RECTANGULAR WATER TANK

Q. Design a rectangular Water tank of size 5m × 4m × 3m deep resisting from ground. Use M25 concrete and Fe250 mild Steel.

Ans: Size of tank = 5m × 4m × 3m.

Grade of Concrete = M25

From IS 456 : 2000, Table 21,

$\sigma_{cbc} = 8.5\ N/mm^2$.

$\therefore m = \frac{280}{3\sigma_{cbc}} = \frac{280}{3 \times 8.5} = 10.98 \simeq 11$

For Fe250, $\sigma_{st} = 115\ N/mm^2$.

$\therefore K = \frac{m\sigma_{cbc}}{m\sigma_{cbc} + \sigma_{st}} = \frac{11 \times 8.5}{11 \times 8.5 + 115}$

$= 0.448$

Lever arm depth factor, $j = 1 - k/3$

$= 1 - \frac{0.448}{3} = 0.850$

$\therefore R = \frac{1}{2}\sigma_{cbc} \times j \times k$

$= \frac{1}{2} \times 8.5 \times 0.85 \times 0.448 = 1.618\ N/mm^2$.

In this problem, $L/H = 5/4 = 1.25 < 2$

Horizontal frame action :-

The critical section is at a height $h = H/4$ at 1m. whenever more, hence in this time = 1 m.

$P_x = \gamma(H-1) = 9.81 \times (3-1) = 19.6\ kN/m^2$.

Fixed end moments are :

i) $\frac{PL^2}{12} = \frac{19.6 \times 5^2}{12} = 40.83$ kN-m in long wall.

ii) $\frac{PB^2}{12} = \frac{19.6 \times 4^2}{12} = 26.133$ kN-m in short wall.

Thickness of short and long wall are maintained same distribution factor are shown.

Number	Stiffness	Total	Distribution
Short Wall	$\frac{4EI}{4} = EI$	1.8EI	0.556
Long wall	$\frac{4EI}{5} = 0.8EI$		0.444

Due to symmetry are balancing wall take care of moment distribution as shown in table below :

Short Wall			Long Wall
	0.556	0.444	
	− 26.133	40.883	
	− 8.20	−6.55	
	− 34.333	34.333	

Correct moment, 34.333 kN = 34.33×10^6 N

Section outside effective thickness required for balance section

$$d = \sqrt{\frac{m}{R.b}} = \sqrt{\frac{34.33 \times 10^6}{1.618 \times 1000}} = 146 \text{ mm}.$$

Section is to be sufficiently under reinforce. Hence, let us keep overall thickness of 200 mm with effective cover of 35 mm.

$$d = 200 - 35 = 165 \text{ mm}.$$

Direct pull on long and short walls are given by.

$$T_L = P_x \times B/2 = 19.6 \times 4/2 = 39.2 \text{ kN},$$

$$T_B = P_x \times L/2 = 19.6 \times 5/2 = 49 \text{ kN}.$$

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Eccentricity of Reinforcement from centre of wall

$$x = \frac{200}{2} - 35 = 65 \text{ mm.}$$

Design moment at Corner $= M - Tx$

$= 34.33 - 39.2 \times 0.065$

$= 31.785$ kN·m.

Hence at corner, horizontal reinforcement required for bending resistance,

$$A_{st_1} = \frac{M}{\sigma_{st} \cdot jd} = \frac{31.785 \times 10^6}{115 \times 0.85 \times 165} = 1970 \text{ mm}^2.$$

Using 20 mm bars direct tension

$$A_{st_2} = \frac{T}{\sigma_{st}} = \frac{34.33 \times 1000}{115} = 341 \text{ mm}^2.$$

Total $A_{st} = A_{st_1} + A_{st_2} = 2311 \text{ mm}^2$.

Using 20 mm bars spacing required,

$$s = \frac{\pi/4 \times 20^2}{2311} \times 1000 = 136 \text{ mm}.$$

Provide 20 mm bars at 130 c/c, it is to be provided on water face.

Reinforcement at middle of long walls.

Bending moment $= \frac{P_x L^2}{8}$ - moment at corner

$= \frac{19.6 \times 5^2}{8} - 34.35 = 26.917$ kN-m.

Design moment $= M - T_0$

$= 26.917 - 34.2 \times 0.065 = 24.369$ kN-m

$$A_{st_1} = \frac{24.369 \times 10^6}{115 \times 0.85 \times 16.5} = 1511 \text{ mm}^2.$$

$$A_{st_2} = \frac{39.2 \times 1000}{115} = 341 \text{ mm}^2.$$

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Total $A_{st} = A_{st_1} + A_{st_2} = 1852\ mm^2$.

Using 20 mm bars spacing

$$s = \frac{\frac{\pi}{4} \times 20^2}{1852} \times 1000 = 169\ mm.$$

Hence also bars maybe provided at 130 mm c/c. So that bars may be bent and used.

Reinforcement for short wall,

$M = 34.333 - T$

$= 34.333 - 49 \times 0.065 = 31.198\ kN\text{-}m.$

$$A_{st_1} = \frac{31.198 \times 10^6}{115 \times 0.85 \times 165} = 1931\ mm^2.$$

$$A_{st_2} = \frac{49 \times 1000}{15} = 926\ mm^2.$$

Total $A_{st} = A_{st_1} + A_{st_2} = 2357\ mm^2$.

Using 20 mm bars spacing

$$s = \frac{\frac{\pi}{4} \times 20^2}{2357} \times 1000 = 133\ mm.$$

Hence using 20 mm bars at 130 mm c/c.

Bending moment at ~~corne~~ centre of wall

$= \gamma(H-h) \times \frac{4^2}{8}$ − moment at ends

$= 9.81 \times (3-1) \times \frac{4^2}{8} - 34.333$

$= 1.867\ kN\text{-}m.$

Reinforcement in vertical direction:

Cantilever moment $= \gamma H \cdot \frac{h^2}{6} = 9.81 \times 3 \times \frac{1^2}{6}$

$= 4.9\ kN\text{-}m.$

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$$A_{st} = \frac{M}{\sigma_{st}\, jd} = \frac{49 \times 10^6}{115 \times 0.85 \times 165} = 304\ mm^2$$

minimum Reinforcement $= \frac{0.3}{100} \times 200 \times 1000$
$= 600\ mm^2$.

Provide 304 mm^2 area on each face, so that using 10 mm bars.

$$s = \frac{\pi/4 \times 10^2}{304} \times 1000 = 258\ mm$$

Provide 10 mm bars 250 mm c/c on both face.

Base slab – Provide base slab of thickness 150 mm with 8 mm bars at 220 mm c/c in both direction at top and section of slab. A lean concrete bed of 100 mm may be provided in bottom slabs

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NAME OF EXPERIMENT:- Implementation of 4 bit Adder Subtractor Composite Unit

APPARATUS USED:-

1. Full Adder
2. Half Adder
3. Full Subtractor
4. Half Subtractor

PIN DIAGRAM:-

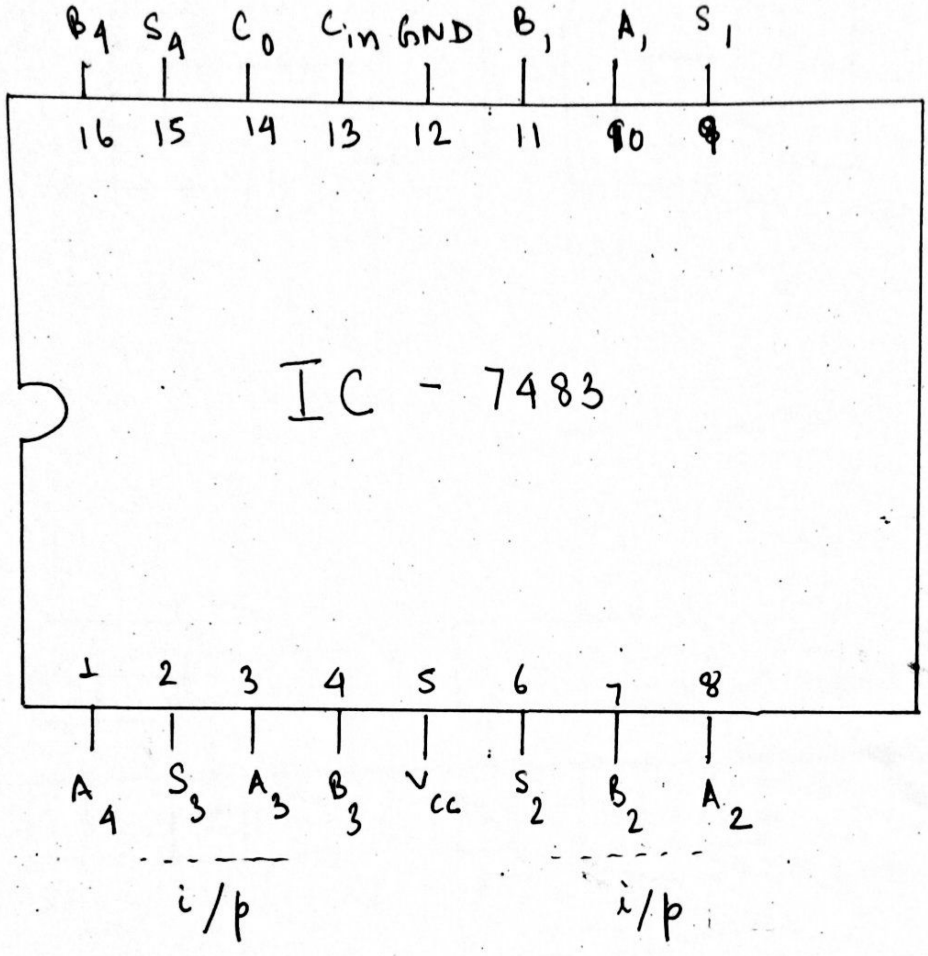


Fig. → Pin Diagram representing of IC-7483

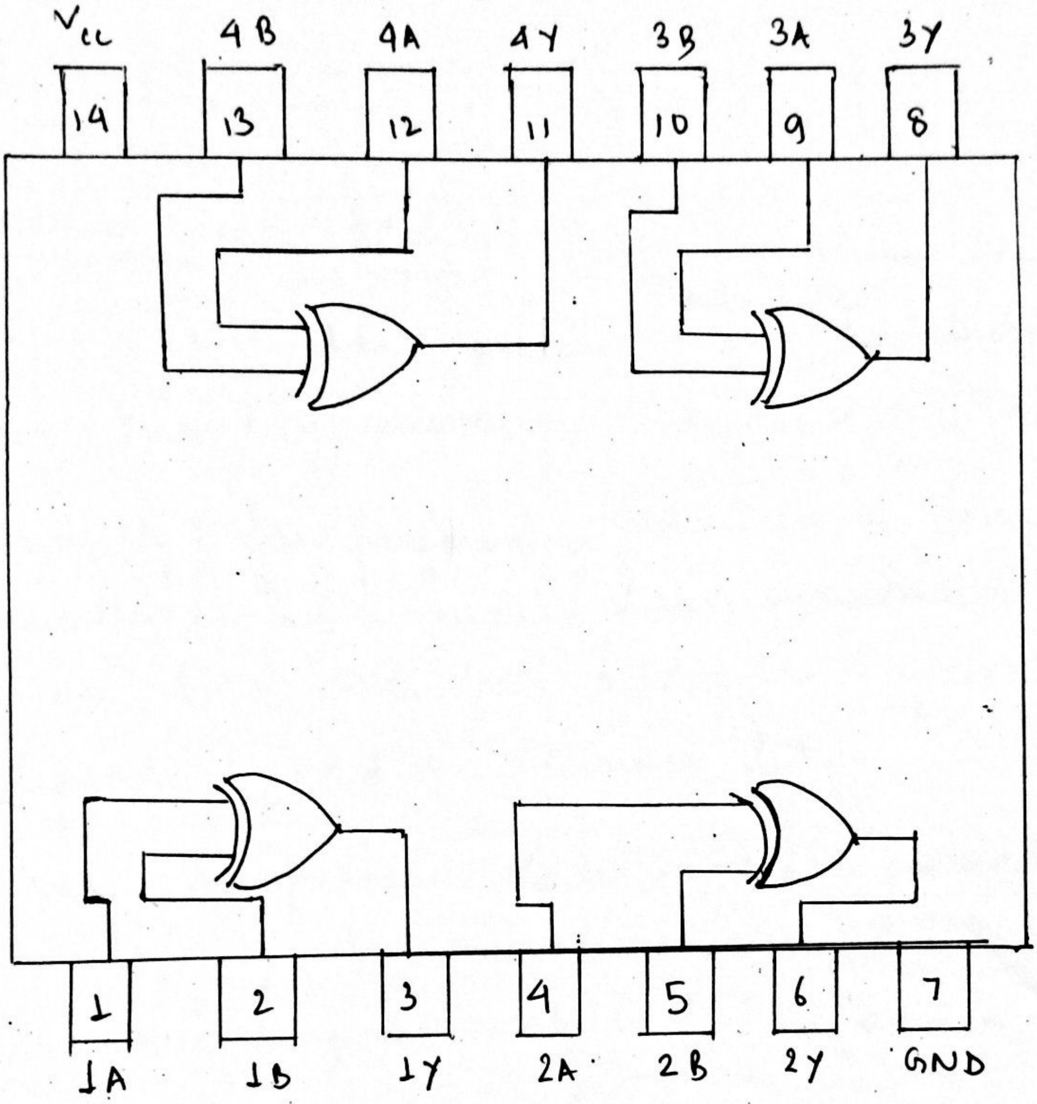
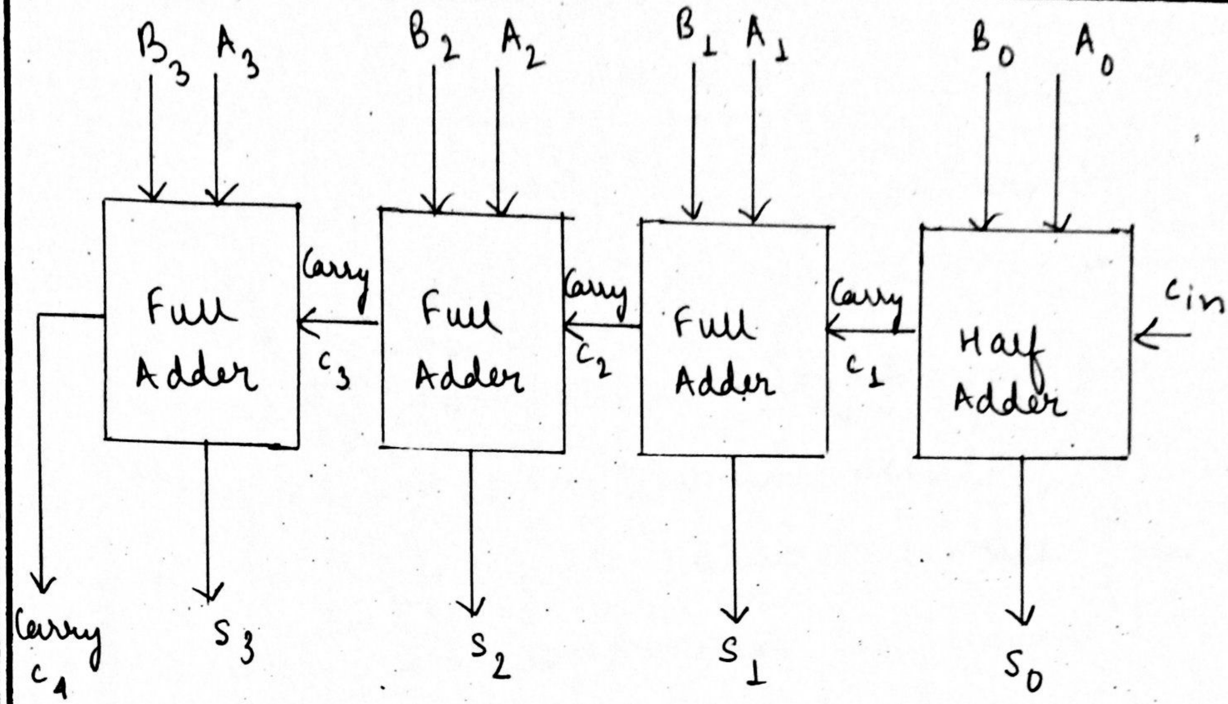


Fig. → Pin Diagram representation of IC-7486

THEORY:-

Parallel Binary Adders:- As, we know that a single full adder performs the addition of two one bit numbers and an input carry. Similarly, for performing addition of binary numbers with more than one bit, more than one full adder is required depending on the number bits.

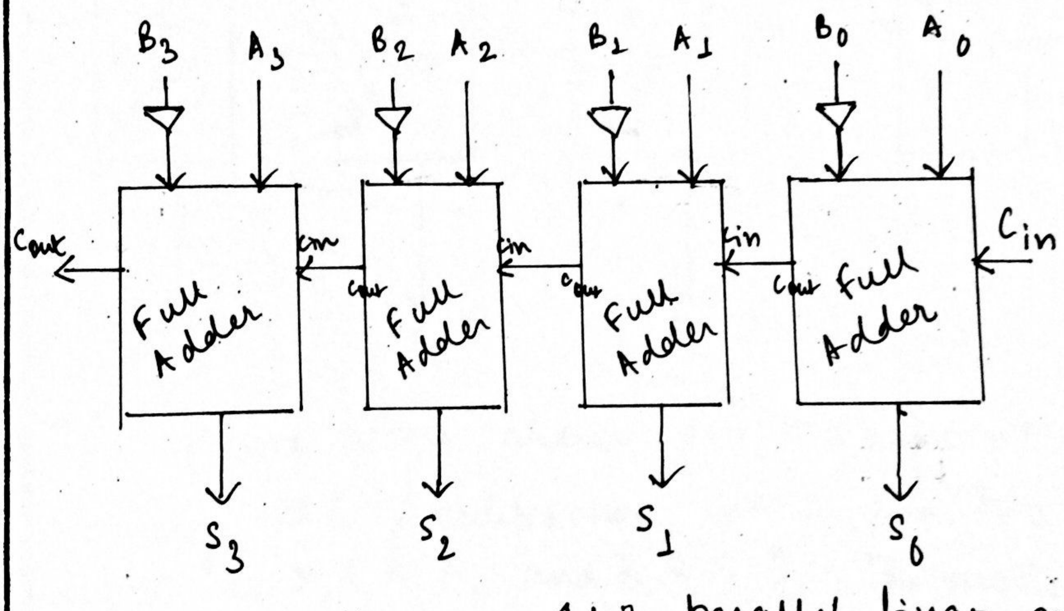
Thus, a parallel adder is used for adding all bits of two numbers simultaneously by connecting a number of full adders in parallel.



The figure above shows a parallel 4 bit binary adder which has three full adder and one half adder. The two binary numbers to be added are $A_3 A_2 A_1 A_0$ and $B_3 B_2 B_1 B_0$ which are applied to corresponding inputs of the adder.

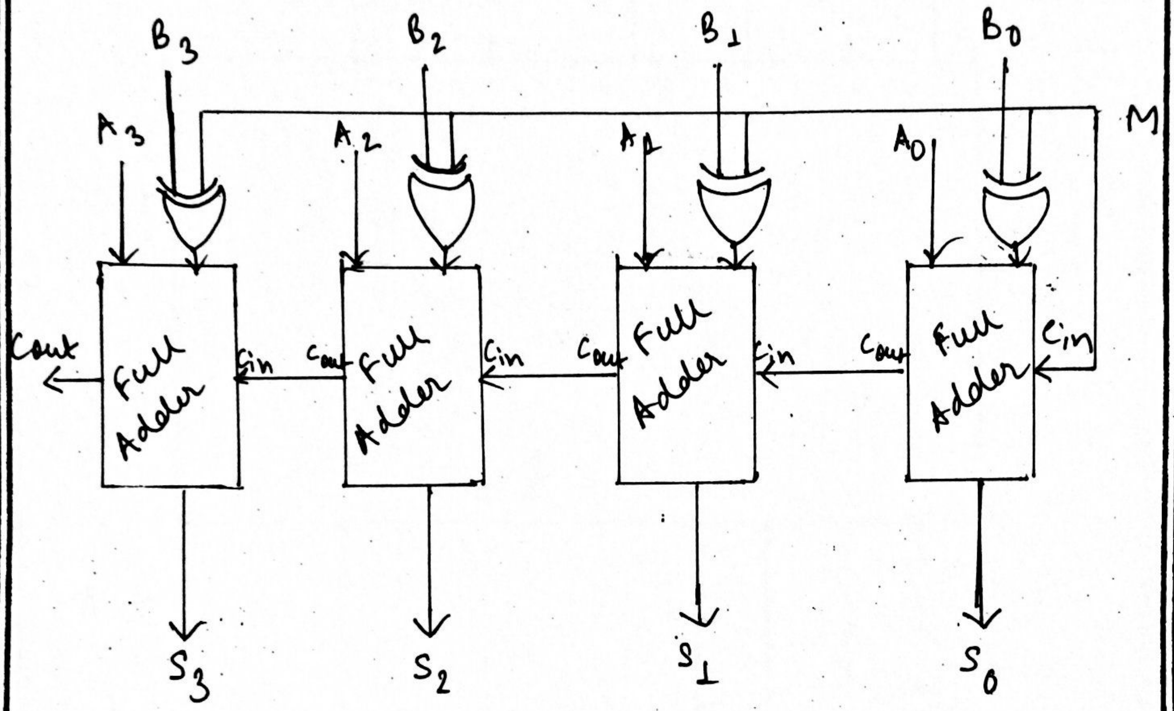
This parallel adder produces their sum as $C_4 S_3 S_2 S_1 S_0$ where C_4 is final carry

Parallel Binary Subtractors :- To perform the subtraction of binary numbers with more than one bit is parallel subtractors are used. This parallel subtractors can be designed in several ways including combination of half and full subtractors, all full adders with subtrahend complement input, etc.



The figure shows a 4 bit parallel binary subtractor formed by connecting 4 full adders. Here $A_3A_2A_1A_0$ is a 4 bit minuend and 4 bit subtrahend $B_3B_2B_1B_0$ is subtracted and output is $D_3D_2D_1D_0$

The operation of both addition and subtraction can be performed by a common binary adder. Such binary circuit can be designed by adding an Ex-OR gate with each full adder.



The figure above shows the 4 bit parallel binary adder/subtractor which has two 4 bit inputs as $A_3 A_2 A_1 A_0$ and $B_3 B_2 B_1 B_0$. The mode input control line M is connected with carry input of the least significant bit of full adder. The control line decides the type of operation

CIRCUIT DIAGRAM :-

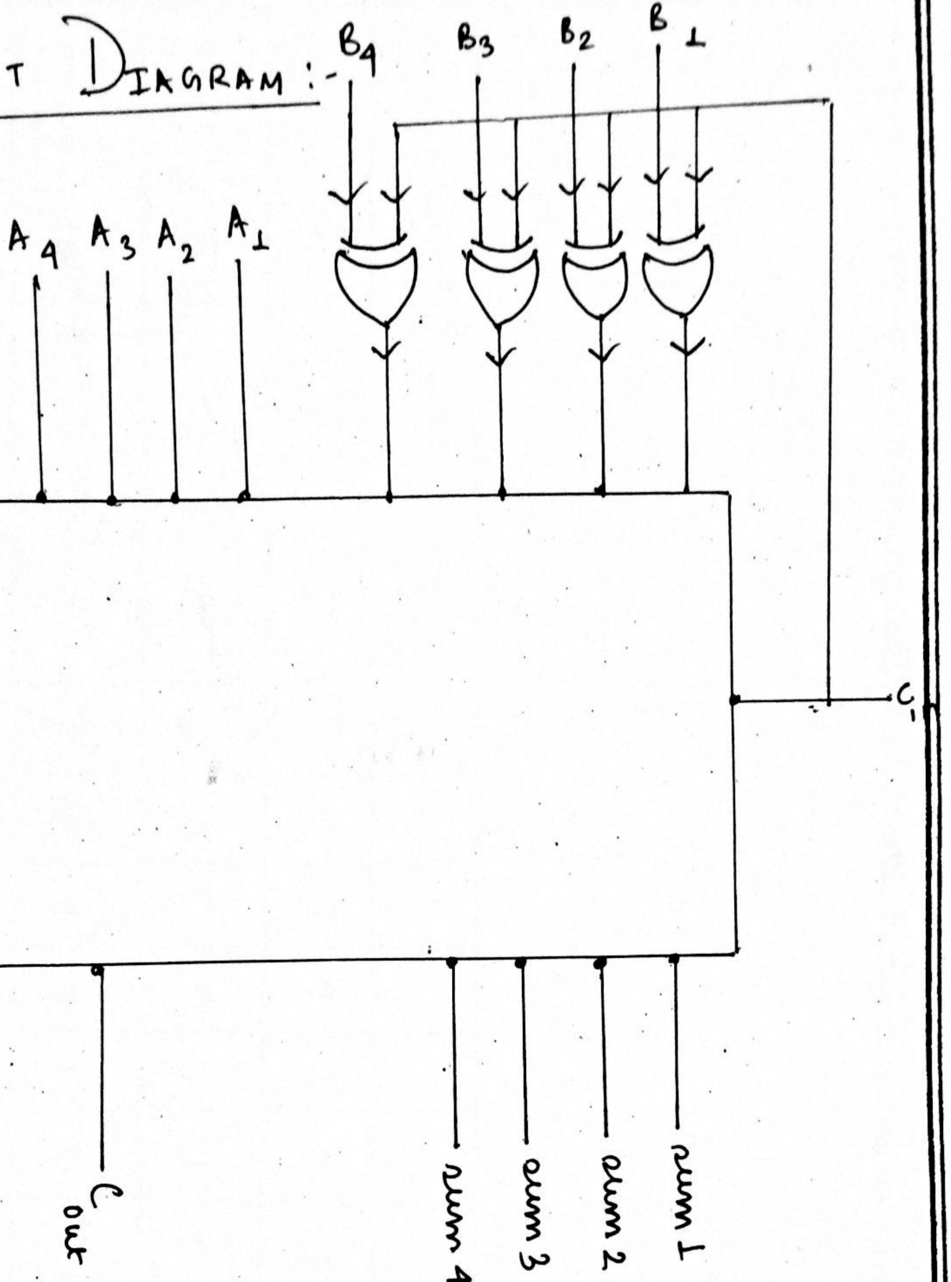


Fig. → Circuit Diagram representing 4 bit Parallel Adder / Subtractor

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Truth Table :-

A3	A2	A1	A0	B3	B2	B1	B0	Cin	Cout	S3	S2	S1	S0
1	0	0	0	0	0	1	0	0	0	1	1	0	0
1	0	1	0	1	0	0	1	1	1	0	0	0	1
1	0	0	1	1	0	1	0	1	0	1	1	1	1
....													

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CONCLUSION:-

(i) When input control line, M = 1 circuit is subtractor and when its M = 0, circuit becomes adder.

(ii) When M = 0, B Ex-OR of 0 produce B.

(iii) The Ex-OR gate consists of two inputs to which one is connected to the B and other to input M.

(iv) When M = 1, B Ex-OR of 0 produce B complement and also carry input is 1.

Hence the complemented B inputs are added to A and 1 is added through the input carry. nothing but a 2's complement operation. Therefore, subtraction operation is performed.

(v) If (A > B) C_{out} glows as result is +ve

If (A < B) C_{out} doesnot glows as result is -ve.