

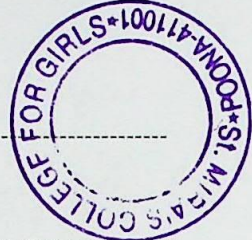


# Locomotive Ergonomics: “An Analysis for Effective Stress Management of Indian Railway Loco Pilots”

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## ABSTRACT

Work stress is inevitable in human life. People working in any organizational setup experience stress at some point in their work life. Work stress leads to lack of interest in work, creates discontent, increases absenteeism as well as mental health issues, which can be seen as a rising trend these days. Many organizations conduct regular workshops and training sessions for managing work stress. But there are certain factors which are not considered in prime fascia. One such factor is ergonomics. Most of the studies have proven that work stress is caused by the workstation design or workplace environment. An appropriate workstation design supports the need of the employees to work in a conducive work environment and utilize and explore their potential to the fullest. The main discussion of ergonomics workstation design in this paper includes control stand, operating equipment, working chairs, lighting, pollution level, sound proof and air pressure level. This paper presents a study on 42 Loco Pilots of Pune Division Indian Railways, channeling in various directions. Descriptive statistics is used for data analysis. The findings support that the control stand, operating equipment, working chairs, lighting, pollution level, sound proof and air pressure levels are not favorable to loco-pilots. Therefore this paper is focused on the importance of ergonomics with respect to occupational stress and its need for improvement in the cabin interiors of loco pilots. The study is concluded with some effective suggestions after having a discussion with a few respondents.

**Keywords:** Loco Pilots, Occupational Stress, Stress Management, Ergonomic, Workplace

## INTRODUCTION

“Ergonomics is also known as human factors. It's the way of disciplined scientific study that helps us to study and understand the human interactions with the products, equipment, environment and systems.” (Journal of Ergonomics Research.)

It is an open truth that the ergonomics can make our job easier and keep our work force safer. Safety is an asset which has to be valued more than just a priority. But it's given very little light on. One of the factors that assure safety is Ergonomics. Therefore, it must be incorporated and treated as an asset. Ergonomics began in the United States during World War II, when scientists designed new advanced systems without fully considering the people who would use them. Gradually it became clear that systems and products should be designed to take into account many human and environmental factors if they should be used safely and effectively. This awareness of the physical requirements of the people resulted in the discipline of ergonomics. Safety and ergonomics are the sciences of human factors. Both play a significant role in the success of a design or task. They can work synergistically to enhance each other, improve safety and productivity and also reduce employer's costs.

Both safety risk assessments and ergonomics help to identify hazards in the workplace that are at risk, and determine adequate preventive measures and risk monitoring. Each type of evaluation must be based on a holistic approach considering the total burden on the body while at work.

**Loco Pilots means Engine Loco Pilots or any other competent Railway servant for the time being in charge of driving a train under the system of working. This Paper focuses to identify the efficiency of ergonomics of Loco Pilots, Indian Railways.**

Loco Pilots are the unsung heroes of the Indian Railways. Their contributions have seldom been appreciated. Working for almost 10 hours a day, Loco Pilots not only have to perform their duties with mere perfection but they also have to ensure the life safety of other people. They cannot afford the slightest errors because the work that they do has always given them stringent punishment for errors, that is life or fatal accidents. The greater injustice is that even though the Loco Pilots may receive salary, allowances, reimbursement, quarters etc. to that of Class 3 employees, the workload as well as stress is preminent to Class 1 employees. Work pressure is unbearable and cannot be described in words.



The job requires Loco Pilots to be in their full attentive zone, a slight miss of focus or attention could be a serious mistake. Even small mistakes like missing a signal or crossing the speed limit of the track could be attributed as a reason for an accident. In addition, their working conditions with extreme noise pollution and irregular working hours affects their sleeping patterns as well. Most of the Loco Pilots are facing ear related ailments such as hearing loss, vertigo in the later stages of their careers due to their long working hours in the noisy environment. The odd timings and erratic working hours greatly affect their regular activities, which leads to disturbances in their social life/interactions; a reason for rising mental related issues in their profession. Unlike other professions they don't even have a loo or toilet in the loco (cabin) and they are not supposed to take toilet breaks in between their work schedule. It is shocking to note that some of them use tracks to relieve themselves. The small loco cabin with just two people is another addition to their occupational hazard. Many times, the loco pilots witness accidents where animals or humans get run over by the train, which create a lasting impact on them. It greatly affects their mental well-being.

Lack of facilities such as AC in their cabins adds to the discomfort to work in hot, humid or even cold conditions be it day or night. A Loco Pilot job requires them to pull mostly night shifts and work on weekends giving them very little time to spend with their family members. All this in some way or other adds worries to their already stressful life.

### Objectives of the Study

1. To study the ergonomics of loco cabins of Loco Pilots.
2. To study the impact of ergonomics of loco cabins on Loco Pilots in their occupational stress.
3. To analyze the need for improvements in the ergonomics of loco cabins.

### Hypothesis

H0: Ergonomics of Loco Cabins are appropriately designed for a conducive working environment for a loco pilot.

H1: Ergonomics of Loco Cabins are not appropriately designed for a conducive working environment for a loco pilot.

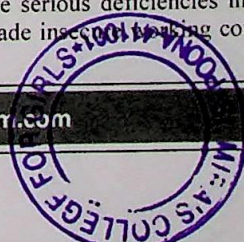
## REVIEW OF LITERATURE

Kian Sek Tee, Eugene Low, Hashim Saim, Wan Nurshazwani Wan Zakaria, Safinaz Binti Mohd Khairuldin, Hazlita Isa, M. I. Awad and Chin Fhong Soon (2017) "A study on the ergonomic assessment in the workplace", This document aims to review the approaches and instruments used by the previous works of the researchers in the evaluation of ergonomics. Ergonomics has earned attention and taken into consideration the workers of different fields of work recently. It has had a great impact on the comfort of workers who directly affect efficiency of work and productivity. The workers have claimed to suffer pain and injuries in their workplace. Musculoskeletal disorders (MSDS) are the most common problem that workers frequently report. This problem occurs due to the lack of knowledge and alertness of workers to ergonomics in their surroundings. The two main methods that are often used for ergonomic evaluation are the rapid assessment of the upper extremities (rule) and the rapid body assessment (REBA). Popular devices are inertial measurement units (IMU) and Microsoft Kinect.

kayla. M. Fewster, Maureen, F, Riddle, Surabhi Kadam and Jack.P.Callaghan(2019), "The need to accommodate Monitor Height changes between sitting and standing", has emphasized on the necessity of sit-to-stand workstations in the workplace. The study has identified a research gap regarding the height adjustments of the desk from sitting to standing, for which there is not much study conducted so far. To overcome the limitation the study was conducted on 16 participants who stood and sat at a sit-to-stand workstation while adhering to current Canadian Standards Association (CSA) Guidelines for Office Ergonomics.

Dennis R. Jones(2015), "The relationship between working conditions and musculoskeletal / ergonomic disorders in a manufacturing facility – a longitudinal research study", the researcher studied the relationship between the working conditions and musculoskeletal / ergonomic disorders in a manufacturing facility. The researcher claims that the biomechanical and psychosocial aspects of work have a significant influence on the individual worker's health and well-being. The data was collected from a large manufacturing unit. The objective of the research was to identify the stressful working conditions and the means to arrest it. The overall aim of this research was to improve the long-term health and well-being of workers in a manufacturing facility. The methodology applied was the Balance Theory Model of Smith & Carayon-Sainfort. The study identified a research gap that more research studies need to be done in order to provide an answer to the existence of the link between biomechanical factors and psychosocial factors, and musculoskeletal disorders.

R. N. Sen and A. K. Ganguli (1982), "An Ergonomic Analysis Of Railway Locomotive Loco Pilots Functions In India", had conducted a 3-tiered analysis of electric locomotive Loco Pilots functions in India and a task-operation-subsystem. The researcher concluded that there were serious deficiencies in the design of the current cabins of the locomotives of the Indian railroads. These defects made insecure working conditions, and opened the door to "human



error" accidents. Therefore, the role of man, the activities he has to carry out, and the physical and social environment in which they have to do work, all must be given detailed consideration to optimize the relationship of man-machine-environment. Only in this way can efficiency and alertness be ensured, along with both physiological and psychological well-being. It must be remembered that the correct design of the workplace is an essential part of operational security and reliability.

**Kate Dobson (2015), "Human Factors and Ergonomics in transportation control systems"**, The research paper observes the evolution of Human Factors (HF) and ergonomics in the railroad from Operator's point of view. The practical areas for the application of HF at specific points in rail signaling and control systems are briefly described. HF's considerations in advanced train control systems and movement towards automation are discussed, as well as the impact of new technologies in the context of the operation itself. It has been claimed that there is a greater dependence on the operator to be vigilant and react efficiently when the intervention is required in the automation, both within the control room and within the environments of the control cabin. This article illustrates some of the human performance concerns for the new transport control systems that are faced today and analyzes how this area of cognitive care, human error and workload is difficult to evaluate and predict.

From the above review of literature, the identified gap is the study related to stress management of Loco Pilots. A very few studies are conducted on this topic. For a long time not much research has been done on this area. Since we are rapidly witnessing revolution in climate, culture and society, it is the utmost need to conduct more such researches to serve the betterment of railways in the fast-progressing society. This paper fulfills one of the purposes to reduce the widening research gap in this area and also provide a scope for future research studies.

### RESEARCH METHODOLOGY

In order to fulfill the objectives, the study has adopted the survey method for soliciting the relevant data. The Loco Pilots connected with the train movement who formed the sample representing the universe for the study, were approached personally by the researcher at their workplaces and residences.

The collected data was codified and transferred to summary sheets for tabulation. The codified data was converted into percentages and based on the frequency and percentage the analyzed findings were presented in the form of tables and graphs. Hypothesis is tested and the conclusions were drawn accordingly.

#### Sample DESIGN

The universe for this study comprises the following personnel.

All Loco Pilots and assistant Loco Pilots connected with the train movements.

The Loco Pilots are groups that are distinct and therefore each group can be considered as a stratum. Stratified random sampling method is adopted for drawing 30% of sample from the total population of Loco Pilots of Pune division.

Sample is chosen as follows.

Sr.No	Category	Population	Sample	Percentage
1	Mail LP	39	16	41%
2	Passenger LP	8	3	37.5%
3	Goods LP	36	6	16.67%
4	Asst LP	76	17	22.36%

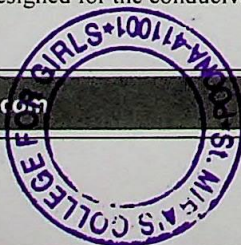
The total size of the sample is the sum of the samples drawn from the four categories i.e.,  $16+3+6+17 = 42$ . Therefore 42 is the sample size for the Loco Pilots.

### FINDINGS

The study has the following hypothesis set to be tested.

H0: Ergonomics of Loco Cabins are appropriately designed for the conducive working environment for a loco pilot

H1: Ergonomics of Loco Cabins are not appropriately designed for the conducive working environment for a loco pilot





The study has considered 3 aspects of Ergonomics – Control Stand, Driving Seat and working space. For each of these aspects, the researcher had prepared statements to assess the status. The respondents were given three options for each of the statements – Always, Sometimes and Never. The statements were made in such a way that; if the respondent perceives ergonomics as conducive, he/she will respond as “Always”. The tool was administered on 42 loco pilots. Table 1 below gives the number of responses to a particular category for each of the statements under the aspect “Control Stand”

**Table 1a: Number of Responses to Each of the following statements under Control Stand**

	Always	Sometimes	Never	Total
Uniform design of control stands	3	6	33	42
Easily accessible	6	30	6	42
Are Gauges and Displays readable during night time on run	8	29	5	42
Is Front visibility clear in all types of Locos	3	37	2	42
Are lookoutglasses clear	5	36	1	42
Are wipers working properly during the raining season	2	39	1	42
Is the head light focus sufficient during Night Time	3	37	2	42
Is speedometer easy to read on run	5	36	1	42
Is digital speedometer more convenient to you	38	4	0	42
Is the location of speedometer convenient to Loco pilots	5	34	3	42
Is the speedometer parallel to the Loco pilot’s eye view	1	24	17	42

The above table clearly shows that the number of respondents saying “Always” is very low, not even 25% of respondents showed content in the statements regarding the control stand. The only aspect of the digital speedometer showed satisfaction; which could be overall interpreted as the loco-pilots are not happy with respect to the control stand aspect.

The assessment was done in one more way. There are 11 statements under “Control stand”. Total of “Always” response was calculated. Following table depicts the number of “Always” responses out of 11.

**Table 1b: Count of “Always” response out of 11 statements**

	Frequency	Percent
0	3	7.1
1	25	59.5
2	4	9.5
3	4	9.5
4	3	7.1
5	1	2.4
6	1	2.4
8	1	2.4
Total	42	100.0

The table 1b shows that, out of 11 statements; maximum of 25 respondents have said “Always” for only one statement.

This again could be interpreted as the control stand aspect is not favorable to loco-pilots.

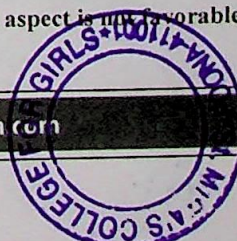




Table 2 below gives the number of responses to a particular category for each of the statements under the aspect "Driving Seat"

**Table 2a: Number of Responses to Each of the following statements under Driving Seat**

	Always	Sometimes	Never
Does adequate technical maintenance take place	6	26	10
Height Adjustment	6	28	8
Forward and Backward movement	5	30	7
Side Adjustment(Right to left)	5	30	7
Back Rest	10	25	7
Hand Rest	5	30	7
Proper cushion seat	9	28	5
Foot Rest	6	17	19

The above table clearly shows that the number of respondents saying "Always" is very low, not even 25% for all statements; which could be interpreted as the loco-pilots are not happy with respect to the driving seat aspect. The assessment was done in one more way. There are 8 statements under "Driving Seat". Total of "Always" response was calculated. Following table depicts the number of "Always" responses out of 8.

**Table 2b: Count of "Always" response out of the 8 statements**

	Frequency	Percent
0	28	66.7
1	4	9.5
2	8	19.0
7	1	2.4
8	1	2.4
Total	42	100.0

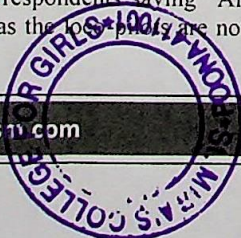
The table 2b shows that, out of 8 statements; maximum of 28 respondents have said "Always" for 0 statements; i.e., for none of the statements respondents have said "Always". This supports the finding that driving seat's aspect is not favorable to loco-pilots.

Table 3 below gives the number of responses to a particular category for each of the statements under the aspect "Working Space"

**Table 3a: Number of Responses to each of the following statements under Working Space**

	Always	Sometimes	Never
Enough working space	2	34	6
Effective heating and cooling systems	2	27	13
Are the drivers trained in the use of cabin components	18	23	1
Is Driver cab pollution free	1	3	38
Are drivers' cabin sound proof	0	0	42
Are the horns located far from the driver's cab	0	35	7

The above table clearly shows that the number of respondents saying "Always" is very low, not even 25% for all statements except 8.22; which could be interpreted as the loco-pilots are not happy with respect to the working space aspect.





The assessment was done in one more way. There are 6 statements under "Working Space". Total of "Always" response was calculated. Following table depicts the number of "Always" responses out of 6.

**Table 3b: Count of "Always" response out of 8 statements**

	Frequency	Percent
0	23	54.8
1	16	38.1
2	2	4.8
3	1	2.4
Total	42	100.0

The table 3b shows that, out of 6 statements; maximum of 23 respondents have said "Always" for 0 statements; i.e., for none of the statements, respondents have said "Always" and 16 respondents have said "Always" for only 1 statement.

**This supports the finding that working space aspect is not favorable to loco-pilots.**

### SUGGESTIONS

The study would like to suggest certain points for the improvement of the conditions of locomotives. This may help in reducing the stress of loco pilots due to poor ergonomics.

#### Table No: 1a (Control Stand)

The loco pilots are working with various types of diesel and electric locos on a day-to-day basis. The cabs and operating handles are differently designed on each loco which may create stress and confusion among them. Therefore, introducing a uniform cab is very essential. It's been a long-standing demand from the loco pilots.

The regular maintenance and upgrading of the following such as head light focus, proper working of wipers and sanders, visibility of important cab gauges, visibility of speedometer or digitizing it is recommended.

During the summer season, the temperature of the loco cabin is normally higher than the atmospheric temperature for about 5 -7 degrees and vice versa. In the winter season the cab is not air proof to work efficiently. As Loco Pilots efficiency is bound to suffer if the temperature of the cab is either too low or too high, it is essential to have air-conditioning in the cab.

It has been noticed that the Joy Stick type throttle handle provided may be prone to accidental movement while operating. E.g., Jumping to dynamic brake while easing the throttle and vice versa and over jumping the notches. Operating switches and controls shall be clearly marked, so that they are easily identifiable by the Loco Pilot. Critical controls should be positioned or designed (e.g. covered) to prevent accidental operation. Operating switches and controls shall be positioned in such a way as to enable easy navigation of the cab controls.

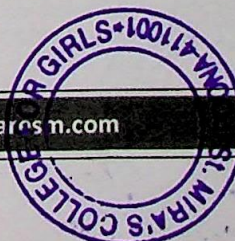
#### Table No: 2a (Driver's seat)

The loco pilots' working chairs should be upgraded with modern features such as cushion seat, height adjustment, side adjustment, forward and backward movement, back rest, hand rest, foot rest etc. It will provide comfort for working long hours on duty. Compressed air suspension seats will be preferred to absorb the vibrations so that back pain is minimized.

#### Table No: 3a (Working Space)

Prolonged Exposure to loud noise more than permissible may lead to stress and deafness. Various studies proved that noise can cause hearing impairment, hypertension, ischemic heart disease, annoyance, mental stress, sleep disturbance as well as changes in the immune system. Therefore, the loco cab should be sound proof and both the side horns can be shifted far end off the cab. Noise levels in the Loco Pilot's compartments must be kept as low as possible by limiting noise at its source through appropriate measures (acoustic insulation, sound absorption) using the 'State of the art' technology available at the time of installation.

Doors of the Loco Cabin should be wide in such a manner that accommodates different body sizes of Loco Pilots. It has been noticed that internal and external doors of the Loco Cabin are open frequently and distract the attention of the Loco Pilot due to improper latches.





Loco Cab and Running plate floor surfaces should be slip resistant.

It has been noticed that no Emergency Exit doors are provided in all types of Locos. It will play a vital role in case of accidents when the Loco is capsized and normal doors are unable to open.

#### General Suggestions:

The interview and discussion with the Loco Pilots helped to identify their problems and the requirements that need to be taken care of.

Driving crews must be protected against sudden and major air-pressure fluctuations that might occur - especially at high speeds - when passing other trains and/or travelling through tunnels (both of these may occur at the same time). This system should also be capable of being adjusted manually by the Loco Pilot.

Loco should design and construct cabs which reduce exposure to Electromagnetic Fields to the minimum that can be achieved. The driving cab must be regularly tested to ensure that the exposure to Electromagnetic Fields (EMF) is kept to a minimum. In the electrified section Locos are running constantly with a prolonged time under the 25 KV watt. There is no proper adjusting windscreen provided in look out glasses to avoid sun glazes.

All indicator lights must be designed and positioned so that they can be read in all variations of natural or artificial lighting especially during periods of bright sunlight. Indicators should be positioned on the desk in such a way that windscreen glare is mitigated during periods of darkness. Indicator lighting behind the Loco Pilot should be kept to a minimum and shrouded to prevent windscreen glare during periods of darkness. When additional lamps are provided (e.g. a lamp for the ALP) these must not dazzle the Loco Pilot. Desk and instrument lights should be provided with a rotary control dimmer so that the lighting levels within the cab can be kept to a minimum to aid vision during times of reduced visibility and darkness.

Toilet facilities must be provided on Locos since Loco Pilots are working long hours on duty, sometimes without stopping for a longer period. It will help to minimize the physical and mental stress of Loco Pilots by holding back the natural calls.

#### CONCLUSION

The construction and design of the Locomotive is one of the factors highly influencing the performance of the train Loco Pilots in security related matters. The cabin is the daily workplace of the Loco Pilots; the facilities offered are of great importance to them both physically and mentally. Control stand, Driver seat, working space are the three variables taken for the present study. The study found that Loco Pilots face a common problem of lack of uniformity in the control stand, which is similar to a dashboard for a four-wheeler of different Locos. This leads to confusion among them which can cause stress leading to some grave mistakes.

Another major problem is noisy cab since the Engine sound and Horn can cause hearing ailments among the loco pilots. Most Loco Pilots also suggested more comfortable driving seats. Since the working hours exceeds more than 8 hours, it's a necessity to have comfortable seats, or else which could lead to other health problems such as backache etc. Considering all these major issues, the working space should be acoustic and of high standard.

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