FANS AT WORK IN BOILERS

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Today many Boiler users are quite knowledgeable, to buy a boiler with high heat transfer surfaces at a competitive price. After installation suddenly they are perplexed why the boiler does not generate the required steam to meet the process demand. Sometimes the problems are related to fan and the draft system design.

Author wishes to share his design and trouble shooting experience for the benefit of boiler users and the boilermakers. In this article the case studies are presented.

CASE 1

The boiler was a 30 TPH bagasse fired one. In this installation two 60 % capacity ID fans were provided. Both ID fans had to be kept in operation to meet the steam demand. The furnace draft was inadequate. There was lot of back firing whenever the boiler load was increased beyond a point. The ID fan inlet ducting arrangement was provided as shown in figure 1. The pressure drops were checked along the Flue gas path and found to be OK as per design.

It was doubted that there could be interrupted gas flow, as the gas had to split into two streams in opposite directions. Hence a partition plate was introduced in the inlet ducting as shown. And it worked. The smooth flow of gas in to the ID fan inlet now ensured the design performance of the ID fans.

CASE 2

The boiler was provided with a high pressure FD fan to meet the combustion air requirement of a 30 TPH FBC boiler. Client reported problem of noise & vibration from the FD fan particularly at partially loaded condition. FAN vendor could not resolve the problem. The sound could be heard at the factory entrance which was nearly half a kilometer away from the boiler house. On a close inspection of the inlet guide vane (IGV), it was observed that the IGV would induce a swirl motion to the entering air in a direction opposite to that of Fan rotation. The linkages were removed and the IGV was totally modified so that the rotation of swirl was in the same direction to that of FAN. Incidentally the Fan vendor had tried just reversing the IGV. This would not change the swirl direction.

The problem was solved after the turbulence created by the IGV was removed. See figure 2.

CASE 3

The boiler was provided with a fluidized bed combustor. The capacity of the boiler was 6 tph. The FD fan was not developing the required head. The bed could not be fluidized under cold condition.

Client had planned for replacement of FD fan. Yet it was felt that the problem could be related to obstruction at Fan mouth. The FD fan was provided with a circular damper as shown in figure 3. The fan was too small to provide an Inlet guide vane. The FD fan inlet damper was too close to the Fan inlet. As such the FD fan entry velocities are kept as high as 25 m/s by fan vendors. It is very necessary to have a proper inlet system, which would ensure a free uninterrupted flow to the eye on the impeller.

A small length of duct was provided in between the Damper and the Fan. The fan served its purpose. It is necessary to check the velocity at the inlet flange of fan and provide necessary transition to reduce the velocity and thus the damper draft loss.

CASE 4

In this case the fan assembled by the vendor was wrong there was no overlapping of the Inlet mouthpiece in to the Impeller. This overlapping is very important to realize the design performance of the Fan. Recirculation of air / gas is reduced by the overlap. The overlap was provided and the fan proved its capacity.

CASE 5

It was a case again related to improper assembly. There was excess overlapping and the impeller had been placed much forward than what was designed. Some manufacturers do specify the back plate to impeller clearance. Since this was a shop-assembled fan from vendor, this information was not available. Once the impeller was pulled out, keeping a minimum overlapping between impeller and inlet mouth, the problem got solved. In narrow width impellers this would be a common problem. When the mouthpiece is projected too much inside, the full impeller width is not utilized and hence both volume handled and head developed will be low.

CASE 6

There were 5 x 35 TPH boilers with this client. The client had complained that the boiler performance was OK for the four years. Later on the boiler never generated rated steam capacity. The entire flue path was checked for any air ingress. The leakages were arrested. Yet there was a shortfall in capacity. The ID fan was opened and inspected. It was found that the portion of inlet mouthpiece was cut and removed. On inquiry with maintenance staff, it was learnt that this had to be done for replacement of ID fan impellers in all five boilers.

It was true that the ducting system did not have any provision for removal arrangement of the impeller. The suction ducting should have been provided with a spool piece or an expansion joint, to facilitate easy replacement of the impeller.

CASE 7

Once a client owning a rice mill called up for solving his chimney vibration problem. Not only that. The residents around the plant could not use their phone, as there was noise interference. People who have the habit of sleeping on floor complained that they hear humming noise.

The problem boiled down to fan design. There is a minimum clearance to be maintained between the casing and the impeller at the cut off. When this is less, the fan develops high frequency air pulsation equal to no of blades multiplied by fan rpm. This high frequency noise had lead to chimney vibration. The clearance at cut off was reduced and this solved not only the chimney vibration but also the nuisance to the surrounding residents. See figure 5.

CASE 8

A common ducting arrangement followed by the boilermakers is shown in figure 6. In one case, the ID fan was mounted on concrete slab of the first floor. The ducting arrangement was as shown in figure 6. The Client experienced vibration of the floor slab. He had procured a new ID fan from different manufacturer to solve the problem. The vibration continued. Client always blamed the vibration due to improper balancing. The ID fan was brought to ground and run without any connected ducting on suction side. Of course on the discharge side a damper was put to avoid overloading of the motor. The fan ran smooth. Client realized that the circular damper and the bend ducting in front of the fan were the causes. The bend & damper had prevented the smooth flow of gas in to the impeller eye. A suction box design was adopted as shown in figure 7, to remove the vibration.

CONCLUSION

The fan performance is linked to ducting system associated with it, both at suction side and discharge side. Improper ducting leads to poor performance of fan. Before we blame it on the boiler / combustor, a closer examination of ducting system is required.

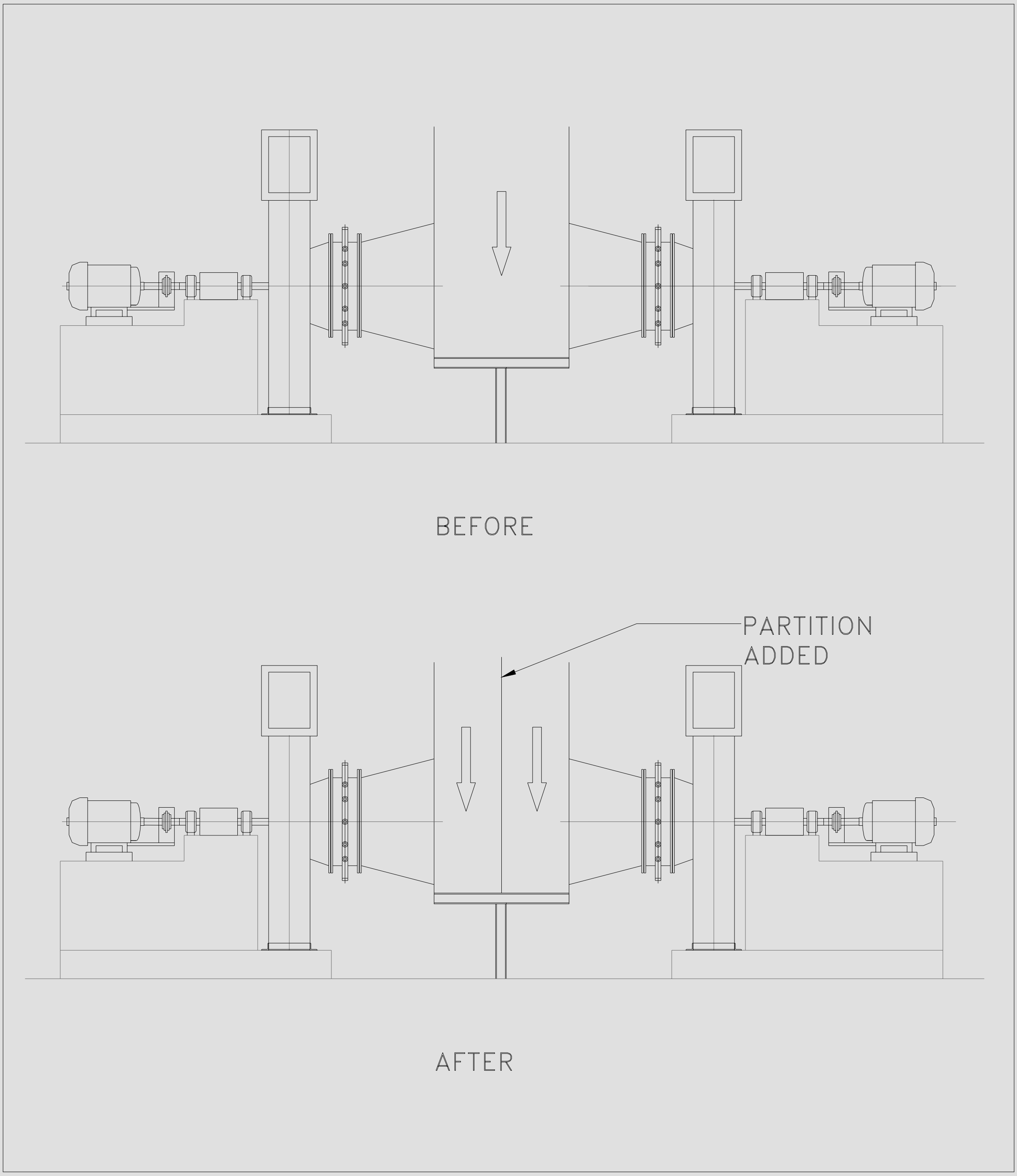

FIGURE 1

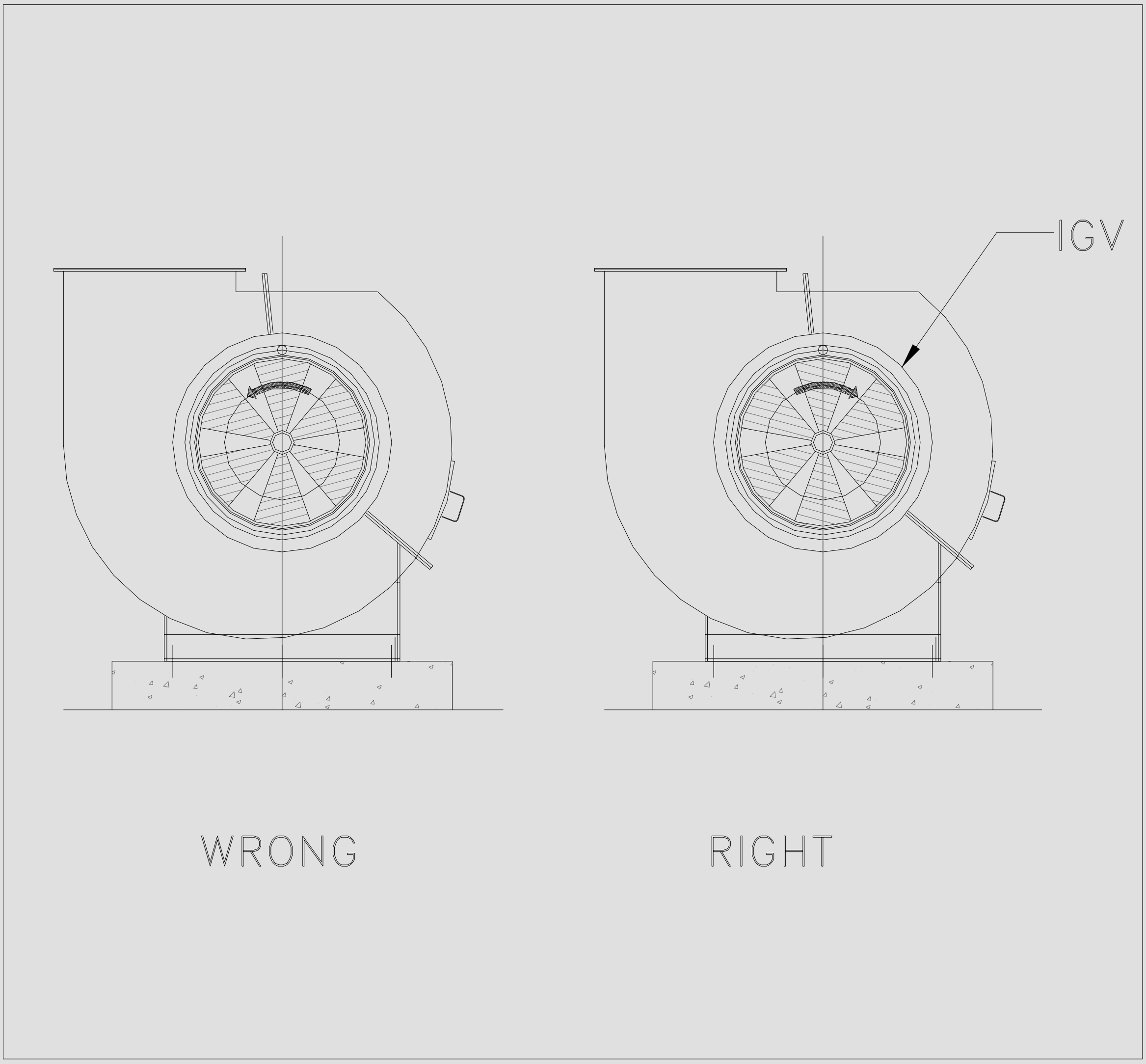

FIGURE 2

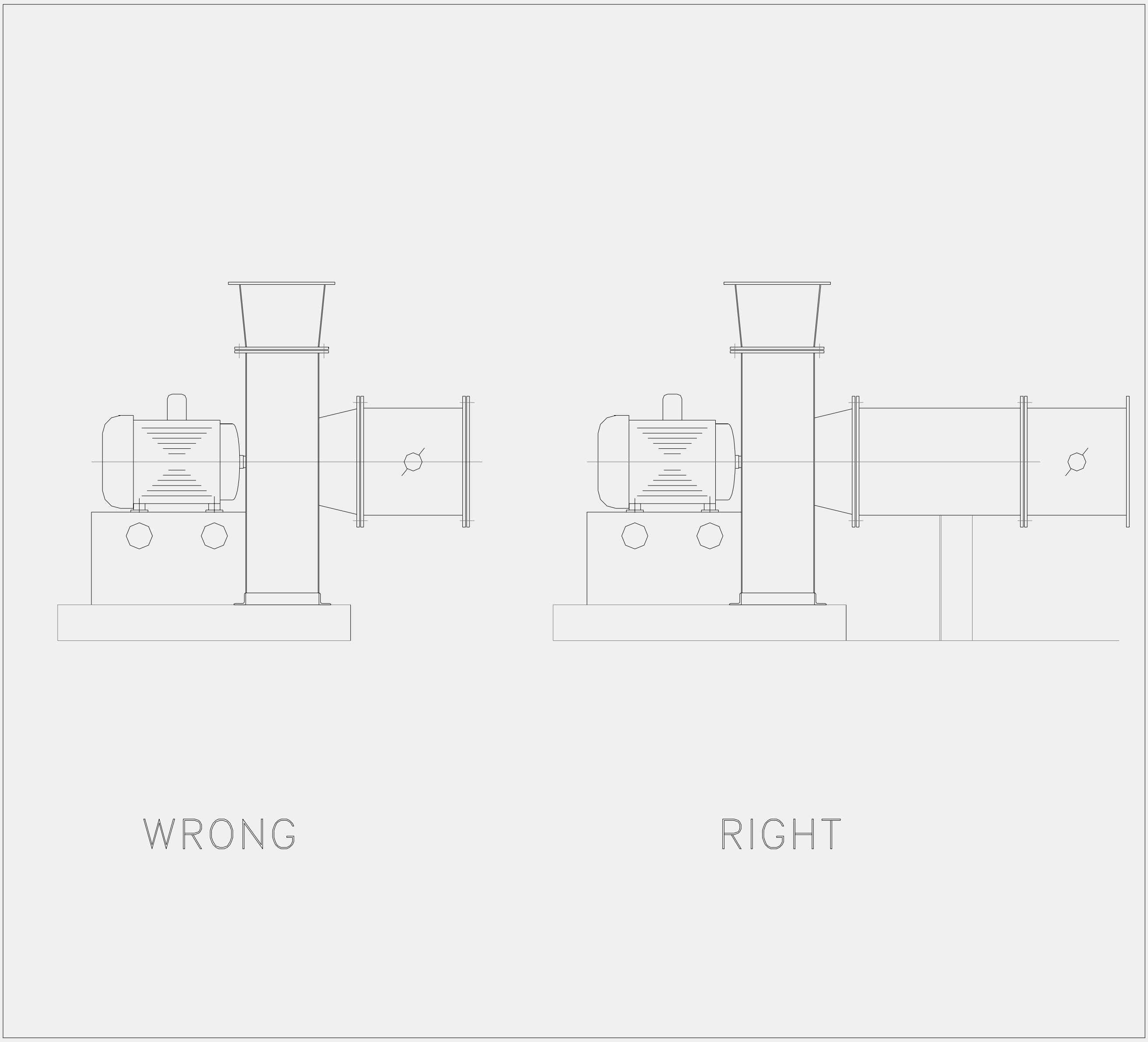

FIGURE 3

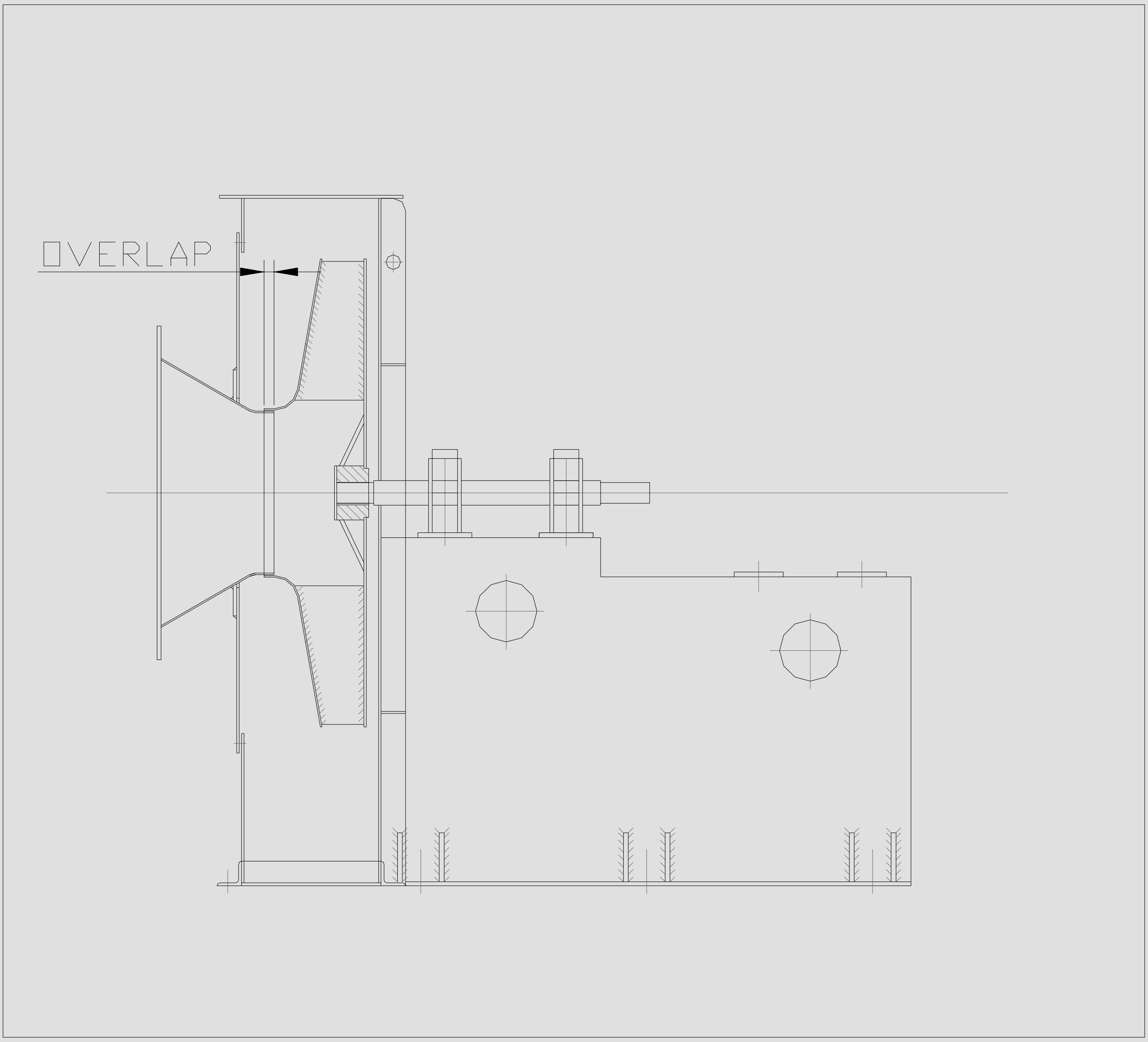

FIGURE 4

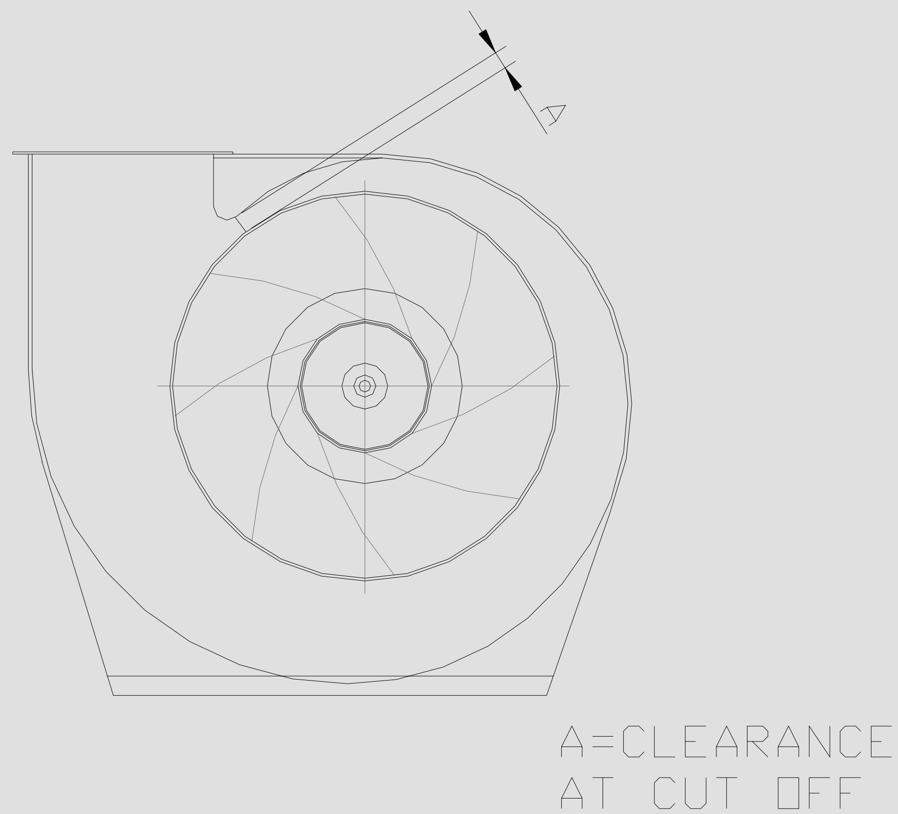

FIGURE 5

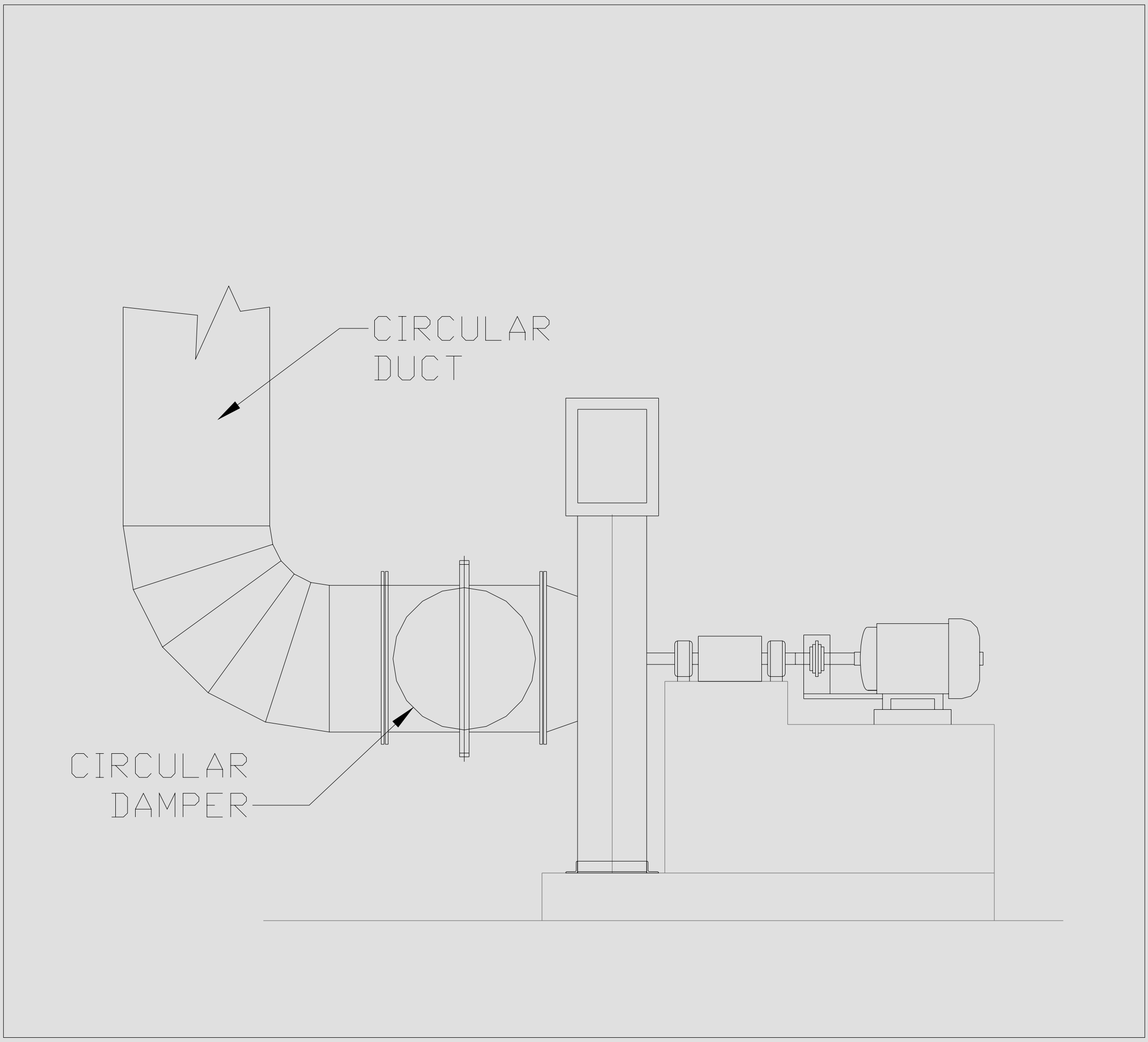

FIGURE 6

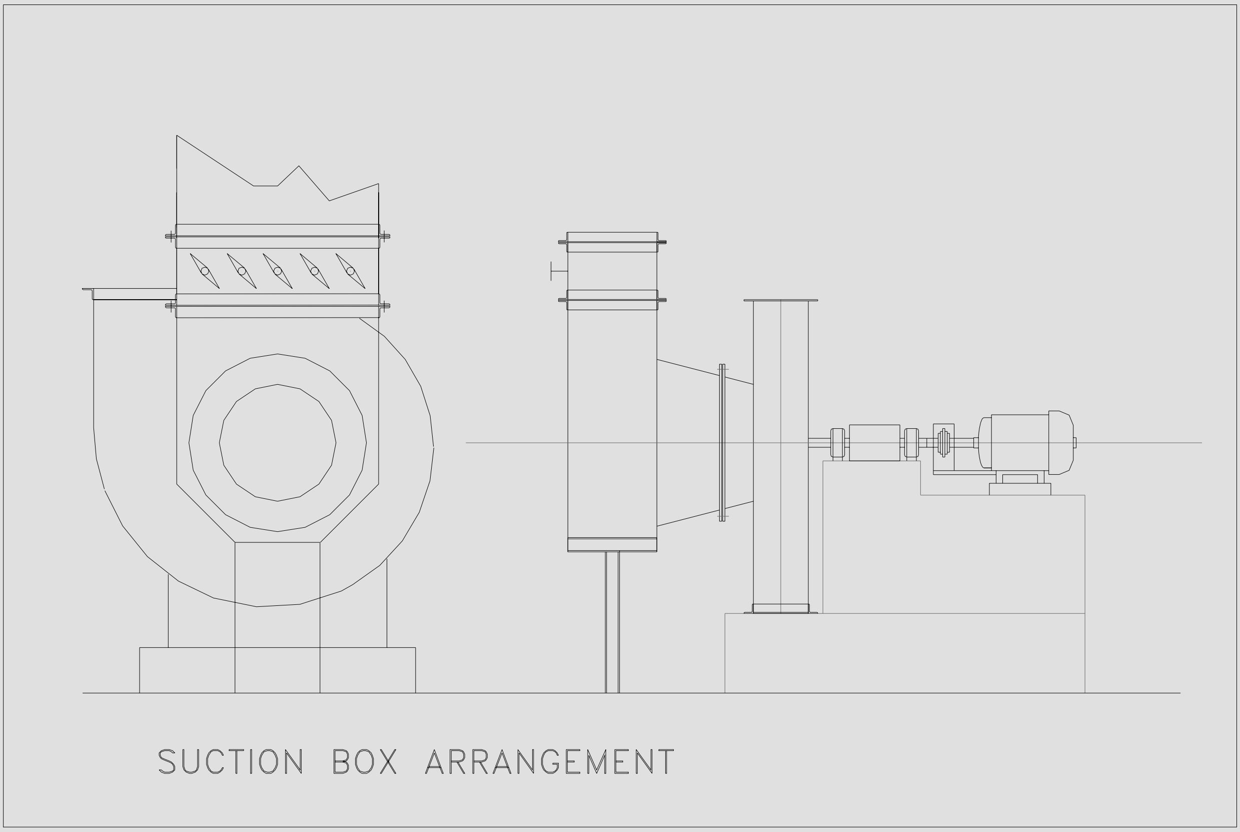

FIGURE 7

Photo 1: One more installation with flap damper right at the fan inlet.