Preface

In all types of industry , large , medium and also in the smaller units, utility related equipments like pumps, blowers, compressors are quite common and only their sizes and designs vary as per the need and requirement.

Of the above stated utility equipments the blowers & the fans have greater and wider applications not only at furnaces as combustion fans, forced draft (FD) fans or induced draft (ID) fans but also in pollution control units, cooling units and in heating, ventilation and air-conditioning (HVAC) equipments.

In the core sector industries like Steel, Power, Mines and Oil various sizes of fans and blowers are installed and their sizes and types vary as per the specific requirement. In the industry where this research work was carried out there were fans with impeller diameter as large as 3m and driven by 6.6kV-4.5MW motors. Smaller sized blowers whose impeller diameter were less than even 1m were driven by 440V-15kW motors.

Apart from the wide variation in impeller sizes and drives the structures of the blowers and fans are also different. Some are simply supported or of cantilever type and are supported on bearings. There are also blowers where the impellers are directly mounted on the motor shaft and usually they are of smaller ranges in between 9.3kW-37kW with LT motors and rpm varying from 900 to 3000. In the industry these motors on which impellers are directly mounted are known as mono-bloc blowers or fans and are normally used as combustion air fans in furnaces or as blowers for air cooling purposes.

These simply supported and cantilever type blowers or fans are normally of large frame size and driven by HT or LT motors and speed range varying from 450 rpm to 3000 (max) rpm. Most of these fans or blowers are directly coupled with the motor by a suitable coupling and some are also belt driven because of space restrictions. For large motors (1 MW & above) & fans the supported bearings are of journal type with oil-film lubrication and water cooled. Medium size fans or blower are driven by LT motors and the motor and the fan bearings are anti-friction bearings and normally air cooled.

The large blowers which are normally cantilever or simple supported type are mounted on a steel fabricated base which are placed on concrete foundation and rigidly held in position with pre-grouted bolts in the concrete base. These steel structural bases are specifically designed to take the dynamic load of the blowers during operation and also to absorb vibrations of both the blower and the motor units so that the overall vibration of the units are well within the norms as per the vibration standards ISO 10816(3) .These fabricated bases are either supplied by the manufacturer of the blowers or they provide the drawing, based on which the end-users fabricate and mount the blowers. With these designed bases there are seldom any major vibration problem except when due to various other external factors like unbalance of the impellers, misalignment between the motor and the blower or due to looseness of the mountings, the vibration increases. Once these vibration data are collected and analysed by the plant’s condition based engineering department then the root cause for the vibration increase are detected and rectified. For the plant engineers these large size fans and blowers seldom give any major problem and with proper and timely preventive maintenance schedules, these fans and blowers have a high degree of reliability.

In case of the smaller size blowers, especially those whose impellers are directly mounted on the motor, the situations are slightly different. In operating these blowers the problems are many and varied. Many ,because these small size blowers are more in numbers in an industry than the large blowers and varied because these smaller blowers specially the motor mounted ones seldom are installed on a similar designed steel structures on concrete mass base.

As the blowers are small and less expensive, manufacturers only supply the blower mounted on the motor, as per the specification and leave it to the end-user to fabricate the base and construct the foundation. Departments where these blowers are installed, fabricate in-house a steel structure to mount these blowers on the concrete foundation as per site requirement. The focus is more on positional accuracy rather than stability and rigidity. The blowers mounted on these in-house fabricated bases when commissioned usually shows high vibrations and signature analysis mostly indicates weak base and structural looseness. To reduce the vibrations, stiffeners at times are welded to the base and needless to state that the size of the stiffeners and location of the weld are all on the thumb rule basis and more on the experience of the maintenance team. Our experience shows in rare cases the vibration problems were solved by welding stiffeners and the department lives with the problem till a breakdown occurs. After repair and corrective actions, new problems starts and it becomes a vicious cycle. This is what I had experienced in the industry where I was working and this repeated failure of these motor mounted blower bases were the starting point of this investigation work and the basis of this thesis.

In the industry, where this investigation work was carried out, centrifugal ductile iron pipes were manufactured and, there were more than 100 blowers and majority were the simply supported or cantilever type with prime movers ranging from 15kW to 1MW. Some of the blowers were motor mounted and known as mono-bloc type. These mono-bloc blowers were of smaller sizes but all were mounted on bases fabricated in-house as supplying the bases did not fall into the manufacturer’s range of supply. During operation these blowers were unreliable and were always running with abnormally high vibrations and at times the department had no other alternative but to live with the problem hoping it gets resolved in due course of time.

As a head of the condition base monitoring department it became one of my regular activity to rectify and resolve the sudden increase of high vibration in these mono-bloc blowers and in the absence of any drawing or design specification the job became more difficult.

It is not economically viable to have a full project team design a base and foundation for these small blowers operating mostly at furnace roofs or as combustion blowers. There is a need to have a broader guide line for the department maintenance persons in fabricating the base each time such blowers are commissioned after a new purchase or replacement. Abnormal vibrations then are restrained right from the beginning and the mono-bloc blowers becomes reliable equipment like the large sized blowers and not always prone to failures and frequent stoppages.

In this thesis it has been discussed how series of failures of these installed mono-bloc blowers due to weak bases and foundation led to the process of selection of a common structural material for fabricating a base for an experimental mono-bloc blower . After selection of the base structure it was validated with a finite element analysis model and by regression analysis. It was proved that theory developed through the experimental analysis was correct and finally it was applied at a running plant blower successfully.

After the successful trial run in the plant now the channel (ISMC) base structure has been standardised and being used on RCC foundation for all newly installed variable speed motor mounted blowers in the plant for better results.