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Effect of piles on the design of the raft foundation

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ABSTRACT
The combined raft, soil and pile foundation system has reached a high level of familiarity and is now being used to support a large number of structures. When the bearing capacity of the raft foundation is acceptable but the settlement value exceeds the permissible limit, raft-soil system is reinforced with piles to reduce settlement. Here, piles act as settlement reducers to the raft-soil foundation system.

Different researchers have studied the effect of varying pile, raft and soil parameters on the settlement response and load-sharing behavior of the raft and piles in a combined raft, soil and pile foundation system but less attention has been paid to the stress response behavior of the raft. As this aspect is considered to be important from economics of raft design, a study has been performed to understand the stress response of the raft on the introduction of piles. The stress response of the raft for varying load conditions, Ec/Es ratios, thicknesses of raft and diameters of pile have been studied by performing numerical analyses on the foundation system supporting a moderately loaded 12-storeyed real-time commercial structure located in Chennai, India. An attempt has been made to study the applicability of Equivalent Pier concept. The above analyses were performed for two different layouts of piles. The behavior of the stress and settlement responses of the raft reinforced with piles was compared with unpiled raft. Staad-Pro V8i and Ansys 16.0 have been used for the study and this paper presents observations and discussions from the study.

1 INTRODUCTION

Exponential growth in infrastructure development has forced the designers to accept any ground condition irrespective of its nature. The foundation system must satisfy the serviceability and ultimate limit state conditions and also be viable economically in spite of the ground conditions. The economics of the raft design lies in designing the foundation such that the factor of safety against bearing capacity failure is at the minimum specified value and the total settlement is less than the permanent settlement.

Rafts are designed for the required bearing capacity, however, when the bearing capacity of the raft foundation is acceptable but the settlement values exceed beyond the permissible limits, the raft-soil system is reinforced with piles to reduce settlement (Zeavert, 1957). Here, piles act as settlement reducers to the raft-soil foundation system.

Extensive research had been performed by various researchers to understand the settlement reduction in raft on introduction of piles (Poulos, 1994a, b). Various raft, soil and pile parameters that affect the settlement response and the load-sharing behavior of the raft and piles in a combined raft, soil and pile foundation system had been also studied extensively. However, very little research has been performed to study the effect of introducing piles on the raft stress response and bending moment. Therefore, it becomes a necessity to study the behavior of raft stresses on the introduction of piles in a raft-soil foundation system for an effective and economical design since the economy of a foundation lies in both optimum pile layout and provisions in raft.

2 OBJECTIVE

The main objective of this study is to determine the effect of reinforcing the raft-soil system with piles on the raft stresses and bending moment.

3 METHODOLOGY

In the present study, a twelve-storied commercial building resting on a raft-soil foundation system reinforced with piles has been adopted. The structure was analyzed in Staad-Pro to obtain the column reactions. These column reactions act at the base of the structure. The linear soil-structure interaction analysis of the combined raft-soil and pile foundation system was performed using Ansys Workbench 16.0.

The behavior of the raft stress and settlement response were studied by plotting graphs and contours for four different conditions obtained by varying parameters like Young's modulus of soil (Es), Pile diameter (D), Raft thickness (t) and type of loading. The above analyses were performed for two different pile layouts. The stress response for the pile reinforced raft was compared with unpiled raft. An attempt was made to study the applicability of Equivalent Pier concept (Balakumar et al, 2013 a). Effort was made to know if there was any variation in the raft stress response.

3.1 Structural Analysis

The shape of the twelve-storied commercial building is irregular with a width of 27.38m and a length of 41.2m along the largest span. The building lies on a raft – soil foundation system reinforced with piles. The dimensions

of the raft are same as the shape of the building. Figures 1 and 2 represent the floor plan and the structural frame of the twelve-storied building. Table 1 presents the dimensions of the building components.

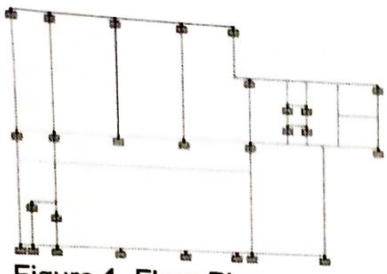

Figure 1. Floor Plan

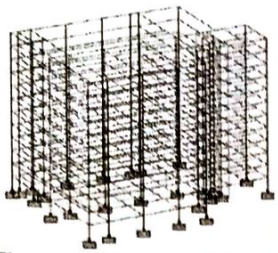

Figure 2 Structural Frame

Table 1. Physical properties of model

Specification	Value(mm)
Slab thickness	200
Size of beams along lateral direction	800 x 750
Size of beams along transverse direction	450 x 600
Size of columns	800 x 800
Outer wall thickness	230
Inner wall thickness	230
Storey height	3750
Number of storeys	12

The framed model is subjected to a combination of Dead load (D.L.) and Live load (L.L.). Three dimensional analysis has been performed to obtain the support reactions. These reactions obtained at the base of the structure act as the structural load on the foundation.

3.2 Numerical Analysis

In the case of Staad-Pro, it is a known fact that geotechnical problems cannot be handled. Although some approximations can be done, the applications are very limited like preliminary analysis of retaining walls which is conforming to beam elements. Since the soil cannot be modelled, Ansys was chosen to do the soil-structure interaction studies. The physical and material properties of the combined foundation system are mentioned in tables 2 and 3 respectively.

Table 2. Physical properties of raft, piles and soil

Property	Raft	Piles	Soil
Material	M25 concrete	M25 concrete	Medium dense sand
Shape	Irregular	Circular	Cube
Depth	1m	24m	68.45m
Width	27.38m	0.9m	82.14m

Table 3. Material properties of raft, piles and soil

Property	Raft	Piles	Soil
Material	Concrete	Concrete	Sand
Compressive strength (kN/m^2)	27579	27579	-
Elastic modulus (Pa)	3x10^{10}	3x10^{10}	3x10^6
Density (kN/m^3)	22.54	22.54	15.5
Poisson ratio	0.18	0.18	0.3
Shear angle	-	-	33^0

The pile length of 0.8 times the least dimension of the raft (B) was chosen since it is the optimum limit beyond which the piles do not possess additional bearing capacity (Cooke 1986, Balakumar 2008). Figures 3 and 4 show the individual raft and pile models respectively.

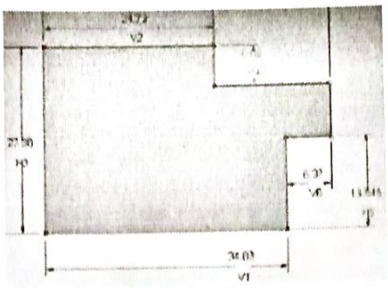

Figure 3. Raft

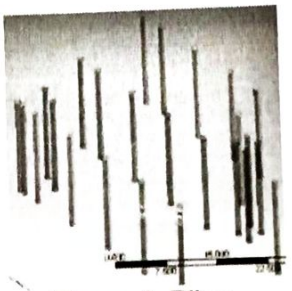

Figure 4. Piles

In the case of unpiled raft, the depth of the soil block is taken as 2.5 times B and the length and width of the soil block as 3 times B as shown in figure 5.1. This is due to the reason that the impact of the raft does not exceed these limits in the surrounding soil (Balakumar, 2008). Figure 5.2 represents the raft reinforced with piles in the raft-soil system wherein the depth of the soil is taken equal to the length of the piles to provide contact between the tip of the piles and the bottom of the soil surface.

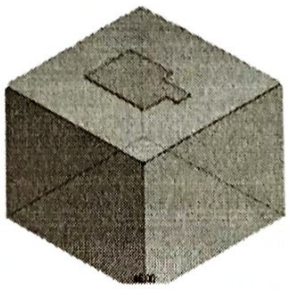

Figure 5.1 Unpiled Raft

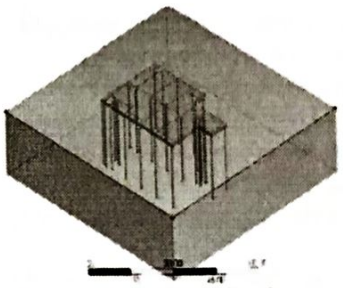

Figure 5.2. Piled Raft

Perfect contact is provided between raft – soil, raft – piles and piles – soil. (Balakumar, 2008). The accuracy of the analysis depends upon meshing and continuity of the elements in the nodes. Hence, in generation of mesh, extreme care was taken to ensure identical mesh refinement patterns for different analytical cases under comparison. A 2 meter uniform quadrilateral mesh was provided throughout the entire foundation system.

Fixed boundary conditions are provided at the bottom surface and along the four edges of the soil block. (Balakumar, 2008). The fixity conditions act as bounding limits to the soil. The loads are imposed on the raft and the settlement and stress values are obtained after the analysis. The values thus obtained at each node along the orthogonal directions of the raft at the center and the edge are used in plotting the graphs.

3.2.1 Type of loading

The column loads at the base of the structure were given as two different types of input for soil-structure interaction analysis in Ansys Workbench. They are:

- Concentrated loads
- Equivalent uniformly distributed load of 157.766kN/m2

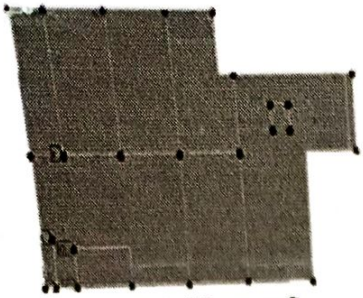

Figure 6.1. PL on raft

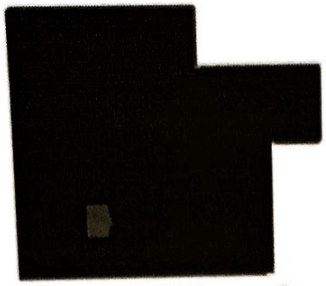

Figure 6.2. UDL on raft

Figures 6.1 and 6.2 show the type of loading imposed on raft. Initially, the unpiled raft (Case – A) was subjected to concentrated load as well as equivalent UDL for Ec/Es ratios of 10,000, 2,000, 1,500, 1,200, 1,000 and 100.

Later, the piles were introduced below the raft in two different layouts, one layout with piles below the position of the columns under the raft (Case – B) and the other layout with piles located in between the position of the columns under the raft (Case – C). Figures 7.1 and 7.2 represent the pile layout under the raft for both the cases.

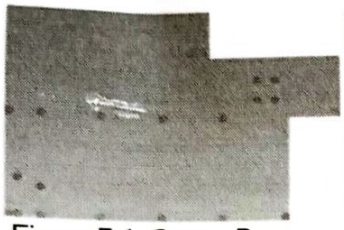

Figure 7.1. Case - B

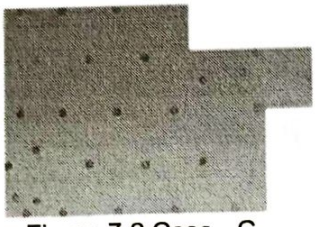

Figure 7.2 Case - C

Table 4 presents a comparison for the maximum settlement between cases A, B and C subjected to PL and UDL respectively. It can be seen that the total settlement exceeds the permissible limits in all cases except for one case where there is an extreme reduction in the maximum settlement in the unpiled raft when the Ec/Es ratio is equal 100. This is because the Ec/Es ratio equal to 100 indicates a very dense and stiffer soil condition. Such a stiffer and denser soil possesses a very high bearing capacity and hence the raft-soil foundation system in such dense soil shows less settlement. Designing the raft for such maximum settlement values will make the design uneconomical. This necessitates the introduction of settlement-reducing piles.

Table 4. Comparison – Settlement - Cases A, B and C

Ec/Es	Maximum settlement under PL (mm)			Maximum settlement under UDL (mm)		
	Case A	Case B	Case C	Case A	Case B	Case C
10,000	1347.0	1079.3	1028.7	1160.8	694.0	694.4
2,000	309.0	356.1	356.7	255.0	166.3	167.1
1,500	297.0	294.0	266.7	194.2	132.7	132.3
1,200	192.9	253.9	228.0	158.0	111.9	111.4
1,000	300.7	225.6	200.6	131.9	97.3	96.7
100	20.3	50.8	49.8	138	13.6	5.9

It was observed from table 4 that the introduction of piles in the raft-soil system has reduced the total settlement to about 25-45% on an average. This validates the purpose of the addition of piles as settlement-reducers to the raft-soil foundation system. It can be seen from table 4 that the settlement reduction is maximum for Ec/Es equal to 10,000 and it decreases with an increase in Ec/Es ratio. This is because piles are fully fractionized when Ec/Es is equal to 10,000 but as the Ec/Es ratio decreases, the soil becomes denser and the capacity of the piles to turn into friction piles reduces. (Cooke, 1986).

A considerable difference was observed in the settlement contour pattern under PL and UDL conditions for all the three cases. This is because of the variation in the type of loading. In the case of raft – soil foundation system subjected to PL, the contact pressure varies due to variation in loads and hence the settlement profile also varies accordingly as seen in figure 8.1.

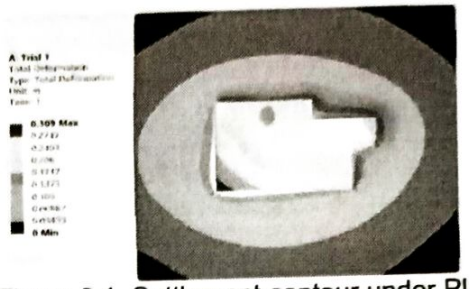

Figure 8.1. Settlement contour under PL

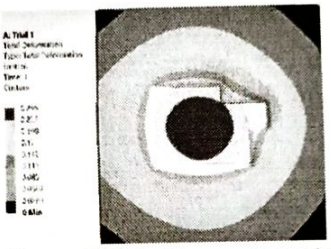

Figure 8.2 Settlement contour-UDL

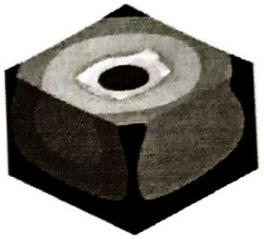

Figure 8.3 3D view

In the case of UDL, there is uniform contact pressure distribution throughout the area of the raft due to the uniformity in loading. This resulted in a more uniform settlement contour as seen in figure 8.2. Figure 8.3 indicates that the effect of raft settlement is negligible at the bottom and at the edge of the soil which justifies that the impact of the raft is limiting in the soil as discussed in section 3.2.

Figures 9.1 and 9.2 represent the settlement and section settlement contours in a combined raft, soil and pile foundation system under UDL for case B. It can be seen from the figures 8.2 and 9.1 that the settlement pattern remains identical but vary in magnitude.

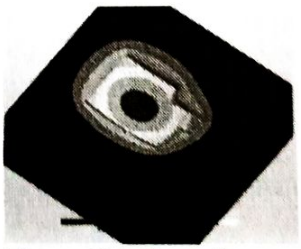

Figure 9.1 Case B

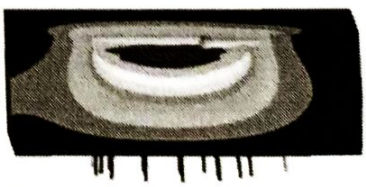

Figure 9.2 Section contour

Figure 9.2 show the settlement contour along the depth of the foundation. The maximum settlement occurs at the center as well as the tip of the piles. This denotes the transfer of the load to the surrounding soil trough the tip of the piles from the center portion of the raft.

The settlement of the raft along the orthogonal grids were obtained and graphs have been plotted to present a comparison for the settlement in Cases A, B and C when subjected to PL and UDL. Figures 10.1 and 10.2 present a comparison between cases A and B for the raft

settlement along the transverse grid when subjected to PL and UDL for a ratio of Ec/Es equal to 2,000.

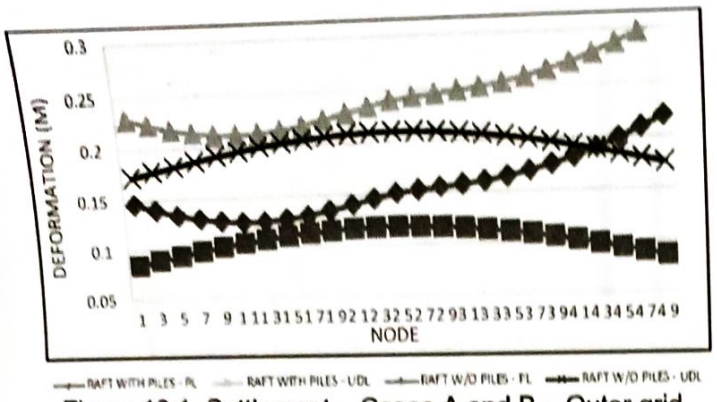

Figure 10.1. Settlement – Cases A and B – Outer grid

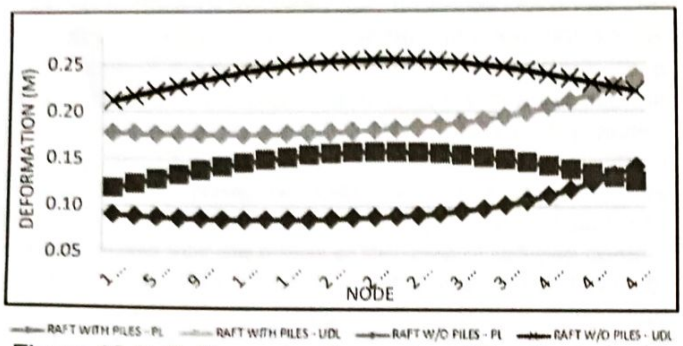

Figure 10.2. Settlement – Cases A and B – Central grid

It can be observed from the figures 10.1 and 10.2 that the settlement pattern for unpiled raft and piled raft subjected to PL and UDL are similar respectively but the raft reinforced with piles exhibited much lesser settlement compared to unpiled raft. This validates that the piles act as settlement-reducers in raft-soil system.

It can be seen from the above settlement graphs that the settlement trend curve for foundation system subjected to UDL showed a concave profile with maximum settlement at the center reflecting the nature of the raft mainly flexible raft. But under the same condition, when the load is considered as PL, the outer and central grids show a reversal in shape due to their dependence on the individual column load. Similar graphs were plotted for all other cases for different Ec/Es ratios and it was observed that the raft settlement response remained same but varied in magnitude. It was observed that the deformation reduced from 45-55% at the edges and 40 - 45% at the center of the raft on introduction of piles.

Table 5.1 Maximum stress under PL

Ec/Es	Maximum stress under PL (Pa)		
	Case A	Case B	Case C
10,000	11.28×10^7	11.24×10^7	11.28×10^7
2,000	11.29×10^7	11.21×10^7	11.29×10^7
1,500	11.29×10^7	11.25×10^7	11.29×10^7
1,200	11.29×10^7	11.25×10^7	11.29×10^7
1,000	11.28×10^7	11.25×10^7	11.29×10^7
100	11.29×10^7	11.25×10^7	11.29×10^7

Similar to settlement profile, table 5.1 presents a comparison between the maximum stress values of the combined foundation system subjected to PL and UDL for different Ec/Es ratios. It can be seen from tables 5.1 and 5.2 that the maximum stress value remained same for unpiled rafts subjected to PL for all the Ec/Es ratios whereas the maximum stress value varied for unpiled rafts subjected to UDL. In the case of foundation system subjected to PL, the stresses were concentrated in the raft area subjected to high concentrated loads whereas under UDL, the stresses were redistribute throughout the entire area of the raft due to uniformity in the distribution of loads. It can also be seen that the maximum stress value decreased with a decrease in the Ec/Es ratio. As the Ec/Es ratio decreases, the soil becomes denser leading to less deformation and eventually lesser stresses in the raft.

Table 5.2 Maximum stress under UDL

Ec/Es	Maximum stress under UDL (Pa)		
	Case A	Case B	Case C
10,000	2.91×10^7	3.39×10^7	2.65×10^7
2,000	1.21×10^7	1.43×10^7	1.28×10^7
1,500	0.99×10^7	1.05×10^7	1.06×10^7
1,200	0.85×10^7	0.89×10^7	0.90×10^7
1,000	0.74×10^7	0.77×10^7	0.77×10^7
100	0.12×10^7	0.13×10^7	0.12×10^7

Similar to the raft settlement response, a variation in the stress contours of unpiled rafts subjected to PL was observed. Figures 11.1 and 11.2 represent the stress contours in the unpiled raft-soil foundation subjected to UDL for Ec/Es ratio equal to 2,000.

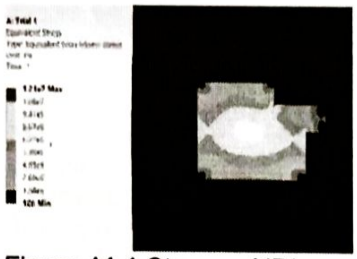

Figure 11.1 Stress – UDL

Figure 11.2 Stress in soil

From the figure 11.1, it can be observed that the raft stresses are concentrated more at the center portion of the raft and are negligible at the edges. Since the settlement is more at the center of the raft, the stresses are highly concentrated at the center. This trend in stress variation is similar to the settlement response of the unpiled raft when subjected to UDL as seen in figure 9.1. It can be seen from figure 11.2 that the stresses in the soil are negligible.

The stress contours at the section of the unpiled raft were obtained to study the stress pattern along the depth of the foundation. The stresses in the soil were negligible for all the three cases as discussed previously.

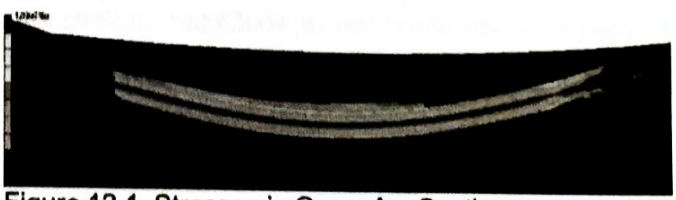

Figure 12.1. Stresses in Case A – Section contour - UDL

It can be seen from figure 16.1 that the raft stress is minimum at the center and maximum at the top and bottom of the unpiled raft under UDL. The raft design can

therefore be optimized accordingly with respect to raft stress and settlement behavior.

The variation in stresses means that the Bending Moment (B.M.) and Shear Force (S.F.) will also vary along the raft area. Hence it becomes important to study the stress response behavior of the raft from the view of the economics of the raft.

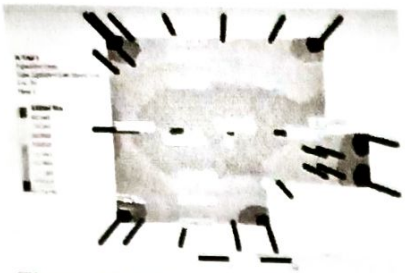

Figure 12.2 Stress -raft bottom

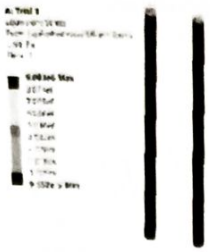

Figure 12.3 Stress - piles

Figure 12.2 represents the stress variation at the bottom surface of the piled raft. It can be observed that the stress varies uniformly along both the orthogonal directions of the surface of the raft. Similar stress trend was observed in Cases B and C but with a variation in magnitude under PL and UDL for different Ec/Es ratios.

Figures 13.1, 13.2 and 13.3 represent the stress in piles. It was observed that the stress in piles was minimum in all cases as seen in figure 12.3. It can also be observed that the stress at the area of raft-pile contact is maximum. This is due to the transfer of raft stress to the piles. The stress in the piles is maximum at the head and it reduces with an increasing depth in the piles as indicated in figure 13.1. Variation of stress indicates a variation in the B.M. and shear forces. Hence, the reinforcement in the raft can be optimized by designing it in areas of higher stresses leading to an economical design.

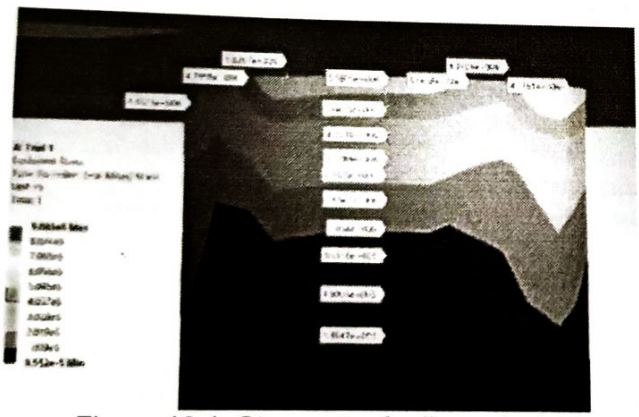

Figure 13.1. Stress at raft-pile contact

Figure 13.2 Stress-Pile head

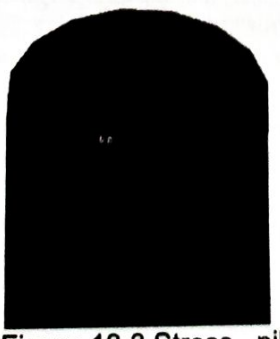

Figure 13.3 Stress - pile tip

Further, it was observed that the stress was concentrated more at the center of the pile head and varied along the surface of the pile as seen in figure 13.2. The stress at the tip of the pile was negligible as seen in figure 13.3. Therefore, the pile design can also be optimized accordingly.

Graphs have been plotted for raft stresses at the bottom surface in cases A, B and C and a comparison has been made between them to study the raft stress behavior. Figures 14.1 and 14.2 present a comparison between the unpiled and piled raft stresses at the bottom surface area of the raft for Ec/Es equal to 2,000.

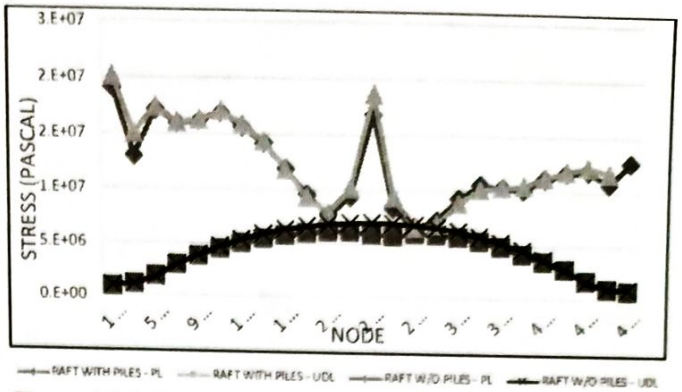

Figure 14.1. Raft stresses – Transverse axis - Outer grid

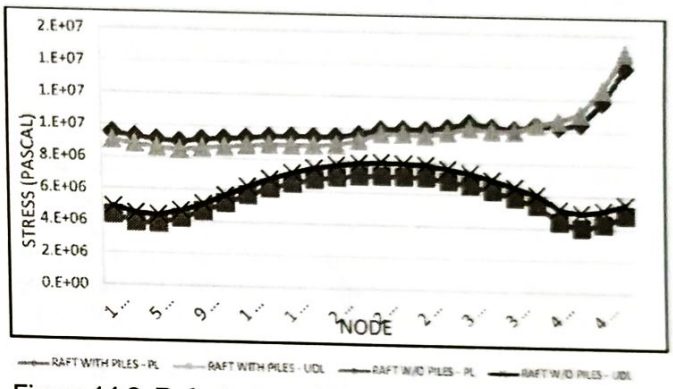

Figure 14.2. Raft stresses–Transverse axis - Central grid

It was observed from the stress response graphs of the raft that the stress pattern although remains similar in trend under UDL, the stress pattern has a pronounced variation particularly in the case of outer grids. This is mainly due to the varying magnitude of the column load. The upper peaks in the stress trend curves under PL reflect the concentration of raft stresses at the pile locations. The transfer of stresses from the raft to the piles occur here as mentioned previously. The lower peaks reflects the raft in between the piles. In the present structure, columns are very widely spaced, therefore, the stress pattern under the PL follows the same pattern.

Similar graphs were plotted for all other cases for different Ec/Es ratios and it was observed that the stress pattern remained same but with a variation in magnitude. It was observed that the stress value reduced from 7 - 15% at the edges and 10 - 20% at the center of the raft due to the introduction of piles in the raft.

Thus, it can be concluded that the method of applying loads influences the displacement and stress patterns. It was observed that the displacement and stress patterns were identical for all the three cases with a pronounced reduction in magnitude in raft reinforced with piles i.e. cases B and C. The raft and pile design can be optimized efficiently by studying the settlement and stress responses of the raft and the piles.

3.2.2 Variation in Ec/Es

In the present case, numerical analyses were performed on an unpiled raft of thickness 1m located at a depth of 3m from the ground surface. Retaining wall was considered around the raft. A pressure of 111276 Pa was obtained by deducting the surcharge pressure at 3m depth. Numerical analyses were repeated for cases B and C and the results were compared to study the raft behavior. In the analysis, the Ec value was kept constant as $3x10^7 kN/m^2$ whereas the Es value was varied. The raft, pile and soil properties were adopted as mentioned in tables 2 and 3.

Table 6. Comparison - Stress - Cases A, B and C

Ec/Es	Maximum stress under a load of 111276Pa (Pa)		
	Case A	Case B	Case C
10,000	2.45×10^7	2.39×10^7	1.80×10^7
2,000	0.95×10^7	0.90×10^7	0.90×10^7
1,500	0.80×10^7	0.74×10^7	0.74×10^7
1,200	0.69×10^7	0.63×10^7	0.63×10^7
1,000	0.57×10^7	0.54×10^7	0.54×10^7
100	0.08×10^7	0.09×10^7	0.08×10^7

From the above table, it can be seen that the stress reduces on the introduction of piles for both the pile layouts. It was observed that the stress contour trend remained similar to unpiled and piled rafts under UDL in section 3.2.1 but with a slight variation in magnitude. For the present case, the settlement value for Ec/Es ratio equal to 2,000 satisfies the permissible limits. Hence, the ratio of Ec/Es equal to 2,000 had been adopted in the further studies.

Graphs were plotted similar to section 3.2.1 and comparison was made. It was observed that the trend for the settlement and stress responses of the raft varied along a concave profile which was similar to the previous observations but with a variation in magnitude. It was observed that the settlement reduced from 45 – 55% at the edges and 40 – 45% at the center of the raft on the introduction of piles. Similar results were observed for all the other grids under all cases.

Figures 15.2 and 15.2 represent the stress response of the raft for cases A and B when Ec/Es is equal to 2,000. The raft stresses were obtained at the raft-soil contact surface but on the raft surface. The pattern of stress distribution with piles obtained after analysis was similar to the results published by Balakumar, V (2017). The slight variation in the stress trend curves is due to the non-uniform spacing of piles in figures 15.2 and 15.2.

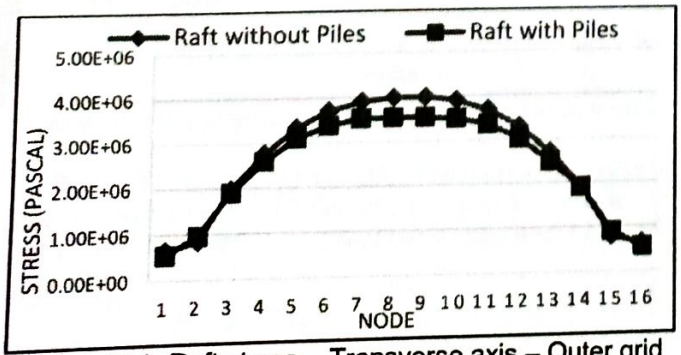

Figure 15.1. Raft stress – Transverse axis – Outer grid

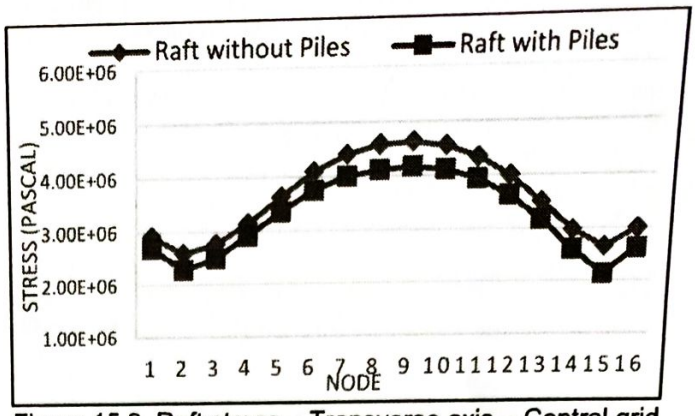

Figure 15.2. Raft stress – Transverse axis – Central grid

It was observed from the calculations that the stress value reduced about 7-15% at the edges and 10-20% at the center of the raft due to the introduction of the piles for both the layouts. At the raft edges, the variation in stress was marginally less compared to the center. This variation is mainly due to the edge being free and not restrained by retaining walls in actual analysis.

3.3.3 Variation of D/t when pile diameter is constant

In the present case, the numerical analyses were performed on the combined raft, soil and pile foundation system for four D/t ratios where D is the diameter of the pile and t is the thickness of the raft. The diameter of the piles was kept constant as 0.9m and the raft thickness was varied. The raft was located at a depth of 3m from the ground surface and the piles of length 24m were modelled under the raft beneath the location of the columns. The soil was modelled as a block of medium dense sand condition. A constant Ec/Es ratio of 2,000 was adopted to perform all the analyses under the present case where Ec was equal to $3x10^{10}$ N/m² and Es equal to $1.5x10^7$ kN/m². The results obtained from various analyses of conditions A, B and C were compared with each other.

It was observed that the introduction of piles reduced the settlement for about 23 - 37%. It was also observed that the reduction in the overall settlement increased with an increase in the raft thickness (Poulos, H.G., 1998, 2001) for a constant pile diameter.

Table 7. Comparison - Stress – Cases A, B and C

D/t	D (mm)	t (mm)	Maximum Stress(Pa)		
			Case A	Case B	Case C
1.2	900	750	0.90×10^7	0.89×10^7	0.89×10^7
1.0	900	900	0.94×10^7	0.92×10^7	0.92×10^7
0.9	900	1000	0.95×10^7	0.90×10^7	0.90×10^7
0.8	900	1125	0.94×10^7	0.86×10^7	0.86×10^7

Table 7 presents a comparison between the maximum stresses for cases A, B and C. It was observed that there was no much variation between the maximum stress values for Cases B and C when the pile diameter was kept constant. It was observed that the settlement and stress trend was similar to section 3.3.1 for all the D/t ratios but with a variation in magnitude. It was observed that the deformation reduced for about 45 - 55% at the edges and 40 - 45% at the center of the raft on introduction of piles.

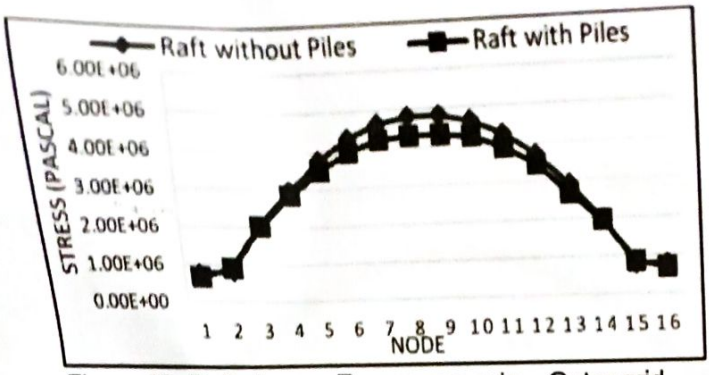

Figure 16. Raft stress – Transverse axis – Outer grid

Graphs were plotted to compare the raft stress response for cases A, B and C. Figure 4.1 represents the stress response behavior of the raft respectively for a D/t ratio of 1.2. The stress value reduced from 7 – 15% at the edges and 10 – 20% at the center of the raft due to the introduction of piles. Similar trend was observed in all the other cases.

3.3.4 Variation of D/t when raft thickness is constant

In the present case, the numerical analyses were performed similar to section 3.3.3 but here, raft thickness of 1m was adopted and kept constant whereas the pile diameter was varied.

Table 8. Comparison - Maximum stress

D/t	D (mm)	t (mm)	Maximum stress (Pa)		
			Case A	Case B	Case C
2.00	2000	1000	0.85×10^7	0.76×10^7	1.42×10^7
1.75	1750	1000	0.85×10^7	0.81×10^7	0.72×10^7
1.5	1500	1000	0.85×10^7	0.83×10^7	0.79×10^7
1.2	1200	1000	0.85×10^7	0.85×10^7	0.86×10^7
1.0	1000	1000	0.85×10^7	0.90×10^7	0.90×10^7
0.8	800	1000	0.85×10^7	0.91×10^7	0.93×10^7

It can be observed from the table that the stresses in the raft under cases B and C increases as the pile diameter decreases for a constant raft thickness. For D/t ratios less than 1.2 i.e. when the pile diameter is less than the raft thickness, there is an increase in the raft stresses. It was observed that the settlement and stress trend was similar to section 3.3.1 for all the D/t ratios but with a variation in magnitude. The graph representing the stress response behavior of the raft was also similar in pattern but varied in magnitude as seen in figure 17.

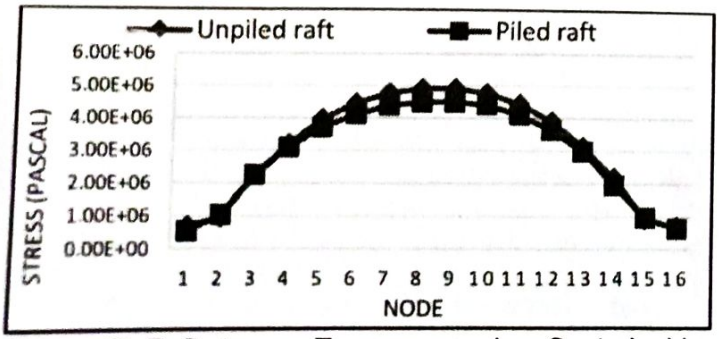

Figure 17. Raft stress – Transverse axis – Central grid

Figure 17 represents the stress response behavior of the raft respectively for a D/t ratio equal to 1.2. The stress value reduced from 7 – 15% at the edges and 10 – 20% at the center of the raft due to the introduction of piles. Similar trend was observed in all the other cases.

3.3.5 Equivalent pier analysis

A special case of equivalent pier system has been analyzed to study its applicability and influence on the behavior of raft deformation and stresses. Three equivalent pier analyses have been performed by adopting a raft of thickness 1m located at a depth of 3m from the ground surface. Equivalent piles of length 24m were modelled under the raft surrounded by medium dense sandy soil. Ec/Es ratio of 2,000 has been adopted for the analyses.

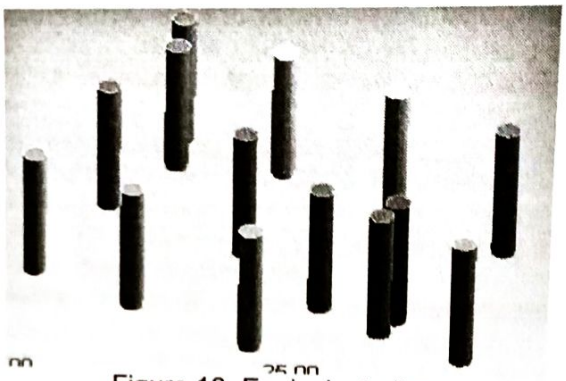

Figure 18. Equivalent piles

Tables 9.1 and 9.2 present a comparison for the maximum settlement and stresses in a raft between the cases of unpiled raft, raft reinforced with piles below the position of columns and raft reinforced with equivalent piles below the columns.

Table 9.1 Comparison - Maximum deformation

D (m)	t (m)	D_{equ} (m)	Maximum Deformation (mm)			
			Case B	Equivalent Case B	Case C	Equivalent Case C
1.5	1	2.1	119.13	118.48	117.95	119.19
1.2	1	1.8	118.97	118.20	118.01	119.08
1.0	1	1.4	118.81	118.81	117.93	118.87

Table 9.2 Comparison - Maximum stress

D (m)	t m	D_{equ} (m)	Maximum stress (Pa)			
			Case B	Equivalent Case B	Case C	Equivalent Case C
1.5	1	2.1	0.83×10^7	0.83×10^7	0.79×10^7	0.77×10^7
1.2	1	1.8	0.85×10^7	0.84×10^7	0.86×10^7	0.86×10^7
1.0	1	1.4	0.90×10^7	0.90×10^7	0.90×10^7	0.89×10^7

It was observed from tables 9.1 and 9.2 that the maximum settlement and stress values reduced on the introduction of equivalent piles in the raft when compared to unpiled raft. Also, the settlement and stress values showed a very negligible variation in the cases between raft reinforced with regular piles and raft reinforced with equivalent pier for the two different pile layouts. The settlement and stress trend contours and magnitude also remained similar for the above two cases.

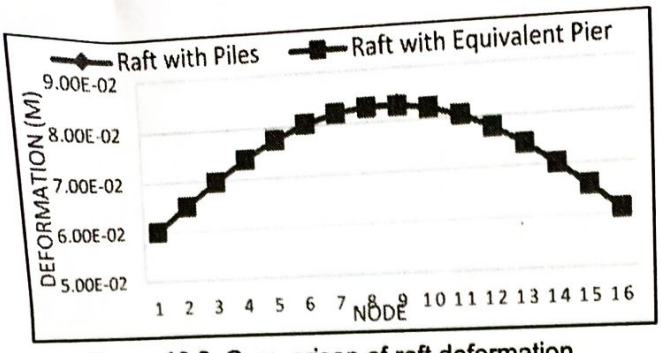

Figure 19.2. Comparison of raft deformation

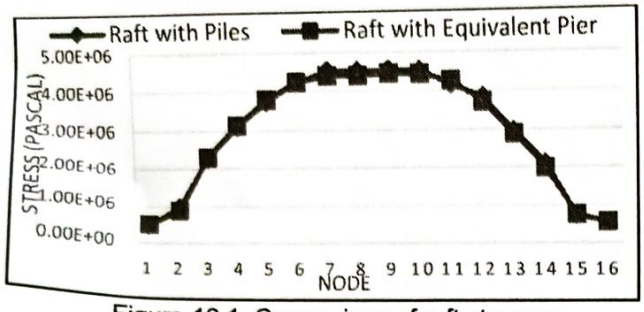

Figure 19.1. Comparison of raft stresses

From figures 19.1 and 19.2, it was observed that the settlement and stress response pattern of the raft remained similar to other cases. It was observed that the variation in stresses and deformation between equivalent pier and piles was only about 2 - 5%. Thus, it can be concluded that equivalent piles can be used in the combined raft, pile and soil foundation system based on their availability.

4 CONCLUSION

It was observed that the trend of settlement and stress variation in unpiled raft and piled raft for different layouts of piles was identical but with a variation in magnitude. The deformation reduced from 45-55% at the edges and 40-45% at the center of the raft and the stress value reduced from 7 –15% at the edges and 10 –20% at the center of the raft on an average due to the introduction of piles.

The load on the piles located at the center of the raft was much higher than the piles positioned at other locations in the raft. The raft contact stresses obtained from the numerical analyses show uniform distribution except at the edges and pile locations. The stress distribution obtained from the numerical analysis indicated that the shaft stress is higher near the pile head and reduces towards the pile tip. The high stress at pile head was due to the transfer of raft stresses to the piles. It was also observed from the analyses that the tip stresses in piles were lesser than the head stresses indicating that the shaft friction was fully mobilized and the piles were dominantly friction piles. Also the mobilization of higher raft stress as the load increased and low pile tip stress at the final settlement confirms the behavior of the pile group as settlement reducer (Cooke, 1986).

It was observed from the present study that the introduction of the piles not only reduced the raft settlement but also the stress level. Consequent to the reduction in stresses, the bending moment and the shear forces also get reduced. Thus, the study of raft stresses and bending moment along with the raft settlement leads to a better and effective design of the raft.

The variation in stresses and deformation between equivalent pier and general piles was only about 2 -5%. Hence, equivalent pier system can also be used effectively based on requirement.

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Model studies for Vellar river training project in Tamilnadu

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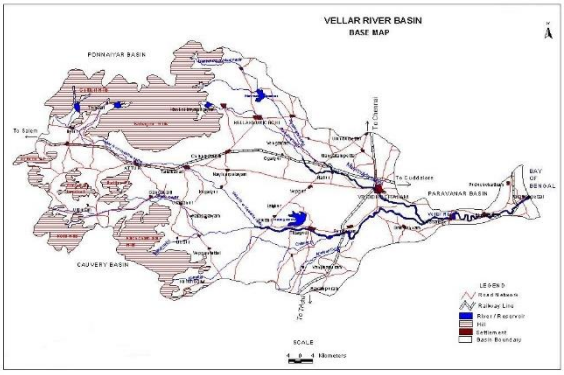
Abstract (Times New Roman – 10 Font-Bold-Italic): *The Vellar river basin is located in the Northern part of Tamil Nadu State in South India, between the latitudes 11^0 13' N – 12^0 00' N and longitudes 78^0 13' E – 79^0 47' E. The total area of the basin is 7520.87 Sq. Km. The total length of the river is about 150 km. The river Vellar emanates on the southern slope of Kalvarayan hills in Salem Dist. and drains into Bay of Bengal near Parangipettai (Port-O-Nova) in Chidambaram taluk of Cuddalore District. In the lower reaches the river is meandering resulting in heavy erosions due very high discharge during north east monsoon rainfall resulting loss of agricultural lands and roads. Initial field surveys were conducted for actual field information. Using the data, HECRAS-1D and Mike 21 numerical modeling studies were performed. Based on the studies vulnerable locations were identified and initial river training works were designed and experimentally verified through physical modeling techniques and finalized. The details of numerical and physical model studies and finalized remedial measures are detailed in the paper.*
Keywords*: Physical model, spur, flood discharge*

1. Introduction:

The Vellar river originates in the Kalrayan hills of Salem district in the reserve forest area at of Salem in Salem District and drains into Bay of Bengal near Parangipettai (Port-O-Nova) in Chidambaram taluk of Cuddalore District.The Vellar river basin is located in the Northern part of Tamil Nadu State in South India, between the latitudes 11^0 13' N – 12^0 00' N and longitudes 78^0 13' E – 79^0 47' E. The total area of the basin is 7520.87 Sq. Km. The total length of the river is about 150 km (Fig 1). The river Vellar is having 6 tributaries. In the lower plain river takes meandering course . During the flash floods of north east monsoon the river causes very heavy erosions resulting heavy damages to cultivable lands and bridges. Hence, the affected people represented to the Government to safeguard their villages from the damages, dwellings units, agricultural land, live stocks and their properties by forming flood banks, construction of spurs and retaining walls. The government of India has also sanctioned the schemes under flood management program by forming flood banks, construction of spurs and retaining walls.

The total area of the basin is 7520.87 Sq. Km. The total length of the river is about 150 km (Fig 2 & 3). The lower meandering reach of river for a length of about 80km is in Cuddalore district.The average rainfall of the district is 134cm. Nearly 70% of rainfall is during north east monsoon



.During the flash floods of north east monsoon the river causes very heavy erosion at locations where river is meandering resulting heavy damages to cultivable lands and bridges. TV Puthur is one such agriculture village located along the meandering stretch which has undergone heavy damage resulting erosion of agriculture land. The area is active in agriculture and hence necessary representations were made by the locals for suitable protection works. Subsequently the project proposals were made and protection works were sanctioned under flood management program of Government of India.

Fig 2 Vellar river course

Fig 3 Location of TV Puthur

2 Methodology

Field visit was made and initial site investigations were carriedout. With the available data it was decided to use various modelling approach. In the present situation one dimensional modelling, two dimensional modelling and physical modelling studies were carried out.

2.1 One dimensional modelling

In order to assess the existing hydraulic conditions of the field, numerical model studies were made. For the present study the U.S. Army Corps of Engineers' River Analysis System (HEC-RAS) software is used. This software is developed by the Hydrologic Engineering Center (HEC-2008), which is a division of the Institute for Water Resources (IWR), U.S. Army Corps of Engineers. HEC-RAS allows users to perform one-dimensional steady and unsteady flow calculations (HEC, 2002). In a HEC-RAS steady state simulation, water surface profiles are computed from one cross-section to the next by solving the standard step iterative procedure to solve the energy equation. The energy equation is intended to calculate water surface profiles for steady gradually varied flow.The input are geometric, flow and boundary data. The geometric data consisting of cross section and chainages were keyed in after making a base map of the study area. The flow data adopted was the maximum value as suggested by the field engineers. The upstream and downstream slopes were given as boundary conditions. With the above flow data and the boundary conditions, results are obtained by running the HEC-RAS model for different scenarios. The results of the same are obtained for the steady state flow conditions. The maximum value of discharge of 3596 cumecs was adopted. The results of HECRAS study indicate that there is a need to redesign the existing banks since the waterway is insufficient for the design discharge (Fig 4) resulting overflowing .

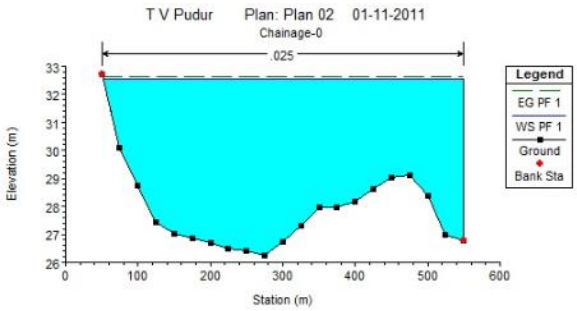


Fig 4 HEC-RAS result

2.2 Two dimensional model studies

MIKE 21 HD is the basic computational hydrodynamic module of the entire MIKE 21 system (DHI 2001) providing the hydrodynamic basis for other MIKE 21 modules. The modelling system is based on the numerical solution of the two/three-dimensional incompressible. Reynolds averaged Navier-Stokes equations. The model consists of continuity, momentum, temperature, salinity and density equations and it is closed by a turbulent closure scheme. The input to the model is hydrographic details of river, discharges at the open boundaries. The output includes velocity contours and water levels...The river bed contours are detailed in Fig 5 and this is used as input for Mike21 software. The study indicate eddy formation with high velocity on the right side bank. It was proposed to strengthen the river banks by providing spurs.Then the studies were performed with spurs on the right side of bank and then flow pattern observations with spurs placed at locations suggested by field engineers were studied. The lengths are adopted as discussed in Technical report of CBIP (1971, 1987). The spurs with an angle of 22^0 from normal to the bank of 30m length facing upstream found to be effective in reducing velocity adjacent to right bank (Fig 6 & 7).

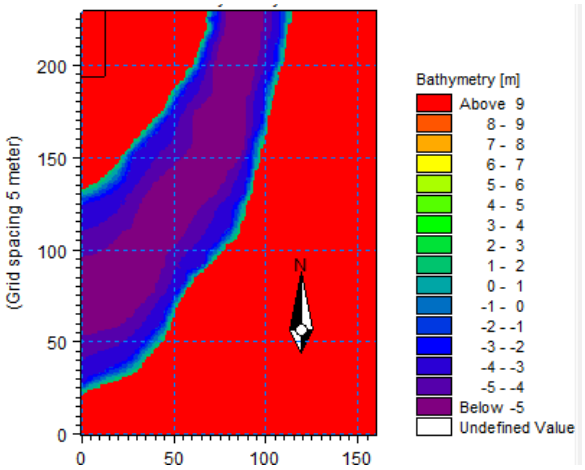


Fig 5 Details of river hydrography

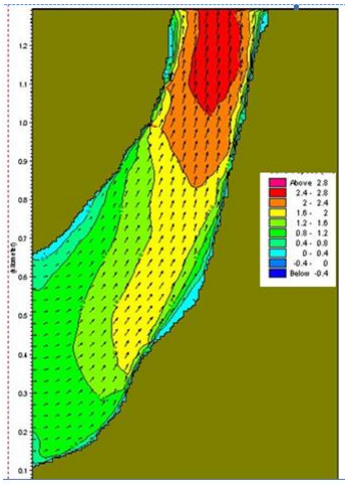


Fig 6 Mike 21 result for existing bed

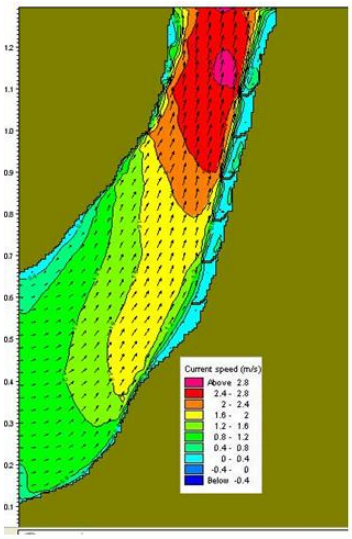


Fig 7 Mike 21 result with spurs

2.3 Findings of numerical model studies

The site TV Puthur is under heavy erosion. The Right bank is found to be highly vulnerable to erosion. The presence of shoals in the river diverts the flow creating erosion. The numerical experiments with HECRAS indicates that insufficient water way to carry the quantum of flood values suggested and needs a redesign of the section with a top level (Fig 4) by providing a free board of 1.8m. The 2D studies with Mike 21 suggest that about 1km of length of river right bank is vulnerable to erosion due to high eddy formation (Fig 5 to 7). Hence based on the discussion with field engineers, it is proposed to raise the bank height and to introduce six repelling spurs on the right bank.

3 Remedial measures

The remedial measures proposed in the form of revised bund level and repelling spurs The bund level and location of the spurs as finalized are tabulated below. The length of groin is of 30m length . The orientation angle is 25^0 deg from normal to the bank facing upstream side. This data is used for finalising the performance using physical model technique.

Table 1: *Input data*

Chainage (m)	Top level (m)
42910	35.270
43020	35.200
43120	35.100
43210	35.070
43320	34.970
43410	34.870

4 Physical model studies

Physical model studies were carried out to study the performance of river training spurs proposed from Mike21 model studies and top level of the banks were revised based on HECRAS model studies with a free board of 1.80m. A comprehensive mobile bed, geometrically distorted physical river model, with a horizontal scale of 1:500 and vertical scale of 1:100, and the representing affected site of Vellar River at TV Puthur with the proposed spur location was constructed. Model discharge of the river was allowed through 'V' notch. Necessary gauge wells have been constructed for measuring the water levels as done for other reaches of Vellar (IHH Poondi-1995)

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4.1 Mobile bed setup

In the model, bed of the river has been properly simulated. The effective size of the sand particles were arrived based the tractive force in the field. From this, utilizing the roughness index, model sediment size was calculated based on Shield stress criteria and found to be 0.6 mm. Accordingly corresponding mesh was utilized to get the 0.6 mm diameter sand materials. The mobile bed was formed utilizing the above sieved sand particles. The completed model is shown in Fig. 8 & 9.

Fig 8 Dry mobile bed model

Fig 9 Running mobile bed model

Fig 10 Comprehensive model view

5 Results and discussion

The spurs provided on the Right bank deflects the flow current concentrate to the central portion of the river. Eddy formations observed near the toe of the spurs, for which suitable toe protection is to be provided to avoid local scour. Slight modifications of orientation angles were made with the initial value obtained from 2D Mike 21 model studies in consultation with field engineers. Accretion of sand is noticed between the spurs. This imparts a good bank protection. The trial model photos of the TV Puthur is shown vide (Fig 8 to 10).

6 Conclusions and recommendation

The inferences on the model run with sufficient number of trials account to the effective functioning of the Repelling. Repelling Spurs of length 30m having an angle of 22^{o} were provided. The performance also seemed to be satisfactory.

Thus, it is concluded that the model study ascertains the functioning of the spurs and the flow pattern in the river course is found to be satisfactory. Necessary protective measures must be provided at the toe of each spurs to avoid scour.

7. Acknowledgements

The authors acknowledge the services of field engineers Balamurugan, Tilakam and Palanikumar for collection of field data and suggestions during the course of model studies

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BEHAVIOUR OF PILED RAFT- IMPORTANCE OF OBSERVATIONAL STUDY

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ABSTRACT:

Piled raft foundation system is an intelligent geotechnical concept, developed towards reducing the settlement of the raft and the footings by providing pile elements below the raft or footings, as the case maybe. Although a large volume of works has been done on the behaviour of piled rafts by observational studies, the effect of construction methodologies such as deep excavations, the installation methodologies used for piling etc appear to have not been covered adequately. This paper discusses the effect of deep excavations, pile installation techniques and the effect of adding structural elements, based on the data available from published literatures. Based on this study, the performance of the piled raft monitored by the author has been revisited and the results of such a study are discussed.

KEYWORDS: Piled raft, ANSYS, Compressible layer

INTRODUCTION

The basic difference between the traditionally designed raft supported on piles and the piled raft is that, the traditionally designed pile group supported raft does not distinguish between the bearing capacity problem and the settlement problem. Cunha et al., (2018), has defined the piled raft foundation system, as a pile group, in which the raft connecting the pile heads positively contributes to the overall foundation behaviour. Hence ignoring the presence of the raft, and its contribution in transferring the load to the competent ground cannot be justified from engineering principles. When the ground has adequate bearing capacity, but settlement alone is a problem, in providing a large group of piles, the number of piles is governed by the geometry of the foundation. This leads to an uneconomical design with a very high factor of safety, not justifiable from an engineering point of view to reduce the settlement.

LIMITATIONS OF ANALYSES

The analyses of piled raft is essentially a three dimensional process and warrants the use of sophisticated computational tools, namely an appropriate software and a compatible hardware for the initial and final design. An overview of the literature confirms that even by adopting most rigorous methods of analyses, the results relating to the load sharing show wide variations as established by Russo and Viggiani (1997). Irrespective of the nature of the software, the accuracy of the results depends upon the accuracy with which the in-situ parameters have been evaluated. However, the evaluation of in situ subsoil properties is the most difficult part for almost all geotechnical problems; more so in the pile foundations as the properties are influenced to a significant extent by the methods of pile installations. Further the application of the superstructure load is time dependent and so the rate of settlement and the friction mobilised, which is governed by the properties of the soil surrounding the pile shaft. Franke (1991) had pointed out that the development of shaft stress from tip to top is caused by the movement of piles, the soil in between the pile group, and the raft; hence the movement of the system as a whole is very important, which depends upon the in-situ soil properties after the completion of the pile installation and the rate of loading.

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OBJECTIVE OF THIS STUDY

Even though the design of pile group is complex matter, the design of the constituent elements of piled raft in all the stages before execution, is carried out based on the parameters obtained from the tests on "undisturbed samples" extracted from the boreholes, during the soil investigation. Standard empirical correlations between N-Values and the elastic modulus (E_s), which is one of the most important parameters, are used in practice in the design of piled raft. Such an analysis and design may not take into account the effect of construction procedure and the field issues into account. This is a matter of concern when some variations occur between the observed and computed results. This is mainly because of the variability in the behaviour of piles due to many random factors. It also depends upon the post construction behaviour of the single pile and the pile group. In the recent past the use of large diameter bored piles, whose design methods are settlement based has created a further limitation in the form of installation effects on the properties of the soil. An interesting feature to note is that in the pre-construction design stage, the design of the un-piled raft and the piled raft is processed based on the parameters obtained under undisturbed conditions of the sub soil strata or from standard correlations. It appears that many of the field issues, that alter the parameters used in the design, have not been recognised in the post construction evaluation.

Keeping all the above limitations in mind the paper attempts to study some of the important factors, that can affect the interaction behaviour of the constituent elements. Hence there appears to be a need for a revisit on the analyses using the parameters evaluated after the pile installation. Also, a well suited in situ testing procedure which will evaluate the parameters needed is suggested.

FIELD ISSUES

The behaviour of piled rafts is a three-dimensional interaction problem, and the interaction takes place gradually, as the construction progresses. The progressive increase in the applied loading is also time dependent, with a probable variation in the sequence. In that process the surrounding soil is susceptible for disturbance, remoulding, densification etc. Hence it is quite possible that there can be variations between theoretically predicted and the observed values. The probability of such variations becoming detrimental has to be anticipated. Such anticipation in the design of the foundation system for Burj Dubai (Poulos 2008) resulted in the increase of pile length, and the pile termination was done in a layer close to the gipsyferrous sandstone layer. There was a possibility of a potential long term degradation of the engineering properties that can reduce the capacity of the pile.

In spite of detailed investigations of several high-rise buildings having been carried out in various places, (Katzenbach et al., 2000), Burg Dubai, (Poulos,2008), structures like 13 storeyed hospital, 45 storeyed apartments (Yamashita et al., 2015), not so many case histories exist on the monitoring the load sharing between the raft and the piles, as well as the settlements. Monitoring the behaviour of the piled raft under construction is an essential feature, considering the issues that are construction process based. This is because, the condition of measurements in the case of a load test on a single pile and the pile group of piled rafts are different and the measurements and monitoring has to be done as construction progresses. Measurements have to be taken during construction and after construction also.

Effect of Excavation

The effect of excavation will be pronounced when a structure has multiple basements and is the general trend in the construction of tall structures nowadays. More specifically when the ground is very soft the performance of the pile group and the raft get affected by the over- consolidation caused by the excavation on the stiffness and the ultimate capacity of the raft and the pile group. Renato et

al., (2020), in their study has pointed out that settlement distribution and the load sharing between the pile and the raft are influenced by factors like, excavation process, time between end of excavation and casting of the raft, time of construction and so on.

Sales et al., (2010) has pointed out that when deep excavations are involved, such excavation reduces the soil stress, and the reloading of the soil should be taken into account. Sales et al. (2010) allowed the influence of the variation of the stress level on the piled raft behaviour in a complex manner, introducing the excavation sequence (stepwise) in the numerical analyses through what has been called as a "compensated" piled raft analysis. The reduction in the soil stress due to excavation and the reloading results in the reduction in the piled raft settlement than the uncompensated one. It has been established that the foundation system would be more economical when the excavation effect is taken into account, the raft becomes more effective, and the combined use of piles and compensation via excavation leads to a combined foundation system that will provide a superior performance, to that of an uncompensated piled-raft.

However, this stress reduction causes an over-consolidation effects reducing its compressibility. In-situ tests such as SPT or CPT conducted from the existing ground level cannot predict the soil behaviour at the construction stage, as the reloading parameters are required. The downward soil movement will induce compressive stress on the upper part of the pile. Combined with the possible locked in tensile stress due to the excavation process, there will be a redistribution of the stress along the pile shaft, and such redistribution may change with time. The settlement measurements can commence before casting of the raft or after casting the raft. Between these two processes there can be a difference of several millimetres in the measured settlements. The water table can influence the load sharing between the raft and the pile. The simplified approach using Plaxis 2D settlement analyses for a raft over an equivalent pier seems to be a useful but approximate method, that can be used in the analyses of large piled raft. In addition, understanding of the construction steps and measuring system play a very important role. The sequence of excavation, pile installation and the reloading by the structure affect the load distribution. If the piles are installed before excavation, locked in tensile stresses can get generated and this changes the pile stiffness, especially during the beginning of construction. This aspect needs further study.

Ibañez et al. (2014) considered the effect of the excavation with a more simplified procedure, simply by correcting the effective original stresses of the ground to the relief stress/reloading caused by both the extracted soil during excavation and the self-weight of the raft cast. However, the above considerations have to be simplified to a large extent for any numerical analysis. But such simplifications may not lead to perfect simulations of the real phenomena, but they can considerably improve the settlement pattern predicted by the numerical simulations, although parameters like geotechnical variability etc cannot be modelled.

Effect of pile installation

In the analyses of single pile and pile group, it is always assumed that the soil surrounding the pile is homogeneous and that the installation of piles has no effects on the deformation properties of the soil. However, it is well known that the method of installation may have profound influence on the soil and the subsequent performance of the pile and the pile group. When the displacement (driven) piles are installed in the cohesive strata, the driving has two major effects, namely, the remoulding of the soil around the pile and the creation of excess pore water pressure. This can stiffen the soil around the pile in the case of soft clay but a softer zone in the case of stiff clay. In the case of bored cast in situ piles in clay, the pile installation generally tends to the formation of soft a zone of the soil surrounding the pile. For driven piles in sand severe compaction of sand occurs in the vicinity of the pile tip. In all the

cases the effect of installation of the pile is to create a zone of the soil around the pile which has the strength and deformation characteristics different from the soil mass in general or what has been obtained from the soil investigation report

DeMello (1968) had presented some investigation on the results of the extent of disturbance around the pile during driving. In spite of the conflicting results, it appears that the extent of remoulding varies from 100% at the pile soil interface to almost zero, at about 1.5 to two times the diameter from the pile surface. Although such a variation has not been quantified, on the basis of certain correlations between the pile soil adhesion C_a and the undrained cohesion $C_{u,}$ it appears that the C_a/C_u can be as high as 1.5 for very soft clay and as low as 0.2 for stiff clay. Bored piles, in the case of clay soften the clay during the installation and reduces the C_a to about 0.45 $C_{u.}$ In the case of sand, according to researchers like Meyerhoff (1959), for a loose sand, the disturbed zone extends for 3 to 4 times the pile diameter from the side of the pile, and 2.5 to 3.5 times the diameter below the tip. In the case of medium sand, the extent of disturbance is larger, and is 4.5 to 5.5 times the diameter from the sides of the pile, and 3 to 4.5 times below the tip. The effect of compaction of sand been found to enhance the penetration resistance of the sand by a factor of around 8 due to driving. This increase in the penetration resistance corresponds to roughly a tenfold strength increase and presumably the deformation modulus of the sand also. The final recommendation is that in the theoretical solution for a pile in a homogeneous soil with an equivalent Young's modulus may be considered. In the case of detailed analyses for settlement distribution in the soil near the pile, it is essential to take into account the non-homogeneous nature of the strata arising out of pile installation.

Unusual behaviour

Yanghoon Roh et al.,(2015) had monitored the performance of a piled raft (it is a piled footing) supporting a 41.4 m tall concrete and steel framed composite structure. The foundation system comprised of 3,.06m square footing supported on piles. The soil profile as in Fig 1 at the test site comprised of 3.0m thick fill followed by weathered residual soil layer with N-Value ranging from 18 to 40 upto 11.0m depth. Weathered soft rock layer was found at 6.1m, 7.4m , and 8.9 to 12m. Shallow foundations could not have been provided, keeping the height and the nature of the loading. The authors have reported a lot of variations in the soil profile with further variations between what has been reported and what was observed.

Figure 2 presents the three piled rafts installed at the edge of the building, and the central one was meant for monitoring. It comprised of 5 piles of 23 m length with 1m socketing in the weathered rock. The piles were tubular piles, 0.508m outer diameter with a wall thickness of 0.014m spaced at 0.9m c/c. The piles were installed in a pre-bored holes of 0.65m diameter with the annular space between the outer face of the pile and the inner face of the bore was grouted. The piles were instrumented and monitored for a period of 350 days,including post construction monitoring,that was done to study the long term performance of the foundation.The piles were spaced at 0.9m c/c and socketed into the weathered rock for a depth of 1m. The initial design assumption was that the system would be piled footings (addressed as piled raft). Later a design modification was done for the sake of seismic enhancement. The addition was strip pedestals 1m wide and 0.3m thick. Fig 4 presents the loading sequence with time and Fig 5. presents the load settlement curve. It appears that the measured load transfer curves of the piles showed a contradicting trend, namely an increase in the shaft stress as in and Fig 5 with depth in the upper zone. While the raft load was increasing, when the load reached around 4MN , it started decreasing , which was unusual as the load capacity of the piles of piled raft increased even at a smaller settlement than that of the raft which would have mobilised later with

further increase in the settlement. Although the strip pedestals were not designed to take any load, they would have transferred some loa,d when they came into contact with the ground, as the loading increased in steps.

It was found that various factors affected the measured load-carrying behaviour of the piled raft, including those that were not identified and considered in the design. The measured load-transfer curves of the piles showed an increase in axial load with depth within the upper soil zone, which was different from those assumed in the design and commonly observed from axially loaded piles. Factors that contributed to such unusual load-carrying behavior were the subsoil-layer condition, design modification, and the unplanned addition of strip pedestals. Pile loads continuously increased throughout the entire settlement range, while raft loads increased and then decreased slightly, after a certain settlement range. This was somewhat unusual as the load capacity of piles for a piled raft is mobilized earlier at smaller settlement than that of raft that is mobilized later with further increase in settlement due to the size difference of raft and piles. It is also noted that the proportion of load carried by piles is quite low.

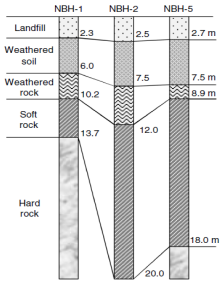

Fig 1 Soil profile at test site Yanghoon Roh et al.(2015

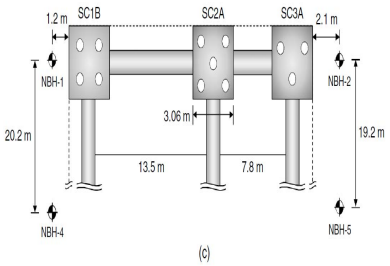

Fig 2 Schematic layout of piled rafts, Yanghoon Roh et al.,(2015)

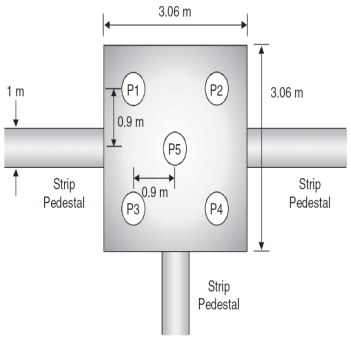

Fig 3 Configuration of test piled raft- Geometry of test piled raft, Yanghoon Roh et al.(2015)

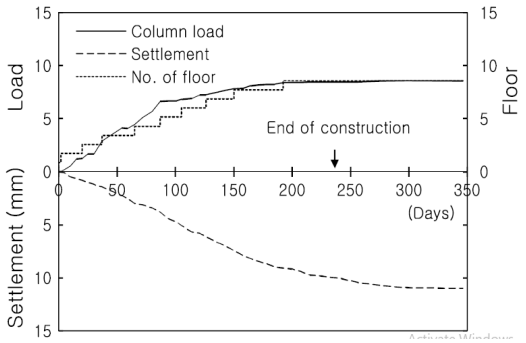

Fig 4 Measured total load on piled raft Vs Time. Yanghoon Roh et al.,(2015)

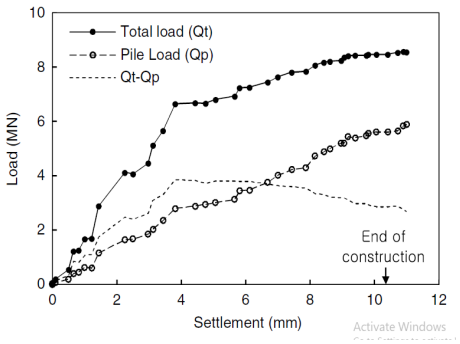

Fig 5: Load-settlement curves - piled raft piles Yanghoon Roh et al.,(2015)

The field monitoring and measured results in this study revealed that actual load response and load-carrying behavior of piled rafts can differ significantly from those assumed in the design. Such unexpected and unidentified load response would not have been caught and detected unless specifically addressed through a field monitoring program. Probably after the load increased the pedestals might have got full contact with the soil and might have

transferred some load. Considering the fact that the piles were socketed, the piles would have carried a higher load.

APPLICABILITY OF THE ABOVE STUDY

Having discussed the various but important site issues, an attempt has been made to see how far the above observations are applicable for the observational study conducted by the author on a piled raft supporting a basement, ground plus 10 storeyed structure, namely Palace Regency. The discussion is based on the inferences made from the existing results.

Paalace Regency at Chennai (Balakumar and Ilamparuthy,2007)

The above structure is a basement + 11 upper floors, basement and the first two floors are commercial and all the other floors are residential. Detailed soil investigation was conducted and the Fig 6 presents a plot of N-value with depth; corresponding E_S values are also given.The state of compaction as can be seen improves with depth and hence it was decided to support it on a piled raft, instead of deep piles as was decided earlier. Due to paucity of time initial design was done by an approximate method). The factor of safety against block failure was checked and found to be satisfactory. The piled raft consists of 93 numbers, 600mm diameter piles 14 m long below the bottom of the raft which was 600mm thick located at 3m below the existing ground level, and the water table was at 4m below the ground level. Figure 7 presents the pile layout with the settlement markers marked in the layout plan. More details are given in the earlier publication. Figure 8 presents loading sequence, and the corresponding settlement observed in a typical section. Table 1 presents the settlement observed with time. The basement had an RC wall, and the ground level slab was fixed on the wall. The wall was passing through the column and a floor beam was cast on the edge connecting the column. The structure itself was a framed structure. The settlement observations commenced after the raft was cast;. The settlement became measurable only after the 3rd level slab was cast. Since the depth of excavation was 3 meters below ground level, and above water table the relief in the stress was about 2.0 t/m^2 considering the buoyant density of the soil excavated. The applied stress, by casting a 600mm thick raft was 1.5t/m^2. Considering the water table at the base of the raft, the raft was subjected to an uplift of 3t/m^2. Till the 3rd floor was cast, the entire applied load from the structure appeared to have been resisted by the upward force, and hence there was no measurable settlement. The raft, RCC wall and the ground level slab formed a box type construction providing a high level of rigidity which was not considered in the design.

Figure 9 presents a comparison between the observed settlement and the settlement obtained through a three-dimensional linear elastic analysis (Balakumar and Ilamparuthy,2007). and Fig 10 presents the load shared by the raft with time, computed from the settlement, based on the elastic theory A comparison of the observed settlement and the computed settlement presents a common trend. In the edges, the computed settlement was higher than the observed settlement. This is mainly because of two issues, namely the raft top was kept flush with the ground and the basement wall which was present all-round the edges which was not considered in the analyses. In other words these two aspects can be considered as a simplification to make the analyses devoid of any complications and it would perhaps save the computational time.

Typically, in the case of Grid G, which is the central grid the settlement observed is far less than the computed one. In this case the difference between the outer column load and the next inner column is somewhat higher; in the numerical analyses the column load was applied as point load at the column location, whereas generally at the base the applied load would get transformed into uniformly distributed load. Hence the method of application of the load could also have played an important role

in causing a difference between the observed and computed settlement. The structural rigidity also could have contributed for the difference in the observed and the computed settlement. Although numerically they are smaller, this study confirms the effect of such short comings.

The sequence of construction was that, piling was done from the ground level and then the excavation was done. Although the excavation was of smaller depth, the levels of pile head was checked after trimming the pile head and no uplift was seen. The mobilisation of raft stress was computed from elastic theory and is provided in Fig 10. In the initial 100 days the applied load was 36 to 38% of the total load, but the settlement was of the order of 1mm to 3mm (7% to 21% of the total observed settlement.) and the raft stress developed was 10%; out of the 35% of the applied load, and the pile group had shared 25% of the load. In the next 100 to 150 days the rate of increase in the raft stress was smaller. The applied load increased by25%, but the raft share increased only by 5%.

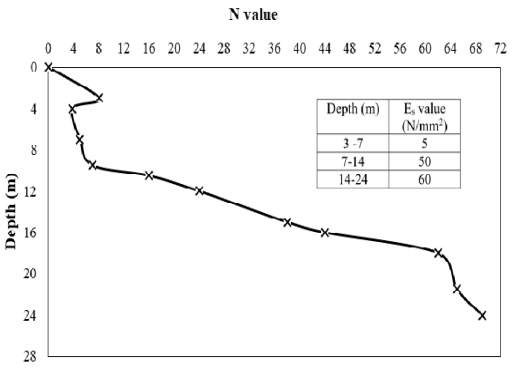

Fig 6: N-Values and E_S with depth.

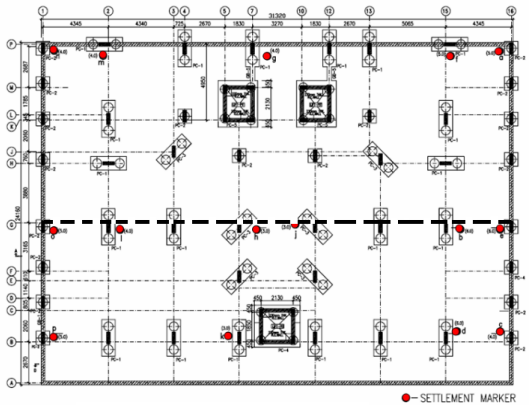

Fig 7 Layout of piles and settlement markers

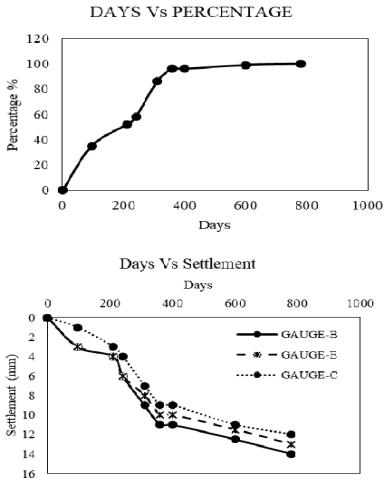

Fig 8. Rate of construction loading and observed settlement with time (typical)

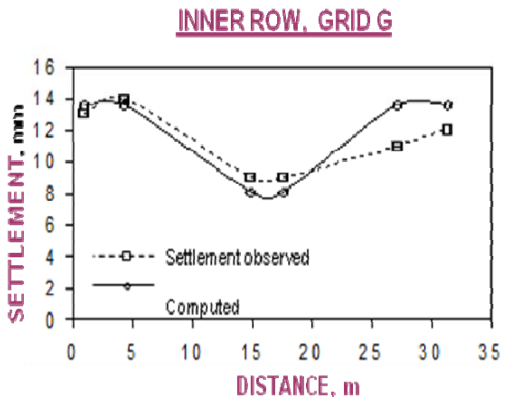

Fig 9: Observed and computed settlement

This is mainly due to the fact that the remoulded soil around the piles was getting consolidated, enhancing the confining pressure around the piles leading to the piles taking a higher share of the applied load. Thereafter the load shared by the raft increased rapidly, and at 600th day the applied load

was nearly 100% and the raft shared 40 % of the load, which increased to 45% finally. It is seen that although the piles were bored cast in situ piles as the strata was predominantly non cohesive, and so there was not much of a loss in shear strength; so, there were practically no detrimental effects due to pile installation. It can be seen from the fact that the enhancement of confining pressure reduced the rate of increase in raft stress between 100 and 200days, during which the applied load was 35 to 55%. The behaviour trend was in conformity with the predicted load sharing and settlement reduction behaviour.

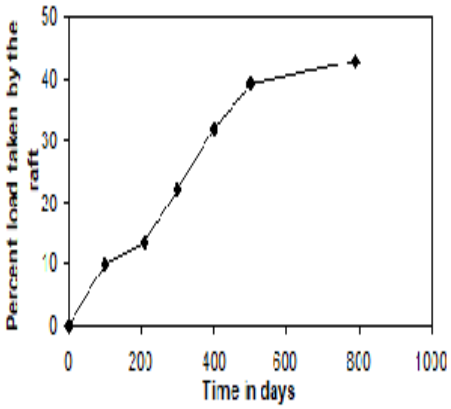

Fig 10 Load shared by raft time (computed)

Table 1 settlement observed with time.

Settlement in mm										
Days	A	B	H	C	G	K	J	E	D	Stages of construction
91	3	3	0	1	2	0	1	3	3	III floor
143	3	3	2	2	2	2	2	3	3	VI floor
204	4	4	3	3	3	3	2	4	4	VII floor
236	5	6	3	4	4	3	3	6	6	VIII floor
312	7	9	5	7	6	5	4	9	8	X floor
360	9	11	6	9	8	7	5	10	10	Completion
402	9	11	6	9	9	7	8	10	10	Post construction
796	12	14	9	12	12	10	11	13	13	Post construction

IN-SITU TESTING AND DESIGN METHOD

In the case of most of the numerical simulations, the reliability of the evaluation methods adopted to obtain the insitu parameters of various layers is very important. In order to obtain the insitu parameters directly, tests conducted with flat plate dilatometer and Menard's pressuremeter appear to be very effective. Research work carried out on behalf of ISSMGE- Technical Committee TC16 (Ground Property Characterization from In-Situ Testing), by Marchetti et al.,(2001) had brought out the features of the instrument, testing procedure and interpretation methods. The main advantage with this method is that it does not need any pre-boring like pressuremeter tests. Further pressure meter tests provide shear modulus and pressure versus volume change response; for evaluating the pressure meter modulus Poisson's ratio has to be assumed. Although correlations are available between N-values and pressure meter modulus these correlations are expected to be site specific and hence using them directly may not be advisable. However, pressuremeter tests have been successfully conducted to predict the load settlement response of the piles and the shaft stress distribution along the length of the piles, and the results have been published (Frank et al.,1991).

Frank et al., (1991) had studied the load settlement response of two piles forming a part of a bridge foundation and had established that their behaviour can be predicted by conducting the pressure meter test. Their prediction of pile behaviour is based on a tri-linear relationship for the shaft friction mobilisation based on the pressure meter tests. The model they had used is given in Fig 11;,and more details can be had from Frank et al., (1991. The terms k_τ and k_q are given as functions of pressuremeter modulus and pile diameter. The first segment has a constant slope. The slope of the second line has a flatter slope than the initial segment and third segment represents the mobilisation of total skin friction. The end of the second part is the limiting value of the friction. The slopes of the

lines depend upon the pressuremeter modulus (E_m) and radius of the pile. Frank et al., (1991) had conducted the pressuremeter tests on two piles forming a part of a bridge foundation and predicted the load transfer with depth under the pile loads 3.2MN and 7.2MN for the two test piles for the two test piles the pile soil system was divided into number of segments and the load transfer functions for the skin friction were constructed according to the trilinear simulation using the pressure meter data E_m and p_t- namely the limit pressure, more details are given in Frank et al.(1991),. Figure 12 presents the shaft stress distribution obtained for the test piles from test and numerical study. The close agreement between theoretical and the experimental values establish the effectiveness of the pressure meter test.

It has been established that while studying the settlement behaviour of the pile group, that if the pile group with the soil prism can be considered as a single pier, then the procedure applied for a single pile behaviour can be used for the prediction of the load settlement response of the equivalent pier numerically, using axisymmetric analyses. This establishes the fact that if the pile group of piled raft can be idealised as a single large pier (Balakumar et al., 2013), then the procedure adopted by Frank et al(1991) can be used to predict the shaft friction (pier shaft friction) of pile group of piled raft foundations adopting the equivalent pier modulus given by the expression given below:

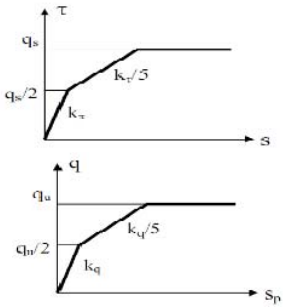

Fig 11 Trilinear model (Frank et al (1991))

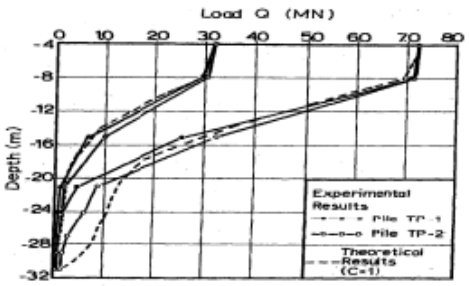

Fig 12 Comparison of Theoretical and Experimental Load Distributions for Test Piles, (Roger Frank et al., 1991)

The equivalent pier modulus e_{eq} is given by the expression, which can be used in the analyses is given by:

$$Eeq = E_S + (E_p - E_s)\, A_t/A_g \qquad [1]$$

The value of the Es can be derived from pressure meter tests, E_p is the pile material modulus, A_t is the total cross sectional area of the piles and A_g is the gross plan area of the group. ed in the detailed analyses.

CONCLUSIONS

The present study has established that monitoring during construction, and post construction is essential to identify the causes for any variations between the computed and observed values, particularly settlement and general behaviour. Whenever deep excavation is involved, and is done after installing piles, there are chances of tension getting mobilised in the pile due to the heave. Also, addition of structural elements during the construction of the foundation system can change the load settlement response as observed by researchers. Similarly pile installation remoulds the surrounding soil to varying degrees. Prediction of such issues during design may not be possible with the help of SPT and CPT results. This necessitates not only the monitoring of the works but also evaluations of in-situ parameters after the piles are installed to assess the remoulding effect. The changed parameters may be used to validate the design. In this process pressure meter tests and tests with dilatometers

appear to be an ideal method for assessing pre construction and the post construction parameters which can be used for validation of the design using equivalent pier concept.

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STUDIES ON STABILITY OF SEAWALLS OF KARNATAKA COAST

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ABSTRACT

The coastline of Karnataka stretches from Mangalore to Karwar over a length of about 300km. It is bounded on the west side by Arabian sea and east by Western ghats. Along the coast ten major rivers like Netravathy, Gangavathy, Sharavathy, Sowparnika confluences with Arabian Sea. The coast is mainly influenced by south west monsoon from June to September. The waves during the non-monsoon months are generally less than 1 m in height.- The predominant wave direction is W and N-W and occasionally S-W directions. The littoral drift along Karnataka coast very low. However erosions are reported on open coast, the erosions reported particularly on the open coasts during monsoon. The coast consists of one major port namely New Mangalore port and minor ports like Old Mangalore, Batkal, Gangoli, Malpe.. Coastal erosion along Karnataka coast dominated by direct wave action. Along certain stretches, there is concentration of wave energy due to refraction and these areas are more vulnerable to erosion. The tides in this region are mixed semi-diurnal dominant, the range of which increases towards the north. Karnataka Engineering Research Station, Mysore under Government of Karnataka has carried out observations on beach formations along the coast for over 25 Km length every year in critical areas. Based on the observations the eroding coasts are identified. In order to combat erosion seawall section was designed. Physical model studies are done in flumes to assess the stability and designs are finalised. The paper describes the details of observations and modifications of seawall sections.

Keywords: coastline, waves, littoral drift, erosion, seawall

1. INTRODUCTION

Karnataka has about 300 km coastal line bordering the Arabian sea on its western side. Erosion at various segment along the coastal is almost an annual feature during the south west monsoon period damaging valuable lands, natural wealth and human habitation. As reported by Dattari (1973) waves reaching upto 6.5 m in height have been recorded off the Karnataka coast. A study carried out from satellite imageries by Rajawat et al (2015) concludes that nearly 0.47Km^2 coastline of the state is under threat of erosion. A Technical Sub-committee (TSC) was constitute first in 1978 which recommended temporary protection measures to combat beach erosion. On this basis, temporary seawalls with single layer armour stones were constructed. Government of Karnataka, considering the severity of problem constituted a Technical sub-committee to look into the aspect of erosion problem, to find a permanent solution by evolving suitable design and measures and entrusted Karnataka Engineering Research Station, Krishnarajasagara with the work of design and also to conduct model studies to check the efficiency of the design. The designs of permanent seawall comprising of two layers of armour stones were recommended by the TSC during 1982. The permanent seawall design comprised of individual armour stone of 1360 Kg were laid to a thickness of 1.85m, heavier weight of armour stones, due to construction difficulties, slowly necessitated a need to examine by the Technical Experts Committee (TEC) set up in April 1987. Later in August 1987 two new design of seawall were furnished by the TEC. While working out of these designs the entire Karnataka cost was divided into two reaches from Mangalore to Marvanthe adopting structure slope of 1:5 and other from Marvanthe to Karwar adopting structure slope of 1:7.(Fig 1 &2).

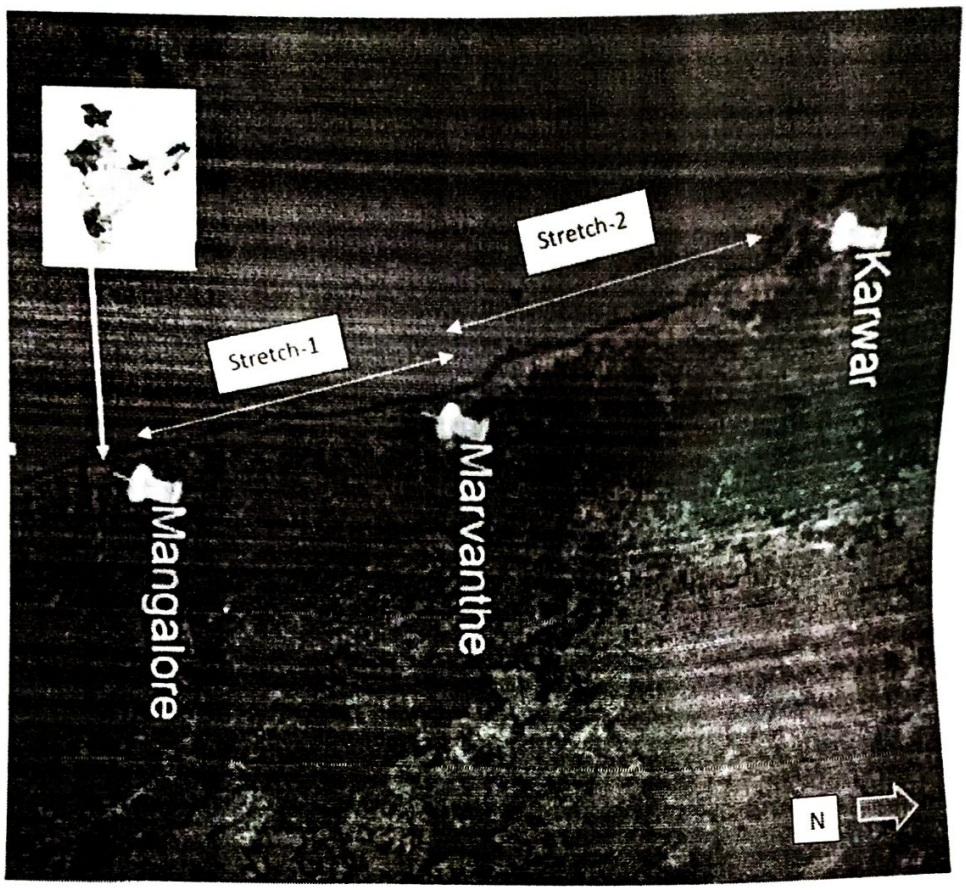

Fig 1 Index map

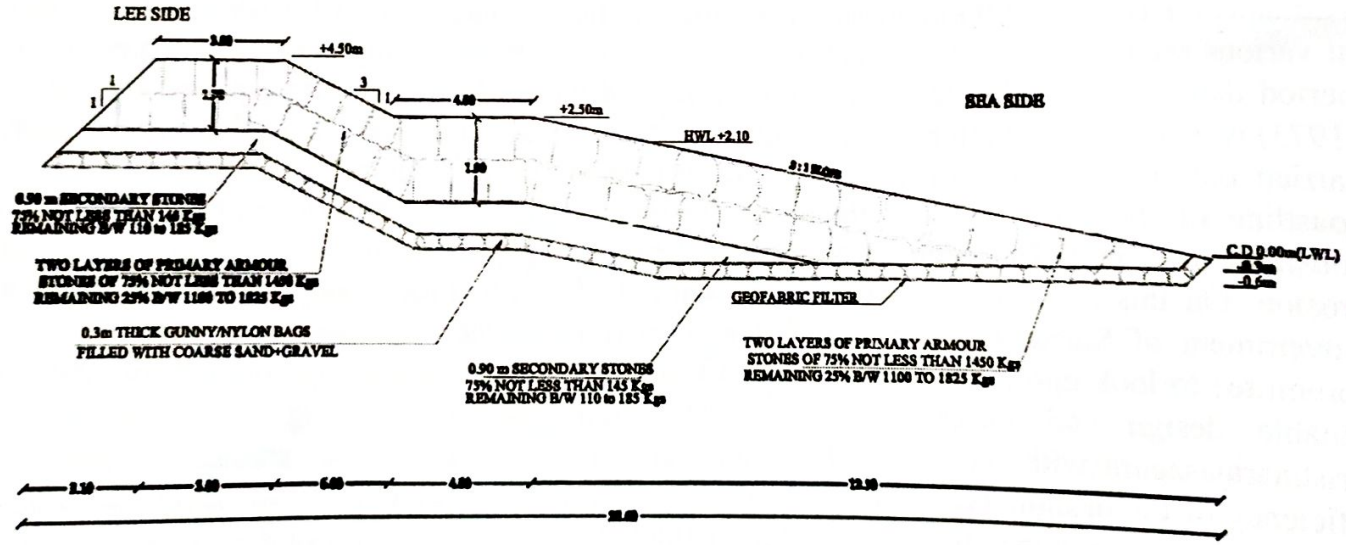

Fig 2 Typical design

Further, the technical sub-committee in its 6th meeting held on 27.6.1991 opined to design seawall for different beach slopes ranging from 1: 5 to 1: 7 as type design to account for in the absence of relevant data. (1:5 Slope in Strech 1 and 1:7 in strech 2 shown in fig 1)

Karnataka Engineering Research Station , KERS, took up this work, and on the basis of average beach slope type designs comprising of different beach slopes ranging from 1:25 to 1:10 beyond

the toe has been worked out. These designs are to be finalised after conducting physical model studies. Designs for Seawalls have been finalysed at many sites in West coast of Karnataka since several years. In the meantime recently the department of fisheries requested the institute to develop a sea wall design at Mangalore where the slope of beach is 1:20 beyond CD in surf zone.

2 .OBJECTIVE.

Sea walls are being felt indispensible as they are comparatively economical and immediate solution at vulnerable small reaches where net retreat with time is insignificant. Small stretches of west coast of Karnataka especially in Mangalore and Udupi districts are under severe erosion during monsoon. The coast is highly populated one with fishing hamlets. A site specific seawall is to be designed based on physical model studies.

3. DETAILS OF SITE

The length of reach is 275 M. The road level is (+) 6.650M.. Houses are located at +5.5 to +6.00 M level from CD. High Flood Line (Max wave run up) is up to + 3.80 M during HTL of 1.90mtr at this site. On the day of inspection of site, the beach slope of about 1 in 10 up to High Tide Line from CD. And about 1 in 17 to 20 above High tide line of +1.90 M.

4 .COASTAL PARAMETERS FOR THE STUDY

1. Effective size (D_{50}) of the Beach Material = 0.10mm
2. Breaker wave height = 1.30 m
3. Wave period = 8 Secs
4. Porosity of the Beach material = 40%
5. Manning's constant = n = 0.002
6. Depth of water at CD= HTL = 1.90 M
7. Storm surge = 0.30m
8. Maximum wave run up data supplied by Project authorities and local enquiry = 1.60 m
9. The position of location of "Toe" of the proposed sea wall is just 10 m from HTL line.
10. The position of Houses is about 15 m from max wave run up line.

5. DETAILS OF PHYSICAL MODEL

The theoretical designs are prepared as per the Shore Protection Manual Vol-II U S Army Coastal Engineering Research Center. Specific gravity of Armour stone =2.65 with adequate

filter, have been considered for the design of Sea wall. For the purpose of model study the laboratory a two dimensional wave flume of dimensions 44.5m* 1.50m * 1.50 m having a glass panel side at one end and a flap type wave speed dynodrive motor at the other end capable of generating only monochromatic waves of required height and Period. The wave generating unit consists of Variable speed mechanical motor, Gear box, Fly wheel, Flap unit (Fig 3).

Fig 3 Physical model flume

A sectional model of the seawall with granite armour stones with a model to proto scale of 1:12.205 was laid on a sand bed using High Density Polythene (HDP) mat as filter (Fig 4). A bed profile slope of 1:20 was provided beyond the toe. The model was run to a period of 1 hr. 46 min. 37 sec. for each level (corresponding to 6hr. 12.5 min. in proto). The sea wall section drawing and beach slope is plotted on the glass frame in the model then the sand is shaped as per the beach slope and sea wall section. HDPE mat will be put on shaped seawall section. In the model study instead of using gunny bags ,we use a sand layer of defined thickness on the HDPE mat, in proto gunny bags is used. Two layer of secondary armour stone is placed on the sand layer then two layer of primary armour stone is placed maintaining specified gradation. Each primary armour stone and secondary armour stone is weighed and counted before using in the model study.

The model bed is made rigid from the wave generating end till 0.50 mtr from CD, accomodating a moving bed in front of the sea wall to observe the possible qualitative erosion/accretion in front of the Toe.The model studies were carried out to know the effect of waves on seawalls for a period of 5 day cycle, at different water depths. As it was not possible to stimulate the actual

irregular wave conditions with the existing facilities in the laboratory, monochromatic waves of designed breaker wave height were made to act on the sea wall with the help of flap type wave generating unit. Each day cycle consisted of five levels starting from the level corresponding to , Mean Sea Level (mean water level), being increased to High Water Level including storm surge, lowering to Mean Sea Level again, further lowering to the Low Water Level/Chart Datum, finally again back to Mean Sea Level (from where started). Thus the sequence of operation being Mean Water Level, High Water Level, Mean Sea Level, Low Water Level/Chart datum and again Mean Water Level

Table 1 Proto - Model Details

Sl. No.	PARTICULARS	PROTO	MODEL
1	Breaker wave height (Hb)	2.762 m	0.226m
2	Wave period (T)	8 seconds	2.289 sec
3	Storm surge	1.60 m	0.131 m
4	Primary armour layer thickness	0.3048 m	0.025 m
5	Weight of each primary armour stone (W)	1.55 m	0.127 m
6	Secondary armour layer thickness	800.00 Kg	0.440 Kg
7	Weight of each secondary layer stones(W/10)	0.72 m	0.059 m
8	Seating of toe including filter	80.00 Kg	0.044 Kg
9	High water level (HWL + Storm Surge = d*s*)	-0.75m	-0.060 m
10	Mean water level(MWL)	2.20 m	0.180 m
11	Low water level (LWL)(CD)	1.3 m	0.1065 m

6. OBSERVATION AND DISCUSSION :

At the end of the 5th day cycle, it was observed that the primary armour stones dislodged beyond the toe were 6 No's, compared to the total number of 1214 No's of stones. It is 0.494 % which is less than 1%. Hence design is safe. It is preferred to lay heavier armour weighing more than 1000 Kg at "Toe portion" to make the Toe more stable. Modification of front slope with 1:6 from 1:5, made the structure comparatively less reflective promoting accretion near the toe rather than scouring and Toe protection improved its stability. The proposed design is furnished vide Fig 5.

In the event of rise in water level during storm beyond +2.20 mtr and wave period more than 8 secs with breaker wave height more than 2.75m there is likely hood of the "Toe " getting damaged. Hence as in the case of any structure, a periodical proper inspection and maintenance of the Toe and front slope is also important act of which can pay highest dividend in the long run.

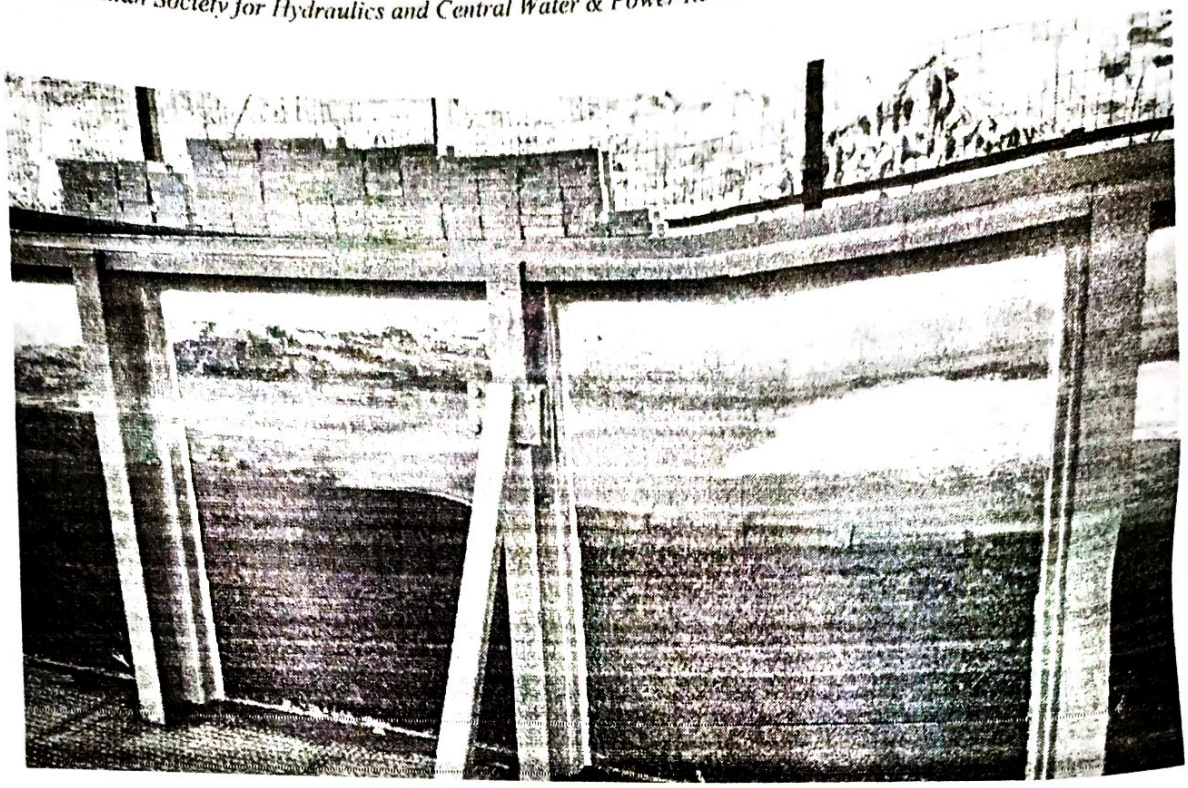

Fig 4 Model trial run

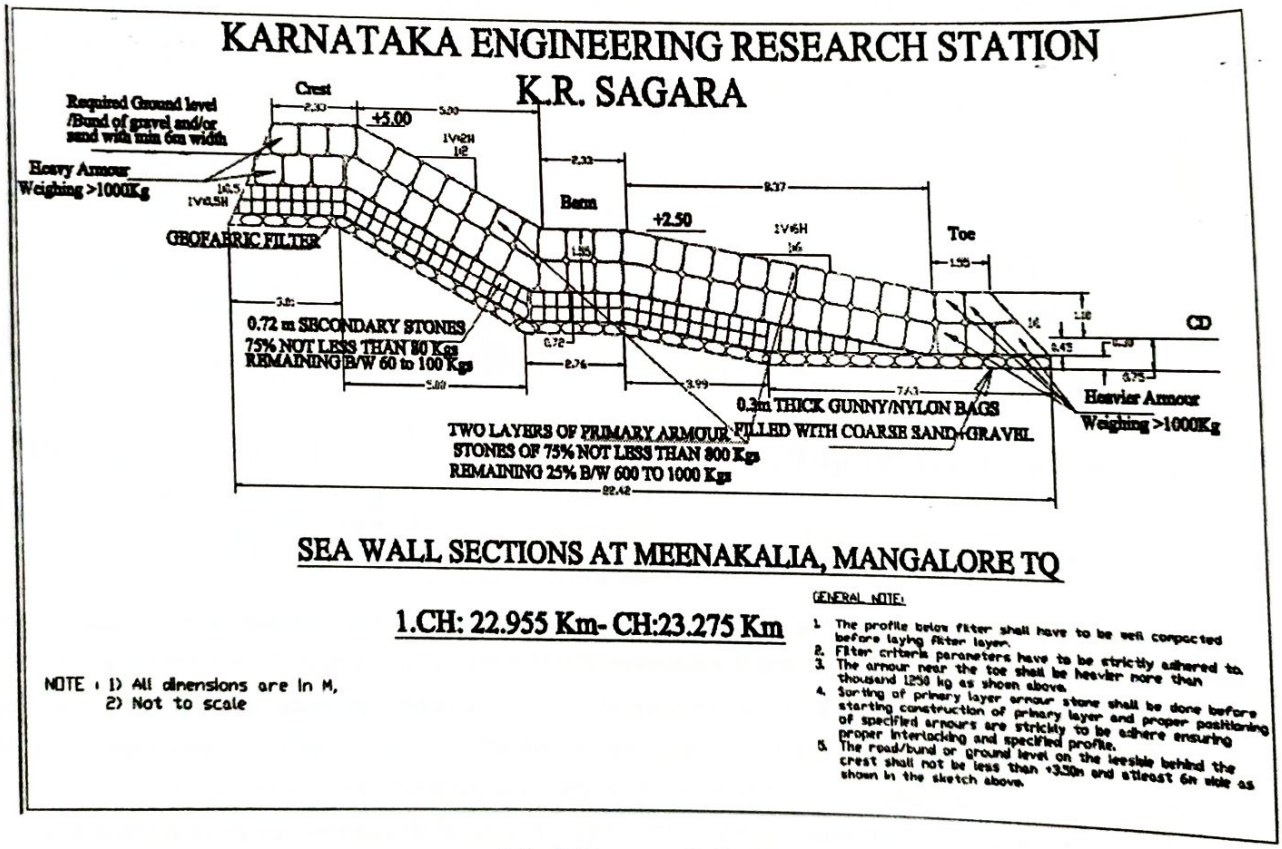

Fig 5 Proposed design

7. CONCLUSION

Initially a theoretical section was designed based on the guidelines by Shore Protection Manual. This was tested for hydraulic stability in a flume and the disturbance was in the range of 0.494%. Hence design is safe. It is preferred to lay heavier armour weighing more than 1000 Kg at Toe portion to make the "Toe" more stable

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Biogas Generation from Domestic Waste with the help of Algal Sequestration

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ABSTRACT - Kitchen waste can be utilized to produce biogas due to its high biodegradability, calorific value and nutritive value to microbes, which will reduce our dependency on fossil fuels. The research work was conducted to investigate the production ability of biogas as an alternative energy from kitchen waste with co-digestion of cow manure through anaerobic digestion (AD). Firstly, digester was prepared to observe the individual degradation rate of kitchen waste, cow manure and the combination of co-digested kitchen waste with cow manure at room temperature and at temperature of mesophilic digestion respectively and observed the degradation rate for co-digested kitchen waste with cow manure was higher than kitchen waste and cow manure alone. Secondly, digester was constructed to observe the effect of alkalinity at mesophilic digestion temperature. Finally, a portable biogas reactor was fabricated for pilot-scale biogas production which included an agitator and heating system. This reactor was operated at both digestion temperature and room temperature. It is observed that the digestion rate was faster at mesophilic digestion than room temperature. The prime object of this work was to investigate the prospect of kitchen waste for biogas production and ultimate protection of environment from the bad effect of methane gas that would be produced by uncontrolled anaerobic digestion.

KEYWORDS: Biogas, anaerobic digestion, filtration, carbon sequestration

I. INTRODUCTION

Due to scarcity of petroleum and coal it threatens supply of fuel throughout the world also problem of their combustion led to research in different corners to get access the new sources of energy, like renewable energy resources. Solar energy, wind energy, different thermal and hydro sources of energy, biogas are all renewable energy resources. But, biogas is distinct from other renewable energies because of its characteristics of using, controlling and collecting organic wastes and at the same time producing fertilizer and water for use in agricultural irrigation. Biogas does not have any geographical limitations nor does it require advanced technology for producing energy, also it is very simple to use and apply.

II. METHODOLOGY

The methodology involved in the extraction of biogas from the domestic waste is starting from collection of sufficient amount of domestic waste(both solid and liquid) which includes leftover food, vegetable waste ,water used for washing hands etc. This is followed by testing the physical and chemical characteristics of the collected waste water. The waste water should be properly treated through organic method so that it could be effectively used in the biogas plant. After treatment the characteristics of the water is again tested to check the efficiency of the treatment process. Finally Carbon sequestration is carried out with the filtered water which is later mixed with domestic waste and the resultant inoculums is thus fed into the biogas plant for the anaerobic digestion to take place. The project execution follows the sequence of work mentioned below.

Stage 1-Physical Chemical Characterization of Domestic Waste Water

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Reason: To know the characteristics of waste water so that quality of water can be analyzed.
Stage 2- Filtration of Waste Water

Reason: To make use of waste water instead of normal water for anaerobic digestion to take place.

Stage 3- Carbon Sequestration

Reason: To capture the carbon dioxide emitted as well as to from an algal biomass which will be used a stimulant in biogas production process instead of the conventional cow dung.

Stage 4- Biogas Production

III. PHYSICAL CHEMICAL CHARACTERIZATION OF WASTE WATER

Municipal wastewater is mainly comprised of water (99.9%) together with relatively small concentrations of suspended and dissolved organic and inorganic solids. Among the organic substances present in wastewater are carbohydrates, lignin, fats, soaps, synthetic detergents, proteins and their decomposition products. Municipal wastewater also contains a variety of inorganic substances from domestic and industrial sources, including a number of potentially toxic elements such as copper, lead, zinc, etc. Table 1 gives the physical chemical characteristics of raw waste water.

PARAMETERS	**UNTREATED DOMESTIC**
SAMPLE DETAILS	**WASTEWATER**
APPEARANCE	A TURBID WATER
COLOR	DIRTY COLOR
ODOUR	UNPLEASANT ODOUR
TURBIDITY	5 NTU
TOTAL DISSOLVED SOLIDS	11593 ppm
TOTAL SUSPENDED SOLIDS	3493 ppm
ELECTRICAL CONDUCTIVITY	23.420 macro Siemens
pH VALUE	9.5
ALKALINITY	5.24
TOTAL HARDNESS	1035.6 ppm
CALCIUM	356.7 ppm
MAGNESIUM	982.3 ppm
SODIUM	1040.7 ppm
POTASSIUM	270.3 ppm
CHLORIDE	1987.5 ppm
FLUORIDE	6.3 ppm
IRON	10.5 ppm
AMMONIUM	140.3 ppm
NITRATE	145.6 ppm
SULPHATE	1198.2 ppm
COPPER	12.35 ppm
ZINC	21.93 ppm
PHOSPHORUS	20.4 ppm
NITRITE	12.56 ppm

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IV. FILTRATION OF WASTE WATER

Waste Water treatment is the process of removing contaminants from waste water, primarily from household sewage. It includes physical, chemical, and biological processes to remove these contaminants and produce environmentally safe treated wastewater (or treated effluent). A by-product of the treatment is usually a semi-solid waste or slurry, called sludge, that has to undergo further treatment before being suitable for disposal or land application. So in our laboratory treatment setup, we used layers of 12mm aggregate, 20mm aggregate, orange peel powder and sand. Before introducing waste water into the filter media, screening process is done to remove the coarser particles. And Table 2 gives the characteristics of filtered water.

TABLE II PHYSICAL CHEMICAL CHARATERIZATION OF FILTERED WATER

SAMPLE COLLECTION DATE	**09/01/2017**
SAMPLE DETAILS	**DOMESTIC WATER**
SAMPLE QUANTITY	**10LITRES**
APPEARANCE	VISIBLE SUSENDED PARTICLES
COLOR	SLIGHT DIRTY COLOURLESS WATER
ODOUR	SLIGHT STINKY SMELL
TURBIDITY	5 NTU
TOTAL DISSOLVED SOLIDS	5934.5 mg/litre
TOTAL SUSPENDED SOLIDS	219.5 mg/litre
ELECTRICAL CONDUCTIVITY	15.49 macro Siemens
pH VALUE	8.45
ALKALINITY pH	5.12
TOTAL HARDNESS	574.6 mg/litre
CALCIUM	350.5 mg/litre
MAGNESIUM	975.3 mg/litre
SODIUM	1035.7 mg/litre
POTASSIUM	246.7 mg/litre
CHLORIDE	985.7 mg/litre
FLOURIDE	5.91 mg/litre
IRON	2.023 mg/litre
AMMONIUM	125.7 mg/litre
NITRATE	140.6 mg/litre
SULPHATE	1056.7 mg/litre
COPPER	10.2 mg/litre
ZINC	20.6 mg/litre
PHOSPHOROUS	14.3 mg/litre
NITRITE	10.1 ppm

V. CARBON SEQUESTRATION

In recent years, biomass-derived fuels have received increasing attention as a solution to the nation's continued and growing dependence on imported petroleum-based fuels, which exposes the country to the risk of critical disruptions in fuel supply and concern of climate changes. Some of the aspects of algal bio fuel production that have combined to capture the interest of researchers and entrepreneurs around the world include

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a) High productivity of biomass yields per acre of cultivation.

b) Use of otherwise non-productive, no arable land, and avoids nutrients used for conventional agriculture.

c) Non-food-based feedstock resources.

d) Reduced competition for limited freshwater supplies by utilizing waste water, produced water, and saline water.

In this carbon sequestration we made a closed photo bioreactor provided algal species called *schenedesmus.* It is green algae through which bio sequestration is achieved. The CO_2 was incorporated at the amount of 5% to 90%. And it is observed that the tolerance limit of the bioreactor is 80%. Therefore the amount of carbon sequestered is 53.29% for schenedesmus species. And Table 3 gives the characteristics of the sequestered sample.

TABLE III. CHARACTERISTICS OF SEQUESTERED SAMPLE

ORGANISM	SCHENEDESMUS
SAMPLE COLLECTION DATE	10/02/2017
SAMPLE DETAILS	DOMESTIC WATER
SAMPLE QUANTITY	10 LITRES
APPEARANCE	Dark Green
ODOUR	Unpleasant odour
TURBIDITY	2 NTU
TDS	1067 mg/litre
TSS	767 mg/litre
TOTAL SOLIDS	1952 PPM
ELECTRICAL CONDUCTIVITY	5.0 macro Siemens
PH	6.63
ALKALINITY PH	5.09
TOTAL HARDNESS	550 mg/litre
CALCIUM	156 mg/litre
MAGNESIUM	67.7 mg/litre
SODIUM	498.7 mg/litre
POTASSIUM	98.7 mg/litre
CHLORIDE	287.9 mg/litre
FLUORIDE	2.4 PPM
IRON	0.98 PPM
AMMONIA	5.12 mg/litre
NITRATE	7.93 mg/litre
SULPHATE	45.7 PPM
COPPER	1.02 mg/litre
ZINC	0.91 PPM
NICKEL	Not detected
CADMIUM	In traces
CARBOHYDRATES	0.11 gm

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LIPIDS	10.35 mg/litre
VITAMIN C	9.34 mg/litre
VITAMIN E	Nil
BOD	120.3 mg/litre
COD	255.3 mg/litre
VITAMIN B1	Nil
VITAMIN B2	Nil

VI. BIOGAS PRODUCTION

It is also referred to as biomethanization, is a natural process that takes place in absence of air (oxygen). It involves biochemical decomposition of complex organic material by various biochemical processes with release of energy rich biogas and production of nutritious effluents.

Various Biological process involved are

1. Hydrolysis

2. Acidification

3. Methanogenesis

A. Hydrolysis

In the first step the organic matter is enzymolysed externally by extracellular enzymes, cellulose, amylase, protease & lipase, of microorganisms. Bacteria decompose long chains of complex carbohydrates, proteins, & lipids into small chains. For example, Polysaccharides are converted into monosaccharide. Proteins are split into peptides and amino acids.

B. Acidification

Acid-producing bacteria, involved this step, convert the intermediates of fermenting bacteria into acetic acid, hydrogen and carbon dioxide. These bacteria are anaerobic and can grow under acidic conditions. To produce acetic acid, they need oxygen and carbon. For this, they use dissolved O_2 or bounded-oxygen. Hereby, the acid-producing bacteria create anaerobic condition which is essential for the methane producing microorganisms. Also, they reduce the compounds with low molecular weights into alcohols, organic acids, amino acids, carbon dioxide, hydrogen sulphide and traces of methane. From a chemical point, this process is partially endergonic (i.e. only possible with energy input), since bacteria alone are not capable of sustaining that type of reaction.

C. Methanogenesis

Methane-producing bacteria, which were involved in the third step, decompose compounds having low molecular weight. They utilize hydrogen, carbon dioxide and acetic acid to form methane and carbon dioxide. Under natural conditions, CH_4 producing microorganisms occur to the extent that anaerobic conditions are provided, e.g. under water (for example in marine sediments),and in marshes. They are basically anaerobic and very sensitive to environmental changes, if any occurs. The methanogenicbacteria belongs to the archaebacter genus, i.e. to a group of bacteria with heterogeneous morphology and lot of common biochemical and molecular-biological properties that distinguishes them from other bacteria. The main difference lies in the makeup of the bacteria's cell walls.

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D. Construction of Biogas Plant

For the construction of biogas plant, we used a water can of 20liters and polyvinylchloride pipes in order to create a anaerobic digester. And the digestion of organic materials takes place when the digester is maintained at 30°C to 40°C. Mix ratio of water and organic waste should be 1:1 that is 1Kg of waste is mixed with 1 liters of water. Tire tube is used as a pressure gauge for storage of gas.

VII. CONCLUSION

After the thorough study on the performance of reactor and evolution of acidogenic reactor, the following conclusion have been reached, As a result of the treatment of food effluent using microorganisms, the useful bi product, bio-gas has been produced with a considerable rate of decrease in the values of COD, BOD, pH, acidity and alkalinity. Through the successful anaerobic processing inside the reactor in 30days food waste treatment, methanogen gradually converts the organic acids into the methane gas and carbon dioxide, which indicates that the waste has better anaerobic biodegradability. Thus achieves a waste of resource utilization. The results show that reactor can treat food waste with high contaminated load.

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An Intelligent Fire Detection and Surveillance System

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Abstract— Fire detectors are designed to detect one or more of the three characteristics of fire-smoke, heat and flame. The fire detection and alarm system function together to provide timely fire warnings to those in emergency zones. But the drawback is that it may include false alarms. The proposed idea is to monitor industries and to detect fire and smoke using sensors and camera. In order to save energy, space and cost, Raspberry pi 3 is used which acts as both processor and controller. The sensors detect flame and smoke using the spectrum range. If it detects any issues, then it signals the motor to sprinkle water either automatically or manually. The camera acts by detecting the thermal motion of any organisms and if any fluctuation is detected, that moment is captured and sent as a mail to the user via a third party authentication system. The videos captured by the camera are stored in cloud and is used as proof during fire accidents to claim insurance. This system also avoids false alarm.

Keywords—Raspberry pi, PIR sensor, Intruder detection, Mail Service.

I. INTRODUCTION

Nowadays security has become a major challenge in the modern world. It is important to achieve utmost security possible. In order to implement it, IOT has paved an easier way. The aim is that the user should enhance security remotely. To achieve this, IOT is widely used as it has remote access control. The user can monitor and access control from remote locations easily. The traditional systems do not tend to perform a continuous detection and it fails in the case where it may produce false alarm.

The system proposed uses two sensors, a PIR sensor [1] to detect intruders and a Flame sensor to detect fire. In order to have a safe storage of data, the use of cloud for storing purposes is implied. Also, to achieve space, time and cost efficiency, this paper signifies the use of Raspberry pi [5].

The security is affected by various issues and in this paper, two important factors are focused. First is the rapid fire break out involving lethal effect. In order to prevent fire at its outbreak, it must be notified immediately so that the situation can be cleared or at least major issues can be prevented. Many papers have been proposed to detect fire before it creeps, though they tend to have a disadvantage of producing false alarm. This paper mainly tends to avoid this false alarm by introducing another part of analysis. The second major focus is to detect the intruders and notify the user concurrently. This part also adds up to avoid false alarm. Once it is known that fire is detected, the system captures pictures of the corresponding spot with is location [8] and sends it to the user by the alert mail.

The rest of the paper is organised as follows. Section 2 gives the efforts made by different experimenters along with the shortcomings. Section 3 specifies the propounded system and the methods to overcome hindrances. Section 4 discusses about the results achieved. And, Section 5 wraps up the work.

II. RELATED WORK

In this section, the works contributed by some of the researchers in this area are presented. The following are the ideas that were previously presented:

Sanoob.A.H et al. [1] proposed Smartphone Enabled Intelligent Surveillance System which introduced a new design involving smart phones. PIR sensor and MCU (Micro Controller Unit) for surveillance. In order to detect motion, this system includes a PIR connected to a Smartphone using a MCU. The camera is activated and video is captured only when any thermal motion is recognised and an alert message

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SURVEY ON DEEP CONVOLUTIONAL NEURAL NETWORKS FOR BACKGROUND IMAGE DETECTION

Akula Monika[1], Rimo Mallick[2], C. Jerin Mahibha[3]

Abstract— Computer vision and object identification are two critical fields that assume real part in image recognition and detection. image discovery and detection has been utilized as a part of the considerable number of fields we know. It incorporates the techniques for getting, handling and breaking down the datasets that are given. Neural systems and datasets are the two critical variables for deep learning. As deep learning is a propelled condition of-workmanship which helps in accomplishing insight in computer vision with the assistance of creating models and calculations. It utilizes learning calculation, such as SVM(Support Vector Machines), ANN(Artificial Neural Network) and CNN(Convolution Neural Network).The essential advances associated with image discovery and recognition is pre-processing where the information picture is standardized, further includes extraction where imperative data is separated from the image and arrangement which utilizes learning calculation algorithm.

Keywords—Convolutional Neural Network, Deep Learning, Image Detection, Background Subtraction, Feature Extraction

1. INTRODUCTION

Deep learning is a learning method that processes target classification. It requires less human interventions and provides better accuracy and faster results. The deep learning system automatically learns the features and representations that can be applied to object recognition. Deep learning techniques are widely used in artificial intelligence. Using automated systems for discovering hidden features, it has achieved improved performance and efficiency. The most popular deep learning architecture is convolutional neural networks (CNNs). The input images and respective annotations are provided, and a CNN model is designed to learn and generate predictive data representations. These representations are used for target classification of testing image. Unsupervised learning is also sometimes applied to neural networks for data representation learning. The advantage of using unsupervised feature learning is that it does not involve human annotations. Deep learning, which learns feature representations and pattern recognition, takes advantage of large-scale high dimensional image data to discover hidden structures for better image detection. These days, deep learning is the major technique among the best solutions in image detection. It holds great potential for the field. In this paper, we emphasis on deep learning in image detection, which conceals several topics, such as pre-processing, feature extractions followed by training and testing the systems. Finally, we discuss the efficiency of the results produced by various deep leaning systems. This survey intent to help other investigators to catch a hint of the state-of-the-art methods in the ground of image detection.

The rest of the paper is organized as follows. Section 2 deals with detection of objects in computer vision. Section 3 involves various background subtraction algorithms. Section 4 involves the concept of deep learning and further ventures regarding them. The Section 5 deals with Convolutional Neural Network which helps in computational model. Finally we conclude the work.

2. OBJECT DETECTION

This technology is related to image processing. This is used to track semantic objects. This technology is also implemented in computer vision and in face recognition. This uses the objects feature to track them

In [1] the focus is on designing discriminative features and training powerful object detectors for judging whether there exists an object in each candidate region. When these detectors are used in real surveillance scene where the view changes rapidly then the performance and efficiency drops to overcome this here this paper uses an adaptive method to track the objects.

In [2] Object detection is developed from the single object recognition to the multi-object recognition. The meaning of the first is just from an image to identify a single object, it can be said that it is a problem of classification, and the meaning of the later is not only can identify all the objects in an image, including the exact location of the objects. It uses COCO(Common Objects In Context) which was introduced by Microsoft for image recognition and segmentation datasets.

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AN INNOVATIVE EAR BASED RECOGNITION SYSTEM FOR AUTOMATIC ATTENDANCE MONITORING

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Abstract- Biometrics is analysis of physical or behavioral characteristics that can be used for human identification. There are several typical means of recognition which include access cards, personal identification number (PIN), passwords etc. They can be lost, stolen, duplicated, cracked or shared. These drawbacks can cause a great loss to the concerned. In this paper we have used ear as a biometric for validation and verification of a user to determine their identity or to verify a claimed identity. Ear is a stable biometric and does not vary with age. This is a standard technique in forensic investigation and has been used as evidence in hundreds of cases. Ear recognition is unique identification technique rather than face recognition, fingerprint recognition so on. We have used Image processing approach and Watershed Segmentation algorithm, to segment an image into regions for better results. The input ear image is pre-processed and segmented, based on the matching percentage attendance is marked for that concerned user and displayed as output. This paper provides good future prospects for the upcoming researchers in the field of ear recognition. For the purpose of result and analysis, experimental MATLAB tool is very useful for result oriented works.

Keywords- Biometric, Validation, Verification, Image Processing, Segmentation.

1. INTRODUCTION

The basic approach in biometrics is to identify an object or an individual based on their physical structure, behavioral or emotional characteristics. This can be verified using the various techniques & algorithms. Basically biometrics includes three vital tasks:

- Enrollment: In this process ,the user enrolls in the system by establishing baseline measurement for comparison.
- Submission: Here, the user represents the biological behavior of his or her identification to the capture system.
- Verification: Here, the system compares the submitted sample with the stored sample.

Ears are new biometrics: they appear to maintain their structure with increasing age. Ear images have more identification richness than some other parts of the human body. These ear images can be detected using various algorithms and approaches. The images can be segmented using various algorithms: this segmentation process will partition the image into multiple regions which will extract the foreground object from that image. Here, we have used marker based watershed transformation, which helps us to differentiate between the foreground and the background objects in an image.

Image segmentation plays a vital role in the image processing domain; this explains the key procedure from processing to analyzing. Edge detection is performed on the segmented image using the edge operator. Wherever an edge junction is found, the list is terminated and a separate list is generated. All pixels present in an edge may not be equally important and may not be necessary to represent the edge.

So, to get compact representation of the ear, the line segments are fitted to the edges obtained. This eliminates all unnecessary pixels from the edge and breaks every edge into a set of line segments and finds the size and position of the maximum deviation from the line that joins the endpoints. If the maximum deviation exceeds the tolerance value, then the edge is shortened up to the point of maximum deviation and this method is repeated.

2. RELATED WORKS

Dayanand B.Gore, Seema S. Kawthekar, Vipin Y. Borole.[1]."Ear Recognition Techniques for Biometrics Using Digital Image Processing", proposed the ear recognition system using ANN classifier based on Artificial Neural Network. Iannarelli, (1989). [2]."Ear Identification, Forensic Identification Series", Paramount Publishing Company, Fremont, California. The use of the ear for human identification began with the development of the Iannarelli System. This system is based upon geometric

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WIRELESS SENSOR BASED POTABLE WATER QUALITY MONITORING AND ANALYSIS USING INTERNET OF THINGS(IOT)

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Abstract-Water is the most prominent resource needed to lead a healthy life. Hence, it is pretty important to ensure the quality of drinking water and it must be monitored in real time. Internet of things (IoT) is the mesh of real-time devices, where those devices are sensed, controlled remotely and share their data to cloud-based approaches. IoT based smart devices are designed in a manner that they utilize every bit of data available in everyday life and these devices will use the data to interact with real-time systems. In this paper, we proposed a prototype for water quality monitoring system using IoT which constantly monitors the quality of water and controls it in order to provide potable water. This system uses pHsensor's ,levelsensor's and gas sensor's parameters to measure the water quality. The measured values from the sensors are transmitted to the cloud via the IoT module and the sensor's data can be viewed on system application from anywhere. This project also includes monitoring water quality through mobile devices in the internet via an android application.

Index terms-IoT, WSN, real-time, potable, cloud, Water quality monitoring.

1. INTRODUCTION

IoT enables the objects to be connected in order to computerize complex tasks. When devices can represent themselves digitally, they can be controlled remotely as shown in Fig. 1. The connectivity then helps to make sure the ways of increasing productivity of the system and accuracy [7].Water being the source of survival of all the living beings can also cause diseases that can compromise with the lives of human beings. Due to lack of constant monitoring of water, most of the deadly water-borne diseases are caused by the contaminated water. To overcome this issue, we proposed a system that constantly monitors the water making it potable using IoT.

Figure 1.IoT Architecture

The rest of this paper is structured as follows. Section II analyses the related works that were that were scrutinized and considered important to this article. Section III provides a brief overview of the system architecture. Section IV deals with the qualification criteria that were taken into account while designing the system. Section V describes the analysis of the real-time system .Section VI provides results and conclusionsSection VIII provides acknowledgentand finally, the paper concludes with section VII.

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Identity based Encryption and Revocation Techniques in Cloud: A Survey

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***Abstract*— Cloud computing allows users to store and access large amount of data without actually owning major resources. Security is a prime concern in cloud as most of the data available are critical and sensitive. The level of security offered by cloud is declining and hence users are reluctant in using the cloud technology. Thus, it is necessary to place cryptographically enhanced access control on the data shared in cloud. Identity-Based Encryption is a promising cryptographic primitive to build a practical data sharing system. Identity-Based Encryption is a type of public-key cryptography technique, which is applied to encrypt files using the receiver's unique identity. Various other techniques such as revocation, data sharing, and outsourcing are employed along with Identity based encryption to improve the security concerns. In this paper, a survey of such Identity-Based Encryption techniques and the associated revocation mechanisms data sharing, outsourcing in Cloud is presented. It also presents the pros and cons of these techniques employed in various Cloud computing scenarios.**

Keywords*— *Cloud Computing, Identity-Based Encryption, Key Revocation, Fuzzy based, Revocable storage.

I. INTRODUCTION

Cloud computing allows users to store and access their hardware or software resources from anywhere in the world over the internet. One of the main drawbacks in cloud computing technology is the declining security level that is promised for the data that is stored in the cloud. Many asymmetric cryptography techniques have been applied on to such data to keep the intruders away from finding the original message. One such public key cryptography technique is the Identity-Based Encryption (IBE) [1]. This method works devoid of any Public Key Infrastructure or Certificate Authorities. Identity-Based Encryption has much less overload than the other public key cryptographic techniques as it does not involve any communication to the Public Key Infrastructures or the Certificate Authorities. It instead introduces a Private Key Generator, as a third party entity that produces the Master Public Key and the Master Private Key. The sender encrypts the file using the receiver's unique identity as one of the parameters along with the Master Public Key. The receiver proves its authenticity and decrypts the file using the Private Key generated by the Private Key Generator [1]. The revocation mechanism involved in Identity-Based Encryption is handled by another third-party entity thereby reducing the overhead. The main objective of this paper is to present a survey of such Identity-Based Encryption techniques and the associated revocation mechanisms in Cloud. It also presents the pros and cons of these techniques employed in various Cloud computing scenarios.

The remainder of the paper is organized as follows: Section II deals with some of the attacks and its counter measures related to identity based encryption. Section III deals with the identity based encryption with outsourced revocation. Section IV presents revocable storage based encryption. Section V deals with the schemes related to secure data sharing. Section VI presents composite identity based encryption. Section VII presents the concluding remarks on identity based encryption.

II. ATTACKS ON IDENTITY BASED ENCRYPTION

In [2], the various security constraints dealt in a cloud environment is presented. One of the possible attacks concerning data confidentiality is eavesdropping. This is overcome by using advanced strong encryption and key generation algorithms. Attacks on data integrity involve masquerading which can be overcome by using efficient data audibility algorithms. Attacks on user privacy include cloaking attacks which can be prevented using efficient cryptographic keys. Access Control must handle the issue of Denial-Of- Service (DOS) which can be solved by using mandatory access control, discretionary access control or role based access control. Using the appropriate

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ANDROID BASED PROSOPIS JULIFLORA DETECTION AND ELIMINATION SYSTEM USING INTERNET OF THINGS(IOT)

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Abstract: Plant leaves provide sufficient features to distinguish them among other species. Identification of plants using leaf images is a classic problem in digital image processing. In this paper we describe a prosopisjuliflora (*informallykaruvelam*) identification and elimination system. We developed an Android application that identifies the juliflora plant leaves and activates an injecting machine that contains mera – 71 (glyphosate), 2, 4-D amine and ester which injects the chemical into the plant and clinically kills the plant. The android application is connected with the injecting machine using Internet of Things(IoT).

Keywords: plant identification; image processing; leaf features, internet of things

I.INTRODUCTION

The basic approach in image processing is to identify a leaf or an object based on their physical structure. This can be verified using the various techniques &algorithms. Basically image processing includes three important tasks:

- **Pre Processing:** In this process, the user enrolls in the system by identifying the basic requirements for comparison.
- **Feature Extraction:** Here ,the user determines the type of the leaf and segments it to compare with the leaf that is present in the system.
- **Classification:** The image is classified based on the features extracted from the leaf.

Leaves are the main objects; they appear to maintain their structure with different size. The leaf image can be detected using various algorithms and approaches. The image is segmented; the segmentation process involves partitioning the image into multiple regions that will separate the foreground object from that image. Here, canny edge detection algorithm technique is used which helps us to differentiate between the foreground and the background objects in an image.

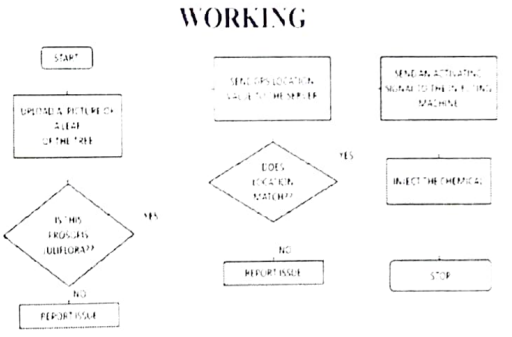
II.EXISTING SYSTEM

Prosopis is fast growing, salt-tolerant and drought-tolerant trees that can grow in an areas receiving as little as 50 mm of rainfall per year. This is a rhizomatous perennial weed dominating an important part of productive agricultural lands in most of the developing countries including India.
The existing methods of destroying this harmful plant include mechanical methods that involves uprooting the plant which is not an environment friendly method and soil solarisation which is an environment friendly method but proves to be non-effective. Moreover, prosopis tolerates these traditional methods of weed control.

III.PROPOSED SYSTEM

The Proposed system explains the process of leaf identification system and the techniques involved in the detection and processing of a leaf image. An Input leaf image is captured and stored in the database (system folder)using a camera. Then preprocessing is carried out to segment the image into regions which is further separated to find out the edges of image using various edge detection algorithms such as canny. Canny edge detection method gives best results for the segmentation of a leaf image that is exactly captured with proper features.

A. Workflow



The Image of a leaf is captured. This leaf Image is then uploaded and stored separately. In a mobile application ,a default leaf image is stored in the cloud server. The leaf

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A Survey on Sharing Data in Cloud

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***Abstract*—** Cloud is an online storage application mainly used to store documents, media and various files. However, due to large and easy access of cloud there arise various security issues such as data stealing and authentication issues when trying to share data on public platform. Fine-grained sharing of encrypted data is achieved through Attribute-based encryption. This is done with a methodology to provide data confidentiality and integrity using key generation, encryption and decryption. There are various techniques used to share data in cloud and each of these techniques employ different procedures or steps to achieve the end result. One among those techniques are public key encryption techniques which is a form of asymmetric key encryption where both public and private keys are used to keep the data or document secure. A security model is built through verifiable decryption algorithm. This is achieved by introducing a verification key from the output of the encryption algorithm. Finally, we present an approach to securely share data in an efficient manner through the ABE scheme.

***Keywords*—** cloud computing, attribute-based encryption, Key Exchange, Data Sharing.

I. INTRODUCTION

Cloud computing have grown vastly over the years and lately many IT industries rely on safe and secure form of transfer of data to either individuals or to a group of people. The benefit organizations can gain from data sharing is higher productivity. With social networking services gaining popularity it needs to focus on sharing data. Google Docs is one such cloud platform which provides data sharing capabilities as groups of students, or teams working on a project can share documents and can collaborate with each other effectively. There is an assumption that data servers can be trusted to keep the data secure. However, this assumption is no longer true today since services are increasingly storing data across many servers that are shared with other data owners. The Cloud is susceptible to many privacy and security attacks. The biggest obstacle hindering the progress and the wide adoption of the Cloud is the privacy and security issues associated with it.

An example of this is cloud data storage where cloud service providers are not in the same trusted domains as end users, and hardware platforms are not under the direct control of data owners. To mitigate user's privacy concerns about their data, a common solution is to store data in encrypted form so that it will remain private, even if data servers or storage devices are not trusted or compromised.

The encrypted data, however, must be amenable to sharing and access control. Data encryption using symmetric or public key cryptography is not amenable to scalable access control. A promising approach to address this issue is attribute-based encryption (ABE). ABE schemes can be divided into two categories: Cipher text- Policy ABE (CP-ABE) and Key-Policy ABE (KP-ABE), depending on the access policy is embedded into the ciphertext or the user's private key. Here, Both CP-ABE and KP-ABE can prevent any unauthorized users from accessing data, even if the user stores data in an untrusted server.

The rest of this paper is organized as follows. Section 2 presents some fundamental concepts Public Key Encryption. Section 3 gives the details of domain based storage protection. Section 4 gives the verification of performance evaluation through high level petri nets. Section 6 presents privacy preserving techniques employed over the years to share data across database; section 7 involves the key exposure techniques and key aggregate cryptosystems. Finally, Section 8 concludes our work.

II. PUBLIC KEY ENCRYPTION

This type of encryption is also called asymmetric cryptography. Here it uses both public and private keys to encrypt and decrypt data.

A. Identity-Based Encryption

An Identity Based Encryption scheme is a public-key cryptographic algorithm, which consists of 3 elements: key generation, encryption and decryption where any string is a valid public key.

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OAuth Enabled Security Desk, HR Management System with Audit Report Generation and Scheduled Mailing Services Using Spring REST, Cloud Computing and IOT

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Abstract— Traditional security desk and HR management system would involve either manually entering the records into ledgers or if digitized, it involves manual entry into multiple Excel sheets which does not provide flexibility for utilizing the data for auditing purposes. With the help of Cloud Computing the data in large volumes can be stored and retrieved in an efficient manner. In addition to this, inducing the concept of NoSQL will support dynamic schema design, allowing the documents in a collection to have different fields and structures. The database uses a document storage and data interchange format called BSON, which provides a binary representation of JSON-like documents. Using REST technology over Simple Object Access Protocol (SOAP) technology would leverage less bandwidth, making it more suitable for internet usage. Using Apache POI the data that is retrieved from the cloud can be converted into Excel format which is the desired format for audit purposes. Job Schedulers can be used to trigger emails in a timely fashion based on the user's preferences. Finally, including Internet of Things (IoT) will ensure more security and helps to reduce entering redundant data.

Keywords—Cloud Computing, NoSQL, REST, Apache POI, Job Scheduler, Internet Of Things.

I. INTRODUCTION

Security desk and HR management is a tedious process as it deals with a large amount of data, it must be secure, it must be reportable and finally it must be done efficiently. Traditional systems often fail make the process feasible. Digitizing the process would solve only half the problem and would fail to provide the flexibility to handle the data. In addition to this it does not provide the desired security and efficiency. Hence by using cloud computing large amount of data can be stored and retrieved from the internet. A NoSQL database provides a mechanism for storage and retrieval of data that is modeled in means other than the tabular relations used in relational databases. The database uses a document storage and data interchange format called BSON, which provides a binary representation of JSON-like documents. Jackson is a very popular and efficient java based library to serialize or map java objects to JSON and vice versa. Using Apache POI the data that is retrieved from the cloud can be converted into Excel format which is the desired format for audit purposes. Custom Job Schedulers can be used to trigger emails in a timely fashion based on the user's preferences. Finally, including Internet of Things (IoT) will ensure more security and helps to reduce entering redundant data.

The system can be used for multiple purposes such as security desk management, Inventory management, HR management and so on. It could further be utilized for managing the attendance of employees in an organization. It modularizes the work by giving the user the flexibility to create registers to manage the various aspects of management in an organization. Using filters, which in turn uses appropriate criteria and queries, the user can get details relevant to the filters. Security of the system is in turn taken care by OAuth (which provides REST security) and Spring Security (which provides Role-Based security). Hence, the system provides greater flexibility to handle multi-purpose management systems.

II. RELATED WORK

Logbook enables to stay in control through an overview on the company's systems and their compliance status. During the total lifecycle of systems all events and changes are fully traceable. Permanent inspection readiness can be maintained through scheduling and automated generation of notifications.

In [1]Visitor gate-pass management system is outlined to supplant conventional guest enlistment and visitor information administration exercises in the premises, it helps to assist the guest enlistment process, determine who is still interior of the premises after assembly and inform to the framework. It solves the issue of arrangements and electively captures all-relevant data around the guests and that information is recorded in centralized database server, which gives information to administration and control through searching for future purposes in the organization. The benefits of Visitor gate pass management system is enhancing the level of security upheld in premises, giving an organized see of guest records and decreasing the time spent on overseeing guest data. It is utilized

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SURVEY ON FLEXIBLE DATA ACCESS CONTROL BASED ON WEB BROWSER APPLICATION WITH CDN PEER- TO- PEER HYBRID ARCHITECTURE IN CLOUD COMPUTING

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Abstract- Cloud Computing is a design in which assets can be spared and recovered for all intents and purposes on the virtual server with insignificant exertion over the web in an open domain. A web program has been produced utilizing some progressed scripting procedures which offers client experience and responsiveness appropriate for different stages are ending up progressively prevalent. To keep touchy client information secret against unapproved servers, utilize cryptographic techniques by giving information decoding key just to approved clients. Be that as it may, this prompts a substantial calculation workload on the information proprietor for key and information taking care of when little-grained information gets to control is wanted, and in this way don't have much movement. The Internet usage has been shifted from host-to-host centralized model to content dissemination model. The Content Delivery Network and Peer to Peer are two fundamental advances that give information construct benefits in light of the Internet. We have actualized the Http information extraction on the customer side to diminish the over-burden on the server side. The extracted information has been transmitted to the server over TCP/Ip(Stateful) as opposed to Http(Stateless) convention. Both ask for and reaction have been connected cryptographic procedures (128 piece AES) for every exchange where encryption and unscrambling are done on both customer and server side or the other way around. The decoded information will be shown on the program. We propose ID related web program with some reserving functionalities which gives a route to the substance to be scattered and to discover the closest system in ID Net having comparative substance. Inside the cryptographic component, we incorporate the idea of setting mindful confirmation and benefit assessment keeping in mind the end goal to help different control procedures. Through a profound investigation, the security and execution of our plan have been assessed. The outcomes demonstrate that our plan is adaptable and productive for information privacy of access control in distributed computing.

Keywords—Cloud computing; access control; CDN; Peer- to- Peer; Http; AES encryption decryption; TCP/IP

1. INTRODUCTION

Cloud computing is a rising innovation in which calculation of assets framework is given in a shape of administration over the Internet. In cloud computing, there is no compelling reason to think about the area and the arrangement of the framework which gives the administration. The cloud empowers the server farm to work like the web and process the assets to be gotten to and shared as a virtual asset in a safe and way. The fundamental qualities of mists are versatility, homogeneity, virtualization, minimal effort programming, secure access, geographic dispersion. Distributed computing organization models are of three kinds: private, open and mixture. General society cloud powerfully assigns assets in view of client premise through web applications. The private cloud gives security to workers and clients of an association. Though in the Hybrid cloud which is the blend of Public cloud and private cloud. In this sort of cloud benefits, the inner assets are made under the control of the client and outer assets are conveyed by a cloud benefit provider(CSP). The web application has been created where it delivers the responsive website page. The web application is of two sections customer and server. The customer shows the web structure characterized by HTML substance and CSS alongside JavaScript. For the most part in a customer service where the customer asks for takes excessively to react keeping in mind the end goal to diminish the time and utilize it productively CDN and Peer to Peer are utilized. Content Delivery Network(CDN) is a gathering of servers that convey page and web substance to the client in light of the client's area, the source of the site page. CDN will scan for the closest server and store the imitations of an every now and again got to page and give that substance to the client. Associate to-Peer(P2P) is a system of PCs where each companion goes about as a customer and server for sharing assets between them. The Http ask for of the page to be seen is removed from the customer side keeping in mind the end goal to diminish the over-burden of the server. The extricated information is changed into TCP/Ip organize. TCP/Ip is utilized for a dependable transmission of information and furthermore recovers the site page fastly. For security reason encryption and decoding is done on both customer and server side. The current framework isn't adequate to guarantee the security of clients. The proposed approach is utilized a cryptographic system, for example, AES (Advanced Encryption Standard) calculation to scramble the separated information for the security concerns.

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Prediction of Social Media User's Mood using Deep Learning

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Abstract— In recent times, there is a huge increase in the usage of social media to share one's opinion, feelings and even daily activities. By predicting the mood of the users in social media, we can identify the users who discuss or express suicide-related information. Prediction of user's mood based on the likes, shares and status posted by them on social media is a challenging task as the mood of users change frequently. In this paper, a scheme is proposed to predict the user's mood based on the likes, shares and status posted in social media and identify the users in the state of depression. This scheme classifies the mood of user as happy, sad, neutral, angry etc. using deep learning. It presents news feeds to keep the depressed user happy and enthusiastic. When the user is in a prolonged state of depression, the alert system alerts the top five users in his/her friend list. This scheme predicts the mood of the users with accuracy around 87%. Further, time critical information is sent to some users who regularly share information such that it reaches all the users within a certain period of time.

Keywords—Mood Prediction, Social Media, Alert System, Time Critical Information, Depression, News Feed

I. INTRODUCTION

Emotions are the way of expressing human's feelings. Nowadays, most of the people express and share their feelings via social media. Social media brings up the social interaction among people and acts as an interface for humans to express their feelings according to their mood swings. The expression of their emotions in social media has its pros and cons. The mood of the user can be classified into different types such as happy, sad, disgust, angry, contempt, etc. This mood of the user swings due to current situation, stress, clinical activities etc. The mood of the social user is predicted based on their emotions they express as likes, shares and status posted. The need to predict the mood of the social media users is to promote marketing for business development, prevent suicidal activities etc. The major advantage of using social media in business is to track the user's likes and interests and then the marketing takes place in response to user's interest. The second advantage is that it is the easiest way to communicate and get connected with all the people [1]. The drawback of the social media is that some users wrongly use this media and land up in prolonged depression leading to suicidal activities. This occurs due to the mood swings of the user. To overcome this drawback, the mood of the user is predicted using their postings. The mood swings are monitored for determining the user's characteristics. Machine learning techniques are used to classify the data based on the training sets. Machine learning is nothing but feeding the dataset to a machine and making it learn. This helps in predicting user's mood using deep learning. The statistics of Facebook [2, 3] such as the total number of users, the number of posts, likes etc. is presented in Table 1.

Table 1. Statistics of Facebook

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Survey on Deep Learning Analysis Of Spectrophotometric Data

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Abstract— **Deep learning-based study of visual datasets plays an important role in automated image scrutiny ideology. This paper investigates amalgamated feature learning and classifier training approaches for designing an efficient image recognition system. Of late, deep learning is emerging as an upcoming machine learning tool and has fascinated substantial attention in the fast-growing field of spectrophotometric analysis. The main idea of this paper is to inspect the emerging utilization of deep neural networks and examine the current deep learning advancements in various fields such as pattern recognition, segmentation, and classification in visual data analysis. Particularly, we demonstrate the frameworks and the fundamentals of convolutional neural networks, fully connected networks, stacked auto encoders and optimizers, and python deep learning libraries, and interpret their formulations for different operations on various spectrophotometric images. Furthermore, we explore the open challenges and the prospective trends of future research in spectrophotometric image analysis using deep learning.**

Index Terms— **Convolutional Neural Networks, Deep Learning, Feature extraction, Spectrophotometric data**

I. INTRODUCTION

Spectrophotometric analysis using deep learning provides a quantitative pathway for enhancing characterizations of various visual datasets, that serve as an input to the image recognition systems. With the increasing size of visual datasets, it is inefficient or even impossible to manually process the large amount of data. Automated methods significantly improve the efficiency. It attracts considerable attention in the recent works. Particularly, deep learning techniques have been applied in the research of deep learning, natural language processing and image processing. Deep learning is a learning method that processes target classification. It requires less human interventions and provides better accuracy and faster results. The deep learning system automatically learns the features and representations that can be applied to object recognition. Deep learning techniques are widely used in artificial intelligence. They have been successfully applied to natural language processing, computer vision, speech recognition and so on. Using automated systems for discovering hidden features, it has achieved improved performance and efficiency. It has also provided very accurate performance in biomedical applications as well. Off late, deep learning is emerging as an efficient tool that attracts considerable attention in spectrophotometric analysis, including cell segmentation, nuclei detection, image classification, and so on. The most popular deep learning architecture is convolutional neural networks (CNNs). The input images and respective annotations are provided, and a CNN model is designed to learn and generate predictive data representations. These representations are used for target classification of testing data. Unsupervised learning is also sometimes applied to neural networks for data representation learning. Autoencoders and Support Vector Machines (SVM) are unsupervised neural networks, commonly used in spectrophotometric analysis with promising accuracy. The advantage of using unsupervised feature learning is that it does not involve human annotations. There are several books and articles explaining deep learning architectures, historical reviews, and applications in various technical areas. Many authors have presented a historical survey of deep neural networks by summarizing relevant methodologies. The papers reviewed in this survey explains several deep learning algorithms. They also provide speculative ideas for future research. Several deep learning applications in medical image computing are analysed. Deep learning, which learns feature representations and pattern recognition, takes advantage of large-scale high dimensional image data to discover hidden structures for better spectrophotometric analysis. Deep learning can significantly eliminate the liability of feature engineering in predictable deep learning practices. These days, deep learning is the major technique among the best solutions in spectrophotometric analysis. It holds great potential for the field. In this paper, we emphasis on deep learning in spectrophotometric data analysis, which conceals several topics, such as pre-processing, feature extractions followed by training and testing the systems. We also point out several techniques in which deep learning analysis of spectrophotometric data can be carried out. Finally, we discuss the efficiency of the results produced by various deep leaning systems. This survey intents to help other investigators to catch a hint of the state-of-the-art methods in the ground of spectrophotometric analysis.

II. PRE-PROCESSING THE IMAGES

Pre-processing is the initial step performed in any image recognition system. The dataset that is subjected to analysis is first analysed and processed thoroughly to make sure that all the images are formatted in a similar fashion. One of the key steps

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A Health Decision Support System for Disease Diagnosis based on Machine Learning via Big Data

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Abstract— The usual method of health decision support system through regular database provides less efficient prediction. The analysis accuracy is reduced when the quality of medical data is incomplete. It is replaced by a health decision support system which uses big data and a framework called hadoop. The decision support system is used for implementing the healthcare with the help of Hadoop as it contains large amount of data. Hadoop is used to predict the disease based upon the symptoms. The patients are provided with the unique ID. The Patient's Health Record (PHR's) of the patient is stored in the public cloud and is encrypted by homomorphic encryption. When the PHR is needed, they are retrieved from the cloud by decrypting it with the key so, this results in providing the confidentiality to the data. This proposed system provides accurate information and is handy for doctors to diagnose the patients quickly.

Keywords— Disease prediction, Machine learning, big data, Naïve Bayes, Hadoop, Health care, diagnosis

I. INTRODUCTION

A health decision support system predicts the disease, from big data through decision making done by machine learning. Big data is the huge amount of data which is collected from the globally available database. When regular database is used for the prediction, it becomes quite challenging, because when size of the data increases, the computational and the processing time increases. This is the major disadvantage of the existing system [1]. Due to this disadvantage, the diseases are not predicted on time by the doctors and the patients' health condition becomes even poorer. In order to overcome the challenge of processing time, this system is proposed to ensure that the diseases are predicted quickly on time by the doctors and this system is proved to be handier.

The existing system [1] uses relational database for storing the set of symptoms. It predicted rare diseases using the list of symptoms in the normal database. Disease Prediction was also carried on through systems which included wearable devices like AMON (A wearable multipara meter medical Monitoring and alert system)[3]and LOBIN(E-Textile and Wireless-Sensor-Network Based Platform for Healthcare Monitoring in Future Hospital Environments) [5] which is a combination of both electronic textiles and WSN.AMON[3] is a wearable belt like device which was worn on wrist of the patient and the disease or the panic of the affected were predicted or sensed by using sensors and the information was sent to the MMC(On Line Medical Mission Control) through GSM link. In LOBIN [5] the system included wearable fabrics and the location subsystem which were connected to Wireless Sensor Network (WSN) and WSN contains a gateway which is linked to the management subsystem connected through the IP network. In system [5] diseases are predicted by the sensors which are attached along with the fabrics and sends the information to the management subsystem. Although the systems [3] and [5] are wearable and portable they face many challenges. Even if any one of the sensor or the component is damaged, the systems [3] and [5] may not work. With the disadvantages faced by the systems [1],[3] and [5] this new system is proposed by using big data and a framework called hadoop for efficient health monitoring.

Section II contain the related work of the proposed system, Section III contain the some measures of this system, Section IV contain the architecture and essential steps of this proposed health monitoring system, section V explain the proposed methodology with flowchart, and section VIII concludes research work with future directions.

II. RELATED WORKS

Some of the related works for the health monitoring of the patients included: a system which analyzes the patients by using the physiological data [2], a system which included an alert mechanism [4] and a system which was monitoring patients continuously with personal care and proved to be energy-efficient [6].The health monitoring system [2] is based on anomaly detection and data mining. The system [2] included a flexible framework which had three phases. The first phase comprises of historical data that has both common

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False data detection and dynamic selection of aggregator nodes with pair-wise key establishment in homogeneous wireless sensor networks

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Abstract: Compromised sensor nodes inject false data in wireless sensor networks which distorts data integrity and consumes battery power unnecessarily. In the existing false data detection schemes, the aggregator nodes suffer from rapid battery drain due to the computational overhead, leading to reduced network lifetime. To avoid this, the aggregator nodes must be dynamically selected from the sensor nodes in the network. This dynamic selection of aggregator nodes introduces security challenges in symmetric key exchange among the sensor nodes. In this paper, a scheme called, false data detection-dynamic selection of aggregator nodes is proposed to address these issues. This scheme discards the false data injected into the network and also prolongs the network lifetime by the dynamic selection of aggregator nodes. The problem of symmetric key exchange arising due to the dynamic selection of aggregator nodes is resolved by the proposed Chebyshev polynomial-based pair-wise key establishment which has lesser computational overhead and offers better security strength. Simulation results indicate that the scheme eliminates false data injected by multiple compromised nodes and also offers higher network lifetime in homogeneous wireless sensor networks.

Keywords: aggregator node selection; Chebyshev polynomial; false data detection; network lifetime; pair-wise key establishment; homogeneous wireless sensor networks.

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AUTOMATIC NODEMCU BASED WASTE SEGREGATION

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Abstract- The ever growing human population is imposing a strong demand and pressure on the environment for sustenance. This growth spurt has resulted in a steady increase in the amount of waste being disposed on a daily basis. In most of the developing countries, segregation and timely collection of waste is a major challenge. Due to inefficient waste segregation, a large amount of recyclable content go as waste.The waste, if not separated properly, gets mixed up and may eventually leak, resulting in toxicity and may contaminate the groundwater table through poisonous methane gas. In this paper, we present a SmartBin, a bin that is able to segregate waste at source with no human intervention and can automatically alert the waste collection center. The system segregates the medical wastage as metal, dry and wet based on the sensors . The system is used in recycling garbage. The waste is moved on the conveyor belt which moves it to the smart bin. The status and capacity of this SmartBin can be monitored by the municipal worker over their mobile phone, connected using a NODE-MCU Microcontroller.

I. Introduction

A notable inflation in municipal solid waste generation has been registered worldwide. This increase can be attributed to overpopulation, industrialization, urbanization and economic growth, which have caused a significant and noticeable effect on the total solid waste that is generated. Overflowing landfills are impossible to reclaim because of the unruly accumulation of wastes on the outskirts of the cities over the years. The separator will change the direction of medical garbage handling, which is but one part of the hardware module which is available in conveyor set up. The conveyor control, sensing operations, diversion control and other operations will be controlled by the NODE-MCU controller.

This controller drives the conveyor belt. This is the controller module which controls the output devices with the help of input devices such as the sensors, and a developed program. Now-a-days, industrial processes are monitored in an RTU unit. Thus, when Medical waste is being disposed, it requires the presence of an individual to monitor any decision-rule conflicts manually. If any error occurs in this process, it could lead to fatalities, so we need human involvement in today's existing system.

II. Drawbacks of Existing System

The most prominently used system of waste segregation today is manual segregation, which leaves a wide margin for human error. These errors can be fatal if the wastes are chemical or biomedical in nature.

The existing automated methods of segregation only separate wastes based on moisture, which can lead to metals being categorized erroneously. Systems that do incorporate metal detection fail to monitor the moisture levels of wastes. The greatest disadvantage of existing methods is the lack of isolation of human effort. There is no automated monitoring or alert system to track the bin capacities remotely.

III. Proposed Method

As discussed in the previous section, human effort is needed for analyzing the medical garbage and segregating it, which is very tedious. This drawback can be overcomed by our proposed system: an automated device which can be used for easily dividing and analyzing the medical garbage by the use of sensors and a NODE-MCU controller.

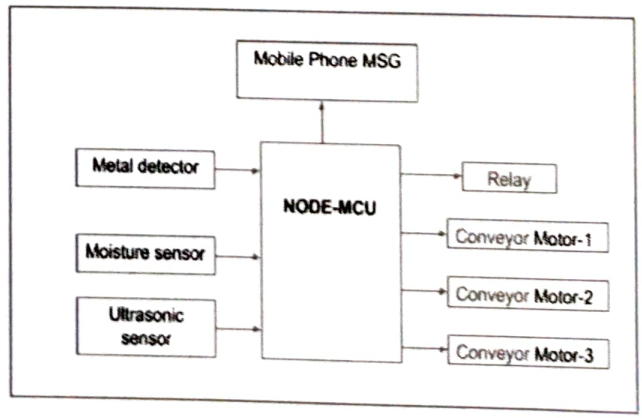

fig.1. Block diagram of NODEMCU

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