Cascade Control
**What is cascade control?**
The set point of a controller that controlling the final control element is set by another controller.

**Purpose**
1. To eliminate the effects of disturbances.
2. To improve the dynamic performance of the control loop.

**Characteristic**
Two controllers, two sensors/transmitters and one final control element for a two level cascade system.

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Terminology
Inner = master = primary
Outer = slave = secondary

Preheater furnace
Reactant A
Fuel
I/P
FC
TT
TC
FT

Reactor
Cooling water
Product

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Cascade control scheme

Single input single output (SISO) feedback control
Cascade control scheme

Cascade control: Two level - Temperature over temperature
Cascade control scheme

Two level - Temperature over flow

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Three level - Temperature over temperature over flow

Cascade control scheme
Cascade control scheme

Block Diagram: SISO feedback

\[ T_{Air\,in}(s) \]

\[ \frac{1}{2s+1} \]

\[ T(s) \]

\[ G_C \]

\[ R(s) \]

\[ 0.5 \]

\[ C_1(s) \]

\[ \frac{3}{0.2s+1} \]

\[ M(s) \]

\[ \frac{1}{(3s+1)(s+1)} \]

\[ F(s) \]

\[ T_H(s) \]

\[ \frac{0.8}{(4s+1)(s+1)} \]
Figure 9-1.3 Response of feedback and cascade control to a $-25^\circ C$ change in feed temperature to heater.
Cascade control scheme