केवल कार्यालयीन उपयोग हेतु
For official use only

सत्यमेव जयते

भारत सरकार – **Government of India**
रेल मंत्रालय – **Ministry of Railways**

यंत्रीकृत निर्माण

MECHANIZED CONSTRUCTION

केमटेक / 2013 / सि / यं.नि. / 1.0

CAMTECH/2013/C/MC/1.0

मार्च – 2013

March – 2013

अअभासं RDSO
रेल अग्रदूत Transforming Railways
www.rdso.gov.in

An ISO 9001:2000 Certified Organisation
उत्कृष्ट अनुरक्षण प्रौद्योगिकी केंद्र
Excellence In Maintenance

Indian Railways
Centre for Advanced Maintenance Technology

महाराजपुर, ग्वालियर – 474005
Maharajpur, Gwalior – 474005
✆ : 0751 - 2470869 & Fax : 0751 - 2470841

यंत्रीकृत निर्माण

MECHANIZED CONSTRUCTION

प्राक्कथन

जहॉ तक रेलपथ संरचना के आधुनिकीकरण एवं रेलपथ फॉर्मेशन के यंत्रीकृत निर्माण से संबंध है तो भारतीय रेल परिवर्तन अवस्था से गुज़र रही है। यह अनुभव हो चुका है कि जब भी कोई औद्यौगिक प्रणाली यंत्रीकृत होती है तो यह बेहतर उत्पादन, बेहतर गुणवत्ता व बेहतर अर्थव्यवस्था की ओर ले जाती है।

मशीनीकरण, निर्माण और वितरण में न केवल गति में सुधार बल्कि यह उच्च गुणवत्ता मानकों को प्राप्त करने में मदद करता है। जब एक विशेष कार्य के लिए एक मशीन का चयन किया जाता है तो मशीन की उपलब्धता और इसकी परियोजना विशेष तैनाती दृश्यपरक होना चाहिए।

केमटेक द्वारा तैयार इस पुस्तिका में निर्माण मशीनरी जो कि सामान्य रुप से, कार्य की वांछित गुणवत्ता को प्राप्त करने के लिए तैनात की जाती हैं, के विभिन्न प्रकारों को शामिल किया गया है।

यह उम्मीद की जाती है कि भारतीय रेल के समस्त सिविल इंजीनियरिंग स्टाफ के लिए यह पुस्तिका निश्चित रुप से उपयोगी सिद्ध होगी।

केमटेक, ग्वालियर *(ए. आर. तुपे)*
दिनांक 26, मार्च 2013 *कार्यकारी निदेशक*

FOREWORD

Indian Railway is undergoing through a transition phase as far as modernization of track structure and mechanization of construction of track formation is concerned. It has been an experience that whenever any industrial process has been mechanized, it has led to improved productivity, improved quality and better economy.

Mechanization not only improves speed in construction and delivery but also help to achieve high quality standards. When selecting a machine for a particular task, the machine's availability and its project-specific deployment should be visualized.

The handbook prepared by CAMTECH incorporates various kinds of construction machineries generally deployed for achieving desired quality of works.

It is expected that the handbook will be quite helpful to civil engineering personnel of Indian Railways engaged in this activity.

CAMTECH/Gwalior ***(A.R. Tupe)***
Date: 20, March 2013 ***Executive Director***

भूमिका

पूरे भारत में विशाल ढांचागत सेट अप देने वाली भारतीय रेल ने विभिन्न गतिविधियों के यंत्रीकरण की प्रगति में तेजी लाने के लिए और निर्माण की गुणवत्ता में सुधार के लिए कुछ कदम उठाए हैं। मशीनीकरण निर्माण का तात्पर्य है कि निर्माण के श्रम आधारित तरीकों को लागू करने के बजाय मशीनों का प्रयोग करते हुए आधुनिक तकनीकों का उपयोग करना।

रेल्वे निर्माण परियोजना में फॉमेशन निर्माण हेतु भूमि आधारित कार्य ब्लेंकेटिंग, छोटे एवं बड़े पुलों का निर्माण, गिट्टी की आपूर्ति और मशीन टेंम्पिंग द्वारा रेलपथ जोडने जैसे कार्य शामिल रहते हैं। आज–कल वैश्वीकरण के दौर में नवीनतम मशीनरी का आयात बहुत आसान है और भारतीय रेल से जुड़ी कुछ कंपनियॉ निर्माण में इन मशीनों का उपयोग निश्चित रुप से कर सकती हैं। मशीनरी की तैनाती से परियोजना में लगने वाले समय की बचत की जाती है।

'यंत्रीकृत निर्माण' पर इस पुस्तिका को तैयार करने का उद्धेश्य निर्माण में मशीनीकरण के ज्ञान का प्रसार करना तथा उच्च क्षमता उत्खनन, डोज़र, डम्पर और थरथराने वाला कम्पेक्टर के रुप में विभिन्न प्रकार की मशीनरी की तैनाती के माध्यम से भूमि जनित कार्यो को करना एवं अन्य उपकरणों जिनका व्यापक रुप से निर्माण कार्यो में उपयोग होता है, से कम समय और खर्च में लक्ष्य की प्राप्ति करना है।

यह पुस्तिका वैधानिक नहीं है तथा इसमें दी गई जानकारी का उद्धेश्य केवल मार्गदर्शन है। किसी न किसी रुप में अधिकांश डेटा एवं जानकारी, साहित्य सर्वेक्षण तथा इंटरनेट खोज पर आधारित है। अधिक जानकारी के लिए, इस पुस्तिका में निहित किसी भी जानकारी को अंतिम रुप से लागू करने से पहले विषय पर उपलब्ध प्रासंगिक साहित्य का अध्ययन संदर्भ रूप में किया जाना चाहिए।

इस पुस्तिका के सुघार हेतु पाठकों के किसी भी सुझाव का हम स्वागत करते हैं।

केमटेक, ग्वालियर *(एस.के.सक्सेना)*
दिनांक 19, मार्च 2013 *उप निदेशक/सिविल*

PREFACE

The Indian Railway having vast infrastructural setup all over India has taken certain initiatives for mechanizing various activities to accelerate the progress and to improve the quality of construction. Mechanization in construction means application of modern techniques by using machines instead of applying labour based methods of construction.

The railway construction project consists of execution of works for laying formation i.e. earth work including blanketing, construction of minor & major bridges, ballast supply and track linking including machine tamping. Now-a-days with the globalization, the import of the latest machineries is very easy and there are certain firms on Indian Railways which can definitely use these machineries in construction. By deploying machineries considerable reduction in project time is achieved.

The objective to prepare this handbook on 'Mechanized Construction' is to disseminate the knowledge of mechanization in construction and to achieve projected goal in less time and expenditure through deployment of the various kinds of machineries such as high capacity excavators, dozers, dumpers and vibratory compactors for earth moving operations and other equipments that are widely used in construction industry.

This handbook is not statutory and contents are only for the purpose of guidance to the civil engineering personnel involved in construction activities. Most of the data & information in some form or the other are based on literature survey and internet search. For more in-depth information, the relevant literature on the subject may be referred before final implementation of any information contained in this handbook.

We welcome any suggestions from our readers for further improvement.

CAMTECH/Gwalior ***(S.K. Saxena)***
Date: 19, March 2013 ***Dy. Director/Civil***

विषय–सूची / CONTENT

अध्याय / CHAPTER	विवरण / DESCRIPTION	पृष्ठ संख्या / PAGE NO.
	प्राक्कथन / *FOREWORD*	*i*
	भूमिका / *PREFACE*	*ii*
	विषय–सूची / *CONTENT*	*iii*
	संशोधन पर्चियॉ / *CORRECTION SLIP*	*iv*
1.0	परिचय / INTRODUCTION	1
2.0	भूमि चालन / EARTH MOVING	2
3.0	सामग्री प्रहस्तन / MATERIAL HANDLING	7
4.0	सड़क निर्माण / ROAD CONSTRUCTION	12
5.0	कंक्रीट उत्पादन / CONCRETE PRODUCTION	18
6.0	सामान्य रुप से उपयोग की जाने वाली मशीनरी / COMMONLY USED MACHINERIES	22
	संदर्भ / REFERENCES	26
	टिप्पणी / NOTES	27

संशोधन पर्चियों का प्रकाशन
ISSUE OF CORRECTION SLIPS

इस हस्तपुस्तिका के लिये भविष्य में प्रकाशित होने वाली संशोधन पर्चियों को निम्नानुसार संख्यांकित किया जायेगाः

The correction slips to be issued in future for this handbook will be numbered as follows:

केमटेक / 2013 / सि / यं.नि. / 1.0 / सीएस # XX दिनांक _____

CAMTECH/2013/C/MC/1.0/CS # XX date _____

जहॉ XX सम्बन्धित संशोधन पर्ची की क्रम संख्या है (01 से प्रारम्भ होकर आगे की ओर)

Where "XX" is the serial number of the concerned correction slip (starting from 01 onwards).

प्रकाशित संशोधन पर्चियॉ
CORRECTION SLIPS ISSUED

क्र.सं. / Sr. No.	प्रकाशन की तारीख / Date of issue	संशोधित पृष्ठ संख्या तथा मद संख्या / Page no. and Item No. modified	टिप्पणी / Remarks

Go to Main Index

अध्याय / CHAPTER – 1
परिचय / INTRODUCTION

Mechanized Construction may be defined as *"The condition of having a highly technical implementation or the act of implementing the control of equipment with advanced technology; usually involving electronic hardware; automation replaces human workers by machines."*

In India, the large majority of construction still happens with manual efforts that neither guarantees economy of construction, nor of its quality. With the boom in Indian economy, there is tremendous demand for development of infrastructure to meet the needs of growing economy. In fact, apart from the growing volume and size of infrastructure projects, the rising labour cost is considered one of the major factors forcing the industry to look for alternative approaches. The construction industry that had been traditionally conservative in accepting new technologies, is now increasingly adopting mechanized construction. The mechanized construction is aimed at to continue and complete a project at reasonable cost within agreed time schedule.

Indian Railways being life line of our country needs to optimize present semi-mechanized system by bringing strategic changes in current practices, to control delays & poor quality so as to make it a perfect semi-mechanized construction system. It has been taken into consideration that the manual methods of construction cannot achieve the desired quality of earthwork in construction of formation. Earthen formation is an inevitable part that plays a vital role in the service life of a railway line. *Two assets, which are rare to-day but was in plenty in olden days, had dictated the method of forming the formation; these two assets being time and man power. Now we are deficient in both.* This has led to large scale mechanization in the construction of formation.

Indeed, technology is the need of the hour and the new methodologies being adopted by the construction industry include advanced engineering, innovative materials and efficient construction management to meet the rising infrastructure demands. The mechanization in construction industry is advantageous because of Economy, Quality, Safety, Speed, and Feasibility. The technology can be applied to Railways projects, Highway projects, Buildings, Power plants, etc. *The commonly used construction equipments are Earth moving equipments, Hauling equipments, Hoisting equipment, Conveying equipment, Concrete production equipment, Pile driving equipment, and Pumping and de-watering equipment.*

The selection of proper equipment is crucial to achieving efficient earthmoving and construction operations. Once the decision of deployment of construction equipment is taken, required construction equipment need to be identified in order to complete the work in comparatively less time and expenditure.

***

Go to Main Index

अध्याय / CHAPTER – 2
भूमि चालन / EARTH MOVING

Earthmoving may include site preparation; excavation; embankment construction; backfilling; dredging; preparing base course, sub-base, and sub-grade; compaction; and road surfacing. For earthmoving operations, material is placed in three categories - rock, soil (common earth), and unclassified. Soil weight affects the performance of the equipment as how dozers push, graders cast, and scrapers load the material.

2.1 उत्खनन / Excavators: For earth work, the commonly used excavators are hydraulic excavators, which work with great efficiency. They consist of a boom, stick (dipper arm), bucket and cab on a rotating platform known as the house that sits atop an undercarriage with tracks or wheels.


Heavy duty hydraulic excavator (chain mounted)

The undercarriage includes the blade (if fitted), tracks, track frame, and final drives, which have a hydraulic motor and gearing providing the drive to the individual tracks, and the house includes the operator cab, counterweight, engine, fuel and hydraulic oil tanks. The house attaches to the undercarriage by way of a centre pin, allowing the machine to slew 360° unhindered. The main boom attached to the house can be one of several different configurations:

- Most are mono booms having no movement apart from straight up and down.
- Some others have a knuckle boom which can also move left and right in line with the machine.
- Another option is a hinge at the base of the boom allowing it to hydraulically pivot up to 180° independent to the house; however, this is generally available only to compact excavators.

Attached to the end of the boom is the stick (called as dipper arm), which provides the digging force to pull the bucket through the ground. The stick length is optional depending whether reach (longer stick) or break-out power (shorter stick) is required. On the end of the stick is usually a bucket with a straight cutting edge used for cleanup and leveling where the material to be dug is soft. A general purpose bucket is generally smaller, stronger, and has hardened side cutters and teeth used to break through hard ground and rocks. Bucket can be replaced by grapple, breaker or shovels as per usage. Crawlers (tracks) help the excavator to move on uneven path without any problem.

Excavators are extensively used in many roles such as digging of trenches and foundations, demolition, general grading/landscaping, heavy lifting (e.g. lifting and placing of large concrete pipes), river dredging, mining and brush cutting with hydraulic attachments and driving piles in conjunction with a pile driver.

They come in a range of capacities and are usually classified on the basis of tonnage. The lower end excavators, referred to as mini excavators, find greater usage in urban infrastructure development and road development.

Mini or Compact Excavator is highly productive in small civil engineering projects like Landscaping; Digging and Excavating sites; Building and road construction; Small demolitions; Digging trenches for conduit; Removal of concrete and other materials from road, bridges, walls, driveways etc.; Street repairs, drainage ditches, and repairs on water and sewer lines; Digging test holes and removing contaminated soil or for any jobs that require a high level of production in confined spaces.



2.2 ट्रेन्चर/Trenchers: Trenchers must be handled with extreme care because they are very dangerous equipments. However, trenchers perform following functions like Landscaping; Irrigation; Plumbing; Underground utility construction for gas, telephone, electrical, and water and sewer services; Special trenching components available to cut through rocky soils, paving and frozen ground etc.



Based on the size and usage these can be categorized as chain trenchers, wheel or disc trenchers and bucket trenchers. With attachments like backhoes, saws and reel carriers, trenchers become more versatile and efficient.

2.3 लोडर/Loaders: Loader is a machine usually wheeled that uses a wide tilting bucket on the end of movable arms to lift and move materials such as sand, debris, dirt and mud into other vehicles, thereby clearing rubble and digging materials in the construction sites. The wheeled loaders are more popular and provide better mobility and speed. The flexibility of usage is low as compared to a backhoe. Loaders are largely used as complimentary products for material re-handling in construction and mining applications.



Backhoe Loader: An important engineering machine which comprises of a small backhoe in the rear end, a tractor, front shovel and replaceable bucket, *can duplicate the work of a bulldozer, front end loader and excavator.* The backhoe loader also has the advantage of being driven directly to the different job areas. These can also be associated with variety of other instruments like augers, hydraulic hammers, asphalt grinders and grapples.



The attachment of different tools allows backhoe loaders to do multiple jobs like Light demolition; Transportation of light building material; Digging holes; Paving roads; Breaking asphalt; Small urban engineering projects.

2.4 मोटर ग्रेडर/Motor Grader: A motor grader is a huge productive earth-moving apparatus equipped with a long blade which is used to level a surface of roads and construction sites. Graders can produce inclined surfaces, to give cant (camber) to roads. At the end it has a plow which stays close to the ground. A blade is situated under the cab to spread and push gravel.



Motor graders operated from the centre of the machine are commonly used in the construction and maintenance of dirt roads and gravel roads. In the construction of paved roads they are used to prepare the base course to create a wide flat surface for the asphalt to be placed on. Similarly, graders are used for levelling the surface during earthwork in embankments and providing blanket surface before spreading ballast and laying track. Graders are also used to set native soil foundation pads to finish grade prior to the construction of large buildings and for underground mining.

2.5 डोज़र/Dozers: Dozers equipped with hydraulic system are heavy machines used for clearing and grading land, usually having continuous treads and a broad hydraulic blade in front. Tractor, blade and rippers are the main parts of dozer whose primary function is to do major construction works. The blade may be lifted and forced down by hydraulic rams. For digging, the blade is held below surface level; for transporting, it is held at the surface level and for spreading, it is held above the surface level, as the tractor moves forward.



Depending on the nature of the work, dozer blades come in three varieties that are **Straight Blade**, which is short having no lateral curve and no side wings and used only for fine grading; **Universal Blade**, which is very tall and curved and has large side wings capable to carry more material around; and **Combination Blade**, which is short in length, less curved and has smaller side wings.

Many modern dozers have a ripper claw with a hardened tungsten steel tip mounted on the end opposite the shovel. The ripper is used to break up compacted ground or paved areas. Based on the size, nature of work and the blades used, dozers find their applications in Earthmoving; Road construction; Military operations; Loading ores into hoppers at mines; Lifting various materials; Breaking pavements and compacted grounds; Digging of canals; Land clearing and land levelling; Preparation of construction sites; Removal of snows and other smaller and bigger civil engineering projects.

2.6 स्क्रेपर/Scrapper: One of the most versatile equipment that performs different functions is used for excavating, digging and hauling of materials. The construction scrapers have hydraulically operated bails and push blocks with hooks. During loading, the trailing scraper's bail snags the hook and holds the machines together. This push-pull arrangement works efficiently without consuming much time.



Scrapers are highly useful in various projects like in preparing the ground for the new loads of solid waste; in preparing work at landfills; in preparing the sites for construction (road, etc.) through digging, loading, hauling and dumping the wastes materials etc.

2.7 मिट्टी कम्पेक्टर/Soil Compactors: Soil compactors are used for compacting soils in various construction projects like compaction in urban areas, roads and highways; compaction of mixed soils and cohesive soils in thin and medium layer thicknesses in large areas; landscaping and preparing sites for building construction and compaction of soils and gravels in trenches, around retaining walls and or any other difficult job site.



In soil compacting techniques, energy is applied to loose soil or other material which increases its density and consequently its load-bearing capacity. There are certain advantages of soil compacting which are as follows:

- Water seepage is minimized
- Damage from frosts is prevented.
- Load bearing capacity of soil is increased.
- Contraction and swelling of soil is reduced to a certain extent.

Different types of compactors are used for different types of soils, e.g. **static steel wheel and pneumatic rollers** for thin layer of soils; **impact machines like jumping jack rammers** for cohesive type of soils; and **plate compactors** for granular soils and asphalt. For soils with greater cohesive content, machines like **vibratory rollers** available in single and dual drum models with either smooth or pad-foot drums are used. Soil compactor plays an important role in many infrastructure projects.

2.8 क्षैतिज दि ात्मक ड्रिलिंग उपकरण/Horizontal Directional Drilling Equipment: With trenchless methodology, horizontal directional equipment provides an installation which is easier than traditional open cut drilling. It is very helpful in installations of municipal pipes, pipes for gas, oils etc. The horizontal drilling methodology involves drilling of small pilot hole, following straight alignment to minimize friction bore. Pilot hole is enlarged by pulling back larger reamers or reaming heads. Followings are the applications of horizontal directional equipments:

- Used to install pipelines of various sizes and materials below the ground surface.



- Feasible in open cut installations like road and river crossings.
- Useful in the installation and replacement of gas pipeline, water pipelines etc.
- It helps in the installation of conduit under an obstacle, such as a river or a road, without disturbing the surrounding area.
- Used for the installation of underground gas, electric, water, telecommunication or soil remediation lines without excavation or trenching.



2.9 हाड्रोलिक ब्रेकर/Hydraulic Breakers: Hydraulic breakers are powerful, productive machines used to break a variety of materials. These breakers are light, medium or heavy and can be mounted on some equipment (called as carriers) such as backhoes, excavators etc. The size of the breaker must match the size of the carrier as the vibrations transmitted to the operator are very strong and unbearable. The application of hydraulic breakers mainly lies in breaking concrete roads; breaking rocks and asphalt surfaces; trimming of RCC pile heads; concrete demolition projects involving bridge decks, foundations and pavement.



2.10 ड्रिलिंग रिग/Drilling Rig: A drilling rig is a machine which creates holes in the ground. Drilling rigs can be massive structures used to drill water wells, oil wells, or natural gas extraction wells, or they can be small enough to be moved manually by one person. Drilling rigs can be mobile equipment mounted on trucks, tracks or trailers, or more permanent land or marine-based structures. The term "rig" therefore generally refers to the complex of equipment that is used to penetrate the surface of the Earth's crust. Drilling rigs can be

- small and portable, capable of drilling for mineral exploration, water wells and environmental investigations and
- huge, capable of drilling through thousands of meters of the Earth's crust.



The progress of major bridges depends on proper planning of foundation based on soil investigation. Pile foundations are being adopted with Rotary Rigs in most of the cases. The traditional tripod method is able to complete one pile in three days; whereas the rotary rigs can complete three piles in a day at almost same cost of work. The application of these machines is for improved quality and faster progress.

***

Go to Main Index

अध्याय / CHAPTER – 3
सामग्री प्रहस्तन / MATERIAL HANDLING

3.1 लिफ्ट ट्रक / Lift Truck: A lift truck is a machine which lifts and transports materials by using forks under the load. These are available in different models and capacities for different working environment and requirement. These are generally powered by an LPG, gasoline or diesel fuelled internal combustion engine or electric motor powered by battery. Counterweight which compensates for the load is at the rear of the machine. Load is lowered, raised and tilted by the mast which is operated hydraulically and consists of a cylinder and interlocking rails. The applications of lift trucks are lifting and removing of materials to the job sites and in various construction projects like roads, highways, buildings etc.


Lift Truck

3.2 डम्पर / Dumper: A dumper is usually an open four wheeled vehicle with the load skip in front of the driver. The skip can tip to dump the load; this is where the name "dumper" comes from. They are used to carry loads and materials to the construction sites. A towing eye is fitted for secondary use as a site tractor to tow such things as an air compressor to run pneumatic drills. The main applications of dumpers are in transporting materials to construction sites, in manufacturing and production line.



3.3 डम्पर ट्रक / Dumper Trucks: Dumper trucks (also called as Tipper) are those trucks whose contents can be emptied by raising the front end of the platform pneumatically so that the load is discharged by gravity. They are available in various sizes and mainly used in activities such as to clear material wastes from the building construction sites, in road and port construction, to supply materials to the construction sites etc. The most commonly used dumper trucks are:

- **Standard Dumper Trucks:** A dump body (bed) mounted to the frame of a truck chassis is raised by a hydraulic ram mounted under the front of the dumper body between the frames. The back of the bed is hinged at the back to the truck. The tailgate can be configured to swing on hinges or it can be configured in the "High Lift Tailgate" format wherein pneumatic rams lift the gate open and up above the dump body.



- **Articulated Dumper Trucks:** An articulated dump truck has a hinge between the cab and the dump box. This vehicle is highly adaptable to rough terrain. In line with its use in rough

terrain, longer distances and overly flat surfaces tend to cause driveline troubles and failures. Articulated trucks are often referred to as the modern scraper, in the sense that they carry a much higher maintenance burden than most trucks.



3.4 क्राउलर डम्पर/Crawlers Dumper: These are used for the purpose of supplying materials to the construction sites and removing the wastes from the sites. These are mounted on the tracks which allow them to work even in rough terrains. Crawlers dumper too have a box hinged at the rear of the truck which through hydraulic operations lift the front of the dumper and allow the contents to be deposited on the ground behind the truck at the site of delivery. They are used in various construction and engineering projects; in road construction in rough terrain; for the clearance of the sites; for supplying materials to the construction sites; in certain mining operations.



3.5 रेल लॉरी/Rail Lorries: Machine crushed ballast duly phasing out hand broken ballast, is collected alongside the track as per land availability. About 25% of Ballast is collected in depot to truck out with hoppers or ballast Lorries at required locations. In addition, mini depots are created nearby the LCs for loading, leading and dumping using Rail Lorries with shorter lead.



3.6 मॉडिफाइड टिपर/Modified Tippers: The road tippers after removing the tyre and mounting it on rails by fixing modified rail wheels can be used for carrying ballast on the track and unloaded by tipping. The released rail wheels modified by fixing tippers hub, welded on the rail wheels fitted to the tipper tyre disc was used for its traction. The above locally modified machines for trailing out the ballast can ensure a uniform spreading of ballast all along the track.



3.7 क्रेन/Cranes: Of all the heavy machines, cranes acquire an important position as they are involved in the building and maintenance of huge projects. These are the huge tower like machineries having ropes meant to lift or to lower any heavy devices. Cranes are not permanent structure and either fixed in the ground or mounted on certain vehicles. Cranes are operated either through cab operator or through infrared or radio signals. Cranes are used for the loading and unloading of goods in the transport industry, for the movement of debris, sand, mud and other materials in the construction industry and for the assembling of heavy equipment in the

manufacturing industry. Based on the size and the loading capacities cranes can be grouped as follows:

3.7.1 टॉवर क्रेन/Tower Cranes: Tower cranes are fixed on to the foundation on a concrete slab and give the best combination of height and lifting capacity. They are used to lift steel, concrete, large tools, and a wide variety of building materials for construction of various projects like sky scrapers; multi-storied buildings; huge industrial projects etc.



The important components of the tower crane are horizontal boom, long and short arm, mounted cabin, lifting hook, etc. Across the top of the tower, horizontal tower is balanced asymmetrically. Counterweight of the concrete block is balanced by short arm whereas long arm carries the lifting gear. The lifting hook of the crane is set into motion by the pulleys. The crane is operated by the operator either from the crane cabin, or from the ground using radio remote control. The boom which is mounted on slewing bearing is rotated by means of a slewing motor.

3.7.2 क्राउलर क्रेन/Crawler Cranes (Track mounted): These are all terrain cranes mounted on tracks. The track provides mobility and stability to the crane. These cranes are available in variety of sizes and with different loading and carrying capacities and suited to every terrain including rough and geographically inhospitable regions. Tracked cranes serve multiple purposes like in building construction; in soil remediation job; Decontamination of sludge; Covering rubbish dump; Raising ground; Lifting heavy materials; Loading of heavy industrial devices etc.



3.7.3 व्हीकल क्रेन/Vehicle Crane (Truck mounted): As they are not permanent structures, they are either fixed on the ground or mounted on certain vehicles such as car, trucks or any types of engineering vehicles. The vehicle cranes are very popular and available in different models with varying loading capacities. With jib, boom, cab, pulleys and ropes they serve many purposes such as Loading and unloading of heavy materials (both industrial and building); in the road construction; in building construction; in port construction; Demolition; Dynamic soil compaction; Construction of big buildings etc.



3.7.4 फ्लॉटिंग क्रेन/Floating Cranes: Floating cranes are used mainly in port and bridge construction, but they are also used for occasional loading and unloading of especially heavy or awkward loads on and off ships. Some floating cranes are mounted on a pontoon; others are specialized crane barges used to transport entire bridge



sections. Floating cranes have also been used to salvage sunken ships.

3.7.5 ओवरहेड क्रेन/Overhead Cranes: An overhead crane, also known as a bridge crane or suspended crane, is normally used in a factory where the hook-and-line mechanism runs along a horizontal beam that runs along two widely separated rails. The hoist is set on a trolley which will move in one direction along one or two beams, which move at angles to that direction along elevated or ground level tracks, often mounted along the side of an assembly area.



3.7.6 साइड–लिफ्ट क्रेन/Side-Lift Crane: A side lifter crane is a road-going truck or semi-trailer, able to hoist and transport standard containers. Container lift is done with parallel crane-like hoists which can lift a container from the ground or from a railway vehicle.



3.7.7 रेलरोड क्रेन/Railroad Crane: Railroad crane has flanged wheels which run on rails. These cranes mounted on a flatcar are purpose-built and used for maintenance work, recovery operations and freight loading in goods yards and scrap handling facilities. The largest cranes are used for accident recovery work, usually forming part of a breakdown train that includes staff accommodation and recovery equipment. These are large enough to lift derailed rolling stock back onto the track, although two or more cranes may be required to safely recover a locomotive.



3.7.8 जिब क्रेन/Jib Crane: A jib crane is a type of crane where a horizontal member (jib or boom), supporting a moveable hoist, is fixed to a wall or to a floor-mounted pillar. Jib cranes are used in industrial premises and on military vehicles. The jib may swing through an arc, to give additional lateral movement, or be fixed. Similar cranes, often known simply as hoists, were fitted on the top floor of warehouse buildings to enable goods to be lifted to all floors.



3.7.9 लोडर क्रेन/Loader Crane: A loader crane (also called a knuckle-boom crane or articulating crane) is a hydraulically powered articulated arm fitted to a truck or trailer, and is used for loading/unloading the vehicle. The numerous jointed sections can be folded into a small space when the crane is not in use. One or more of the sections may be telescopic. Often the crane will have a degree of automation and be able to unload or stow itself without an operator's instruction.



3.7.10 रफ टेरैन क्रेन/Rough Terrain Crane: A crane that is mounted on an undercarriage with four rubber tires, designed for operations off road. The outriggers extend vertically and horizontally to level and stabilize the crane when hoisting. These types of cranes are single engine machines where the same engine is used for powering the undercarriage as it is for powering the crane. In these types of cranes, the engine is normally mounted in the undercarriage rather than in the upper portion.



***

Go to Main Index

अध्याय / CHAPTER – 4
सड़क निर्माण / ROAD CONSTRUCTION

Good roads not only make transportation easier but also benefit the economy in a substantial way and provide connectivity between two cities and between cities and rural areas. To construct roads and highways, there are many construction machineries with different mechanical principles and operations.

4.1 एस्फाल्ट पेवर / Asphalt Pavers: Asphalt pavers are used for distribution, shaping and compaction of asphalt layer. Normally the asphalt pavers are self propelled but sometimes they are towed by the dump trucks delivering the asphalt. Screed and the tractors are the two major constituents of asphalt pavers. Material is discharged from the lorry in a tipping action. The width of the screed is adjustable. The important constituents of the tractor are hopper, conveyor, distribution augur etc. Asphalt pavers are of two types - asphalt crawler paver and wheeled paver.



4.2 एस्फाल्ट रोड कटर / Asphalt Road Cutter: Asphalt road cutter is a machine which removes the existing asphalt surface of roadways, runways, or other asphalt surface. It can be operated both manually and mechanically and can be attached with any tractor or backhoe that gives it maximum downward pressure. It is suitable for working in tight conditions or where precise cutting is required. The asphalt removed by the cutter can be used in hot mix plants.



4.3 एस्फाल्ट रिसाइकलर / Asphalt Recyclers: Asphalt recyclers are used to recycle asphalt to use it again as the asphalt roads or pavements are not permanent. Asphalt recycling is a process for rehabilitation of deteriorated asphalt pavements. This machinery recycles asphalt pavement in separate stages like preheating, hot milling, heat and stir, pug mill mixing and compaction. Asphalt recycling saves money and time and conserves diminishing resources of aggregates and petroleum products.



4.4 एस्फाल्ट प्लांट / Asphalt Plant: Hot mix plants (both stationary and mobile), wet macadam mix plant, etc. are some of the asphalt based plants that are widely used for the production of asphalts for various constructions. These are described as:

4.4.1 हॉट मिक्स प्लांट या एस्फाल्ट ड्रम मिक्स प्लांट / Hot Mix Plant or Asphalt Drum Mix Plant: These are used for producing good quality of hot mix for flexible pavement construction. The ingredients of the hot mix in required proportion are continuously fed to the rotating drum in

drying & mixing zones and the discharge end of the drum delivers continuous output of the hot mix. The main ingredients of hot mix are virgin cold aggregates of different grades, asphalt (bitumen) and mineral fillers. Asphalt drum mix plant generally consists of Cold Aggregate Four Bin Feeder; Single Deck Vibratory Screen for Oversized Material Removal; Slinger (Cold) Conveyor; Drying Cum Mixing Thermo drum; Load out conveyor with Gob hopper; Asphalt Tank; Mineral Filler Unit; Centralized Control Panel With Insulated Cabin; Dryer Auto Burner; Fuel Storage Tank and Pollution Control Unit (Optional).



The cold aggregates of different grades which are stored in the multiple feeder bins are transferred in required proportion to the primary section of the rotary drum through slinger conveyor. The burner fitted on the in-feed side of the drum produce appropriate flame to remove the moisture from the aggregates and heat the dried aggregates to the desired temperature in the primary section of the drum. The hot aggregates then travel down the secondary section where they are mixed & coated with the asphalt & filler material. The asphalt and filler material are pumped in the secondary section in predetermined proportion from asphalt tank and mineral filler unit respectively. This hot-mix from the drum is then transferred to truck through load out conveyor. The heavy dust is collected by the multi cone type dust collector and the exhaust is passed through wet scrubber type pollution control unit before letting it to the atmosphere.

Asphalt Drum Mix Plants offer advantages of higher production rates, less moving parts, lower maintenance, simple to operate, lower fuel consumption & better economy.

4.4.2 वेट मिक्स मेकेडम प्लांट/सॉइल स्टेब्लॉइजिंग प्लांट/Wet Mix Macadam Plant / Soil Stabilizing Plant: This equipment is employed for producing homogenous mixture of aggregates, sand, cement and water which is laid in base or sub base preparation of rigid or flexible pavements. The aggregates and sand stored in multiple feeder bins discharged by each bin feeder belt in desired proportion to gathering belt. This mixed material is then conveyed by gathering belt to Pug mill where it is mixed with water and cement in order to produce the homogenous mixture. The homogenous mixture is further conveyed to storage silo or trucks for lying at site. Wet Mix Plant generally consists of Multiple Feeder Bins; Pug mill Mixture; Collecting Conveyor; Load out conveyor; Water storage tank; Cement silo; Storage Silo; Control Panel.



4.5 कोल्ड प्लेनर/Cold Planers: A cold planer, also known as a pavement planer, is a construction machine, which is used to remove bituminous pavement or asphalt concrete from roadways, resulting in a somewhat rough, even surface that



can be immediately opened to traffic. The surface material that is removed is normally fed by conveyor into a dump truck or semi trailer. Cold planer is available in various models like front down design, hydraulic controls, backhoe mounted planer and open drum planer.

4.6 रोड क्लीनिंग मशीन/Road Cleaning Machine: Road cleaning machines are used to sweep roads quickly with a powerful high pressure air blower within a short time thereby saving labour, time and also bitumen. This machine is provided with a rotary brush which mechanically operates and cleans the dust particles settled on the road.



4.7 रोड कर्बिंग मशीन या कंक्रीट कर्बिंग मशीन /Road Kerbing Machine or Concrete Kerbing Machine: A kerb is the edge where a raised pavement/sidewalk/footpath, road median or road shoulder meets an un-raised street or other roadway. Typically made from concrete, asphalt or long stones (often granite), the purpose is twofold: first as a gutter for proper drainage of the roadway and second for safety, to prevent motorists from driving onto the shoulder, median, sidewalk or pavement.



Road kerbing equipment is widely used in various road projects. These machines generally diesel powered is built under strict guidelines as per international quality standards and used for the concrete landscaping. The needle vibrators in some kerbing machines ensure compact and easy concrete flow. The other important components of the kerbing machines are hydraulic kit, micron filtering system, slop, grade and steering systems. These machines find their applications in Contouring landscape; Retention of bark and garden soil; Paving subways, pathways and car parks; Paving of bus and rail way stations; Mower strips; Paving borders.

4.8 पॉटहोल पेचर मशीन/Pothole Patcher Machine: Potholes are cracks and cleavages formed on roads due to various reasons like water logging, frost, heavy traffics etc. There are many pothole machines that are also called as pothole patchers which are used to cover up these potholes. Generally hot mix asphalts or asphalt with various additives are used to patch these pot holes.



4.9 पेवर फिनिशर/Paver Finisher: Paver Finisher is a unique paver with combination of features designed and engineered to give maximum output with comforts and efficiency. Tractor and the screed unit are two important components of the typical paver machine that is used to give final finish to surfaces of roads, highways, runways, canal paving etc. The screed is not fixed but is free to pivot about tow points. The screed is towed by the tractors,



which are either wheel mounted or track mounted. The width of the screed can be mechanically adjusted with mechanical bolt on extensions on either side. Screeds are of different types like combination screed, vibratory screed, tamping screed etc.

The paver can be employed for both asphalt as well as wet mix for paving or laying hot mix material on constructed surface. This is simple to operate and require negligible maintenance.



4.10 ट्रक मॉउन्टेड बिट्यूमन स्प्रेयर/Truck Mounted Bitumen Sprayer: Mobile bitumen sprayer is generally truck mounted and designed for spraying hot bitumen. These trucks generally have a high capacity burner to heat the bitumen. The tank of the bitumen sprayer truck is fully insulated and is cladded with steel sheets. To avoid clogging after the usage, pressure cleaning system is applied. Bitumen sprayer finds its application in various fields like Construction of roads and high ways; Patching and maintaining weared roads; Paving pathways, pavements and parking areas.



4.11 थर्मल कन्टेनर/Thermal Container: Asphalt thermo containers are employed to process asphalt to be used in the construction, maintenance and repairing of roads. Asphalt containers are either single chambered or double chambered. Double chambered container is widely used.

To maintain the asphalt at the necessary working temperature, the chambers are heated with an environment friendly propane gas burner. To prevent the asphalt from cooling, the chamber is provided with insulation. In some container there is an option of electrical heating. Conveyor fitted in the container is applied for spreading the material. There are the following advantages of thermal containers:

- Cost effective processing of asphalt.
- Precise discharge of the materials through conveyor.
- Without any temperature losses asphalt can be maintained at the required, placement temperature for a long time.
- No waste due to cooled mix.
- Longer road construction season.
- No pre-compaction of the asphalt.



4.12 चिप स्प्रेडर/Chip Spreader: For maintaining the quality and giving the roads a long-lasting effect, stone chipping is one of the most effective methods and this is done by a chip spreader, which is a unique self-propelled machine for laying of pre-coated chipping. A chip spreader through chip sealing gives special protective wearing surface to an existing pavement.

Before spreading chips, asphalt is mixed with water. This emulsified mixture is then applied to the road using a chip spreader or spray truck. As soon as the liquid asphalt meets the road surface, the water starts to evaporate. After this a layer of crushed gravel is applied and compacted and embedded into the asphalt by rubber-tire rollers. Its applications are:



- Chip spreader distributes different quantities of chips for optimum grip of asphalt layers evenly.
- Chip can be distributed directly behind the pavers.
- It can also be applied to bituminous chips also.
- Chip flows continuously without the problems of oversized grains and humidity.

4.13 बलॉस्ट स्प्रेडर/Ballast Spreader: The road pavers can be used for laying initial layer of ballast. The paver can be loaded with ballast using track dumper/tipper and spread by the road paver on the finished formation to maintain uniform thickness and width. The light road roller can be used for compaction of the initial layer.



4.14 रोड रोलर/Road Rollers: Road roller is an important engineering vehicle for the roads and highway constructions and used for the compaction of dirt, gravel, concrete, and asphalt. In landfill compaction too, road roller has great utility. Its size varies from simple drum with a handle, to a size of many tonnes. Based on their sizes rollers are of following types:

- **Sheep-foot Roller:** A sheep-foot roller has almost hoof like structures protruding from a roller to provide pinpoint pressure all across the soil. Protruding studs on the drum is similar to a sheep-foot, which provides a kneading action. The teeth size slightly varies from one sheep-foot roller to another, depending on the specifications of different manufacturers. For compaction of plastic soils like clay or silt it is very effective. On granular materials, sheep-foot rollers tend to shove rather than compact such soils. The sheep-foot roller works very well on cohesive soils and as well in wet conditions they are used frequently.



- **Combination Rollers:** Combination rollers are used for better efficiency and for the compaction of asphalt base and sub-base courses for medium and large road construction and road maintenance. A special kneading effect of the combination roller is attributed to their designs which results in a well closed surface structure. Some of the compact rollers also use vibratory system on the front drum for density requirements and four pneumatic tires in the rear to provide impermeability and smoothness of the material. Compacted material manipulated by the four pneumatic tires helps in improving surface texture and reduce water intrusion.





- **Tandem Rollers:** Tandem rollers have their utility in soil and asphalt compaction, construction and repair on small to medium jobs on highways. Apart from repairs and patching, it is also ideal for smaller town works like compacting pavements, drive ways, cycle paths, parking lots etc. Some of the tandem rollers are also provided with thick steel plate enclosures, lined with sound-absorbing materials for noise prevention. An automatic vibration braking system eliminates drum bounce and avoids ripples.



4.15 स्लरी सील मशीन/Slurry Seal Machines: Slurry seal is a cold mix paving system that can remedy a broad range of problems on streets, airfields, parking lots, and driveways. The principal materials used to create slurry are aggregate, asphalt emulsion, and fillers which are mixed together. Water is also added for workability. Slurry Seal is also a unique bituminous mixture that can be used to meet the demands of a variably textured surface filling cracks and voids, sealing the surface weather tight, and providing colour and texture delineation in a single pass. The new surface is ready for use just hours after application.

***

Go to Main Index

अध्याय / CHAPTER – 5
कंक्रीट उत्पादन / CONCRETE PRODUCTION

5.1 क्रसिंग प्लांट / Crushing Plants: Crushing plants are the huge assembly of machines designed to recycle and reprocess the rubbles of buildings, roads, or other materials into commercially sized aggregate for use as base materials or other value-added applications such as ballast for railway track.

Crushing plants are either static assemblies or mobile assemblies and consist of different arrays of equipments like screens, pre-screener, intake hopper, magnetic separator, conveyor both undersized and oversized, loading conveyor and crushing units like jaw crusher, cone crusher etc. They find their applications in Road Construction; Building Construction; Construction of over bridges; Construction of pavements and paths etc. There are two types of Crushing Plants:



Mobile crushing plants



Stationary crushing plants

5.2 रेत बनाने की मशीन / Sand Making Machine: Sand is an important constituent for the construction industry. River sand is generally preferred but sand mining from the river bed and its transportation is not an easy task. Sand making machine fulfills the demand of the construction industry in a substantial manner. The machine consists of feeding hopper, rotopactor, sand screen, conveyors, elevators, electrical prime movers and controls, etc. Rotopactors of varying sizes are used to crush stone from which sand is obtained. The sand so produced is utilized in the construction of buildings, pavements, streets, roads etc.



5.3 रेत धोने की मशीन / Sand Washing Machine: Sand washer is used to remove the dust in sand. It aims at improving the quality of sand. It is widely used for cleaning materials in the following industries: quarry, minerals, building materials, transportation, chemical industry, water conservancy and hydropower, cement mixture station and so on. Sand washing machinery drives the impeller in the water groove to move like a circle transmitted by electric motor and decelerator and then mixes, overturns, cleans and discharges the sand or slag pellets in the water groove.



5.4 कंक्रीट ब्लॉक मशीन/Concrete Block Machine (Stand Type): Hydraulically operated concrete block machine produces blocks of different types like solid, hollow, paving, tree guard blocks of different shapes and sizes. The tabletop vibrator in machine provides optimum vibration in the mix so that the ratio of cement used can be reduced substantially without affecting the strength of the blocks. The other important equipments used in stand type hydraulically operated concrete block machines are vibratory motor, pump motor, hydraulic levers, hopper and hydraulic filler box etc.



5.5 कंक्रीट बेंचिंग एवं मिक्सिंग प्लांट/Concrete Batching and Mixing Plant: A concrete batching and mixing plant is a huge set up of machines meant to combine cement, aggregates such as sand or gravel, and water to form concrete (ready-mixed). These plants are either mobile or stationary and their sizes range from portable mixer to heavy industrial mixing plant.



Stationary plant mixer mixes the concrete before it is discharged into a truck mixer. Revolving drums, conveyor and diesel or electric powered engines are used in this plant. The truck mixer is used primarily as an agitating haul unit at a central mix operation. Dump trucks or other non-agitating units are sometimes used for low slump and mass concrete pours supplied by central mix plants.

Apart from stationary concrete plant mixer, mobile concrete mixing plant is also very popular and widely used. Mobile concrete mixer plant is a unit mounted on a trailer which carries sufficient unmixed materials, such as cement, sand, coarse aggregates, water, and any chemicals required, for special mix specifications to the job site. In this type of plant cement, sand and aggregates are carried in separate bins. The materials mixed proportionately are mixed with water and then discharged through the conveyor system.

5.5.1 ट्रक कंक्रीट पम्प/Truck Concrete Pumps: Truck mounted concrete pumps are used to supply concrete to places which are difficult to reach by other heavy machines. Concrete Pumping Equipments are concrete pump, heavy-duty pipe, hose and other accessories. When pressure is applied to a column of fresh concrete by the concrete pump, it forces the concrete through a lubricated pipe. Concrete pumping is useful in the areas where space available for construction equipment is limited. It is faster and saves enough man power and energy. It is all weather operation and does not require heavy equipments like cranes and hoists for other construction operations.



5.5.2 ट्रेलर कंक्रीट पम्प/Trailer Concrete Pumps: Like truck concrete pump, trailer concrete pump is designed to spread concrete in an area which is difficult to reach out. The trailer pump is ideally suited for the construction of foundations and pools, pressure grouting, and rockscaping. Trailer concrete pump can pump concrete both horizontally and vertically. It can pump concrete to the difficult areas. Pumping is faster than other methods. It is all weather operations. It saves enough time and energy and helps in the completion of work with the faster rate. Concrete can be easily handled as it is pumped to desired spot.



5.6 मोबाइल कंक्रीट प्लेसर/Mobile Concrete Placer: This Machine can be used for Bridges, Culverts, mass Concreting Purpose and Canal Works. It is available in 56 feet length, pouring at the height of 27 feet and ability to fold for Towing without removing discharge hopper. Mechanical power for the conveyor is provided by 25 HP (19 Kw) Engine, which drives a Hydraulic Double Pump. Hydraulic steering which pivots the two under carriage wheels 90^0 to the Right and 45^0 to the Left and the steering wheel at the charging end rotates the towing hitch wheel 360 degree about its yoke. So the conveyor can be moved in a straight line and vertical too.

- *Mobile Concrete Placer - 56* can place concrete of any mix at the rate of 25 cum/hr up to 8.5 meter height and underground up to 5 meter.



- *Mobile Concrete Placer - 56/650*, can place concrete of any mix at the rate of 50 cum/hr and can handle up to 80 mm aggregate up to 6 meter height and underground up to 5 meter.



5.7 कंक्रीट मिक्सिर ट्रक/Concrete Mixer Truck: The hydrostatic truck mixer transports concrete/mortar directly from plant to the place where it is to be poured. Concrete mixer with various capacities like 3, 4 and 6 cum is mounted on truck. It has a wide range of applications specially for mass concreting works like Multi-storeyed buildings, Bridge works etc. The basic function of transit mixer is to maintain the concrete's liquid state, through the turning of the drum till the point of delivering at construction site.



5.8 स्लिप–फॉर्म/Slip-form: Concrete is placed continuously in side form which moves at a set rate. Forms are not removed; they slip over the concrete which can support itself by the time it is out of the form. Slip-form System (Electro-Hydraulic self climbing system) may be defined as a method of continuously moulding or forming concrete, with the use of a moving formwork. The rate of movement or slipping is controlled by the setting or curing rate of the concrete, which must be capable of supporting at least its own weight when exposed by the moving formwork. This is undoubtedly the most unique aspect of slip forming, the ability of concrete to stand safely and unsupported within 2 to 4 hours after being placed into the formwork in a plastic state.



Construction of reinforced concrete wall structures such as silo complexes, chimneys, reservoirs, medium to high-rise housing, office buildings, hotels, hospitals, bridge piers, in ground shafts, caissons, dam structures, power stations etc. The major components of slip form System are Shuttering/form panels, Walers, Yokes, Working decks, Hanging scaffolds, Truss system, Hydraulic jacks, Jack rods, Pumping units for jacks, Bracings, Operation screws, Extraction jacks, and Miscellaneous equipment.

***

Go to Main Index

अध्याय/CHAPTER – 6
सामान्य रुप से उपयोग की जाने वाली मशीनरी/ COMMONLY USED MACHINERIES

For the development of an infrastructure and manufacturing industries, light machineries play an important role. They are used in both small and big industries and also for the construction, development and maintenance of big infrastructures. Some of the commonly used machineries are:

6.1 एयर कम्प्रेशर/Air Compressor: A light machine which is considered to be the central power source, works on the principle of reducing the volume of a gas while increasing the pressure and heat. The pressure and the heat so generated have many industrial and small infrastructural applications. *Gas powered air compressors* are applied in those areas where there is no electric supply, whereas *electric powered air compressors* are best suited to those enclosed areas where gas fumes are unacceptable. On the basis of their construction air compressors are categorized as Reciprocating Compressors; Centrifugal Compressors; Axial-flow Compressors; Scroll Compressors and Rotary Screw Compressors.



6.2 कंक्रीट कटर/Concrete Cutter: Concrete is removed by sawing or drilling through skillful operations of concrete cutter. The most common types of concrete cutting machines are core drilling, wall sawing and slab or flat sawing. Having hydraulic and pneumatic power and armed with petrol or diesel engine, valves, nylon filters, protective hoods, off-on chokes these cutters are applied for various purposes.

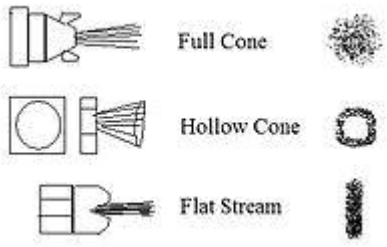


6.4 वाइब्रेटर सेंड स्क्रीनिंग मशीन/Vibrator Sand Screening Machine: Sands before they are put to use are screened and washed. Screening is essential to remove dirt, dust, and slit from the sand to bring quality in construction. It has following features:



- It can sieve both dry as well as wet sand in an efficient manner.
- It avoids sand wastage.
- Eccentric shaft creates vibration.
- Only screen vibrates and not the chassis. Screen is replaceable.

6.5 वायुरहित स्प्रे गन/Airless Spray Gun (Spray Painting): Spray painting is a painting technique where a device sprays a coating (paint, ink, varnish, etc.) through the air onto a surface. The most common types employ



compressed gas usually air to atomize and direct the paint particles. Air gun spraying uses equipment that is generally larger used for covering large surfaces with an even coating of liquid. Spray guns can be either automated or hand-held and have interchangeable heads to allow for different spray patterns.

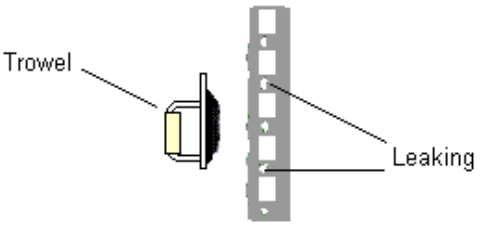
6.6 प्लॉस्टरिंग मशीन/Plastering Machine: It is particularly designed for the building and construction industry to improve work efficiency and effectiveness. Unfortunately in India due to high humidity, the types of materials used and mostly the style of plastering the phenomenon of the fungi and cracked wall surfaces in old and new buildings are wide spread. In new buildings, just within a span of maximum two years numerous cracks, exfoliated and fungus across all surfaces indoors and outdoors appears. The plastering machine provides homogeneity and higher density and consistency of the plastered surface and in combination with lime which is a natural insulator or with plasticizer that provides waterproofing capabilities on the walls. Below are the advantages of using plastering machines:





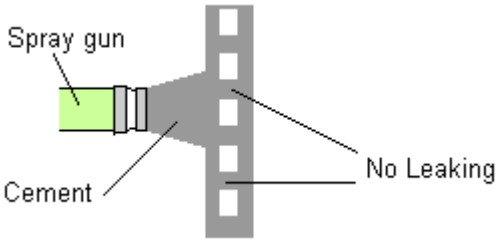
- Better quality of the plastering, which eliminates leakage, cracking and peeling off dried plaster,
- Reduced on-site labours,
- Reduce material wastage,
- Shorten working time,
- Spray and deliver mixture up to 80 meters,
- Low maintenance and low downtime
- Stop the humidity from leaking in the wall that causes decay of the interior and exterior and chaps of the interior paint and surface.

Conventional Plastering Method: Traditional manual plastering requires the continual movement of the cement, both prior to and after mixing. Normally this requires either a large number of employees or a relating small area being completed per day. Constantly changing locations also mean continual movement of materials and clean-up of the previous locations. Also when manually mixing cement, the final product may not be consistent as desired.



Manual Plastering leads to wall cracking and leaking as this method is unable to entirely penetrate gaps and spaces in brick walls.

Spray Plastering Method: The Spray Plastering Machine only requires a maximum of four workers for set up and operation. Our machine allows for operation at a number of locations while construction materials remain at one location. This also allows for more centralized, easier storage of materials, less



movement and set up, more consistent mixture and orderly construction sites. Therefore, it saves time and substantially cuts cost by reducing manpower, and the amount of materials wasted. The machine is designed with sufficient power to pump and spray up to 30 stories combined with well designed spray gun that allows for smooth operation, without recoil and jerking actions, and enable cement to be applied evenly, penetrating gaps and spaces.

6.7 कंक्रीट लाइनिंग पेवर/Concrete Lining Paver: Concrete lining paver is widely used for pavement of canal, Airport Apron & Runway roads, Flooring, Reservoir, Bridges etc. It consists of sturdy frame structure made from plates, pipes & angles etc. It consists of two hydraulic power pack units, one is at fix console from where the operator operates the machine & another is travelling unit i.e. undercarriage. Each unit is equipped with electric motor. The complete frame (according to the required length) is mounted on four nos. heavy duty mechanical jacks, which are used for levelling of the machine. The four jacks are fitted on structure which carries two set of rollers i.e. four bogies runs on rail.



The fix console is fitted at one end from where the operator controls long travel speed & drum bogie operation. It is equipped with electric motor and power pack. The undercarriage also consists of power pack unit equipped with electric motor which operates drum, groove cutter, drum vibration. The function of concrete lining paver is to finish the laid concrete in desired thickness & prepare a level finished concrete layer. Expansion joint in concrete is prepared by two methods. In first method transverse & longitudinal groove cutter (driven by hydraulic motor) are provided & in second method PVC inserter is provided longitudinally & in transverse direction.

6.8 कंक्रीट वाइब्रेटर/Concrete Vibrators: Since concrete contains particles of varying sizes, the most satisfactory compaction would perhaps be obtained by using vibrators with different speeds of vibration. The vibrators for compacting concrete are manufactured with frequencies of vibration from 2800 to 15000 rpm. The various types of vibrators used are as below:

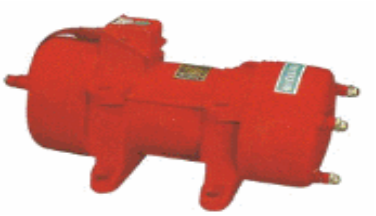
6.8.1 Immersion or Needle Vibrators: This is perhaps the most commonly used vibrator available in size varying from 40 to 100 mm diameter. It essentially consists of a steel tube (with one end closed and rounded) having an eccentric vibrating element inside it. This steel tube called poker is connected to an electric motor or a diesel engine through a flexible tube. The diameter of the poker is decided from the consideration of the spacing between the reinforcing bars in the form-work.



6.8.2 External or Shutter Vibrators: These vibrators are clamped rigidly to the form work at the pre-determined points so that the form and concrete are vibrated. They consume more power for a given compaction effect than internal vibrators. The external vibrators are more often used for pre-casting of thin in-



situ sections of such shape and thickness that cannot be compacted by internal vibrators.



6.8.3 Surface Vibrators: These are placed directly on the concrete mass and best suited for compaction of shallow elements and compaction of very dry mixes. The main application of this type of vibrator is in the compaction of small slabs, not exceeding 150 mm in thickness, and patching and repair work of pavement slabs.

6.9 न्यूमेटिक गुनाइटिंग/शॉटक्रीट मशीन/Pneumatic Guniting/Shotcrete Machine: Guniting/Shotcreting is the process of conveying desired mixer of dry cement, sand and/ or aggregate under air pressure at high velocity with just sufficient quantity of water for hydration. Equipment consists of a twin chamber gun and a twin water tank and is powered by air motor. The material is deposited on the desired surface through a placing nozzle under compressed air. The applications of these machines are as under:





- for sand blasting work by fitting on a sand blasting nozzle
- for repair work of concrete structures of all kinds including reinforced concrete and stone floors damaged by fire, weathering or chemical attack
- for repair of cracked walls, piles or beams of concrete (or reinforced concrete structures) and masonry
- for production of thin walled structures like walls, dams, shells in conjunction with steel fibre or mesh wire
- for production of watertight plaster for vessels, tunnels, dams etc.,
- for repair of foundations and load bearing elements, repair of bridge section, fire-proofing of iron structures, consolidation and extension work in mining tunnels, etc.

***

संदर्भ / REFERANCE

1	Compendium of Const. Equipments published by RDSO/Lucknow
2	www.iricen.gov.in
3	www.rdso.indianrailways.gov.in_76
4	www.kappamachines.com
5	http://www.hoshenlee.com/plastering_machine.html
6	http://www.infrawindow.com/news/mechanised-construction-to-address-rising-labour-cost_2705/
7	http://articles.economictimes.indiatimes.com/2012-03-05/news/31124152_1_schwing-stetter-construction-equipment-anand-sundaresan
8	http://theconstructor.org/constrution/equipment/
9	http://www.theconstructionmachinery.com/
10	http://www.engineeringcivil.com/theory/construction-equipments/
11	http://www.articlesbase.com/industrial-articles/construction-machines-names-and-pictures-5420873.html
12	http://catalogs.indiamart.com

***

टिप्पणी / NOTES

गुणवत्ता नीति

रेलों में यात्री और माल यातायात की बढती माँग को पूरा करने के लिए गुणवत्ता प्रबंध प्रणाली में अनुसंधान, डिजाइनों और मानकों में उत्कृष्टता तथा सतत् सुधारों के माध्यम से सांविधिक और नियामक अपेक्षाओं को पूरा करते हुए सुरक्षित, आधुनिक और किफायती रेल प्रौद्योगिकी का विकास करना।

QUALITY POLICY

To develop safe, modern and cost effective Railway technology complying with Statutory and Regulatory requirements, through excellence in Research, Designs & Standards and Continual improvements in Quality Management System to cater to growing demand of passenger and freight traffic on the Railways.

*डिस्क्लेमर/**Disclaimer***

The document prepared by CAMTECH is meant for the dissemination of the knowledge/ information mentioned herein to the field staff of Indian Railways. The contents of this handbook/booklet are only for guidance and not statutory. Most of the data & information contained herein in the form of numerical values are indicative and based on the tests/trials conducted by various agencies generally believed to be reliable. While reasonable care and effort has been taken to ensure that information given is at the time believed to be fare and correct and opinion based thereupon are reasonable. Due to very nature of research it can not be represented that it is accurate or complete and it should not be relied upon as such. The reader/user is supposed to refer the relevant codes/ manuals available on the subject before actual implementation in the field.

हमारा उद्देश्य

अनुरक्षण प्रौद्यौगिकी और कार्यप्रणाली को उन्नयन करना तथा उत्पादकता और रेल्वे की परिसम्पत्ति एवं जनशक्ति के निष्पादन में सुधार करना जिससे अन्तर्विषयों में विश्वसनीयता, उपयोगिता और दक्षता प्राप्त की जा सके।

यदि आप इस सन्दर्भ में कोई विचार और सुझाव देना चाहते हों तो कृपया हमें इस पते पर लिखें:

सम्पर्क सूत्र	:	उप निदेशक (सिविल)
पत्राचार का पता	:	भारतीय रेल उच्च अनुरक्षण प्रौद्योगिकी केन्द्र, महाराजपुर, ग्वालियर (म.प्र.) पिनकोड - **474005**
टेलीफोन	:	0751–2470869
फैक्स	:	0751–2470841
ई–मेल	:	**dircivilcamtech@gmail.com**

Our Objective

To upgrade Maintenance Technologies and Methodologies and achieve improvement in productivity and performance of all Railway assets and manpower which inter-alia would cover Reliability, Availability, and Utilisation.

If you have any suggestion & comments, please write to us:

Contact person	**:**	**Dy. Director (Civil),**
Postal Address	**:**	**Indian Railway Centre for Advanced Maintenance Technology,** **Maharajpur, Gwalior (M.P.)** **Pin code – 474 005**
Phone	**:**	**(0751) - 2470869**
Fax	**:**	**(0751) – 2470841**
Email	**:**	**dircivilcamtech@gmail.com**