

[CS502302]

Leveraging AutoCAD capabilities for design of pit sludge emptying solutions

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Learning Objectives

- Implement human centered design techniques to deliver construction solutions that meet the needs of users.
- Adopt AutoCAD automation for better design efficiency, reduce design errors and complexities.
- Implement AutoCAD digital tools for improved. collaboration accomplish quick design iterations based on user feedback

Description

Sanergy implements a pit sludge emptying solution to capture harmful pit latrine waste that would otherwise be dumped untreated in the open environment causing harm to the environment and public health. With AutoCAD's automation and digital capabilities, such as the Trace tool, Count, design center library, tool palettes, and the mobile app, the team has achieved accurate design and build of our user-centered pit latrine waste transfer centers in Nairobi's informal settlements where manual pit latrine emptiers (MPEs) can safely empty waste collected from pit latrines in their communities, and maintain high hygiene standards during operations. This session discusses Sanergy's approach to generating valuable design insights from our customers (manual pit emptiers) feedback and leveraging AutoCAD automation and digital tools to design our solutions. The talk will include the benefits gained by exploring AutoCAD's automation and digital tools as well as the opportunities present for the construction industry

Speaker(s)



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Bonface Odera is a mechanical engineer by training with over six years as a project engineer in construction and building works, mechanical installation, and electrical works. He is currently a product engineer at Sanergy developing and implementing innovative solutions for sanitation and waste management in Kenya. Bonface leads the design and construction of pit sludge waste management infrastructure from concept through design to practical completion. He also leads the Fresh_Life toilet's product development initiatives. In his free time, Bonface enjoys participating in social initiatives at his rural home in Kenya and spending time with his family and friends.

Introduction

This talk covers Sanergy's approach to solving the sanitation and waste management challenge in fast-growing cities, starting with Nairobi in Kenya. Specifically, this handout will focus on Sanergy's pit sludge management service. We will aim to provide insights into how we leveraged AutoCAD tools for iterative design to achieve effective and efficient construction outcomes.

Sanitation challenges in growing cities around the world

Cities around the world continue to grow at exponential rates. It is estimated that over 50% of the world's total population lives in urban areas. More than 1 billion people live in urban slums today and the number is expected to surpass 3 billion by 2050. With the existing infrastructure, in developing countries like Kenya, already inadequate, 70% of residents in urban slums live with lack of access to water and a safe sanitation option. As a result, over 1 million people die every year due to sanitation related illnesses while economies lose over \$260 billion in impaired productivity.

Sanergy's full value chain sanitation solution

Over the last 10 years, [Sanergy](#) has implemented a variety of bold sanitation and waste management solutions for these fast-growing cities. The solutions are based on a **circular economic model and seek to address all systemic gaps from waste containment, emptying, transport, treatment and reuse**. Sanergy's approach involves building a network of high quality, cost-effective sanitation products and services for residents living in the low income, non-sewered informal settlement areas. Through these facilities, Sanergy removes all the waste generated by our customers and transport it to a central recycling facility for treatment and upcycling into high quality agricultural inputs. Sanergy has built and distributed over 4,000 sanitation facilities to date, serving over 150,000 people with safe services every single day. On the other hand, we have safely removed and up-cycled over 20,000 metric tons of sanitation waste every year. [Here](#) is a brief introduction of Sanergy by Lindsay Stradley, one of the organization's co-founders and [Sanergy's](#) circular model in action.



Sanergy's Pit Sludge Emptying Solution

Pit latrines account for about 80% of sanitation facilities used in Nairobi's informal settlements. Due to space limitations, these toilets have to be emptied when they fill up as digging a new pit is not an option. Exhaustion services are available but are expensive, and the narrow pathways in the community inhibit access. Therefore, most waste from the pit latrines is collected and disposed of by manual emptiers using a drum on wheels (as pictured below) at a fee. For lack of safe disposal stations, the waste ends up in open waterways and poorly maintained manholes resulting in profound implications to both the environment and public health.

Sanergy has launched a pit sludge emptying solution - a pit latrine waste management initiative that affords manual pit emptiers (MPEs) a safe disposal station for their pit latrine waste. The disposal centers are designed and constructed according to the desires and needs of the manual pit emptiers (MPEs). They consist of a waste holding tank, a tipping station and other facilities suited to meet safe emptying as well as personal and equipment hygienic needs of the emptiers. This solution protects urban residents and the environment from unsafe and illegal sanitation waste dumping practices.



Illegal pit latrine waste dumping



Sanergy's pit emptying solution

The use of AutoCAD in the design of Sanergy's pit sludge management facilities

1. Implementing human-centered design techniques to deliver construction solutions that meet the needs of users.

Human-centered design is a creative problem-solving approach that seeks to understand the needs of the people it's designing for and ends with creative solutions tailored to meet those needs. At Sanergy, we have adopted a **human-centric design approach** to design and construct waste transfer centers that work for manual pit emptiers (MPEs).

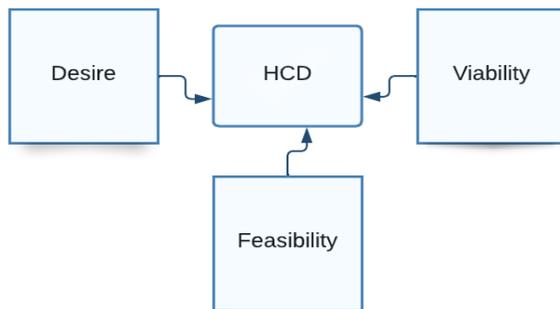


Fig 1: Human centered design is an iterative process that focuses on the desires of the people, taking into account the viability, and feasibility of the design solution.

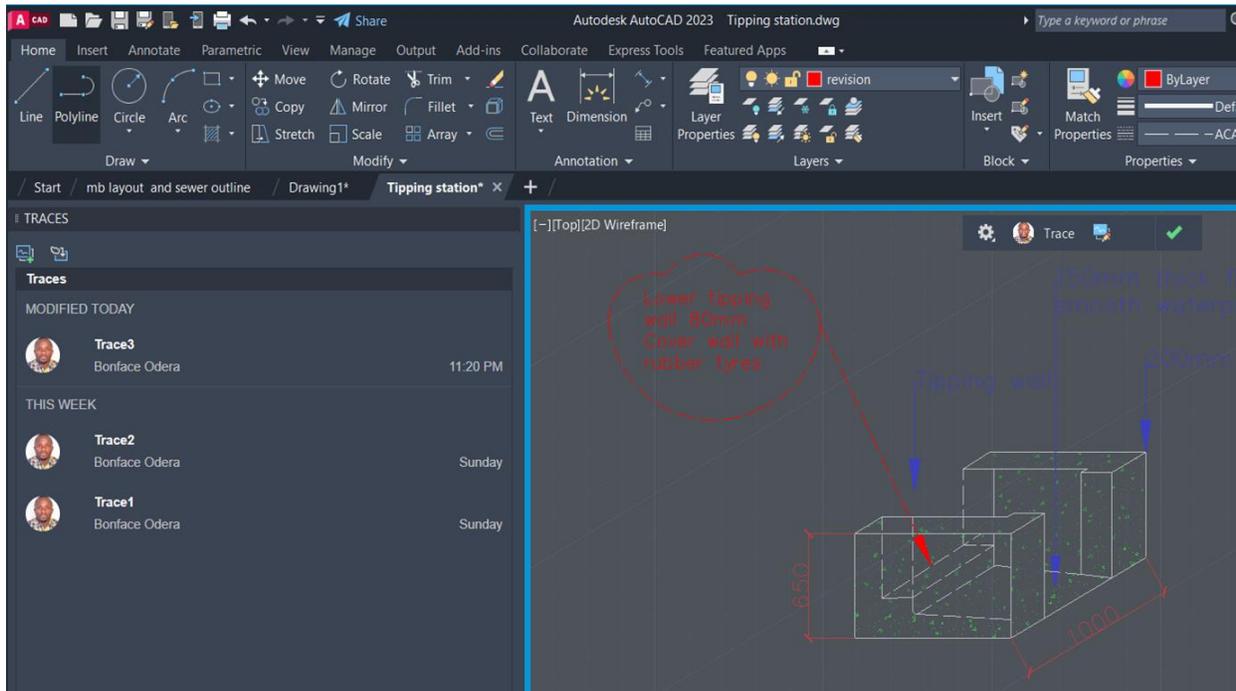
As people are central to Sanergy's design and construction strategy, AutoCAD provided us with the vital tools we needed to **gather critical insights from site users** (MPEs, and site operators). We used this feedback to test, learn, iterate and improve designs ensuring that facilities are designed and constructed from the perspective of its users. Two important AutoCAD tools were essential in ensuring effective collaboration between Sanergy team, our customers and external consultants/contractors.

The are:

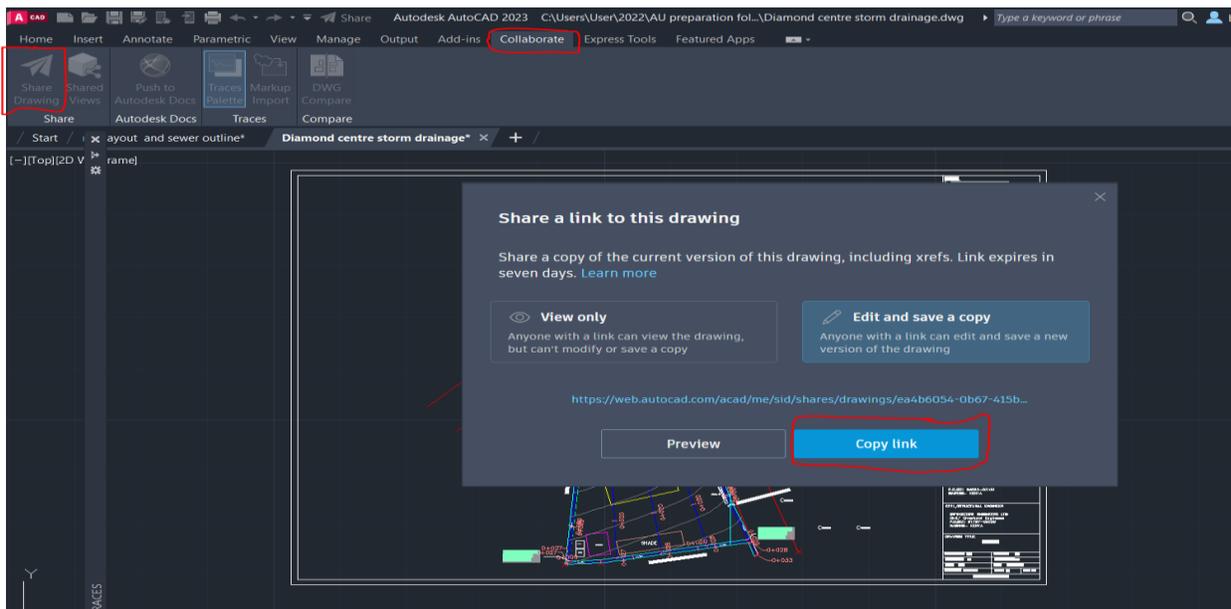
- Trace tool
- Share URL feature.

With AutoCAD's **trace tool**, we reviewed and added feedback directly to the dwg files without altering the content of the original drawing. The trace tool feature is available on **AutoCAD mobile app** and **Web app**, which allows for easy remote collaboration between project stakeholders and to gather real time feedback from MPEs and site operators during pilot trials, which is later incorporated.

A practical example: When designing for the site entrance ramp, tipping stations, sludge holding tank manholes and washing areas, we used the trace tool to record the correct tipping height through observing a practical tipping operation and recording the most ergonomic position for tipping including lining material for the walls. Drawing **revision clouds** around the proposed changes enabled us to keep track of these changes and to quickly identify them. This way, all project collaborators delivered a facility that works for our customers. If you wish to learn how to incorporate the trace tool command into your design workflow click [here](#).



The **share tool** allowed for quick sharing of dwg files with non-AutoCAD users or external vendors who did not have AutoCAD installed on their devices, saving them the extra effort of installing the software.



By sharing a web link of the cad files, collaborators accessed and viewed drawings easily on **Autocad mobile**, or **web app** or **AutoCAD desktop** anywhere, anytime enabling timely stakeholder feedback and approval.

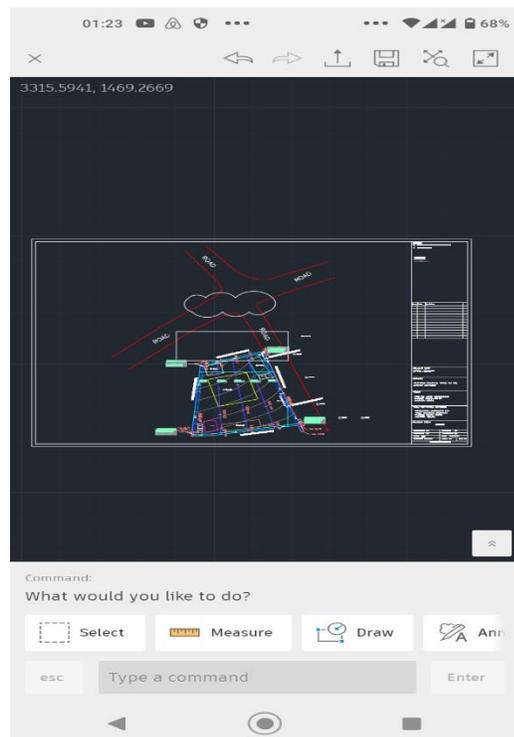
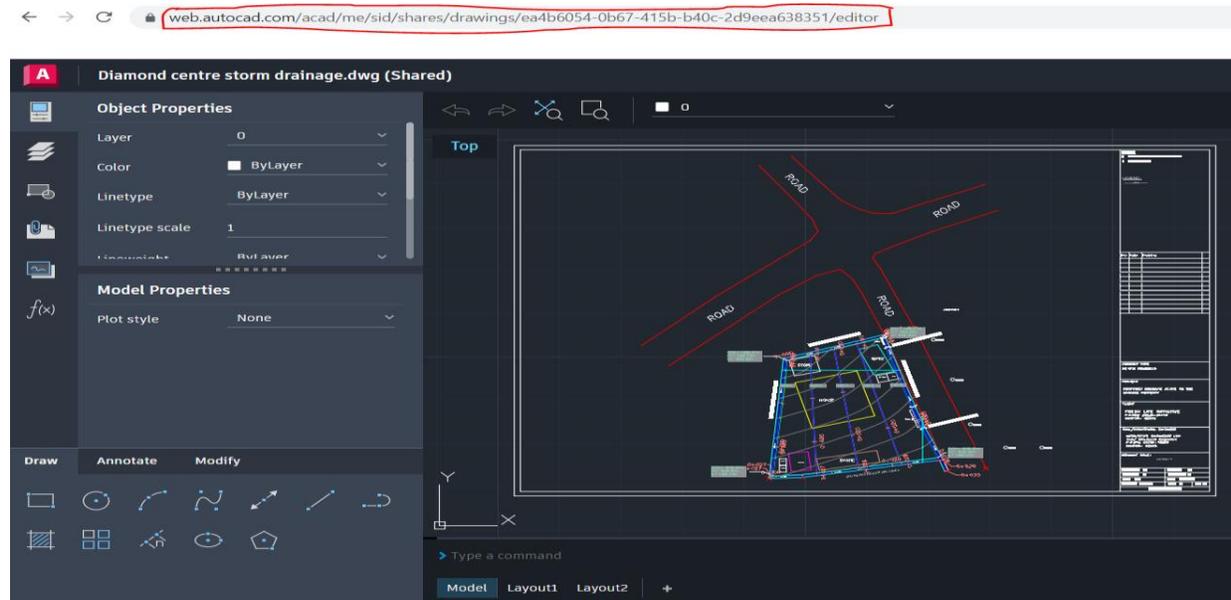
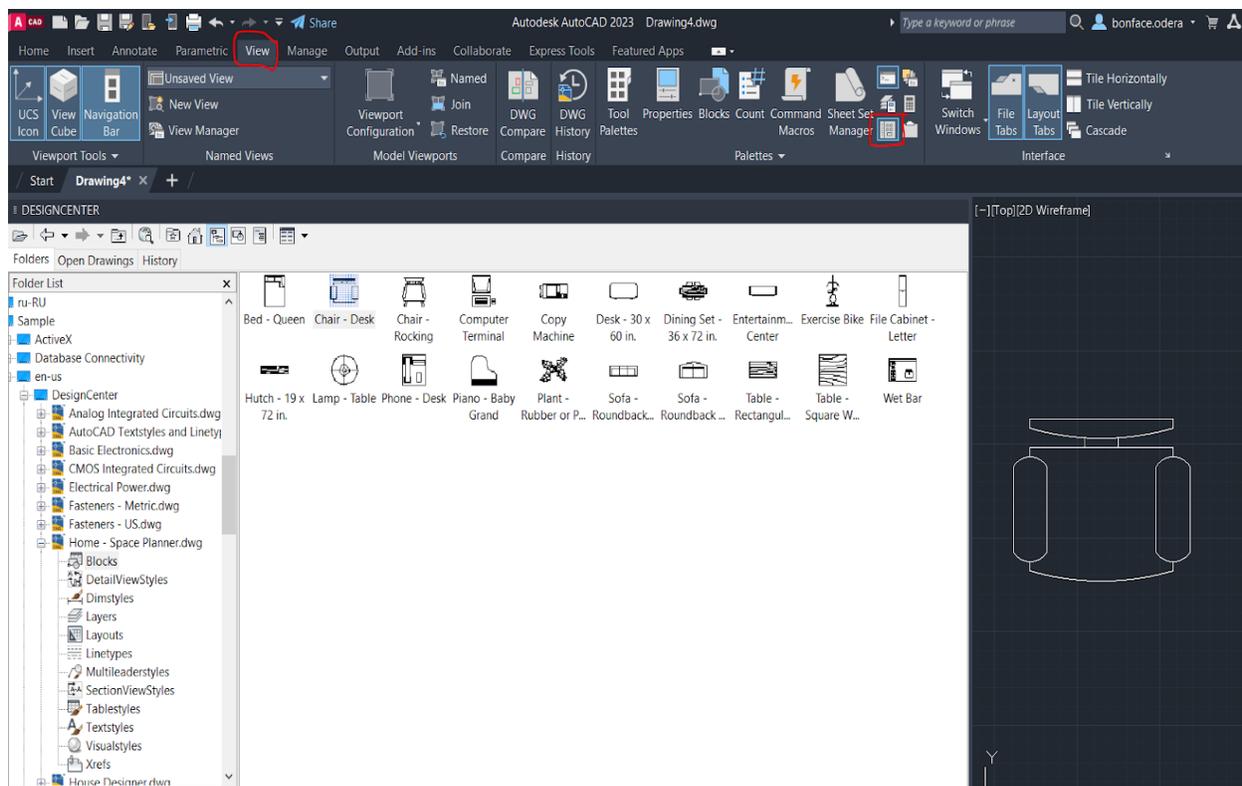


Fig: DWG file viewed on mobile

2. Adopting AutoCAD automation for better design efficiency, reduction of design errors and complexities

AutoCAD automation features have streamlined design workflows for Sanergy's scale and replication. The **AutoCAD's design center library** enabled us to create common facilities which were shared on **google drive** as blocks or in a customized **tools palette**. This saved project collaborators time when designing for new sites by eliminating the need to develop new equipment drawings from scratch. Instead, they imported the saved files as blocks, exploded, edited and added them into current drawings. In case there was a need to count any blocks of geometry in the drawing file, the **count tool** was used. It is an efficient tool as it eliminates the block counting exercise within the drawing file, while removing any human errors.



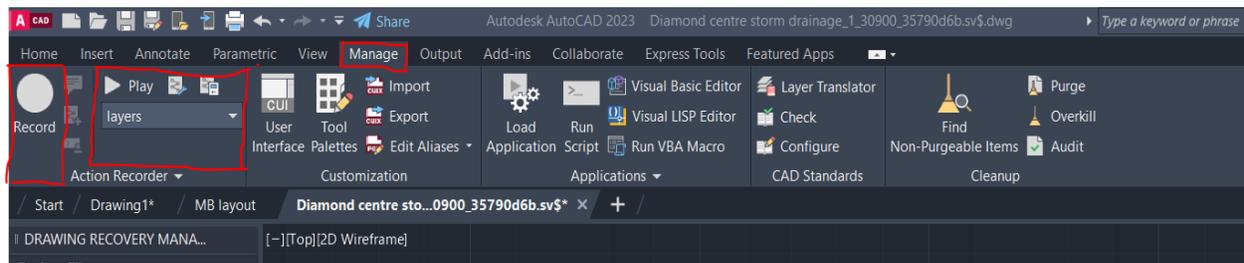
3. Implementing AutoCAD digital tools for improved collaboration and to accomplish quick design iterations.

With AutoCAD's machine learning capability-markup **import tool**, Sanergy's design team has easily imported images or pdf markups (design reviews) into AutoCAD, allowing us to quickly collaborate with consultants and field supervisors with more flexibility and reduced risk of errors. For example, a construction supervisor could report errors on the construction drawings by simply sharing the image with a note on their **AutoCAD mobile app**. The design team would then view the image on desktop and review changes.

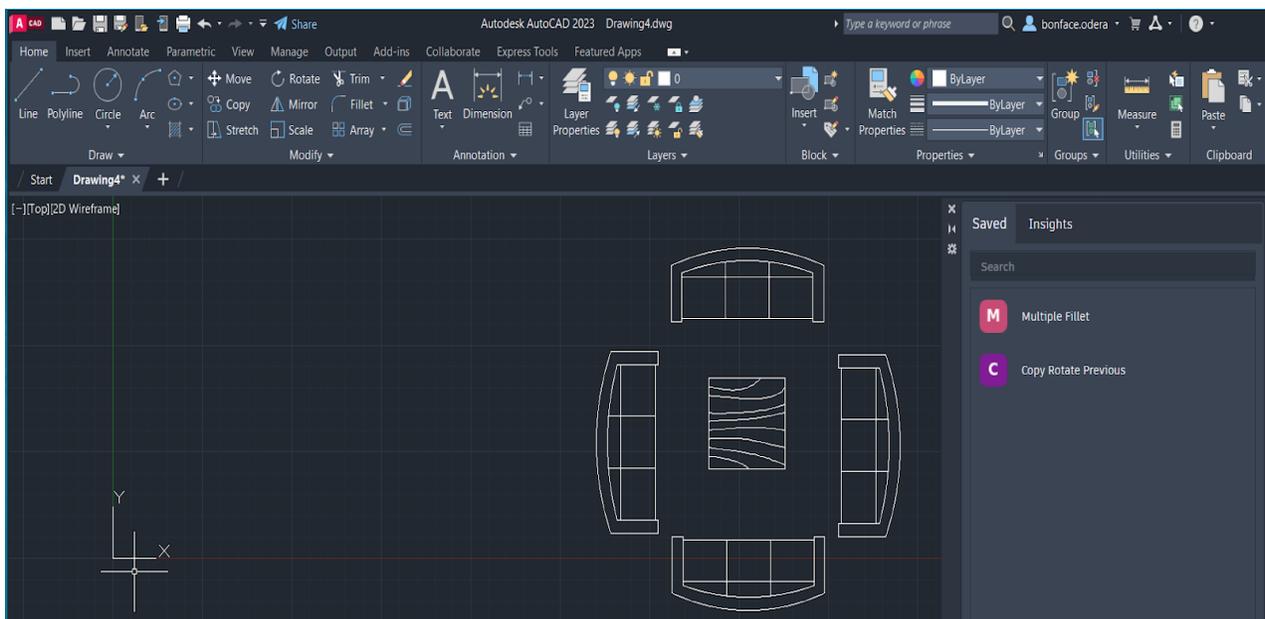
Learning how to maximize AutoCAD's new capabilities to streamline design workstreams

With the **action recorder**, the team has learnt to automate repetitive design tasks allowing us to draft faster and more efficiently. For example, the team has created a macro for automatically creating layers into the AutoCAD workspace, which every member of the design team can access, allowing us to speed up our design workflows. Being a good **integration tool**, AutoCAD enabled us to create common design template files, which we stored in a common google drive, for easy retrieval by all collaborators.

This feature also ensures consistency of our drawings within the organization. We are able to automate design maintenance functions like **audit** and **purge** to quickly clean up our drawings and eliminate duplicates or unused objects in a drawing file.



Command macro, the latest of AutoCAD feature releases allows us to merge simple commands and accomplish simple tasks with speed. To learn more about the command macro, watch the video by Autodesk [here](#)



In some instances, the Sanergy team needed to easily locate and capture features of the transfer centers for our drawings and for sharing with external design consultants. The **geo location** tool in AutoCAD enabled us to locate and insert clear maps using the site address, draw site plans and extract dimensions giving our designs a real-world context. Click [here](#) to learn more about inserting maps into AutoCAD using the geolocation feature.

