

**INTERNSHIP REPORT**  
**ON**  
**DESIGN & DEVELOPMENT OF**  
**45/15 TON EOT CRANE CIRCUIT**  
**AT**  
**TATA STEEL GROWTH SHOP**



**Submitted for partial fulfilment of**  
Bachelor of Technology  
**ELECTRICAL & ELECTRONICS ENGINEERING**



**CAMBRIDGE INSTITUTE OF TECHNOLOGY,**  
**RANCHI**

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# CERTIFICATE

This is to certify that the project entitled "**Design & Development of 45/15 Ton EOT Crane Circuit**" has been successfully carried out by **PRIYANKA MURMU** (Reg. No.: 24050475018) in partial fulfilment of the requirements for the award of the degree in **Electrical & Electronics Engineering** during the **Academic Year 2025–2026**.

The project work has been completed under the guidance and supervision of **Mr. Chandan Kumar Mohanty (Manager Design E&I)**, and meets the prescribed standards of quality and technical detail laid down by the institute.

During this project, the student has shown keen interest, dedication, and a good understanding of the subject matter. The work demonstrates the application of engineering principles in the **Design and development of EOT crane control circuits**, and reflects the student's ability to analyse, design, and implement practical solutions in the field of electrical engineering.

Place: Jamshedpur

Date: 19/6/2026

**Guide/Supervisor**

  
Signature

# ACKNOWLEDGEMENT

I would like to express my sincere gratitude to my project guide and mentor for their invaluable guidance, continuous support, and encouragement throughout the successful completion of this project. Their expert advice, technical insights, and constructive suggestions played a vital role in enhancing my understanding and helped me overcome various challenges encountered during the work.

I am deeply thankful for their constant motivation and timely assistance, which enabled me to successfully complete the project titled "**Design and Development of a 45/15 TON EOT Crane Circuit.**"

I also take this opportunity to express my appreciation to all those who directly or indirectly contributed to the successful completion of this project.

# ABSTRACT

The primary objective of this project is the **design and development of the electrical control circuit for a 45/15 TON Electric Overhead Traveling (EOT) crane**. The project focuses on the systematic design and analysis of essential electrical and control components required for the efficient operation of the crane.

The study emphasizes key aspects such as **motor protection systems, control logic, interlocking arrangements, safety features, and operational requirements**. The designed control circuit ensures **safe, reliable, and efficient operation** of the three fundamental crane motions, namely **hoisting, cross travel (CT), and long travel (LT)**.

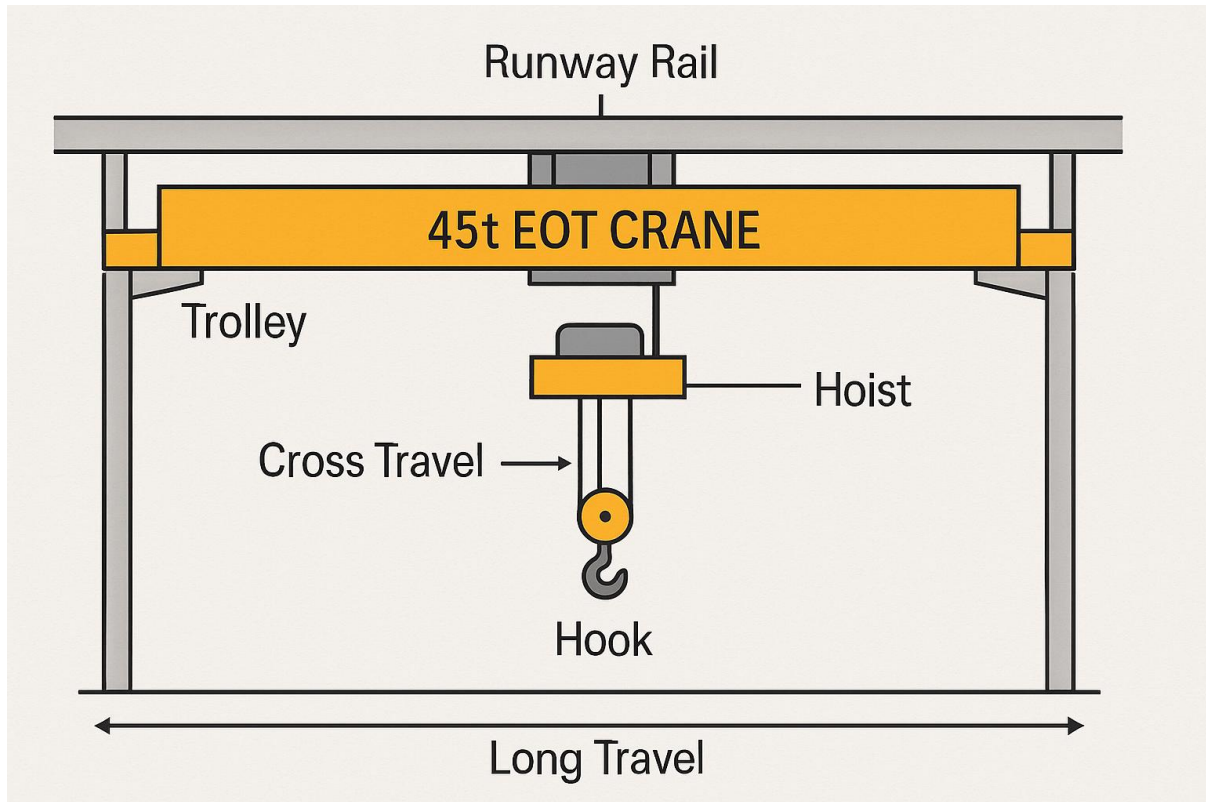
In addition, the project includes the selection of appropriate **switchgear components**, implementation of **overload protection mechanisms**, and integration of **emergency stopping systems** to enhance operational safety. The design also considers important aspects of **control panel configuration and layout**, ensuring ease of operation, maintenance, and fault identification.

Overall, the developed system provides a **comprehensive and practical solution** for the safe and efficient functioning of heavy-duty EOT cranes in industrial environments.

# TABLE OF CONTENTS

1	Introduction
2	Objectives
3	EOT Crane Overview
4	Technical Specifications
5	Components Used
6	Circuit Design Methodology
7	Switchgear Selection
8	Motor Selection
9	Protection System
10	Control Circuit Description
11	Safety Features
12	Advantages
13	Applications
14	Conclusion
15	References

# 1. Introduction – 45/15 TON EOT Crane



A **45/15 TON EOT (Electric Overhead Traveling) Crane** is a heavy-duty industrial lifting machine designed to **lift, transport, and position loads up to 45 metric tons** within a defined working area such as a shop floor, steel plant bay, or maintenance workshop.

This type of crane operates on **overhead runway rails** and is widely used in industries where handling of **large and heavy components** is required with precision, safety, and efficiency.

## Key Features of 45T EOT Crane

- **Capacity:** Up to 45/15 TONs (heavy-duty application)
- **Type:** Usually **double girder construction** for higher strength and stability
- **Drive System:** Electric motor-driven (Hoist, Cross Travel, Long Travel)
- **Control:**
  - Pendant control
  - Radio remote / Cabin control
- **Duty:** Suitable for continuous and heavy industrial operations

## Motions of the Crane

A 45T EOT crane performs three main motions:

1. **Hoisting (Up/Down)**
  - Lifting and lowering of the load through wire rope hoist
2. **Cross Travel (CT Motion)**
  - Movement of the trolley across the bridge
3. **Long Travel (LT Motion)**
  - Movement of the entire crane along the runway rails

## Applications of 45/15 TON EOT Crane

- Steel plants (billets, slabs, ladles)
- Power plants (turbine handling)
- Heavy fabrication shops
- Railway workshops
- Shipyards and large assembly units

## Importance

A 45T EOT crane is essential for:

- Handling **very heavy equipment safely**
- Improving **production efficiency**
- Reducing **manual handling risks**
- Ensuring **precise positioning of loads**

## Summary

The **45/15 TON EOT crane** is a **robust and high-capacity material handling system** that integrates **mechanical strength, electrical control, and safety features** to perform reliable operations in demanding industrial environments.

## 2. Objectives of EOT Crane System

The **primary objectives of an EOT (Electric Overhead Traveling) crane** are focused on achieving **efficient, safe, and economical material handling** in industrial environments.

### 1. Efficient Material Handling

- To **lift and transport heavy loads quickly and smoothly.**
- Minimize manual handling and worker effort.
- Improve production rate in industries.

### 2. Safe Operation

- To ensure **maximum safety of personnel and equipment**
- Incorporates:
  - Limit switches
  - Overload protection
  - Emergency stop systems.
- Reduces accident risks during lifting operations.

### 3. Full Area Coverage

- To cover the entire working area using:
  - Long travel (LT)
  - Cross travel (CT)
  - Hoisting motion
- Enables **flexible and precise load positioning.**

### 4. High Load Capacity Handling

- Designed to handle **heavy loads (e.g., 45/15 TONs and above)**
- Suitable for heavy industries like:
  - Steel plants
  - Power plants
  - Fabrication shops

## 5. Cost-Effective Operation

- Reduce manpower requirement.
- Minimize material handling time.
- Lower operational and maintenance costs

## 6. Reliability and Continuous Duty

- To operate under **heavy-duty and continuous working conditions**
- Ensures consistent performance in industrial applications.

## 7. Automation & Control

- Facilitate integration with:
  - PLC
  - VFD
  - SCADA systems
- Enables:
  - Remote operation
  - Smart monitoring

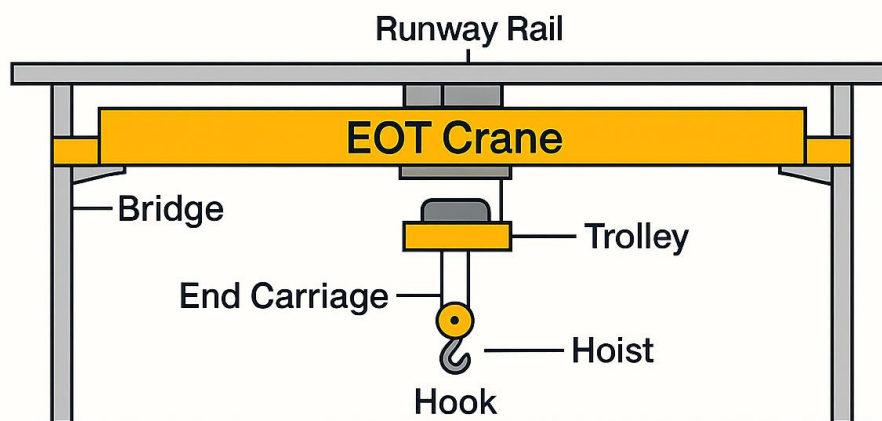
## Summary

The main objective of an EOT crane is to provide a **safe, efficient, and reliable solution for handling heavy materials**, while improving **productivity and reducing operational cost**.

### 3. EOT Crane Overview

An **EOT (Electric Overhead Traveling) crane** is a type of industrial lifting equipment used for **handling heavy materials efficiently within a fixed area** such as factories, workshops, warehouses, and production plants. It operates on **overhead runway rails**, allowing it to move loads across the entire workspace without occupying floor space.

## EOT Crane Overview



#### Basic Structure

- Bridge (Girder)
- End Carriages
- Trolley
- Hoist Mechanism, Hook

#### Motions of EOT Crane

- Hoisting Motion (Up/Down)
- Cross Travel (CT Motion) – Trolley large

#### Control System

- Pendant push buttons
- Radio remote control
- Cabin control precise automation

#### Key Features

- High load carrying capacity

## Basic Structure

The main components of an EOT crane include:

- **Bridge (Girder)** → Horizontal beam that carries the load.
- **End Carriages** → Wheels that enable movement along the rails.
- **Trolley** → Moves across the bridge (cross travel)
- **Hoist Mechanism** → Lifts and lowers the load.
- **Hook** → Holds the material.
- **Runway Rails** → Support the long travel motion.

# Motions of EOT Crane

An EOT crane performs three fundamental movements:

1. **Hoisting Motion (Up/Down)**
  - For lifting and lowering the load
2. **Cross Travel (CT Motion)**
  - Trolley movement across the bridge
3. **Long Travel (LT Motion)**
  - Crane movement along the runway rails

## Control System

The crane is operated using:

- Pendant push buttons
- Radio remote control
- Cabin control (in large cranes)

Modern systems include **PLC and VFD** for precise control and automation.

## Key Features

- High load carrying capacity.
- Efficient material handling
- Safe and reliable operation
- Better space utilization
- Suitable for automation

## Summary

The EOT crane is an essential material handling system that combines **mechanical structure, electrical drives, and control systems** to ensure **efficient, safe, and reliable movement of heavy loads** in industrial environments.

## 4. Technical Specifications – 45/15 TON EOT Crane

The following are the **typical technical specifications** of a **45/15 TON Electric Overhead Traveling (EOT) Crane** used in heavy industrial applications.

### 1. Basic Specifications

- **Crane Type:** Double Girder EOT Crane
- **Rated Capacity:** 45/15 TONs
- **Span Length:** 10 – 30 meters (depending on plant layout)
- **Lifting Height:** 10 – 20 meters
- **Duty Class:** Heavy Duty (Class III / IV as per IS/FEM standards)
- **Application:** Steel plants, power plants, heavy fabrication

### 2. Power Supply Details

- **Supply Voltage:** 415V  $\pm$ 10%
- **Phase:** 3-phase AC
- **Frequency:** 50 Hz
- **Control Voltage:** 110V AC / 24V DC
- **Power Feeding System:**
  - DSL (Down Shop Lead) system or
  - Cable festoon system

### 3. Motion Specifications

Motion Type	Speed (Typical)	Motor Type
Hoisting	2 – 8 m/min	Slip ring / VFD motor
Cross Travel (CT)	8 – 20 m/min	Squirrel cage motor
Long Travel (LT)	20 – 60 m/min	Squirrel cage motor

### 4. Hoisting System

- **Type:** Electric wire rope hoist
- **Rope Type:** Steel wire rope
- **Drum Type:** Grooved drum
- **Brake:** Electromagnetic fail-safe brake
- **Gearbox:** Helical / planetary gear box

### 5. Control System

- **Operation Mode:**
  - Pendant push button
  - Radio remote control
  - Cabin control (optional)
- **Control Panel Type:**
  - Contactors + relays OR
  - PLC-based control
- **Drive System:**
  - Direct-on-line (DOL) starter OR
  - VFD (Variable Frequency Drive)

## 6. Protection System

- Overload protection (OLR / Load limiter)
- Short circuit protection (MCB/MCCB)
- Earth fault protection
- Phase failure protection
- Limit switches (UP/DOWN, CT/LT)

## 7. Mechanical Specifications

- **Bridge Type:** Welded box girder
- **End Carriage Wheels:** Forged steel wheels
- **Buffers:** Rubber / spring type
- **Hook Type:** Forged steel hook with safety latch

## 8. Safety & Accessories

- Emergency Stop (E-Stop)
- Warning hooter / alarm
- Limit switches
- Anti-collision system (optional)
- Load indicator / display

## 9. Environmental Conditions

- **Operating Temperature:** -10°C to +50°C
- **Humidity:** Up to 95%
- **Working Environment:**
  - Indoor / outdoor
  - Dusty / high-temperature zones (with special design)

## Summary

A **45/15 TON EOT crane** is a **high-capacity, heavy-duty lifting system**, It is specifically designed to handle **large and heavy industrial loads safely and efficiently**.

## 5. COMPONENTS USED

The **EOT (Electric Overhead Traveling) Crane system** consists of various **mechanical, electrical, and control components** that work together to ensure efficient and safe operation.

### 5.1 Mechanical Components

These components are responsible for **load lifting and movement**:

- **Bridge (Girder)**  
Main horizontal structure supporting the crane load.
- **End Carriage (End Trucks)**  
Wheel assemblies for movement along runway rails
- **Trolley**  
Moves across the bridge (cross travel motion)
- **Hoist Mechanism**  
Includes:
  - Drum
  - Wire rope
  - Gearbox
  - Motor
- **Hook Block**  
Used for lifting and holding the load.
- **Wire Rope**  
High-strength steel rope for lifting.
- **Crane Wheels**  
Enable smooth movement on rails.
- **Buffers**  
Absorb impact at the end of travel.

### 5.2 Electrical Components

These components control and operate crane motors:

- **Electric Motors**
  - Hoist motor
  - CT motor
  - LT motor
- **Control Panel**

- Houses electrical equipment.
- **Contactors**
  - For switching motor circuits
- **Overload Relay (OLR)**
  - Protects motors from overload.
- **MCB / MCCB**
  - Protection against short circuit
- **Limit Switches**
  - Hoist limit (UP/DOWN)
  - Travel limits (CT/LT)
- **Brake System**
  - Electromagnetic fail-safe brakes

## 5.3 Control System Components

Used for **operation and control of crane motions**:

- **Pendant Push Button Station**  
Manual control of crane
- **Radio Remote Control** (optional)  
Wireless control operation
- **PLC (Programmable Logic Controller)** (in modern cranes)  
For automation and logic processing
- **VFD (Variable Frequency Drive)**  
Smooth speed control
- **Interlocking System**  
Prevents unsafe operation.

## 5.4 Safety Devices

Essential for safe operation:

- Emergency Stop (E-Stop)
- Load limiter
- Anti-collision system
- Alarm / hooter
- Safety hook latch
- Earth protection system

## Summary

The EOT crane system is a combination of **mechanical components for movement, electrical components for power and protection**, and **control components for safe operation**, ensuring efficient and reliable handling of heavy loads.

## 6. CIRCUIT DESIGN METHODOLOGY

The **circuit design methodology of an EOT crane system** involves a systematic approach to designing the **power and control circuits** to ensure **safe, reliable, and efficient operation** of the crane.

### 6.1 Design Objectives

The main objectives of circuit design are:

- Safe operation of crane movements
- Reliable motor control (Hoist, CT, LT)
- Proper protection against faults
- Smooth starting and stopping of motors.
- Prevention of incorrect operations (interlocking)

### 6.2 System Study and Requirement Analysis

Before designing the circuit, the following parameters are considered:

- Crane capacity (e.g., 45/15 TON)
- Number of motions (Hoist, CT, LT)
- Duty cycle (continuous/intermittent)
- Power supply rating (415V, 3-phase)
- Environmental conditions

### 6.3 Power Circuit Design

The **power circuit** is designed to supply electrical power to motors.

#### Key Steps:

- Selection of **MCCB/Isolator**
- Selection of **motors** (hoist, CT, LT)
- Selection of **contactors** (forward/reverse)
- Design of **phase reversal circuit** for direction control
- Integration of **overload protection (OLR)**

#### Basic Flow:

Supply → MCCB → Contactor → OLR → Motor

## 6.4 Control Circuit Design

The **control circuit** operates at low voltage and controls the crane movements.

### Key Design Elements:

- Push buttons (UP/DOWN, LEFT/RIGHT, FWD/REV)
- Contactor coils
- Auxiliary contacts
- Limit switches
- Emergency stop

### Logic Flow:

Push Button → Control Relay → Contactor Coil → Motor Operation

## 6.5 Interlocking Design

Interlocking ensures safe operation by preventing incorrect commands.

### Types:

- **Electrical Interlocking**
  - Uses NC auxiliary contacts.
  - Prevents forward and reverse at the same time.
- **Mechanical Interlocking**
  - Physically prevents both contactors ON

## 6.6 Protection Integration

Protection devices are incorporated into the circuit:

- Overload relay (OLR)
- Short circuit protection (MCB/MCCB)
- Earth fault protection
- Phase failure relay
- Limit switches

All protection devices are connected in **series with control circuit** for fail-safe operation.

## 6.7 Control Voltage Design

- Use **control transformer** (415V → 110V/24V)
- Low voltage improves safety.
- Separate protection for control circuit (MCB/fuse)

## 6.8 Selection of Components

Based on design calculations:

- Motor rating based on load and duty.
- Contactor rating based on motor current.
- Cable size based on current capacity.
- Protective devices as per fault level

## 6.9 Advanced Design (Modern Approach)

- Use **PLC-based control system**.
- Integrate **VFD for speed control**.
- Include sensors and feedback devices.
- Provide SCADA for monitoring.

## 6.10 Testing and Validation

After design, the system is tested for:

- Correct operation of all motions
- Interlocking functionality
- Protection system operation
- Fault conditions (overload, limit, E-Stop)

## Summary

The **circuit design methodology** ensures that the EOT crane operates with:

- High safety
- Reliable performance
- Proper protection
- Efficient control

# 7. SWITCHGEAR SELECTION

Switchgear selection is a critical part of the **EOT crane electrical design**, ensuring **safe control, protection, and reliable operation** of motors and circuits.

## 7.1 Objective of Switchgear Selection

The main objectives are:

- Protection against **overload and short circuit**
- Safe switching of **motors and circuits**
- Ensuring **operator and equipment safety**
- Providing reliable system performance

## 7.2 Types of Switchgear Used

### (a) Main Circuit Switchgear

- **MCCB (Moulded Case Circuit Breaker)**
  - Protects entire crane system.
  - Selected based on:
    - Rated current.
    - Short circuit capacity (kA rating)
- **Isolator / Load Break Switch (LBS)**
  - Used for safe isolation during maintenance.

### (b) Motor Control Switchgear

- **Contactors**
  - Used for switching motors ON/OFF
  - Separate contactors for:
    - Hoist (UP/DOWN)
    - CT (Left/Right)
    - LT (Forward/Reverse) Selection criteria:
- Motor rating (HP/kW)

- Rated current.
- Duty type (AC-3 for motors)

### **(c) Protection Switchgear**

- **Overload Relay (OLR)**
  - Protects motor from overcurrent.
  - Selected based on motor full load current.
- **MCB (Miniature Circuit Breaker)**
  - Protects control circuits.
- **Fuses**
  - Backup protection for control circuits
- **Earth Leakage Protection (ELR/RCCB)**
  - Detects leakage current.

### **(d) Control Switchgear**

- **Push Buttons (Pendant Station)**
  - For crane operation
- **Selector Switches**
  - Mode selection (local/remote)
- **Control Relays**
  - Used for logic and interlocking.

## **7.3 Selection Criteria**

Switchgear selection is based on:

### **Electrical Parameters**

- Rated voltage (415V)
- Rated current.
- Short circuit level

### **Motor Data**

- Motor HP/kW
- Full Load Current (FLC)
- Starting characteristics

### **Operating Conditions**

- Duty cycle of crane (heavy-duty operation)

- Frequency of switching
- Ambient temperature and environment

## Safety & Standards

- Compliance with **IS / IEC standards.**
- Proper insulation and protection level (IP rating)

## 7.4 Typical Selection Example (45T Crane)

Component	Typical Selection
MCCB	250A–400A, 25kA breaking capacity
Contactors	Rated as per motor current (AC-3 duty)
OLR	Adjustable range matching motor FLC
Control MCB	6A–10A
Control Voltage	110V AC / 24V DC

## 7.5 Protection Coordination

- Proper coordination between:
  - MCCB
  - Contactors
  - OLR

Ensures:

- Fault is cleared at appropriate level.
- Avoids unnecessary tripping.

## 7.6 Advantages of Proper Switchgear Selection

- Enhanced system safety
- Reliable operation
- Reduced equipment failure.
- Easy maintenance and troubleshooting

## Summary

Proper switchgear selection in an EOT crane ensures:

- **Safe switching of motors**

- **Protection against faults**
- **Efficient and reliable crane operation**

## 8. MOTOR SELECTION

Motor selection is a crucial step in the **design of an EOT crane system**, as motors are responsible for performing the **three main motions**: hoisting, cross travel (CT), and long travel (LT). The selection must ensure **safe, reliable, and efficient performance** under heavy-duty conditions.

### 8.1 Objective of Motor Selection

- Provide adequate torque for lifting and movement.
- Ensure smooth starting and stopping.
- Handle heavy loads safely (e.g., 45/15 TON)
- Operate efficiently in continuous duty.
- Withstand frequent starts and stops.

### 8.2 Types of Motors Used

#### Hoist Motor

- Type: **Slip Ring Induction Motor / VFD Controlled Motor**
- Reason:
  - High starting torque
  - Smooth acceleration
  - Suitable for heavy load lifting

#### Cross Travel (CT) Motor

- Type: **Squirrel Cage Induction Motor**
- Reason:
  - Simple construction
  - Reliable operation
  - Moderate starting torque required.

#### Long Travel (LT) Motor

- Type: **Squirrel Cage Induction Motor**
- Reason:
  - Used for horizontal movement.
  - Requires steady speed and moderate torque.

### 8.3 Hoist Motor Power Calculation (Example)

## Given:

- Load = **45/15 TON = 45000 kg**
- Lifting speed = **6 m/min = 0.1 m/sec**
- Efficiency ( $\eta$ ) = **0.85**

## Formula:

$$\text{Power (kW)} = (\text{Load} \times g \times \text{Velocity}) / (1000 \times \text{Efficiency})$$

Substitute:

$$P = (45000 \times 9.81 \times 0.1) / (1000 \times 0.85)$$

$$P = 44145 / 850$$

$$P \approx 51.9 \text{ kW}$$

**Required Motor Power  $\approx$  52 kW.**

Select standard motor:

- **55 kW Hoist Motor**

## 8.4 CT & LT Motor Selection (Typical)

Motion	Power Range	Reason
CT Motor	7.5 – 15 kW	Moving trolley
LT Motor	15 – 22 kW	Moving crane

Final selection depends on:

- Crane span
- Load condition
- Operating speed

## 8.5 Torque Requirement

### Hoist Motor:

- Requires **high starting torque (150–200%)**

### CT & LT:

- Moderate torque sufficient

## 8.6 Duty Classification

- Crane motors are designed for:
  - **Intermittent duty (S3 duty cycle)**
- Handles:
  - Frequent starts/stops.
  - Variable loading

## 8.7 Speed Control

- Multi-speed motors OR
- **VFD (Variable Frequency Drive)** used for:
  - Smooth acceleration
  - Reduced mechanical stress.
  - Energy efficiency

## 8.8 Protection Requirements

Motors must be protected using:

- Overload relay (OLR)
- Thermal protection (PTC/RTD)
- Short circuit protection
- Phase failure relay

## 8.9 Motor Selection Summary (45T Crane)

Motion	Motor Type	Selected Rating
Hoist	Slip ring / VFD motor	55 kW
CT	Squirrel cage motor	10–15 kW
LT	Squirrel cage motor	15–22 kW

## Summary

Motor selection for an EOT crane ensures:

- Adequate power for lifting heavy loads.
- Smooth and controlled operation
- Reliable performance under heavy load.

## 9. PROTECTION SYSTEM:

The **protection system of an EOT (Electric Overhead Traveling) crane** is critical for ensuring **safe operation, equipment protection, and personnel safety**. It includes electrical, mechanical, and control-level protections to prevent overload, short circuits, mechanical failures, and unsafe movements.

Below is a structured explanation:

### **1. Electrical Protection System**

#### **(a) Overload Protection**

- Prevents lifting load beyond crane rated capacity.
- Uses:
  - **Load cells / Load moment indicators (LMI)**
  - Current sensing in hoist motor
- Action: Stops hoist or gives alarm when load exceeds safe limit.

#### **(b) Short Circuit Protection**

- Protects electrical circuits from faults.
- Devices used:
  - **MCB (Miniature Circuit Breaker)**
  - **MCCB (Moulded Case Circuit Breaker)**
  - **Fuses**
- Action: Immediately disconnects power supply.

#### **(c) Overcurrent Protection**

- Protects motors from excessive current draw.
- Devices:
  - **Overcurrent relays**
  - **Thermal overload relays (OLR)**
- Action: Trips motor supply when current exceeds present limit.

### **(d) Earth Fault Protection**

- Protects against leakage current to ground.
- Devices:
  - **Earth Leakage Relay (ELR)**
  - **RCCB/ELCB**
- Action: Disconnects supply to avoid electric shock/fire.

### **(e) Under/Over Voltage Protection**

- Ensures proper voltage operation.
- Devices:
  - Voltage monitoring relays.
- Action:
  - Stops crane in abnormal voltage conditions.

### **(f) Phase Failure / Phase Sequence Protection**

- Prevents operation if:
  - One phase is missing.
  - Phase sequence incorrect
- Device:
  - **Phase monitoring relay**
- Important for 3-phase motor protection.

## **2. Mechanical Protection System**

### **(a) Limit Switch Protection**

Critical for movement restriction:

#### **Types:**

1. **Hoist Upper Limit Switch**
  - Stops hook from over-travel upward.
2. **Hoist Lower Limit Switch**
  - Prevents rope unwinding.

### 3. Cross Travel Limit Switch

### 4. Long Travel Limit Switch

- Prevents collision with end stops.

## (b) Over-Speed Protection

- Detects excessive speed in hoisting mechanism.
- Device:
  - Speed sensor / encoder
- Action: Activates brake.

## (c) Mechanical End Stops / Buffers

- Installed at rail ends.
- Types:
  - Rubber buffers
  - Spring buffers
  - Hydraulic buffers
- Protect crane from collision damage.

## (d) Brake System Protection

- Fail-safe electromagnetic brakes:
  - Applied when power OFF.
- Prevents load dropping.

## 3. Motor Protection System

Each crane motion (Hoist, CT, LT) has dedicated motor protections:

- **Thermal overload relays**
- **PTC thermistors (motor winding temperature)**
- **RTD sensors for temperature monitoring**
- **Stall protection**
- **Single phasing protection**

## 4. Control & Automation Protection

### (a) Interlocking System

- Prevents unsafe operations like:
  - Opposite direction command simultaneously

- Wrong sequence of motion
- Implemented in:
  - Relay logic / PLC

### **(b) Emergency Stop (E-Stop)**

- Mushroom push button.
- Immediate shutdown of entire crane system.

### **(c) Anti-Collision System**

(Especially in multiple crane bays)

- Uses:
  - Infrared sensors / Laser sensors
  - Prevents cranes from hitting each other.

### **(d) Slack Rope Protection**

- Detects rope slack condition.
- Stops hoisting operation.

### **(e) Hook Safety Latch**

- Prevents wire rope slipping off hook.

## **5. Safety Monitoring & Indication**

- **Audio-visual alarms**
- **Load display unit**
- **Fault indication panel**
- **Hooter during crane movement**

## **6. Advanced Protection (Modern Cranes)**

- **VFD-based protections**
- Overvoltage, undervoltage, overheating.
- **PLC/SCADA monitoring**
- **Remote diagnostics**
- **Condition monitoring system**

## Summary

Protection Type	Purpose
Electrical	Protects circuits & motors
Mechanical	Prevents physical damage
Motor	Protects motors from failure
Control	Prevents unsafe logic
Safety systems	Protects personnel

# 10. Control Circuit Description

The **control circuit** of an EOT crane is a **low-voltage electrical system** used to operate crane motions safely by controlling contactors, relays, and protection devices.

It ensures:

- Safe starting/stopping of motors.
- Direction control (Forward/Reverse)
- Interlocking to avoid faults.
- Integration of protections (OLR, limits, E-stop)

## 1. Control Circuit Basics

### Control Voltage

- Typically: **110V AC / 24V DC**
- Derived from **control transformer**

### Main Elements

- Push buttons (Pendant / Radio control)
- Contactors (Coils & Aux contacts)
- Overload relay (OLR)
- Limit switches
- Emergency stop (E-Stop)

- Interlock

## 2. Working Principle

The control circuit works on this simple logic:

Push Button → Energize Contactor Coil → Close Power Contacts → Motor Runs

When any protection operates:

Protection trips → Coil de-energized → Motor Stops

## 3. Hoist Control Circuit Description (UP/DOWN)

### Sequence of Operation (UP motion)

1. Operator presses **UP push button**.
2. Current flows through:
  - Stop PB (NC)
  - Emergency Stop (NC)
  - Overload Relay (NC)
  - UP Push Button (NO)
  - UP Limit Switch (NC)
  - DOWN Contactor Aux (NC – interlock)
3. **UP contactor coil energizes**.
4. Main contactor closes → Motor runs in UP direction
5. Brake releases automatically

### DOWN Motion

Same process with:

- DOWN push button
- DOWN limit switch
- UP contactor interlock

### Electrical Interlocking (Important)

- UP circuit has **DOWN NC auxiliary contact**
- DOWN circuit has **UP NC auxiliary contact**.

Prevents:

- Simultaneous UP & DOWN operation
- Phase short circuit

## 4. Cross Travel (CT) Control Description

### Operation:

- LEFT PB pressed → CT Left contactor energizes.
- RIGHT PB pressed → CT Right contactor energizes.

### Safety features:

- Electrical interlock (left vs right)
- End limit switches stop travel at extreme ends.

## 5. Long Travel (LT) Control Description

### Operation:

- FORWARD PB → LT Forward contactor energizes.
- REVERSE PB → LT Reverse contactor energizes.

### Includes:

- Interlocking (FWD vs REV)
- Rail end limit switches
- Anti-collision (in advanced systems)

## 6. Emergency Stop Circuit

- E-Stop is a **NC (Normally Closed) contact**.
- Installed in **series with control supply**.

### Operation:

- Press E-Stop → Circuit opens → All contactors drop.
- Entire crane stops instantly.

## 7. Protection Integration in Control Circuit

### (a) Overload Relay (OLR)

- NC contact wired in control circuit.
- On overload → opens → stops motor

## (b) Limit Switches

Connected in series with motion:

Motion	Limit Function
Hoist UP	Stops over-hoisting
Hoist DOWN	Prevents rope slack
CT/LT	Prevents end collision

## (c) Phase Failure Relay (optional)

- Blocks control circuit if supply abnormal

## (d) Control Fuse/MCB

- Protects control wiring from short circuit.

## 8. Holding (Seal-in) Circuit

To keep motor ON after push button release:

PB (NO) → Contactor Coil → Auxiliary NO → Parallel to PB

After energizing:

- Aux contact keeps coil energized.
- PB can be released.

## 9. Control Logic Summary

Action	Result
Press PB	Coil energizes
Coil ON	Motor runs
Limit reached	Circuit opens
Overload	OLR trips
E-Stop pressed	All stops

## 10. Modern Control (PLC Based)

Instead of hardwired control:

Push Button → PLC Input

PLC Logic → Output → Contactor/VFD

### **Advantages:**

- Easier interlocking
- Fault diagnostics
- Automation possible
- Remote operation

## **11. EOT Crane Safety Features**

Safety features in an EOT crane are designed to **protect personnel, equipment, and load** by preventing unsafe conditions such as overload, collision, over-travel, and electrical faults.

### **1. Electrical Safety Features**

#### **(a) Emergency Stop (E-Stop)**

- Mushroom type push button
- Located in pendant/control panel.
- **Function:**
  - Immediately cuts off control power.
  - Stops all crane motions.

#### **(b) Overload Protection**

- Prevents lifting beyond rated capacity.
- Devices:
  - Load cell / Load limiter
  - Overload relay

- **Action:**
  - Stops hoisting and gives alarm.

### **(c) Short Circuit Protection**

- Devices:
  - MCB / MCCB / Fuses
- **Action:**
  - Instant disconnection during fault

### **(d) Earth Fault Protection**

- Devices:
  - ELCB / RCCB
- Prevents electric shock and fire hazards.

### **(e) Phase Failure Protection**

- Phase monitoring relay
- Prevents motor damage due to:
  - Single phasing
  - Phase reversal

## **2. Mechanical Safety Features**

### **(a) Limit Switches (Very Important)**

#### **Types:**

- **Upper limit switch (hoist)** → Stops over-hoisting.
- **Lower limit switch** → Prevents rope slack.
- **CT & LT limit switches** → Prevent travel beyond limits.

### **(b) Mechanical End Stops / Buffers**

- Installed at rail ends.
- Types:
  - Rubber buffers
  - Spring buffers
- Absorb impact during accidental overrun.

### **(c) Brake System (Fail-Safe)**

- Electromagnetic brakes
- **Fail-safe design:**
  - Brake ON when power OFF.
- Prevents load from falling.

### **(d) Hook Safety Latch**

- Prevents rope/chain from slipping off hook.

## **3. Control System Safety Features**

### **(a) Electrical Interlocking**

- Prevents:
  - Forward & reverse at same time.
- Uses:
  - Auxiliary contacts

### **(b) Control Circuit Protection**

- OLR (Overload Relay) in control circuit
- Control fuse/MCB protects wiring.

### **(c) Dead Man Control (Pendant)**

- Crane moves only while button is pressed.
- Prevents unintended motion.

## **4. Operational Safety Features**

### **(a) Warning Alarms**

- Hooter / Siren before crane movement
- Alerts nearby personnel.

### **(b) Indication Lamps**

- ON/OFF status
- Fault indication

### **(c) Speed Control**

- VFD or multi-speed motors
- Smooth operation reduces accidents.

## **5. Advanced Safety Features (Modern Cranes)**

### **(a) Anti-Collision System**

- Sensors (IR/Laser)
- Prevents crane-to-crane collision.

### **(b) Over-Speed Protection**

- Detects abnormal speed.
- Activates braking system.

### **(c) Slack Rope Protection**

- Detects loose wire rope.
- Stops hoisting.

### **(d) Load Display System**

- Shows real-time load to operator.
- Prevents overloading.

### **(e) Zonal Protection / Area Limit**

- Prevents crane from entering restricted zones.

## **6. Maintenance & Safety Features**

### **(a) Isolation Switch (LBS/Isolator)**

- Used for safe maintenance.
- Ensures complete electrical isolation.

### **(b) Earthing System**

- Proper grounding of crane structure
- Prevents electric shock.

### **(c) Regular Inspection Points**

- Wire rope
- Brake system
- Limit switches
- Hooks

## **Summary Table**

<b>Category</b>	<b>Safety Feature</b>	<b>Purpose</b>
Electrical	E-Stop	Immediate shutdown
Electrical	OLR, MCCB	Fault protection
Mechanical	Limit switches	Prevent over-travel

Mechanical	Brakes	Prevent load fall
Control	Interlocking	Avoid incorrect operation
Advanced	Anti-collision	Prevent accidents
Operational	Alarms	Personnel safety

## Key Practical Insight (Important)

For real plant implementation:

- Always design **fail-safe circuits (NC logic)**
- Ensure **redundancy in critical protections.**
- Follow standards:
  - IS / IEC / FEM / OSHA guidelines.
- Regular testing of:
  - Limit switches
  - Brake system
  - E-Stop.

### In short:

EOT crane safety features are a combination of **electrical, mechanical, and control protections** that work together to ensure **safe and reliable operation** in industrial environments.

## Advantages of EOT Crane System

### 1. Efficient Material Handling

- Can lift and move heavy loads quickly and safely.
- Reduces manual labour significantly.
- Improves overall productivity in plants.

### 2. High Load Carrying Capacity

- Suitable for **light to very heavy loads (tons to hundreds of tons)**
- Ideal for industries like:
  - Steel plants
  - Power plants
  - Manufacturing

### **3. Better Space Utilization**

- Installed at height → frees floor space.
- No obstruction on shop floor
- Allows smooth movement of men and materials below.

### **4. Multi-Directional Movement**

- Provides movement in **3 axes**:
  - Hoist (Up/Down)
  - Cross Travel (Left/Right)
  - Long Travel (Forward/Reverse)

Covers entire working area efficiently.

### **5. High Safety Level**

- Equipped with:
  - Limit switches
  - Overload protection
  - Emergency stop
- Reduces risk of accidents and equipment damage

### **6. Automation Capability**

- Can be integrated with:
  - PLC
  - VFD
  - SCADA systems
- Enables:
  - Remote operation
  - Automatic material handling

### **7. Low Operating Cost**

- Once installed, requires minimal manpower
- Energy efficient operation

- Reduced handling time lowers operational cost.

## **8. Flexibility in Operation**

- Can handle:
  - Different shapes and sizes of loads
- Attachments possible:
  - Hooks
  - Grab buckets.
  - Magnets

## **9. Continuous Operation**

- Designed for **heavy-duty and repetitive tasks.**
- Suitable for 24/7 industrial operations

## **10. Easy Maintenance (Comparatively)**

- Standardized components
- Easy access for inspection (with proper design)
- Fault detection is simpler with modern systems.

## **11. Suitable for Harsh Environments**

- Works in:
  - High temperature areas
  - Dusty environments
  - Outdoor applications

## **12. Improved Productivity & Workflow**

- Faster loading/unloading.
- Reduced downtime.
- Improves plant efficiency.

## **Summary**

<b>Advantage</b>	<b>Benefit</b>
High capacity	Handles heavy loads
Space saving	No floor blockage
Multi-direction movement	Full area coverage
Safety systems	Reduced accidents
Automation	Smart operations
Cost-effective	Saves time and labour

## **Key Insight**

EOT cranes are one of the **most efficient and reliable material handling systems** because they combine:

- **Power**
- **Precision**
- **Safety**
- **Automation capability**

# **12. Applications of EOT Crane System**

EOT cranes are widely used wherever **heavy material handling, lifting, and movement** is required across a defined area (shop floor, bay, warehouse, etc.).

## **1. Steel Plants & Metal Industries**

- Handling of:
  - Molten metal (ladle cranes)
  - Billets, slabs, coils
- Used in:
  - Blast furnaces.
  - Rolling mills
- Special types:
  - **Ladle cranes**
  - **Charging cranes**

## **2. Manufacturing Industries**

- Moving raw materials and finished goods.

- Assembly line support
- Used in:
  - Automobile plants
  - Heavy machinery manufacturing
  - Fabrication shops

### **3. Power Plants**

- Used for:
  - Turbine installation and maintenance
  - Boiler handling
  - Coal handling systems
- Types:
  - **Erection cranes**
  - **Maintenance cranes**

### **4. Construction Industry**

- Lifting and placing:
  - Steel structures
  - Concrete elements
- Used in:
  - Precast yards
  - Large construction workshops

### **5. Shipyards & Ports**

- Loading and unloading heavy cargo
- Handling ship components
- Yard material movement

### **6. Warehouses & Logistics**

- Handling:
  - Heavy pallets
  - Large equipment
- Helps in space optimization and faster handling.

## **7. Oil & Gas Industry**

- Used in:
  - Refineries
  - Petrochemical plants
- Applications:
  - Equipment maintenance
  - Heavy component lifting

## **8. Mining Industry**

- Handling:
  - Mining equipment
  - Spares and heavy machinery.
- Used in maintenance workshops.

## **9. Chemical & Process Plants**

- Material handling in hazardous environments
- Maintenance of reactors, pumps, vessels

## **10. Railway Workshops**

- Handling:
  - Locomotives
  - Bogies
  - Wheel sets
- Used in maintenance sheds and production units.

## **11. Specialized Applications**

### **Magnetic Cranes**

- Handling scrap, steel plates

### **Grab Bucket Cranes**

- Used for:
  - Coal
  - Sand
  - Bulk material
  -

## Explosion-Proof Cranes

- Used in hazardous areas (oil & gas, chemicals)

## 12. Automated & Smart Industries

- Integrated with:
  - PLC
  - SCADA
  - Robotics
- Used in:
  - Smart warehouses
  - Automated storage systems

## Summary Table

Industry	Application
Steel plants	Molten metal, slabs
Manufacturing	Assembly, material movement
Power plants	Turbine & boiler handling
Construction	Structural lifting
Shipyards	Cargo handling
Warehousing	Load movement
Mining	Equipment handling

## Key Insight

EOT cranes are primarily used where:

- **Heavy loads need to be moved repeatedly.**
- **Floor space must remain free.**
- **Efficient and safe handling is essential.**

# 13. Conclusion – EOT Crane System

The **EOT (Electric Overhead Traveling) crane** is a **highly efficient, reliable, and versatile material handling system** widely used in modern industries. It plays a crucial role in improving **productivity, safety, and operational efficiency**.

## Key Takeaways

- **Efficient Handling:** Enables quick and smooth movement of heavy loads across the entire workspace.
- **Space Optimization:** Uses overhead space, keeping the floor free for other operations.
- **Multi-Directional Control:** Offers complete coverage through hoist, cross travel, and long travel motions.
- **Integrated Safety:** Equipped with multiple protection systems like limit switches, overload protection, interlocks, and emergency stop.
- **Automation Ready:** Can be integrated with PLC, VFD, and SCADA systems for advanced control and monitoring.
- **Versatile Applications:** Used across industries like steel, power, manufacturing, warehouses, and construction.

## Engineering Perspective

From an **E&I design viewpoint**, an EOT crane is a system where:

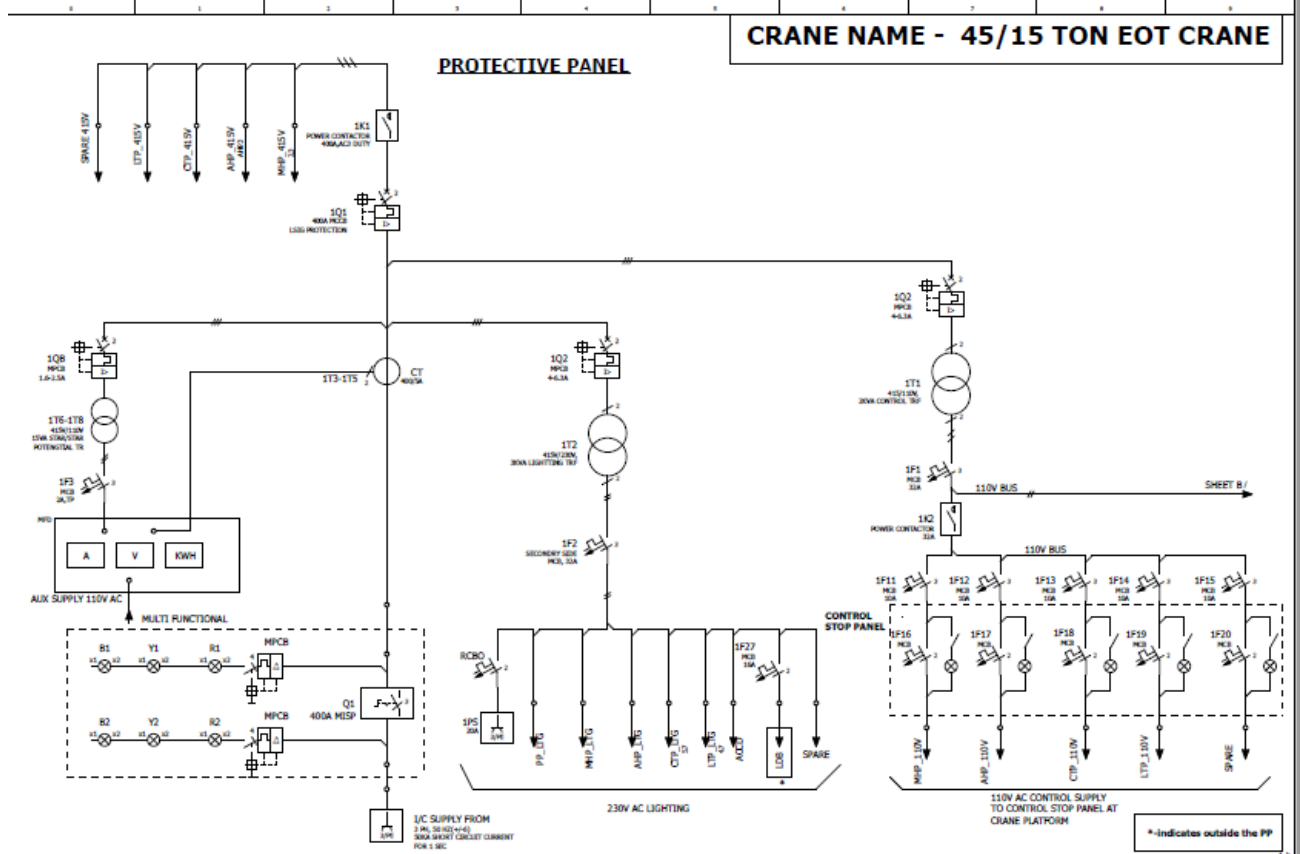
- **Control circuits ensure safe logic operation.**
- **Protection systems safeguard equipment and personnel.**
- **Mechanical and electrical systems work in coordination.**

## Final Statement

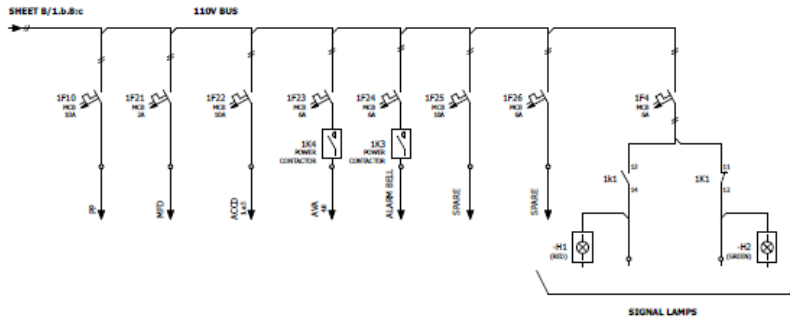
In summary, the EOT crane is an **indispensable industrial lifting solution** that combines **power, precision, safety, and automation**, making it essential for efficient material handling.

# SINGLE LINE DIAGRAM

CRANE NAME - 45/15 TON EOT CRANE



Rev.	1	Date	10-10-2020	By	SP/AN	Checked by	SP/AN
Rev.	2	Date	20/03/24	By	SP/AN	Checked by	SP/AN
Rev.	3	Date		By		Checked by	
Rev.	4	Date		By		Checked by	
Rev.	5	Date		By		Checked by	
Rev.	6	Date		By		Checked by	
Rev.	7	Date		By		Checked by	
Rev.	8	Date		By		Checked by	
Rev.	9	Date		By		Checked by	
Rev.	10	Date		By		Checked by	
Rev.	11	Date		By		Checked by	
Rev.	12	Date		By		Checked by	
Rev.	13	Date		By		Checked by	
Rev.	14	Date		By		Checked by	
Rev.	15	Date		By		Checked by	
Rev.	16	Date		By		Checked by	
Rev.	17	Date		By		Checked by	
Rev.	18	Date		By		Checked by	
Rev.	19	Date		By		Checked by	
Rev.	20	Date		By		Checked by	
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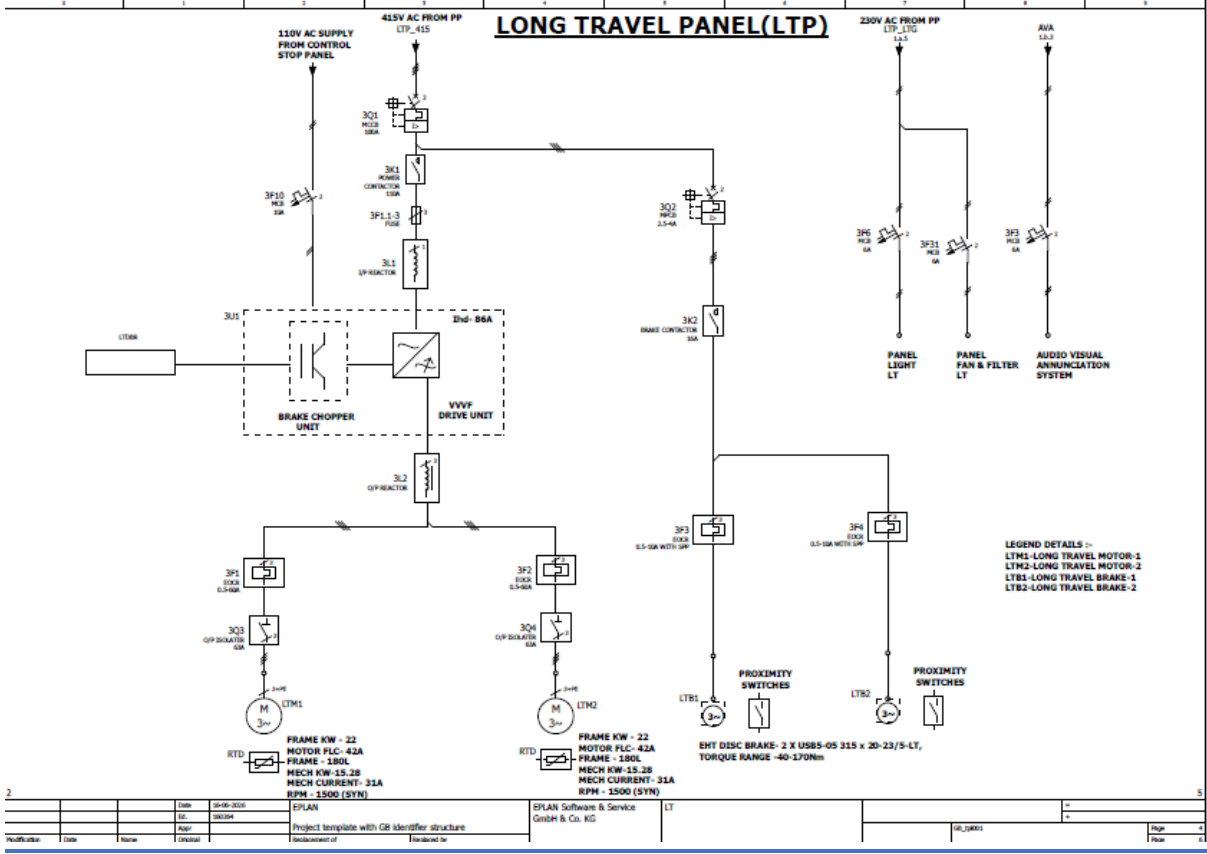
**NOTES**

1. THE CRANE ELECTRICS SHALL BE SUITABLE FOR 50 DEG C AMBIENT TEMPERATURE.
2. THE VVVF DRIVE DYNAMIC BRAKING RESISTANCE CONTROL SHALL BE PROVIDED FOR PROVIDED FOR ALL MOTIONS SUITABLE AS PER AMBIENT TEMPERATURE.
3. THE CRANE SHALL BE OPERATED ON NOS. SPEED STEPS IN EACH MOTION (10%-100%) THROUGH MASTER CONTROLLER OPERATE FROM OPERATOR CABIN.
4. CLOSED LOOP VECTOR CONTROL SHALL BE CONSIDERED FOR ALL HOIST MOTIONS AND OPEN LOOP VECTOR CONTROL SHALL BE CONSIDERED FOR ALL TRAVEL MOTIONS.
5. ALL CONTROL PANEL SHALL BE SUPPLIED IP55 PROTECTIVE ENCLOSURE AND NECESSARY FAN FILTER ARRANGEMENT FOR COOLING PURPOSE.
6. INCOMING MCCB SHALL HAVE LSIG RELEASE WITH O/C, S/C & E/P PROTECTION. MCCB SHALL HAVE RELEASE FEATURE. THE SAME SHALL ALSO HAVE POSITIVE ISOLATION FEATURE AND INBULT PADLOCKING FACILITY IN OFF POSITION.
7. HEAVY DUTY CURRENT (Ihd) OF DRIVE FOR EACH MOTION SHALL BE 125% OF LOAD CURRENT BASED ON MECHANICAL KW. VVVF DRIVE PANEL SHALL BE SUITABLE AS PER DESIGN AMBIENT TEMP. WITH IP54 ENCLOSURE.
8. ALL POWER CONTACTOR SHALL BE AC3 DUTY.
9. THE DMR SHALL HAVE THERMAL SWITCH FOR PROTECTION AGAINST OVER HEATING AND INTERLOCK SHALL BE PROVIDED IN DRIVE PANEL ACCORDINGLY.
10. ALL SQUIRREL CAGE INDUCTION MOTOR & GEARED BRAKE MOTOR(=7.5KW) SHALL BE PROVIDED WITH 1 NO TO PT 100 RTD PER PHASE & THE SIGNAL SHALL BE TAKEN TO MASIBUS MAKE TEMP SCANNER AT RESPECTIVE VFD FOR TEMPERATURE MONITORING & TRIPPING.
11. GEARED BRAKE MOTORS HAVING RATING <7.5KW SHALL BE PROVIDED WITH 1 NO PTC THERMISTOR PER PHASE (ALL CONNECTED IN SERIES) AND THE SIGNAL SHALL BE TAKEN TO RESPECTIVE VFD FOR TEMP MONITORING & TRIPPING.
12. ALL THE PLUG & SOCKET FEEDER SHALL BE CONNECTED THROUGH MCCB.
13. ALL DBRS OF DRIVE PANEL SHALL BE SUPPLIED IN IP11 PROTECTIVE ENCLOSURE.

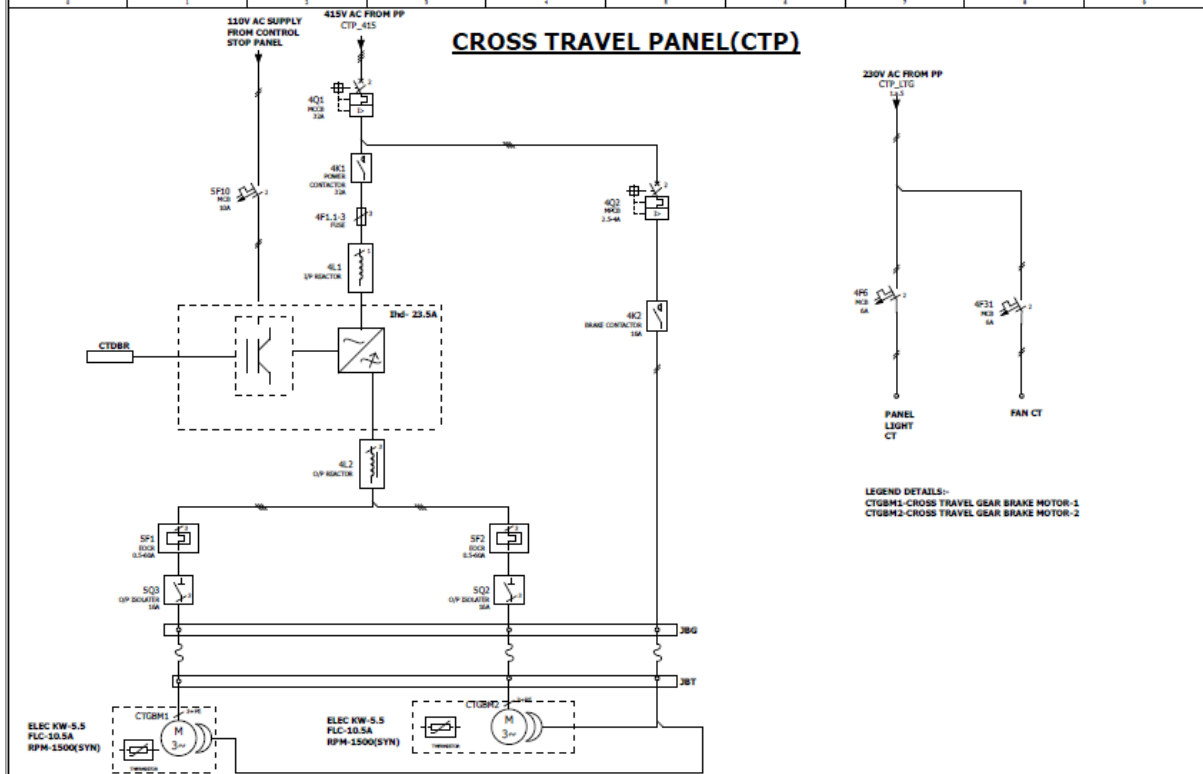
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# LONG TRAVEL PANEL (LTP)



# CROSS TRAVEL PANEL(CTP)



**LEGEND DETAILS:-**  
 CTGBM1-CROSS TRAVEL GEAR BRAKE MOTOR-1  
 CTGBM2-CROSS TRAVEL GEAR BRAKE MOTOR-2

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					Project template with GB identifier structure		1
Manufacturer	Code	Name	Version	Manufacturer of	Manufacturer	Part No.	Page
							1



# 14. References

1. **IS 3177:1999**  
*Code of Practice for Electric Overhead Travelling (EOT) Cranes and Gantry Cranes*  
→ Provides guidelines for electrical systems, control circuits, and safe crane operation.
2. **IS 807:2006**  
*Design, Manufacture, Erection and Testing of Cranes*  
→ Covers overall crane design including mechanical and electrical integration.
3. **IEC 60204-32**  
*Safety of Machinery – Electrical Equipment of Machines (Cranes)*  
→ International standard for crane electrical circuits and protection systems
4. **Siemens Crane Application Guide**  
→ Industrial reference for motor control, VFD implementation, and crane automation
5. **ABB Crane Systems Engineering Manual**  
→ Advanced electrical drive systems and protection schemes for EOT cranes.
6. **EPLAN Electric P8 Documentation**  
→ Standard guidelines for preparing **Single Line Diagrams (SLD)** and electrical schematics used in industrial crane panel design.
7. **B.L. Theresa & A.K. Theresa**  
*A Textbook of Electrical Technology*  
→ Fundamental concepts of electrical circuits, protection, and control systems
8. **P.S. Bibra**  
*Electrical Machinery*  
→ Motor selection and starting methods used in crane applications.
9. **S.K. Singh**  
*Industrial Automation and Control*  
→ Control logic, relay circuits, and automation techniques
10. **Project Work: EPLAN-Based SLD Design of 45/15 TON EOT Crane Circuit**  
→ The power and control circuits in this project are designed and represented using **EPLAN-style Single Line Diagram (SLD)** methodology for industrial standard documentation.