Study of Economical Design of Storage Bunker by Changing the Height by Breadth Ratio

CH. Srivarma[1], G.Niranjan[2]

[1,2]*Assistant Professor, Department of Civil Engineering, Adikavi Nannaya University –University College of Engineering*

***Abstract* - In order to study the most economical configuration of a storage bunker to store a given volume of material for bunkers design. In this investigation for each volume 100m3, 200m3 and 300m3. the length to breadth ratio is constant. Finally the most economical section is determined by changing the height to breath ratio. For this purpose we considered three height to breath ratios for each volume i.e., h/b > 1 h/b =1 h/b < 1. values then for the same volume cost of the bunker compared for three h/b ratios finally the most economical height to breath ratio is found out for economical design. All the design have been based on the recommendations of IS456-2000 & IS4995-1974 codes based on the design dimensions of the bunker which leads to safe design and least amount of material i.e., steel and concrete and cost to store a given amount of material have been found out.**

***Index Terms* - Bunker, Most economical, Length to Breath ratio, Height to Breath ratio, coal, cost.**

I.INTRODUCTION

Bunkers are the structures constructed to store the materials like coal and food grains in many industries. Bunker is a large container or compartment used in industries for storing bulk amount of materials ranging from a few tonnes to thousands of tonnes these are called as storage bunkers .bunkers are also constructed sometimes to protect people from bombs during wars or natural disasters like tornadoes these are known as personal bunkers. however, they differ on the size of the structure.

II. OBJECTIVE OF STUDY

The main objective of the study is to identify the most economical design by changing height to breadth ratio

SCOPE OF STUDY

The bunker is varied from 100 m^3 to 300 m^3. The material to be stored is taken as bituminous coal having an angle of internal friction of 35° and unit weight of 8kN/m^3. For storing a given volume of material, the effect of the ratio of height to lateral dimension on the total cost has been studied in depth. The provision of IS: 4995 (part I) - 1974 (criteria for design of reinforced concrete Bunker for storage and Granular and powdery Materials), and IS: 4995 (part II) - 1974 (criteria for design of reinforced concrete Bunker for storage and Granular and powdery Materials), and IS: 456-2000 (code of practice for plain and reinforced concrete) are made use of whenever required. M20 grade concrete and Fe 415 grade steel are used throughout the investigation for design of bunkers .

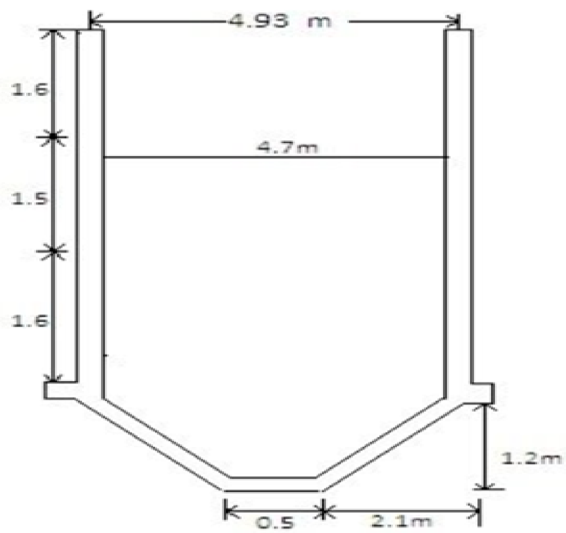
COST ESTIMATION FOR STEEL:

Steel estimation for footing with column:

1. 12mm dia @ 0.89 kg in
Number of bars = (110 - 8/15) + 1 = 7.8 ≈ 8 no's
L =110 - 2 × 4 + 8.5 × 1.2 = 112 cm = 1.12 m
Wt = 2 × 8 × 1.12 × 0.89 = 15.948 kg
Cost = 15.948 × 8 × 35 = 4465.44/-
2. 16mm ϕ dowel bars @ 1.58 kg
L = 1 + 0.25 – cover + bend = 1.25 - 0.08 + 0.15
= 1.32 m
6 No's × 1.32 × 1.58 = 12.51 kgs
Cost = 12.51 × 6 × 32 = 2401.92/-
3. 16mm dia bars @ 1.58 kg in column
L = 4.7 + 0.60 + 0.10 + 0.10 = 5.5 m
6No's × 5.5 × 1.58 = 52.14 kgs
Cost = 52.14 × 6 × 32 = 10010.88/-
4. 10mm dia bars @ 0.62 kg in
Lateral ties {No = (4.7 +1)/0.15 = 38 No's}
{L = (π × 0.22) = 0.7 m}
38× 0.7 × 0.62 = 16.492 kgs
Cost = 38 × 16.492 × 37 = 23187.75/-

Total weight = 97.082kg
Total cost = 40065.99/-

Steel estimation for central portion and hopper bottom:
Central portion:
1st portion = 4.93 × 4
= 19.72
= 19.72 × 12 m dia wt. for 1 m steel
= 19.72 × 0.88
= 17.353 kgs



Consider 1.6 m on central portion (1)
50 mm c/c – 12mmϕ, 1.6 m depth
No's = 1600/50 = 32 No's bars
2nd portion = 4.93 × 4 = 19.72
= 19.72 × 0.88 = 17.535
Consider 1.5 m on central portion (2)
200 mm c/c – 12 mm dia, 1.5 m depth.
No of bars =1500/200 =7.5 No's.
3rd portion = 4.93 × 4 = 19.72 × 0.39 = 7.69 kgs
Consider 1.6 m on central portion (3)
250 mm c/c – 8 mm dia, 1.6 m depth
No of bars = 1600/250 = 6.4 No's.
Hopper bottom:
Wt = (2.4 + 0.23) × 4
= 10.52 × 12 mm dia of bars
= 10.52 × 0.88 = 9.257 kgs
100 mm c/c, 12 mm dia bars
No of bars = 1200/100 = 12 No's
Cost:
For central portion no of bars = 32 No's @ 50 mm c/c
Weight = 17.353 kgs
Central portion cost = 17.35 × 32 × 35 = 19,432/-
Hopper bottom cost = 9.257 × 12 × 35 = 3,887/-
Total cost = 23,320/-

III.COST ESTIMATION FOR CONCRETE:

S.NO	ITEM OF WORK	NO	LENGTH (m)	BREADTH (m)	DEPTH (m)	QUANTITY (m^3)	COST OF WORK
1.	Earth work excavation in foundation	4	1.1	1.1	1.25	6.05	6.05×300 =1,815/-
2.	Concrete in foundation	4	1.1	1.1	0.25	1.21	1.21×4000 =4,840/-
3.	Columns in concrete	4	0.17	0.17	5.4	0.62	0.62×4000 =2,480/-
4.	Down slopping slab (hopper bottom)	4	4.7	0.23	1.2	5.18	5.18×4000 =20,720/-
5.	Side walls	4	4.7	0.23	4.7	20.32	20.32×4000=8 1,280/-
6.	Top slopping slab	4	4.7	0.23	1.64	7.09	7.09×4000 =28,360/-

Concrete cost for 100 m3 = 1,39,495/-

COST ESTIMATION FOR h/b > 1 h/b =1 h/b < 1 for a volume of 100 m3.

Volume	h	a/b ratio	h/b ratio	a	b	Cost (Lakhs)
100	6.3	1.0	1.70	3.7	3.7	2,05,670
100	4.3	1.0	1	4.40	4.40	2,03,460
100	3.5	1.0	0.74	4.7	4.7	2,02,879

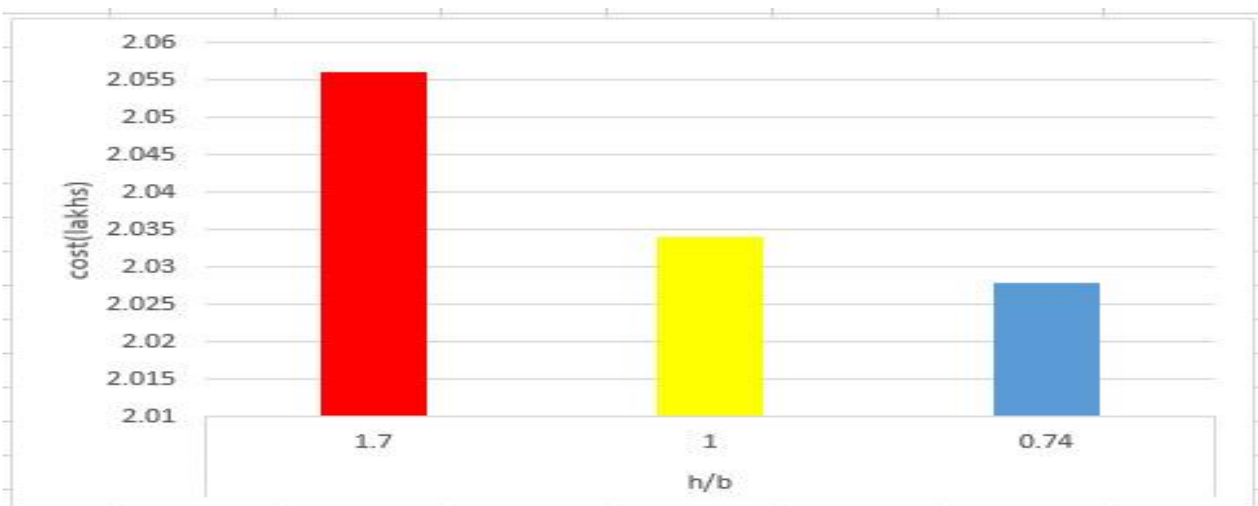
COST ESTIMATION FOR h/b > 1 h/b =1 h/b < 1 for a volume of 200 $m^{3.}$

Volume	h	a/b ratio	h/b ratio	a	b	Cost (Lakhs)
200	9	1.0	2	4.50	4.50	3,26,521
200	6	1.0	1.13	5.3	5.3	3,23,962
200	4.6	1.0	0.76	6	6	3,23,898

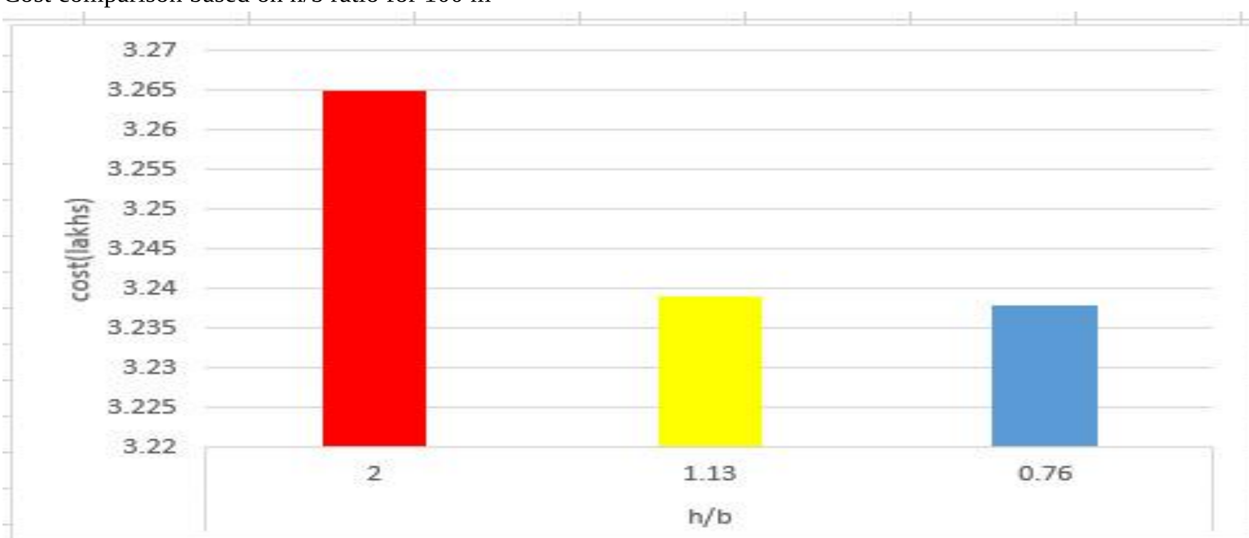
COST ESTIMATION FOR h/b > 1 h/b =1 h/b < 1 for a volume of 300 $m^{3.}$

Volume	h	a/b ratio	h/b ratio	a	b	Cost (Lakhs)
300	9	1.0	1.63	5.5	5.5	5,50,890
300	6.8	1.0	1	6.2	6.2	5,46,573
300	7.5	1.0	0.78	5.9	5.9	5,46,463

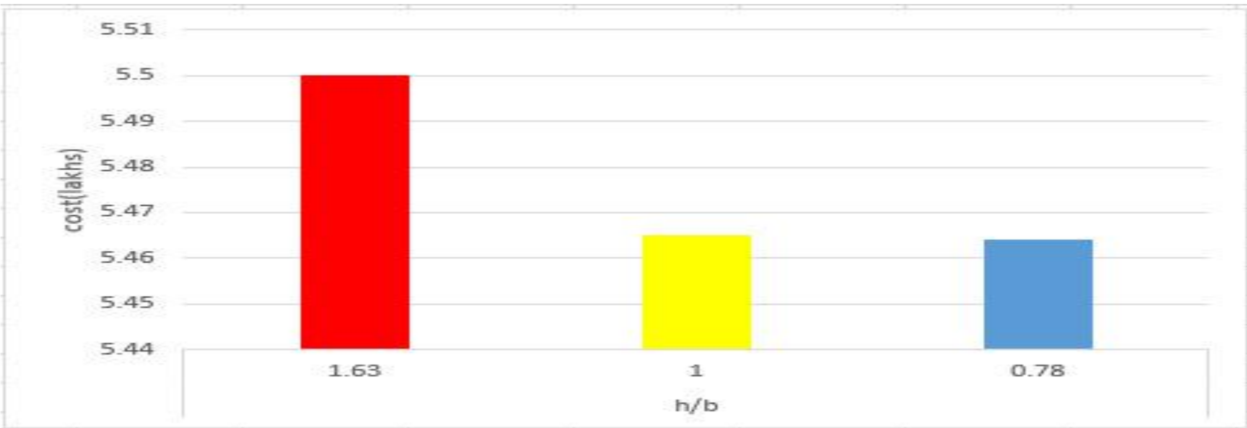
IV.BAR CHARTS



Cost comparison based on h/b ratio for 100 m^3



Cost comparison based on h/b ratio for 200 m^3



Cost comparison based on h/b ratio for 200 m^3

V.CONCLUSION

Based on the cost estimation of bunkers for various volumes 100, 200 and 300 m3 the following conclusions are drawn

- It is observed that for 100 m3 volume of bunker is found to be economical at h/b ratio 0.74 and 1, uneconomical for h/b ratio 1.7.
- For 200 m3 volume of bunker h/b ratio 0.76 is found to be economical and h/b ratio 2 is most expensive.
- • For 300 m3 volume of bunker h/b ratio 0.78 and 1 is found to be economical, and h/b ratio 1.6 is uneconomical.
- It is concluded that for various volumes from 100 m3 to 300 m3 capacity is economical for h/b ratio 0.7 to 1.0.
- As the ratio of h/b increases more than 1 for volumes 100 m3 to 300 m3 capacity of bunkers is found to be uneconomical.

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