A TECHINICAL REPORT ON THE STUDENT INDUSTRIAL WORK EXPERIENCE SCHEME (SIWES)

UNDERTAKEN AT

MINISTRY OF PUBLIC WORKS AND TRANSPORT SECRETARIAT, IBADAN, OYO STATE.

PREPARED BY

ADEPOJU PRECIOUS AYOMIDE

ND/23/CEC/PT/00

SUBMITTED TO

THE DEPARTMENT OF CIVIL ENGINEERING TECHNOLOGY, INSTITUTE OF TECHNOLOGY, KWARA STATE POLYTECHNIC, ILORIN

IN PARTIAL FULFILLMENT OF THE REQUIREMENT FOR THE AWARD OF NATIONAL DIPLOMA IN CIVIL ENGINEERING TECHNOLOGY

AUGUST – DECEMBER, 2024

DEDICATION

The report is dedicated to Almighty God and my beloved parents Mr. and Mrs. Adepoju for their support and unconditional love.

ACKNOWLEDGEMENT

I would like to place on record my deep sense of gratitude to God for His love, mercy, favour and protection during this Student Industrial Work Experience Scheme (SIWES).

I appreciate the efforts of my parent Mr. & Mrs. Adepoju, my Siblings and my friends who where a source of support for me all through the SIWES period.

I express my profound gratitude to my Department Lecturers, my SIWES Supervisor **ENGR. AREO THOMAS** and Coordinator for the support towards the success of my SIWES. Also, I give thanks to my brothers, sisters, and the entire family of Adepoju Family for their advice to me during my SIWES program. May GOD bless you all (AMEN).

I also appreciate the effort of the entire staff of the Ministry of Public Works and Transport Secretariat, Ibadan, Oyo State for the tremendous moral assistance throughout the period of my attachment; and my lovely friends for their contribution in one way or the other. May Almighty God bless them all and provide for their needs.

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CHAPTER ONE

1.1 ABOUT SIWES

The Student Industrial Work Experience Scheme (SIWES), also known as Industrial Training is a compulsory skill training programme designed to expose and prepare students of Nigeria Universities, Polytechnics, College of Education, College of Agriculture and College of Technology, for the industrial work situation they are likely to meet after graduation.

SIWES introduction, initiation and design was done by the Industrial Training Fund in 1993 to acquaint students with the skills of handling employer's equipment and machinery.

The Industrial Training Fund solely funded the scheme during its formative years. However, due to financial constraints, the fund withdrew the scheme in 1978.

1.2 HISTORY AND BACKGROUND OF THE MINSITRY OF PUBLIC WORK AND TRANSPORT

The ministry evolved from public works department to become a full-fledged ministry. It is in charge of the execution of government project and it's incorporates operation, planning and management of government infrastructure.

The history of the ministry dates back to 1976 when the state was created. It is considered as an engine room of growth and development of the state, due to its strategic importance.

CHAPTER TWO

2.1 HIGHWAYS DEPARTMENT/ FOUNDATION LAB

The Highways Department is involved in the following activities as the need arises:

- Design and construction of roads, culverts and bridges
- Supervision of construction works
- Appointment of consultants for design and supervision of road projects
- Consultancy services to ministries and other agencies on civil engineering related matters
- Structural design and supervision of public buildings
- Granting of right-of –way permit reinstatement of road damage by mobile telecommunication companies due to cable laying activities
- Approval of construction of speed breakers
- Response to petitions from the public
- Operation of soil material testing laboratory.

The administration has awarded 79 roads projects covering all the zones of the state out of which 66 have been fully completed, however with some outstanding interim certificates and or retention fees.

The Foundation laboratory provides soil and rock investigation (geotechnical) information necessary in determining foundation depth and safe bearing capacity for bridges, dams and buildings.

The Laboratory is well equipped with equipment that carry out the physical analyst of samples obtained from the geotechnical investigations which includes:

- SOIL ANALYSIS TEST:-These include Atterberg limit tests, Particle size distribution, Hydrometer analysis for silt and clay, Oedometer, Permeable test on granular materials, Unconfined compression test (UCS), Fall cone test, Swelling pressure, Shear box, Tri-axial test, Crumb and Pin-Hole test for sol dispersion and Moisture density relationship, Standard proctor, Compaction test.
- CORES/ ROCKS ANALYSIS TEST:-Includes Moisture content, Bulk density, Uniaxial compressive strength (UCS), Point load and dynamics cone penetration (DCP)
- FOUNDATION FIELD TEST:-Includes Standard penetration test (SPT), Plate loading test (PLT), Lugeon test and Falling head permeable test.

CHAPTER THREE

3.1 MY EXPERIENCE

During my stay in the Foundation Lab/Highways Department I was exposed to a lot of engineering equipment, went to various field works, attended various seminars and had the privilege to present my learning to the team.

I learnt about Compaction test (British standard compaction test, West African standard compaction test and AASHTO), Sieve Analysis, Atterberg Limit test, California Bearing Ratio(CBR), Integrity test, Dutch Cone Penetration test, Compressive Strength test, Field Density.

DURATION at Work

During my SIWES programme at the Foundation Lab/ Highways Department at Ministry of Public Works and Transport Secretariat Ibadan. I resumed work at 8 o' clock in the morning and close by 4 o' clock in the evening for every working day. The training at the department lasted for three months.

SUPERVISOR

I was supervised by **ENGR. AREO THOMAS** who is a research fellow in the Foundation Lab/ Highways Department, Ministry of Public Works and Transport, Secretariat Ibadan.

3.2 COMPACTION TEST

Compaction test is the bringing closely together of loose particles by adding water to eliminate voids to obtain maximum dry density and moisture content. And the graphical relationship of the dry density to moisture content is then plotted to establish the compaction curve.

DIFFERENT TYPE OF COMPACTION TEST

- **British Standard Compaction:** British standard compaction is used to ascertain unsuitable soil material and also for subgrade material. This type of compaction test, a small rammer of 2.5KG, 3 layers of 25 blows of sudden weight is used, with small cylinder of 1000v.
- **West African Standard Compaction:** West African standard compaction is used for sub-base material. This type of compaction a big rammer of 4.5KG, 5 layers of 27 blows of sudden weight is used, with small cylinder of 2305v.
- **Aashto**: This type of compaction a big rammer of 4.5KG, 5 layers of 62 blows of sudden weight is used, with big cylinder of 2305v.

PURPOSE OF THE EXPERIMENT

This laboratory test is performed to determine the relationship between the moisture content and dry density of a soil for a specified compactive effort.

The compactive effort is the amount of mechanical energy that is applied to the soil mass. Several different methods are used to compact soil in the field, and some examples include;

tamping, kneading, vibration and static load compaction. The laboratory employs the tamping or impact compaction method using the type of equipment and methodology developed by R. R. Proctor in 1933, therefore, the test is known as the proctor test.

SIGNIFICANCE

Mechanical compaction is one of the most common and cost effective means of stabilizing soil. An extremely important task of geotechnical engineer is the performance and analysis of field control test to assure compacted fills are meeting the prescribed design specifications. Design specifications usually state the required density (as a percentage of "maximum" density measured in a standard laboratory test), and the water content. In general, most engineering properties, such as strength, stiffness, resistance to shrinkage, and imperviousness of the soil, will improve by increasing the soil density. The optimum water content that results in the greatest density for a specified compactive effort. Compacting at water content higher than (wet of) the optimum water content results in a relatively dispersed soil structure (parallel particle orientations) that is weaker, more ductile, less pervious, softer, more susceptible to shrinking, and less susceptible to swelling than soil compacted dry of optimum to same density. The soil compacted lower than (dry of) the optimum water content typically results in a flocculated soil structure (random particle orientation) that has the opposite characteristics of the soil compacted wet of the optimum water content to the same density.

MATERIAL AND APPARATUS:

(A) MATERIAL:-

- Sample of soil (Laterite).

(B) APPARATUS:-

- Mixing pan.

- Weighing balance accurate to 0.1g (0.2% of the sample weigh).

- Mold.

- Manual rammer.

- Moisture can.

- Extruder.

- Spatula.

- Drying oven set at 105^0c.

- Hand trowel.

- Graduated cylinder.

- Straight edge.

PROCEDURE

- Weigh 5000g of soil with weighing balance, pour into the mixing tray and add desired amount of measured water, mix thoroughly and put into cylinder, compact to the layer and number of blows according to the type of compaction.
- Repeat this for about 4 to 5 times.
- Small quantity of the mixed soil is packed inside moisture content container for moisture determination and the container is weigh as wet sample after the mixed soil is poured inside the moisture content container, then the container is put inside oven to dry, the next day the container is removed from the oven so it's measured as dry sample.
- Therefore, we find percentage of moisture content

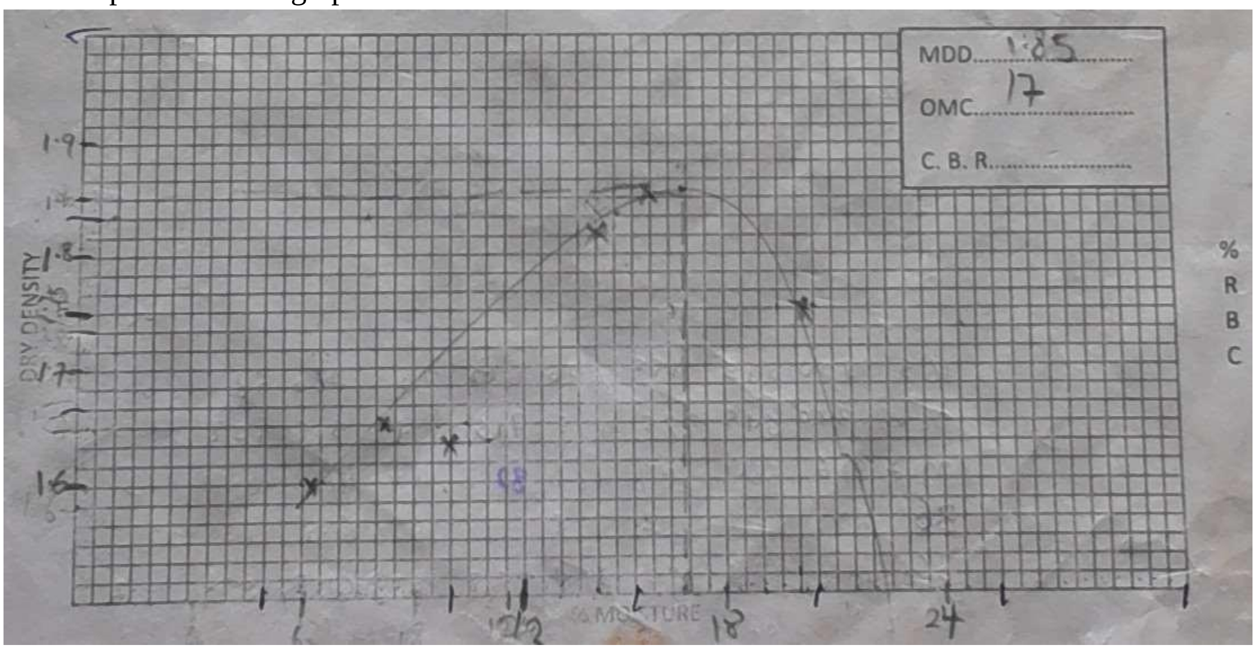
DATA ANALYSIS FOR A WEST AFRICAN STANDARD COMPACTION TEST CARRIED

OUT IN THE LABORATORY

- Calculations for moisture content for each compacted soil specimen

WT. OF CYL. AND WET SAMPLE	3690		3750		3784		4032		4114		4099	
WT. OF CYLINDER	1976		1976		1976		1976		1976		1976	
WT. OF WET SAMPLE	1714		1774		1808		2056		2138		2123	
WET DENSITY	1.71	1.71	1.77		1.81		2.06		2.14		2.12	
CONTAINER NUMBER	27A	9B	SK	63	36A	510	225	13A	420A	1A	681	C37
WT. OF CONT. AND WET SAMPLE	84	75.5	63	72	50.5	75.5	73	77	62	56.5	54.5	59.5
WT. OF CONT. AND DRY SAMPLE	79.5	72.5	59.5	68.0	47.0	70.0	66.0	69.5	56.5	50.5	48.0	52.0
WT. OF MOISTURE	4.5	3.0	3.5	4.0	3.5	5.5	7.0	7.5	5.5	6.0	6.5	7.5
WT. OF CONTAINER	17.0	16.0	16.5	16.5	15.5	17.0	16.0	16.0	16.5	16.0	17.0	17.0
WT. OF DRY SAMPLE	62.5	56.5	43.0	51.5	31.5	53.0	50.0	53.5	40.0	34.5	31.0	35.0
MOISTURE CONTENT %	7.2	5.3	8.1	7.8	11.1	10.4	14.0	14.0	13.8	17.4	20.1	21.4
AVER. MOISTURE CONTENT %	6.3		8.0		10.8		14.0		15.6		20.8	
DRY DENSITY	1.60		1.64		1.63		1.81		1.85		1.75	
C. B. R												

- The compaction curve graph



DISCUSSION

In the test we find relationship between dry density and water content for a specified compactive effort. We note that at the beginning of our curve the addition of the water reduce the void of the water and increase dry unit weight but after wet of optimum the YD decrease. In this test result we draw a (zero-air-void-line) which if this curve not intersect curvature between dry density and moisture percentage, but our intersect each other and this means our soil sample is not fully saturated and this mean air void in our soil is not equal to zero are retained so that our soil sample is not well compacted because the air void is equal to zero.

CONCLUSION

In compaction of soil, the main aim is to keep the soil particles close together which leads to improve dry density of soil. The soil maximum dry density is suitable for several constructional purposes. But maximum dry density of soil through compaction will be possible at particular moisture content called optimum moisture content. Hence compaction purely depends upon the relationship between moisture content of the content of soil and its dry density.

3.3 SIEVE ANALYSIS

Sieve analysis is a method that is used to determine the grain size distribution of soils that are greater than 0.075mm in diameter. It is usually performed for sand and gravel but cannot be used as the sole method for determining the grain size distribution of finer soil.

A sieve analysis (or gradation test) is a practice or procedure used (commonly used in civil engineering) to access the particle size distribution of a granular material. The size distribution is often of critical importance to the way the material performs in use.

A sieve analysis can be performed on any type of non-organic or organic granular material including; sand, crushed rock, clay, granite, feldspars, coal, soil, a wide range of manufactured powders, grain, seeds, down to a minimum size depending on the exact method. Being such a simple technique of particle sizing, it is probably the most common used in practice.

SCOPE OF THE EXPPERIMENT

The sieve analysis, commonly known as the gradation test, is a basic essential test for all aggregate technicians. The sieve analysis determines the gradation (the distribution of aggregate particles, by size, within a given sample) in order to determine compliance with design, production control requirements, and verification specifications. The gradation data may be used to calculate relationships between various aggregate or aggregate blends, to check compliance with such blends, and to predict trends during production by plotting gradation curves graphically, to name just a few uses. Used in conjunction with other tests, the sieve analysis is a very good quality control and quality acceptance tool.

PROCEDURE

- In order to perform the test, a sample of the aggregate must be obtained from the source. To prepare the sample, the aggregate should be mixed thoroughly and be reduced to a suitable size for testing. The total weight of the sample is also required.
- A suitable sieve size for the aggregate should be selected and placed in order of decreasing size, from top to bottom, in a mechanical sieve shaker. A pan should be placed underneath the nest of sieves to collect the aggregate that passes through the smallest.
- The entire nest is then agitated, and the material whose diameter is smaller than the mesh opening pass through the sieves. After the aggregate reaches the pan, the amount of material retained in each sieve is then weighed.

MATERIAL AND APPARATUS:

(A) MATERIAL:-

- Sample of soil (Laterite).

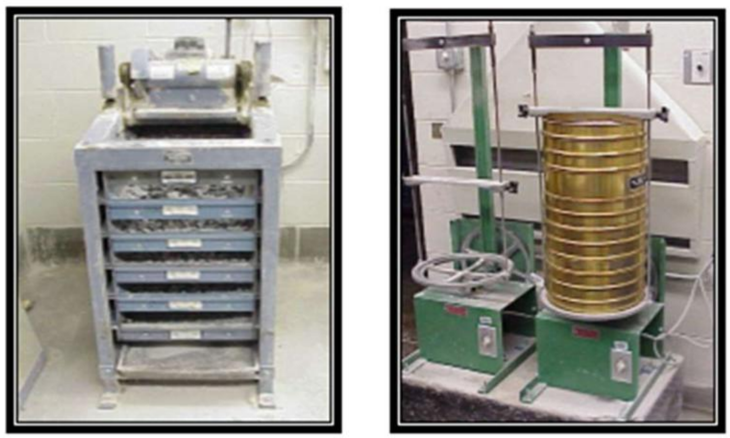
(B) APPARATUS:-

- Drying oven set at 105^0c.

- Weighing balance accurate to 0.1g.

- Set of sieves.

- Sieve shaker.



- Crusible.

- Wire brush.

DISCUSSION

Various preconditions must be fulfilled for a reproducible and meaningful sieve analysis and the settings must also be properly adapted. The most important criteria are the following: there must be a representative part sample – “Representative” means that the properties of the part sample, in this case the particle distribution must be identical to the properties of the whole bulk material to the sampled. Another one is a calibrated and certified test sieves – the choice of test sieve (diameter and mesh) depends mainly on the amount of sample and its particle size distribution. Optimal sieving time and amplitude or speed wherein the settings for the sieving time and the optimal amplitude or speed depends on the material to be sieved. Lastly are the sieving aids which are useful in very fine samples that lend to adhere together. They are used to make the sample sievable.

RECOMMENDATION

In this experiment, several precaution must be taken into consideration in order to avoid and prevent errors to occur. The screen on the sieve should be carefully cleaned in order to remove all grain sands. The stack of sieves on the sieve shaker must be locked tidily to avoid them from moving away during shaking process. Ensure that all the left over sand in each sieve is transferred to the container use in weighing process. The area around digital scale balance scale must be cleaned first to get accurate readings and avoid the environmental effects. Students can also use a soft bristle brush to gently wipe the screen.

3.4 DUTCH CONE PENETRATION TEST (DCPT)

The test is also called, Dutch Cone test. Due to its simplicity and efficiency, the cone penetration test is one of the most commonly accepted and used in-situ testing methods in geotechnical investigation worldwide.

The cone penetration test (CPT) is a common in-situ testing method used to determine the geotechnical engineering properties of soils and assessing subsurface stratigraphy. The testing apparatus consists of an instrumented still cone having a tip facing down, with a usual apex angle of 60° and cross-section area of 1000 mm^2. The code is attached to an internal steel rod that can run inside an outer hollow rod, which itself is attached to a sleeve. In the more elaborate CPT instruments, the cone and the sleeve (attached to the outer rod) can move separately.

The test's results from cone penetration test can also be used to determine the soil's bearing capacity at various depths below ground level. This test can also be used to determine the skin friction values that are used to establish the needed pile lengths in a given condition, in addition to bearing capacity values.

The cone penetration test (CPT) was developed in the Netherlands in the early 1930s as a deep sounding apparatus that measured cone resistance and was used to assess the distribution of alluvial soils and peat. It was developed further by increasing the push-down force to provide a method of designing piles. During the 1940s, improvements were made by increasing the pushdown force, also improving the probe geometry and test procedure. One of the most important developments of the CPT was made in Indonesia by Dutch engineers in the 1950s, who added the friction sleeve used to measure local friction. The data from this device were used in an empirical design method to determine the bearing capacity of friction piles. The device became known as the 'mechanical CPT' and has now been superseded by probes with the same basic dimensions but with loads and pressures measured locally using transducers. The modern 'electric CPT' offers significant advantages; however, there are still places where the mechanical CPT is used widely, such as in Nigeria. It should be appreciated that there can be significant differences in the measured parameters, such that awareness of the type of probe being used is important, as are the methods of interpretation.

SCOPE OF THE TEST

- To determine the allowable bearing capacity of the soil around the area.
- To present the bearing capacity in a tabular form depending on foundation footing 'b'.
- Compile Data, summarize report and conclude on the type of foundation that would be appropriate for the proposed structure.

APPRATUS:

- Dutch cone penetrometer machine.

PROCEDURE

- 2 Anchor legs are piled into the ground. The Dutch Cone Penetrometer machine is installed (tightened) on the anchor legs to prevent movement of the machine during readings.
- A gauge of 250kp/cm2 is attached to the machine and an extension rod of 1m each is also attached at a standard velocity of 1 to 2 cm/s while keeping the sleeve stationary.
- This was drilled into the ground and readings were taken at 0.25m interval.
- For any depth, the resistance of the cone, called cone penetration resistance q_c, is recorded using the force probes provided for this purpose in the cone. Then the cone and the sleeve moved and penetrated together into the soil and the combined cone and sleeve resistance, indicated by q_t, is recorded at any depth using tension load cells embedded in the sleeve.
- This procedure is repeated and the measurements are made at regular depth intervals during penetration.

A

DATA ANALYSIS FOR A DUTCH CONE PENETRATION TEST CARRIED OUT IN A LANDED PROPERTY AT ELERUWA, CHALLENGE IBADAN, OYO STATE

D.C.P.T. NOS	Depth (m)	Cone Resistance KP/CM^2	b≤1.2m	b<1.2m	Irrespective of b for all foundations.
1	0.25	10	36	21	27
	0.50	10	36	21	27
	0.75	15	54	31.5	40.5
	1.00	20	72	42	54
	1.25	50	180	105	135
	1.50	60	216	126	162
	1.75	80	288	168	216
	2.00	130	468	273	351
	2.25	150	540	315	405
	2.50	165	594	346.5	445.5
2	0.25	20	72	42	54
	0.50	20	72	42	54
	0.75	20	72	42	54
	1.00	50	180	105	135
	1.25	65	234	136.5	175.5
	1.50	80	288	168	216
	1.75	100	360	210	270
	2.00	120	432	252	324
	2.25	130	468	273	351
	2.50	135	486	283.5	364.5
	2.75	150	540	315	405
	3.00	155	558	325.5	418.5
3	0.25	20	72	42	54
	0.50	20	72	42	54
	0.75	20	72	42	54
	1.00	50	180	105	135
	1.25	100	360	210	270
	1.50	150	540	315	405
	1.75	165	594	346.5	445.5

CONCLUSION

In conclusion, the Dutch Cone Penetration Test (CPT) serves as a pivotal tool in geotechnical engineering for assessing subsurface soil stratification and properties. Its methodology, characterized by the continuous measurement of resistance as the cone is advanced into the ground, provides invaluable data for informed decision-making in site investigation and foundation design. The precision and efficiency of the CPT enhance the reliability of geotechnical assessments, ultimately contributing to the safety and stability of civil engineering projects. Thus, the application of the Dutch Cone Penetration Test is essential in modern geotechnical practice, facilitating the development of robust and sustainable infrastructure.

3.5 COMPRESSIVE STRENGTH TEST

Compressive strength is a crucial property of materials, particularly in the fields of civil engineering, materials science, and construction. It refers to the ability of a material to withstand axial loads without failure.

Compressive strength is defined as the maximum amount of compressive stress that a material can withstand before failure occurs. It is typically expressed in units such as megapascals (MPa) or pounds per square inch (psi). The compressive strength of materials varies significantly; for instance, concrete can have a compressive strength ranging from 20 MPa to 40 MPa or higher, while metals like steel can exceed 200 MPa.

MATERIAL AND APPARATUS (A) MATERIAL:-

- Concrete cube.

(B) APPARATUS:-

- Weighing balance.

- Compressive strength machine.

PROCEDURE

- A cube of 15cm × 15cm is made from a fresh concrete and its left to dry, then 'CURE' for a certain amount of days, then brought to lab for testing.
  CURING is the process of maintaining the moisture and temperature of freshly poured concrete to help it develop its desired strength and durability.
- Weighing the cube with weighing balance and determine the density.
  Formula for DENSITY= MASS/VOLUME.
- The cube is then placed in the compressive strength machine and load of 2000KN is applied to the concrete.

IMPORTANCE OF COMPRESSIVE STRENGTH TEST

Compressive strength tests are important because they help ensure the structural integrity of materials and buildings by measuring a material's ability to withstand loads:

 CONSTRUCTION

Compressive strength tests are a fundamental benchmark for concrete in construction, helping to ensure that buildings are durable and resilient. They also help to determine the capacity of concrete to support the load of a structure.

- **MATERIAL SELECTION**

Compressive strength tests help to determine if a material is suited for a specific application or if it will fail under certain stresses.

- **BATCH QUALITY**

Compression force testing can help to ensure batch quality during production.

- **QUALITY CONTROL**

Compressive strength tests can be used to monitor the quality of concrete on-site.

CONCLUSION

The compressive strength test is a vital tool in many industries, including construction, automotive manufacturing, aerospace, and packaging. It measures a material's ability to withstand compressive forces, which helps ensure safety, reliability, and effectiveness. Here are some conclusions about compressive strength tests:

- **SAFETY**

Compression tests ensure that materials can withstand the compressive forces they're subjected to without failing. This protects people and property.

- **REGULATORY COMPLIANCE**

Many industries have regulations that require materials to meet certain compressive strength standards. Compression tests verify that materials meet these standards.

- **MATERIAL PROPERTIES**

Compression tests can determine a material's modulus of elasticity, proportional limit, compressive yield point, compressive yield strength, and compressive strength. These properties help determine if a material is suitable for specific applications.

- **CONCRETE**

Compressive strength tests are essential for determining the capacity of concrete to withstand a load and the point at which it will fail.

- **SIZE EFFECT**

The CSEL and the MFSL are the models that best fit the data for the size effect. The CSEL is preferred because the structure geometry is positive and unstable crack propagation occurs after crack initiation.

CHAPTER FOUR

4.1 CHALLENGES ENCOUNTERED

The main problem I encountered was transportation. It was quite challenging for me that live in a far place to get to the institute every working day.

4.2 RECOMMENDATION

My recommendation is that the Department of Foundation lab/ Highways in Ministry of Public Works and Transport Secretariat Ibadan, Oyo state should replace Silicon carbide with tungsten carbide which is more human an eco-friendly one to save people from future harms.

The Department of Civil Engineering, Institute of Technology, Kwara State Polytechnics should make sure the students find appropriate places for their Industrial Training.

I would propose that the university management create a mutual relationship with a number of industries to accept more students for I.T. placements with accommodation, transportation and monetary support. I also would propose more frequent impromptu visit of the school supervisors so as to ensure that students are able to fully comprehend the theoretical work done in school. Hence, I implore the university to create strong ties with neighboring industries.