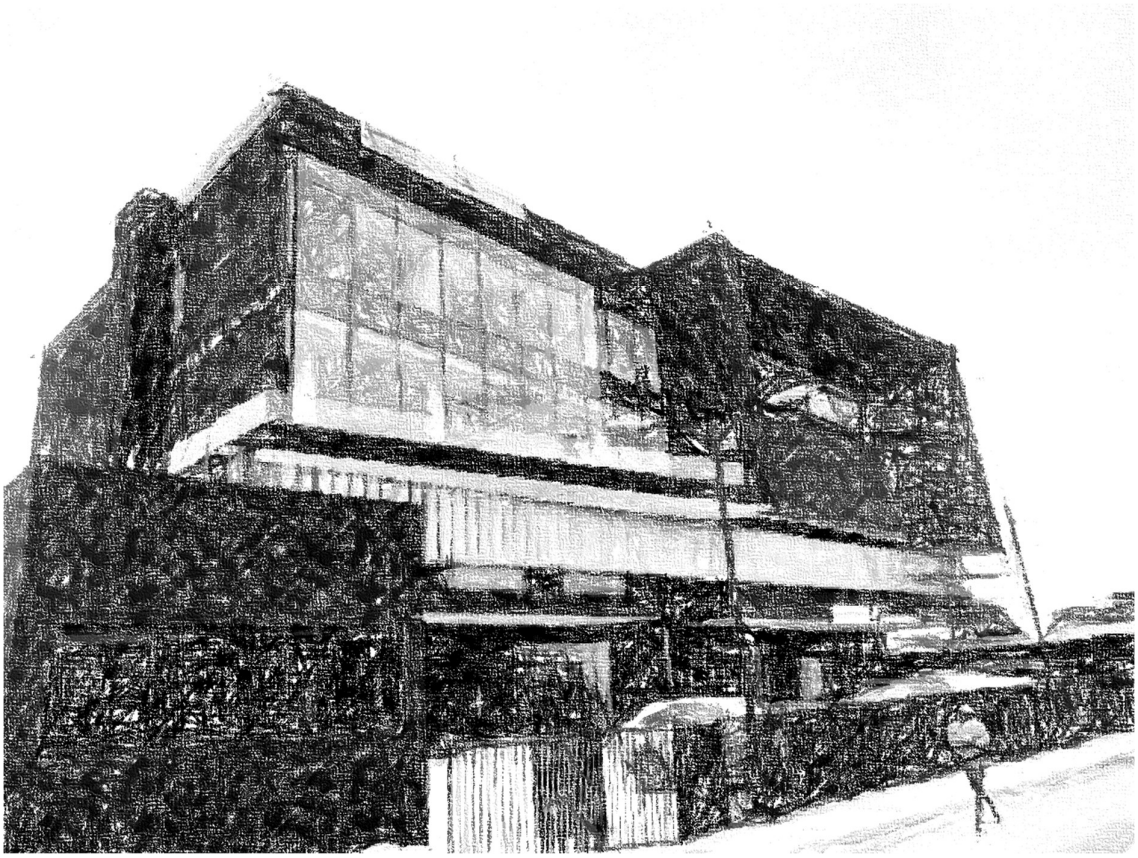

Report on "BLACKBELL MALL"

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Contents

1 Project Introduction

The **Blackbell Mall** at Ikota, Lagos, Nigeria is a **5750 m²** commercial development of top standards, class and elegance. From its jaw dropping architecture (interior and exterior) to the Structural concept realization and Services.

The project consists of **Ground + 3$^{1/10}$ Suspended floors + 2 Roof** levels all well planned to efficiently serve intending visitors. Floor by floor function are given as follows: Ground Floor- Eateries, Pharmacy; Mezzanine Floor (approx. 1/10th area)- Staff Facilities; *1st Floor*- Eatery, Cinema; *2nd Floor*- Clothing Store, Cinema; *Pent Floor*- Club/Lounge, Suspended Swimming Pool; *Roof 1 & 2*- Mechanical Services Equipment.

Project team- Architect: Baron Architecture; Structural Engineer: **BOM Associates**; MEFP Engineer: BSDCL; Cost Consultant: Construworth; Main Contractor: Migliore Construczione & Tecniche; MEFP Subcontractor: Mar & Mor.
Project Timeline: August 2019 (Conceptual Design) - October 2022 (Operation commenced).

2 Structural Concept

The Primary material for the "**Rigid Frame**" Structural System is Reinforced Concrete with compressive strength between 25N/mm^2 (floor slabs, beams, cinema galleries & staircases) to 30N/mm^2 (foundation & columns).

An efficient grillage of ground beams and pile caps (up to 1350mm deep) transfer the superstructure column loads to the 450 diameter Piles terminating at 22m depth (Medium dense Sand strata) with a Safe Working Load of 850kN. Furthermore, the

project reality, a must…

250mm thick ground slab acts as a secondary foundation "raft" mobilizing 50kN/m^2 to further limit overall building settlement.

Floor framing adopted was a mix of 175-225mm Solid Slabs and 400mm thick 2-way ribbed slab (2.4m x 2.4m modules) in massive column free areas up to 150m^2, all spanning towards drop and/or flat beams supported by an irregular column placement.

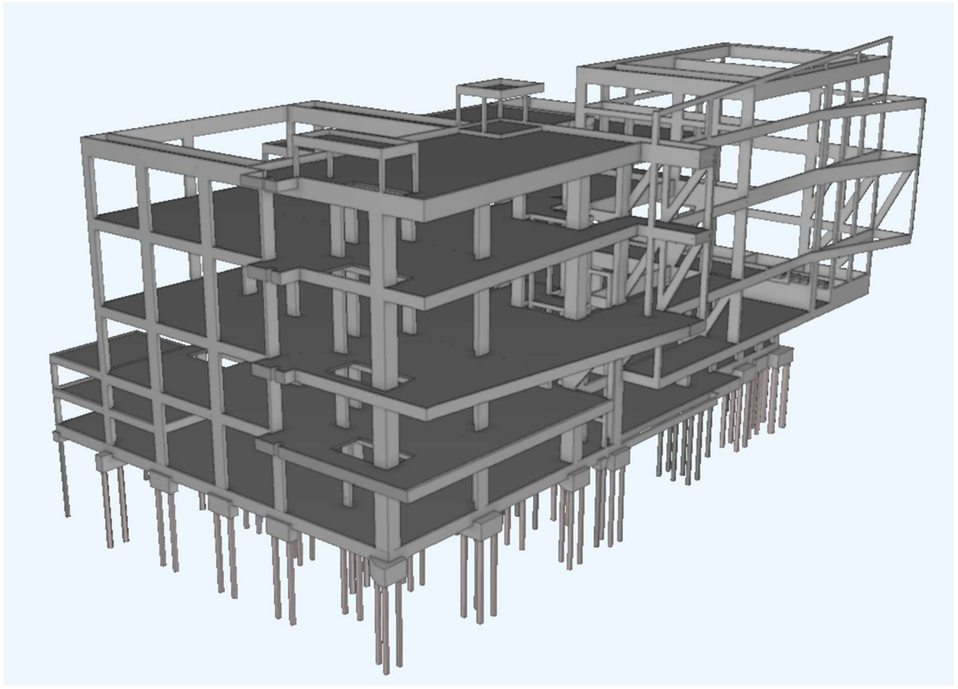
Columns positioning were irregular because the architect/client desired column free spaces in most areas, prompting long span beams with columns embedded in walls. Furthermore, the building features scenic lifts as such, no reinforced concrete "core" for lateral load resistance implying all gravity and lateral forces are resisted by the very robust columns (vertical and inclined ones) all of which curb overall building drift to limiting H/400.

Structural Highlight: *In a bid to gain useable floor area from the 1st floor level, the architect cantilevered 3.5m to the right, 3-9m at the front and 6m at the rear. To achieve those cantilevers ≥3.5m in most cases, a well-planned combination of beams, vertical & inclined columns acting together as concrete trusses were deployed all buried within walls and beneath cinema gallery seats to preserve the architecture. See Appendix B.*

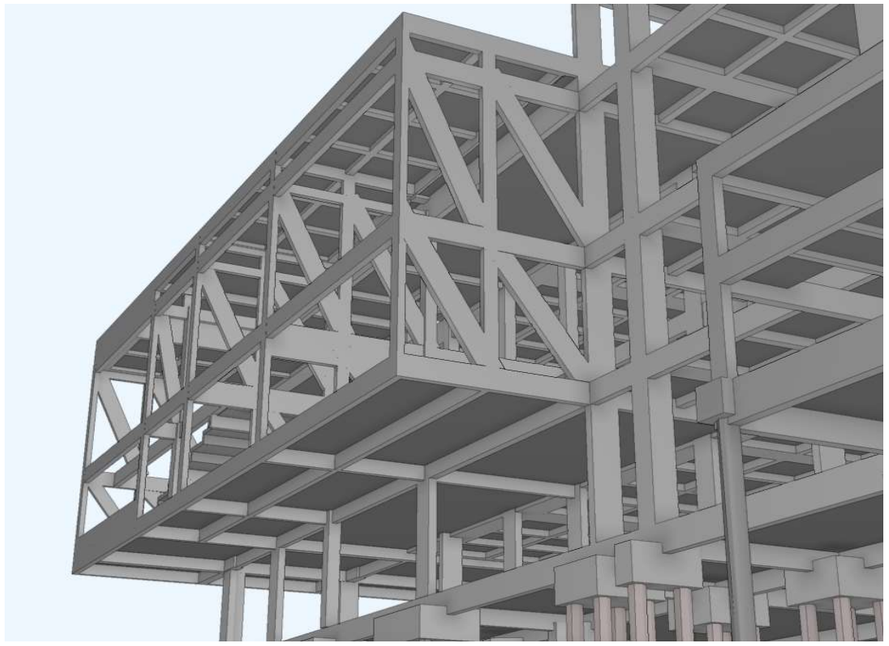
3 Project Takeaway

The Blackbell Mall project was a great opportunity for us to learn and develop our practice. It opened further our insight towards Simplification of "Complex" Problems- in this scenario use of simple struts & ties (truss system) to overcome excessive vibrations & deflections in the immediate and long term owing to the cantilever lengths.

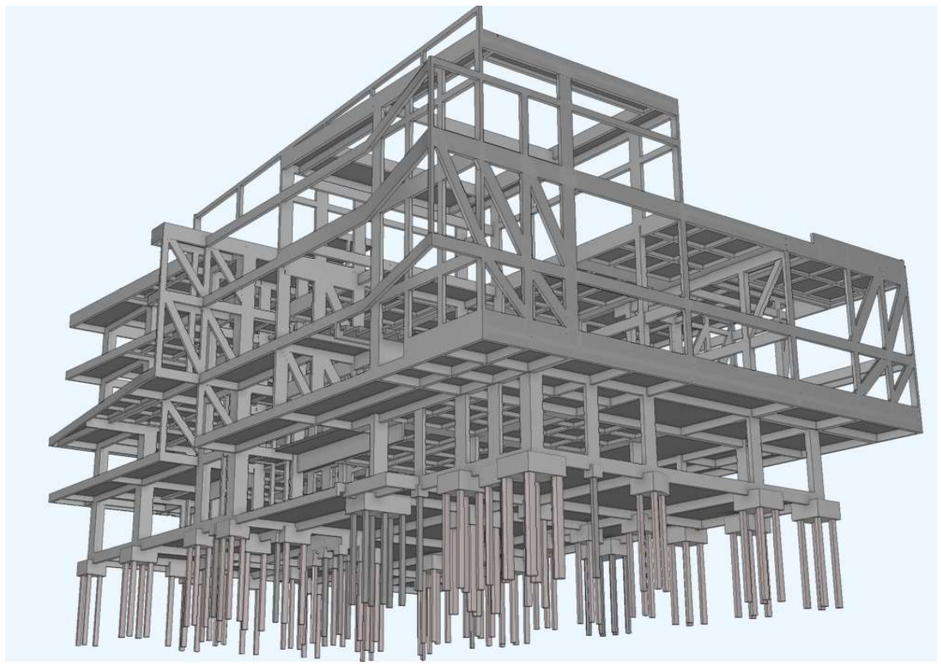
APPENDIX A- Structural BIM Model Images



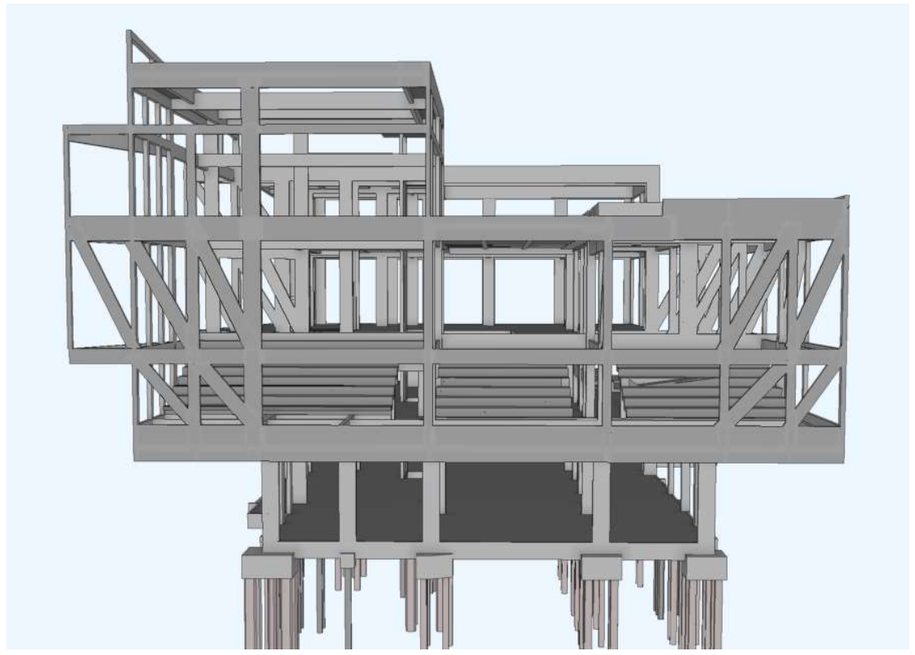
View 1 of Structural BIM Model



Rear 6m Cantilever achieved with Concrete Trusses

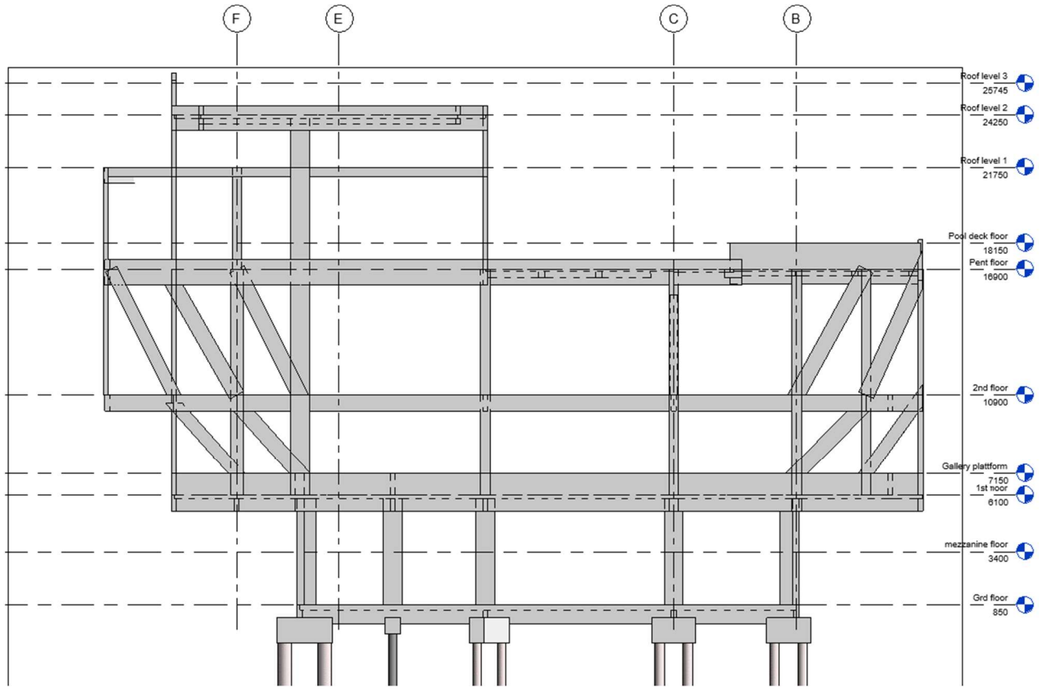


View 2 of Structural BIM Model

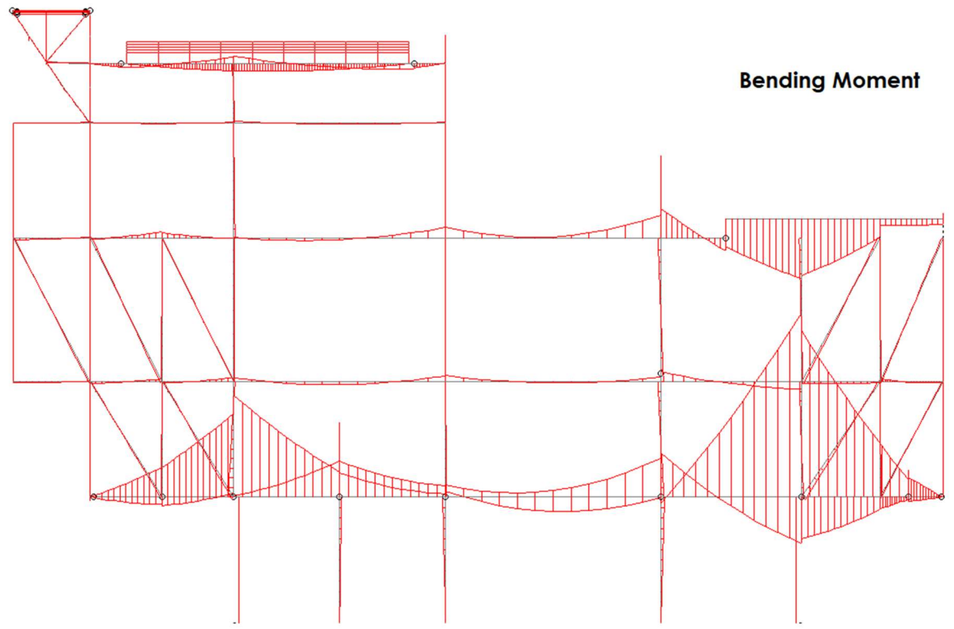


Right-Side Structure Showing 6-9m Cantilevered Concrete Trusses

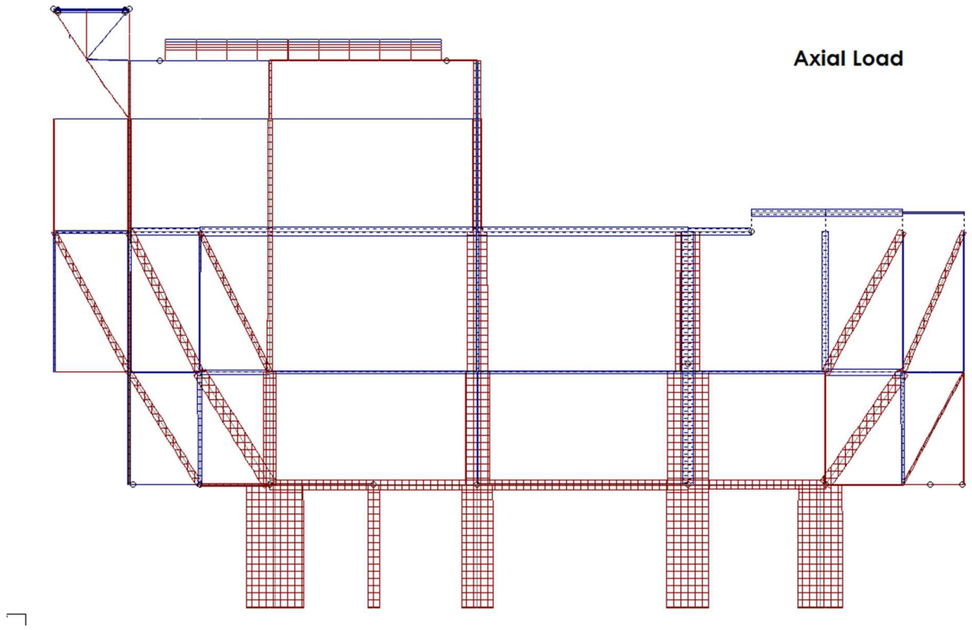
APPENDIX B- "Critical" Subframe Elevation & Analysis Results



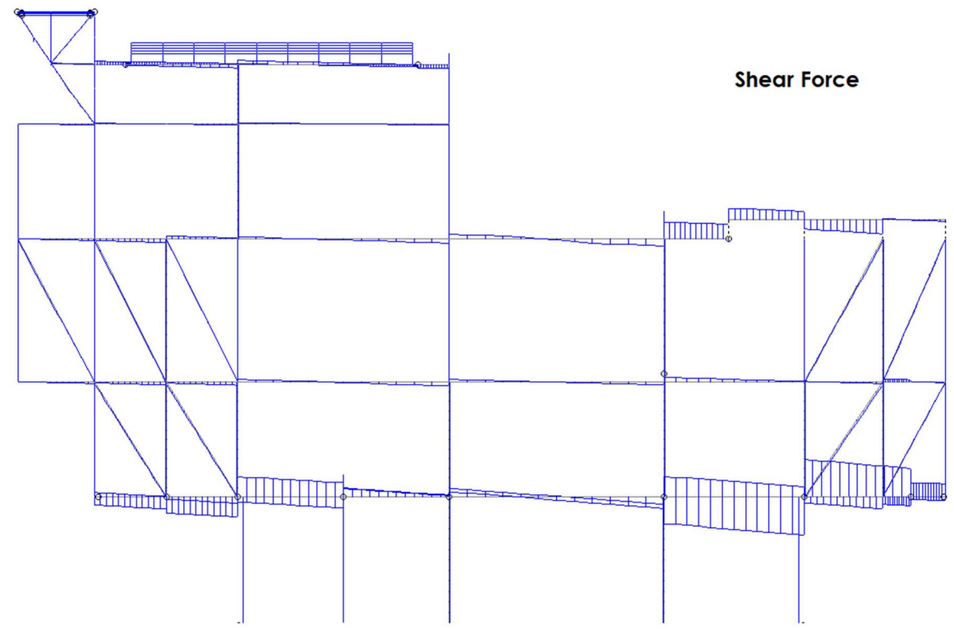
Elevation of Right-Side Structural Frame



Bending Moment Diagram of Right-Side Structural Frame

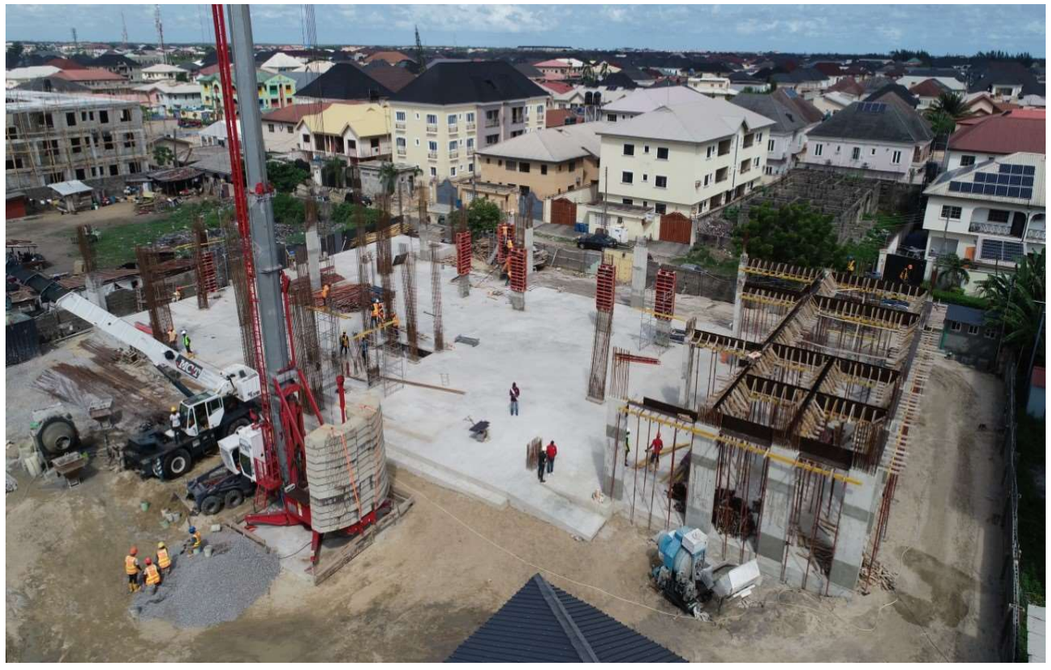


Axial Load Distribution of Right-Side Structural Frame



Shear Force Diagram of Right-Side Structural Frame

APPENDIX C- Construction Images



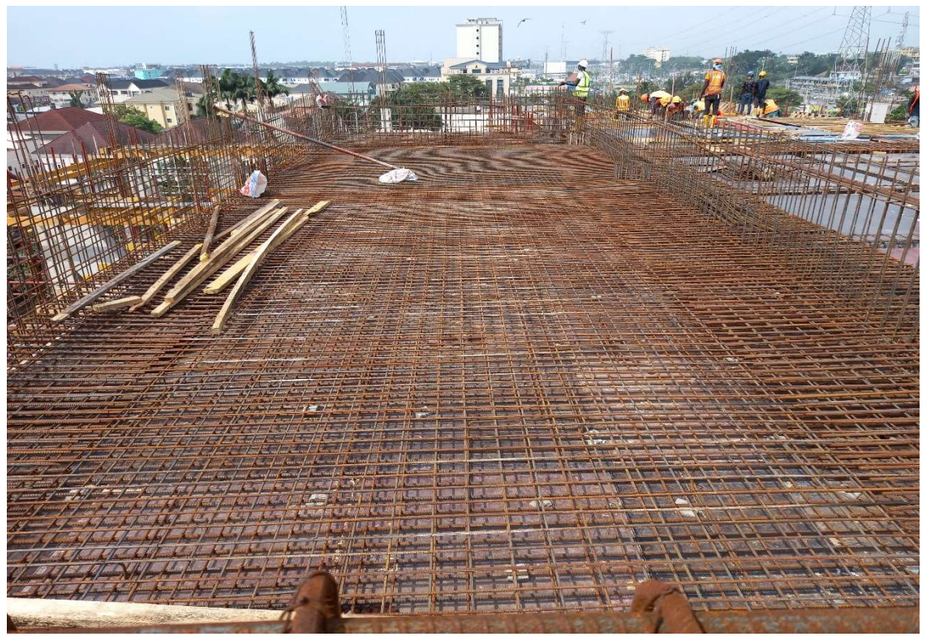
Drone Image at Ground Floor Level

Drone Image at 1st Floor Level

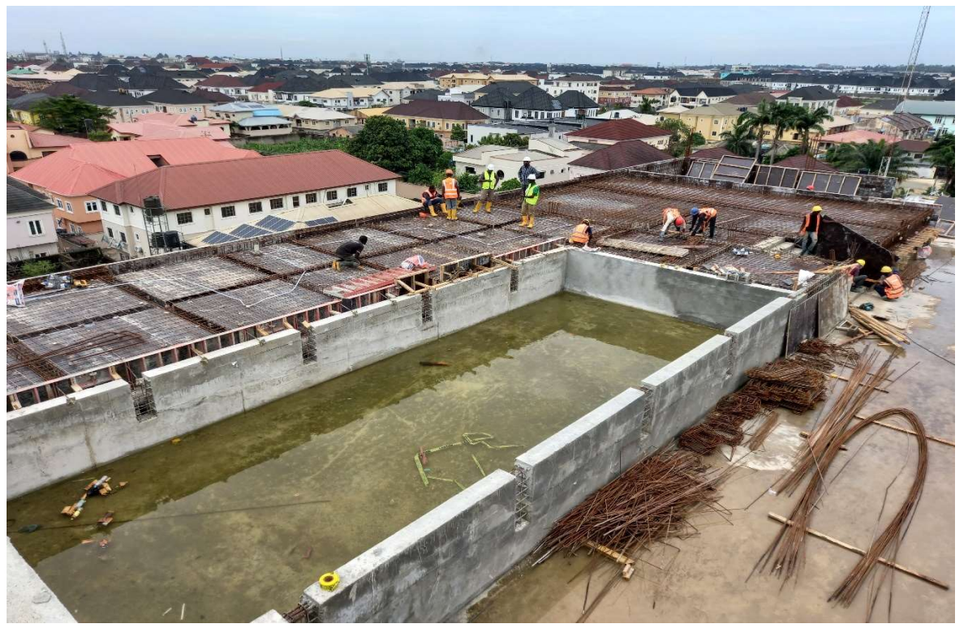
1st floor level soffit after removal of forms and props

Reinforcement Arrangement of Cinema Gallery

APPENDIX C- Construction Images



Reinforcement Arrangement in the Suspended Swimming Pool



Suspended Pool Base, walls & reinforcement for Pool Deck Ongoing

Concrete Truss System Beneath Cinema Gallery

Right Side of Structure awaiting Top Off

APPENDIX C- Construction Images

3-6m cantilevers at building Approach -Left

Drone Image at Building Top Off awaiting Finishes- approach

6m Cantilever at building rear

Drone Image at Building Top Off awaiting Finishes- rear

APPENDIX D- Images of The Completed Building

Perspective View of Completed Building

6m Cantilevered Building Rear

Right Side of the Building

Building Interior- General Area