

Outbreak Conditions of Downdraft

*Kana Fukunaga¹

1. Yokohama Science Frontier High School

What is Downdraft

Smoke discharged from the chimney will get caught in the vortex behind the building and descend near the chimney. And high concentrations of pollutants will accumulate leading to environmental pollution. In order to prevent the occurrence of downdraft that adversely affects the environment, Attention was paid to the vortex generated behind the causal building and investigates the occurrence conditions of downdraft.

Experimental method

Place the styrofoam which was considered as a building in the visualization wind tunnel device. And Change the position of the building to 4 places every 4 cm and the position of the propeller to 3 places every 2 cm. Then Measure the size of the visualized vortex. Also Measurement is made five times per condition.

[Measuring method]

Measure these with vortices seen

- (1) Distance to building
- (2) Distance to descent [fig.1]

[Experiment 1 Change the shape of the building's roof]

- (1) Square [fig.2]
- (2) Isosceles triangle [fig.3]
- (3) right triangle [fig.4]
- (4) Circular shape [fig.5]

[Experiment 2 Collapse the position of the incense stick]

Based on the results of Experiment 1, experiments are conducted by narrowing the installation position of the incense stick under the condition that vortices are generated.

- (1) Lower than the roof [fig.6] (2) Higher than the roof [fig.7]

Experimental result

[Experiment 1 Change the shape of the building's roof]

- (1) Square [table1]

- 1. The shorter the propeller distance is, the easier it is to lower
- 2. The shorter the building's distance is, the easier it is to pass near the building
- 3. Distance from building and drop point are not relevant

(2)Isosceles triangle[table2]

4. It is easy to descend
5. The value of the descent point is smaller than the experiment result of (1)

(3)right triangle[table3]

6. The longer the building's distance is, the easier it is for the distance to the building to be smaller
7. Descent is occurring but the value of the distance to the building is large
8. Something descending along the slope was seen

(4)Circular shape[table4]

9. There was hardly any descent
10. Short distance from building

[Experiment 2 Collapse the position of the incense stick]

- (1)When installed in a position higher than the roof, it increased in all the experiments.
- (2)When installed in a position lower than the roof Descent was observed in all experiments.

Consideration

Squares, isosceles triangles and other corner roofs have similar vortex readiness. So the shape of the roof is heavily involved in the generation of vortices. And a roof with no corners is suitable to prevent the occurrence of downdraft.

The larger the wind power is, the easier the vortex is generated on the roof with corners. Also there is no relationship between the height of the building and the value of the descent point.

Since the value of the descent point of the right triangle is large, it is suitable for the downdraft measures among (1) to (3). On the contrary, since the value of the descent point of the isosceles triangle is small, it is not suitable for measures. For this reason, the upward slope extends the descent point and the downward slope makes the descent point closer.

From the experiment [2], air passing through the lower part than the roof is likely to be involved in the swirl.

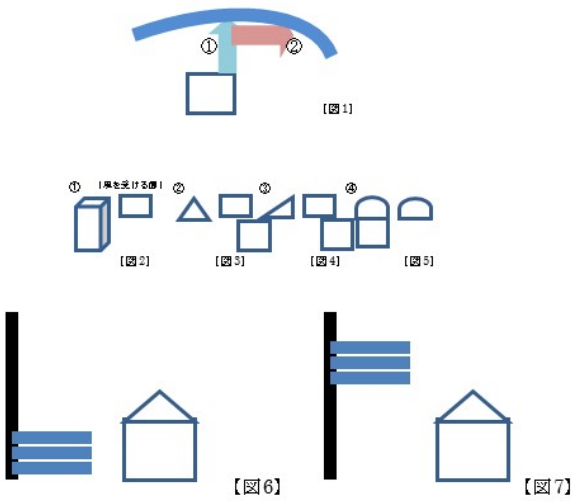
From the above, the conditions for downdraft occurrence and conditions for promoting damage is

1. Having a corner on the roof part of the building
2. Having a downward slope in the roof part
3. Large wind power

References

www.eic.or.jp/ecoterm/?act=view&serial=1665
www.mirai-kougaku.jp/laboratory/pages/130109.php

Keywords: Downdraft



【表1】

建物との距離(cm) / 降下点(cm)		建物の距離(cm)			
		0	4	8	12
プロペラの距離 (cm)	0	1.3 / 1.8	1.2 / 1.0	1.1 / 0	1.1 / 0
	2	1.1 / -or 1.5	1.3 / -	1.8 / -	1.7 / -
	4	1.9 / -or 1.6	2.8 / -	天井/天井	天井/天井

〈-:降下なし 天井:天井にあたった〉

【表2】

建物との距離(cm) / 降下点(cm)		建物の距離(cm)			
		0	4	8	12
プロペラの距離 (cm)	0	1.2 / 1.8	1.5 / 1.0	1.3 / 0.8	0.8 / 0
	2	1.6 / -or 1.0	2.5 / -or 天井	1.0 / 0	0.9 / 2.2
	4	1.3 / -or 天井	2.3or 天井/天井	2.3 / -	天井/天井

【表3】

建物との距離(cm) / 降下点(cm)		建物の距離(cm)			
		0	4	8	12
プロペラの距離 (cm)	0	1.3 / 5.7	0.6 / 4.8	1.0 / 4.8	0.7 / 1.9
	2	1.2 / -or 8.0	1.4 / -or 天井	1.0 / 0	0.9 / 2.2
	4	1.3 / -or 天井	2.3or 天井 / 天井	2.3 / -	天井/天井

【表4】

建物との距離(cm) / 降下点(cm)		建物の距離(cm)			
		0	4	8	12
プロペラの距離 (cm)	0	0.2 / -or 0.5	0.2 / -	0.2 / -	1.0 / -
	2	0.2 / -	0.2 / -	8.3 / 天井	天井/天井
	4	0.2 / -	0.8 / 天井	天井/天井	天井/天井