# Static Timing Analysis (STA)

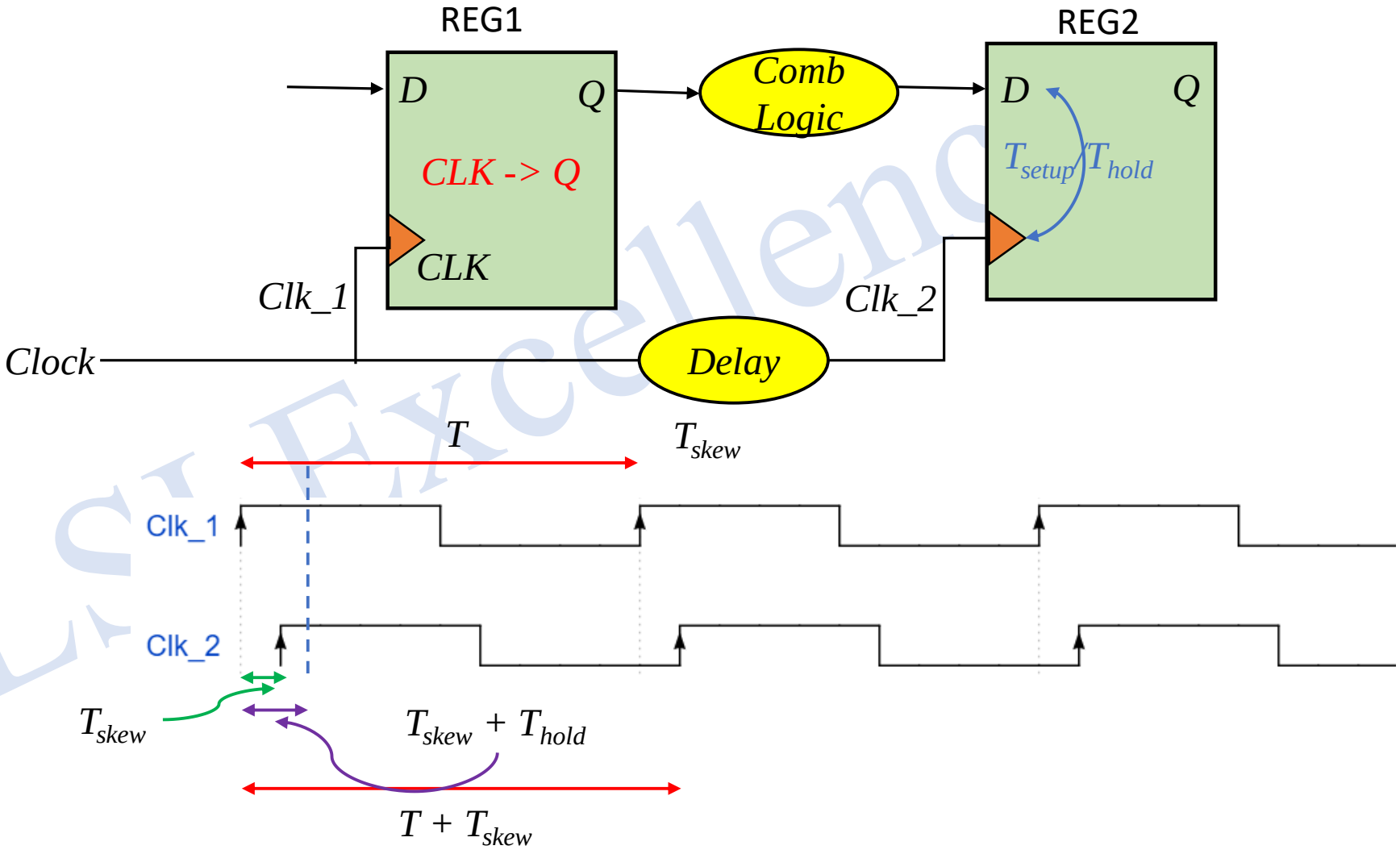
***Lecture #13: Effect of Clock Skew on Setup & Hold Timing Equations***

***Video Lecture Link***

# Static Timing Analysis (STA) – Setup & Hold Equations (with Clock Skew)

## Positive Clock Skew:

*Both Clock and Data*
*Flow in same direction*
*OR*
*Launch Clock Path Delay*
*Is Less than Capture Clock*
*Path Delay*



# Static Timing Analysis (STA) – Setup & Hold Equations (with Clock Skew)

## Positive Clock Skew

**Setup Equation:**

**Clk_to_Q [REG1] + Comb Delay <= Clock Period + $T_{skew}$ – $T_{setup}$[REG2]**

Clock Period >= Clk_to_Q[REG1] + Comb Delay + $T_{setup}$[REG2] – $T_{skew}$

Here, Required Time = Clock Period + $T_{skew}$ – $T_{setup}$[REG2]
Arrival Time = Clk_to_Q [REG1] + Comb Delay

Hence, Setup Slack = Required Time – Arrival Time

**Note: Positive skew improves the performance( Setup)**

# Static Timing Analysis (STA) – Setup & Hold Equations (with Clock Skew)

## Positive Clock Skew

**Hold Equation:**

**Clk_to_Q [REG1] + Comb Delay >= Hold_Check[0] + $T_{hold}$ [REG2] + $T_{skew}$**

Here, Required Time = Hold_Check[0] + $T_{hold}$ [REG2] + $T_{skew}$
Arrival Time = Clk_to_Q [REG1] + Comb Delay
Hence, Hold Slack = Arrival Time – Required Time

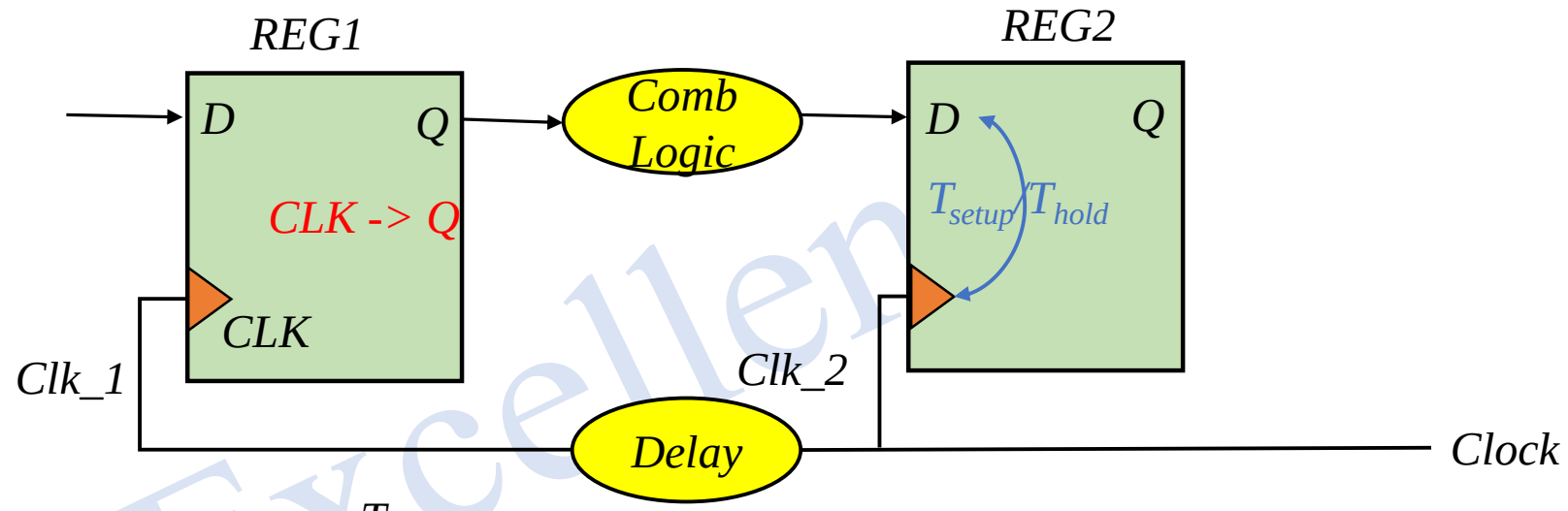
Note: Default Hold Check is at 0

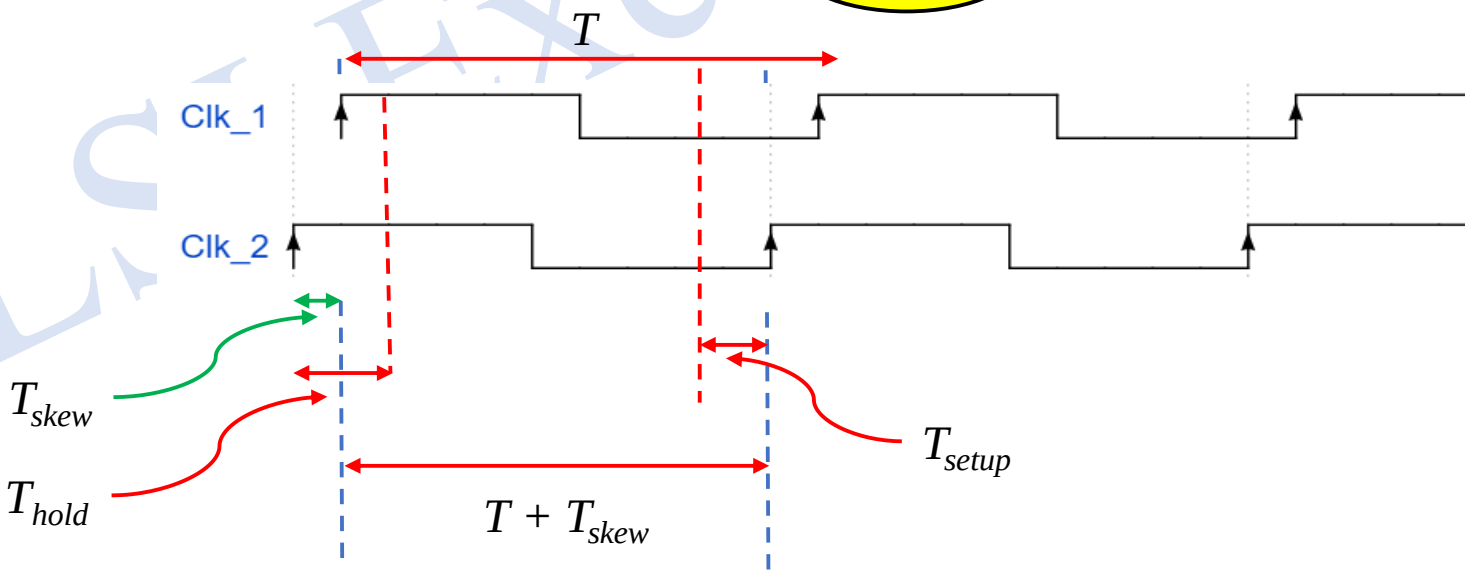
**Note:** Positive skew improves the performance(Tsetup) **but makes it harder to meet hold requirements**

# Static Timing Analysis (STA) – Setup & Hold Equations (with Clock Skew)

## Negative Clock Skew:

*Clock and Data*
*Flow in opposite direction*
*OR*
*Launch Clock Path Delay is Greater than Capture Clock Path*



# Static Timing Analysis (STA) – Setup & Hold Equations (with Clock Skew)

## Negative Clock Skew

**Note: $T_{skew\ is} < 0$**

**Setup Equation:**

**Clk_to_Q [REG1] + Comb Delay <= Clock Period - $T_{skew}$ – $T_{setup}$[REG2]**

Clock Period >= Clk_to_Q[REG1] + Comb Delay + $T_{setup}$[REG2] + $T_{skew}$

Here, Required Time = Clock Period - $T_{skew}$ – $T_{setup}$[REG2]
Arrival Time = Clk_to_Q [REG1] + Comb Delay

Hence, Setup Slack = Required Time – Arrival Time
**Note: Negative Clock skew Degrades the performance of Design**

# Static Timing Analysis (STA) – Setup & Hold Equations (with Clock Skew)

## Negative Clock Skew:

**Note: $T_{skew\ is} < 0$**

**Hold Equation:**

**Clk_to_Q [REG1] + Comb Delay >= Hold_Check[0] + $T_{hold}$ [REG2] - $T_{skew}$**

Here, Required Time = Hold_Check[0] + $T_{hold}$ [REG2] - $T_{skew}$

Arrival Time = Clk_to_Q [REG1] + Comb Delay
Hence, Hold Slack = Arrival Time – Required Time

Note: Default Hold Check is at 0

**Note:** Negative Clock skew **Degrades** the performance(Tsetup) but makes it **EASY** to meet hold requirements

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