Chapter:3 Problems & Analysis of Motor Mounted Centrifugal Blowers.

3.1 Introduction:

In the industry where the experimental study was carried out different types of blowers were installed and in total over 80 blowers were in operation throughout the plant. The most common type were however the centrifugal blowers and they were either directly motor driven (Fig: 3.1) or directly mounted on the motor shaft (Figure 3.2). Some centrifugal blowers were belt driven also (Fig: 3.3)

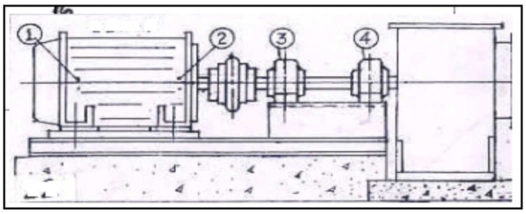


Fig: 3.1 Direct Driven Centrifugal Blower

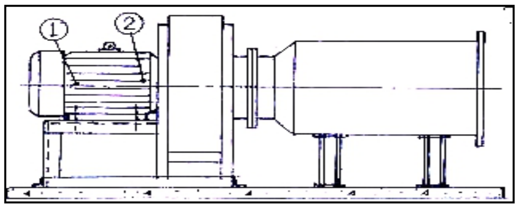


Fig: 3.2 Motor Mounted Centrifugal Blower

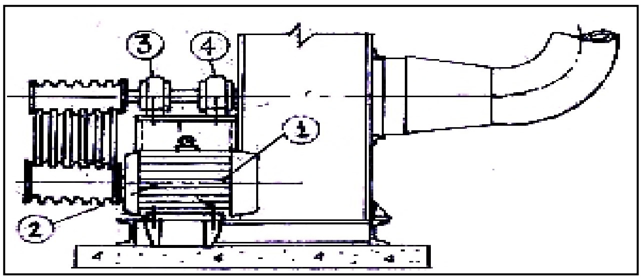


Fig: 3.3 Belts Driven Centrifugal Bower

The directly motor coupled blowers and also the belt driven blowers are usually of large sizes and they are either cantilever type or simply supported type with both the shaft bearings being on the either side of the impeller. Some of the cantilever type of blowers are driven by HT motors of rating between 550kW to 1 MW. The directly motor mounted centrifugal blowers are however normally of small sizes with motor kW ratings ranging from 15 kW to 37 kW.

All these blower's vibrations are monitored by the plant's condition based monitoring team (CBM) under specific schedule and whenever any vibration increase trend are observed in any of the blowers then the spectrum analysis was done by the in-house condition based monitoring team and corrective actions are conveyed to the plant engineers for implementation.

Over the years it was observed that vibration level of large size centrifugal blowers with motor capacity 37 kW and above which were either directly coupled or belt driven performed more reliably and the vibration levels were within the norms as specified in ISO 10816-3 . The mean time between failures (MTBF) of these blowers were reasonably long and in addition with timely lubrication and tightening carried out by the maintenance team these blowers operated without any problem for years together. Sometimes due to bearing wear out or foreign material deposition on the impellers vibration increases temporally but after carrying out the spectrum analysis the condition monitoring engineers recommend corrective actions which again helps to reduce the vibration and the blowers again operate within the accepted vibration norm for further years on end.

However in case of the motor mounted centrifugal blower's vibration fluctuation problems were very frequent and common. These blowers are generally installed in vital areas like furnaces, boilers and chimneys and mainly performed as combustion air fans, forced draft and induced draft fans respectively. Any failures of these blowers during operation lead to total plant stoppage causing enormous losses to the plant operation.

To solve this perennial problem it was decided to take at least 25% of these motor mounted blowers running in the plant at various areas and study the vibration trend over the years at failures or alarm stage vibration level using the tool of spectrum analysis and phase analysis find the root cause of failure and recommend corrective action.

Since 20 numbers of such blowers are in operation we selected 5 such blowers as case study and in the selection we listed the worst performing blower from each areas of installation.

In this chapter each case study is discussed in detail and the counter measure to eliminate the cause of failure was decided. The plant nomenclature of identifying the blowers like DBL-10, DBL-15 etc. has been retained as the spectrum analysis of the particular bower has been saved with the plant identification numbers so they are easy to retrieve.

3.2 Case Study -1: Combustion Air Blower of a Furnace (DBL-10)

The blower is mounted on the motor shaft and the common base for the blower and the motor is supplied by the blower manufacturer. The common base is a box type of base fabricated with steel angles and plates and the placed on a low concrete base and is tightened to the bolts grouted it the concrete base (Fig: 3.4)

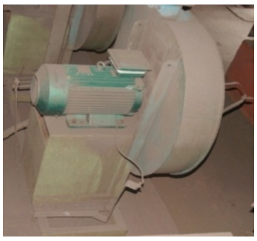
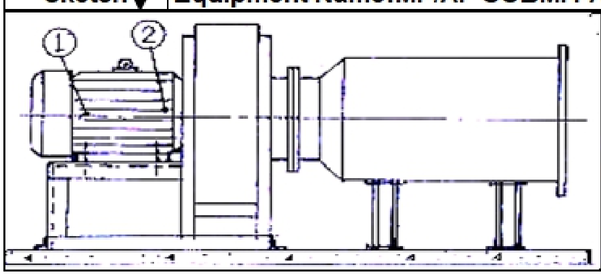


Fig: 3.4 Blower mounted on a steel box frame and bolted to concrete foundation

The specifications of the motor and blower are shown in Fig: 3.5

Sketch ↓



Equipment Name:MP/AF COBM. FAN ZONE 1 NO-2		No	DBL-10
Foundation	FLEX	Drive KW	15
CouplingType	NA	Drive RPM	2910
Belt Tension	NA	Frame Size	NA
No of belts	NA	Make	
Fan blade nos	8	Drive.DE brg	6306
Drive brg lub	EP2	Drive NDE brg	6306
Driven brg lub	NA	Driven RPM	2910
Class	III	Driven DE brg	NA
Insp Schedule	Q	DrivenNDEbrg	NA

Fig: 3.5 Schematic sketch of the blower with the motor and the specifications.

The vibration of the centrifugal blower and the motor were regularly monitored by the engineers of the Condition Based Monitoring Cell and monitoring points of the motor non-drive end & drive end bearing are shown in Fig:3.5 as Point 1 & Point 2.In each measuring point vibration was measured in all the three axes on regular intervals and a trend for about 7 years is shown in Fig :3.6 , Fig:3.7 & Fig:3.8

The data for these trend graphs is provided in Appendix A.

3.2.1 Vibration Trend of Motor Non Drive End Bearing for Three Axes.

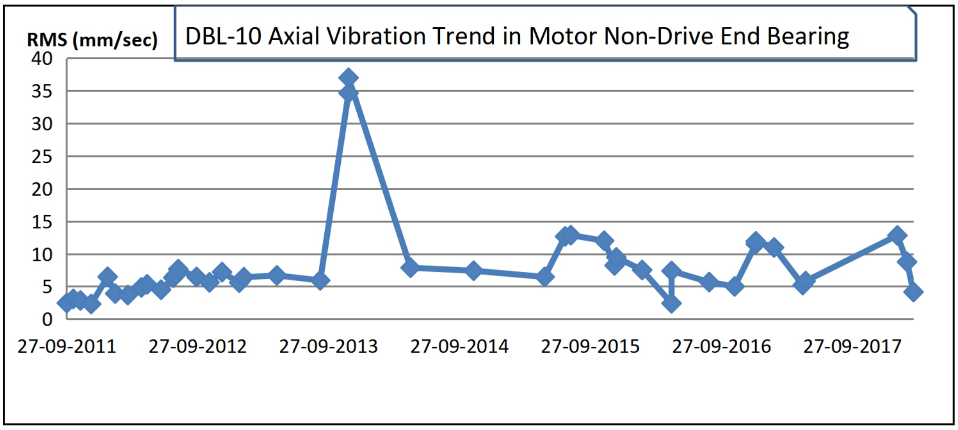


Fig: 3.6 Vibrations (Axial) Trend of DBL-10 Blower MNDE Bearing.

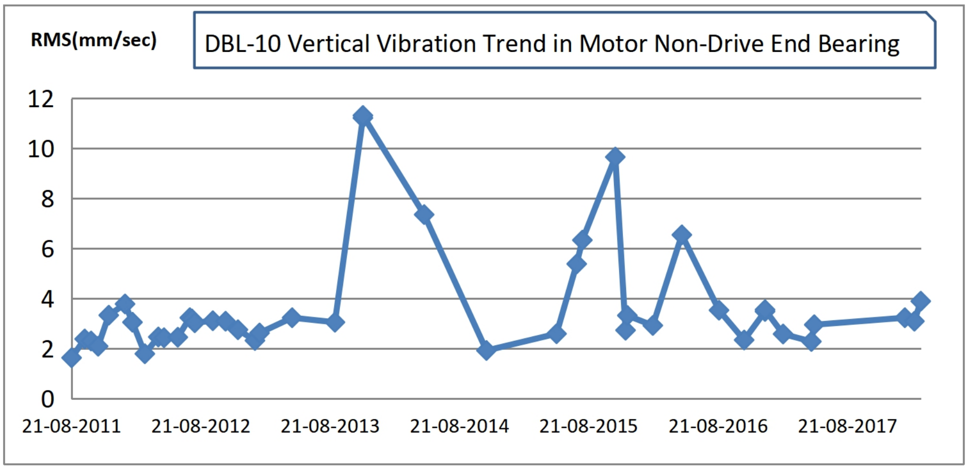


Fig: 3.7 Vibration (Vertical) Trend of DBL-10 Blower MNDE Bearing

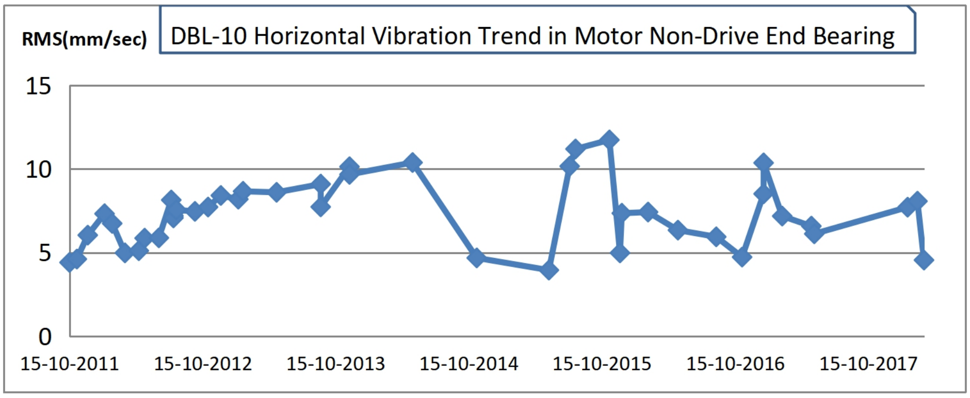


Fig: 3.8 Vibration (Horizontal) Trend of DBL-10 Blower MNDE Bearing

3.2.2 Vibration Trend of Motor Drive End Bearing for All Three Axes.

Similarly vibration trend of all three axes of the motor drive end bearings for the same period of time were taken as shown in Fig 3.9.Fig 3.10 & Fig.3.11.

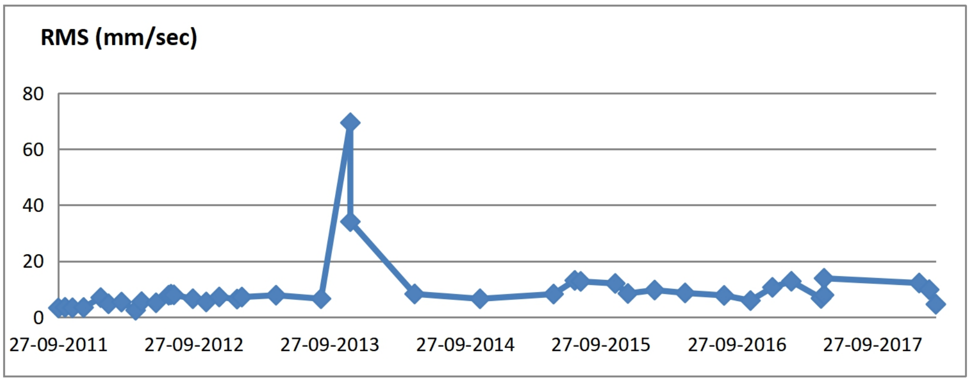


Fig: 3.9 Vibrations (Axial) Trend of DBL-10 Blower MDE Bearing.

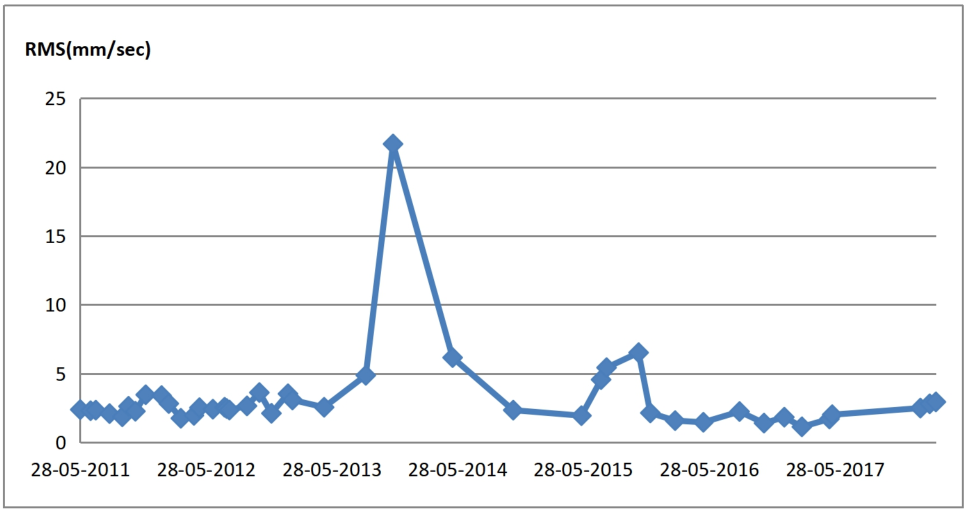


Fig: 3.10 Vibration (Vertical) Trend of DBL-10 Blower MDE Bearing

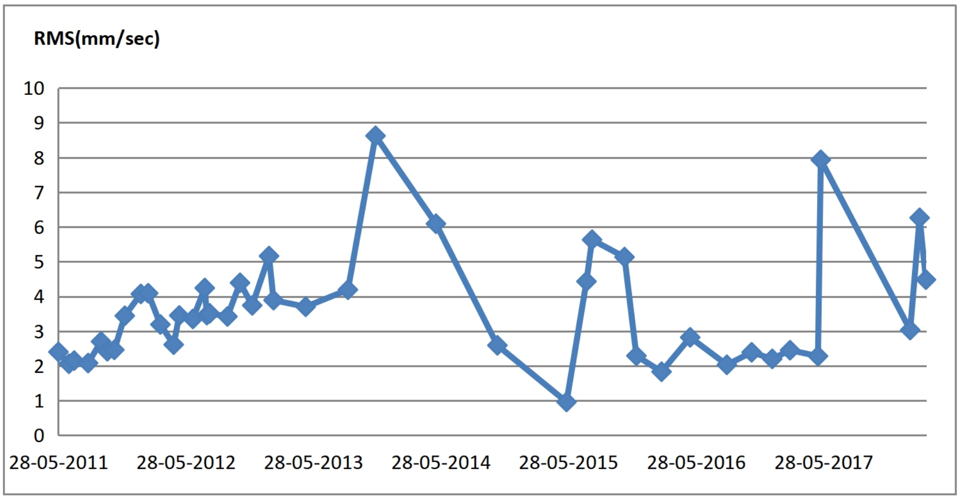


Fig: 3.11 Vibration (Horizontal) Trend of DBL-10 Blower MDE Bearing.

3.2.3 Discussion on the Vibration Trend Graphs of the Blower Motor (DBL-10)

The common feature in all the five graphs except for the vibration trend of the blower-motor non-drive end bearing in horizontal axis, indicate that for the first two years the vibration trend was within the normal zone and constant. The horizontal axis vibration of the motor non-drive end bearing was in increasing trend and much higher than the other vibrations observed. The spectrum analysis of the horizontal axis of a non-drive end bearing is shown. (Fig: 3.12)

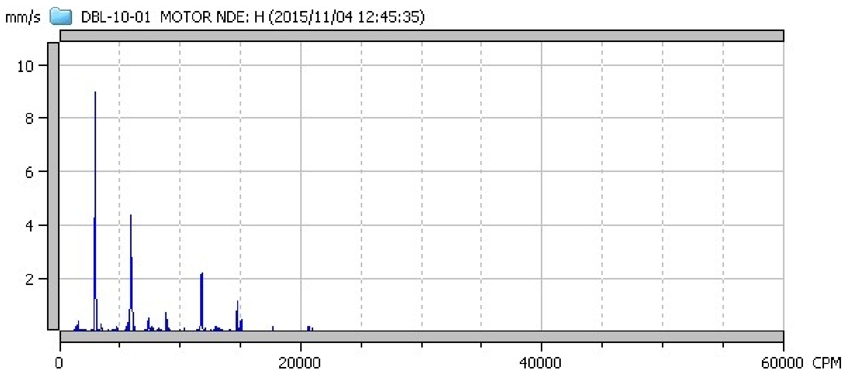


Fig: 3.12 Spectrum Analysis of MNDE Bearing Horizontal Axis

Phase analysis revealed approximate 180^0 phase difference between vertical measurements on machine foot base and base itself. As per the Table 6.0 Illustrated Vibration Diagnostic Chart (Appendix :B) the spectrum analysis indicates base looseness and the phase analysis confirms it. The machine ultimately failed on 25.11.2013 due to crack propagation at the base.

The base was repaired by welding but since then the vibrations in all the axes would periodically increase due to the loosening of the holding bolts because of constant high vibration and same is contained by frequently stopping the blower to retighten the base bolts.

3.2.4 Conclusion:

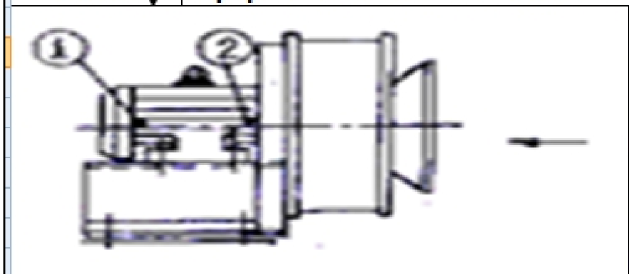
The study of the trend graphs and the spectrum analysis indicated that the box type base provided by the manufacturer was not suitable for the high rpm motor mounted blower and this led to the failure of the base which even after repair could not be made rigid to absorb the vibration and this has made the operation of the blower very unreliable. Corrective action is to change the base with a proper designed one fabricated with proper structural.

3.3.0 Case Study-2: Combustion & Atomising Blower No: 1 (DBL-13)

3.3.1 Introduction:

This blower is also used for the furnace. It provides both the combustion and the atomising air for a burner located for a different zone in the furnace. The specification of the blower is given in Fig: 3.13.

Sketch↓	Equipment Name:MP/AF COBM. FAN ZONE 5&6 NO-1		No	DBL-13



Foundation	FLEX	Drive KW	15
CouplingType	NA	Drive RPM	2890
Belt Tension	NA	Frame Size	NA
No of belts	NA	Make	
Fan blade nos	8	Drive.DE brg	6309
Drive brg lub	EP2	Drive NDE brg	6309
Driven brg lub	NA	Driven RPM	2890
Class	III	Driven DE brg	NA
Insp Schedule	Q	DrivenNDEbrg	NA

Fig: 3.13 Schematic sketch of the Blower Mounted on Motor and the specifications.

This motor mounted blower was supplied with a common base by the supplier and the same was on a structure fabricated in-house and bolted to a concrete base. (Fig: 3.14)

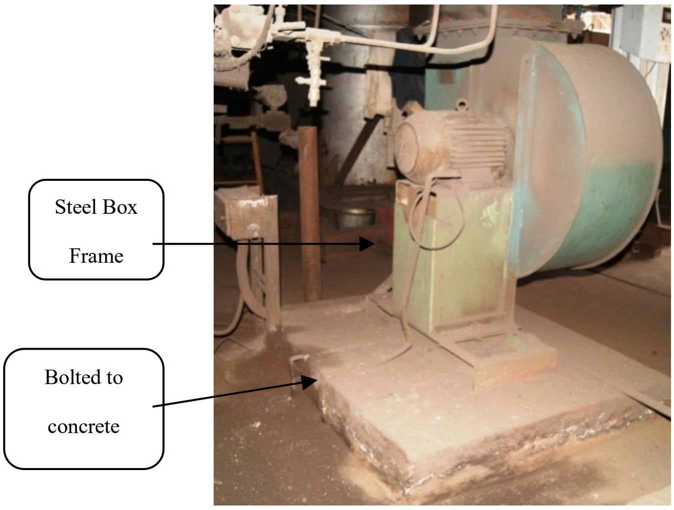


Fig: 3.14 Motor Mounted Blowers (DBL-13)

The vibration of the centrifugal motor mounted on the blower were regularly monitored by the engineers of the Condition Based Monitoring Cell and monitoring points of the motor non-drive end & drive end bearing are shown in Fig: 3.13 as Point 1 & Point 2.In each if the measuring point vibration was measured in all the three axes in regular basis and a trend is shown in Fig: 3.15 .Fig:3.16 & Fig: 3.17 .The complete data for these trend graphs is provided in Appendix A.

3.3.2 Vibration Trend of Motor Non Drive End Bearing for Three Axes.

Trending of the vibration amplitude for all the three axes were done for a period and the same are produced below (Fig: 3.15- Fig: 3.17)

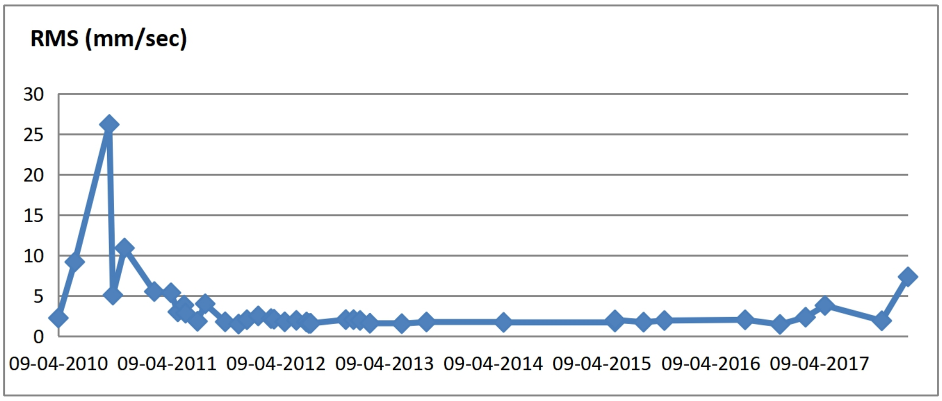


Fig: 3.15 Vibrations re (Axial) Trend of DBL-13 Blower MNDE Bearing

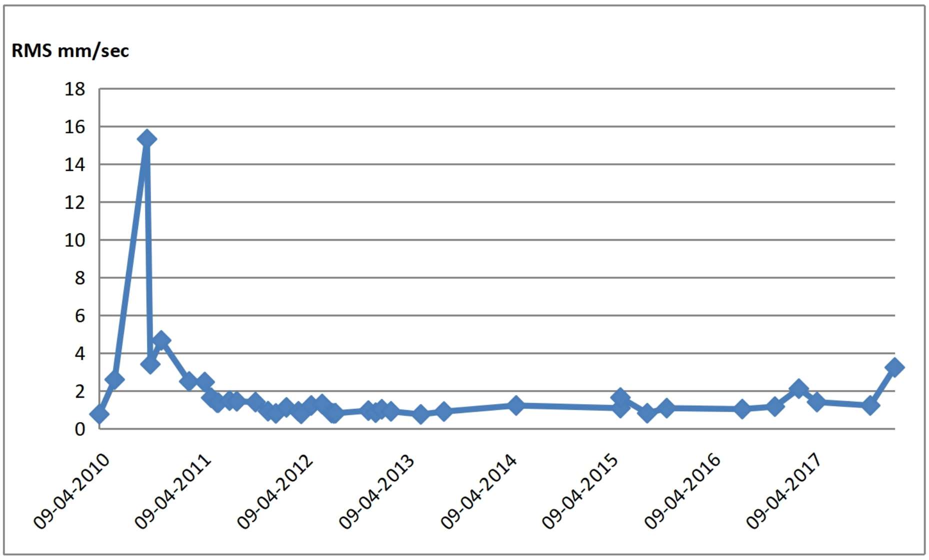


Fig: 3.16 Vibration (Vertical) Trend of DBL-13 Blower MNDE Bearing.

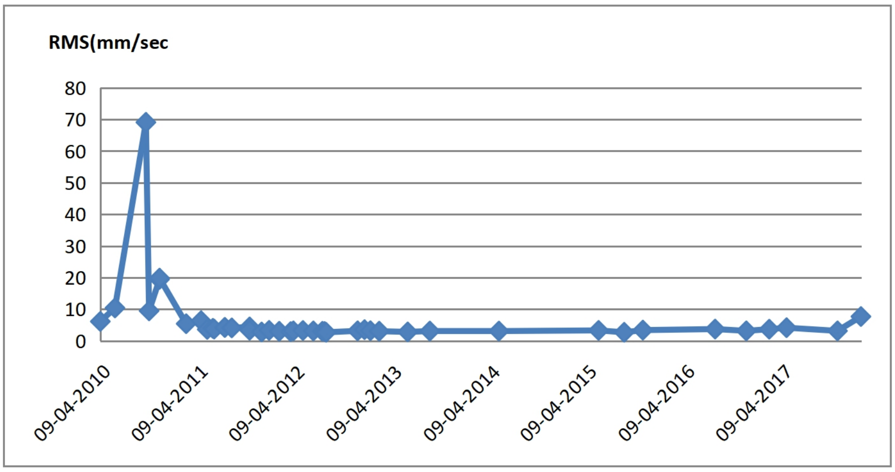


Fig: 3.17 Vibration (Horizontal) Trend of DBL-13 Blower MNDE Bearing.

3.2.3 Vibration Trend of Motor Drive End Bearing for Three Axes.

Trending of the vibration amplitude for all the three axes were done for a period the same are produced below (Fig: 3.18- Fig: 3.20)

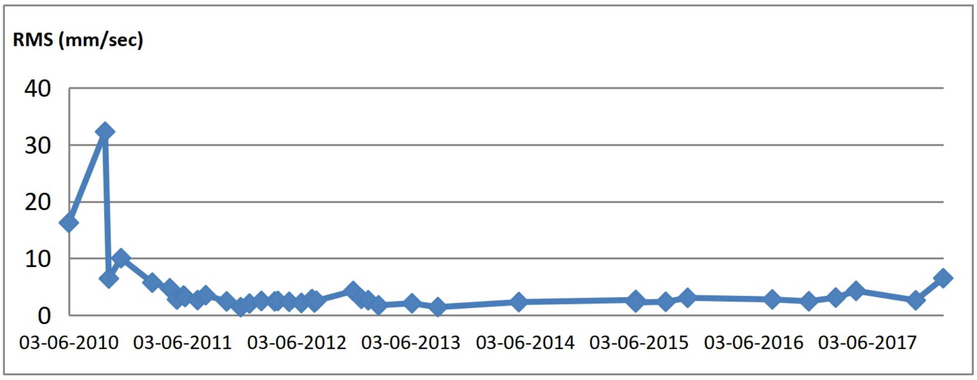


Fig: 3.18 Vibration (Axial) Trend of DBL-13 Blower MDE Bearing

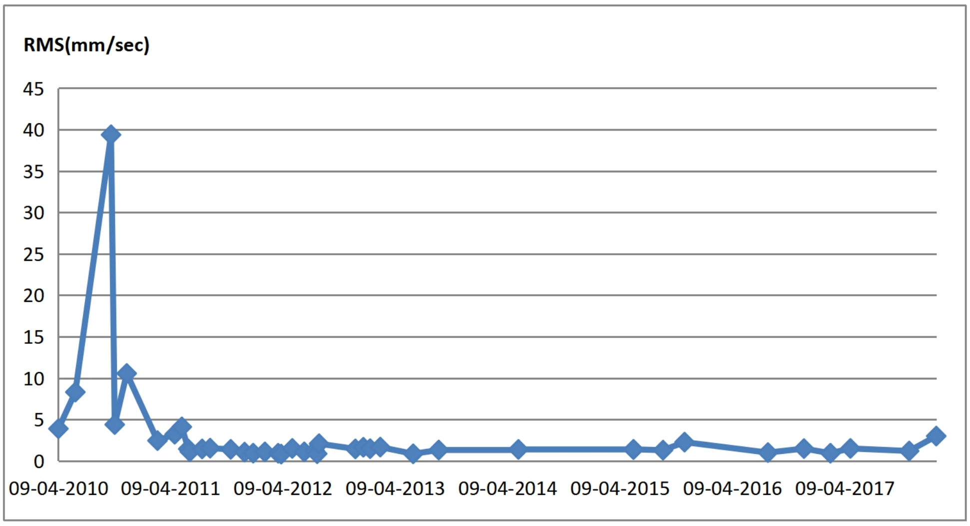


Fig: 3.19 Vibration (Vertical) Trend of DBL-13 Blower MDE Bearing

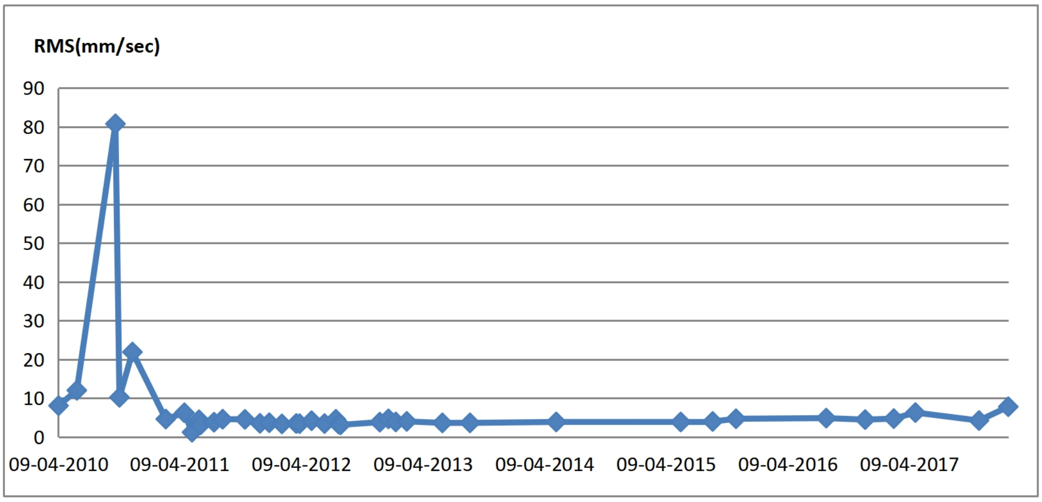


Fig: 3.20 Vibration (Horizontal) Trend of DBL-13 Blower MDE Bearing

3.3.4 Discussion on the Vibration Trend Graphs of the Blower Motor Drive and Non-Drive End Bearings. (DBL-13)

The study of all the trend graphs (Fig: 3.15-Fig: 3.20) shows that after commissioning the blower vibration in both the bearings and in all the axes increased till it reached a failure of base. After base welding and adding more stiffeners the vibration was contained. In this blower the frame was a box structure made by welding two channels structural face to face. The spectrum analysis (Fig: 3.21) and phase analysis indicated that the vibration increase was due to structural looseness of the base.(Fig:3.21 & Fig:3.22)

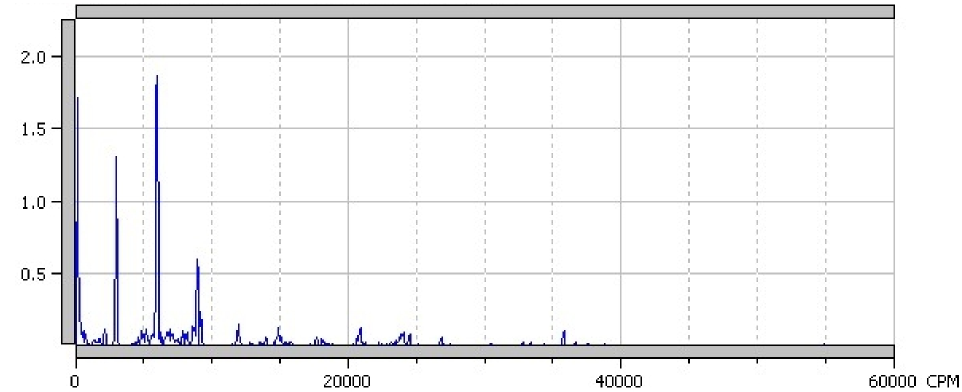


Fig: 3.21 Spectrum analyses indicate structural looseness of the base frame.

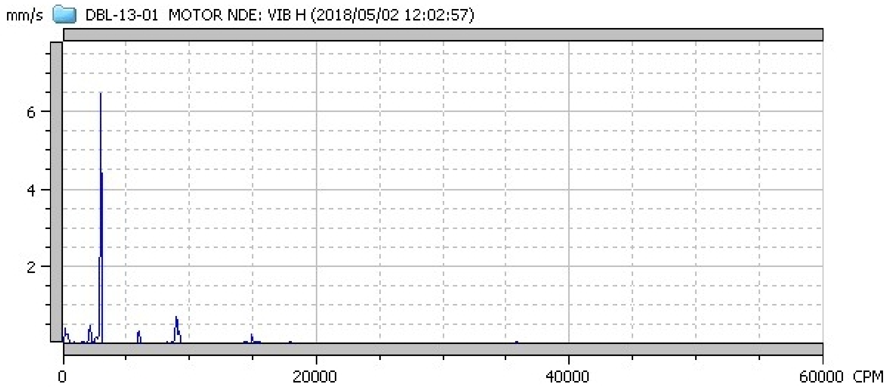


Fig: 3.22 Spectrum Analysis after welding stiffener on the base frame.

3.2.5 Conclusion

In this Case Study -2 the blower base frame was made of box structure by welding two channels face to face. Unlike Case Study -1(DBL-10) this blower vibration was observed from the initial monitoring period which ultimately led to the failure of the base. After repair and modification of the base and adding further stiffeners the vibration amplitude had come down and remained constant over the period. The solution to the problem was making the base more rigid by welding stiffeners and this corrective action was taken more on shop floor intuition than based on any mathematical calculation.

3.4.0 Case Study-3: Furnace Air Cooling Fan (DBL-15)

3.4.1 Introduction:

The fan blows in ambient air inside the furnace for the purpose of cooling. Like the previous two case studies this blower is also mounted on the motor and operates at a fixed speed of about 3000 rpm. The other specifications of the blower are given in Fig: 3.23

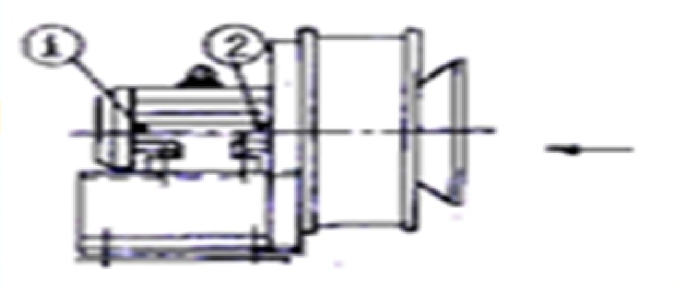
Sketch ↓	Equipment Name:MAIN PLANT A/F AIR COOLING FAN		No	DBL-15
	Foundation	FLEX	Drive KW	9.3
	CouplingType	NA	Drive RPM	2975
	Belt Tension	NA	Frame Size	NA
	No of belts	NA	Make	
	Fan blade nos	8	Drive.DE brg	6208
	Drive brg lub	EP2	Drive NDE brg	6208
	Driven brg lub	NA	Driven RPM	2975
	Class	III	Driven DE brg	NA
	Insp Schedule	Q	DrivenNDEbrg	NA

Fig: 3.23 Specification of the Furnace Air Cooling Fan (DBL-15)

The blower is mounted on the motor and is on a common frame supplied by the manufacturer. The common base was mounted on a base fabricated in-house and tightened on the bolts grouted concrete foundation. (Fig: 3.24)

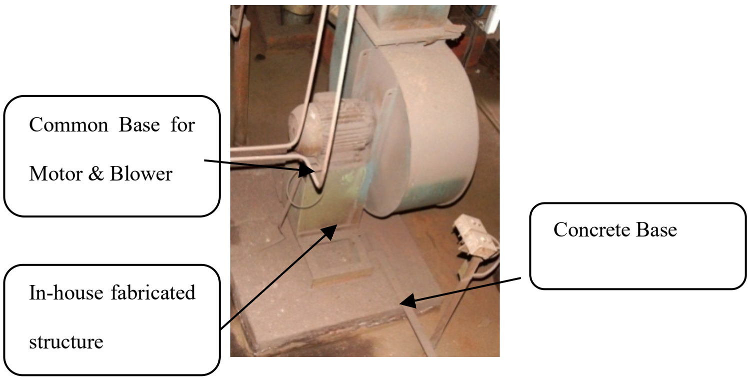


Fig: 3.24 the Motor Mounted Blower (DBL-15)

3.4.2 Problem Identification of the Blower (DBL-15):

The vibration of the centrifugal blower mounted on the motor was regularly monitored by the engineers of the Condition Based Monitoring Cell and monitoring points of the motor non-drive end & drive end bearing are shown in Fig:3.33 as Point 1 & Point 2.In each of the measuring point vibration was measured in all the three axes on regular basis and a trend for a period is shown in Fig:3.25 .Fig :3.26 & Fig:3.27 .The complete data for these trend graphs is provided in Appendix A.

3.4.3 Vibration Trend of Motor Non Drive End Bearing for Three Axes.

The vibration trend of all three axes of the motor non-drive end & drive end bearing are shown from Fig: 3.25 to Fig: 3.30)

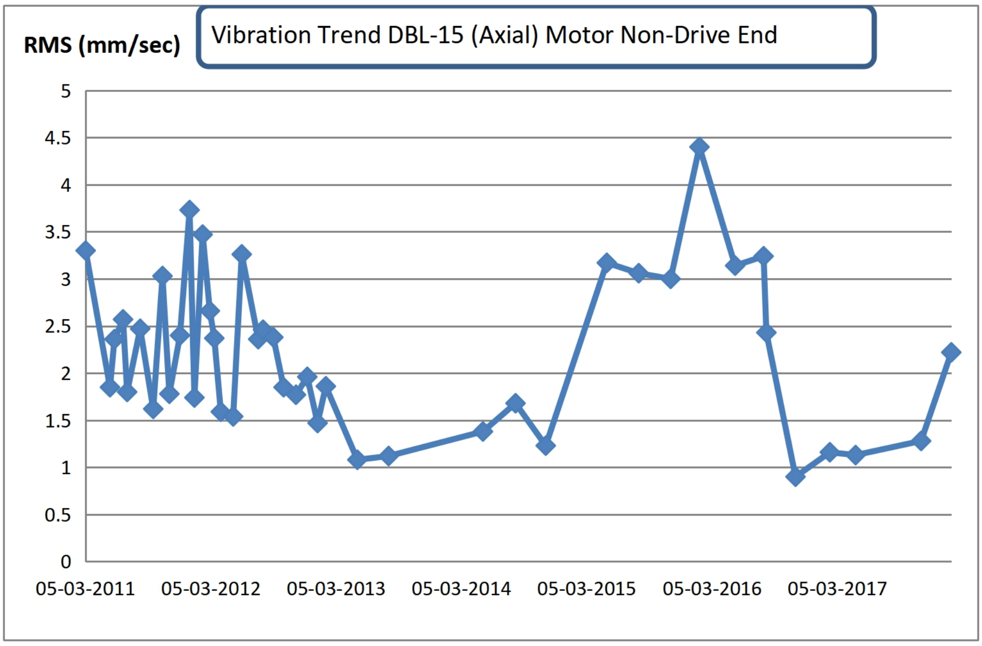


Fig: 3.25 Vibration Trend of DBL-15(axial) of MNDE bearing

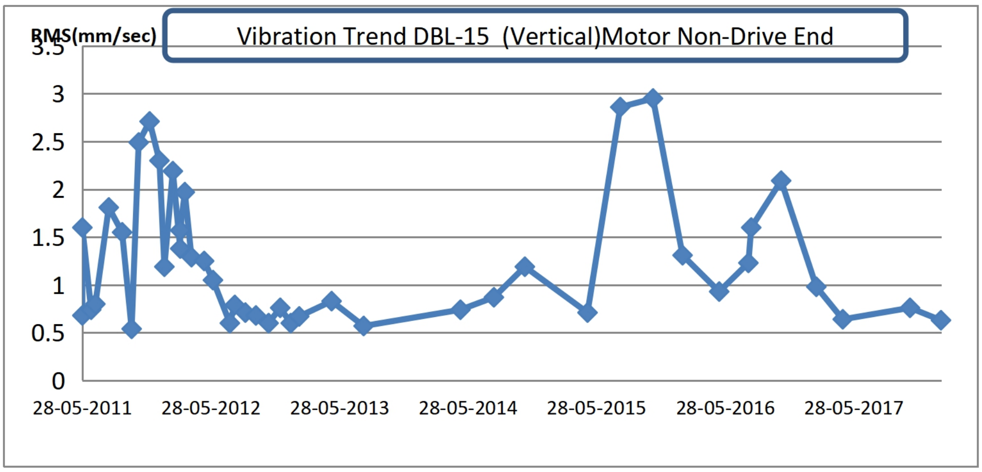


Fig: 3.26 Vibration Trend of DBl-15 (Vertical) of MNDE Bearing

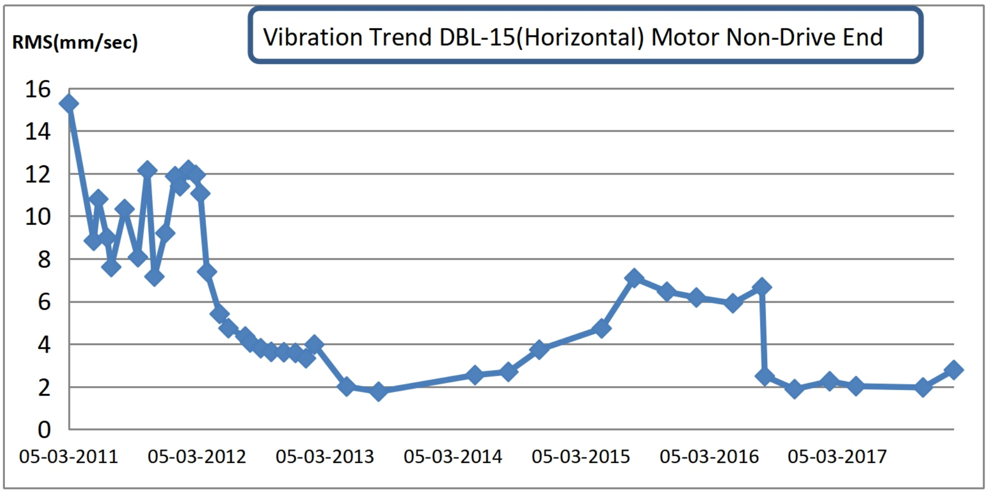


Fig: 3.27 Vibration Trend of DBl-15 (Horizontal) of MNDE Bearing

3.4.4 Vibration Trend of (DBL-15) Motor Drive End Bearing for Three Axes.

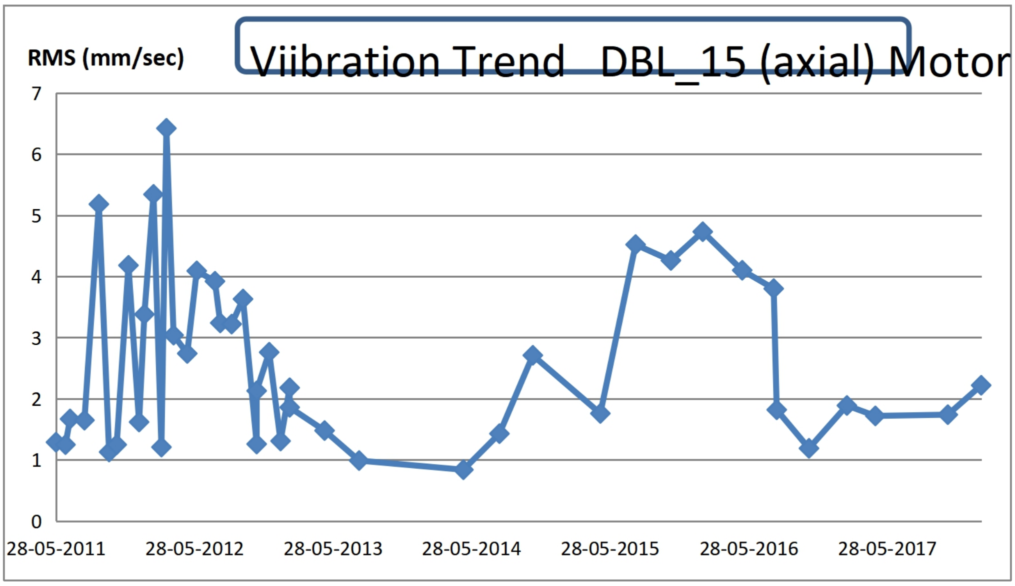


Fig: 3.28 Vibration Trend of DBl-15 (Axial) of MDE Bearing

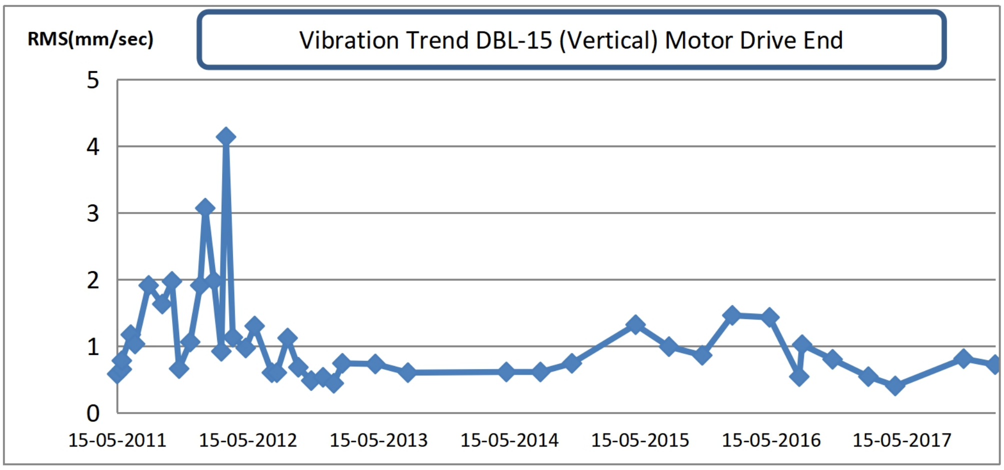


Fig: 3, 29 Vibration Trend of DBL-15 (Vertical) MDE Bearing

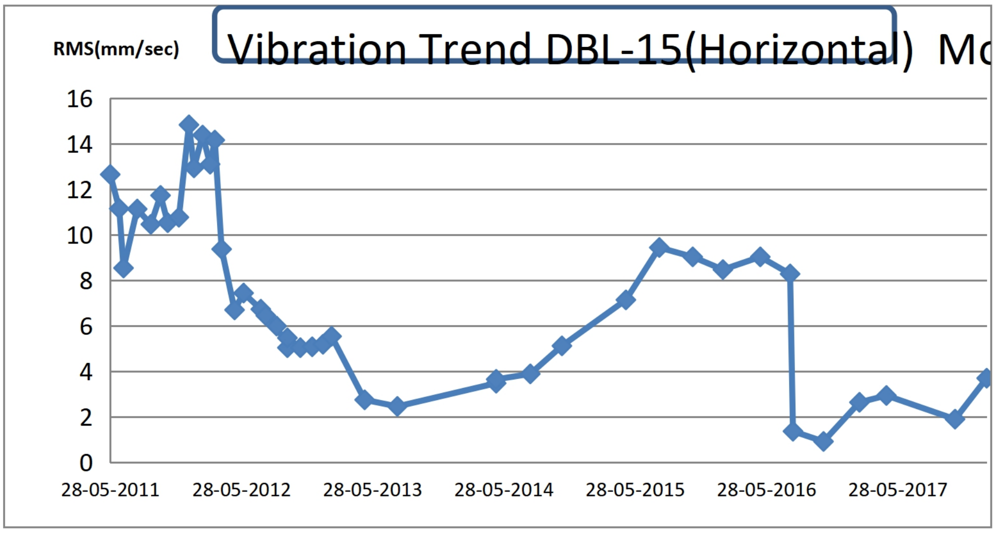


Fig: 3.30 Vibration Trend of DBL-15 (Horizontal) of MDE

3.4.5 Discussion on the DBL-15 Vibration Trend Graphs of Drive and Non-Drive End Bearings.

The study of all the trend graphs (Fig: 3.25-Fig: 3.30) shows that after commissioning the blower vibration in both the bearings and in all the axes continuously fluctuated. Due to high vibration base bolts would get loosened and increase vibration. The spectrum analysis (Fig: 3.31) confirms the findings. Each time after shut down the base bolts had to be retightened to decrease vibration level.

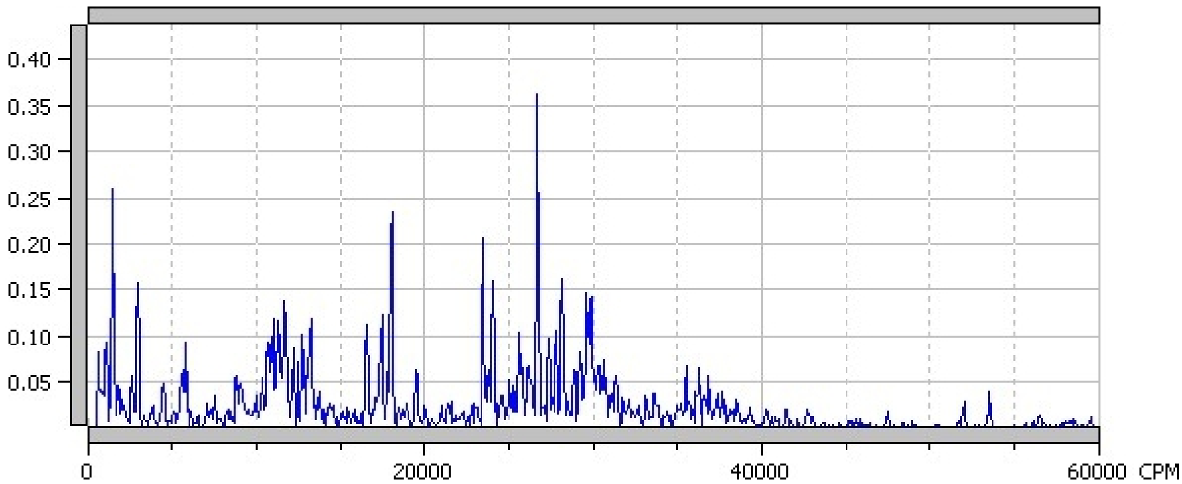


Fig: 3.31Spectrum Analysis of a Measuring Point Indicates Mechanical Looseness

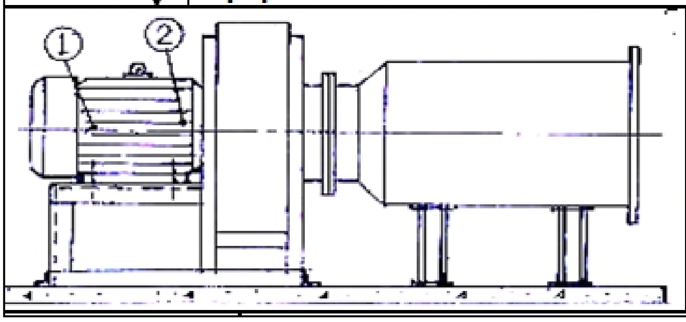
3.4.6 Conclusion

Unlike the previous two case studies (Case Study-1 & Case Study-2) this vibration problem could not be solved by welding stiffeners to make the base frame more rigid. The box structure was unable to absorb the vibration generated by the high speed blower and as a result due to continuous high vibration the base bolts get loosened and needs frequent tightening.

3.5.0 Case Study-4: Furnace Air Combustion Blower No: 1 (DBL-25)

3.5.1 Introduction:

The blower is mounted on a motor and is installed at the furnace as a combustion air blower for supply air to the gas burners which are heating the furnace. The other specification the blower is given in Fig: 3.32



Sketch ↓ Equipment Name: SDP/AF COBM. FAN ZONE -1 NO-1		No	DBL-25
Foundation	Rigid	Drive KW	37
CouplingType	NA	Drive RPM	2930
Belt Tension	NA	Frame Size	NA
No of belts	NA	Make	
Fan blade nos	8	Drive.DE brg	6312
Drive brg lub	EP2	Drive NDE brg	6312
Driven brg lub	EP2	Driven RPM	2930
Class	II	Driven DE brg	NA
Insp Schedule	M	DrivenNDEbrg	NA

Fig: 3.32 Schematic sketch of the blower DBL-25 with other specifications.

The blower is mounted on the motor and both are on a common base supplied by the manufacturer. Like the blowers in the previous case studies this blower and the motor on the common base has been mounted on a in-house fabricated base frame which has been bolted to the bolts grouted in the concrete base as shown in the Fig:3.33

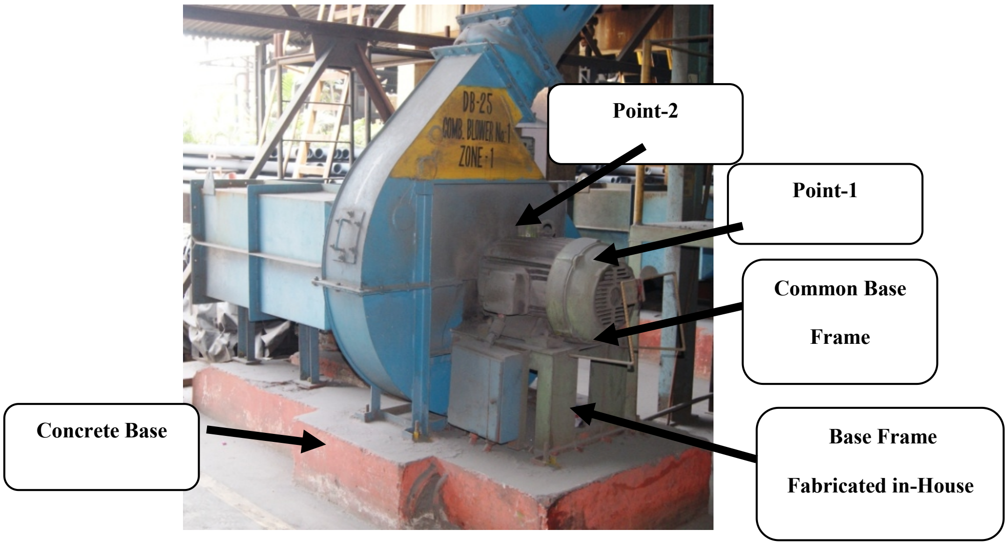


Fig: 3.33 Picture of the Blower Mounted on the Motor.

3.5.2 Problem Identification of the Blower (DBL-25):

The vibration of the motor with the blower was taken on regular basis and the measuring point of the vibration in all the 3 axes were taken at the motor's non-drive end (NDE) bearing location and also at the motor drive end (DE) as shown as point: 1 & point: 2 in the above Fig: 3.33.The details of the data in Appendix C

3.5.3 Vibration Trend at MNDE Bearing Measuring Point-1 for 3 Axes.

Vibration trend of 3 axis MNDE Measuring Point: 1(Fig: 3.33) shown (Fig: 3.34-3.36)

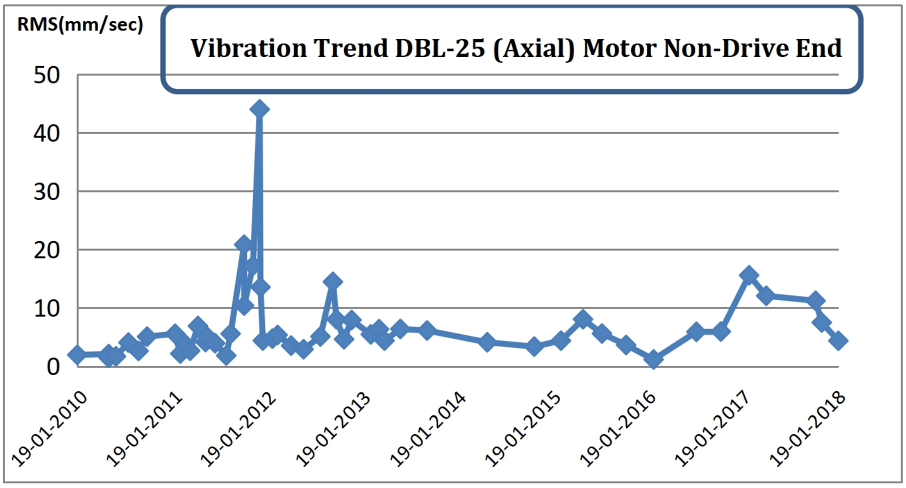


Fig: 3.34 Vibration Trend of DBL-25 (Axial) of MNDE Bearing

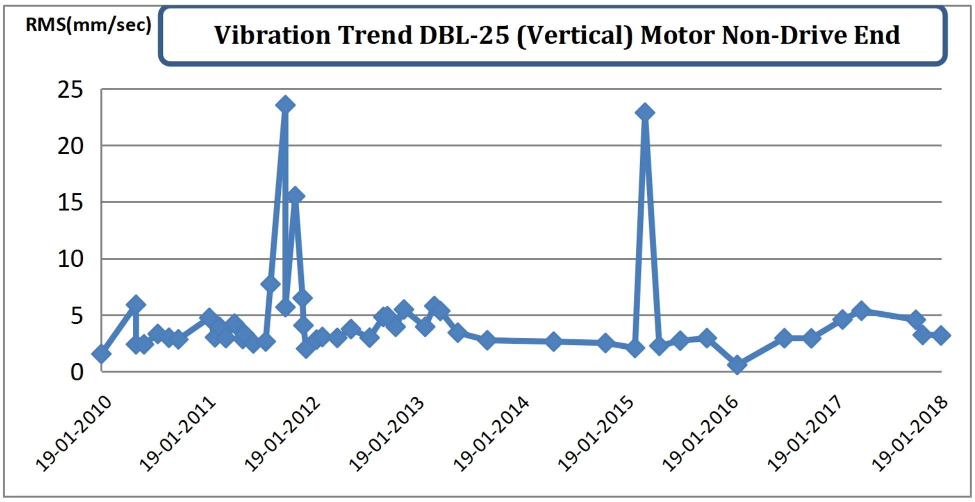


Fig: 3.35 Vibration Trend of DBL-25 (Vertical) of MNDE Bearing

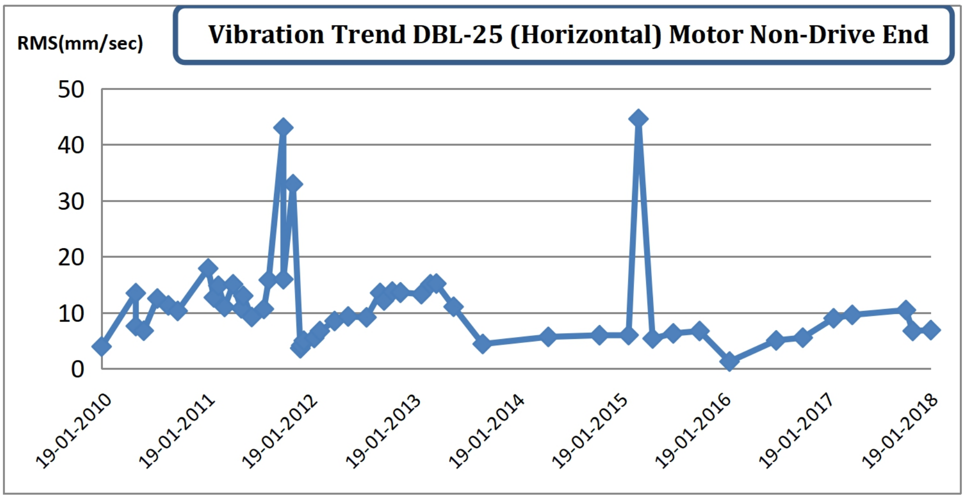


Fig: 3.36 Vibration Trend of DBL-25 (Horizontal) MNDE Bearing

3.5.4 Vibration Trend at Motor Drive End Bearing Measuring Point-2 for 3 Axes

Vibration trend of 3 axes MNDE Measuring Point: 1are shown (Fig: 3.37-3.39)

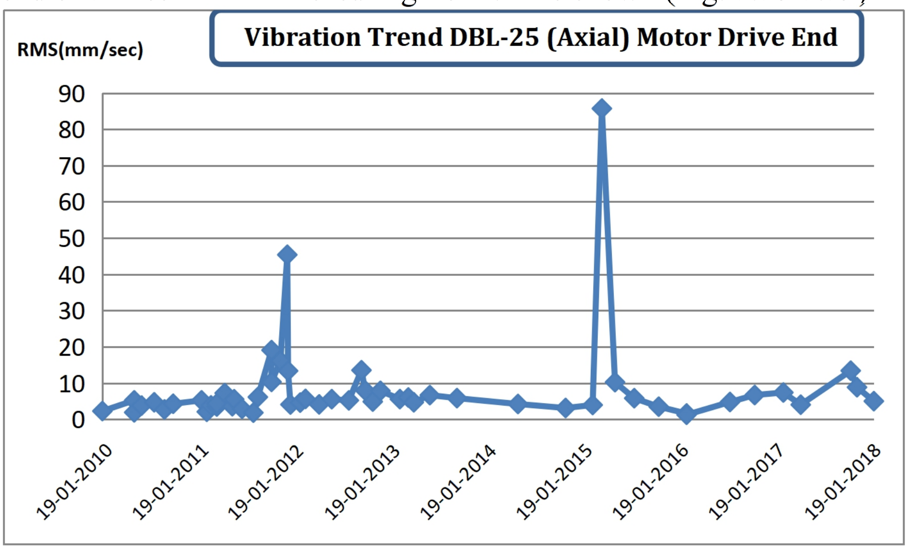


Fig: 3.37 Vibration Trend of DBL-25 (Axial) of Motor Drive End Bearing

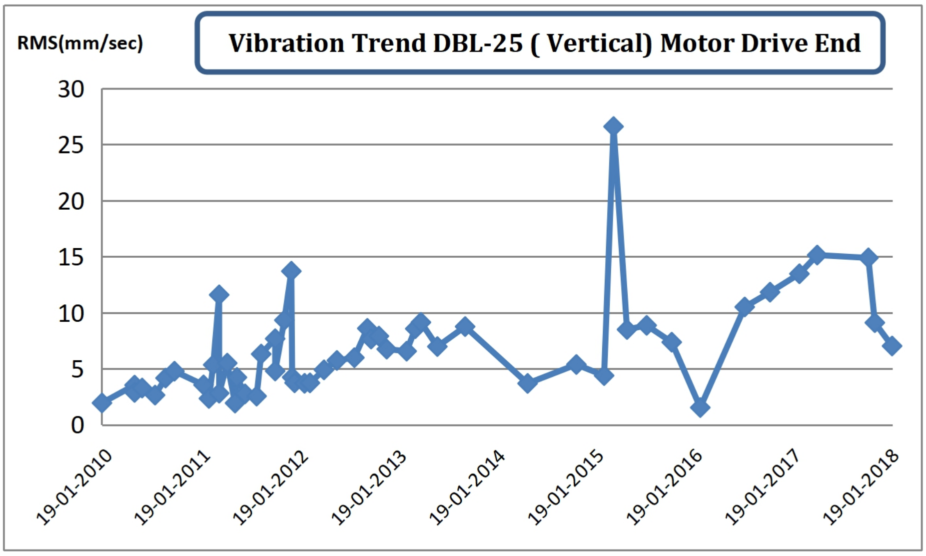


Fig: 3.38Vibration Trend of DBL-25 (Vertical) of Motor Drive End Bearing

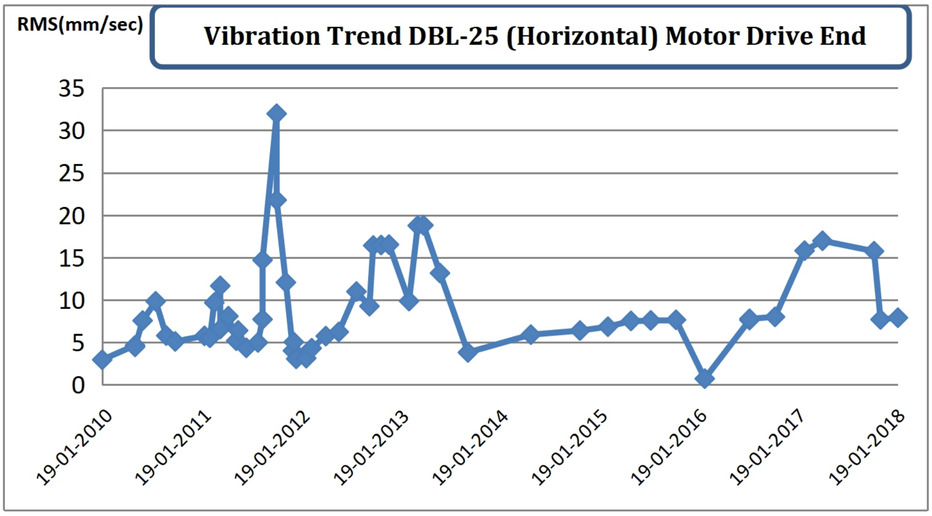


Fig: 3.39 Vibration Trend of DBL-25 (Horizontal) of MDE Bearing

3.5.5 Discussion on the DBL-25 Vibration Trend Graphs of Drive & Non-Drive End Bearings.

The study of all the trend graphs (Fig: 3.34-Fig:3.39) shows that from the period of vibration monitoring the motor vibration in both the bearings and in all the axes was increasing at a gradual trend till it ended in a major failure of the base which had to be repaired. Spectrum analysis during that period shows of structural looseness(Fig:3.40) and to eliminate the same stiffeners were welded on the base frame to increase rigidity (Fig: 3.41) After welding of the stiffeners there was some stability in the vibration trend but after an year of operation there was another failure of the base frame which had to be further repaired and to bring back rigidity additional stiffeners were further welded (Fig: 3.42)

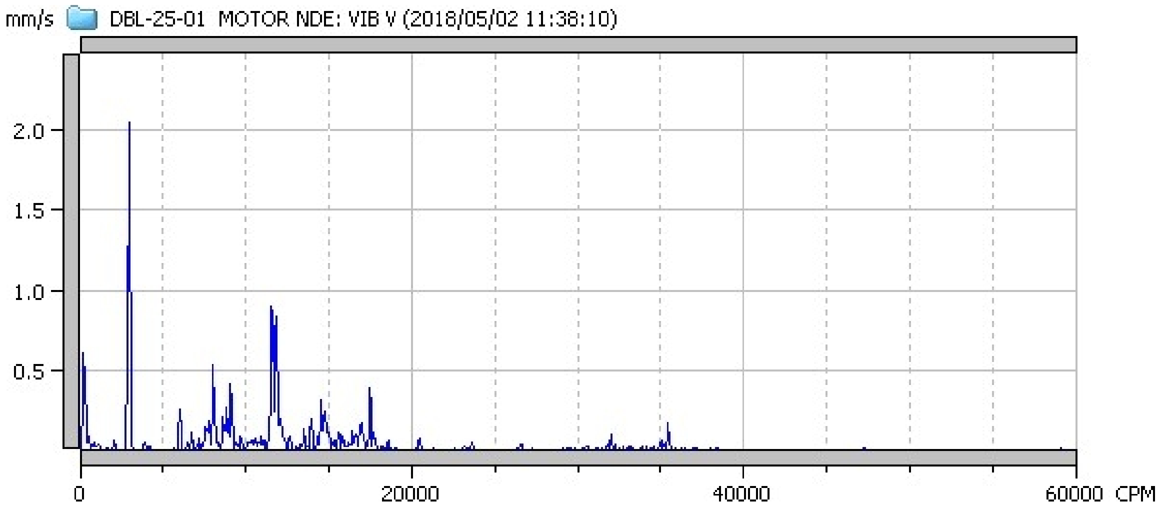


Fig: 3.40 Spectrum Analysis indicates structural looseness.

Fig: 3.41 Stiffeners Welded on Base Frame

Fig: 3.42 Additional Stiffeners Welded on Base Frame

3.5.6 Conclusion

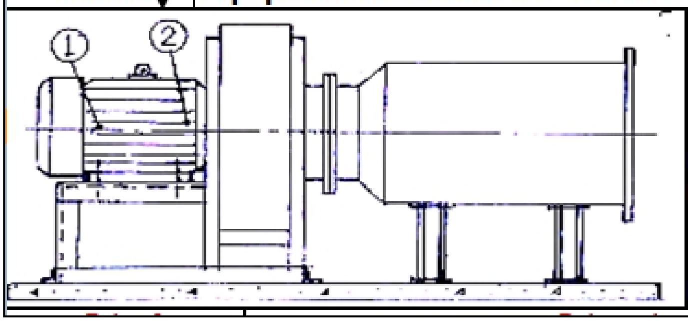
Like the previous two case studies (Case Study-1 & Case Study-2) this vibration problem of structural looseness was observed and as the structure could not be changed the structure had to be made more rigid with welding of stiffeners. Like the other case studies the base frame was fabricated from available material at site and in this case it was unequal angles. The root cause of the failure was weak structure and due to increase of vibration amplitude the base had failed twice in the seven year period and after rectification of the crack in the base stiffeners had to be welded to make the base rigid.

3.6.0 Case Study-5: Furnace Air Combustion Blower No: 2 (DBL-26)

3.6.1 Introduction:

The blower is mounted on a motor and is installed at the furnace as a combustion air blower for supply air to the gas burners which are heating the furnace. The factory code for the blower is DBL-26.There are two such blowers but they operate one at a time and the other is a standby. The operating rpm of the blower is 3000 rpm and driven by a 37 kW motor .The other specification of the blower is given in Fig: 3.43

Sketch ↓ | Equipment Name: SDP/AF COBM. FAN ZONE -1 NO-2 | No | DBL-26



Foundation	Rigid	Drive KW	37
CouplingType	NA	Drive RPM	2930
Belt Tension	NA	Frame Size	NA
No of belts	NA	Make	
Fan blade nos	8	Drive.DE brg	6312
Drive brg lub	EP2	Drive NDE brg	6312
Driven brg lub	EP2	Driven RPM	2930
Class	II	Driven DE brg	NA
Insp Schedule	M	DrivenNDEbrg	NA

Fig: 3.43 Schematic Sketch of the Blower and Specifications

The blower is mounted on the motor and both are on a common base supplied by the manufacturer. Like the blowers in the previous case studies this blower and the motor is mounted on an in-house fabricated base frame which has been bolted to the foundation bolts grouted in the concrete base as shown in the Fig:3.44

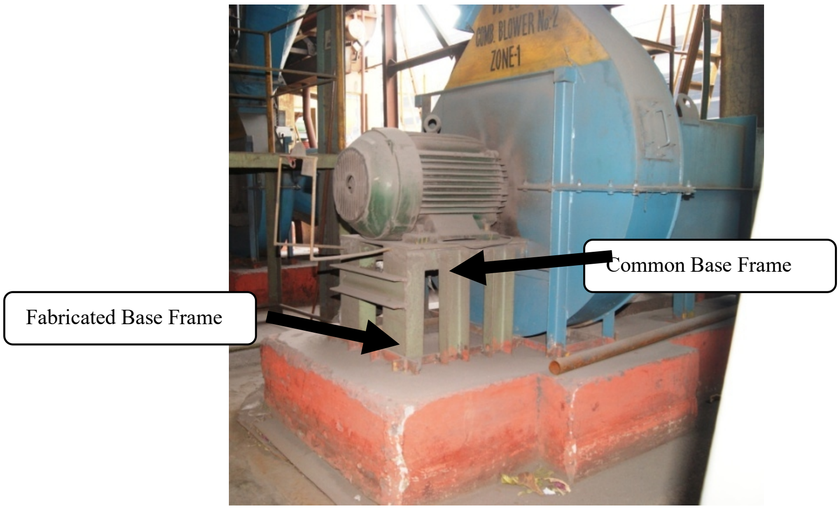


Fig: 3.44 Picture of the Blower (DBL-26) Mounted in the Motor

3.6.2 Problem Identification of the Blower (DBL-26):

The vibration of the motor with the blower was taken on regular basis and the measuring point of the vibration in all the 3 axes were taken at the motor's non-drive end (NDE) bearing location and also at the motor drive end (DE) shown as point: 1 & point: 2 as shown in Fig: 3.43 The vibration trend indicated that the vibration had a trend to increase beyond the accepted level of a 37 kW motor on a flexible structure. The data of the trend graph is provided in (Appendix: A)

3.6.3 Vibration Trend at MNDE End Bearing Measuring Point-1 for 3 Axes.

Vibration trend of all 3 axes of MNDE Measuring Point: 1are shown. (Fig: 3.45-3.47)

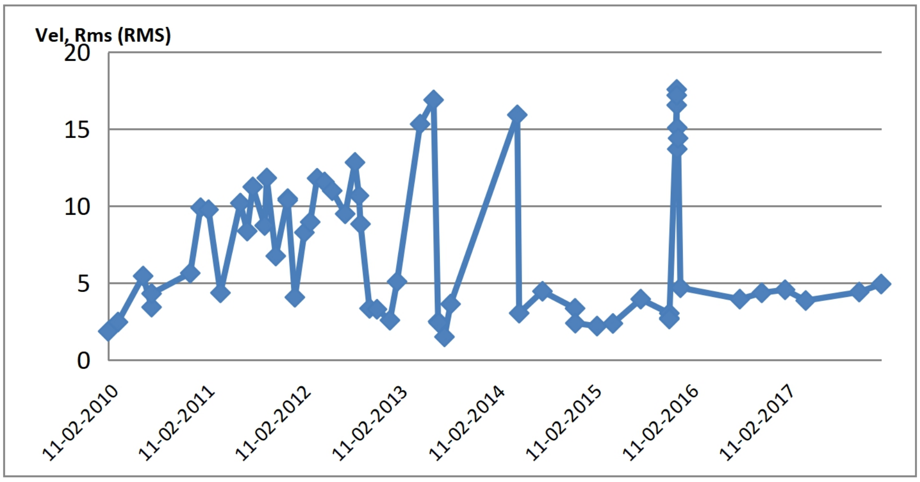


Fig: 3.45 Vibration Trend of DBL-26 (Axial) of MNDE Bearing

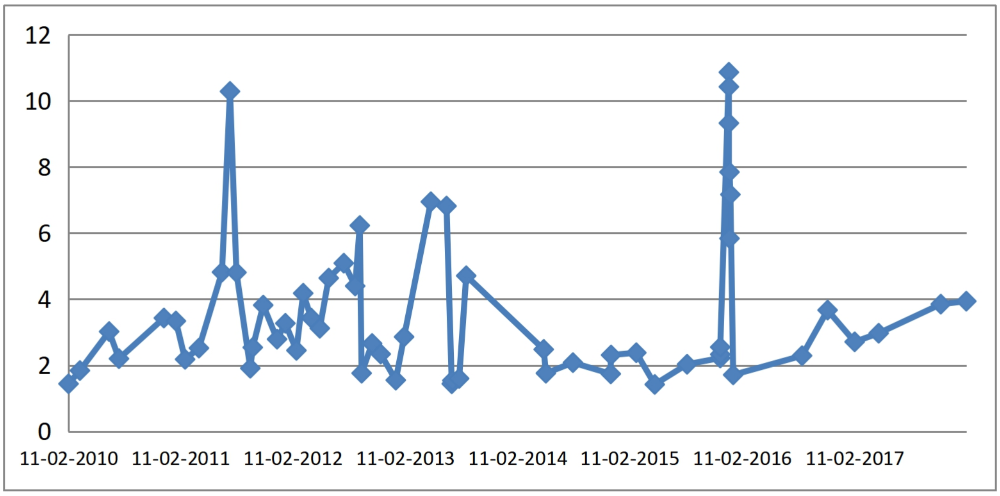


Fig: 3.46Vibration Trend of DBL-26 (Vertical) of MNDE Bearing

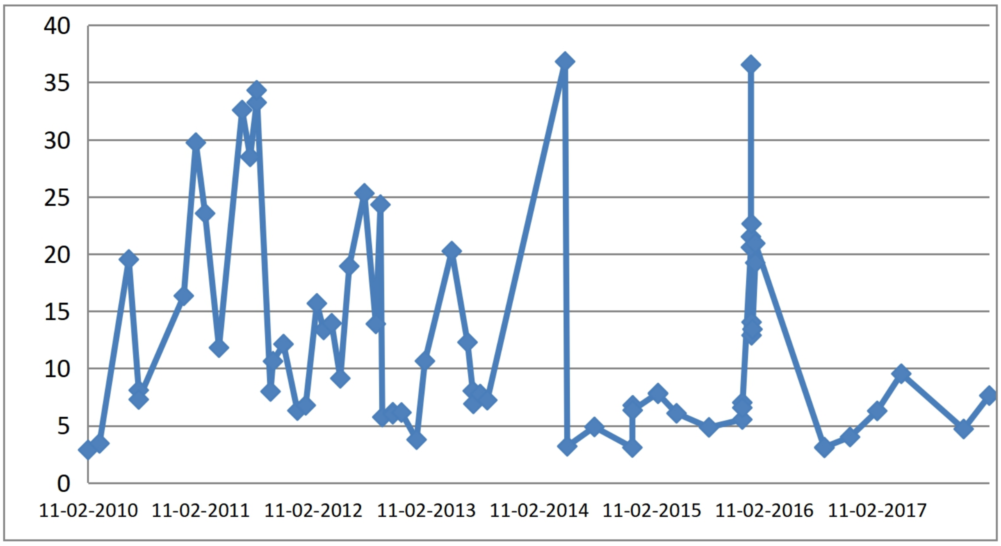


Fig: 3.47 Vibration Trend of DBL-26 (Horizontal) of MNDE Bearing

3.6.4 Vibration Trend at Motor Drive End Bearing Measuring Point-1 for 3 Axes.

Vibration trend of all 3 axes of MNDE Measuring Point: 1are shown. (Fig: 3.48-3.50)

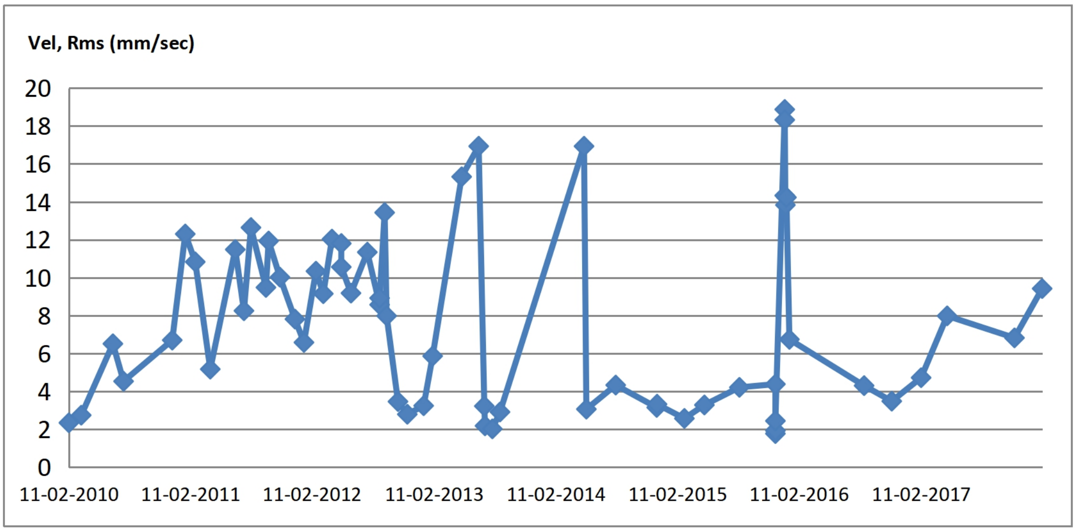


Fig: 3.48 Vibration Trend of DBL-26 (Axial) of MDE Bearing

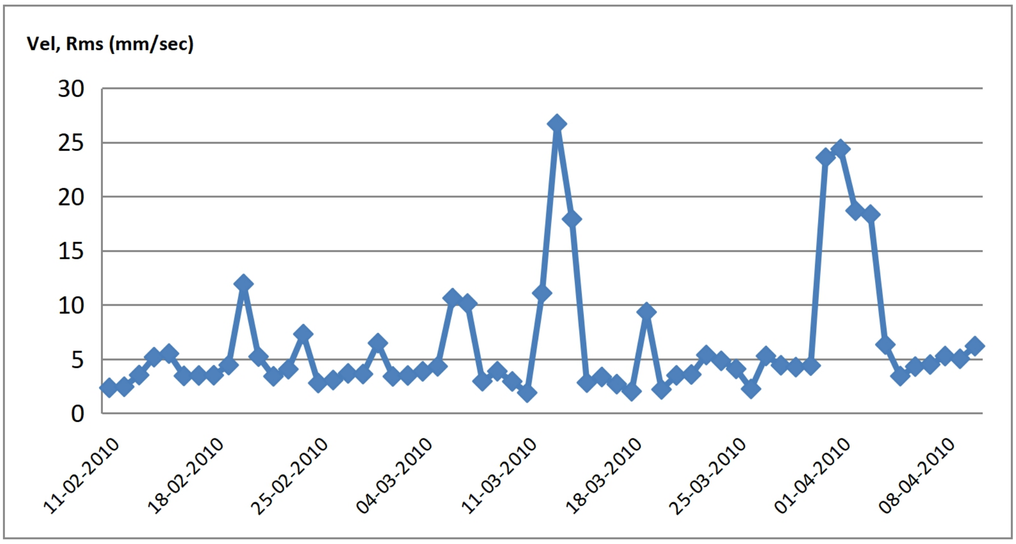


Fig: 3.49 Vibration Trend of DBL-26 (Vertical) of MDE Bearing

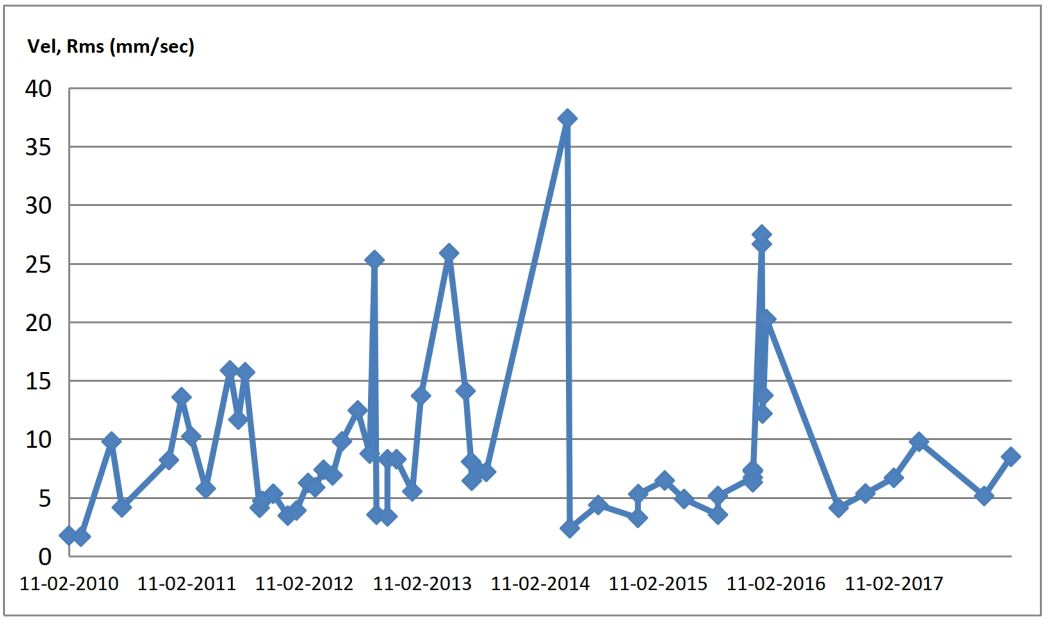


Fig: 3.50Vibration Trend of DBL-26 (Horizontal) of Motor Drive End Bearing

3.6.5 Discussion on DBL-26 Vibration Trend Graphs of DE & NDE Bearings.

In reference to the vibration trend of motor's non-drive end and drive end bearings in all the axes we observe that vibration amplitude was never constant. The spectrum analysis also confirms that vibration was due to the looseness of the structure (Fig: 3.51)

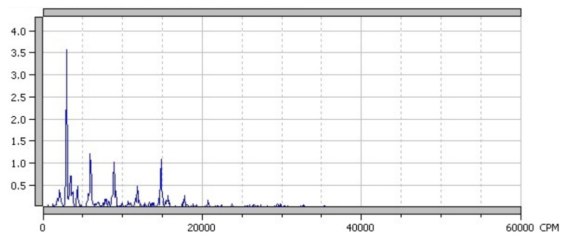


Fig: 3.51 Spectrum analysis shows structural looseness.

To make the structure more rigid stiffeners were welded as shown in the Fig: 3.52

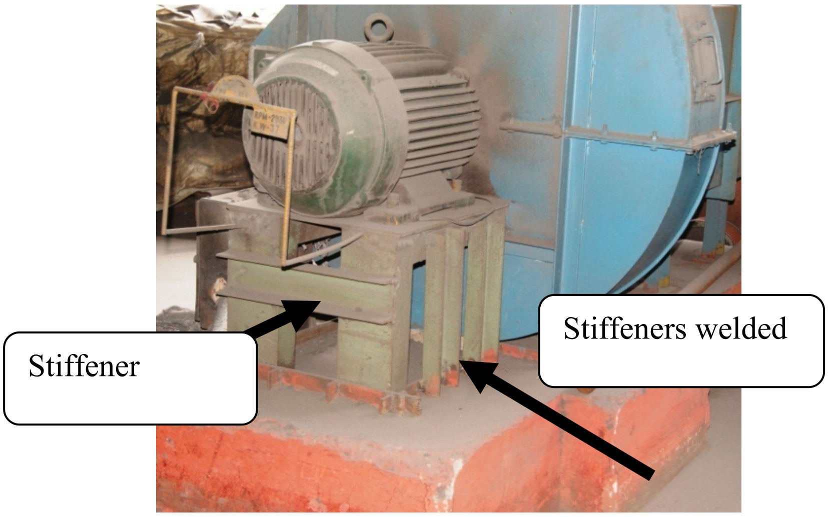


Fig: 3.52: Stiffeners welded on the base frame during the course of time

After welding the stiffeners the blower vibration would reduce for few weeks and the same would increase again as holding bolts would get loose and needed retightening. The blower is still running in this condition as it needs a longer shut down to change the present base to a rigid one.

3.7 Overall Conclusion on the above 5 Case Studies.

As stated earlier that in a normal plant operation we have various types of centrifugal blowers ,large size and smaller sizes and the general observation is that there is lesser vibration problem in the larger size blowers except for 'teething' problem like misalignment, unbalance , looseness etc. and once these problems are identified and corrective actions are taken the performance of the blowers becomes reliable and operates for months on end at constant vibration level until there is some unbalance due to dust deposition on the impeller blades or due to misalignment or when the bearings are changed after routine hours of services.

In case of the smaller size motor mounted blowers, as the 5 case studies show, vibration level is always fluctuating and getting worse with time. Till the base frame cracks and needs urgent repair after stopping the blower. In size these blowers are smaller than other centrifugal blowers but operate in vital areas like as combustion air bowers for the furnace fans and also as induced and forced draft fans in chimneys and boilers. Stoppage or failure of these blowers will bring the whole plant to a grinding halt.

When the root cause for the failure analysis is done based on discussion of the vibration trends & spectrum analysis of all the five case studies three aspects are highlighted and need to be addressed:

1. Manufacturers supply the motor mounted blowers on a common base but they do not provide or recommend any extended base frame structure which may be required to install the blower at the required site.
2. In the absence of designed base frame it becomes the onus of the user department to fabricate a base to support the common base frame of the blower mounted motor and the steel support is fabricated with whatever structural like I beam, channel, angles etc are available at site and more attention is towards positional accuracy rather than rigidity of the base.
3. Normally these blowers operate at 1435-3000 rpm and at this rpm and any residual unbalance of the impeller increases drastically which the in-house fabricated steel base fail to absorb.

To address the above three issues there are two options:

1. Each time a motor mounted blower is installed a machine designer is requisitioned to prepare the specific drawings for each motor mounted

blower that will be installed. This option is though good but not feasible for most of the industries do not have a full design office in their rolls and also if off-loaded to external design agency it becomes uneconomical as the fabricated tonnage on the average is below a tonne of steel materials.

2. The second option to experiment and prepare a broad outline like selection of best structural , stiffeners location etc so that the function department work force skill can be utilised to fabricate a base each time a motor mounted blower is installed so that it becomes reliable in operation and does not call for regular adjustment and maintenance.

The last option gave the thought process to this project work to select the best structural from the available structural for fabricating the bases for these motor mounted blowers and the selection process will be through experimentation, investigation validation of the findings and final application at plant level. If successful at all stages then the process can be standardised for the benefit of the industries.