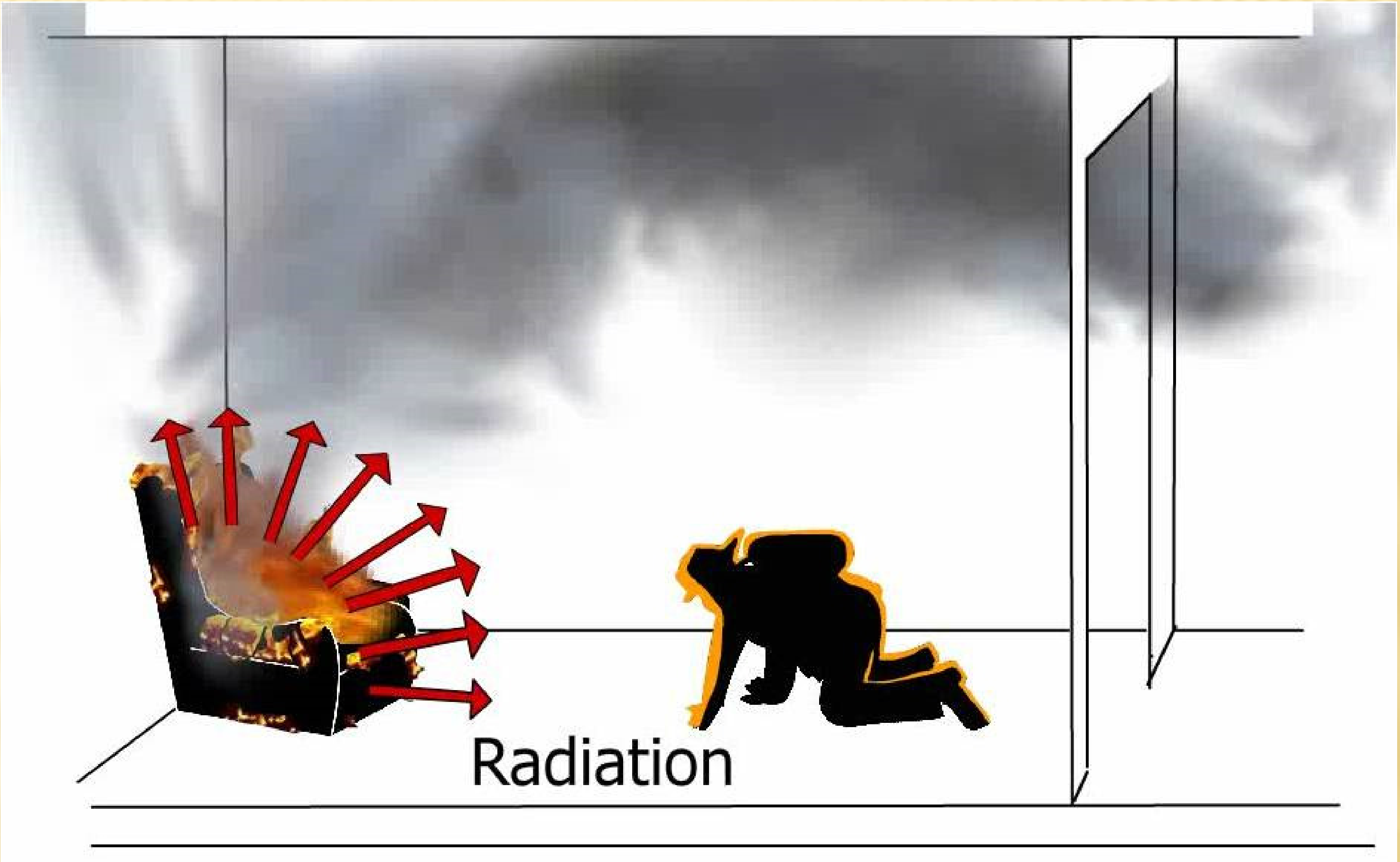
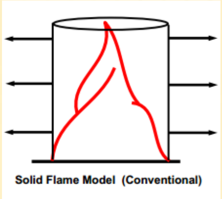
Radiação Atingindo um Alvo

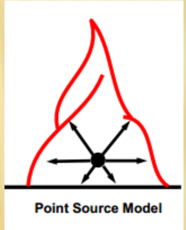


Radiação Atingindo um Alvo

- **Método Solid Flame**



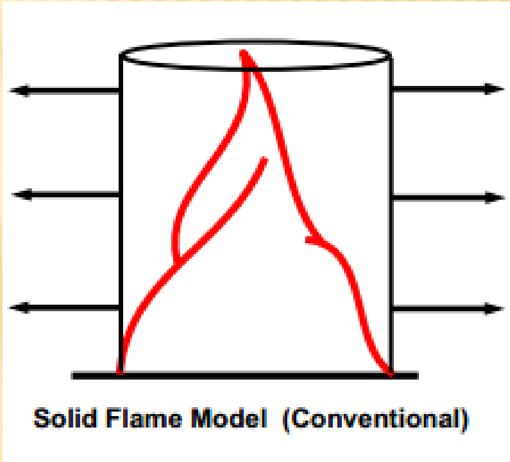
- **Método Point Source**



- **Correlação de Shokri e Beyler**

Radiação Atingindo um Alvo

Método Solid Flame



Radiant Heat Flux
(kW/m2)
Note: metro quadrado de alvo

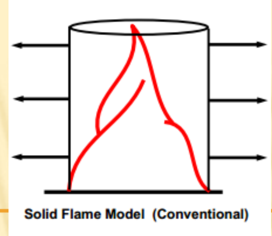
$$q'' = E \; \varphi \; \tau \; \varepsilon$$

Emissividade = 1 (aproximadamente)

Atmospheric Transmissivity = 1 (aproximadamente)

Emissive Power
(kW/m2)
Note: metro quadrado de chama

Configuration Factor



Método Solid Flame

Radiant Heat Flux
(kW/m2)
Note: metro quadrado de alvo

$$q'' = E \quad \varphi \quad \tau \quad \varepsilon$$

Emissive Power
(kW/m2)

Emissive Power:

Calcule!

Padrões

Radiação Atingindo um Alvo

Referências para residências:

Valor máximo: 20 W/cm2 = 200000 W/m2 = 200 kW/m2
Valor padrão: 17 W/cm2 = = 170 kW/m2
Valor reduzido: 8,5 W/cm2 (incêndios pequenos ou limitados pelo combustível) = 85 kW/m2

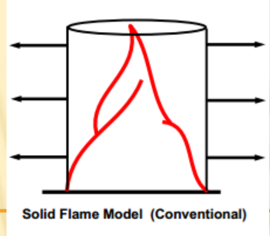
Referências (NFPA):

Severe: 358 kW/m2
Moderate: 179 kW/m2
Light: 90 kW/m2

Referências (NIST):

Pool Fire:
50 kW/m2 a 100 kW/m2

Radiação Atingindo um Alvo



Método Solid Flame

Radiant Heat Flux (kW/m2)
Note: metro quadrado de alvo

$$q'' = E \varphi \tau \varepsilon$$

Emissividade = 1 (aproximadamente)

Atmospheric Transmissivity = 1 (aproximadamente)

Emissive Power (kW/m2)

Configuration Factor

Ou...

Radiação Atingindo um Alvo

Proteção por escudo de água.

Water curtain between the flame and target:

$$\tau = e^{(-3 W d / 4 v r)}$$

Water flow rate per unit horizontal area of curtain (ft^3 / (s.ft^2))

Espessura da cortina (ft)

Velocidade de queda das gotas (ft/s)

Raio médio das gotas (ft)

Radiação Atingindo um Alvo

Radiação Atingindo um Alvo

Radiação Atingindo um Alvo

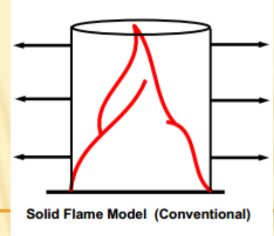
Radiação Atingindo um Alvo

Material complementar sobre escudos de proteção:

Heat transfer through a water spray curtain under the effect of a strong radiative source
P. Boulet, A. Collin, G. Parent http://www.sciencedirect.com/science/article/pii/S0379711205000822

Absorptance and transmittance of water spray/mist curtains
C.C. Tseng, R. Viskanta http://www.sciencedirect.com/science/article/pii/S0379711206001007

Thermal shielding by water spray curtain
Jean-Marie Buchlin http://www.sciencedirect.com/science/article/pii/S0950423005000987



Método Solid Flame

Radiant Heat Flux
(kW/m2)
Note: metro quadrado de alvo

$$q'' = E\ \varphi\ \tau\ \varepsilon$$

Emissividade = 1 (aproximadamente)

Atmospheric Transmissivity = 1 (aproximadamente)

Emissive Power
(kW/m2)

Configuration Factor (equações, tabelas, gráficos)

Radiação Atingindo um Alvo

Método Point Source

Radiant Heat Flux (kW/m2)
Note: metro quadrado de alvo

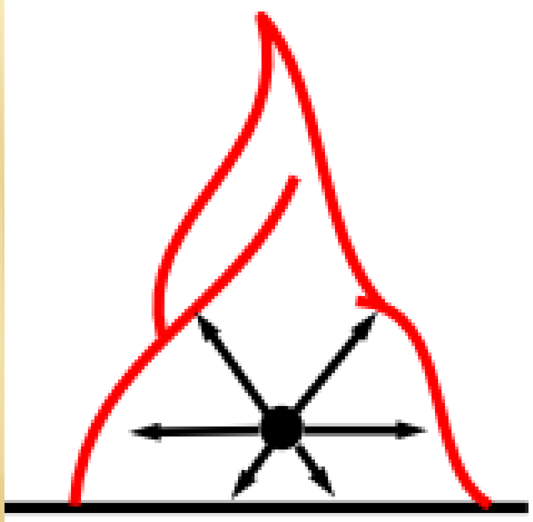
$$q'' = (X_{rad} \; Q) / (4 \pi r^2)$$

Ou,

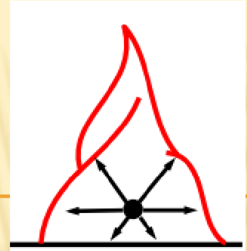
$$q'' = Q_{rad} / (4 \pi r^2)$$

Onde:
r : distância do centro da chama até o alvo

Atenção: distância em relação ao centro da chama, não em relação a borda.



Point Source Model



Método Point Source

Exemplo:

Example 3-3 You are preparing a plan of action for fighting a possible fire in a power plant. In one area there is a cable tray on the ceiling. The tray contains thermoplastic cables. The tray is 3.5 m from the center of a potential fire's base. You estimate that the fire's heat release rate is 800 kW. Research shows you that thermoplastic cables are damaged by a heat flux of 8 kW/m^2 for ten minutes. Will the heat from the fire damage the cables?

$$q'' = \frac{\dot{Q}}{4\pi R^2} = \frac{800}{4\pi (3.5)^2} = 5.2\ {}^{kW}\!/_{m^2}$$

Since 5.2 kW/m^2 is less than the damaging heat flux of 8 kW/m^2, damage to the cables is unlikely.

Radiação Atingindo um Alvo

Correlação de Shokri e Beyler:

Radiant Heat Flux
(kW/m2)
Note: metro quadrado de alvo

q" = 15,4 (L / D) ^ -1,59

fire diameter (m)

distance from the center of the fire (m)

http://www.thunderheadeng.com/downloads/conference/Papers/Day2A/2/2a-5-Fleury.pdf

Radiação Atingindo um Alvo

Correlação de Shokri e Beyler:

Radiant Heat Flux
(kW/m2)
Note: metro quadrado de alvo

$$q'' = 15,4 \ (L / D)^{-1,59}$$

fire diameter (m)

distance from the center of the fire (m)

Hipóteses:

-fogo circular

-o fluxo de calor depende apenas da distância e do diâmetro do fogo. **Não é função do fator de forma ou do material combustível.**

-desenvolvido a partir de experimentos de incêndio em poça

http://www.thunderheadeng.com/downloads/conference/Papers/Day2A/2/2a-5-Fleury.pdf

Radiação Atingindo um Alvo

Correlação de Shokri e Beyler:

Shokri and Beyler Correlation

Shokri and Beyler (1989) developed a simple correlation based on experimental data from large-scale pool fire experiments. This method calculates the radiant heat flux at ground level as a function of the radial position of a vertical target. The heat flux received by the target is given by Equation 1:

$$\dot{q}'' = 15.4\left(\frac{L}{D}\right)^{-1.59} \qquad (1)$$

The correlation assumes that the target is vertical and located at ground level.

http://www.thunderheadeng.com/downloads/conference/Papers/Day2A/2/2a-5-Fleury.pdf

Radiação Atingindo um Alvo

Referências Complementares:

EVALUATION OF THERMAL RADIATION MODELS FOR FIRE SPREAD BETWEEN OBJECTS (Rob Fleury, Michael Spearpoint, Charles Fleischmann)
http://www.thunderheadeng.com/downloads/conference/Papers/Day2A/2/2a-5-Fleury.pdf

EVALUATION OF THERMAL RADIATION MODELS FOR FIRE SPREAD BETWEEN OBJECTS (Rob Fleury)
http://ir.canterbury.ac.nz/bitstream/10092/4959/1/thesis_fulltext.pdf

FLAME RADIATION CHARACTERISTICS OF OPEN HYDROCARBON POOL FIRES (Ufuah, Bailey)
http://www.iaeng.org/publication/WCE2011/WCE2011_pp1952-1958.pdf

MODELLING OF THERMAL RADIATION FROM EXTERNAL HYDROCARBON POOL FIRES (Rew, Hulbert e Deaves)
http://www.sciencedirect.com