REPORT ON AN IN-SITU INTEGRITY TEST (NON-DESTRUCTIVE) OF COMPRESSIVE STRENGTH OF STRUCTURAL ELEMENTS ON AN ONGOING BUILDING LOCATED AT 62, COLLEGE ROAD, OFF IJU ROAD IFAKO IJAIYE, LAGOS STATE.

FOR

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CONTENTS

1.0 INTRODUCTION

The test (NDT) was carried out on the building on Monday, 9th December, 2024. It is often necessary to test concrete structures after the concrete has hardened to determine whether the structure is suitable for its designed use. Ideally such testing should be done without damaging the concrete.

Non-Destructive Testing (NDT) is defined by the American Society for Non-destructive Testing (ASNT) as: "The determination of the physical condition of an object without affecting that object's ability to fulfill its intended function". Buildings and other structures deteriorate with time and use. The deterioration process is affected by several characteristics: traffic, rain, freeze, thaw cycles, climate, pollution, temperature, and moisture variations. This deterioration process can lead to eventual failure of the structure. Periodic building inspections are therefore necessary to assess the extension, implications, and current state of the deterioration process.

2.0 SCOPE OF WORK

The scope of the work done was as follows:

1. Visual inspections were carried out on the structure tested.
2. Calibration of the Ultrasonic Equipment was done before commencing the test.
3. Indirect method was employed using 120mm spacing then, three (3) test points were randomly selected to get a good representation/result on each structural member, according to BS EN12504-4:2004, for testing concrete.
4. The transit time of each structural member was determined.
5. Analysis of results and compilation of report.

3.0 FIELD WORK

Visual inspection was carried out on the structure to ascertain any possible structural defects (e.g. Cracks, Settlement, Honeycombs) this is a vital aspect of non-destructive test.

4.0 PURPOSE OF INVESTIGATION/APPRAISAL

The purpose of the test is as follows;

- To determine the compressive strength of the structure.
- To understand and determine the quality of the concrete with respect to BSCE standard.
- To put safety measures in place to forestall any future tragedy on human life and properties.
- To find critical areas to repair immediately.
- To comply with Municipal or any statutory requirements.
- To enhance life cycle of structure by suggesting preventive and corrective measure.
- To know the status of the structure and to project the expected future life.

5.0 SITE LAYOUT/ACCESSIBILITY

Site Location: 62, College Road, Off Iju Road Ifako Ijaiye, Lagos State.
Major Access Road: College Road.

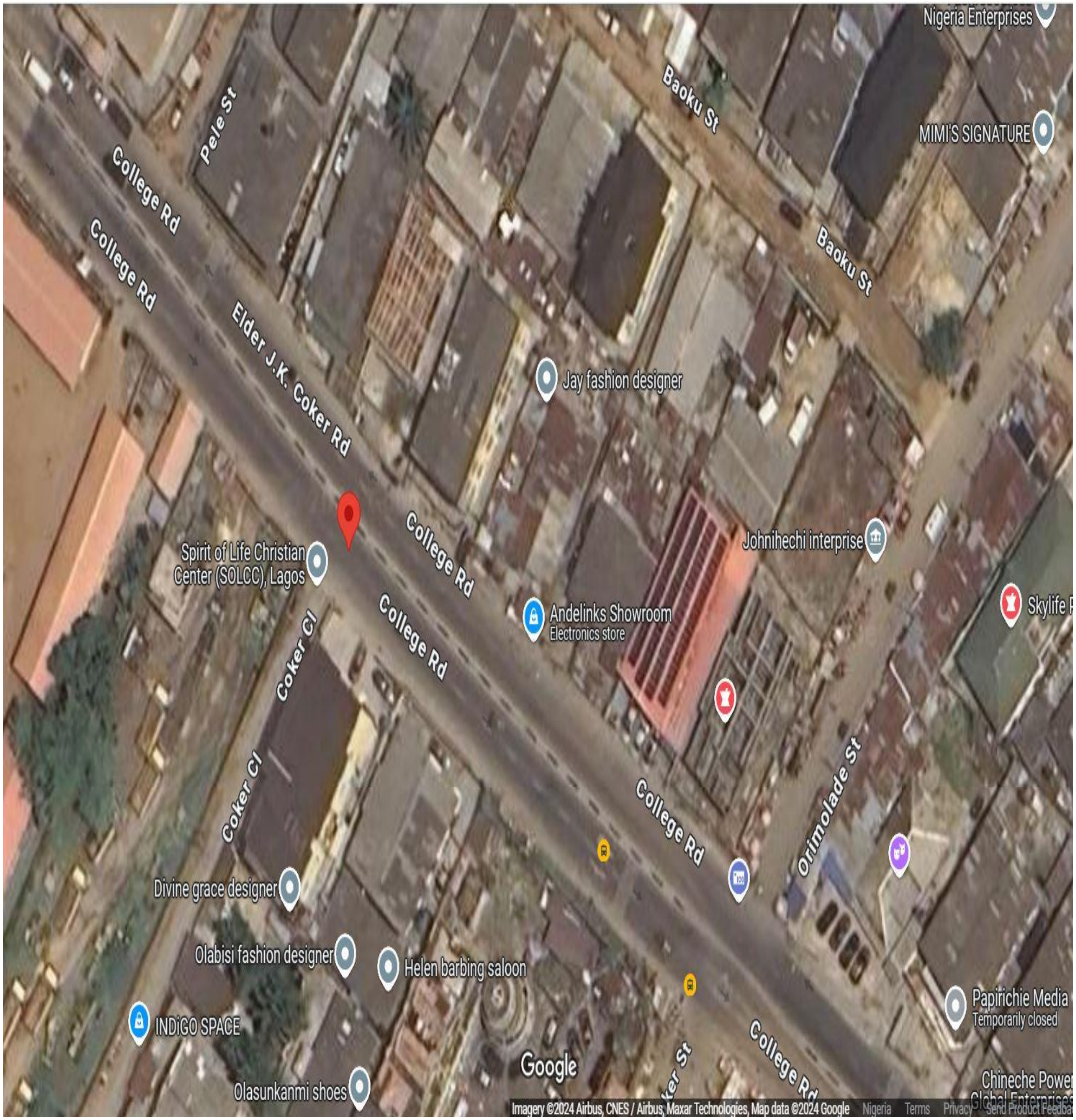


FIG. 5.1: Google map of the site location.

6.0 SITE DESCRIPTION/ INFORMATION SUPPLIED

- The structure is an ongoing three floor building *(see fig 1)*.
- Construction stage: finishing *(see fig 1)*.
- It is built for commercial purpose *(see fig 1)*.
- No drawing was provided as at the time of test.
- All structural members are over 28 days as at the time of test.

7.0 GENERAL RECONNAISSANCE AND PROBLEM IDENTIFICATION

- No visible settlement observed on the building.

GROUND FLOOR

- Exposure of reinforcement was observed on slab *(see fig 2&3)*.
- No dampness was observed on the building.
- No spalling was observed on reinforced concrete slab.
- No cracks were observed on the building.

FIRST FLOOR

- Sagging was observed on first floor slab panel S3, S4, S10 *(see fig 9)*.

SECOND FLOOR

- No defect observed

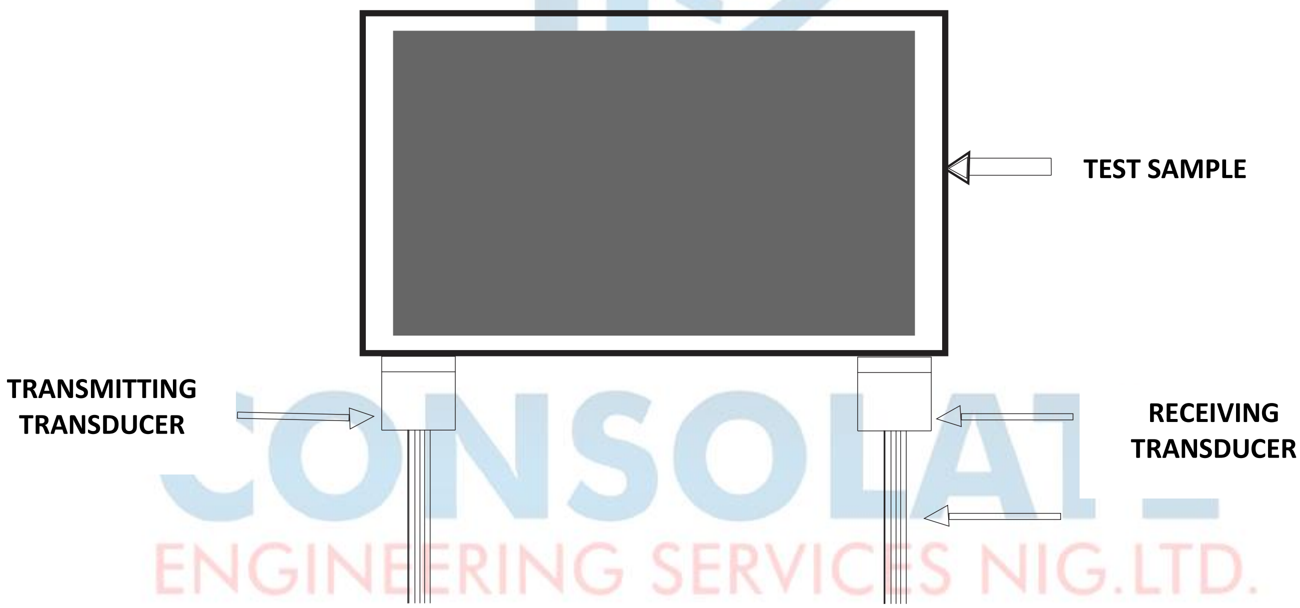
8.0 DESCRIPTION AND OPERATION OF INSTRUMENTS

Portable Ultrasonic Non-Destructive Digital Indicating Tester (PUNDIT LAB). Non-Destructive, as the name implies means that the material under test is not damaged during the test

A pulse of longitudinal vibrations is produced by an electro-acoustical transducer, which is held in contact with one surface of the concrete under test. When the pulse generated is transmitted into the concrete from the Transducer using a liquid coupling material such as grease or cellulose paste, it undergoes multiple reflections at the boundaries of the different material phases within the concrete. The first waves to reach the receiving Transducers are the longitudinal waves, which are converted into an electrical signal by a second transducer. Electronic timing circuits enable the transit time T of the pulse to be measured. This test is conducted for assessing the quality and integrity of concrete by passing ultrasound waves through the specimen under test. This test can also be used to determine the presence of honeycombs, voids, cracks etc. The equipment consists essential of an electrical pulse generator, a pair of transducers, an amplifier and an electronic timing device for measuring the time interval between the initial of a pulse generated at the transmitting transducer and its arrival at the receiving transducer.
Measurement of the velocity of Ultrasonic pulses at longitudinal vibrations passing through concrete may be used for the following applications:

- Determination of the uniformity of concrete in and between members.
- Measurement of changes occurring with time in the properties of concrete
- Correlation of pulse velocity and strength as measure of concrete quality.
- Determination of the modulus of elasticity and dynamic Poisson’s ratio of the concrete.

The velocity of an ultrasonic pulse is influenced by those properties of concrete which determine its elastic stiffness and mechanical strength. The variations obtained in a set of pulse velocity measurements made along different paths in a structure reflect a corresponding variation in the state of the concrete. Pulse velocity measurements made on concrete structures is used for quality control purposes. In comparison with mechanical test on control samples such as cubes or cylinders, pulse velocity measurements have the advantage that they relate directly to the concrete in the structure rather than to samples, which may not be always truly representative of the concrete in situ.



T - Transmitting Transducer
R - Receiving Transducer

8.1 Guideline for Reinforced Concrete Grade Design

S/N	GRADE	GOOD 99.9%-100%	POOR 87.4% and below
1	40	40 and above	Below 40
2	35	35 and above	Below 35
3	30	30 and above	Below 30
4	25	25 and above	Below 25
5	20	20 and above	Below 20

8.2 Building Categories and Assumed Concrete Grade

S/N	TYPE	CATEGORY	ASSUMED GRADE	MIX. RATIO
1	Commercial	A	40 and above	Design/specification
		B	35-40	Design/specification
		C	30-35	Design/specification
		D	25-30	1:11/2:3
2	Residential	A	30 and above	Design/specification
		B	25-30	1:11/2:3
		C	20-25	1:2:4

8.3 Expected Minimum Compressive Strength For Concrete Grade 25

AGE	PERCENTAGE (%)	STRENGHT (N/mm2)
7 days	65	16.25
14days	90	22.5
28days	100	25.0

TEST ANALYSIS

AND

COMMENT

TABLE 9.1: GROUND FLOOR COLUMN RESULT

STRUCTURAL ELEMENT	TEST POINT	PATH LENGTH (mm)	TRANSIT TIME (ps)	PULSE VELOCITY (m/s)	AVERAGE PULSE VELOCITY (km/s)	EQUIVALENT COMPRESSIVE STRENGHT (N/mm2)	REMARKS
C1	1	120	29.3	4092.00	4.00	27	GOOD
	2		29.6	4056.00			
	3		31.2	3852.00			
C2	1	120	28.4	4231.20	4.10	28	GOOD
	2		30.5	3936.00			
	3		29.0	4132.80			
C3	1	120	32.3	3712.50	3.75	23	GOOD
	2		31.1	3858.75			
	3		32.6	3678.75			
C4	1	120	30.4	3949.65	3.93	25	GOOD
	2		30.4	3949.65			
	3		30.8	3890.70			
C5	1	120	49.9	2403.79	2.42	11	POOR
	2		49.7	2416.13			
	3		49.2	2440.09			
C6	1	120	30.8	3896.10	3.90	25	GOOD
	2		30.8	3899.61			
	3		30.8	3899.61			
C7	1	120	47.0	2552.70	2.54	11.5	POOR
	2		47.4	2529.84			
	3		47.3	2537.46			
C8	1	120	44.5	2697.30	2.70	12.5	POOR
	2		44.8	2681.10			
	3		44.1	2721.60			
C9	1	120	46.5	2582.85	2.57	12	POOR
	2		47.0	2552.01			
	3		46.6	2575.14			
C10	1	120	109.2	1098.90	1.10	6.7	POOR
	2		108.5	1105.50			
	3		109.5	1095.60			
C11	1	120	44.9	2671.98	2.69	12.5	POOR
	2		44.7	2685.70			
	3		44.2	2712.33			
C12	1	120	68.6	1748.25	1.75	8.3	POOR
	2		68.6	1749.83			
	3		68.6	1749.83			
C13	1	120	47.4	2532.60	2.52	11.5	POOR
	2		47.8	2509.92			

	3		47.7	2517.48			
C14	1	120	33.4	3596.40	3.60	20	GOOD
	2		33.6	3574.80			
	3		33.1	3628.80			
C15	1	120	33.2	3618.00	3.60	20	GOOD
	2		33.6	3574.80			
	3		33.3	3607.20			
C16	1	120	51.0	2352.90	2.30	10.5	POOR
	2		51.5	2332.20			
	3		54.2	2214.90			
C17	1	120	74.5	1609.92	1.56	8.0	POOR
	2		80.1	1497.60			
	3		76.3	1572.48			
C18	1	120	69.3	1732.50	1.75	8.3	POOR
	2		66.6	1800.75			
	3		69.9	1716.75			
C19	1	120	47.6	2522.55	2.51	11.5	POOR
	2		47.6	2522.55			
	3		48.3	2484.90			
C20	1	120	43.7	2747.25	2.75	13.3	POOR
	2		43.9	2730.75			
	3		43.3	2772.00			
C21	1	120	108.5	1105.50	1.10	6.7	POOR
	2		109.9	1092.30			
	3		108.9	1102.20			

TABLE 9.2: FIRST FLOOR BEAM RESULT

STRUCTURAL ELEMENT	TEST POINT	PATH LENGTH (mm)	TRANSIT TIME (ps)	PULSE VELOCITY (m/s)	AVERAGE PULSE VELOCITY (km/s)	EQUIVALENT COMPRESSIVE STRENGHT (N/mm2)	REMARKS
B1	1	120	80.1	1498.50	1.50	8.0	POOR
	2		79.6	1507.50			
	3		80.3	1494.00			
B2	1	120	48.5	2472.30	2.46	11.5	POOR
	2		49.0	2450.16			
	3		48.8	2457.54			
B3	1	120	47.5	2527.47	2.53	11.5	POOR
	2		47.8	2512.29			
	3		47.1	2550.24			
B4	1	120	56.3	2130.60	2.12	9.5	POOR
	2		57.0	2105.16			
	3		56.5	2124.24			

B5	1	120	46.2	2597.40	2.60	12	POOR
	2		45.9	2613.00			
	3		46.3	2589.60			
B6	1	120	49.3	2433.59	2.45	11.5	POOR
	2		49.1	2446.08			
	3		48.6	2470.34			
B7	1	120	51.8	2317.68	2.32	10.5	POOR
	2		51.7	2319.77			
	3		51.7	2319.77			
B8	1	120	44.1	2723.55	2.71	12.5	POOR
	2		44.5	2699.16			
	3		44.3	2707.29			
B9	1	120	49.8	2412.00	2.40	11	POOR
	2		50.4	2383.20			
	3		49.9	2404.80			
B10	1	120	46.0	2607.39	2.61	12	POOR
	2		45.7	2623.05			
	3		46.2	2599.56			

TABLE 9.3: FIRST FLOOR SLAB RESULT

STRUCTURAL ELEMENT	TEST POINT	PATH LENGTH (mm)	TRANSIT TIME (ps)	PULSE VELOCITY (m/s)	AVERAGE PULSE VELOCITY (km/s)	EQUIVALENT COMPRESSIVE STRENGHT (N/mm2)	REMARKS
P1	1	120	33.2	3618.00	3.60	20	GOOD
	2		33.5	3585.60			
	3		33.4	3596.40			
P2	1	120	33.0	3638.10	3.62	20	GOOD
	2		33.4	3594.66			
	3		33.1	3627.24			
P3	1	120	35.2	3406.59	3.41	18	POOR
	2		35.0	3427.05			
	3		35.3	3396.36			
P4	1	120	51.4	2334.26	2.35	11	POOR
	2		51.1	2346.24			
	3		50.6	2369.51			
P5	1	120	33.3	3606.39	3.61	20	GOOD
	2		33.2	3609.64			
	3		33.2	3609.64			
P6	1	120	32.9	3648.15	3.63	20	GOOD
	2		33.2	3615.48			
	3		33.1	3626.37			
P7	1	120	33.0	3636.36	3.64	20	GOOD

	2		33.2	3614.52			
	3		32.7	3669.12			
P8	1	120	32.9	3648.15	3.63	20	GOOD
	2		33.3	3604.59			
	3		33.0	3637.26			
P9	1	120	33.4	3596.40	3.60	20	GOOD
	2		33.2	3618.00			
	3		33.5	3585.60			
P10	1	120	33.1	3625.55	3.65	22	GOOD
	2		32.9	3644.16			
	3		32.6	3680.30			

TABLE 9.4: FIRST FLOOR COLUMN RESULT

STRUCTURAL ELEMENT	TEST POINT	PATH LENGTH (mm)	TRANSIT TIME (ps)	PULSE VELOCITY (m/s)	AVERAGE PULSE VELOCITY (km/s)	EQUIVALENT COMPRESSIVE STRENGHT (N/mm2)	REMARKS
C1	1	120	54.0	2221.05	2.21	10	POOR
	2		54.0	2221.05			
	3		54.8	2187.90			
C2	1	120	33.6	3575.88	3.60	20	GOOD
	2		33.4	3594.24			
	3		33.1	3629.88			
C3	1	120	48.0	2497.50	2.50	11.5	POOR
	2		48.0	2499.75			
	3		48.0	2499.75			
C4	1	120	52.8	2271.30	2.26	10.5	POOR
	2		53.3	2250.96			
	3		53.2	2257.74			
C5	1	120	33.1	3626.37	3.63	20	GOOD
	2		33.3	3604.59			
	3		32.8	3659.04			
C6	1	120	44.4	2703.45	2.69	12.5	POOR
	2		44.9	2671.17			
	3		44.5	2695.38			
C7	1	120	62.6	1918.08	1.92	8.5	POOR
	2		62.2	1929.60			
	3		62.8	1912.32			
C8	1	120	33.2	3615.61	3.64	20	GOOD
	2		33.0	3634.18			
	3		32.7	3670.21			
C9	1	120	32.6	3676.32	3.68	22	GOOD
	2		32.6	3679.63			

	3		32.6	3679.63			
C10	1	120	43.7	2743.65	2.73	12.5	POOR
	2		44.1	2719.08			
	3		44.0	2727.27			
C11	1	120	41.3	2907.09	2.91	14	POOR
	2		41.5	2889.63			
	3		40.9	2933.28			
C12	1	120	32.7	3668.25	3.65	22	GOOD
	2		33.1	3624.45			
	3		32.8	3657.30			
C13	1	120	39.8	3017.85	2.95	14.5	POOR
	2		40.1	2991.30			
	3		42.2	2840.85			
C14	1	120	31.4	3818.40	3.70	22	GOOD
	2		33.8	3552.00			
	3		32.2	3729.60			

TABLE 9.5: SECOND FLOOR BEAM RESULT

STRUCTURAL ELEMENT	TEST POINT	PATH LENGTH (mm)	TRANSIT TIME (ps)	PULSE VELOCITY (m/s)	AVERAGE PULSE VELOCITY (km/s)	EQUIVALENT COMPRESSIVE STRENGHT (N/mm2)	REMARKS
B1	1	120	43.3	2773.80	2.76	13.3	POOR
	2		43.7	2748.96			
	3		43.5	2757.24			
B2	1	120	40.3	2977.02	2.98	14.5	POOR
	2		40.6	2959.14			
	3		39.9	3003.84			
B3	1	120	45.6	2633.10	2.62	12	POOR
	2		46.1	2601.66			
	3		45.7	2625.24			
B4	1	120	31.0	3866.13	3.87	25	GOOD
	2		30.9	3889.35			
	3		31.1	3854.52			

TABLE 9.6: SECOND FLOOR SLAB RESULT

STRUCTURAL ELEMENT	TEST POINT	PATH LENGTH (mm)	TRANSIT TIME (ps)	PULSE VELOCITY (m/s)	AVERAGE PULSE VELOCITY (km/s)	EQUIVALENT COMPRESSIVE STRENGHT (N/mm2)	REMARKS
P1	1	120	30.5	3936.06	3.94	25	GOOD
	2		30.5	3939.61			
	3		30.5	3939.61			

P2	1	120	30.8	3899.40	3.88	25	GOOD
	2		31.1	3864.48			
	3		31.0	3876.12			
P3	1	120	31.9	3756.24	3.76	23	GOOD
	2		32.1	3733.68			
	3		31.7	3790.08			
P4	1	120	31.4	3819.00	3.80	23	GOOD
	2		31.8	3773.40			
	3		31.5	3807.60			
P5	1	120	30.7	3906.09	3.91	25	GOOD
	2		30.5	3929.55			
	3		30.8	3894.36			

TABLE 9.7: SECOND FLOOR COLUMN RESULT

STRUCTURAL ELEMENT	TEST POINT	PATH LENGTH (mm)	TRANSIT TIME (ps)	PULSE VELOCITY (m/s)	AVERAGE PULSE VELOCITY (km/s)	EQUIVALENT COMPRESSIVE STRENGHT (N/mm2)	REMARKS
C1	1	120	44.7	2681.91	2.70	12.5	POOR
	2		44.5	2695.68			
	3		44.1	2722.41			
C2	1	120	44.5	2697.30	2.70	12.5	POOR
	2		44.4	2699.73			
	3		44.4	2699.73			
C3	1	120	32.9	3648.15	3.63	20	GOOD
	2		33.2	3615.48			
	3		33.1	3626.37			
C4	1	120	71.5	1678.32	1.68	8.3	POOR
	2		71.9	1668.24			
	3		70.9	1693.44			
C5	1	120	33.0	3638.10	3.62	20	GOOD
	2		33.4	3594.66			
	3		33.1	3627.24			
C6	1	120	33.0	3636.36	3.64	20	GOOD
	2		32.8	3658.20			
	3		33.1	3625.44			
C7	1	120	61.6	1946.87	1.96	9.1	POOR
	2		61.3	1956.86			
	3		60.7	1976.27			
C8	1	120	49.2	2437.56	2.44	11	POOR
	2		49.2	2439.76			
	3		49.2	2439.76			
C9	1	120	33.1	3628.05	3.61	20	GOOD

	2		**33.4**	**3595.56**			
	3		**33.3**	**3606.39**			
C10	**1**	**120**	**32.9**	**3646.35**	**3.65**	**22**	**GOOD**
	2		**33.1**	**3624.45**			
	3		**32.6**	**3679.20**			
C11	**1**	**120**	**42.3**	**2834.10**	**2.82**	**13.3**	**POOR**
	2		**42.9**	**2800.26**			
	3		**42.5**	**2825.64**			

COMMENT

- Assumed Concrete Grade: $20N/mm^2$.
- All structural members are over 28 days as at the time of test.
- The test was carried out only on **super structure.**

10.0 SUMMARY OF TEST RESULT

TABLE 10.1: TEST RESULTS BASED ON PERCENTAGE

STR. MEMBER	NUMBER TESTED		TOTAL	PERCENTAGE	
	GOOD	POOR	TESTED	GOOD	POOR
GROUND FLOOR COLUMN	7	14	21	33.3	66.7
FIRST FLOOR BEAM	0	10	10	0.0	100.0
FIRST FLOOR SLAB	8	2	10	80.0	20.0
FIRST FLOOR COLUMN	6	8	14	42.9	57.1
SECOND FLOOR BEAM	1	3	4	25.0	75.0
SECOND FLOOR SLAB	5	0	5	100.0	0.0
SECOND FLOOR COLUMN	5	6	11	45.5	54.5

BUILDING ANALYSIS CHART

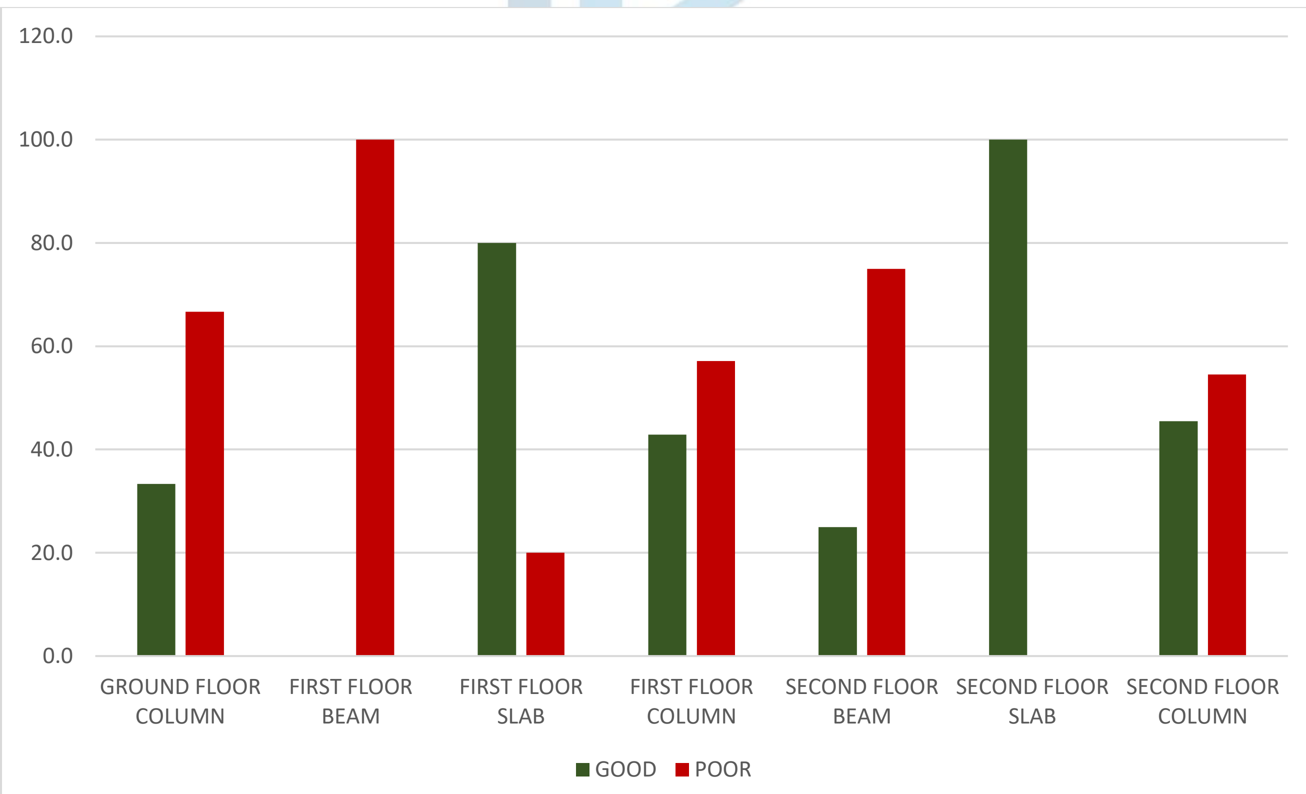


FIG 10.1: Chart illustrating the percentage of the strength of structural element of the building.

11.0 REMEDIAL WORKS AND RECOMMENDATION

In light of the outcome of assessment of the tested structural members, it is therefore advised that**:**

1. Ground, first and second floor columns should be properly retrofitted by way of jacketing.
2. All first and second floor beams should also be retrofitted.
3. Structural members where exposure of reinforcement was observed should be properly grouted.
4. New beams and columns should be introduced at sagging area as specified by a structural engineer.
5. Structural Engineer should be engaged when carrying out the works on the building.
6. All safety precautions must be taken during the process.
7. The materials which will be used for the works on the building must be subjected to quality control /quality assurance test.
8. At the completion of works on the building, a **confirmatory test** (NDT) should be carried out on the building to validate the work done.
9. It is also recommended that stationary objects capable of causing overburden load on the building should be completely avoided.

12.0 CONCLUSION

From the information obtained at site and the analysis of the test conducted, the following conclusions were reached;

- The result above indicates that the ground floor column, first floor beam, first floor slab, first floor column and second floor column are 33.3%, 0%, 80%, 42.9, 25%, 100% and 45.5% good respectively using **ULTRASONIC EQUIPMENT**.
- Based on the recommendation stated on the previous page, it is necessary to state clearly that non-adherence to this recommendation excludes us of any responsibility.

Note: Assumed concrete grade is $20N/mm^2$.

ENGR. GABRIEL TAIWO

AUTHORISED SIGNATURE

SELECTED SITE PHOTOGRAPHS, DRAWING AND SKETCH

PICTURES SHOWING STATE OF THE BUILDING

FIG. 1: Front View

PICTURES SHOWING DEFECTS AREA ON THE BUILDING

FIG. 2: Exposure of reinforcement on Slab

FIG. 3: Exposure of reinforcement on Slab

PICTURES SHOWING TESTED AREA ON THE BUILDING

FIG 4: Pundit on Beam

FIG 5: Pundit on Slab

PICTURES SHOWING TESTED AREA ON THE BUILDING (CONTD.)

FIG 6: Pundit on Column

FIG 7: Pundit on Column

SKETCH SHOWING TESTED POINTS ON THE BUILDING

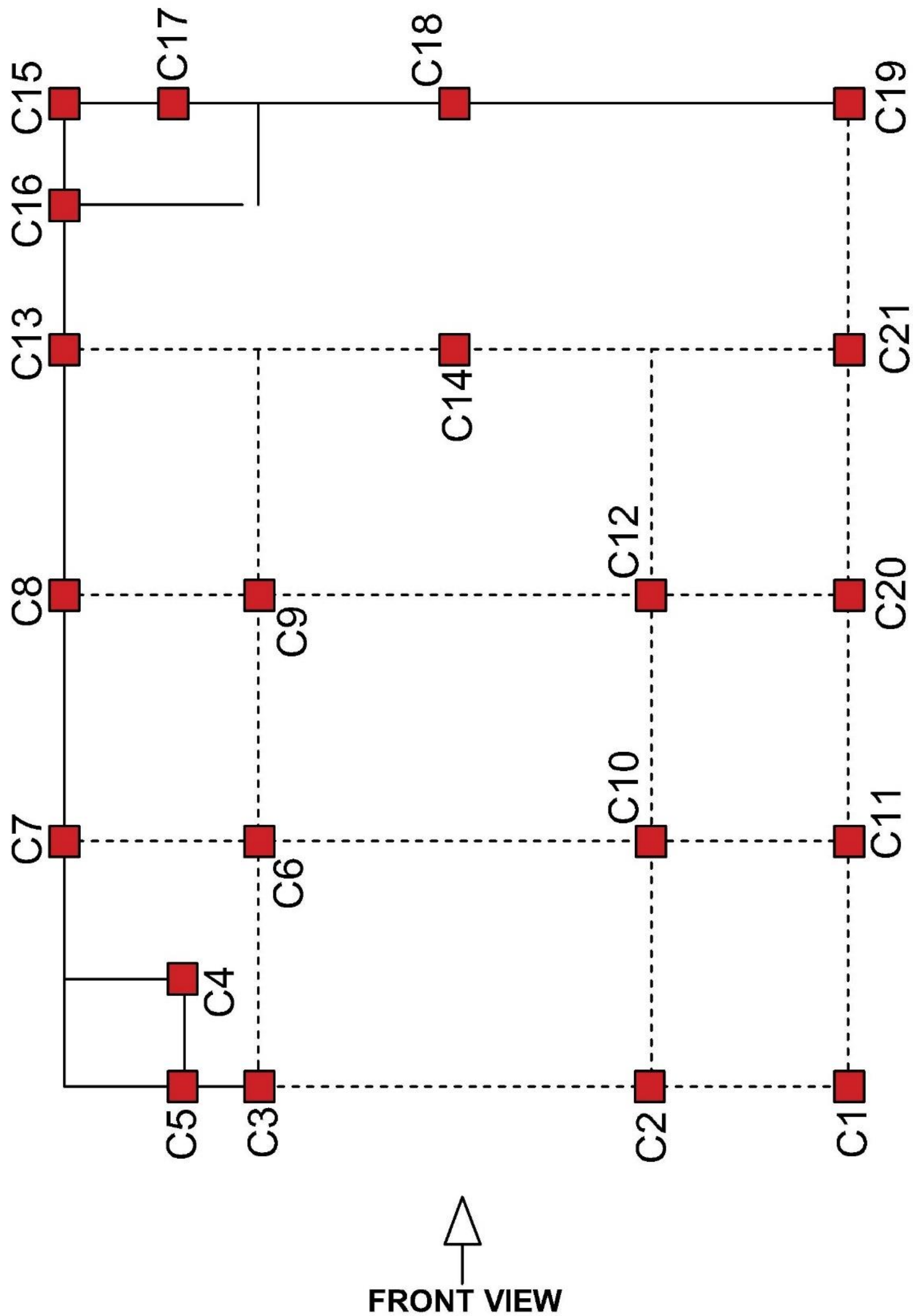


FIG. 8: Ground Floor

SKETCH SHOWING TESTED POINTS ON THE BUILDING (CONTD.)

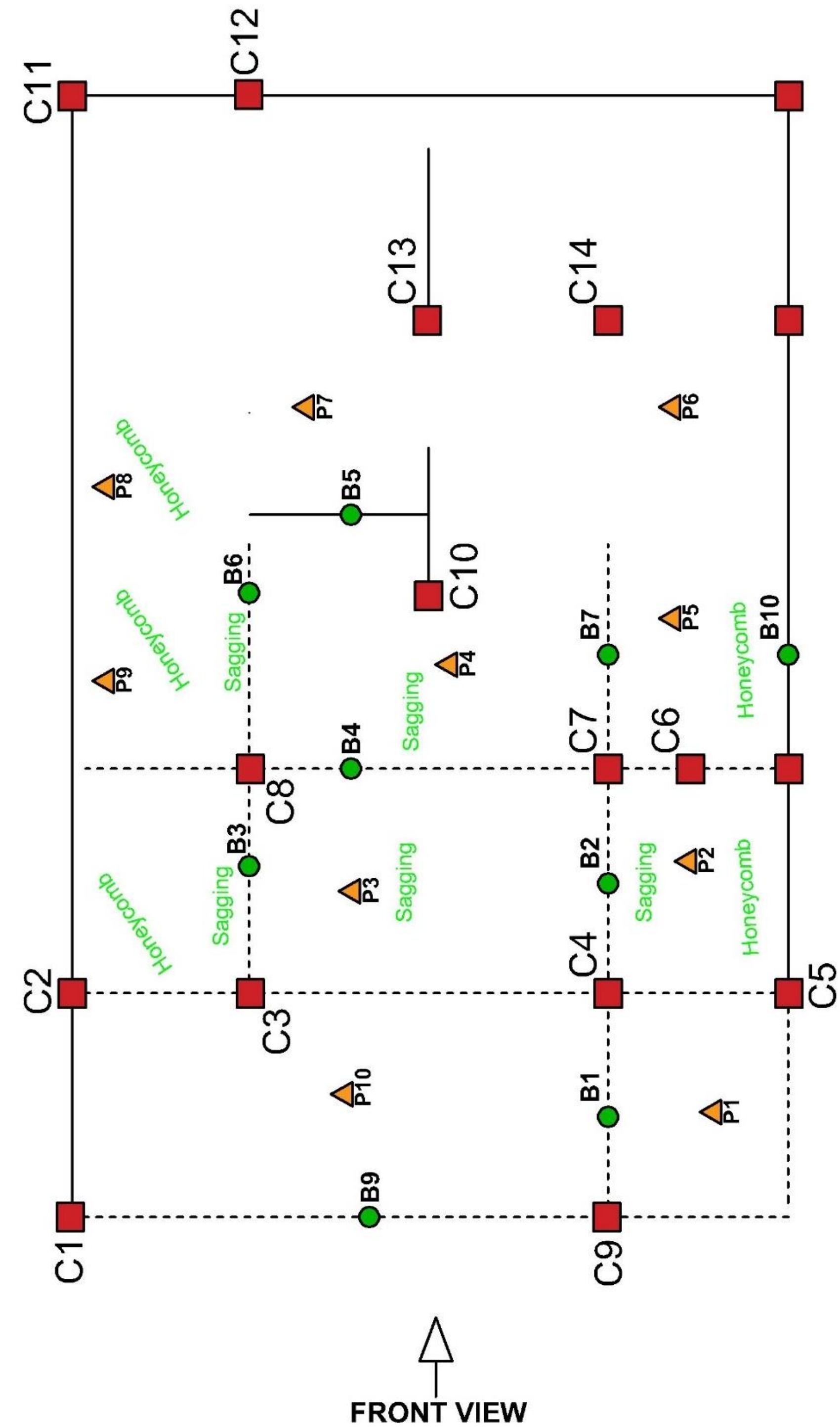


FIG. 9: First Floor

SKETCH SHOWING TESTED POINTS ON THE BUILDING (CONTD.)

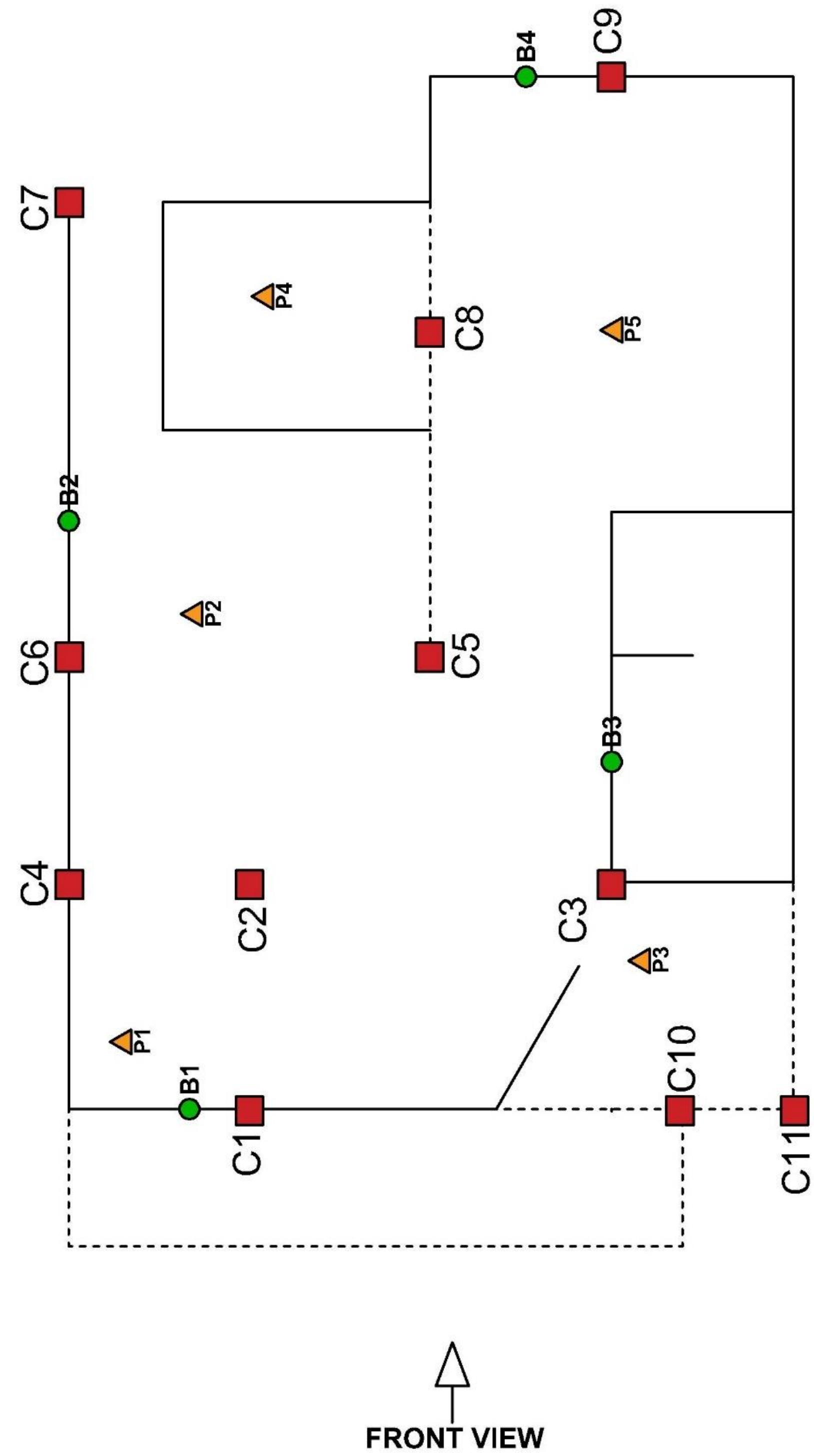


FIG. 10: Second Floor