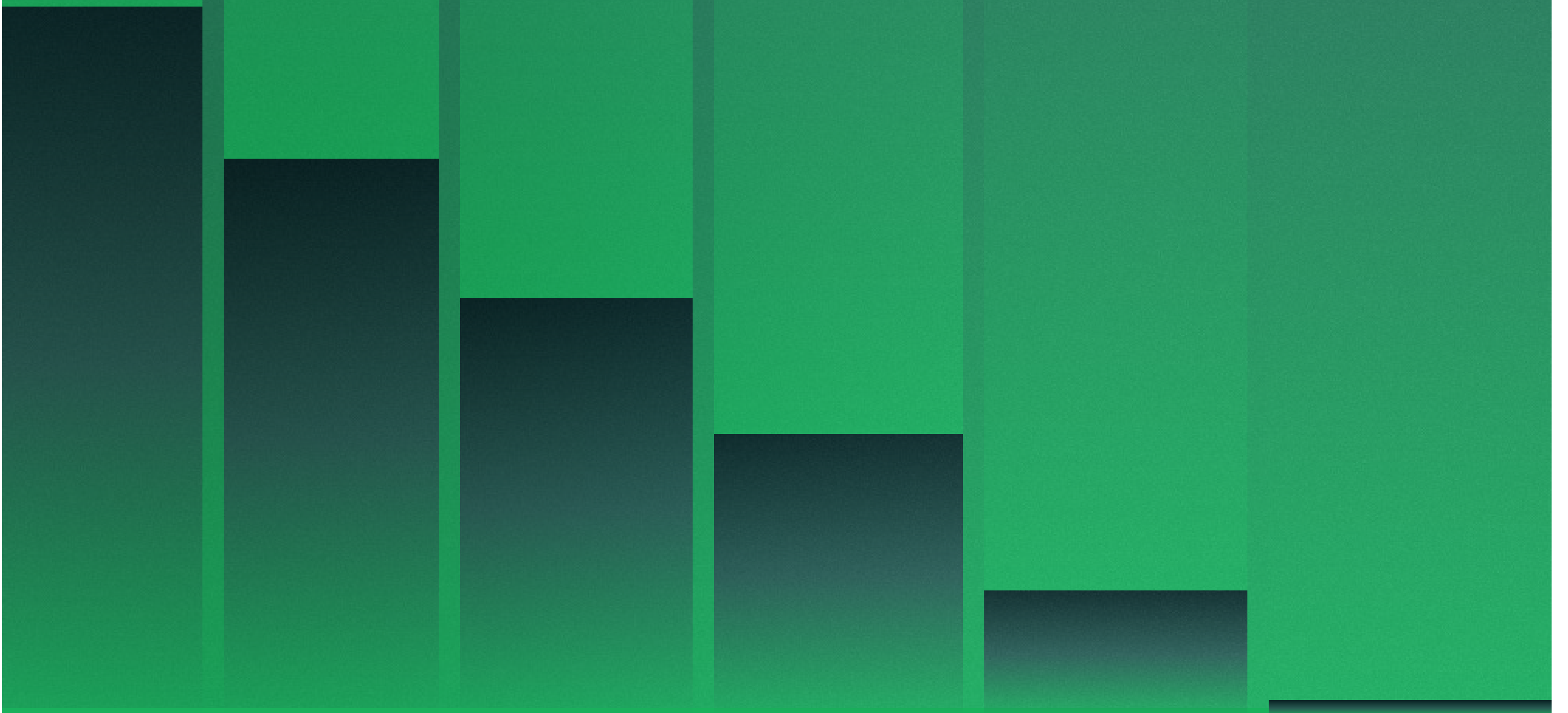


GRASS ENGG.



GRASS ENGG. Pvt. Ltd. is a research-driven engineering and manufacturing company focused on developing indigenous industrial assets built for scale.

We design innovative specialized machinery in fields of propulsion systems, marine mobility, and Industrial problem-solving technologies, creating foundational platforms that enable long-term industrial growth.

Our team is dedicated to developing industrial assets that are entirely indigenous in design and execution, contributing meaningfully to the nation's industrial advancement.

The M-TBM(Mini-Tunnel Boring Machine) Project

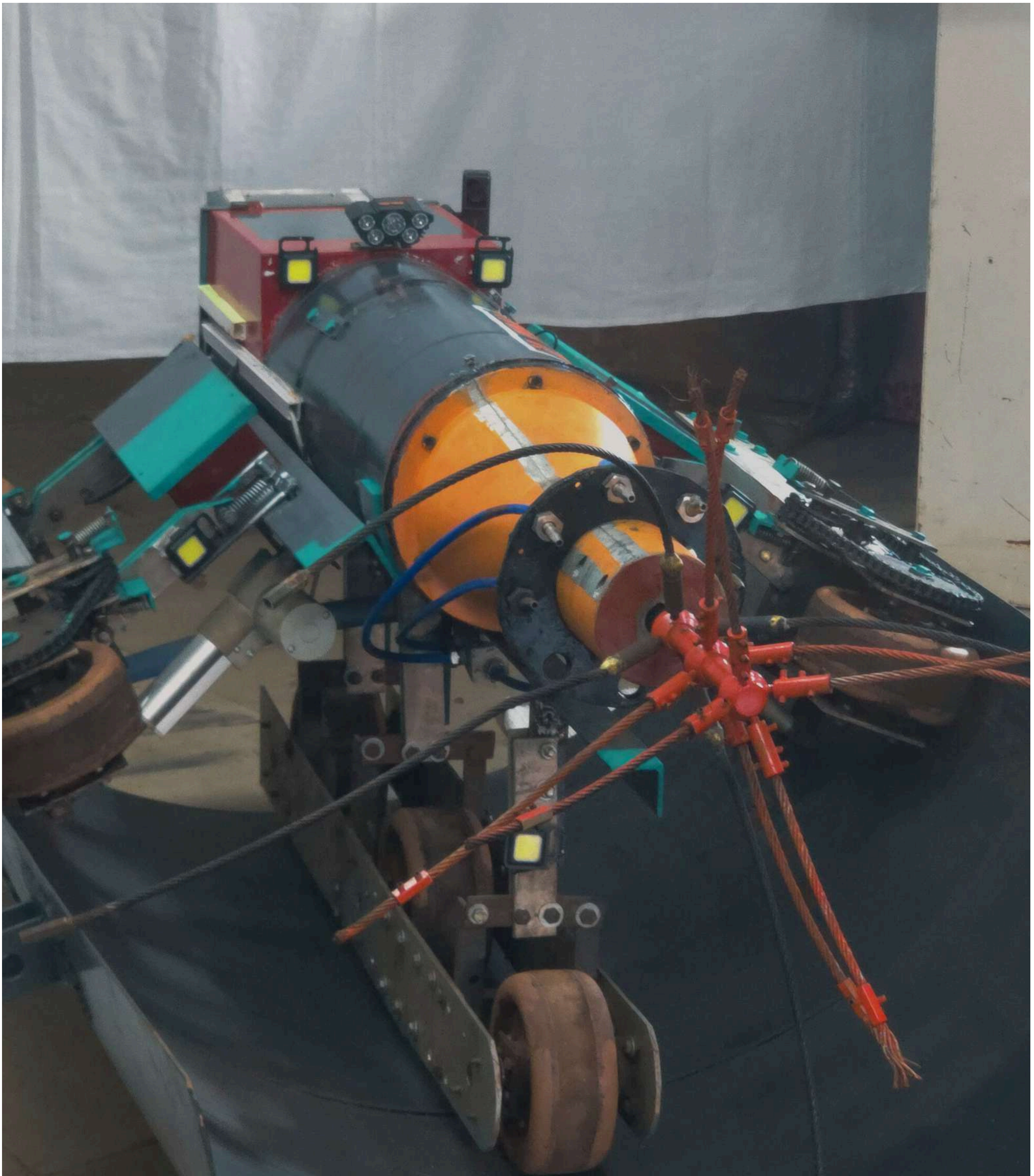


Fig.1 : M-TBM Prototype 2

The M-TBM (Mini Tunnel Boring Machine) is a service-based industrial solution designed for internal pipeline cleaning without the need for dismantling - fabrication - Manual Cleaning. Developed over 1.5 years, tested at Tata Steel, this technology focuses on automating maintenance in hazardous environments.



Fig.2: Slag Deposit in industrial pipe



Fig.2.1: Dismantling of industrial pipe for maintenance

The Problem: Traditional Pipeline Maintenance Process

Current cleaning processes are labor-intensive and carry high operational liabilities:

Manual Labor: Requires 11–15 personnel and exposure to hazardous environments, confined spaces, hot work.

Time & Cost: Involves a 12–13 day shutdown and costs ₹2–3 lakh per pipe section for material and replacement.

Logistics: Necessitates dismantling sections through cutting, welding, and flange fabrication.

Environmental Impact: Leads to debris spillage, land damage from dumping, and production loss



Fig.2.2: Dismantling of industrial pipe for maintenance

The Problem: Traditional Pipeline Maintenance :

Physical Dismantling: Large sections of pipe must be removed to gain access for cleaning or repair.

Heavy Machinery: The use of specialized equipment, is necessary to reach and handle high-elevation infrastructure.

For a 1200 mm COG section of length 15-meters, conventional dismantling/ cleaning /replacement process may cost ₹20–30 lakh.



Fig.2.4: Inspection of industrial pipe for maintenance

The Solution : M-TBM(Mini Tunnel Boring Machine)

The M-TBM offers a platform for in-situ pipe maintenance, extends operational life and delays capital required for pipe replacement.

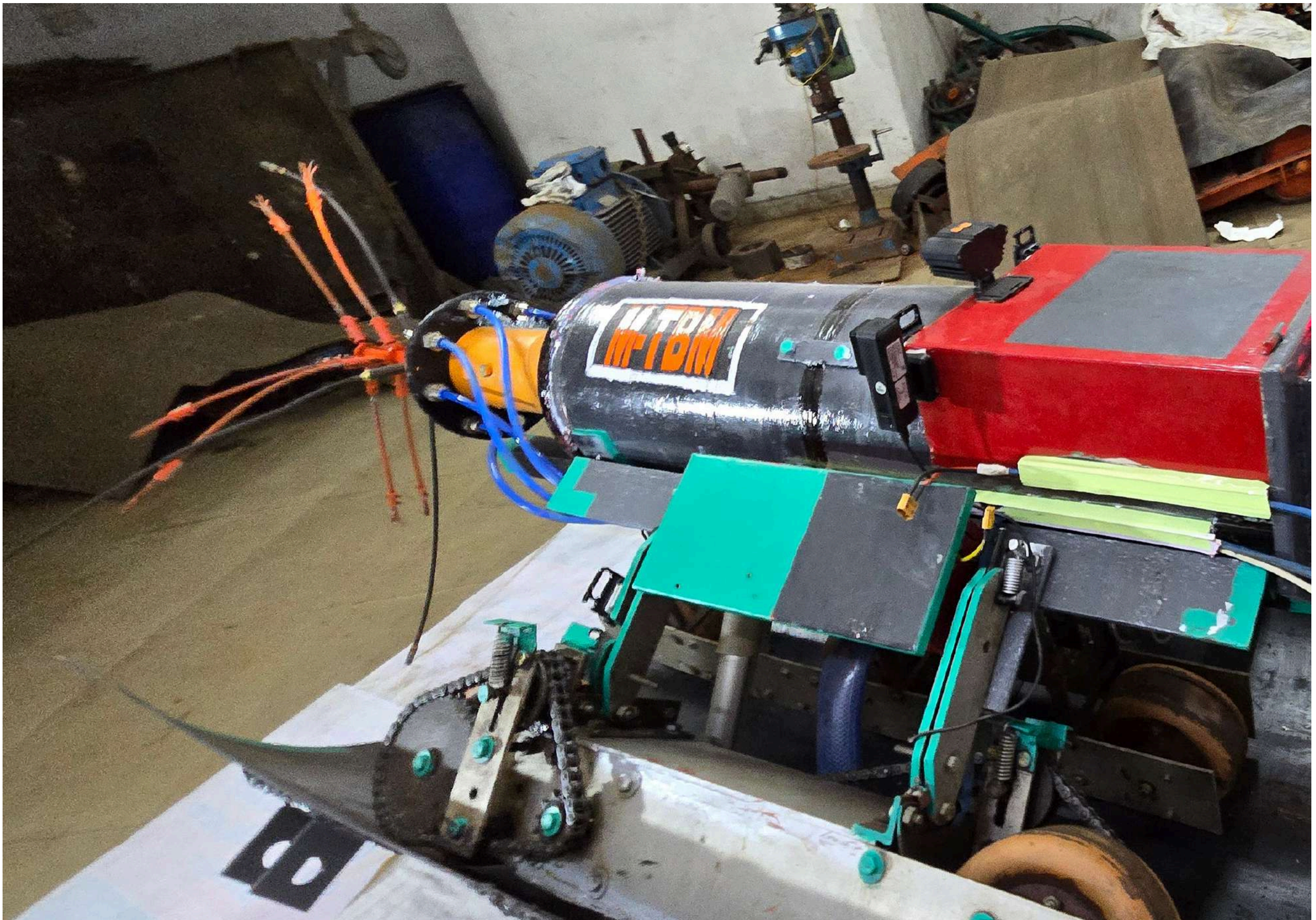


Fig.3.1: M-TBM Prototype 2 in workshop

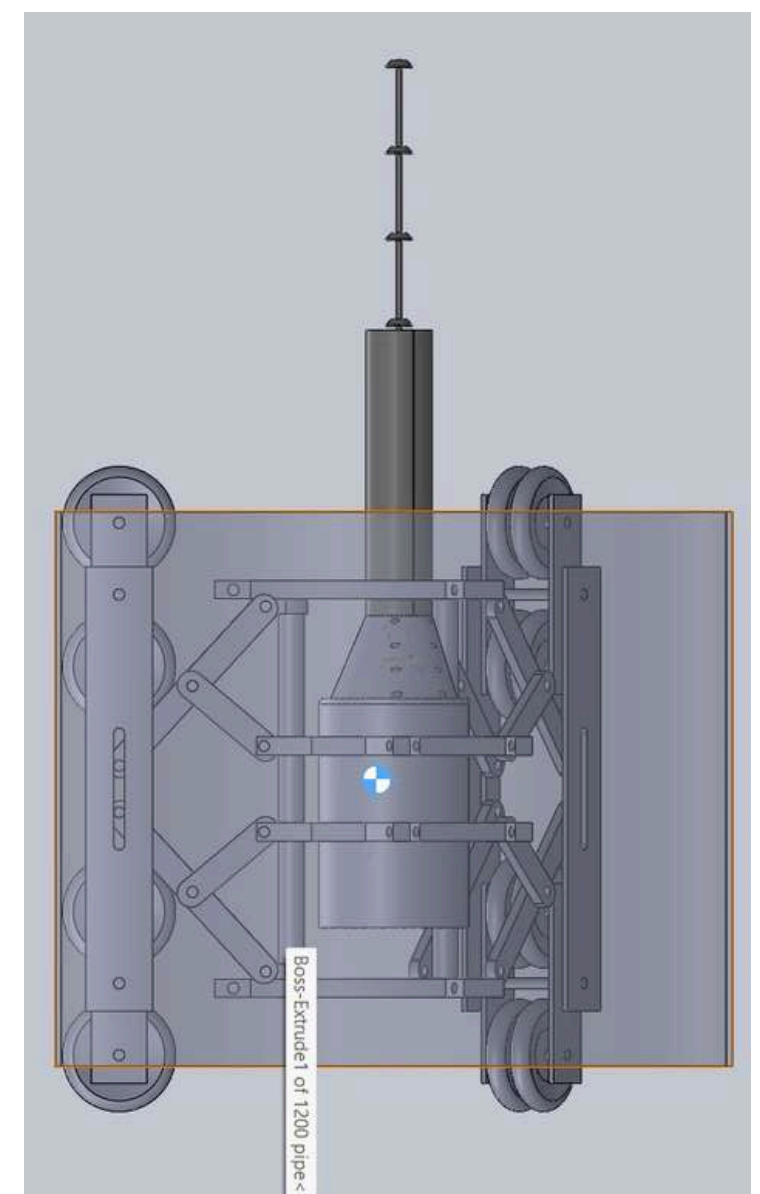
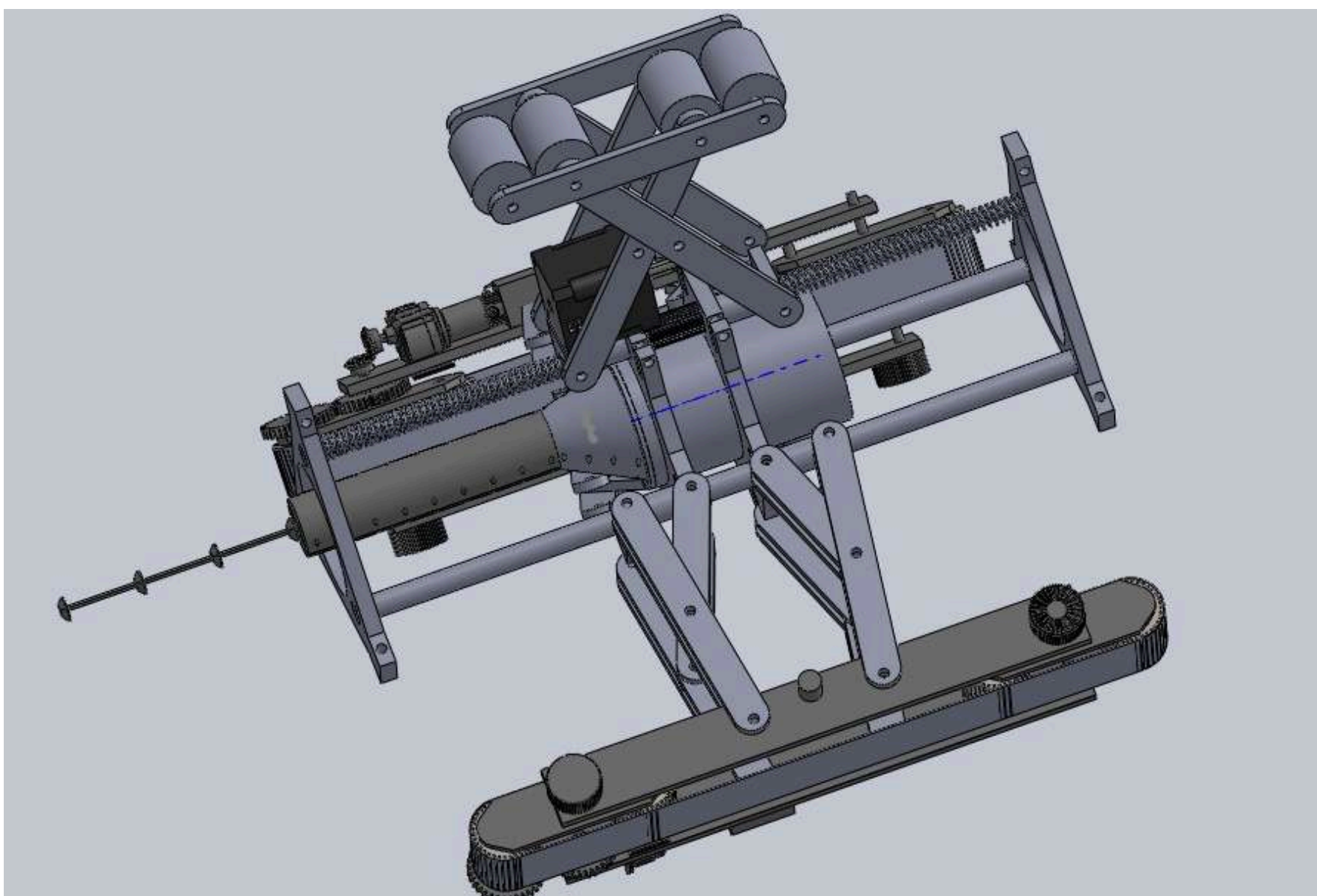


Fig.3.2 & 3.3: M-TBM Prototype 1 & 2 in Design phase

Salient Features :

The design and engineering of the platform is derived from real-time information gathered during shut-downs and site maintenance conducted by our team at TSK.

Feature	Specification
Pipeline Range	800mm – 1600mm Diameter(Current prototype: 1200mm Straight sections Only.)
Speed	100 meters per hour with 15-minute deployment
Power	DC powered, 3-hour battery runtime (15-min swap)
Operating Environment	Waterproof; Electrically isolated, suitable for gas-pipeline, Fire averse, operates up to 80°C and 5° inclines
Manpower Required	3 operators (controlled by one person wirelessly)

Table : 1 Describes the Specifications and Capabilities of M-TBM prototype 2

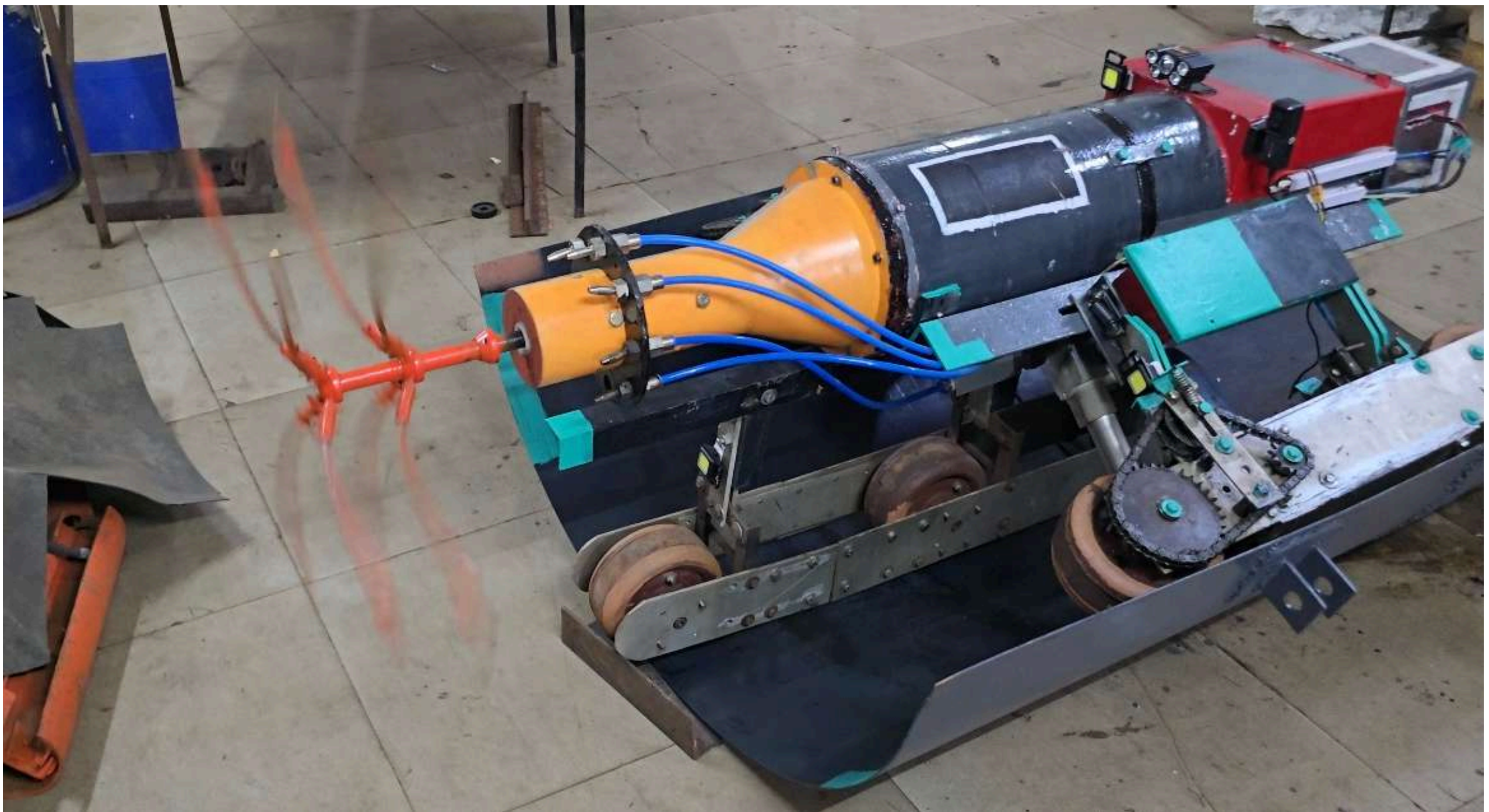


Fig.4.1 : M-TBM Prototype 2 rotating assembly in action.

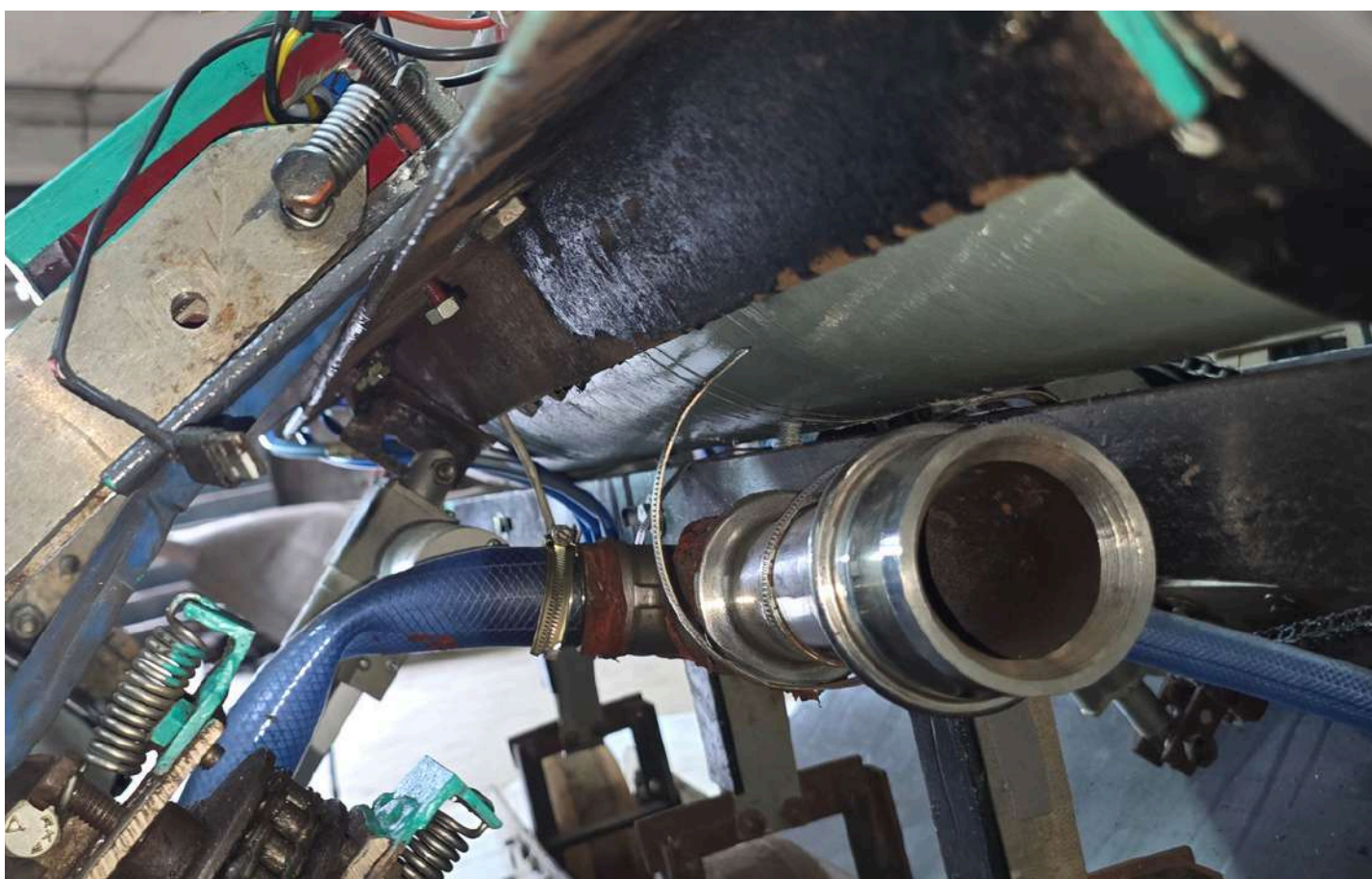


Fig.4.3 : Show the Firehose connector attachment of M-TBM



Fig.4.4 : Show the Remote operational capabilities of M-TBM

Key Advantages (USPs)

Safety: Eliminating dismantling of the pipeline we reduce 1) hot-work, 2) fabrication issue, 3) alignment risk and 4) extended shut-down.

Efficiency: Eliminates over 70% of welding and cutting requirements.

Compact Design: 1.8m length allows for work in highly restricted spaces.

Compliance: Supports ESG and environmental standards by preventing debris spillage.

1. Machine Overview

Machine Name: M-TBM (Mini Tunnel Boring Machine)

Application: Internal pipeline cleaning, descaling, debris removal, and high-risk confined pipeline operations.

Operating Environment: Industrial pipelines (straight section all types), confined and hazardous zones.

The M-TBM is a wireless, DC-powered, remotely operated pipeline maintenance machine. The system enables internal cleaning and cutting operations while maintaining operator safety and reducing downtime.

Fig 5.1 Shows the compact machine in a half pipe from the rear end.

The cutting shaft is adaptable to the purpose. Currently it houses a Steel wire assembly for pulverization and scrubbing, abrasive descaling. Designed to prevent pipe damage due to its flexibility.



2. Pipeline Compatibility

Minimum Pipe Diameter: 900 mm

Maximum Pipe Diameter: 1600 mm

Current Operational Configuration: Fully equipped for 1200 mm diameter pipelines

Expandable Design: Outer shell, leg branches, linear actuators, and wire-rope layout can be reconfigured for other diameters

3. Mobility & Drive System

Drive Type: Chain-driven wheel system, combined torque of 120 N-m

Wheel Configuration: Wheels on either side sharing a common shaft.

Transmission: Chain and sprocket system on both sides

Motor Type: DC geared motor

Traversing Speed: Up to 1 km/hour (application dependent)

4. Support & Load-Bearing Structure

Central Load-Bearing Leg: Mounted on bearings allows free sliding when actuators are retracted

Linear Actuators: Control radial expansion and anchoring enable firm positioning inside the pipe

Outer Shell: Lifiable enclosure Machine can be placed inside shell and lowered directly into the pipeline

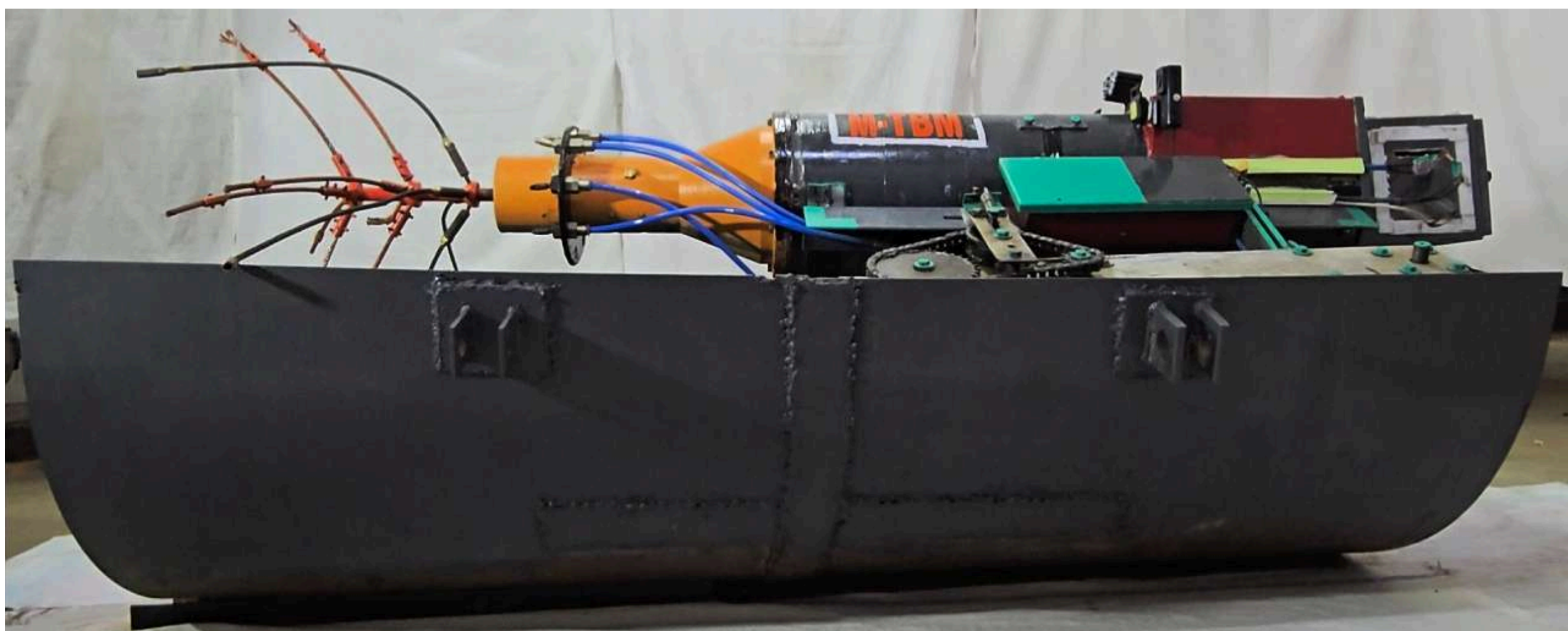


Fig.5.2 : Show the profile of M-TBM in a half pipe.

5. Deployment & Retrieval :

Machine can be lowered directly into pipe using outer shell retrieved by reversing drive or external pulling support designed for fast deployment and extraction

6. Water Management System

Water Input: Accepts industrial fire hydrant hose at rear end.

Primary Exhaust: 1-inch diameter outlet Water turns left and exits at rear Acts as major drainage path

Secondary Exhaust: 1/2-inch diameter outlet Water moves forward briefly, turns right, exits at rear additional drainage support cutting water Supply. Remaining water enters an aluminium distribution block Six outlets (1/4 inch each) Water flows through 6–10 mm tubes directed towards wire ropes for, cooling debris flushing dust suppression



Fig.6.1,6.2 & 6.3 : Shows the before, during and after of M-TBM cleaning process at TATA Steel Kalinganagar.

7. Power & Control

Power Source: DC powered (battery operated)

External Power Requirement: None , Control Type: Wireless remote operation. Advantages: No trailing power cables Suitable for wet and hazardous environments

8. Cutting & Cleaning System

Cutting Method: Wire-rope based cleaning and cutting Front Shaft: Equipped with wire ropes configured for 1200 mm pipes Cutting Shaft Speed: Up to 5000 RPM

9. Vision & Monitoring:

Real-time internal pipe monitoring by onboard camera.

Lighting System: Integrated high-intensity lights enables clear visibility in dark pipelines



Fig. 6.4 Test run at TATA Steel Kalinganagar.

Development and Future Roadmap

The technology has evolved from an initial AC-cabled system to a more stable, second-generation wireless DC model Designed to operate inside pipelines installed at heights.

Proven Field Validation : Completed a 3-day mechanical trial at Tata Steel, Kalinganagar, accomplishing 3 objectives :

- To demonstrate effectiveness of the cutting assembly.
- The ability of M-TBM to traverse inside the pipe.
- Ability of M-TBM to drain the debris outside the pipe.

Future Capabilities: This platform has unrealized potential in industrial maintenance, like cleaning rotary kilns, agitator tanks, Chimney cleaning, vertical hoppers.

Planned expansions include internal painting, epoxy coating, thickness measurement, and kiln adaptation.

The current objective is to demonstrate the second-generation M-TBM in a live facility.

M-TBM Deployment Process

Requirements

- We must be provided an opening on one end of the pipeline.
- We must be provided a fire hydrant connection.
- We will require a crane to lift the M-TBM to the opening provided.
- We will require tanker trucks to transport the collected deposit slurry to safe dumping.

Work Execution

M-TBM will be lifted to the provided opening and will be attached to the pipe segment.



Fire hydrant nozzle will be connected to the M-TBM.



The cleaning process will start.



The slurry will start to come out of the pipeline from the designated exit point.



The slurry will fall into a flexible pipe and run-off will be collected inside the tanker truck.



The M-TBM will reverse back inside its shell and the crane will bring it down.

GRASS ENGG. PVT. LTD.
JAMSHEDPUR 831001

Manufacturer : GRASS ENGG. Pvt. Ltd

(Engineering solutions focused on safety,
automation, and indigenous development)

Contact Information

GRASS ENGG. Pvt. Ltd.

Swarn Swarup Tower 00215, New Kalimati Road,
Sakchi, East Singhbhum, Sakchi, Jharkhand,
India, 831001.

+91 6204488701

operations@grassengg.in

Website : <https://grassengg.in/>

For technical discussions or partnership inquiries regarding the M-TBM Project, please contact us directly via email with project details.