International Journal of Research in Engineering, Science and Management
Volume-1, Issue-10, October-2018
www.ijresm.com | ISSN (Online): 2581-5782

Turbo Air Ventilator Used in Natural Ventilation

Mansi Joshi[1], Suhas Choudhari[2], Aradhana Maheshwari[3]
[1,3]*Student, Department of Architecture, SDPS Women's College, Indore, India*
[2]*Assistant Professor, Department of Architecture, SDPS Women's College, Indore, India*

***Abstract*—Natural ventilation has gained greatness in current period of time as a special method of ventilating buildings. The two elementary principles of natural ventilation are stack effect and wind driven ventilation. This paper reviews variegated wind driven techniques. The paper has a main center of attention on turbo ventilator. The roof top turbo ventilator is now extensively accepted for industrial ventilation as it works efficiently at low wind speed hence always functional and it relies on varied functioning parameters and environmental conditions, therefore study about turbo ventilator in detail has become the basis of research. The practical study has been done according to wind calculations by calculating the area and providing turbo ventilator.**

***Index Terms*—Natural ventilation, Turbo air ventilator, weather conditions, Performance**

I. Introduction

Ventilation is exchange of atmosphere from a close surrounding to outside. It is a mandatory thumb rule to cross change air from an interior with exterior so as to maintain healthy air composition, concentration and a room should be devoid of contaminated air. Ventilation follow concentration gradient and ensure supply of air from outside to inside. A safe and extensive ventilation for indoor is must to keep the building as well as life free from pollution and its devasting effects.
It has three basic components:

- Ventilation rate: It is the total amount of atmospheric air and its quality.
- Airflow gradient: Direction of building from safe clean zone to polluted zone.
- Air distribution or airflow patter: nDesign should be such so as to ensure adequate amount of air in each space and internally generated filth to be expelled out through the same inflowing air.

A. What is Natural Ventilation

Natural forces like wind pressure and stack effects are used in natural ventilation to support and straighten the flow of air through buildings. A rise is given to positive pressure on the windward side when wind incident on a building face and will cause comparable negative pressure on the leeward side. Due to this pressure variance the air flow will drive into the inner surface of the building. Two factors are relatively bases on wind driven ventilation. Mean operating pressure at the opening is the first parameter and second is the wind driven ventilation, thus swinging pressure can cause unsteady flows around an openings.

Clerestories which is often used in architecture as an extra natural ventilation system. Above eye level clerestories have high walls and have windows on upper most side. This replicated feature in factory and building complexes aids as warm air travels from lower position to higher one and exits through the high windows whereas cooler fresh air enters through lower windows or vents. From ancient Roman times, courtyard design has been broadly used as a way to naturally ventilate buildings.

B. Different Types of Natural ventilation

It is extremely significant to find alternative efficient system as the energy utilization for ventilation is high.

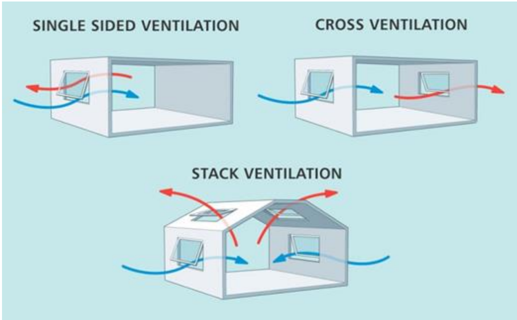

Fig. 1. Types of ventilation

C. Different Types of Techniques Used in Natural Ventilation

- *Passive ventilation technique*

This is the elementary method of ventilation with dissimilar types of roof vents without any parts which are in motion. Static vent, domer vent, gable vent, ridge vent, etc are miscellaneous types of openings which are commercially available. Stack effect occurs due to this ventilation.

- Active ventilation technique

Fan driven exhaust systems are used in active ventilation technique. Working of this system is based on natural ventilation. Active ventilation techniques include turbo ventilators.

D. Turbo Air Ventilator

The turbo ventilator is an option to motor driven ventilating system. For industrial ventilation the rooftop turbo ventilator is broadly accepted as well as becomes significant ventilation feature which is used for ventilation of commercial, residential and many industrial buildings. The working is very efficient even at very low wind speed, thus always functional.

Turbo ventilator dependent on its different parameters and environmental conditions. It also comprises of vertical blades (curved or straight) in a frame that is spherically mounted. The top and bottom most bearings are supported by the shaft which is at the center. For the protection rain proof dome is provided. As the air movement strikes the blade resultant of which the turbine rotates due to the dragged forces. The negative pressure which is generated due to the rotation at the center of the turbine ventilator extracts hot air, which enters the turbine axially through the base duct and then pushed out radially. Turbo ventilator does not depend on the wind movement rather works due to the stack effect.

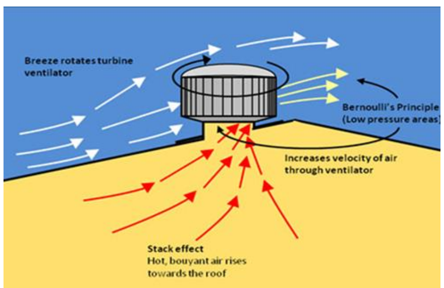

Fig. 2. Turbo air ventilator

1) Materials

- Aluminium body, polycarbonate for chemical industry.
- FRP fixture (fiber reinforced plastic)

TABLE I
SPECIFICATIONS

SPECIFICATION	
SIZE (THROAT DIA)	24 inches
BODY DIA	30 inches
NO. OF BLADES	39 inches
EXHAUST CAPACITY	184,000 cfh (cubic feet per hour)
VANES (BLADES)	Anodized Alu 100/1000 0.4mm thickness (0.8mm on outer side)
SHAFT	Zinc coated steel
TUBE	Zinc coated steel
SUPPORT	Galvanized
RIVETS	5/32inches x 3/8 inches made of aluminium
TOP COVER (OUTER)	Galvanized 0.50mm thickness
ROTATION TECHNOLOGY	Bearing free hardened steel shaft with rotation on single point steady and consistent RPM even after significant passage of time unlike ventilators using ball bearings

Fig. 3. Specifications of turbo air ventilator

E. Wind Roof Turbo Ventilator

- Works on self-lubricating polymer device with steel shaft.
- High grade anodized aluminium is used in the manufacturing of blades which is crimped on outer surface for protection and durability.
- Silent operation
- Rain proof, special concealed protection inside the top plate.
- Works well in oily and dust environment.
- No maintenance is required in wind roof turbo ventilator.
- 5 years warranty.

II. CASE STUDIES

On the basis of Natural Ventilation 2 desktop studies and one live case study is done:

A. Torrent Research Center Ahmedabad

Torrent Research Pharma is a role model work designed by Ar. Nimish Patel and Ar. Parul Zaveri located in Ahemedabad, Gujrat covering a space of about 19700sqm with innovative technological solutions.

Fig. 4. Torrent research center

B. Design Features

- Design stretches the use of locally available natural materials and avoids the use of synthetic materials.
- RCC-framed structure with brick in-filled walls, with glossy enamel paint on cement plaster on the internal surface.
- Vermiculite, a natural mineral, is extensively used for the insulation in roof and cavity walls to attain the required R-

values, along with cement-brickbat-based waterproofing.

- PDEC (passive downdraft evaporative cooling) system was created and adopted for space conditioning of the building.
- Unconventional use of half round ceramic pipes, on the outer face of the inlet and exhaust shafts of the PDEC system, to minimize the entry of larger dust particles by crating local turbulence.

C. *Sangath: An Architect's Studio, Ahemedabad*

Sangath is a role model work designed by Ar. Balkrishna Doshi located on Ahemedabad Gujrat covering a space of about 2346sqm with passive solararchitectural technicalities.

Highlights:

- Underground construction methodology
- Thermostatic wall management
- Adequate surface ratio by vaulted roof; air flow through convection.
- Temperature and humidity maintained by local vegetation and water bodies.

Fig. 5. Exterior view of Sangath

D. *Live Case Study of Industry for Turbo Ventilator*

Location- Mandideep, total area 396.8sqm, owner jhalani engineering. In this industry wind turbines were arranged according to machines so that the heat which is evolved is suck out by wind turbines to maintain the inner temperature .There were total 5 turbo ventilators. Each ventilator is arranged at 500 sq. foot.

There was a pitched roof in which at center height was 22 ft. and in the ends it was 18 ft. There were total 15 machines, the area was open from front, and at sides the shelters were arranged in the manner such that the air can circulate in the whole area for proper ventilation.

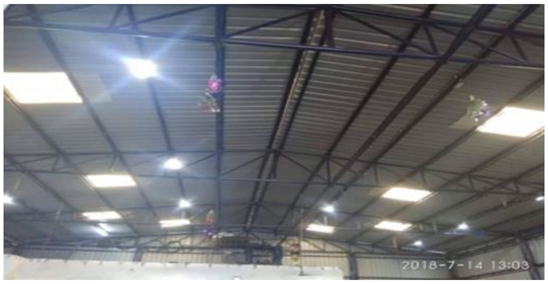

Fig. 6. Roof shed having no. of ventilators

Fig. 7. Turbo ventilator with transparent shed for light ventilation

Fig. 8. Alternative shed arranged for cross ventilation

Fig. 9. Exterior view

III. CALCULATIONS

The aim of my study is to calculate and provide no of ventilator for natural ventilation in context of Indore, M.P.

Turbo air ventilator working depends upon temperature, average wind speed, humidity. Now to determine no. of ventilators, we need to calculate volume of space to be ventilated,

L=100ft, W=50ft, H=20ft
Volume=100000 (3ft)

With reference to Table-2 air change rate per hour for light industrial area is 12 times per hour, therefore ventilation rate Q(cfm) is

Q(cfm)= Voume(ft3) x air change rate per hour/60
Q(cfm)=100000 x 12/60
Q(cfm)=20,000cfm

International Journal of Research in Engineering, Science and Management
Volume-1, Issue-10, October-2018
www.ijresm.com | ISSN (Online): 2581-5782

TABLE II
A RECOMMENDED AIR CHANGE RATES

Type of building	Air change Per hour	Type of building	Air change Per hour
Assembly Hall	6-12	Factories(heavy)	10-30
Auditorium	4-12	Laundry	12-30
Bakeries	12-20	Paper Mill	8-30
Boiler Room	15-60	Textile Mills	4-12
Brewery	8-30	Packing Room	8-30
Class Room	10-15	Transformer Room	12-30
Engine room	12-30	Paint Shops	10-30
Factories(light)	6-12	Ware House	4-6

TABLE III
PERFORMANCE DATA

Seasons			SUMMER (Avg)			WINTER (Avg)			RAINY (Avg)		
Months			March	April	May	Dec	Jan	Feb	July	Aug	Sep
Wind speed (avg) m/s for Indore., M.P.			4	7	5	2	4	4	5	6	7
Temperature Difference(degree celcius)			6	2	1	3	4	1	5	8	10
Model No	Throat No	Stack Height ft	Exhaust Capacity in cfm								
Wind-e	22 inches	10	939	1000	1102	1436	1498	1600	1792	1854	1958
		20	1005	1084	1216	1503	1582	1714	1859	1938	2070
		30	1058	1154	1314	1556	1652	1812	1915	2010	2168
		40	1107	1216	1398	1605	1714	1896	1961	2070	2252

Now with reference to Table-3, select suitable data for wind-e 22 inches type of turbo air ventilator having stack height 20ft.

For summer

- If wind velocity= 4m/s and average temperature difference is 6 degree Celsius than

Exhaust capacity=1005cfm
No. of turbo air ventilator = 20,000/1005
= 20

- If wind velocity= 7mps and average temperature difference is 2 degree Celsius than

Exhaust capacity=1084cfm
No. of turbo air ventilator= 20,000/1084
= 18

- If wind velocity= 5m/s and average temperature difference is 1 degree Celsius than

Exhaust capacity=1216cfm
No. of turbo air ventilator= 20,000/1216
= 16

So average no of turbo air ventilator for summer =20

For winter

- If wind velocity= 2m/s and average temperature difference is 3 degree Celsius than

Exhaust capacity=1503cfm
No. of turbo air ventilator= 20,000/1503
= 13

- If wind velocity= 4m/s and average temperature difference is 4 degree Celsius than

Exhaust capacity=1582cfm
No. of turbo air ventilator= 20,000/1582
= 13

- If wind velocity= 4m/s and average temperature difference is 1 degree Celsius than

Exhaust capacity=1714cfm
No. of turbo air ventilator= 20,000/1714
= 12

So average no of turbo air ventilator for summer =13

For Rainy

- If wind velocity= 5m/s and average temperature difference is 5 degree Celsius than

Exhaust capacity=1859cfm
No. of turbo air ventilator= 20,000/1859
= 11

- If wind velocity= 6m/s and average temperature difference is 8 degree Celsius than

Exhaust capacity=1938cfm
No. of turbo air ventilator= 20,000/1938
= 10

- If wind velocity= 7m/s and average temperature difference is 10 degree Celsius than

Exhaust capacity=2070cfm
No. of turbo air ventilator= 20,000/2070
= 10

So average no of turbo air ventilator for summer =11

Now from above calculation conclusion is that average total no of turbo air ventilator = 20

IV. CONCLUSION

Various wind techniques have been reviewed but main area of research is done on the turbo air ventilator. It was found that minimum work has been carried on various operating parameters like diameter at throat, blade design, blade width, diameter of turbo ventilator, blade angle. Turbo air ventilator is dependent on wind velocity, temperature and humidity.

From above Calculations, the conclusion is that total 20 no. of ventilators will be used for natural ventilation and these calculations are not applicable for heat evolving equipment used in the industry.

References

[1] Naghman Khan, Yuehong Su, Saffa B. Riffat, A review on wind driven techniques.
[2] D Harun, Zulfadhli, H Akhyar Department of mechanical enginnering, SyiahbKuala University.
[3] Ganesh K. Jadhav Dr. D. Y. Patil Institute of Enginering and Tech. Pimpri, pune, Mr Sharad Garg Sigma Contours, Pune.
[4] www.freexhaust.com About turbo air ventilator, specifications, details
[5] ISHRAE 427540 WMO Station Number Weather Data summary Indore, Madhya pradesh
[6] ISRHRAE 426670 WMO Station Number
[7] Weather Data summary Bhopal, Madhya Pradesh