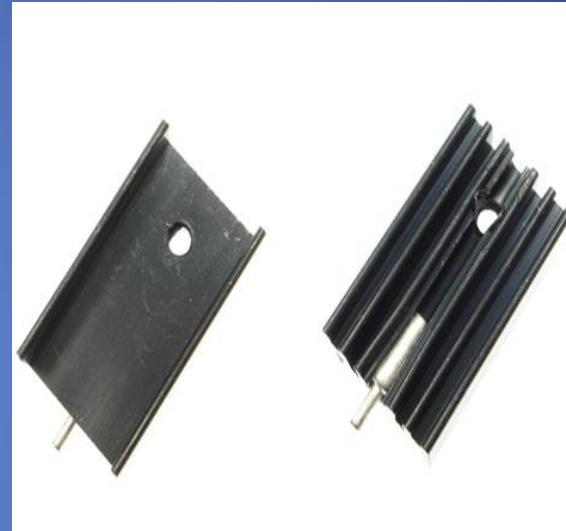
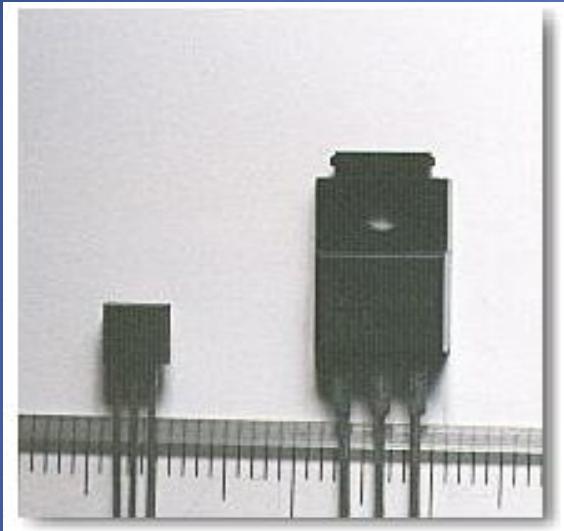


# Regulator Heat Sink Design



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

- 2003006535 홍윤기 (조장)
- 2003007000 정현욱

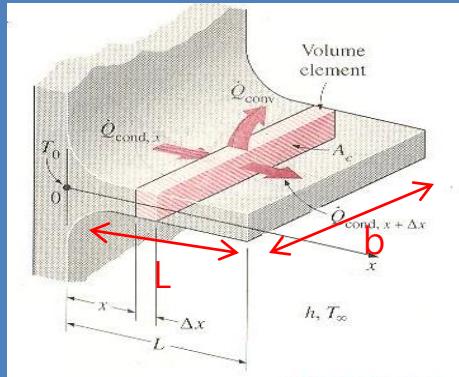
# Contents

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3. Optimum point depends on initial values
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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)

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

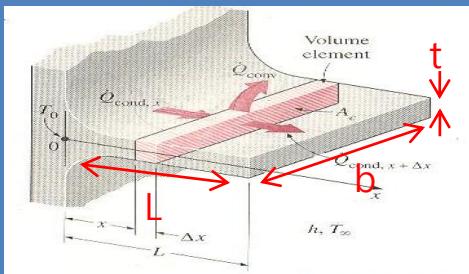
## Constraints

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

# Complement the previous design

- Complement the previous design

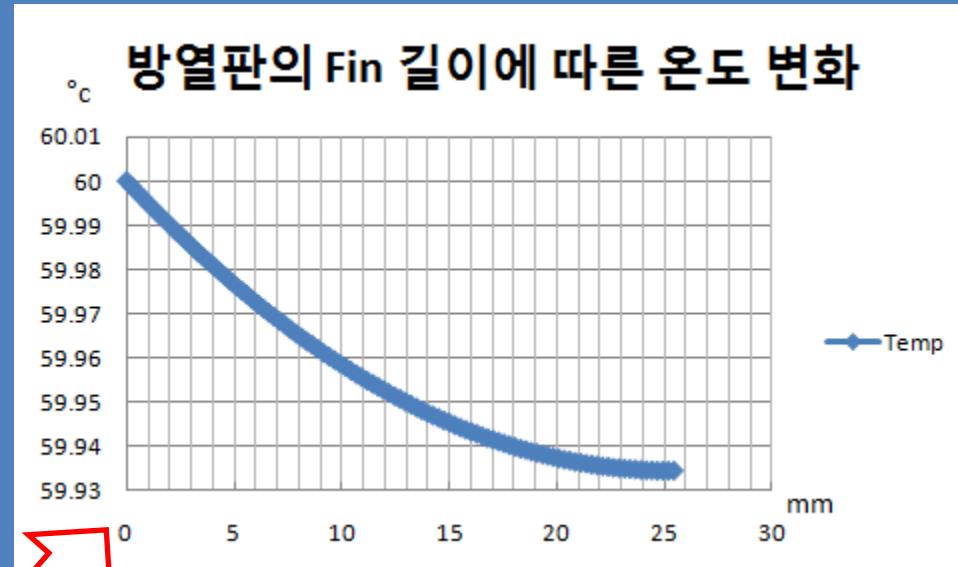
## New variable



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

## Nusselt Number

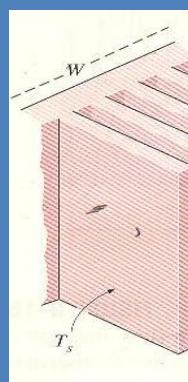
- 유체와 고체 표면
- Convection coefficient



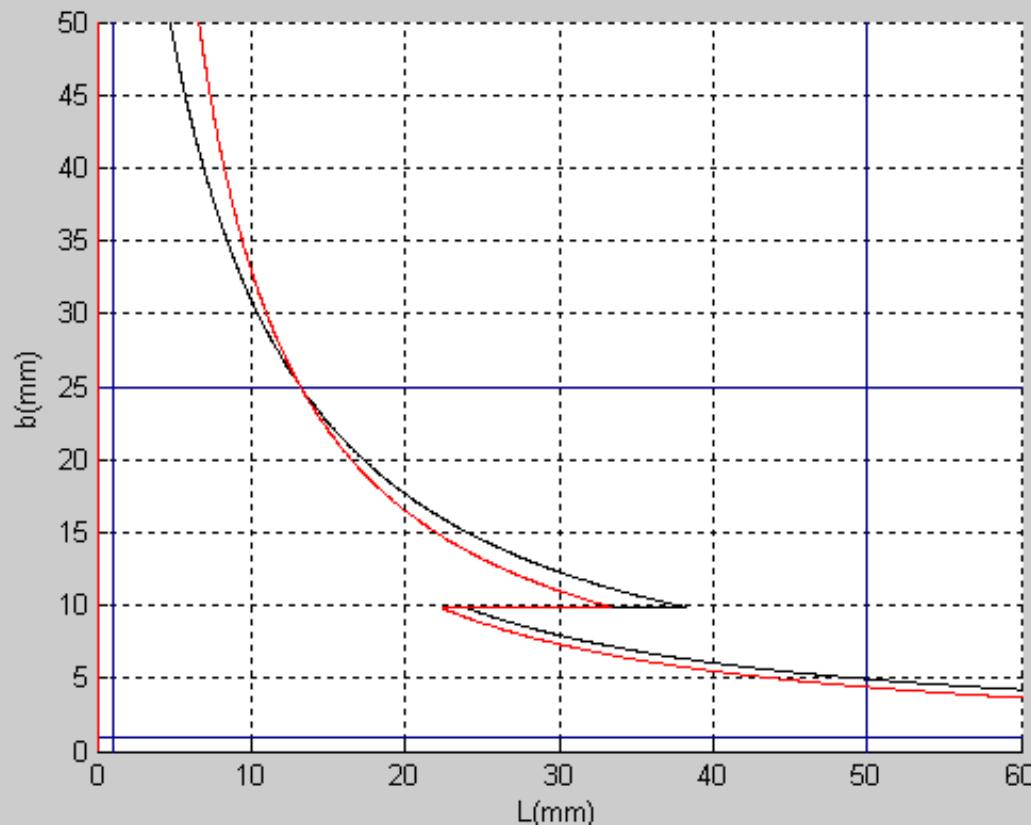
$$Nu = (0.825 + 0.387 RaL^{\frac{1}{6}}) \left(1 + \left(\frac{0.492}{Pr}\right)^{\frac{1}{27}}\right)^{\frac{1}{2}} \quad (10^4 \leq RaL \leq 10^{13})$$
$$h = \frac{k_{air} \times Nu}{b}$$

# Complement the previous design

- Complement the previous design



Num



화  
불가능함

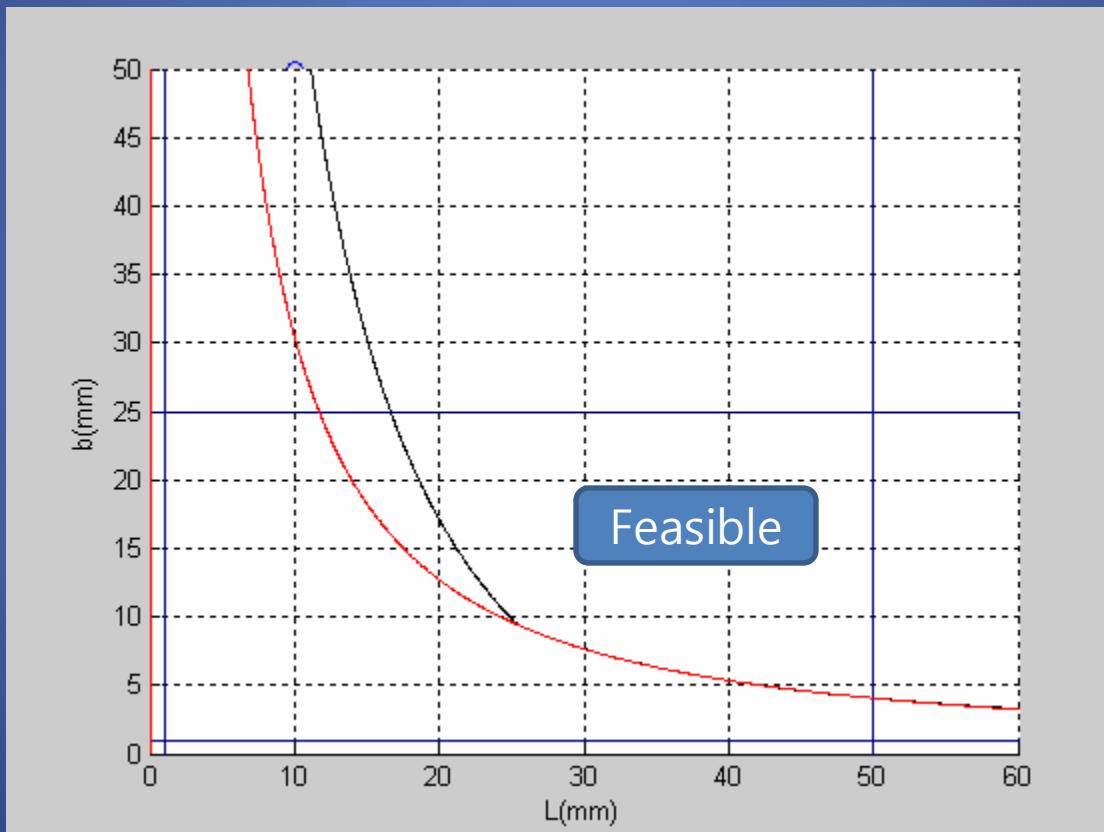
× (n - 1)

Fin의  
얻은 최적

찾음  
값 찾음

# Optimum point depends on initial values

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

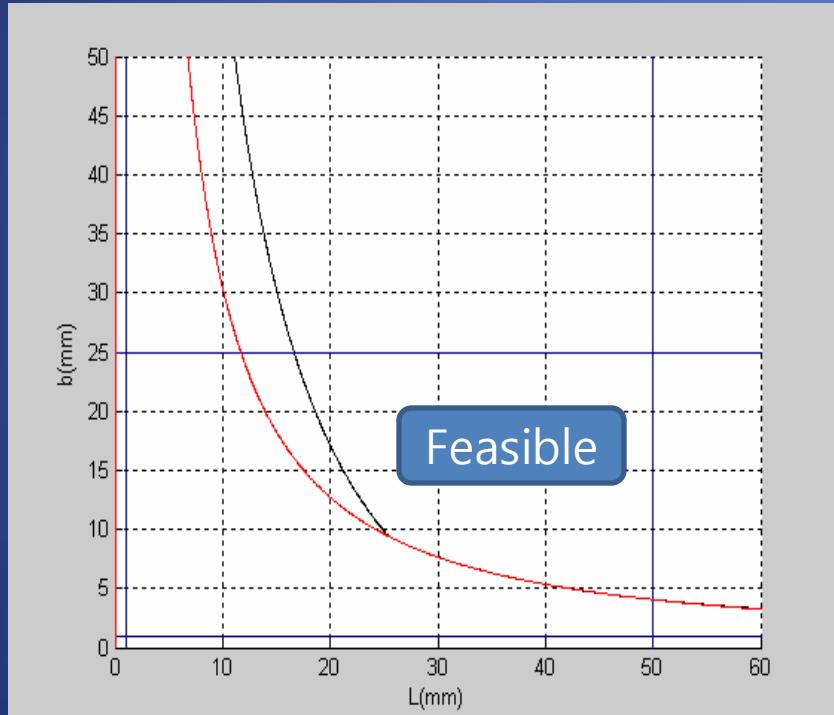


Fmincon(Matlab)

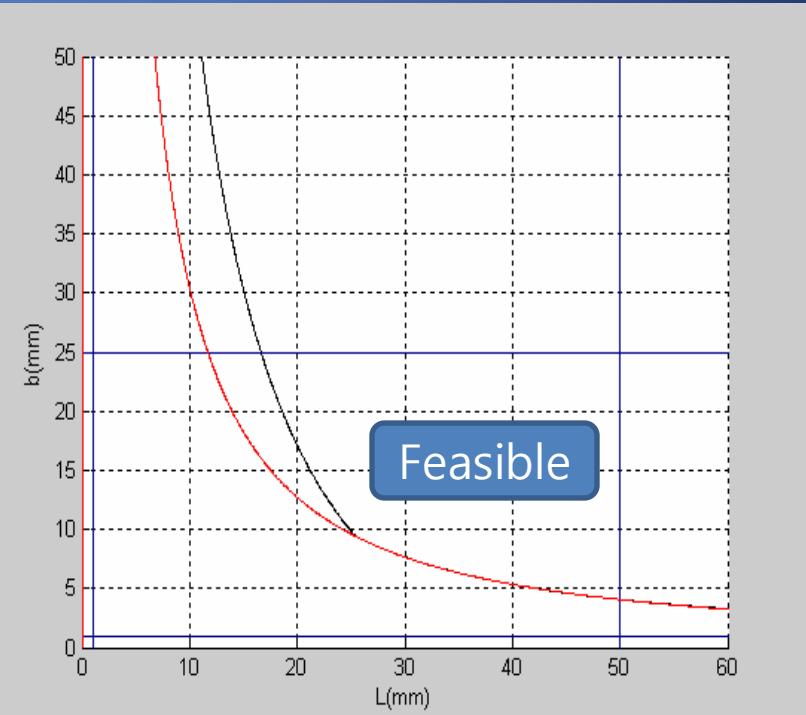
Regulator Heat Sink Design

# Optimum point depends on initial values

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



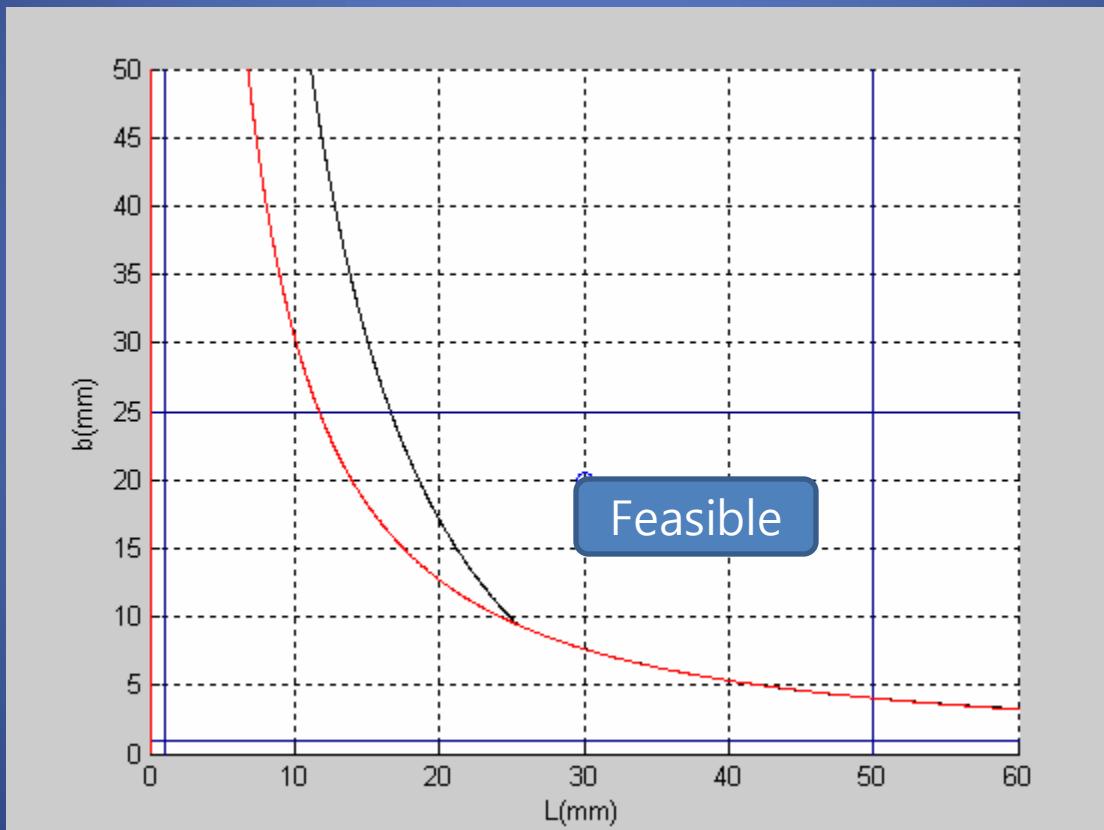
Newton (Excel)



Conjugate (Excel)

# Optimum point depends on initial values

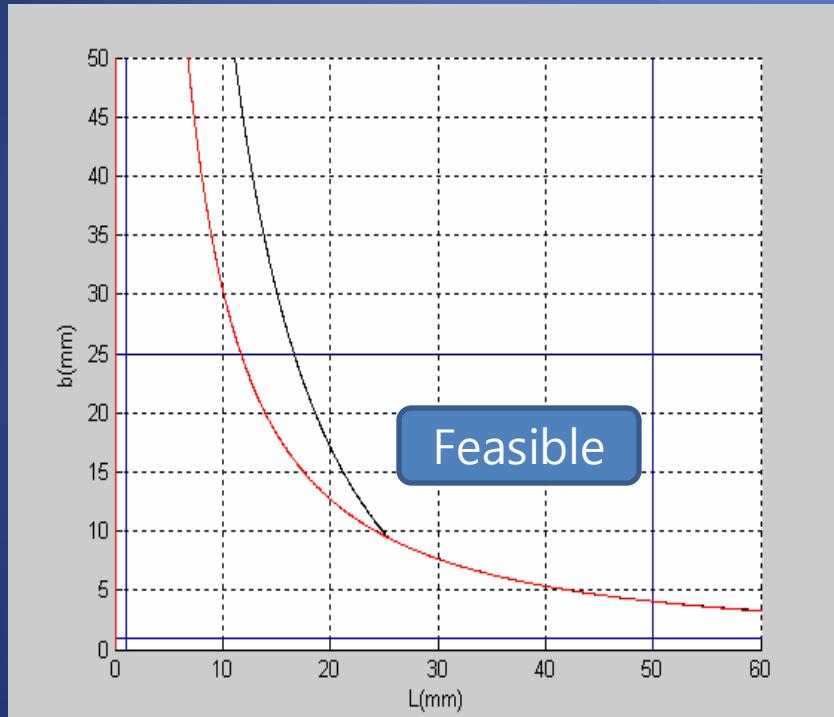
- Feasible Region ( $b=20\text{mm}$ ,  $L=30\text{mm}$ ,  $t=1\text{mm}$ )



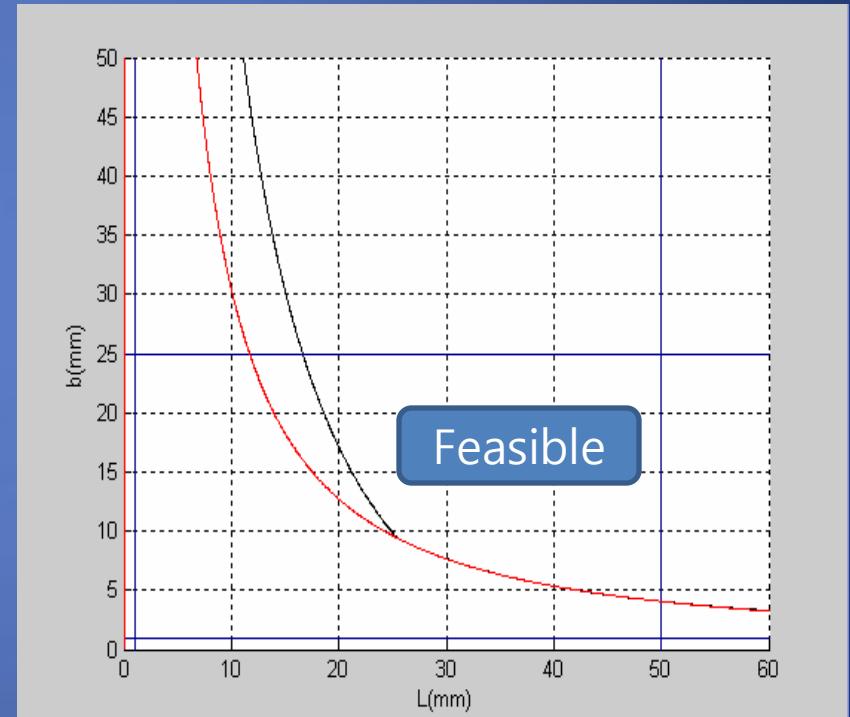
Fmincon(Matlab)

# Optimum point depends on initial values

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



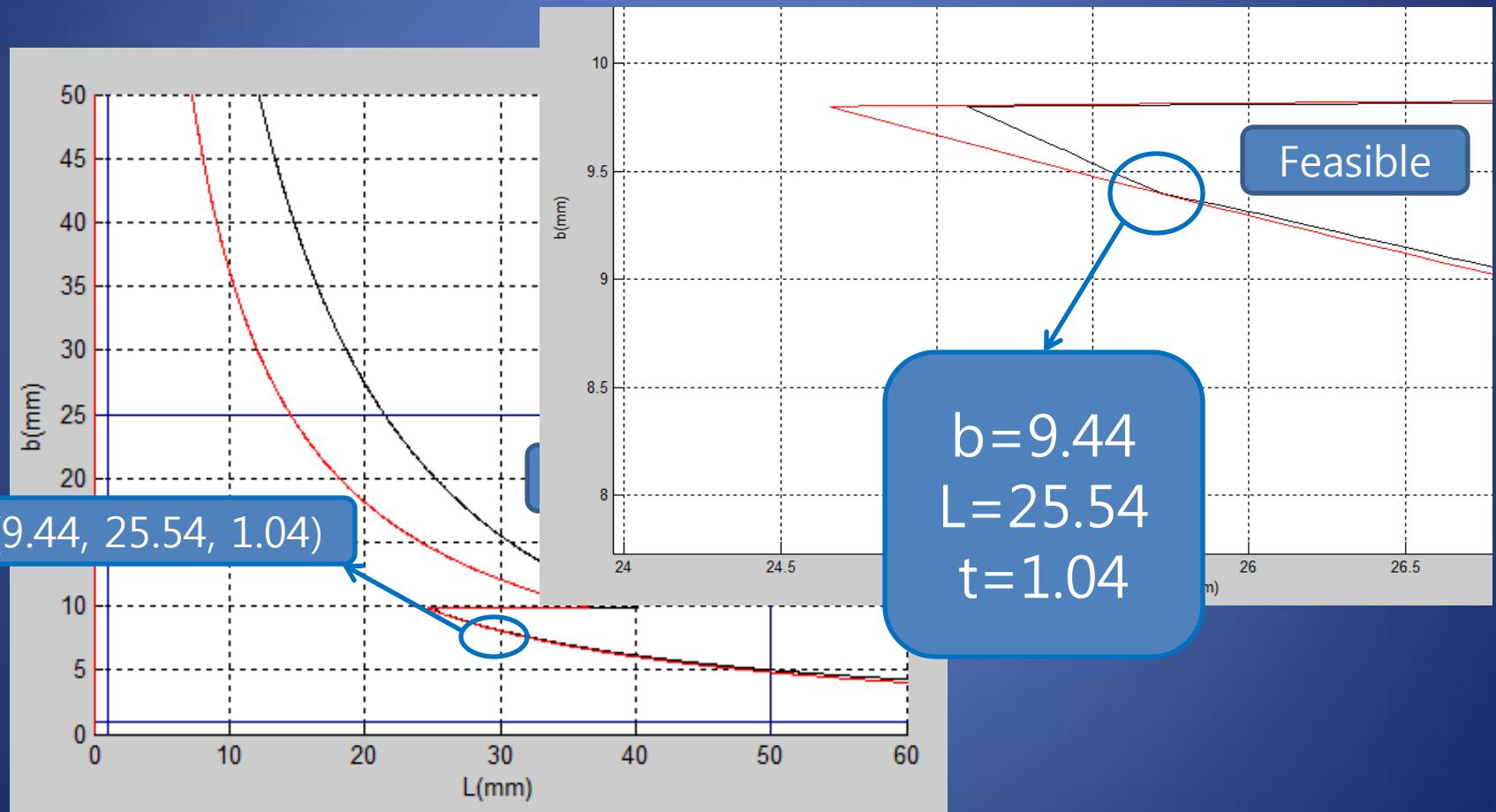
Newton (Excel)



Conjugate (Excel)

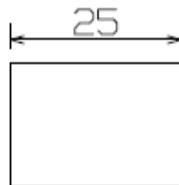
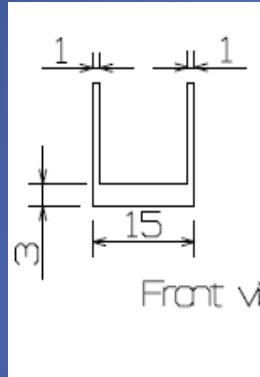
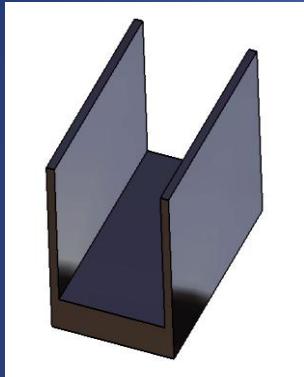
# Optimum Design

- Fin의 개수를 이산화하여 최적값 재계산



# Optimum design

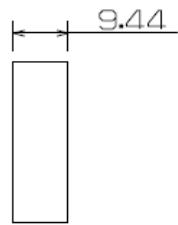
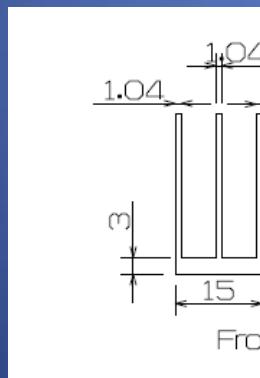
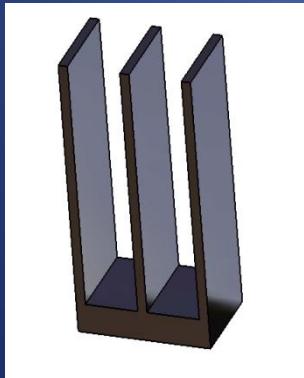
- Compare between the previous & complementary design



<Previous design>

Volume of the heat sink

666 mm<sup>3</sup>



<complementary design>

Volume of the heat sink

752 mm<sup>3</sup>

# 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