AI BASED
WAGON INSPECTION SYSTEM

BY

MLIT-18 TECHNOLOGY PRIVATE LIMITED

Introduction

Wagon inspection is a critical activity that must be performed meticulously before loading and dispatching at the plant. This process ensures that all wagons are in optimal condition to prevent any issues during transportation. On average, 4-5 rakes are loaded and dispatched daily from the plant, highlighting the significant volume and importance of this task.

Current Challange

Manual Inspection: The current inspection process is done manually, which is labor-intensive and time-consuming. Each wagon needs to be carefully examined by trained personnel to ensure it meets the required standards for loading and dispatch.

Time Constraints: Given the high volume of daily dispatches, manual inspection can create bottlenecks. The time required for thorough manual checks can delay the loading process, impacting overall operational efficiency.

Demurrage Charges: Inefficiencies and delays in the inspection process can lead to demurrage charges. These are penalties incurred when wagons are not loaded and dispatched within the stipulated time frame, resulting in additional costs for the plant.

Inconsistency: Manual inspections are subject to human error and inconsistency. Different inspectors might have varying levels of expertise and attention to detail, which can result in missed defects or issues.

Need of Automation

To address these challenges, there is a pressing need to automate the wagon inspection process. Automation can bring several benefits:

Speed and Efficiency:
Automated systems can perform inspections much faster than manual methods, significantly reducing the time required for each wagon. This can streamline the loading and dispatch process, allowing the plant to handle more rakes daily.

Accuracy and Consistency:
Automated inspection systems can provide consistent and precise assessments of each wagon. These systems can be programmed to detect specific defects and issues, ensuring that no detail is overlooked.

Cost Reduction:
By reducing inspection times and eliminating delays, automation can help achieve the target of nil demurrage charges. This can result in significant cost savings for the plant.

Enhanced Safety: Automated systems can minimize the need for human intervention in potentially hazardous environments, improving overall safety for the inspection personnel.

Implementation Strategy:

To implement an automated wagon inspection system, the plant can consider the following steps:

Technology Selection:
Choose appropriate technologies such as machine vision systems, sensors, and AI-based software that can accurately inspect wagons for defects and issues.

System Integration:
Integrate the automated inspection system with existing plant operations to ensure seamless data flow and coordination between inspection, loading, and dispatch processes.

Training and Transition:
Provide training for staff to operate and maintain the new automated system. Ensure a smooth transition from manual to automated processes, with minimal disruption to daily operations.

Continuous Monitoring and Improvement:
Regularly monitor the performance of the automated system and make necessary adjustments to enhance accuracy and efficiency. Collect data to identify trends and areas for further improvement.

Project Deliverables:

Complete Supply and Installation of Hardware:
Provision and installation of all necessary hardware components required for the automated inspection system.This includes cameras, sensors, and any other equipment needed to facilitate accurate and reliable inspections.

Networking for Data Collection and Transfer:
Setting up a robust networking infrastructure to enable seamless data collection from the inspection points. Ensure efficient transfer of collected data to the AI terminal and the control room PC for real-time analysis and monitoring.

Development of Deep Learning Algorithm for Inspection:
Creation and implementation of a sophisticated deep learning algorithm tailored for wagon inspection. The algorithm will be designed to accurately detect and assess various types of defects and issues.

Optical Character Recognition
Optical Character Recognition (OCR) technology will be implemented to automatically scan and identify the unique identification number of each wagon as it passes through the inspection area. This process ensures that every wagon is accurately recognized and logged into the system.

Side Inspection:
Implementation of inspection protocols for the wagon doors and the body. The system will be capable of identifying and reporting any damages larger than 50 mm on the wagon body.

Top Inspection:
Ensuring the automated system can inspect the top side of the wagons, specifically the containers. The system will check for container emptiness and identify any damage larger than 50 mm on the inner surface of the containers.

Development of a User Dashboard:
Creation of an intuitive and user-friendly dashboard to display inspection results. The UI/UX design for the dashboard will be developed based on user requirements, allowing up to three iterations for refinement and feedback.

Key Features

Inspection Speed:
The system is designed to perform inspections starting from 0-120km/hour.
This ensures that inspections are conducted efficiently without causing delays in the loading and dispatch process.

Inspection Result:
The system provides inspection results within 5 minutes of the entire rake passing through the inspection point.
This rapid turnaround time allows for quick decision-making and minimizes potential delays.

Accuracy:
The system is highly accurate, with a true positive rate of at least 99%.
The false positive rate is maintained at 2% or lower, ensuring reliable and trustworthy inspection results.

Inspection Process:

Step 1: Identification of Rake on Track:
The system identifies the rake as it approaches the inspection point.

Step 2: Activation of Lights and Machine Vision Cameras for Inspection:
Upon identification, lights and Machine Vision cameras are activated to perform the inspection.

Step 3: Post-Inspection Energy Conservation:
After the inspection, all electronic items are switched off to conserve energy.

Step 4: On-Site Processing:

An on-site processor processes the videos and images using a deep learning algorithm and sends the results to the central control room via an industrial access point.

Step 5: Dashboard Display:
The central control room dashboard displays all inspection points and images, automatically highlighting detected defects for user action.

Step 6: Maintenance and Loading Plan:
Users develop maintenance and loading plans based on the inspection results displayed on the dashboard.

By implementing this automated wagon inspection system, we aim to enhance the speed, accuracy, and reliability of inspections, reducing costs and improving overall operational efficiency. This system will set a new standard for quality and reliability in wagon dispatch operations

Technical Specifications:

Sr .no	Attributes	Value
1	Power Supply	230V AC
2	Power Consumption	2300 Watts
3	Current	20 AMP
4	Optical resolution	>= 1280X1080 Pixels<= 2400*1400
5	Inspection sensor	CMOS
6	Enclosure IP ratings	IP65
7	Sensor Cleaning	Automatic
8	Inspection Range	1.8 metre to 3 metre
9	Inspection result time	15-20 mints after wagon passing
10	Inspection Type	Visual
11	Inspection report	.PDF
12	Communication Mode	WIFI
13	Weight	800KG

Technical Specifications:

14	Structure Dimension	500x500x6338
15	Material Make	MS
16	Control Panel Dimensions	500x803x1700
17	Control Panel IP Ratings	IP 65
18	Control Panel cooling	Outdoor Panel AC
19	Illumination	DC powered 300 watts*6 lights
20	AI Algorithm	Resnet 101, Pytorch Framework
21	Communication Protocol	TCP IP

Customer scope:

To ensure the successful implementation of the automated wagon inspection system, the customer is responsible for providing the following items and specifications:

Power Supply:

230V AC at Inspection Unit: Ensure a stable power supply of 230V AC is available at the location of the inspection unit.

230V AC in the Server Room: Provide a 230V AC power supply in the server room where the AI terminal and control room PC are housed.

230V AC at Access Point Mount: Ensure a 230V AC power supply is available at the location where the industrial access point is mounted.

Heavy Machinery:

Crane: Supply and operate a crane for the installation of heavy components.

Hydra: Provide a hydra for material handling during installation.Scaffold: Supply scaffolding for the safe installation of elevated equipmnt.

Equipment for Internal Transfer of Material: Provide necessary equipment for the internal transfer of materials within the site.

Earthing:

Inspection Station: Ensure proper earthing is provided at the inspection station to ensure safety and functionality of the equipment.

Server Room: Provide earthing in the server room to protect the equipment and ensure stable operations.

Civil Work:

Installation of Poles: Perform civil work required for the installation of poles needed for mounting cameras and other inspection equipment.

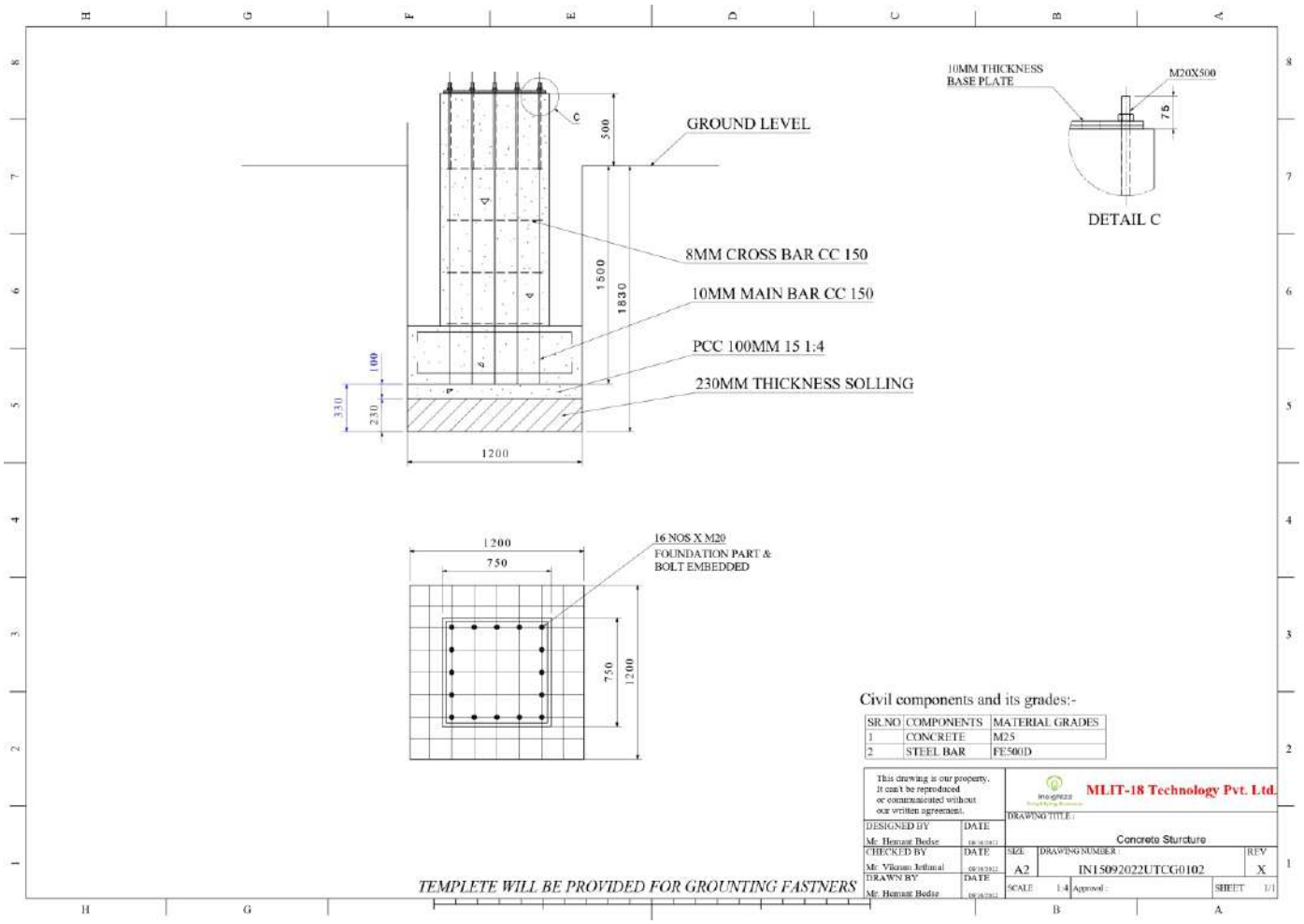
Defect Data:

Provision of Defect Data: Supply defect data for training the deep learning algorithm.

1000 Images of Each Defect: Provide 1000 images of each defect type to train the algorithm for accurate defect detection.

By fulfilling these responsibilities, the customer ensures that the automated wagon inspection system is installed and operates efficiently, meeting the project's goals of enhancing inspection speed, accuracy, and reliability while minimizing operational delays and costs

Civil Drawing



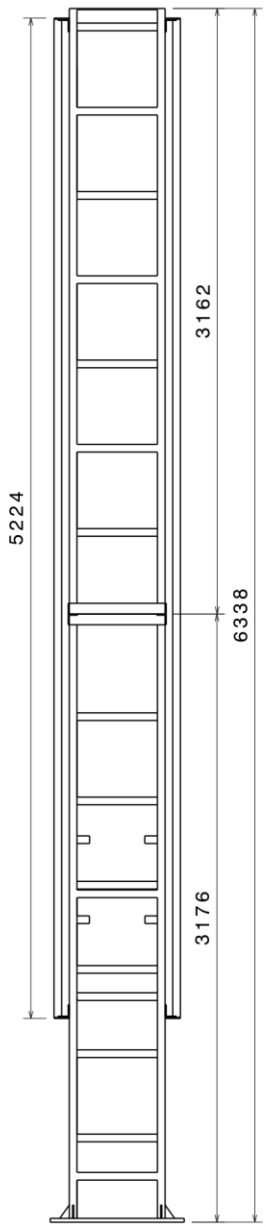
Civil components and its grades:-

SR.NO	COMPONENTS	MATERIAL GRADES
1	CONCRETE	M25
2	STEEL BAR	FE500D

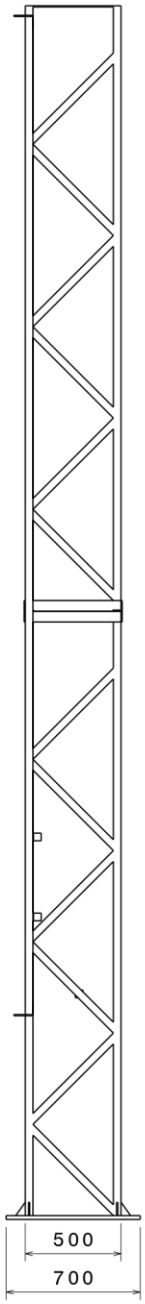
MLIT-18 Technology Pvt. Ltd.

DESIGNED BY: Mr. Hemant Bedse	DATE	DRAWING TITLE: Concrete Sturcture		
CHECKED BY: Mr. Vikram Jethlal	DATE	SIZE: A2	DRAWING NUMBER: IN15092022UTCG0102	REV: X
DRAWN BY: Mr. Hemant Bedse	DATE	SCALE: 1:4	Approved:	SHEET: 1/1

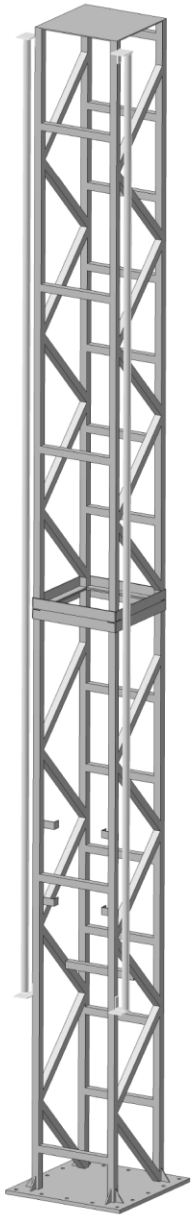
Design Specification



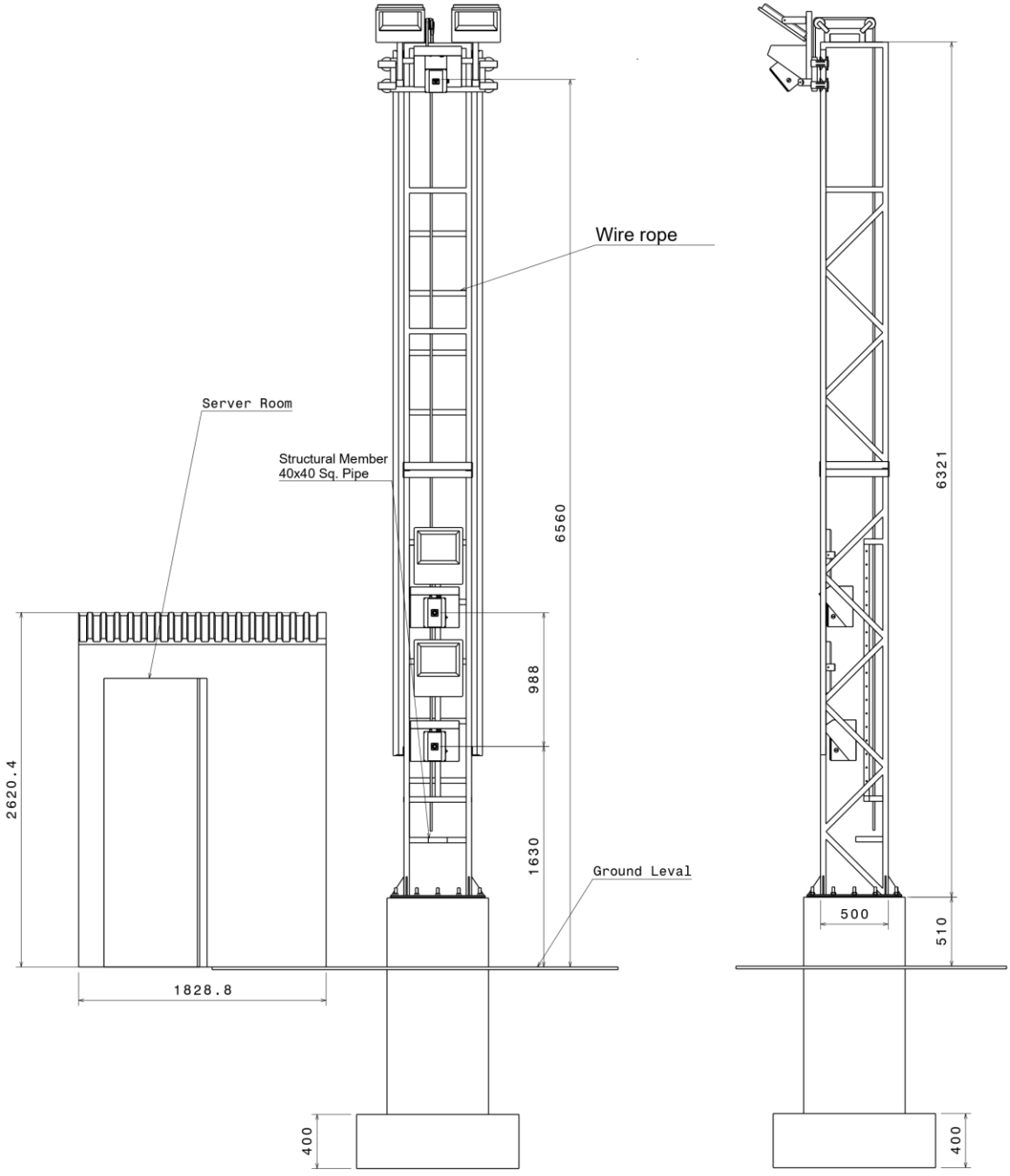
Front view



Side View



Isometric view


Wire rope
Server Room
Structural Member
40x40 Sq. Pipe
6560
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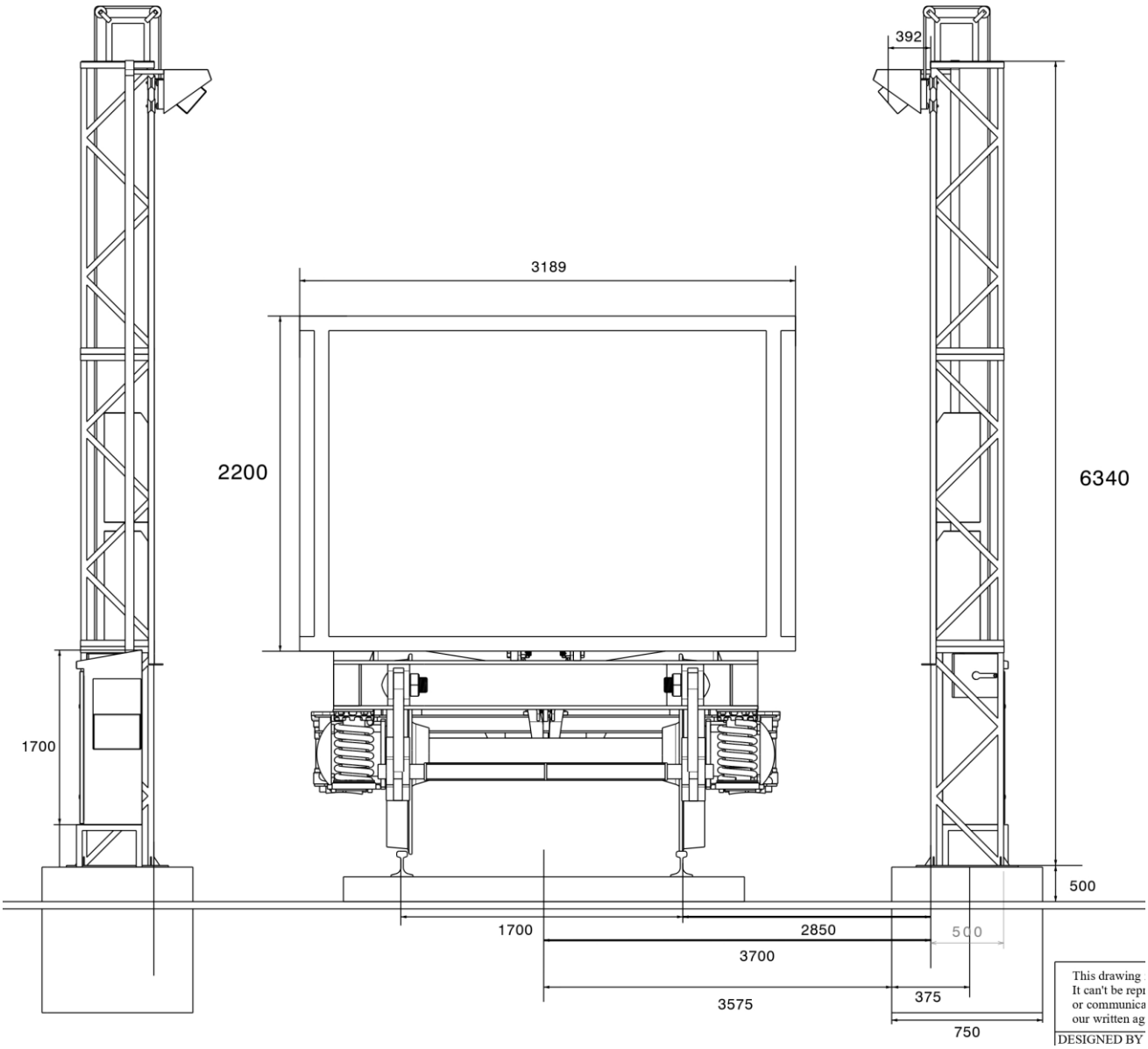
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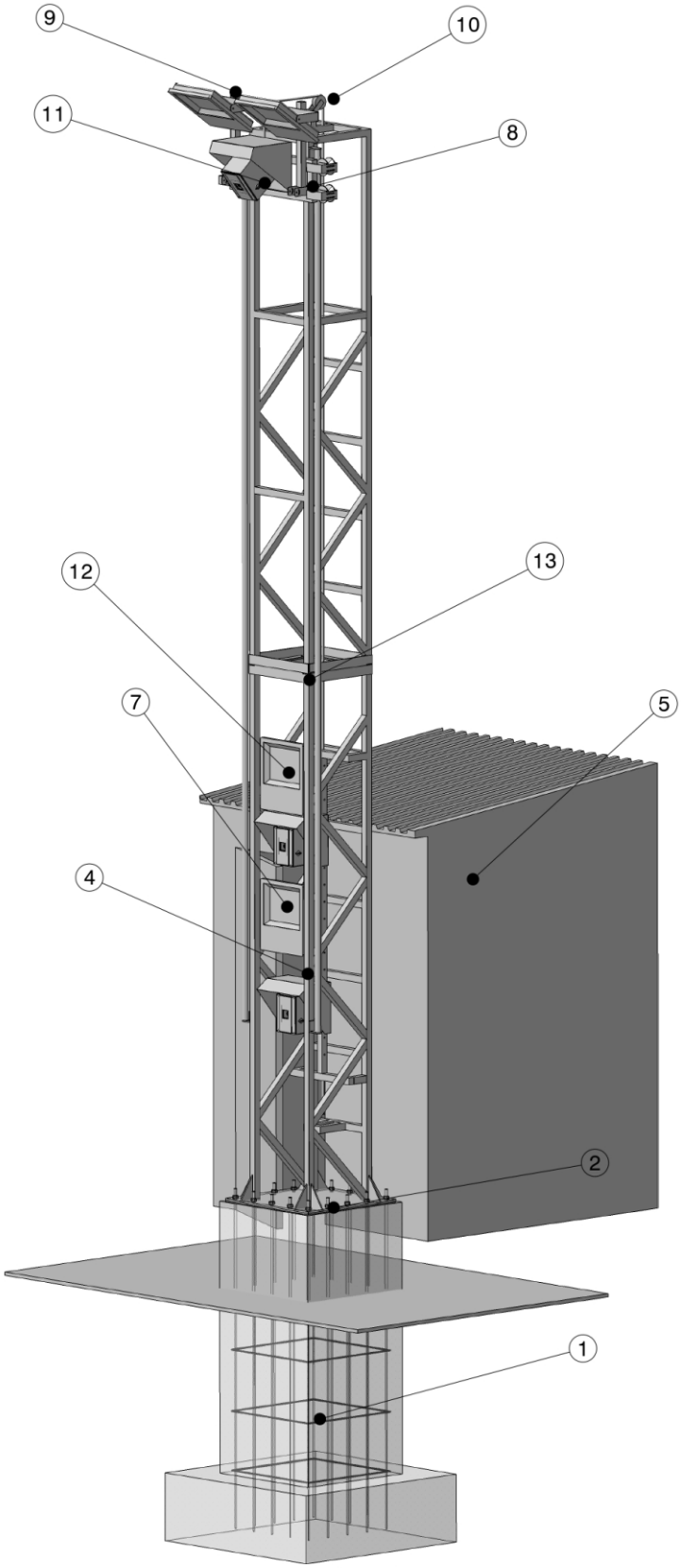
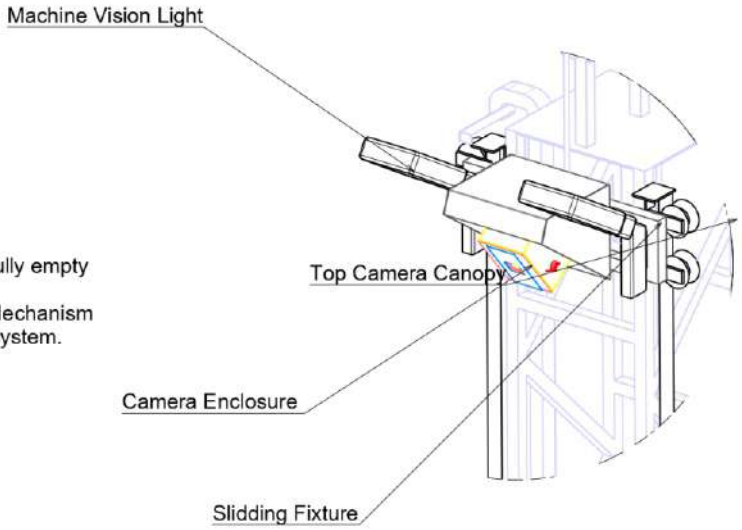


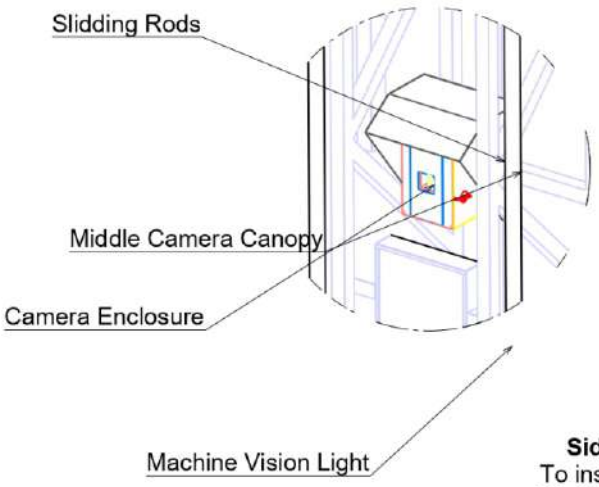
Isometric view
Scale: 1:24

Description(For Both Side Vision System)			
Sr. No	Components	Qty	Material
1	Concrete Block	2	Concrete
2	Base Plate	4	MS
3	Structure	2	MS
4	Lifting Handle	2	MS
5	Server Room	2	MS
6	Camera	6	-
7	Camera Canopy	6	MS
8	Sliding Pulley	8	Durlin
9	Drag Chain	8	PLASTIC
10	Guide Pulley	4	MS
11	Camera Enclosure	6	MS
12	MV light	12	-
13	Sliding Rod	4	SS
14	Cooling Unit	2	-

Design Specification



Top Camera
To check the wagon status, Wagon is fully empty or any material available inside
MV Camera is provided with cleaning Mechanism (for dust, water, fog, etc.) and Cooling system.



Side Camera 1 & Camera 2
To inspect outer surface of wagon:-
Wagon door damage Inspection, Wagon Number/sequence Identification
MV Camera is Provided with automatic lens cleaning Mechanism to protect from dust,water droplets, fog. Cooling system to maintain ideal Temperature.

Tata Steel

Joda, Jharkhand
Noamundi, Jharkhand

Ultratech Cement

Chittorgarh, Rajasthan
Rawan, Chhattisgarh
Chandrapur, Maharashtra
Hirmi, Chhattisgarh
Gulbarga, Karnataka
Chandrapur, Maharashtra
Nathdwara- Rajasthan
Biakunth, Chhattisgarh

Dashboard


Insightzz
Simplifying Business
DRISHTI PORTAL - WAGON INSPECTION
Back
DETAIL VIEW - WAGON INSPECTION
Train Number : 16714351800
Wagon Count : 61
Status : NOT OK
No Of Defects : 6
DateTime : 2023-01-02, 16:18:14
WAGON-1
WAGON-2
WAGON-3
WAGON-4
WAGON-5
WAGON-6
WAGON-7
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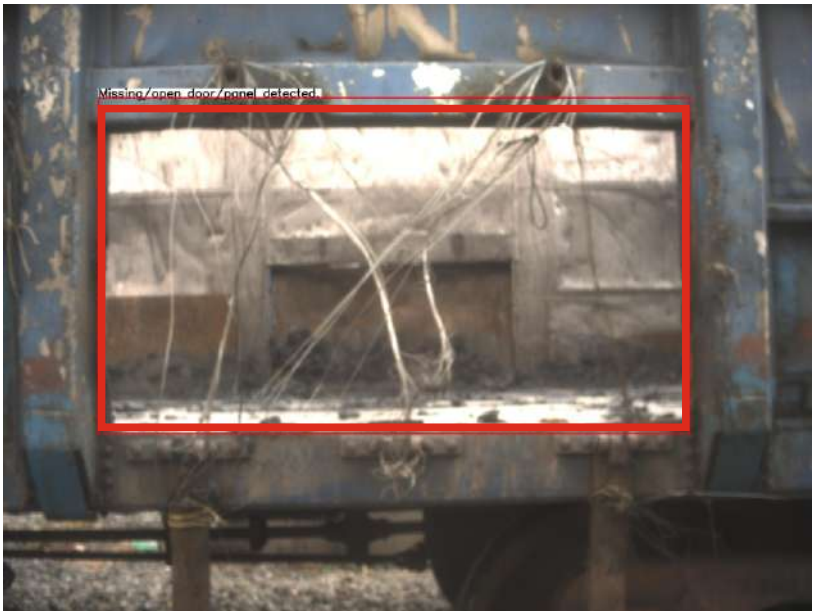
WAGON-61

Detection Images

Optical Character recognition

Door Gap

Missing Door



Unwanted Material

Broken Floor

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