


<b>INTER PLANT STANDARD – STEEL INDUSTRY</b>		
 <b>IPSS</b>	<b>SAFETY GUIDELINES FOR DEMOLITION OF BUILDING AND STRUCTURE IN STEEL INDUSTRY</b>	<b>IPSS: 1-11-031-17</b>
	Corresponding IS does not exist	

## **0. FOREWORD**

- 0.1 This Inter Plant Standard prepared by Standards Committee on Safety Appliances and Procedures, IPSS 1:11, with the active participation of the representatives of all the steel plants and manufacturers of safety items was adopted in April 2017.
- 0.2 Objective of this Standard is to describe the basic safety Procedure for demolition of building and structures. It describes briefly the precautions to be taken, safety appliances to be available and their use.
- 0.3 Demolition of any structure is, inherently, more hazardous than the construction or erection of the same. From the point of view of safety, the conditions usually encountered while dismantling a structure, whatever its magnitude, do not lend themselves to the degree of control possible in construction operations where more stable conditions are generally obtainable. It is all the more imperative, therefore, that adequate attention is given to the planning and the execution of demolition work, its various stages, so as to minimize the risk of accident and injuries to the personnel engaged on demolition operations. Adoption of predetermined and well planned safety measures for demolition work will not only prevent accidents but also will increase all-round efficiency.

## **1 SCOPE**

It describes the recommended basic safety Procedure for demolition of building and structures and the precautionary measures and the safety appliances. Associated Hazards during demolition of Buildings and structures such as Collapse of structure, falling material, flying material, impact/hit by material, collapse of equipment/machinery, noise, entrapment, fall from height, electrocution, Fire, explosion etc. This standard is applicable for all locations of steel plant and Mines in India. Responsibility to use this standard is of the Executing Authority, Contractors and his Consultants.

## **2 PROCEDURE:**

### **2.1 PREPLANNING & PRECAUTIONS BEFORE STARTING DEMOLITION WORK:**

- 2.1.1 Prior to permitting employees to start demolition operations, an assessment of structural stability of the structures / buildings/ equipment shall be made, by a competent person, to determine structural stability and the possibility of collapse of any of its portion of the structure/building/equipment. Any adjacent structure where employees may be exposed shall also be similarly checked. The employer shall have in writing, evidence that such a survey has been performed.

- 2.1.2 Ensure that proper document/letter is available for demolition of a building / structure / equipment etc. Schematic sketches for the key plan and elevations showing the different buildings/ structures/ equipment etc to be demolished, are to be prepared. Necessary documents are prepared and furnished to executing authority-
- 2.1.3 Adequacy & stability of parts to be demolished / retained, are to be ensured. A definite plan of procedure for the demolition work shall be prepared by contractor and finalized in consultation with Executing Authority. A copy of the survey report and of the plans and/or methods of operations shall be maintained at the job site for the duration of the demolition operation.
- 2.1.4 The written job plan must detail that the work must be stopped, re-evaluated, and a new plan developed, if any condition changes. It must include the process to be used and persons who must be involved in developing the new plan.
- 2.1.5 Job safety protocol should be prepared before demolition.
- 2.1.6 Good quality of Tested Tools and Tackles equipment to be deployed for execution of demolition job.
- 2.1.7 DEMOLITION SAFETY PLAN (Job Method Statement ) :

- Equipment – **All Tools and Tackles should have valid Test Certificate as per statutory norm for all the equipments engaged for demolition job.**
  - Personal Protective equipment to be used:
  - Risk to health and adequate control measures to be taken in case of use of Hazardous substances e.g Hydraulic Oil, Diesel, Gases ( oxygen/LPG etc.)
- i) Responsibility : Executing Authority
- Technical content of the job:
- ii) Follow the approved dismantling sequence given in 2.2 to 2.12 .
- iii) Disposal of demolished debris and scrap as per instruction of the Executing Authority .
- Safety risk assessment of the work to be done-:

(The person in charge of the Executing Authority is responsible for ensuring that all controls are in place well in time )

Hazards Associated with	Contols to be used
Slips, Trips & Falls	i) <b>Employ good housekeeping , remove materials from the work place progressively.</b>  ii) <b>At the end of the shift remove all tools etc. and inspect all areas to ensure they are left in a safe condition.</b>

<b>Cuts, grazes &amp; Abrasions</b>	<b>i) Ensure a safe system of work is in place and is explained to all operatives and carry out toolbox talks on any hazardous areas etc.</b>
<b>Falling material</b>	<b>i) Flagmen and workers of the executing Authority are to be positioned at a safe distance away prior to demolition.</b>
<b>Utility and Services llnes</b>	<b>All known live services are to be identified, isolated and protected/ rerouted prior to the demolition as per the site condition.</b>
<b>Manual Handling</b>	<b>Adopt proper handling technique method.</b>
<b>Fire</b>	<ul style="list-style-type: none"> <li>▪ <b>As soon as is reasonably practicable, remove waste from site to prevent a build up of combustible material.</b></li> <li>▪ <b>Access of fire tenders to be ensured</b></li> </ul>
<b>Foot Injuries</b>	<b>i) Safety boots as specified in safety standard of PPEs, are to be used.</b>
<b>Obstruction of assigned emergency access/ egress routes</b>	<b>The site supervisor should coordinate for ensuring that the access to the site is not blocked.</b>
<b>Clothing</b>	<b>i) Loose clothing must not be worn</b>
<b>Traffic movements</b>	<b>Traffic movements in and out of the barricaded area to be co-ordinated by the Flagmen during traffic movements to ensure that traffic is not affected.</b>
<b>Injury to operatives</b>	<ul style="list-style-type: none"> <li><b>i) Avoid lone working</b></li> <li><b>ii) Ensure suitable first aid facility on site.</b></li> <li><b>iii) Suitable PPE to include, Full body Harness, Safety Boots, Safety Helmet, Gloves, Safety goggles, Earplug, Dust Mask etc.</b></li> </ul>
<b>Hazardous Materials</b>	<b>i) There shall be no hazardous materials within the site boundary. Incase any material / substance be found on site, the Site Supervisors must immediately be informed.</b>
<b>Flying particles/</b>	<b>i) Standard safety goggles to be worn.</b>

<b>/ Dust / Noise</b>	<p>ii) Dust will be minimized as far as possible by wetting down during the demolition.</p> <p>iii) Workers working with the noisy equipment must wear ear plug.</p>
<b>Uncontrolled Collapse</b>	<p>i) workers are to be briefed about the sequence of demolition prior to commencement, by the job and site supervisors.</p> <p>ii) The machine operator shall be fully conversant with the sequence of removal of any support members.</p> <p>iii) No structure/s to be left partially collapsed or in an unsafe condition overnight.</p>
<b>Unsafe structure</b>	<p>i) The plant operator is to be briefed on the method of demolition by the supervisor prior to commencement.</p> <p>ii) Progressive demolition by controlled methods. No structure is to be left in an unsafe condition overnight.</p> <p>iii) <u>Proper illumination to be ensured</u></p>
<b>Weather Condition</b>	<p>No job should be taken up during inclement weather like high wind speed, lightening, heavy rains etc.</p>
<b>Loading / Unloading</b>	<p>All unloading activities should be carried out in a safe area within the barricaded demolition site or adjacent to the demolition site at a safe place as per space availability, in the presence of a flag man.</p>

2.1.8 Executing Authority shall implement this plan in actual practice.

2.1.9 Any device or equipment such as scaffolds, ladders, derricks, hoists, etc., used in connection with demolition work shall be constructed, installed, inspected, maintained and operated in accordance with the regulations governing the construction, installation, inspection, maintenance and operation of such device or equipment. The cage, hoists, tackles shall not be overloaded. Safety appliances (Helmet, Shoes, Goggles, Gloves, Safety Belts and others as may be required) shall be used.

2.1.10 Demolition of all buildings and structures shall be conducted under competent supervision,

and safe working conditions shall be provided to the employees. Before the commencement of each stage of demolition, the supervisor shall brief the workmen in detail regarding the safety aspects to be kept in view.

- 2.1.11 When employees are required to work within a structure to be demolished which has been damaged by fire, flood, explosion, or other cause, the walls or floor shall be shored or braced.
- 2.1.12 Ensure **POSITIVE ISOLATION** of the building / structure from electrical or any other energy source. All electric, gas, water, steam, sewer, and other service lines shall be shut off, capped, or otherwise controlled, outside the building line before demolition work is started. In each case, any utility service which is involved shall be notified in advance.
- 2.1.13 All the mains and meters of the building shall be removed or protected from danger. If it is necessary to maintain any power, water or other utilities during demolition, such lines shall be temporarily relocated, as necessary, and protected.
- 2.1.14 All the roads and open areas adjacent to the work site shall be protected and Caution Boards/Danger Sign in local language, Hindi and English shall be displayed at prominent places. Unauthorized entry to the building under demolition shall be efficiently controlled.
- 2.1.15 Provisions shall be made for at least two independent exits for escape of workmen during any emergency.
- 2.1.16 During nights, red lights or luminescent danger sign shall be placed on or around all the barricades.
- 2.1.17 All necessary work permits shall be obtained by Executing Authority from the concern department.
- a) Power cutting clearance
  - b) Work permit for Gas cutting, welding and working at height as may be applicable.
  - c) Work permit for working in gaseous areas, if applicable.
  - d) Any other clearance as found appropriate by executing department in consultation with the concerned department .
- 2.1.18 Walkways and passageways shall be provided for the use of the workmen and they will be strictly instructed to use these only. All such walkways and passageways shall be kept adequately lighted, free from debris and other materials.
- 2.1.19 Shoring of other buildings/adjacent structures shall be provided when the demolition operation exposes or breaches an adjoining wall of the adjacent structure.

- 2.1.20 Before demolition buildings with over hangs, chajjas, etc. they should be properly supported and demolished first before demolishing superstructure of the building.
- 2.1.21 While breaking roof slabs, workmen shall not be allowed to sit on the same floor, but on a separate platform, supported independently. In case they have to work from the same floor, independent life line to fasten their lanyard shall be provided. Lifeline should not be connected with the portion to be dismantled.
- 2.1.22 It shall be determined whether asbestos, hazardous materials, hazardous chemicals, glasses, gases, explosives, flammable materials, or similar dangerous substances are present at the work site. When the presence of any such substance is apparent or suspected, testing and removal or purging shall be performed and the hazard should be eliminated before demolition is started.
- 2.1.23 Protruding nails in boards, planks and timber shall be withdrawn, driven in or bent over as soon as the same is removed from the structure being demolished.
- 2.1.24 Any material to be removed which will cause dust to be formed, shall be sprinkled with water to suppress the dust incidental to its removal.
- 2.1.25 Adequate provision for drainage of storm water shall be ensured.

## **2.2 SEQUENCE OF DEMOLITION OPERATIONS:**

- 2.2.1 Before demolition work is started, glazed sash, glazed doors and windows, all fragile and loose fixtures shall be removed. All loose plaster shall be stripped off throughout the entire building.
- 2.2.2 All exterior wall openings, which extend down to floor level shall be barricaded to a height of not less than one meter above the floor level. This provision shall not apply to a storey after structural demolition has been started for the ground level floor.
- 2.2.3 All floor openings and shafts not used for material chutes shall be closed and be enclosed with guard rails and toe boards.
- 2.2.4 The demolition shall always proceed systematically storey by storey in descending order and the work on the upper floors shall be completely over before any of the supporting members or other important portion on the lower floor is disturbed (These requirements shall not prohibit the demolition of structure in sections., if means are taken to prevent injuries to persons or damage to property).
- 2.2.5 Stability of the remaining part of structure must be checked, before dismantling of any part is taken up.
- 2.2.6 Demolition work should causes least damage and nuisance to the adjoining building and the members of the public and it satisfies all safety requirements to avoid any accidents.

2.2.7 All existing fixtures required during demolition operations shall be well protected with substantial covering to the entire satisfaction of the rules and regulations of the undertakings or they shall be temporary relocated.

### **2.3 REMOVAL OF MATERIALS/DEBRIS**

2.3.1 Debris shall not be allowed to be thrown from height. Remove all debris promptly, using chutes or by using bags (Lowered by winch).

2.3.2 Metal chutes may be provided for removal of materials. The chutes shall preferably be provided as per site requirement for efficient disposal of debris.

2.3.3 Chutes, if provided at an angle of more than 45 degree from the horizontal shall be entirely enclosed on all the four sides, except for opening at or above the floor level for receiving the materials.

2.3.4 Opening for the chutes shall not exceed 1.2 m in height measured along the wall of the chute and in all stories below the top floor such opening shall be kept closed when not in use.

2.3.5 To prevent the descending material attaining a dangerous speed, chute shall not be extended in an unbroken line for more than two stories. A gate or stop shall be provided with suitable means for closing the bottom of each chute to stop the flow of materials.

2.3.6 Chutes at an angle of less than 45 degree with the horizontal may be left open on the upper side provided that at the point where such a chute discharges into a chute steeper than 45 degree to the horizontal. The top of the steeper chute shall be boarded over to prevent the escape of materials.

2.3.7 Any opening into which workmen dump debris at the top of a chute shall be guarded by a substantial guard rail extending at least one meter above the level of the floor or other surface on which men stand to dump the material into the chute.

2.3.8 A wooden toe board or bumper not less than 50 mm thick and 150 mm high shall be provided at each chute opening, if the material is dumped from the wheel barrows. Any space between the chute and the edge of the opening in the floor through which it passes shall be solidly planked over.

### **2.4 STAIRS, PASSAGEWAYS AND LADDERS**

2.4.1 Stairs and stair railings, passageways and ladders shall be left in place as long as possible.

2.4.2 All stairs, passageways and ladders to be used by workmen during the process of demolition shall be maintained in a safe condition.

2.4.3 Ladders or their side rails shall extend not less than 1.0 m above the floor or platform to which such ladder gives access.

2.4.4 All ladders shall be secured / fastened against slipping / turning out at the bottom as well as top end.

## 2.5 DEMOLITION OF WALLS

- 2.5.1 When walls or sections of masonry are being demolished, it shall be ensured that they do not fall as single mass upon the floors of the building that are being demolished, so as to exceed the safe carrying capacity of the floors.
- 2.5.2 Overloading of floors shall be prevented by removing the accumulated debris through chutes or by other means immediately.
- 2.5.3 Walls shall be removed part by part. Stages shall be provided for the men to work in, if the walls are very thin and dangerous to work by standing over them.
- 2.5.4 No section of wall whose height is more than 8 times of thickness shall be permitted to stand without lateral bracing unless such wall is in good condition and was originally designed to stand without such lateral bracing or support.
- 2.5.5 Dismantling shall be done on opposite side of the work force employed for dismantling.
- 2.5.6 Structural or load supporting members on any floor shall not be cut or removed until all the storeys above that floor have been demolished and removed.
- 2.5.7 In framed structures, the steel frame may be left in place during demolition of masonry work. Where this is done, all steel beams, girders, etc. shall be cleared off loose materials as the demolition of masonry work progresses downward.
- 2.5.8 Walkways shall be provided to enable workmen to reach or leave their work on any scaffold or wall. Such walkways shall not be less than 0.75 m in width.
- 2.5.9 At the completion of each days work all installations shall be left stable to avoid any danger of getting overturned.
- 2.5.10 Foundation walls which serve as retaining walls to support earth or adjoining structure, shall not be demolished until such an adjoining structure has been underpinned or braced and the earth removed by sheet piling or sheeting.

## 2.6 DEMOLITION OF FLOORS

- 2.6.1 In cutting holes in floor which spans in one direction, a slit of width not exceeding 300 mm shall be cut at the first stage for the entire length of the slab along which it spans. The opening shall thereafter be increased to the desired width by suitable installments.
- 2.6.2 Planks of sufficient strength, not less than 50 mm thick and 250 mm wide, shall be provided at spacing not greater than 0.4 m for the workmen to work. The length of planks shall not be less than 2 m. These planks shall be so placed as to give workmen firm support to guard against any unexpected floor collapse.
- 2.6.3 Stringers of ample strength shall be installed to support the planks where necessary and the ends of such stringers shall be supported by floor beams, girders and not by floor slab alone.



- 2.6.4 When floors are being removed, no workman shall be allowed to work in the area, directly underneath and such area shall be barricaded to prevent access to it.
- 2.6.5 The demolition of floor shall be started only after the floor in question and the surrounding floor area for a distance of 6 m have been entirely cleared of persons, and the debris and other unnecessary materials removed.
- 2.7 DEMOLITION OF STRUCTURES:**
- 2.7.1 When a derrick is used, care shall be taken to see that the floor on which it is supported is amply strong for the loading so imposed, if necessary heavy planking shall be used to distribute the load to floor beams and girders.
- 2.7.2 Overloading of equipment shall not be allowed.
- 2.7.3 Load of the material to be calculated before demolishing.
- 2.7.4 Tag lines shall be used on all materials being lowered or hoisted up and standard signal system shall be used. The workmen shall be instructed on the signals.
- 2.7.5 No person shall be permitted to ride the load line.
- 2.7.6 No beams shall be cut until precautions have been taken to prevent it from swinging freely and possibly striking any worker or equipment or any part of the structure being demolished.
- 2.7.7 All structural steel members shall be lowered from the building and shall not be allowed to drop.
- 2.7.8 No column shall be cut until they have been made free from the imposed load.
- 2.7.9 Area shall be barricaded.
- 2.7.10 The structures shall be supported as per requirement to avoid collapse.
- 2.7.11 Equipment used for dismantling must be inspected and tested.
- 2.8 CATCH PLATFORMS**
- 2.8.1 In demolition of exterior wall of multistoried structure, it is advisable to provide catch platform of heavy planking (minimum thickness 50 mm) to prevent injuries to the worker working below and to the public, when the external walls are more than 20 m in height.
- 2.8.2 Such catch platform shall be constructed and maintained not more than 10 metre below the storey from which exterior walls are being demolished. When demolition has progressed to within 10 metre of ground level, catch platform will not be considered necessary.

2.8.3 Catch platforms shall not be less than 1.5 m in width, measured in a horizontal direction from the face of the structure and shall consist of outriggers and planks/steel decks. These shall be laid tight together without openings between them and the walls. Catch platform shall be provided with a continuous preferably solid parapet along its outer edge of at least 1 m height. The parapet shall be constructed of the same specifications as the platform.

2.8.4 Catch platforms can be constructed of material other than wood also, provided such material is of equal strength.

2.8.5 Catch platform shall be capable of sustaining a live load of not less than 610 kg per square meter.

2.8.6 The outriggers shall be of ample strength and shall not be spaced more than 3 m apart.

2.8.7 Materials shall not be dumped on catch platform nor shall such catch platform be used for the storage of materials.

## 2.9 **REMOVAL OF WALLS, FLOOR AND MATERIAL WITH EQUIPMENT.**

2.9.1 Mechanical equipment shall not be used on floors or working surfaces unless such floor or surfaces are of sufficient strength to support the imposed load.

2.9.2 Floor openings shall have strong curbs to prevent equipment from falling over the edge.

## 2.10 **REMOVING AC/GC/GP etc FRAGILE SHEET ROOFING**

2.10.1 Before attempting the actual removal, a careful study should be made to find out the strength of the asbestos sheet. In any case, workmen should not be allowed to walk and stand on AC/GC/GP etc fragile sheets.

2.10.2 A firm ladder should be provided for workmen to climb to the roof.

2.10.3 A cat ladder/ crawling board which can be kept on the sloping roof (supported from the ridge) should be used for the workmen to approach, work and remove the sheets.

2.10.4 Only experienced workmen should be engaged. They will never step on the unsupported portion of the sheets.

2.10.5 Caution boards should be fixed at the ladders leading to the roof top, **DANGER: DO NOT GO ON THE ROOF TOP WITHOUT PERMISSION** Safety norms to be followed

## 2.11 **MECHANICAL DEMOLITION**

2.11.1 When demolition is to be performed by mechanical devices, such as weight ball and power shovels, the following additional precautions may be observed.

2.11.2 The building height should not exceed 25 m.

2.11.3 The area shall be barricaded for a minimum distance of 1.5 times the height of the wall or the maximum available space, whichever is less. In all cases, precaution is to be taken to prevent entry of people in the barricaded area. In case of lesser available space additional precaution shall be taken like hard fabrication.

2.11.4 While the mechanical device is in operation, no workman shall be allowed to enter the building being demolished.

2.11.5 The device shall be so located as to avoid falling debris upon it.

2.11.6 The mechanical device when being used shall not cause any damage to adjacent structure, power line, etc.

## 2.12 **RECOMMENDATION FOR DEMOLITION OF CERTAIN SPECIAL TYPES AND ELEMENTS OF STRUCTURES.**

### 2.12.1 **Roof Trusses**

- If a building has a pitched roof, the roof structure should be removed to wall top level by hand methods. Sufficient purlin and bracing should be retained to ensure stability of the remaining roof trusses while each individual truss is removed progressively.
- Temporary bracing should be added, where necessary, to maintain stability. The end frame opposite to the end where dismantling is commenced, or a convenient intermediate frame should be independently and securely guyed in both directions before work starts.
- On no account should the bottom tie of roof trusses be cut until the principal rafters are prevented from making outward movement.

### 2.12.2 **Heavy Floor Beams**

Heavy blocks of timber and steel beams should be supported before cutting at the extremities and should then be lowered to a safe working place.

### 2.12.3 **In-Situ Reinforced Concrete**

- Before commencing demolition, the nature and condition of the concrete, the condition and position of reinforcement and the possibility of lack of continuity of reinforcement should be ascertained.
- Attention should be paid to the principles of the structural design to determine which parts of the structure depend on each other to maintain overall stability.
- Demolition should be commenced by removing partitions and external non-load bearing cladding. It should be noted that in some buildings the frame may rely on the panel walls for stability.
- Where hand demolition methods are to be used, the following procedures should be used.

#### **2.12.4 Reinforced concrete beams**

For beams, a supporting rope should be attached to the beam. Then the concrete should be removed from both ends by pneumatic drill and the reinforcement exposed. The reinforcement should then be cut in such a way as to allow the beam to be lowered under control to the floor.

#### **2.12.5 Reinforced concrete columns**

For columns, the reinforcement should be exposed at the base after restraining wire guy ropes have been placed round the member at the top. The reinforcement should then be cut in such a way as to allow the column to be pulled down to the floor under control.

#### **2.12.6 Reinforced concrete walls**

Reinforced concrete walls should be cut into strips and demolished in the same way as columns.

#### **2.12.7 Suspended floors and roofs**

Before demolishing suspended floors and roofs, the type of construction should be ascertained. In solid slabs, the direction of the main reinforcement should be determined; the slab should then be cut into strips parallel to the main reinforcement and demolished strip by strip. Where ribbed construction has been used, the principle of design and method of construction should be determined before demolition is commenced. Care should be taken not to cut the ribs inadvertently.

#### **2.12.8 Precast Reinforced Concrete**

- Precast reinforced concrete units used in a structure are normally held in position by the strength of the joints made in-situ or on supporting walls, etc. As such, before starting demolition, the joint structures and/or the supporting mechanisms shall be studied and understood.
- In devising and following the demolition sequences due precaution shall be taken to avoid toppling over of prefabricated units or any other part of the structure and wherever necessary temporary supports shall be provided.
- Before commencing of the demolition work involving such structures advice of an expert in such demolition shall be obtained and followed.

**2.12.9 Chimney and Spires**

Before commencing the demolition work, involving such structures, advice of an expert in such demolition shall be obtained and followed.

**2.12.10 Steel Structures**

Please see the attached procedure on “Recommended practice for sequential dismantling of steel structure”.

**Attachment-1**  
**Practice for Sequential Dismantling of Steel Structure**

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## SECTION – 1

### **PRECAUTIONS TO BE TAKEN BEFORE DISMANTLING OF STEEL STRUCTURALS.**

Before any dismantling job is taken up, the Executing Authority shall officially identify a “Dismantling Leader” by a letter to respective authorities. The Dismantling Leader must have adequate knowledge and experience of structural dismantling and shall be responsible for safe dismantling work. Apart from other safety precautions, he will take particular care of the points, mentioned below:

1. Ensure that the structural members to be dismantled are not supporting any other structural members. In case, it is supporting, the other structures should be suitably supported before dismantling work is taken up.
2. All service lines like Oxygen, Nitrogen, Compressed air, CO gas, BF gas, LD gas etc carrying lines supported on the structurals intended to be dismantled, should be re-routed. In case, it is decided that structurals will be partially dismantled to retain support of the service lines, adequate safety precautions should be taken while dismantling, to avoid fire hazards and puncturing of service lines. Structural stability and adequacy shall be ensured before dismantling and even after partial dismantling.
3. All electrical lines supported on structurals intended to be dismantled, should be disconnected from source of power, and dismantling should start only after necessary clearance to that effect is obtained, in writing from concerned Electrical Power/Operation Department. Ensure **Positive Isolation** for the entire building.
4. The condition of structurals intended to be dismantled shall be inspected for corrosion, to ensure that it does not collapse while dismantling.
5. All tools and tackles used for dismantling should be in sound condition and adequately strong. Lifting tools and tackles used should have test certificate, issued by competent authority.
6. Cranes, used for dismantling, should have necessary fitness certificate. The driver shall also have necessary health and eye test certificate.
7. If derrick is used in place of crane, it should be properly guyed for stability and should have specified lifting capacity. In no case, the specified lifting capacity should be exceeded.
8. All persons engaged in dismantling work should be given safety training and they should ensure use of safety appliances. If the dismantling is near any gas line, then the workmen engaged should be given gas safety training.
9. While working at height, Full body Harness should be used. While climbing up or down, Fall arrestor should be used. A wire rope shall be tied at two rigid points to fasten the life line of safety Full body Harness, where other tying members are not available.
10. All dismantled material shall be lowered down on ground in controlled way.
11. Job safety analysis shall be done before dismantling.
12. Dismantling sequence shall be prepared before dismantling.

**SECTION – 2 (Refer Sheet No. 1)**

**GENERAL SEQUENCE OF DISMANTLING  
STRUCTURAL BUILDING**

The sequence of dismantling should be such that the structure does not lose its stability at any point of time during the entire process of dismantling.

1. Ensure that all precautions, as indicated in Section – 1, are taken.
2. Remove all roof and side sheetings.
3. Purlins should not be dismantled at this stage, but side girts can be dismantled.
4. All Purlins between monitor truss can be removed and monitor truss dismantled without damaging the roof truss.
5. Start dismantling from gable end, and work towards any intermediate braced bay. This braced bay is to be dismantled last.
6. Remove gable steel (gable posts and gable runners) work except roof truss.
7. Remove alternate purlins between end roof truss and adjacent truss.
8. Hold the roof truss to be dismantled with crane or derrick and remove balance purlins, rafter bracings, bottom chord bracings and struts, if any, between this truss and adjacent truss.
9. Gas cut the truss members along the face of column on both sides, and lower the roof truss.
10. Sequence 6 to 8 to be repeated for dismantling subsequent roof trusses.
11. While removing the last two trusses, both the trusses should be held with crane before repeating sequence 6, 7 and 8.
12. Dismantle gantry girder, surge platform, surge girder and outrigger (Auxiliary) girder between end column intended to be dismantled and adjacent column.
13. Remove longitudinal bracings and struts if any, between end column and adjacent column. Also remove any other structurals or platform. Dismantle end column.
14. Repeat sequence 11 and 12 for subsequent columns on both lines. Vertically braced bay columns shall be dismantled last.
15. For multi storeyed building dismantle all floor beams and floor plates except the beams connecting the building column. These framing beams and parts of columns shall be dismantled floor wise, starting from top, maintaining the stability of structures at all time.
16. For bin house, dismantle all bin plates except the girder or bin plates connecting the building columns.



17. Dismantle longitudinal bracings, struts, floor beams, bin plates etc., between end columns and adjacent columns on both rows. Also dismantle beam, bin plates etc. across the building for end column.
18. Dismantle end columns. For long columns, columns can be dismantled in pieces starting from top.
19. Repeat sequence 16 and 17 for subsequent columns on both sides.
20. Refer to sketch sheet no. 1 for identification of shed type building components.
21. If during dismantling, a situation is faced, where the remaining component to be removed is likely to lose its stability due to removal of other connecting members, the component must be stabilized with guy ropes.

Based on the above sequence of dismantling, for hazardous jobs, the components like columns, bracings, girders etc. may be given identifying marking at site to avoid wrong member cutting.

## **SECTION – 2A**

### **SEQUENCE OF DISMANTLING OF SIDE SHEETING WORK**

- Before dismantling of side sheeting work temporary platform to be made along the outside of building and gable end side. All statutory safety rules & safety harnesses to strictly adhered to e.g use of safety belts, slings etc.
- Remove the bolts or fixings carefully and place them in the waste container. Unbolt, or use cutters to release gutters , drain pipes, ridge caps etc.
- Loose materials like nuts, bolts, hooks and tools shall be kept in a box, Care shall be taken to prevent fall of objects like hooks, nuts and bolts. Dismantling of old sheets shall start from one end of building.
- Dismantled sheets shall not be thrown down from top. They shall be lowered to the ground by means of ropes and shall be stacked on ground properly before the workmen leave the site.

## **SECTION – 3 (REFER SHEET NO. 3)**

### **GENERAL SEQUENCE OF DISMANTLING OPEN GANTRY.**

1. Ensure that all precautions, as indicated in Section – 1 are taken.
2. Start dismantling from the end, where column bracing is not provided.
3. Hold the top of end column/A-frame using a crane/derrick.
4. Remove gantry girder, surge girder/platform, outrigger girder and any other structural between end column/frame and adjoining column/frame.
5. Dismantle end frame/column.
6. Repeat sequence 3 to 5 for all other frames/columns except for last two braced columns/frames.
7. For last two braced columns/frames, cut and remove all structural except bracing between the columns/frames.
8. Cut and remove top portion of bracing strut and diagonals along with top portion of columns/frames.
9. Repeat sequence 8 for next lower portion of bracings and columns/frames, till complete column/frame is removed.
10. Refer to Sketch Sheet No. 3 for identification of structural parts of open gantry.

**SECTION – 4: ( REFER SHEET NO. 4 AND 5 )**

**GENERAL SEQUENCE OF DISMANTLING CONVEYOR GALLERY:**

1. Ensure that all precautions as indicated in Section – 1 are taken.
2. Remove all mechanical parts like conveyor belt, idlers, deck plates, stringers etc. before removing the gallery structurals. Remove all cables, pipes and cable trays.
3. Remove all roof and side sheeting including purlins and side runners.
4. Dismantling work to start from expansion joint/end.
5. Hold the portion of conveyor gallery at portal location with crane/derrick. Depending on situation, slinging positions, crane position etc. must be planned and documented. Sling should be tied to junctions of column and beam of portal.
6. Gas cut the base connections of portals without damaging the supports and conveyor gallery.
7. Lower the complete conveyor gallery to ground.
8. After lowering on ground, the structures can be removed in small pieces by gas cutting.
9. Two legged trestle shall be suitably tied with wire rope while end gallery is being dismantled to provide adequate stability to the two legged trestle. Two legged trestle shall be cut & dismantled. This sequence shall be followed towards the four legged trestle which shall be dismantled last.
10. Refer Sketch Sheet No. 4 and 5 for identification of structural components of conveyor gallery.

**SECTION – 5**

**GENERAL SEQUENCE OF DISMANTLING EOT CRANE:**

Ensure that all precautions as given in Section – 1 are taken.

6.8.8. Dismantle all gear boxes, motors, electrical panels etc. and bring them down to ground.

6.8.9. Dismantle Trolley structurals and hook block using crane/derrick/Repair trolley. Trolley assembly may be dismantled as a unit if crane or repair trolley capacity is available.

6.8.10. Dismantle driver's cabin using crane/derrick.

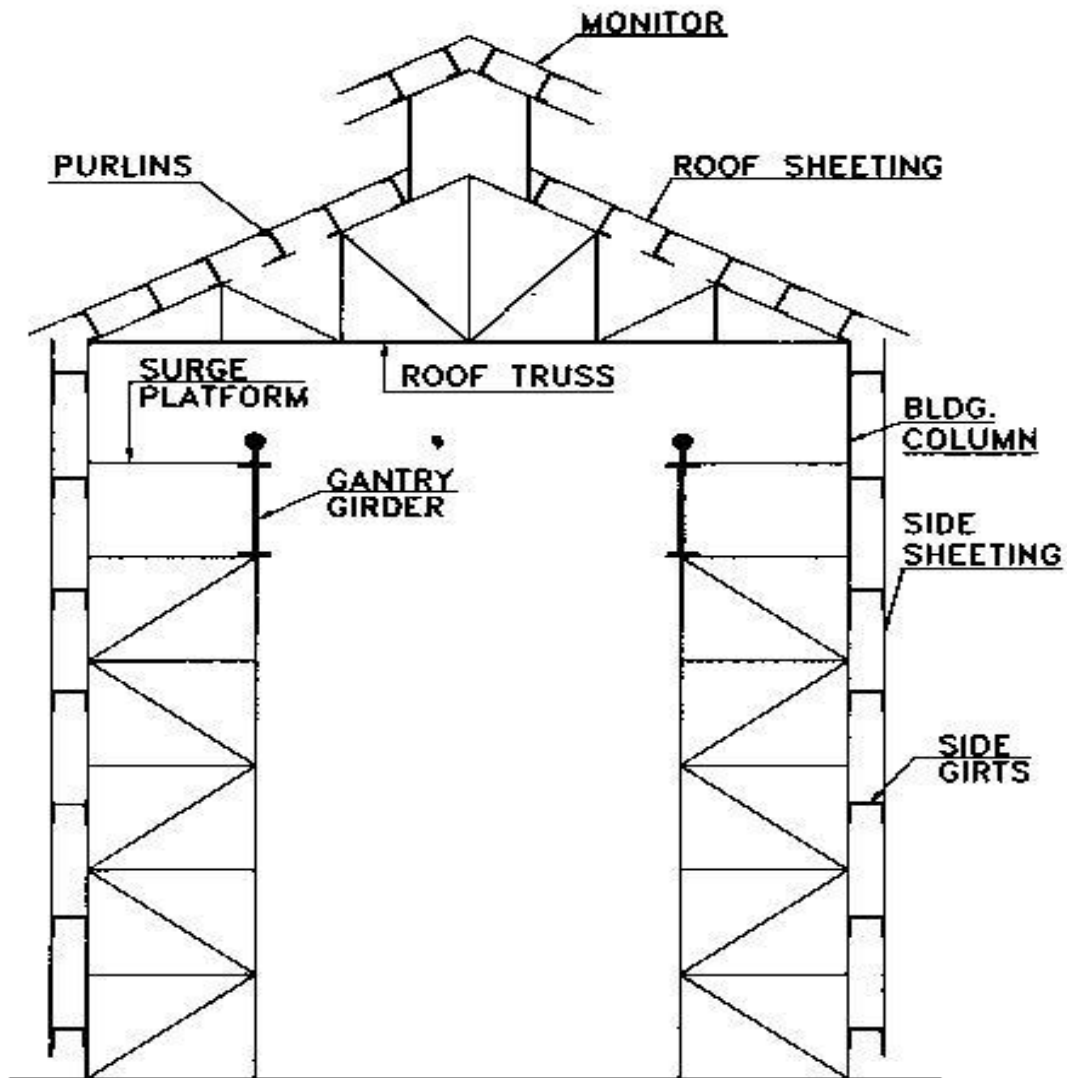
6.8.11. Tie end carriage with existing gantry girder and building structurals.

6.8.12. Dismantle bridge girders one by one using crane/derrick.

6.8.13. Lower end carriage using crane/derrick.

SKETCH SHEET NO.1  
SHEET '1' OF '2'

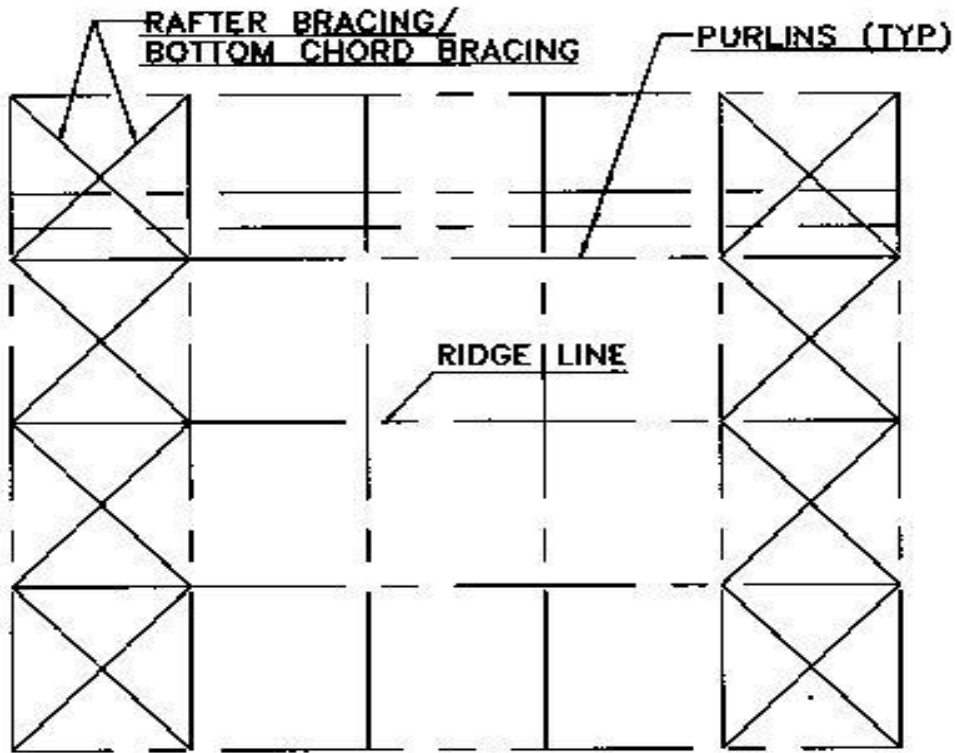
DETAIL OF SHED TYPE BUILDING  
SHEET '1' OF '2'



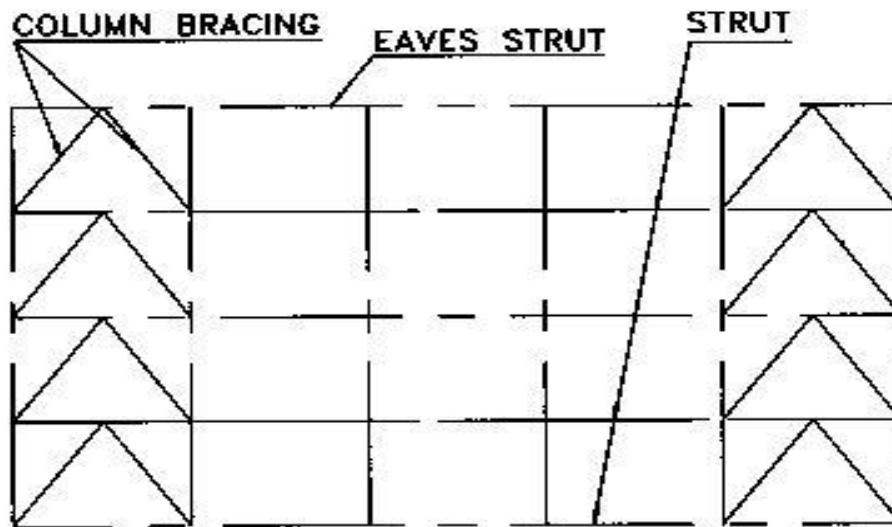
CROSS SECTION OF BUILDING

SKETCH SHEET NO.2  
SHEET '2' OF '2'

DETAIL OF SHED TYPE BUILDING  
SHEET '2' OF '2'



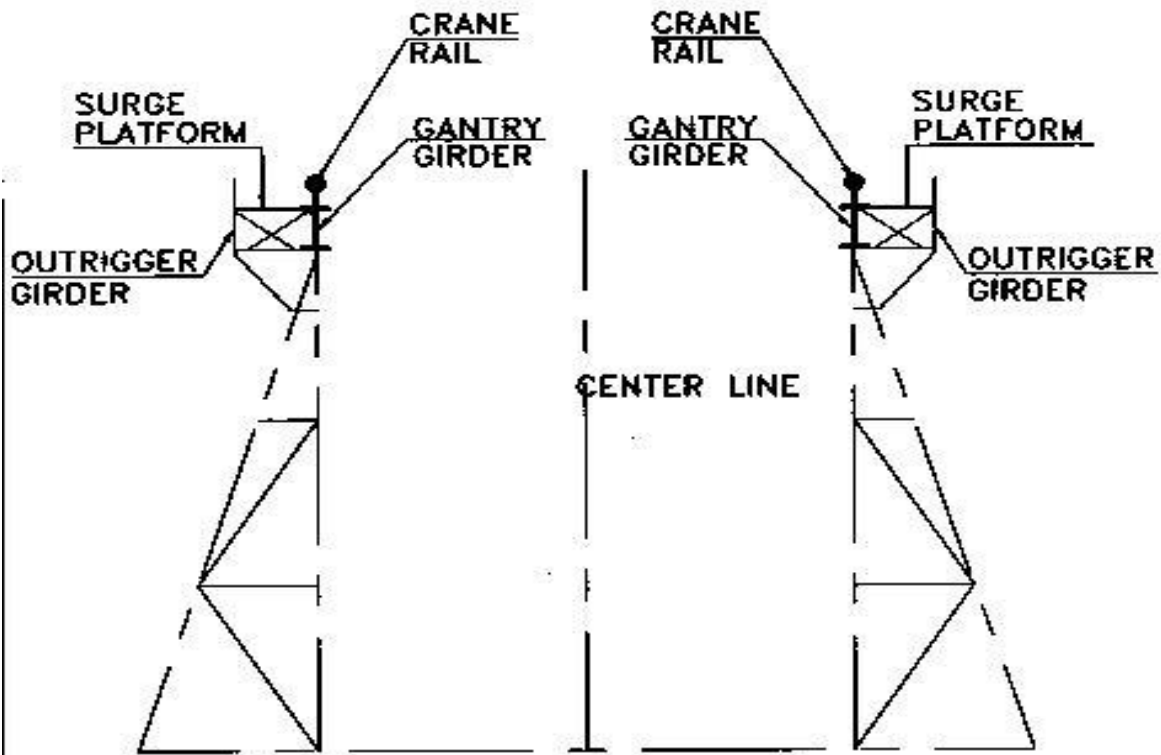
ROOF PLAN



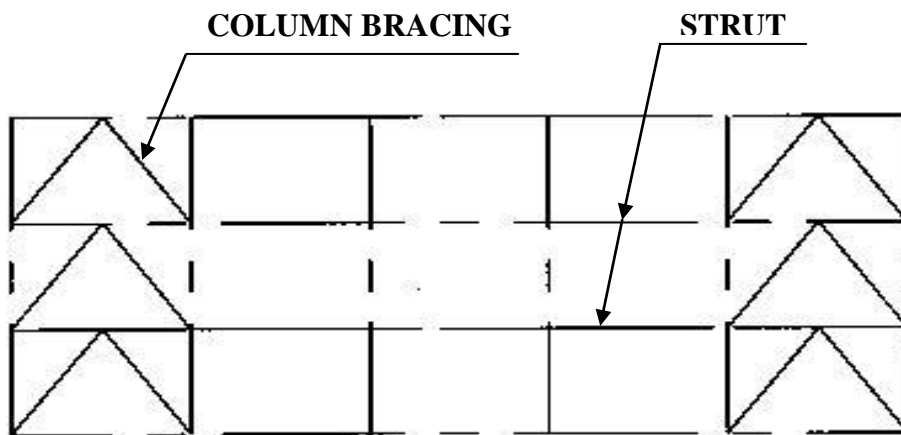
ELEVATION

SKETCH SHEET NO.3

DETAIL OF OPEN GANTRY



SECTION OF OPEN GANTRY

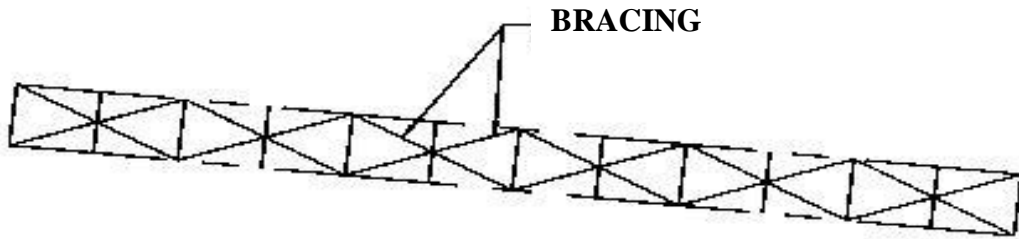


ELEVATION

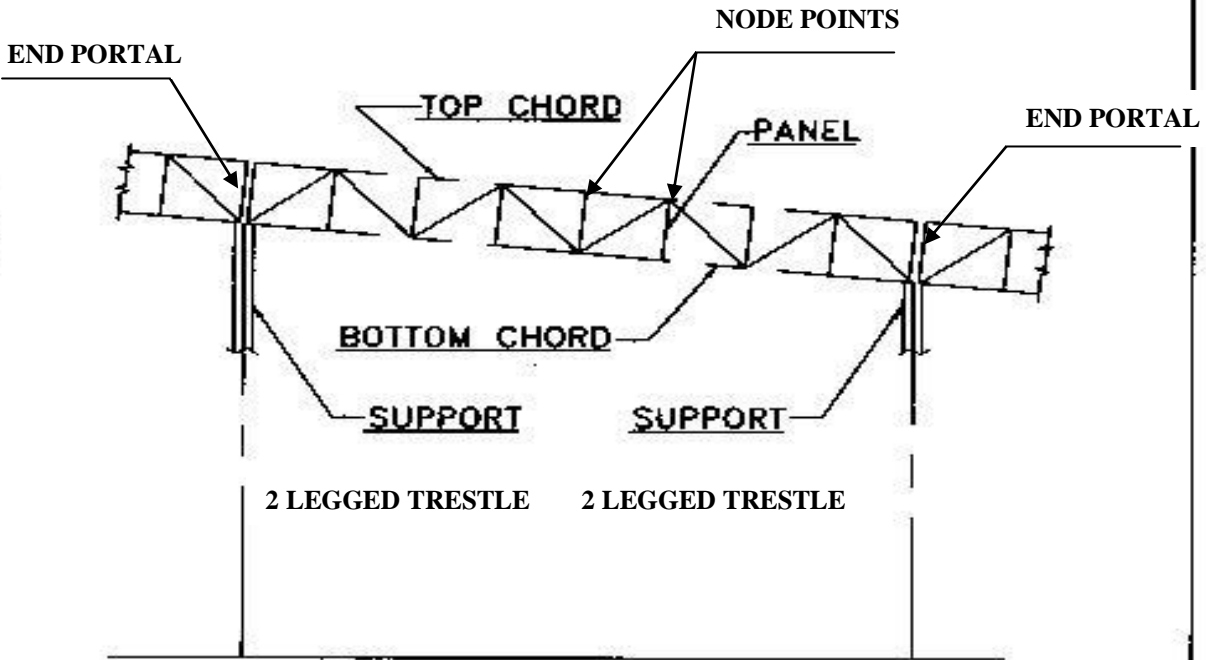
SKETCH SHEET NO.4

SHEET '1' OF '2'

DETAIL OF CONVEYOR GALLERY  
SHEET '1' OF '2'



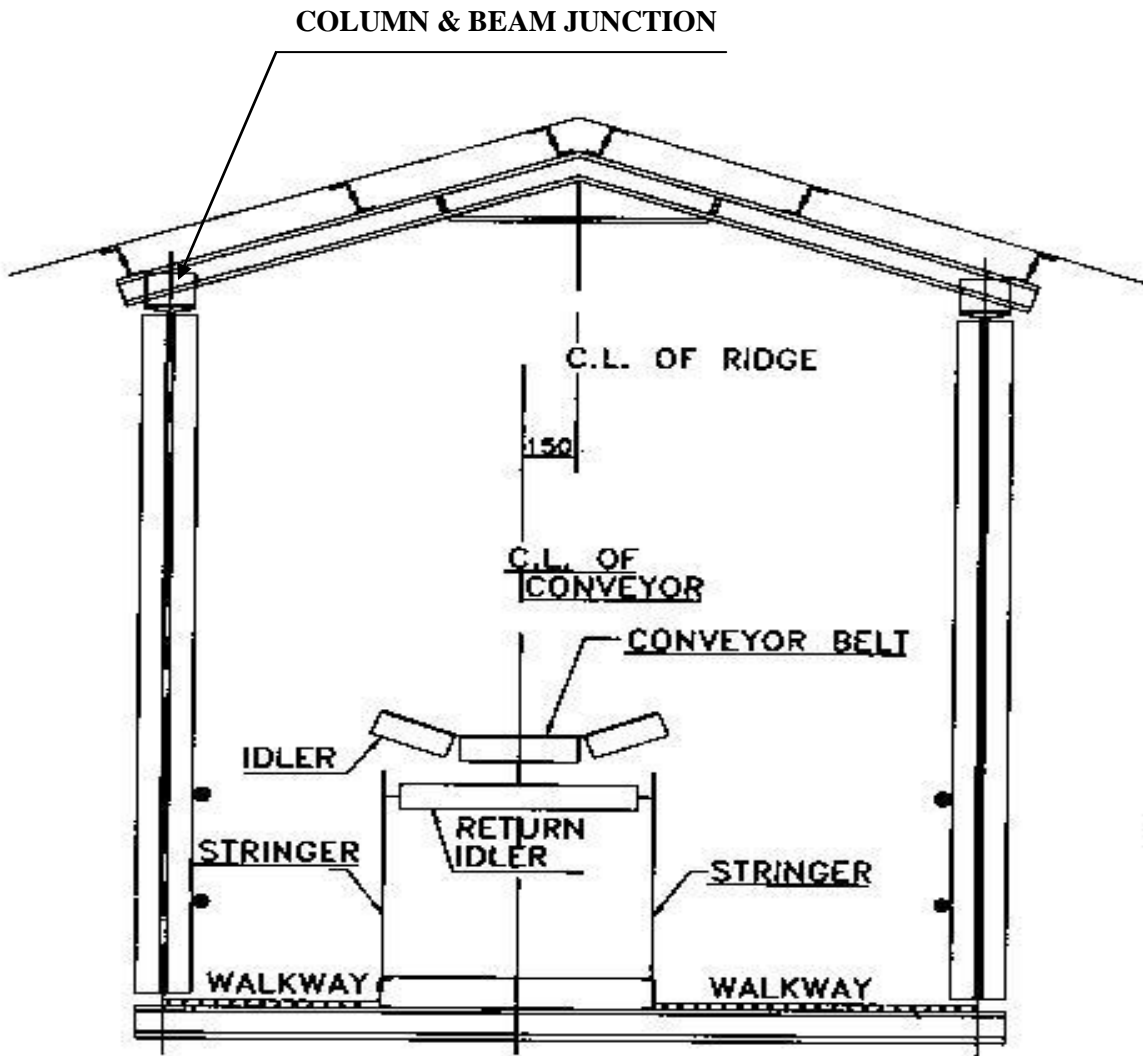
PLAN OF BOTTOM CHORD AND  
TOP CHORD BRACING



ELEVATION



SKETCH SHEET NO.5  
SHEET '2' OF '2'



TYPICAL CROSS SECTION OF CONVEYOR GALLERY

## **Attachment -2**

### **Recommended Practice for Dismantling and Rearranging (D&R) facilities**

The following practices are strongly recommended for all “large” D&R projects. Sites electing not to adopt any of these practices must have an alternative better practice that is at least equal to those not adopted.

#### **1. Equipment Identification**

- Use different color paints or stickers on equipment, piping, or electrical to be removed to distinguish it from equipment, piping, or electrical to remain.
- Identify both what is to be removed and what is to remain.
- Use different colors to identify the presence of asbestos, lead, etc. and non-hazardous coatings. Use unique color paint, stickers, or tags to identify the exact location of subsequent breaks being performed by the contractor personnel.
- Signs or posters describing the identification method including examples of the actual colors or tags must be posted in strategic locations throughout the work area.
- The integrity of the markings should be reviewed throughout the life of the project.

#### **2. Utilities diversion / isolation**

- Executing Authority should perform isolation and all utility diversion activities. As a best practice, the facilities should be completely isolated (de-energized, drained, blanked out, etc.) before the work to begin.
- For diversion / isolation of electrical utilities, prior approval / permit shall be taken from concerned electrical department or Electrical Maintenance Department.
- For diversion / isolation of various gas / steam pipe lines, prior approval / permit & clearance for dismantling of pipes shall be taken from concerned department or from Fuel / Energy Management Department as applicable.
- For diversion / isolation of underground sewer line, storm line and other service water lines, prior approval / permit shall be taken from Civil department/ concerned department..

#### **3. Auditing**

- Conduct D&R focused audits separate from the site’s normal audit process.
- Participants on the audit must be trained to recognize unique D&R hazards and be knowledgeable of the D&R job plan.

- Daily focused D&R audits to be conducted.
- Audit team shall comprise of at least a Safety Department, operating area representative, and D&R contractor supervisor.

#### **4. Electrical**

- All persons employees performing demolition & rearranging of electrical conduit, cables or conductors must be trained
- Provide general “electrical safety awareness training” to D&R contractor personnel not engaged in electrical demolition & rearranging.
- Identification and marking of circuits must be performed by personnel with long-term site experience.
- Remove all fuses from motor control centers.
- If lighting panels must remain active, determine how energized electrical panels and circuits will be clearly identified and the location communicated to the D&R contractor.

#### **5. Building and Process Decontamination**

- De-inventory and flush all process vessels, storage tanks, receivers, pumps, and piping systems of all residual chemicals.
- Written authorization from the consultants / engineers required before torch cutting any vessels, tanks, or piping carrying flammable liquid or gas.
- Positive verification of removal of flammable liquid, gas, or residual materials by purging before authorizing torch cutting.
- Remove gas from large fixed refrigeration units.
- Open process equipment inspection ports/nozzles for internal inspection.
- Open all low point equipment and piping systems drains and leave all valves in open position. Open all jackets and coils and utility side of heat exchangers.
- Decontaminate any process equipment/piping systems that are not “visually clean”.
- Open, inspect and clean, if necessary, ventilation ductwork. Clean building ditches, trenches and pumps.

#### **6. Building Isolation**

- Define and identify any process and/or service piping systems that must be relocated to isolate the building.

- Define and identify any electrical services that must be relocated to isolate the building.
- Use a service of person with long-term site specific experience to physically break all electrical, utility, and process piping. Ensure POSITIVE ISOLATION of the equipment / system from electrical source or any other energy source.

## **7. Rigging, Mechanical and Manual Lifting**

Treat all rigging and mechanical lifting jobs as “critical” lifts.

Rigging plan review includes the following:

- Contractor rigging training
- Crane operator certification
- Crane certification and inspections
- Chain fall, hoist, sling inspections
- Routes of “travel”
- Job supervisor of contractor will plan all mechanical lifts, including the use of ropes. Equipment drawings need to be obtained to determine equipment weights. Allowances may have to be added to the weights due to residual product, catalyst, and/or caking if the equipment could not be adequately cleaned.
- Weights of platforms, piping, etc., that will remain on the equipment when it is being dismantled must also be determined.
- Verify contractor employees involved in any form of rigging have been adequately trained or perform on-site rigging training.
- Designate specific operators of freight elevators and provide training.
- All load-conveying equipment must be labeled with its capacity. Skilled and qualified operators on all demolition equipment.
- Equipment operator training verified through review of training documentation. Utilize mechanical equipment for lifting.
- Overhead hoisting equipment and supports left in the area must be inspected by the job supervisor of the contractor.
- Only steel chains and slings shall be used for securing / supporting heavy loads and use of Manila ropes, Fibers ropes in rigging activities shall be strictly prohibited for heavy loads greater than 70 Kg.

- Limit manual material handling and lifting to a maximum of two persons; no manual material handling or lifting with more than two individuals is allowed.

## **8. Staffing**

- Contractor with safety knowledge, safety resources dedicated to the D&R project to be utilized.
- Contractor is to utilize experienced operators, mechanics, and resident contractor employees for decommissioning and decontamination.
- Contractor is to utilize experienced operators and mechanics.
- Contractor is to engage qualified electrical resource dedicated to follow electrical D&R fieldwork.
- Contractor-provided safety supervisor to be assigned to continuously monitor contractors with inexperienced workers regardless of size of workforce.
- Require contractor to submit proposed workforce makeup, i.e., experienced workers vs. inexperienced workers, and worker to supervisor ratio.

## **9. Communications**

Communicate safety expectations and requirements clearly and early in the bidding process. Hold weekly / daily safety/schedule meeting between concerned department and operating area personnel and D&R contractor project management and field supervisors and safety supervisors.

## **10. Identification of Area with similar Hazards**

Develop a plan that requires sampling of all homogenous areas for the presence of hazardous materials such as asbestos, lead, etc.

## **11. Contract Bid Preparation**

As a minimum, involve the following in the bid package preparation:

- Contractor safety representative
- Plant safety resource
- Operating area owner representative
- Plant environmental resource
- Contract administration
- Electrical resource
- Mechanical and rigging resource

## D&R project team resources

As a minimum, include in the bid package the following:

- Well written, clear, and detailed scope of work
- All relevant safety procedures
- List of required submittals
- Waste disposal guidelines
- Lead, asbestos, and other hazardous coatings assessments
- Examples of relevant work, flame, etc. permits
- Barricading requirements
- Clear and concise worker training requirements

## **12. Contractor Selection**

- Competent contractors having
  - records of self initiative approach for safety measures.
  - attitude & behavioral dedication towards safety.
  - adequate mechanized resources.
  - competent Engineers, Job supervisors, safety supervisors and other competent staffs for various works related with demolition.
  - capability to mobilize adequate resources for completing the work speedily with adequate safety measures.
- No default case found for compromising safety measures for any previous orders.
- Contact other sites for performance history if possible.
- Select electrical contractor to perform electrical cable and conduit D&R.
- Select authorize contractors to perform lead and asbestos removal.

### **13. Miscellaneous**

- The written Job Plan must detail that the work must be stopped, re-evaluated, and a new plan developed if any condition changes. It must include the process to be used and persons who must be involved in developing the new plan.
- Develop a project-specific disciplinary process that is focused on the contractor supervision's accountability for the actions of their workers rather than one that focuses solely on the workers.

Use task-specific work and hot work permits.

D&R is truly "reverse construction." The planning of the work must take this into account. As an example, small piping, lighting, instruments, steam and trap manifolds, etc. should be removed first around major pieces of equipment prior to their dismantling.

### Attachment -3

## RECOMMENDED PLANNING CHECKLIST FOR D&R FACILITIES

**1. Intent** This checklist is to be used during the planning of D&R . It list items that should be evaluated before D&R on facilities, buildings, or equipment takes place.

### 2. Regulations

All regulations which govern D&R activity must be complied with.

### 3. Pre-Assessment

3. Prior to conducting a field assessment of the area, equipment, or facilities to be D & R'd, a knowledgeable/competent person should conduct a pre-assessment to establish background information and scope of D&R.

- Identify the products produced at the facility or in the equipment being D & R'd and their respective health and physical hazards.
- What chemicals were used in the process?
- How and when was the facility or equipment idled, mothballed, or decontaminated?
- Is the area or equipment considered "clean," i.e., are there any concerns with re-use of scrapped material?
- Where will scrap be processed?
- What methods/tests will be needed to determine the state of decontamination?
- What materials can be recycled?
- Where and on what equipment will torch cutting be allowed or will cold cutting be required throughout?
- Will the entire facility or area be D& R'd or are only certain pieces of equipment within the area being removed?
- Is equipment (vessels, etc.) to be removed whole or cut up in pieces?
- Know weights of equipment, vessels, etc.
- What method will be used to distinguish between equipment to be removed and equipment to remain?
- Will any safety or control feature be temporarily or permanently disabled? How will this affect operating equipment?
- What is the current operating/energized state of the area?



- How will the equipment be, or is it, isolated from pressurized or energized sources (electrical, service, process, etc.)?
- Have equipment changes or modifications occurred that are not reflected in the system documentation?
- What is the proximity of area, equipment, or facilities being D& R'd to occupied area / operational areas?
- Will access into the area by those not involved in the D&R be required? If so, what routes will they use and what protections will be required for them?
- Will confined space entry be necessary?
- Is there a possibility of ground or soil contamination?
- What is the degree of unknown underground services? Will extensive hand excavation be required?
- Do pits that have been opened by removal of equipment contain residual lubricants, finish paints or other flammable liquids?
- Do pits need to be cleaned prior to burning and welding around or above them?
- Are there any biological hazards associated with residual materials contained in pits? (Consult the site industrial hygienist.)

#### **4. Assessment**

Conduct a field assessment of the area, equipment, or facility to be D& R'd. (photograph areas adjacent to the area, equipment, or facilities (if any) being D& R'd to be used to identify damage done to them in the event it occurs during D&R.)

#### **5. Environmental and Health Related**

- Identify location of ditches, trenches, sewers and other routes of possible contaminated runoff. Will monitoring for contaminants in runoff be required?
- Identify coatings containing lead.
- Identify asbestos-containing materials in insulation, transite, roofing, flashing, and other coatings and materials.
- Will large enclosures be needed to remove asbestos-containing material?
- Check for refractory ceramic fiber (RCF) materials such as firebrick in boiler linings, etc.
- Analyze process/chemical residue.

- Test for cadmium in high-temperature coatings etc.
- Check for the presence of biological hazards such as bird droppings, vermin, etc.
- Identify mercury-containing equipment such as lighting ballast and tubes.
- Will the currently used landfill accept asbestos, lead, etc. contamination?
- Will contaminated soil be encountered?
- Consider dust, smoke, noise, and vibration created by D&R activity and the effect it may have on adjacent areas and equipment.

## **6. Structural Related**

- Condition of the structure; has it been idled for an extended period of time and deteriorated?
- What temporary or permanent bracing will be required for equipment or structures being removed or remaining?
- Overhead electrical conductors in close proximity?
- Proximity to other structures not being D& R'd?
- Type of structure (steel, masonry, combination)?
- Composition and condition of roof (built-up, precast concrete, transit, brittle)?
- Allowable roof and floor loads?
- Existing elevator capacities?
- Location and conditions of any confined spaces?
- Basement and sumps involved?
- Presence and location of under piping and electrical feeders?
- Coatings, insulation, mastics (flammability, lead, asbestos)?
- Do combustible metals such as titanium with an oxide coating glass / glass – wools exist?
- Vessels empty or do they contain material which adds weight?

## **7. Planning**

Once the pre-assessment and field assessment have been conducted, a preliminary plan must be developed. The plan should be laid out step-by-step and encompass every activity of the project with particular attention to the safety of D&R crew and other employees.

## **8. Employee Safety**

- PPE requirements.
- Fall prevention and fall protection.
- Hygiene and decontamination needs.
- Special training needs
- Special medical surveillance required.
- Special clothing.
- First-aid plan and clinic location and injury treatment/management process.

## **9. Miscellaneous Planning**

- What governmental permits (federal, state, and local) will be required and who will obtain them?
- Spill-handling procedure, emergency response, and clean up.
- Does the area have adequate ventilation should a spill occur?
- Will temporary containment enclosures create a negative impact on natural ventilation and cause a build up of flammable vapors?
- Fire and explosion response.
- How will fire watch personnel be identified (orange vest, red hardhat, etc.).
- Traffic control and routing of equipment and personnel.
- Perimeter barricading.
- What analytical test will be required and who will perform them (lead, cadmium, asbestos, organic residue)?
- Heavy equipment inspection and operating requirements. Auditing of work (method, by whom, frequency).
- Incident (safety, health, and environmental) reporting needs, by whom to whom).
- Lay down area location.

## **10. Information Provided to the Contractor**

In addition to the standard bid documents, the following should be provided to the contractor performing the work.

- Structural engineer reports.
- Results of any and all tests performed (lead, asbestos, chemical, etc.) including location, coding on map, and regulatory consequences.
- History of structure and general conditions..
- Training and certification requirements of supervisors and employees performing the work for asbestos, lead, cadmium, equipment operations, etc.
- Weights of equipment and basis of assessment.
- Permit system on site.
- Project manager contact.

## **11. Information Required from the Contractor**

- Methods used to D&R including major equipment to be used.
- Fall prevention and protection plan.
- Relevant supervisory and employee training records.
- Lifting and rigging plans.
- Lay down area requirements including trailers for supervision, lunch, change rooms, showers, etc.
- Decontamination trailer requirements (if needed).
- Detailed plan for controlling dust (foot and airborne) and other identified contaminants.