TECH-CHRONICLE
AN INTERNATIONAL E-JOURNAL ON
EMERGING TRENDS IN SCIENCE, TECHNOLOGY AND MANAGEMENT

To Study Concept & Detailing of Pre Engineered Building

KetanThakre[a], Amit Patle[A], AkashAtkare[A],
DipakChanne [A], SagarPardhi[A], Prof.A. R. Khedikar[b]
[a]*U. G. Student, TulsiramjiGaikwad-Patil College of Engineering and Technology, Mohgaon, Nagpur, INDIA*
[b]*Assisstant Professor, TulsiramjiGaikwad-Patil College of Engineering and Technology, Mohgaon, Nagpur, INDIA*

***Abstract*—The construction technology has advance since the beginning from construction technology to the present concept of modern town house building. The present construction methodology for building calls for the best aesthetic look, high quality and fast construction, cost effective & innovative touch.Pre-engineered steel structures building offers low cost, strength, durability, design flexibility, adaptability and recyclability. Steel is the basic material that is used in the materials that are used for Pre-engineered steel building. Infinitely recyclable, steel is the material that reflects the imperatives of sustainable development. This project effectively conveys that PEB structures can be easily designed by simple design procedures in accordance with country standards. In light of the study, it can be concluded that PEB structures are more advantageous than CSB structures in terms of cost effectiveness, quality control speed in construction and simplicity in erection. The paper imparts simple and economical ideas on preliminary design concepts of PEBs. The concept depicted is helpful in understanding the design procedure of PEB concept.**

Keywords—construction; Pre-engineered;sustainable; innovative touch; quality control speed

I. INTRODUCTION

In the USA, where PES Concept was originally conceived during the early years of this century, nearly 70% of all single Non-Residual construction now utilizes pre- engineering structures. Applications range from small car parking shed to 90 m (+) wide clear span industry, to low raise multistory buildings. Almost every conceivable buildings use has been achieved using the pre-engineered structure approach. Until 1990, the use of PES was confined mostly to North America and the Middle East. Since then, use of pre engineering structure has spared throughout Asia and Africa where the PES construction concept has how been widely accepted and praised. A growing number of prominent international contractors and designers, who previously specified conventional structural steel buildings exclusively, have recently converted to the Pre-engineered building approach. They now enjoy significant cost savings and benefits from the faster construction cycle resulting from this concept. From excavation to occupancy no other building system matches. The pre-engineered building system when it comes to speed and value. The advantages of pre-engineered steel buildings are numerous and are the major reason for the spectacular growth of PES industry during the past 50 years. These advantages include: Low cost, superior quality, fast project construction, functional versatility, Architectural flexibility, low maintenance and operating costs [2].

India being one of the fastest growing economies, infrastructure development is inevitable. Thus there is wide scope of PES in India. As compare to other countries Indian codes for building Design are stringent but safer. Thus, PES being an upcoming field in construction Industry in India, it becomes necessary to study the PES concept & its detailing. The pre-engineered steel building system construction has great advantages to the single storey buildings, practical and efficient alternative to conventional buildings, the System representing one central model within multiple disciplines. Pre-engineered building creates and maintains in real time multidimensional, data rich views through a project support is currently being implemented by STAAD.Pro software packages for design and engineering [2].

Pre-engineered steel structures building offers low cost, strength, durability, design flexibility, adaptability and recyclability. Steel is the basic material that is used in the materials that are used for Pre-engineered steel building. Infinitely recyclable, steel is the material that reflects the imperatives of sustainable development. This project effectively conveys that PEB structures can be easily designed by simple design procedures in accordance with country standards. In light of the study, it can be concluded that PEB structures are more advantageous than CSB structures in terms of cost effectiveness, quality control speed in construction and simplicity in erection. The paper also imparts simple and economical ideas on preliminary design concepts of PEBs. The concept depicted is helpful in understanding the design procedure of PEB concept [3].

Authors of Pre-engineered building design of an industrial warehouseeffectively conveys that PEB structures can be easily designed by simple design procedures in accordance with country standards. In light of the study, it can be concluded that PEB structures are more advantageous than CSB structures in terms of cost effectiveness, quality control speed in construction and simplicity in erection. The paper also imparts simple and economical ideas on preliminary design concepts of PEBs. The concept depicted is helpful in understanding the design procedure of PEB concept [4].

The paper imparts simple and economical ideas on preliminary design concepts of PEBs. The concept depicted is helpful in understanding the design procedure of PEB concept.

II. TYPES OF BUILDING

A healthy trend in the form of growth in demand for construction works in residential, Commercial, Institutional, industrial and infrastructure sectors are being seen over the past decade. Modern Structures are much more complex and sophisticated as compared to earlier period. One of the major changes which are being felt by all is that the present structures are taller and thinner. Modern day requirement of structures is that these should be lighter yet not compromising on functionality.

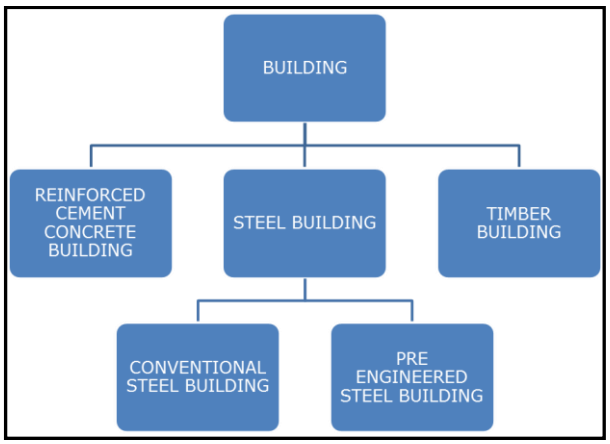

Fig. 1. Classification of Buildings

1. Reinforced Cement Concrete Buildings

Reinforced concrete is concrete in which reinforcing bars have been integrated to improve one or more properties of the concrete. For many years, it has been utilized as an economical construction material in one form or another. A large part of its worldwide appeal is that the basic constituent materials cement, sand, aggregate, water, and reinforcing bars are widely available and that it is possible to construct a structure using local sources of labor and materials. Reinforced concrete is one of the most widely used modern building materials. Concrete is "artificial stone" obtained by mixing cement, sand, and aggregates with water. Fresh concrete can be molded into almost any shape, which is an inherent advantage over other materials. Concrete became very popular after the invention of Portland cement in 19th century; however, its limited tension resistance prevented its wide use in building construction. To overcome this weakness, steel bars are embedded in concrete to form a composite material called reinforced concrete. Developments in the modern reinforced concrete design and construction practice were pioneered by European engineers in the late 19th century. At the present time, reinforced concrete is extensively used in a wide variety of engineering applications (e.g., buildings, bridges, dams) [5]. The advantages of RCC Building are they have relatively high compressive strength, better resistance to fire than steel and have a long service life with low maintenance cost. It also have some disadvantages like it have a low tensile strength of about one-tenth of its compressive strength, the mixing, casting, and curing, all of which affect the final strength of concrete, cost of the forms used to cast of concrete placed in the forms, cracks developed in concrete due to shrinkage and the application of live loads and concrete is heavy in weight and requires large quantity of steel in the construction as the self-load is greater.

2. Steel Buildings

The design and use of all steel buildings first gained popularity in the early 20th century. Steel rapidly became the material of choice for many structures do to the strength and cost efficiency. Software was developed for designing steel trusses and building packages. This software expanded the use and capabilities of steel buildings and allowed them to be easily designed for different snow and wind loads with clear spans up to 300'.These buildings are ideal for large commercial projects or sporting arenas, they can be very cost effective on large non-insulated buildings. If these buildings are not insulated at time of erecting the building may sweat causing interior condensation and dripping. Depending on the manufacturer some field welding and drilling may be required. Many rigid frames are sold through brokers and some rigid frame systems are not designed for the do-it-yourselfer even though they are presented that way [6].

3. Timber Buildings

Timber frame housing is not a new concept - even for the UK. For centuries it was one of the most common construction materials and examples of timber framed houses from the 12th century are still in existence today. Softwood based timber housing systems (similar to those in uses today) date back to the 1780's with fine examples dotted along the East and Southern coasts. Dramatic growth in market share came in the 1960's and 70's with the industrialized housing boom. In 1982, 27% of all new build homes in the UK were constructed from timber frame. A combination of adverse publicity regarding robustness (since proved groundless) and a slowing of the housing market have seen market share fall in Great Britain to around 6% over the last 15 years. Interestingly, in Scotland the market share has remained between 40-45% of all new-built housing throughout this period. It is estimated that of the ~20 million homes that exist in the UK, around 2 million are constructed from timber frame. The last 18 months have seen a dramatic resurgence in the market with timber frame now accounting for over 8% of all new homes. Advantages are they can be erected quickly, reduces site labor, reduce time to weather the structure, low embodied energy if constructed in local timber, recyclable material, reduce construction waste through efficient controlled manufacturing, low volume of waste on site requiring removal, can be built to exceed 60-year design life, energy efficient when constructed to current standards. These buildings also have some disadvantages like lack of experienced builders and erection crews, lack of experience of following trades, transportation and carriage access, exposure to weather before enclosed and deficiency of site quality control [7].

4. Pre-Engineered Buildings

Pre-Engineered Steel Buildings are manufactured or Produced in the plant itself. The manufacturing of structural members is done on customer requirements. The detailed structural members are designed for their respective location and are numbered, which cannot be altered; because members are manufactured with respect to design features. These components are made in modular or completely knocked condition for transportation. These materials are transported to the customer site and are erected. Welding and cutting process are not performed at the customer site. No manufacturing

process takes place at the customer site. These components are made in modular or completely knocked condition for transportation. The manufacturing of structural members is done on customer requirements [8]. Steel is the material of choice for design because it is inherently ductile and flexible. It flexes under extreme loads rather than crushing and crumbling. Structural steels low cost, strength, durability, design flexibility, adaptability and recyclability continue to make it the material of choice in building construction. Today's structural steel framing is bringing grace, art and function together in almost limitless ways and is offering new solutions and opportunities to create challenging structures, which were once thought impossible. Steel structures have reserve strength. Simple stick design in the steel framings allows construction to proceed rapidly from the start of erection.

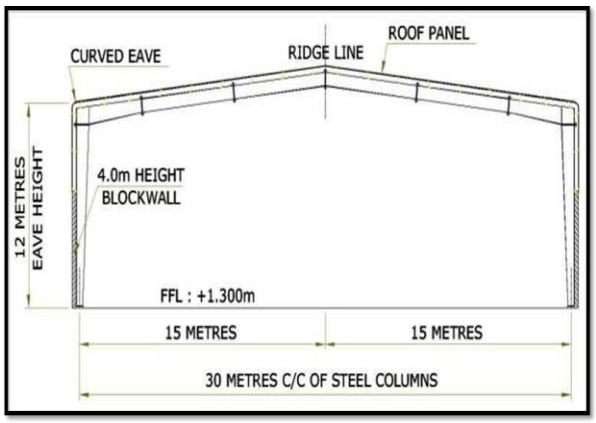

Fig. 2. Pre-Engineered Buildings

III. Comparative Study of Analysis of Pre-Engineered Buildings and Conventional Frames

Long Span, Column free structures are the most essential in any type of industrial structures and Pre Engineered Buildings (PEB) fulfill this requirement along with reduced time and cost as compared to conventional structures. The present work involves the comparative study of static and dynamic analysis and design of Pre Engineered Buildings (PEB) and Conventional steel frames. Design of the structure is being done in Staad Pro software and the same is then compared with conventional type, in terms of weight which in turn reduces the cost. In the present work, Pre Engineered Buildings (PEB) and Conventional steel frames structure is designed for dynamic forces, which includes wind forces and seismic forces. Wind analysis has been done manually as per IS 875 (Part III) – 1987 and seismic analysis has been carried out as per IS 1893 (2002).

Steel industry is growing rapidly in almost all the parts of the world. The use of steel structures is not only economical but also eco-friendly at the time when there is a threat of global warming. Here, "economical" word is stated considering time and cost. Time being the most important aspect, steel structures (Pre-fabricated) is built in very short period and one such example is Pre Engineered Buildings (PEB). Pre-engineered buildings are nothing but steel buildings in which excess steel is avoided by tapering the sections as per the bending moment's requirement. One may think about its possibility, but it's a fact many people are not aware about Pre Engineered Buildings. If we go for regular steel structures, time frame will be more, and also cost will be more, and both together i.e. time and cost, makes it uneconomical. Thus in pre-engineered buildings, the total design is done in the factory, and as per the design, members are pre-fabricated and then transported to the site where they are erected in a time less than 6 to 8 weeks.

IV. History of Pre-Engineered Building

In the USA, where PES Concept was originally conceived during the early years of this century, nearly 70% of all single Non-Residual construction now utilizes pre- engineering structures. Applications range from small car parking shed to 90 m (+) wide clear span industry, to low raise multistory buildings. Almost every conceivable buildings use has been achieved using the pre engineered structure approach.

Until 1990, the use of PES was confined mostly to North America and the Middle East. Since then, use of pre engineering structure has spared throughout Asia and Africa where the PES construction concept has how been widely accepted and praised. A growing number of prominent international contractors and designers, who previously specified conventional structural steel buildings exclusively, have recently converted to the Pre-engineered building approach. They now enjoy significant cost savings and benefits from the faster construction cycle resulting from this concept. From excavation to occupancy no other building system matches. The pre-engineered building system when it comes to speed and value. The advantages of pre-engineered steel buildings are numerous and are the major reason for the spectacular growth of PES industry during the past 50 years. These advantages include: Low cost, superior quality, fast project construction, functional versatility, Architectural flexibility, low maintenance and operating costs [2].

PES is upcoming field in construction industry in India. It felts necessary to study the PES concept. The project was therefore selected accordingly with following Aims & Objectives.India being one of the fastest growing economies, infrastructure development is inevitable. Thus there is wide scope of PES in India. As compare to other countries Indian codes for building Design are stringent but safer. Thus, PES being an upcoming field in construction Industry in India, it becomes necessary to study the PES concept & its detailing.The pre-engineered steel building system construction has great advantages to the single storey buildings, practical and efficient alternative to conventional buildings, the System representing one central model within multiple disciplines. Pre-engineered building creates and maintains in real time multidimensional, data rich views through a project support is currently being implemented by Staad pro software packages for design and engineering [2].

Pre-engineered steel structures building offers low cost, strength, durability, design flexibility, adaptability and

recyclability. Steel is the basic material that is used in the materials that are used for Pre-engineered steel building. Infinitely recyclable, steel is the material that reflects the imperatives of sustainable development. This project effectively conveys that PEB structures can be easily designed by simple design procedures in accordance with country standards. In light of the study, it can be concluded that PEB structures are more advantageous than CSB structures in terms of cost effectiveness, quality control speed in construction and simplicity in erection. The paper also imparts simple and economical ideas on preliminary design concepts of PEBs. The concept depicted is helpful in understanding the design procedure of PEB concept [1].

V. PRE-ENGINEERED BUILDINGS

Pre-engineered building systems provide real value to clients without sacrificing durability, seismic and wind resistance, or aesthetic appearance. Cost savings begin right at the drawing preparation stage. Systems engineering and fabrication methods help reduce interim financing costs through faster construction and minimized field erection expense. An added benefit is earlier occupancy of the facility and a head start on day-to-day operations by the client. Apart from costs, there is an assurance of factory-built quality and uniformity in design and fabrication. These systems are also energy efficient; incorporate watertight roofing systems; enable easy disassembly or future expansion and have the lowest life cycle maintenance costs. In India, Pre-engineered building systems find application primarily in the construction of Warehouses, & Industrial sheds & Buildings. The recent focus has also shifted to cover rural as well as urban, individual and mass housing projects, farmhouses, slum re-organization project sand rehabilitation projects, amenity structures like health centers, kiosks, primary schools, panchayatghars etc. The pharmaceutical industries and exhibition centers, and functional requirements like offices, seminar halls, call centers, supermarkets, showrooms etc. have also attracted PEB. Earthquake-resistant buildings are the recent applications of PEB with wide and immediate acceptance.

Applications of Pre Engineered steel buildings include Houses & Living Shelters Factories, Warehouses, Sport Halls (Indoor and Outdoor), Aircraft Hanger, Supermarkets, Workshops, Office Buildings, Labor Camps, Petrol Pumps/Service Buildings, Schools, Community centers, Railway Stations, Equipment housing/shelters. The per capita consumption for steel structures in India is currently between ~6-7 kg, growing at a CAGR of over 10% since the past five years. This market has witnessed a higher growth as compared to both – the Indian steel GDP as well as the Indian construction GDP, driven by large investments in industry and infrastructure, the two key end use segments for steel structures in India.

The designed loads play a crucial role in case of PEB. The failure of the structures occurs if not properly designed for loads. The determination of the loads acting on a structure is a complex problem. The nature of the loads varies essentially with the architectural design, the materials, and the location of the structure. Loading conditions on the same structure may change from time to time, or may change rapidly with time. Loads are usually classified into two broad groups as dead loads and live loads. The determination of the loads acting on a structure is a complex problem. The nature of the loads varies essentially with the architectural design, the materials, and the location of the structure [7].

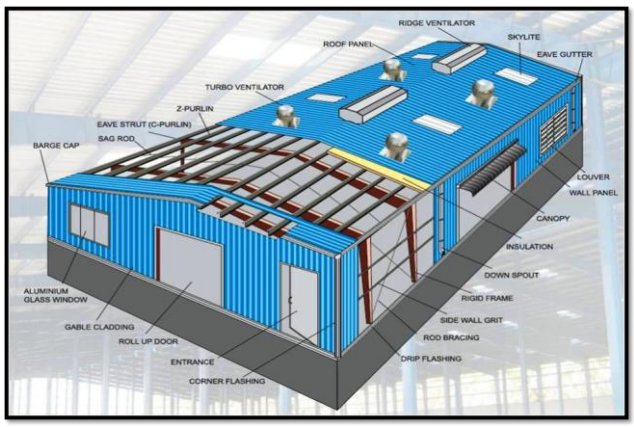

Fig. 3. Components of Pre-Engineered Buildings

VI. CONCLUSION

."PEB is getting its due credit as a favorable alternative construction methodology in India today. More sectors are realizing the benefits of metal over brick and mortar. The scope of metal/steel buildings is very vast for the Indian market. PEB proves to be relevant and beneficial to several const ruction verticals including warehousing, infrastructure, oil & gas refineries as well as group housing,"(Kirby). "The advantages of having a steel structure or building over traditional concrete are far too many. Primarily, speed and quality of construction are the top two benefits. Steel buildings are fire, quake and cyclone resistant hence from as safety and longevity perspective, these buildings are timeless".

REFERENCES

[1] C. M. Meera," Pre-engineered building design of an industrial warehouse",International Journal of Engineering Sciences & Emerging Technologies, ISSN: 2231 – 6604 Volume 5, Issue 2, pp: 75-82 ©IJESET, June 2013.

[2] Syed Firoz, Sarath Chandra Kumar, S. Kanakambara Rao, "Design concept of pre engineered building", / International Journal of Engineering Research and Applications (IJERA) ISSN: 2248-9622 www.ijera.com Vol. 2, Issue 2, pp.267-272, Mar-Apr 2012.

[3] JOulas, Aijaz Ahmad Zende, Prof. A. V. Kulkarni, Aslam Hutagi, "Comparative Study of Analysis of Pre-Engineered Buildings and Conventional Frames", IOSR Journal of Mechanical and Civil Engineering (IOSR-JMCE) ISSN: 2278-1684 Volume 5, Issue 1, PP 32-43, (Jan. - Feb. 2013).

[4] K. K. Mitra," Pre-engineered metal – the latest trend in building construction",International Journal of Engineering Research & Technology (IJERT), Vol. 1, Issue 5, July 2008.

[5] Dr. Abhay Gupta," Pre-engineered building systems Promising Future",International Journal of Engineering Research & Application, (IJERA) ISSN: 2398 – 1124 Volume 2, Issue 2, pp: 332-337 ©IJESET, May-June 2009..

[6] J. P. Rammant, "Intelligent design of Industrial Pre-engineered building-a Bim Approach design of an industrial warehouse" International

Journal of Engineering Sciences & Emerging Technologies,ISSN: 2100-0921, Volume4, Issue 2, pp: 75-82 © IJESET, July 2009.

[7] N. Subramanian, "Pre-engineered building selection of Framing System Roofing And Wall Materials" International Journal of Engineering Research & Technology (IJERT), Vol. 3, Issue 2, pp:23-26 JULY 2012.

[8] Amit Bharana, "Design of Long Span Pre-Engineered Structures" (IJERA), Vol. 3, Issue 1, pp: 93-100 (May 2009).

[9] R. Satishkumar, A. R. Santhakumar, "Design Of Steel Structures', (IOSR-JMCE), ISSN: 2309-1728 Volume 3, Issue 4, PP 22-38, (Feb. - Mar. 2013).