ROLE OF MECHANICS AND ITS BRANCHES IN THE FIELD OF CIVIL EINGINEERING TECHNOLOGY (A LITERARY VIEW)

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ABSTRACT: *Mechanics plays a paramount role in the terrains of civil engineering. Mechanics is the study of forces that act on bodies and the resulting motion that these bodies experience. Mechanical engineering, civil engineering and aerospace engineering, industrial engineering and material engineering all have their roots or strength in engineering mechanics. This technology century become easy for human being cause of mechanics as we see that static structure bridges are mechanisms especially modern suspension bridges. Dams have lots of mechanisms in them from turbines for electricity generation to flood control gates that can be raised and lowered. Whole objective of engineering mechanics is to design and analyses systems that are both at rest and motion. For a beam, the service conditions are the way they are supported and loaded. Mechanics helps you to figure out the dimensions of your beams cross section for the selected material. Mechanics are most often used in structures for cantilevers simple beams, trusses while bending moments and shearing stresses are related to force application at some distance or a pinpoint application or a distributed mass system which could enter into a resonance due to its distributed or pinpoint mass. Referring to Chladni's vibration figure would be a great experience in the vibration of sheets and columns at different modes. The manner of operation of cantilever and beams between two supports is only explained by the principles of mechanics.*

Keywords: Importance of mechanics, It branches, role of mechanics, and recommendation

I INTRODUCTION

Mechanics is the physical science which deals with the effects of forces on objects. No other subject plays a great role in engineering analysis than mechanics. Although the principle of mechanics is few, they have wide application in engineering. The principle of mechanics is central to research and development in the fields of vibrations stability and strength of structure and machine, robotics, rockets and space craft design, automatic control, engine performance, fluid flow, electrical machine and apparatus, and molecular, atomic, and subatomic behavior. A thorough understanding of this subject is an essential prerequisite for work in these and many other fields.

Mechanics is the oldest of the physical science. The early history of this subject is the synonymous with the very beginning of engineering. The earliest recorded writing in mechanics is those of Archimedes (287-212 **B.**C) on the principle of the lever and the principle of buoyancy. Substantial progress came later with the formulation of the laws of vector combination of forces by Stevin's (1548-1620), who also formulated most of the principle of statics. The first investigation of a dynamics problem is credited to Galileo (1564-1642) for his experiments with falling stones. The accurate formulation of the laws of motion, as well as the law of gravitation, was made by Newton (1642-1727), who also conceived the idea of the infinitesimal in mathematical analysis. Substantial contributions to the development of mechanics were also made by Vinci, Varignon, Euler, D'Alembert, Lagrange, Laplace, and others.

The subject of mechanics is logically divided into two parts, statics dynamics, which concern the motion of bodies. The study of forces without motion is known as statics, in more formal terms, is the branch of mechanics concern with forces in the absence of motion. Alternatively we might define it as a field of mechanics concerned with the analysis of load (force and torque) acting on physical systems that do not experience acceleration ($a = 0$) but are in statics equilibrium with their surroundings.

The summation of forces which may be unknown, allows for the discovery of that what unknown. When the system is in static equilibrium the acceleration is zero and the system is either at rest or moving at a constant velocity. Similarly, applying the zero acceleration assumption to the total of moment operating on the system result is: ($\boldsymbol{M = I\alpha = 0}$),where M is the sum of all moments operating on the system, is the mass moment of inertia, and (a=0) is the system rotational acceleration, which, when assumed to be zero results in (M=0), the sum of moment, which may be unknown, permits that unknown to be found. These two equilibriums can be used combined to solve for as many loads, force and moment as three acting on the system.

The net force and net torque on every part of the system are zero, according to Newton's first law, the first condition for equilibrium is fore the net forces to equal zero, see statically indeterminate for the further information

Dynamics, on the other hand, is the study of forces and motion, or, to put it another way, the part of mechanics that deals with the effect of forces on the motion of things. The term "static" refers to a state of being inactive. Change entails dynamics. Acceleration is the important change. Although the term "statics" suggests that something is stationary, this is not always the case. It's all about speed. One strategy to avoid accelerating is to sit stationary for a long length of time. Another option is to travel in a straight path at a constant speed for a long length of time. Being at rest and travelling at a steady velocity has no physical distinction. The planet follows the sun through the Milky Way galaxy at an increasing rate. Physically, there is no difference between being at rest and travelling at a steady speed. Because our acceleration is almost negligible (10-10 m/s), the planet is diligently following the sun through the Milky Way at an unfathomable pace (250000 m/s). We feel as if we are at rest with relation to the entire cosmos while we are at rest on the moving earth. So this is the nature of physics, whichis playing a huge role in the field of engineering, construction, excavation, and many more.

II OBJECTIVES

Civil engineering structure is not just the laying of bricks with mortar in between and a dollop of rendering to make it look presentable. All that holds civil engineering structure is the presentation with static and dynamic contents of mechanics.

- Mechanics is the foundation for additional structural analysis investigations, which are essential for the structure design of various building components or bridges.
- Referring to Chladni's vibration figures would be a great experience in the vibration of sheets and columns at different modes. The manner of operation of cantilever and beams between two supports is only explained by their mechanics.
- Lintels and arches owe their success to the application of vector forces which must balance each other. In a lintel supported by two side walls, the point of contact is subjected to mechanical distributed forces that are complex a
- To think that the Egyptians and the Greeks did not understand the mechanics of the arch makes one think on the depth of understanding of their short lintels across the high columns. It was all show off with little depth of thought in mechanics or vector theory!
- The many different combinations of trusses to hold wide roof spans and bridges owe their success or failure depending on whether one understands the use of the triangle which is a relation that cannot change its shape.
- Corners in the building can set up a noise effect for after all any civil engineering building is a giant structure of any musical instrument which resonates at various modes.

III LITERATURE REVIEW

The value of mechanics in engineering education is immeasurable. It is the foundation of mechanical engineering machinery and the first stage of civil engineering design work. It serves as a foundation for electrical and other engineering disciplines. I've noticed that students normally grasp the fundamentals of theory before enrolling in engineering colleges, but they require additional problem-solving practice. Furthermore, engineering mechanics gets exciting when a student is able to solve a problem without the assistance of others [1].

This text explores the mechanics of solids and statics as well as the strength of materials and elasticity theory. In addition to introduction the fundamentals of structural analysis, it combines and applies importance concepts in engineering mechanics. It many design exercises encourage creative student initiative and systems thinking. Statics equilibrium, force resultant, support condition, and analysis of determinate planer structure-including beams, trusses, and frames-are among the topics, along with stresses and strains in structural elements, and states of stress such as shear, bending, and torsion. Additional subjects include statically indeterminate systems, displacement and deformation, an introduction to matrix methods, elastic stability, and approximate methods. Suitable for undergraduate and graduate students of civil engineering and engineering mechanics, this text is also relevant to students of architecture. The author alerts students to see the world from the perspective of engineeringcertainty that the structure doesn't fail, that the bridge doesn't sway in the wind, that the latch works firmly, or that the landing gear do not collapse upon touchdown.[2].

Engineering mechanics is considered one of the most difficult introductory course in undergraduate education in civil engineering, aero spacing engineering, and material science and engineering. Built on the foundation and framework of mathematics and physics, the course required students to have not only strong abstract thinking and reasoning skills, but also solid spatial abilities.However, the role of spatial ability in learning engineering mechanics has not been investigated adequately in the literature. This paper serves four purposes. First, it presents a critical analysis of finding from an extensive literature review regarding the role of spatial ability in solving physics problems and make connection to relevant problem of engineering mechanics. Second, this paper applies theories from cognition science and psychology to interpret the role of spatial ability in learning abstract concept and complex motion in an engineering mechanics course. Third, this paper introduces intervention strategies that engineering mechanics instructors may use to devolved students' spatial abilities. Finally, this paper provides engineering instructors and researchers with the implications for future research and instructional practices to help students succeed in this important introductory cours [3].

Mostof the streams of civil engineering is heavily based in engineering mechanics. The most popular civil engineering disciplines include: structural, geotechnical transportation municipal, hydrologywastewater, buildingscience. Structural engineering and geotechnical engineering both rely heavily on statics and material science. the objective is usually to deliver a minimal cost solution that won`t fail given the load conditions expected. Probability& statistics important for Geodetic, as material properties vary. Transportation could refer to demand modeling or road design (both very different). The former is basically probability & statistics - developing computer simulated demand models, while the latter use empirical formulae and material science to determine strength and durability.

Municipal engineering, hydrology,and wastewater engineering rely heavily on fluid mechanics &dynamics, as well as elementary thermodynamics and chemistry. A civil engineer`s role in these sectors would usually be focused in the mechanics realm-dealing with maximum pressures, hydraulichead, material selection. Like transportation water flow is usually governed by stochastic weather patterns so probability &statistics are also important. Building science is heavily based in thermodynamics, with an understanding of the construction process, mechanics, and material science.

Again probability & statistics is Important here too, as the moisture and temperature conditions are usually stochastic [4].

Civil Engineering is the engineering required for civilization, to build civilizations. Everything that is built to build civilization, is made of soil, or is built on soil, or is built within soil. Hence the knowledge of mechanical behavior of soil, i.e., soil mechanics, is an integral part of civil engineering. Soil mechanics investigates how and how much soils deform, as well as how they resist deformation and estimate their strength under various boundary and loading circumstances. Any civil engineering structure's loads must be transported to and carried by the earth foundation system (for example, bridges, pipelines, infrastructure, buildings, highways, oil and gas refineries, factories, dams, and so on). Soil mechanics understanding is required for foundation engineering (sometimes rock mechanics). To protect our civilization from geo-hazards (such as slope instability, massive landslides, liquefaction, ground subsidence, and cracking of building foundations), settlement, heave, swelling, sinkhole formation, shallow or deep isolated or connected cavity formation under infrastructures, caving soils, general subsidence, ground collapse, foundation disintegration, and loss of bearing causation. we need to know the mechanical behavior of problematic soils and mechanics of how these geo-hazards form and affect our civil engineering structures [5].

Few to none. Materials scientist might use some quantum mechanics to develop understand the properties of some new materials that a civil engineer might later work with. But the civil engineer wouldn’t need to understand the details of development process; they would instead need to understand the resulting properties of the material.

Similarly, a civil engineer needs to understand some chemical processes like corrosion. A chemist might need quantum mechanics to understand what’s going on at the molecular level, but the civil engineer would instead need to know practical methods for dealing with chemical processes.

So, a civil engineer might occasionally consult with somebody who uses quantum mechanics or use a material developed by people who understand quantum mechanics. But you could be quite the respected civil engineering expert without ever mastering QM [6]

Most civil engineering materials have mass, and some are flexible and some are not. Those parts that are solid may be joined to others with flexible permanent or not permanent joints. Other systems have distributed masses while some may be regarded as solids with particular shapes. Steel cables are flexible and so can vibrate while sheets of most material also vibrate at different modes, even stone one above each other will vibrate if a wall is formed [7].

If something is regarded as being solid without motion then there could be aerodynamics taking place as the functions in a aircraft where a solid wing can fly. This leads to noise being incurred in sharp roofs and corners. When the wind blows noise can form at different corners and a building can become alive on a windy day with whistling and terrible noises. Even erosion effect is related to dynamics and many stone and concrete in building show a lot of erosion as little distance away from sharp corners Most Civil engineers do not care about the aerodynamics of building and the swaying of a large and tall building is all due to mechanical dynamics and not civil engineering.

Earthquakes are sources of signals which can excite buildings into resonance which could be destructive. Resonance in any building and columns need to be appreciated including resonance in beams and sheet proofs, including the resonance of window panes when the terrific flow by. Dirt accumulation in streets and corners all depend on the building having a good flow without stagnant points. Few civil engineers think about the wind flows around the building and there are situations in cities where the wind blows so hard that the pedestrian cannot walk so comfortably.

Civil engineers who build floodwater channels are not always acquainted water dynamics and channels joining each other at right angles do mess up the flow in the main channel. I saw roads were held with 48 columns all with their foundations set in water channel. In heavy rains, the debris accumulates around thecolumns and what is supposed to flow channel will become a dam where the floods overflow the roads.

There were situations where floods were made to flow at right angles and when heavy rain came to the momentum of water as it was dissipated on the corner, the height of water increased lowering the head of water from the higher incoming water so the flow slowed down. Such terrible mistakes civil engineering is well known.

When it comes to bridges, I cannot understand how no one ever considered that the dynamics of a one never considered that the dynamics of a cat nary suspension bridge do not have triangles but only rhombuses and rectangles which can change shape hence the instability of the Tacoma Narrow Bridge. The Silver Bridge also suffered because of its civil engineering errors and the London Millennia Bridge did oscillate laterally so much because all the cat nary suspension system was all parallel. That expensive damping mechanism was totally unnecessary if the original design skewed some of the catenaries at 45 degrees rather than kept them vertical as in conventional cat nary suspension bridges. I really do not comprehend why the cable-stayed bridge took so long when all those triangles do keep the same shape unlike the rectangles in the golden Gates Bridge which would have been a better bridge had it included some diagonals on the vertical desk suspension cables, those two flat planes on either side of vibration they could support. Where the vertical cables can move up and down relative to each other not a good design and lady luck had a helping hand in the design of Golden Gate Bridge. The real dynamics of that bridge were not fully appreciated.

The dynamics of joints and anchored ends is also subjecting to different dynamics and I have seen roofs falling because the column was pin jointed at the bottom and the top so the bending moments took the easiest way out. If those thin columns jointed that building would not have fallen down.

When pile driving dynamics can be used to resonate the pile where it is much easier to work with the heavy blows with a gravity hammer. The manner in which the lower end of the pile works on the ground is amazing and the mathematics of a dynamic pile at resonance it to be seen once I made an aquarium-like container, filled it with different material and resonated a pile in it where all the movement could be seen at the face of the glass in the aquarium glass container are Beautiful dynamics that all civil engineers should experience.

Niel, leon [7], although they are basically static structures bridges are mechanism especially modern suspension bridges. There is mechanism in draw bridges to raise and lower the road bed so ships can travel underneath. Dams have lots of mechanism in them from turbines for electricity generation to flood control gates that can that can be raised and lowered. Just look at the flood protection system in the Thames river. Tunnels and the construction of tunnels involve mechanism. Just look at the modern tunnels boring machine [8].

Everything from individual particles to the tallest building to a rushing river experience forces and torque. Each object liquid or solid, large or small responds different under different condition. Engineering mechanic examine these external forces by studding statics, dynamics, materials strength, elasticity, viscosity and fluid dynamics. As a bridge between theory and application, engineering mechanics is used formulate new ideas and theories, discover and interpret phenomena, and developed experimental and computational tools. Using mechanics principle is not fantasy but its real [9].

IV CONCLUSION

- Furthermore, we believe that mechanics is a subject that is not only useful in the field of civil engineering, but is also required in other engineering fields.
- Some issues in civil engineering have a hierarchical knowledge structure and require complicated problem solving. These are topics that cannot be approached without the use of mechanics.
- And we find that the uses of the principle and rule it becomes so easy for the solution of problems. We note that every succession of a project and mega structure project like (PETRONAStwin's tower) are the example, are only done by principle and rues of mechanics.
- Researchers must continue to strengthen construction mechanics research in order to provide adequate theoretical foundations for civil engineering construction analysis and to promote the construction industry's healthy and stable development.

V RECOMMENDATION

The following are recommendation for importance of mechanics and its branches in the field of civil engineering.

- Particular research topic is collected here. This problem appeal to the use of mechanics analysis and experiment to unify the many aspect of behavior of reinforced, constructions, and bridges.
- Fundamental mechanism analysis incorporates realistic inelastic constitutive response. Large deformations and inertial effect as appropriate to provide accurate mechanism characterization of crack tip fields.
- Mechanical properties under high loads Modeling of critical conditions for share band formation and dynamics fracture, including of twining, phase transformation, and the interaction of multiple defects
- Material response at very high strain rates dynamics fracture, surface motion of impact loaded structure, measurement of share strain rates and temperature during shear band creation Field measurement.
- As a result, there is a need to investigate the continuum damage mechanics of concrete and brittle materials, particularly under severe mechanical, thermal, and internal pressure loading conditions.

VI REFERENCES

1. Brinias, Jonathan (2018, 12 2). what are the application of engineering mechanics in the field of civil engineering. B.A.Sc. civil engineer, university of toronto.
2. frank brown, F. l. (1942). engineering mechanics. south carolina, united state of America : j. wiley & sons, incorporated, 1942.
3. Carmel, pule (2019, 8 17). what is the importance of mechanics in civil engineering . ph.D Engineering & Education, newcastle university (1964).
4. dover, courier (2009). importance of mechanics in civil engineer. 13-14.
5. Emory, Kimbrough (2018, 3 21). importance of mechanics in civil engineer. studied physics in gradual school.
6. kia, mohammadali (2013). president, principle geotechnical engineer at Alpa adriot Eingineering ltd.
7. Niel, leon. (2016). iimportance, of mechanics, in the field of Engineering. Degreed Mechanical, Engineering And Laser Safety, Advocate, from Hopkins, University,.
8. waldemar, Grzechca (2014). mechanical engineer. silesian university of technology, 47.
9. Xuedong, fan (2014). building materials, technology, Machining Mechanical. ph.D in mechanical engineering in Joint instute, shangahi, china.