Construction Site Tour as a High Impact Pedagogical Technique to Actively Engage and Enhance Students Performance in an Online Engineering Class

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Dr. Oludare Owolabi, a professional engineer in Maryland, joined the Morgan State University faculty in 2010. He is the assistant director of the Center for Advanced Transportation and Infrastructure Engineering Research (CATIER) at Morgan State University and the director of the Civil Engineering Undergraduate Laboratory. He has over eighteen years of experience in practicing, teaching and research in civil engineering. His academic background and professional skills allows him to teach a range of courses across three different departments in the school of engineering. This is a rare and uncommon achievement. Within his short time at Morgan, he has made contributions in teaching both undergraduate and graduate courses. He has been uniquely credited for his inspirational mentoring activities and educating underrepresented minority students. Through his teaching and mentoring at Morgan State University he plays a critical role in educating the next generation of underrepresented minority students, especially African-American civil engineering students. He is also considered to be a paradigm of a modern engineer. He combines practical experience with advanced numerical analysis tools and knowledge of material constitutive relations. This is essential to address the challenges of advanced geotechnical and transportation research and development. He is an expert in advanced modeling and computational mechanics. His major areas of research interest centers on pavement engineering, sustainable infrastructure development, soil mechanics, physical and numerical modeling of soil structures, computational geo-mechanics, constitutive modeling, pavement design, characterization and prediction of behavior of pavement materials, linear and non-linear finite element applications in geotechnical engineering, geo-structural systems analysis, structural mechanics, sustainable infrastructure development, and material model development. He had been actively involved in planning, designing, supervising, and constructing many civil engineering projects, such as roads, storm drain systems, a $70 million water supply scheme which is comprised of treatment works, hydraulic mains, access roads, and auxiliary civil works. He had developed and optimized many highway design schemes and models. For example, his portfolio includes a cost-effective pavement design procedure based on a mechanistic approach, in contrast to popular empirical procedures. In addition, he had been equally engaged in the study of capacity loss and maintenance implications of local and state roads (a World Bank-sponsored project). He was the project manager of the design team that carried out numerical analyses to assess the impact of the new shaft and tunnel stub construction on existing London Underground Limited (LUL) structures as per the proposed alternative 3 design of the Green park Station Step access (SFA) Project in U. K. He was also the project manager of Category III design check for the Tottenham Court Road Tunnel Underground Station upgrade Project in UK.
Abstract

High impact pedagogical techniques and tools are very crucial in enhancing learner’s engagement and mastery of competencies/concepts in an online environment. To facilitate learners’ engagement and mastery of engineering concepts, instructor-learners, content-learners, and learner-learner interactions in an online environment; teaching techniques and tools must be carefully selected. This paper describes how construction site tour was adopted as a high impact pedagogical technique to actively engage and enhance students’ performance in an online Statics class during a short mini-winter semester. It has been noted that students become more engaged when learning experiential, hands-on, inquiry–based and project oriented. The paper further reveals how this technique fosters direct hands-on experience where students are given the opportunity to learn in real-world settings (construction site) and reflect in a classroom setting. The online environment gave the students the opportunities to achieve the course objectives while residing in their home countries/states during the winter break. As the students were spread all over the world during the winter break some in Northern America, Asia, Europe and in the middle east, they were subsequently required to visit any construction site in their vicinity where they would be able to visualize and experience the application of principles of statics and dynamics in the safe operation and maintenance of all the construction equipment as well as visualize the structural members of the infrastructure. The students were required to write a detailed report in accordance with an earlier supplied rubrics, which served as an instrument to assess the student achievement from the real-life application pedagogy. In order for the author to validate that the students actually visited the site, the author adopted an innovative approach by requiring each student to produce a construction site tour video with each student appearing in the video. The integration of the video production is the novel portion in this study. The instruments that were used to assess the impact of the construction site tour on students’ performance were the construction site report and video; and the correlation of the construction tour grade with the overall course grade. There is a strong statistical association (89% correlation) between the construction site tour and final course grade. The paper finally recommends that this pedagogy can be adopted by intuitions that are contemplating of offering Statics in an online environment.
1. Introduction

High impact pedagogical techniques and tools are very crucial in enhancing learner’s engagement and mastery of competencies/concepts in an online environment. To facilitate learners’ engagement and mastery of engineering concepts, instructor-learners, content-learners, and learner-learner interactions in an online environment; teaching techniques and tools must be carefully selected. Such high impact pedagogical technique must be able to enhance the cognitive ability of the students and increase student interest and attitude towards the subject matter. Field experiential learning pedagogy is a good supplementary teaching method, along with other methods that promote social presence in an online classroom environment such as discussion forums, chat logs, web-based meetings, virtual class rooms, enforced sequential viewing of lecture videos, and virtual class meetings, can all be used to enhance learner’s engagement and performance in an online environment. Bull (2014) suggests adding an element to online courses in which students are required to conduct an activity, and then discuss the results. Suggestions for these activities include face-to-face interviews with professionals in a relevant industry, observations of actions in the natural world or a professional environment, service learning activities, and capturing and sharing relevant photo and video footage from their area. According to Woods and Bliss (2016), these activities could bridge the gap between hand-on, traditional and e-learning. One of such field experiential learning activity is construction site visit, where students are given the opportunity to learn in real-world settings. According to Bull (2014), construction site visit is one of the offline activities that enables students make analogies and connections between what they are learning and what they see in the physical world around them. This drives their thinking to higher levels (analysis, evaluation, even creation) and makes it fun and interesting sharing in the online discussion. Construction site visit is a learner-centered pedagogy that increases observation and memorizing capabilities as well as improving recall competency. Consequently, this paper describes how construction site tour was adopted as a high impact pedagogical technique to actively engage and enhance students’ performance in an online Statics class during a short mini-winter semester. The paper further reveals how this technique fosters direct hands-on experience where students are given the opportunity to learn in real-world settings (construction site) and reflect in a classroom setting. The online environment gave the students the opportunities to achieve the course objectives while residing in their home countries/states during the winter break. As the students were spread all over the world during the winter break some in North America, Asia, Europe and in the middle east, they were subsequently required to visit any construction site in their vicinity where they would be able to visualize and experience the application of principles of statics and dynamics in the safe operation and maintenance of all the construction equipment as well as visualize the structural members of the infrastructure.

2. The Course Statics

The course Statics is the first basic engineering-science that is required by all civil engineering undergraduate students. The Statics course has the following catalog description:

This is the first basic engineering-science course required in the civil engineering curriculum at Morgan State University. The course emphasizes the proper utilization of vector algebra and free body diagrams to solve problems in engineering mechanics (statics). Vectors are used to describe the action of forces and moments acting on particles (point masses) and rigid bodies, which are fixed in space or undergoing uniform motion. The course begins with a description
of how the topic of Statics fits into the broad picture of the engineering curriculum, and more particularly, the area known as Engineering Mechanics. The course then moves into six major areas of study: (i) vector algebra of forces and moments, (ii) free body diagrams and equilibria of particles and rigid bodies, (iii) centroids and centers of gravity, (iv) internal forces in trusses and frames, (v) friction and applications to machines, and (vi) moments of inertia.

The instructional objectives and learning outcomes of this course are:

1. Students will apply prerequisite knowledge from physics and mathematics to engineering mechanics problems.
2. Students will be able to apply the fundamental principles and concepts of statics and dynamics in solving engineering mechanics problems.
3. Students will be able to analyze the equilibrium of a body under the action of forces.
4. Students will be able to analyze the motion of a body under the action of forces.
5. Students will be able to use vector methods to solve engineering mechanics type problems.
6. Students will be able to communicate by free-body-diagrams and use such diagrams to aid problem solving.
7. Reasonable ability to carry out design of a structural or machine system or component to meet static conditions.

Table 1 shows the grade distribution for the course.

**Table 1: Grade Distribution of the Statics Course**

<table>
<thead>
<tr>
<th>Points or %</th>
<th>Description</th>
</tr>
</thead>
<tbody>
<tr>
<td>15%</td>
<td>Homework, Project, Clicker Responses, Quizzes</td>
</tr>
<tr>
<td>10%</td>
<td>Discussion</td>
</tr>
<tr>
<td>15%</td>
<td>Field Trip</td>
</tr>
<tr>
<td>10%</td>
<td>Mid Term Exam</td>
</tr>
<tr>
<td>45%</td>
<td>Final Exam</td>
</tr>
<tr>
<td>100</td>
<td>Total Points Possible</td>
</tr>
</tbody>
</table>

3. **Description of the Teaching Methodology**

Experiential learning is any learning that supports students in applying their knowledge and conceptual understanding to real-world problems or situations where the instructor directs and facilitates learning. According to Wurdinger and Carlson, 2010, the classroom, laboratory, or studio can serve as a setting for experiential learning through embedded activities such as case and problem-based studies, guided inquiry, simulations, experiments, or art projects.

According to University of Texas at Huston, Learning Sciences when students are given opportunities to learn in authentic situations on campus or in the community like those provided in internships, field placements, clinical experiences, research and service-learning projects, the learning becomes significantly more powerful. By engaging in formal, guided, authentic, real-world experiences, individuals:
• deepen their knowledge through repeatedly acting and then reflecting on this action,
• develop skills through practice and reflection,
• support the construction of new understandings when placed in novel situations, and
• extend their learning as they bring their learning back to the classroom.

Also according to Kolb, 1984\(^5\) the experiential learning process includes the integration of:

• knowledge—the concepts, facts, and information acquired through formal learning and past experience;
• activity—the application of knowledge to a “real world” setting; and
• reflection—the analysis and synthesis of knowledge and activity to create new knowledge” (Indiana University, 2006\(^6\))

Elements of experiential learning

The Association for Experiential Learning, 2007-2014\(^7\) has defined that experiential learning has the following elements:

• Experiences are carefully chosen for their learning potential (i.e. whether they provide opportunities for students to practice and deepen emergent skills, encounter novel and unpredictable situations that support new learning, or learn from natural consequences, mistakes, and successes).
• Throughout the experiential learning process, the learner is actively engaged in posing questions, investigating, experimenting, being curious, solving problems, assuming responsibility, being creative, and constructing meaning, and is challenged to take initiative, make decisions and be accountable for results.
• Reflection on learning during and after one’s experiences is an integral component of the learning process. This reflection leads to analysis, critical thinking, and synthesis.
• Learners are engaged intellectually, emotionally, socially, and/or physically, which produces a perception that the learning task is authentic.
• Relationships are developed and nurtured: learner to self, learner to others, and learner to the world at large.

Field experiential learning is part of experiential learning in which learning is done outside the classroom and students are forced to engage with application of concepts in a real world situation. According to Claiborne et al 2015\(^8\), along with the engagement with concepts that is required by these experiences, the student bonding that occurs on the field trips enhances the learning experience and creates a learning community as students continue in a discipline. Teaching in the field also gives instructors the opportunity to get to know their students in greater depth in terms of how students see the world differently than the instructor\(^8\). This insight into student world-views can help the instructor to better communicate the concepts of the course.

Statics being the first basic engineering-science course in civil engineering, thus there is therefore the need to increase students’ motivation and attitude towards engineering mechanics. The construction site visit is adopted as a field experiential learning pedagogy to enhance the cognitive ability of the students as well as increase their interest and attitude towards civil engineering. The construction site visit gives the students the opportunities to achieve the course objectives while residing in their
home countries/states during the winter break. The online students are required to search for any ongoing construction site in their vicinity during the winter break where they will be able to visualize and experience the application of principles of statics and dynamics in the safe operation and maintenance of all the equipment as well as visualize the structural members of the infrastructure, like beams, columns, foundation, shear walls, roof trusses.

Few weeks/one week ahead of the visit a letter is usually made available to the students that will be presented to the project manager of the construction site requesting for permission to visit the site and also requesting the manager to take the students round the site and elucidate the applications of principles of static and dynamics in the safe operation and maintenance of the construction equipment as well as critically reveal the structural members of the infrastructure. The purpose of the visit is clearly elucidated in the letter and the grading rubrics by which the student field work report will be accessed is even attached with the letter so that the project manager can help in disseminating the appropriate concepts to the students.

The rudiments of the basic hypotheses is given to the student. Various examples on statics problems on machines and equipment similar to the ones they will see the field and are given to the students. Also equilibrium problems on trusses and structural analysis of structural members are given. Students are instructed to wear appropriate attire during the visit: thick sole shoes (boots with treads), pants, shirts with sleeves. No tennis shoes, open toe shoes or heels are permitted. Students are briefed on safety issues before entering the construction site and they are provided with reflective vest, goggles and hard hats as safety measures.

This practice was proven to improve their positive attitude and perception of learning Engineering Mechanics and they were able to connect the course to their field of learning. The students were well able to visualize the concepts in absolute clarity. The real life application of concepts of statics and dynamics experienced on the construction site facilitated the acquisition and integration of engineering mechanics knowledge. The students were required to write a detailed report in accordance with an earlier supplied rubrics, which served as an instrument to assess the student achievement from the real-life application pedagogy. In order for the author to validate that the students actually visited the site, the author adopted an innovative approach by requiring each student to produce a construction site tour video with each student appearing in the video. The integration of the video production is the novel portion in this study. The students were also given detailed instructions on how to produce the video online. The online resource where the students can obtain information about online video production was also supplied (https://studio.stupeflix.com/en/). The students are assessed on how they can be able to succinctly describe the site, the foundation and substructure and superstructure of the infrastructure. They are also evaluated on their ability to relate the application of principles of geotechnical engineering in the design and construction of the sub-structural/foundation elements of the building/infrastructure as well as critically reveal the structural and foundation members of the building infrastructure. Finally their organization and logical presentations of ideas are assessed.
4. **Impact of the Pedagogical Technique on Students Performance**

The instruments that were used to assess the impact of the real-life application pedagogy on student engagement were the students’ field report and statistical relationship between the students’ construction site report and final exam.

In order to demonstrate the mastery of the students of the principles of statics and dynamics in the application of concepts of statics and dynamics experienced on the construction site facilitated the acquisition and integration of engineering mechanics knowledge the essential components of a few online student field reports are shown in Appendix A.

The students reports A to D in Appendix A demonstrate a mastery of the concepts of statics and dynamics by the students. Student A reported the application of the principles of statics and dynamics in the safe operation of the construction equipment, while student B shows an in-depth understanding of the mechanics of the operation of the crane. Through Student C report it is clearly seen that the student thoroughly understands the concept of friction, while student D comprehensively reported the importance of safety on sites and precautions that must be taken when operating equipment on site.

The students were also required to participate in a class discussion on structural members of buildings. The following is the class discussion: “Given the determination of loads onto a frame of a two-floor building what are the consequences if the loads are wrongly determined.”

Here are a few responses from the students:

“If the loads are wrongly determined many consequences will take place. A few to name is the building will collapse, the safety measures will be highly altered, the performance/purpose of the building will be decreased, etc. The determination of loads is very important for the safety of the workers and later the users of the building.”

Students Grades:

Figure 1 shows the results of the field report of 13 students compared to their final Semester grade. From Figure 1 it is clearly demonstrated that students’ grades in the field project has a strong influence on their final semester grade. This is a strong justification that the field experiential pedagogy adopted greatly enhanced the students’ performance in the class. From the correlation in Figure 1, there is a strong statistical association (89% correlation) between the construction site tour and final course grade.
Construction site tour was adopted as a high impact pedagogical technique to actively engage and enhance students’ performance in an online Statics class during a short mini-winter semester at a Historical Black University. As the students were spread all over the world during the winter break some in America, Asia, Europe and in the middle east, they were required to visit any construction site in their vicinity where they would be able to visualize and experience the application of principles of statics and dynamics in the safe operation and maintenance of all the construction equipment as well as visualize the structural members of the infrastructure. The students were required to write a detailed report in accordance with an earlier supplied rubrics, which served as an instrument to assess the student achievement from the real-life application pedagogy. In order for the author to validate that the students actually visited the site, the author adopted an innovative approach by requiring each student to produce a construction site tour video with each student appearing in the video. The integration of the video production is the novel portion in this study.

The students are usually accompanied by the project manager during the tour. In a report one of the online students made the following comments: “The field trip was very informative and we fulfilled our objectives. It was no doubt a wander that was being built with beauty at its peak. What we observed at construction site was everybody was safety conscious and quality was being assured at every step. Additionally we also learned the practical applications of statics and dynamics. It will not only help us to understand the word of civil engineering better but will also boast our moral to work more diligently once we are in our professional life. Such tours must be arranged from time to time so we can know what actually is happening in a construction site and how the construction technique was changing with the passage of time. This project will also help us a lot in our studies. In getting real concepts behind the problems that we are going to solve in
the semester”. Another student also commented that “Overall, this field was a complete success and a perfect way to apply real world concepts to what was learned online in this class. I want to give a special thank you to the Project Manager over at SBB Inc. for taking time out of his busy day to show me around his site. From the field trip I’ve learned that civil engineers jobs in planning and designing new buildings is greatly substantial. Also, safety is the number one priority on a construction site. Construction workers on scaffolds had to be tied down, and sheet metal was sprayed with silicone for fire prevention. In conclusion, even though this field trip was a requirement I actually enjoyed the tour and gained a lot of new information from this trip."

The students are also able to witness firsthand the design and construction of the structural members of the building. The outcome has been very encouraging as students have been able to link theory with practice. The field tour is part of the experiential learning initiative of STEM field. As it has been noted that students become more engaged when learning experientially- hands-on, inquiry-based and project-oriented. Experiential learning connects content to real-world application and integrates technology and 21st Century skills. Experiential learning of this kind will broaden the participation of underrepresented students in STEM field. The instruments that were used to assess the impact of the construction site tour on students’ performance were the construction site report and video; and the correlation of the construction tour grade with the overall course grade. There is a strong statistical association (90% correlation) between the construction site tour and final course grade. This learning activity implemented provide opportunity for interaction that support active learning as well as promote mastery of the course learning objectives. Future study shall involve conducting a questionnaire survey with the students and the construction site project managers. It is recommended that this pedagogy should be adopted by intuitions that are contemplating of offering Statics in an online environment as this technique will facilitate learners’ engagement and mastery of engineering concepts, instructor-learners, content-learners, and learner-learner interactions in an online environment. This concept is easily scalable as construction sites are ubiquitous. Finally it is the author opinion that as engineering educators continue to engage in the field tours; this will foster experiential learning amongst our student, and subsequently will improve STEM education and better enhance and strengthen our nation and raise the standards of solving engineering problems. Finally this methodology is not only sustainable and scalable, but can be easily adopted in any university in teaching engineering online classes.

References


APPENDIX A

Essential Components of Students A-D Field Report

Student A:

“Introduction

The object to perform this lab was to visit a nearest construction site and analyze it on basis of educational grounds of statics and dynamics. The goal was to see how the construction was being done and how machines were helping to do the work. Where statics and dynamics knowledge was being applied. The basic structure of building was also observed along with the protocol of its construction. The activity not only enhanced the vision but also built confidence in us to do better designs and get over the preventions of senses from construction sites.

Site features

The site under construction is a three-year project comprising of three stories in the basement and additional 16 floors above. Total area that is to be covered under the roof is $25,742 \text{ m}^2$. The building when operational will be the headquarters of federal government ministry known as Awqaf and Islamic affairs building (Fig. A1). It has a design capacity of 1464 people and can be extended to accommodate a 25 percent additional capacity.

Figure A1 Awqaf Ministry Head Quarter Building (3D Visual)

Safety guidelines

As the building is under construction, subsequently, our visiting associates Engineer Saeed from the construction company asked us to wear safety helmets. We were also instructed to wear glasses along with full sleeves shirts and jeans. He also provided us with ear buds to protect us from the construction noise. The visiting associate was also the site engineer. He was the shift in charge. He told us that the construction will take 1080 days to complete and if not completed by the date the construction company will be paying 17000 KD for every day they are late.

There building was designed as a 16 story structure, so a lot of concrete was to be transported along with steel. That was being done by five tower cranes that were placed at various positions
around the construction site. As you can see from Figure A2 there is a tower crane with the I steel sections all around the main four pillars that are used to transfer loads and stresses so it cannot tilt. The crane can be moved up and down on the tower and the height of tower can be adjusted after completing every story. Vehicle mounted crane was also used occasionally to transfer the steel reinforced concrete beams that were made in form of blocks at ground to the various floors (Figure A3). These cranes have an advantage that they can be moved quickly from site to site and they don’t need any assembling and dissembling mechanism. They dynamics is involved in their working. The pressure system used by the crane is hydraulic and mostly the area change mechanical concept is used to lift heavy loads. This crane was not the main machinery but was reserved for few of the tasks.

The concrete was primarily lifted with help of concrete lifter as shown in the figure A4 below these were operational at feasible positions. It moves in one dimension of vertical rail track with help of three steel cables that are passed through a system of mounted pulleys. The pulley system are arranged in such a way that it gives a mechanical advantage. The driving force is provided by diesel or electrical engine. Sometimes gears are also used. Artificial span Colum structure (Figure A5) was also implied where it was needed. It carries the weight of the concrete filling when a floor is being filled with concrete. It will keep lifting the load of concrete unless the concrete is dried.
and can support itself. As clear from the picture it distributes the load unanimously in all direction and it is fundamental artificial structure that is needed when we have to fill the roof with concrete.

Figure A4: Concrete Lifter at Construction Site
Picture Taken by Student A

Figure A5: Artificial Span Column. Picture 4 taken by Student A

Figure A6: Picture 5 taken by student A
Conclusion
The field trip was very informative and we fulfilled our objectives. It was no doubt a wander that was being built with beauty at its peak. What we observed at construction site was everybody was safety conscious and quality was being assured at every step. Additionally we also learned the practical applications of statics and dynamics. It will not only help us to understand the word of civil engineering better but will also boast our moral to work more diligently once we are in our professional life. Such tours must be arranged from time to time so we can know what actually happening in a construction site and how the construction technique was changing with the passage of time. This project will also help us a lot in our studies. In getting real concepts behind the problems that we are going to solve in the semester”.

Student B

“Health and safety considerations
The construction process has employed appropriate measures for health and safety. According to the construction superintendent the construction workers are supposed to be on full safety gear to prevent injuries that may occur during the construction. During the tour of the construction site, wearing helmet and safety boots is mandatory for purposes of protection from the falling objects. The workers who use the machines are properly trained to prevent failure of the machines and accidents during construction. Most importantly, internal safety audits are conducted to ensure that workers abide by the safety standards.

Machines employed for safe construction
Machines played an important part in the construction. The initial phase of the construction involved the use of trucks and bulldozers. However, the pictures of the truck and the bulldozer could not be captured since the foundation of the building had been done. Another important machine that was employed in the construction was a crane. The crane rose hundreds of feet in the air. This machine was used in many ways. First and foremost it was used to lift heavy metals that are used in the construction. Moreover, the machine was used to lift important things like concrete materials, generators and other construction materials. Figure A7 below shows the picture of the crane that was attached to the building, while Figure A8 shows a model of the crane.
Mechanism of the crane

The crane usually has a large load on one side. In this case, the load is usually balanced like a scale. The computerized systems of the crane will ensure back and forth movement. Cables can be used to move forces within the building. Figure A8 shows a model of a crane.

Conclusion

In conclusion, my trip to the construction site was informative. I learnt many things that I didn’t know before. Most importantly, I understood the principles of statics since I was able to connect what I learnt in class with the real things on the ground”.

Link to video submitted by Student B:
https://studio.stupeflix.com/v/HqbFHTRqXBhO/?ga_session=video-ready-email&autoplay=1

Student C

“Introduction

The field trip was conducted at a site in George Mason University in Fairfax campus. The design of the structure started in October 2012, and completed September 2014. After that, the construction started in June 2015, and it will be completed in October 2017. The budget of this construction is $67,686,799.

The objective of this trip was to:

7. Learning implementation & application of the principles learnt in class in real life situations.
8. Learn about safety operations & equipment used and standard industry practices.

Description of Construction Site

1. Project Number - 17999-000
2. Project Type - Construction
3. Campus – Fairfax
4. Phase – Concept
5. Contractor - Whiting Turner
6. Designer - Perkins Eastman

Machineries

While working on an incline or a slope, it is imperative to take into consideration the forces while working with machinery. The forces working will be Gravitational force, which will act vertically downwards, Normal force which will act perpendicular to the surface and the friction force which will act up in the direction of slope if the machinery is still (Figure 9). The component of Gravitational force perpendicular to the surface at any point will balance the Normal force. The component of Gravitational force due to earth in the direction of down the surface will be
balanced by the static friction generated in the upward direction of the incline. If the component of the gravitational force in direction parallel to the surface is smaller than the product of friction coefficient and the Normal force then it will be balanced by the static friction, but if it is exceeded, then the machinery will accelerate down the incline. This needs to be taken care while operating any machinery on an incline.

Figure A9: Forces on a machinery on an incline plane

Before actual start of the construction phase, the materials used for construction like sand, gravel, soil etc. need to be transported to the construction site. Dump trucks are used for depositing such items at the sites. They are named so because the content of the box of the truck can be dumped with the help of hydraulic operated hinge which is attached at the rear of the box by lifting it up. The hydraulic hinge is lifted up which orients the box in an incline. The content of the box gets deposited due to the component of gravitational force applied on the content of the truck in the direction of the inclined box minus the frictional force. While dumping the material from the truck, it is important to keep special precaution as the truck might also tilt and lose equilibrium and the lighter truck might also topple”.

Student D

“Description of the site

The avenue mall is constructed by the Gensler London and Los Angeles offices in conjunction with Mabanee, a Kuwait based company, Herb, 2014. Its latest phase lies on 86,000 sqm when completed. Its construction targets to bring together six unique shopping areas that is the mall, Grand Avenue, souk, the souk, luxury mall and a shopping bazaar. The mall has a unique outlook and has already enjoyed interest from international brands like Harvey Nichols. Also there will be the biggest dome in the gulf area in that mall (Figure 10). The Gensler design team is responsible for its interior design and the ambience to be created should bring about character and vibrancy, Herb, 2014. Well there are several dynamics that the contractors face and this determined the kind of equipment they use and for this reason the kind of protective measures that is taken. There is the dynamic of climate due to the high temperatures experienced in Kuwait, Kartam, Flood, & Koushki, 2000. Other than this there are working areas dynamics like vibration, ionizing and deionizing radiation, noise, explosion and other dynamics. The cranes chosen are able to withstand
extreme heat, cold and humidity as these are the climatic conditions that vary as the day passes. The engineer on site confirmed that there is fire voting on the site to delay melting. Since the cranes are metallic and there is expansion and contraction under these conditions, they have unique designs that cater for this variation in climatic conditions, Kartam, Flood, & Koushki, 2000. They have a unique ergonomic design that ensures minimization of mechanical vibration; also the workers have alternative working methods and at no particular time are one over exposed to these vibrations. They wear unique helmets that minimize exposure to noise while at the same time they are able to communicate. Radiation emitted from the vigorous vibration is earthed and the workers are not exposed to any harmful radiations, Kartam, Flood, & Koushki, 2000.

In 2014, Kuwait experienced a couple of occupational fatalities, Jarkas, & Bitar, 2014. One in five workers lost their lives due to construction and extraction cases. Likewise in countries like America, China and even Dubai the number of construction related deaths is on the increase and is higher than in any other discipline. These deaths were either being caused by things falling from the top, caught in between objects like gears, electrocution and struck by objects. For this reason Mabanee and Gensler construction train their workers every once in a while. Through this training the workers learns to know and identify what might injure and eventually hurt them, Jarkas, & Bitar, 2014. According to findings, safety design tasks, monitoring and eventual inspection of sites are some of the areas where training should be adhered to. The leading cause of injury and eventually death is falling off of objects from above, Thomas & Napolitan, 1995. The worker is not aware of what can snap and fall on him or a worker cannot tell if his colleague may accidentally fall a hammer or any big that is capable to give him a permanent injury or even kill him. To protect themselves workers wear fall protection especially when they are on unprotected sides and edges, overlaying bricks and related works and other areas necessary as perceived by the contractor, this is according to the occupational safety and health administration handbook, Jarkas, & Bitar, 2014. Most countries have their own guidelines and regulations on safety and especially on fall protection that is documented and they are strict on workers to follow them. They thrive to ensure that construction sites are safe as they could possibly be to reduce the number of deaths and injuries. The growth of a city is most of the time measured by its infrastructure and this includes buildings and malls, like the avenue mall that is now being constructed, Kartam, Flood, & Koushki, 2000. Kuwait is on the verge of growth and construction is inevitable. It is only necessary that care is taken but construction cannot be avoided (Figure A11).

![Figure A10: The site](image-url)
Conclusion

At the end, I really want to thank my professor for this field trip, because I learnt a lot and I got the opportunity to visit a site this the avenues mall. It is really hard to get into it and talk to the engineers there but thank god I have visited it and enjoyed my visit. And also I want to thank the engineers there that taught me some stuff and helped me. It was very helpful and enjoyable (Figure A12).”
References


