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DESIGN APPROACH FOR INDUSTRIAL ARCHITECTURE

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ABSTRACT

Industrial architecture is a style of architecture that is employed in the construction of industrial structures. Industrial buildings are designed to transform raw materials into new products in an efficient and safe manner. Power plants, distilleries, breweries, manufacturing facilities, factory buildings, grain silos, and refineries are examples of industrial structures.

The Industrial development additionally fulfill the purpose of job creation, enforcement to secondary and tertiary sector, boosting national economy, converting the India to A self-reliant country and to give the India economy global recognition.

The aim is to understand the potential for finding industry suitable for Indian context. It also focuses on the environmental concern that needs to be addresses while developing such an industry and also understanding the various factors impacting the industrial development.

Thus, the ultimate goal of this research is to create an industrial building which will fulfill the needs of the industrial workers by improving their human comfort with the help of effective planning and passive green builing strategies.

A BRIEF HISTORY OF INDUSTRIAL ARCHITECTURE

Industrial architecture can be traced all the way back to the 1700s, and it continues to shape our world today.

The First Industrial Revolution: Industrial architecture emerged during the First Industrial Revolution that took place in England between 1760 and 1830. These early industrial facilities processed materials like silk, cotton, and brass. They were built as efficiently as possible using the building materials of the day: lumber and masonry.

The Second Industrial Revolution: What we think of today as industrial architecture is largely based on buildings from the Second Industrial Revolution, which was brought about by the introduction of new building materials such as steel and concrete. These advancements transformed industrial facilities in the late nineteenth and early twentieth centuries. These new materials helped to make industrial structures more efficient and safer for workers.

Industry shifts: By the mid-twentieth century, Europe and the United States began to shift towards a post-industrial economy. No longer dependent on manufacturing jobs, many industrial facilities fell to disrepair and ruin.

An industrial revival: Beginning in the 1960s, architecture firms in New York City began turning obsolete industrial buildings into upscale apartments. This started a wave of adaptive reuse projects—architecture projects that seek to preserve the history of industrial buildings and bring new life to previously abandoned spaces.

Modern factories: As the world has become more aware of the adverse effects of industry, many industrial architects are prioritizing sustainability and modern aesthetics.

AIM

To come up with parameters to design industrial buildings in Chennai.

OBJECTIVE

- To create eco-friendly industrial corridor,
- To create design standards for industrial buildings.
- To create parameters for industrial architecture.
- To Create conscious understanding about industrial designs.

CASE STUDY:1

RENAULT-NISSAN AUTOMOTIVE INDIA PVT. LTD., TAMIL NADU

Type of Industry: Automobile Plant
Location: Oragadam, Tamil Nadu
Year of completion: February 2010
Area: More than 310,000 sqm

DESIGN STANDARDS

Buildings are all designed as per IS 800-1984 working stress method and deflection under different criteria with high level of complexity.

MANUFACTURING STANDARDS

Structures designed and fabricated in accordance to AWD D1.1 welding standards.

IMPACT OF THE PROJECT IN ENVIRONMENT

Soil pollution – NIL, Noise Pollution - in the prescribed limits, Air Pollution – Nil, Water Pollution – Nil, Solid Waste - Solid waste like packing sheets, papers and wood generated during execution of the project was disposed as per the national / local laws, Followed IFC Guidelines for environment

- Largest single PEB (pre-engineered building) in the world, and the first of its kind in India utilize PEB structures totally for an automobile plant.
- The maximum width of the building is 260 m with a single slope of 130 m.
- A single building of size 220m x 483m with process beams carrying 120 kg/sqm loading and mezzanine - trim & chassis building - 9780 MT.
- It has been designed taking into account thermal stress due to temperature effect.
- The building is designed to support all process equipment's and conveyors.
- This design allows incorporation of all future expansions.
- Two rafters, purlins, sag rods and bracing were all assembled on the ground and lifted as a single lift.
- The main structures were completed in a record time of 7 months and two buildings were handed over in full in December 2009.
- The site was completely hand over to the client in February 2010.

CASE STUDY:2

Name of plant: BorgWarner
Description of manufacturing unit: Chain auto-motive component
Location: Tiruvallur
Year of completion: 1995
(JV between Ti and BorgWarner),2008 – BorgWarner
Area: 174240 Sq ft. (3.43 acres)
Construction materials: Composite structure- masonry walls, PEB (pre engineered building) structure for roof.

PHYSICAL ABSORPTION ON SITE VIST

- Total green environment- 40% of site area Road width-16 ft
- Pedestrian width-6ft Turning radius-32ft
- Maximum span-301 sq ft x 188 sq ft the outdoor environment was made cooler by planting trees along the periphery of the site
- Natural lighting through provision of skylights in metal roof Provision of north light for even lighting throughout the day Artificial lighting- directly above head height- 6.5’ – 7’
- Liquid waste from machineries is drained by double height spaces extending out of the workshop area utilized as mezzanine floor used as office space
- Beans of perforated metal grates in floors.
- Reinforced heavy structural columns for double height roof.
- Effective use of space by utilizing double height spaces extending out of the workshop boundary as office spaces by introducing mezzanine floors.

STRUCTURAL DESIGN

Column, beam and roof truss- heavy reinforced columns instead of reinforced concrete columns reduces the dead load of building while also considerably cutting down the overall cost for erection of structure.

KEY INFERANCE FROM THE STUDY

SITE PLANNING

- This factory has a single gated entry, and the built unit is surrounded by 16ft roads on all four sides
- Adjacent to the main office loading bay is located, at the back end of the plant unloading bay is located.
- There is no dedicated bike parking is available inside the plant for blue collar employees, car parking -10nos for the white-collar employees including visitor’s parking is provided, Bus parking – 2nos for shuttle service.
- The transformer and EB are located at the front end of the plant for easy connectivity and maintenance.

ENVIRONMENT AND RECREATION

- The environment around the industry was made much cooler by planting trees along the periphery of site. This serves as a tranquil transition zone from the workshop area.
- Canteen and recreational zones are separated from the main workshop area.
- Dormitories provided for workers within site premises

STRUCTURE AND SAFETY

- Economizes on weight through usage of PEB structures.
- Hybrid PEB roof and RCC wall structure with a maximum span of 30 M
- Clear demarcation of boundaries for machinery and aisles for safety purpose.
- Flooring-RCC floors designed to withstand the weight and vibration of machineries.
- Drainage to drain chemicals and waste water coming out directly from the machinery through means of metal grates in floor.

LIGHTING AND VENTILATION

- Natural lighting provided by means of skylights and north-lights.
- Efficient usage of artificial lighting by placing the lights right above the head level- 7’-0” height.
- Natural ventilation enabled through means of wide opening on walls.
- Rotating chimney cowl are used to suck out heat from the furnace area.
- Effective use of stack effect cuts down heat radiated from furnace area into the work space. Wide-open spaces: open floor plans and high ceilings
- Minimalist aesthetics: design is more functional than looking into the aesthetic aspects.
- Exposed materials
- Natural lighting: efficient use of natural light via large, metal-grid windows or floor to ceiling windows.

FINALIZING THE DESIGN PARAMETERS FOR INDUSTRIAL ARCHITECTURE

– Wide-open spaces: Industrial buildings tend to have open floor plans and high ceilings.
– Minimalist aesthetic: Industrial architecture tends to follow the philosophy of modern architecture by prioritizing functionality over ornamental flourishes.
– Exposed materials and utilities: Exposed brick walls, concrete floors, and steel beams are commonly found inside industrial residential spaces. You'll likely find exposed ductwork, wiring, and plumbing as well.
– Natural light: Industrial architecture makes efficient use of natural light via large, metal-grid windows or floor-to-ceiling windows.

CONCLUSION

- Industrial buildings are constructed for the purpose of efficiently and safely processing raw materials into new products.
- Industrial building design tends to prioritize functionality and worker safety over aesthetically pleasing interior design.
- PEB Structures provide advantages such as large span, economic, light weight structure, speedy erection, scope for expansion and alteration and aesthetic in terms of curved forms.

This paper aims at designing an industry which has a major inflow in Indian Economy- the automobile/ automotive industry. Additionally, a new take on industrial design- designing green, sustainable factory that is both functional and aesthetically appealing and that which has scope for incremental expansion.

• Locating site based for automotive/ automobile industry along the Chennai- Bengaluru corridor- main cities include Chennai, Bangalore, Sriperumbudur, Hosket and Chittoor.
• Having a detailed understanding of the process involved in manufacturing for that particular industry- this has a direct impact on the zoning.
• Understanding the local byelaws and regulations based on the location and standards for designing.

- Designing structure based on the spatial requirements and general circulation involved in manufacturing process.
- Designing for sustainability using passive design strategies and better management of natural resources and waste.

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