# 探討

# 風機與節能的相關議題

報告人：吳夢龍　　日期：24.11.2016

台灣科祿格通風設備股份有限公司

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# 介紹大綱

- 適當風機設計
- 正確與錯誤安裝實例
- 推薦風管系統的設計
- Q & A

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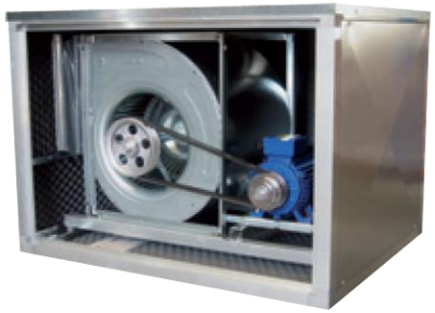

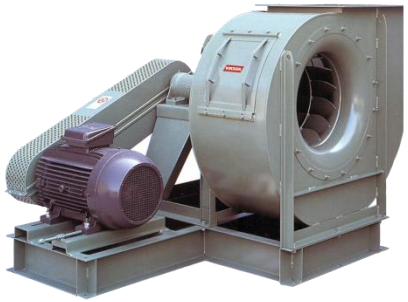

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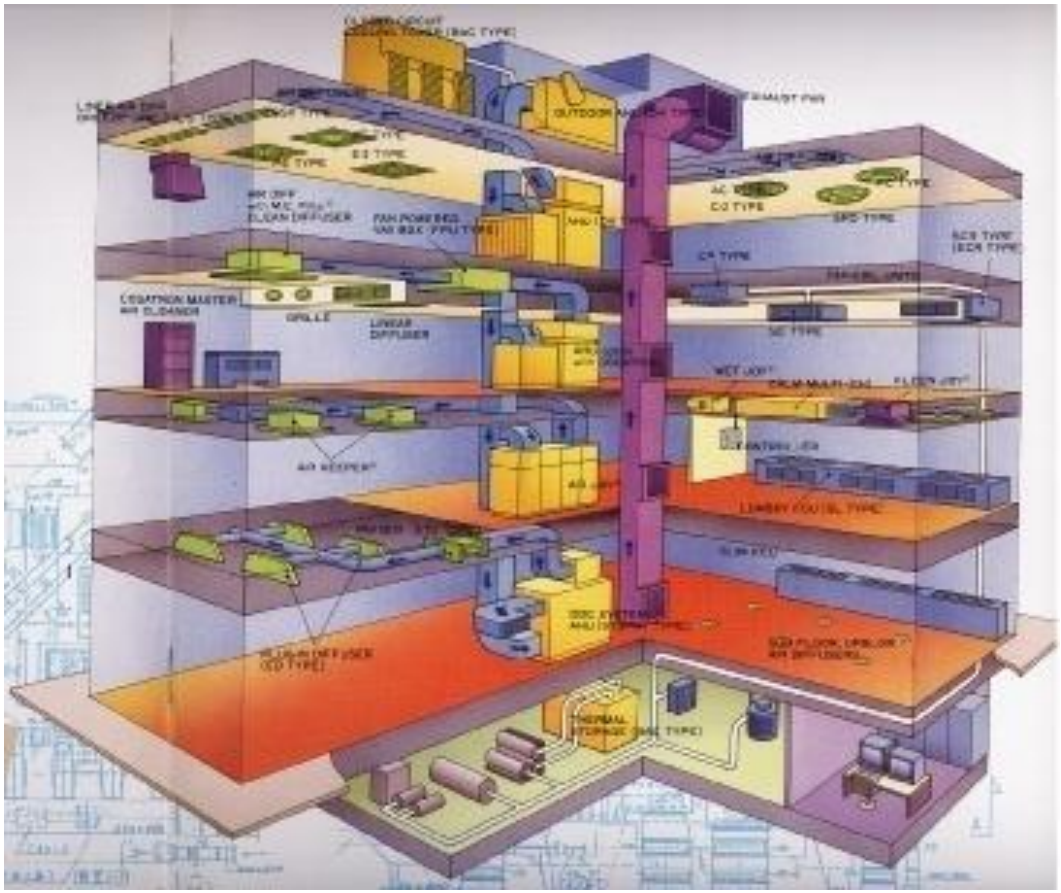
# 風機在建築物中的應用



1. 空調系統

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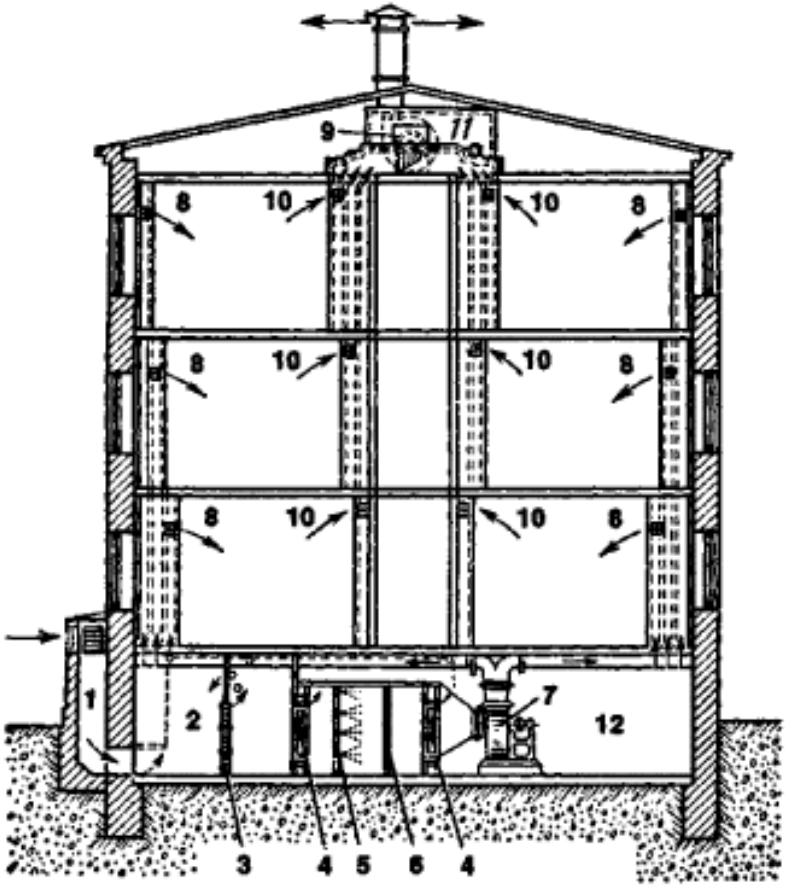
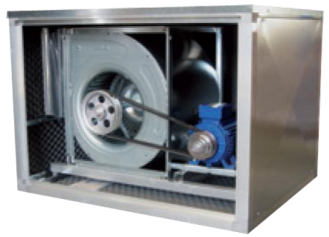
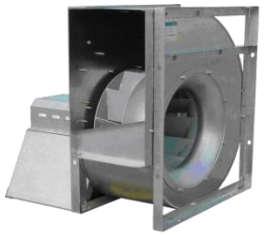
# 風機在建築物中的應用





2 通風系統

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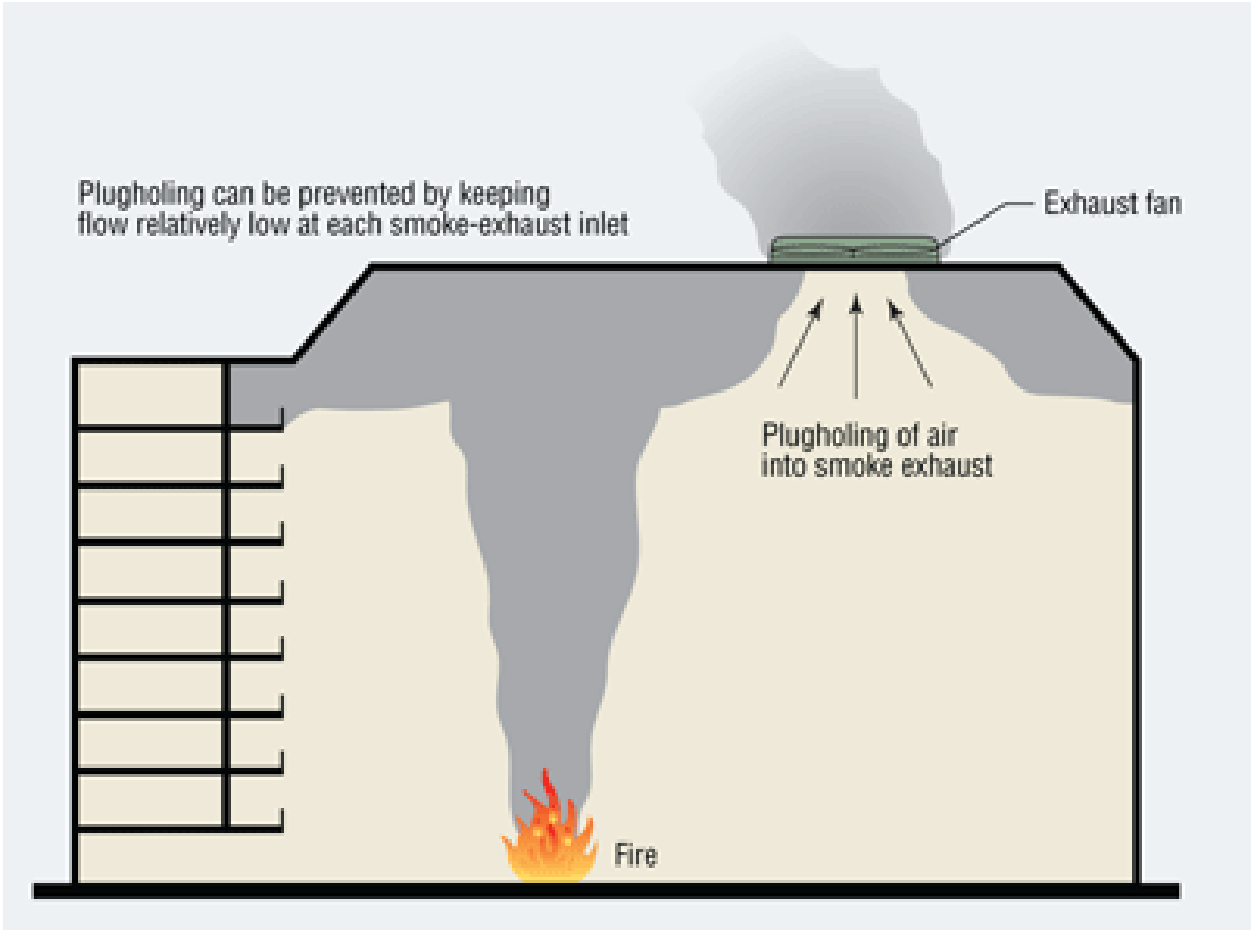
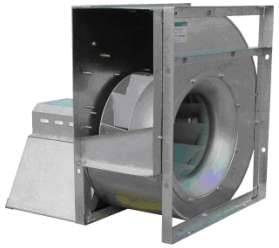
# 風機在建築物中的應用



3 消防排煙系統

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# 通風的節能, 如何做？

A. 空調通風系統設計

B. 風機的選用

C. 風管的施工

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# A. 空調通風系統設計

## 1. 以適度的安全係數來估算風量與靜壓

發電機排風量爲 1450CMM，靜壓爲 35 mmAq，馬力爲 30HP
依照圖檔得知發電機安置於 B4 樓層
假設 1 樓層高度爲 3 M，B1~ 1F = 5層，風管長度爲 3M×5層=15M

壓力損失計算
1.風管長度損失：15M × 0.08 mmAq = 1.2 mmAq
2.彎型管損失： 1只 × 0.7 mmmAq = 0.7 mmAq
3.彎管損失： 2只 × 1 mmmAq = 2 mmAq
4.消音箱損失： 1只 × 1 mmmAq = 1 mmAq
5.百葉損失： = 10.0 mmAq
6.其他損失：(1＋2＋3＋4＋5)**×10%** = 1.49 mmAq
合計損失：(1＋2＋3＋4＋5+6) = 16.39 mmAq

**35mmAq** ＞ 16.39 mmAq

馬力計算式：
Q = 1450 CMM = 24.17 CMS
Ps = **35** mmAq = 350 Pa
kW = **1.2** ( Q × Ps) / (**Eff** ×1000)
= **1.2** ( 24.17×**350**)/(**0.5** ×1000)
= 20.3
HP = 20.3 / 0.75 = 27.06 → **30 HP**

馬力計算式：
Q = 1450 CMM = 24.17 CMS
Ps = **20** mmAq = 200 Pa
kW = **1.2** ( Q × Ps) / (**Eff** ×1000)
= **1.2** ( 24.17×**200**)/(**0.5** ×1000)
= 11.6
HP = 11.6 / 0.75 = 15.46 → **20 HP**

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# A. 空調通風系統設計

## 2. 盡可能的將設計的系統靜壓, 降至最低


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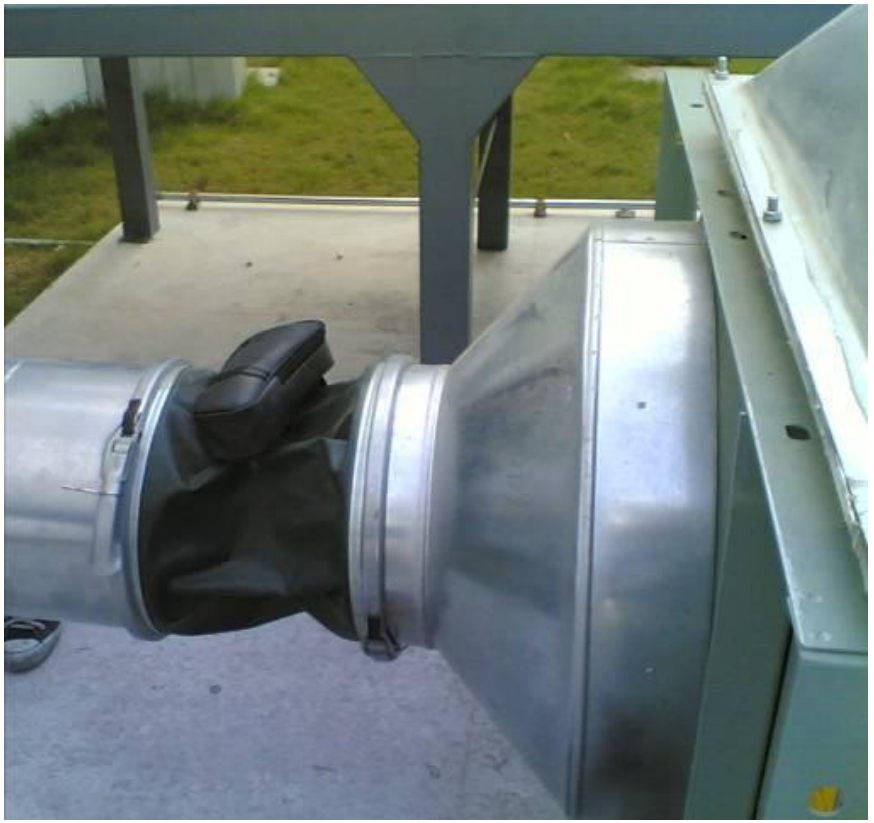
# A. 空調通風系統設計

## 3. 應避免急擴或急縮的風管變徑設計



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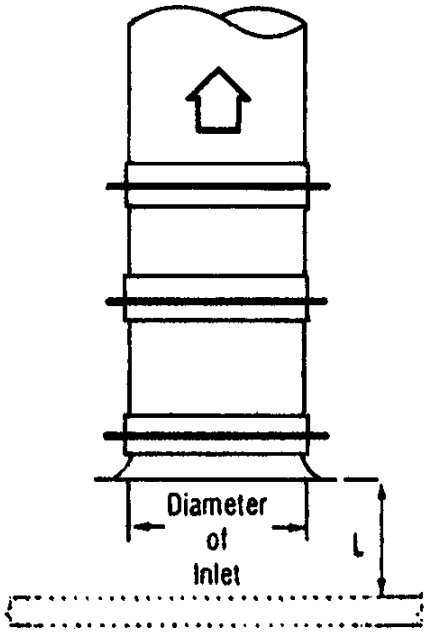
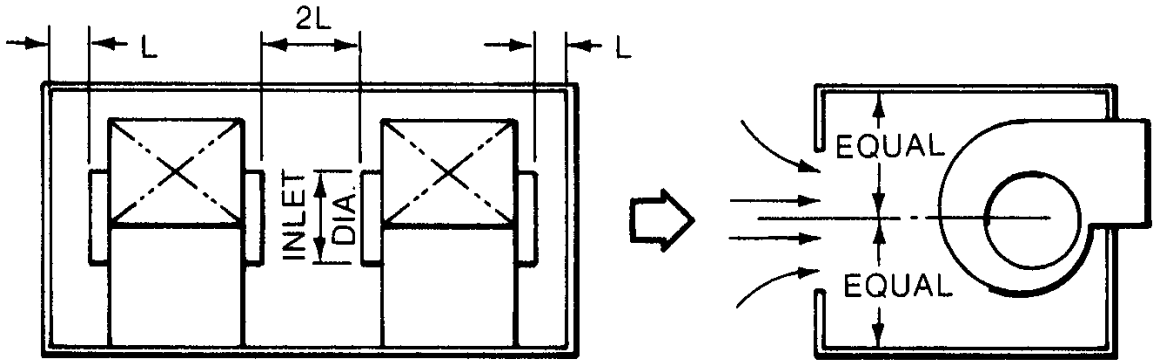
# A. 空調通風系統設計

## 4. 預留足夠的空間來放置風機




Axial Fan Near Wall




Fans and Plenum

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# 風機如何選用

高效率的風機

是否就代表減省能源的使用?

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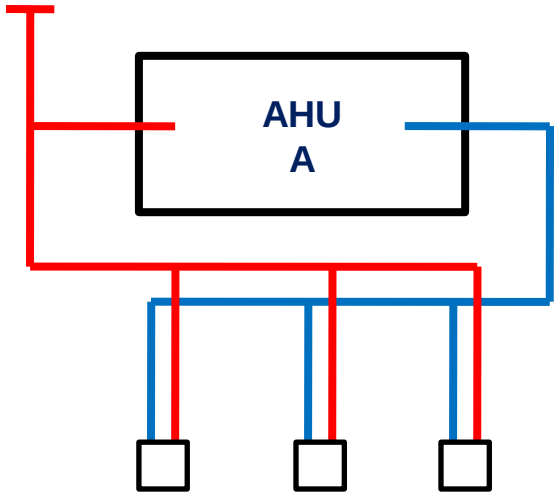
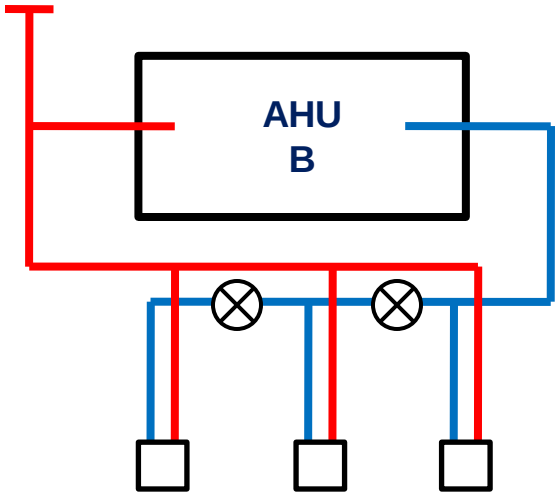
設計風量：20,000 CFM(9.4m³/s) ； 機內靜壓：2in-wg (500Pa)




**系統 A**

機外靜壓：3.5 in-wg (870 Pa)

總 靜 壓：5.5 in-wg (1,370 Pa)

**靜壓效率：65%**

軸動力：26.6 hp (19.8kw)

**系統 B**

機外靜壓：5.0 in-wg (1,250 Pa)

總 靜 壓：7.0 in-wg (1,750 Pa)

**靜壓效率：70%**

軸動力：31.4 hp (23.4kw)

**在系統 B裡的風機能耗，比系統 A的要多 3.6kw = 23.4kw-19.8kw**

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# 設計上常碰到的糾結

1. 擔心風機效率差 → 用低效率計算馬力
2. 擔心風管洩漏率大→ 風量、安全系數加大
3. 擔心噪音過大 → 增加消音箱→增加了 Ps
4. 機房空間限制→ 無法選用合適機型
5. 預算及交期限制→ 無法選用合適機型
6. 高度及建築限制→ 無法選用正確風管尺寸

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# 空氣在風管裡, 是如何移動?

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# 風機 與 風管的配置

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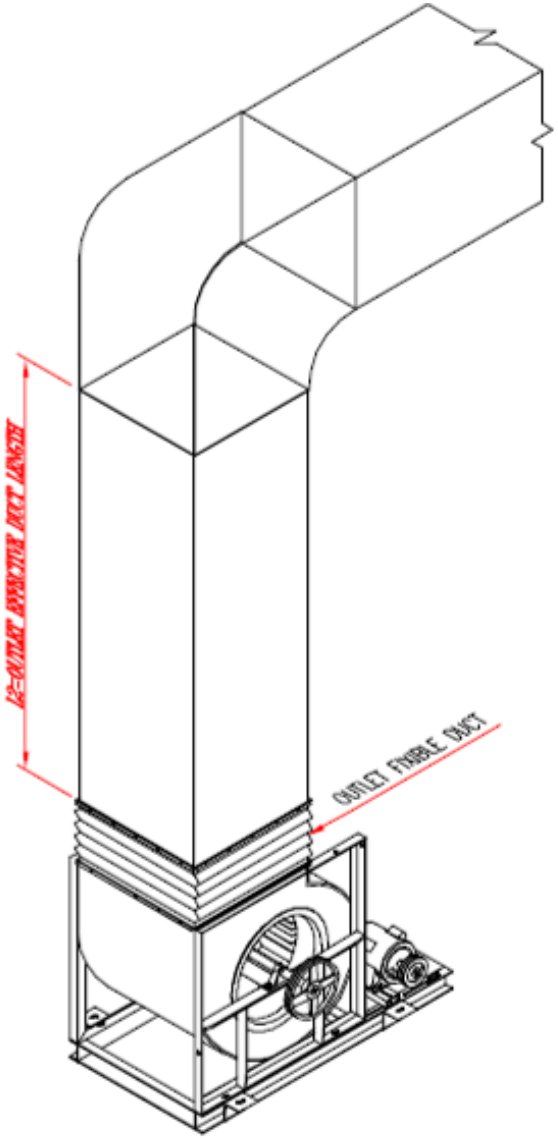


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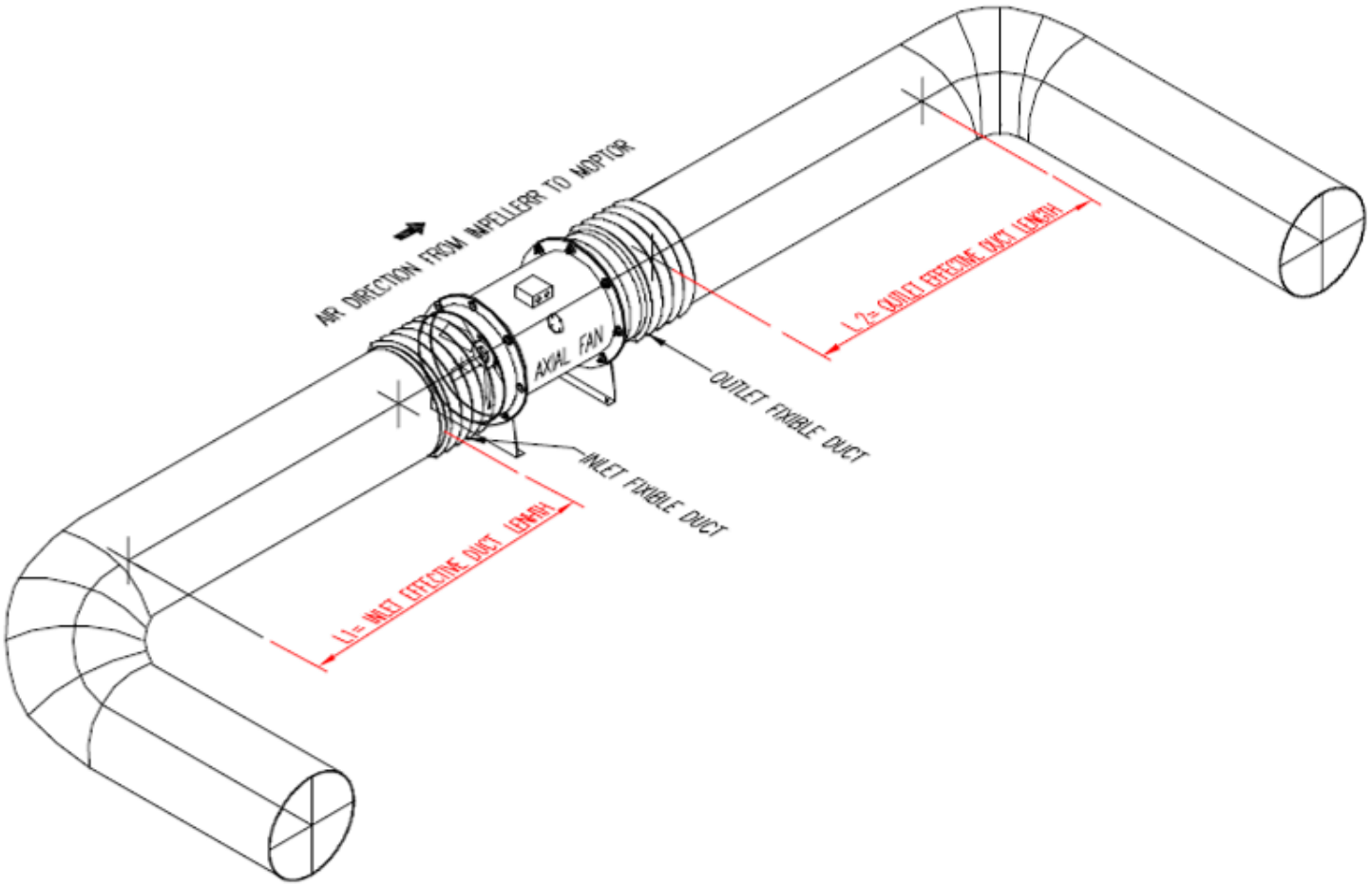


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# 等效風管的長度

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等效風管的長度：
當主風管風速在2,500FPM (或 12.5m/s)及以下時,
有效風管的長度(L)為當量直徑(De)的2.5倍.

$$De = \frac{1.3(AB)^{0.625}}{(A+B)^{0.25}}$$

若主風管風速大於2,500FPM (或12.5m/s)則風速每+1,000FPM(5m/s),有效風管的長度(L)為當量直徑(De)的2.5+1倍.

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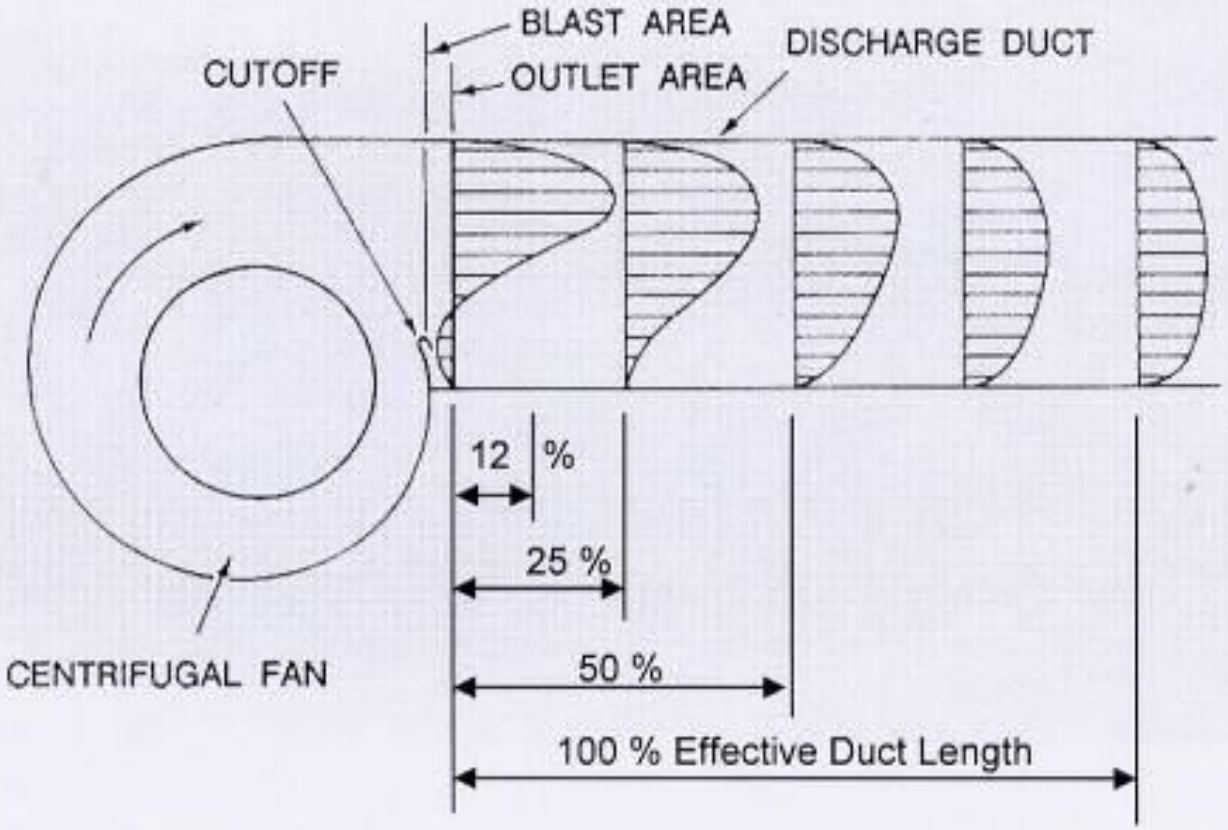
# Outlet Effective Duct Length




Effective duct length = 2.5 equivalent duct diameter (2,500 FPM or less) + 1 equivalent duct diameter for every additional 1,000 FPM ( ≦ 12.5 M/S )

( 5.0 M/S )

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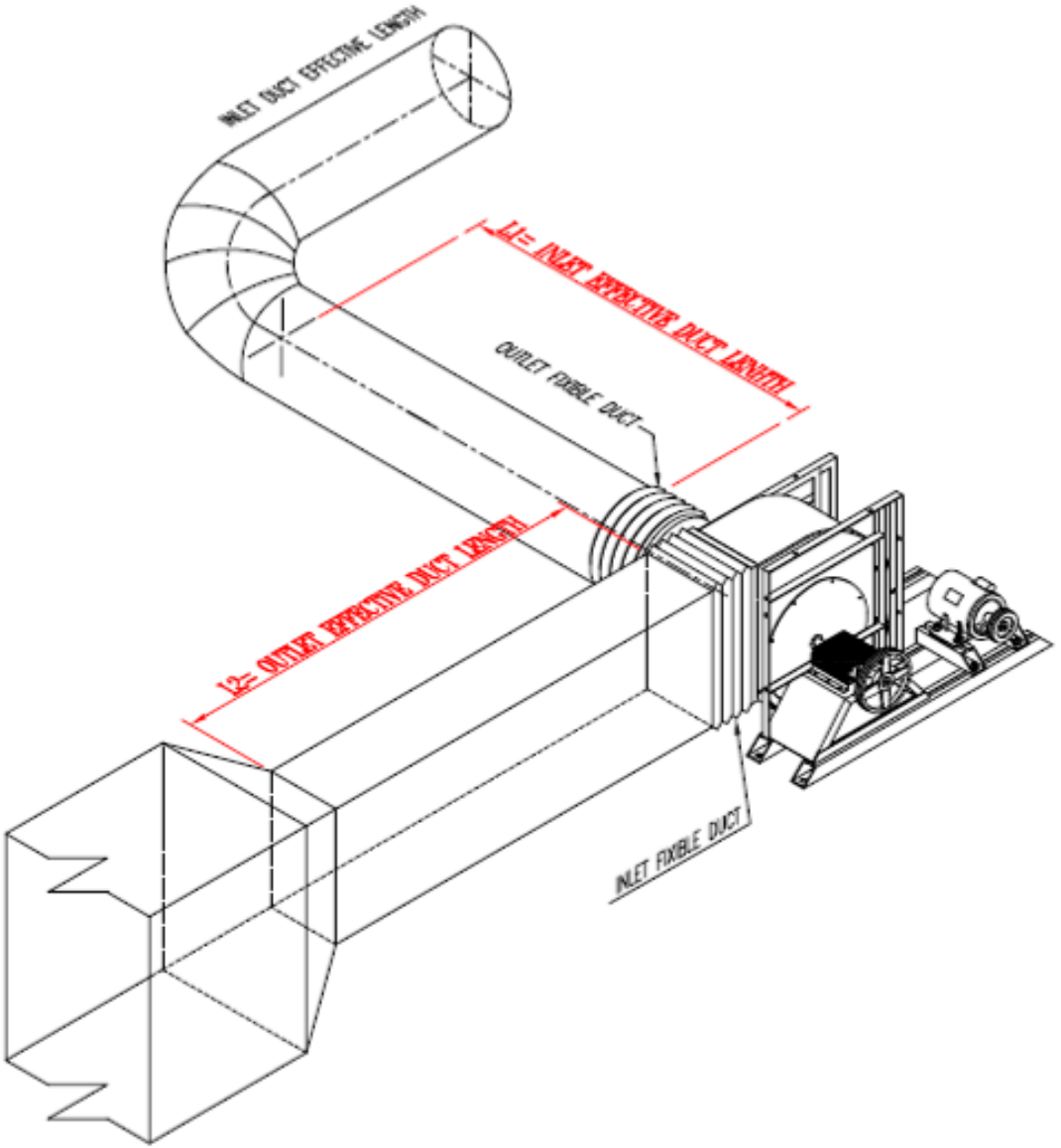
# SISW

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# **Outlet** Effective Duct Length

| OUTLET EFFECTIVE DUCT LENGTH | | | | | | |
|---|---|---|---|---|---|---|
| MODEL FSA | OUTLET AREA ($mm^2$) | EQUIVALENT DUCT DIAMETER,De (mm) | EFFECTIVE DUCT LEGTH,2.5 De (mm) | | | |
| | | | 12% | 25% | 50% | 100% |
| 200 | 256x130 | 206 | 62 | 129 | 257 | 515 |
| 225 | 288x146 | 231 | 69 | 145 | 289 | 578 |
| 250 | 322X164 | 274 | 82 | 171 | 343 | 685 |
| 280 | 360X182 | 289 | 87 | 181 | 361 | 722 |
| 315 | 404X204 | 324 | 97 | 202 | 405 | 810 |
| 355 | 452X228 | 362 | 109 | 226 | 453 | 906 |
| 400 | 506X256 | 406 | 122 | 254 | 508 | 1015 |
| 450 | 568X288 | 456 | 137 | 285 | 570 | 1141 |
| 500 | 638X322 | 511 | 153 | 320 | 639 | 1279 |
| 560 | 714X360 | 572 | 172 | 358 | 715 | 1430 |
| 630 | 800X404 | 641 | 192 | 401 | 802 | 1604 |
| 710 | 898X452 | 719 | 216 | 449 | 899 | 1797 |
| 800 | 1006X506 | 805 | 242 | 503 | 1006 | 2013 |
| 900 | 1130X568 | 904 | 271 | 565 | 1130 | 2260 |
| 1000 | 1266X638 | 1014 | 304 | 634 | 1268 | 2535 |
| 1120 | 1422X716 | 1139 | 342 | 712 | 1423 | 2846 |
| 1250 | 1524X804 | 1249 | 375 | 781 | 1561 | 3123 |
| 1400 | 1794X902 | 1435 | 431 | 897 | 1794 | 3588 |

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# **Outlet** Effective Duct Length

| MODEL ASA / BSB | OUTLET AREA ($mm^2$) | EQUIVALENT DUCT DIAMETER,De (mm) | EFFECTIVE DUCT LEGTH,2.5 De (mm) | | | |
|---|---|---|---|---|---|---|
| | | | 12% | 25% | 50% | 100% |
| 315 | 404x223 | 339 | 102 | 212 | 423 | 847 |
| 355 | 452x247 | 377 | 113 | 236 | 471 | 943 |
| 400 | 506x274 | 420 | 126 | 263 | 525 | 1050 |
| 450 | 568x308 | 472 | 142 | 295 | 590 | 1180 |
| 500 | 638x345 | 529 | 159 | 331 | 662 | 1323 |
| 560 | 714x383 | 590 | 177 | 369 | 738 | 1475 |
| 630 | 800x433 | 664 | 199 | 415 | 830 | 1660 |
| 710 | 898x749 | 925 | 278 | 578 | 1157 | 2314 |
| 800 | 1006x533 | 826 | 248 | 516 | 1033 | 2066 |
| 900 | 1130x595 | 925 | 278 | 578 | 1157 | 2313 |
| 1000 | 1266x663 | 1034 | 310 | 646 | 1292 | 2584 |
| 1120 | 1422x744 | 1161 | 348 | 725 | 1451 | 2902 |
| 1250 | 1524x798 | 1244 | 373 | 778 | 1555 | 3111 |
| 1400 | 1794x930 | 1457 | 437 | 911 | 1822 | 3644 |

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# Inlet Effective Duct Length

| INLET EFFECTIVE DUCT LENGTH | | | |
|---|---|---|---|
| MODEL<br>**FSA, BSB, ASA** | INLET DUCT<br>DIAMETER,Di (mm) | EFFECTIVE DUCT LEGTH (mm) | |
| | | 2D | 5D |
| 160 | 160 | 320 | 800 |
| 180 | 180 | 360 | 900 |
| 200 | 200 | 400 | 1000 |
| 225 | 225 | 450 | 1125 |
| 250 | 250 | 500 | 1250 |
| 280 | 280 | 560 | 1400 |
| 315 | 315 | 630 | 1575 |
| 355 | 355 | 710 | 1775 |
| 400 | 400 | 800 | 2000 |
| 450 | 450 | 900 | 2250 |
| 500 | 500 | 1000 | 2500 |
| 560 | 560 | 1120 | 2800 |
| 630 | 630 | 1260 | 3150 |
| 710 | 710 | 1420 | 3550 |
| 800 | 800 | 1600 | 4000 |
| 900 | 900 | 1800 | 4500 |
| 1000 | 1000 | 2000 | 5000 |
| 1120 | 1120 | 2240 | 5600 |
| 1250 | 1250 | 2500 | 6250 |
| 1400 | 1400 | 2800 | 7000 |

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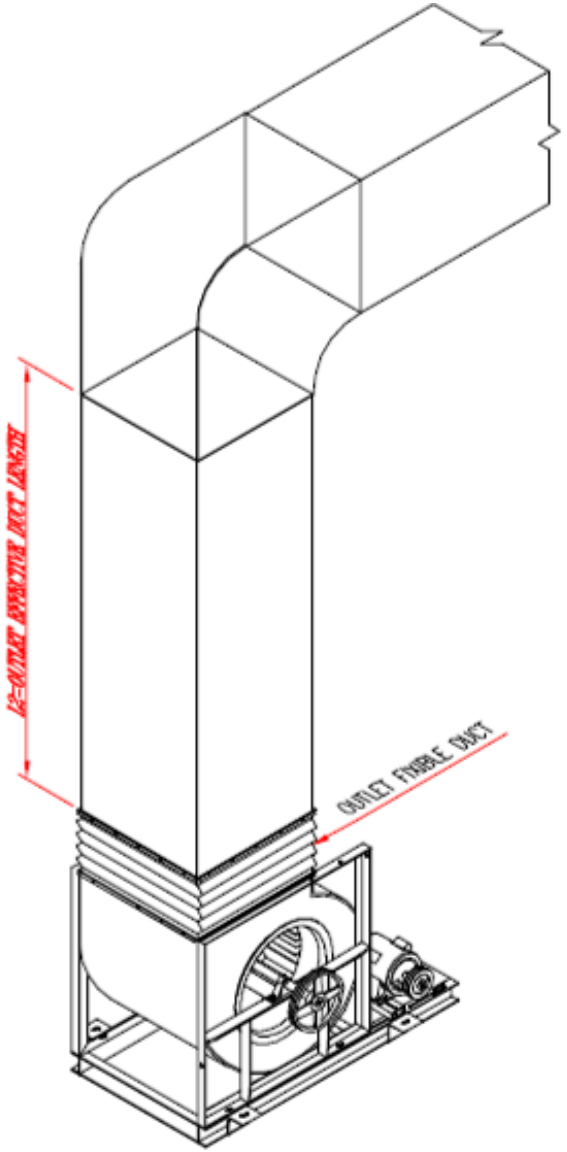
# DIDW

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# **Outlet** Effective Duct Length

| OUTLET EFFECTIVE DUCT LENGTH | | | | | | |
|---|---|---|---|---|---|---|
| MODEL FDA | OUTLET AREA ($mm^2$) | EQUIVALENT DUCT DIAMETER,De (mm) | EFFECTIVE DUCT LEGTH,2.5 De (mm) | | | |
| | | | 12% | 25% | 50% | 100% |
| 160 | 204x204 | 230 | 69 | 144 | 288 | 575 |
| 180 | 228x228 | 257 | 77 | 161 | 322 | 643 |
| 200 | 256x256 | 289 | 87 | 181 | 361 | 722 |
| 225 | 288x288 | 325 | 97 | 203 | 406 | 812 |
| 250 | 322x322 | 363 | 109 | 227 | 454 | 908 |
| 280 | 360x360 | 406 | 122 | 254 | 508 | 1016 |
| 315 | 404x404 | 456 | 137 | 285 | 570 | 1140 |
| 355 | 452x452 | 510 | 153 | 319 | 638 | 1275 |
| 400 | 506x506 | 571 | 171 | 357 | 714 | 1427 |
| 450 | 568x568 | 641 | 192 | 401 | 801 | 1602 |
| 500 | 638x638 | 720 | 216 | 450 | 900 | 1800 |
| 560 | 714x714 | 806 | 242 | 504 | 1007 | 2014 |
| 630 | 800x800 | 903 | 271 | 564 | 1128 | 2257 |
| 710 | 898x898 | 1013 | 304 | 633 | 1267 | 2533 |
| 800 | 1006x1006 | 1135 | 341 | 709 | 1419 | 2838 |
| 900 | 1130x1130 | 1275 | 383 | 797 | 1594 | 3188 |
| 1000 | 1266x1266 | 1429 | 429 | 893 | 1786 | 3571 |
| 1120 | 1422x1422 | 1605 | 481 | 1003 | 2006 | 4011 |
| 1250 | 1524x1524 | 1720 | 516 | 1075 | 2150 | 4299 |
| 1400 | 1794x1794 | 2024 | 607 | 1265 | 2530 | 5061 |

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# **Outlet** Effective Duct Length

| OUTLET EFFECTIVE DUCT LENGTH | | | | | | |
|---|---|---|---|---|---|---|
| MODEL ADA / BDB | OUTLET AREA ($mm^2$) | EQUIVALENT DUCT DIAMETER,De (mm) | EFFECTIVE DUCT LEGTH,2.5 De (mm) | | | |
| | | | 12% | 25% | 50% | 100% |
| 315 | 404x404 | 456 | 137 | 285 | 570 | 1140 |
| 355 | 452x452 | 510 | 153 | 319 | 638 | 1275 |
| 400 | 506x506 | 571 | 171 | 357 | 714 | 1427 |
| 450 | 568x568 | 641 | 192 | 401 | 801 | 1602 |
| 500 | 638x638 | 720 | 216 | 450 | 900 | 1800 |
| 560 | 714x714 | 806 | 242 | 504 | 1007 | 2014 |
| 630 | 800x800 | 903 | 271 | 564 | 1128 | 2257 |
| 710 | 898x898 | 1013 | 304 | 633 | 1267 | 2533 |
| 800 | 1006x1006 | 1135 | 341 | 709 | 1419 | 2838 |
| 900 | 1130x1130 | 1275 | 383 | 797 | 1594 | 3188 |
| 1000 | 1266x1266 | 1429 | 429 | 893 | 1786 | 3571 |
| 1120 | 1422x1422 | 1605 | 481 | 1003 | 2006 | 4011 |
| 1250 | 1524x1524 | 1720 | 516 | 1075 | 2150 | 4299 |
| 1400 | 1794x1794 | 2024 | 607 | 1265 | 2530 | 5061 |

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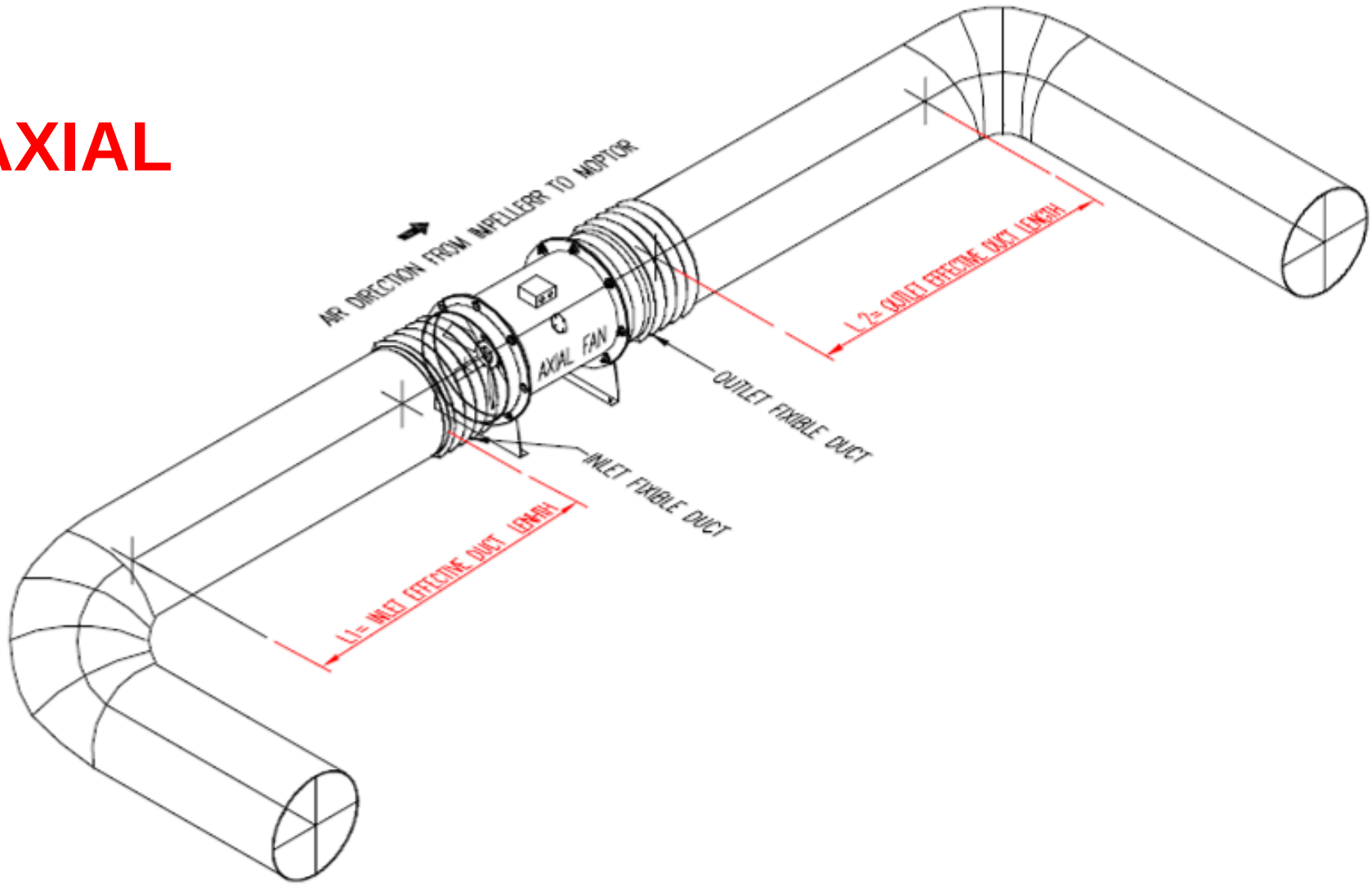
# AXIAL

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# 錯誤的安裝
# 及
# 推薦的修改

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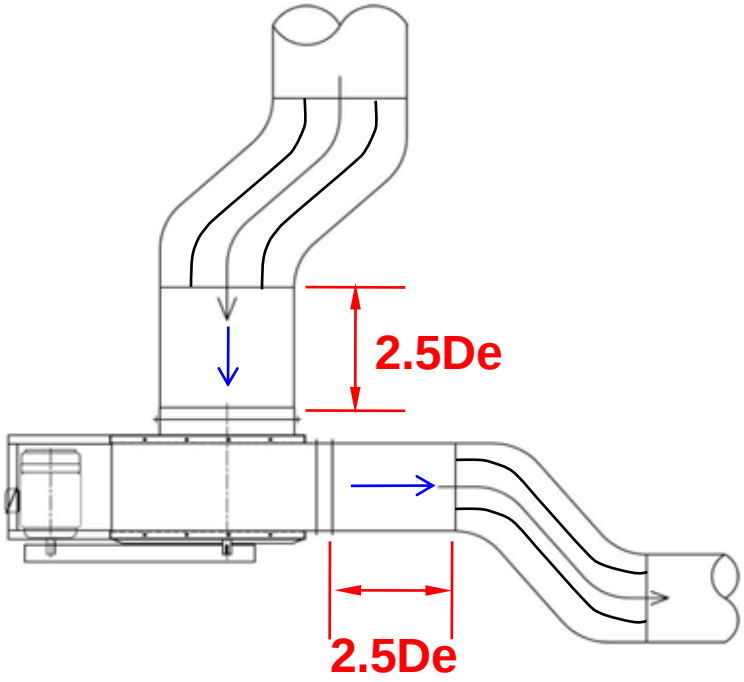


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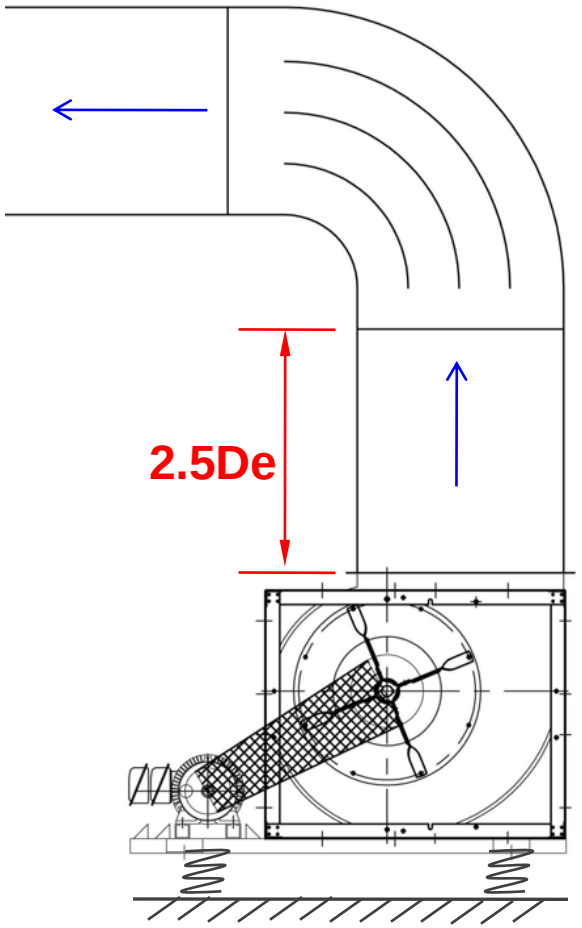


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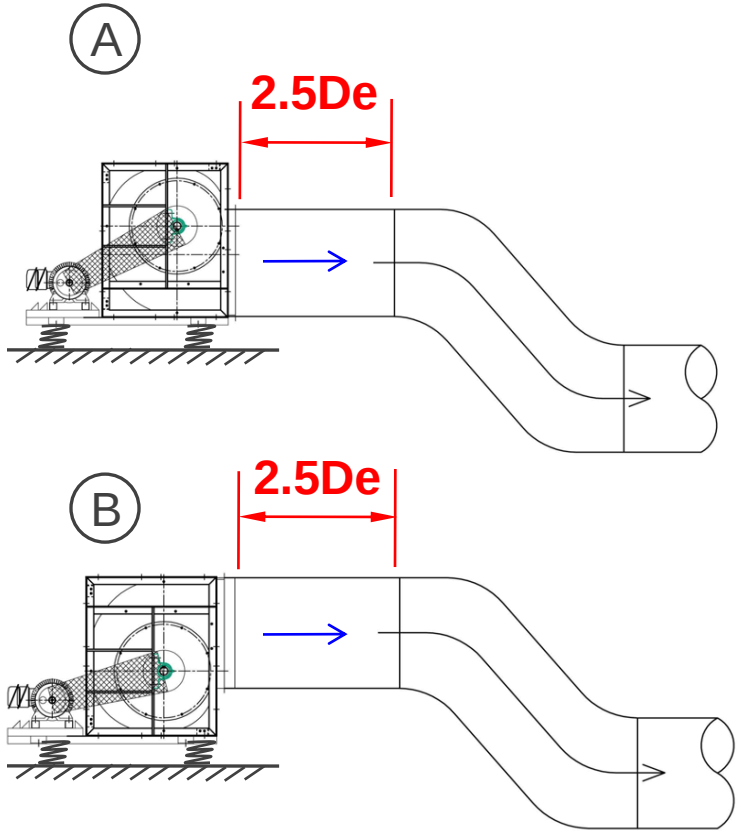


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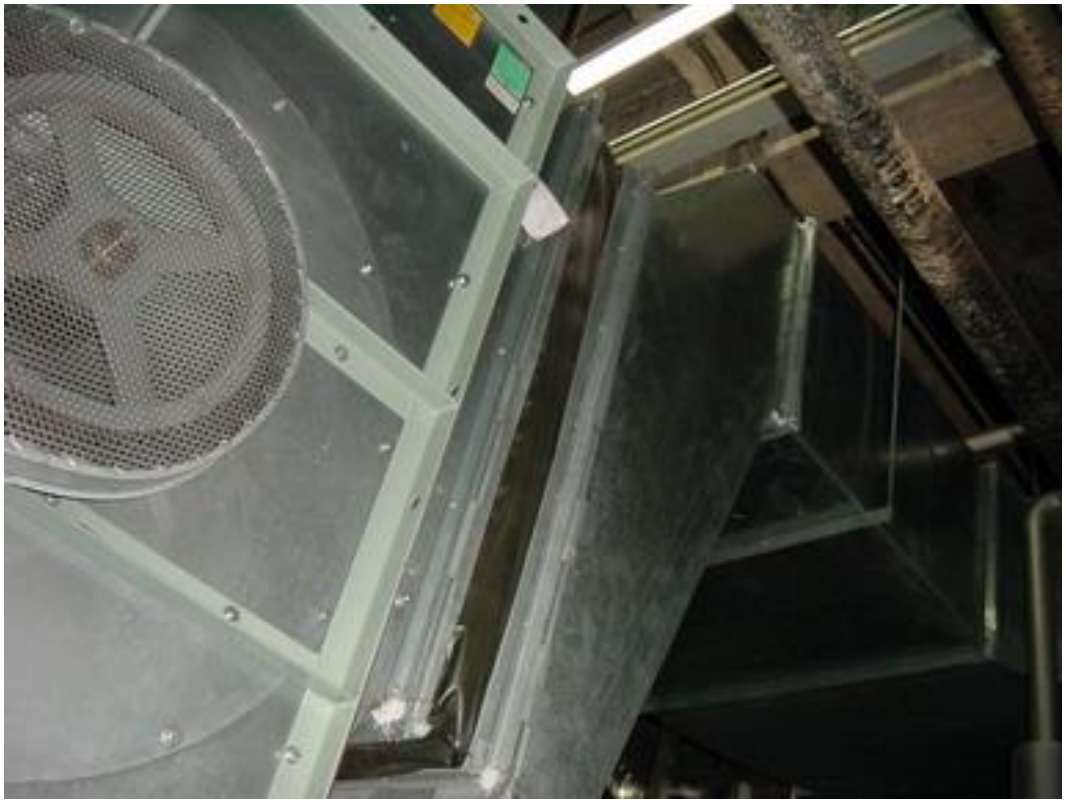

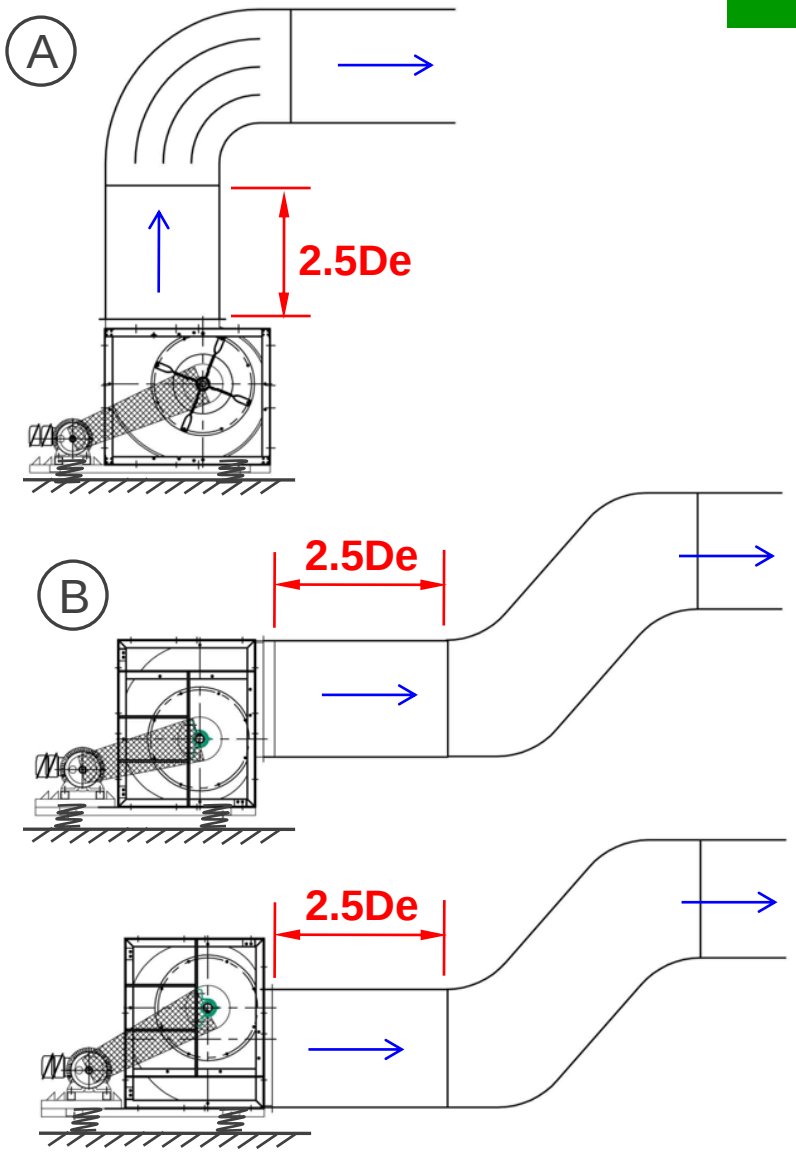


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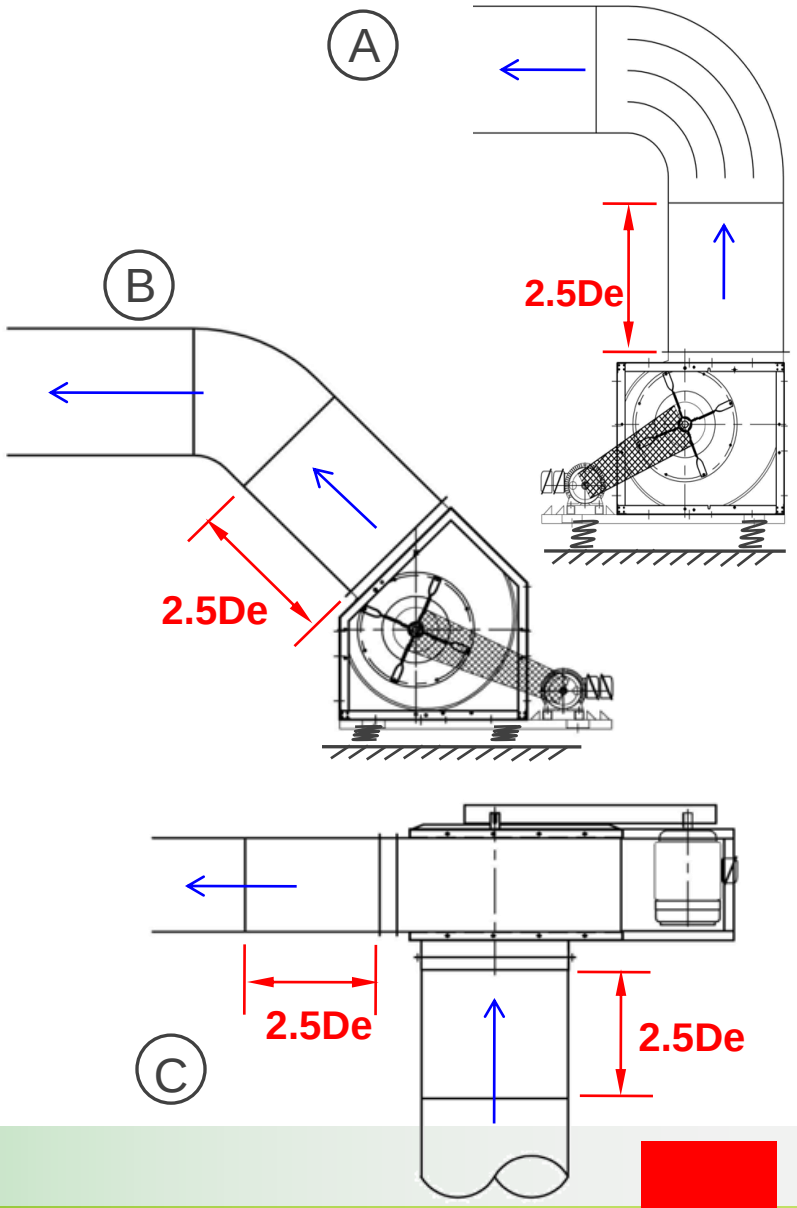


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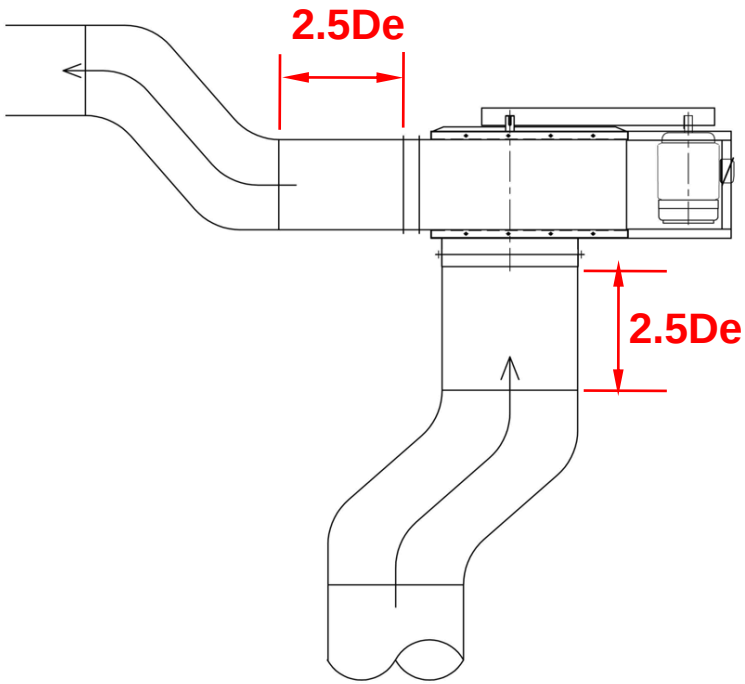


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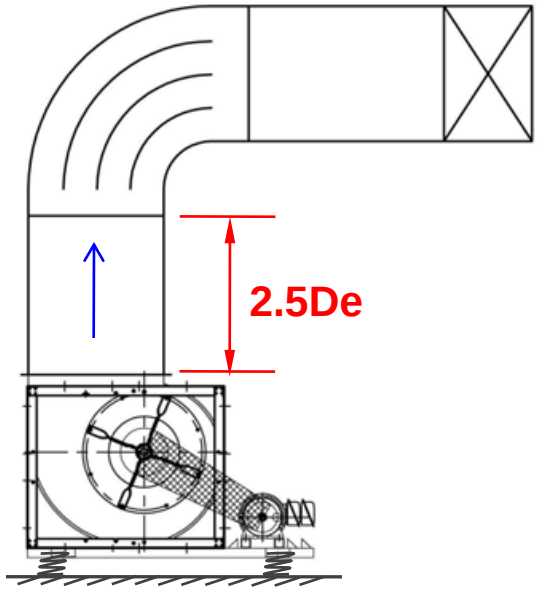


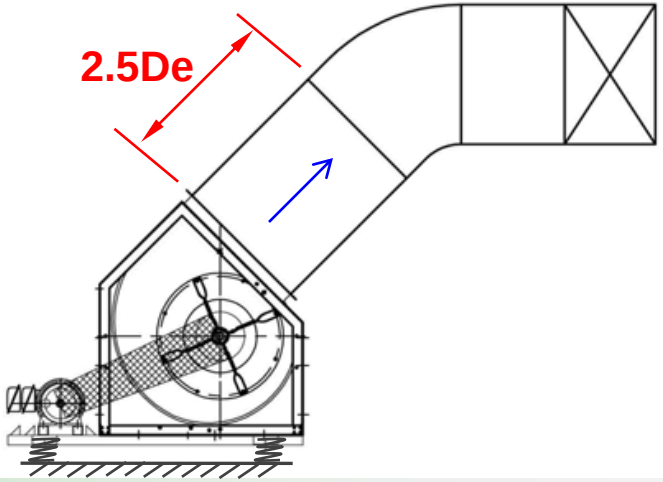


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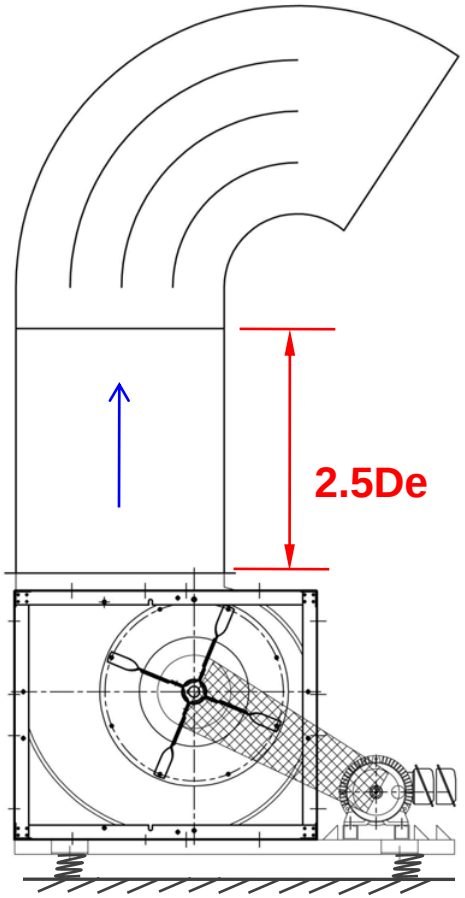


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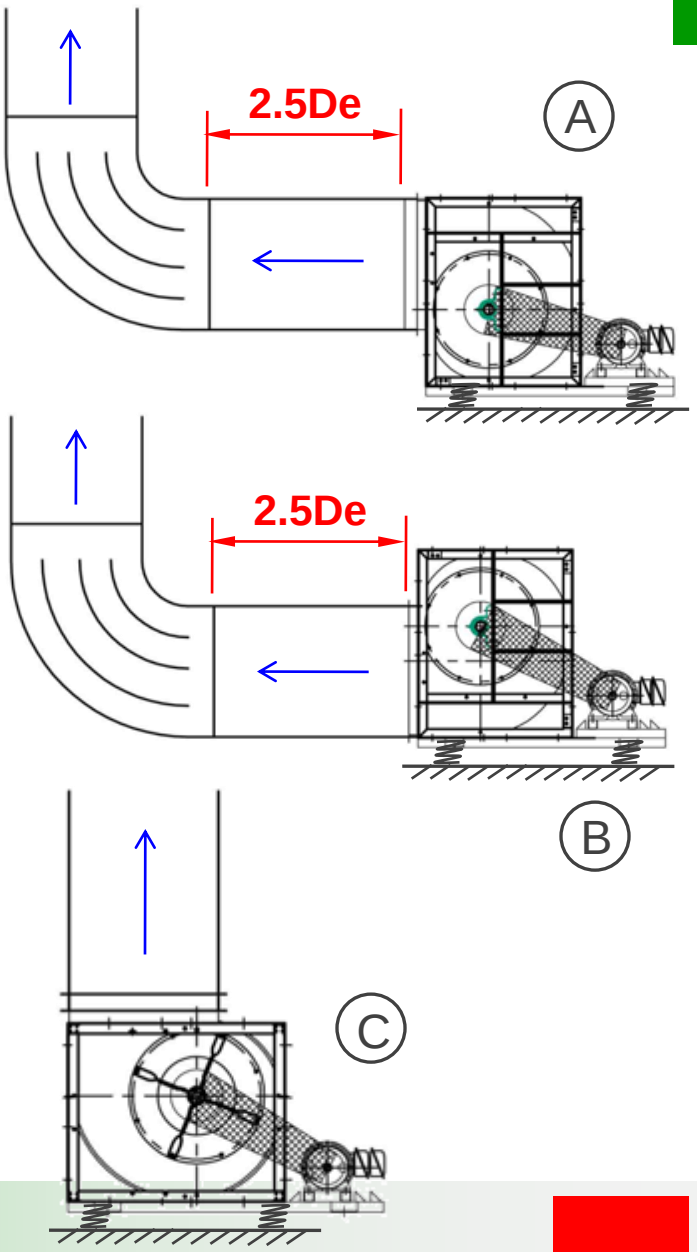


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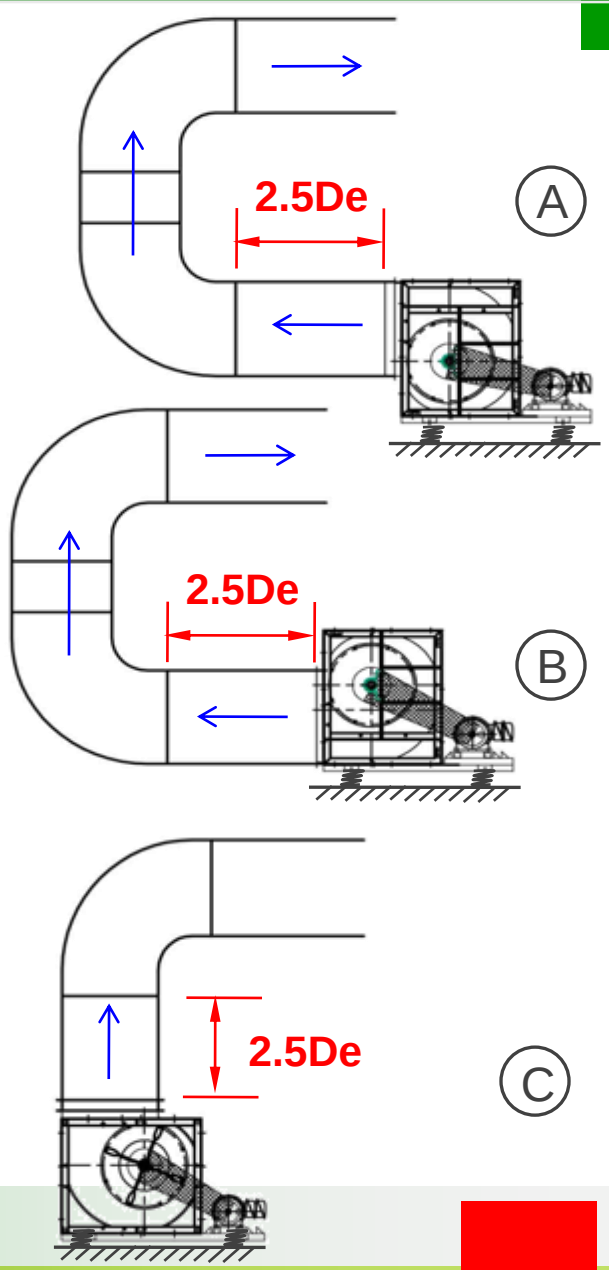


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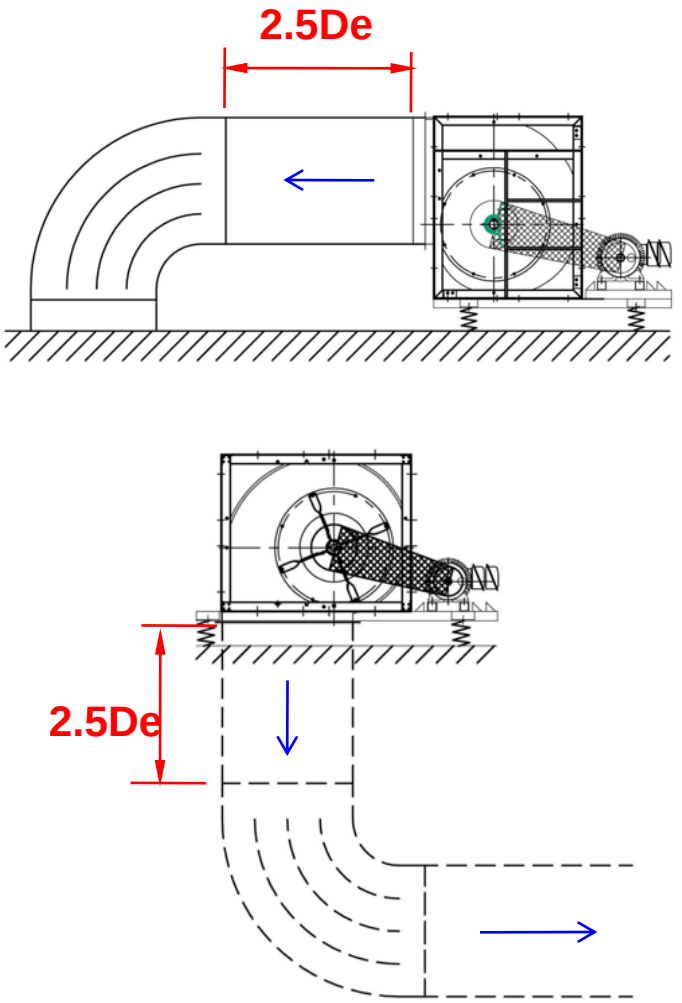


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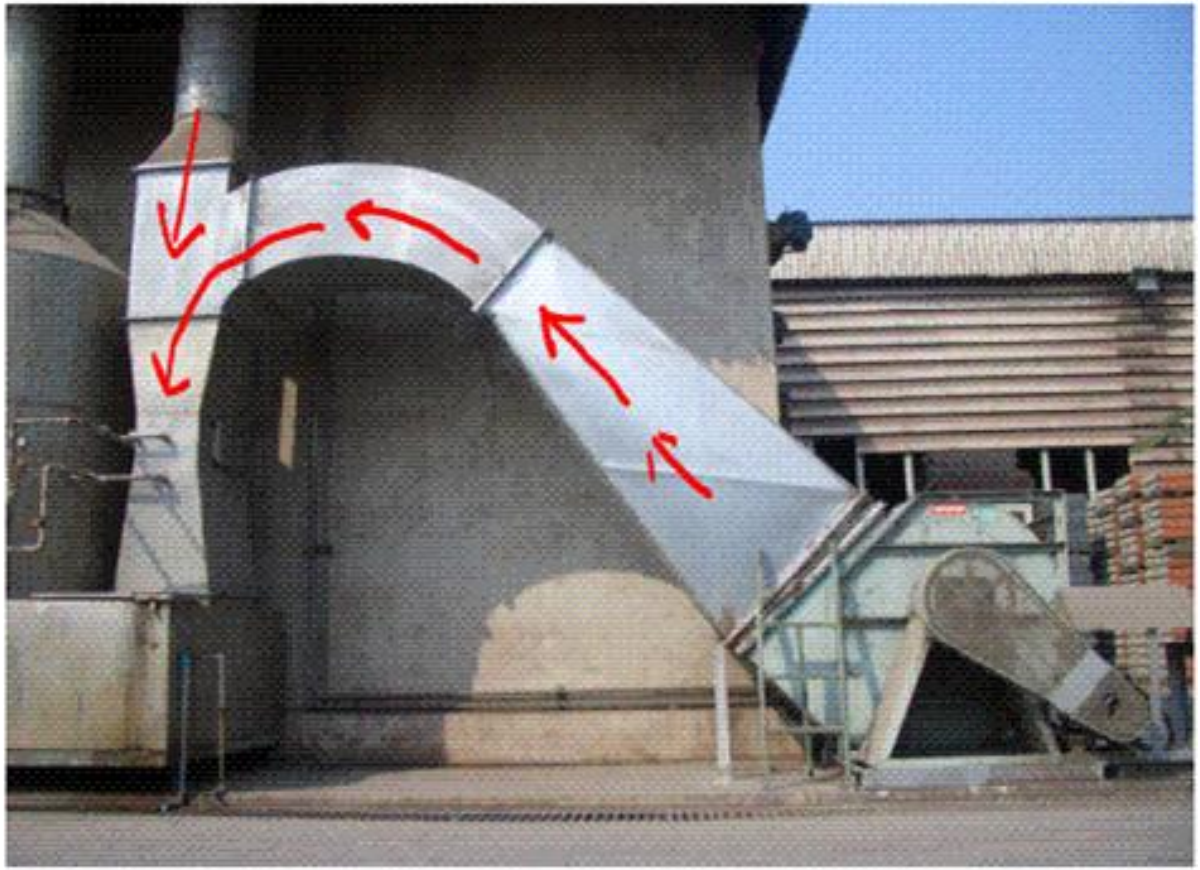

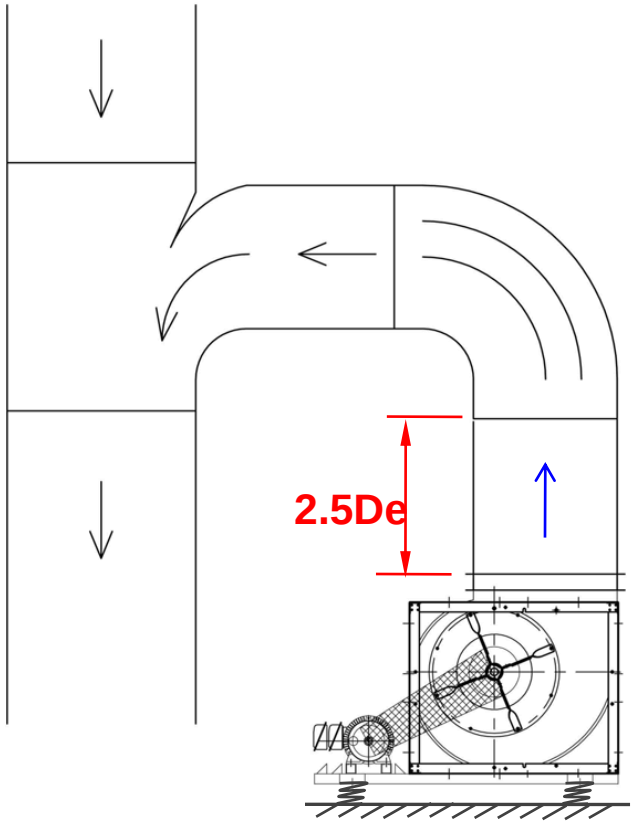


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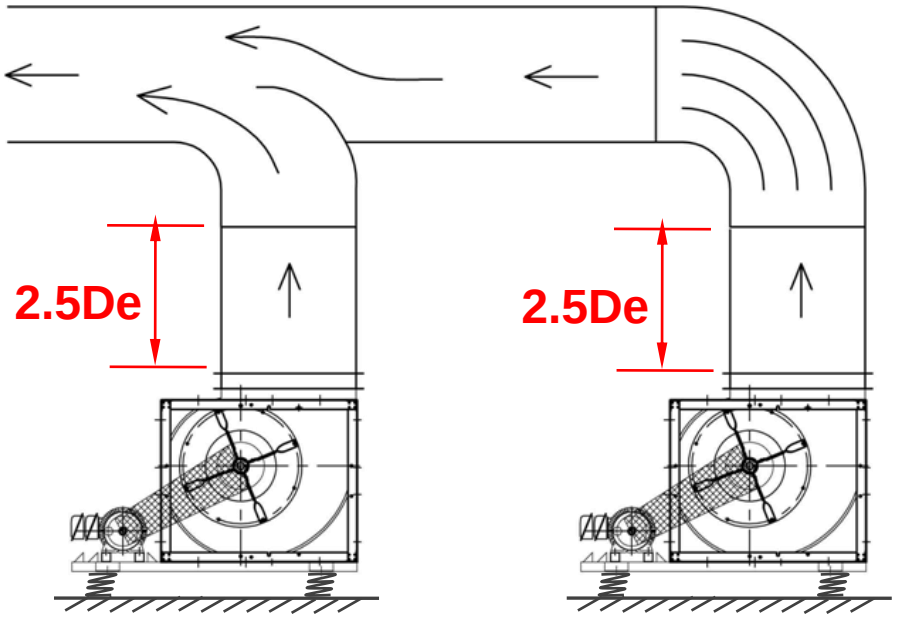


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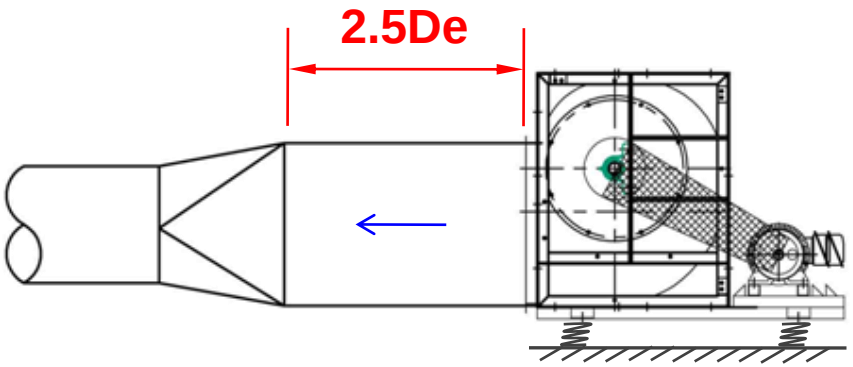


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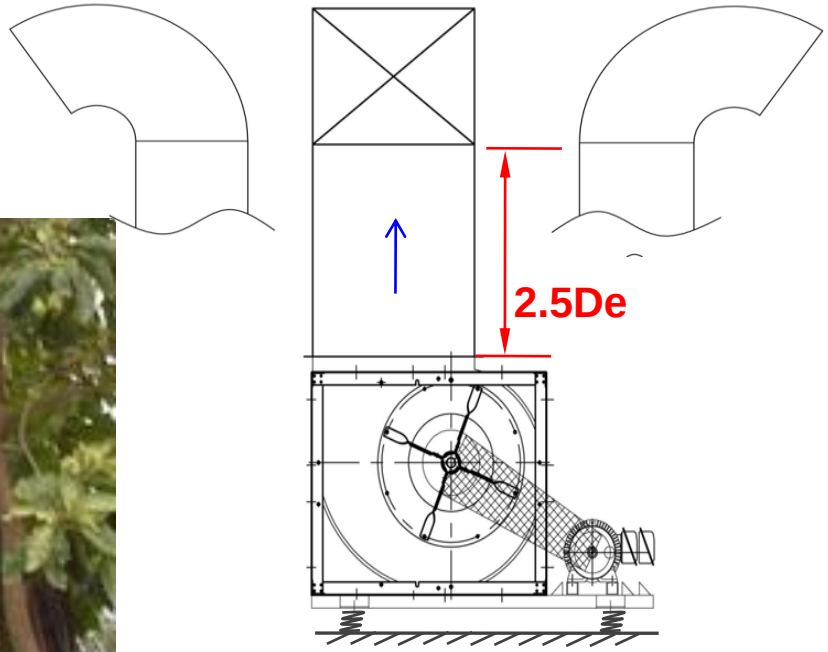


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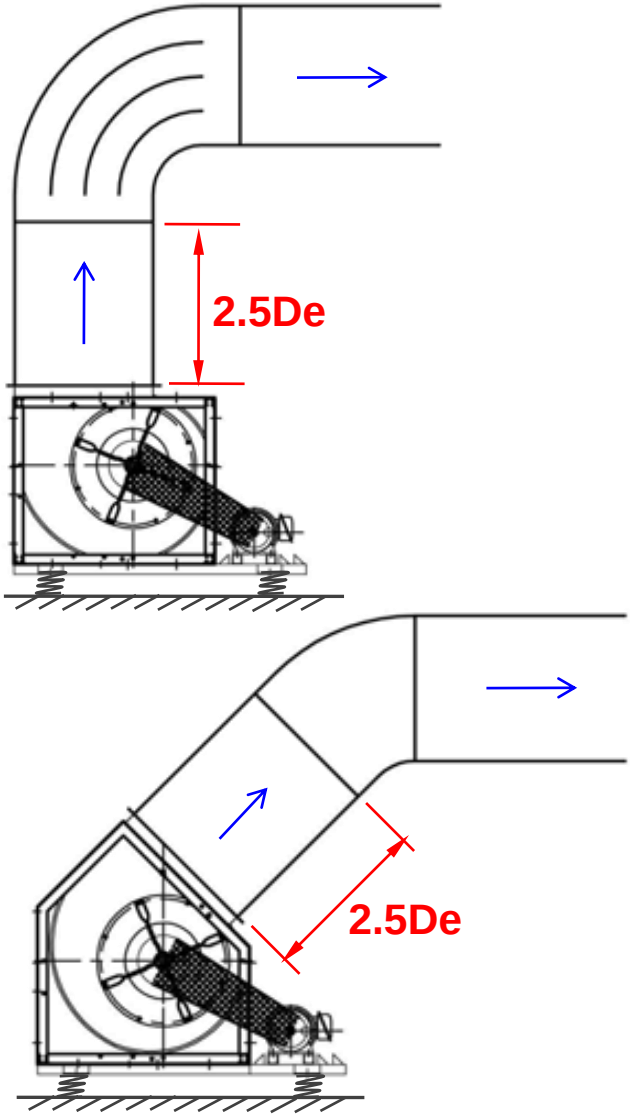


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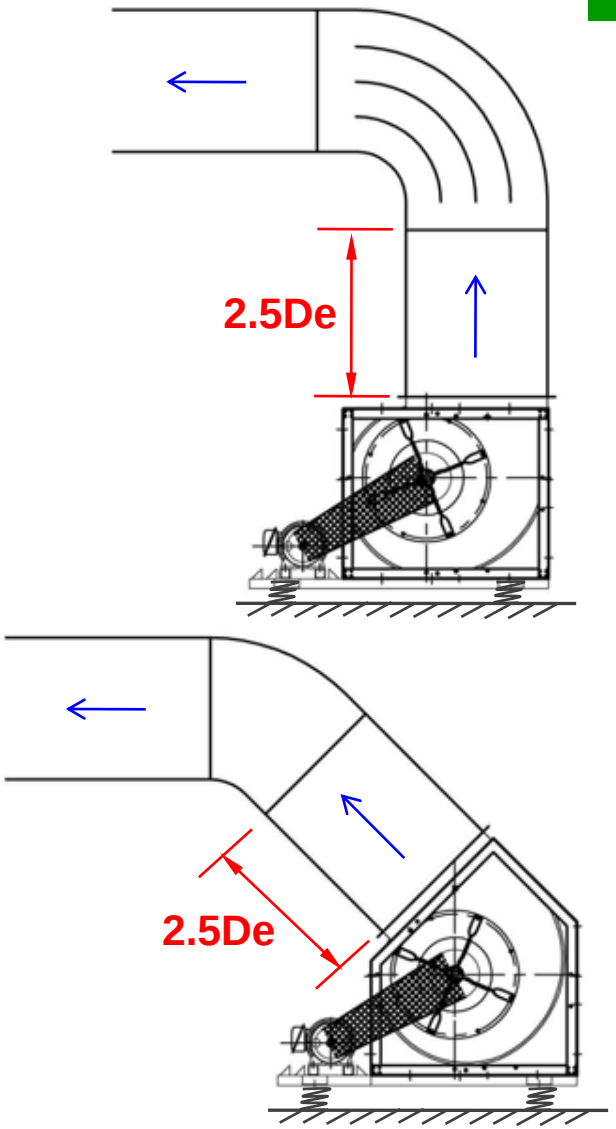


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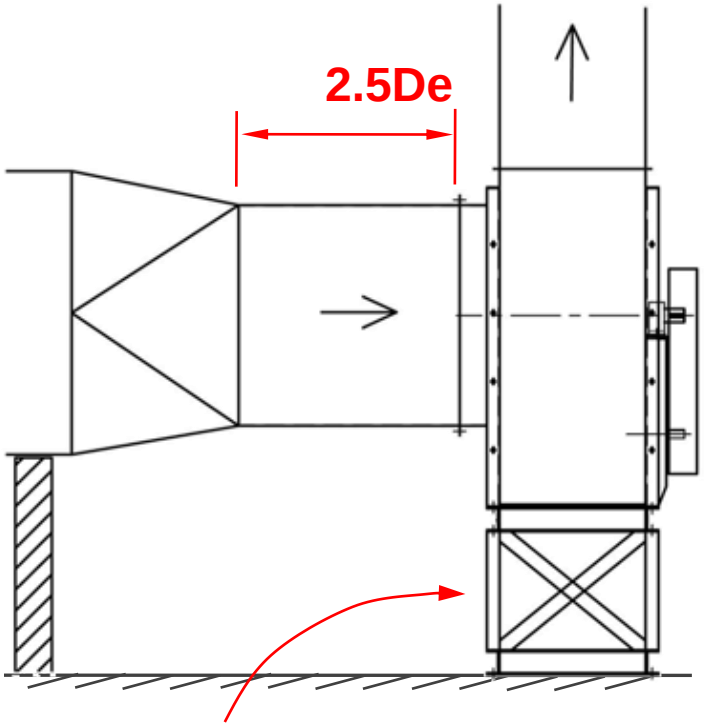


Fan supported

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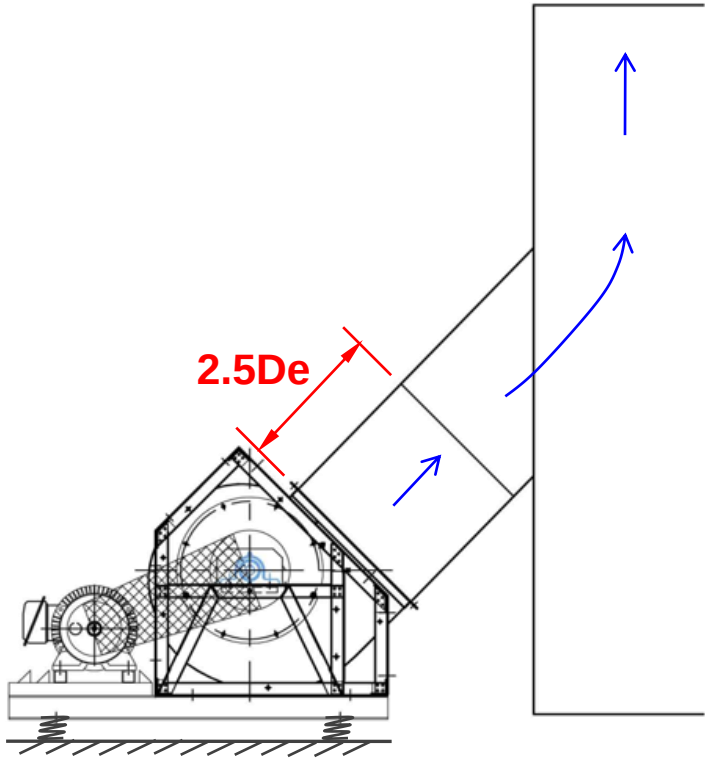


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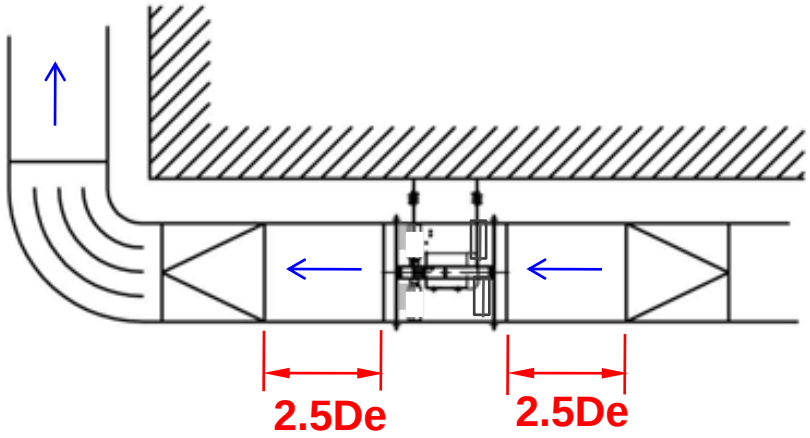


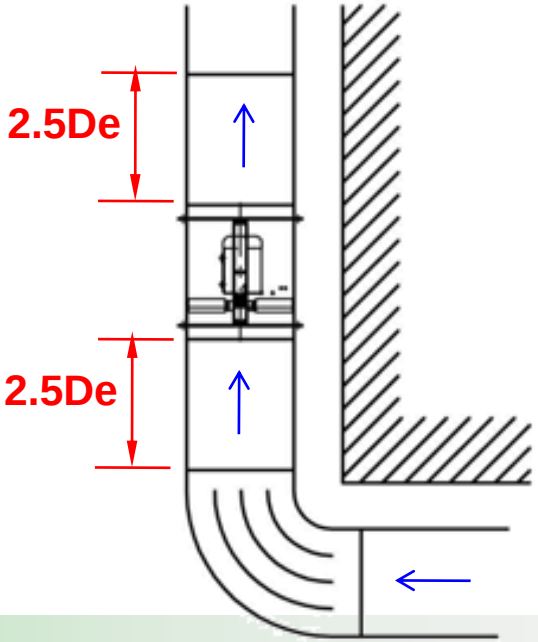


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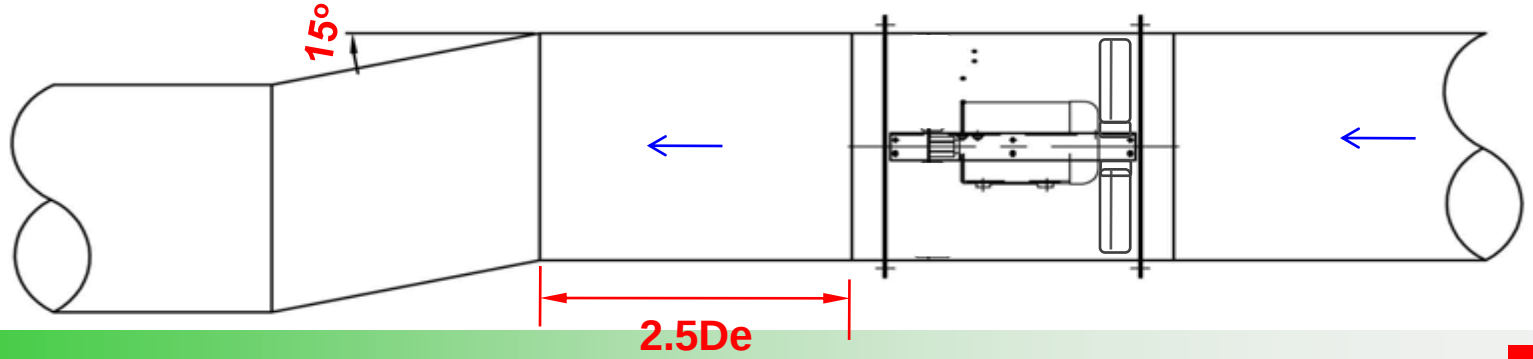


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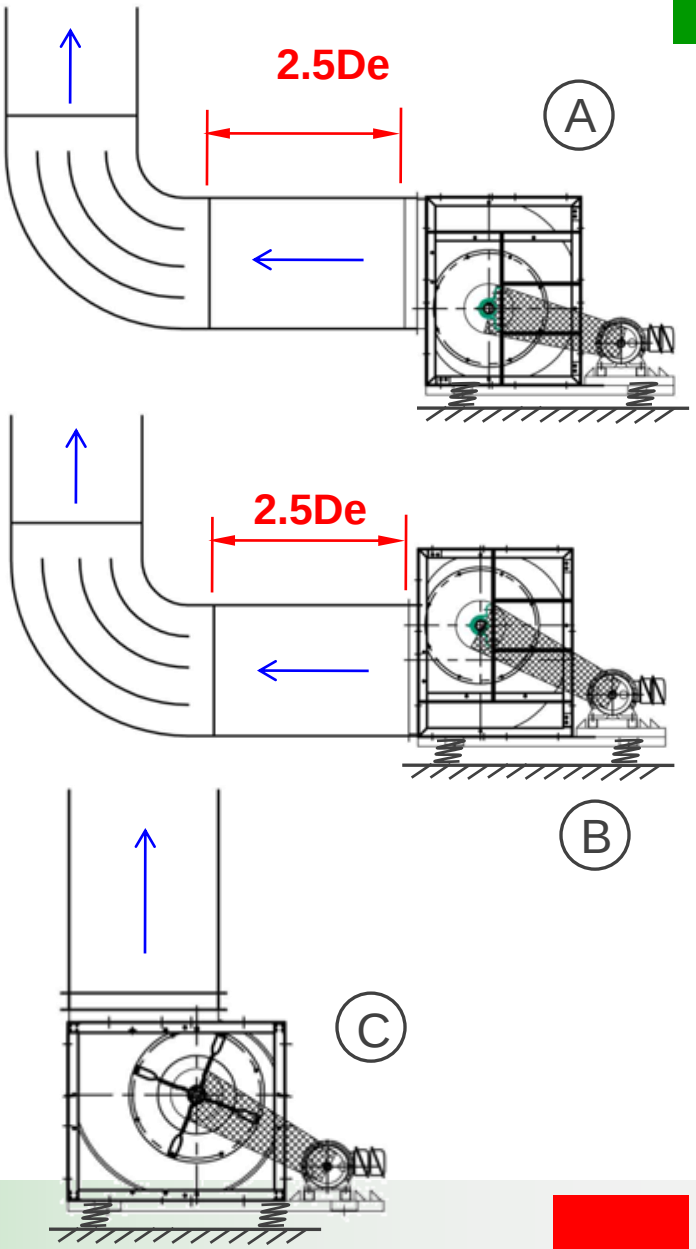


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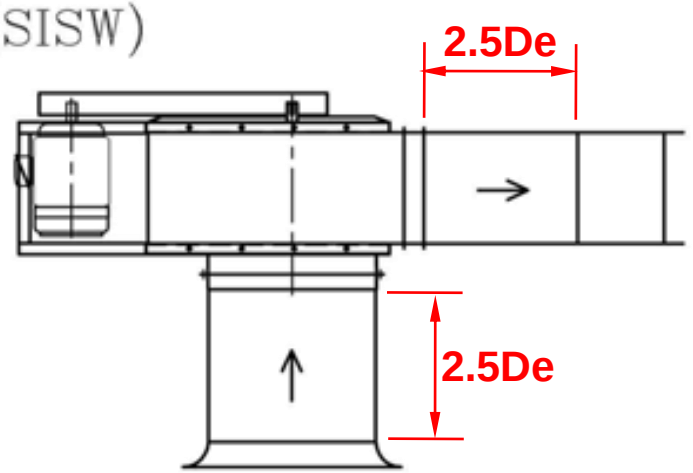


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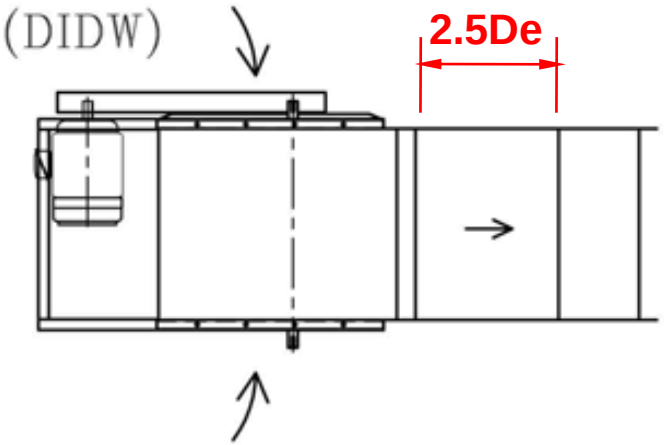


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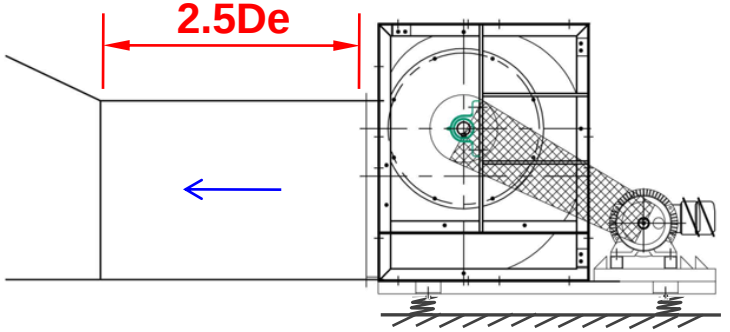


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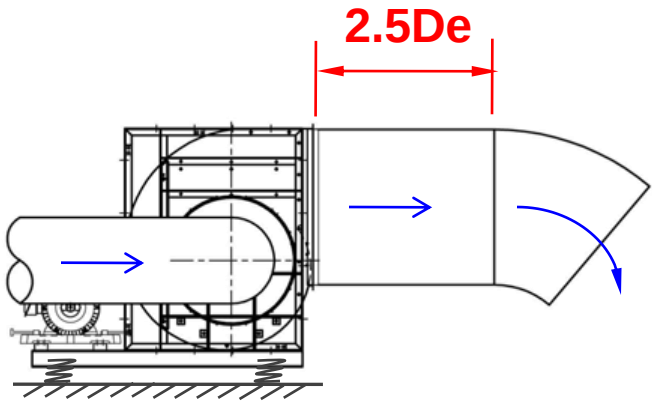


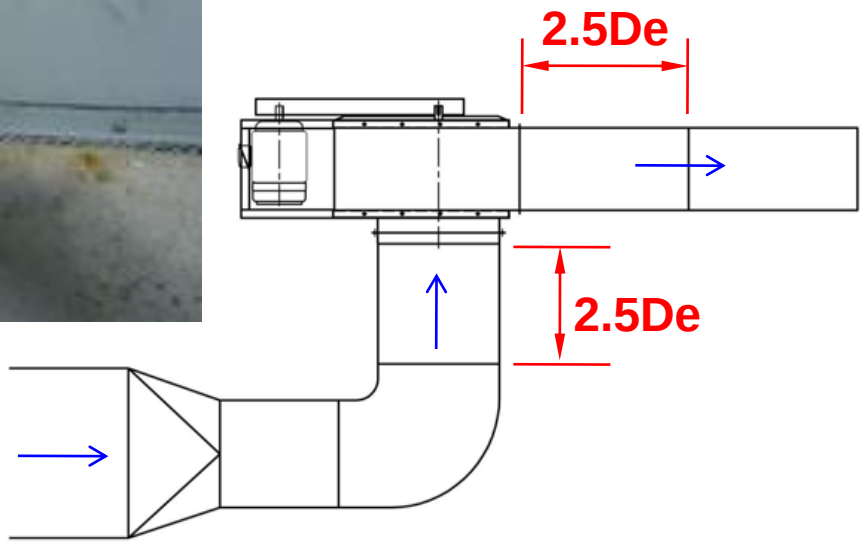


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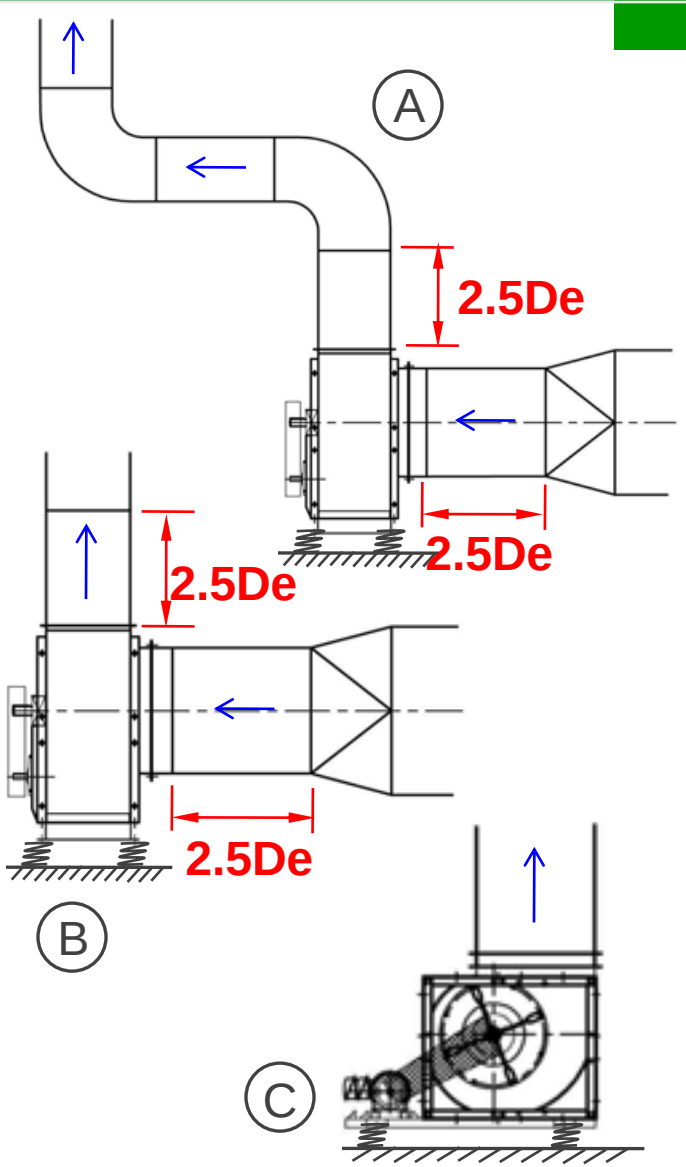


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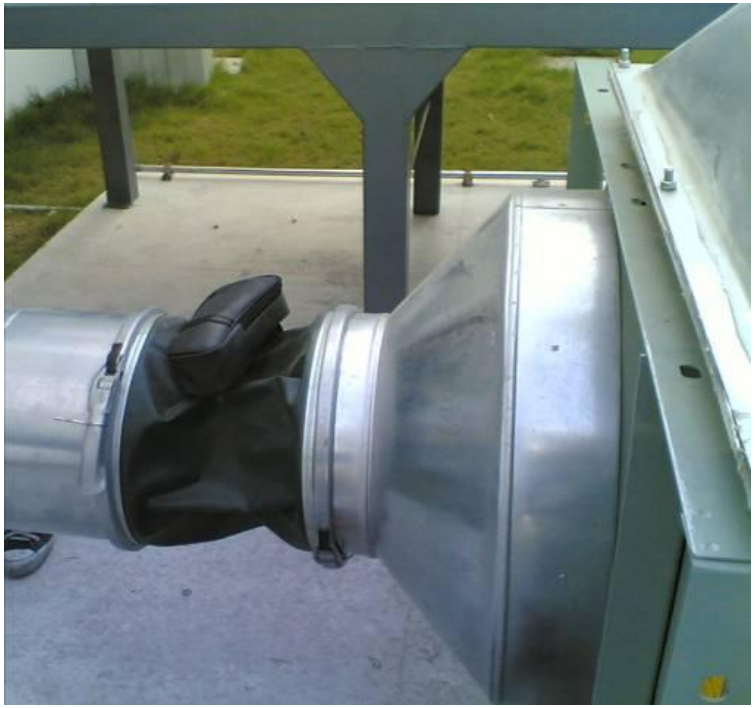

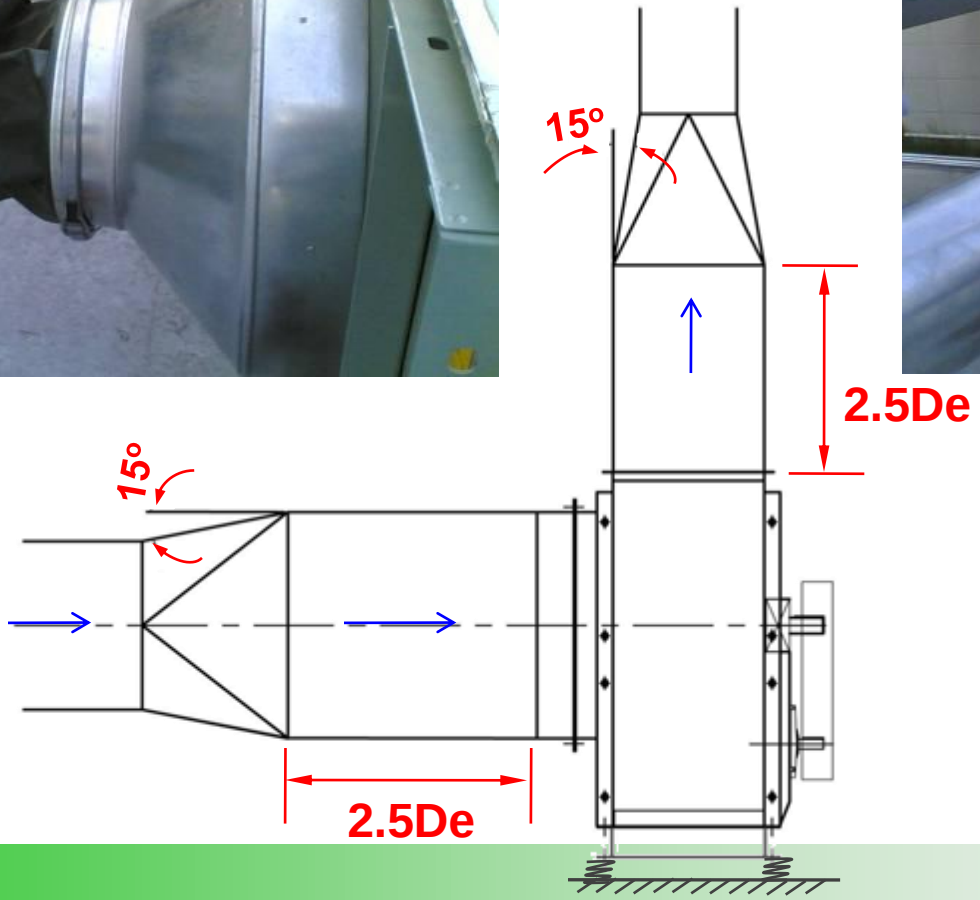


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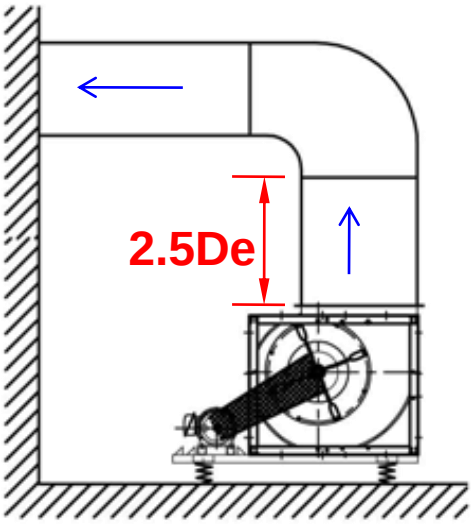


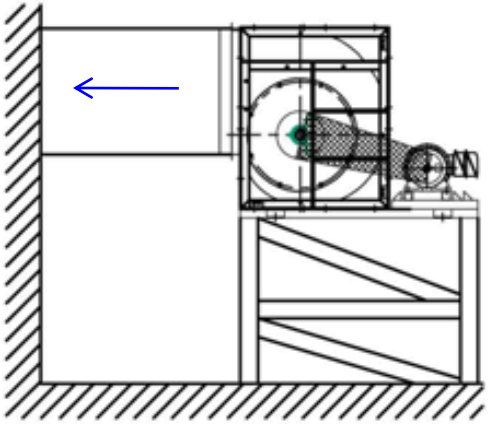

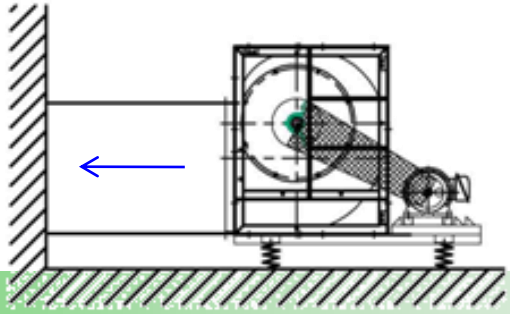

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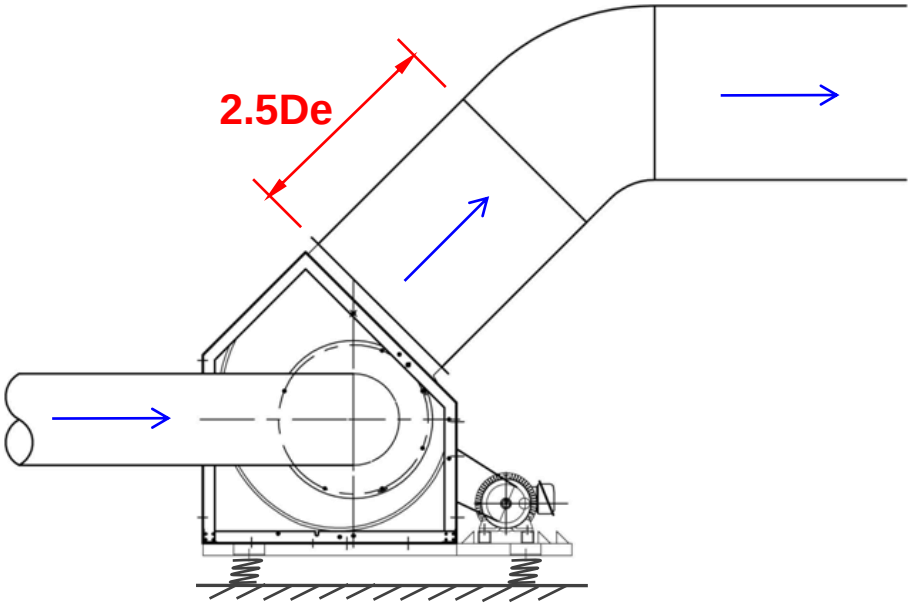


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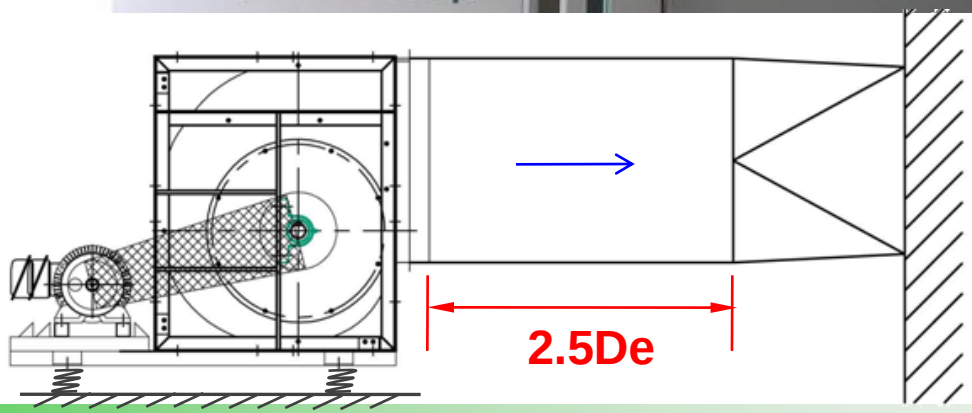


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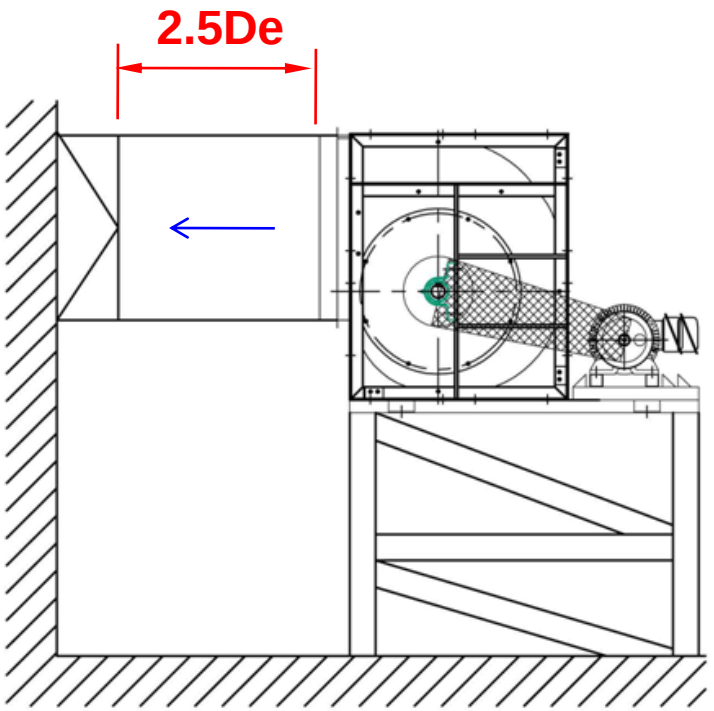


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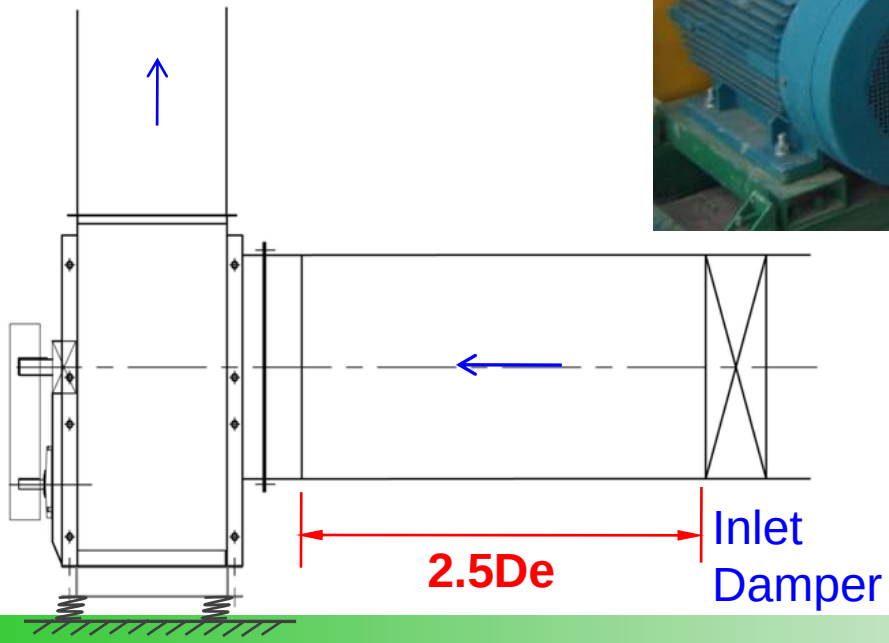


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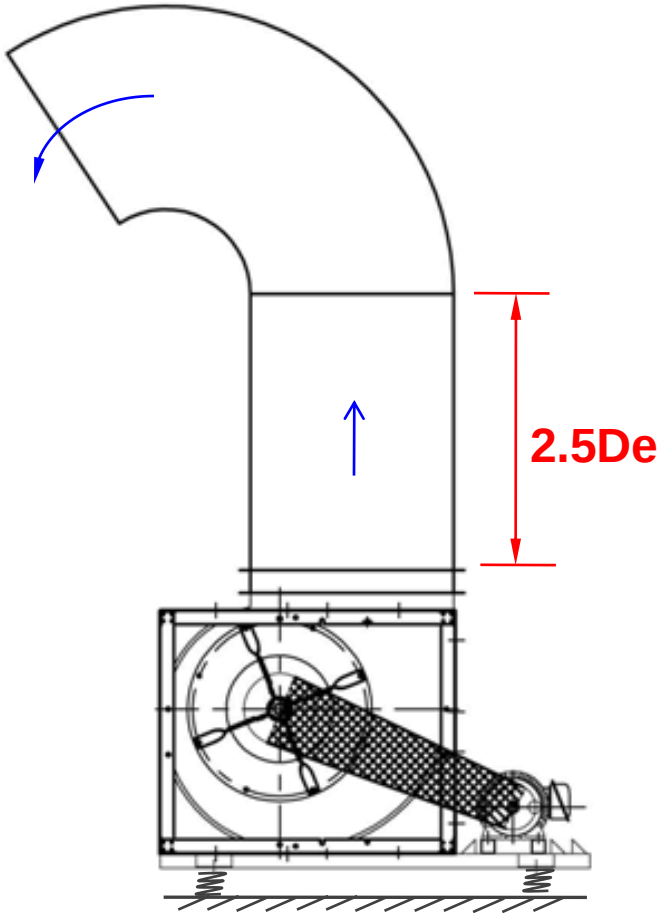


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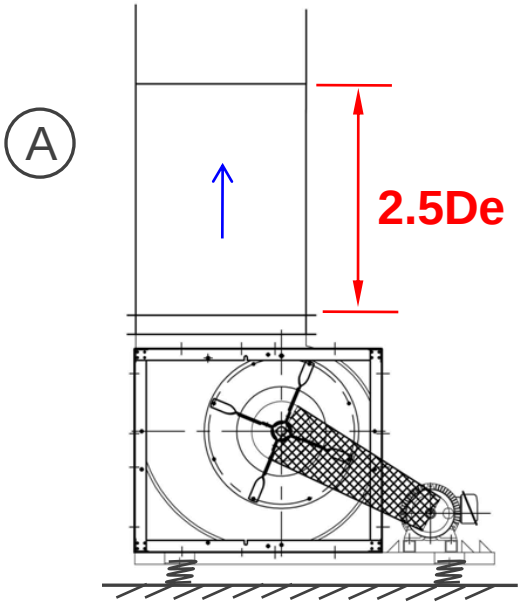


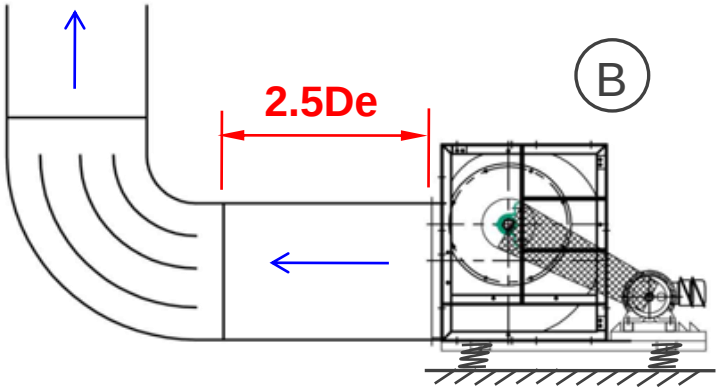


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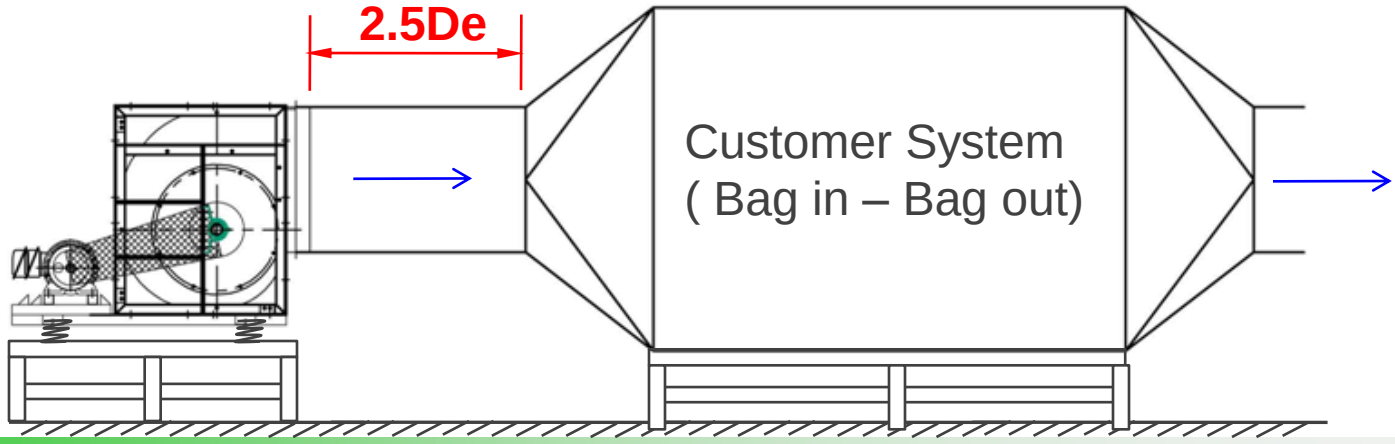


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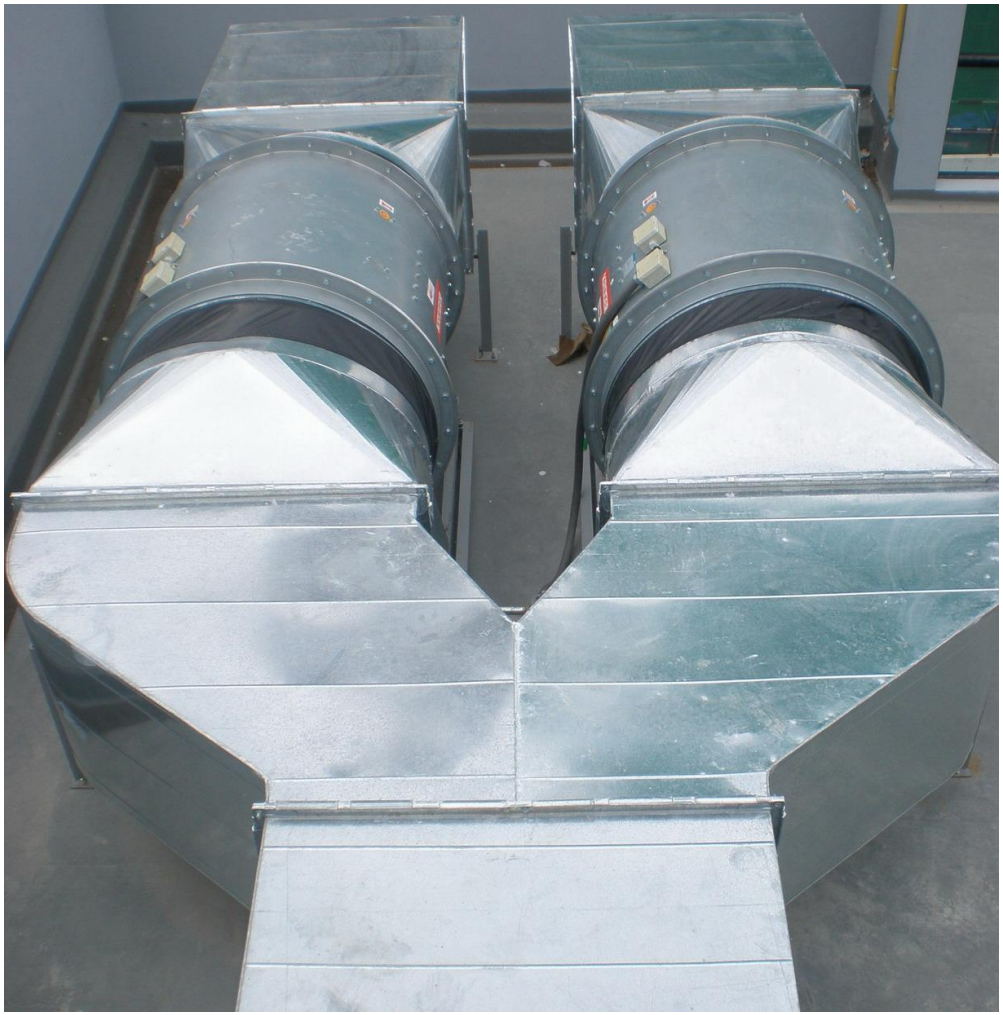

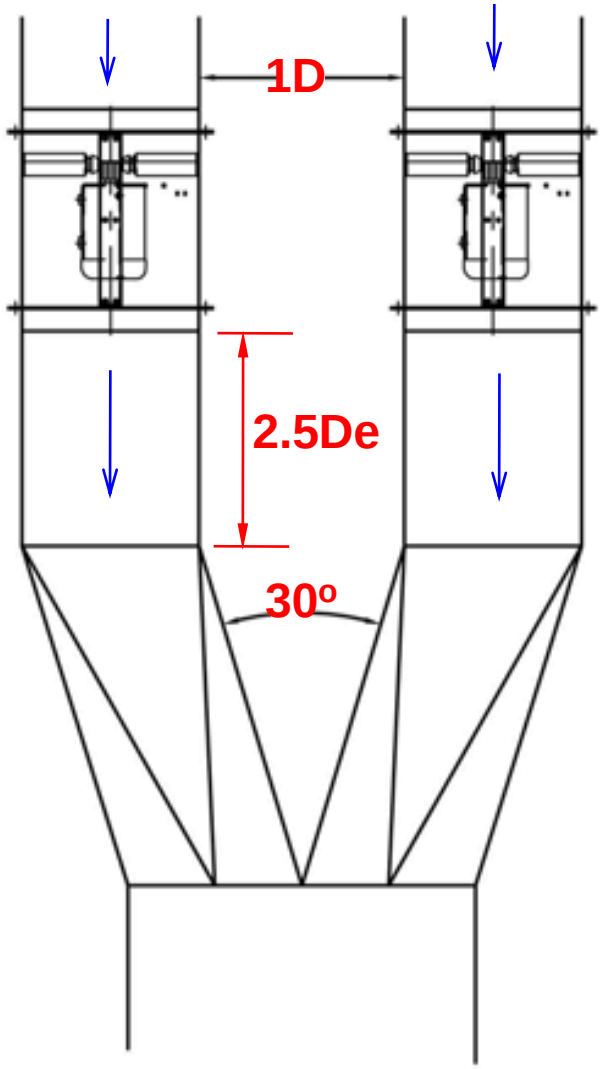


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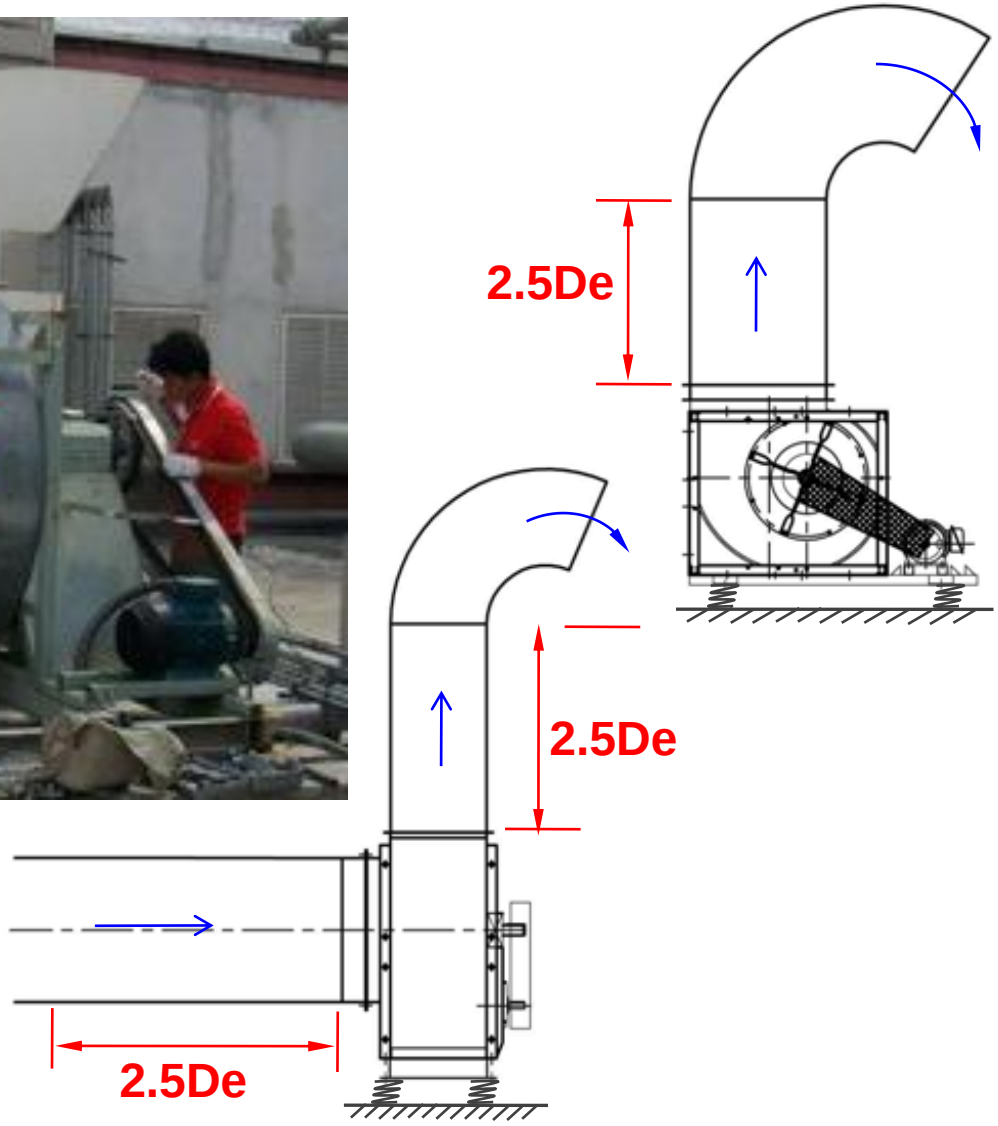


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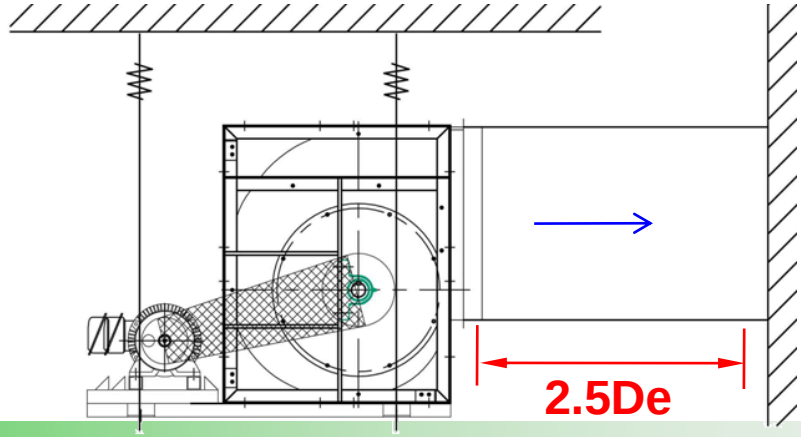


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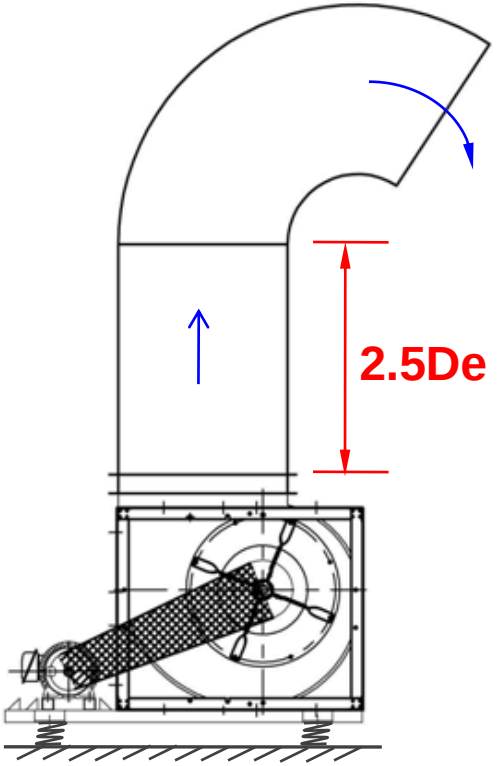


Outlet Fan

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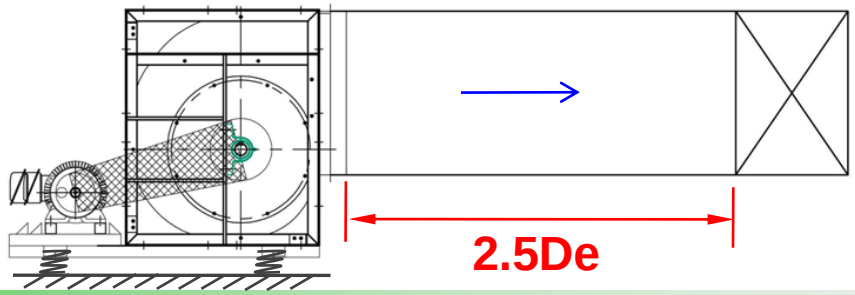


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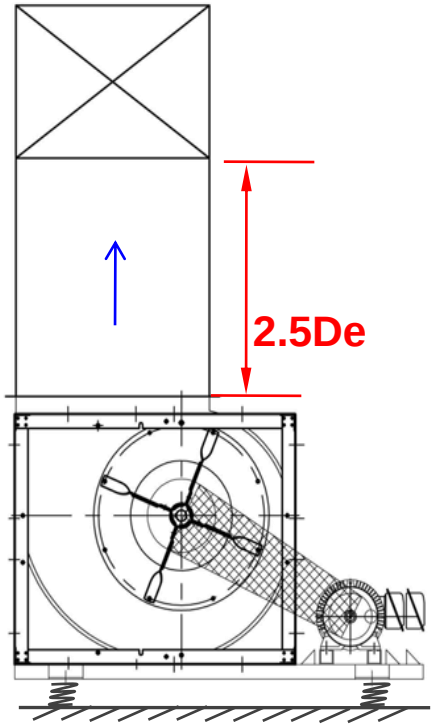


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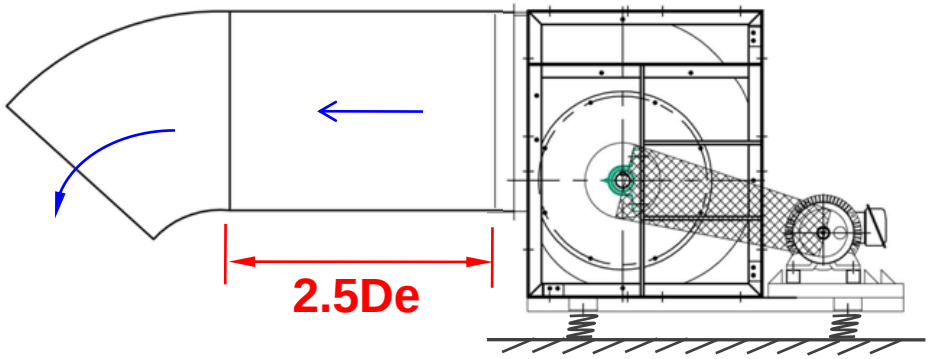


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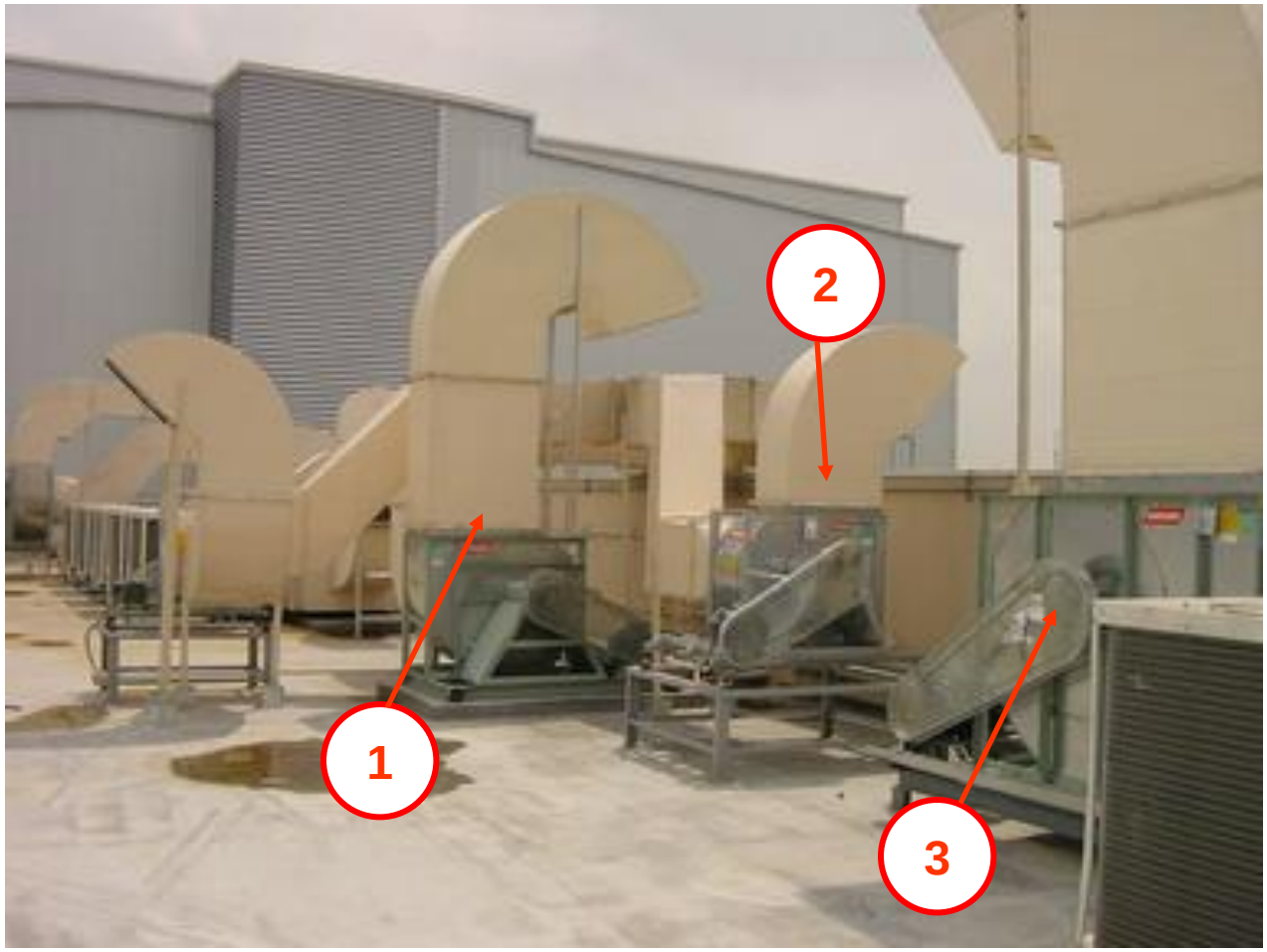


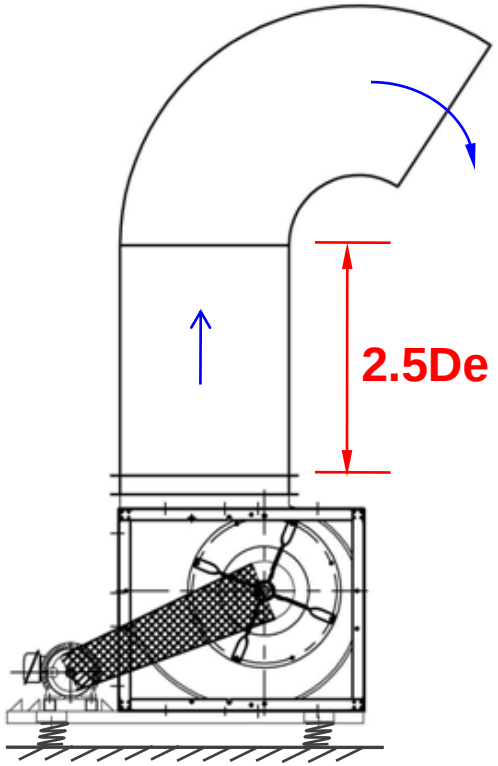


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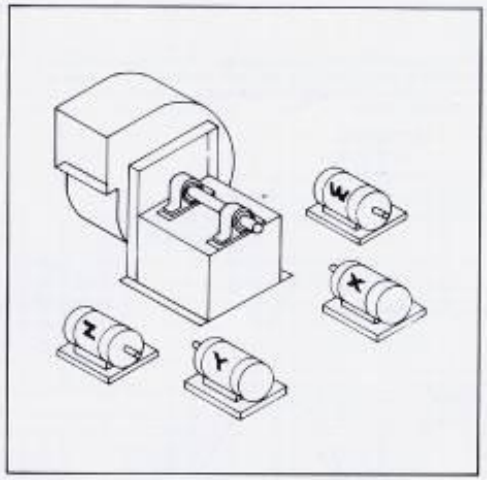
**Notes:**

1. Direction of rotation is determined from drive side of fan.
2. On single inlet fans, drive side is always considered as the side opposite fan inlet.
3. On double inlet fans with drives on both sides, drive side is that with the higher powered drive unit.
4. Direction of discharge is determined in accordance with diagrams. Angle of discharge is referred to the vertical axis of fan and designated in degrees from such standard reference axis. Angle of discharge may be any intermediate angle as required.
5. For fan inverted for ceiling suspension, or side wall mounting, direction of rotation and discharge is determined when fan is resting on floor.

| AMCA STANDARD 99-2406-83 | DESIGNATIONS FOR ROTATION AND DISCHARGE OF CENTRIFUGAL FANS | Adopted 2-22-83 / Reviewed |
|---|---|---|




Location of motor is determined by facing the drive side of fan and designating the motor positions by letters W, X, Y, or Z as the case may be.

| AMCA STANDARD 99-2407-66 | MOTOR POSITIONS FOR BELT OR CHAIN DRIVE CENTRIFUGAL FANS | Adopted 11-30-66 / Reviewed 1983 |
|---|---|---|

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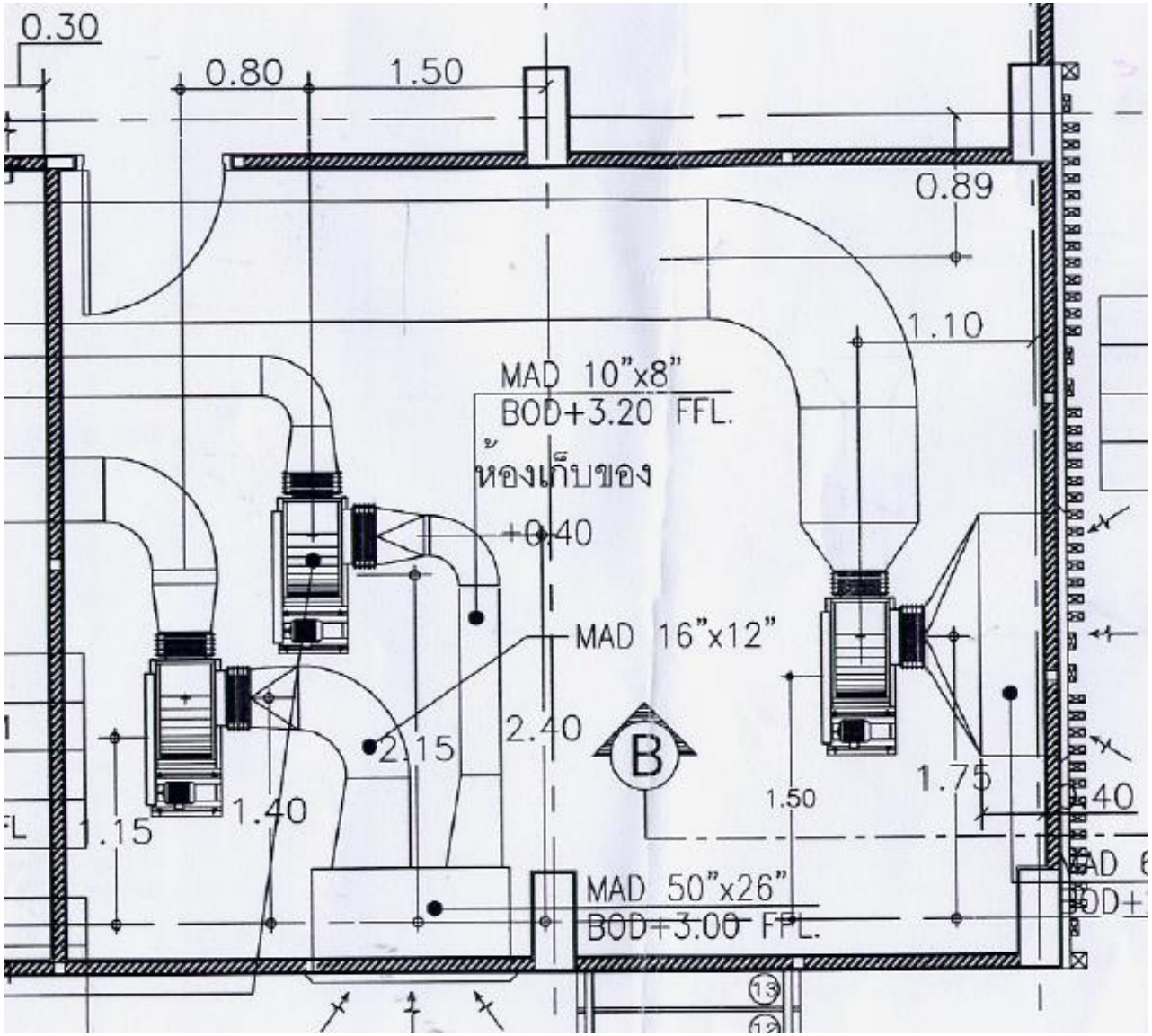


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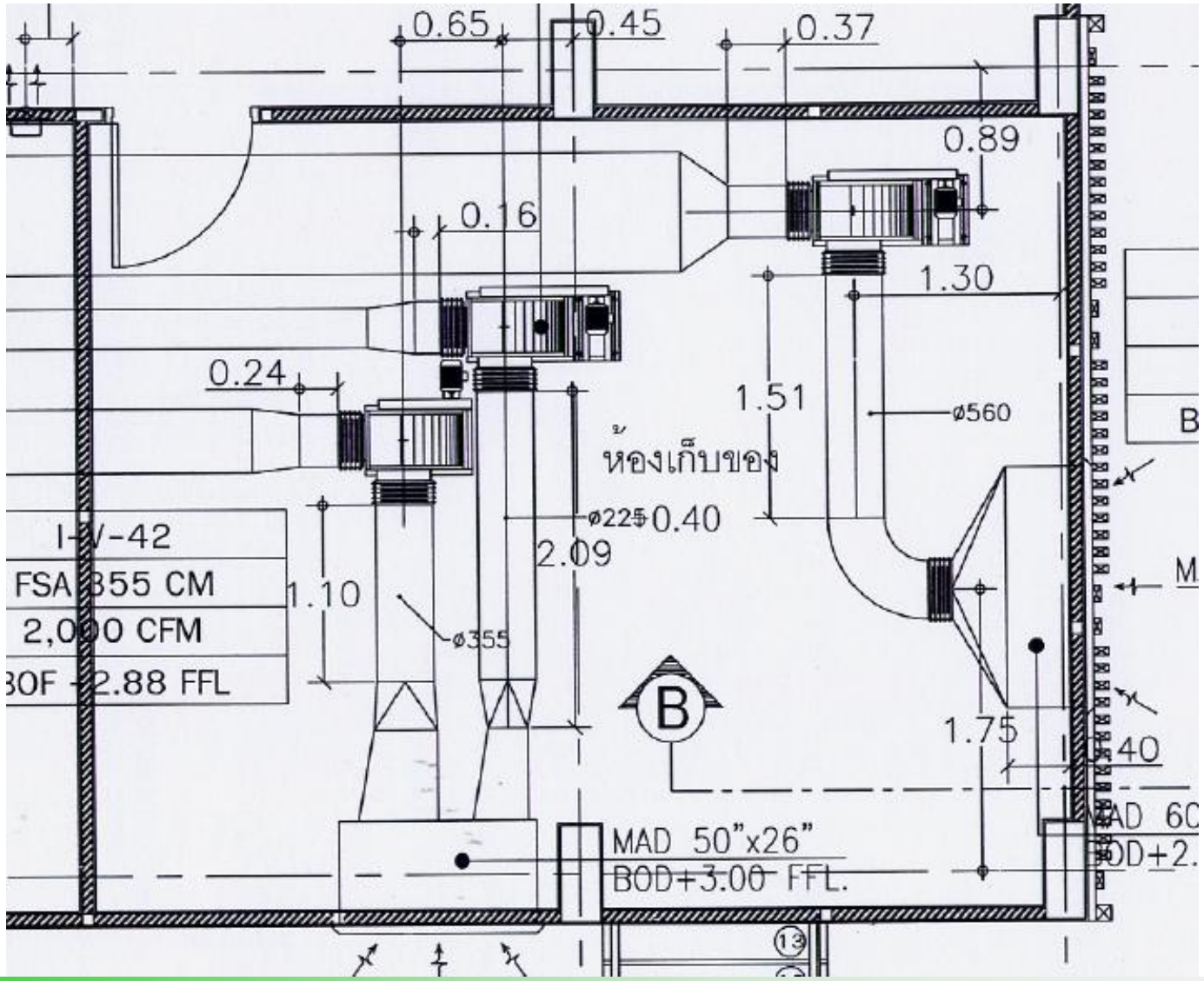


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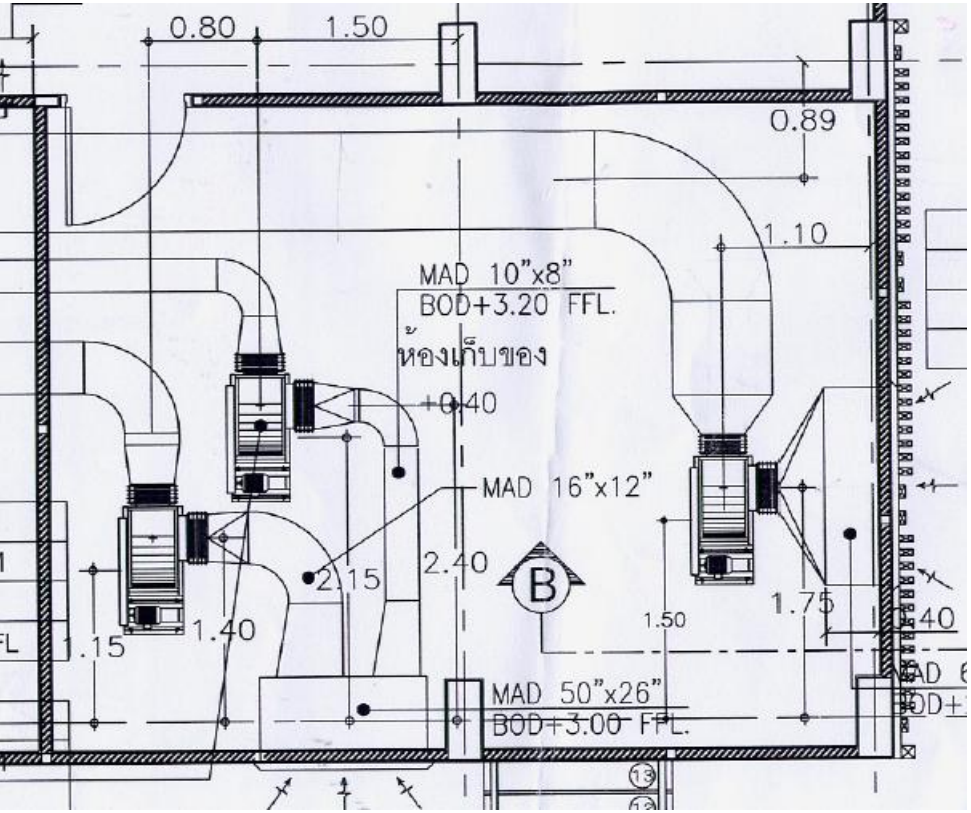


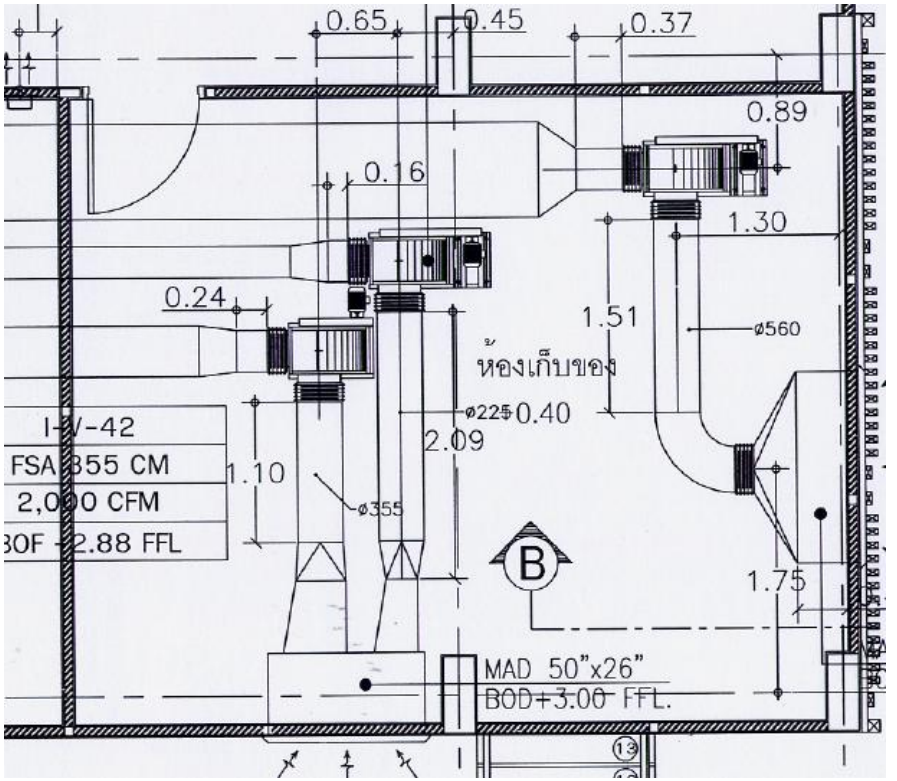


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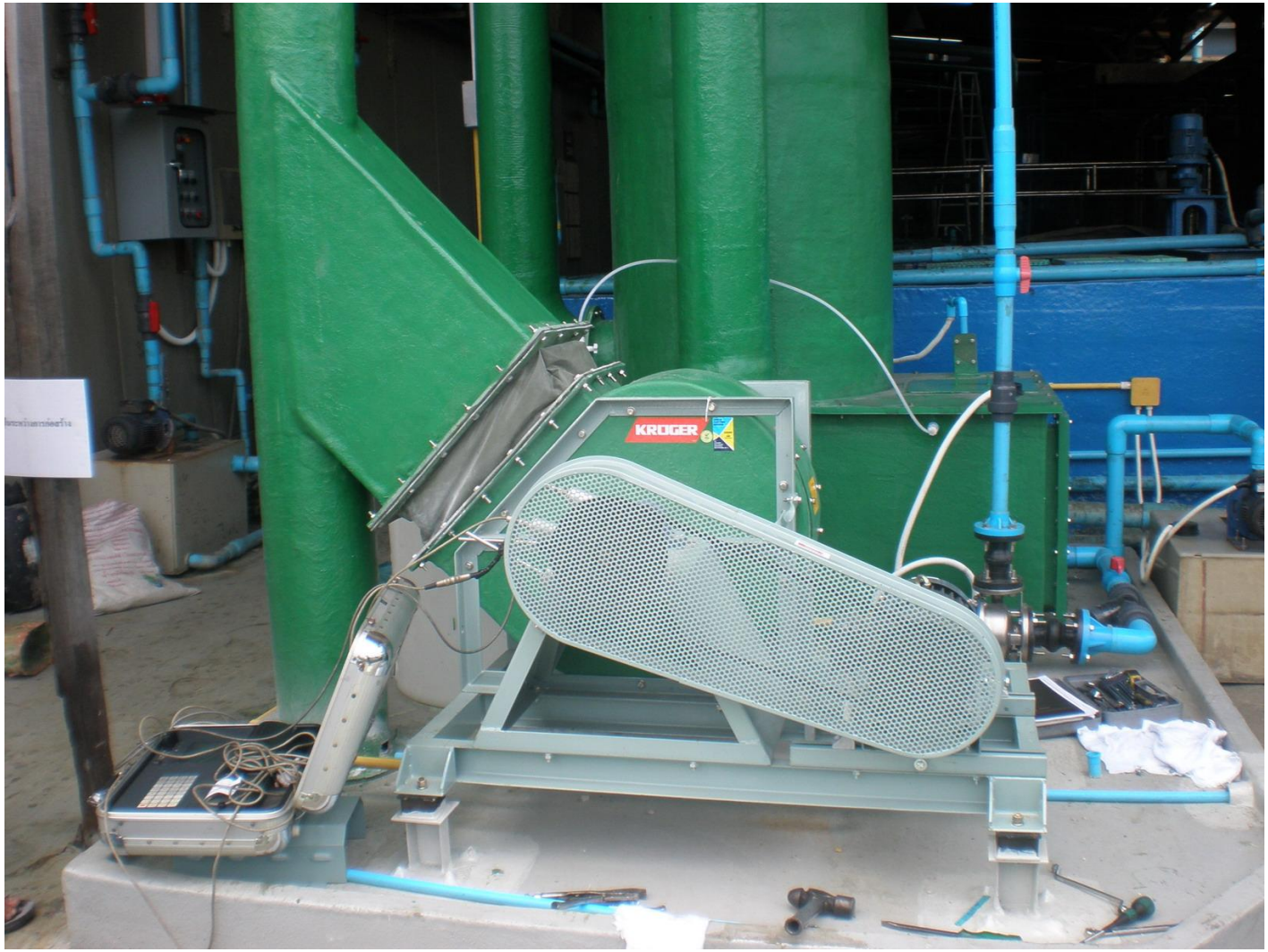


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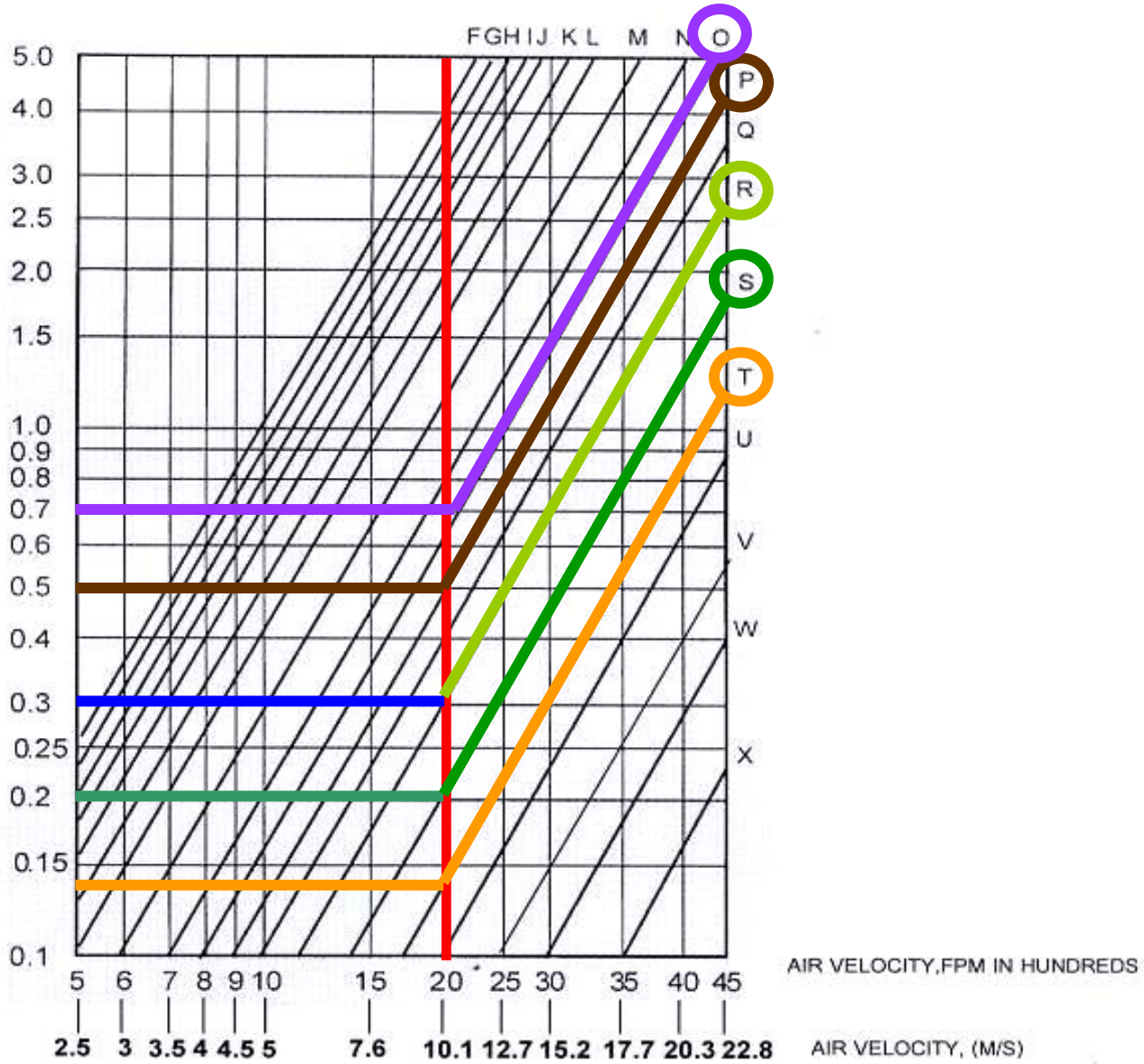


# System Effect Curves

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# 節 能 策 略

風機節能是整個系統節能的一部分，科祿格提供了：

1. 高效的風機
2. 廣泛的產品– 不同的設計點需要不同類型的風機
3. 技術的支援 – 確保風機和系統達到完善的匹配
4. 量身訂做的系統及其調整與平衡

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# Q & A

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