CHAPTER ONE

1.0 INTRODUCTION

Many materials are used in construction industry. Concrete is one of such material, very widely used in many instances of most structural element. This is because the constituents material of concrete are easily obtained. Concrete is the world most consumed man made material (Naik, 2018).

Its great versality and relative economy in filling wide range of need has made it a competitive building material. Concrete production is not only a valuable source of societal development but it is also significant source of employment.

Production of concrete relies to a large extent on the availability of cement sand and coarse aggregate such as granite. The cost of which have risen astronomically over the past few year. Despite the rising cost of production, the demand for concrete is increasing. The negative consequences of the increasing demand for concrete includes depletion of aggregate deposited environmental degradation and ecological imbalance.

The possibility of complete depletion of aggregate resources in the near future can therefore not be over emphasized.

Rising construction costs and the need to reduce environmental stress to make construction sustainable, has necessitated research into the use of alternative materials, especially locally available one which can replace conventional one used in concrete production.

The use of such replacement materials should not only contribute to construction cost reduction and drive infrastructural development but should be able to contribute to reduce stress on the environment and make engineering construction sustainable to help transform the building and construction sectors of national economics and contribute towards the realization of national and global poverty reduction strategies such materials should be cheap and readily available. The cheaper building materials without loss of performance is very crucial to growth of developing countries (Zemke & Wood, 2019).

Historically, agriculture and industrial wastes have created waste management and pollution problems. Complement other traditional materials in construction provide both practical and economical advantages the waste generally have no commercial value and being locally available transportation cost in minimal (Chandra & Berntsson, 2022).

Agricultural wastes have advantages over conventional materials in low cost construction. The use of waste materials in construction contribute to conservation of natural resources and the protection of the environment (Ramezanian, Mahdikhani & Ahma Dibeni,2019). Investigating the use of coconut husk ash, com cob ash and peanut shell ash as cement replacement in concrete production.

The palm oil industry produces wastes such as palm kernel shell. Palm oil fibres which are usually dumped in the open thereby impacting the environment negatively without any economic benefits. Palm kernel shell (PKS) are hard, carbonaceous, organic by products of the processing of the palm oil fruit. Palm kernel shell consists of small size practices, medium size particles and large size particles in the range 0 - 5mm, 5 - 10mm and 10 - 15 the shell have no commercial value, but create disposal and waste manage ment problem. In Ghana palm kernel shell are generally not used in construction they are used as fuel by local blacksmiths and as fill materials or as palliatives.

Investigating the comparative strength of concrete with palm kernel shell as a par tial replacement for coarse aggregate in asphalt concrete.

As part of effort to make efficient use of locally available materials, this study wa s conducted to investigate and compare the influence of weight replacement and volum e replacement of conventional aggregate by palm kernel shell on the workability, density and compressive strength of concrete as well as to assess the suitability of palm kernel shell concrete as a structural materials.

1.1 STATEMENT OF THE PROBLEM

The materials in construction can be defined as an item that can be permanently fixed in position as a component of the final products. Labour, equipment, management and finance are other major construction inputs, to facilitate and bring in the materials s hape.

There is no doubt that there is now a high demand for various substitute materials in the construction industry in Nigeria due to ever increasing price of the conventional construc tion materials because materials input supersede all other input in building activities.

The following points are given so as to justify the uses of palm kernel shell as a partial s ubstitute in concrete.

a. Availability: Palm kernel shell is readily available unlike gravel and granite, which invol ves a bit of bureaucracy at quarries.

b. The cost of acquiring natural coarse aggregate in the market is very high unlike the co st of palm kernel shell.

C. Possession of favourable chemical and physical properties by palm kernel shell is als o added to its advantages.

d. Cost of production: Since palm kernel shell is a waste product, it requires little or no co st or production unlike high sum of capital involved in the production of gravel and grani te.

1.2 AIM AND OBJECTIVES

The aim of this project is to test and compare the strength of concrete with concre te produce with palm kernel shell as a partial replacement for coarse aggregate.

The objective of this project is

i. To determine the compressive strength of the concrete by the used of cube tes ting

processes at the curing ages of 7, 14, 21, and 28 days.

ii. To determine how to reduce the environmental waste.

iii. To determine the strength or palm kernel shell as a partial replacement of con crete.

1.3 JUSTIFICATION OF THE STUDY

This research work will help us to know if palm kernel shell can be used instead o f granite and identifying the effect of palm kernel concrete with respect to the strength at tained also the rate at which it is attained. As a result of increasing in the price of granite and gravel in concrete. It is important to look towards finding alternative building materi als that could be substituted for granite and gravel in concrete.

1.4 THE SCOPE OF THE PROJECT

The scope of study is limited to determine the compressive strength of concrete produced with palm kernel shell as a partial replacement for coarse aggregate. which includes the compressive strength of concrete cubes at 7, 14 and 28days.

CHAPTER TWO

LITERATURE REVIEW

2.1 General introduction

Various research have been under taken to confirm the feasibility of using natural aggregate such as palm kernel shell as a partial substitute for coarse aggregate and light weight aggregate in concrete.

The research also based on how the substitution of this Agricultural waste materials will conserve dwindling resources and will avoid the environmental factors or problems and ecological damages caused by quarrying and exploitation of the raw materials for making cement. Jackson 1999).

In this review of literature a concise approach shall be employed to give ex planation on this project work with respect to the research materials, concret e, its properties. design and practical situations. Previous studies have show t hat palm kernel shell posses similar properties with coarse aggregate and ligh t weight

2.2 Concrete

Concrete is a composite inert materials comprising of a binder course e.g cem ent. mineral filter (body) in aggregate and water. Aggregate on the other hand are two categories of fine (Sand) and coarse (gravel or crushed stone) aggreg ate. The aggregate are usually graded from fine sand to stones of about 20rm m in diameter depending on the project to be executed.

Concrete is a man-made composite materials made up of natural aggregate li ke gravel, crushed rock and sand. such aggregate particles are bound togethe r using a binding medium made up of cement and water. It is reported that go od concrete is that which is dense and non-porous and as such the proportion of fine aggregate present in any given mix ratio should not fall short or exceed that proportion that would fill the spaces present in the coarse aggregate. (Neville A.m.2001).

The amount of water added to any concrete mix should be that which would allow for proper workability and this amount of water is usually determined considering the water cement ration and aggregate cement ratio. The mathematical equation of the water-cement ratio and

aggregate cement ratio are show below:

$$\text{Water-Cement Ratio} = \frac{\text{Mass of water}}{\text{Mass of Cement}} \quad \ldots\ldots(1)$$

$$\text{Aggregate Cement ration} = \frac{\text{Mass of aggregate}}{\text{Mass of cement}} \quad \text{(ii)}$$

Combing equation 1 and 2

$$\text{Mass of cement} = \frac{\text{Mass of water}}{\text{Water cement}} = \frac{\text{mass agg.}}{\text{Agg-cement ration}}$$

Fresh concrete exist in a plastic state and due to its fluidity care take the shap e of any mould or formwork it is poured into

Table 2.1	Properties of concrete
Strength in tension	concrete
Strength in compression	good
Strength in shear	fair
Durability	Good
Dire	Good

Source: Mosley and Bunger (1992).

Typical concrete mixes are proportioned by absolute

weights.

Table 2.2

Satish Chandra. waste materials used in concrete manufacturing

Concrete can also be classified based on place and for type of productio

n i.e.

1. in-situ

2. Pre-cast

3. Ready mix

4. Un-rein forced

5. Light weigh concrete

Definitions

(a) In-situ concrete: This is concrete produced on site, poured and cured at its final positions as a beam slab column etc.

(b) Pre-cast: This describes a variety of concrete unit produced. cast and cured in moulds in factory or site other than their final position. These types of concrete are used usually when there is need for tensioning.

The structure either pre-tensioning or pos-tensioning pre- cast concrete is used as roof quitters. lintels. stair case unit. kerbs. brick etc.

(c)Ready-mix Concrete: This is used to describe concrete mixed at one location usually a batching plant and transported to site via a rotating drum mounted on a truck. It is used mostly when large volumes of concrete are required

(d) Un-reinforced Concrete: This is sometime referred to as mass concrete. Th e resulting concrete here has considerable compressive strength but low tensile stresses due to bending. shear, and torsion. These types of concrete can be used for thick spread foundation and also in a mass retain wall

E Reinforced concrete : This is a concrete in which steel is embedded in such a manner that the two material act together in resisting force, the reinforcing steel rods,bans or mesh absorb the tensile,shear, and sometimes compressive stress in a concrete structure.

Generally speaking any concrete when subjected to a loading is stronger on compression than in tension (British cement association 2001)

2.5 The Palm Kernel Shell

The kernel seed of oil palm is covered by the shell. A single gene controls, the shell thickness. Oil palm is now a major produce in some tropical countries of the world, the major producers in the world today include Malaysia (higher producer). Nigeria.

Table 2.33 World Production of Oil Palm

Oil palm shell is the hard endocarp that surrounds the f palm kernel fruit used in the production oil palm oil. The oil palm industry in Malaysia account f or over half of the worlds total palm oil output problem contributing as much 2.6 million tones of solid waste in form of oil palm shell annually (Basriet AL 1998). Oil palm shell is light and naturally sized and ideals for substitution as aggregate in light weight concrete construction. Due to their hardness and org anic virgin, they will not contaminate or leach to produce toxic substances onc e they are bound in concrete matrix.

Oil palm shell concrete is the best suited for light weight concrete applic ation that require low to moderate strength such as pavement and infilling pa nels for floorings and Well and foot bridge. Currently. There is also an increasi ng demand for low-cost houses in Malaysia and therefore palm kernel shell ca n be used as alternative to the conventional aggregate in fulfilling this deman d.

The shells are lack and surface textures are fairly smooth for both conc ave and convex laces while the broken edges are rough and spiky.

Table 2.4 Physical Properties of Oil Palm Shell and Crushed stories

2.6 Properties of Palm Kernel Shell

The properties of palm kernel shell that are considered of importance in this work includes the shape, size the void ratio, crushing strength durability w ater absorption rate thermal conductivity and moisture content.

1. Shape and Size: Palm kernel shell after cracking the nut is remove. The kernel inside assume an irregular shape and size. the cracking 1s done manually with aid of a stone or using mechanical by using a palm null cr acker.

   As a light weight aggregate, it has the advantages of being able to insul ate the walls to prevent excessive exchange of heat between the inside and the outside Of the structure

2. void ratio: As a result of the irregular shape and Sizes of the shell a lot of voids will be created inside the concrete. The pores will be created withi n the concrete makes it permeable to water, which can lead to frost acti on. Frost weakens the structure and reduced its life span.

3. Water Absorption Rate: A good coarse aggregate and light weight aggr egate should be stabled in mature. The affinity rate should be stabled i mmature. The affinity for water must be very if the materials absorb w ater at a high rate, it will lead to an increase in us bulk density when Su

bjected to a continuous wetting and drying the collapse of the structure may soon be imminent. Palm kernel shell has a relatively to absorption rate when it immersed in water.

4. Moisture Content: In its natural state, Palm Kernel shell contain very low moisture. If the moisture content is high, it will affect the workability of the concrete paste and difficult will be faced in determining the water Cement ratio. Before being used as a light weight aggregate the moisture content in dry bores must first be in a weathering chemical action and wear. The internal coarse are the effect on interaction between the materi1als and other constituent materials to make up the concrete. These includes alkali aggregate reaction, volume change, absorption and permeability. Palm kernel shell has been found to be chemically inactive either in alkali or acidic conditions, hence it could be stable when used as a light weight aggregate.

5. Thermal Conductivity: Thermal conductivity is a measure of flow of heat through a material. It is measured in walls per unit meter, Per unit meter in temperature. A research carried out by Folayan (1988), on the measurement of thermal conductivities of oil palm kernel shell and fiber shows

that about 0.12 wrn-1 at 70°c. This is a good property of aggregate for a lig ht weight concrete as it is resistance to heat flow is low.

2.7 Physical Properties Tests on Course Aggregate Grading Test

Grading Test is carried out in materials to know the population of differe nt sizes of particles in making up. The materials BS 410 gives the guideline for carrying out the test. In the test carried out in he coarse aggregate, a known w eight of a sample was allowed to pass through a set of sieves o progressively smaller openings by the use o mechanical shaker.

1. Unit weight: Unit weight of a sample is the ratio of a given weight of the sample to the volume it occupies. The volume comprises of the voids b etween and within the particles. To determine the bulk density of palm k ernel shell. it is the weight of aggregate that will ill the container of unit volume and this depends on the grading distribution, aggregate shape a nd degree of compaction.

The difference in the volume of the container and that of water used to f ill up the void in sample was noted and actual volume occupied by palm kernel shell in the container estimated. The bulk density for loose aggregate and test method would also different. The un-compacted bulk density determined for p

alm kernel shell sample is given below.

Weight of empty container = w_i

Weight container plus sample = w_2

Volume of empty container = V

The unit weight of the sample is the ratio between the weight of the sampl

e to the actual volume it occupied divided by the volume.

Therefore, Bulk density = W2 WL

V

For the given palm kernel shell sample weight of sample

filling mould = 0.582kg

Volume of mould used = 9.423x 10-3m3

Bulk density = 0.582 = 61.76m3

9.423x10-3

Comparing the bulk density value of palm kernel shell with that of their light weight aggregate like

1. Expanded shale and day made by sin star stand process.
2. Expanded blast furnace slag. it was concluded that palm kernel shell can be used as light relatively low. (Okpala 1990).

2.Moisture Content: This is the amount of moisture present with and on the surface aggregate materials (tree moisture) The absorbed moisture and free moisture together gives the total moisture content of the aggregate. For give sample of palm kernel shell. The moisture content was determined using drying method and the result expressed either as a percentage of the sample dry weight or as a percentage of it weight.

Moisture content is given as

$$Mc = \frac{Ww - Wd}{Wd} \times 100$$

It should be noted that palm kernel shall when compared to normal weight aggregate have higher absorption rate and this range between 21.7% 24% a corresponding moisture content between 14.90%-15.6% (Akomolafe, 1998).

Laboratory Test conducted on two samples of palm kernel shell gives th e following result.

Table 2.5 Moisture Content of palm kernel shell

Adeyemi 1998. Use of palm kernel shell as partial replacement in concrete.

In order not to exceed the water cement ratio for any given concrete mi x. The water absorption rate and moisture content of the palm kernel shell sh ould be known. Knowing that moisture content of palm kernel shell has a grea t influence on the workability and strength of the hardened concrete.

3. Void Ratio: for any given aggregate, the ratio of volume occupied by void to that volume occupied by solid is called void ratio. Aggregate with sma ll volume of ratio produce concrete with low drying shrinkage and ther mal movement. With the apparent specific gravity(s) and the bulk dens known as void ratio is calculated from the expression.

Void ratio = 1 - bulk density

5 x [unit weight of water)

For palm kernel shell,

Void ratio = 1-617.64

1.307x 10o = 0.528

Thus, it can be concluded that for palm kernel the ratio is almost one (1). therefore palm kernel shell can be predicted to produced concrete of mod erate drying shrinkage and thermal movement.

4. Grading Analysis: T his is a process of defined size distribution within an y given aggregate sample using standard test sieve determined by the diameter of its openings. the sieve are arranged in the order of reducin g mesh diameter i.e. sieve with large openings are placed on top sieve with smaller hereby given a progressively reducing mesh diameter whic h would only allow very line particles to pass through. The sieves are us ually mounted in a frame and materials, retained in each sieve after sha king a sample through is weight and record. Result of a mechanical siev e analysis is usually represented graphically on grading curves with a W ell defined range of upper and lower limits.

The dividing line between the fine and coarse aggregate is the mm sieve s ize. It should however be noted that aggregate size are affected by the action of water that accompanies the production of such aggregate and their handlin g on any job site.

Grading requirement of Bs 88:2 1973 allows between 5 and 15 percent wer e size and between 5 and 10 percent under size material for any concrete mi x.

5. Workability Test: Workability is a physical properties of concrete. which describe the case with (ASTM and British code of practice) from a point of mixing to it final compacted stage. The workability of a given concret e lend to affect the quality of the fresh concrete and the hardened conc rete

The test already reported f or determining workability of concrete s given b elow.

i. Slump test

ii. V-B consistometre test

iii. Compaction factor test

These tests usually do not give a fill physical assessment on the concrete c onsistency. compatibility or mobility instead act as practical guide on the work ability of a mix in accordance with standards such as the British standards. Sl ump test described in BS 1881: Part 2.

Apparatus

a. Mould (slump cone 300mm high)

b. Tapping rod

c. Flat base plate

d. steel ruler

e. trowel

Aims

To measure consistency of fresh concrete and detect and changes in w orkability .

Also to control the waste content in various mix batches

Procedure

i. Place cone on the flat base plate with the larger diameter opening of the cone resisting firmly on the plate.

ii. Fill the cone in lour layer in which each layer receiving 25 tamping wit h the aid of a standard 16mm diameter steel rod rounded a the end.

iii. Level the top of the cone using bricklayer trowel.

iv. Live cone vertically and solely in order to allow the unsupported conc rete to slump

v. Place empty cone beside the slumped concrete. Place the rod across it and cone beside the slump from the top of the slump concrete to t he botton of the rod. This height differences is regarded as the slump for a particular batch for normal weight concrete sample a slump of 2 5-100 is regarded of medium workability 10-50mm as 1ow workabilit y and less than 10mm as very low workability (Neville, 1987). it has b een reported that are increased in water content is required where p alm kernel shells are partially introduced in to the light weight aggreg ate concrete is reported to have a lower slump than normal weight c oncrete due to a reduced gravitational force in lightweight co aggreg ate concrete (Neville, 2001).

Thus. For a light weight aggregate concrete using Pks a slump of 50-75 mm represent a high workability and a slump in excess of 75-100 may cause particle segregation

Basri et al 1998). Table

2.6 Result of slump test Slump

Precaution

a. The thickness of layers were kept fairly constant

b. The cone and base were properly oiled avoid honey combing.

c. Carefully removal of cone was ensured avoid dissertation during concre te pouring and tamping. V.B Consistometer Test

Apparatus

1. V-B consistometer consisting of slump cone
2. Shell metal container
3. Vibrating table
4. Funnel and transparent disc

5. Scope

6. Ramping rod

7. Stop clock

Aim

Is to measure workability of concrete in terms of vibration.

Procedure.

1. Fill concrete sample into the slump cone using the scoop

2. Place the transparent disc on the concrete

3. Switch vibration t able on.

4. Measure the time taking for the concrete to completely cover the un derside of he transparent disc starting from when the table was swit ch on.

Observation

It is reported that rich mixes almost immediately remold into a cylindrica l from when the slump cone is removed.

Precautions

1. Adequate accuracy was ensure during the timing process
2. Vibration was done under a three phase power supply. So as not to reduce the time of a total remolding

7. **Compressive Strength Test**

The strength of concrete is define on the maximum load it can carry.

The strength of hardened concrete change with age and environment in an increase manner. Concrete compressive is Commonly used for the purpose of specification quality control as started in the British standard of codes.

Compressive strength is defined as the maximum compressive 1oad an element of hardened concrete can carry per area. t is reported that specimens for compressive Strength test can be cast in three (3) shape which are cubes, cylinder and prisms but the cubes are most widely used.

The cube moulds are usually 150mm x 150mm x 150mm and they are cost with the same concrete for structural elements. The inner surface of the mould is coated thinly with mould oil in order to avoid bond between concrete and mould. Concrete is poured into the mould in three 3) layers with each layer being compacted with 35shokes of tamping road.

Scrape off excess concrete On the mould and smoothen Surface. The mould is removed after 24hr and the cubes kept in a water bath unit their age is ripe for testing (Crushing). The crushing ages are 28 days each cubes is removed from the water bath and placed in a concrete cube crushing machine to crush under increasing load. Loads at final failure of the cube are recorded as crushing load.

The compressive Strength of the cubes is calculated using the expression below.

$$\text{Compressive strength} = \frac{\text{Crushing load (w)}}{\text{Cube area (mm2)}}$$

The reading is then recorded against the cube. Three (3) readings Were obtained from each percentage constituent of palm kernel shell and the average determined.

CHAPTER THREE

3.0 Methodology

3.1 It 1s very important to give details of the procedure to be adopted in this research work and this would include the sourcing of materials, step inv alid in their conversion, experimental test carried out to know the physic al properties etc.

The procedure to be adopted in carrying out this research work is divide d into three [3). Stage

(a) The design of mix proportion

(b) the procurement and preparation of materials

(c) The mixing of concrete casting and curing.

3.2 Material Procurement.

1. Ordinary Portland cement. Confirming to BS 12 (1996) was used in the concrete and production

2. Fine aggregate (sharp sand)

3. Coarse aggregate (Granite size 20mm)

4. Water

5. Painting brush

6. Palm kernel shell

7. Lubrication oil

8. The tools involved during the cube concrete production stage are shove l, head pan.

3.3 Material Treatment

The palm kernel shell was washed thoroughly with detergent, to further remove palm oil form the shell and other impurities that could be detrimental t o concrete, and then rinsed with water thrice to remove the detergent used in washing the palm kernel shell.

3.4 Preparation of Material and Equipment

The palm kernel shell was thoroughly cleaned to removed dirt and was later spread on the floor for proper drying. The Sand after transporting was sie ved to remove stones and Other unwanted materials that might have been tra nsported along with it.

The sand was allowed to dry appreciable so that when felt with hand does not contain a great amount of moist. black oil was used as a primer to the surface of the mould, So that when removing the mould the concrete will not be having cracks.

3.5 Procedure of the concrete cube.

The steps involved in the production of the concrete for this research work are outline below

1. Mould acquisition
2. Mix design
3. Hand mixing procedure
4. Concrete production and pouring
5. curing of the cube
6. Crushing test

3.5.1 Mould acquisition

The mould used for this research work was collected from Kwara State Polytechnic Laboratory of Civil Engineering Department and the mould dimens ion is 150x150x150mm, the formwork is made of metal. The mould coated with used of black oil to facilitate mould removal and avoid honey comb in the cube. The specimens were made in accordance with Bs 1881 (1996).

Diagram

150mm x 150mm x 150mm

Figure 3.1 Shows the diagrammatic representation of the mould for the experiment.

3.5.2 Mix Design

Numerous method of mix design are in use but all can be categorized either by weight or volume. Batching weight by making use of weighing spring balance to carried out the quality of different constituents.

Mixing by weight of concrete is more specific than by volume because of the avoid ratio of the aggregate. The mass of each constituent was determined relatively to the mass of cement required in the mix.

3.5.3 Hand Mixing Procedure

The aggregate s spread in a uniform layer on hard clears and non-porous base. Cement is then uniformly Spread over the aggregate and the dry materials are mixed by turning over from one end to the other and cutting with a shovel until the mix appears uniform.

Water is then gradually added so that neither water nor water with cement can escape.

The mix is then mixed again until it appears uniform in color and consistency. It is important to note in modern days, Concrete is mixed using mechanical mixers and when large quantities are needed, the batching plant is put to use. When using mixers, it is important to note the minimum mixing time necessary to produce a concrete mixing. it is not actually the time, but the total number of revolutions done by the mixer and this depends on the type of mixer. Since there is an optimum speed of rotation recommended by the manufacture of mixer. The number of revolutions and time of mixing are interdependent for small quantities of concrete like the quantity of this experiment, hand mixing method is employed.

3.5.4 Concrete Production and Pouring

This study utilized two control mixes ratio of 1:2:4, batched by volume and 1:2:4, batched by weight. The percentage replacements of the aggregate by palm kernel shell are 0%. 30%. 60% ,90%, 100% by volume and by weight respectively.

Concrete pouring is the process of transferring the fresh concrete from the point to mixing to its final compacted state with the mould. Neat polythene was placed on level ground and the mould was placed on it. Steady compaction was maintained during the process of concrete pouring.

3.5.5 Curing the Cube

Curing is the process that describes the gradual attainment of strength due to transformation of fresh concrete to hardened concrete. After 24hours, the formworks were strike and concrete cube were immediately fully immersed in a ready made. Long period of moist curing reduces the incidence of cracking (Kong and Evans 1994)

Concrete are Cured Under Moist Condition

Ensure that moisture is available to hydrate the cement. Reduce the rate at which initial drying shrinkage Occur in order to minimize cracking

-Reduce the permeability and increase the durability of concrete.

-Curing period of 7,14, 28 days are reported here.

The compaction factor apparatus was used to assess workability of the fresh concrete. The concrete cubes were crushed using Matest Digital Compression Machine, which automatically evaluate both the compression load and the compressive stresses at failure and displays the results on LCD screen. The cubes were removed from the curing tank and let in the open air for about two hours before crushing.

All tests were conducted at the material laboratory of the Department of Civil Engineering of the Kwara State Polytechnic.

CHAPTER FOUR

4.0 DATA ANALYSIS

This chapter shows the result of the investigation how variation in a comparatives study on the compressive strength of concrete produced from palm kernel shell concrete and granite with conventional Aggregate.

4.1 RESULT AS COLLECTED

The table below shows the result obtained from the compressive testing of the concrete cubes.

Compressive strength result for palm kernel shell concrete and granite at 0% for control Normal ratio 1:2:4.

4.2 ANALYSIS AND DISCUSSION

The following are the fact drawn out based on the best result collected from the laboratory

1. The weight of each cubes differs even through 150mm' mould was used throughout in this study

2. The compressive strength of the concrete cubes decreases as the percentage of palm kernel shell is increase than that of granite

3. It was noticed that in the process of using palm kernel shell only as coarse aggregate, the weight of the cube is low compared to other cubes

4. The concrete made of palm kernel shell only also have lowest compressive strength at 7, 14, 28 days.

5. The crushing lead of the concrete cube decrease as the percentage of palm kernel shell increase.

Table 4.1 compressive strength result for palm shell concrete and granite at 0% for control.

Date of cast	Identification mark	Age of cube	Cube size (mm2)	Dry weight to cube (kg/m3)	Dry density (kg/m3)	Failure load	Compressive strength (N/mm3)	Average comp strength (N/mm3)	Average dry density (kg/m3)
08-03-2025	1	7days	150× 150× 150	8.036	2381.40	380	16.9	14.45	2379.95
	2			8.032	2378.25	270	12.0		
	1	14days		8.250	244.44	470	20.9	18.90	2439.26