
고기집 '연기흡입덕트' 시공
덕트 형상 개선을 통한 비용 최소화
<냄새과 함께 사라지다>
조장 : 김병기
조원 : 이민규
장성균
Unique Boy


-http://s3not.byus.n
(photo by. ㅇㅌㅇ)


고기!!
고기
!!!!!!
우우!!
햄 보케!
고
기
!!!!!
우우!!


10 7:04PM


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점심특선


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Contents

1. Problem Statement

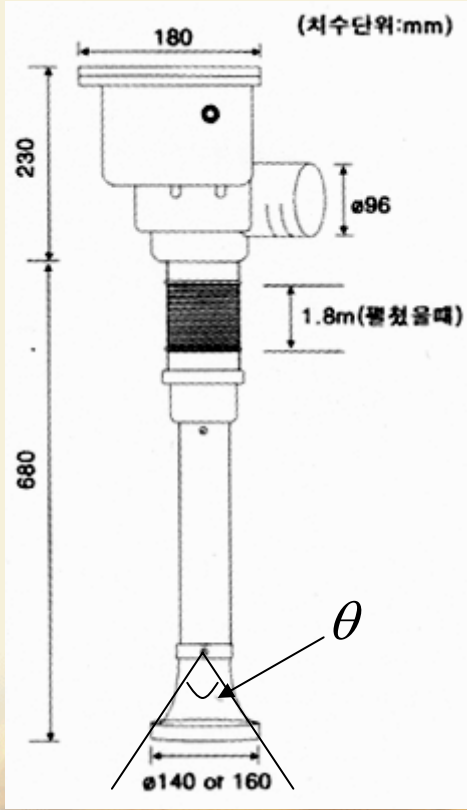
- Design the geometry of duct which can reduce material cost without any other additional cost, e.g. power consumption, purchasing of more powerful fan.
- The new duct shoud be operated at least the same performance of the exist one.
- Material cost is directly related to the surface area of the sheet metal.

2. Data and Information Collection

- 속도: $V_1 = 8.5\ \mathrm{m/s}$
- 점성계수: $\mu = 1.708 \times 10^{-5}\ \mathrm{kg/m \cdot s}$
- 밀도: $\rho = 1\ \mathrm{kg/m^3}$
- 후드의 각도: $\theta = 35°$
- 후드입구의 마찰계수:

  $K_3 = 0.26$ ($\theta = 35°$일 때)
- 덕트 내부의 조도:

  $e = 0.15\ \mathrm{mm}$ (아연도금강관)

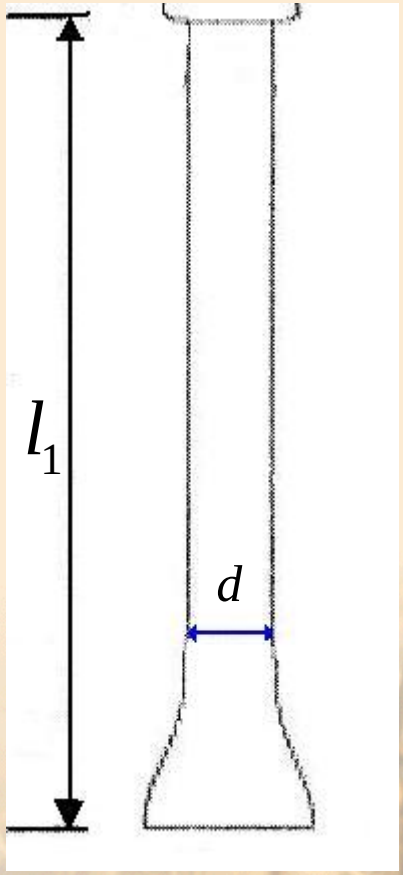


모델명	소비전력 Z_p	풍량 $Q_{\min}$	길이 (접었을 때, 모터길이 제외)	내부 지름	정압 $\Delta P_{\min}$
PC140F	50 W	240 ㎥/h	776 mm	Ø100 mm	23 mmAq

(출처: 다나와공구)

3. Design Variables

- d : diameter of the duct (m)
- l_1 : length of the duct between hood and ceiling (m)



4. Cost Function

- Total surface area of the sheet metal

$$\underset{d,\, l_1}{\text{Minimize}}\ f = \pi d l_1$$

5. Constraints

$$g_1 = -\frac{\pi}{4} d^2 V_1 + Q_{\min} \le 0$$

$$g_2 = \Delta P \cdot Q - Z_P \le 0$$

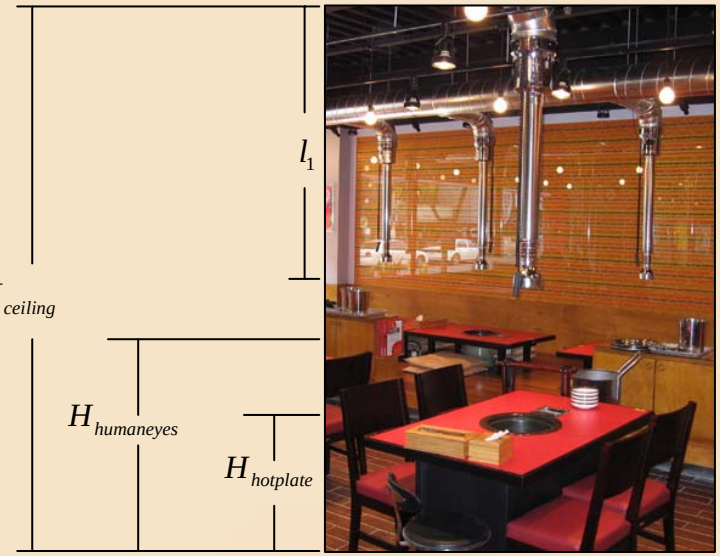
$$= \left\{ \Delta P_{\min} + \rho g \left(h_L + h_m \right) \right\} \cdot \frac{\pi}{4} d^2 V_1 - Z_P \le 0$$

where $h_L = 0.0055 \left[1 + \left(20000 \frac{e}{d} + \frac{\mu \cdot 10^6}{\rho V_1 d} \right)^{\frac{1}{3}} \right] \frac{V_1^2}{2g} \frac{l_1}{d}$

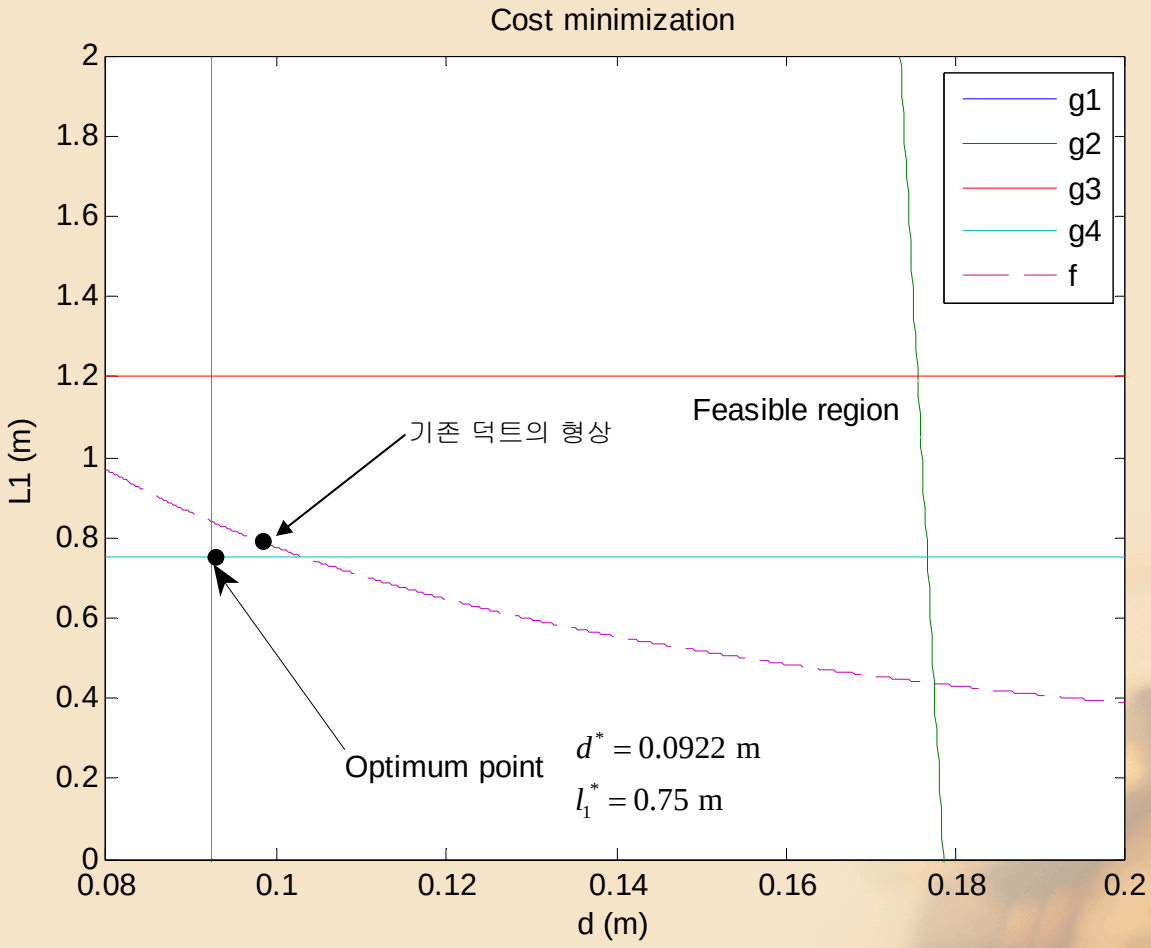
$$h_m = K_3 \frac{V_1^2}{2g}$$

$$g_3 = l_1 - H_{ceiling} + H_{humaneyes} \le 0$$

$$g_4 = H_{ceiling} - l_1 - H_{hotplate} - L_{regular} \le 0$$



6. Optimization




Master plan
Optimization
Plan #3
Plan #2
Plan #1