

Significance and Applications of Earth Moving Machinery in Infrastructural Development of a Country.

O. M. Kaulgud¹, A. A. Kumbhojkar², A. P. Shrotri³

P.G. Student, Department of Mechanical Engineering, P.V.P.I.T Budhgaon, Sangli, Maharashtra, India¹

Associate Professor, Department of Mechanical Engineering, P.V.P.I.T Budhgaon, Sangli, Maharashtra, India^{2,3}

ABSTRACT: Earthwork and earth moving appear to be the most elementary of engineering trades. They certainly are, when only a handful of earth is moved. But when it involves the movement of five to six million cubic meters of earth within a limited space of time they turn out to be highly organized and skillfull trades. Projects be their air ports, Docking yards, Dams, Railways, Roads, Residential Sites, agricultural activities which involves earth movement. The most versatile machine of the earthmoving family is the self track laying tractor fitted with any of its auxiliary equipment. But it has no equal in clearing jungle, dozing earth and rocks and hauling heavy loads over comparatively short distances. For hauling the most efficient are pneumatic tyred wagons. For loading there are draglines, shovels and elevating grades, each one having its advantages over the other. For spreading and grinding the bull dozer and motor grader are the best, for consolidating there is none to beat the sheep foot tamper. The paper explains the structure of each type of earthmoving equipment along with its applications and its significance with their design aspects such as for the Mechanical equipment includes any bulldozer, compactor, dumper, excavator, grader, loader, locomotive, lorry, scraper, truck and any mobile machine which is used for the handling of any material on a construction site. Mechanical equipment includes earth-moving machines. Amongst the listed mechanical equipment, excavators are lifting appliances in the context of the Factories and Industrial Undertakings. The safety systems to the operator as well as the environment is very important for which some safety devices must be provided such as the covers grills, glass windows with that one has to consider the aesthetics and ergonomics should be applied to increase the performance of this machines and loading capacity also.

KEYWORDS: Infrastructural Development, Air ports, Docking yard, Dams, Railways, Roadways, Shovels, Spreading, Excavator, Compactors, Loaders.

I. INTRODUCTION

Projects such as Airports, Docking yards, Dams, Railways, Roads, Residential Sites, Agricultural activities which involves huge amount earth movement can be easily carried out by the help of earthmoving equipment's, which will lead into infrastructural development of the country. As the world is moving fast to coupe up with changing and increasing demands of infrastructural scope, huge amount of development in infrastructural facilities is necessary which will result into infrastructural development of the country. Industries such as mining and construction in which earthmoving plays a fundamental role are constantly under pressure to improve productivity (amount of work done), efficiency (cost of work done in terms of labour and machinery), and, safety (injury sustained by workers). Automation offers the possibility of contributing to each metric but has been slow in being accepted. Until recently, it has been possible to make gains using traditional means[1] over the last four decades earthmovers have become progressively larger and their mechanisms more efficient. Also, automation of field worthy earthmovers is a difficult problem. These machines must operate in unstructured, dynamic, outdoor environments, often in

International Journal of Innovative Research in Science, Engineering and Technology

(An ISO 3297: 2007 Certified Organization)

Vol. 3, Issue 11, November 2014

poor visibility conditions and inclement weather. However, after decades of increases in size and power, practical limits have been reached and now automation is being sought for further improvements. At about the same time, several enabling technologies relevant to earthmovers, particularly in the area of environmental perception, are becoming reliable and affordable. Computing technology has also reached the stage where fast, compact and rugged. Compact specialists[3]:- For machines used in horticultural and agricultural construction, the bottom line is ensuring high mobility and power output under tight manoeuvring conditions. Earthmoving machines are therefore ideally compact and agile and also distinguish themselves by versatile and quickly exchangeable attachments, limited load on the bearing surface as well as low-emission drive units. The compact machines of the Liebherr range of earthmoving machinery are predestined for such special uses.

1)Hydraulic Excavators:-In horticultural and agricultural construction, the Liebherr hydraulic excavators are especially impressive due to their compact dimensions and high performance even in the most restricted spaces. Various supports and attachments enable a wide range of applications.

2)Stereoloaders:- Liebherr Stereoloaders® stand out in horticultural and agricultural construction due to their unique steering, which enables extremely high agility, and due to a small articulation angle of only 30°, which ensures safe transport of high net loads.

3) Crawler Tractors and Loaders:-With their high efficiency and enormous versatility, Liebherr crawlers have proven themselves in horticultural and agricultural construction. Especially in restricted spaces, the unique Liebherr single-lever control demonstrates its quality. It guarantees the user a very precise control of the driving or working hydraulics and thus the highest manoeuvrability and an exact installation of material.

4) Telescopic Handlers:-With a variety of application options and simple operation, the Liebherr telescopic handlers are particularly well suited for horticultural and agricultural construction. Higher steering angle paired with a long wheel base ensures the highest possible agility and stability. An easy way to comply with the conference paper formatting requirements is to use this document as a template and simply type your text into it.

1) Hydraulic Excavators:-[Figure:- 1]

Powerful components:-The hydraulic excavators from Liebherr are built for high performance. Equipped with in-house manufactured Liebherr components such as hydraulic cylinders, travel and swivel drives, even difficult applications in tight spaces can be powerfully mastered with excellent performance characteristics.

Variety of uses:-The blade support divided into two parts, in addition to offering more stability, also provides more application options. Levelling work or ground cleaning can be performed quickly and with the best results.

Intelligent cooling system:-Equipped with the thermostat-controlled cooling system, which only operates depending on need, fuel consumption is lowered and the noise level reduced while the service life of the drive components is considerably extended.

High bearing loads:-The hydraulic excavators from Liebherr have a wide range of applications. The intelligent design of the upper carriage distribution combined with the perpendicular position of the engine in front of the ballast weight allows a superior standing torque and high bearing loads. Equipped with the Liebherr. Litronic system, performance is increased, fuel consumption is minimised and the highest sensitivity is achieved.

Following table shows model wise specifications of a Hydraulic Excavator machine:-

Model Number	A 309	A 311	A 313	A 314	A 317	A 914	A 916	A 917
Engine output kW/hp	65/88	68/92	90/122	76/103	90/122	95/129	110/150	110/150
Operating Weight T	11.3-12.5	12.1-13.5	14.4-16.6	14.6-17.2	17.2-21.7	15.1-17.1	16.8 - 18.7	17.5 - 19.5
Backhoe Bucket Capacity Cu.m	0.15-0.44	0.15-0.44	0.17-0.80	0.17-0.80	0.17-0.95	0.17-0.80	0.17 - 0.95	0.17 - 0.95

(Ref :- <http://www.liebherr.com/> for the details)



Figure 1 Hydraulic excavator.



Figure 2:- Stereoloaders

2) Stereoloaders [Figure:- 2]

Manoeuvrability

Due to the unique Stereoloaders, the turning circle of the Stereoloaders is up to 20 % smaller than that of articulated wheel loaders and thus ensures higher efficiency in use.

Stability:-The small articulation angle of only 30° (on conventional models 40°) provides greater stability. With reduced operating weight, the Stereoloaders can transport relatively higher net loads.

Variety of attachments:-Due to their universal attachment options, Stereoloaders have a wide range of applications. The machines can be optimally adapted to the special work requirements in horticultural and agricultural construction thanks to a large variety of attachments.

Efficiency:-

Mature technology and high quality, such as water-cooled diesel engines or the optimised cooling system, provide demonstrable savings in fuel consumption and in maintenance, and make the Stereoloaders among the most efficient of their class.

Comfort:-

An optimal all-round view and clearly laid out instruments in the cabin, as well as the combined swinging which reduces the lateral swinging of the cabin by 50%, provide optimal operating comfort.

Maintenance:-

The engine compartment is opened through a compact engine hood and is then accessible for all maintenance work

Following table shows model wise specifications of a Stereoloaders machine:-

Model	L 506	L 507	L 508	L 509	L 510	L 514
Tipping Load flexed kg	3.231	3.501	3.824	4.225	4.581	5.680
Shovel Capacity m³	0.8	0.9	1.0	1.1	1.2	1.5
Operating weight kg	5.120	5.240	5.480	6.080	6.250	8.350
Engine output kW/hp	46/63	48/65	48/65	60/82	60/82	72/98

(Ref:- <http://www.liebherr.com/> for details)

characteristics. Whether for creating exact planes for sports facilities or for modelling complex three-dimensional surfaces - the material can be installed quickly inch-by-inch and thus at a cost savings. The PR 714 and PR 724 are thus suited perfectly for all uses in horticultural and agricultural construction.

International Journal of Innovative Research in Science, Engineering and Technology

(An ISO 3297: 2007 Certified Organization)

Vol. 3, Issue 11, November 2014

3) Crawler Tractors and Loaders:-[Figure:- 3]

Highly efficient due to the innovative drive concept:-

Crawler tractors and loaders from Liebherr ideally meet the requirements of horticultural and agricultural specialists. The hydrostatic drive provides full power on both chains without interruption and gives the machine excellent manoeuvrability even in restricted spaces.

Economical diesel engines running at a constant speed ensure low fuel requirements and the limited expenditures for service and maintenance additionally lower the operating costs. Liebherr crawlers thus represent a reliable contribution to economic success.



Figure 3:- Crawler Tractors and Loaders

A powerful machine due to a large variety of attachments:-

Liebherr crawler loaders stand out due to their universal applicability for all kinds of work (moving, levelling, loading, lifting, sorting, etc.), especially on surfaces of lower load-bearing capacity. Equipped with a standard or a 4-in-1 bucket and 3-shank ripper, only a single machine is required for numerous applications. Fast cycle times, outstanding driving characteristics under load and thus high performance make the LR 614, LR 624 and LR 634 the perfect universal machines.

Economical and cost-saving with machine control systems [2]:-

With their hydrostatic drive, Liebherr crawler tractors are especially suited for operation with automatic machine control systems such as laser control or GPS. Since the systems of all conventional manufacturers can be used similarly, flexibility for the user is guaranteed. The long track frames and the sensitive control system ensure outstanding levelling.

International Journal of Innovative Research in Science, Engineering and Technology

(An ISO 3297: 2007 Certified Organization)

Vol. 3, Issue 11, November 2014

Following table shows model wise specifications of a Crawler Tractors and Loaders machine:-

Model	LR 614	LR 624	LR 634	PR 714	PR 724
Engine output kW/hp	72/98	105/143	135/184	86/117	120/163
Operating weight t	10.7 - 12.0	16.9 - 18.5	20.7 - 22.7	12.6 - 14.3	16.8 - 20.3
Bucket capacity, m ³ Blade capacity	1.20 – 1.25	1.50 - 1.80	1.90 - 2.40	2.63 - 2.87	3.14 - 4.27

(Ref:- <http://www.liebherr.com/> for details)

4) Telescopic Handlers [Figure:-4]

Variety of attachments

Versatility is particularly demanded in horticultural and agricultural construction. Telescopic handlers with their universal attachment options and high lifting heights therefore play a significant role. A large selection of attachment tools and quick conversion ensure that the widest range of different work tasks can be accomplished with a single machine.



Figure 4:- Telescopic handlers

Perfect operation

All movements of the multifunctional joystick can be precisely controlled independently of the load to be moved. With a precision control function as well as various acceleration stages, you can adapt to the requirements of every application. For greater safety, the left hand can remain always on the steering wheel so that the right hand can alter the driving direction directly on the joystick.

Efficiency

The continuous regulation and sensitive control characteristics of the hydrostatic travel drive allow precise manoeuvring and smooth driving without gearshifts across the entire speed range. Depending on the deflection of the joystick, the speed of the diesel engine and thus the speed of the working hydraulics is automatically regulated. The tried-and-tested interaction of travel drive, working hydraulics and diesel engine ensures cost-savings in fuel consumption. The two lift cylinders mounted oppositely to the boom arm additionally provide for an incomparable tearing force.

Cabin comfort

Non-fatiguing and concentrated working with the best possible view to the right and to the back is facilitated by the spacious cabin dimensions. The noise level in the cabin interior is comparable to that inside a passenger car.

International Journal of Innovative Research in Science, Engineering and Technology

(An ISO 3297: 2007 Certified Organization)

Vol. 3, Issue 11, November 2014

Following table shows model wise specifications of a Telescopic Handler machine:-

Model	TL 441-10	TL 451-10	TL 441-13	TL 451-13
Engine Output kW/hp	74/101	74/101	74/101	74/101
Max. load Kg	4,100	4,999	4,100	4,999
Max. lift height m	9.6	9.6	13.0	13.0
Operating weight kg	8,800	9,700	9,800	10,900

(Ref:- <http://www.liebherr.com/> for details)

Case Study of Movements of Excavator:- (Ref:- Taken in private farm in Athani, Karnataka.)

Case Study for the excavator used for displacing large volume of earth.



C.S Figure 1



C.S Figure 2



C.S Figure 3



C.S Figure 4

C.S Figure 1:- The Boom Lowers for the approach and the arm digs into the mud.

C.S Figure 2:- The Boom Lowers for the approach and the arm digs into the mud.

C.S Figure 3:- The volume of earth displaced which is equal to the volume of Bucket. Based on model it will change.

C.S Figure 4:- The machine is counter balanced by the weight attached on back side.

International Journal of Innovative Research in Science, Engineering and Technology

(An ISO 3297: 2007 Certified Organization)

Vol. 3, Issue 11, November 2014



C.S Figure 4



C.S Figure 5

C.S Figure 4:- The ease of movements of the Boom and Arm gives flexible movements and approach.

C.S Figure 5:- It is Designed for quick return for saving time and minimizing machine idle time.

II. CONCLUSION

Previously the men used to carry baskets of earth on their Heads. But as we know Good Brains are Wasted on Men Who March in Rank and File Rhythm of Drum, the Spinal Cord would Do.

The Good Brains are meant for Better Work. So with this concept advance design techniques are implemented for quick movement of earth from one point to another resulting into wide application required in infrastructural development. The case study gives the overview of the motions which are designed for maximum approach and for greater volume transportation.

III. ACKNOWLEDGEMENT

I hereby take an opportunity to express my deep sense of gratitude towards **Managing Editor, IJIRSET** for giving me the opportunity to publish my review paper in there Journal. I would also like to thank **Prof A.A. Kumbojkar** and **Prof A.P.Shrotri** for their valuable guidance and esteemed suggestions along with constant encouragement during each of my paper publication which has enable this paper to be successful.

I would also like to express my thanks to entire Mechanical Department Staff, P.V.P.I.T Budhgaon, sangli and my friends for their valuable cooperation for completion of this review paper.

REFERENCES

- [1] Advances Anchor: Handbook of Kawasaki 9577 New Design.
- [2] Sangiv Singh, scientist Robotics Institute Carnegie Mellon University Pittsburgh, "State of art Automation of Earth Moving system" Carnegie Mellon University, Research Showcase @ CMU, 10-2002 P.A 15213.
- [3] Earth Moving Equipments: New product catalogue by Telcon Published in Indian Concrete Journal March 2002.
- [4] A.H.Mendis, Deputy Resident Engg Galoya Project Irrigation Dept, "Earth and Earth Moving Equipments". Engineers association of Ceylon, For Annual Conference, 1950
- [5] Bromberg A. A. and Voitsekhovskii R. I. and Ul'yanov N.A. A. A. Balkema, "Machines for Earthmoving Work", Theory and Calculations., Rotterdam, 1985.
- [6] Bernold L. E., "Low Level Artificial Intelligence and Computer Simulation to Plan and Control Earthmoving Operations". Tempe, AZ, 1986. Journal of Aerospace Engineering. January, 1991.
- [7] Bernold L., "Motion and Path Control for Robotic Excavation". ASCE Journal of Aerospace Engineering. 6(1), January, 1993.

International Journal of Innovative Research in Science, Engineering and Technology

(An ISO 3297: 2007 Certified Organization)

Vol. 3, Issue 11, November 2014

BIOGRAPHY



O.M. Kaulgud is pursuing M.E. in Mechanical- Design Engineering from Padmabhooshan Vasantodada Patil Institute of Technology, Budhgaon, Sangli, Maharashtra, India. His research interest includes Design Engineering, Product Design and Development and Fatigue Failure Analysis.



A. A. Kumbhojkar has received M.Tech. in Mechanical- Design Engineering from IIT, Madras in 1984. He is Associate Professor and P.G. Co-ordinator (Design Engg) of Mechanical Engineering Department Padmabhooshan Vasantodada Patil Institute of Technology, Budhgaon, Sangli, Maharashtra, India. His research interest includes control Engineering, Mechatronics and Design Engineering.



A. P. Shrotri has received M.E. in Mechanical- Production Engineering from Shivaji University, Kolhapur. He is Associate Professor and Head of Department of Mechanical Engineering Department Padmabhooshan Vasantodada Patil Institute of Technology, Budhgaon, Sangli, Maharashtra, India. His research interest includes Production Engineering, Quality Manufacturing, Industrial Engineering.