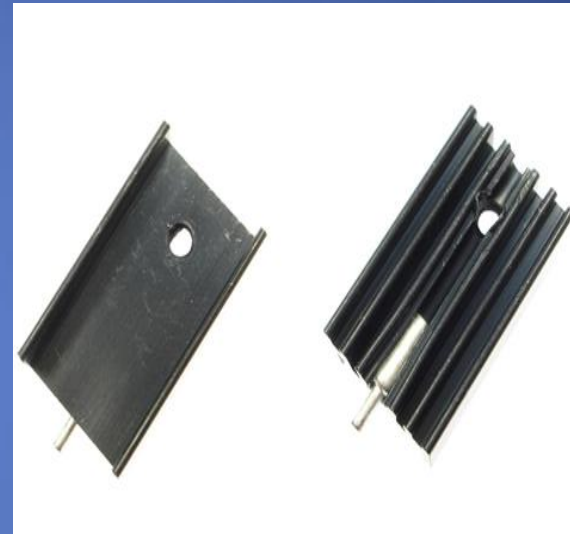
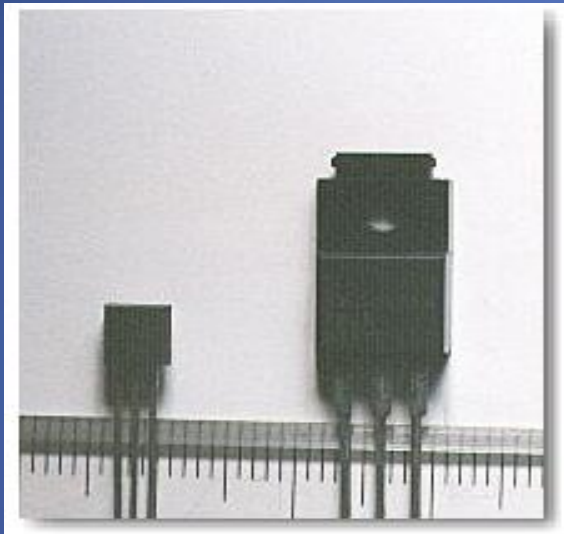


Regulator Heat Sink Design



7th December
S & O (6sigma & optimization)

- 2003006535 홍윤기 (조장)
- 2003007000 정현욱

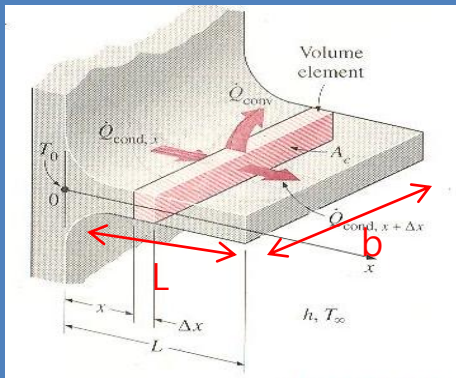
Contents

1. Introduction of the previous design
2. Complement the previous design
3. Optimum point depends on initial values
 - Initial value of the infeasible region
 - Initial value of the feasible region
4. Compare between the previous & current design
5. Comments

Introduction of Fin Design

- The previous Design

Variables & objective function



- 기하학적 형상 변형을 위한 설계 변수
b(Height) & L(Length)
- 최소 단가(Cost)를 위한 목적 함수 (부피 최소화)

$$V = ALn = btL \frac{a \left(\frac{q\beta(T_b - T_\infty)}{\nu^2} Prb^3 \right)^{0.25}}{t + 2.714 \frac{b}{\left(\frac{q\beta(T_b - T_\infty)}{\nu^2} Prb^3 \right)^{0.25}}} = btL \frac{a \left(\frac{q\beta(T_b - T_\infty)}{\nu^2} Prb^3 \right)^{0.25}}{t \left(\frac{q\beta(T_b - T_\infty)}{\nu^2} Prb^3 \right)^{0.25} + 2.714b}$$

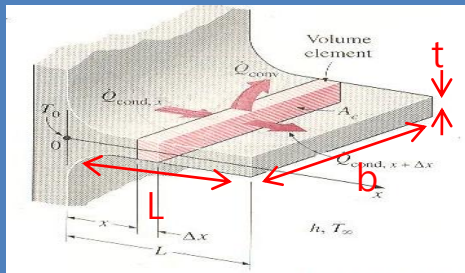
Constraints

- G1. 방열판의 전체 방열량은 0.7 W 이상
- G2. 방열판의 전체 효과는 1.0 이상
- G3. 방열판의 Fin과 Fin의 간격은 최소 간격 S
- G4. 방열판의 Fin은 일정 길이 이상으로는 효과가 없으므로 최대길이 제한
- G5. 방열판의 기하학적인 형상 제한 (핀의 형상 크기 제한)

Complement the previous design

- Complement the previous design

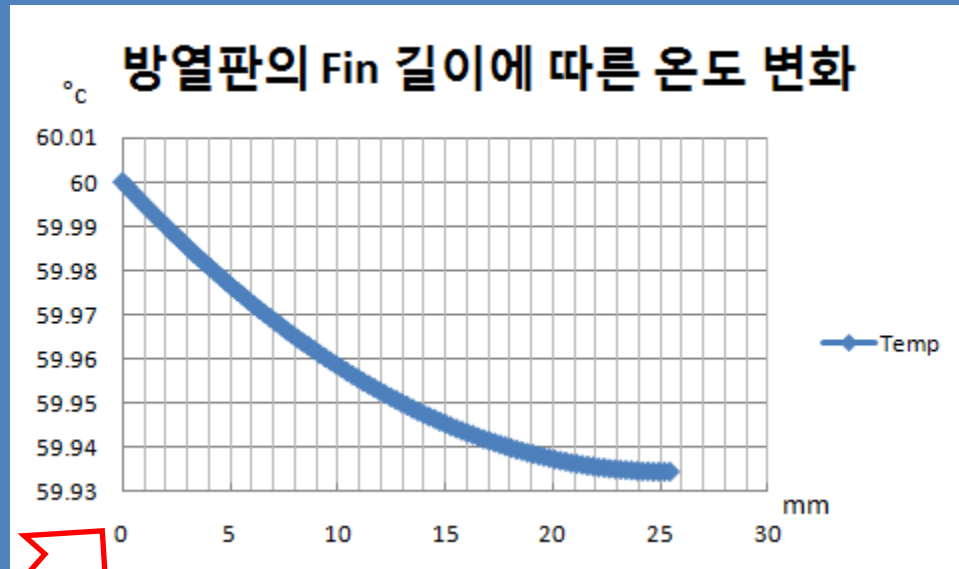
New variable



RaL Pr : 온도(대기온도+표면온도)에 따라 변화
방열판의 표면온도의 변화가 매우 미미

Nusselt Number

- 유체와 고체 표면
- Convection coef



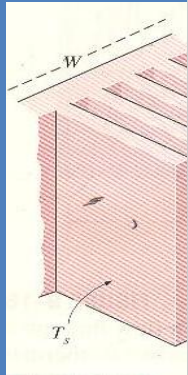
$$Nu = (0.825 + 0.387 RaL^{\frac{1}{6}}) (1 + (\frac{0.492}{Pr})^{\frac{1}{4}})^{\frac{1}{4}} \quad (10^4 \leq RaL \leq 10^{13})$$

$$h = \frac{k_{air} \times Nu}{b}$$

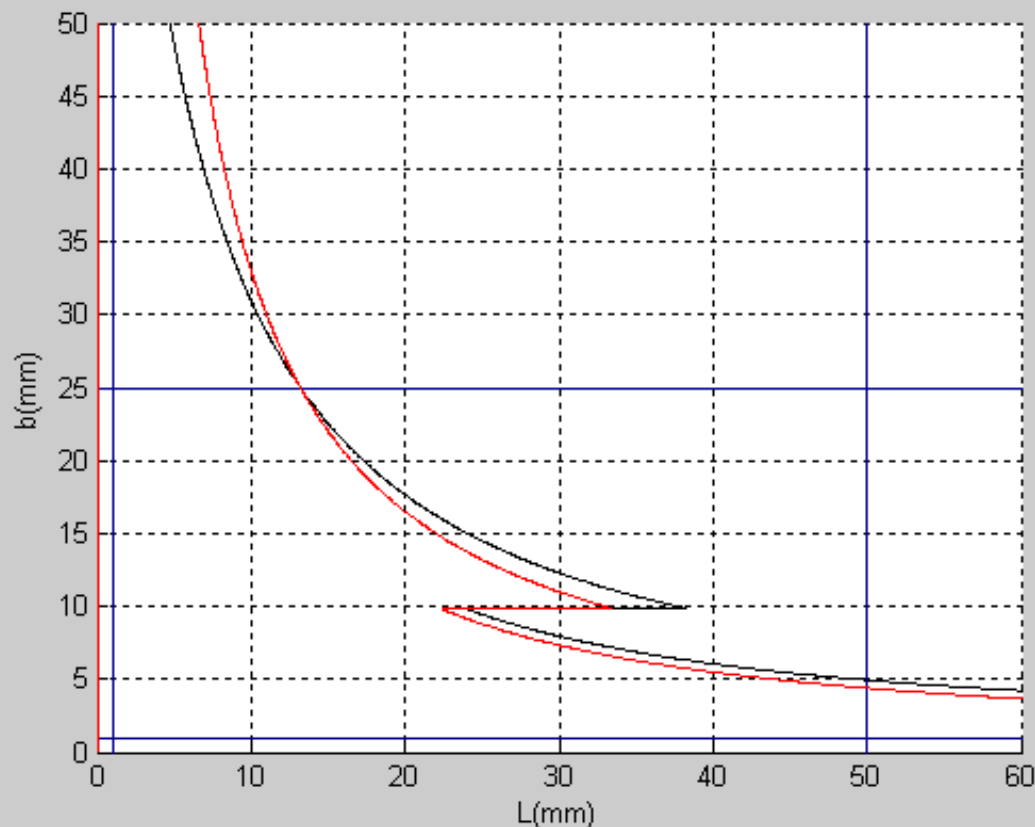
Complement the previous design

- Complement the previous design

Num



Fin의
얻은 최적



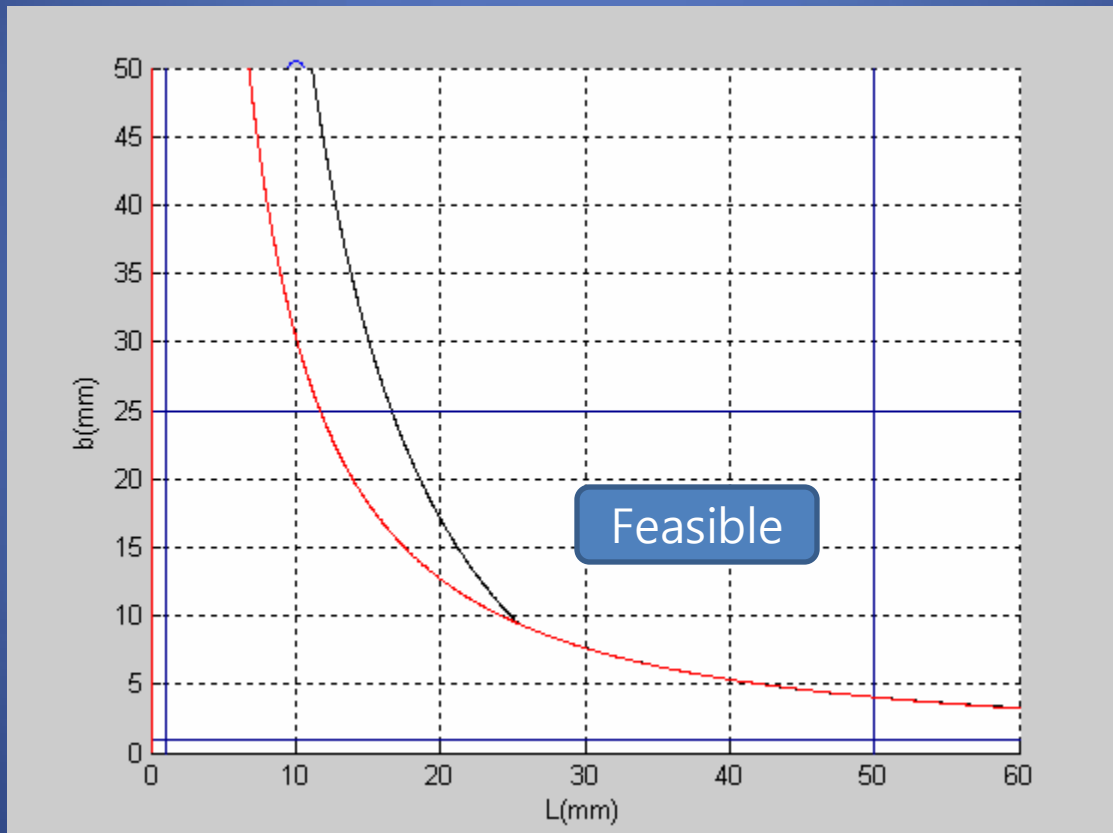
화
불가능함

$\times (n-1)$

찾음
값 찾음

Optimum point depends on initial values

- Infeasible Region ($b=50\text{mm}$, $L=10\text{mm}$, $t=1\text{mm}$)

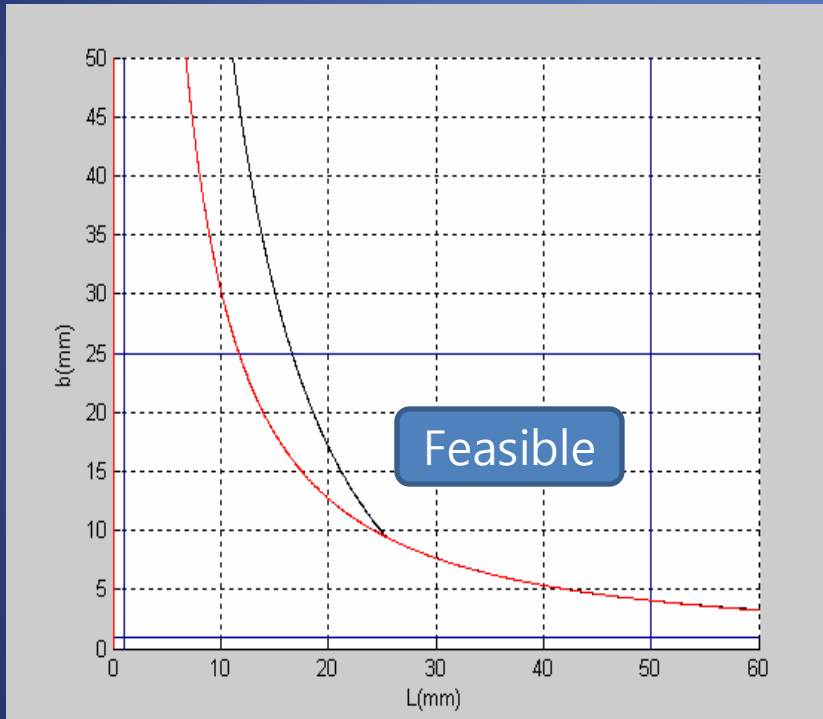


Fmincon(Matlab)

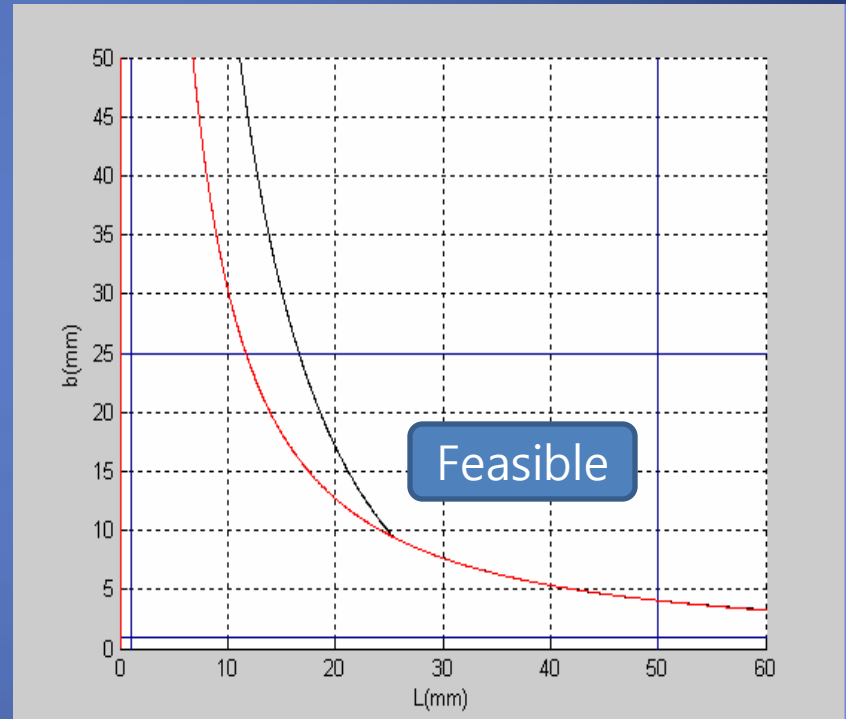
Regulator Heat Sink Design

Optimum point depends on initial values

- Infeasible Region ($b=50\text{mm}$, $L=10\text{mm}$, $t=1\text{mm}$)



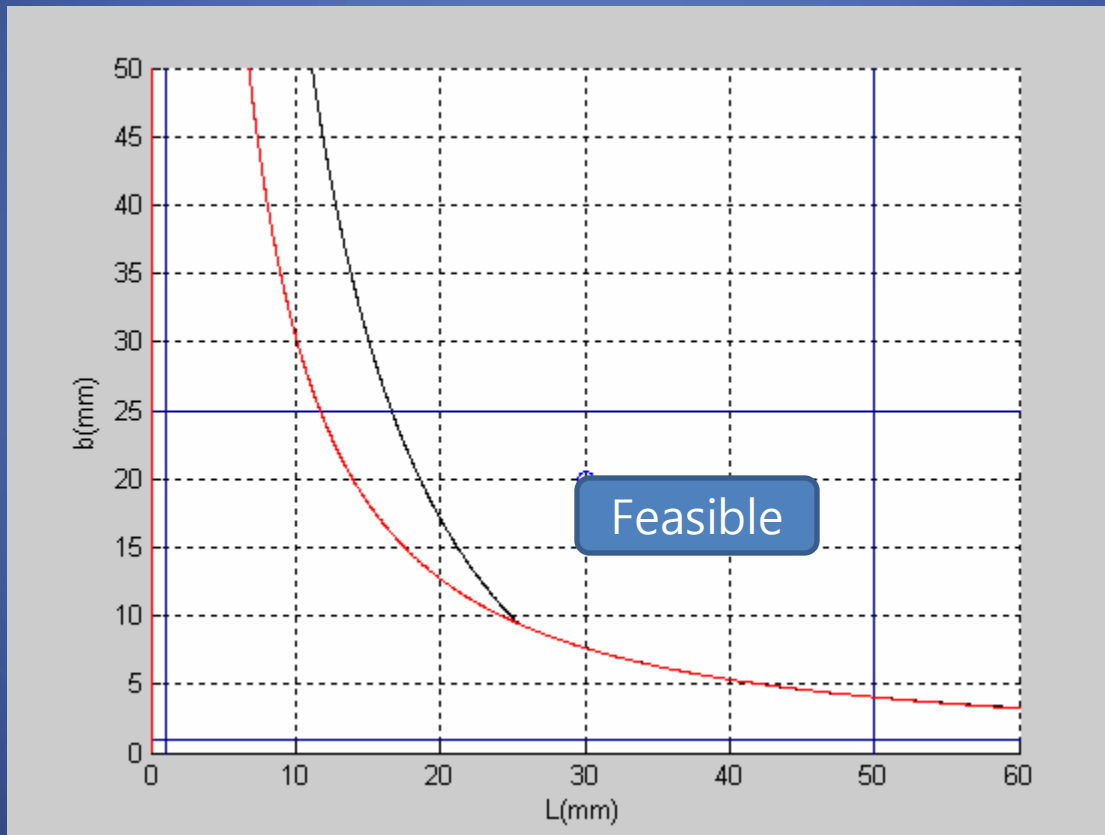
Newton (Excel)



Conjugate (Excel)

Optimum point depends on initial values

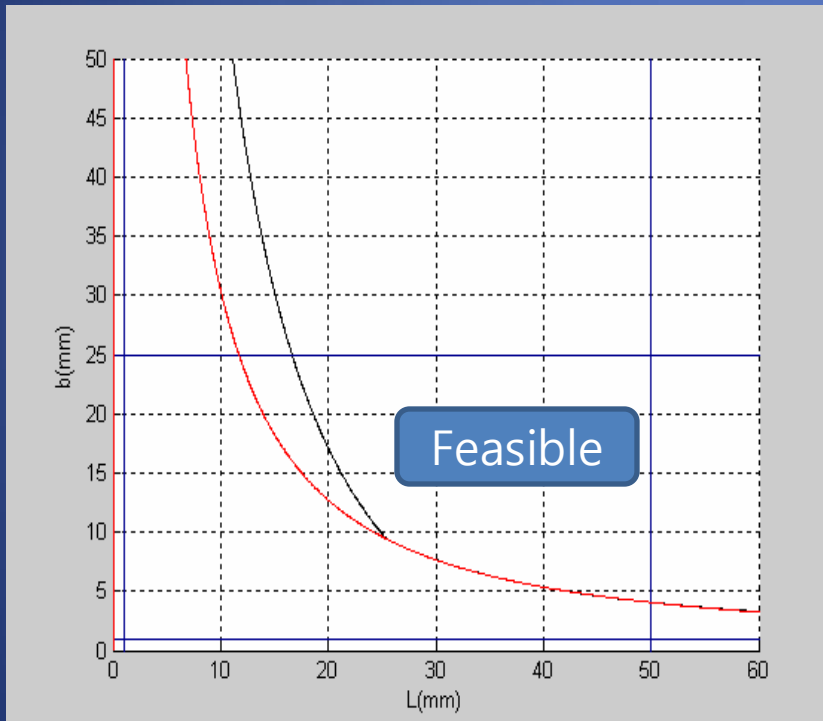
- Feasible Region ($b=20\text{mm}$, $L=30\text{mm}$, $t=1\text{mm}$)



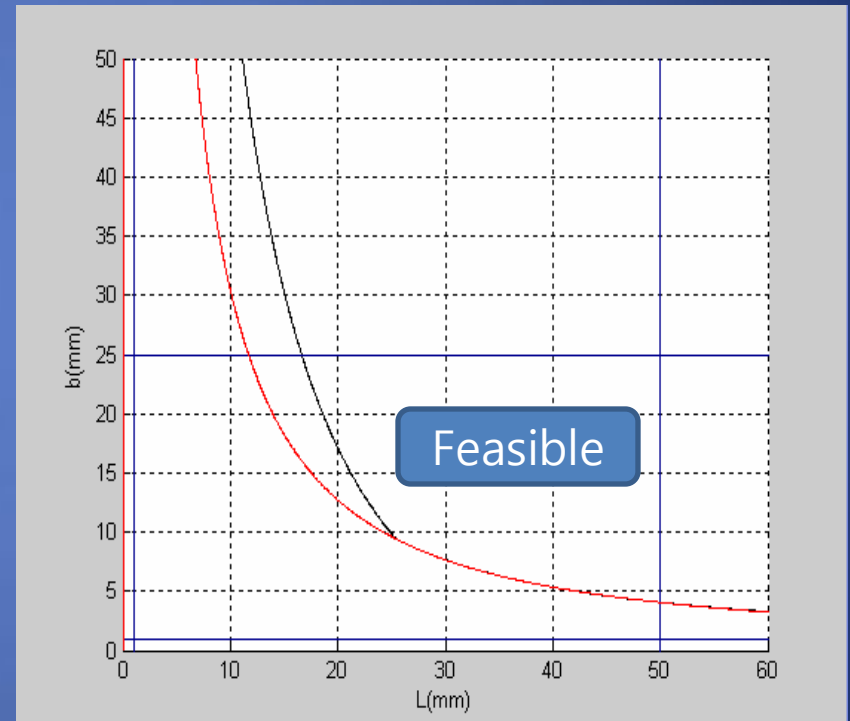
Fmincon(Matlab)

Optimum point depends on initial values

- Feasible Region ($b=20\text{mm}$, $L=30\text{mm}$, $t=1\text{mm}$)



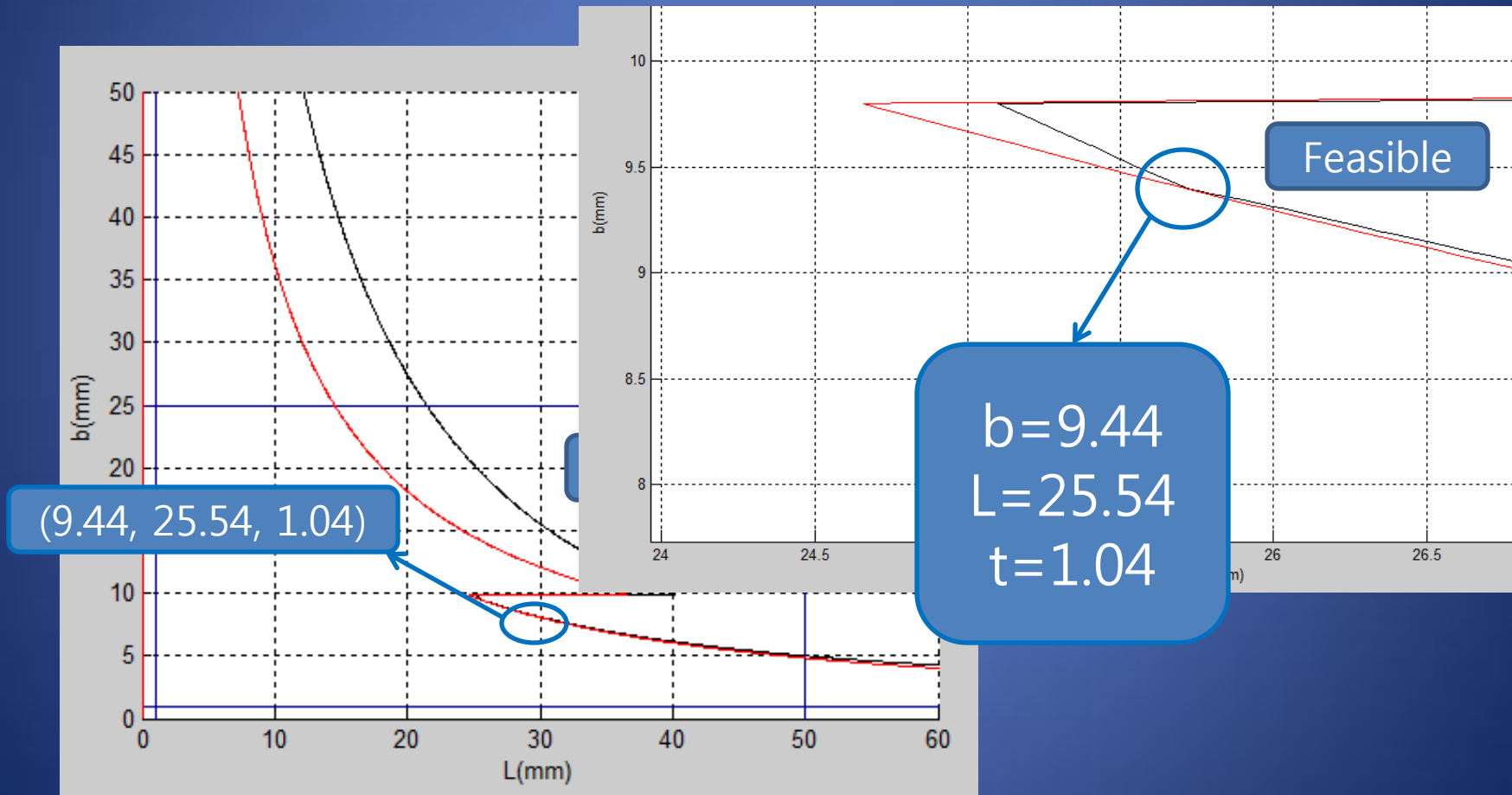
Newton (Excel)



Conjugate (Excel)

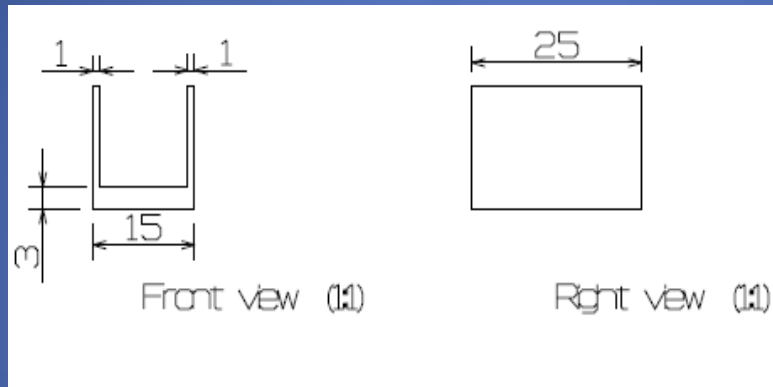
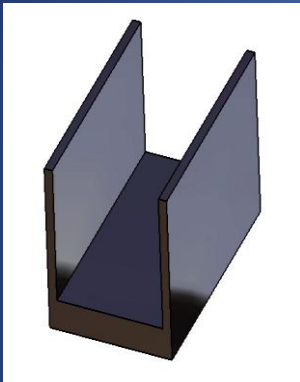
Optimum Design

- Fin의 개수를 이산화하여 최적값 재계산



Optimum design

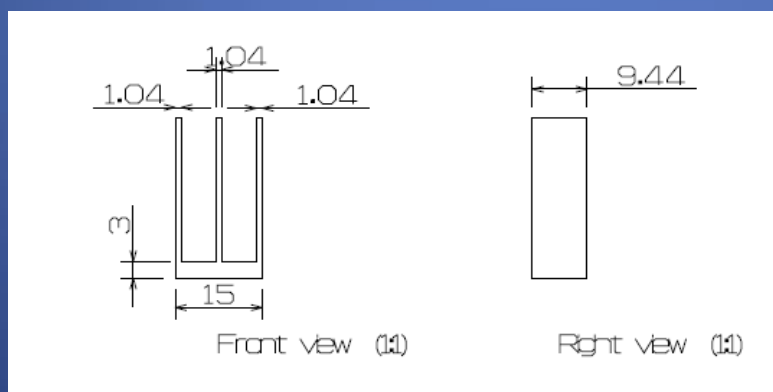
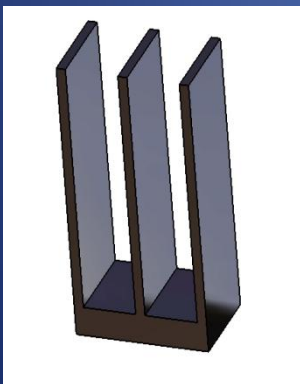
- Compare between the previous & complementary design



<Previous design>

Volume of the heat sink

666 mm³



<complementary design>

Volume of the heat sink

752 mm³

Comments

- 함수가 미분 불가능한 점이 포함될 경우 Matlab, Excel이 해를 못 찾음 => 수학적 모델링을 연속 함수로 변환
- 단위를 m단위로 다룰 경우 정확한 최적 값을 찾지 못함
=> m단위를 mm단위로 변환
- 이전 설계보다 체적이 증가했지만 타당한 이론추가에 의한 결과
- 최적 설계에 의해 체적 값은 감소했으나 실제로 fin이 회로상에 차지하고 있는 면적은 증가