

Note: 若 WB stage 要寫回 rd 時，剛好有指為 read rd，

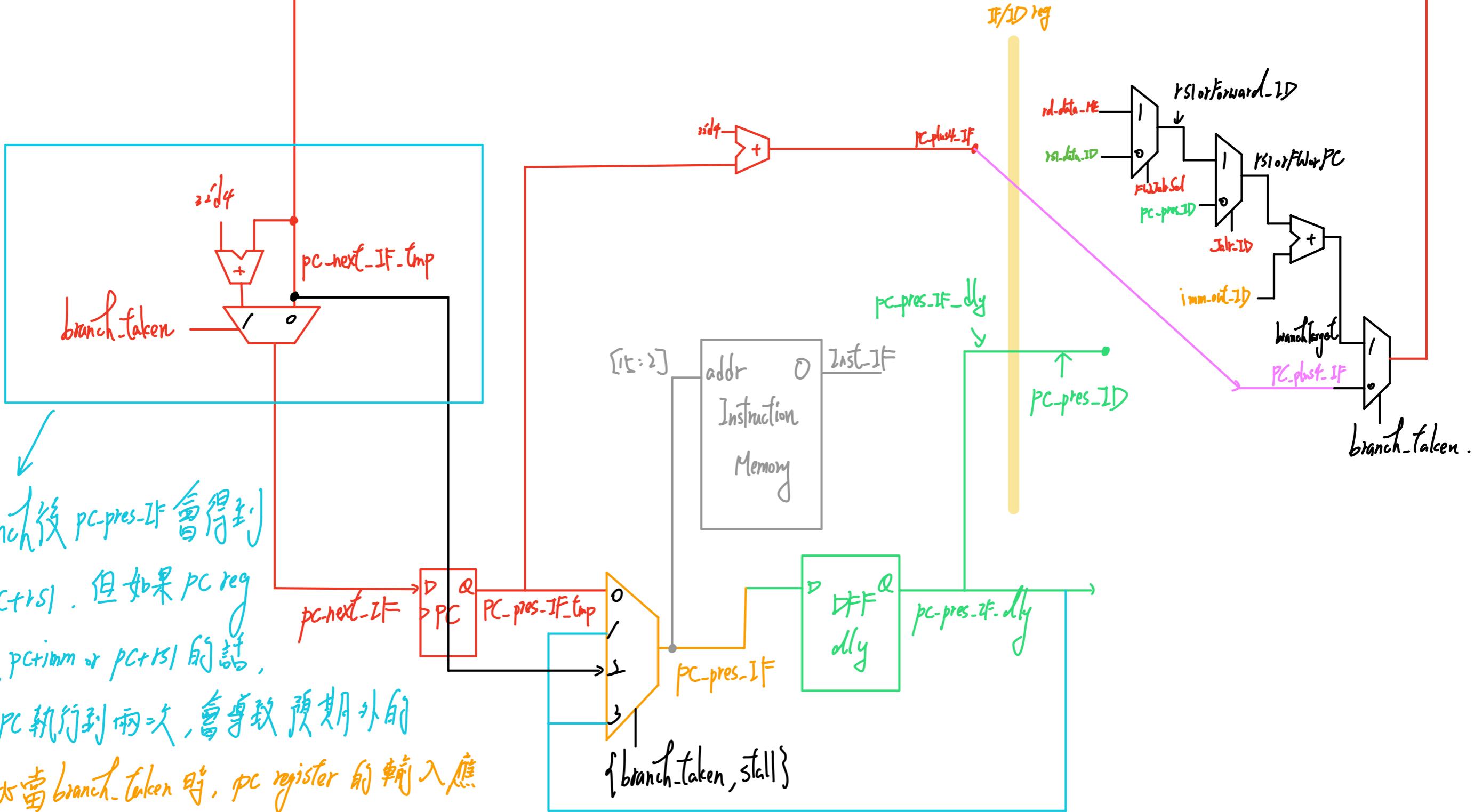
則會取不回，可以讓 RF 的輸出 = 輸入來解決後  
等符-cycle 的問題！

DM 有 delay 輸出，對應 policy:

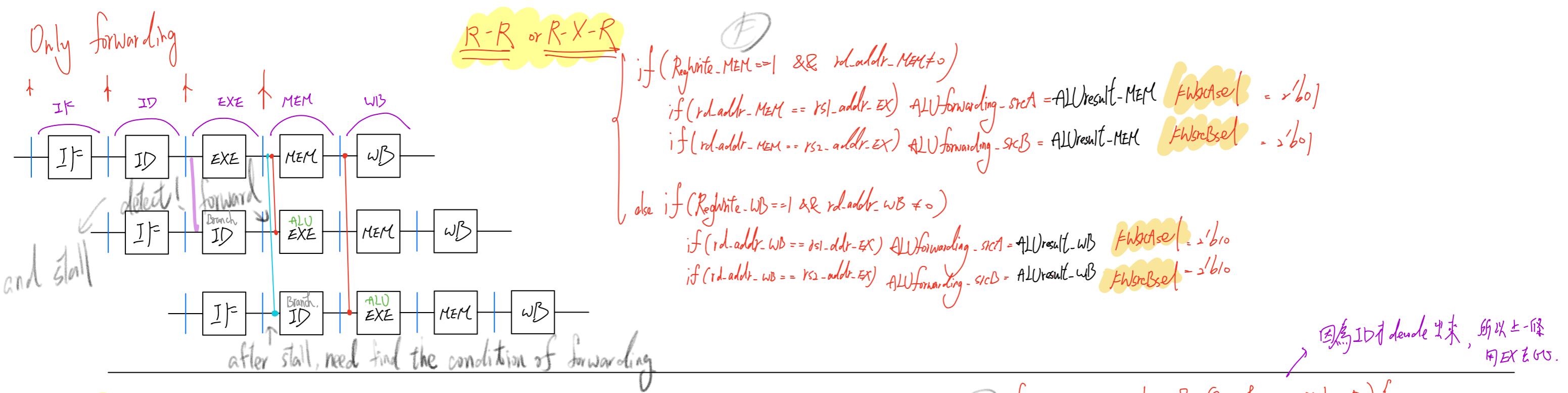
1. 將 addr 提早一個 cycle，data 也會與  
沒有 delay 的 DM 同時出來。

2. 因為會影響到寫入時序，因此也將寫入  
data & write enable 提早。  
rs20Forward sel      MemWrite-EX

IM 有 one cycle delay 後的改動



為 branch 後的下一道指令, 也就是 `PC+imm+4` or `PC+rS1+4` \*



R - Branch

④ if (Regwrite\_MEM == 1 && rd\_addr\_MEM != 0) {

need to stall for one cycle.  
mind the flush!!

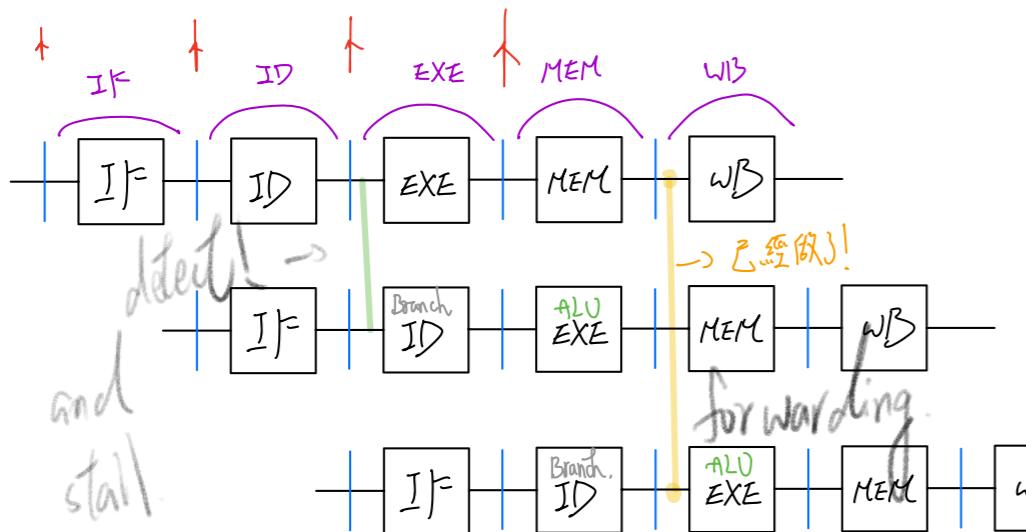
    if (rd\_addr\_MEM == rs1\_addr\_ID) FwCompSel[0] = ALUresult\_MEM  
     if (rd\_addr\_MEM == rs2\_addr\_ID) FwCompSel[1] = ALUresult\_MEM

⑤ if (regWrite\_EX == 1 && (Branch\_ID || Jalr\_ID)) {  
     if (rd\_addr\_EX == rs1\_addr\_ID || rd\_addr\_EX == rs2\_addr\_ID)  
         stall = 1  
     else  
         stall = 0.

stall 1 cycle & forwarding

Load - R

→ need stall one cycle.

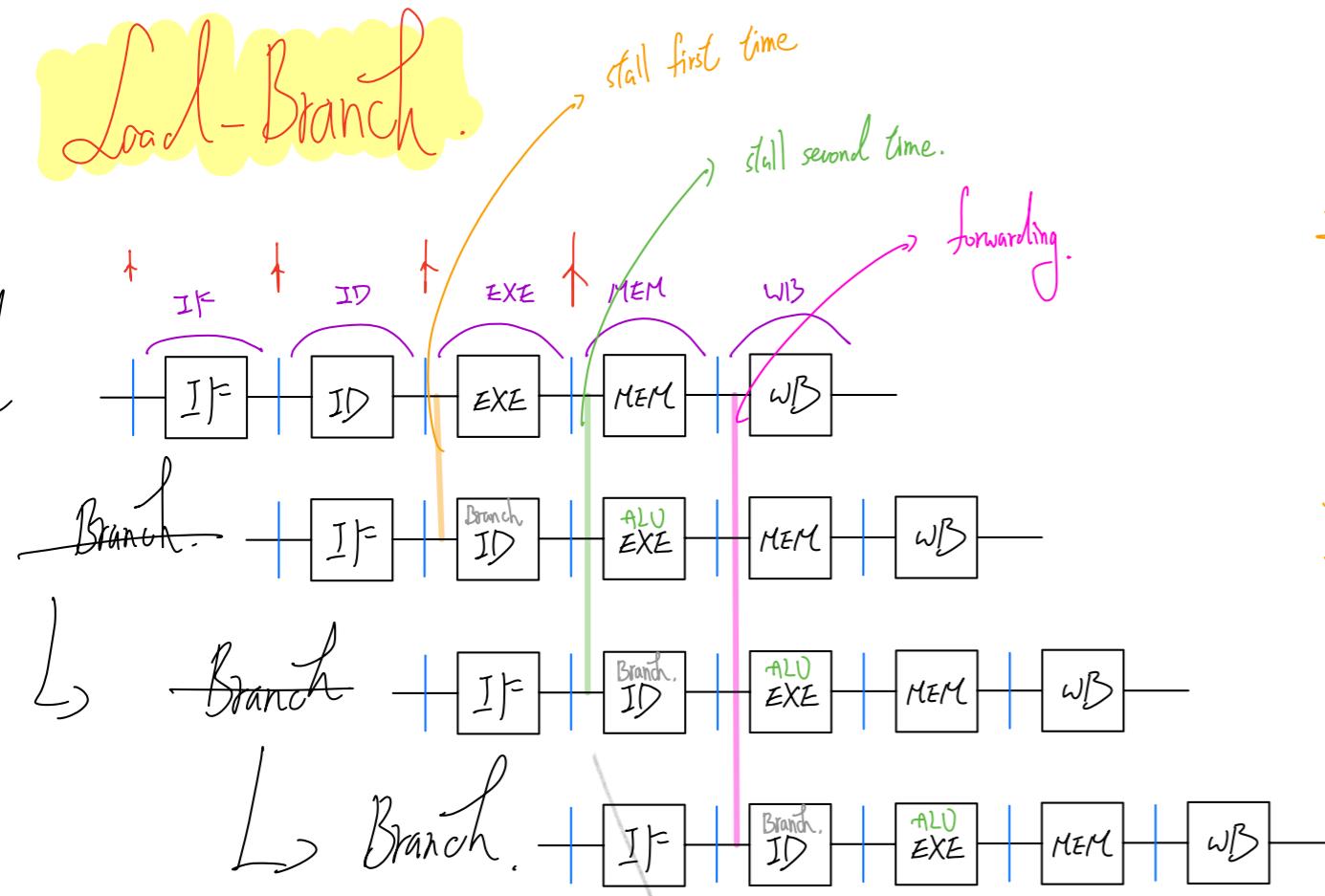


⑥ if (MemRead\_EX == 1 && Regwrite\_EX == 1) {  
     if (rd\_addr\_EX == rs1\_addr\_ID || rd\_addr\_EX == rs2\_addr\_ID)  
         stall = 1  
     else  
         stall = 0

Same.

stall 1 cycle & forwarding.

# Load-Branch



already forwarding in other  
condition (R-R, R-B)

stall first time. (S1)

```

if(memRead_EX == 1 && Regwrite_EX == 1) {
    if(rd_addr_EX == rs1_addr_ID || rd_addr_EX == rs2_addr_ID)
        stall = 1;
    else
        stall = ∞;
}

```

stall second time. (S2)

```

if(memRead_MEM == 1 && (Branch_ID | Jalf_ID)) {
    if(rd_addr_MEM == rs1_addr_ID || rd_addr_MEM == rs2_addr_ID)
        stall = 1;
    else
        stall = ∞;
}

```

X

if (op == STYPE) begin

case (fncts)

,  
,  
,  
,

endcase

end

$$\begin{array}{c} 4'1 \\ 4'b \\ 4'b \\ 4'b \\ 4'b \\ \parallel \\ [0] & [1] \\ \parallel & \parallel \\ [0] & [1] \end{array}$$

$$\overline{a+b} = \overline{a} \& \overline{b}$$

$$a \cdot (\overline{b} \cdot c)$$

$$= \overline{a} + \overline{b} \cdot c$$

$$= \overline{a} + \overline{b} \cdot c$$

$$a \cdot b \oplus c$$

$$= \overline{a} + b \cdot c$$

$$= \overline{a} + \overline{b} \oplus c$$