Remediation TOOL BOX

LABS

Life And Building Safety

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ISSUE DESCRIPTION:- FIRE RATED SELF CLOSING DOORS

Requirement of fire door –
Fire rated door is an important safety component in any premises. It prevents fire and smoke from spreading across the building and contains fire to the demarcated compartment of the building. Fire doors are used as a part of lift lobby, staircase, corridors and other areas which are prone to fire hazards. Fire door enables safe evacuation for employees in case of fire.

Process for Remediation-: Before submission of draft CAP (Corrective action Plan) factory needs to consult with their remediation firm for design of fire doors, or factory can check with fire door supplier and procure the test certificates to get CAP approval and subsequently get the design approval form the Inspection Firm

LABS standard reference-:
4.5.2.1-Fire doors assemblies shall conform to IS 3614 Part 2: 1996 or NFPA 252.
Also refer standard 4.5(Page no -25) for more details about fire doors.

Remediation-

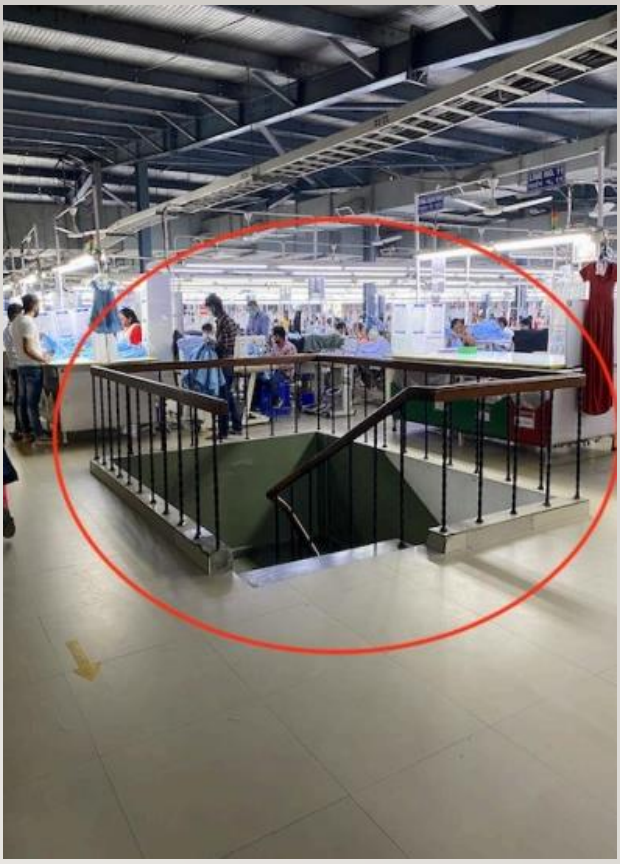
- Installed fire rated door should be certified for providing required fire resistance.
- Fire rated door must be installed by competent person/authority in accordance with manufacturer guidelines.
- Fire rated door must be inspected for smooth movement of its hinges, latches, smoke seals, fire rated glass or any alteration.

ISSUE DESCRIPTION:- FIRE RATED COMPARTMENTATION FOR STAIRCASES

Purpose of Remediation

Fire compartmentation is proposed in staircase to provide enclosure that separate staircase from vertical opening between floors using fire rated/non combustible material.

- It is provided for life safety purpose to protect internal staircase escape route from fire.
- Fire compartmentation provides occupants of building additional time to safely evacuate.
- Fire compartmentation is provided to protect property by preventing or limiting spread of fire from one floor to another.

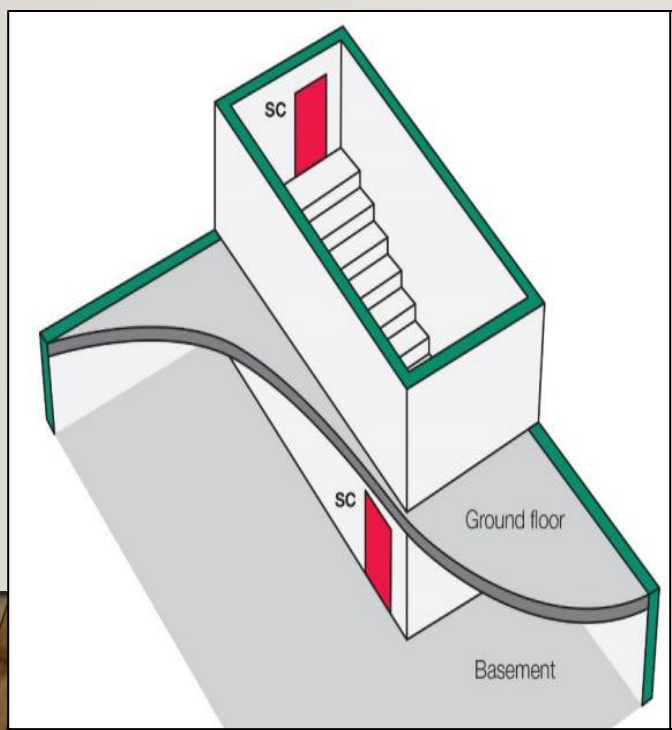


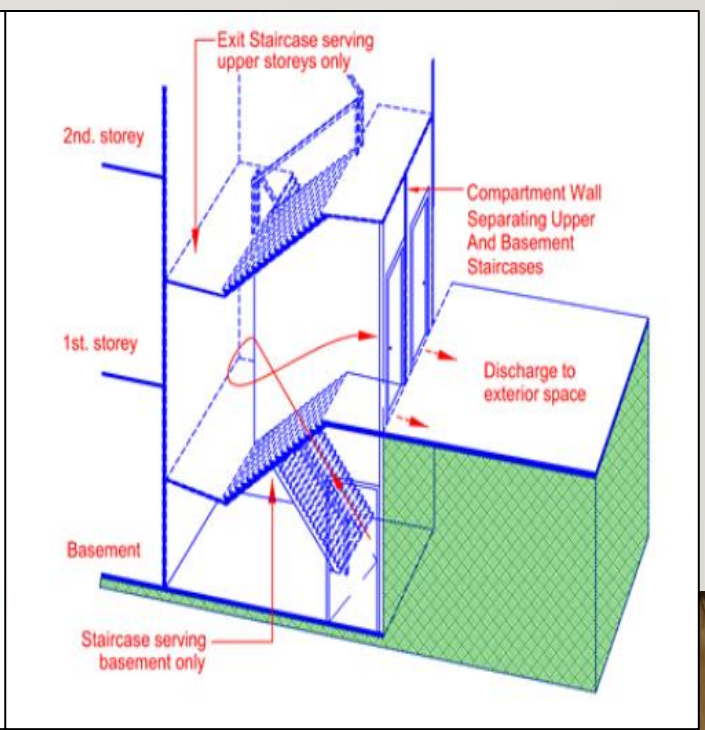
Process to remediate issue-: Before submission of CAP(Corrective action Plan) factory needs to consult with their remediation firm for design of compartmentation along with material to be used and get cap approval & design approved during design sign off by inspection firm before commencing remediation.

LABS standard reference-: Refer Part 4 fire protection construction(Pg 23)

Remediation

Fire stairs compartmentation is achieved through the provision of fire resisting wall around staircase and will include measure to address any opening in the compartment such as service line doors.





ISSUE DESCRIPTION:- FIRE RATED SEPARATION IN STORE

Purpose of Remediation

Storage segregation is proposed to prevent chances of fire in store by separating fire hazards due to machinery, electrical fixture and chemicals used in shop floor, It also prevent spread of fire from store to other areas or vice versa.

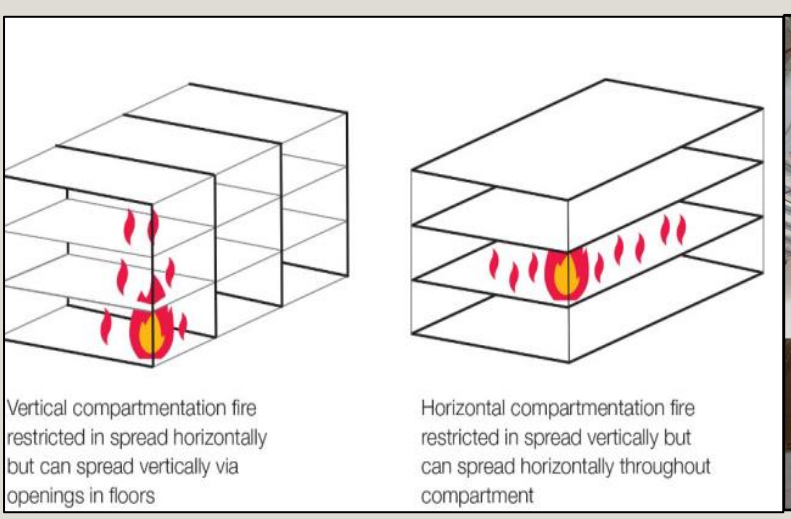
Storage segregation is not required if factory has installed fire sprinklers & incidental to other occupancy.

Process to remediate issue:- Before submission of CAP (Corrective action Plan) factory needs to consult with their remediation firm for design of compartmentation along with material to be used and get Cap approval & design approved during design sign off by inspection firm before commencing remediation.

LABS standard reference-: Refer 3.13 & 3.14 Use and Occupancy (Pg 14)

Remediation

Compartmentation is achieved through the provision of fire resisting wall that separate two area completely and will include measure to address any opening in the compartment.



Design of Remediation

ISSUE DESCRIPTION:- FIRE SEPARATION OF HIGH RISK AREA

Purpose of Remediation

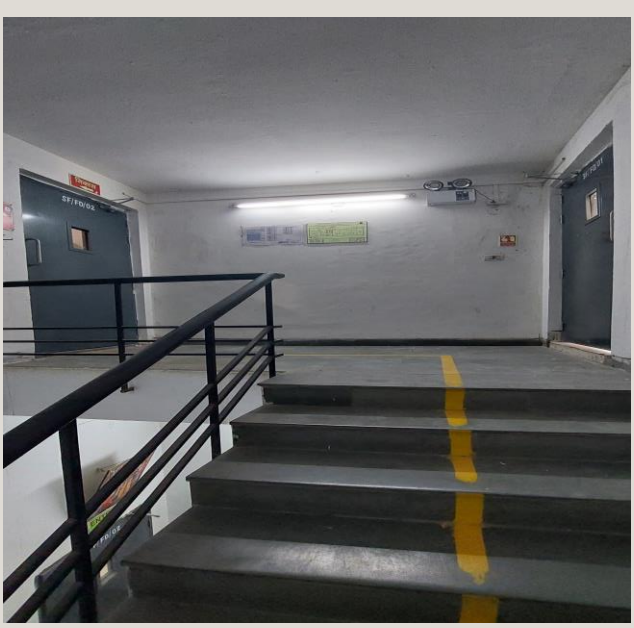
Fire separation of high risk installation(i.e. transformer, UPS ,battery bank HT switch, PNG skid installation etc) are recommended when these areas are located in production floor or in escape route to restrict their risk from escalating or causing hindrance in case of fire emergency.

Process to remediate issue:- Before submission of CAP (Corrective action Plan) factory needs to consult with their remediation firm for design of Separation along with material to be used and get Cap approval & design approved during design sign off by inspection firm before commencing remediation.

LABS standard reference-: Refer 3.6.2,4.2.3 & 10.14 Use and Occupancy (Pg 23,79)

Remediation

Compartmentation is achieved through the provision of fire resisting wall that separate two area completely and will include measure to address any opening in the compartment.



Design of Remediation

ISSUE DESCRIPTION:- IN RACK SPRINKLERS

Purpose of Remediation
In-rack sprinklers are design for protection of storage racks in case of fire. Ceiling mounted sprinklers will not be able to extinguish fire inside solid shelved storage racks as there is no space available for water to percolate in between racks where as in-rack sprinkler ensure fire that begin in the middle of the rack can be extinguished.

Process to remediate issue: Before submission of CAP(Corrective action Plan) factory need to consult with their remediation firm for design of in rack sprinkler along with connection to water resource and get Cap approval & design approved during design sign off by inspection firm before commencing remediation.

LABS standard reference-: Refer 5.3.9.9 Racks(Pg 30)

Remediation

- Sprinklers pipe line can be designed inside material storage rack or could be design parallel to rack beam.
- Sprinkler detector need to be placed within close proximity to stored materials and equipment with minimum clearance of 6 inches.

Design of Remediation

ISSUE DESCRIPTION:- EMERGENCY LIGHT

Purpose of Remediation

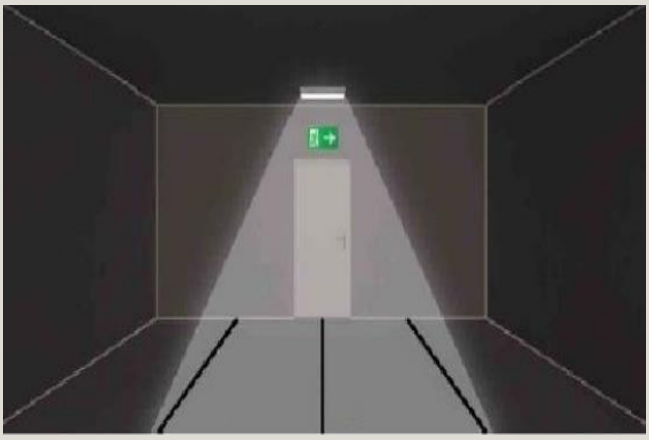
Safety lighting can help to protect individuals within a building in the event of an emergency, lighting key areas and showing the best route out of the building. Inside the buildings, emergency lighting should be installed in all common areas and escape routes. Escape routes should be sufficiently lit and should navigate people out of dangerous situations safely and effectively.

Process to remediate issue: Identify escape route and common location which would be part of emergency escape layout and install battery operated light or .

LABS standard reference-: Refer 3.10.9 (Pg 13)

Remediation

- All other escape routes shall be illuminated with light with illuminance level not less than 10 lux
- Emergency lighting should be provided to provide a minimum lighting level along the entire escape route
- All first aid points or firefighting equipment and fire alarm call points should be visible



Design of Remediation

ISSUE DESCRIPTION:- LPS (LIGHTNING PROTECTION SYSTEM)

Purpose of Remediation

The purpose of installing lightning protection system is to transfer a lightning strike surge safely into earth. It protects building structure, Electronic system and people from effects of a lightning current. Lightning strike can cause electrocution, fire, explosion and failure to mechanical and electrical equipment's.

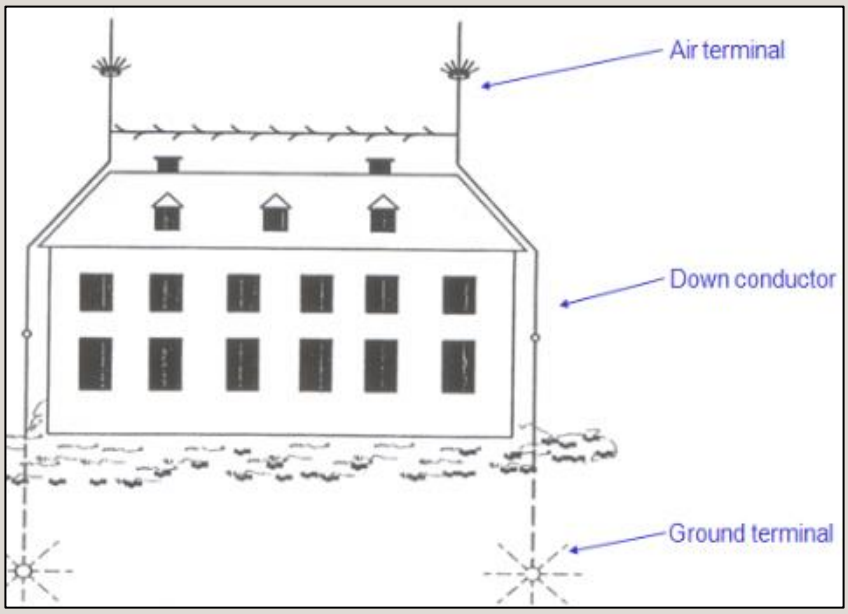
LPS is installed on highest point of building based on the calculations as per the design of the particular Air terminal.

Process to remediate issue: Before submission of CAP (Corrective action Plan) factory needs to consult with their remediation firm for design of LPS system, type of LPS, requirement calculations and get Cap approval & design approved during design sign off by inspection firm before commencing remediation.

LABS standard reference-:Refer 10.26 Lightning Protection system(Pg 85)

Remediation

- Lightning protection system to be installed under supervision of competent person, all its components should be installed as per calculation.
- LPS down conductor must be insulated from building structure.
- LPS earthing should be kept separate.
- Commissioning certificate to be submitted post installation



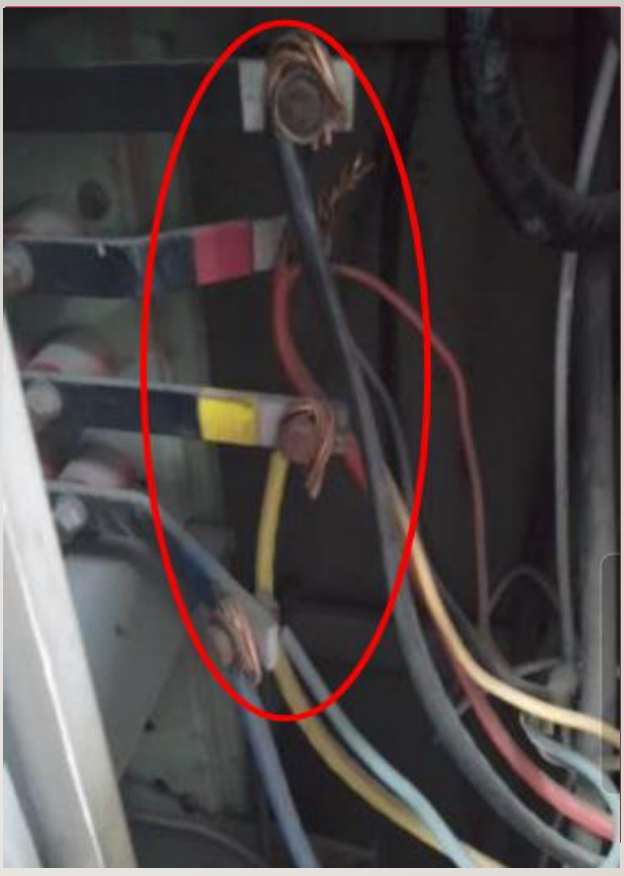
Design of Remediation

ISSUE DESCRIPTION:- USAGE OF LUGS & GLANDS

Purpose of Remediation

A stranded cable if inserted into a terminal, the screw used to tightening cable will push some strands aside leaving few strands making contact and reducing the current carrying capacity which in turn means that the actual load could cause over heating of cable leading to fire

The purpose of installing cable lugs allows supply and distribution of electric current uniformly without any hindrance between electrical cables



Process to remediate issue: Factory team need to ensure that each cable terminating into electrical panel or MCB must have provided with lugs/thimble. Factory team can introduce SOP for wiring which include use of Lugs for wire termination

LABS standard reference-:Refer 10.8.15.2 Wiring of distribution board(Pg 77)

Remediation

- Select proper Lugs as per size of wire
- Outgoing cables shall be connected to terminals only by soldered or welded lugs
- Provide sleeves over remaining part of lugs

Design of Remediation

ISSUE DESCRIPTION:- USAGE OF GLANDS IN ELECTRICAL PANEL

Purpose of Remediation

Cable Gland are proposed as they act as a seal and terminating device to ensure the protection of electrical equipment inside junction boxes. It prevents entry of rodents, dust & vapor from entering in electrical panel. Dust & rodent entry into panels may led to short circuit and fire.

Glands provide additional support to cables in electrical panel.

Process to remediate issue: Factory team need to ensure that all unused openings in such equipment's to be closed/concealed properly. Factory team can introduce SOP for wiring which include use of glands and sealing of openings after use.

LABS standard reference-:Refer 10.8.8 Switchgear(Pg 75)

Remediation

Opening in the panel could be closed by providing glands over electrical cables or by putting sealant into them however glands are advised for better maintenance.

Design of Remediation

ISSUE DESCRIPTION:- INSULATIVE RUBBER MATS

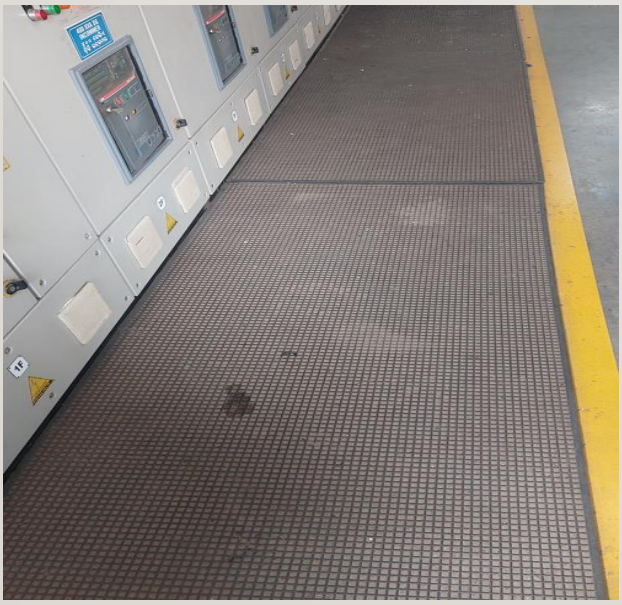
Purpose of Remediation
Insulation rubber mats are special rubber mats that are designed to prevent electric shock by enabling high insulation between ground and person standing above it. Rubber mats are used in front of high voltage equipment's. Electrical panel are advised to be kept in 3ft clearance area of panel for effective movement of maintenance personnel working on panel.

Process to remediate issue: For obtaining maximum practical safety in adverse working conditions, the mat should be permanently pasted, All joints and comers shall be filled/covered with insulating material of matching color.. Wherever the floor is porous in nature and attracts moisture, waterproofing compound is recommended to be used to protect insulating and electrical properties

LABS standard reference-:Refer 1,5.5.11,10.5..4.6 of LABS standard

Remediation

Insulation rubber mats installed under electrical panel

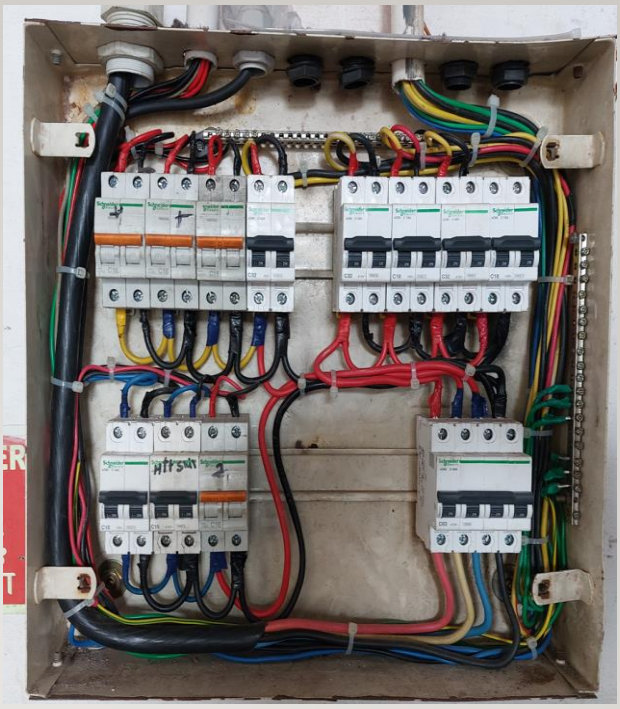


Design of Remediation

ISSUE DESCRIPTION:- SURGE PROTECTION DEVICE

Purpose of Remediation

Surge protection device is used to limit voltage surge in normal electrical system to protect electrical installation from over voltages.
An electric surge is caused due to spike in voltage of ac current which could damage your live equipment. At the time of surge, Surge device can absorb this spike and release it in the form of heat or divert the current to earth.

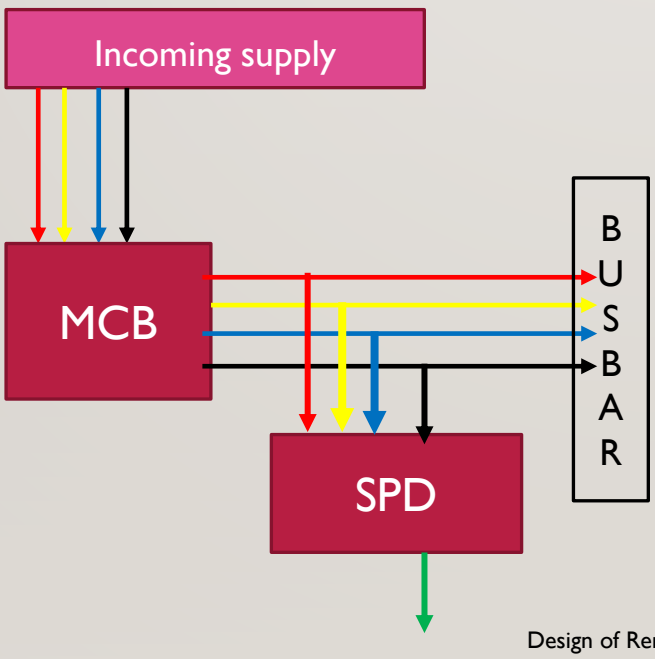


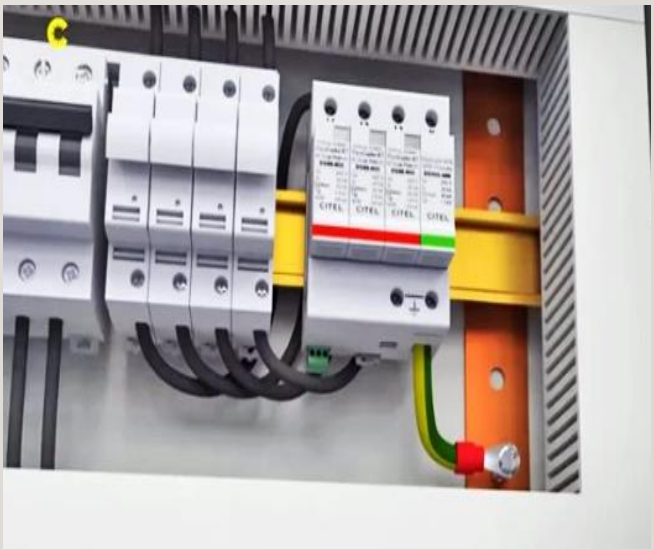
Process to remediate issue: Factory team/Remediation firm need to layout design of power supply distribution with SPD install such that current is passing through SPD into machine installed.

LABS standard reference-:Refer 10.23 protection of circuits (Pg 83) of LABS standard

Remediation

SPD is connected to the conductor before it enters the equipment. The surge arrester is also connected to earth and functions by routing energy from an over-voltage transient to ground if one occurs.





Design of Remediation

ISSUE DESCRIPTION:- LAYING OF CABLE THROUGH CABLE TRAY

Purpose of Remediation

Cable tray are used to provide support to electrical cables for power distribution to prevent open wiring or conduit wiring system.

Cable tray allowed efficient heat dissipation, identification and easy maintenance and repair of electrical cables.

Process to remediate issue: Factory team need to lay cable on cable tray affixed on wall or suspended through ceiling .

LABS standard reference-: Refer 10.11.4 installation of LABS standard(Pg78)

Remediation

Installed electrical cable on cable tray, to be clear from the gas/fuel/water pipelines

Design of Remediation

ISSUE DESCRIPTION:- BODY EARTHING OF PANELS

Purpose of Remediation

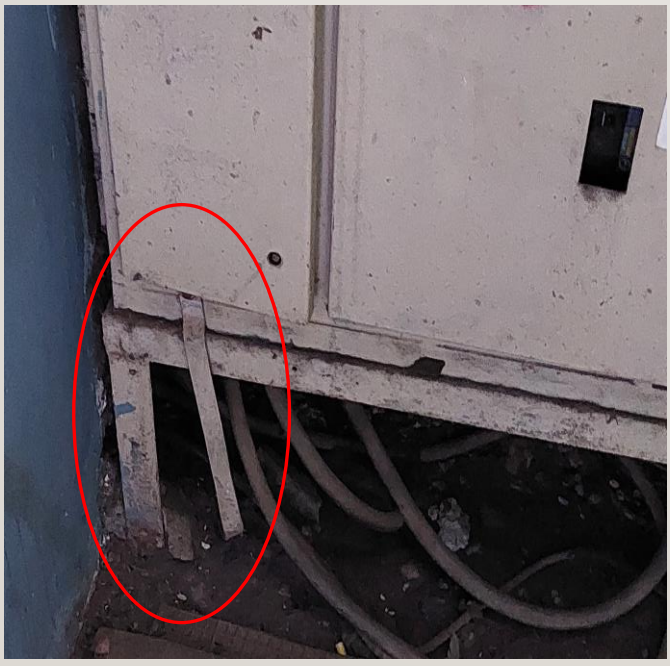
During fault condition, high current flows through the system and there is a possibility that current does not flow through its intended path instead flows through metallic body of machines or panel. When a person comes in contact with such an electric circuit or source of electric energy, he/she is prone to an electric shock. An electric shock may result in either no injury at all or one which can prove to be fatal, causing death therefore body earthing is recommended

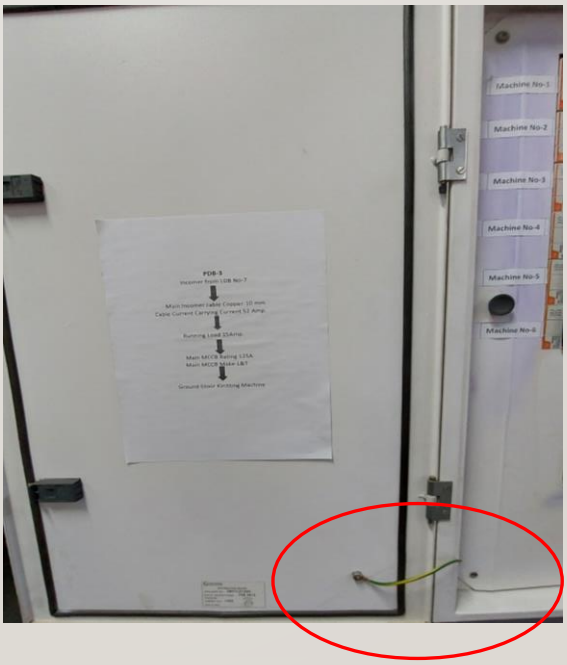
Process to remediate issue: Factory team need to connect body of metal clad switchgear to earth through wire or strip

LABS standard reference-: Refer 10.8.12 installation of LABS standard(Pg76)

Remediation

Connect panel body to earth through wire or copper strip also ensure not to connect body earthing to system earthing. Ensure to use appropriate cable/wire with defined cross-sectional area

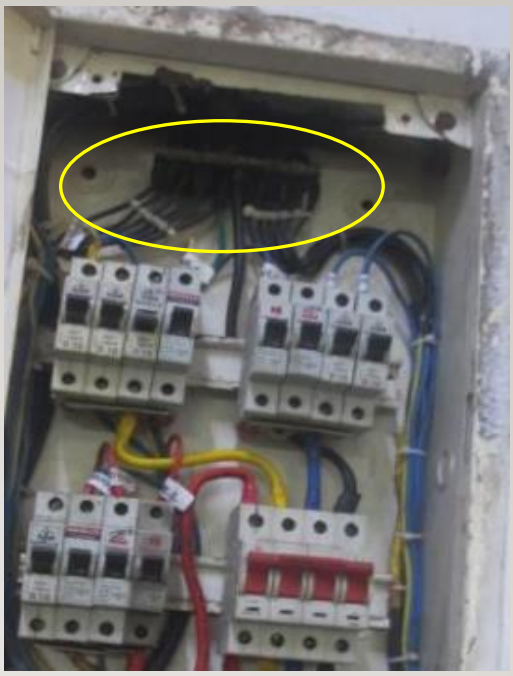




ISSUE DESCRIPTION:- HIGH TEMPERATURE OF ELECTRICAL PANEL

Purpose of Remediation

Due to an unbalanced load, Loose connections or usage of low-capacity conductor wires high-temperature zones develop inside the electrical panel As electrical panels are enclosed there is high chance that these high-temperature points are left unattended ,Which leads to fire inside the electrical panels and could lead to cause of the catastrophic disaster.



Process to remediate issue:The factory team need to carried out thermographic survey of installed electrical panel and DB boards in defined intervals.

LABS standard reference-: Refer 10.27.2 periodic inspection and testing Pg 86

Remediation

Thermographic surveys need to be carried out using a thermal scanner designed to capture thermal images in defined intervals (suggested at least thrice a year) by a competent person. If a high temperature is observed inside the electrical panel then it needs to be remediated after identifying the cause of rise in temperature.

Before

After

CASE STUDY – INCIDENT DURING THERMOGRAPHIC SCANNING

Introduction: Serious eye injury caused during a thermographic scanning exercise

Key issues:

- Arc-Flash hazard identification
- Safe Thermographic Scanning practices

Arc-Flash hazard during Thermographic Scanning process

The electrical technician performing monthly thermographic scanning, opened the inner cover of electrical cabinet, which was secured by bolts. While removing the cover, detected that one nut fell inside the cabinet. He tried to use test pen to take the nut out, but during this process, the nut slipped and came in contact with the MCCB resulting in a short circuit and the arc-flash released directly into technician's eyes. The electrical cabinet immediately turned off due to the short circuit protection.

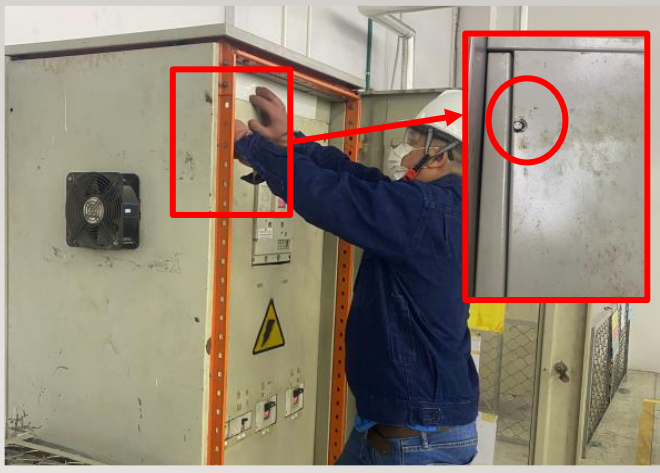


Figure 1. Cabinet door lock by bolts

Figure 2. Arc-flash released position

Root cause analysis

1. **Electrical cabinet design outdated:**
   - The cabinet installed in 2014, with inner door locking mechanisms by bolts
   - Lack of phase separators in the sub MCCB
2. **Electrical thermographic scanning safety induction**
   - Thermographic scanning safe work induction/procedure was not established
3. **Arc-Flash risk assessment**
   - Arc flash hazard was not identified and evaluated
4. **PPE compliance**
   - The plant provided: insulted shoes, facemask, insulated gloves and glass. But the technician did not wear them during do the thermographic scanning

Next steps

1. **Hazard review:**
   - When conducting the risk assessment for electrical work, consider the arc-flash hazard and calculate safety distances and arc-flash energy.
2. **Work procedure**
   - Develop and implement electrical thermographic scanning safe procedure
3. **Arc-Flash resistant PPE**
   - Provide/use the suitable PPEs while working on electrical cabinet based on Arc-flash calculation
4. **Safe Work Permit**
   - Evaluate the applicability & use of Safe Work Permit to work on live electrical equipment

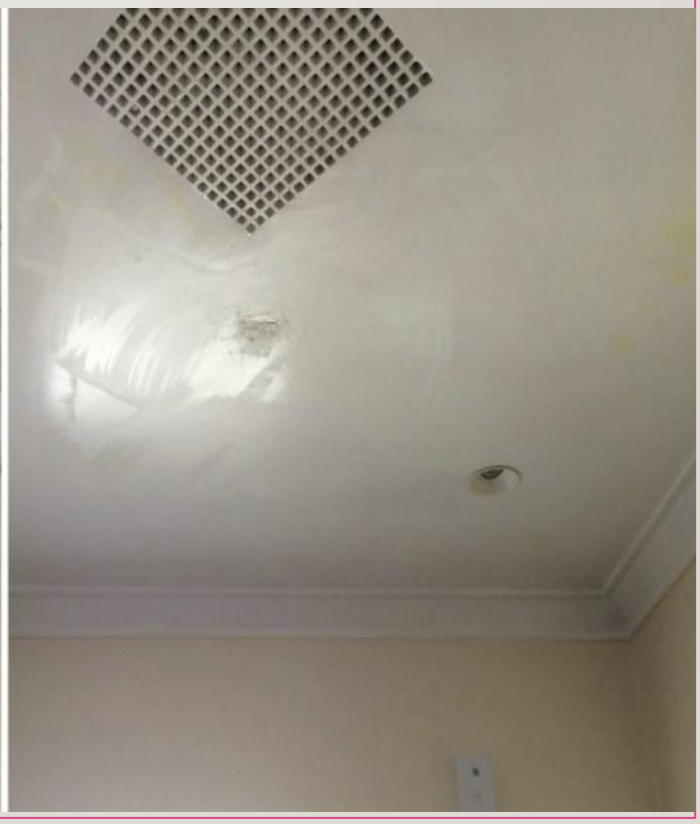
ISSUE DESCRIPTION:- DAMPNESS/ WATER INGRESS

Purpose of Remediation
Dampness tends to cause secondary damage to a building. The unwanted moisture enables the growth of various fungi in wood, causing rot or mould health issues. Dampness along with warmth and darkness germs of dangerous diseases such as tuberculosis, neuralgia, rheumatism etc.

Process to remediate issue: The most effective way of preventing dampness problems in buildings, including those resulting in damp masonry at the foot of walls, is to minimize moisture sources and provide adequate passive moisture sinks to dissipate any penetrative moisture so as to make the system fail safe.

LABS standard reference-:Refer 8.25 of LABS standard(Pg 63)

Remediation
Dampness prevention and control.
Damp proof exterior paint need to be applied to prevent dampness and water seepages along with arresting the leakage source.



ISSUE DESCRIPTION:- STRUCTURAL STEELWORK CORROSION

Purpose of Remediation
The surface of a reactive metal slowly reacts with the moisture and air present in the atmosphere; as a result, a brownish compound is formed on the surface. The compound formed on the surface makes the metal appear dull and deteriorate which results in the structural integrity fail (Load Bearing capacity) this leads to injuries and metal structure collapse accidents.

Process to remediate issue: The rusting of metal can be prevented by greasing, painting, galvanizing, anodizing.

LABS standard reference-:Refer 8.25 of LABS standard(Pg 63)

Remediation
Factory need to apply anticorrosion treatment then apply primer and final anticorrosion paints on corroded parts and then further corrosion prevention and control can be achieved by carrying out visual inspection of MS structures and preventive maintenance at regular intervals.

ISSUE DESCRIPTION:- VISUAL INSPECTION OF THE BUILDING & STRUCTURES

Purpose of Remediation
Physical examination of the building & structures to identify visual signs of subsidence, cracks on walls/ beams/ columns/ slabs, exposure of reinforcements, corrosion of steel structural, roof top water proofing,conditions, buckling/ bending of members, seepages/ leakages, etc., or any other structural distress, including inaccessible areas. Such inspection to be carried out once in 3 years by a competent Civil Engineer with sufficient experience in inspection.

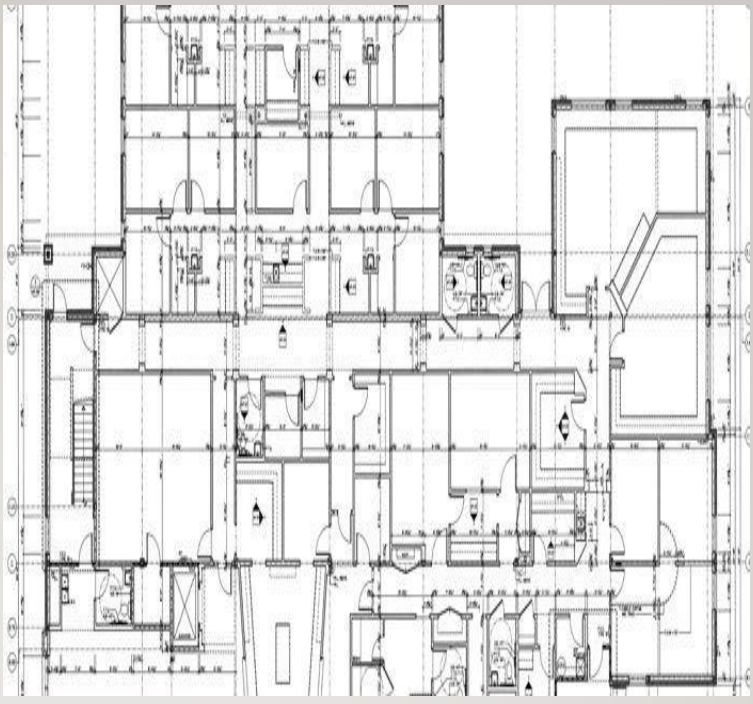
Process to remediate issue: Structural Inspections to determine the current condition of the structure. To specify type; cause; and extent of deterioration, the rate of deterioration, and whether deterioration is active or not. To estimate the remaining time before repair or replacement as per Qualified Structural Engineer recommendations.

LABS standard reference-:Refer 12.7.4 of LABS standard(Pg 90)

Remediation
Load bearing capacity for civil structure must be calculated by structural engineer. The Safe Load Plan for each suspended floor and roof shall be permanently and conspicuously posted on that floor,
If during structural inspection it is identified that structure need repair or strengthening, then it needs to be carried out under guidance of structural engineer

ISSUE DESCRIPTION:- REQUIREMENTS FOR AS-BUILT DRAWINGS.

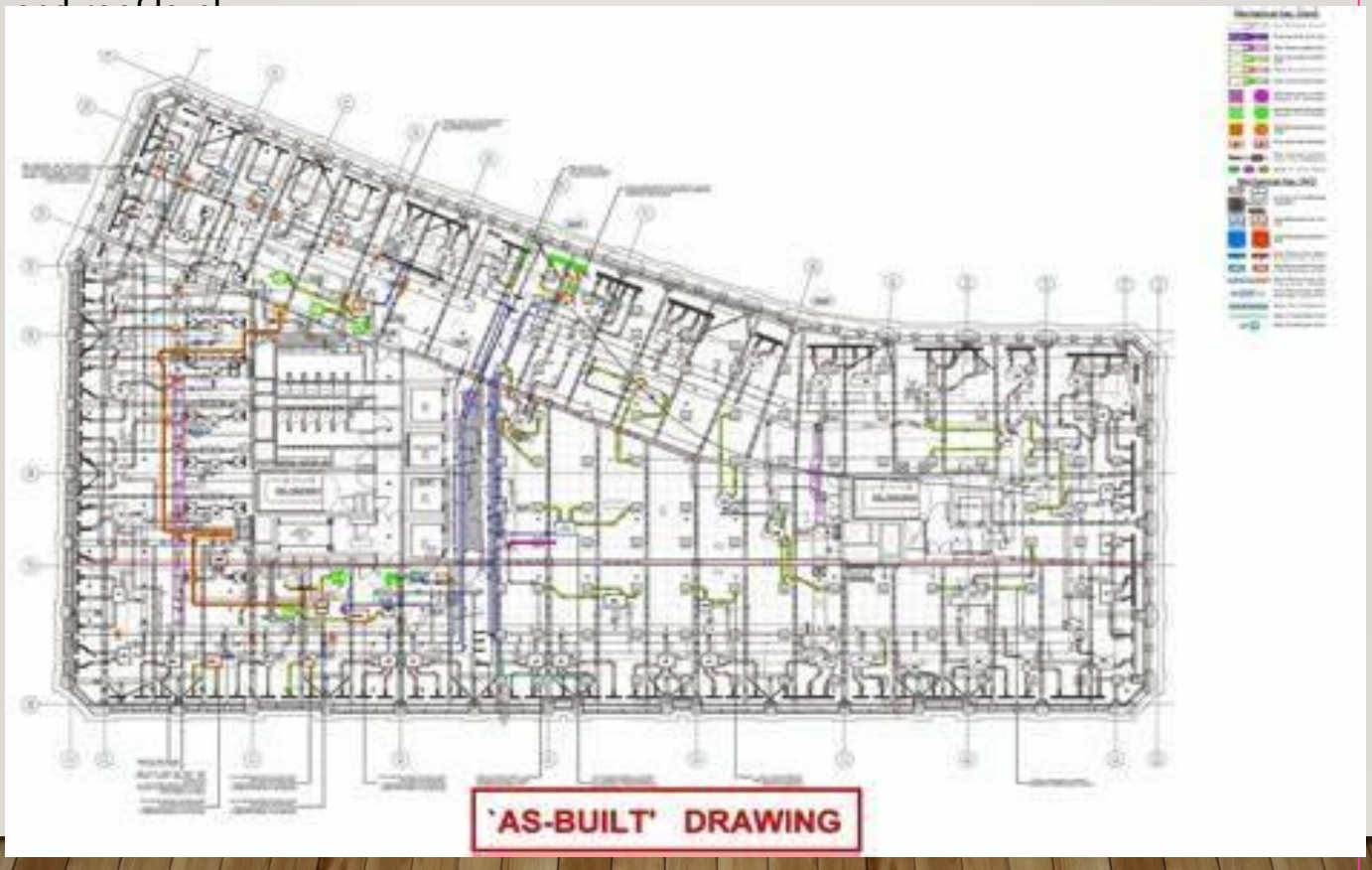
Purpose of Remediation
Purpose of an as-built drawing is to record any modification made during the building process that deviates from the original design. The drawings that are first completed for a planned construction project are not the ones that are needed once the project is finished. Instead, the contractor needs to submit the as-built drawings.



Process to remediate issue: As built drawing is used for review of various factors,
1. To analyze adequacy of structure to withstand the purpose and use of the building.
2. Understand the fire load of each area
3. Provide reference to factory for further expansion of load or structure

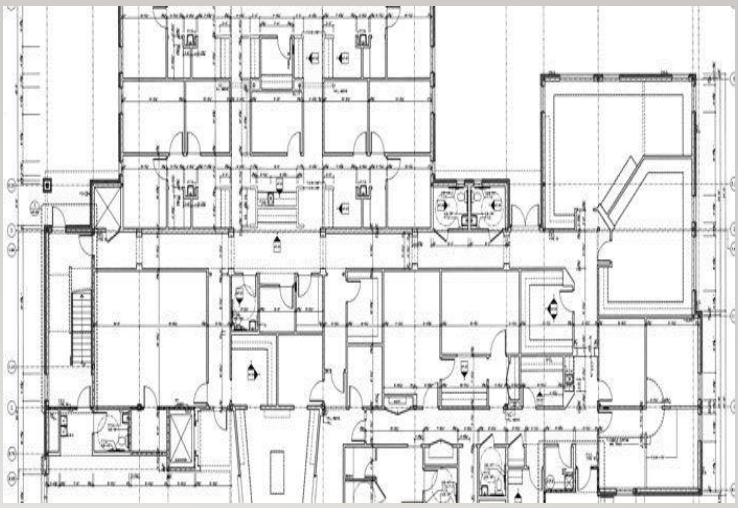
LABS standard reference-:Refer 3.10vof LABS standard(Pg 11)

Remediation
Qualified Structural Engineer to verify the drawings for as built conditions and should use the architectural plan documents as background and should show, for every floor



ISSUE DESCRIPTION:- FLOOR LOADING PLANS AND FLOOR LOAD MARKINGS.

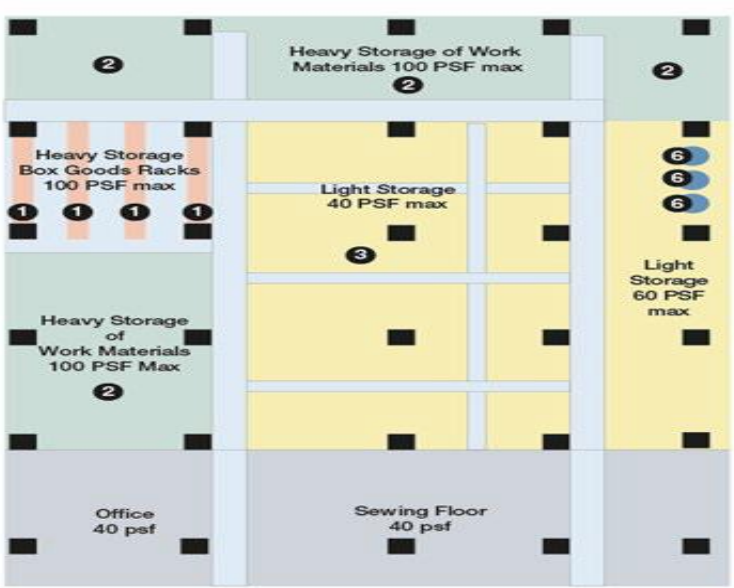
Purpose of Remediation
Floor loading is the load that a floor (as of a building) may be expected to carry safely if uniformly distributed, it is usually calculated in kilonewtons per square meter or kN/m2. It is also known as live load.



Process to remediate issue:
In every factory building, Safe Load Plans shall be prepared, by a Qualified Structure Engineer, for each suspended floor and roof level (if roof is accessible). These Safe Load Plans shall document the actual maximum operational loading allowable. The Safe Load Plan for each suspended floor and roof shall be permanently and conspicuously posted on that floor

LABS standard reference-:Refer 8.9.3 & 8.9.4 of LABS standard(Pg 55)

Remediation
The Factory Owner shall ensure that the live load for which a floor or roof is or has been designed, will not be exceeded during its use.



Typical Floor Loading for this Floor:

No	Type	Item	Max PSF Load	Description
1	HS	Box Goods Rack	120	W36" x H72", Max 6 boxes high, 15kg/box
2	HS	Denim Rolls Storage	150	13" dia, 72" long, 150 kg/roll. 6 high max
3	LS	Bundled Box Storage	40	Max 48" high, 24" aisle each bay
4	Light	Office	40	W36 x H72, 6 boxes high, 15 kg/box
5	Light	Sewing Tables	40	Typical sewing tables
6	Special	Water Tank	N/A	4000 lbs, 60" dia, 84" tall, 5000 gal

Notes:
HS - Heavy Storage
LS - Light Storage

Floor x Load Plan:
Factory Name: _____ Prepared by: _____
Date Approved: _____ Approved by: _____

ISSUE DESCRIPTION:- SEISMIC BRACING OF NON STRUCTURAL ELEMENTS

Purpose of Remediation
Non structural elements are those elements that are not part of primary structure and are not part of structural member purpose of seismic bracing is to restrict horizontal shaking from an earthquake. All seismic braces firmly attach equipment to structural members of a building so that they move with the structure during an earthquake Ex ventilation system ,material racks ,air coolers, Chimney etc.

Process to remediate issue: Qualified Structural Engineer to Inspect to determine the current condition of the structure and provide bracing accordingly to primary structure

LABS standard reference-:Refer 8.17 of LABS standard(Pg 58)

Remediation
Non key structure to be anchored or attached adequately with primary structure to resist seismic force.

ISSUE DESCRIPTION:- SLAB REINFORCEMENT EXPOSED

Purpose of Remediation
Reinforcement steel bars exposed to the atmosphere This exposure results in corrosion of these reinforcement bars. Corrosion of reinforcement bars is a common Cause of degradation of structures & The concrete will not be able to bond itself to the steel leading to reduced load carrying capacity

Process to remediate issue: Qualified Structural Engineer to inspect to determine the current condition of the reinforcement based on which it can be decided either to simply cover exposed part or it need to be replaced

LABS standard reference-:Refer 8.25 of LABS standard(Pg 63)

Remediation

Qualified Structural Engineer to inspect to determine the current condition of the reinforcement and would recommend course of action it could be just covering up of exposed part, removing of exposed part or cutting of exposed part

REFERENCES

1. https://www.scdf.gov.sg/firecode/table-of-content/chapter-2-means-of-escape/clause-2.3
2. https://alesayistorage.com/products-solutions/in-rack-sprinkler-systems/
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