iJRASET
International Journal For Research in Applied Science and Engineering Technology

INTERNATIONAL JOURNAL FOR RESEARCH

IN APPLIED SCIENCE & ENGINEERING TECHNOLOGY

Volume: 10 **Issue:** IV **Month of publication:** April 2022

DOI: https://doi.org/10.22214/ijraset.2022.41569

www.ijraset.com

Call: 08813907089 | E-mail ID: ijraset@gmail.com

International Journal for Research in Applied Science & Engineering Technology (IJRASET)
ISSN: 2321-9653; IC Value: 45.98; SJ Impact Factor: 7.538
Volume 10 Issue IV Apr 2022- Available at www.ijraset.com

A Review on Comparative Study between the Pre-Engineered Building and Conventional Steel Building

Nikita D Radake[1], R V R K Prasad[2]
[1]*Post Graduate Student, KDK College of Engineering & Technology, Nagpur, Maharashtra*
[2]*Associate Professor, KDK College of Engineering & Technology, Nagpur, Maharashtra. Department of Civil Engineering, K.D.K. College of Engineering, Nagpur-440009, India*

***Abstract:** In steel structure design the Pre-engineering building (PEB) system is a modern technology that provides economical, eco-friendly, and sustainable structures. The pre-Engineered Building (PEB) concept is a new conception of single-story industrial building construction. This methodology is versatile not only due to its quality pre-designing and prefabrication but also due to its lightweight and economical construction. This concept has many advantages over the Conventional Steel Building (CSB) concept of buildings with roof trusses. This paper mainly focuses on the PEB concept and CSB concept. The study is achieved by designing a Warehouse building as PEB and as CSB with the help of Staad Pro. The CSB is designed and analyzed by IS 800:2007 (LSM) and PEB is designed and analyzed by AISC 360:10.*
***Keywords:** Pre-Engineered Building (PEB), Conventional steel building (CSB), Structure analysis and Design, STAAD PRO V8i*

I. INTRODUCTION

PEB is modern technology introduced in steel structures. The steel industry is growing rapidly in almost all parts of the world. The use of steel structures is not only economical but also eco-friendly at a time when there is a threat of global warming. Here, the "economical" word is stated considering time and cost. Time is the most important aspect, steel structures (Pre-fabricated) are built in a very short period and one such example is Pre Engineered Buildings. If we go for regular steel structures, the time frame will be more, and also cost will be more, and both together i.e. time and cost, make it uneconomical. Steel concrete composite construction technique offers several advantages like increased load carrying capacity and stiffness, saving in weight of steel, reduction in the cost of the foundation, and most importantly a large saving in construction time. 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.

A. Concept Of Conventional Steel Building

Nowadays, steel is used worldwide due to its ductility and flexibility properties. Steel bend when it's subjected to heavy loading rather than crushing. Conventional steel buildings (CSB) are small rise steel buildings with roofing structures of truss with roof coverings. Steel roof trusses are normally used for industrial buildings, workshop buildings, warehouses, and even residential buildings. The selection criterion of roof truss also includes the slope of the roof, fabrication and transportation methods, aesthetics, climatic conditions, etc.

B. Concept Of Pre-Engineered Building

Pre-Engineering Building is a combination of the tapered built-up section, hot roll section, and cold-formed section material. Pre-Engineered steel structures are fabricated or created necessity in the plant itself. The production of structural members is done on customer requirements. A pre-engineered building (PEB) is designed by the producer to be fabricated using a pre-determined inventory of raw materials and production techniques that may efficiently satisfy a wide variety of a structural and aesthetic views of design requirements within a few geographic manufacturing sectors these buildings are also called as Pre-Engineered Steel Buildings. These members are made up of a cold-formed section. The section's sizes depend on the bending moment diagram. PEB provides lightweight, less time-consuming, and it is advantageous over CSB when the span is large and column-free space is required. The design and manufacturing of structure members are done at the plant and later it's transported to the construction site and the erection process will take place.

C. Applications

The pre-Engineered Building concept has wide applications including warehouses, factories, offices, workshops, gas stations, showrooms, vehicle parking sheds, aircraft hangars, metro stations, schools, recreational buildings, indoor stadium roofs, outdoor stadium canopies, railway platform shelters, bridges, auditoriums, etc. PEB structures can also be designed as re-locatable structures. Conventional steel building applications include multi-story buildings, heavy-loaded industrial facilities, special shapes for architectural features, etc.

II. LITERATURE REVIEW

This section discusses the literature reviewed related to the design of industrial warehouse

The paper titled "A Review on Comparative Study on the Structural Analysis and Design of Pre-Engineered Building [PEB] with Conventional Steel Building [CSB]" author: Mitaali Jayant Gilbile and S. S. Mane. Published by: International Journal of Engineering Research & Technology (IJERT)-September 2020. In this paper, an industrial structure (PEB & CSB Frames) is analyzed and designed according to Indian standards. They observed that PEB structures are proven to be more economical. The researches show that PEB structures are easy to design. These structures are more reliable than CSB.

The paper titled "COMPARATIVE STUDY OF PRE-ENGINEERED BUILDING AND CONVENTIONAL STEEL STRUCTURES" author: Sudhir Singh Bhadoria and Yash Pathak Published by: International Research Journal of Engineering and Technology (IRJET)-September 2017. They observed that a comparative study made on various models of Pre-Engineered buildings and Conventional steel structures shows that PEB is economical. The provision of a tapered section in PEB makes it economical and tapering of the section is done as per the bending moment diagram. From all the analyses made it can be concluded that steel consumption in PEB is on average 30% lesser than a conventional steel structure. PEB frames are light and more flexible than conventional steel frames and provide higher resistance to seismic forces.

The paper titled "Comparative Study of Conventional Steel Building and Pre-engineered Building to be used as an Industrial Shed" author: Abhyuday Titiksh, Abhinav Dewangan, Ankur Khandelwal, Akshay Sharma Published by: International Journal of Engineering Research and Applications [ijera] November 2015

They observed that the pre-engineered buildings are more advantageous than conventionally designed buildings in terms of cost-effectiveness, time-saving, and future scope economy. This paper on a comparative study between conventional and pre-engineered buildings shows their experimental and analytical studies carried out in this field. The results show that steel structures are far more economical energy-efficient and flexible in design than other types of structures for industrial use.

The paper titled "Comparative Study of Pre Engineered and Conventional Steel Building" author: M.K.S.S.Krishna Chaitanya and M.K.M.V.Ratnam Published by: INTERNATIONAL JOURNAL OF INNOVATIVE RESEARCH IN TECHNOLOGY [IJIRT] – August 2015

They observed that after analysis, the total steel take-off for PEB is 16% of the conventional steel building. It is observed that the maximum moment will be high for PEB than for CSB. It is observed that maximum shear force will be high for PEB than for CSB. For PEB the axial force is higher than CSB. For CSB the axial force at the ridge is higher than PEB

The paper titled "A Comparative Study on Analysis & Design of Pre-Engineered & Conventional Industrial Building" author: Hemant Sharma Published by: IJIRST –International Journal for Innovative Research in Science & Technology-March 2017, In this case, after analysis, Designed, and comparison between the PEB and CSB they observed that the bending moments at different sections and observed that after doing a detailed analysis of PEB and CSB 37% overall material saving & cost reduction in PEB compared to CSB.

The paper titled "Comparative Study of Conventional Steel Structure and Pre-Engineered Steel Structure (PEB)"

Author: Rohit C. Pingle, P. J. Salunke, N. G. Gore, V. G. Sayagavi Published by: International Journal of Emerging Science and Engineering (IJESE) - May 2015 After the comparative study between PEB and CSB they observed that PEB proves to be relevant and beneficial for warehouses equipped with cranes and the advantages of having a PEB portal over a traditional many. Apart from the main parameters like structural load, Steel Quantity, Concrete Quantity, and Cost. Speed and Quality of construction are also benefits.

The paper titled "Comparative Study of Pre Engineered and Conventional Industrial Building" author: Pradeep V, Papa Rao G Published by: International Journal of Engineering Trends and Technology (IJETT) –March 2014 This paper effectively conveys that PEB structures can be easily designed by simple design procedures by country standards. Low-weight flexible frames of PEB offer higher resistance to earthquake loads. PEB roof structure is almost 26% lighter than Conventional Steel Building. In secondary members, lightweight "Z" purlins are used for PEB structure, whereas heavier hot-rolled sections are used for CSB. Support

reactions for PEB are lesser than CSB as per the analysis PEB building cost is 30% lesser than the cost of CSB structure. PEB offers low cost, strength, durability, design flexibility, adaptability, and recyclability.

The paper titled "Design and Analysis of Conventional and Pre-Engineered Building" author: D.Rakesh, V.Sanjay Gokul, G.Amar Published by: International Journal of Engineering Development and Research-. In this study pre-engineered structure shows less displacement in columns and less consumption of steel. Pre-engineered steel structure building offers low cost, strength, durability, and design flexibility. Based on the analytical design results theorem of conventional and pre-engineered steel buildings. The total steel take-off for PEB with primary frame spacing of 5m is 60% of the conventional steel building. It is also seen that the weight of PEB depends on the Bay spacing, with the increased bay spacing up to certain spacing the weight reduces and further increase makes the weight heavier. In this study, the displacements are more in the conventional building compared to the Pre Engineered building and the axial force are more in Pre Engineered building compared to the conventional steel building. Hence authors propose Pre –Engineered Building Construction is more cost-effective and economical when compared to conventional steel building and construction time and cost are also reduced.

The paper titled "Analysis and Cost Comparative study of Conventional Industrial building with PEB structure" author: Er. Vivek Thakre Published by: International Journal of Recent Engineering Research and Development (IJRERD) - August 2017 this paper effectively conveys that PEB structures can be easily designed by simple design. In this case, 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 an erection. The paper also imparts simple and economical ideas on preliminary design concepts of PEBs.

The paper titled "Comparative Study of an Industrial Pre-Engineered Building with Conventional Steel Building" author: Pradip S. Lande, Vivek V. Kucheriya Published by: International Journal of Pure and Applied Research in Engineering and Technology-April 2015, In this case, study they analyze and design of Conventional Steel Building and Pre-Engineered Building has been carried out and conclude that PEB structure can be easily designed by simple design procedures by country standards. Low-weight Flexible frames of PEB offer higher resistance to wind load. Cold-Formed steel section over the hot rolled section-rolled in is almost lighter than 32%. Pre Engineered Building weight is 35% lesser than the weight of conventional steel building. Pre-engineered Building construction gives end users a much more economical and better solution for long-span structures where column-free areas are needed. The economy of structure is discussed in terms of its weight comparisons.

The paper titled "Comparative Study of an Industrial Pre-Engineered Building with Conventional Steel Building" author: Deepti D. Katkar, Prof.N.P.Phadtare Published by: International Research Journal of Engineering and Technology (IRJET) - Oct 2018 they observed that the pre-engineered buildings are more advantageous over conventionally designed buildings in terms of cost-effectiveness, time-saving, future scope, subtleness, and economy. This paper on a comparative study between conventional and pre-engineered buildings shows their experimental and analytical studies carried out in this field. The results show that steel structures are far more economical energy-efficient and flexible in design than other types of structures for industrial use.

The paper titled "Analysis and Comparative Study of Conventional Steel Structure with PEB Structure" author: T D Mythili Published by: International Journal of Scientific & Engineering Research [IJSER] - April-2017 In this work Pre-Engineered Building concept involves the steel building systems which are predesigned and prefabricated. The present construction methodology calls for the best aesthetic look, high quality & fast construction, and cost-effective & innovative touch. The adaptability of PEB in the place of the Conventional Steel Building (CSB) design concept resulted in many advantages, including economy and easier fabrication. Also, the contribution of pre-engineered building systems in India to the economic growth of the country through various applications is stated briefly.

The paper titled "A REVIEW ON PRE-ENGINEERED BUILDING DESIGN OF AN INDUSTRIAL WAREHOUSE" author: Anisha T. Goswami, Shalaka Sharma Published by: International Journal of Scientific Research and Review-2017 this paper is a comparative study of PEB concept and CBS concept. The study is achieved by designing a typical frame of a proposed Industrial Warehouse building using both the concepts and analyzing the designed frame using the structural analysis and design software Staad Pro. They observed that PEB structure can be easily designed by simple design procedures by country standards, it is energy efficient, speedy in construction, saves cost, sustainable, and most important it's reliable as compared to conventional buildings. Thus PEB methodology mist is implemented and researched for more outputs.

The paper titled "Comparative Study of Design of an Industrial Workshop with Pre-Engineering Building" author: Mansi B Solanki, Tausif F Kauswala Published by: International Journal of Advance Engineering and Research Development (IJAERD)-2015 in this paper they observed that price per square meter is around 30% lower than conventional steel building due to lighter weight. Moreover, a heavy foundation is required for conventional roof truss due to heavy loads on the column.

Thus we can say that—Pre-Engineered Building Construction gives the end-users a much more economical and better solution for long-span structures where large column-free areas are needed.

The paper titled "Comparative Study of Pre Engineered Building and Conventional Steel Building" author: Pornima Pritish Naik, Dr.S.H.Mahure Published by: International Research Journal of Engineering and Technology (IRJET)-May 2021 In this study and analysis, they observed that The weight and cost of a Pre-engineered building are almost 15% less than the weight and cost of a Conventional Steel Building. Pre Engineered buildings offer low cost, strength, durability, design flexibility, adaptability, and recyclability. Pre-Engineered Building construction gives end users a much more economical and better solution for long-span structures where large column-free areas are needed. Therefore, a Pre-Engineered Building is preferable to a conventional steel building.

III. ADVANTAGES OF PEB

PEB is a suitable Construction technique for developing countries for the following reasons:

1) This entire system is of zero maintenance
2) It is superior in strength
3) It is of a low Budget and cost-effective
4) Highly economical and Eco friendly
5) Reduces the usage and wastage of excess steel
6) Entire Space uses without obstructions like center supports, etc.
7) Reduces construction time duration
8) Reduce mass pollution due to construction and prevents nature

IV. CONCLUSION

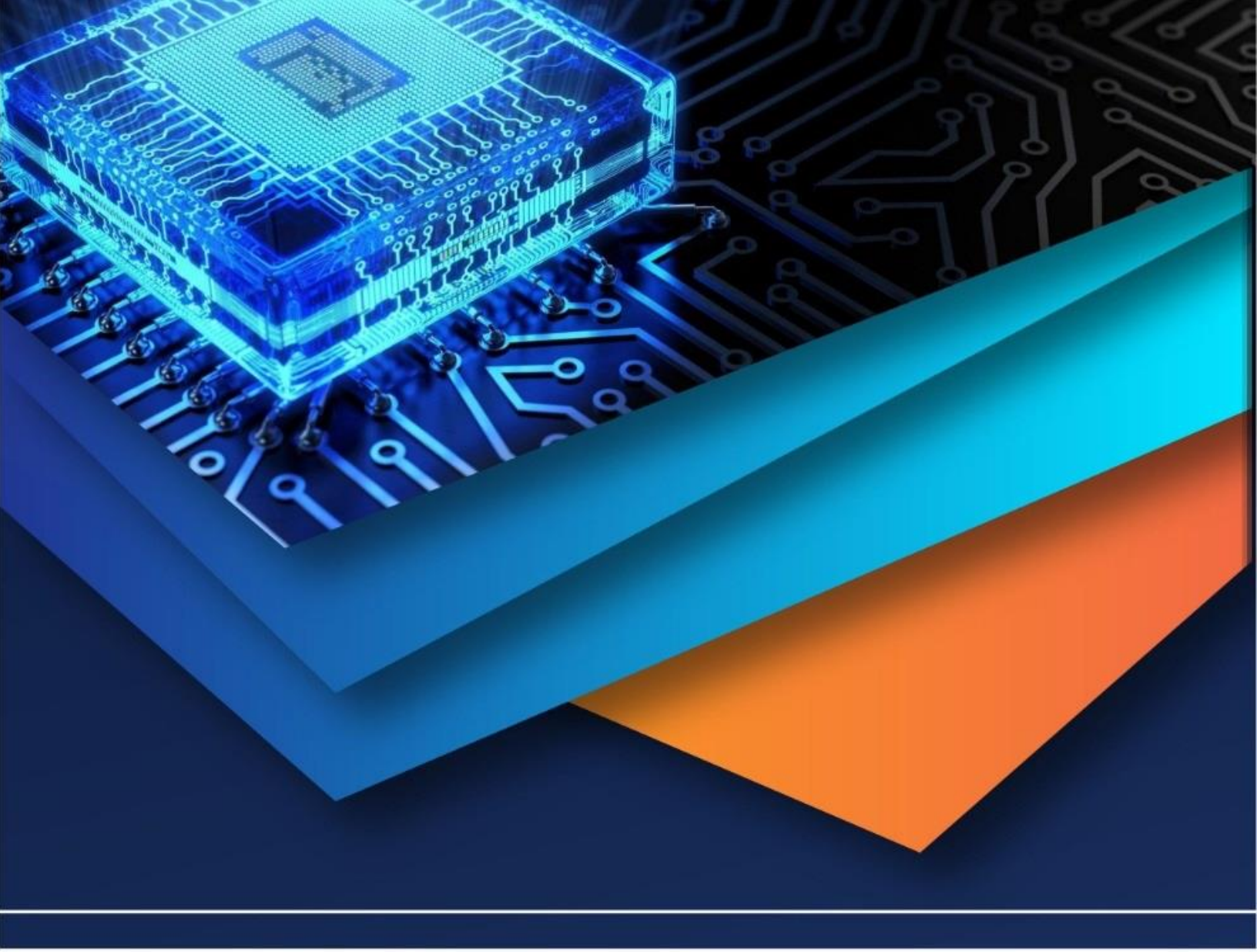
This study results in the following conclusions

1) In the comparison of Pre-engineered buildings and Conventional steel buildings PEB structures are easy to design. These structures are more reliable than CSB.
2) PEB structures are more advantageous than CSB structures in terms of cost-effectiveness, quality control speed in construction, and simplicity in an erection.
3) PEB building cost is 30% lesser than the cost of CSB structure.
4) PEB roof structure is almost 30% lighter than conventional steel building.
5) PEB construction is 30% to 40% faster than conventional steel building.
6) PEB offers low cost, strength, durability, design flexibility, adaptability, and recyclability.
7) Therefore, a Pre-Engineered Building is preferable to a conventional steel building.

REFERENCES

[1] Mitaali Jayant Gilbile and S. S. Mane, "A Review on Comparative Study on the Structural Analysis and Design of Pre-Engineered Building [PEB] with Conventional Steel Building [CSB]" International Journal of Engineering Research & Technology (IJERT) ISSN: 2278-0181 Vol. 9 Issue 09, September-2020
[2] Sudhir Singh Bhadoria and Yash Pathak, "COMPARATIVE STUDY OF PRE-ENGINEERED BUILDING AND CONVENTIONAL STEEL STRUCTURES," International Research Journal of Engineering and Technology (IRJET) ISSN:2395-0056 volume:04, Issue:06- September 2017
[3] Abhyuday Titiksh, Abhinav Dewangan, Ankur Khandelwal, Akshay Sharma, "Comparative Study of Conventional Steel Building and Pre-engineered Building to be used as an Industrial Shed" International Journal of Engineering Research and Applications [ijera] ISSN: 2248-9622, Vol. 5, Issue 11, (Part - 2) November 2015
[4] M.K.S.S.Krishna Chaitanya and M.K.M.V.Ratnam, "Comparative Study of Pre Engineered and Conventional Steel Building," International Journal of Advanced in Management, Technology, and Engineering Sciences Volume 8, Issue IV, ISSN NO: 2249-7455 APRIL/2018
[5] Hemant Sharma, "A Comparative Study on Analysis & Design of Pre-Engineered & Conventional Industrial Building," International Journal of Emerging Science and Engineering (IJESE) ISSN (online): 2349-6010 Volume 3 | Issue 10 - May 2015
[6] Rohit C. Pingle, P. J. Salunk N. G. Gore, V. G. Sayagavi "Comparative Study of Conventional Steel Structure and Pre-Engineered Steel Structure (PEB)," IJRET: International Journal of Research in Engineering and Technology ISSN: 2319–6378, Volume-3 Issue-7 May 2015
[7] Pradeep V, Papa Rao G, "Comparative Study of Pre Engineered and Conventional Industrial Building" International Journal of Engineering Trends and Technology (IJETT) ISSN:2231-5381volume9 –March 2014
[8] D.Rakesh, V.Sanjay Gokul, G.Amar, "Design and Analysis of Conventional and Pre-Engineered Building" International Journal of Engineering Development and Research ISSN:2321-9939 volume4, Issue2 May 2016
[9] Er. Vivek Thakre, "Analysis and Cost Comparative study of Conventional Industrial building with PEB structure" International Journal of Recent Engineering Research and Development (IJRERD) ISSN: 2455-8761 Volume 02 – Issue 08 - August 2017
[10] Pradip S. Lande, Vivek V. Kucheriya, "Comparative Study of an Industrial Pre-Engineered Building with Conventional Steel Building" International Journal of Pure and Applied Research in Engineering and Technology ISSN: 2349-879X volume 2-April 2015

[11] Deepti D. Katkar, Prof.N.P.Phadtare, "Comparative Study of an Industrial Pre-Engineered Building with Conventional Steel Building " International Research Journal of Engineering and Technology (IRJET) - Oct 2018
[12] T D Mythili, "Analysis and Comparative Study of Conventional Steel Structure with PEB Structure," International Journal of Scientific & Engineering Research [IJSER] ISSN (Online): 2319-7064 Volume 6 Issue 4 - April-2017
[13] Anisha T. Goswami, Shalaka Sharma, "A REVIEW ON PRE-ENGINEERED BUILDING DESIGN OF AN INDUSTRIAL WAREHOUSE" International Journal of Scientific Research and Review ISSN NO: 2279-543X Volume 6, Issue 12-2017
[14] Mansi B Solanki, Tausif F Kauswala, "Comparative Study of Design of an Industrial Workshop with Pre-Engineering Building" International Research Journal of Engineering and Technology (IRJET) ISSN: 2348 - 4470 -May 2021
[15] Purnima Pritish Naik, Dr.S.H.Mahure, "Comparative Study of Pre Engineered Building and Conventional Steel Building" International Research Journal of Engineering and Technology (IRJET)- ISSN: 2395-0056 Volume: 08 Issue May 2021



10.22214/IJRASET

45.98

IMPACT FACTOR: 7.129

IMPACT FACTOR: 7.429

INTERNATIONAL JOURNAL FOR RESEARCH

IN APPLIED SCIENCE & ENGINEERING TECHNOLOGY