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MODERN INSTALLATION PROCESS OF PRE-ENGINEERED STEEL BUILDING

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ABSTRACT
In our construction sector Pre-engineered building (PEB) system is the new concept. It has huge advantages including economical solution, easier fabrication and prompt Installation which reduced time and cost. The present work represents the Installation process of steel building which involves with the gathering of steel materials into a structure on the site. This process briefly describes the materials unloading, lifting, placing the materials into better position and then assembles them as an entire member by bolting. The processes must be completed with quickly, safely and economically. Installation cost varies around 10-12% of the whole project price which is primarily dependent on the speed of installation of the building. If we do the Installation carefully the cost will be minimized with maintaining safety. By this we can assure the safe Installation procedures and structural stability of the building. To focus all these relevant aspects the procedure for the Installation process are describe in this paper.

KEYWORDS: Installation Process, Pre-Engineered Steel Building, Colum, Rafter, Purlin, Sheeting.

INTRODUCTION
The installation procedure is the process for erecting the buildings with safely and accurately as much as possible. It involves setting of the components, align and fix them on foundations to develop a complete structure. To increase the rate of construction and ensure safe process, heedful planning is necessary. Heedful planning involves with the maintaining of realistic installation sequence and maintaining ease in gathering formation. All Site works are expensive and our initial aim is to shrink the costs by minimize the time on site because time is money [1]. Standardization, tolerances, structure type and floor systems must be measured for reduction of time on site. Installation process must be formed so as to set up a stable unit as fast as possible. Presently rapidity of Progress of Pre-Engineering-building structure (PEBs) accelerated speed of construction maintaining all the safety factors reducing the Installation time of the building. PEB materials are delivered as a total finished product to site from a single point with a fundamental structural steel support [2]. Now in USA 60% of low rise structure prefer PEB structure over conventional buildings [3]. Making the construction very quick is a needful step for manufacturing sector, residential and institutional sectors. Pre-engineered buildings (PEB) are developed in such a technique that helps in proficient utilize of time and funds [4].

METHODOLOGY
To do this research some company and site visit was necessary. We observed full Installation of a steel structure from starting to the completion. We make note all the issues involves with the procedures. The research was based on both exploratory and descriptive method. A random set of Installation site had

chosen. This study is mainly based on data we collected form site. Various study concept of pre-engineered steel building and its installation procedure. current innovation and replacement techniques which are implemented for pre-engineered steel building will highlight [5].

PRE-ENGINEERED BUILDING (PEB)

In civil engineering, pre-engineered buildings (PEB) are design by PEB contractor or PEB supplies, to fabricate the best suited account of raw materials which is on hand from all sources and methods that can be competently suit the structural and visual design requirements. In the south Asian industry sectors those buildings are called Pre-Engineered Metal Buildings (PEMB). It also common for reducing the quantity of pre-engineering occupied in the computer-aided designs, basically Engineered Metal Buildings (EMB).
Normally, primary frames are two-dimensional frames. Advances for computer-aided design expertise, materials and industrialized capability has expansion in a forms of pre-engineered building such as the fabricated buildings and more difficult study like 3D analysis is required for some design codes [6].
Cold formed members like Z and C types are use as secondary structural members to fix and hold the outside sheets. Roll-formed profiled metal sheets, precast concrete, brickwork block, glass wall might be use for the exterior cladding of the building [7].

PEB ADVANTAGES

- Ability to span long distances
- Faster occupancy
- Cost efficient
- Low-cost maintenance
- Unique and visually agreeable architecture designs
- Time efficient
- Light weight
- Greater durability
- Higher tensile strength

APPLICATIONS OF PEB

- Warehouses
- Factories
- Workshops
- Offices
- Gas stations
- Vehicle sheds
- Showrooms
- Aircraft hangars
- Metro stations
- Schools
- Recreational
- Roofs in internal stadium

PEB TECHNICAL PARAMETERS

BUILDING LENGTH, WIDTH AND HEIGHT

Building length is the dimension calculated from outer surface of flanges linked in the end wall columns to outer end of flanges in the opposed end wall columns. Width of the building is the dimension calculated from outside of eave strut of one sidewall to outside of eave strut of added sidewall [8]. Building height is known as eave height, is the measurement considered from foot of base plate of major structure column to crest point of the eave strut [9].

ROOF SLOPE (X/10)

Roof slope is the angle measured from the inclined roof plane with relate to horizontal face [10].

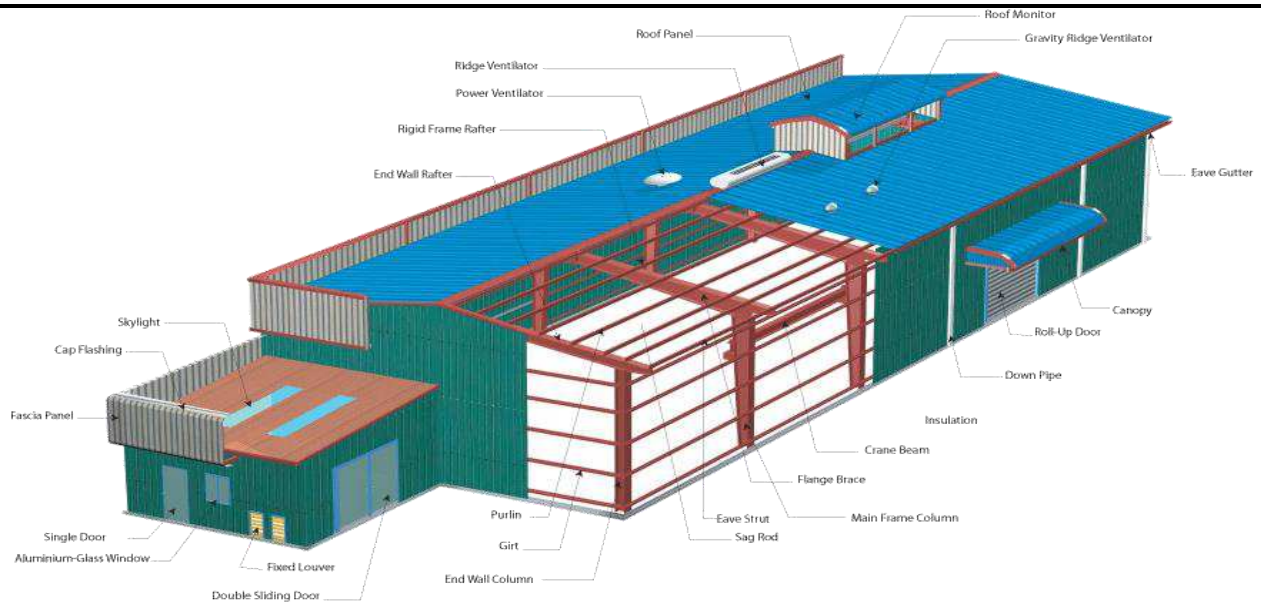

Figure-1: Pre-Engineered Building Components.

ROOF PURLIN AND WALL GIRT

Roof purlin which is set to peak flanges of rafters of clip that is bolted to rafters and the purlin web bolted to that clip [8]. Wall girt, that is set to peak flange of side wall columns [3].

ROOFING AND CLADDING MATERIALS

Roofing and cladding materials are used for PEB structure reason case to their durability, strength and capability to resist wind pressure, high temperature, weather etc [9].

INSULATION AND SKYLIGHT

Insulation is the materials which helps to diminish total building heat consumption, creates better comfort for the people and equipments within the building and can diminish HVAC components. PEB system provide natural system of roof lighting which is better working environment with no electricity cost and give enormous benefits[10].

ANCHOR BOLT SETTING AND CHECKING

This is the first step which needs anchor bolt fixing plan to where anchor bolts are casted and checked for agreement with particulars provided. It ensures by inspect it approximately that the relevant templates fit smoothly over bolting allocation. If they don't fit the bolts are fixed straight up by using the tube without harmful threads of bolts. This ensure correct and appropriate Installation [1].

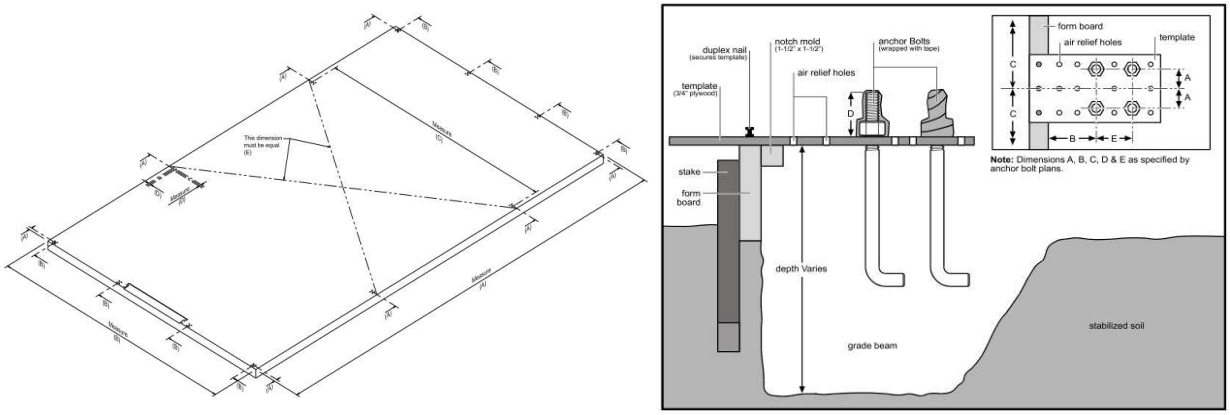

Figure-2: Detail of Anchor Bolts Setting.

MATERIAL HANDLING, UNLOADING AND STORING

A huge time and hitching can be saved if the structure parts are unloaded at the structure territory according to a pre plan. suitable location and handling of materials will reduce avoidable handling [11]. A mobile crane or a forklift is important for unloading the PEB building materials. One can use a tractor with a fork as well. Care has to take always to keep away from damage components [12].

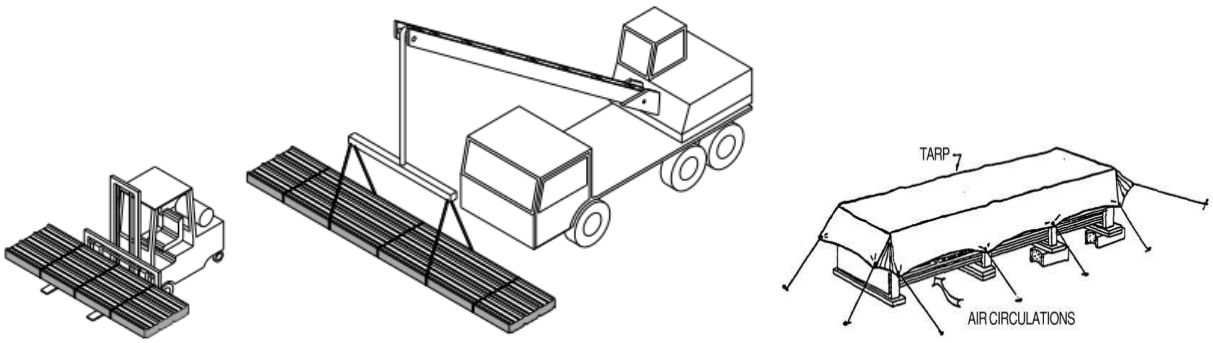

Figure-3: Materials Lifting and storage [13].

STRUCTURAL FRAMING

The layout, get-together and Installation of steel components must be done by respective personnel, knowledgeable in rigs and can handle the light steel items in a secure way. Improper handling is the result of injury, delays and unwanted extra costs. This is extremely right for lifting assemble rafters for large buildings [13]. Locations of structural materials are

1. All columns and rafters are normally unloaded near their individual erection positions on ready blocking and placed for simple Installation.
2. End walls must be laid out at every end of slab with columns close to individual anchor bolts.
3. Hardware packages must be located centrally, usually along one sidewall near to center of building.
4. Depending on figure of bundles roof purlins and wall girts are generally stored next to sidewalls free of other components.
5. Sheeting materials are usually placed along with one or both sidewalls off floor and inclined to one last part to support drainage at the time of rainfall.
6. Accessories materials are generally unloaded on a edge of the slab or off to the slab close to one side of building to maintain them out of as much as possible from the useable area throughout the steel materials Installation.

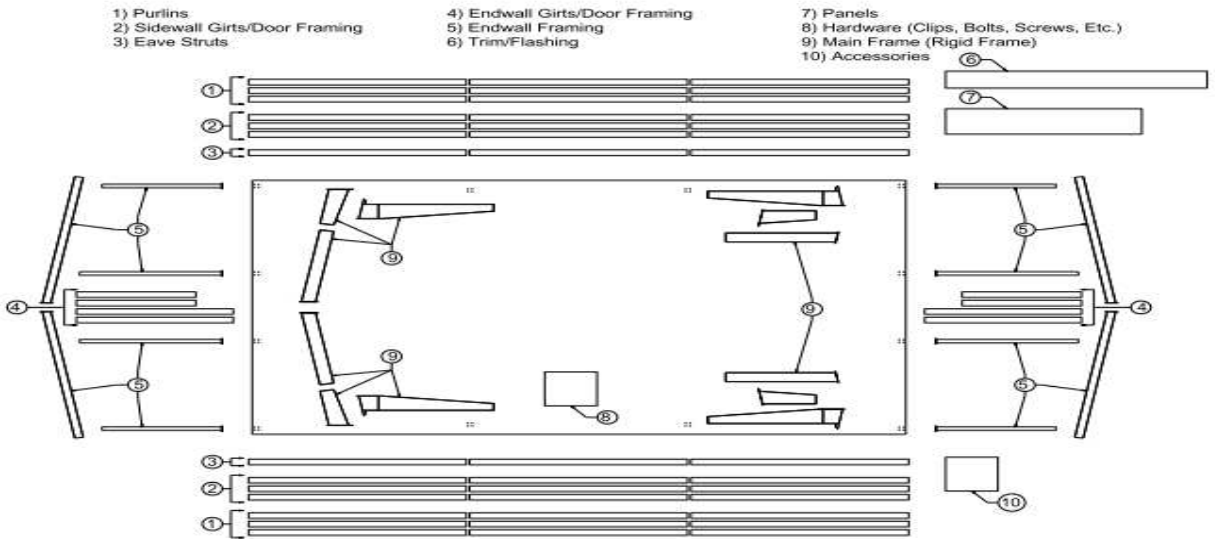

Figure-4: Materials placement [13].

INSTALLATION PROCEDURE

One can prepared to begin installing the PEB structure when all pre-Installation job is done, inspected and approved by Quality Control with register completed.

BOLTING OF THE RIGID FRAMES

We have to clean all the dust and debris from top face of foundation and then outline and bolt base plates tightly to the concrete, before bolting the rigid-frame [14]. One must have to use suitable washers between the plates and nuts. Layout the assemble column and rafter at each pair of base plates, by using nut bolt on each part of base plate to perform as pivots in raising the structural frame. To make line up plate holes use drift pins if wanted.

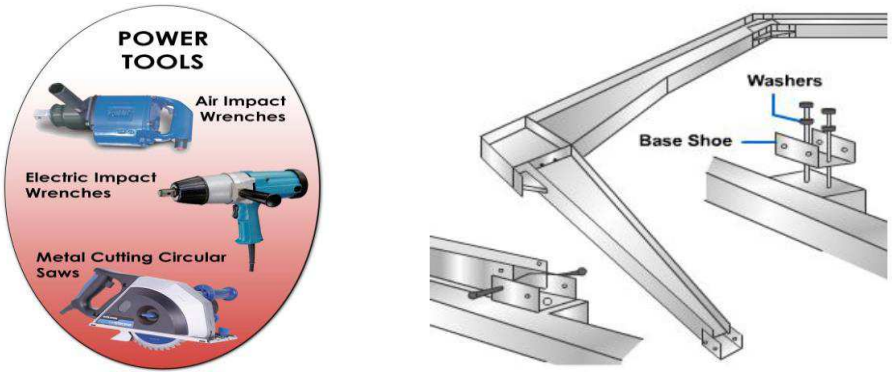

Figure-5: Installation Tools and Frame Assembly.

FRAME INSTALLATION

One can normally apply gin post to lift the end frame of building. To protect from buckle of frame when it is being lifted, fix a bridle firmly to every side of frame under the join connection and also to the crest on the rafter. Dive a drift pin in the frame to avoid the bridle from slip up. Fix the gin pole with a hunk at the top. One can also use a mobile crane or other equipment to lift frames into position with the subsequent suggested method [14]:

1. Lift the columns, bolt them with base plates, and support them in rigid place.
2. Erect all wall girts to maintain the columns as firm as possible.
3. Bolt the rafter together and erect the gable column and end wall header.
4. Locked the guy lines with tag lines to the rafters.
5. Erect the rafter into location on peak of columns and bolt them in position.
6. If the second frame is in secured position, erect all the purlins, gable angles and louver angles.
7. Erect brace rods and bring into line first bay. First bay has to be aligned prior to installing other bays.

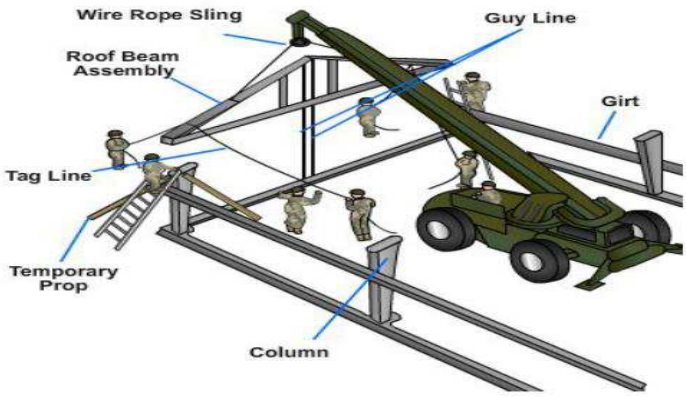

Figure-6: Frame Installation.

COMPLETING AND PLUMBING FIRST BAY

When the first internal all frames have been situated, all purlins, wall girts and eave struts must be installed in braced bay and whole bay plumbed, align and braced before going on advance. If these bays are appropriately and correctly plumb and brace, the rest materials to a large volume, will automatically plumb and make straight when erected [11].

BRACINGS

Bracing rods must be installed in initial bay installed. These rods are the major significance since they hold frames in a vertical location. Never omit the brace rods, either sidewall or roof.

SAG RODS

Sag rods which are use to grip purlins and girts in a straight procession. First erect sag rods which join two purlins at crest of building. Each rod has to attach from the peak hole of one purlin throughout the underside hole of next purlin. One has to utilize two nuts at the end, one on each surface of each purlin. Fine-tune nuts on those rods, so purlins are held in a straight line and firm.

BRACE AND BASE ANGLE

After more than two bays have been erected, element of erection crew can be assigned to erect the crossways brace angles. To erect the brace angles, place the notched part next to the structure flange and turn it into position. Diagonal brace angles are needed to hold up inner flange of frame. Be sure to install them so that, they are taut[13].

NUT BOLT TIGHTENING:

After installation of all primary and all secondary members all the nut bolt should be tight properly.

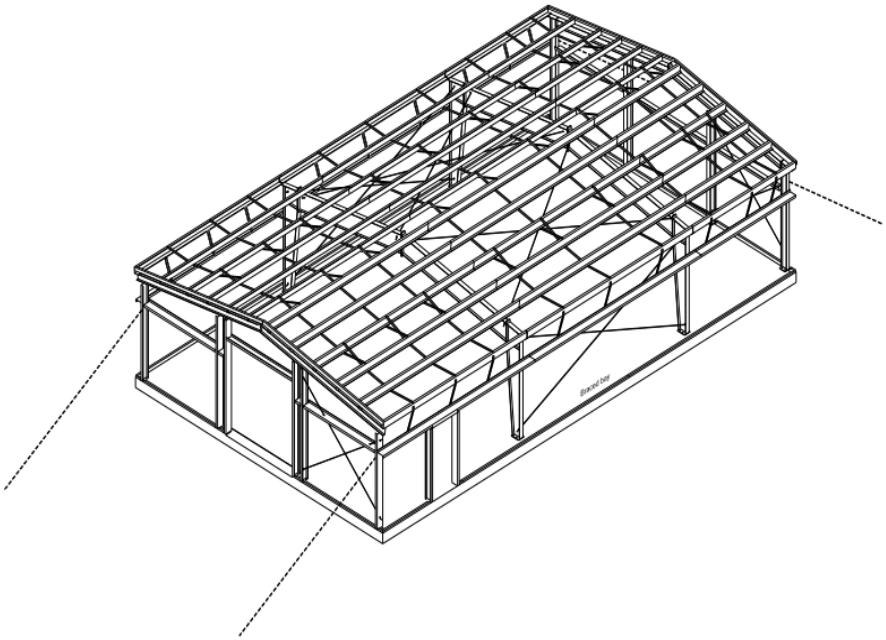

Figure-7: Skeleton of PEB Builing after Installation.

INSULATION

One can insulate a pre-engineered steel building by any of several methods. Fiberglass insulation is the most frequent type used. One face of this insulation must have a steam barrier which must face indoor of building in spite of whether the insulation is for heating or cooling [15]. Precut the roof insulation to arrive at from eave to eave allowing around 2 feet of extra length to ease handling. Hold insulation at one wall and roll out insulation crossways the purlins, steam barrier to interior of structure. To provide firm and smooth surface one has to stretch the insulation.

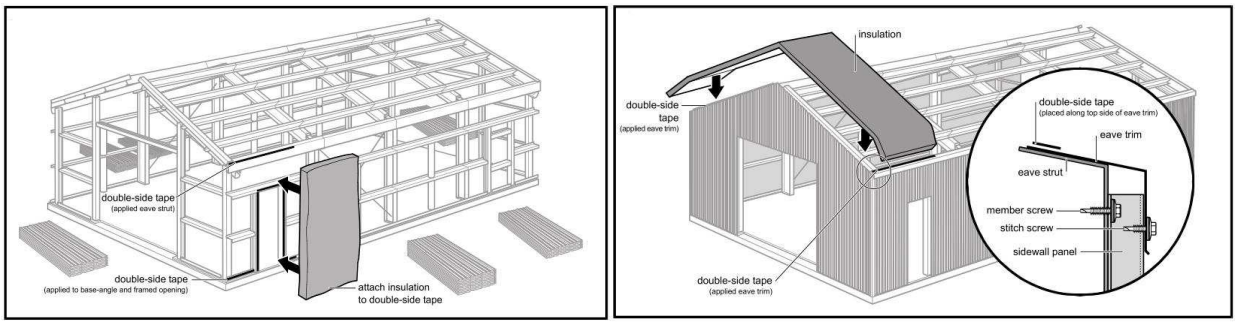

Figure-8: Wall and Roof Insulation installation.

SAFETY FOR ROOFING WORK

Working at the roofing area in installation of roof structural, insulation or roof panels requires proper training, accurate equipment and steady awareness to lessen the risk of falls. Solid hats must be ware on the working sites to avoid injury from falling matter. Safe working practices on all installation duty should be cautiously reviewed with Installation crews prior to start each work.

SHEETING

All primary and secondary building materials should be erected plumbed and tightened the bolts correctly before sheeting of building is started. Wall and roof panels should quality products and must be handled with special care [13]. At time of unpacking sheets, select them up and separate; never slip one panel above another. At lifting time of panels, hold long panels to avoid buckling.

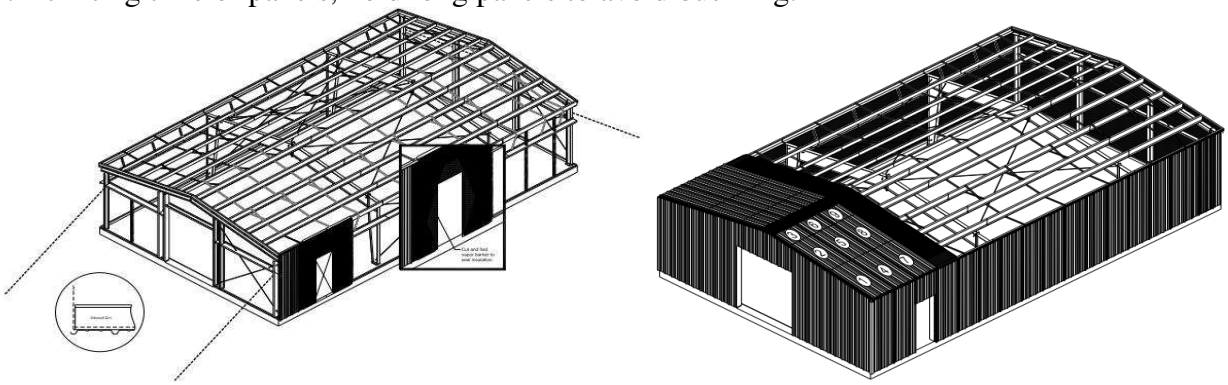

Figure-9: Wall and Roof Sheeting.

FASTENER ERECTION

Proper fastener erection is one of the most significant steps when erecting roof panels. Drive the fastener properly, until it is firm and the washer is tightly seated. Should not overdrive the fasteners [12]. Use the appropriate instrument to fix fasteners. A fastener driver of 1700-2000 rpm must be used for all self-drilling screws. For self-tapping screws, 500-600 rpm fastener driver should be used. Remove worn sockets, which can source the fastener to vibrate during erection.

Figure-10: Fasteners tighten system.

FLASHING, TRIM AND GUTTER

Proper erection of flashing, trim and gutter must not be overemphasized. The whole looking of the completed building depends mainly on worth of installation of flashing, trims and gutters. All gutter and flashing lines must be straight. Lapping and end joints must be strongly controlled.

MASTIC SEALANTS

Accurate mastic sealants application is significant to the weather stiffness of structure. Mastic must not be extended at moment of installed. It should be apply to the fresh and dry surfaces. During warm weather, store mastic in a cool and dry place. In cold climate mastic should be kept warm until use. After mastic applied, maintain caring paper in place until panel is set to erect**.**

Figure-11: PEB building after Installation.

CONCLUSION

At the Installation time, it is mandatory to uphold the strength of building with full safety. Top supervision has to maintain strictly. Environment, health and safety (EHS) guideline should be maintained properly. If the Installation going on night time, proper lighting and safety must be maintain. No steel materials should handle manually which save the life of labor and material. During Installation period, occurrence of structures collapse happens. So, the Installation guidelines are essential to understand the procedure and maintain with proper safety as it is more critical. So the proper regulations and guidelines regarding the equipment, manpower, tools and arrangements minimize the threat of accident. The more we follow the proper guideline the more we complete the structure in time with minimum accident.

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