficiency and safety in our projects.

Urbanization presents both opportunities and challenges. In this issue, we tackle pressing topics such as the challenges and solutions related to water supply, treatment, and distribution in Nairobi.

We are also proud to feature the voices of our future engineers. Contributions from the students in various engineering institutions showcase their innovative ideas and perspectives, reminding us of the bright future that lies ahead for engineering in Kenya.

Our commitment to community and collaboration is evident from the 5th Engineering partnerships Convention (EPC) held in DeKUT by EBK. IEK trough partnership with the Kenya Red Cross was able to support flood victims. These initiatives highlight the impact we can make when we work together towards common goals.

As we look to the future, we remain dedicated to fostering a culture of excellence and innovation within IEK. Our goal is to continually provide a platform for knowledge exchange, professional development, and the promotion of engineering best practices.

I encourage all members to actively engage with this issue on Building Services Engineering. Together, we can achieve remarkable milestones and drive the progress of our nation's infrastructure.

Thank you for your unwavering support and commitment to the IEK. Let us continue to build, innovate, and inspire.

The IEK Council 2024-2026

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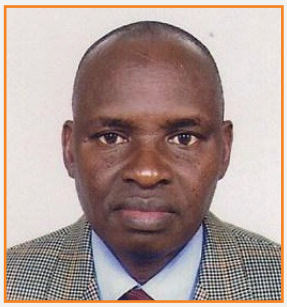

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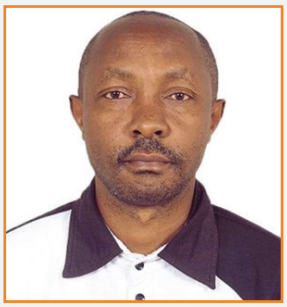

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ENGINEERING PARTNERSHIPS CONVENTION | 2024

The 5th Engineering Partnerships Convention (EPC 2024)

7th - 10th May 2024 DeKUT, Nyeri County

Keynote Address

I am happy to join you this morning for the 5th Engineering Partnerships Convention. It is always my pleasure to address, interact and engage with professionals. The theme of this Convention, "Engineering @60: Reflections, Response, Resetting", gives you, the participants of this meeting, a moment to look back at the milestones of the profession since independence. It is also a time to identify gaps and opportunities to re-engineer the engineering strategy of contributing to the socio-economic transformation of Kenya and the Region. Africa is not the Continent of the Future; Africa is the Continent of Today.

Esteemed Engineers, Ladies and Gentlemen; We hold this Convention when our country is deep in a Climate Crisis. All sectors of our economy have been put to test. The structural integrity of our infrastructure· buildings, roads, bridges, among others· has been violated by the enhanced rains. The collapse of infrastructure, similar to what happened during El-Nino last year, has brought the Engineering Profession into sharp focus. Climate Change is real. Climate Change is challenging us not to invent for the future, but to invest and innovate for today and posterity.

Integration of Climate Smart Innovation, therefore, is a priority for this Convention. We must harness the collaboration and partnership in redefining the various Subsectors of Engineering to meet the demands of changing times- offering unquestionable safety and security. From the exhibition here today, there is promising potential that will propel us to the next level of development.

Distinguished Engineers, Ladies and Gentlemen; While we have robust laws and policies stipulating what must be covered in training some universities have continued offering courses, not approved by the Engineers Board of Kenya. It is a waste of resources as the graduates will not be certified to practice. We congratulate EBK for the planned bridging for graduates. But a sustainable solution on accreditation of courses lies in a joint re-evaluation and detailed discussion with learning institutions to align training to industry· focused skills. This needs to be done in collaboration with the Ministry of Education and the Commission for University Education, while involving the relevant professional bodies and stakeholders. Universities must also be ready to match their capacity demands to meet the course-specific requirements. Quality of our Engineering training must be beyond reproach.

Esteemed Engineers, Ladies and Gentlemen; We are concerned that quacks have raided the Engineering Profession. They masquerade as professionals. In this regard, I would like to throw a challenge to the Engineering regulator. They need to work with other agencies in

exposing such people for prosecution. They are not only intruders to the trade, but also criminals putting lives at risk. This, Esteemed Engineers, should also apply to colleagues delivering substandard work, that puts the safety of machines, buildings, other infrastructure and installations into question.

Distinguished Engineers, Ladies and Gentlemen; One of the reasons for low quality work is leasing of service by qualified Engineers, who do not show up to inspect and supervise projects. Endemic corruption and wanting integrity are others. This Convention needs to identify gaps in regulation of training as well as enforcement of laws in practice.

We need to nab the quacks and corrupt officials in the entire network to protect the image of the distinguished profession and the professionals, who are delivering above-board work. In the same breath, engineering professionals and Physical Planners regulatory bodies must strictly adhere and enforce the relevant national and international civil and structural designs and construction standards.

Herein, we are joined by legislators and key policy makers. The legislators are ready to work with you in strengthening the relevant frameworks. We can also borrow and domesticate good practices from other professions on self-regulation and disciplining of those who do not abide by the regulations.

Esteemed Engineers, Ladies and Gentlemen; The Engineering profession and Engineers remain central and strategic to our Nation. That is why we must continually explore ways of developing the profession. One of such ways is for relevant agencies such as the National Construction Authority (NCA) and National Environmental Management Authority (NEMA), to plough back for development of the Engineering profession. Such a kitty may facilitate advanced training and other capacity strengthening initiatives, As we strive to raise standards even higher, it is critical to nurture aspiring and upcoming engineers.

With less than 20% of women in engineering, this is an opportunity to bring in more of them into the profession. As a strong believer in youth mentorship, I congratulate the Engineers here for this initiative. Esteemed Engineers, Ladies and Gentlemen;

The Kenya Kwanza Plan of transforming our Nation, under President William Ruto, heavily relies on Engineering. The Affordable Housing Programme, Manufacturing, Agriculture, the Digital Economy, among others, we have confidence that you have a place to plug in your contribution.

With evolving technology, we are staring at the big leap into Artificial Intelligence, which has registered efficiency and effectiveness in countries that are more advanced. We have no reason to wait and consume innovations of other people with engineering admitting the best of the best into university. We have an equal opportunity to invent and show the world that Kenya is the epicenter of innovation in Africa.

Esteemed Engineers, Ladies and Gentlemen; In this Convention, we have a moment to interact, network and form formidable teams. These teams will propel our mission of integrating invaluable innovation into development. The Ruto Administration looks forward to full support of Engineers for informed decisions in various projects leading us to a transformed Kenya.

On this note, I thank the Dedan Kimathi University of Technology, Agencies and Partners for making this event a reality. I wish you fruitful deliberations as we wait for the outcome of the Convention for action.

It is now my pleasure to declare the 5th Engineering Partnerships Convention Officially Open.

ASANTENI SANA.

H.E. Rigathi Gachagua, EGH

Deputy President of the Republic of Kenya

Remarks by Cabinet Secretary, Ministry of Roads and Transport

60 years of independence and 60 years of celebrating this profession is not a short period of time. And therefore, it's a signature of our independence. It's important to appreciate that as a country, we have been able to grow to the stage where the entire construction industry, every sector that we need engineers, it is led by Kenyan engineers.

I know, like the chair said, and also the president of the World Federation of Engineers spoke, we still have some steps to make when it comes to business, especially when it comes to engaging consulting engineers, when it comes to contractors, that we still have situations where, even though we have very qualified engineers locally, we still have situations where a lot of business still goes to engineers who come from out of the country. We have committed ourselves with the PS Roads, that we will change that trend. And I had a meeting with the team from the consulting engineers, and the chair is sitting here, and we agreed that we will work towards achieving total compliance.

We are ready and willing to also get proposals from the associations who are here, the Federation of Engineers, the consulting engineers, to give us proposals on how we can make sure that there is a higher level of accountability beyond just registering all the practitioners with the Engineers Board of Kenya. Number two, I am extremely impressed with what I saw today with the Semiconductors Technology Limited, and to have such high-level investment in so far as science and technology is concerned in this university is a testimony that we are now moving forward as a country to marry education and practice in so far as industry is concerned. I really hope that this is a model that is being replicated in most of the universities across the country, because universities in the world have become what they are, because the centers of innovation are not the industry out there, it's the industry as established within the university environment.

I was so impressed because the people who took us through the laboratories and the research work that is going on and the innovation that is going on are very, very young people. And I was also extremely impressed that it was not just young people, but I think 70 or 80 percent were young women, and I think that is extremely unique. And I hope that this is something I wish my colleague in charge of education was here, but this is something I will make a mention at the cabinet meeting, to just say that there's something that is cooking in the universities, and this should be the practice.

When I came to office, I insisted that as much as possible, some of the consulting works that is being done by our institutions and within our ministry should also be outsourced to the institutions that work from the university, so that our students get an opportunity to learn and to be able to grow. So, this is extremely important.

We also had a conference last year that involved women contractors and women engineers, and we are going to have a stocktaking meeting this year, and I really hope that the agencies represented here, you made progress concerning the issues we agreed that we want to work towards gender parity in this very sector, because I am very happy to have Eng. Margaret being a CEO and being a lady CEO, but we want to have more CEOs who are going to run these institutions who are women.

The other issue I'd like to mention is that we are working hard to make sure that the regulation of the engineering sector is done well, and I'm happy also that the Commission of University Education is here, and I am glad that the previous pull and push between Engineers Board of Kenya and the Commission of University Education regarding training of engineers in the university has now been sorted. We should not have a situation, we should never have a situation again where a student is trained for five years only to be told that you don't meet the minimum qualification to transit. I know there was a situation where some universities had such challenges, and that should never happen again.

We also appreciate the partnership we have with the East Africa Community partner states, and also the support we are getting with the World Federation of Engineers to make sure that our engineers are recognized globally. As a ministry, we support you 100% to make sure that we all

accede to the Washington Accord to make sure that our engineers are recognized in their practice globally. And therefore, I have told the chair and the CEO that we will facilitate as a ministry everything you need to make sure that this application is successful.

The last part of it is that we are in a very precarious situation as a country. The reality we are facing is that climate change is a real challenge in so far as our existence in the planet Earth is concerned. You've seen the enhanced rains, the floods, and the destruction that ensued as a result of the floods. We have suffered immense destruction of infrastructure, starting with the bridges, the roads, and we are suffering this at a situation where we're also struggling to manage our budget to make sure that we live within our means. We will be sitting down with the road agencies here and the other infrastructure institutions to make sure that we do proper assessment of the situation across the country. And we will call upon all of you as engineers to provide lasting solutions and long-term solutions in so far as having climate resilient infrastructure across the country.

We request you to adhere to the standards that are required, both by your profession, but also the law. Because we need institutions and we need engineers. We would like all of you as engineers here to maintain the highest standard of professional work. That is why the register of all the engineers is very important under the EBK. It's also important to account for every work that is supervised by a particular engineer. So we need to make sure that we are holding professionals into account the same way we hold lawyers and other professionals to account to make sure that, and I'm happy the president of the World Federation of Engineers Organizations spoke about establishment of specific tribunals that are going to try individuals who are not going to abide by this very important provision so that we do not have few people messing up the institution of engineers in the country.

I know that even when it comes to supervision of works, even when we have given contractors works like we did for the airport and for the port and for the roads, it's important to know that it is our engineers who must hold those contractors into account.

I am happy to join this convention.

Thank you all

Hon. Kipchumba Murkomen, EGH
Cabinet Secretary, Ministry of Roads and Transport

Remarks by Governor, Nyeri County

I am delighted to join you this morning as we open the Engineering Partnership Convention (EPC) 2024.

I am honored to address you today at this pivotal moment as we come together to celebrate the Engineering Board of Kenya Convention. It is with great pride that we commend our engineers as the main drivers of infrastructure development, serving as the catalyst for positioning Kenya as an infrastructure and innovation hub, not only regionally but also on the international stage.

In the spirit of innovation, let's plunge into the theme of "Engineering @60: Reflections, Response, Resetting." This theme holds immense significance for the engineering community. It's a time to reflect on the remarkable achievements of the past 60 years, respond to current challenges, and reset our focus for a more sustainable future.

Ladies and Gentlemen

I stand before you today brimming with excitement. We are not only gathered to celebrate the power of engineering at this esteemed Engineers Board of Kenya convention, but we are at a pivotal moment for Nyeri County.

Nyeri has always been a land of remarkable strength and potential. We are the cradle of the Mau Mau freedom fighter, Dedan Kimathi, whose unwavering spirit embodies the innovative drive coursing through our county. This spirit thrives not just in our people, but also in the very fabric of our land.

Nyeri boasts breathtaking natural sites that inspire awe. The Aberdare Ranges, with their lush rainforests and cascading waterfalls, are a haven for nature enthusiasts. Mount Kenya, the majestic peak that graces our national flag, stands tall as a symbol of our county's limitless potential.

Our fertile lands nurture a thriving agricultural scene. Tea plantations, a hallmark of Nyeri, paint the landscape in vibrant green. Coffee farms, renowned for their aromatic beans, contribute to our rich agricultural heritage. And don't forget the Carnation flower farms, whose blooms bring a touch of beauty to the world.

Beyond natural beauty, Nyeri is also home to a robust industrial sector. Our factories hum with activity, producing everything from dairy products to textiles. This blend of natural wonder and industrial prowess underscores Nyeri's unique character.

This combination of a skilled workforce, a strategic location, and a rich tapestry of natural resources and industry positions Nyeri perfectly to become a leader in technological advancement and that's why I am here to open the innovation fair.

As we embrace the Bottom-Up Economic Transformation Agenda (BETA), it's clear that leveraging emerging technologies is the key to unlocking a prosperous future for all. And Nyeri is perfectly positioned to lead the charge.

Let me tell you why.

We are incredibly fortunate to have the highest literacy level of 82.88% in Kenya. This, coupled with our vibrant young population where nearly 80%of Kenyans are less than 35 years old, creates a fertile ground for fostering a skilled and innovative workforce. Additionally, Nyeri is a major transport hub, seamlessly connecting us to regional and global markets – a crucial advantage in today's interconnected world.

Ladies and Gentlemen,

I am thrilled to welcome over 40 exhibitors to this convention. Each of you plays a vital role in showcasing the cutting-edge technologies that will shape our future. A special note to our own Semi-Conductor Limited. Your decision to invest in Nyeri is a testament to our county's potential, and I have no doubt you will be one of the most captivating exhibitors for our attendees.

To our esteemed delegates from the East African Community – Mutual Regional Agreement, your presence underscores the importance of regional and international linkages. Together, let's push the boundaries of innovation and propel ourselves towards the global high-tech scene.

And last but not the least, a heartfelt thank you to Dedan Kimathi University of Technology, our gracious host. We are committed to collaborating with you to develop the necessary infrastructure to nurture a thriving science and technology park within your esteemed institution.

Nyeri County is on the cusp of something extraordinary. With a spirit of innovation, a skilled workforce, and strategic partnerships, we are poised to become a national leader in technological advancement. Let this convention be the spark that ignites our journey. Let us leverage the power of engineering to build a brighter future for Nyeri, for Kenya, and for the entire region.

God bless you and God bless Kenya.

Thank you!

H.E. Mutahi Kahiga, EGH
Governor, Nyeri County

Picture: Courtesy

Speech by Principal Secretary, State Department for Roads

Ladies and Gentlemen, It gives me great pleasure to join you this morning as we launch the Engineering Partnership Convention (EPC) 2024. This year's theme "Engineering @ 60: Reflections, Response, Resetting" is timely as it highlights engineers' critical participation in the Kenya Kwanza Plan and the MTP IV which will be implemented from July.

Ladies and Gentlemen Engineering Partnership Convention 2024 will provide a platform for engineers and the delegates to witness how problems solving innovations and solutions that can enhance our quality of life, development and transformation of our Country's physical infrastructure, technology, and systems. I am honored to address you today on a matter of utmost importance - the enhancement of governance and value for money in the engineering value chain. As we gather here, it is good that we confront the challenges facing our engineering sector head-on and chart a course towards greater accountability and efficiency.

First and foremost, I wish to extend my heartfelt condolences to all families affected by the recent floods. These tragic events serve as a stark reminder of the critical role that engineers play in mitigating such disasters. It is incumbent upon us, as stewards of the engineering profession, to reflect on these outcomes and strive for continuous improvement.

I challenge all engineers to prioritize governance and value for money in every aspect of the engineering value chain. From project conception to implementation and maintenance, we must ensure transparency, accountability, and efficiency. The mitigation of floods, which often result from engineering failures compounded by multiple factors, underscores the urgency of this call to action. As we confront these challenges, I assure you that the government is committed to addressing them with the utmost seriousness. We will expedite efforts to assess the root causes of engineering failures contributing to floods and take decisive action to prevent future occurrences.

Ladies and Gentlemen, I am pleased to announce our commitment to fast-tracking scheme of service on career progression within the engineering sector. We recognize the need to define clear career pathways between technologists and engineers, facilitating smooth transitions and maximizing the talents of all professionals within our ranks. In line with this commitment, I am proud to announce the establishment of the Kenya School of Engineering. This institution will play a pivotal role in enhancing training and governance in engineering education, producing a new generation of engineers equipped with the skills and knowledge needed to tackle the challenges of tomorrow.

Moreover, we will prioritize the training of technical auditors to ensure robust oversight of engineering projects and promote adherence to best practices. By strengthening governance mechanisms and investing in professional development, we will elevate the standards of the engineering profession and build a brighter future for our nation.

Ladies and Gentlemen Let us embrace this challenge with determination and resolve. Together, let us strive to build a culture of excellence, accountability, and innovation within the engineering sector. By working collaboratively towards our shared goals, we can ensure that engineering continues to serve as a catalyst for progress and prosperity in Kenya.

God bless you and God bless Kenya.

Thank you!

Eng. Joseph M. Mbugua, PE

Principal Secretary, State Department for Roads

Remarks by Chairman, Engineers Board of Kenya

Our mandate as Engineers Board of Kenya includes: Registration of engineers and engineering consulting firms; Regulation of engineering professional services; Setting engineering standards; and Overseeing the development and general practice of engineering.

As a Board, we are presently pursuing 3 Strategic Intentions including: To Increase the number of registered engineers from 3,500 to 10,000; To Strengthen compliance to the Engineers Act 2011 to 100% by developing and enforcing engineering standards in national and county governments; To Develop capacity of the general practice of engineering in Kenya by: Establishing the Kenya Academy of Engineering Technology; Establishing the Kenya School of Engineering; and Acceding to the Washington Accord. Lastly, to develop and sustain the Engineers Board of Kenya.

I wish to Thank H.E. Dr. William Samoei Ruto PhD, the President of the Republic of Kenya and Commander in Chief of the Defence Forces, for the appointment of three Engineers as Vice Chancellors including our host Vice Chancellor here at DeKUT, Eng (Prof) Peter Muchiri; for promoting multi agency government approach in the construction industry amongst Engineers Board of Kenya (EBK), National Construction Authority (NCA), and The Board of Registration of Architects and Quantity Surveyors (BORAQS), for supporting the Board as we make noteworthy progress in acceding to Washington Accord. As a result of this Government support, we are on track with raising numbers towards realization of 10,000 target of registered Professional Engineers in our country.

The Board has carried out a technical audit on the construction sector and established there is low technical capacities in the counties. We request the Intergovernmental Budget and Economic Council Summit, to enhance involvement of Professional Engineers of all areas of governments to help us build local technical capacity and enhance projects quality of our national infrastructure.

An audit of technical operations in MDAs reveal that there are several unregistered foreign firms and Engineers working in Kenya who are not registered with the Board. We request for enforcement for local content policy in engineering projects by requiring foreign engineers to register with EBK and comply with regulatory standards without financial waivers.

EBK has led the establishment of a comprehensive legal and regulatory review which is anchored on policy for strengthening engineering capability. We have submitted to the Ministry the TORs for establishment of a task force. Further, we wish to Propose a percentage cut in each development infrastructure fund dedicated to training of Graduate Engineers. During the 2023 EPC in Naivasha last year, His Excellency the President directed that we expand the Graduate Engineers Internship program from 100 to 500 this year and 1000 next year. We will roll off this programme immediately we receive the directive from the Chief of Staff and Head of Public Service.

Science, Technology and Innovation (STI) has a lot to do with Engineering and we request to appointment of Engineers to the STI advisory committee.

In conclusion, I acknowledge Kenya's innovation and technological advancements, including the first semiconductor manufacturing plant in Africa, the Science and Technology Park here at Dedan Kimathi University of Technology, and local tea plant manufacturing by TEA Machinery and Engineering Company (TEMEC), a subsidiary of Kenya Tea Development Agency (KTDA). I encourage our delegates to visit exhibitions showcasing these achievements.

I challenge all Engineers to collaborate, innovate, and inspire one another towards a future where engineering excellence fosters progress and prosperity for all.

Thank You and God Bless you All

Eng. Erastus Mwongera, CE, FIEK, CBS

Chairman, Engineers Board of Kenya

Remarks By President, World Federation of Engineering Organizations

As we gather here, we celebrate not only the progress made in engineering over the past six decades, but also to look forward to the challenges and opportunities that lie ahead. My address is on a pivotal topic, the role of regulatory bodies in the context of globalization of engineering practice.

As we navigate the complexities of an increasingly interconnected world, the role of engineering and regulatory bodies become more critical than ever before. Globalization has transformed the way we live, work and interact. Countries are increasingly interconnected and the boundaries that, once defined, our world are fading. Immediate access to information transcends geographical proximity and engineers must adapt to the new reality.

In this era of globalization, engineering has emerged as a driving force behind economic development, innovation and sustainable growth. However, this global landscape presents unique challenges and opportunities. As African nations strive to compete on the global stage, it is imperative that we ensure our engineering and regulatory bodies are equipped to navigate the complexity of the world, complexities of globalization and uphold the highest standards of professional practice.

In brief I have to say a little about the institution I represent that is the World Federation of Engineering Organization. It was established on the 4th of March 1968 under the auspices of UNESCO and it's a global body that unites engineers from diverse backgrounds, cultures and disciplines. Our mission is to be a global leader of the engineering profession providing strategic guidance for sustainable development and innovation.

Now let us delve a little into what we do at it a World Federation of Engineering Organizations. First of all, we are in advocacy and guidance we offer advocacy and guidance for sustainable development. WFEO aims to be a respected and reliable source of advice and guidance on engineering and technology related issues. We engage with governments, industries and universities and professional engineering institutions. We emphasize the role of engineering and technology steps for developing the new field we wish to pursue.

WFEO actively participates in international efforts especially with United Nations (UN) and its agencies. WFEO coaches the scientific and technological major group of the United Nations, it participates in high-level political forum and holds side events annually in relation with UN sustainable development goals. By collaborating with global partners we ensure that engineering solutions address critical challenges such as climate change adaptation disaster risk mitigation food security clean water public health and poverty alleviation diversity and inclusion.

WFEO promotes diversity within the engineering profession. We recognize that a globalized engineering practice thrives on varied experiences and backgrounds; we have support from all over the world, strong policy implementation committees of women in engineering and young engineers who are future leaders. Our membership cuts across all regions, backgrounds and colors same for the leadership of the federation. Our membership actually has more than 100 engineering institutions, for more than 100 countries and at the leadership of the federation you have people of all backgrounds from all over the world.

In fact, standing here addressing you as a president of WFEO signifies diversity and inclusivity. If you gauge our inclusivity not only that of the president but we also have many Africans in the executive council of the world federation of international affairs including a Kenyan, in the person of Eng. Nathaniel Matalanga.

We had to establish at the board level an Africa projects committee headed by the president of the Federation of African Engineering Organizations so that even if I finish my tenure, whoever will be the president of WFEO will have that committee headed by an African. A big 10-year program we have rolled out together with the chairman of the capacity

building committee of the World Federation of Engineering Organizations, who happens to be an African Zimbabwean by nationality.

It's a huge program and we have started discussing on it at global level and the China Association of Science and Technology has even offered to give us an overseas office. But then we have to talk to our leaders and I'm glad the cabinet secretary is here. We have to open offices in East Africa, in West Africa, in Southern Africa, in Central Africa and North Africa because capacity building is what we need.

And I'm glad to be part of the presentation by the semiconductor company limited that and I've also seen for myself the laboratory, which to me we have to make sure that the Dr. Anthony is really part of that engineering capacity building program because we have to set up a curriculum to train the trainers because whatever we do at the international project office, we have to come and reflect it in all parts of Africa so that we take the destiny of Africa in our hands. It is no more acceptable that we blame or we depend on people outside Africa for our condition or for our inadequacies. We have all it takes to take Africa to where we want it to be.

Now on the roles of engineering regulatory bodies, it includes setting the standards, licensing and certification accreditation, ethics and discipline. I want to talk a little about the ethics and discipline. Engineering regulatory bodies enforce the use of standards state in the practice for the profession and the code of ethics that their members must follow.

While engineering standards relates to specifics in the practice of engineering, code of ethics address issues such as honesty, integrity, welfare of the public. They also handle disciplinary actions against members who violate these codes. They can include suspension and revocation of license of a practitioner.

This is very important for engineering regulatory bodies so that the public and the government will have confidence in us as engineers because as much as we are advocating the use of our engineers for our development, we also have to be sensitive that sometimes our own engineers or engineering practitioners can go beyond the line to do some things that are unethical. So, if the government knows and the public knows that if anybody does anything unethical, the institution has a way of dealing with him, they will be comfortable that we are not defending our members blindly. And that is why in some countries like in Nigeria, the regulator partners with independent correct practices and related offenses commission to have the current tribunal where engineers and engineering practitioners are tried for any offense during the execution of any engineering project.

So, it's very important for the regulators also to make sure that engineers and engineering practitioners are disciplined if they commit any offense in the discharge of their responsibility.

As engineering projects and personnel increasingly cross-national borders, regulatory bodies often collaborate internationally to harmonize standards and allow for mutual recognition of qualifications among countries. This also facilitates the global mobility of engineers. We're all aware of the fact that while we have projects that are limited to a country, there are also projects that cross boundaries of countries. So, for that reason, there has to be that mutual recognition of practitioners between one country to another.

And also, there is also the issue of some engineers may decide to practice outside their continent, even maybe in the UK or in the US or in Canada. So, all these issues bring about the need to have a qualification that would be respected and, I mean, that would be respected in other climates. And I'm glad that in East Africa, we have a model for this mutual recognition agreement, which we have been discussing at the Africa level that we have to copy the model of East Africa so that at least the Africa as a continent can have such mutual recognition agreement. And we provide opportunity for our own people, at least within Africa, because Africa is the least developed continent in the whole world. So, the opportunities for the engineers is even more in Africa.

So, the more we are recognized within our continent, the more opportunities we have. So as much as we desire to be recognized internationally, it is actually more important even to recognize ourselves within Africa so that a Kenyan can comfortably go to Ghana, go to Nigeria, go to Somalia, go to Egypt and practice. So, I commend the East African engineering institutions for this mutual recognition agreement. And the last time we had a meeting on, I mean, the FAEO meeting, which I was part of, we decided to copy the East African model.

So, we thank you very much for that. Now at the WFEO, because we are a global organization, we understand the need that these organizations need to be recognized in other climates. And that is why we have a partnership with the International Engineering Alliance, with the partnership with Engineering Alliance. It means we can be a signatory to Washington Accord.

I'm glad Kenya has applied and the process is going on. We are actually working on the International Engineering Alliance to make sure that the path to this journey becomes clearer and smoother. And I'm glad the response we are having with them is very positive.

While we are desirous of getting this Washington Accord signatory, we also know that there are challenges on this mobility. These challenges include diverse educational systems, language and cultural barriers, licensing, and continuing professional development. Continuing professional development, especially for young engineers, is very important. And that is why I always emphasize on the need for our senior engineers to please be very accommodating to our younger ones; give them opportunities for training within and outside the country.

I have seen so many companies that are doing huge projects in Africa, but the younger engineers are not being given opportunities to attend conferences, seminars, or trainings on certain skills. So please, this is very important. We cannot progress as a continent if our younger ones are not being given the opportunity. We are pleading with the government to have trust in us, so that projects at any magnitude should be handled by our engineers. And I believe with the coming of the Cabinet Secretary and Principal Secretary here, we are telling you, sir, your excellency, if we can be trusted at a global level, it goes without saying that we should be trusted at home.

So, there should be no project that is too big for a Kenyan engineer or for an African engineer. If he needs any support, he knows where to get the support. And we can always get it. We are not saying that we know everything. So, the two things I want to appeal to the audience, first to the leadership of our countries, that we should have that trust in our engineers have gone around the world. They are champions in their domains. There is nothing developmental in this country that they cannot handle.

And for the engineers that have construction firms, consulting firms, please, when you are getting projects, make sure that the young engineers are given opportunities for training and retraining, because engineering is always evolving. It's very dynamic. If we don't train and retrain these young engineers, we are not going to solve the problems of our country.

So, with these few remarks, I want to thank you very much, Your Excellencies, and the chairman of EBK, the registrar of EBK. And I'm glad I'm part of this convention.

Thank you so much.

Eng. Mustafa B. Shehu, FNSE
President, World Federation of Engineering Organizations Kenya


Picture: Courtesy

Remarks by President, Institution of Engineers of Kenya (IEK)

I thank the ministry and EBK for holding this 5th EPC here in Nyeri.

Your excellency we thank EBK more specifically for holding this EPC in Dedan Kimathi University of Technology because it is here that research is being carried out that will transform this country. Semiconductors are being manufactured right here in this university. They have produced prototypes speed governors and smart meters.

Right here, Dr. Fredrick Madaraka produced an alloy of Steel and Aluminum harder than either of the materials. Things are happening right here in this great university.

Your excellency Kenyans have been affected by floods. As a result, many of our fellow citizens have died. Others have lost their loved ones and others have lost their property due to floods. Engineers have come in to assist and our donation to these affected Kenyans will be handed over to the Red Cross this Friday 10.5.24. In addition to this, we propose more investment in measures towards flood resilience.

We propose a summit that will bring together all stakeholders to discuss ways of ensuring that the country emerges out of this better, stronger. We need to review our drainage infrastructure and develop strategies to mitigate against urban flooding currently ravaging many parts of this country. We have also established BETA taskforces to constructively engage with government in finding practical solutions.

As IEK we are excited to participate in this EPC because we are leading in the conversation on industrial development for employment creation and economic development. Our annual convention later this year will focus intensely on industrialization for employment creation and economic transformation.

Your excellency all the countries that have realised faster development have invested in engineering. As a country we must do so too. China, Russia, India, United States produce the most number of engineers every year. These are 452,000, 448,384, 295,000, 268,044 respectively based on a presentation by City Globe. This is why they're advanced nations technologically. We produce 2500 annually and so you can see that we need to improve significantly to catch up.

Your excellency I know you are a good man. I know this because in 2020 as an MP you sponsored this Bill to curtail the contracts below 1 billion to be reserved for Kenyans. Your excellency I know it was not successful in parliament but I want to let you know that IEK intends to take amendments to the law which will achieve the same end. I already have a complaint from engineers on the mistreatment they're receiving from Chinese contractors. We will bring this, together with a few others that in our view require amendments and bring them as an omnibus bill for parliament to consider and pass them.

Your excellency, Engineering firms have sent staff home. This is how pending bills are directly affecting us as engineers. We pray that project funds are dispatched without further delay as this impacts the wider economy.

Your excellency engineers go through tough training in the university. They go through a five-year tortuous training where they handle complicated subjects like thermodynamics which is basically study of fire and theory of structures. Engineers also integrate vectors in space to determine escape velocity of a rocket from earth but also how it lands in Mars.

After this your excellency they get employed in public sector and they realize their entry grade is Job Group K. Just like a graduate of a 4-year course. Your excellency this is a historical injustice because PSC guidelines indicate that a 5-year course the entry level job in public service should be Job Group L. In this regard your excellency I implore you to call Hon. Moses Kuria to effect this change so that

all Engineers enter public service at JG L instead of K. To aggravate issues your excellency, engineers employed in public service don't enjoy non practicing and other allowances like lawyers and doctors do. Your excellency, as a result of this at entry engineers will earn 25% what their peers in these other fields earn even in the same Job Group and level in public service. This is not good and the country can't realize development without engineers.

Please intervene for PSC and SRC to effect non practicing, risk, call, extraneous allowances so that engineers will be appreciated for the hard work they put in. We implore the government to employ engineers because natural attrition is already leading to few engineers who remain in the service meaning they're overworked.

God Bless You All

President; Eng. Shammah Kiteme, CE, FIEK, PMP®

President, Institution of Engineers of Kenya

Picture: Courtesy

Remarks by Chairperson, Association of Consulting Engineers of Kenya (ACEK)

Distinguished guests, fellow engineers, and esteemed participants.

It is with great honor that I stand before you today at the 5th Engineering Partnerships Convention, themed "Engineering @ 60: Reflections, Response, and Resetting." As we celebrate 60 years of engineering excellence in Kenya, it's an opportune moment to reflect on the critical role of local content in our industry's future.

The construction sector serves as a powerful indicator of a nation's economic well-being. It generates employment, drives infrastructure development, and stimulates related industries like manufacturing and materials supply. A robust construction sector fosters investment, improves living standards, and propels overall economic activity.

The impact of construction extends far beyond building infrastructure as the sector plays a critical role in Infrastructure Development: Roads, bridges, dams, and transportation networks – the backbone of a thriving economy – are all products of the construction industry, Job Creation: Construction provides employment opportunities for a diverse workforce, from engineers and architects to skilled laborers, Social Development: Hospitals, schools, and other social amenities contribute to a nation's social progress and well-being.

The Imperative of Local Content

While knowledge sharing and collaboration are vital, fostering a strong local engineering industry is paramount. A skilled and experienced domestic workforce strengthens Kenya's competitive edge. Local engineers understand the nuances of the Kenyan context, leading to solutions that are culturally and environmentally appropriate. Investing in local talent keeps resources within the economy, promoting long-term stability and Knowledge Transfer. Collaboration with international firms fosters knowledge transfer, equipping local professionals with cutting-edge skills and expertise.

Building a Strong Local Engineering Industry Through Collaboration

Professional services like engineering are the backbone of a thriving construction sector. These services generate and disseminate vital knowledge, fostering innovation and productivity. Strong legal and fiscal frameworks, championed by qualified engineers, create a level playing field for businesses and attract investors. However, simply investing in professional development isn't enough. While a skilled domestic workforce is crucial, closing borders to foreign expertise hinders progress. Instead, we advocate for a collaborative approach that builds upon Kenya's existing strengths in professional services. Partnerships between local and international firms allow knowledge sharing while promoting domestic participation in large-scale projects. Experienced international professionals can mentor and train Kenyan engineers, fostering a pipeline of future leaders. Additionally, local firms can specialize in areas where they possess a competitive advantage, such as traditional construction methods or in-depth knowledge of the local environment, Investing in Our People and Fostering Innovation.

To ensure long-term competitiveness, Kenya can further strengthen its local engineering industry, Investing in Professional Development: We must prioritize training programs and capacity building initiatives for Kenyan engineers at all levels, Promoting Innovation and Technology Transfer: Collaboration with international firms can facilitate knowledge exchange and technology transfer, empowering local firms to adopt advanced practices and remain competitive. Develop policies promoting knowledge sharing, allowing local firms to learn from international players. A robust regulatory framework ensures fair competition between local and international firms. This fosters innovation and incentivizes continuous improvement by all players.

Let us invest in our people, create a supportive environment for innovation, and build strategic partnerships to secure a prosperous future for all.

Eng. Jane Mutulili, CE

Chairperson, Association of Consulting Engineers of Kenya

Remarks by Chairman, EAC - MRA

Nawasalimu kwa jina la Jamhuri ya Muungano wa Tanzania.

It is good to be here. I am hailing from Kilimanjaro. It looks so similar. It feels so similar to this place. So, we have come to learn. We've come to learn on the similarities. And we see a lot of them. The air smells the same. The people look the same.

I congratulate you for this setting for this event. We are learning we are copying. We invite you to our event in September, and you'll see some features in there. I said, we came to be taught, but we got more than we bargained for. When we visited the Dr. Tony Githinji complex, we were utterly astonished. We were mesmerized. We were flabbergasted. You have to go there to see it. And we were also mesmerized by the youthfulness and the genius, especially of the girls who received us.

Thank you so much. And we are now inviting you to Tanzania and help us through. It is possible. I'd like to also to thank Margaret, from whom I'm taking the chairmanship. She is a gift to Kenya, and it was quantified 360 degrees. I think that is an understatement. She's a gift to East Africa. Thank you so much, Margaret. And we are going to build on this partnership in the MRA, and it is helping us. So, we have now new countries joining us. DRC, and Somalia is coming, we have Burundi. We are at different levels of maturity, and we have adopted a slogan of no one will be left behind.

With those few remarks, it's good to be in Kenya.

Asante sana! Asante sana!

Eng. Bernard Kavishe

Registrar, Engineers Registration Board, Tanzania / Chairman, EAC-MRA

Picture: Courtesy

Remarks by Registrar/CEO, Engineers Board of Kenya

The Engineering Partnership Convention is annually held by the Engineers Board of Kenya, and the 2024 Convention marks the fifth to be held by the Board.

We would like to express our sincere gratitude and appreciation to all those who played a significant role in the success of the Engineering Partnership Convention (EPC) 2024 under the theme of "Engineering @ 60: Reflections, Response, Resetting" and guided by the pillars of Accelerated Delivery of Infrastructure Programs for BETA, Education for Wealth, Employment Creation and Global Competitiveness, Adoption of Frontier Technologies and Green Transition for Economic Growth and Sustainability, Liberalizing Professional Engineering Services, and Enhancing Regulatory Frameworks in Engineering for Public Safety and Welfare.

First and foremost, we would like to extend our deepest appreciation to His Excellency the Deputy President, Hon. Rigathi Gachagua, EGH, for his esteemed support. We are grateful for his recognition of the importance of engineering in shaping the nation's economy especially in this time when the country and by extension the world is facing a climate change crisis.

We would further like to acknowledge the invaluable contributions of the Cabinet Secretary Roads and Transport, Hon. Kipchumba Murkomen, EGH, and H.E. Mwalimu Mutahi Kahiga, EGH, the Governor of Nyeri County. Their presence, insights, and support greatly enriched the convention and demonstrated their dedication to the advancement of engineering and infrastructure in Kenya.

Our heartfelt appreciation goes to Eng. Joseph Mbugua, CBS, the Principal Secretary State Department of Roads, for his guidance and expertise in the field of roads, as well as Eng. Erastus Mwongera, CBS, the Chairman EBK, for his valuable insights and contributions throughout the planning and execution of EPC 2024.

Our appreciation to Eng. (Prof). Peter Muchiri, Vice Chancellor, Dedan Kimathi University of Technology for being our partners and cohosting a successful Convention with us. This being one of the top-notch universities in terms of technology and innovation, the convention has strengthened on the academic and industry linkages.

We would like to extend our gratitude to Eng. Shammah Kiteme, the President of the Institution of Engineers of Kenya (IEK), and Eng. Jane Mutulili, the Chairperson of ACEK, for their leadership, support, and active involvement in the convention. Their commitment to the engineering profession has been instrumental in driving its growth and development in Kenya.

We would also like to acknowledge WFEO President, FAEO President the foreign delegates from Tanzania, Uganda, DRC and others, whose participation and contributions fostered international collaboration and knowledge exchange.

A special mention goes to Eng. James Mwangi, the Vice President FIDIC, for his presence and valuable contributions during the convention. His expertise and insights have significantly enriched our discussions on global engineering practices.

Our deep appreciation goes to our esteemed sponsors, including the World Bank, GIZ, KeNHA, KETRACO, KPLC, KURA, KeRRA, KPA, and Tana Water Works Development Authority. Their generous support and partnership made the convention a resounding success, enabling us to address crucial engineering challenges and explore avenues for sustainable development.

We express our gratitude to the exhibitors and organizations, such as Caetano Motors/Ford, Muthokinju Paints, Cement & Water Proofing, Davis & Shirtliff, Konza Technopolis Development Authority, Kenya Roads Board (KRB), Sika Kenya, East Africa School Of Aviation (EASA), Institute Of Applied Project Management (IAPM), National Commission For Science, Technology & Innovation (Nacosti), Tea Machinery Company (Temec/Ktda, Exhibitors), Chint Global, Cooperative Bank, Machakos University (Exhibitors), Nas International Group, Numerical Machining Complex (NMC), Motherland Concrete, Kenya Pipeline Company (KPC), Development Bank of Kenya, Green-life Crop Protection Africa, IEEE Kenya for their valuable contributions and presence, which added innovation, depth and diversity to the convention.

We also extend our heartfelt appreciation to the Board Members, Management and Staff of the Engineers Board of Kenya (EBK) for their commitment, hard work, and dedication in planning and executing the successful EPC 2024. Their efforts have been instrumental in fostering collaboration, knowledge sharing, and the advancement of the engineering profession in Kenya.

We are truly grateful to all the individuals, organizations, and partners who contributed to the success of EPC 2024. Your support and involvement have made a significant impact on the engineering landscape in Kenya, and we look forward to continued collaboration and progress in the future to enhance the practice of engineering in the country.

Eng. Margaret Ogai, CE, FIEK

Registrar/CEO, Engineers Board of Kenya

PICTORIAL

The 5th Engineering Partnership Convention (EPC) 2024 at Dedan Kimathi University of Technology

The Institution of Engineers of Kenya (IEK) was adequately represented at EPC 2024 IEK President Eng. Shammah Kitemeh, 1st Vice President, Eng. Harison Keter, Honorary Secretary Eng. Jactone Mwenge and The Immediate Past President, Eng. Erick Ohaga leading other Council Members

The IEK President Eng Shammah Kiteme welcomes the Cabinet Secretary for Ministry of Roads and Transport Hon. Onesimus Kipchumba Murkomen at EPC 2024

IEK first VP, Eng. Harrison K. Keter presents the Infrastructure Rate Card to the Principal Secretary (PS), State Department of Environment & Climate Change Eng. Festus Ng'eno during the EPC 2024

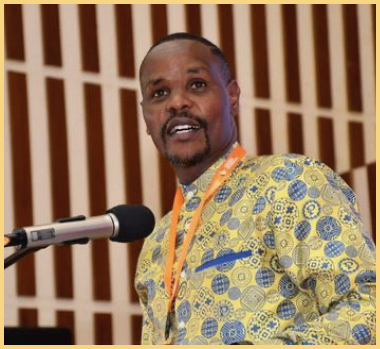
IEK President, Eng. Shammah Kitemeh joined fellow EBK Board members during Tree planting in DeKUT on Friday 10th May 2024 at the end of EPC 2024

Nyeri Deputy Governor H.E. Kinaniri Waroe during official launch of the 5th Engineering Partnership Convention

The 2nd Vice President presenting the 2023 IRC to the Deputy Governor Nyeri County, H.E. Kinaniri Waroe, noting the ratings across various sectors in Nyeri.

The Cabinet Secretary for Ministry of Roads and Transport Hon. Kipchumba Murkomen, EBS addresses the congregation at EPC 2024

Principal Secretary, State Department of Roads Eng Joseph Mbugua addresses in attendance members at EPC 2024



PS Eng. Festus Ng'eno acknowledges that "Climate change is real, driven by human activities, and manifesting in Kenya through extreme weather like floods".

DeKUT Vice Chancellor Prof. Eng. Peter N. Muchiri: "We have successfully incubated 16 startups at Dedan Kimathi University of Technology, showcasing our unwavering faith in the potential of our students."

Members in attendance of the EPC 2024

Members in attendance of the EPC 2024

IEK donates aid to Red Cross for flood victims, targeting over 100 families with support from engineers nationwide, aiming to sustain each 100 families for about 10 days.

Two-Day Retreat for Editorial Board at Nairobi Club

By EiK Correspondent

On May 17th and 18th, 2024, the Editorial Board, under the leadership of Eng. (Prof.) Lawre Gumbe, held a significant two-day retreat at the Nairobi Club. The primary objective of this retreat was to redefine the board's goals and foster a sense of cohesive collaboration among its members, setting a clear path for future endeavours.

The event saw the active participation of IEK Executive members, including the President of IEK, Eng. Shammah Kiteme, CE, FIEK, and the registrar/CEO of the Engineers Board of Kenya (EBK), Eng. Margaret Ogai, FIEK.

IEK, renowned for its publications such as the **Engineering in Kenya Magazine**, the **African Journal of Engineering Research and Innovation (AJERI)**, and its regular **newsletter**, took this opportunity to reassess and strengthen its editorial strategies. The discussions and activities conducted over the two days were aimed at ensuring that these publications continue to serve the engineering community with high-quality, relevant, and impactful content.

The retreat concluded with a renewed sense of direction and purpose, laying the groundwork for more dynamic and collaborative editorial processes in the future. The outcomes of this retreat are expected to significantly contribute to the continuous improvement of IEK's publications, reinforcing their role in advancing the engineering profession in Kenya.

Courtesy call to the Principal Secretary, State Department for Public Works

By EiK Correspondent

The Leadership of the Institution of Engineers of Kenya (IEK), paid a Courtesy call to the Principal Secretary, State Department for Public Works, Mr. Joel Arumonyang, at Works Building, 6th Ngong Road, Community Area.

This occasion was graced by the Principal Secretary, State Department for Public works, Mr. Joel Arumonyang, Secretary Administrative, Mr. Rioba Mbogai, Qs,Mr. Nicholas Mutua, IEK President Eng. Shammah Kiteme, CE, FIEK, PMP, 1st Vice President, Eng. Harrison Keter,PE,MIEK , Hon. Sec. Eng. Jacton.A. Mwembe, PE,MIEK, Hon. Treasurer Eng. Jennifer Korir, PE, MIEK, CPA Fulgence Ndilo and Timothy Cheruiyot.

The delegates engaged in constructive dialogue concerning pertinent issues directly impacting engineers.

PICTORIAL

The IEK President in attendance of the launch of the new Kenya National Housing Corporation Kenya -NHC , Brand to mark NHC's 70 years of service delivery at Bomas of Kenya

ENGINEERS BOARD OF KENYA
Enhancing Professionalism

Measures Board is putting in place to increase the Number of professional Engineers.

By Eng. Margaret Ogai, CE, FIEK
Registrar/CEO, Engineers Board of Kenya

The Board has put in place the following measures to register 10,000 No Professional Engineers in the next Five Years.

- Reduced the timelines for professional registration to **3 Months.**
- ***Expanding the Professional Examination Panels.***
- Introduction of document review process which ensures qualitative evaluation of professional examination reports prior to the professional interviews.
- The Board is in the process of ***digitizing the registration process*** which will improve on efficiency and customer service.
- ***Conducting sensitization workshops*** on professional examination reports to offer guidance to graduate engineers willing to transition to professional engineers.
- Develop harmonized report templets to assist in registration process.
- The Board has come up with ***Registration guidelines*** to guide on ***registration process.***
- Through the ***Graduate Engineers Internship programme (GEIP)***, the Board has been offering structured internship program to graduate engineers ensuring transitioning to Professional engineers within 3 years. The Board intends to ***increase the number of Graduate engineers*** under the programme.
- Developed the graduate engineers training curriculum to offer ***structured trainings for career pathways.***
- The Board remains committed to ***stakeholder engagements and partnerships*** to ensure ***transitioning of graduate engineers to Professional engineers.***

Engineers Board of Kenya Compliance Tools

1. Engineers Portal

The Engineers Project Registration Portal (EPRP) was launched in June 2023 by the President, H.E. William Ruto, CGH, during EPC2023, and aims to improve the declaration of engineering projects and the interaction of engineers with the Engineers Board of Kenya (EBK). The goal is to ensure efficient regulation of engineering services by the Board. To enhance its uptake, the Board intends to make several modifications to the Portal, including:

- Making it mandatory for all engineers to declare all projects they are involved in (both in design and Supervision) with the EBK.
- Redesigning the portal interface to make it user-friendly and reducing the amount of documentation needed to be input into the system.
- Introducing a publicly available search function on the website, allowing approving authorities and the general public to confirm the authenticity of an engineer's involvement in a particular project using a unique serial number generated during the project registration on the portal. All approving authorities will use this function to confirm the authenticity of the engineering stamp appearing on engineering documents submitted for approval.
- Incorporating all building services engineers (Mechanical and Electrical) to declare their involvement in projects, as well as be part of the statutory approvals.

Additionally, the National Construction Authority (NCA) will provide access to EBK for their OPRS system. The primary objective is to integrate the systems to facilitate seamless information sharing. However, low registration numbers present a significant challenge. Overcoming this issue is essential for enhancing overall compliance and service delivery.

2. Compliance Monitoring by Field Visits

For the current financial year 2023/2024, the Board has conducted compliance monitoring inspections across several counties, revealing relatively low levels of compliance. These visits aim to evaluate and ensure that engineering practices adhere to the required standards. Key findings from these inspections include:

- Inadequate site supervision arrangements.
- Lack of quality management measures on sites, with no supervision and testing records available.
- Engineers listed as supervision engineers on NCA records are not present on-site while works are ongoing.
- Some counties have approved engineering designs and drawings submitted by unqualified individuals or without the Board-issued engineer's stamp.
- Inadequate technical capacity in the counties to review and approve engineering documents.
- Unqualified persons offering professional engineering services.
- Some engineers are offering professional engineering services through firms that are not registered by the Board.
- Conflicts of interest among some county employees involved in providing engineering services, including supervising works, acting as agents for developers, and facilitating illegal approvals of engineering designs and documents not done by professional engineers.
- Neglect of mechanical and electrical services during project approvals.
- Unregistered foreign engineers offering professional engineering services without being registered by the Board.
- Engineers neglecting the design of temporary works, leading to collapses and fatalities.
- Engineers being engaged through intermediaries without proper authority to represent developers and without signed contracts between the engineer and the developer.
- Contractors undertaking engineering works without engaging engineers to perform, execute, or supervise these works.

3. Use of Engineers' Tools (Stamps, IDs):

It is essential and mandatory that all engineering designs, surveys, reports, documents, and drawings are endorsed with the engineer's stamp provided by the Board. This stamp must be accompanied by a unique serial number generated by the engineer through the Engineers Project Registration Portal for authentication purposes. This process ensures that all documents are properly authenticated and confirms the involvement of licensed engineers. This practice will serve to verify the authenticity of involvement and approval by licensed engineers, thereby helping to maintain the integrity and quality of engineering work.

Other Initiatives

1. EBK's Membership in MSACC and Development of Control Bill:

The EBK is actively participating as a member of the Multi-Sectoral Agency Consultative Committee (MSACC), chaired by the PS of the State Department for Public Works. The EBK is involved in joint compliance monitoring inspections and enforcement of actions. Additionally, the MSACC is currently developing a building control bill. This initiative aims to anchor the National Building Code and ensure that building approvals are undertaken according to the requirements of the National Building Code and set regulatory standards.

2. Establishment of EBK Branches:

In the upcoming financial year 2024/2025, the EBK plans to establish branches across various regions using a phased approach. This strategic expansion aims to bolster compliance monitoring efforts by offering localized support and ensuring that engineering practices align with the stipulated regulations.

3. Sensitization Efforts:

The EBK, in collaboration with IEK and other stakeholders, will undertake sensitization programs targeting developers, county governments, and engineers. These programs will emphasize the crucial importance of compliance with engineering standards and regulations. Through raising awareness, the EBK aims to enhance adherence to established guidelines and improve the overall quality of engineering projects.

Picture: Courtesy

What is Building Services Engineering?

By EiK Correspondent

Building Services Engineering (BSE) is a vital and complex field that encompasses the design, installation, operation, and maintenance of the essential services and equipment found in buildings. These services include heating, ventilation, air conditioning (otherwise known as HVAC), plumbing, electrical systems, lighting, fire safety, security, including others. The main purpose of Building Services Engineering is to promote safe, comfortable, efficient, and sustainable buildings for the residents.

The Scope of Building Services Engineering

Building Services Engineering covers a broad range of services, all of which are critical for the functionality and comfort of buildings. The scope can be divided into these main categories:

i. Mechanical Services:

- Heating, Ventilation, and Air Conditioning (HVAC): HVAC systems regulate the temperature of the buildings and ensure optimal indoor air quality. Apart from temperature, they regulate humidity and air purity.
- Plumbing and Water Supply: This involves the design and installation of systems for potable water distribution, waste removal, and water heating.

ii. Electrical Services:

- Power Supply and Distribution: Efficient and safe electricity supply to buildings.
- Lighting Systems: Designing lighting solutions that are both aesthetic pleasing and functional.
- Telecommunications and IT Networks: Installing and maintaining data and communication systems essential for modern building operations.

iii. Public Health and Safety:

- Fire Detection and Suppression Systems: A collection of components designed to detect, alert, and suppress fires in a timely manner to limit property damage and ensure the safety of those in the building.
- Security Systems: Systems that incorporate surveillance and access control to prevent, detect and deter unwanted access to buildings.

iv. Sustainability and Energy Management:

- Energy Efficiency: Designing systems that minimize energy consumption and reduce carbon footprint.
- Renewable Energy Integration: Incorporating solar, wind, or other renewable energy sources into building operations.

The Role of Building Services Engineers

Building Services Engineers play a pivotal role in the lifecycle of a building. Their roles include:

a. Design

Building Services Engineers work in liaison with architects and other engineers to incorporate their services into the overall design. They also make sure the laid out plans and specifications meet the relevant codes and standards.

b. Installation and Commissioning

Building Services Engineers see to it that the installation of the said services is done in a timely manner and that they meet the stipulated budget. They also ensure all systems work well before the building is handed over.

c. Operation and Maintenance

They conduct routine maintenance and inspection to make sure the systems remain efficient and address any arising problems and mishaps.

d. Upgrades and Retrofitting

Systems get outdates with time, and they are not entirely immune to wear and tear. In such events, BSE may update the systems to improve efficiency, to meet updated policies and regulations or to address new user needs.

The Future of Building Services Engineering

Building Services Engineering (BSE) is evolving rapidly. The future is driven by technological advancements, sustainability imperatives, and changing occupant needs.

i. Smart Buildings

Emerging smart building technologies not only affect the way buildings are designed, but they are allowing for better maintenance, management and operation. Through the incorporation of Internet of Things (IoT) devices, sensors and data analytical tools, it has become even easier to control HVAC components and ensure overall optimal comfort for the building occupants.

ii. Sustainable Practices

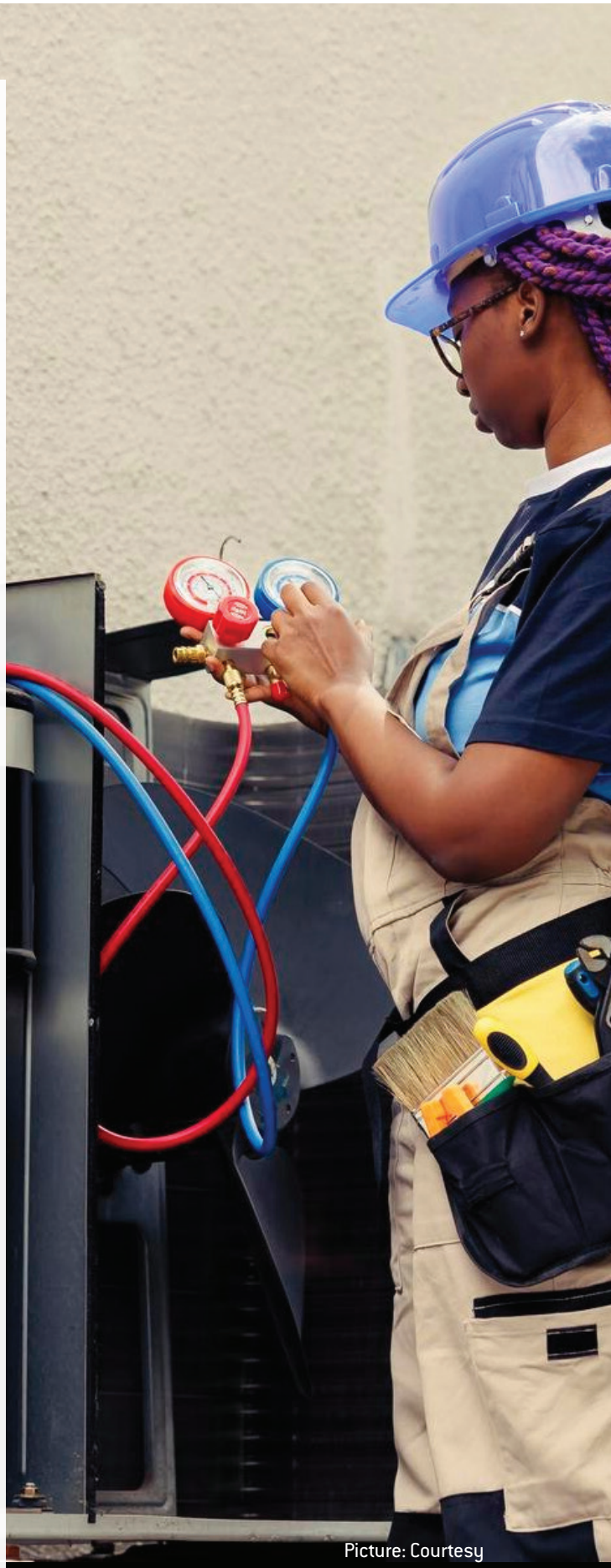
Generally, the construction industry is one of the capital consumers of minerals and natural resources. The finite nature of these resources coupled with climate change concerns has set stage for sustainable construction practices, including sustainable building services. Use of renewable energy sources, on-site water treatment and waste reduction are some of the more sustainable practices in building services.

iii. Resilience and Adaptability

Climate resilience has taken centre-stage when it comes to the future of building services engineering. Thus, there is a glaring need to design adaptable systems that can withstand the adverse effects of climate change that are still functional and sustainable.

Conclusion

Building Services Engineering is a dynamic and essential discipline that sees to it that modern buildings meet the functionality, safety, and sustainability thresholds. Through the professional integration of various systems and technologies, Building Services Engineers create environments that enhance the quality of life for occupants while addressing the challenges of energy efficiency and environmental impact. As technology evolves and sustainability becomes increasingly important, the role of Building Services Engineers will continue to expand, making it a field that is both challenging and rewarding.



Picture: Courtesy

Role of Heating, Ventilation, and Air Conditioning (HVAC) Systems in Building Designs

By Kigen K. Leonard

What is an HVAC System? – HVAC stands for Heating, Ventilation, and Air Conditioning.

What is an AC Unit?

An AC unit, or air conditioner, is a device that is used to cool air and dehumidify a room or building. It works by drawing in warm air from the outside, cooling it, and then pumping it back into the room. The air conditioning unit works by removing heat from the air, which is then released outdoors.

To begin with, we need to understand the engineering terms, key processes involved in an HVAC and AC system. The major mechanical processes involved are discussed below:

i. **Heating**: The HVAC system includes components such as boilers, furnaces, heat pumps, and electric heaters that provide thermal energy to increase the indoor temperature during colder periods.

ii. **Ventilation**: Ventilation involves the exchange of indoor and outdoor air to maintain air quality, remove pollutants, control humidity levels, and replenish oxygen. This is achieved through mechanical ventilation systems, natural ventilation strategies, and air exchange rates.

iii. **Air Conditioning**: Air conditioning refers to the process of cooling and dehumidifying indoor air during warmer periods. This is accomplished using equipment like air conditioners, chillers, evaporative coolers, and heat pumps that extract heat from the indoor environment and release it outside.

HVAC systems are designed to control temperature, humidity, air quality, and air movement within buildings to create comfortable, healthy, and safe indoor environments for occupants.

An HVAC system consist of various Mechanical and Electrical Components, including **heating units, cooling units, ventilation systems, ductwork, controls, sensors, and filtration systems**, all working together to maintain optimal indoor conditions.

Role of Heating, Ventilation, and Air Conditioning (HVAC) in Building Structures

a. An HVAC system is designed to control the environment in which it works. It achieves this by controlling the temperature of a room through heating and cooling.

b. It also controls the humidity level in that environment by controlling the movement and distribution of air inside the room.

c. The system also ensures cleanliness of air inside the said environment.

Types of HVAC Systems

There are three main types of HVAC systems available today are; Split and Window AC; Packaged Heating & Air Conditioning System, and Central AC System.

Not all types of HVAC systems work the same way. Some are faster than others while others serve larger environments. In short, some HVAC systems are more effective than others in certain situations. Here's how the above different systems work:

Split and Window AC Systems

In a window AC, fans blow air through the coils. This improves how they separate the heat and cold. Heat gets lost to the outside air while introducing cold is into the room.

Split ACs are used in larger application areas than window ACs. The split AC focuses on splitting the cold from the hot side of the system. The cold side has the cold coil and the expansion valve. This is usually placed inside a furnace or any other form of air handler. The handler blows air over the coil and the cooled air is distributed to various rooms in the building through the air ducts.

Packaged Heating & Air Conditioning System

These units provide an all-in-one benefit in that they have both heating and cooling equipment in a single "package". Users can place them in mechanical rooms, on the rooftop or at a grade close to the conditioning space.

Unlike in split systems where the cold and hot units are separate, the package AC has all the components in one unit. These elements have a centrifugal fan or blower that helps distribute the air throughout the elements of the structure.

Central AC Systems

Most of the air conditioners in residential buildings are in the form of split systems – only bigger. They have a cooling fan, a condenser coil and a compressor housed in a separate condensing unit. The evaporator coil is usually inside an air handler (indoor) unit normally installed on the furnace. When the furnace is electric, a blower is included in the system.

The compressor uses electricity as its source of power to pump the refrigerant across the system collecting indoor heat and removing it from the home. The heat dissipates outdoors by the coil in the condensing unit.

Warm air indoors gets blown through the indoor coil (cold) to remove moisture and heat. The heat in the air transfers to the coil and thus the air cools. The water vapor condenses on the coil (since it is cold) and collects inside a drain pan. It goes outside through the condensate drain.

The heat, after flowing to the evaporator coil, pumps outdoors while the now cooled air inside the room circulates through the fan on the air handler. Hence, the indoor temperature is maintained.

Energy Usage by an HVAC system

There are several determining factors to the quantity of energy that an HVAC system uses. They include; The efficiency of its components; how appropriate its size is in relation to your home; your local climate; how much you use it; and finally the type of fuel it uses.

When evaluating the system's expected consumption of energy, you need to follow industry-standard rating systems. Some of them are:

a. The SEER (Seasonal Energy Efficiency Ratio)

This measures a heat pump system or air conditioner's cooling efficiency. The higher the SEER the greater the efficiency and the energy saving capacity; Some laws requires new cooling systems to have a minimum rating of 13 SEER.

b. The AFUE (Annual Fuel Utilization Efficiency)

This rates oil or gas furnaces to show the amount of fuel used in heating your home and the wasted amount. The rating is in percentages and the higher the AFUE rating, the more energy-efficient the system is.

c. The HSPF (Heating Seasonal Performance Factor)

This one measures the level of efficiency of a heat pump's heating mode. A high rating means greater efficiency and savings on cost. The law requires new heat pumps to have at least a 7.7 HSPF.

d. The Wattage

Wattage rates the amount of electricity your ventilation, air conditioning and heating system uses to provide a comfortable environment for you and your family. The unit of measurement is kilowatt-hours. Speed is the main determinant of the wattage of your system.

It is very important to consider the **efficiency and energy usage** of a system before deciding to buy it. These two factors will go a long way in helping you determine the cost-benefit ratio and whether it's worth it.

Finding Your Comfort Zone: A Guide to Choosing the Perfect HVAC System

When looking to buy an HVAC system, it is important to consider certain factors to ensure you select the most appropriate one. These factors include; the age and size of your home; the number of rooms you want to air-condition; local climate; utility costs at the local and regional level; the available warranties; and the type of system that meets your custom needs best.

This type of system consists of a **compressor, condenser, evaporator, and expansion valve.** The **compressor** is responsible for compressing the refrigerant gas and sending it to the condenser. The **condenser** then releases the heat from the refrigerant and converts it into a liquid. This liquid then passes through the **evaporator** and absorbs heat from the air before being sent back to the compressor. The **expansion valve** regulates the flow of refrigerant and helps maintain the desired temperature.

An HVAC unit is a complex system that requires regular maintenance and servicing in order to ensure it is working properly and efficiently. It is important to have an experienced technician inspect your system on a regular basis in order to ensure it is running at its best.

Picture: Courtesy

Empowering Energy Sustainability: A Closer Look at EPRA's Role in Kenya

By EiK Correspondent

Energy sustainability is a critical driver of modern development, especially in developing economies like Kenya. As one of the developing economies in Africa, industrialization expansion Kenya is nearing its zenith, thereby necessitating reliable supply of green energy. With a stable energy sector, Kenya would be able to make a commendable step towards the Vision 2030 Agenda, which aims to have Kenya become a newly-industrialized, middle-income economy that provides a high quality of life to its citizens in a clean and secure environment.

The Energy and Petroleum Regulatory Authority (EPRA) is to play a critical regulatory role which encompasses key sectors crucial to the nation's energy landscape. Regulation in this case spans a wide range of functions; chief among them being the generation, importation, exportation, transmission, distribution, supply, and usage of electrical energy. This excludes nuclear facility licensing. The authority also regulates the production, conversion, distribution, supply, marketing, and utilization of renewable energy sources. These comprehensive regulatory roles ensures a well-monitored, sustainable, and efficient energy ecosystem for the country.

The Authority has taken several initiatives and made contributions to the cause of empowering energy sustainability in Kenya. To begin with, EPRA operates within a well-defined legislative and regulatory framework which governs its activities. It is established by the Energy Act of 2019, and works hand-in-hand with other institutions in the energy sector such as the Ministry of Energy, Kenya Power and Lighting Company (KPLC), Kenya Electricity Transmission Company Limited (KETRACO), just to name a few.

Facilitating Integration of Renewable Energy

As part of its primary objectives, EPRA makes significant effort in promoting the use of renewable energy in Kenya. For starters, it is responsible for implementing and enforcing all legislation that are aimed at promoting renewable energy use. The authority has been facilitating the progressive integration of renewable energy into the national grid by issuing regulatory incentives; implementing feed-in tariffs; and licensing the players in the renewal energy sub-sectors.

Economic Regulation

EPRA plays a pivotal role in economic regulation and energy sustainability through its Economic Regulation arm, which encompasses various crucial functions. Firstly, EPRA engages in energy planning, which involves strategic foresight and resource allocation to ensure a balanced and sustainable energy supply. Secondly, the authority conducts energy pricing and competition analysis to foster fair market practices and encourage efficiency in the energy sector. Additionally, EPRA monitors compliance with regulations to uphold standards, promote transparency, and safeguard consumer interests. Through these multifaceted activities, EPRA contributes significantly to fostering economic regulation while advancing energy sustainability goals.

Collecting and Maintaining Energy Data

EPRA is mandated under section 10 subsection (jj) of the Energy Act, 2019, to collect and maintain energy data. In carrying out its mandate, EPRA conducts regulatory research and policy analysis across the electricity, petroleum, and renewable energy subsectors. Such information and statistics helps inform policy decisions; monitor market trends; plan energy resources; enforce regulations; attract investments in sustainable energy; and ensure emergency preparedness. This data-driven approach supports efficient energy governance, market transparency, sustainable development, and resilience in the energy sector, ultimately benefiting consumers, industry players, and the environment.

Policy Advocacy

The Energy and Petroleum Regulatory Authority (EPRA) takes its policy advocacy mandate quite seriously, as exemplified by its involvement in engaging other industry stakeholders to formulate policies and regulations that supplement existing energy laws and provide specifically for energy sustainability. A few of these Regulations are The Energy (Solar Water Heating) Regulations, 2022, the Energy (Net Metering) Regulations, 2022 and the Appliances (Energy Performance and Labeling Amendment) Regulations, 2018.

Early 2024, The International Tracking Standard Foundation proposed to have EPRA as an issuer of the International Renewable Energy Certificate (I-REC) in Kenya. This means that if EPRA gets approved as a local issuer, it will have the capacity to issue I-REC certificates to manufacturers who produce their goods using renewable sources of energy. This is one of the most recent strides EPRA has achieved in the realm of renewable energy, in pursuit of energy sustainability.

Energy Audits

As much as the energy sector is on an upward scale currently, any steps made towards the right direction could easily be undone if the industry goes unregulated. Hence, EPRA makes sure to conduct regular energy audits in industrial facilities to make sure their activities are in complete alignment with the objective of sustainable energy consumption. Through these audits, EPRA is also able to identify any areas of inefficiency and provide appropriate recommendations as to how to harness energy in a sustainable way that would benefit both its users and the environment.

EPRA places great emphasis on the importance of using energy in a sustainable manner so as to preserve the environment and mitigate the adverse effects of climate change. Through various awareness campaigns and incentive programs, the Authority aims to reach as many people as possible and sensitize them on the importance of responsible consumption. In the same vein, Kenya is scheduled to host the International Energy Agency's World Energy Efficiency Conference late May, 2024. Notably, Kenya will be the first African country to host this conference, which will bring together global stakeholders in the energy sector, to expedite policy action on energy efficiency.

It is no secret that the growth of Kenya's energy sector is a metric through which her economic viability can be measured. From the Vision 2030 Agenda to Sustainable Development Goal (SDG) 7, which is to ensure affordable, reliable and sustainable modern energy for all, Kenya's commitment to achieving energy sustainability is on the right growth tangent. However, for the energy sector in Kenya to stay on a steady growth path, all the stakeholders in the sector must commit to throwing their weight behind the sustainable use of energy.

EPRA leads the way in empowering energy sustainability in various ways, even going an extra mile beyond its statutorily-provided functions. With collaborative effort, we can fully adopt practices that allow us to utilize energy without putting the energy needs of future generations in jeopardy.

Picture: Courtesy

Navigating Nairobi's Rainy Realities: Impact of Floods on Urban Infrastructure

By EiK Correspondent

Picture: Courtesy

The March-April-May rains have been known to come with an aspect of disruption, but the 2024 rains scaled the otherwise non-anticipated disruption to destruction. From superhighways to bridges; housing estates to businesses; schools, and social establishments – these rains brought flooding that tested even what previously has been beheld as Nairobi's infrastructural masterpieces.

The impact of the March-April-May rains (MAM), has been felt across Kenya; with the Kenya Red Cross putting the number of those whose lives have been claimed at 261 as of May 18. 162 persons remain missing. The damage to infrastructure is wanton, with 67 roads destroyed, 129 schools affected and 47, 531 households displaced. Nairobi, the heartbeat of the country and home to over 4.3 million people, took a massive hit in the unbecoming floods.

Impact of Floods on Urban Infrastructure

Thika Superhighway and Nairobi Expressway are two of Nairobi's masterpiece infrastructural transport marvels. Yet, sections of these two turned into rivers, with depth and flow, at the height of the floods. The floods marred transport in and out the city, affecting other major roads connecting to estates and satellite towns. The impact of the flooded roads ranged from mild inconveniences like traffic jams to life-threatening situations where vehicles were flipped by the storm waters. In some areas, roads were rendered completely impassable when bridges got swept away or rivers burst their banks and spilled onto the roads.

Jomo Kenyatta International Airport was not spared the aftermath of the torrential rains. There was marked damage to some terminals which leaked and grossly affected service delivery. The damage to cargo cold rooms was more pronounced. Sections of the airport and access roads flooded.

Impact on Housing

The impact of floods on residential areas is stark. Informal settlements that constitute poorly constructed homes often bear the brunt of floodwaters, and this has almost become a norm during the long rains. However, the floodwaters from the recent floods permeated middle and upper class residential estates alike, submerging houses and displacing scores. The situation was further aggravated by the lack of proper sewage systems, resulting in a mix of rainwater and sewage that poses serious health risks, including waterborne diseases such as cholera and typhoid.

Impact on Economy

The economic ramifications of flooding will be felt for months to come. The disruption of transportation and commerce leads to lost productivity and increased operational costs for businesses. Infrastructure damage necessitates substantial repair and maintenance expenditure by the government. Informal sector workers, who constitute a significant portion of Nairobi's workforce, are particularly affected as their livelihoods are directly impacted by their inability to operate during floods.

Mitigation and Adaptation Strategies

In many ways, the recent floods are not a disaster in Nairobi's, or Kenya's making. Many countries, regions and cities have been hit hard by extreme weather occasioned by climate change. At the same time, flooding has always been a present reality even when the amounts of rain were much lower than recently experienced. This calls for long-term, multi-faceted approach in addressing the capital's recurrent flooding issues.

- **Urban Planning**

The urban planning in Nairobi, the recent floods have revealed, is no plan at all. Building and construction is haphazard and seems to follow no zoning guidelines. The existing drainage systems cannot withstand heightened precipitation. Unchecked garbage dumping and littering results in blockage of drainage systems. One solution to the flooding problem is implementing master plans that consider the complexity of urban fabric and incorporates spatial and temporal scales in the said planning.

- **Ecological Zoning**

National Environmental Management Authority (NEMA) has strict regulations in place on building on riparian land; but this has so far done little in mitigating construction on riparian land and wetlands. The floods are an urgent call to uphold environmental legislation and checking land sale, land use and construction in flood-prone areas.

- **Political Goodwill**

Flood mitigation in Nairobi reveals a systemic issue deeply entrenched in our political thinking. Even with enough forewarning, not much has been done in terms of flood mitigation projects and prevention measures are shelved the moment the floods seem to pass, awaiting the next rain cycle.

The lack of prioritization puts the whole city, and indeed the country, at risk at a time that the world should be growing alive to the adverse effects of climate change and building climate resilience. Flood risks call for cooperation and prioritization of preventative and adaptive measures across all levels of government, and incorporation of the community in the said measures.

Early warning in itself is not enough to address Nairobi's flooding issues. Warnings can only do so much if nothing is done in anticipation of the floods. Adopting green solutions like planting trees, frequently unclogging drainage, and permeable pavements are some of the solutions that will reduce surface runoff and by extension reduce flooding in Nairobi.

Picture: Courtesy

Comparison Study of the Three Common Short Circuit Methods Used in Building Services: A Case Study of Stoni Athi Resort.

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Picture: Courtesy

1.0 Introduction

When a fault occurs in any electric system, the energy that flows as a consequence usually has the potential to damage the equipment and cables. In certain circumstances, it can also endanger life, either through electrocution or by consequential fire. The fault level will depend on; the power available from the source, the impedance of the network from source to the point of the fault, the impedance of the fault, the voltage at the time of the fault and any stored energy within the power system network.

The type of fault will have an effect on the calculation as there are several ways in which faults can occur. These include; Phase to earth, Phase to phase, Phase to phase to earth and Phase to phase to phase. It is normal to assume the worst case, that is the fault has negligible impedance and is a three –phase symmetrical fault.

2.0 Methodology and Designs

2.01 Project Background

Stoni Athi Phase 1 project currently gets its source of power from the public utility company (Kenya Power). It is served from a pole mounted 315 KVA,11/0.4 KV Transformer and a 350 KVA Diesel Generator for Emergency purposes during Power outage. The Low Voltage Lines and the transformer is located at a distance of 200M from the main Electrical load. Due to expansion, a new transformer of 800KVA is required to serve the new load. To ensure protection of the new installations, a new circuit breaker with a specific short circuit capacity is required.

2.02 Justification

To minimize damage and disruption caused by electrical faults, protection must be provided that will isolate that part of the system in which the fault has occurred. Before protection equipment is selected, it is necessary to carry out assessment of the anticipated fault levels in the network. The fault level should be determined at various locations within the electrical network to ensure that the switchgear and cable which are provided can withstand the energy of a fault without damage or degradation. The power distribution network for the proposed Stoni Athi Resort is as shown on Figure 1. The value of short circuit should be able to be ascertained at any point in the distribution network.

2.03 Design Analysis

For design purposes, a power factor of 0.85 was considered. For Lighting Designs, the percentage reflectance of the Ceiling, Wall and Floor was taken to be 70:50:20 percent. [4] was used for the selection of the light fittings while [5] was used to determine the required luminance level of every room according to its purpose. The maintenance factor of the lamps was taken to be 0.85 while the utilization factors of the lamps were found using extrapolation and interpolation formulas based on the value of the room indices obtained from calculation.

To get the number of bulbs to be used in a certain room, the desired luminance of the room, the area of the room, the utilization factor of the lamps, the maintenance factor of the lamps and the lumen rating of the lamp were obtained first by calculation or by reading from the manufacturers' manuals having considered the room reflectance. Room luminance is the desired light intensity of a room and it is given in lumens per square meter or lux. Every room has its own desired luminance

The area of the room is the total area of the interior room excluding the thickness of the walls. It is given by the room length multiplied by the room height and it is given in square meter. The utilization factor (U_F) of a chosen lamp was obtained from the lamps manufacturers' manuals having considered the desired room reflectance. It can be computed using interpolation or extrapolation in case the values cannot be read directly from the manual. The utilization factor is a value between 0 and 1 which represents the percentage of the total lamp lumens in the room that fall on the work plane. It takes into account the room reflectance, room shape, polar distribution and light output ratio of the fitting. Utilization factor can be obtained from the room index. Room index is a ratio given as follows

$$R_i = L * \frac{W}{(L+W)H_m}$$

Where
-Room Index
-Length of the Room
-Width of the Room
-Working Height of the Room

Lamp lumen maintenance (M_F) factor expresses the usual reduction in luminosity over lifetime. The rated lamp lumen rating (ϕ is a figure which describes the light intensity of a certain lamp. It is measured in lumens or candela. From the foregoing terms, the number of lamps (N) in a room can be obtained from the following equation

$$N = E * \frac{A}{U_F * M_F * \phi}$$

Where
-The number of lamps
-The desired luminance of a room in lumens per square meter or lux
-Utilization Factor
-Maintenance factor
--Lumen rating of the lamp

2.04 Electrical Load Analysis

The Electrical Load for the Proposed Stoni Athi Resort Phase 2 was analyzed under the following Sub-sections; Electrical Lighting Load, Electrical Small Power Load, Electrical Load for Heating, Ventilation and Air Conditioning Systems (HVAC)
and Electrical Load for Solar Water Heating Systems (SWHS).

2.05 Sizing of the Transformer

The total power demand for Stoni Athi Phase 2A and 2B was 189,032.67 W. An allowance of 10% was provided to cater for design errors occasioned by assumptions and omissions. The new real power demand therefore was 207,935.94 W. The Design Power Factor used was 0.85. To convert the real power to apparent power, the real power was divided by the power factor. The apparent power demand was therefore obtained to be 244,630.52 VA, or 244.63 KVA.

2.06 Sizing of the main incomer breaker

The existing Main Incomer Circuit Breaker at the Main Low Voltage Board is rated 400A.The new Incomer Main Circuit Breaker must be able to sustain the load for both Phase 1 and Phase 2 of the Projects. The Secondary phase current for the proposed 800 KVA Transformer is 1309.33 A from calculations. The available breaker according to Schneider Pricing Catalogue is Moulded Case Circuit Breaker, Make Compact NS, Manually Operated, Mic. 2.0 Ref. No. 33484,1600A,4 Pole 50 kA Breaking Capacity, Thermal Trip Unit 0.4-1 In, Magnetic Trip Unit 5-10 Ir. The size of the circuit breaker was selected while considering the current carrying capacity of cables and switchgear protection.

2.07 Sizing of the sub-main cables

The cables were chosen in such a way so as to maintain the voltage at the distribution end within the acceptable limit as recommended by [6].

2.08 Prospective Short Circuit Current

Prospective short circuit current at different points on the building was determined using percentage impedance method. Other methods which can be used to determine short circuit current include symmetrical components method and resistance method among others.

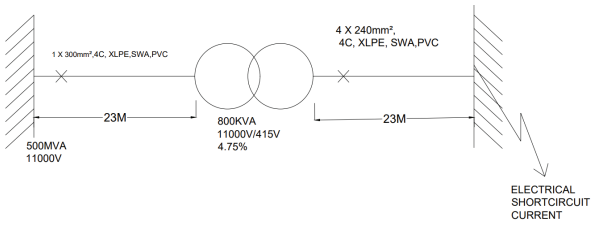

Figure 1: One-line Schematic Diagram for Stoni Athi Resort Project with modification
(Courtesy of Machakos Ranch)

2.081 Load Current and Cable Current Carrying Capacity

The rating of the circuit breaker should be greater than the design current, but less than the maximum current capacity of the cables. [1]

$I_d > I_b > I_c$
Where
I_d-Design Current
I_b-Circuit Breaker Rating
I_c-Cable Current Carrying Capacity
The voltage drop limit of the supply voltage at the consumer's

distribution terminals is not expected to exceed 4% as per the Kenya's National Grid Code. Since the resistance of a cable is directly proportional to the resistivity of the cable and inversely proportional the cross-sectional area of the cable, the right size of the cable was obtained by making sure that the total voltage drop does not exceed the 4% by using the following formula

$$V_d = I * \mathrm{p} * L$$

Where
----------Voltage drop
---------- Design current
----------Resistivity in milliohms per ampere per meter
---------- Length of the cable

3.0 Results

3.01 Percentage Impedance Method

When determining the short circuit prospective current using percentage impedance method, the following equations were used

$$Source\ impedance\ reactance\% = KVA_b * \frac{10^2}{MVA_s * 10^3}$$

Where
base value in KVA
- fault level given by the supply authority

$$Cable\ impedance\ reactance = KVA_b(xl) * \frac{10^5}{V^2}$$

Where
is the impedance per meter of the cable
- is the length of the cable

$$Transformer\ reactance(\%) = KVA_b * \frac{Z}{TR}$$

Where
- is the normal reactance of the transformer
- is the transformer rating
The fault level is given by

$$MVA_F = KVA_b * \frac{10^2}{Total\ \%\ Impedance * 10^3}$$

Short circuit current in kA is given by

$$I_{sc} = MVA_F * \frac{10^3}{1.732 * V}$$

3.02 Symmetrical Method

$$S_B^{Old} = 500\ MVA$$

$$V_B^{Old} = 11000V$$

$$S_B = \sqrt{3}\ V_B * I_B$$

$$500 * 10^6 = \sqrt{3} * 11000 * I_B$$

$$I_B = 500 * \frac{10^6}{\sqrt{3} * 11000}$$

$$= 26{,}243.19A$$

$$Z_B = \frac{V_B}{I_B}$$

3.03 Resistance Method

$$Z_{tr} = \frac{U_{20}^2}{S_n} * \frac{U_{sc}}{100}$$

$$= \frac{415^2}{800 * 10^3} * \frac{4.75}{100}$$

$$= 10.227 * 10^{-3}$$

$$R_{tr} = 0.31Z_{tr}$$

$$X_{tr} = 0.95Z_{tr}$$

Table 1. Comparison of Short Circuit Analysis Methods with Conventional Method

Item Number	Short Circuit Analysis Method	Short Circuit Current(kA)
1.	Conventional Method (Transformer Terminals)	23.43
2.	Percentage Impedance Method	21.50
3.	Symmetrical Components Method	17.50
4.	Resistance Method	23.30

4.0 Discussion

The short circuit current capacities as shown in table 1 are within the same range with acceptable tolerances. Resistance method has the highest short circuit current capacity of 23.30kA, closely followed by percentage impedance method (21.50kA) while symmetrical components method has the least short circuit current capacity (17.50kA) as compared with the short circuit current at the terminals of the transformer.

5.0 Conclusion

When calculating the short circuit current capacity of circuit breakers, it recommended to consider the worst case scenario of the three methods. Out this choice, Resistance method should thus be adopted as the most appropriate method of calculating short circuit currents in building services as its value is much closer to the short circuit values at the secondary terminals of the transformer.

Further research is recommended on computation of the same short circuit values using Park's Transformation and using bus impedance matrix as proposed in other literature.

Acknowledgement

I would like to extend my gratitude to my Msc. Thesis Research Supervisors Professors Christopher Maina Muriithi and Stanley Irungu Kamau for their worthy contributions towards preparation of this Paper as well Stoni Athi Resort Management for granting me an opportunity to use their Electrical Engineering Design Data to present this paper

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Picture: Courtesy

How Kenya is Pursuing a Nuclear Power Plant

NuPEA CEO says it'll help cure problem of frequent blackouts

By EiK Correspondent

NuPEA chief executive Justus Wabuyabo leads the agency's management in a photo op with Energy PS Alex Wachira (third left) and DPP Renson Ingonga (right) during the launch of the strategic plan on March 18/ COURTESY

As the world grapples with the existential threat of climate change, Kenya finds itself at a pivotal moment, ready to embark on a transformative journey towards sustainability. President William Ruto's pledge to achieve complete transition to green energy by 2050 underscores the urgency and ambition driving the country's energy agenda. At the forefront of this movement is the Nuclear Power and Energy Agency (NuPEA), which emerges as a beacon of hope, offering a path to sustainable energy independence.

In an exclusive interview with the agency's CEO Justus Wabubayo, we delve into the ambitious plans to establish the country's first nuclear power plant. Our conversation unfolded like a roadmap to the future, as the CEO unveiled the visionary plans to spearhead the establishment of the plant. We also unravel the complexi-ties, motivations and strategic im-peratives driving the intergration of nuclear power into the energy landscape. From the pressing need for reli-able, low-carbon energy sources to the intricate preparations required to navigate this journey, our inter-view offers a glimpse into the bold vision of the man expected to deliver this vital project.

JUSTUS WABUYABO

We intend to put up a plant of 1,000 megawatts, which will be delivered in five years

Why does Kenya require nuclear energy?

First and foremost, as you are aware, the country has been facing fre-quent blackouts, which sometimes are caused by intermittent sources of energy, and which has really af-fected the efforts by our country to industrialise. Nuclear energy has been proven to be a stable base load in the sense it can provide measured electricity without any intermittency. Another aspect of nuclear is that we are grappling with climate change, and one of its main causes is the Co2 emissions into the air. There-fore, during the COP 28, countries of the world came together and agreed to increase the generation of nuclear energy in a bid to address it. Nuclear power plants do not pro-duce Co2 during operations, and so,

they are a clean source of clean energy. By their size, the nuclear plants also occupy very little footprint and, therefore, they have a very small car-bon footprint. You can choose to locate it in a place where you know it will have little impact on the environment, and you will not have to cut too many trees or affect a lot of vegeta-tion, and that is very important to us as a country.

For a long time, we have depended on energy generated through fossil fuels and as we plan to retire it in 2032, nuclear will provide a very ap-propriate solution to complement the other sources of clean energy that we get from hydro, geothermal, solar and wind. So, nuclear power is important to us at this point in not only providing us a stable, reliable and affordable electricity, but also in spurring our economic growth. By attracting Foreign Direct In-vestment (FDI), we shall have more investors coming into our country to set up industries that will have a ripple effect of creating employment for our people. It also help us as a country to do value addition so that we can export more of finished products rather than exporting raw materials, thus help us manage foreign exchange balance. At an immediate level, nuclear power plant will be a source of em-ployment, because nuclear plants around the world are estimated to employ 800-1,000 people direct-ly and can support an additional 35,000 indirectly.

Where are we in terms of developing the nuclear plant?

As you may be aware, Kenya is a member of the International Atomic Energy Agency (IAEA). For countries planning to set up nuclear power plants, IAEA has set out what we call a 'Milestone Ap-proach', which has three phases to be adhered to. In the first phase, a country makes necessary considerations before a decision to launch a nuclear power programme is undertaken. This is basically a brainstorm-ing session by the policy makers, political leadership among other stakeholders on how to power their economy. According to the IAEA, experience suggests that the time from the ini-tial consideration of the nuclear power option by a country to the.

Sustainable Energy Solutions in Kenya's Built Environment

By EiK Correspondent

Picture: Courtesy

Kenya's built environment is undergoing a significant transformation driven by the need for sustainable energy solutions. As urbanization accelerates and the demand for energy increases, the focus has shifted towards integrating renewable energy sources and energy-efficient technologies into buildings.

The Need for Sustainable Energy Solutions

Globally, many countries are facing the dual challenge of the ever-increasing energy demands and the urgent need to minimize environmental impact. The rapid growth of urban areas has marginally increased energy consumption. If this increased consumption is not approached sustainably, the results on the environment can be devastating. Sustainable energy solutions are crucial for addressing these challenges and ensuring that Kenya's development is both environmentally friendly and economically viable.

Renewable Energy Integration

If Kenya hopes to achieve sustainability in its built environment, the most obvious route to go is integrating renewable energy sources. Thankfully, there is an abundance of renewable energy sources like solar, geothermal, wind and biomass. Capitalizing on these resources will reduce dependence of fossil fuels and also reduce carbon emissions.

1. Solar Energy:

- Solar Photovoltaic (PV) Systems: Solar PV systems are becoming commonplace in residential, commercial, and industrial buildings across Kenya. These systems convert sunlight directly into electricity, providing a clean and sustainable energy source. For instance, the Strathmore University in Nairobi has implemented a large-scale solar PV system that supplies a significant portion of its electricity needs.
- Solar Water Heating: Solar water heaters are an efficient way to harness solar energy for domestic and commercial hot water needs. The Kenyan government has mandated the use of solar water heaters in new buildings, promoting widespread adoption.

2. Wind Energy:

- While large-scale wind farms are more common in rural areas, small wind turbines are being installed in urban settings to supplement building energy needs. The Ngong Hills Wind Power Station is a prime example of a successful wind energy project that contributes to the national grid, showcasing the potential for wind energy integration.

3. Geothermal Energy:

- Kenya is an undisputed leader in geothermal energy production, which provides a reliable and sustainable power source for buildings. The Green Energy Park in Olkaria promises geothermal energy for industrial, commercial and recreational purposes.

Energy Efficiency in Building Design

In addition to renewable energy integration, energy efficiency is a critical component of sustainable building design. Energy-efficient buildings reduce energy consumption, lower operational costs, and decrease environmental impact. Several strategies and technologies are employed to enhance energy efficiency in Kenya's built environment.

Green Building Standards: Adopting green building standards such as Leadership in Energy and Environmental Design (LEED) and the Green Star rating system helps promote energy-efficient practices. These standards provide guidelines for designing and constructing buildings that meet high sustainability criteria.

Building Insulation and Design: Proper insulation and building design can significantly reduce energy consumption by maintaining indoor temperatures and reducing the need for heating and cooling. Techniques such as double-glazed windows, reflective roofing materials, and insulated walls are increasingly being used in Kenyan buildings.

Efficient HVAC Systems: Heating, Ventilation, and Air Conditioning (HVAC) systems are major energy consumers in buildings. Energy-efficient HVAC systems, such as variable refrigerant flow (VRF) systems and geothermal heat pumps, are being integrated into modern buildings to optimize energy use.

Government Policies and Incentives

The Kenyan government has implemented several policies and incentives to promote sustainable energy solutions in the built environment. One such policy is the Feed-in Tariffs (FiTs) which allows renewable energy producers to sell excess electricity to the national grid at a predetermined rate, making investments in renewable energy more attractive.

Tax incentives for renewable energy projects, such as reduced import duties on solar panels and wind turbines, will help lower the cost of sustainable energy solutions. Finally, regulations and standards like The Energy (Solar Water Heating) Regulations which require all buildings using more than 100 liters of hot water per day to install solar water heating systems will further align sustainability measures.

Challenges and Future Outlook

Despite the progress, several challenges hinder the widespread adoption of sustainable energy solutions. High initial costs, limited access to financing, and inadequate technical expertise are some of the impeding factors. Addressing these challenges requires continued government support, public-private partnerships, and investment in capacity building.

Still, the future of sustainable energy in Kenya's built environment is promising. Advances in renewable energy technologies and increased awareness of sustainability issues are steering the transition towards greener buildings. Continued efforts to promote energy efficiency and renewable energy integration will be crucial in ensuring that Kenya's built environment is sustainable, resilient, and capable of supporting the country's economic growth.

Picture: Courtesy

Electrical Engineering Services in Built Environment - Opportunities for Electrical Engineers in the Affordable Housing Program

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Introduction

Housing Agenda is one of the key pillars of the Government of Kenya's Bottom-up Economic Transformation Agenda (BETA) plan and is aligned to the Fourth Medium Term plan (MTP) of Kenya's vision 2030. The government of Kenya aims at delivering Two Hundred and Fifty affordable, low cost housing units annually with a budgetary allocation of Kshs 35.5 billion. Additionally the Housing agenda aims at creating over 100,000 jobs for youths including Engineers. This is a very great opportunity for the engineers to play their rightful roles in national prosperity and development. Key programs of the Housing Agenda include: Construction of markets, Construction of Housing units for National Police and Kenya Prisons, Kenya Urban Programme, Construction of Social Housing Units, Construction of affordable housing units and Mortgage facilities. [1]

Table 1: Distribution of 2023/2024budgetary allocations in Housing Agenda

Program	Allocation (Kshs)
Construction of Markets	5.1 Billion
Mortgage facilities	5.0 Billion
Construction of Affordable Housing Units	3.2 Billion
Kenya Informal Settlement Improvement Project – Phase II	5.6 Billion
Construction of Housing Units for National Police and Kenya Prisons	1.0 Billion
Kenyan Urban Program (KenUP);	7.2 Billion
Construction of Social Housing Units	3.3 Billion

Source: The National Treasury and Economic Planning-Financial year 2023/2024 Budget

The Housing agenda will achieve its objective with full inclusion and adoption of relevant electrical engineering services in the built environment. Efficient, safer, environmental friendly and affordable electrical engineering services shall be adequately designed, installed, operated and maintained under the supervision of Electrical Engineers.

A building without installation of electrical engineering service cannot be adequately used for residential, commercial, occupational, recreational or even health facility. These services make a building functional, efficient, and comfortable safer and secure livable. Unfortunately some developers and builders opt for exclusion of Electrical engineers from their projects thus ending up with a risky electrical installations that is hazardous to the building itself and its occupants. This has led to electrical accident that have been destructive to environment, property and to unfortunate extent fatal as recorded by the Energy and Petroleum Regulatory Authority (EPRA).

In the year 2020/2021, 65 out of 120 reported cases of electrical accidents and incidents were fatal whereas in 2019/2020 97 out of 133 reported cases were fatal. [2] More than 50% of these cases were in both financial years were caused by the following occurrences:

Table 2: Root causes of reported accidents in the years 2019/2020 and 2020/2021

Period Cause of accident	2019/2020	2020/2021
Poor state of repair of the electricity distribution network.	25.6%	19%
Defective Consumer Installation	14.3%	12%
Illegal extension	12.0%	7%
Low awareness on electrical safety/Ignorance and Negligence	10.5%	6%
Unsafe work practices/work related	8.3%	11%
Proximity to power lines	3.8%	10%
Total for these causes	**74.5%**	**65%**

Source: Energy and Petroleum Regulatory Authority (EPRA) – Integrates Annual Report and Financial Statements for the years ended 30th June 2020 and 30th June 2021.

In view of the above data, it is evident that electrical accidents in Built environment is significantly high and this can be attributed to lack of adequate involvement of Electrical Engineers in development projects.

2. Overview of Electrical Engineering Services in Built environment.

The scope of electrical engineering services in the built environment have expanded over time due to demand for energy efficiency and conservations, aesthetics, safety and security, improved accessibility, Power back up systems, telecommunications services, automated solutions, building management systems, Artificial Intelligence among others. Electrical Engineers, with their enormous attributes of creativity, team player, problem solving skills, reliability, safety conscious, inquisitive among many more, have demonstrated the ability to tackle these demands thus enabling the client realize their dreams. This has been achieved through design calculation from first principles based on various factors which depend on building type, purpose, location and physical parameters. [3].

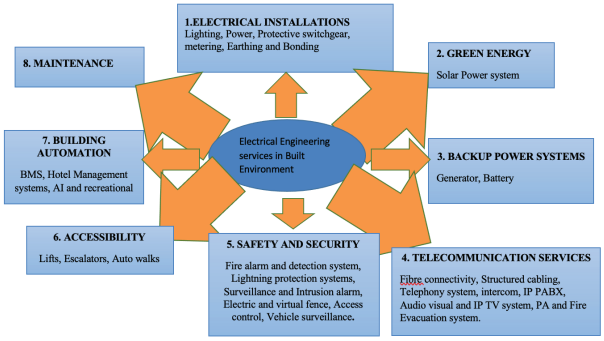

Figure 1: Electrical Engineering services in Built environment

3. Opportunities for Electrical Engineers in Built Environment- A case of government of Kenya advertised tenders.

Electrical Engineers are the prime movers in the global, regional and national quest towards full adoption of green energy and mitigation against climate change. The United Nations SDG goal 7 aims at ensuring access to affordable, reliable, sustainable and modern energy for all whereas SDG goal 13 aims at urgent action to combat climate change and its impact. The International Energy Agency (IEA) records that the built environment accounts for more than a third of global energy consumption and emissions through construction, cooling, heating, lighting as well as appliances and equipment. [4] IEA notes that incorporating right strategies could see buildings becoming 40% more energy efficient than today by the year 2040. [4] In the recently concluded Inaugural Africa Climate summit 2023 (ACS2023), African heads of state committed to building effective partnership between Africa and other regions, to meet the needs for financial, technical and technological support, and knowledge sharing for climate change adaptation as well as Promoting investments in urban infrastructure through upgrading informal settlements and slum areas to build climate resilient cities and urban centers. [5]

The involvement of Electrical Engineers in the affordable house not only does it ensure that the goals are realized but also ensures achievement of many other benefits such as: Reduction of GHG emissions and other environmental impacts, lower energy costs, increased employment opportunities and market enhancement, demonstrated leadership in public awareness of energy conservation, improved comfortability, Value addition to the projects among others.

The government through various MDAs has advertised opportunities under Housing agenda for electrical engineers though tenders. The categories of these tenders are:

Construction of Various Economic stimulus Program (ESP) markets in various counties; Proposed Development of fresh produce markets in various counties; Design, Build, Finance and Transfer of Housing Units and Associated Infrastructure for National Police service, Kenya Defense forces and in various counties; proposed construction of county aggregation and industrial parks in various counties. [6]. In these projects, the government has laid down terms of references that embrace green building adoption incorporating green energy supply, compliance with IFC EDGE minimum standards, robust future proof ICT systems, surveillance, fiber inter-connectivity to commercial and other dwellings, enhanced accessibility by elderly, differently enabled, vulnerable group among others. The element of efficiency and affordability during occupation and maintenance phase has also been greatly emphasized.

Despite the need for electrical engineering services in built environment and the massive rollout of infrastructural projects in Kenya, several gaps and impediments to full involvement of Electrical Engineers in affordable housing projects have been noted.

An analysis of the advertised tenders revealed these gaps in documentation that include:

Designs, Specifications and Bills of quantities for Electrical Engineering services. Electrical Installation works and structured cabling works were provided for as provisional sum. Most of the projected had these provisional sums capped at One Million Kenya Shillings which is an under budgeting for these services considering the magnitude of the project and target groups. This implies that the opinion of Electrical Engineers was not sought for or was ignored during project design and documentation.

Qualification for Electrical subcontractor was not included in the tender evaluation criteria. This gives room for the

contractor to avoid using right personnel in implementation of Electrical Installations works. The contractor may opt to involve inexperienced and semi-skilled personnel to in installing the electrical works.

Little or no emphasis to involvement of local personnel especially for turnkey projects. In the evaluation criteria, inclusion of local professionals was assigned a maximum of 1 mark only. This is a threat to the local professionals including electrical Engineers who may be replaced by foreigners whose credentials may not be known or they are not in touch with the local regulations in the built environment.

These gaps if not addressed in urgently may lead to deficiencies in design, implementation and maintenance of the noble projects.

4. Challenges faced in deployment of Electrical Engineering services in Built Environment.

The National Construction Authority (NCA) in its Research Study on Failure and collapse of buildings in the construction Industry in Kenya noted that there was a weak regulatory regime in electrical engineering sector in the built environment with most building construction lacking electrical designs prepared by a Professional electrical engineer thus not compliant with the building code. [7] It also noted high involvement of unskilled and uncertified personnel undertaking electrical installation works with faulty designs and use of substandard materials for electrical installation works. This is a clear indication that the Electrical Engineers are not fully involved in these projects and gives room for shortcuts by unscrupulous business people who are out to save or make money at the expense of electrical safety and energy efficiency. The record keeping and public awareness on Electrical engineering services in built environment is also wanting especially from the industry regulators.

5. Conclusion

The government's housing agenda provides a great opportunity for Kenyan Engineers to showcase their skills, creativity and expertise. The electrical engineering services in built environment plays a critical role towards safety, energy conservation, interconnectivity, accessibility, comfortability, affordability and economic growth. There is no doubt based on the data and reports available from regulatory bodies in built environment that there are projects being implemented without full and adequate involvement of Electrical engineers thus causing electrical accidents and incidences some of whom have led to loss of lives.

Electrical engineers role in the successful deployment of built environment projects cannot be ignored considering the vast benefits they bring onboard as far as energy efficiency is concerned as well as safety, security, connectivity, automation and artificial intelligence is concerned. Despite the gas witnessed in the sampled government tenders above, there is still light at the end of the tunnel if all stakeholders can give this matter a collaborative approach for effective results.

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Understanding Automatic Fire Sprinkler System Design: (Hydraulic Calculation Method)

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Introduction

Automatic fire sprinkler system design is the process of planning, specifying, and creating detailed drawings and documents for the installation of an automatic fire sprinkler system within a building or structure. The design encompasses the selection of sprinkler types, locations, hydraulic calculations, pipe sizing, water supply requirements, alarm and detection system, control valves, piping network, breeching inlet, and other critical elements necessary to effectively control and suppress fires in accordance with NFPA standards and local building codes (National Plan and Building Regulation).

An understanding of automatic sprinkler system design is essential for engineers in the field of fire protection. It allows engineers to design systems that are efficient, cost-effective, and capable of responding quickly and effectively to changes in the environment. It is also essential for engineers to stay updated with technological advancements in automatic sprinkler system design to enhance their problem-solving skills related to this topic.

The purpose of this article is to ensure the efficiency, and effectiveness of these systems. By reviewing the current knowledge and practices in designing automatic sprinkler systems, engineers can identify gaps or areas for improvement in their designs.

This paper reviews the fundamentals of automatic fire sprinkler system design. It provides a comprehensive literature review on the topic and aims to be a resource for young engineers and professional engineers. The paper also discusses the modern monitoring components that are finally linked to the alarm and detection system and to the Building Management System (BMS) for the management of the system.

Materials and Methods

Automatic sprinkler systems have evolved significantly since their invention in 1864. Key concepts and theories in fire behavior, fluid dynamics, and material science have helped engineers design more effective and efficient systems. Fire behavior research has shown that different types of fires exhibit varying characteristics, such as heat release rate, flame spread rate, and smoke production. This knowledge helps engineers determine appropriate water discharge rates and coverage areas for optimal fire suppression. Fluid dynamics principles are essential for ensuring adequate water supply throughout the system. Engineers must consider factors such as pressure loss calculations, flow rates, pipe sizing, and hydraulic calculations to design efficient water distribution networks. The selection of suitable materials is critical for ensuring the longevity and reliability of automatic sprinkler systems. Research has focused on the corrosion resistance of pipes, sprinkler heads, and other components to prevent premature failures.

Several studies have contributed to the existing knowledge of automatic sprinkler system design. For example, research by Babrauskas and Peacock (1992) investigated fire suppression effectiveness in various occupancy types. Their findings highlighted the importance of considering factors such as ceiling height, fuel load, and ventilation conditions when designing sprinkler systems. Another study by Liu et al. (2017) focused on optimizing water distribution in automatic sprinkler systems using computational fluid dynamics simulations. Their research provided valuable insights into improving water flow patterns and minimizing pressure losses within the system.

Despite significant advancements, there are still gaps in our understanding of automatic sprinkler system design. One major gap is the lack of research on incorporating advanced technologies such as artificial intelligence or machine learning algorithms into the automatic fire sprinkler system. Exploring how these technologies can enhance fire detection accuracy or optimize water distribution could lead to more efficient designs. Additionally, there is a need for further research on integrating automatic sprinkler systems with other fire protection measures like smoke detectors or fire alarms. By continuing to research and develop new technologies, we can make fire prevention and suppression even more effective.

How does an Automatic Fire Sprinkler System work?

The system is a network of pipes filled with water under pressure. Individual sprinkler heads are strategically placed throughout the building. Each sprinkler head has a heat-sensitive element that triggers the release of water when exposed to high temperatures. When a fire breaks out, the heat causes the air temperature to rise. When the temperature reaches a certain threshold, the heat-sensitive element activates and releases water from the sprinkler head. The water absorbs heat from the fire, suppressing its growth. It is only where the fire is located that the sprinkler heads are activated. The advantage of installing such systems is that they respond quickly to fires due to their automatic activation mechanism, minimizing potential damage to property and reducing risks to occupants' lives.

Hydraulic calculations in system design

Hydraulic calculations are crucial for ensuring system design meets performance and safety standards. They involve determining water flow, pressure, friction loss, and pipe sizing to provide adequate water supply for effective fire suppression. Accurate calculations ensure the system functions correctly during emergencies.

Automatic Sprinkler System Design References

Applicable Codes: International Building Code (IBC), International Fire Code (IFC), NFPA 101

Applicable Standards: (NFPA 13), (NFPA 20), (NFPA 72), Underwriters Laboratories Inc. (UL) (Listing Authority), Factory Mutual, Inc. (FM) (Listing Authority)

Hydraulic Calculation Method: Detailed explanation of each step involved.

Consider The Following Example

Application: A typical Open Office,

Area: (37m) 120ft x (34m) 110ft = (1258m^2) 13200 ft^2

The Office consists of furniture, carpet, fall ceilings, and Venetian blinds, with stockpiles height of (≤ 3m) (≤ 10ft)

Note : (Refer to Figure 01: Floor Layout and a Schematic Drawing, with Automatic Fire Sprinkler System)

Step 01: Selecting Occupancy.

Ordinary Hazard (Group1) (Source: Table 10.2.4.2.1(a) pg.No.13-78 of the 2019 Edition.)

(Maximum Protection Area/Sprinkler) A_s = (12m^2) 130 ft^2

(Maximum Sprinkler Spacing) L max = S max = (4.6m) 15 ft.

Step 02: Select a Hydraulic density (D) GPM /ft^2.

D = 0.15 GPM / ft^2 (Source: Figure 19.3.3.1.1 on pages 13-162 of the 2019 Edition).

Hazard Classification is ORDINARY HAZARD (OH) (G1)

Hydraulic Area = (140m^2) 1500 ft^2 (Minimum Value)

Step 03: Determining the length of the hydraulically most dependent area.

L = 1.2 x √A (Source: NFPA 13 pg.No.13-470 of the 2019 Edition) (Eqtn. 01)

L = 1.2 x √1500ft^2

L = 46.47, therefore L ϕ48 ft (15m)

A = L x W,

W = (A / L), W = (1500ft^2/48ft)

Therefore W = 31.25 ϕ32ft (10m)

Step 04: Determine the number of sprinklers along the length of the hydraulic area.

$N_s = L_H / S_{max}$,

N_s = (48ft/15ft), Ns = 3.2. Therefore

N_s ϕ4 Nos.

Where:

N_s = Number of sprinklers, and

L_H = Length of Hydraulic Area.

Therefore, the actual distance between the sprinklers

S = (48ft/4ft), S = 12ft

Verifying "S" dimensions with total space length: = 120ft/12ft, = 10 Nos.

Take an offset of 6ft from both vertical lines, and continue offset with 12ft (Referring to the AutoCAD drawing)

Step 05: Determining the number of branch lines in the hydraulic area.

Width of Hydraulic area = 32 ft

No. of Branch line NB = (W_H /L_{max})

NB = 32ft/15ft

NB = 2.13 Nos., NB = 3 Nos.

The actual distance between branch lines L1= 32ft/3

L1= 10.66ft

Verifying the distance with the total width of 110 ft.: = 110ft/10.66ft

= 10. 32 Nos., ϕ11 Nos.

Therefore, L2 = (110ft/11)

L2 = 10ft

Take an offset of 5ft from both horizontal lines and continue offset with 10ft (Referring to the AutoCAD drawing).

Copy or add a sprinkler at each intersection point.

Verifying area coverage: A = S x L, A = 12 x 10, A = 120 ft^2 < 130 ft^2 and Therefore Accepted

Step 06: Determining minimum flow at hydraulically most demanding sprinklers.

Qs = D x As.

Verifying area coverage: As = L x S ft^2

As = 10 x 12

As = 120 ft^2 < 130 ft^2

Qs = D x As

Qs = 0.15 x 120

Qs = 18 GPM

Step 07: Determining the minimum pressure at the hydraulically most demanding sprinkler. (Ps)

$Q = K \times \sqrt{P}$

Where: K = 5.3 to 5.8

K = 5.6 (80), and (Orifice Dia ½ Inch)

Q = Flow rate

K = Factor (For pressure drop in sprinkler)

P = Pressure in "Psi" $P = (Qs/K)^2$

$P = (18/5.6)^2$, P = 10.33 Psi

Design Hint: The value of the pressure of the sprinkler is accepted (10.33Psi > 7 Psi (0.5bar)

Node calculation means hydraulic calculation.

Summary:

Type of system- wet, Hazard- OH-G1, Number of sprinklers in the hydraulic area - 12 Nos.

Qs= 18 GPM, Ps= 10.33 Psi, Material = Black Steel- SCH-40 (C-120)

Step 08: Pipe sizing and determining friction loss in each pipe segment and fittings. (Done In Excel)

Note: The Initial pipe size estimates are done using the Pipe Schedule Method (Source: Table 27.5.3.4 pg.No.13-304 of the 2019 Edition.) as shown in Table 01. And using the Hazen-Williams tables to calculate pressure drop in piping and across the fittings.

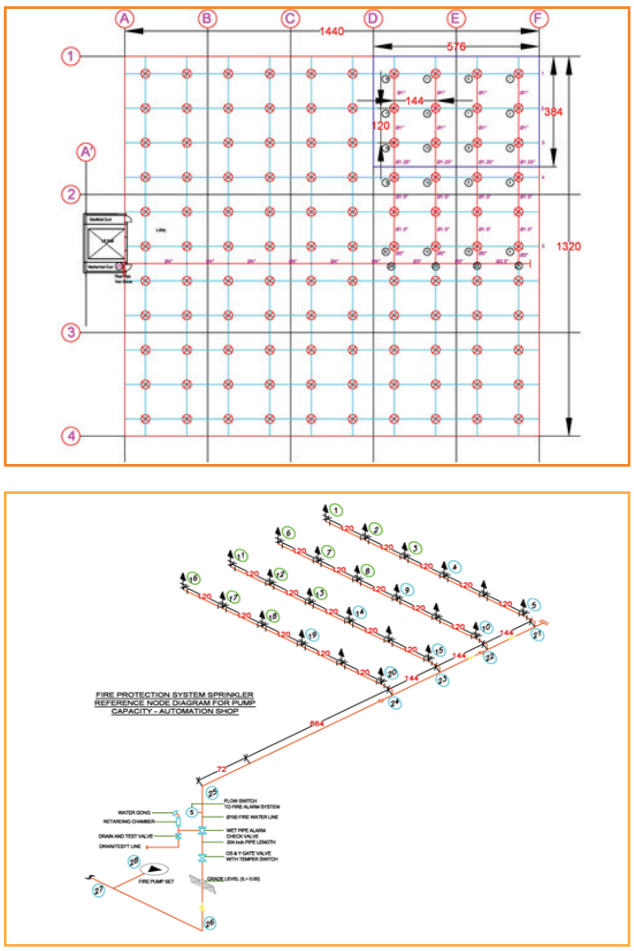

Figure 1: Floor Layout and Schematic Drawing, with Automatic Fire Sprinkler System

Table 1: Manual Hydraulic Calculations

Start Node	Q (Flow) - gpm	Pipe Dia. Size (Inch)	Pipe Length (ft.)	EQ. Length, for F+A (ft)	Pf Psi/ft. (Head Loss)	Total Pressure Drop	Required Pressure $P=(Q/5.6)^2$ + TPD	Calculation ($Q=K\sqrt{P}$)	End Node
1	18	1"	10	N/A	0.11	1.07	11.40	18.91	2
	18	1"	1Elbow / 1Tee	7	0.11	0.75	12.15	19.52	
2	37.52	1"	10	N/A	0.43	4.27	16.42	22.70	3
	37.52	1"	1Tee	5	0.43	2.13	18.55	24.12	
3	61.64	1.25"	10	N/A	0.28	2.78	21.33		4
	61.64	1.25"	1Tee	6	0.28	1.67	22.99		
4	61.64	1.5"	20	N/A	0.13	2.62	25.61		5
	61.64	1.5"	2Tee	16	0.13	2.10	27.71		
5	61.64	2"	5	N/A	0.04	0.19	27.90		21'
	61.64	2"	1Tee	10	0.04	0.39	28.29		
21'	61.64	2"	0.34	N/A	0.04	0.01	28.30		21
	61.64	2"	1Tee	10	0.04	0.39	28.69		
21	61.64	2.5"	12	N/A	0.02	0.21	28.90		22
	61.64	2.5"	1Tee	12	0.02	0.21	29.11		
22	123.28	3"	12	N/A	0.02	0.25	29.36		23
	123.28	3"	1Tee	15	0.02	0.31	29.67		
23	184.92	3"	12	N/A	0.04	0.51	30.18		24
	184.92	3"	1Tee	15	0.04	0.64	30.82		
24	246.56	4"	78	N/A	0.02	1.55	32.37		25
	246.56	4"	1Elbow / 6Tee	130	0.02	2.59	34.96		
25	246.56	4"	17	N/A	0.02	0.34	35.30		26
	246.56	4"	1E,1BV, 1CV	34	0.02	0.68	35.98		
26	246.56	4"	7	N/A	0.02	0.14	36.12		27
	246.56	4"	1Tee	20	0.02	0.40	36.51		
27	Pump								28
						P+F+A	36.51	PSI	
	1 foot of head is equivalent to 0.433 psi. (17 + 0.34 + 0.2)					STATIC HEAD P = (17.54*0.433 = 7.6)	7.6	PSI	
						Sub - Total	44.11	PSI	
						SAFETY FACTOR 10%	4.411	PSI	
						Total	48.521	PSI	

Therefore, System Demand is: 246.56gpm @ 48.741Psi

Step 09: Verify Compliance with NFPA Standards

Review design documentation, including layout and calculations, to ensure they follow NFPA standards. Conduct field inspections to confirm proper installation and perform flow tests on water supplies to meet NFPA 13 pressure requirements.

Step 10: Verify Manual Design Calculation with Elite Fire software for accuracy

Use Elite Fire Software for more accurate pipe sizes, flow, pressure drop, and System Curves.

Step 11: Pump Selection

Horizontal split-case pumps are widely used for their versatility and compatibility with diesel or electric motors. When selecting a system pump, several factors must be considered, including water supply, pump performance, and system demand. The pump must deliver a minimum of 150% of the rated flow at not less than 65% of the rated pressure. The pump must also not deliver over 140% of rated pressure with no flow. Refer to NFPA for pump characteristics curves. Each pump has a unique design curve representing its specific performance characteristics. Key Components Associated with the Pump Set: Suction Piping, Eccentric Reducers, Gate Valves (Outside Screw and Yoke, OS&Y) Butterfly Valves, Elbows and Tees, Circulation Relief Valve, Discharge Piping, Check Valve, Control Valve, Pressure Sensing Device, and Fire Sprinkler Pump Control Panel. Note: Avoid installing shutoff valves in pressure-sensing lines.

Setting Pressure

The pressure maintenance pump STOP pressure should equal the fire pump chum pressure plus the minimum static suction supply pressure. Pressure maintenance pump STOP pressure is 115 psi + 50 psi = 165 psi. The pressure settings for this example are for a fire pump rated at 1000 gpm and 100 psi with a chum pressure of 115 psi. The minimum static suction pressure is 50 psi.

The pressure maintenance pump START pressure should be at least 10 psi below its STOP pressure. Pressure maintenance pump START pressure is 165 psi - 10 psi = 155 psi

The fire pump START pressure should be 5 psi below the pressure maintenance pump START pressure. Fire pump START pressure is 155 psi- 5 psi = 150 psi.

Fire pump can be set to shut off automatically if the fire pump is the sole water supply, the pump can only be set to manual stop. Many fire departments and property insurers recommend manual stop settings. Verify pressures by observing the system pressure gauges.

Sizing Pump for Listing:

The formula for sizing a pump in horsepower (HP):

$$HP = (Q * H * \phi) / (3960 * \phi$$

Eqtn. 02

Where: HP: - The horsepower required, Q: - The flow rate in gallons per minute (GPM), H: - The head loss in feet., ϕ- The specific density of the fluid (usually in lb/ft^3), ϕ- The efficiency of the pump (expressed as a decimal, not a percentage). Note: 3960 is a constant used to convert units.

Step 12: Tank Sizing

Water supply is mainly from tanks and municipal services, and adequate pressure is crucial for effective fire sprinklers at the highest point of the system.

Key tank components: Anti-vortex plate, Puddle flange, Testing line, Suction line, Pressure relief pipeline. To calculate the needed water capacity for firefighting (e.g., 2 hours), use this formula:

(Water Storage Capacity (in gallons) = Firefighting Flow Rate (in GPM) Eqtn. 03

× Duration (in hours) × 60

Step 13: Fire Alarm System (Automatically Initiated)

Mechanical engineers Install detectors and alarms; while Electrical engineers and ICT handle wiring.

The system has three categories: inputs (detectors, pull stations, monitoring devices), an addressable control panel (system's brain), and outputs (notification appliances, door releases, speakers). Monitoring devices are crucial for sprinkler systems, including water flow detectors (sized for 175% of pump capacity), tamper switches, supervised/motorized gate valves, and electric butterfly valves.

Conclusions

Understanding automatic sprinkler system design is crucial for engineers and fire protection experts. By using hydraulic calculations, engineers ensure effective fire control. These calculations consider various factors to determine the necessary water density. A step-by-step example calculation is provided to aid in understanding the complex calculation process. This review aims to fill knowledge gaps and improve fire automatic fire sprinkler system design. Extensive research is needed to optimize computational tools in hydraulic calculations. This could save millions by creating better, more efficient systems.

Acknowledgment

I would like to express my sincere gratitude to the following individuals and organizations who have contributed to the successful design of the automatic sprinkler system presented in this article: Eng. Prof. Alex Muumbo, Eng. Nixon Oloo, Eng. Sarah Kimpaye, and the KAA Fire & Rescue team.

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Comprehensive Electrical Engineering Solutions: A Spotlight on Gedox Associates Limited

By Eng. Gabriel Jabongo

Director Gedox Associates Ltd and the Honorary Secretary Association of Consulting Engineers of Kenya.

About Gedox Associates Limited

Gedox Associates Limited, incorporated in 2001, is a registered consulting electrical engineering company by the Engineers Board of Kenya. Owned and operated by Kenyan directors, the company is staffed with fully qualified and Registered Engineers. We are fully compliant with all statutory registrations, licenses, and certificates required for operation.

Who are Electrical Services Engineers?

Electrical Services Engineers are integral in the design, installation, operation, and monitoring of technical systems within buildings. These systems encompass electrical, heating, and information and communication technology (ICT) services. The primary aim of building services engineers is to ensure that buildings operate sustainably and with minimal environmental impact. Their work is vital in integrating these services into building designs seamlessly, working closely with architects, structural engineers and quantity surveyors. They contribute significantly to energy-efficient structures, including green buildings, passive houses, and zero-energy buildings.

'Career paths for Electrical Services Engineers typically start with a university degree in electrical engineering, with a focus on Building Services, renewable energy, sustainability, low-carbon technologies, energy management, building automation, and building information modeling (BIM). Some professionals seek further accreditation, such as LEED (Leadership in Energy and Environmental Design), BREEAM (BRE Environmental Assessment Method), or CIBSE Low Carbon Consultants (LCC) and Energy Assessors (LCEA),' he added.

Scope of services offered in Electrical Building Services Engineering

The scope of work for Electrical Building Services Engineers is broad, from the initial design, implementation, commissioning, maintenance and monitoring as covering the below:

- **Incoming electrical supplies and electrical substations**

  The provision and management of incoming electrical supplies and substations are critical components of electrical services. This involves establishing connections to the main power grid and setting up substations to step down high-voltage electricity to safer, usable levels for buildings. These substations must be designed to handle the load requirements of the building while ensuring reliability and safety.

- **Electrical distribution system**

  The electrical distribution system ensures the efficient delivery of electricity from the substation to various parts of the building. This includes designing and installing electrical panels, circuit breakers, and distribution boards to manage and control the flow of electricity. Proper planning and implementation are essential to prevent overloads and ensure that power is delivered where and when it is needed.

- **Electrical lighting and power installations**

  This encompasses the installation of lighting fixtures, power outlets, and other electrical accessories. It includes selecting and installing lighting luminaries for both interior and exterior spaces, ensuring adequate illumination, and optimizing energy efficiency. Power accessories and fittings must be strategically placed to provide convenient access to electricity throughout the building.

- **Security/street lighting**

  Security and street lighting are vital for safety and visibility around the building's exterior. These systems are designed to provide adequate illumination to deter criminal activities and ensure safe passage for pedestrians and vehicles. This involves selecting appropriate energy efficient lighting fixtures, designing the layout for optimal coverage, and integrating with security systems.

- **Lightning protection systems**

  Lightning protection systems safeguard buildings from the damaging effects of lightning strikes. These systems include lightening spikes, grounding mechanisms, and surge protectors designed to direct the electrical energy safely into the ground, preventing damage to the structure and its electrical systems.

- **Fire detection and alarm systems.**

  Fire detection and alarm systems are crucial for early detection and warning of fires. These systems include smoke detectors, heat detectors, manual call points, and alarm sounders. Proper installation and integration with other safety systems ensure that occupants are quickly alerted and can evacuate safely in the event of a fire.

- **Security monitoring-controlled access management systems**

  Controlled access management systems are designed to monitor and regulate entry into a building. These systems include electronic locks, key card access, biometric scanners, and surveillance cameras. They ensure that only authorized personnel can access certain areas, enhancing security and preventing unauthorized entry.

- **Voice and data communication systems**

  These systems are essential for modern buildings, facilitating internal and external communications. These systems include telephone lines, intercoms, network cabling, and wireless access points. Proper installation ensures reliable and high-speed communication for occupants.

- Satellite Master Antennae Television System (SMATV) Installation

  SMATV systems provide television signals to multiple receivers within a building. This involves installing a central antenna system that receives satellite broadcasts and distributes them to individual units or rooms. This setup is commonly used in hotels, apartment complexes and commercial buildings.

- **Conference management system**

  Conference management systems facilitate the organization and execution of meetings and conferences. These systems include audio-visual equipment, video conferencing tools, projectors, and sound systems. Proper installation ensures seamless communication and presentation capabilities for business meetings and events.

- **Standby generating plants**

  These plants provide backup power in the event of a power outage. The systems include diesel or gas generators that automatically activate to supply electricity when the main power fails. They are essential for ensuring continuous power supply to critical systems and operations within a building.

- **Lift and escalator installations**

  Lifts and escalators installations are crucial for vertical transportation within multi-story buildings. This includes selecting and installing elevators that meet the building's requirements, ensuring safety, reliability, and compliance with regulations. Proper installation and maintenance are essential for efficient and safe operation.

- **Public address, personnel-location, and call systems**

  Public address systems are used to make announcements to building occupants, while personnel-location systems help in tracking and locating individuals within the premises. Call systems, on the other hand, facilitate communication between different areas of the building. These systems are vital for effective communication and emergency management.

- **Solar power installations**

  Solar power installations harness renewable energy from the sun to generate electricity. This involves installing solar panels, inverters, and battery storage systems. Solar power systems reduce reliance on traditional power sources, lower energy costs, and contribute to environmental sustainability.

- **Public information display system installation**

  Public information display systems provide real-time information to occupants and visitors. These systems include digital signage, LED displays, and information kiosks. They are used to display announcements, directories, schedules, and other relevant information, enhancing the user experience.

- **Building Management System (BMS)**

  A Building Management System (BMS) integrates and automates various building services and systems, such as HVAC, lighting, security, and energy management. A BMS improves operational efficiency, reduces energy consumption, and enhances the comfort and safety of occupants by providing centralized control and monitoring.

Categories of services offered by Electrical Services Engineers

The services offered by Electrical Services Engineers can be categorized into pre-contract, post-contract and project completion phases.

In the pre-contract phase, they conduct site surveys to verify existing services, assess their condition, and consider environmental impacts. This then helps in developing concept designs, outline specifications, planning strategies, cost plans, procurement options, and construction logistics.

During the detailed design phase, they review cost plans, prepare design drawings, conduct cost studies, and provide detailed design reports. They also prepare Bills of Quantities, coordinate measurements, and complete and check these bills. During tender action, they prepare tender documents, participate in tendering, negotiate sums with contractors, and prepare tender analyses and reports.

In the post-contract phase, the responsibilities of electrical building services engineers include attending site meetings, supervising construction, advising on financial implications, preparing valuations for interim certificates, maintaining financial statements, and accounting procedures. They can issue instructions to contractors, inspect and test works, and approve payment certificates but also monitor environmental management plans and ensure quality control.

Project completion involves ensuring all systems operate according to design parameters, testing and commissioning installations, preparing operation and maintenance manuals, training client staff, rectifying defects, and recommending the release of retention after issuing a certificate of making good defects.

Challenges faced and proposed solutions

1. Technical complexity:

Challenge: Designing and implementing intricate electrical systems in modern buildings can be technically demanding, especially with the integration of smart technologies.

Mitigation: Continuously invest in training and development programs for engineers to enhance their skills and knowledge. Collaborate with specialized consultants or experts for specific technical aspects. Utilize advanced software tools for design and simulation to streamline complex tasks.

2. Regulatory compliance:

Challenge: Navigating through a complex landscape of electrical codes, safety standards, and building regulations can be time-consuming and challenging.

Mitigation: Stay updated with the latest regulatory changes and requirements. Conduct regular audits and reviews of designs to ensure compliance. Foster strong communication and collaboration with regulatory authorities to clarify any ambiguities or interpretations.

3. Sustainability and energy efficiency:

Challenge: Balancing sustainability goals and energy efficiency while maintaining operational effectiveness poses a significant challenge.

Mitigation: Incorporate sustainable design principles from the initial stages of project planning. Utilize energy modeling and analysis tools to optimize energy performance. Implement renewable energy sources like solar panels and energy-efficient technologies such as LED lighting and efficient HVAC systems.

4. Budget constraints:

Challenge: Meeting project requirements and quality standards within budget limitations can be a daunting task.

Mitigation: Conduct thorough cost estimation and feasibility studies during the design phase. Explore value engineering options to optimize costs without compromising functionality or safety. Prioritize critical systems and components while identifying areas for potential cost savings.

5. Integration with other systems:

Challenge: Ensuring seamless integration and compatibility of electrical systems with other building services like HVAC, plumbing, and automation systems can be complex

Mitigation: Foster early collaboration and coordination with other engineering disciplines and stakeholders. Utilize Building Information Modeling (BIM) for integrated design and clash detection. Conduct regular interdisciplinary meetings to address integration challenges proactively.

6. Emergency preparedness:

Challenge: Designing and implementing reliable emergency backup systems and response plans to mitigate risks during power outages or failures.

Mitigation: Install robust emergency power systems such as generators, uninterruptible power supplies (UPS), and backup batteries. Develop comprehensive emergency response plans and conduct regular drills and simulations. Train personnel on emergency procedures and protocols.

***7.* Rapid technological changes:**

Challenge: Keeping abreast of rapid technological advancements and integrating new innovations into existing building systems.

Mitigation: Stay updated with industry trends and emerging technologies through continuous learning and professional development. Collaborate with technology vendors and attend industry conferences and seminars. Evaluate new technologies for their suitability and compatibility with existing systems before integration.

8. Maintenance and lifecycle management:

Challenge: Ensuring effective maintenance, monitoring, and lifecycle management of electrical systems to maximize longevity and performance.

Mitigation: Develop proactive maintenance schedules and implement predictive maintenance techniques using IoT sensors and monitoring systems. Keep comprehensive records of equipment performance, maintenance activities, and lifecycle data. Plan for equipment upgrades and replacements based on lifecycle analysis and performance metrics.

9. Environmental impact and green practices:

Challenge: Addressing environmental concerns and adopting sustainable practices in electrical designs and operations.

Mitigation: Integrate green building principles and sustainability measures into design criteria. Utilize eco-friendly materials, energy-efficient equipment, and renewable energy sources wherever feasible. Obtain green building certifications to validate sustainability efforts and promote environmental stewardship.

Factors influencing the remuneration and compensation structure for Electrical Building Services Engineers

According to Eng. Jabongo, remuneration and compensation for Electrical Building Services Engineers are influenced by various factors, including experience level, education and qualifications, location, skills and specializations, company size and reputation, benefits and allowances, performance metrics, market demand, and company policies. Engineers with more experience, advanced degrees, specialized skills, and certifications tend to command higher salaries. Salaries can also vary based on geographic location, company size, and industry trends.

To ensure competitive compensation packages, organizations conduct market research, participate in salary surveys, establish transparent compensation policies, tie compensation to performance, invest in skill development and training, offer retention strategies, provide flexible benefits packages, create clear career paths, recognize outstanding performance, and conduct regular salary reviews.

Career growth and advancement opportunities for Electrical Building Services Engineers are abundant. They can specialize in areas such as energy efficiency, sustainable design, and building automation, or transition into management roles. Earning professional certifications and advanced degrees can enhance career prospects and compensation. Staying informed about industry trends, networking, gaining international experience, entrepreneurship, research and publications, and developing soft skills are also crucial for career development.

Industry trends indicate a shift towards quality-of-life benefits, competitive compensation packages, and the availability of relevant benefits. Aspiring Electrical Building Services Engineers should focus on gaining experience, pursuing advanced degrees and certifications, staying updated on industry trends, networking, seeking international experience, exploring entrepreneurship, engaging in research and developing soft skill. All of which will eventually help them in negotiating fair remuneration packages.

Conclusion

Electrical Building Services Engineers play a vital role by ensuring they create acquiescent,, energy-efficient, and environmentally conscious buildings. By addressing the challenges we face and leveraging career growth opportunities, this profession can significantly impact the built environment and contribute to a more sustainable future.

International Best Practices In Construction: FIDIC'S Perspective

Eng. James N. Mwangi. EBS. CE. FIEK. MACEK. MEI. MKIM.

FIDIC Vice President/ CEO Kurrent Technologies Ltd.

FIDIC credential – Consultant Professional, consulting engineer professional, contract management professional

Picture: Courtesy

This article focuses on proposed policy intervention, the contract forms of procurement in Kenya and needs for improvement

Typical Risks That May Occur on a Project.

Owner & Project – specific risks:

i. Engineering design inadequacies/ errors

ii. Governmental e.g changes to regulatory approvals/ environmental issues/Tax variations/duties

iii. Procurement e.g materials shortages/late deliverirs / Inspection rejections

iv. Contractor Management e.g Inadequate project/contract management/ Subcontractor claims

v. Construction e.g lack of access to site/ unforeseen site conditions/ Poor labour quality or productivity

vi. Claims and disputes: Leading causes of disputes in Construction e.g lack of competence of project participants/ Inadequate design documentation/ Internal disputes

Underlining Principles

- Standardization,
- Provide clarity and certainty,
- Reduce risk of disagreements, increase probability of successful projects,
- Reduce transaction costs,
- Strong dispute avoidance mechanisms,
- Provides international venue for dispute resolution,
- Allows international competitive bidding,
- Compatible with various legal jurisdictions,
- Tested and accepted internationally,
- Used nationally and internationally,
- Endorsed by MDBs.

Contract Administration

Best practices in contract administration include:

- Reading and understanding the contract,
- Awareness of roles and responsibilities,
- Providing information to affected organizations,
- Establishing contract management procedures*,
- Maintaining formal written communications,
- Managing the change process,
- Performance management and progress payments,
- Identifying and analyzing significant variances,
- Conducting regular progress meetings,

FIDIC's Main Construction Contracts

- Red Book 1999 and 2017/2022
- Yellow Book 1999 and 2017/2022
- Silver Book 1999 and 2017/2022

Proposed Policy Intervention.

Public Procurement Regulatory Authority.

Observations:

1. Some of the contract forms need to be improved for better applicability/implementation as well as balance of risk and minimisation of exposure of the employer(public institutions),
2. Some of the contents in some of the contract forms are plagiarised which is an infringement of the copyright of the owner (e.g. FIDIC).

Comment:

- Complex and frequently changing conditions can lead to misunderstandings and misinterpretations, which are often the root causes of disputes in construction projects.
- By maintaining simplicity and consistency in the General Conditions, the likelihood of disputes is significantly reduced, as all parties have a clear and stable understanding of the contract.
- Africa has a shortage of infrastructure and the continent's main challenges to developing infrastructure investments is the fact that many African governments are faced with rising debt-to-GDP ratios, which will limit sovereign spending on infrastructure in the coming years.

Recommendations:

- Consider adoption of FIDIC contracts especially for works lead by an Engineer. This will help to manage risk, reduce costs for clients and companies, and provide a common base for procurement processes.
- Fidic Academy has been established to deliver training in subjects relating to the consulting engineering industry.They offer a wide range of high-quality training conducted by FIDIC certified trainers who are international experts with vast knowledge of FIDIC contracts and business practices.

Quest To Revolutionize Affordable Housing

By Arch. Oliver Okello
Director, KBRC

Kenya Building and Research Centre (KBRC) was established in 1957 under the State Department for Public Works in the Ministry of Lands, Public Works, Housing and Urban Development.

KBRC is mandated to coordinate research services, documents, and disseminate information on low-cost building materials and technologies for sustainable socio-economic development. KBRC is envisioned to be a world class building research and information centre for sustainable built environment and rides on a mission to conduct research findings on building costs and processes to achieve quality, affordability, efficiency, and sustainability in the building industry.

Building sustainable homes, a drive towards affordable housing, is an agenda that avails housing opportunities for all communities in Kenya. KBRC is contributing to this agenda by ensuring access to information on sustainable building materials and technologies with simplified photographic illustration to inspire technology transfer and wide public adoption of the same. This will eventually improve socio-economic development through small sector industrialization and trade.'As Kenya races to house a growing population, the most efficient building technology delivered at the least cost will be the key to development,' says Arch. Oliver Okello, Director KBRC.

Owing to the appropriateness of interlocking technology and its sustainability in use of local materials, the Government of Kenya through MoLPWHUD, has pushed hard for it is use in providing affordable housing, covering easily sourced materials in specific areas that are also environmentally friendly.

The key to ending the shortage of housing in Kenya depends, in large measure on improving access to affordable housing materials. A vast number of people find themselves priced out of Kenya's housing mortgage market and are forced to pay exorbitant amounts in rent to private landlords to have a roof over their heads. The government recognizes that turning the dial on the housing shortage requires a mix of incentives to investors in the housing sector, as well as encouraging Kenyans to explore options that will help them achieve their long-cherished dreams of owning their homes.

The building sector of today has an oversized footprint as it is the single largest contributor to the global greenhouse gas emissions (GHC). It is, in fact, estimated that over 50 per cent of the total energy generated in developing countries is used in urban buildings alone, consuming more energy than the transport or industrial sectors.

The building sector accounts for 38% of greenhouse gas emission worldwide, contributing significantly to climate change. Green construction implies development processes that integrates environmentally responsive and resource-efficiency throughout a building's life cycle, From siting to design, construction, operation, maintenance, renovation, and demolition.

Stakeholder involvement is key to the realization of this goal, notably the engagement of the entire building industry (developers, owners, designers, builders, materials suppliers, among others.

Integration of Building Research with Global Standards and National Ambitions

The intersection of building research and international obligations plays a pivotal role in shaping sustainable development and addressing global challenges. Key frameworks such as the Sustainable Development Goals (SDGs), the COP 21 Paris Agreement of 2015, and national strategies like Vision 2030's flagship projects guide these efforts. By aligning housing initiatives with these comprehensive guidelines, we ensure that our development strategies are not only environmentally responsible but also socially and economically beneficial. This constructive collaboration between local actions and global commitments is essential for creating resilient, inclusive, and sustainable communities.

Building Research and International Obligations: The New Urban Agenda (NUA) Habitat III was adopted in Quito in October 2016 where Kenya is a signatory and launched the Popular Version on the 10th of May 2017. The New Urban Agenda is a unique tool whose combination with adequate building research will contribute to the achievement of Sustainable Development Goals of the 2030 Agenda.

Sustainable Development Goals: SDG 6,7,9,11,12,13 and 17 place emphasis on access to clean water and sanitation, sustainable energy use, innovative processes, safe and resilient cities, consumption patterns, climate change mitigation and adaptation and global partnerships, respectively.

COP 21 (Paris Agreement) 2015: The Paris Agreement (COP 21) recognizes the crucial role buildings play in climate change mitigation and adaptation processes. It calls for

reporting on National Determined Contributions (NDCs) on climate from the building sector.

Vision 2030 Flagship Projects: Vision 2030 aspirations are to provide Kenyans with adequate and decent housing in a sustainable human environment. The vision aspires to realize an adequately and decently housed nation in a sustainable environment. Enhanced building research is a key facet in the realization of Vision 2030 Pillars and Flagship Projects.

Major Initiatives/Research activities

To facilitate the success of the affordable housing program, KBRC, whose mandate is to find affordable and sustainable building options, highlights the importance of incorporating science and indigenous technologies. Arch Okello (Director KBRC), emphasized on the concept of Appropriate Building Materials and Technologies (ABMT), whose role is anchored in Sessional Paper No. 3 of 2004 on the National Housing Policy, which provides for research and development of materials that are appropriate for local communities in terms of affordability, quality, and ease of applications among others.

Kenya has an estimated 12.1 million households with an annual demand of 250,000 housing units against an estimated annual supply of fewer than 50,000 units. Considering that the building materials and components account for 60%/ of the total construction cost, this statistic translates into more than double the number of sanitary wares required to meet housing demand per annum. One of the challenges encountered in the provision of housing is escalating building costs attributed to inadequate innovation in low-cost building technology, building materials, and components. Close to twenty-one million people in Kenya use unsanitary or shared latrines. Only two in three households have satisfactory sanitation facilities .5.6 Million people lack latrines and defecate in the open spaces, alleys, bushes, forests, or grasslands polluting the environment and spreading diseases such as diarrhea and cholera.

The aim of this research was to investigate local materials that can be used for the design and production of sustainable low-cost ceramic toilets, not only to bridge the diverse issues of sanitation and health but also to provide an affordable building material and component solution to support affordable housing. The research sought to address issues of industrialization and universal health propounded as well as spur manufacturing and meaningful employment opportunities.

Research Gap

Most Kenyans are living in health-threatening conditions, and this is because they cannot afford appropriate housing with necessary amenities such as sanitary fitting. The revenue spent on the importation of ceramic sanitary such as wash hand basins, water closet including toilet, sinks, sanitary fittings, urinals, and bathroom vanity is substantial. Rising housing need translates into increased healthcare needs, losses in productivity while accessing healthcare by the sick, premature death amongst children, and time lost in the search for convenient toilet facility.

Objectives

The main objective was to investigate the local production of ceramic fittings that could support the affordable housing program. The other research objectives were:

- Analyze the suitable soil (minerals) that could be used in the manufacturing of ceramic fittings.
- Design and develop a prototype ceramic toilet.
- Develop guidelines for the manufacture and production of ceramic toilets.
- Identify design opportunities in the production and manufacture of ceramic toilets.

Methodology

Research methodology guided by principles of innovation, sustainable development, affordability, public participation, and inclusivity. The research was anchored on literature from the housing development in post-independence era in Kenya and other countries. secondary data was collected from the Kenya Building Research Center, University of Nairobi, KIRDI, SAJ Ceramics, Kazuri among other sources. The project employed design research methods alongside other social research methods including ethnography (Creswell ,2007) and case study (Yin, 2002)

The main activity of the research was design and development of ceramic fittings and therefore, the process was divided into the following five phases: Material sourcing and understanding, material analysis, Design and Production of prototype and Dissemination.

Branding /Packaging

The product developed was branded “Ngisi,” a name coined from Samburu name “Ngisipet,” meaning a shovel-like tool used in the Samburu community to dig holes in the ground which ate later covered whenever they want to relieve themselves. A wider range of ceramic fittings produced will be branded and packaged under Ngisi Brand.

Findings

- The raw materials used in the manufacture of tiles at SAJ include clay in Makueni, Murkurweini, and Nunguni), sand (from Kalama, feldspar, lime, and dolomite. Additionally, ninety% the glaze used is imported from Europe (Spain and Italy) for assorted reasons such as the lack of equipment to produce glazes. Mukurweini-Karundu clay deposit has continued to provide raw material to the local ceramic industries to produce crockery and tiles although it is equally suitable for heavy ceramics production (roofing tiles, bricks, sewage pipes), as well as sanitary ware. Iveti hills clay deposits consist of high-grade Kalolin, of commercial value. The Kaolin is not naturally exposed but is overlain by a thin overburden of superficial soils and alluvium ranging between 0.3 - 1 m thick. Both visual and microscopic examinations reveal the mineral composition of the Tulimani Kaolin to be quite like that occurring at Nuguuni hills. Illite, Kaolin and Quartz are the dominant minerals with minor feldspar, calcite, and pyrite.
- Raw glazing materials are exported, processed, and then imported back into the country at an inflated cost. Moreover, the 1-2% sodium silicate/sodium tripolyphosphate that is used to reduce the plasticity of the clay is locally and readily available. Although coal, commonly used to fire the kilns, is imported, it was observed that it can be found in some deposits locally.
- Incubation for upcoming entrepreneurs interested in ceramic-related industries is provided by KIRDI which also conducts research and training in ceramics and clay technologies offering consultancy services in kiln design and construction. KIRDI also undertakes local clay sampling and screening for appropriate utilization in the production of various products. Some of the materials commonly tested were sourced from Makueni, Mukurweini , and Nandi.
- Kenyatta University has kilns that can accommodate large-scale ceramic products with a capacity up to 1200. The university can produce glazes from local materials and show an opportunity to widen and commercialize the researched production of these toilets.

RECOMMENDATIONS

- Based on field observations and positive laboratory diffraction data achieved, clay deposits in Kenya should be investigated further for their chemical composition (XRF analysis) and physical properties (moisture content ,residue % over 80 and200 mesh sieves, modulus rupture, shrinkage% ,particle size distribution, loss of ignition) to further constraint its properties and uses as a suitable ceramic material.
- The building industry should incorporate 3D printing inti the production of building products such as ceramic fittings as well as in the construction of housing. product development is a major opportunity gap where local and regional researchers and creators can reap the benefit s of digital fabrications, especially in the production of prototypes, pretesting, and iterations in a faster and cheaper process though 3D printing.
- More studies should be conducted to upscale the range of ceramic fittings production and commercialization to lower the cost of housing in Kenya. Areas of interest should be ball clays and minerals with suitable chemical compounds to produce various ceramic fittings, with consciousness of sustainable energy and the environment. High potential in ceramic industry to support affordable housing in Kenya was identified by KBRC. Although clay glazing materials are locally available in large deposits, more research and investments need to be made inti their commercialization. Coal can be mined locally for firing the kilns to supplement gas and electric run kilns. In the effort to exploit clean energy sources. Manufacturing of equipment including kilns with supply can be achieved from local training institutions and innovation incubation centers. Adequate technical know- how in the manufacturing process of ceramic materials is necessary and can be achieved. Considering the elevated level of importation of glazing materials, an opportunity exists for exploring local sources of glazing materials and their value addition to meet industrial standards.

Role of the National Building Inspectorate

STATE DEPARTMENT FOR PUBLIC WORKS

By Eng. Samuel Charagu
HSC, National Building Inspectorate

Q1. Can you provide an overview of the primary objectives and responsibilities of the National Building Inspectorate?

The establishment of the National Building Inspectorate (NBI) in 2015 was part of the Kenyan Government's efforts to improve building safety and enforce compliance with construction standards following a series of building collapses and safety concerns in the country.

Our responsibilities as an Inspectorate are:

- *Inspection of Buildings*: Assessing the structural integrity and safety of buildings, both new and existing.
- *Enforcing Compliance*: Ensuring that construction projects adhere to the Physical Planning regulations, National Construction Authority (NCA) regulations and other relevant laws.
- *Capacity building*: Training the County technical staff on building inspection services.
- Issuing Certificates: Providing certifications for buildings that meet safety and construction standards.
- *Investigating Failures:* Conducting investigations into building collapses and construction-related accidents to determine causes and recommend preventive measures.
- *Public Awareness:* Educating the public and stakeholders about building safety and regulations.

Q2. Elaborate on the process and methodology used by your team to conduct comprehensive audits of buildings, including those under construction.

We have a detailed and systematic methodology to conduct audits of buildings. This methodology includes the following steps:

i. Pre-Audit planning:

Our team collects data on the building, including design documents, construction plans, as well as previous inspection reports if available. It is from this point that we schedule audits by coordinating with building owners, managers, and relevant stakeholders to schedule inspection dates.

ii. On-site inspection:

This step focuses on visual inspection, where we conduct an examination of the building's exterior and interior, including structural elements, electrical systems, plumbing, and fire safety installations. We then use tools and instruments to measure structural components and test materials to verify their integrity and compliance with standards.

On the other hand, we also take photographs of key areas and any observed deficiencies or issues for detailed analysis and reporting.

iii. ***Structural assessment:***

a. Load-bearing analysis: Evaluating the load-bearing components such as beams, columns, and foundations to ensure they can support the intended loads.

b. Material quality assessment: Analyzing the quality of construction materials to confirm they meet the required specifications and standards.

iv. ***Compliance verification:***

Here, we ensure that the building adheres to relevant building codes, safety regulations, and construction standards. It is also at this stage that we review modifications by checking for any unauthorized modifications or extensions that might affect the building's integrity and compliance.

v. ***Functional systems check:***

Safety being a paramount aspect, we inspect fire safety systems, emergency exits, and alarm systems to ensure they are operational and compliant. This is coupled with evaluating the functionality and safety of electrical wiring, HVAC systems, elevators, and other mechanical systems.

vi. ***Documentation review:***

NBI verifies that all necessary permits, licenses, and certificates are in place and up to date. Checking maintenance logs and records to ensure regular upkeep and timely repairs is also a paramount activity.

vii. ***Risk assessment:***

We do this by identifying potential risks and hazards, including structural weaknesses, fire hazards, and other safety concerns. We then provide recommendations for mitigating the identified risks and improving safety and compliance.

viii. ***Reporting:***

A detailed audit report that includes findings, photographic evidence, compliance status, and recommended actions is done and feedback presented to building owners, and relevant authorities, and discussing necessary corrective actions.

ix. ***Follow-up inspections:***

Finally, to ensure long term compliance and safety, we conduct follow-up inspections to ensure that recommended corrective actions have been implemented and compliance has been fully achieved.

Q3. What criteria does the Inspectorate use to assess the quality of building services engineering?

Firstly, we assess the stability and strength of the building's foundation and also be sure to evaluate the conditions of beams, columns, walls, and other structural components to ensure they can support the intended loads.

Another important aspect is verifying that materials used (such as concrete, steel, wood) meet the required standards and specifications. This ensures that the materials used are wear resistance hence can withstand environmental and usage stresses.

Ensuring the building design complies with approved architectural plans and zoning regulations ensures efficiency of space utilization within the building.

The National Building standards and other relevant codes also have to be adhered to. Also, we verify adherence to local building bylaws and regulations.

Ensuring safety is one of our key roles. We do this by checking for the presence and functionality of fire safety systems, including fire alarms, extinguishers, sprinklers, and emergency exits. We also inspect electrical

systems to prevent hazards like short circuits, overloads, and improper installations.

On mechanical aspects and plumbing, we see to it that heating, ventilation, and air conditioning systems are properly installed and operational. On the other hand, we assess the plumbing system for leaks, proper installation, and compliance with health and safety standards.

Environmental considerations are never left behind in our enforcements. NBI evaluates the use of sustainable and energy-efficient materials and technologies and ensuring proper waste management systems are in place.

Quality of workmanship is important as it helps us in assessing the quality of construction work, including finishes, joinery, and adherence to construction best practices.

Documentation and all permits that are needed are checked to ensure safety and adherence to set building standards.

The health and safety of the occupants is also considered as we ensure that all buildings provide a safe environment for occupants, including measures for natural light, ventilation, and safe access especially for individuals who are differently abled.

We do not stop at all the points I have mentioned. We also see to it that we review maintenance logs and records to ensure the building has been regularly maintained.

Q4. What are some of the mechanisms put in place to continually improve the quality building services engineering in Kenya?

In my view, conducting regular scheduled inspections of buildings throughout their lifecycle, from construction to occupancy as well as performing surprise inspections to ensure compliance with safety standards and regulations without prior notice.

There is also dire need to ensure that certificates of compliance are issued to buildings that meet safety and construction standards. This should be coupled with ensuring that all construction projects have the necessary permits before commencement and verifying compliance with these permits throughout the project.

There should be continuous monitoring and surveillance especially for ongoing construction projects to ensure adherence to approved plans and safety standards.

At the heart of keeping up with technology, use of equipment such as drones, sensors, and building information modeling (BIM) for real-time monitoring and data collection would go a long way in ensuring quality construction.

To reduce cases of construction law breaking, taking legal and administrative actions against non-compliant builders and developers, including fines, stop-work orders, and demolition of unsafe structures would go a long way.

Training and capacity building initiatives, which we heavily support as an Inspectorate help the construction professionals in their career growth and professional development as they keep up with the latest building standards, safety practices, and regulatory updates.

Public awareness and engagement has proven beyond reasonable doubt as such a key factor as it plays a key role in enabling all the stakeholders (builders, developers, community groups) to be self-driven on matters of compliance and safety in the industry.

Other than creating awareness, there is need to establish systems for the public and stakeholders to report non-compliance, hazards, or safety concerns.

Collaboration with key sector players is also paramount. For instance, NBI works closely with the National Construction Authority (NCA), Engineers Board of Kenya (EBK), Board of Registration of Architects and Quantity Surveyors, County Governments, The National Police Service and emergency services to ensure a cohesive approach to building safety and quality control. The Inspectorate then sees to it that it shares relevant data with

each of these stakeholders to enhance overall building safety and compliance.

Research and innovation play a key role in ensuring the sector is up to its task. Encouraging the adoption of research and innovative construction methods and materials that enhance safety, sustainability, and efficiency are key.

On the legislative aspect, there is need to regularly review and update building codes, regulations, and policies to address emerging safety concerns and industry trends.

Q5. How does the National Building Inspectorate engage with the public in creating awareness about building standards and compliance?

a. The Inspectorate actively engages on social media platforms to share updates, educational content, and safety tips.

b. Educational programs: We participate in workshops and seminars for homeowners, builders, developers, and other stakeholders to educate them about building standards and best

c. On the lower level, we engage in community forums: We host community meetings and public forums where residents can learn about building standards, ask questions, and voice their concerns.

d. NBI has an informative and user-friendly website that offers resources such as building codes, safety guidelines, and compliance checklists.

e. Collaborations with media especially partnering with national television and radio stations to feature programs and segments on building safety, construction standards, and compliance. We also issue press releases to keep the public informed about important updates, changes in regulations, and safety advisories.

f. The inspectorate has established hotlines and helpdesks where the public can ask questions, report non-compliance, and seek guidance on building standards.

g. We often hold briefings and information sessions for key stakeholders whenever there are significant changes on regulatory compliance matters.

Picture: Courtesy

Eng. Gicheru Kimani: Plumbing Systems in Tall Buildings.

By EiK Correspondent

1. Could you provide an overview of the unique challenges that plumbing systems face in tall buildings, especially in a vibrant area like Westlands?

Vertical living entails providing services to a concentrated user space and hence optimization is the key word, you need to ensure availability and storage for the multiple user points in the space as well as ensure that the drainage of the same is efficient, adequate, limits turbulence and easily maintainable given the challenges of multiple dwellers with different user needs. Westlands is a growing center for skyscrapers due to proximity to the city, high land value and multiple urban appeal and will continue to see a growing number of such units. It is vital that municipal infrastructure keeps pace with this growth.

2. In your experience, how does the design and construction of plumbing systems differ between standard buildings and skyscrapers?

Skyscrapers require careful consideration of the direct relationship between height and pressure. The water booster pumps to supply water to roof tanks as per the design will require to be sized and piping tested to take the pressures required to counter the height while for pressurized system it will be vital that pressure reducing valves are used to manage pressure close to the supply point and ensure comfort use for each apartment. In some instances, skyscrapers would like to eliminate roof tanks to make use roof to create space for a perfect view due to their heights, such instances require near perfect pressurization system that may not be similar case in standard buildings. For standard buildings the pressure ratings are much lower and a standard pump can do the job, not so for pressurized or gravity systems for skyscrapers which require more intricate design for plumbing, drainage and fire fighting systems. Lastly you can mount a ladder against a standard building or erect scaffolding to repair a leak, not so with skyscrapers hence the need to design good MEP ducts with the project architect to ensure ease of maintenance of the systems.

3. With sustainability being a key concern, what measures can be taken to ensure efficient water usage and waste management in tall buildings?

With skyscrapers it is vital to use fittings and fixtures that are EDGE compliant this includes low flow forcets with restrictors/aerators, low dual flush sanitary et cetera, all with the aim to reduce water use and by correlation waste discharge from the building. We also recommend Reverse Osmosis treatment to critical installations like the kitchen sink for cooking and drinking unlike RO for the complete building with results in a higher volume discharge and yet the water use might not require the level of purity. Effluent water from an STP can be used for car and pavement washing as well as the limited gardening while appreciating that there are nuances in each project that need to be considered in application of the concepts. Lastly, use of smart water metering ensures responsible use of water by individuals as this has a direct cost implication.

4. Are there any regulatory or compliance issues that engineers need to consider when designing plumbing systems for tall buildings in urban areas?

Yes, covered in the building code. Water demand/consumption in high rise building is intense. Therefore, measures to ensure proper water utilization is required. Water flushing systems allowed in such building is cistern type and not flush valves system. This design requirement prevents undue consumption of water.

The supply mains from the authority is limited to 1.5bar, this pressure is not sufficient for direct use in high rise buildings. Creation of break/storage tanks is hence required to allow boosting to storage tanks or for direct use. Plumbing materials/piping used must be compatible with water parameters to avoid corrosion or decomposition of pipes that will otherwise contaminated water.

5. How does the choice of materials impact the durability and performance of plumbing systems in high-rise structures?

As mentioned, this is vital. For instance, the greater the pressure a pipe will be subjected the greater the need to ensure a nil failure rate for the design pressures. It is also vital since you don't want the users of the building to share lifts everyday with a plumber carrying wound up PPR piping and some foul-smelling boss white on his way to fix a leak on the 13th floor. Choose good quality products and materials for performance and longevity of the installation. Good quality materials reduce maintenance cost associated with leakages, the need to replace the materials soon, hence reduce the running cost of the building.

6. Can you share any notable projects or case studies where you successfully addressed complex plumbing challenges in tall buildings?

We did work with these complexities while handling Nova Apartments a high class residential development and The Address a commercial building of similar size both on Muthangari Drive. As mentioned, the difference is the schemes from residential to commercial where you have a known occupancy and use to one where the each commercial space might have very different applications required some ingenuity but the competence of the team at the firm allowed us to complete the projects successfully having been in use for over 5 years now.

7. What role does technology, such as IoT sensors or smart plumbing systems, play in optimizing maintenance and performance in skyscraper plumbing networks?

Currently, the application of these and automation systems has been more on status monitoring than systems control. In a conversation this morning with a valued colleague from another firm, we agreed that due to the low cost of labor in this market, it is still possible to have a technician run around and read meters while checking on the piping and general condition of the systems instead of spending valuable resources just to check on status of a meter of pump but as the cost of labor increases and we mainstream automation as a standard function of buildings and use it for decision making such need for maintenance et cetra, then we will see greater adoption. More can be done apart from use of smart meters in our view.

8. With the rise of mixed-use developments, how does plumbing design adapt to accommodate residential, commercial, and recreational spaces in a single building?

Indeed, there is slight complexity and consideration in design for multi-use developments but where we see the greatest challenge in industry is where the mix or multi-use changes over the short life of a project for example you design for a commercial building that morphs to a 3 star hotel when we have already cast the 1st floor, then it does get interesting and great care and caution is required.

9. Looking ahead, what trends do you foresee shaping the future of plumbing engineering in tall buildings, especially in rapidly developing urban areas?

Perfection is the single word that comes to mind, the exposure of developer and the architect on the schemes not to mention buyer needs to pushing plumbing to be seen but not heard, to function and require less maintenance, to be predictive and not temperamental that is, *' Leo hakuna maji ama ni baridi tu iko.'* This calls for greater focus on developing systems that will meet these challenges head-on in vertically concentrated living that is Nairobi today. These challenges will be witnessed in the new affordable housing schemes with GOK on the Bottom-Up economic transformation agenda under the Ministry of Housing but we are confident the level local expertise is well equipment to handle the challenges both at design and installation. Use of technology i.e. smart metering, building management system to monitor operation and performance of different systems and green building where water usage is efficient.

Role of the National Construction Authority in Promoting Green Building Standards and Certifications in Kenya

By Eng. Maurice Akech
Executive Director, National Construction Authority

Introduction

National Construction Authority is a state corporation established through the National Construction Act 2011 and Regulations 2014. The mission of the Authority is to regulate, facilitate and build capacity in the construction industry through strategic interventions and partnerships for sustainable socioeconomic development. The key roles of the Authority are regulatory which include: registration of contractors, accreditation of skilled construction workers and site supervisors, develop and publish a code of conduct for the construction industry, promote and ensure quality assurance in the construction industry, encourage the standardization and improvement of construction techniques and materials. The next role is research and advisory which include: to undertake or commission research into any matter relating to the construction industry, advise and make recommendations to the Cabinet Secretary on matters affecting or connected with the construction industry and provide consultancy and advisory services with respect to the construction industry. And finally, the training and capacity which include: assist in the exportation of construction services connected to the construction industry, initiate and maintain a construction industry information system, provide, promote, review and co-ordinate training programmes organized by public and private accredited training centres for contractors, skilled construction workers and construction site supervisors.

Promoting Green Building Standards and Certifications

The Building Code 2022

The Business Laws (Ammendment) Act 2020, anchored the enforcement of the prescribed building code in the construction industry into the NCA Act 2011, Section 5(ga), therefore giving the Authority powers to enforce the building code. The new building code has been approved by the National Assembly and presented to the National Senate, and therefore awaiting a positive response. The new building code embraces the green building standards in various aspects which include: use of local materials which encourages sustainability, the used materials to be applied in construction must meet performance requirements of the corresponding standard of the materials. The code encourages use of natural lighting and ventilation, the energy efficiency and thermal comfort, it encourages natural lighting, natural cooling and natural ventilation to be provided in a building. Other areas covered to promote green building initiatives include; environmental design concepts which shall be followed to prevent heat gain and the provision for cooling as part of the overall energy efficiency in a building. Sustainable building strategy where the owner is required to conform to the sustainable design strategies derived from green building certification organizations. Climatic consideration is considered with requirements that glazing curtain walling installation shall take into consideration all the climatic aspects based on data from the meteorological department. The code has dealt with water management with the emphasis that construction works shall provide for rainwater harvesting. Issues relating to demolition of Buildings and demolition wastes, and use of renewable energy source are provided for within the proposed building code. There is provision for refuse disposal that requires every building to have an approved means of refuse storage and disposal. Therefore, the new building code has promoted the green building standards with the several provisions focusing on; Energy Efficiency, Water Efficiency, Material Sustainability, Solid Waste Management, Site Sustainability and Indoor Environmental Quality properly embedded in it. National Construction Authority has been given the mandate to enforce the building code.

Projects Registration and Quality Assurance

The Authority registers the projects through collaborations with county governments, enforcement agencies, departments, regulatory bodies and associations involved in the construction industry. Areas of collaboration include but not limited to: Authentication of licenses and permits; Enforcement of construction laws and regulations.; Capacity building; Enforcement of the Building Code; Information-sharing; Partnerships with laboratories for testing of materials used in construction for quality assessment; Investigations and inquiries. The Authority has made it mandatory for approval to be granted by the National Environment Authority in form of NEMA license before registering the projects. In this way, the environmental sustainability and green building standards are incorporated into the projects. Through the due diligence requirement within the Authority's Online Projects Registration System (OPRS), the Authority is able to inspect location and determine whether other related approvals are required which may include Water Resources Authority to deal with riparian reserves and thereby ensuring that buildings and structures are not erected within the riparian zones with a long term effect of attaining climate resilience.

National Construction Authority Research Agenda (NaCRA)

NCA launched the National Construction Research Agenda (NaCRA) for the period 2014-2017 and subsequently revised for 2020-2024. The Authority has been carrying out research based on priority areas published in the NaCRA. NaCRA has been a stakeholder driven process initiated by NCA to identify and prioritize gaps and challenges that require research to be undertaken. The setting of research priorities is guided by principles of stakeholder participation; inclusivity and need for answers to the identified priority areas. The research areas that promote green building standards and considered by the Authority include: suitability and adoption of local and indigenous construction materials to facilitate attainment of housing demand; the use of alternative and emerging technologies for construction products in Kenya-a guidebook on available appropriate building materials and technologies in Kenya; the climate change, geological, social and cultural characterization for the construction industry in Kenya with an aim of promoting environmentally friendly construction methods; Emerging trends that relate to climate change resilience that aims at cleaner environment. These researches are carried out by the Authority and regularly disseminated to the public through seminars and conferences.

Training and Capacity building

The Authority carries out trainings to ensure that contractors, skilled construction workers and site supervisors are equipped with the necessary knowledge, skills, competencies, abilities and attitudes to meet construction industry needs. Some of the training geared towards promoting green building standards include: Greening construction projects for global competitiveness, Appropriate building technologies (ABMTS) for affordable housings, Environmental management in construction, NCA strategic direction towards Affordable housing and ABMT, New technologies in design of power systems and power quality, portable water systems, sanitary drainage systems and storm water drainage systems, smart construction technologies. These trainings are conducted online and physically by the Authority and the accredited training providers.

Buildings and Climate Global Forum

This forum was held in Paris from 4th to 9th March, 2024. It was organized by the French Government and the United Nations Development Programme (UNEP). The Executive Director participated in this forum. The forum was aimed at catalyzing the international collaboration and aggregate momentum across global supply chains and between trajectory of the global buildings sector with the Paris Agreement. Due to this engagement in Paris, the following progress has been achieved;

- National Stakeholders Consultative Forum on Buildings and Climate change in Kenya was held on 15th May 2024 to develop a general sector road map towards achieving decarbonized and sustainable futures in the building sector by 2050.
- The ministry is drafting a national policy on sustainable buildings and public works development.
- Formulating the building standards and control aimed at performance resilience and safety of buildings.

Conference on the Climate change on the built environment

This conference was held on the 15th May 2024 at the Safari Park Hotel, with the full participation of the National Construction Authority. The theme of the conference was zero emission, efficient and resilient buildings in construction sector. The following resolutions were made in the conference;

- Accelerate call to action on decarbonization
- The need to decarbonization road map
- Accelerate and support policy reforms which include legal and institutional frameworks
- Develop Green taxonomy guideline
- Setting up technical working groups
- Organize annual conference in 2025
- Develop implementation framework

The resolutions of this conference, provides a clear road map towards embracing green building standards and certifications and the National Construction Authority is pitched to play a pivotal role.

Conclusion

It is now clear that the Country through the National Construction Authority is championing the implementation of greener measures to address climate change. The new building code rallies to lessen the impacts of buildings to health and environment through resource efficiency. Research and trainings carried out by the Authority serves as a long-term measure to promote green building standards and certifications in Kenya, while quality assurance and compliance ensures that the provisions of the code are implemented.

The Impact of High-Rise Structures and Interior Lighting on Occupants: Hazards and Vitamin D Considerations

Article Written by Mary Ngaruiya|Advocacy Officer, AAK

As of 2023, over 16 Million Kenyans which translates to 30.7% of the total population live in Urban areas. The United Nations World Urbanization projections suggest that by 2050, 68% of the global population will be living in urban areas and Kenya is no exception. As a result, cities around the world continue to grow taller and denser with an increasing number of people living and working in high-rise structures with limited access to natural daylight. While these buildings offer convenience and efficient use of space, they come with hidden health costs – particularly related to vitamin D deficiency and the detrimental effects of excessive artificial lighting.

The Importance of Daylight and Vitamin D

Vitamin D, often called the sunshine vitamin, is a crucial nutrient for human health. Our bodies produce it naturally when exposed to sunlight, specifically the UVB rays. Vitamin D aids in calcium absorption, supports bone health, and plays a vital role in immune function, cell growth, and reducing inflammation.

Unfortunately, a study by the Lancet Global Health in 2020 shows that there is a prevalence of vitamin D deficiency in Africa, citing urbanization as one of the major causes. A 2019 study from the University of Glasgow highlighted the link between lack of UVB exposure during pregnancy and an increased risk of learning disabilities in children. This underscores the far-reaching consequences of vitamin D deficiency, which can affect cognitive development and overall well-being.

The High-Rise Dilemma

In high-rise buildings, access to natural daylight is often limited, particularly in interior spaces and lower floors. Occupants may spend entire workdays under artificial lighting, with little to no exposure to the sun's rays. This lack of natural light can disrupt circadian rhythms, leading to fatigue, mood disturbances, and difficulty sleeping.

Moreover, the very design of high-rise structures can create a canyon effect, where buildings cast long shadows and block sunlight from reaching the streets and lower levels. This calls for proper neighborhood planning, where approaches like stepped zoning can be adopted to prevent the Canyon effect resulting from constructing high-rise buildings on every plot.

Additionally, poor urban development in Kenya and gray areas in our Development Control policies allow property developers to build beacon to beacon, rendering designs that promote natural lighting useless. Furthermore, the lack of open spaces for urban citizens and children to play further exacerbates the issue of vitamin D deficiency for those living in houses where natural daylight is scarce.

Promoting Healthy Building Design

To mitigate the risks associated with high-rise living and artificial lighting, a holistic approach to building design is essential. Architects and urban planners should prioritize strategies that maximize natural daylight exposure while minimizing the need for excessive artificial lighting.

The Healthy Homes Guidelines and Checklist developed by the Architectural Association of Kenya (AAK) in collaboration with Habitat for Humanity International provides a comprehensive framework for creating healthy and sustainable living environments. Natural lighting is one of the 15 principles outlined in this document, emphasizing its importance for occupant well-being.

As recommended in the AAK's Healthy Homes Guidelines and Checklist, daylighting strategies, such as the use of skylights, light shelves, strategically placed windows, ensuring window sizes are proportional to room sizes, and using light-colored interior finishes to enhance light reflection, can help distribute natural light more evenly throughout a building (p. 15-16). These guidelines emphasize the importance of providing direct lines of sight to exterior windows in all work and habitation spaces (p. 15). They also recommend using larger windows with light-colored frames, glass-paneled doors, sun tunnels, skylights, and strategically placed mirrors to maximize natural light penetration and distribution (p. 16).

Additionally, incorporating biophilic design principles, which bring elements of nature into the built environment, can help create a sense of connection with the outdoors and promote overall well-being. Daylighting principles, as outlined in Kenya's 2024 Building Code, emphasize the importance of natural light in enhancing indoor environments. The prescriptive code mandates that new buildings must be designed to maximize natural light penetration, reducing reliance on artificial lighting and thereby improving energy efficiency. This approach not only lowers energy costs but also has been shown to improve occupants' mood and productivity.

Bottom line, as urban living becomes increasingly vertical, it is crucial to address the potential health hazards associated with high-rise structures and excessive artificial lighting. By prioritizing daylighting strategies, biophilic design principles, and sustainable energy solutions, we can create built environments that promote occupant well-being, support vitamin D sufficiency, and mitigate the negative impacts of artificial lighting.

Collaborative efforts among architects, engineers, urban planners, policymakers, and healthcare professionals are essential to ensure that our cities of the future are not just taller and denser but also healthier and more livable for all.

Adopting Sustainable Design in Building Services Engineering

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Sustainable design is an approach to designing systems that meet current needs and consider future generations' needs. Sustainable design in Building Services Engineering aims to improve the quality of the built environment, reduce emissions and minimize negative environmental impacts. The World Green Building Council reports that 39% of global emissions are from buildings, of which 28% result from the energy required to operate functional buildings. In Kenya, 8.3% of CO_2 emissions are from residential and commercial buildings (IEA, 2014).

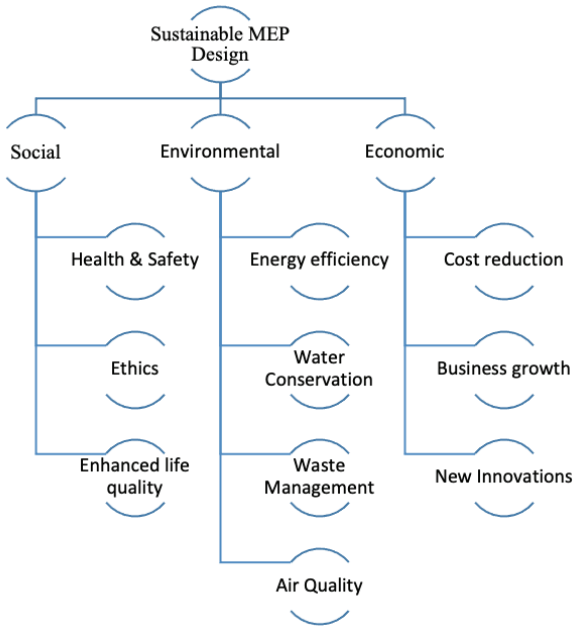
According to the United Nations Climate Change (UNCC), Kenya updated its climate promise to reduce emissions by 32% by the year 2030, which calls for all sectors to reduce their emissions so as to deliver on this promise (UNCC, 2023). Kenya's increase in population has seen an increase in the construction of buildings, which calls for adaptation of sustainable design in buildings in order for the country to deliver on reducing its carbon footprint. Sustainable design in engineering calls for a balance between the environmental, social, economic aspects, functionality and purpose of the design (Skerlos, 2015). Building services engineers, specifically Mechanical, Electrical, and Plumbing (MEP) Engineers, play a significant role in the design and construction of building infrastructure, which makes them a part of the contributors of global emissions from the building industry.

Mechanical engineers deal with mechanical systems that control parameters such as heating, cooling, ventilation, and air conditioning. Electrical engineers deal with powering these systems and the illumination aspect in buildings. Plumbing engineers deal with the water and drainage systems inside the buildings, designing advanced piping layouts for these systems. As is, there is coherent collaboration between the three based on the technical systems intertwining.

In the MEP sector, Sustainable design should focus on energy efficiency, water conservation, cost reduction, materials selection, waste reduction, and air quality.

The measurement of sustainability can be adopted from Lima et Al. sustainability indicators. These indicators consider three (3) dimensions: *environmental, economic, and social*. The Sustainability Matrix analyzes the indicators while looking for the MEP-related aspects as shown in the block figure 1 below:

Figure. 1: Sustainability Matrix



MEP engineers can contribute to designing energy-efficient and environmentally friendly buildings and consequently reduce the carbon footprint in Kenya by the above sustainability indicators. These should be taken into consideration from the design stage to the end-user stage. Some common sustainable practices that should be considered include:

1. Energy efficiency: This can be achieved through a range of strategies, such as optimizing the design of building systems to reduce heating and cooling requirements, improving the efficiency of equipment and appliances, energy modeling to simulate energy consumption patterns and developing smart energy management systems e.g. the Building Management System (BMS).

2. Utilizing renewable energy: Designing MEP systems that use clean energy technologies such as solar, wind, hydro, geothermal, nuclear etc. One common is the solar PV system design and solar water heating. However, there are other energy sources that can be tapped and adopted depending on location and the building's needs.

3. Water usage and recycling: Using water-saving taps and cisterns, wastewater treatment for use in toilets or landscaping or designing a rainwater harvesting system can help in saving water and preserve the ecosystems.

4. Adaptation of smart systems/equipment. Smart systems help in minimizing energy losses while saving on time and cost. For example, smart meters detect failures/ leakages promptly.

5. Using intelligent systems or advanced software in design: With advanced technology, input based on design calculations, building components, and drawing layouts will be automatically programmed and dictate the sustainability of the design. This will also save on time and costs for the project. One such software is Revit MEP.

And finally,

6. Establishing a standardized sustainability matrix or rating system specifically for the MEP sector. Another way is adopting a renowned rating system e.g. LEEDS or BREEAM. This will not only aid in adopting sustainability but will also enhance the industry in terms of efficiency.

Picture: Courtesy

STUDENTS' VOICES

Name: Abigael Chepngetich

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Modern infrastructure designs involve the intersection of electrical and structural engineering knowledge. The fusion of these disciplines offers innovative solutions that not only enhance the functionality and safety of buildings and bridges but also pave the way for sustainable and energy-efficient structures. This synergy is exemplified by embedding smart technologies into structures, using sensors for real-time data on conditions like stress, fatigue, and seismic activity, enhancing early issue detection. Electrical engineers play a crucial role in designing and implementation of the sensor networks, ensuring seamless integration with the structure while optimizing power consumption and data transmission efficiency.

Electrical engineers have contributed to advancements in materials science through the development of novel construction materials with intrinsic electrical properties. For instance, self-healing concrete embedded with conductive materials can detect microcracks and autonomously repair them by applying an electrical current, thereby extending the lifespan of infrastructure and reducing maintenance costs stress into electrical energy, offering a renewable power source for sensors or even the grid itself. The partnership of electrical and structural engineers in renewable energy creates secure integration of solar panels into structures, optimizing energy output and smart grid resilience. This collaboration shapes a future of adaptable, energy-efficient infrastructure, driving sustainable and smart city development. Modern infrastructure designs involve the intersection of electrical and structural engineering knowledge. The fusion of these disciplines offers innovative solutions that not only enhance the functionality and safety of buildings and bridges but also pave the way for sustainable and energy-efficient structures.

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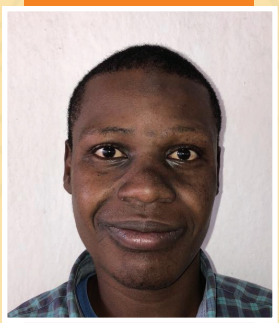

Name: Aaron Kiptoo Ngetich,

Age :25 Years Old.

Institution: Technical University of Mombasa

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At the heart of my educational journey lies a curriculum meticulously crafted to equip aspiring engineers with the knowledge and skills essential for tackling real-world challenges. Central to this pursuit are coursework units delving into solid and structural mechanics, theory of structures, and the design of reinforced concrete. These subjects serve as the bedrock upon which the understanding of Civil Engineering is built, providing a robust framework for comprehending the complexities of structural design and analysis.

Solid and Structural Mechanics are fundamental in Civil Engineering, revealing material behaviour under diverse loads. Theory of structures guides complex system analysis, crucial for integrating mechanical, electrical, and plumbing systems in buildings.

Building Services Engineering as a coursework unit helps us understand robust design process and material selection. By mastering the art of reinforced concrete design, I have not only cultivated an appreciation for the synergy between form and function but also gained a profound understanding of the role played by material properties and structural detailing in ensuring the longevity and resilience of built environments.

Universities play a major role in preparing the next generation of building services engineers by preparing their students to competent and rigorous curriculum training. As I continue my journey in civil engineering, I am grateful for the transformative experiences and invaluable lessons that will undoubtedly shape my future endeavours in building a better tomorrow.

Clinton Mokaya

Age :22

Technical University of Mombasa

Bachelor of Science in Civil Engineering

Year 3 semester 2

Email: mokmakori@gmail.com

Building services engineers are responsible for the design, installation, operation, and monitoring of the technical services in buildings (including mechanical, electrical), to ensure safe, comfortable, and environmentally friendly operation.

I was motivated to pursue a degree in civil engineering which connects with building services due to the interest I had especially in the field of low and zero carbon design and renewables which I know is achievable in Kenya.

Building services engineers' typical duties include designing, inspecting, maintaining, and testing energy, air conditioning, lifts, drainage, and other systems. The curriculum in Technical University of Mombasa offers a wide scope of learning opportunities because it has the units which are essential and equips us with both practical and theoretical knowledge necessary to understand the role and apply in building services.

For any student probably in high school and would wish to pursue a degree in building services engineering, this is the right place to be. It is interesting working on designs and creativity which is about using your imagination or original ideas to create something.
After completing my degree, I would like to major in technological designs and venture into entrepreneurship.

Name: James Karanja Maina

Age: 21

University: Kenyatta University

Major: BSc. Civil Engineering

Year: 4

Building Services Engineering (BSE) is the art and science of ensuring buildings are not just bricks and mortar, but cozy, efficient, and functional spaces. It involves designing and integrating essential systems like heating, ventilation, plumbing, and lighting. In construction, BSE plays a crucial role in ensuring the smooth operation of buildings. This ensures that buildings are optimized to not only stand tall, but also stand out in terms of functionality and sustainability.
My motivation to pursue a degree in BSE stems from a combination of curiosity, and the desire to be at the forefront of shaping the built environment. I am drawn to the opportunity to tackle real-world challenges and contribute to the development of sustainable infrastructure.

In my university, I find the coursework and curriculum related to BSE to be well-rounded, its strength lying in the collaborative approach emphasized by the Engineering departments in internal attachment projects with the electrical, mechanical, civil engineering, and energy engineering departments. However, challenges and areas for improvement in linking students to quality industrial attachment opportunities are still apparent. For me, the hands-on experience in my recent industrial attachment with Mulatya Africa Advisory Services (MAAS) involving the construction of a factory at Tatu City, has provided valuable practical skills in reading & interpreting MEP drawings, and installing the systems.

Overall, I highly recommend the BSE program at my university to prospective students. With a focus on practical applications, industry-relevant skills, and inter-disciplinary collaborative platforms such as the Engineering Students' Association (ESA-KU) which I'm honored to chair, it prepares students for the challenges and opportunities in the field of Building Services Engineering.

Name: Philip Ambeyi

Age: 24

University: Egerton University

Course: Civil Engineering

Year: 5

Building Services Engineering is a discipline in Civil Engineering that involves designing, installing, and maintaining systems within buildings to ensure they are comfortable, safe, and efficient. Motivated by a desire to make a tangible difference, I was drawn to this field's promises of innovation and impact.

At Egerton, the curriculum provides a comprehensive roadmap to success, with hands-on learning opportunities and unwavering faculty support. However, fostering more industry connections could enhance real-world preparation.

Reflecting on my five-year journey, I recognize the pivotal role of analytical skills and innovation. I urge prospective students to sharpen these tools in Egerton's nurturing environment. By embracing innovation and seeking industry collaborations, we can become the visionary engineers the world needs.

As I near the end of my academic voyage, I'm filled with anticipation for what lies ahead. Through the program, I'm evolving into a catalyst for change, ready to leave an indelible mark on the world around me. I'm happy to have walked this dream where every blueprint is a pathway to innovation, every calculation a step towards comfort and every design a beacon of sustainability in the built environment.

Name: Shadrack Kipkurui

Age: (23 years)

University: Kenyatta University

Course: Civil Engineering

5th year

The Impact of Smart Building Technologies on Operational Efficiency and Maintenance in Civil Engineering

Building services engineering involves designing, installing, operating, and maintaining essential building systems such as heating, ventilation, and air conditioning (HVAC), electrical, plumbing, fire safety, and security to create safe, comfortable, and efficient environments by integrating these systems into the architectural and structural design.

Smart building technologies have recently revamped this field by using advanced sensors, data analytics, and automated controls to optimize system performance. These innovations enhance energy efficiency, occupant comfort, and reduce operational costs, while enabling predictive maintenance to minimize downtime and extend system lifespans.

Figure 1: Concept diagram of Smart building

Incorporating smart building technologies into civil engineering indicates a significant shift in building design and management. Civil engineers ought to integrate these advanced systems into their projects, working closely with building services engineers to ensure infrastructure support. This collaboration is essential for developing the next generation of high-performance, interconnected buildings.

Smart Building Technologies and Their Integration into Civil Engineering

By incorporating these technologies into civil engineering practices, buildings can achieve higher performance standards and provide superior services to their occupants. Some of smart building technologies include:

1. Advanced HVAC Systems

Modern HVAC systems are equipped with smart sensors and controls that allow for precise temperature and humidity regulation. These systems can adjust settings in real-time based on occupancy, outdoor weather conditions, and indoor air quality. Civil engineers can design buildings to accommodate the extensive ductwork, piping, and electrical infrastructure required for these advanced HVAC systems to ensure optimal thermal comfort and energy efficiency.

2. Automated Lighting Controls

Smart lighting systems use sensors and timers to control lighting based on occupancy and natural light levels. These systems can significantly reduce energy consumption and enhance the user experience by providing the right amount of light when needed. In collaboration with electrical engineers, civil engineers play a key role in planning the electrical layout and ensuring that the building structure supports the installation of these systems.

3. Smart Meters and Energy Management Systems

Smart meters provide detailed data into energy usage patterns, allowing for more efficient energy management. These meters can be connected to a central building management system that monitors and optimizes energy consumption across different building services. Designs by engineers should ensure that the building's electrical infrastructure can support the installation of smart meters and associated communication networks for cost savings and a reduction in the building's carbon footprint.

4. Integrated Security Systems

Modern buildings often feature integrated security systems that include smart cameras, access control systems, and intrusion detection. These systems can be monitored and controlled remotely, providing enhanced security for building occupants. The design and placement of these systems require careful planning to make sure that structural elements do not obstruct or interfere with their functionality, hence providing safer environments.

Contribution to Building Services Engineering

The integration of smart building technologies into civil engineering practices offers many benefits that enhance building services engineering. These technologies help achieve:

- Energy efficiency by reducing energy consumption and operational costs.
- Occupant comfort and health through consistent maintenance of optimal environment conditions.
- Operational efficiency through reduced downtime and extension of the lifespan of building services.
- Safety and security for building occupants and assets.
- Sustainability by reducing energy usage and promoting efficient resource management.

Conclusion

Integrating smart building technologies into civil engineering significantly advances building services engineering. Utilizing advanced HVAC systems, automated lighting controls, smart meters, integrated security systems, and building automation systems, engineers can create more efficient, comfortable, and sustainable buildings. As the field evolves, the collaboration between civil engineering and smart technologies will be key to developing innovative high-performance buildings. This integration helps achieve safety, efficiency, and sustainability, leading to smarter and more resilient built environments.

Name: Paulpablo Zaire Omondi

IEK Member No: S.11940

Age:23, 5th year

Course: Civil engineering

Kenyatta University

Innovative Use of Rubberized Asphalt in Building Engineering Services

A sustainable and resilient innovative solution gaining traction is the use of rubberized asphalt in construction projects. This cutting-edge material integrates recycled rubber from used tires into traditional asphalt, offering numerous engineering and environmental benefits.

Rubberized asphalt enhances pavement performance by providing superior durability and resistance to cracking and rutting. Its flexibility allows it to better withstand temperature fluctuations and heavy traffic loads, extending the lifespan of roads and reducing maintenance costs. For engineers, this translates into more reliable and cost-effective infrastructure projects.

Environmentally, the use of rubberized asphalt is a significant step towards sustainability. By recycling tires, it helps reduce landfill waste and the environmental impact associated with tire disposal. Additionally, the production process of rubberized asphalt consumes less energy compared to traditional asphalt, further lowering its carbon footprint.

In institutional projects, such as university campuses and public facilities, rubberized asphalt can be particularly beneficial for construction of durable and low-maintenance pathways and parking areas and aligns with green building standards, contributing to the overall sustainability goals.

By adopting rubberized asphalt, we can champion innovative engineering practices that enhance infrastructure resilience and promote environmental stewardship, setting a precedent for future projects in Kenya and beyond.

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