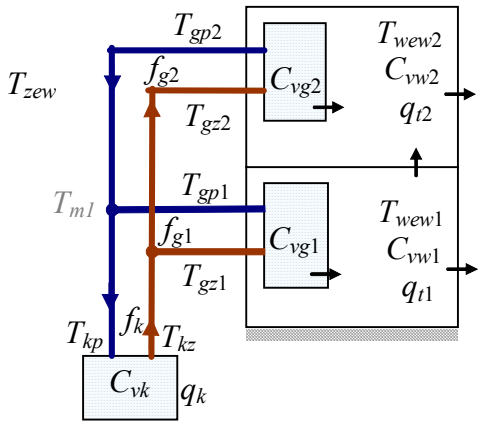
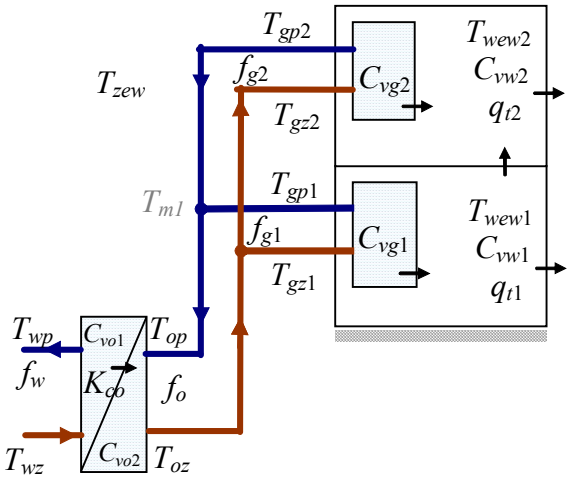
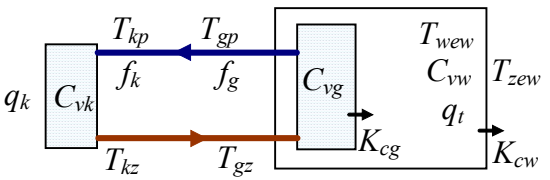
Ogrzewanie budynku – źródło i odbiorniki







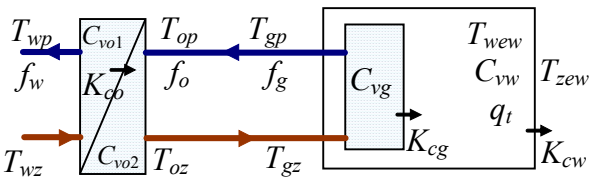
$$\begin{cases} C_{vw}\dot{T}_{wew} = K_{cg}\left(T_{gp} - T_{wew}\right) - K_{cw}\left(T_{wew} - T_{zew}\right) + q_t \\ C_{vg}\dot{T}_{gp} = c_{pw} f_{mg}\left(T_{gz} - T_{gp}\right) - K_{cg}\left(T_{gp} - T_{wew}\right) \\ C_{vk}\dot{T}_{kz} = q_k - c_{pw} f_{mk}\left(T_{kz} - T_{kp}\right) \end{cases}$$

oraz $f_{mk}=f_{mg}$, $T_{gz}(t)=T_{kz}(t-T_o)$, $T_{kp}(t)= T_{gp}(t-T_o)$

$$\begin{cases} 0 = K_{cg}\left(T_{gp} - T_{wew}\right) - K_{cw}\left(T_{wew} - T_{zew}\right) + q_t \\ 0 = c_{pw} f_{mg}\left(T_{gz} - T_{gp}\right) - K_{cg}\left(T_{gp} - T_{wew}\right) \\ 0 = q_k - c_{pw} f_{mg}\left(T_{gz} - T_{gp}\right) \end{cases}$$

$$q_k = c_{pw} f_{mg}\left(T_{gz} - T_{gp}\right) = K_{cg}\left(T_{gp} - T_{wew}\right) = K_{cw}\left(T_{wew} - T_{zew}\right)$$

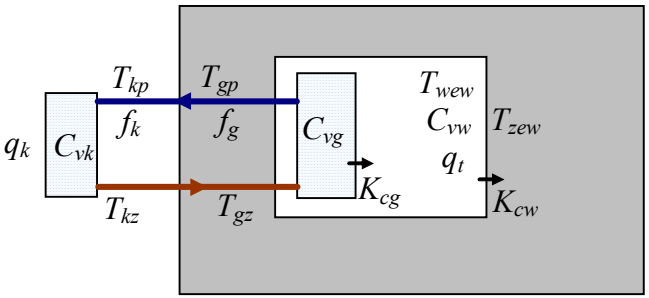
$$c_{pw} f_{mk}\left(T_{kz} - T_{kp}\right)$$

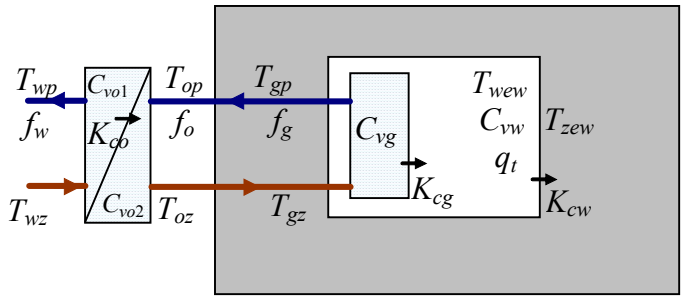


$$\begin{cases} C_{vw}\dot{T}_{wew} = K_{cg}\left(T_{gp} - T_{wew}\right) - K_{cw}\left(T_{wew} - T_{zew}\right) + q_t \\ C_{vg}\dot{T}_{gp} = c_{pw} f_{mg}\left(T_{gz} - T_{gp}\right) - K_{cg}\left(T_{gp} - T_{wew}\right) \\ C_{vo2}\dot{T}_{oz} = K_{co}\left(T_{wp} - T_{oz}\right) - c_{pw} f_{mo}\left(T_{oz} - T_{op}\right) \\ C_{vo1}\dot{T}_{wp} = c_{pw} f_{mw}\left(T_{wz} - T_{wp}\right) - K_{co}\left(T_{wp} - T_{oz}\right) \end{cases}$$

oraz $f_{mo}=f_{mg}$, $T_{gz}(t)=T_{oz}(t-T_o)$, $T_{op}(t)= T_{gp}(t-T_o)$

Opis odbiorników ciepła



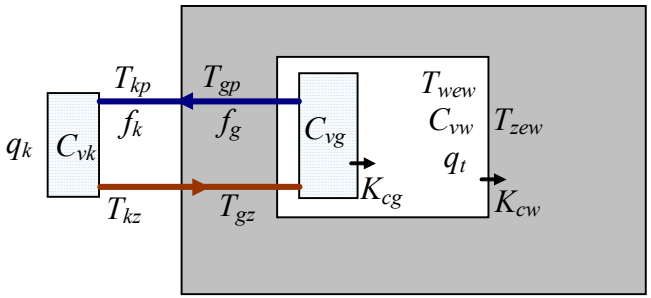


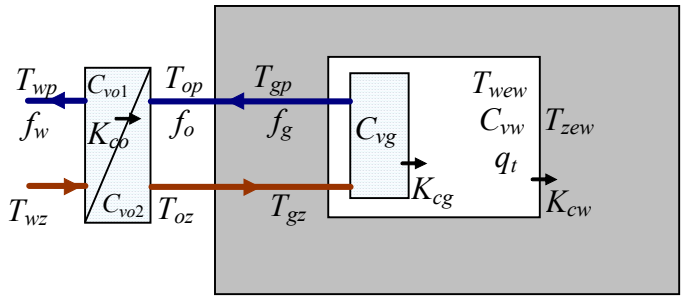
$$\begin{cases} C_{vw}\dot{T}_{wew} = K_{cg}\left(T_{gp} - T_{wew}\right) - K_{cw}\left(T_{wew} - T_{zew}\right) + q_t \\ C_{vg}\dot{T}_{gp} = c_{pw} f_{mg}\left(T_{gz} - T_{gp}\right) - K_{cg}\left(T_{gp} - T_{wew}\right) \end{cases}$$

$$\begin{cases} 0 = K_{cg}\left(T_{gp} - T_{wew}\right) - K_{cw}\left(T_{wew} - T_{zew}\right) + q_t \\ 0 = c_{pw} f_{mg}\left(T_{gz} - T_{gp}\right) - K_{cg}\left(T_{gp} - T_{wew}\right) \end{cases}$$

$$c_{pw} f_{mg}\left(T_{gz} - T_{gp}\right) = K_{cg}\left(T_{gp} - T_{wew}\right) = K_{cw}\left(T_{wew} - T_{zew}\right)$$

Sterowanie pogodowe





Dowolny stan równowagi:

$$c_{pw} f_{mg} \left(T_{gz} - T_{gp}\right) = K_{cg} \left(T_{gp} - T_{wew}\right) = K_{cw} \left(T_{wew} - T_{zew}\right)$$

Stan równowagi w warunkach nominalnych:

$$c_{pw} f_{mgN} \left(T_{gzN} - T_{gpN}\right) = K_{cg} \left(T_{gpN} - T_{wewN}\right) = K_{cw} \left(T_{wewN} - T_{zewN}\right)$$

$$\frac{c_{pw} f_{mg} \left(T_{gz} - T_{gp}\right)}{c_{pw} f_{mgN} \left(T_{gzN} - T_{gpN}\right)} = \frac{K_{cg} \left(T_{gp} - T_{wew}\right)}{K_{cg} \left(T_{gpN} - T_{wewN}\right)} = \frac{K_{cw} \left(T_{wew} - T_{zew}\right)}{K_{cw} \left(T_{wewN} - T_{zewN}\right)}$$

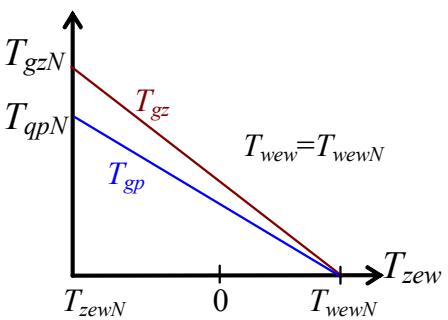
Zał.: przepływ jest nominalny ($f_{mg} = f_{mgN}$):

$$\frac{T_{gz} - T_{gp}}{T_{gzN} - T_{gpN}} = \frac{T_{gp} - T_{wew}}{T_{gpN} - T_{wewN}} = \frac{T_{wew} - T_{zew}}{T_{wewN} - T_{zewN}}$$

Zał.: zmienne wejściowe – T_{zew} (pomiar), T_{wew} (wartość zadana)

zmienne wyjściowe – T_{gz}, T_{gp}

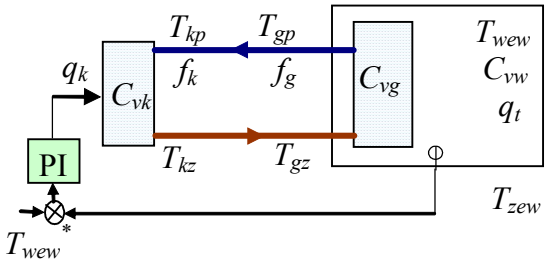
Krzywe pogodowe:



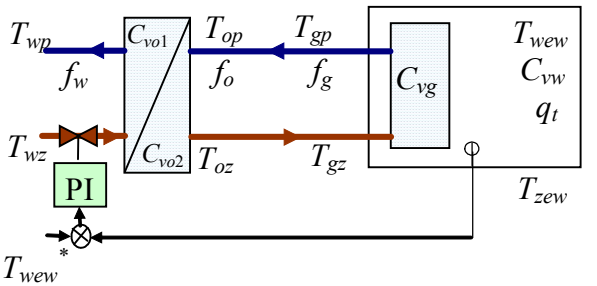
$$T_{gz} = a_z T_{wew} - b_z T_{zew}, \qquad a_z = \frac{T_{gzN} - T_{zewN}}{T_{wewN} - T_{zewN}} \qquad b_z = \frac{T_{gzN} - T_{wewN}}{T_{wewN} - T_{zewN}}$$

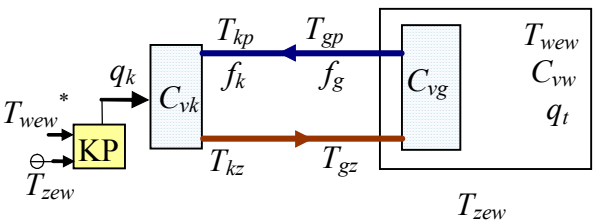
$$T_{gp} = a_p T_{wew} - b_p T_{zew}, \qquad a_p = \frac{T_{gpN} - T_{zewN}}{T_{wewN} - T_{zewN}} \qquad b_p = \frac{T_{gpN} - T_{wewN}}{T_{wewN} - T_{zewN}}$$

Regulacja ogrzewania budynku - regulacja centralna



Regulacja bezpośrednia
(na podstawie bepośredniego
pomiaru reprezentatywnej T_{wew})

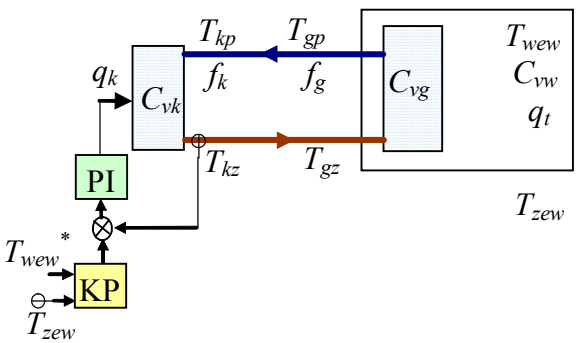




Sterowanie pogodowe
(na podstawie
krzywych pogodowych)

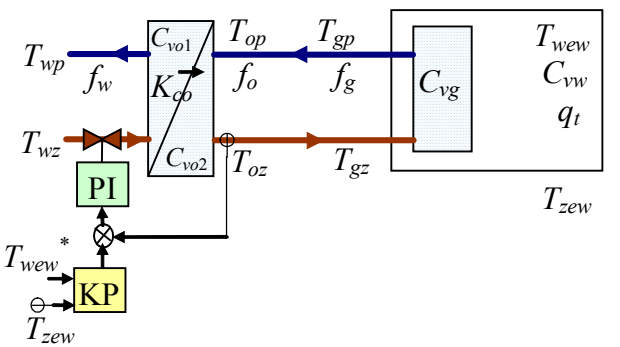
$q_k = c_{pw} f_{mg} (T_{gz} - T_{gp})$

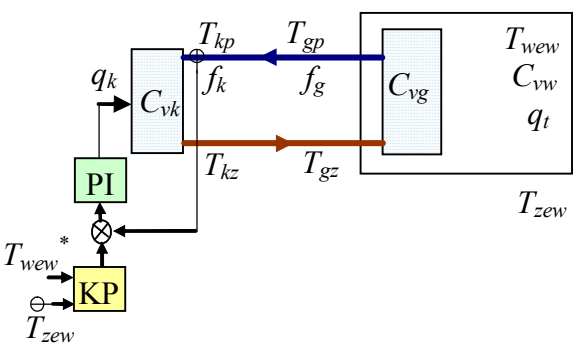
$T_{gz} = a_z T_{wew} - b_z T_{zew}$, $T_{gp} = a_p T_{wew} - b_p T_{zew}$



Regulacja pogodowa
(na podstawie
krzywych pogodowych)

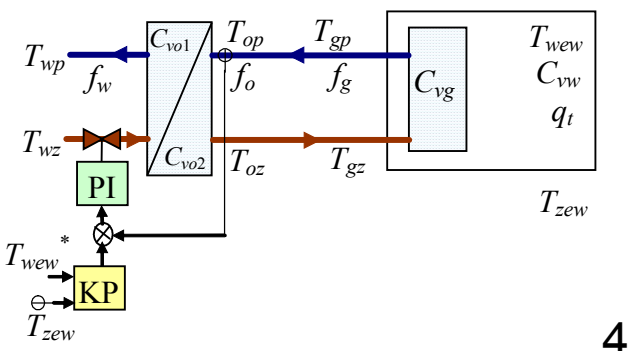
$T_{gz} = a_z T_{wew} - b_z T_{zew}$



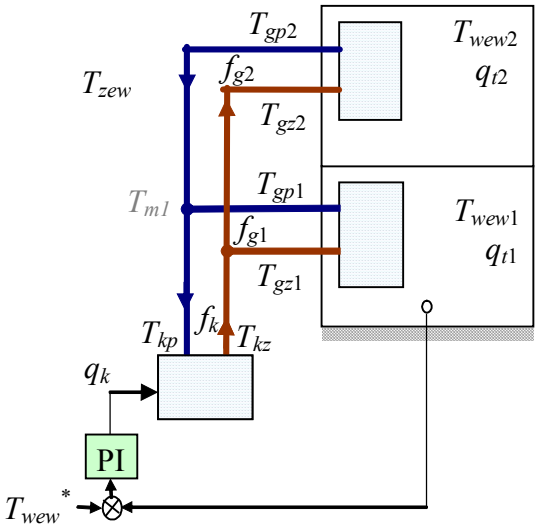


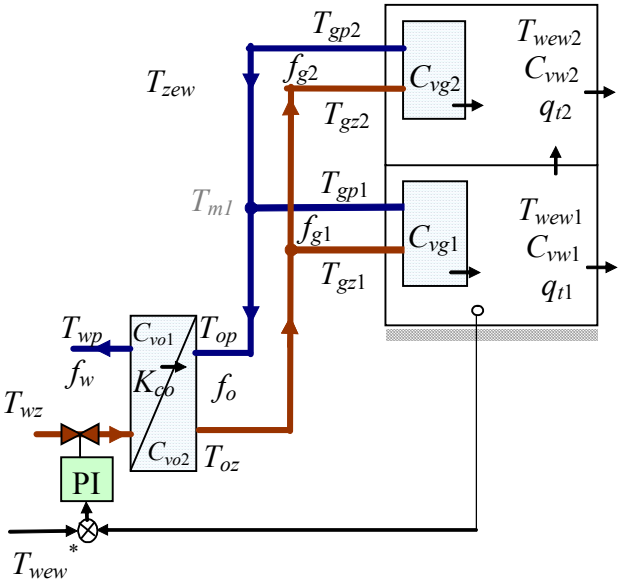
Regulacja pogodowa
(na podstawie
krzywych pogodowych)

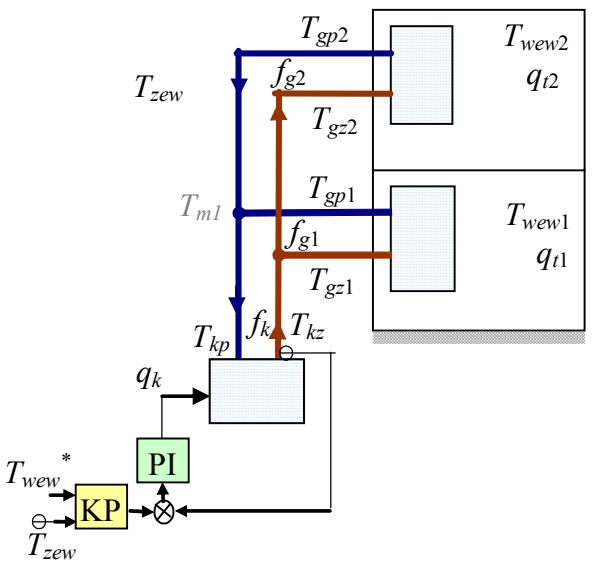
$T_{gp} = a_p T_{wew} - b_p T_{zew}$

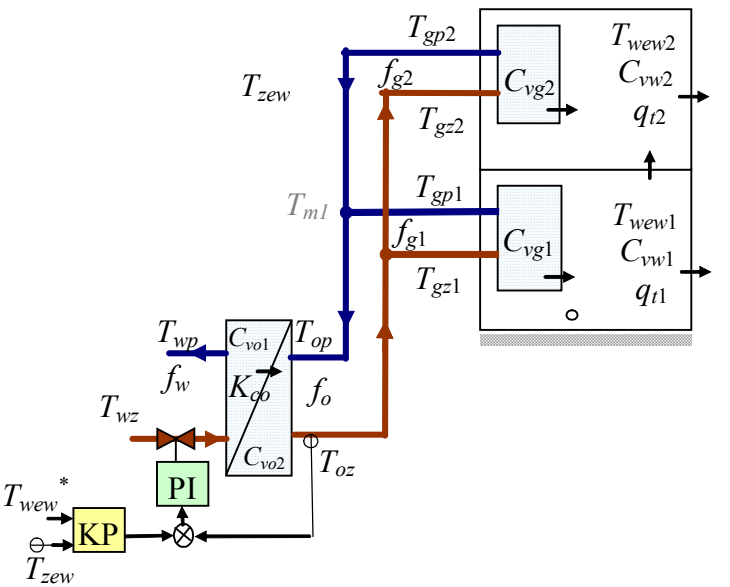


Regulacja ogrzewania budynku - regulacja centralna









Sieć ciepłownicza