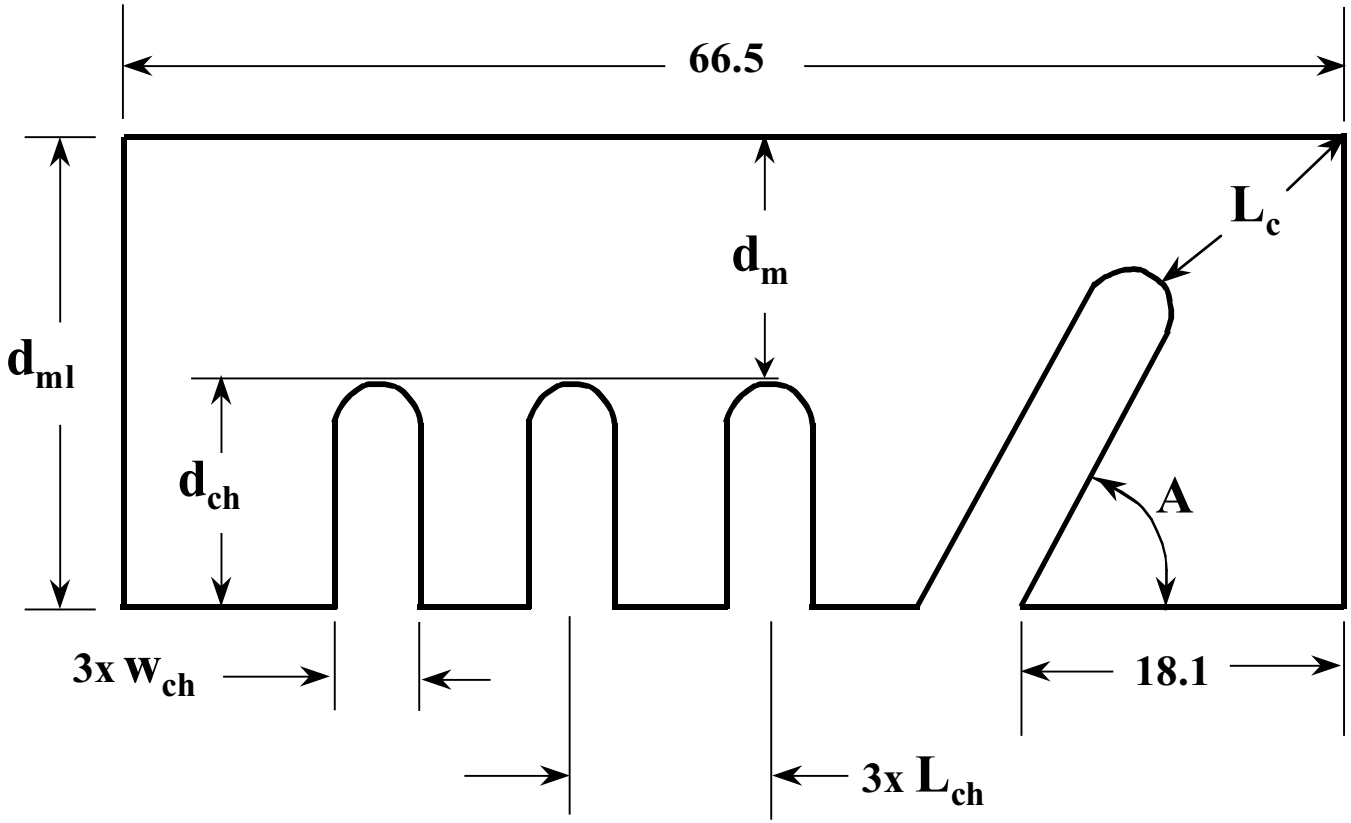
Predicting Mold Corner Temperature Based on Angled Water Slot Geometry

2D Narrow Face



Typical Dimensions

d_{ml} = 25 mm

d_{ch} = 11 mm

w_{ch} = 5 mm

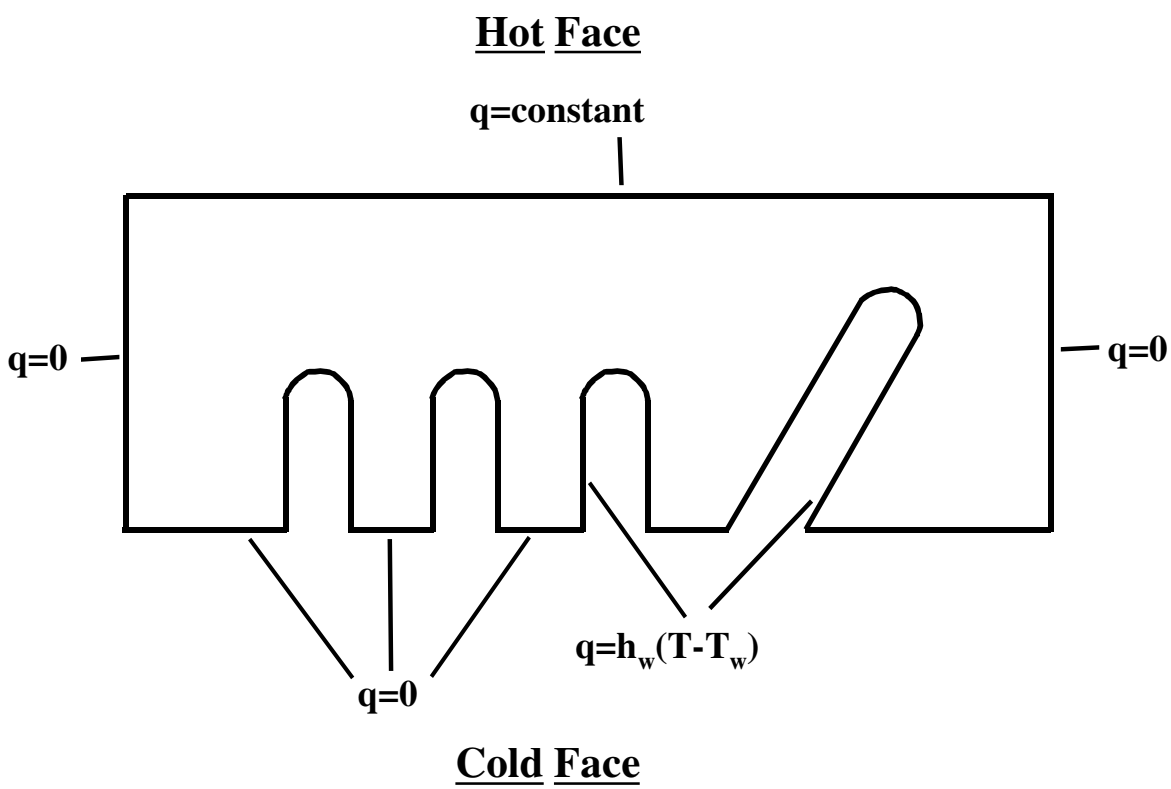
d_m = 13 mm

L_c = 13.5 mm

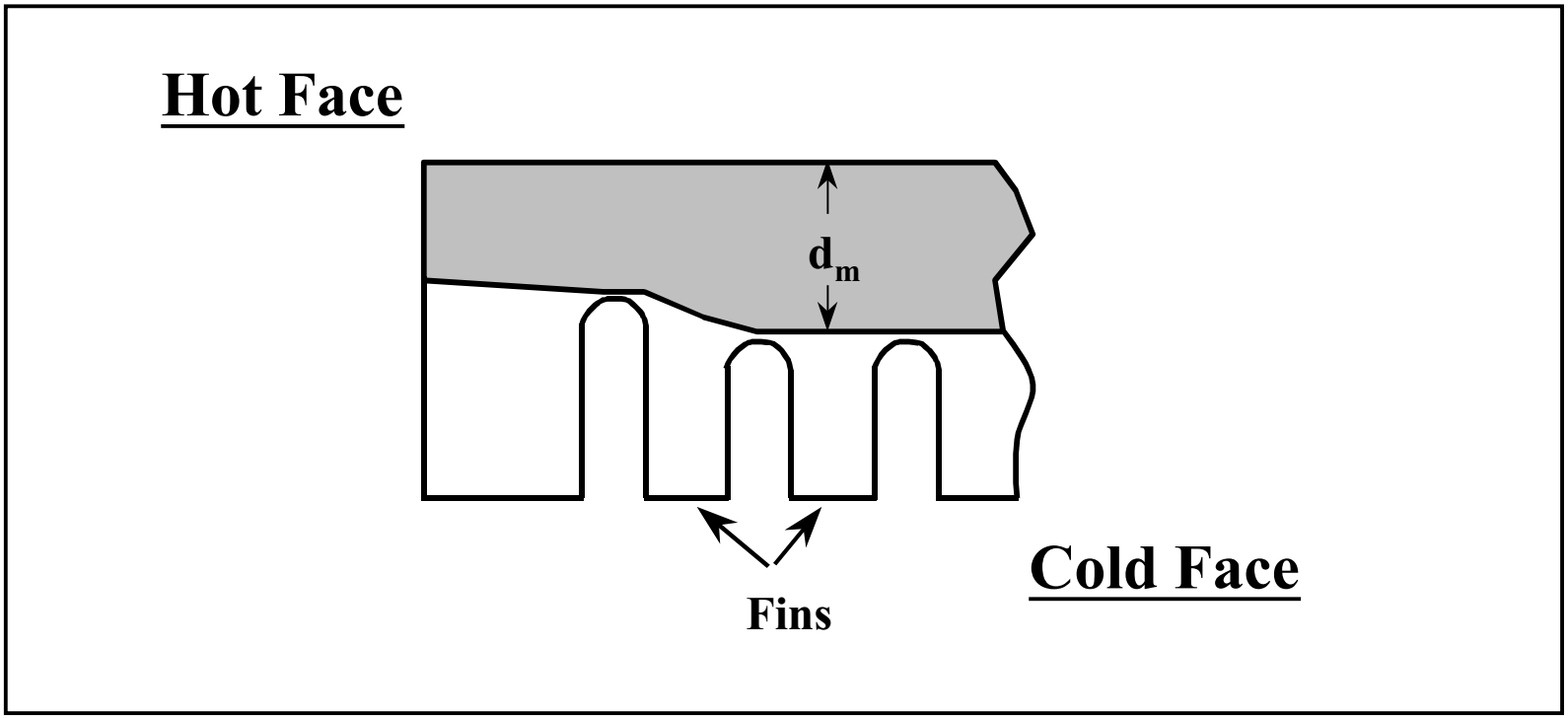
L_{ch}=16 mm

A= 60 °

2D Narrow Face Boundary Conditions

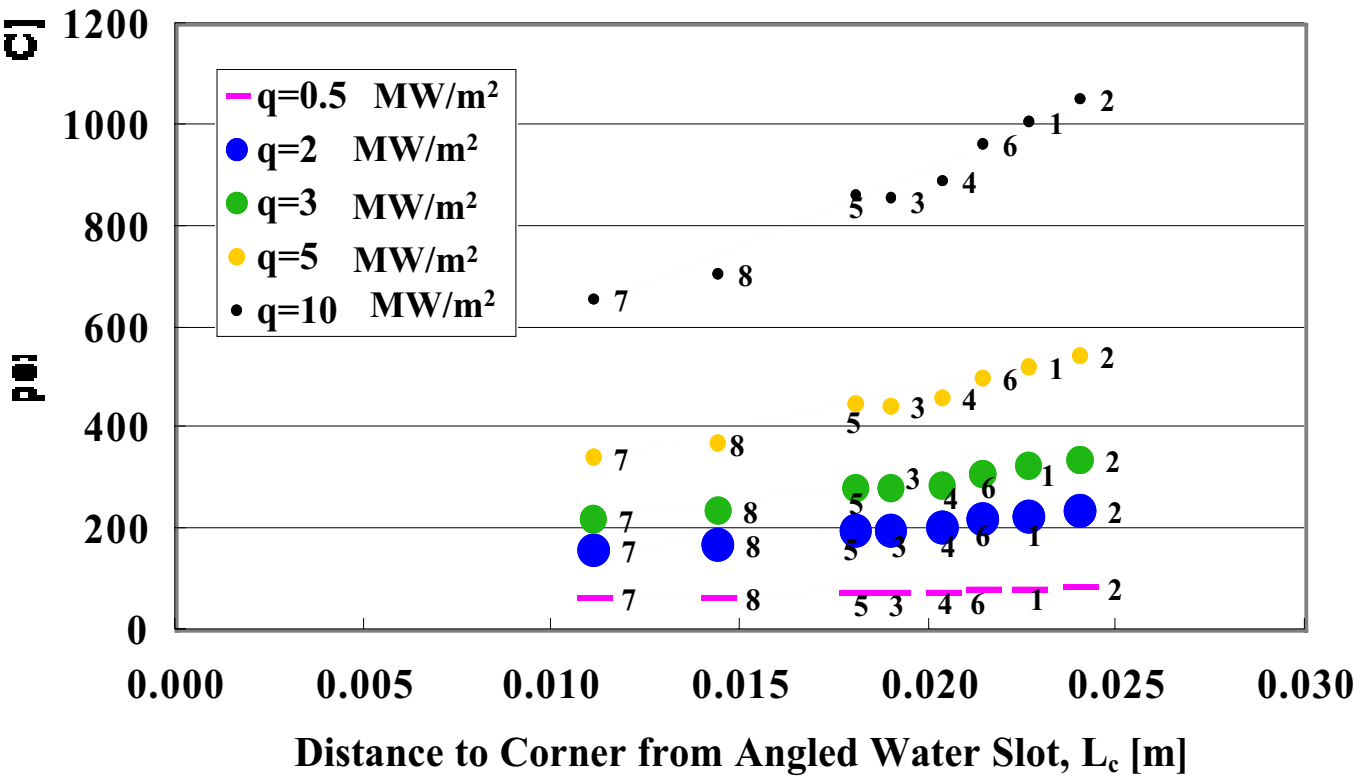


Water slot - Fin Analogy

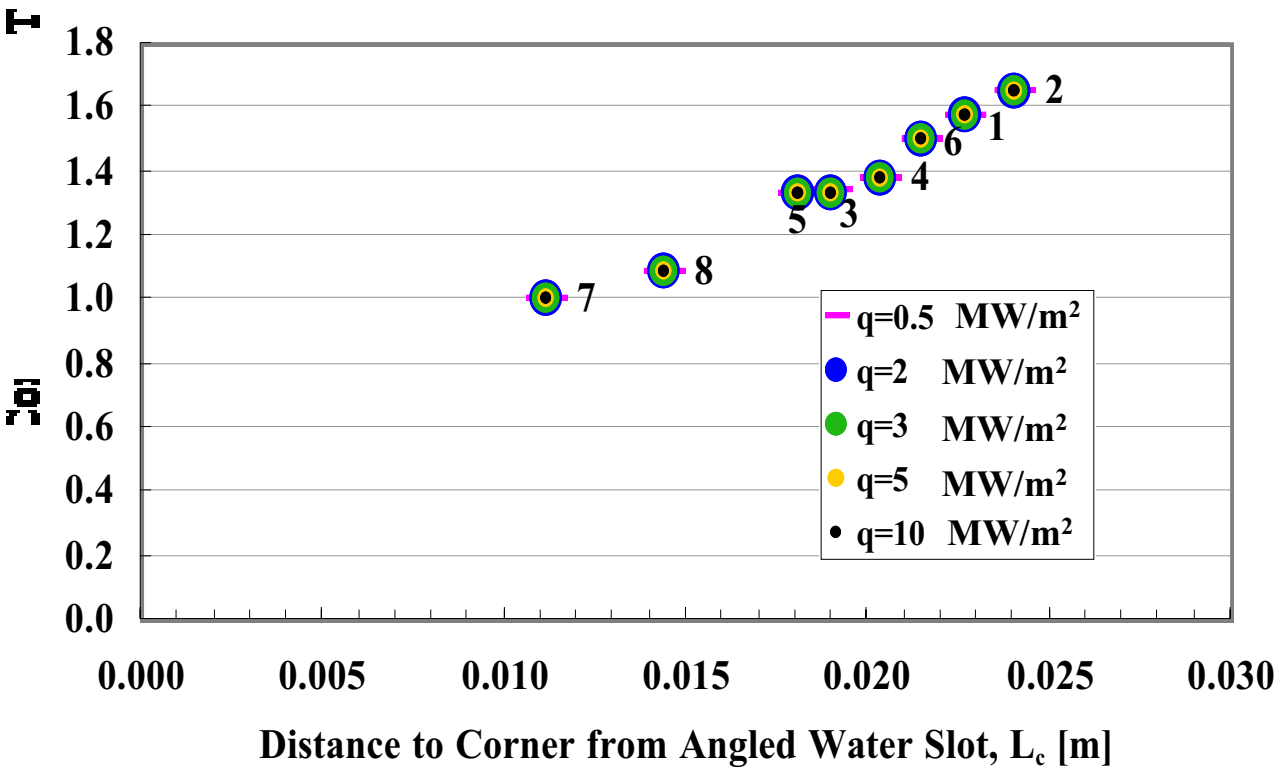


$$h_{fin} = \frac{h_w w_{ch}}{L_{ch}} + \frac{\sqrt{2h_w k_m (L_{ch} - w_{ch})}}{L_{ch}} \tanh \sqrt{\frac{2h_w d_{ch}^2}{k_m (L_{ch} - w_{ch})}}$$

Heat Flux and L_c Influence Corner Temperature



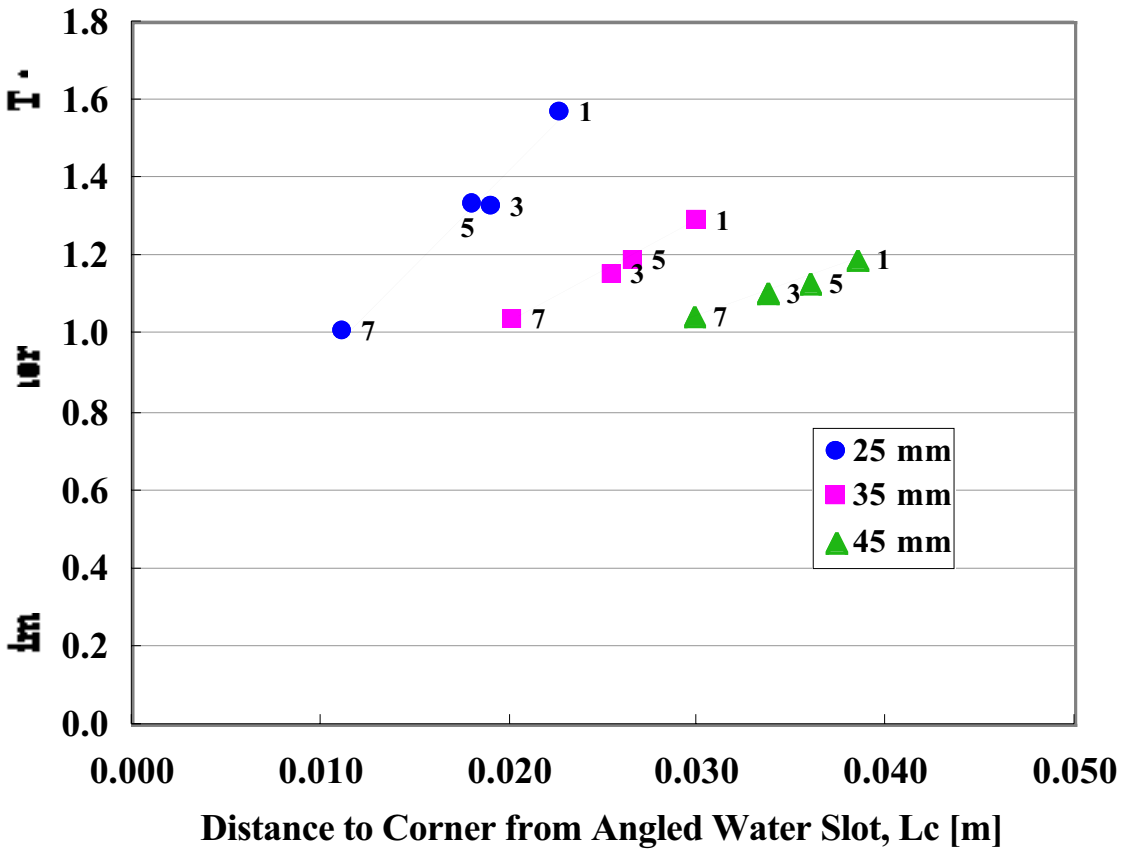
Corner Temperature Normalized by Heat Flux



$$T^* = \frac{k(T_c - T_{water})}{qL_{eff}}$$

$$L_{eff} = \frac{k_m}{h_{fin}} + d_m$$

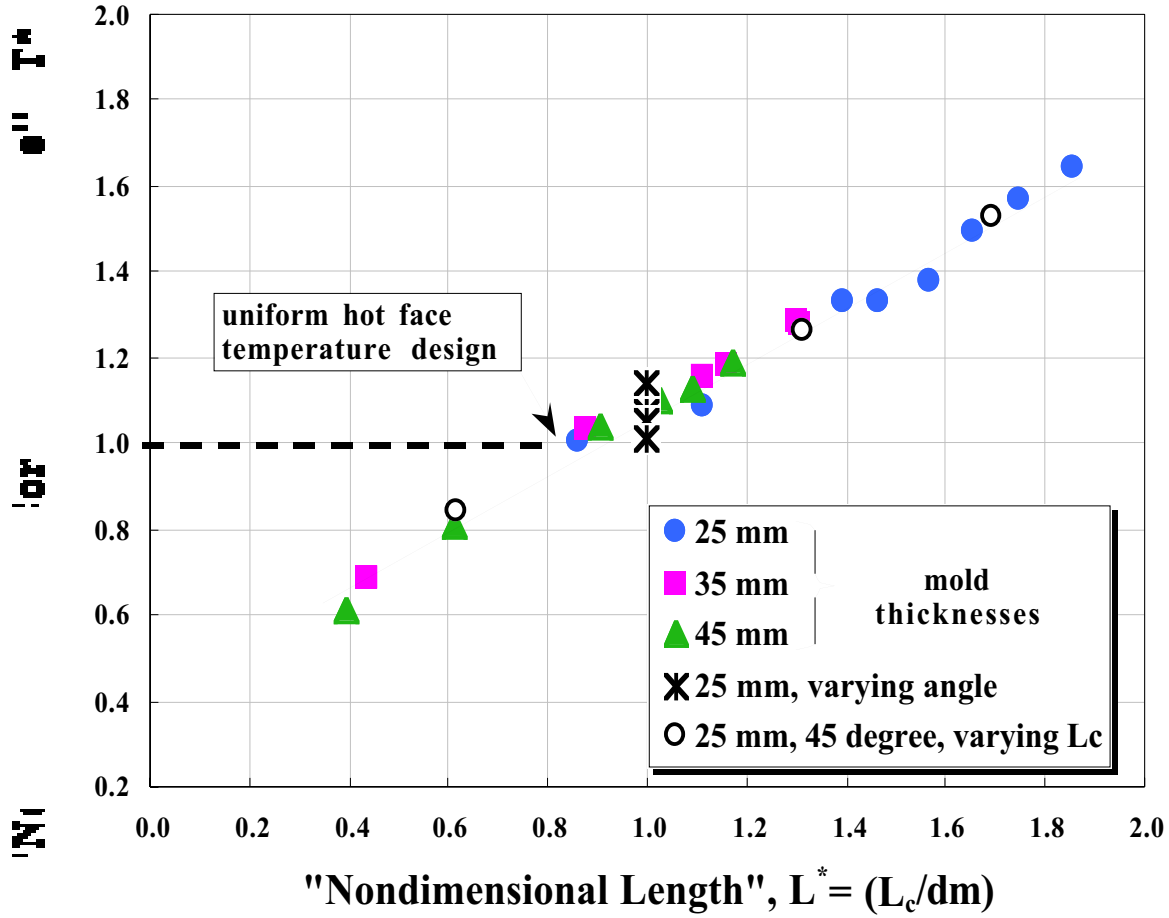
Mold Thickness Effects T_c



$$T^* = \frac{k(T_c - T_{water})}{qL_{eff}}$$

$$L_{eff} = \frac{k_m}{h_{fin}} + d_m$$

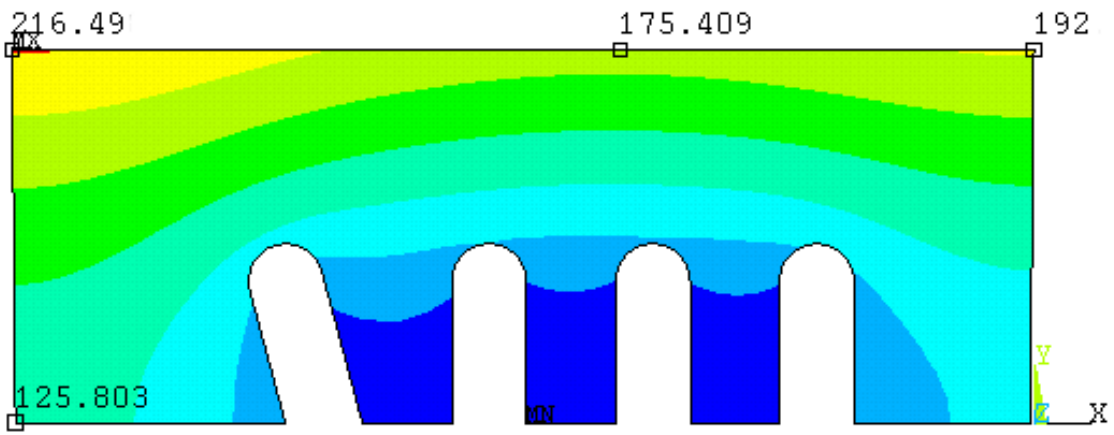
Corner Temperature Prediction



$$L^* = \frac{L_c}{d_m}$$

$$T^* = \frac{k(T_c - T_{water})}{qL_{eff}}$$

$$T^* = 0.65L^* + 0.42$$

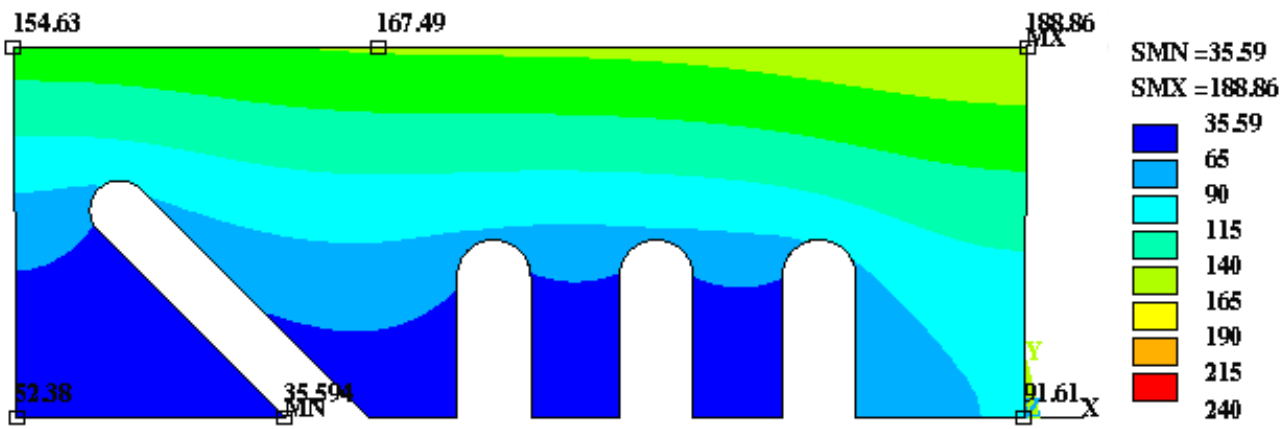


Typical design

A = 75 ^{o}C

L_c = 22 mm

q =2.5 MW/m^2



Optimized design

A = 45 ^{o}C

L_c = 11 mm

q =2.5 MW/m^2

Calculating T_c

$$L^* = \frac{L_c}{d_m} \qquad (1)$$

$$T^* = \frac{k(T_c - T_{water})}{qL_{eff}} \qquad (2)$$

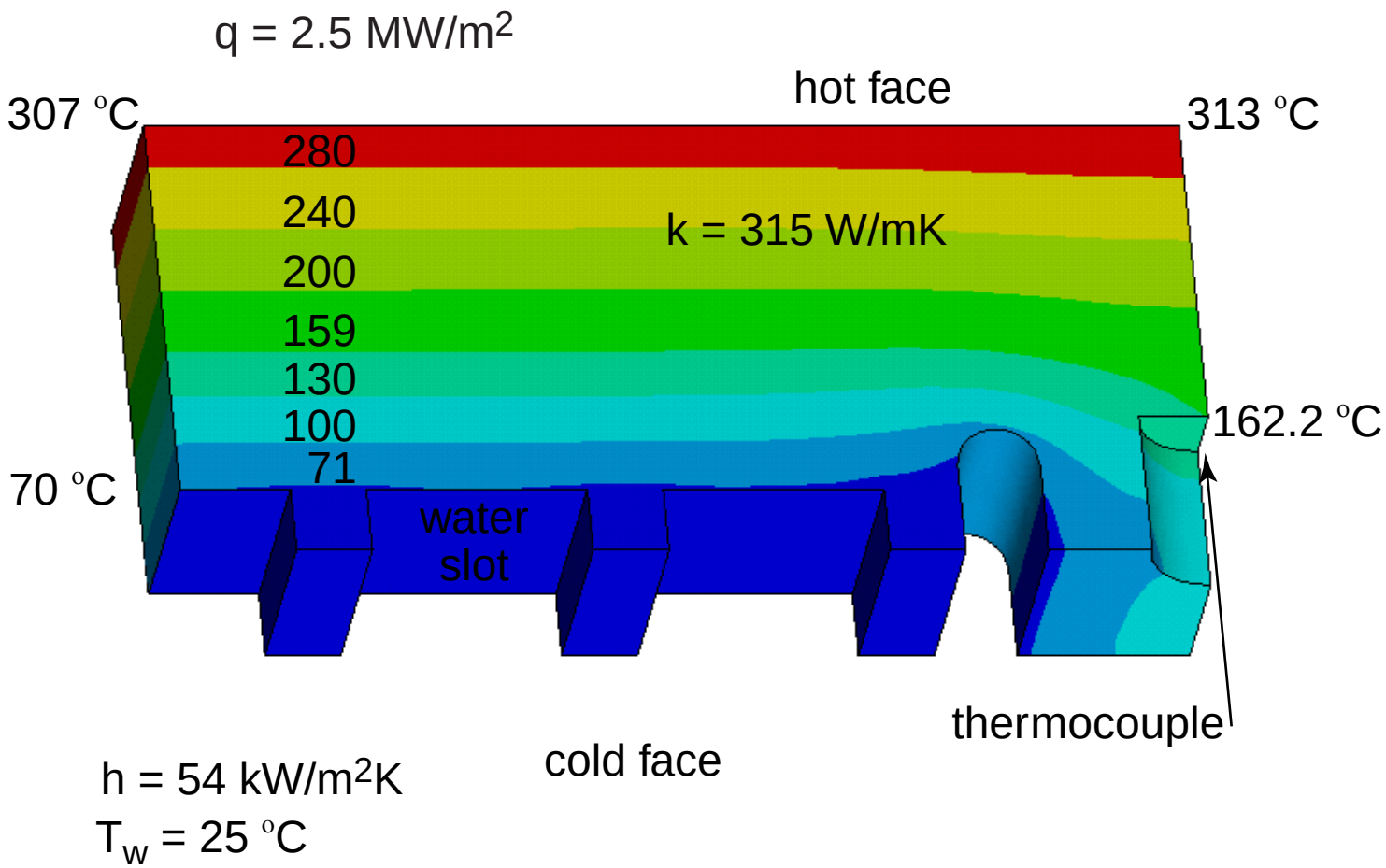
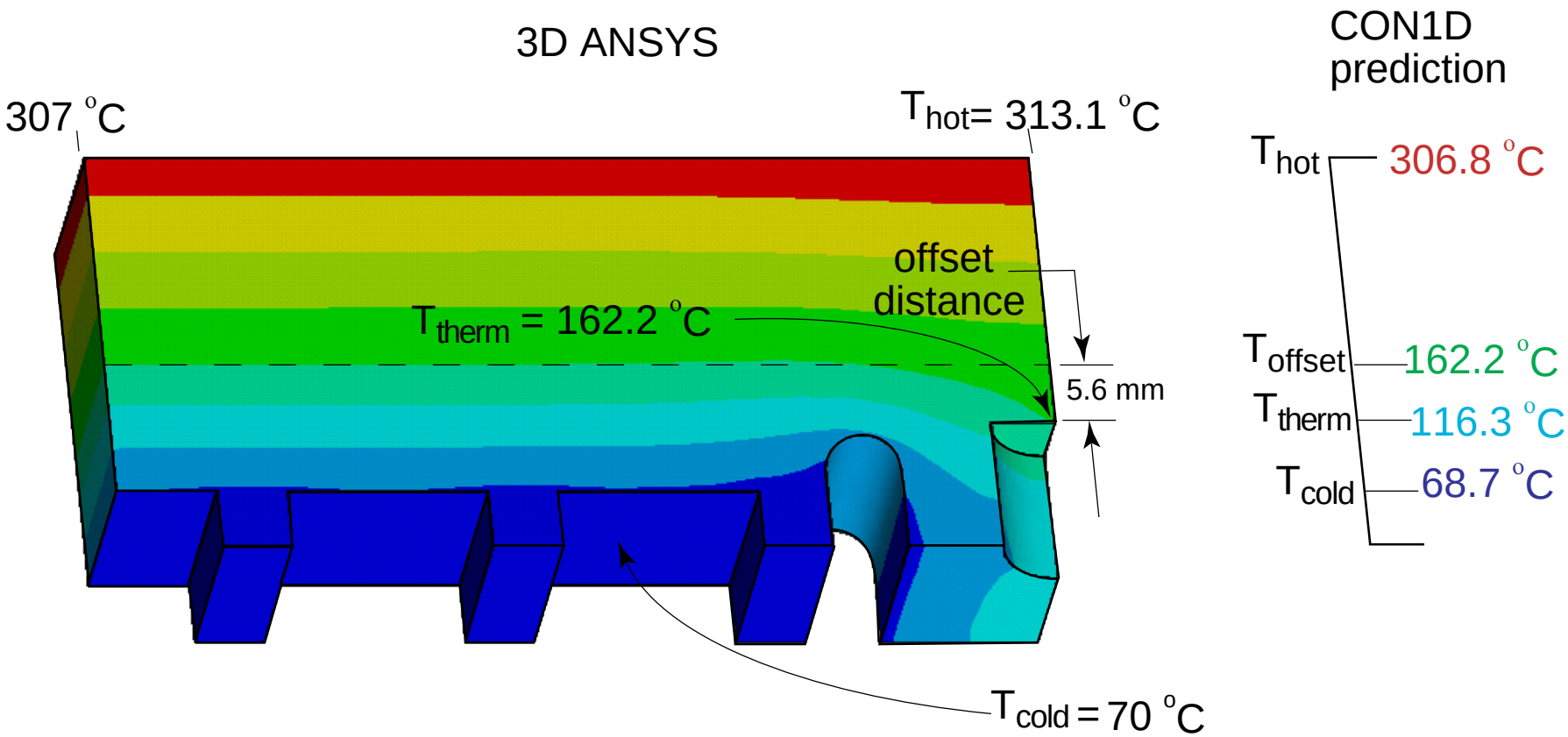
$$L_{eff} = \frac{k_m}{h_{fin}} + d_m \qquad (3)$$

$$T^* = 0.65L^* + 0.42 \qquad (4)$$

$$\boxed{T_c = \left(0.65\frac{L_c}{d_m} + 0.42\right)\frac{q\left(\frac{k_m}{h_{fin}} + d_m\right)}{k_m} + T_w} \qquad (5)$$

Adding Three Dimensional Accuracy to CON1D

3D ANSYS Wide Face Model



3D accuracy in CON1D using an offset