



Research and Development of the Pencil Project, Project Development Institute, Emene, Enugu

Isiofia Lawrence Adizue

Department of Architecture, Enugu State University of Science and Technology, Enugu

Publication Process

Date

Accepted

June 30th, 2018

Published

July 31st, 2018

ABSTRACT

Until now the technology for producing one of the most common materials for Sketching and writing, pencil, was not known in West Africa and a percentage of the nation's foreign exchange earnings are committed to its importation. The paper describes the step-by-step research, design and development of the pencil manufacturing plant at PRODA, Enugu. The study used case study design and field interview to obtain data from various primary and secondary sources. Purposive (non-probability) sampling technique was used to sample opinions from both senior technical staff and production manuals. The result showed that a medium sized plant of ten (10) million tonne capacity is possible in a 7,500m² space.

Keywords: PRODA; Pencil Manufacturing Plant; Production Hall; Space Requirements; Project Development Institute

Introduction

Prior to pen and ink, pencil was a common material for sketching and writing. It was originally thought to comprise of lead (Pb₄) and was unscientifically called 'Lead-Pencil' however, that assumption was fallacious as pencils comprised of graphite? (Bennett 2014). Pencils and crayons used in Nigeria and other African countries were all imported (NGP, 2011). According to world atlas.com, China is the highest exporter of pencil followed by Germany, Brazil, Indonesia and Mexico. By 2009, PRODA under Professor G.C Onuoha, desirous of technological development approved the development of the pencil as envisioned in the research on pencil production by G.O.C Ihezue. To produce pencil, require facilities such as machines and equipment installations. To do so, the most important aspect of the project is the production hall to host the functions of the pencil production line. To this end, the services of professionals of the built environment becomes vital.

Literature

Brief Historical Background of Project Development Institute (PRODA)

Project development institute (PRODA), Enugu, is a parastatal in the federal ministry of science and technology. It was established immediately after the Nigerian/Biafra civil war by then government of East-Central State of in 1971 by edict no 11 of 1971 (PRODA, 2010). The edict establishing PRODA empowered it with Research and Development of science and technology from laboratory research, development and prefabrication of prototypes plants, equivalent and machinery. PRODA was taken over by the Federal government under Decree no. 5 of 1977 upon the creation of Enugu state from Anambra and later became an institute in the Federal ministry of science and technology at the creation of the ministry in 1980. With expanded scope of operation, PRODA carries out research and development (R and D) in materials science, Processing of ceramics, coal and economic food stuff (PRODA, 2010). Others include, science laboratory, electrical/electronic equipment development, mechanical engineering design and fabrication, instrumentation and other technological ventures. By 2009, the planning for PRODA School Pencil Project was conceived (Ihezue, 2009).

Materials and Method

Case study and field interview was used to carry out the plant size studies in order to ascertain the machine typology, technology (in terms of maintainability), materials input/output production capacities and associated labour and energy demand necessary for the school pencil production.

Data Needs:

The data required for plant size study include literature in the various machine manuals regarding intake/output volume, dimensions of the various machines, their wattage, labour input (in hours), installation, operational and maintenance spaces. The data needed to ascertain the space requirement for service, support service (cloakroom, clocking, sick bay, conveniences), ancillary, storage and use spaces were obtained from oral interview conducted on both the technical and executive personnel of the Institute. The data needed include to ascertain raw types and quantity of materials, finished goods and display spaces were deduced from the manuals and cross-matched with the interviews. Design data were obtained from field observations, soil sampling, survey details (including site dimensions, topography and geotechnical). Other data needs include those from architectural, planning guide manuals, local authorities, Federal Ministries of Industry, Science and Technology and local fire service regulations, respectively. Materials include pen, papers, log papers, 100m Stanley measurement tapes (for taking measurements), hammer (for driving pegs), nails wooden pegs, hand-held compass (for field locating), survey instruments and equipment (equipment total station, tripod, Casio calculator, calibrated flag poles, walkie-talkie, umbrella) preparing the site layout, others include recording device for brief-taking and Apple phone camera.

Results and Discussions

The Brief

To develop a plant with annual capacity of 10 million tonnes, other special requirements shall include additional space for future expansion, green areas, a balance space for pencil-making tree planting and above all, to present the plant with an iconic vista that tells its story.

The field inventories were collated and results of the field study presented as follows:

Development of the Brief

Table 1. Distribution of the space requirements

<i>s/n</i>	<i>Activity Space Schedule</i>	<i>Space Requirements (m²)</i>	<i>Percentage Distribution (%)</i>
	Total site area	15000	
1	Production Hall		
i	Machines spaces (installation, operation and demounting)	560	
ii	2nos. storage spaces (equipment/tool)	60	
	Sub total	620	4.13
2	Ancillary Spaces	30	0.2
3	clocking	13	
4	Cloakroom (male/female),	40	
	Sub total	53	0.35
3	Parking space		
i	dump truck bay for timber, graphite, clay,	600	
ii	Material lunch ramp	25	
iii	14 nos. Production Staff	500	
iv	7 nos. General Staff	270	
v	9 nos. Visitors	360	
	Sub total	1755	11.7
4	Exhibition Space	36	0.24
5	Office Spaces		
i	1nos. Production manager	20	
ii	1nos. Quality control lab	30	
iii	1nos. CAD Studio	16	
iv	2nos. Technical heads	27	
v	2nos. Clerical staff	13	
	Sub total	106	0.71
	Special requirements		
6	Future Development	400	2.66
7	Green Areas	4500	30
8	Balance Space	7500	50
9	Finished Goods Store	off-site location	-
i	Shelving	-	-
ii	Clearance	-	-
iii	loading bay	-	-
	Total	15000	100

Analysis of the distribution in table 1. Showed effective planning guided by the brief. Out of the total site area provided, only 20% (3,020m²) was developed. While 30% (4,500m²) was reserved for green areas, 50% (7,500m²) were left for future expansion, development and consideration.

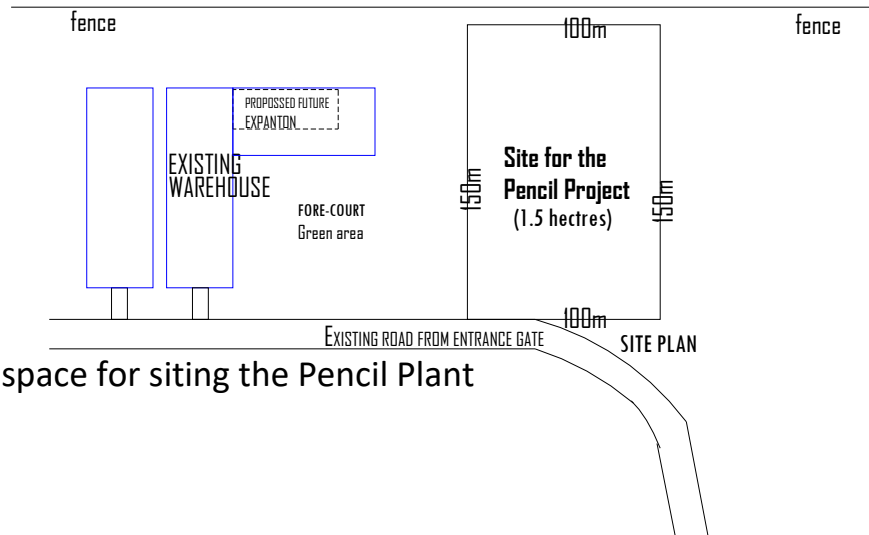


Figure 1. Existing space for siting the Pencil Plant

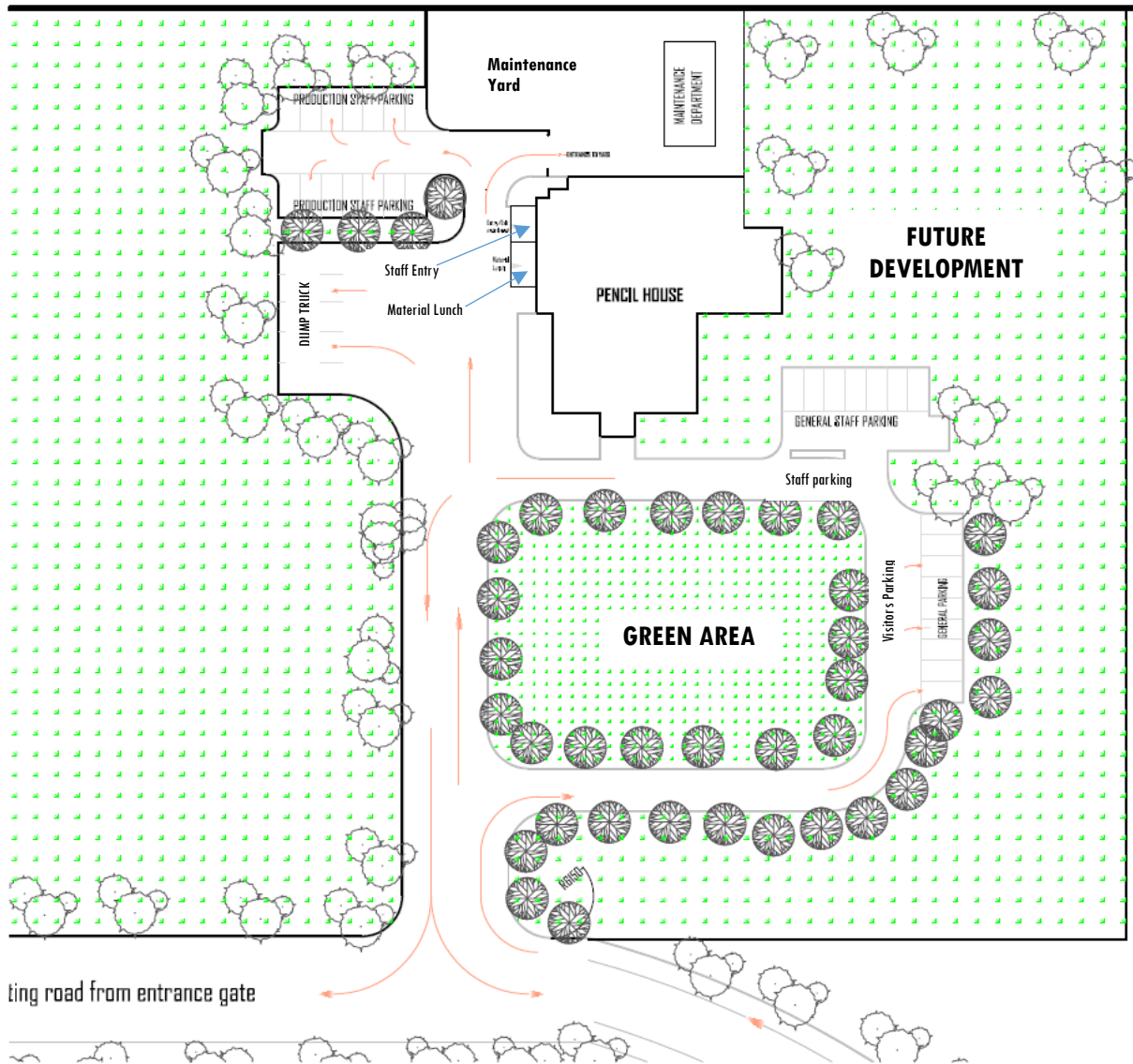


Figure 2: Site Plan showing the plant layout and surrounding

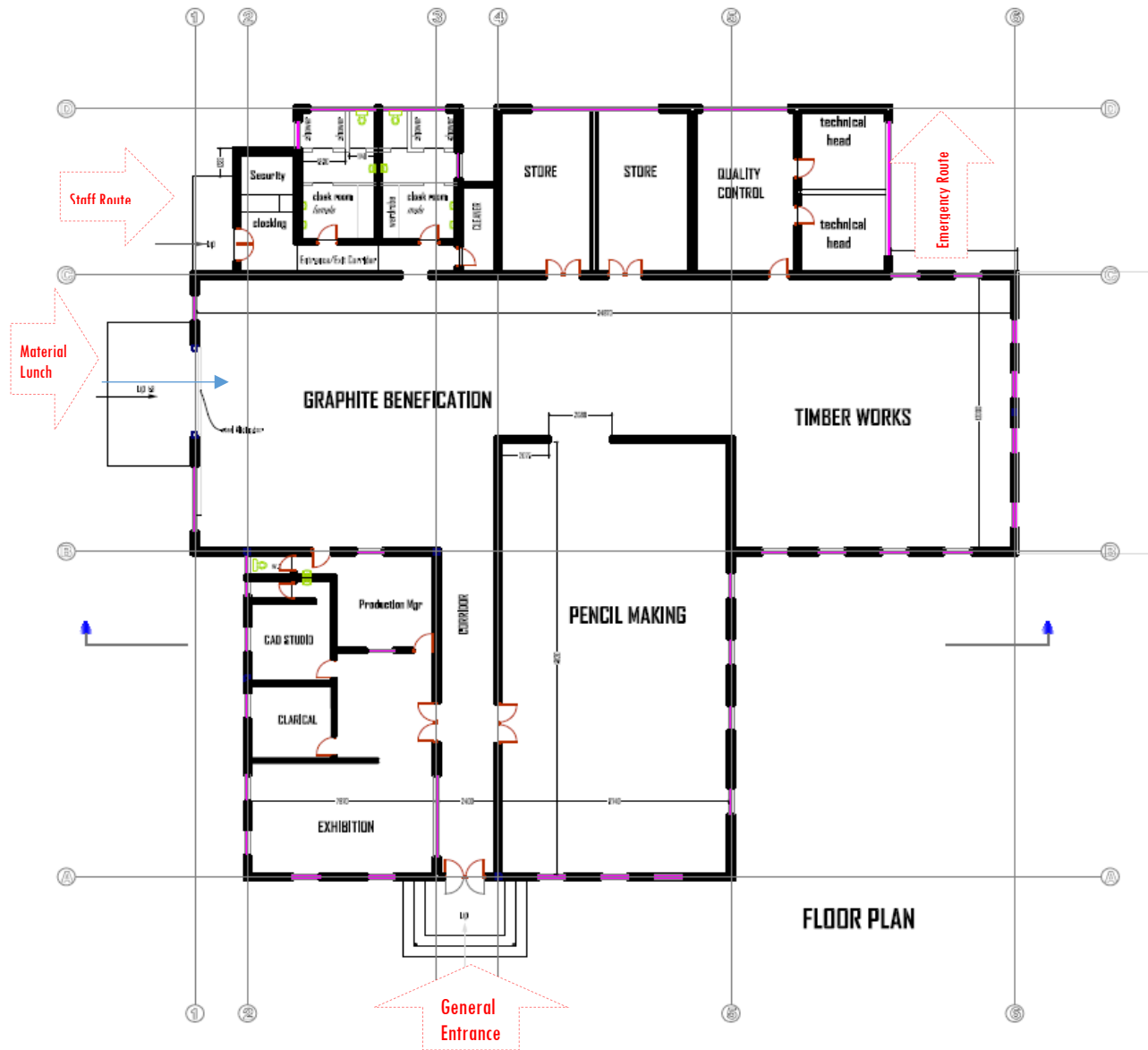


Figure 3: Floor Plan

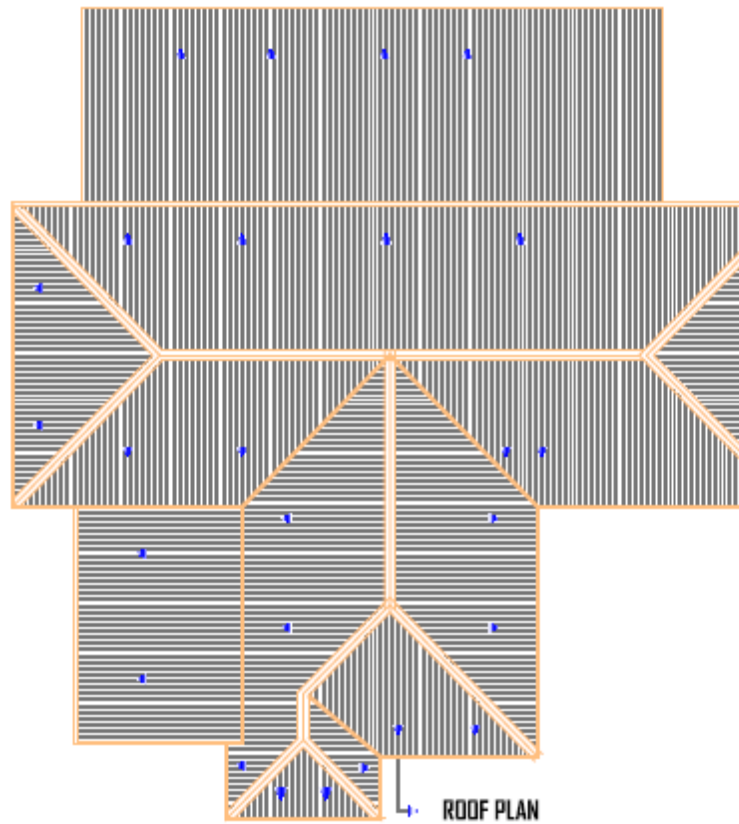


Figure 4: Roof Plan

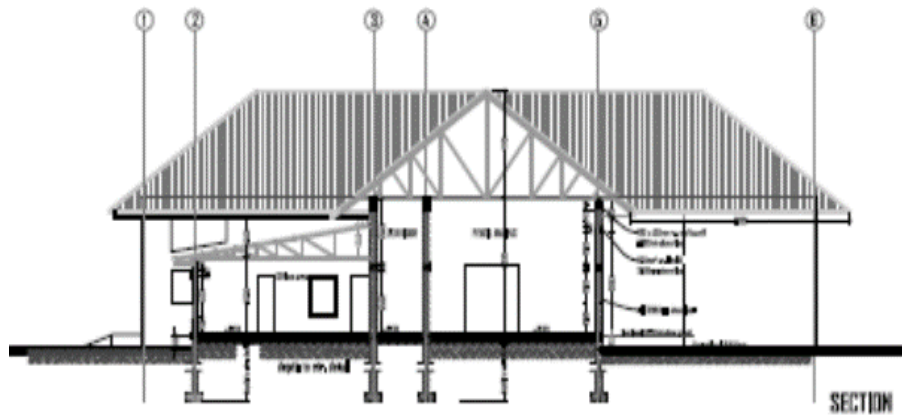


Figure 5: Section through the pencil making area



Plate I: Pictorial view of the iconic ornament



Plate 2: Side pictorial view



Plate 3: Front view

Design Considerations

Zoning

The considerations for zoning activities followed an activity schedule that ensured purposeful space utilisation of the articulated spaces. First, since pencil making require timber which comprise of nearly 60% of its composition, a total of 50% of the land were left for vegetation and nursery for pencil making tree species (*Gmelina spp*). The production plant was zoned to the rear while maintenance yard was sited behind the plant for quick access to production malfunction and rectification. The production activities of the plant were zoned away from the management but in such a manner that it still connected to each other without interruption to production line flow and sequence. In considerations that pencil making is new Nigeria, a 400m² space adjoining the plant house was earmarked for future expansion and development regarding new lines or addition to the installed capacity.

Production Hall

The production hall design created a special entrance for the production staff which conducts staffers into the plant hall through clocking (to track man hours) and cloaking (for changing into work and protective gears) areas. To lunch the raw materials for the pencil making into the production hall, a 4.8m width x 5.4m high steel sliding door fitted at start point of the production line (Graphite beneficiation) admits dump trucks to tip their contents. See figure 3. Floor Plan. With a height of 6 metres (floor to roof soffit) the production has the height clearance for installations and dismantling machinery by forklifting and/or overhead cranes.

Entry/Exit Points

Main Entrance

The main entrance to the pencil project admits customers and visitors into the management area through the products display area. Its entrance canopy is supported by two reinforced concrete columns designed in the form of sharpened pencils in an up-stand position and painted in yellow and black stripes of 'HB' Pencil. By this way, conveyed the iconic concept of the pencil house in a structural symbolism.... The ornament, structured.

Production Hall Entrance

Entry in and out of a production plant is very important. It serves to screen off production area from outside activities while keeping production processes private to the entrepreneurs. To achieve that, two entrances were created. One for the production hall staff and another for the dump truck which can only open to receive raw materials.

Emergency Route

In emergency situations, means of egress should be within site line, easy to assess and be push-out opening for express egress to unnumbered outdoors. As a response, the design created an access at the extreme side of the timber section of the plant such that it is at the centre of the plant considering the future development.

Landscape

Although landscape is not one of the vital sections of any production plant, but the design considered it a biocentric essence where nature meets production to create a good scenic view of verge, hedge, herbs and covers. The landscape features introduced in the environment that surrounds the plant was considered very important and was designed with 2000m² vegetative lawn of platform grass defined by row of *Ixora coccinea* plant behind aligned Kerbs ordering a central driveway that circulates staff and visitor to their respective parking lots. To achieve that, four categories of parking spaces were provided relative to design needs and user convenience as follows:

1. Production staff. Considered for long paring and was taken to the rear near the clocking/cloakroom entrance quite away from no staff route.

2. Service parking. Located directly opposite the offloading bay to receive raw material from dump trucks with enough clearance.
3. Management staff parking was located beside the general entrance to allow for easy access by administration staff as they respond frequently to other departments and units of PRODA.
4. Visitors/customers parking was located away from the plant entrance.

These four categories of parking receive maximum covers from Teak trees (*Tektona grandis*) planted beside the parking lots to provide protection to parked vehicles from thermal agitation along the sun path and away from production activities within the space. See figure 2. Site plan.

Conclusion

Although other materials as graphite, clay, colourants are raw materials for pencil production, the timber element comprise a major component and as such planting the tree species for the pencil making is vital as a renewable resource hence, the incorporation of those tree species plants in the landscape of the environment.

Also, the layout and design in figures 2 and 3 showed that outside the vegetative and future development areas, a medium sized plant of ten (10) million tonne capacity is possible in a 7500m² space.

References

Bennett J. H. (2014). Ever wondered about the lead in pencils?

https://www.washingtonpost.com/lifestyle/kidspost/ever-Ever-wondered-about-the-lead-in/pencils/2014/11/26/f8b5869c-548-11e4-809b-8cc0a295c_story.html.

Callender, J. H. (1982). Time-Saver Standards for Architectural Design Data. McGraw-Hill. ISBN 10: 0070096635.

De 'Chiara, J. (1990). Time-Saver Standards (Building Types). ISBN: 0070162794.

Ernst, P. N. (2012). Neufert's Architects' Data. Wiley-Blackwell, John Wiley & Sons Ltd. Fourth edition.

Hellman, L. (2002). Architecture a – z: A rough guide. John Willey & Sons Ltd. ISBN 0-471-48957-3 Architecture z: A rough guide: Hellman, Louis.

Ihezue, G. O. C. (2009). PRODA School Pencil Project. *A Feasibility Report Submitted to the Federal Ministry of Science and Technology, Abuja*

Nigerian Graphite Project (NGP) (2011). Business plan on Proda School pencil project

PRODA (2010). Annual project report to Federal Ministry of Science and Technology, Abuja.

World atlas.com <https://www.worldatlas.com/articles-of-pencil-and-crayons.html>.