ISSN 2394 - 9554

International Journal of Research in Science and Technology

Volume 2, Issue 2 (I) : April - June 2015

Indian Academicians and Researchers Association
www.iaraedu.com

International Journal of Research in Science and Technology

Volume 2, Issue 2 (I): April - June 2015

International Journal of Research in Science and Technology
Volume 2, Issue 2 (I): April – June 2015

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Research Papers

International Journal of Research in Science and Technology
Volume 2, Issue 2 (I) : April - June , 2015
ISSN 2394 - 9554

BEHAVIOR OF FOUNDATIONS RESTING ON A SLOPE UNDER STATIC LOADS

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ABSTRACT

Many structures in the hilly regions are placed on slopes, although calculation of bearing capacity on hill slopes is not well defined. The present study includes determination of bearing load of foundations resting on slopes subjected to static loads through model studies in the laboratory. The model study was conducted in a test tank of size 1.5 m length, 0.6 m width and 0.9 m height. Locally available sand in dry state was used to prepare the slope. A control-volume compaction technique was used to attain the unit weight of 15.17 kN/m^3 so that a relative density of 50% is achieved. A slope angle of 30^0 was maintained. A square plate of size 10 cm was used as the model footing. Under static loading three tests were performed, one with the footing resting on the slope and the other with the footing resting on the level surface at a distance of 0.5B, 1B, 2B, 2.5B, 3B from the edge of the slope and another on the flat ground over a horizontal surface, where B = width of the footing = 10 cm. The load settlement behavior was observed and the ultimate bearing load was calculated. The results show that both the load settlement behavior and ultimate bearing load are increased if the edge distance is increased. It also shows that after a distance of approximately 2B from the edge of footing the load settlement behavior was almost equal with footing resting on horizontal surface over flat surface. The failure surfaces were observed which are circular in nature.

Keywords: Slope, Footing, Load-settlement, ultimate bearing capacity, failure surfaces.

INTRODUCTION

Geotechnical and foundation engineers must deal routinely with slopes in their work. This is so because foundation works are so often carried out in sloping ground and also because excavations or fills may create slopes where none previously exited. In addition, there is a range of applications not directly related to foundations of which slopes are integral part. In this chapter, we are concerned with soil slopes.

Studies were conducted on flat-surfaced floors, foundation bearing capacity, and settlement behaviors based on improvement from using geogrid reinforcement (Binquet and Lee, 1975a; Akinmusuru and Akinbolade, 1981; Fragaszy and Lawton, 1984; Guido et al., 1985; Huang and Tatsuoka, 1990; Mandal and Sah, 1992; Dixit and Mandal, 1993; Khing et al., 1993; Yetimoğlu et al., 1994; Adams and Collin, 1997; Laman and Yildiz, 2003; Kumar and Saran, 2003; Michalowski, 2004; Kumar and Walia, 2006). However, in certain cases, foundations are constructed on or near slopes (bridge piers, utility poles, and buildings). In such cases, non-transportation capacity of the inclined surface decreases significantly.

In cases where the foundation is built on a slope, one of the solutions to increase bearing capacity is to place the foundation at a sufficient distance away from the top of the slope, which reduces the impact of transportation capacity. An alternative method is using transportation to increase geogrid reinforcement capacity. However, using transportation is not economical. A limited number of studies on strip foundation have been conducted. Selvedurai and Gnanendran (1989) and Lee and Manjunath (2000) used a single reinforcement layer and examined the effects of a strip foundation on the bearing capacity. Huang et al. (1994) started a research using geotextile reinforcement and it explained about failure mechanism on sand slope. Yoo (2001) and Laman et al. (2007) used a multi-layer case in their experimental studies. Bathurst et al. (2003) conducted a large-scale experiment to examine the failure mechanism. El Sawwaf (2007) investigated clay on the parameters of tapered equipment for sand filling. Previous analyses and experiments that mostly focused on single angle of slope, stability, and uniform basic width used geogrid reinforcement.

Moghaddas and Khalaj (2008) conducted an experimental study on the benefits of geogrids to the deformation of small-diameter pipes and settlement of the soil surface when subjected to repeated loads that simulate vehicle loading. According to the report, using geogrid reinforcement can significantly reduce the vertical diameter change of pipes and the soil surface settlement. El Sawwaf and Nazir (2010) conducted a laboratory study on the effects of geosynthetic reinforcement on the cumulative settlement of repeatedly loaded rectangular model footings placed on reinforced sand. Repeated load tests were performed with different initial monotonic load levels to simulate structures. Live loads, such as petroleum tanks and ship-repair tracks, changed slowly and repeatedly.

Moghaddas and Dawson (2010) and El Sawwaf and Nazir (2012) studied repeated loads and cyclic loads, respectively, on model strip footings. A series of experiments were conducted to investigate the behavior of strip footings supported on three-dimensional and planar geotextile-reinforced sand beds subjected to repeated loads. The aforementioned researchers determined the effects of partial replacement of compacted sand layer and the inclusion of geosynthetic reinforcement. They found that the efficiency of sand-geogrid systems was dependent on cyclic load properties and on the location of the footing relative to the slope crest.

In the present study, unreinforced circular foundation bearing capacity, and settlement behavior of place on sandy slopes were investigated through laboratory model tests. In the unreinforced case, we studied the distance from the top of the foundation slope and the degree of stabilizing behavior of bearing capacity.

SCOPE AND OBJECTIVE OF THE PRESENT STUDY

A model study was conducted in a test tank of size 1.5 m length, 0.6 m width and 0.9 m height. Locally available sand in dry state was used to prepare the slope. A control-volume compaction technique was used to attain the unit weight of 15.17 kN/m^3 so that a relative density of 50% is achieved. Plate load test were conducted to observe the load settlement behavior of footing. A circular footing of 10 cm diameter was used in the study. Load is applied by hydraulic jack through proving ring and settlement were measured through dial gauge. Load settlement behavior of footing was observed. Ultimate bearing load was calculated by double tangent method. This paper presents the details and result of the experimental study and also the conclusions.

LABORATORY MODEL TESTS

Model Box and Footing

The experimental work aimed to study the effects edge distance of footing on sand slope on the bearing capacity of a circular footing and calculation of bearing capacity of footing. The model study was conducted in a test tank of size 1.5 m length, 0.6 m width and 0.9 m height. A circular footing of width 10cm was used in the study. The loading system consists of a hand-operated hydraulic jack and pre-calibrated load ring. Settlement of the footing was measured by using two mechanical dial gauges with least count of 0.01 mm.

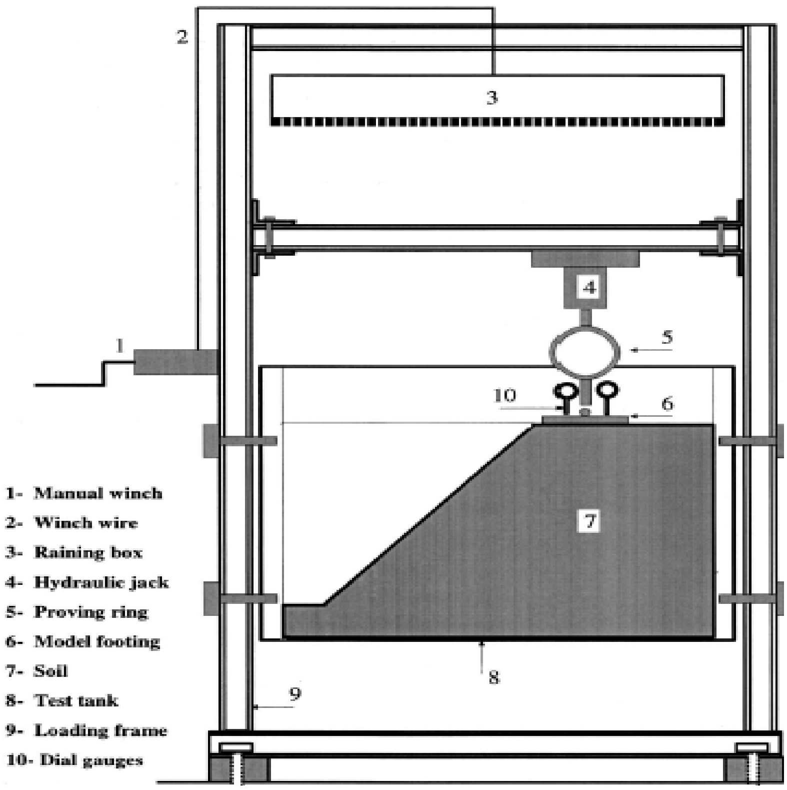


Fig. 1: Schematic view of the experimental apparatus

SPECIMEN PREPARATION AND MATERIAL PROPERTIES

The soil used in this study is uniform medium sand and is classified as poorly graded sand (SP) according to the Indian Standard Soil Classification System. The soil specimen was compacted into the model box using the controlled-volume method and with a unit weight of 15.17 kN/m3. The slope surface was compacted by a modeling tool to keep the slope angle at the designated value. The final slope specimen is shown in Fig. 2 with a length of 1.5m, a height of 0.8 m, a width of 0.6 m, a slope angle of 30°. The details of the material properties are given on Table 1.

Table -1

Property	Notation	Value
Soil classification	SP	
Specific gravity	G	2.65
Uniform Coefficient	C_u	1.64
Grain size (mm)	D_{50}	0.26
Maximum void ratio	e_{max}	0.88
Minimum void ratio	e_{min}	0.55
Strength parameter	C **Φ** Yd R.D	0.1454kg/sq.cm 30.0° 15.17 KN/m3 50 %

Fig 2: A schematic view of slope

RESULTS AND DISCUSSION

A total of 7 model tests were carried out. For the entire model slope angle is kept at 30^0 and relative density of 50%.The effect of edge distance from crest of the slope on the ultimate load and displacement were obtained and discussed.

EFFECT OF EDGE DISTANCE FROM CREST OF SLOPE

The footing was placed at the edge distance of 0.5B, 1B, 2B, 2.5B, 3B (where B=width of the footing) .The load –settlement behavior is increased as the edge distance is more from the crest of the slope. The comparison of load-settlement behavior was given on figure 3. The ultimate load bearing capacity is also increased as the edge distance is more. At 3B the ultimate bearing capacity is more that is 112 kg.

Table - 2

Position of footing	Ultimate bearing load(kg)	Settlement(mm)
Slope	23	1.01
0.5B	42	2.0
1B	68	8.0
2B	108	5.0
2.5B	110	5.26
3B	112	5.32
Flat	113	5.18

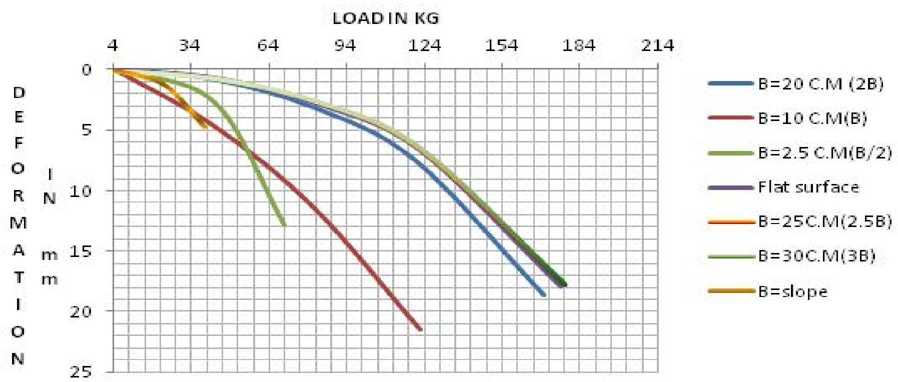
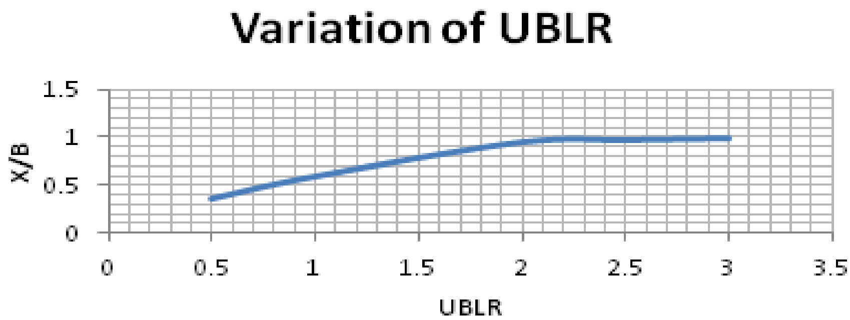


Fig 3: Comparison of Load settlement behavior

EFFECT OF UBLR FROM THE EDGE OF SLOPE

Ultimate bearing load ratio was taken to show the variation of footing bearing load ratio from the edge of slope as a non dimensional factor. The non dimensional factor is defined as the ratio between the bearing loads of the footing on the slope ground to the bearing load of the footing on the flat surface. The results show that as edge distance increase the UBLR increases. The increment of UBLR to the edge distance is mentioned on table 3. The variation of UBLR with X/B is given in Figure 4.

X/B	UBLR
0.5	0.70
1.0	0.60
2.0	0.95
2.5	0.97
3.0	0.99



CONCLUSIONS

This paper includes a model study of footing resting on slopes. Footing is placed at different edge distance from the edge of slopes. Also footing is placed on the slope itself as well as on the flat ground. Based on the results of this experimental study following conclusions can be drawn;

1. The ultimate bearing load is increased if the footing is placed away from the edge of the slope.
2. The farthest most footing is more load bearing capacity than the footing placed on the edge of the slopes.
3. After a distance of 2B (where B=width of footing) the load bearing capacity is almost equal to the load bearing capacity of a footing placed on the flat surface.
4. All the failures surface observed during failures were circular.

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ISSN 2394 - 9554

BEHAVIOUR OF GEOSYNTHETIC REINFORCED STONE COLUMN

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ABSTRACT

Stone columns are being used to improve the bearing capacity and reduce the settlement of a weak or soft soil. The improvement can be enhanced by encapsulating the column with tensile resistant materials. The improvement depends on the confinement offered by the surrounding soil, the reinforcing material and the granular column material. The benefit of using stone columns in low strength soil has been proved to be an efficient method to improve the load-carrying capacity of shallow footings. The bearing capacity of a stone column mainly depends on circumferential confinement provided by the surrounding soil. Circumferential confinement is normally achieved by using a casing. In this study, the confinement is tried to achieve through placement of horizontal layers of geo-textiles placed at different depths. Laboratory model tests were performed on stone columns of diameter 50 mm and length 500mm, i.e. ten times the diameter. Since lateral bulging occurs up to a depth of 1.5 to 2 times of the diameter of a stone column, hence, horizontal layers of geo-textiles were provided up to a depth of 15 cm. The depths of placement of geo-textiles were kept as 0.0cm, 1.5 cm, 3.0 cm, 5.0 cm 10 cm and 15 cm from the base of the footing. Tests were also performed on un-reinforced stone columns for comparison study.

Keywords: Stone column, bulging, geotextile, reinforcing element.

1.0 INTRODUCTION

The increasing infrastructure growth in urban and metropolitan areas has resulted in a dramatic rise in land prices and lack of suitable sites for development. These factors have forced the building industry to look for cheaper land for construction. As a result, construction is now carried out on sites which, due to poor ground conditions, would not previously have been considered economic to develop. These types of land include low-lying areas of marine and estuarine Quaternary deposits which are characterized by very poor geotechnical properties due to their low strength. In India, the use of stone column began in the early 1970s- Origin Germany (1950s) .Various ground improvement techniques have been employed in order to artificially improve the soil properties in these sites. One of the techniques extensively used in soft soils is vibro-replacement, which consists of replacing some of the soft soil with crushed rock or gravel to form an array of stone columns beneath the foundation .Stone columns have been used as a ground improvement technique for a wide range of projects. Potential functions of the stone columns are increase in bearing capacity, reduction in total settlement, and reduction in post-construction settlement (by performing the function of vertical drains). Stone columns may be used to support a column load in a manner similar to piles, i.e. the external load is applied to the top of a stone column but not to the surrounding soft soil. Alternatively, a large number of stone columns can be used to strengthen a weak soil stratum for supporting a fill embankment. In such an application, the stone columns function in a manner similar to soil reinforcement.

Majid Khabbazian, Victor N. Kaliakin, Christopher L. Meehan performed quasilinear elastic constitutive models in simulation of geosynthetic encased columns. Past numerical simulations of geosynthetic encased columns (GECs) using different versions of the quasilinear elastic hyperbolic model for the encased granular material have, in certain cases, yielded unrealistic results. In this paper the cause of such results is investigated by performing three-dimensional finite element analyses of GECs in soft clay, utilizing three common functional forms of the hyperbolic model for the encased granular material. Results indicate that one form of the hyperbolic model can predict an unrealistic lateral response for GECs during application of load to the column [1].

Cho-Sen Wu, Yung-Shan Hong have performed the laboratory tests on geosynthetic-encapsulated sand columns. In this study, the extent of improvement for a sand column subjected to constant confining pressures is studied through laboratory experiments. A series of triaxial compression tests were carried out in laboratory to investigate the response of sand columns encapsulated by geotextiles. The tests consisted of triaxial compression tests on sand columns with two different densities and encapsulated by sleeves fabricated from three different geotextiles. Three types of geotextile were sewed into sleeves to encapsulate sand specimens with two relative densities. For triaxial compression tests on reinforced specimens, the deviatoric stress and volumetric strain were measured and used to evaluate the inspired confining pressure, radial strain and volumetric strain reductions. The cohesion and friction angle corresponding to different strains were evaluated and referred as mobilized pseudo-cohesion cm and mobilized friction angle fm. The laboratory experimental results revealed:

Joel Gniel, Abdelmalek Bouazza have Improved the soft soils using geogrid encased stone columns. This paper discusses the results of a series of small-scale model column tests that were undertaken to investigate the behavior of geogrid encased columns. The tests focused on studying the effect of varying the length of encasement and investigating whether a column that was partially encased with geogrid would behave similarly to a fully-encased column. In addition, isolated column behaviour was compared to group column behaviour. The results of partially encased column tests indicated a steady reduction in vertical strain with increasing encased length for both isolated columns and group columns. Bulging of the column was observed to occur directly beneath the base of the encasement.

Joel Gniel, Abdelmalek Bouazza have performed the test on construction of geogrid encased stone columns: A new proposal based on laboratory testing. To construct geogrid encasement, the geogrid is typically rolled into a sleeve and welded using a specialized welding frame. However, the process is unlikely to be economical for site construction and therefore an alternative method of encasement construction was investigated in this paper. The technique comprises overlapping the geogrid encasement by a nominal amount and relying on interlock between the stone aggregate and section of overlap to provide a level of fixity similar to welding. A series of small-scale tests were initially used to investigate the technique, followed by medium-scale compression tests using different geogrids and typical stone column aggregates. The results of testing indicate that the ‘‘method of overlap’’ provides a simple and effective method of encasement construction, providing a level of fixity similar to welding. The research presented in this paper was used to investigate an efficient and effective method of geogrid encasement construction for use with stone column ground improvement. Small-scale and medium-scale tests were undertaken.

Yipping Zhang, Dave Chan, Yang Wang a have performed a test on Consolidation of composite foundation improved by geosynthetic-encased stone columns. The elastic volumetric strains of the column and the surrounding soil previously obtained by the authors are adopted, and both the horizontal and vertical flows within the column and the soil are considered in this solution. The solution for calculating the consolidation of the type-column composite foundation without geosynthetics is obtained by degenerating the present solution to this special case and compared it with existing solutions. The comparisons show that, as underestimating the volumetric strains of the column and the surrounding soil, the average degree of consolidation calculated by the previous studies are greater than the present model and the differences are noted. Finally, the influence of geosynthetics on the consolidation of composite foundation is analyzed. The results show that the geosynthetics encasement has negligible effect on accelerating the consolidation of the composite foundation in the elastic phase[5].

Mahmoud Ghazavi, Javad Nazari Afshar have performed the test on bearing capacity of geosynthetic encased stone columns. In this paper, some large body laboratory tests were performed on stone columns with diameters of 60, 80, and 100 mm and a length to diameter of 5. Both unreinforced and encased geotextile reinforced stone columns were tested. Vertical encased stone column (VESC) have been considered to investigate the effect of reinforcement on the footing load-carrying characteristics. The main objective of this research is to compare the effectiveness of vertical encapsulating of stone columns in the same conditions for various stone column diameters. In addition, tests on groups of stone columns with 60 mm diameter were carried out to investigate the effect of presence of neighboring columns on the reference loaded stone column. Results show that the stone column bearing capacity increases by using vertical reinforcing material. The test resulted that in all OSC’s and VESC’s, there exists an increase in the ultimate load-carrying capacity of the soft soil. In addition, the ultimate capacities of columns (OSC’s and VESC’s) increase with increasing the stone column diameter. Moreover, geosynthetic material used for vertical encasement increases the stone column ultimate capacities[6].

2.0 OBJECTIVES AND SCOPES

2.1 Objective

- To increase the bearing capacity.
- To reduce the settlement.
- To increase the effectiveness.
- To observe the bulging failure in both the cases.

2.2 Scope
To overcome the drawbacks

- Cost effect.
- Skilled worker.
- Already many researchers have used geosynthetic material as a reinforcement by wrapping the stone column , the experiment is proceed.

Because in this study,

- Geosynthetic material is required in layers.
- Cost is reduced.
- The procedure is simple.
- A totally new research will be performed.

In this study, one clay bed test, two single column test and two group column tests are performed. The diameter of the stone column is taken as 50mm and height of the stone column is taken as 500 mm. In group column test triangular pattern is considered. The center to center spacing between the columns is taken as 3 times of the column diameter i.e. 150mm.In this study, since bulging failure occurs up to depth 1.5D to 2D from the top of the column. Hence, only the top portion of the stone column needs more lateral confinement in order to reduce the bulging, hence, horizontal layers of geo-textiles were provided up to a depth of 15 cm. The depths of placement of geo-textiles were kept as 0.0cm, 1.5 cm, 3.0 cm, 5.0 cm 10 cm and 15 cm from the base of the footing. In all cases stone columns are placed at the center of the clay bed and load test will be performed and bearing capacity and settlement values are found out and the test results are compared .During the tests water content of the clay bed is kept constant.

3.1EXPERIMENTAL INVESTIGATION

3.11Properties of materials
Properties of clay:

Parameters Value
Specific gravity 2.43
Bulk unit weight 1.72gm/cc
Liquid limit63.5%
Plastic limit35.07%
Unified system classification CH

Properties of stone:
Stone size=2-6mm
C=0
Angle of internal friction=37.27^0.

Clay and crushed stone materials were used for current experimental investigations. The properties of the clay are listed above .To determine the various moisture contents corresponding to undrained shear strengths of the clay, a series of unconfined compressive strength (UCS) tests were carried out on cylindrical specimen with 38 mm diameter and 76 mm height .Water content of the clay is 40% and this amount was kept the same in all tests. Crushed stone aggregates with particle sizes ranging 2to6 mm were used as stone column material and their properties are shown above.

3.2 Experimental setup and test program
A test setup is designed for the current research work. This setup consists of a large test box with plan dimensions of 1m*1m*1m.for preparation of clay bed, water content is taken as 40% corresponding to 21.582kpa. The clay bed thicknesses of 900 mm are used to counteract the effect of stone column with bottom of the tank.

3.3 Preparation of clay bed
Clay bed was prepared in a large test box with plan dimension of 1m*1m.The clay bed thickness is taken as 90mm. The clay bed is prepared in layers each of which is 50 mm thick. To prepare the clay bed at a moisture content of 40% corresponding to 21.582 kPa undrained shear strength, initially natural water content of the clay was determined and the amount of additional water content was added to the clay to achieve 40% water content in a large plastic box. The surface of the box was sealed with a nylon sheet for five days to achieve uniform water content within the clayey soil mass. The inner face walls of the test box are coated by a thin layer of

ISSN 2394 - 9554

grease to reduce the friction between the clay and tank wall for each layer. The clay was placed in the tank with measured weight to reach a certain bulk unit weight of 1.72gm/cc.

3.4 Construction of reinforced and unreinforced stone column

In the current test, stone columns diameter is of 50 mm constructed by the replacement method. The column is constructed at center of large test box. The plan dimension of tank is selected such that results of test will not be affected by boundaries of the tank. Thin walled, open-ended seamless steel pipe with outer diameters of 50 mm and wall thickness of 2 mm were used for stone column construction. For the tests, both inner and outer surfaces of the steel pipes are coated by thin layer of oil to ease penetration and withdrawal without any significant disturbance to the surrounding soil. The steel pipe is then pushed into the clay to reach the bottom. The steel pipe is then pulled out slowly after removing clay within the pipe. Therefore, care was taken to prevent disturbance between the pipe and skin of the hole. To construct the stone column, the free drop height was 100 mm with 15 blows. This light compaction effort was chosen such that no significant lateral bulging occurred during column construction or disturbance of the surrounding soft clay. Granular materials of stone columns sustain higher stress than the clay bed. This may lead to the breakage of stone granular materials under loading. For solving this problem, high quality of granular material was selected so that breakage of the stone column material could not occur under high stress level due to the column loading and light stress induced due to compaction. Enough amount of stone column material was prepared to keep uniformity in tests and new stone column material used in each new test, not the material used for the previous tests. A visual control always made on the column material to ensure that no breakage occurred upon the column loading or compaction loading.

3.5 Test procedure

The test procedure involves application of the load and determination of load-displacement behavior of the clay treated with stone columns. For the single column tests, the diameter of the plate is taken as 10 cm and thickness is 10 mm and for the group column test, diameter is 40 cm and thickness is 1.5 cm.

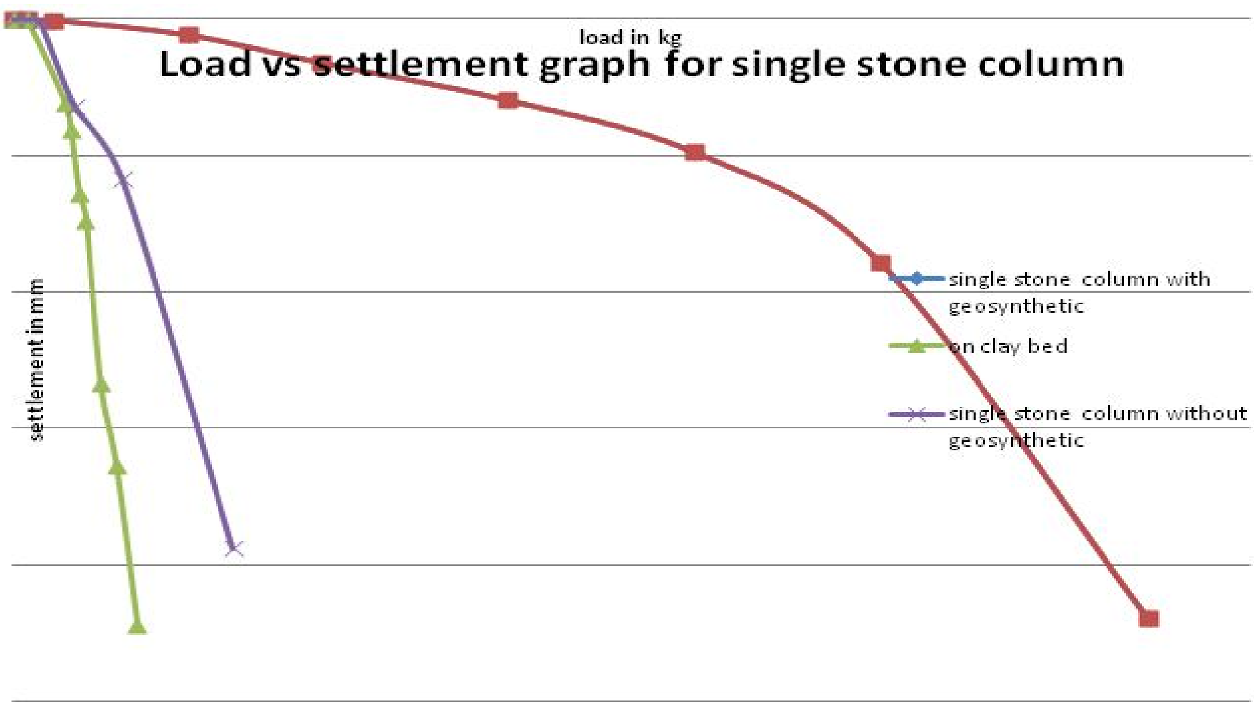
4.0 RESULTS AND DISCUSSION

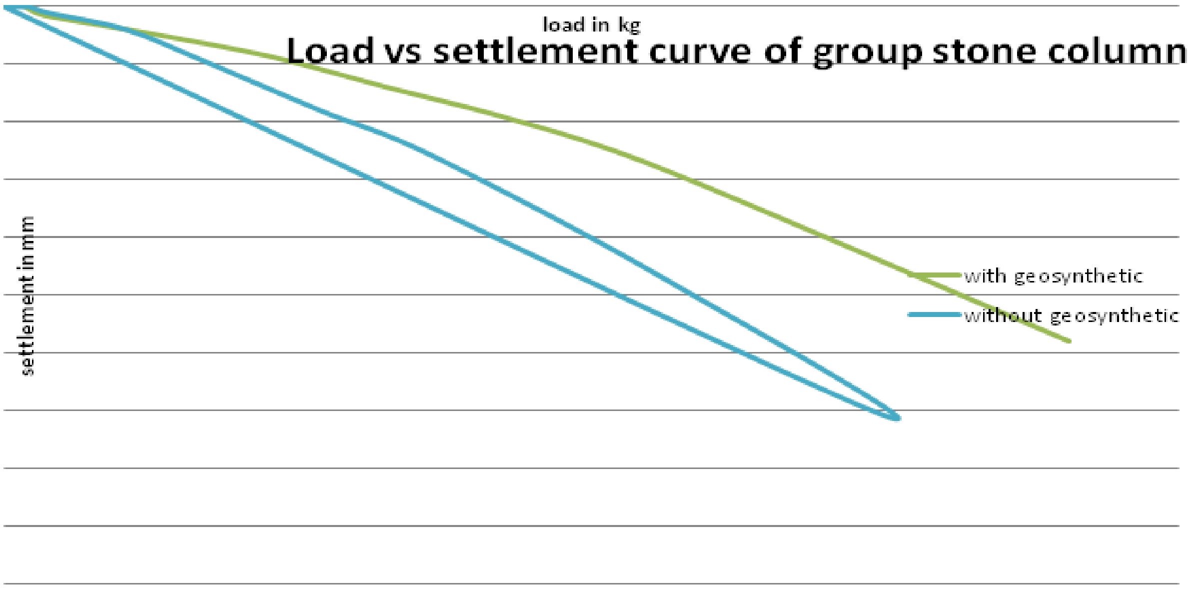
4.1 Deformation and failure mode

After completion of some tests, the deformed shape of the columns are observed. In the single column test, it is observed that the bulging failure mode governed. The bulging failure occurred at a depth of 1.5D to 2D from the stone column head in single stone column test. Since the maximum bulging of stone column under loading usually occurs up to a depth of 1.5to2 times the diameter of stone column from the top of the column. Hence, only the top portion of the stone column needs more lateral confinement in order to reduce the bulging.

4.2 Load-settlement behavior

The load settlement behavior of single column test is shown in fig below.





CONCLUSION

In this investigation, large body laboratory tests have been performed on single and group stone columns with diameters of 50 mm. VESCs with different lengths and reinforcing material were used in tests and the results were compared with those obtained from tests on OSCs. Based on results from experiments on single and group of stone columns, the following concluding remarks may be extracted:

1. Bulging failure mode governs single stone columns. The bulging failure usually occurs at a depth of D to 2D from the stone column head. The failure mode in stone column group was a combination of bulging and lateral deformation.
2. The ultimate load carried by soft soil increases by using OSCs. The ultimate load and stiffness of the treated soil can be further increase by the use of reinforcing material.
3. The lateral bulging amount decreases in reinforced stone column compared with OSCs due to additional lateral confinement provided by geosynthetic material.
4. Tests on group of stone columns have shown that the ultimate capacity of reinforced stone columns is greater than that of group of OSCs.

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International Journal of Research in Science and Technology
Volume 2, Issue 2 (I) : April - June , 2015
ISSN 2394 - 9554

BASELINE WANDER CORRECTION IN FETAL ECG SIGNAL BASED ON EMPIRICAL MODE DECOMPOSITION

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ABSTRACT
The Electrocardiogram (ECG) is usually corrupted by two artifacts: (1) High frequency artifact caused by muscle activity and (2) Low frequency artifact caused by breathing or movement. Baseline Wander (BW) is a low frequency artifact in biomedical electronic recordings. The removal of this artifact is important for reliable visual interpretation. In this paper we study a baseline wander removal method which is a combination of Empirical Mode Decomposition (EMD) and high pass FIR filter. The simulation results show that this method gives good results for baseline wander removal for correct estimation of fetal ECG signals.

Index Terms—Electrocardiogram (ECG), Baseline wander (BW), Empirical Mode Decomposition (EMD)

INTRODUCTION
THE ECG signal is a representation of the bio electrical activity of human heart. ECG signals can be obtained by placing electrodes on the surface of human body. ECG analysis is important for the diagnosis of cardiovascular disease [1]. The first demonstration of the fetal ECG carried out in 1906 by Cremer that can be found in [2]. The fetal ECG can be obtained by placing electrodes on the mother's abdomen. The fetal heart rate (FHR) normally lies between 120 and 160 bits per minutes (bpm) corresponding to a fundamental fetal ECG frequency between 2 and 2.7 Hz [3].

Generally, the recorded ECG signal is contaminated by noise and artifacts. Mainly the ECG signal is corrupted by two different types of noises: (1) low frequency noise such as baseline wander which is caused by breathing or movements and (2) High frequency noise such as electromyographic (EMG) induced noise, Power line interference is caused by muscle activity. Baseline wander lies between 0.15 and 0.3 Hz. The power line interference is centered at 60 Hz (or 50 HZ) with a bandwidth of less than 1 Hz [4-6]. It is important to separate the valid ECG signal from the corrupted ECG for ECG enhancement that allows proper visual interpretation.

In the literature, there are several method for baseline wander correction which are reported by many researchers. These techniques are Wavelet Transform [7], Adaptive filtering [8], Empirical Mode Decomposition (EMD) [9], Ensemble Empirical Mode Decomposition (EEMD) [10], Multivariate Empirical Mode Decomposition (MEMD) [11] and others.

The aim of this paper is to remove the baseline wander noise from fetal ECG signal by using a combination of EMD and High pass FIR filter. The EMD [9] was developed for nonlinear and nonstationary time scales. Like wavelet analysis, EMD decomposes a time series into a combination of intrinsic mode functions (IMFs) and residual. For the simplicity of EMD algorithm, this method has met a large success in various like biomedical engineering applications including ECG analysis [12-15]. However, EMD leads complications due to mode mixing problem. An extension of the EMD algorithm is called EEMD [10] which removes the mode mixing effect. Several IMFs carry similar information due to mode mixing problem. To solve this problem a multivariate version of the EMD (MEMD) has been successfully proposed [11].

This paper is organized as follows: Section II details the EMD algorithm, baseline wander removal by using a combination of EMD and high pass FIR filter is explained in section III. The simulation results and its comparison with published results are highlighted in section IV. Conclusions are drawn in Section V.

EMD ALGORITHM
In this section the mathematical background of the EMD algorithm is summarized.

The EMD has been firstly introduced by Huang et al. [9] for nonlinear and nonstationary time series. It decomposes a time series into a combination of intrinsic mode functions and a residual. The starting point of EMD is to estimate a signal as a sum of low frequency part and high frequency components. In EMD, IMFs are referred to high frequency components and residual is called low frequency part. The residual is considered as a new time series and the procedure is then applied again to the residual for extracting a new IMF and a new residual [16]. The process of finding the IMF is called shifting process [17]. The EMD algorithm can be described as follows:

1) Identify the maxima and minima of the data $x(t)$;
2) Generate the upper and lower envelope ($e_{up}(t), e_{low}(t)$) by connecting the maxima and minima points separately with cubic spline.
3) Compute the local mean $h(t)$, by averaging the envelope.
4) Extract the detail $r(t) = x(t) - h(t)$
   where $r(t)$ details residual information.
5) Iterate on the residual $r(t)$.

At the end of the shifting process the EMD method expresses that the original signal $x(t)$ can be reconstructed from the superposition of components (IMFs and a final residual) as:

$$x(t) = \sum_{i=1}^{n} b_i(t) + r_n(t) \qquad (1)$$

where $b_i(t)$ is the i^{th} order IMF. The last residue $r_n(t)$ is usually considered as a final residual $b_{n+1}(t)$ and equation (1) is rewritten as

$$x(t) = \sum_{i=1}^{n+1} b_i(t) \qquad (2)$$

The higher order IMFs contains fewer signal components while the lower order IMFs contains more signal components. The result of the EMD produces n IMFs and a residue signal.

ECG BW removal using EMD And HIGH PASS FILTER

BW corresponds to a low frequency of the signal, however it can be considered in higher order IMFs. Higher order IMFs contain major BW components and fewer ECG signal components while lower order IMFs contain fewer BW components and more ECG signal components. The residual which can also regard as the last IMF, may not correspond to baseline wander because BW may have multiple extrema and zero crossing which effect the residual definition [18].

BW is estimated here via a "multiband filtering" approach. The estimated BW is then subtracted from the original signal. A bank of high pass FIR filters is applied to the last IMFs. The BW is estimated by the sum of the outputs of this filter bank.

By performing the EMD on data $x(t)$, we obtain all the IMFs, which taken from equation (2). The BW order is denoted as N; a bank of high pass FIR filters $a_i(t)$, $i = 1,2,......N$, is assigned and this filter bank is applied to the IMFs starting from the last $b_{n+1}(t)$. The outputs of the filter bank are

$$\left.\begin{array}{l} c_1(t) = a_1(t) * b_{n+1}(t), \\ c_2(t) = a_2(t) * b_n(t), \\ . \\ . \\ . \\ c_N(t) = a_N(t) * b_{n-N+2}(t) \end{array}\right\} \qquad (3)$$

where $*$ denotes the convolution. The cutoff frequency of the first low pass filter $a_1(t)$ is set to be ω_0 and the cutoff frequency of the k^{th} filter is set as

$$\omega_k = \frac{\omega_0}{M^{(k-1)/2}} \qquad (4)$$

where $M > 1$ is a frequency folding number. The above cutoff frequency gives best results. The outputs $c_i(t)$ extract the BW component in each IMF. Therefore, this output can be used to determine the BW order N. The variance of each $c_i(t)$ is determined [18] as:

$$\text{var}\{c_i(t)\} = \frac{1}{L-1}\sum_{t=0}^{L-1}\left[c_i(t) - \mu_{c_i}\right]^2 \quad (5)$$

where μ_{h_i} is mean value of the output $h_i(t)$. We choose N according to the following condition which is as follows:

$$\text{var}\{h_{N+1}(t)\} < \xi \text{ and } \text{var}\{h_N(t)\} \geq \xi \quad (6)$$

where ξ is an appropriate established threshold. The parameter ω_0, M, ξ can be selected according to the baseline wander behavior.

After the determination of BW order N, the output of all the filter are synthesized to form the estimate as

$$\hat{d}(t) = \sum_{i=1}^{N} d_i(t) \quad (7)$$

The reconstructed signal is obtained by subtracting the estimated $d(t)$ from the signal $x(t)$. Therefore, the reconstructed signal after BW removal is

$$\tilde{x}(t) = x(t) - \hat{d}(t) \quad (8)$$

SIMULATION RESULTS AND DISCUSSIONS

The experiments are performed on the database of Non Invasive Fetal ECG database [19], which has BW noise shown in figure 1. Firstly the EMD algorithm is applied on this database, and then produced 10 IMFs (in form of higher to lower order) are shown in figure 2. From figure 2 we can see that BW is located in higher order IMFs and ECG components are located from 2^{nd} to 5^{th} level IMF. A bank of high pass FIR filter is applied to the last IMFs. The cutoff frequency (ω_0) of high pass FIR filter is set to 0.08 Hz, M is set to 20 and ξ is set to 10. This criterion also fulfils its condition in equation (6). The reconstructed signal is shown in figure 3.

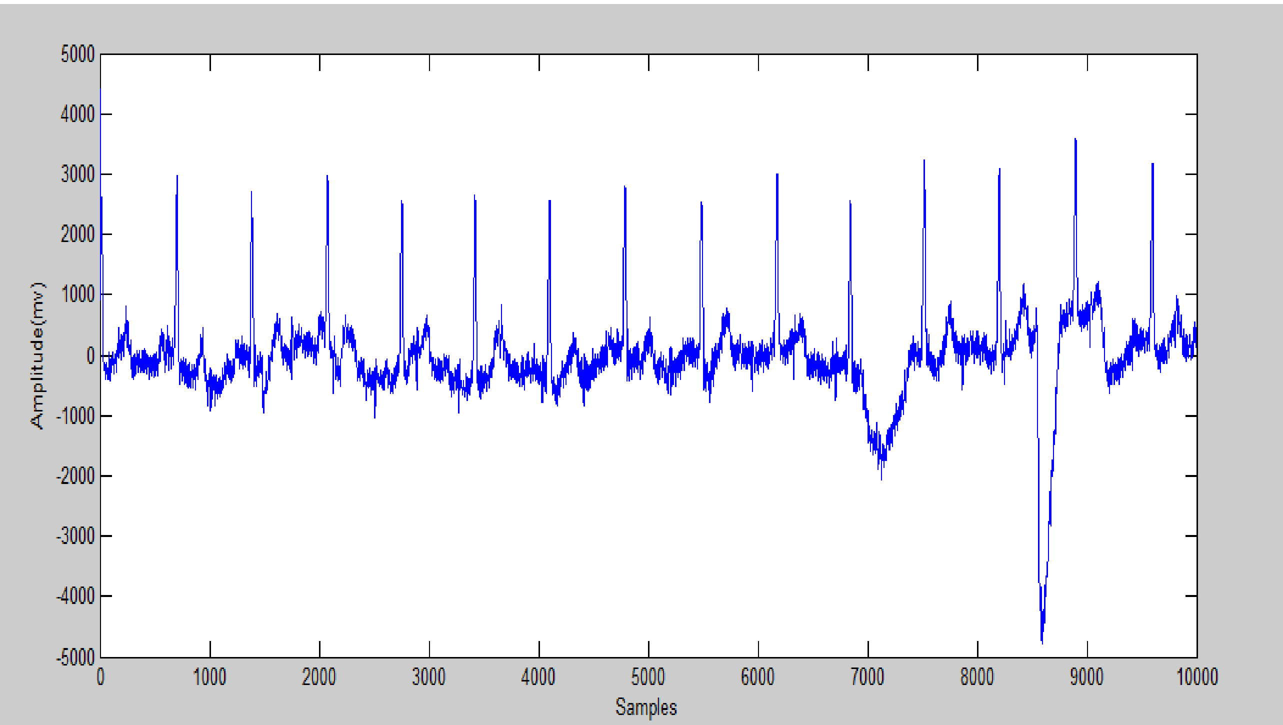

Figure 1: Non Invasive Fetal ECG database

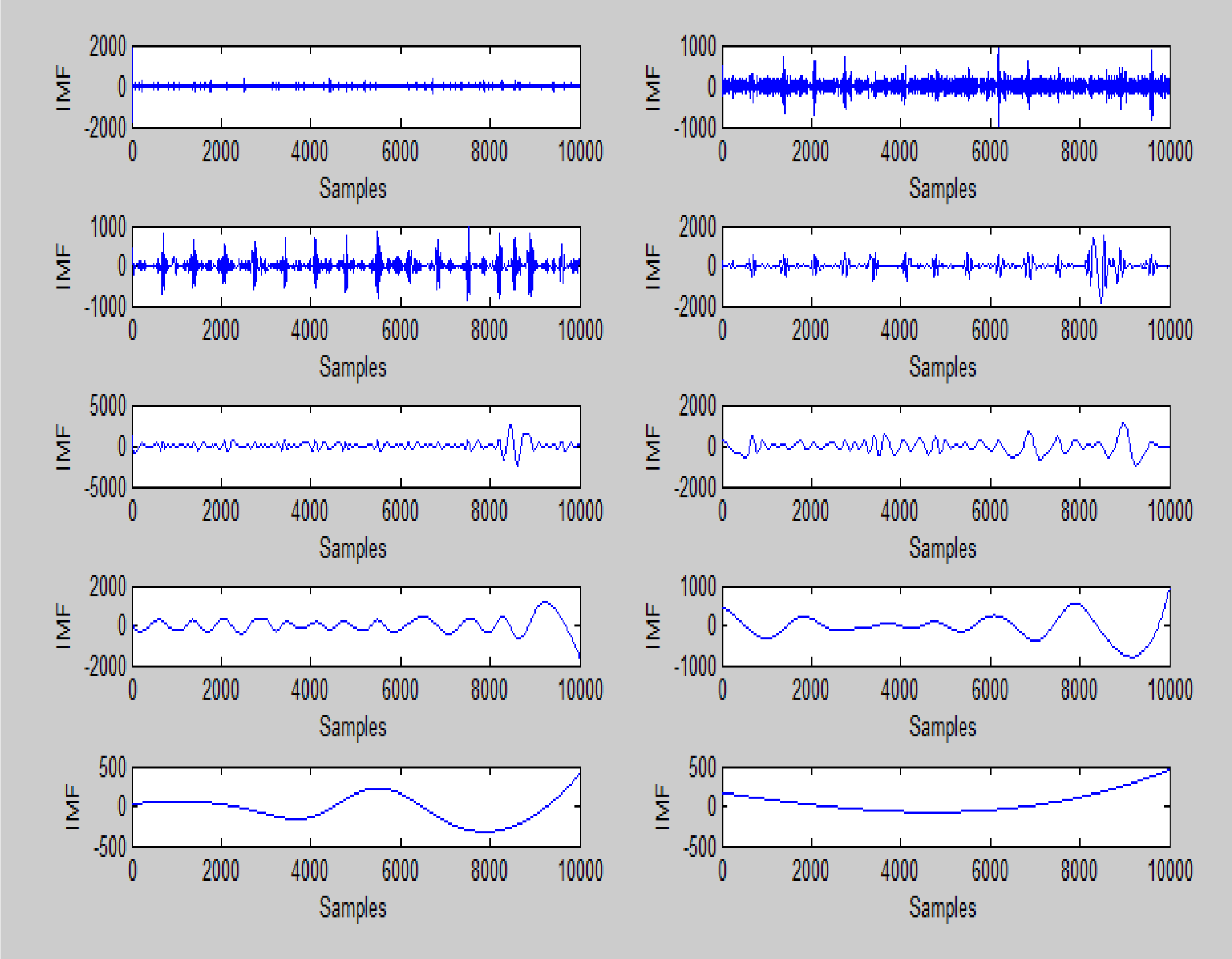

Figure 2: IMFs (1-10) obtained by EMD algorithm

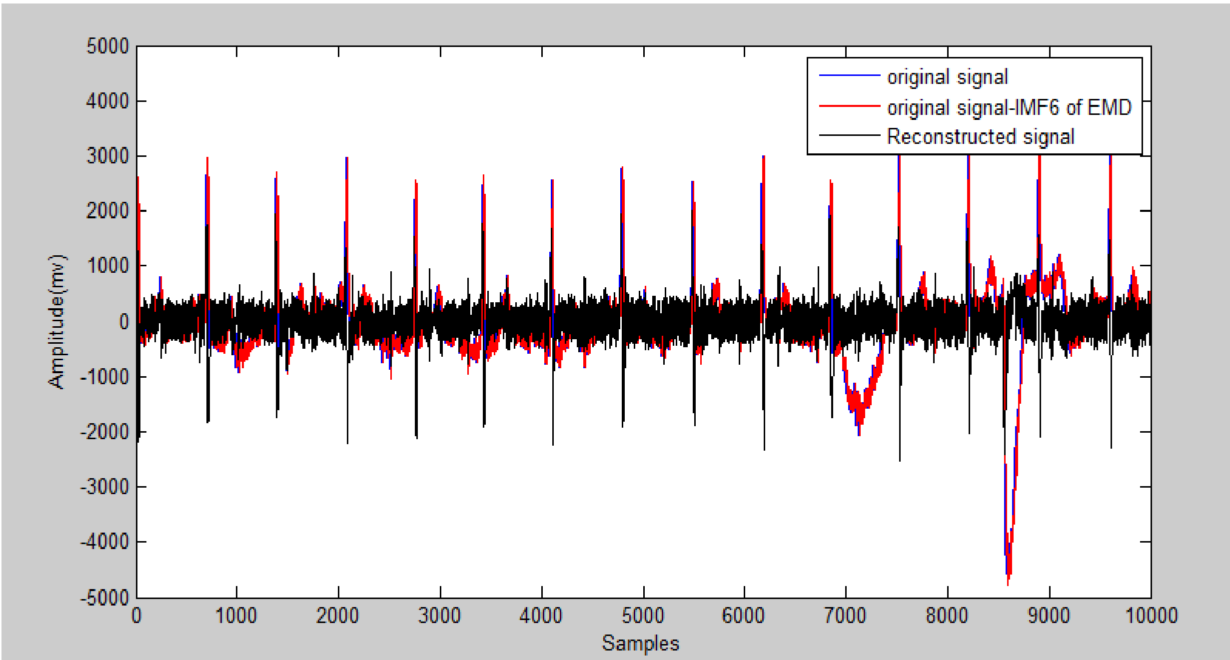

Figure 3: Reconstructed signal

CONCLUSIONS

In this paper a method of baseline wander removal by using a combination of EMD and high pass FIR filter is presented. Baseline wander removal for ECG enhancement is addressed here. Experiments show that this method gives best removal and results indicate effective enhancement tool for baseline wander removal for correct estimation of fetal ECG signals.

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International Journal of Research in Science and Technology
Volume 2, Issue 2 (I) : April - June , 2015

ISSN 2394 - 9554

A REVIEW OF NON CONCENTRATING SOLAR COLLECTOR

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ABSTRACT
In the solar-energy industry great emphasis has been placed on the development of "active" solar energy systems which involve the integration of several subsystems: solar energy collectors, heat-storage containers, heat exchangers, fluid transport and distribution systems, and control systems. The major component unique to active systems is the solar collector. This device absorbs the incoming solar radiation, converting it into heat at the absorbing surface, and transfers this heat to a fluid (usually air or water) flowing through the collector. The warmed fluid carries the heat either directly to the hot water or space conditioning equipment or to a storage subsystem from which can be drawn for use at night and on cloudy days. The objective of present study is to evaluate the performance of non concentrating solar collector and a description about their types including Flat plate collector and evacuated tube collector. Its characteristics are known, and compared with other collector types, it is the easiest and least expensive to fabricate, install, and maintain. Moreover, it is capable of using both the diffuse and the direct beam solar radiation. With very careful engineering using special surfaces, reflectors to increase the incident radiation and heat resistant materials, higher operating temperatures are feasible.

Keywords: *Solar collector; Flat plate collector; Evacuated tube collector*

I. INTRODUCTION

Solar energy can be used by three technological processes [1]: chemical, electrical and thermal (Fig. 1). Chemical process, through photosynthesis, maintains life on earth by producing food and converting CO2 to O2. Electrical process, using photovoltaic converters, provides power for spacecraft and is used in many terrestrial applications. Thermal process can be used to provide much of the thermal energy required for solar water heating and building heating. Another one form of converted solar radiation is mechanical energy as wind and water steams [2].

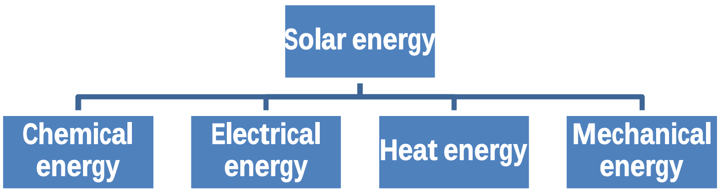

Fig. 1: Conversion of solar radiation to other energy forms

Solar collectors are key Component of active solar heating system. They gather the suns energy, Transforms its radiation into heat, then transfer that heat to a fluid usually water or air). The solar thermal energy can be used in solar water-heating system, The solar Thermal energy can be used in solar water heating system, Solar pool heaters, and solar space heating system. There are a large number of solar collector design that have shown to be functional. These design are classified in two general types of solar collector:

1) **Non concentrating collector** - The absorber surface is approximately as large as the overall collector area that intercepts the suns rays.

2) **Concentrating collector** - Large area of lenses focus the sunlight onto a smaller absorber.[3]

II. STATIONARY OR NON CONCENTRATING COLLECTOR

Solar energy collectors are basically distinguished by their motion, i.e. stationary, single axis tracking and two axes tracking, and the operating temperature. Initially, the stationary solar collectors are examined. These collectors are permanently fixed in position and do not track the sun. Three types of collectors fall in this category:

1. Flat plate collectors (FPC);
2. Stationary compound parabolic collectors (CPC);
3. Evacuated tube collectors (ETC). [4]

 ISSN 2394 - 9554

TABLE I : Stationary Solar Collector

Motion	Collector type	Absorber type flat	Indicative temperature range (K)
Stationary	Flat plate collector(FPC)	Flat	303-353
Stationary	Evacuated tube collector (ETC)	Flat	323-473
Stationary	Compound parabolic collector (CPC)	Tabular	333-573

A. Flat plate collectors (FPC)

Flat Plate Collectors Of the many solar collector concepts presently being developed, the relatively simple flat plate solar collector has found the widest application so far. Its characteristics are known, and compared with other collector types, it is the easiest and least expensive to fabricate, install, and maintain. Moreover, it is capable of using both the diffuse and the direct beam solar radiation. For residential and commercial use, flat plate collectors can produce heat at sufficiently high temperatures to heat swimming pools, domestic hot water, and buildings; they also can operate a cooling unit, particularly if the incident sunlight is increased by the use of a reflector.

Flat plate collectors easily attain temperatures of 40 to 70ºC. With very careful engineering using special surfaces, reflectors to increase the incident radiation, and heat-resistant materials, higher operating temperatures are feasible. fluid from the inlet header or duct to the outlet. Glazing, this may be one or more sheets of glass or a diathermanous (radiation transmitting) plastic film or sheet. Thermal insulation, which minimizes downward heat loss from the plate. Cover strip, to hold the other components in position and make it all Watertight. Container or Casing, which surrounds the foregoing components and keeps them free from dust, moisture, etc. [5]

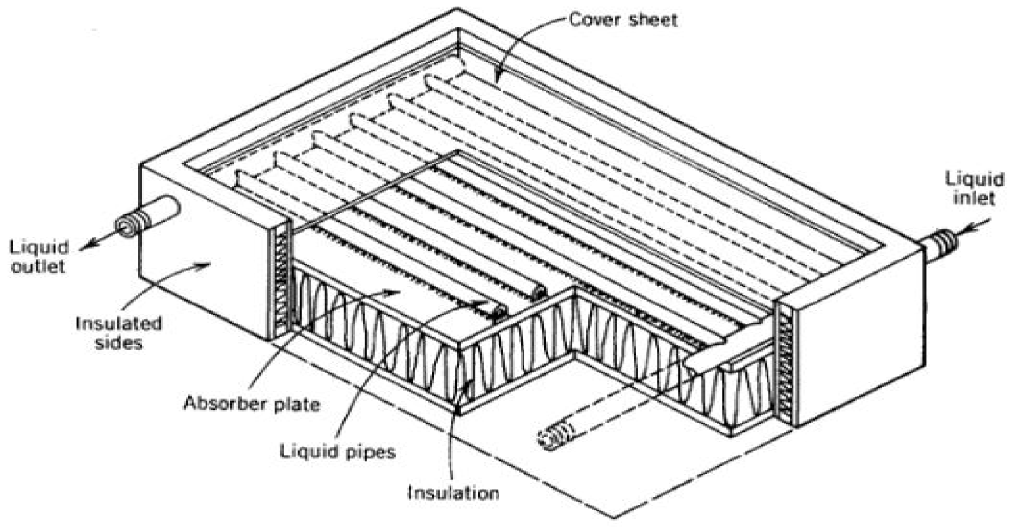

Fig: 2 A typical liquid Flat Plate Collector

The main components of a flat plate solar collector:

- Glazing: One or more sheets of glass or other diathermanous (radiation-transmitting) material.
- Tubes, fins, or passages: To conduct or direct the heat transfer fluid from the inlet to the outlet.
- Absorber plates: Flat, corrugated, or grooved plates, to which the tubes, fins, or passages are attached. The plate may be integral with the tubes.
- Headers or manifolds: To admit and discharge the fluid.
- Insulation: To minimize the heat loss from the back and sides of the collector.
- Container or casing: To surround the aforementioned components and keep them free from dust, moisture, etc.[6]

Flat plate solar collectors are classified into Water-type (hydronic) collectors, using water as the heat-transfer fluid. Air-type collectors, using air as the heat-transfer fluid.

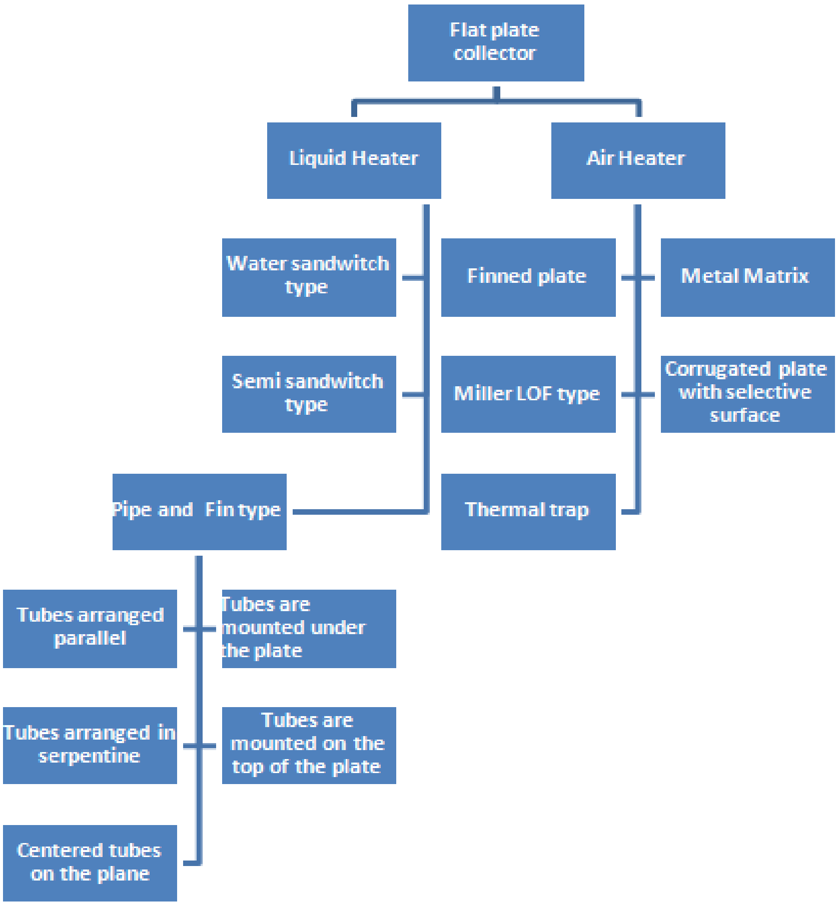

Fig.3: Classification of flat plate collector. [8]

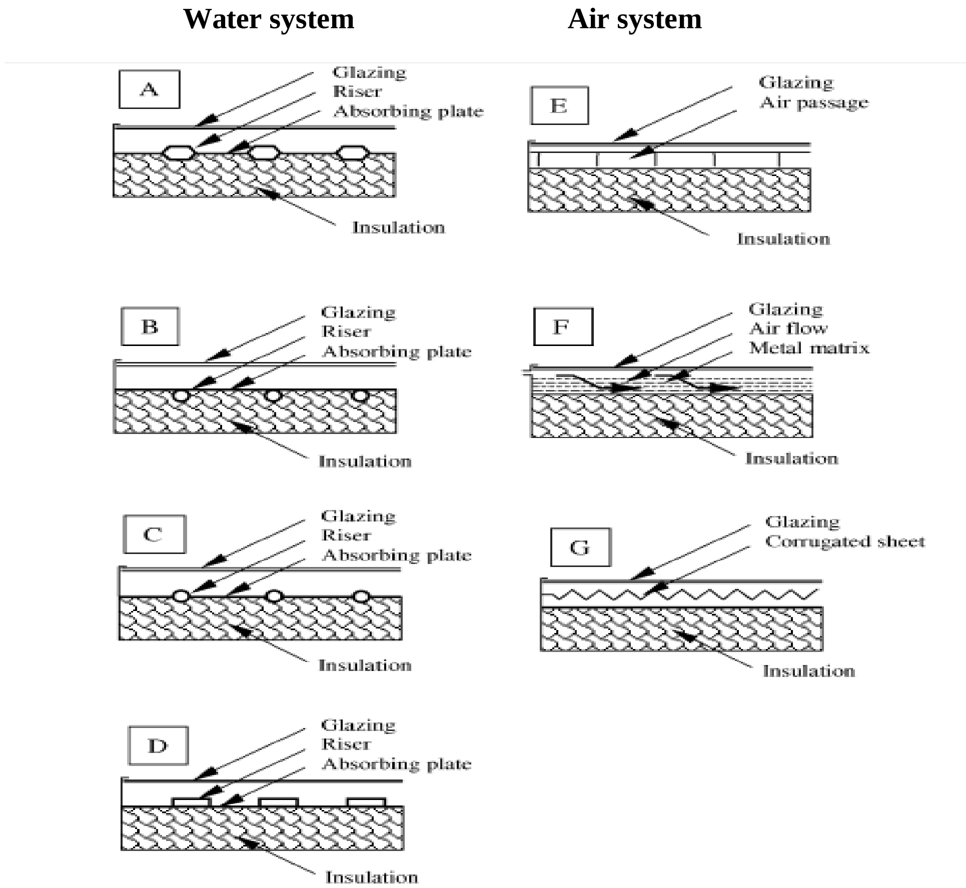

Fig: 4 Various type of Flat plate collector

ISSN 2394 - 9554

B Evacuated tube collector

Conventional simple flat-plate solar collectors were developed for use in sunny and warm climates. Their benefits however are greatly reduced when conditions become unfavourable during cold, cloudy and windy days. Furthermore, weathering influences such as condensation and moisture will cause early deterioration of internal materials resulting in reduced performance and system failure. Evacuated heat pipe solar collectors (tubes) operate differently than the other collectors available on the market. These solar collectors consist of a heat pipe inside a vacuum-sealed tube, as shown in Fig. 5. ETC have demonstrated that the combination of a selective surface and an effective convection suppressor can result in good performance at high temperatures [6].

The vacuum envelope reduces convection and conduction losses, so the collectors can operate at higher temperatures than FPC. Like FPC, they collect both direct and diffuse radiation. However, their efficiency is higher at low incidence angles. This effect tends to give ETC an advantage over FPC in day-long performance. ETC use liquid–vapour phase change materials to transfer heat at high efficiency. These collectors feature a heat pipe (a highly efficient thermal conductor) placed inside a vacuum-sealed tube. The pipe, which is a sealed copper pipe, is then attached to a black copper fin that fills the tube (absorber plate). Protruding from the top of each tube is a metal tip attached to the sealed pipe (condenser). The heat pipe contains a small amount of fluid (e.g. methanol) that undergoes an evaporating-condensing cycle. In this cycle, solar heat evaporates the liquid, and the vapour travels to the heat sink region where it condenses and releases its latent heat. The condensed fluid return back to the solar collector and the process is repeated. When these tubes are mounted, the metal tips up, into a heat exchanger (manifold) as shown in Fig. 5. Water, or glycol, flows through the manifold and picks up the heat from the tubes. The heated liquid circulates through another heat exchanger and gives off its heat to a process or to water that is stored in a solar storage tank. Because no evaporation or condensation above the phase-change temperature is possible, the heat pipe offers inherent protection from freezing and overheating. This self limiting temperature control is a unique feature of the evacuated heat pipe collector. ETC basically consist of a heat pipe inside a vacuum sealed tube. A large number of variations of the absorber shape of ETC are on the market [7].

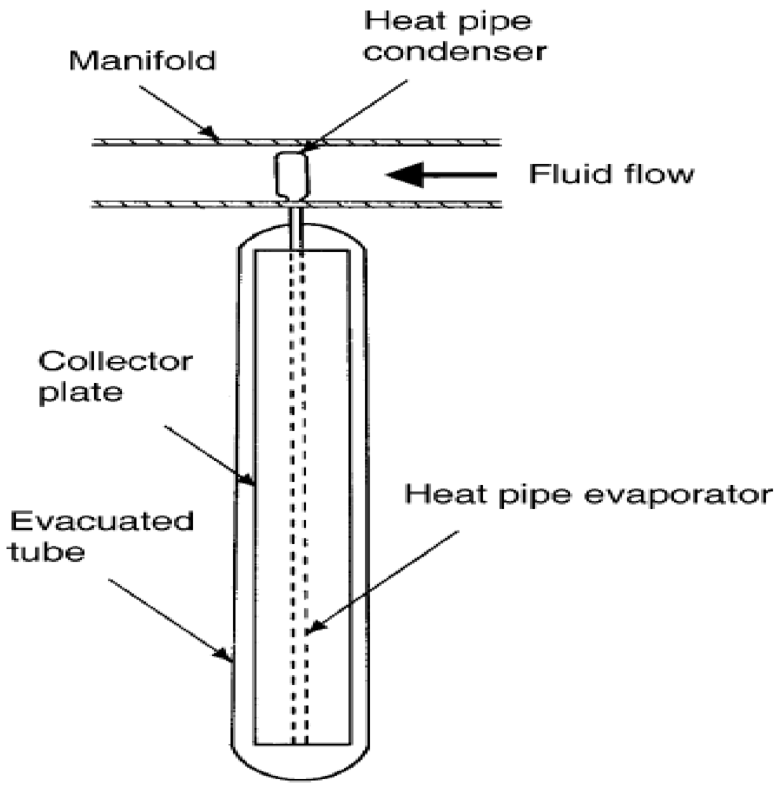

Fig. 5: Schematic diagram of an evacuated tube collector

In order to improve an efficiency of evacuated tube collector there are several types of concentrators depending on its concave radius established. Classification of evacuated solar collectors in Fig. 6 is shown. There are many possible designs of evacuated collectors, but in all of them selective coating as an absorber is used because with a nonselective absorber, radiation losses would dominate at high temperatures, and eliminating convection alone would not be very effective [9].

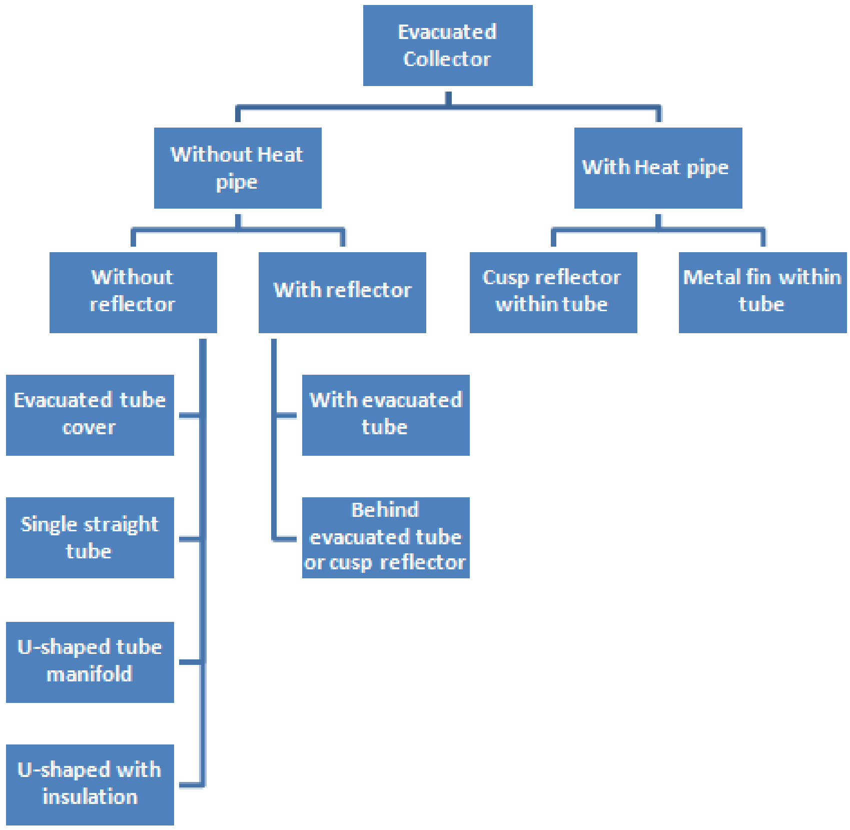

Fig. 6: Classification of evacuated solar collector [8]

III. CONCLUSION

Non concentrating solar collector are presented in this paper and performance of their type include Flat plate collector and evacuated tube collector. A precise and detailed analysis is quite complicated because of the many factors involved. They are easy to maintain, fabric and install. Sufficient temperature are available for water heating, space heating and They also can operate for cooling application. It should be noted that the applications of solar energy collectors are not limited to the above areas. They can be used in a wide variety of systems, could provide significant environmental and financial benefits, and should be used whenever possible.

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International Journal of Research in Science and Technology
Volume 2, Issue 2 (I) : April - June , 2015
ISSN 2394 - 9554

A STUDY OF SUSTAINABLE MANUFACTURING THROUGH LEAN MANUFACTURING - AN EXCOGITATION PARADIGM

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ABSTRACT

An efficient manufacturing process is the essence of sustainability. The old thinking was that the companies adopting environmentally friendly processes add costs. But now with the new thinking which emphasises on green practices like recycling, reusing and reducing waste can cut costs because they make a company more efficient.

Today's corporation is becoming enlightened to the fact that green manufacturing can enhance more profitable manufacturing through a new concept called lean manufacturing. In the 1980's just-in-time techniques became popular in all organisations as they saved costs from production by eliminating the need for high levels of inventories by focusing on using just what was needed, when it was needed. Lean manufacturing takes this one step further and focuses on the elimination of all wastes in the production process. This results in higher value to the customer, less raw materials waste, less wasted worker effort, and an overall greener and more profitable company.

*Lean manufacturing will result in lower material and labour costs and greater production revenues. There is a need to bridging the continuous improvement gap between operationalperformance and environmental performance. This conceptual paper "**A Study of sustainable manufacturing through lean manufacturing- An excogitation paradigm"** focuses on the benefits of lean in relation to green manufacturing. It explores the linkages between lean manufacturing principles and the benefits of green manufacturing.*

INTRODUCTION

Sustainability is about meeting the needs of today without compromising the needs of the future. The challenge today is to think holistically about the way a company does business in order to not compromise the future

In recent years many companies have established a fundamental goal to minimize the environmental impact while maintaining high quality and service for all business processes and products. This is commonly referred to as sustainability or green manufacturing. "Sustainable manufacturing is the creation of manufactured products that use processes that minimize negative environmental impacts, conserve energy and natural resources, are safe for employees, communities, and consumers and are economically sound." Green Manufacturing is part of a continuous improvement strategy helping manufacturers improve their productivity, profitability and competitiveness. The benefits of Green Manufacturing include:

- Reduced scrap and rework
- Reduced hazardous wastes
- Improved environmental performance
- Prevention of compliance and liability costs
- Reduced quantity of raw materials, resource and energy required to realize your product.

As most manufacturers are starting to realize, the quest to become green takes them right back to Lean. 'Lean Principles' is a systematic approach to identifying and eliminating waste through continuous improvement. This is one of the key ways to enhance environmental performance.

'Lean' manufacturing is a set of continuous improvement activities closely connected with the Toyota Production System (TPS) and Just-In-Time Manufacturing systems. One emerging working definition of Lean is "The elimination of waste everywhere while adding value for customers". Green seamlessly integrates with Lean Manufacturing practices to optimize processes resulting in improved environmental, worker health and safety and energy performance.

Any waste creates inefficiency and erodes the sustainability of the enterprise – whether it is waste of human talent, effort, or the transportation of unnecessary materials. Generating waste costs money. You pay for it three times over - when you buy it, when you process it and when you dispose of it.

EVOLUTION OF LEAN MANUFACTURING

The idea of lean manufacturing as a protocol in itself was originated by Toyota in the early twentieth century. Toyota's process – the Toyota Production System, or TPS – involves two key points, the elimination of waste (in Japanese, *muda*) and the streamlining of processes (*mura*). Lean manufacturing identifies wastes as coming from three sources; "muri" wastes which occur during the planning process and result in unnecessary process steps or work, "mura" wastes which are due to inconsistencies in the processes themselves, and "muda" wastes which occur during the actual production process itself.

Lean manufacturing has an especially important focus on automation, and, more importantly, autonomation. With automation, one has machines which do the work of human labourers. Eg. Automatic spray painters, electric washing and drying machines, loom or spinning wheel etc. Autonomation is 'smart automation' – automation which can take place while needing an absolute minimum of human oversight. Toyota has proved to be exemplary in this area and the Japanese economic culture as a whole leads the world in the areas of cybernetics, robotics, and other forms of autonomation.

The four goals of Lean manufacturing systems are to:

Improve Quality

To stay competitive in today's marketplace, a company must understand its customers' wants and needs and design processes to meet their expectations and requirements. For most customers quality at a competitive price

Eliminate Waste

Waste is any activity that consumes time, resources, or space but does not add any value to the product or service. There are seven types of waste:

Transport (unnecessary movement of materials)

Inventory (excess inventory not directly required for current orders)

Motion (extra steps taken by employees because of inefficient layout)

Waiting (periods of inactivity)

Overproduction (occurs when production should have stopped)

Over Processing (rework and reprocessing)

Defects (do not conform to specifications or expectations)

Reduce Time

Reducing the time it takes to finish an activity from start to finish is one of the most effective ways to eliminate waste and lower costs.

Reduce Total Costs

To minimize cost, a company must produce only to customer demand. Overproduction increases a company's inventory costs because of storage needs.

CASE STUDY OF TOYOTA

Toyota's official formulation gives seven 'deadly wastes' of the modern workplace, and designs its business strategies to fight those wastes. These wastes are:

1. Overproduction
2. Transportation
3. Waiting
4. Inventory
5. Motion
6. Over processing and
7. Defects

By eliminating excess movement, product that can't be used, 'idle time' where workers or machinery are not in use, or any of these other items, money can be saved and thereby made, without affecting the price the customer pays at the counter.

ISSN 2394 - 9554

The Story of Lean Production chronicles the ideals and the shaping forces behind Toyota's methods, and boils the process down to six simple steps. First, the value must be specified in the eyes of the customer. The most important part of any business venture is the existence of someone who would be willing to pay for what the offering.

The second step is to identify the value stream and begin to eliminate waste. The 'value stream' is a term efficiency experts use to try to determine exactly which processes in a production line actually add value to the finished product. When evaluating a value stream, experts check each step in a process and, if that step doesn't actually add any value to the final product, that step can be removed.

The third step is making value flow at the pull of the customer. A key thing to remember in manufacturing is that what you do and what you sell should be decided by what the customer wants.

The fourth step is to involve and empower employees. At the heart of every corporation is the people who work for it. Without dedicated employees, a corporation simply cannot succeed. Loyalty, dedication, and good work ethic can make a far bigger difference than any small mechanical change one can make.

The final step is to 'rinse and repeat.' No process is perfect, which means something quite simple: every process can be improved.

SYSTEMS APPROACH

Lean manufacturing looks at manufacturing from a systems perspective, which includes a thorough evaluation of upstream and downstream process inputs and outputs. Viewed this way, suppliers and customers play a critical role in successful lean manufacturing. Heavy emphasis is placed on design and innovation and obtaining input of from supply chain partners, individuals and organizations. Organisations should encourage employees to recycle, switch to reusable coffee mugs and even requests that both sides of a piece of paper are used before it is discarded. With green initiatives, a company becomes a leaner and more efficient organization. Most Companies has done projects as an installation of solar panels. The company has replaced the average light bulb with energy-efficient lights and added motion sensors in all areas — corporate offices, the manufacturing plant and in warehouses.

The leading similarity between the benefits of lean and the benefits of green is waste, and so it makes perfect sense that in order to achieve higher levels of environmental performance, the organization must first adopt the principles and practices of lean manufacturing.

1. **Equipment Reliability**: When implementing lean within the organizations, equipment reliability is the predominant foundational element that enables lean operational performance. Embracing green manufacturing requires giving more focus to environmental and energy concerns during the implementation of reliability improvement projects. Improvements geared toward improving equipment reliability have distinct linkages to environmental performance, such as reducing the amount of product and raw material waste

When bridging the environmental gap, organizations need to evaluate the energy consumption of each engineered alternative as a sustaining cost category. Those solutions or alternatives that effectively utilize higher efficiency motors, alternative fuels will cost less over the life cycle period – be that five, 10 or 30 years. The additional benefit of a green-focused life cycle cost analysis is that it will be easier to identify oversized equipment that could be replaced by smaller, more energy-efficient alternatives. In many cases, organisations tend to over-engineer their plant assets and, therefore, spend more than they should to operate and maintain the system or asset over the life cycle period.

2. **Operator care programs:** This focuses on developing standards of practice within the operating units decrease variation in the manufacturing process, which reduces the amount of product and raw materials waste. This can be done by training operators in better standards of loading, starting and operating manufacturing equipment. Operator care programs also helps manufacturer improve workplace safety and reduce lost workdays.

3. **Kanban**: Kanban or pull-systems established within the manufacturing process, have greatly contributed to material and waste reductions. Kanban practices are designed to provide the right materials at the right time to support manufacturing needs. This concept focuses on reducing excess inventories of raw or work-in-process materials which cannot be consumed immediately by the production cycle. Cell-based manufacturing processes that signal a pull for materials based on the demand for product can significantly reduce raw material consumption, decreasing the amount of waste material delivered to landfills as well as reducing the demand on raw material resources.

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Combining lean manufacturing with green techniques can cut costs, increase productivity, grow and retain jobs, implement sustainable practices and make a company and their products more appealing to the increasingly environmentally conscious marketplace.

APPLICATION

The lean manufacturing ideal applies to more than just industrial processes. No matter how autonomous machines and production lines get, humans are still running it all and a streamlining of the human process is a necessary one for any manager or CEO who wants a truly efficient company. Toyota implements a mentoring system, strongly supported in Japan, which is meant to help bring promising employees up through the system and make sure that the company is run by the most qualified individuals and that, when they get to a high level position, they have already been mentored and educated to be able to fulfill that task. In Japan, this is known as the Senpai and Kohai relationship and is key to making an efficient business structure. Toyota also advocates the use of lean Sensei, which is essentially the use of third party contractors and educators to bring new blood, so to speak, into a corporation's ideas, to provide unbiased outside advice, to perform tasks which only temporarily exist and for which it would be inefficient or not cost worthy to train a full time employee, and any number of other functions contractors and independent workers seek to fulfill.

CONCLUSION

Manufacturing is showing with increased frequency, that companies incorporating lean practices in manufacturing, are (by design or accident) becoming more "green. This is especially true for companies that integrate a number of proven methods e.g. ISO quality and environmental management systems, to meet environmental compliance and stakeholder needs. This is more rapidly accomplished with a dedicated corporate commitment to continual improvement, and incorporating 'triple top line' strategies to account for environmental, social and financial capital. By manufacturers utilizing Lean manufacturing systems, the companies are not only being more profitable for their bottom lines, but also using less resource such as raw materials, electricity, gas, water and transportation costs to limit their impact on the environment. Lean manufacturers are probably some of the greenest companies on the planet.

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International Journal of Research in Science and Technology
Volume 2, Issue 2 (I) : April - June , 2015

ISSN 2394 - 9554

COMPARATIVE STUDY OF LOAD - SETTLEMENT BEHAVIOUR OF MICROPILE-RAFT FOUNDATION IN COHESIVE SOIL

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ABSTRACT

A micropile is a small-diameter (typically less than 300mm), drilled and grouted replacement pile in which the applied loads are resisted by steel reinforcement and cement grout. Micropile are used as in-situ reinforcement for slope stabilization, ground strengthening of soil mass and settlement reduction in existing foundation during renovation work. An experimental program is conducted on model piled rafts in consolidated clay soil. The experimental program is designed to inspect the performance of raft on settlement reducing micropiles. Laboratory program include test on models of raft foundation, raft foundation with 1,4,7,9 number of micropile with diameter 10mm and raft foundation with 2 numbers of conventional piles of diameter 20 mm. The model piles which are placed below the raft are closed end displacement piles installed by injection grouting. In this test two different length of piles are used in order to show slenderness ratio(L/D) of 12and 15 respectively .Circular model raft are used of diameter 150mm with thickness of 15 and 20 mm. Different thickness of model rafts represent different type of rafts ranging from flexible to stiff. The improvement in the ultimate bearing capacity is represented by the Load enhancement Ratio(LER), the reductions in settlement and differential settlement are represented by the Settlement ratio(SR) respectively . In this paper the effect due to change of number of piles, slenderness ratio (L/D) of micropile and thickness of raft foundation on the Load enhancement ratio, Settlement ratio are discussed in detail The result which we get from the test shows effectiveness of using micropile as settlement reducing measure with the model raft foundation as the number of settlement reducing piles increases Load enhancement ratio increases and Settlement ratio decreases.

INTRODUCTION

Micropile are small diameter, drilled, replacement piles generally grouted with neat cement grout that are typically reinforced. The diameter of the micropile is normally limited to 300mm which makes them convenient to be casted under any given situation. They can be installed in access-restrictive environments and in all soil types and ground condition. A micropile was constructed by drilling a borehole, placing reinforcement and grouting the holes. Micropile can withstand axial and lateral loads and may be considered a substitute for conventional piles or as one component in a composite soil/pile mass depending upon design concept employed. Micropile is installed by methods that cause minimal disturbance to adjacent structure and environment. Micropile is currently used in two general applications: for structural support and less frequently in-situ reinforcement. Structural support includes new foundation, underpinning of existing foundation, seismic retrofitting application and earth retention. In-situ reinforcement was used for slope stabilization, ground strengthening, settlement reduction and structural stability. Micropile application for structural support include foundation for new structure, underpinning of existing structure, scour protection and seismic retrofitting of existing structure.

Sridharan and Murthy [1993] presented a paper on “Remedial measure to building Settlement problem” which illustrated the use of micropile as remedial measure to cater the differential settlement in a ten storey building, originally in a precarious condition due to differential settlement, was restored to safety using micropile. Galvanized steel pipes of 100mm diameter and 10 m long with bottom end closed driven at an angle of 60degree with the horizontal were used and the friction between the piles and soil was used as design basis in evolving the remedial measure.

H.G.KEMPERT, F.BOHM Paper introduces that raft foundation on floating micropile show a reduction in settlement when compared with raft foundation it show improvement of the surrounding soil after injection of micropile with cement grout. An increase of the shear strength and stiffness of SSVP foundation and decrease in water content is observed.

J.VELUDD,DIAS –DA –COST A paper introduces the influence of following parameter between bond strength of micropile grout interface like hole diameter, embedment length of micropile, level of confinement of grout mass1Connection capacity between micropile grout interface is first controlled by chemical adhesion and then by friction proportional to the radial confining. In case of micropile grouted in holes pre drilled in existing RC footing, bond strength increases with decrease in hole diameter.

 ISSN 2394 - 9554

SCOPE OF THE PRESENT STUDY

a) To calculate the settlement of raft foundation, raft foundation with different micropile group and raft foundation with conventional piles and calculate Settlement ratio (SR).

b) To find a suitable replacement of conventional piles with effective micropile-raft foundation by calculating Load enhancement ratio (LER).

c) To calculate the load distribution between the micropile and raft foundation for applied load at different thickness of raft foundation

Material and Equipment

The materials required for carrying out the model tests were as follows:

a) Clayey- silt soil,

b) Cement (OPC)- 53 grade,

c) String rod of 1.5 mm diameter

d) Sand (for conventional piling)

e) Water

The equipments used for the construction of the model set ups were as follows:

a)Tank(1500mm*600mm*900mm)

b) Augers (20mm for conventional pile,6mm for micropile)

c) Injecting (grouting) device

d) String cutter

e) Hand Shaw

f) Dial gauges

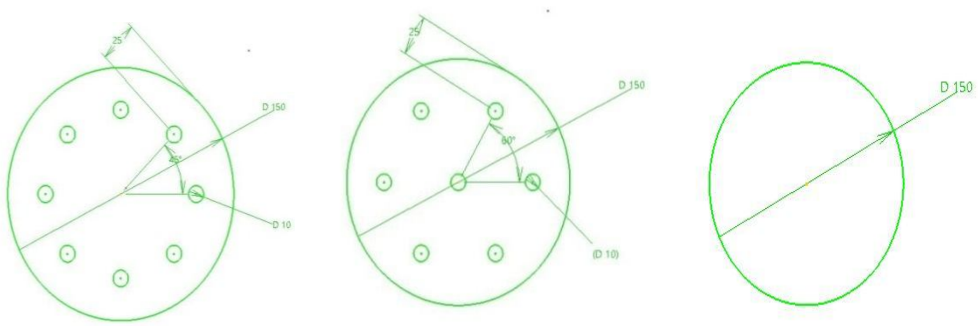
g) Stop watch

h) Casing

i) Angles for fixing dial gauges

EXPERIMENTAL PROGRAM

A series of laboratory tests were performed on models of single pile, un-piled raft, conventional pile and central piled raft. The experimental program consists of 12 tests. Out of which each six test was carried out with Length to Diameter ratio of pile 15 and 12 respectively. The embedded pile lengths of 150 mm, and 120mm were used in the experiments. Six circular rafts with different thickness served as model rafts. Circular raft of diameter 150mm is represented by D 150 in figure. The modulus of elasticity and Poisson's ratio of the soil were 15000kPa and0.30 respectively. The piles configurations and model rafts dimensions for the following cases are given below in Fig D10 represents diameter of micropile as 10mm and D20 represents diameter of conventional pile as 20mm. Micropiles are equally spaced at an angle of 90,60 and 45 degree for group of 4,7and 9number of micropiles beneath the circular raft with side clearance of 20mm from all the sides of circular raft foundation .In case of conventional pile side clearance is 30mm.The dimensions of the model rafts were selected to ensure no effect of the boundary walls on the stresses in the soil, and the height of the soil was selected 2times greater than the maximum pile length to ensure insignificant effect of a rigid base on the behavior of piles.



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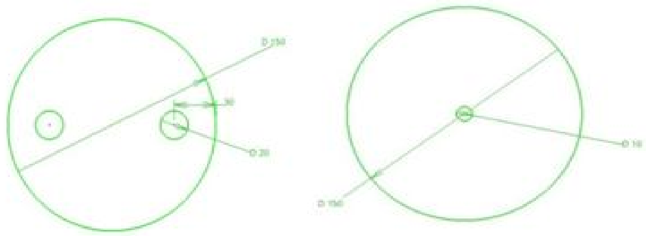

Studied Cases of Different Micropile –Raft Foundation (Unit in mm)

Table1: Index properties of Soil

Liquid Limit	63%
Plastic Limit	37.3%
Specific Gravity	2.43
Coefficient of uniformity (Cu)	2.69
Coefficient of curvature (Cc)	0.71
Optimum Moisture Content (OMC)	31%

TEST PROCEDURE

The procedure for the installation of micropiles was explained in a sequential order below:

1. Positions of the piles on the soil block were marked with the help of pins on the plan. The plan of the micropile is drawn on paper to actual dimensions.
2. Drill holes of 6 mm diameter and 150 mm and 120 mm length with the help of auger.
3. Neat cement paste (1 cement:0.5 water) was injected into the drilled hole with the help of injecting device. As the injection starts, the injecting device is withdrawn slowly.
4. A string of 1.5 mm diameter was then centrally inserted and it penetrates under its own weight.
5. Three days after the installation of pile (both micropile and conventional pile) the soil from the grouted surface was then excavated to the required depth of 2.5 cm (out of which 0.5 cm was to be within the pile cap and 2 cm to be the offset clearance)
6. Strips of thermocoal of size 150mm×15 mm×20 mm (Length×Breadth×Heigth) was placed in between micropile and thermocoal block of sufficient size with 20 mm high was placed around the pile group as a shuttering for the construction of the micropiles cap.
7. Athin polythene was then placed over the shuttering prepared as the micropile being extruded through the polythene.
8. Formwork made of domestic electric cable conduit was then placed over the shuttering.
9. The Micropiles cap was then constructed by placing the cement paste within the formwork.

Experimental set up of Micropile-raft foundation

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RESULTS AND DISCUSSIONS

The experimental results obtained from the laboratory tests are analyzed and discussed in this section. The shapes of the measured load settlement curves indicate that the load at failure was not achieved. Therefore, the allowable and the ultimate raft capacities were determined from the load-average settlements of 10 mm and 15 mm respectively. The settlement values of 10 mm and15 mm are considered acceptable for allowable and ultimate load.

The experimental load-average settlement curves for the un-piled raft models of different relative stiffness or thickness are shown in Fig1. It can be noted that the increase in raft relative thickness causes a slight increase in the load carrying capacity of un-piled raft with a reduction in settlement An increase in raft relative thickness from15 to 20 mm only causes a slight increase in load carrying capacity of raft by 8.85% only.

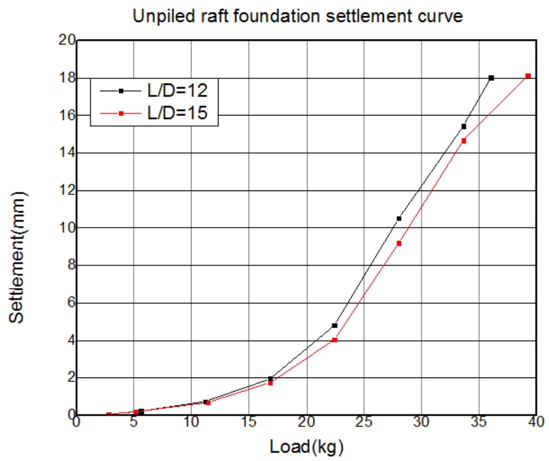

Fig 1

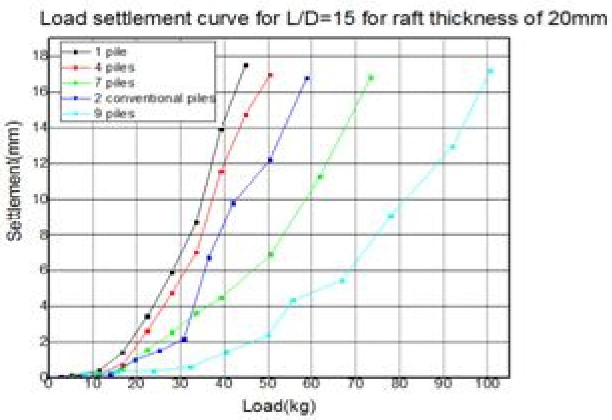

Fig. 2.1

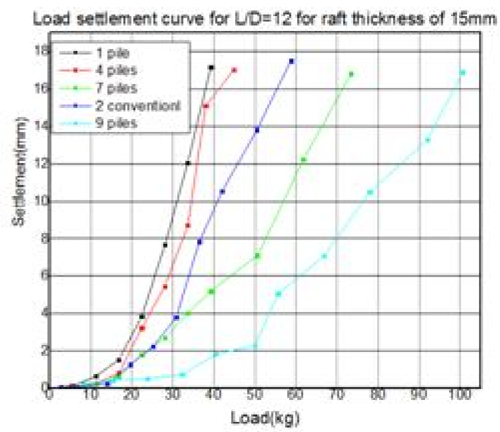

Fig. 2.2

As shown in these Fig 2.1 and 2.2, the load carrying capacity of piled raft increases as the number of settlement reducing piles increases, for all the studied cases. This increase is mainly due to the increase in the portion of load carried by the central piles due to the increase of the number of piles.

In this study, the enhancement in the load capacity of the raft at10 mm and 15 mm settlements, due to the presence of settlement reducing piles is represented by a non-dimensional parameter called Load enhancement ratio (LER)

$$LER = \frac{Ppr}{Pr}$$

Where Pr and Ppr are the loads of unpiled raft and central piled raft at 10 mm and 15mm settlements, respectively. From these figures 3.1 and 3.2, it can be noted that: (1) at the same raft thickness and L/D ratio, the value of LER increases as the number of piles increases (e.g. at 15 mm settlement, for raft of thickness installing 7 settlement reducing piles with L/D = causes an increase in the raft load by66% and for 9piles causes an increase in the raft load by 115%, (2) for all the studied cases, the value of LIR at10 mm settlement is greater than that at 25 mm settlement. This is clearly shown in Fig that the variation of LER with the raft thickness of 15 and 20mm for the raft on 1,4,7 and 9 settlement reducing piles with L/D ratio.

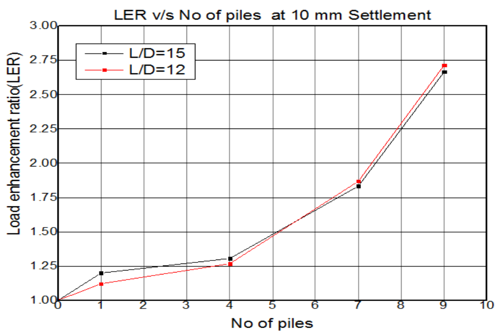

Fig. 3.1

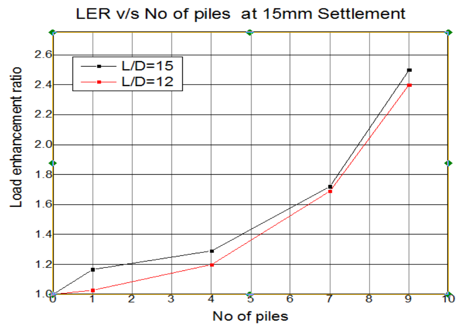

Fig. 3.2

In practice, the inverse of the load improvement ratio, 1/LIR, (i.e equal to the proportion of load carried by raft) presented in this paper can be used in a preliminary design stage to estimate the load-settlement curve of piled raft as described by Poulos (2001). The proportion of load carried by piles increases as the number of piles increases, and inversely the proportion of load carried by raft decreases as the number of piles increases

As in the Fig 4 below the load carried by raft in case of one pile is more as compared to 9 micropile group and also load taken is more equally distributed with 9 micropile group.

Pr/Ppr represents

Pr=load taken by unpiled raft

Ppr=load taken by single central pile raft

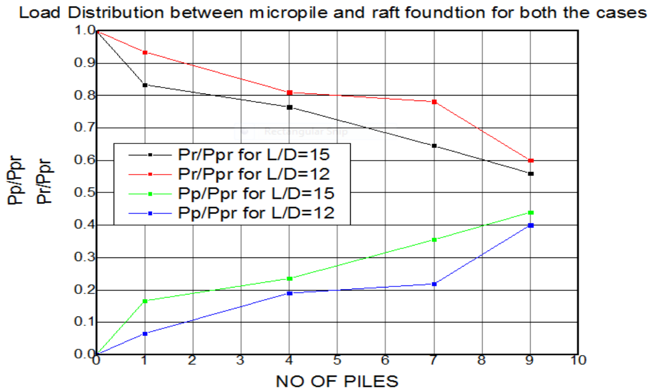

Fig. 4

The reductions in average settlement of raft due to the presence of settlement reducing piles are represented by non dimensional factor called settlement ratio SR as follows:

SR = Wpr/ Wr

Where as Wpr and Wr are settlements of piled raft and unpiled raft respectively, at the load corresponding to 15 mm settlement

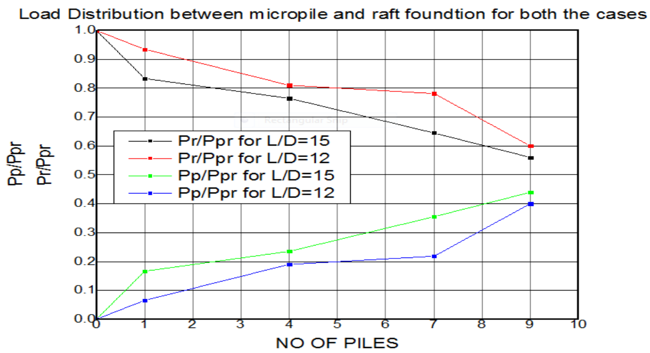

Fig 5

Fig 5 shows the variation of settlement ratio (SR) with the increase in number of piles for rafts with relative thickness of 15 and 20mm respectively. In Fig5 it is observed that: (1) the settlement ratio decreases the number of piles increases (e.g. for the raft with 20 thickness, installing 7 piles with L/D = 15 causes a decrease in the average settlement of the raft by 45%, while installing 9 piles with L/D = 20 causes a decrease in the raft settlement by 55% (2)Generally, the rate of decrease of SR decreases as the number of settlement reducing piles increases (3) for a given number of piles , the settlement ratio decreases as the L/D ratio increases.

CONCLUSION

The paper has presented experimental results of load tests on model rafts on settlement reducing piles embedded in clay soil. Although there may be some scaling effects, the results of the model tests provide insight into settlement behavior of rafts on settlement reducing piles, and load sharing between piles and raft and may provide some general guidelines for the economical design of raft on settlement reducing piles. Based on the results of model tests, the following conclusions are drawn

(1) The addition of even a small number of piles beneath the central area of the raft increases the load bearing capacity of the piled raft, and this enhancement effect increases as the number of piles increases, thickness of raft foundation and the slenderness ratio L/D of the piles increases.

(2) At 10 mm and 15 mm settlements, the load improvement ratio, LER, increases as the number of settlement reducing piles increases and as the L/D ratio increases

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International Journal of Research in Science and Technology
Volume 2, Issue 2 (I) : April - June , 2015
ISSN 2394 - 9554

CONSTANT MODULUS ALGORITHM BASED BLIND ISI CORRECTION FOR QUADRATURE AMPLITUDE MODULATION AND PHASE SHIFT KEYING SIGNALS

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ABSTRACT

This work presents a review and comparative study of noise correction due to Inter Symbol Interference (ISI) of QAM and PSK signal constellations based on Constant Modulus Algorithm (CMA). The bit error rate for both PSK and QAM signals are calculated here and QAM shows better performance in this regard. Also the work includes the study of the convergence of the algorithm for both the signals and offers better convergence for QAM signal.

Keywords: Constant Modulus Algorithm (CMA),Intersymbol Intersymbol Interference (ISI), Minimum Mean Square Error(MMSE),Quadrature Amplitude Modulation(QAM),Phase Shift Keying(PSK), Channel State Information(CSI).

INTRODUCTION

A signal propagating through a channel, suffer from various impairments such as ISI which leads to the change of pulse shape and carrier phase error. To recover the original and faded signal back from the distorted received signal, equalization technique is used. When the equalization is used without a training sequence, it is termed as Blind Equalization, as proposed by Sato, for which case Constant Modulus Algorithm (CMA) is used, as proposed by Godard [1] [2]. The estimation of received signal can also be done on the basis of statistical and probabilistic properties of the signal and thus avoiding the use of training sequence [3, 4]. We will study in this paper the bit error rate after applying blind equalization to PSK and QAM signals and compare their performance. This paper is organized as follows: Section II discusses Blind Equalization model. The development of Constant Modulus Algorithm is studied in section III and Section IV compares the equalized signal constellation and estimation of error rate and then conclusions are drawn in Section V.

BLIND EQUALIZATION MODEL

The use of training sequence is avoided in blind equalization model and the estimation of output signal is based on the probabilistic and statistical properties of the signal [5, 6]. The property of constant modulus is lost when a signal is corrupted by noise. The difference between the received signal before equalization and after equalization may be taken as the parameter (as the cost function) to study the system performance. The value of cost function gives an estimate about the channel noise in the received signal. Higher the cost function, larger would be the noise in the received signal [7].The received signal with noise can be represented as

$$r(t) = kx_1(t) + n(t) \qquad (1)$$

where, $x_1(t)$ is the input signal with normalized unit energy $|x_1| = 1$ and $n(t)$ is the noise in the received signal and k is the constant that depends on channel fading.

The receiver weight vector after equalization can be represented as

$$y = w^H r \qquad (2)$$

where $|y| = 1$ by [8] for CMA and is the cost function.

The magnitude square of error is defined as [4], [9], [10]

$$e^2(n) = (|\hat{y}|^2 - F)^2 \qquad (3)$$

where, F is a real constant that is determined by signal r, and is the kurtosis of signal [11].

The expression for updated equalizer coefficients is given by

$$w(n+1) = w(n) - \mu r e'(n) \qquad (4)$$

And

 ISSN 2394 - 9554

$$e'(n) = (|y|^2 - 1)y \qquad (5)$$

where, $e'(n)$ denotes the complex conjugate of $e(n)$ and μ is the constant of adjustment [8].Upon combining both the equations (4) and (5), we get

$$w(n+1) = w(n) - \mu r(|y|^2 - 1)y \qquad (6)$$

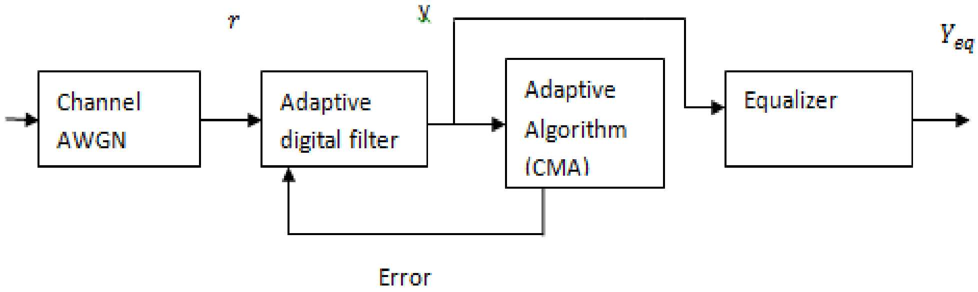

Figure: 4 Blind Equalizer Model

The blind equalization model is depicted in figure 1. The equalization is based on the adaptive filter which consists of an adaptive filter and an adaptive algorithm such as CMA. An adaptive filter consists of two distinct parts: a digital filter with adjustable coefficients, and an adaptive algorithm which is used to adjust or modify the coefficients of the filter. Two signals namely y_k and x_k are applied simultaneously to the adaptive filter. The signal y_k is the contaminated signal containing both the desired signal, r_k, and the noise, n_k, assumed uncorrelated with each other. The signal x_k, is a measure of contaminating signal which is correlated in some way with n_k. x_k is processed by the digital filter to produce an estimate, $\hat{n}_k$, of n_k. An estimate of the desired signal is then obtained by subtracting the digital filter output, $\hat{n}_k$, from the contaminated signal, y_k. The weights are so adjusted that the estimate is very close to the input signal [7].

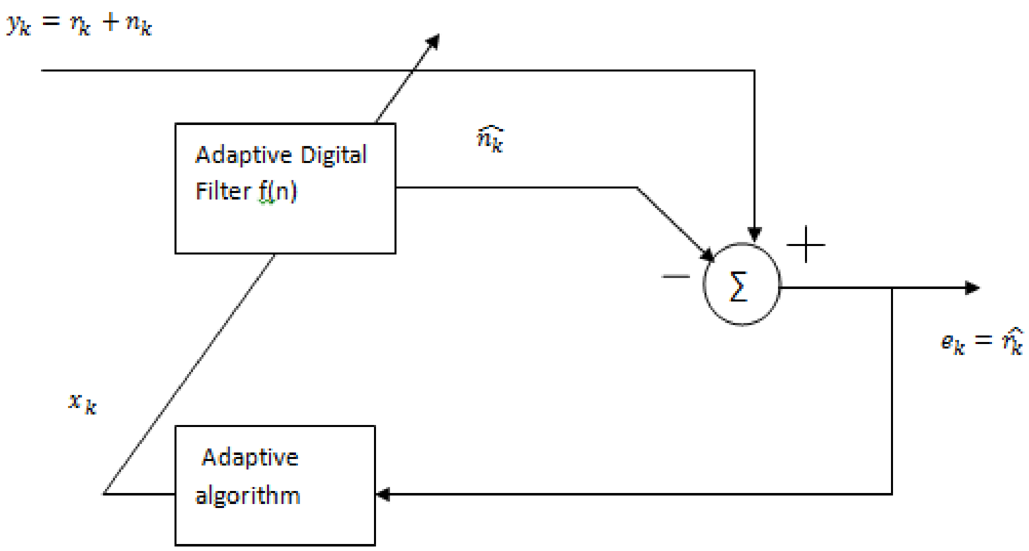

Figure: 5 Adaptive filter

CONSTANT MODULUS ALGORITHM

Firstly, the adaptive filter coefficients are initialized by a specific weight and then error and cost functions are calculated. If calculated error is less than minimum specified error, then final output is calculated otherwise the weight is updated and again the whole process is repeated for the calculation of error and cost function. This process is repeated till the value of calculated error becomes less than the minimum specified error [12].

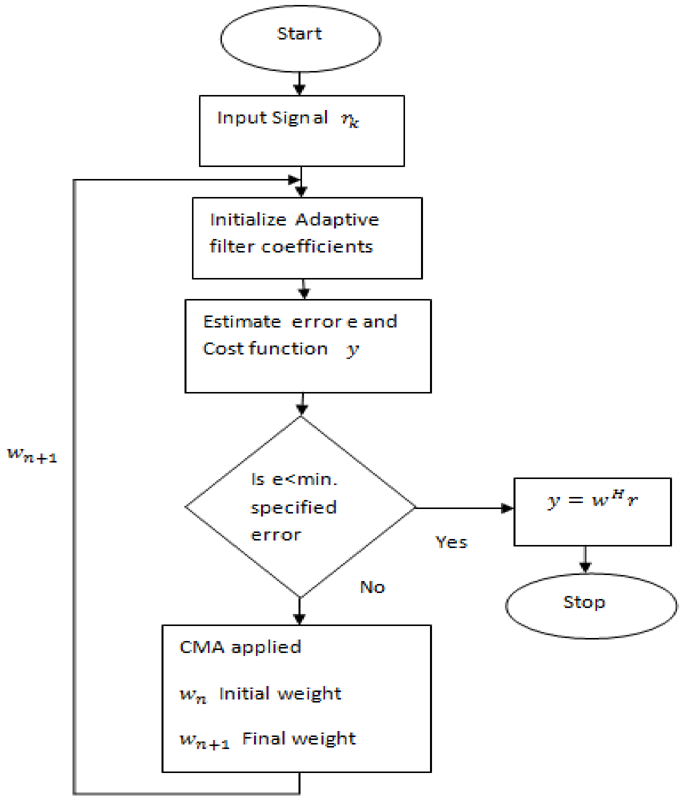

Figure 6: Flowchart for Constant Modulus Algorithm

The transmitted signal for 8-PSK can be written as follows [13]

$$s_i(t) = \sqrt{2E/T}\cos(\omega_o t - \frac{2\pi i}{M}) \qquad (7)$$

where E is the energy of waveform over symbol duration T and ω_o is the carrier frequency, M =8 and $i = 1,\ldots,$ M and $0 \le t \le T$.

The modulated signal waveform for QAM can be expressed as [14]

$$s(t) = A_{mc}g(t)\cos 2\pi f_c t - A_{ms}g(t)\sin 2\pi f_c t \qquad (8)$$

Where, A_{mc} and A_{ms} are the information bearing signal amplitudes of the quadrature carriers and $g(t)$ is the signal pulse and f_c is the carrier frequency.

The Simulink model for 8-PSK is drawn in Fig: 4 can be given as,

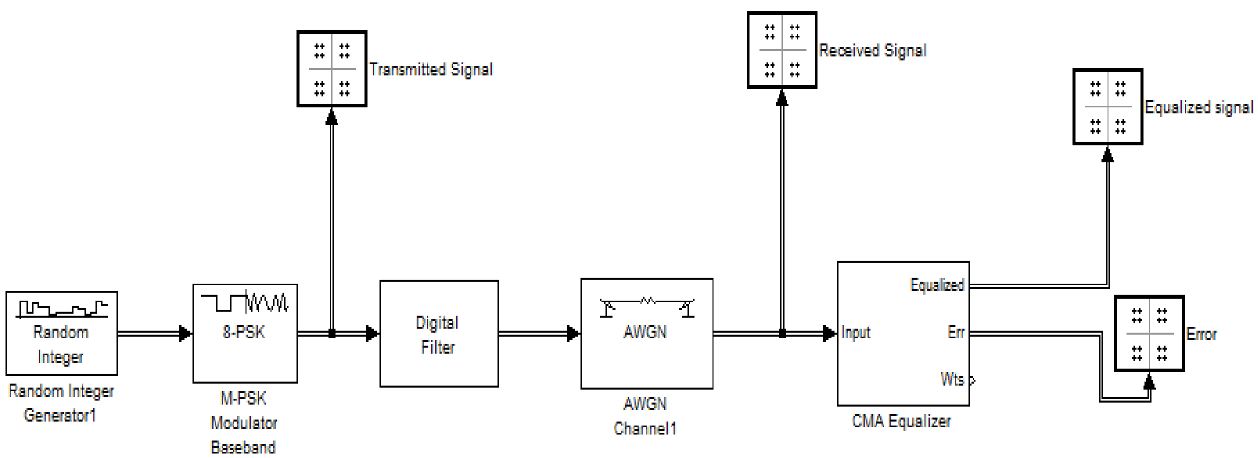

Figure: 7 Simulation model for 8-PSK

 ISSN 2394 - 9554

The modulated PSK signals are passed to AWGN channel and then CMA is applied to them for their recovery. Signals before and after equalization are studied.

The QAM signaling can be viewed as combination of Amplitude shift keying (ASK) and phase shift keying (PSK). The simulation model for QAM is sketched in figure-5.

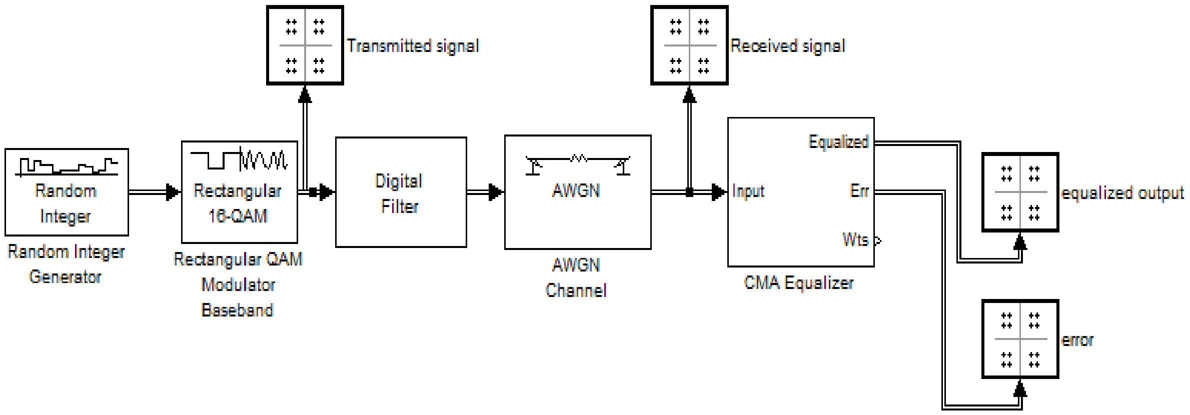

Figure: 8 Simulation Model for 8-QAM

The received equalized constellation of QAM signals was different from PSK signals as explained in the next section.

SIMULATION AND RESULTS

This section compares the bit error rate and convergence of QAM and PSK signals after equalization with the CMA.

RESULTS FOR PSK SIGNALS

Figure: 6 (a-c) shows the signal constellation of 8-PSK, for transmitted signal, received signal and equalized signal.

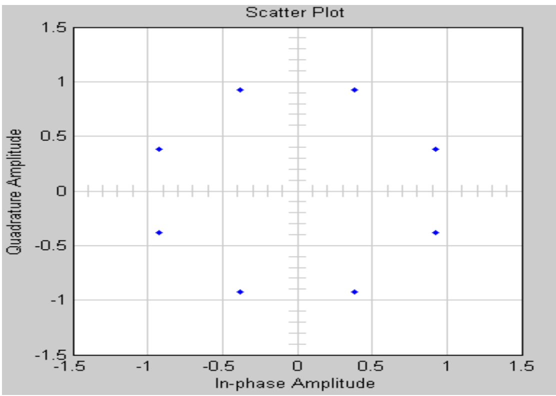

Figure: 9 (a) 8-PSK transmitted signal constellation

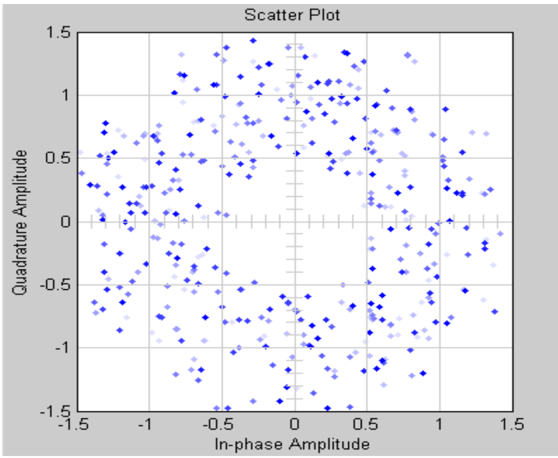

Figure: 6(b) 8-PSK received signal constellation (without equalization)

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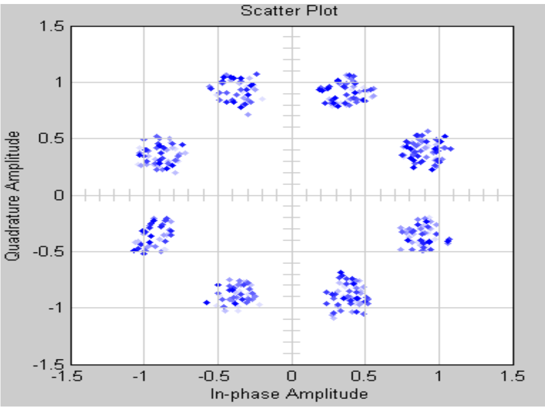

Figure: 6(c) 8-PSK received signal constellation with equalization based on CMA

RESULTS FOR QAM SIGNALS

Fig: 7(a-c) shows the signal constellation of 16-QAM, for transmitted signal, received signal and equalized signal.

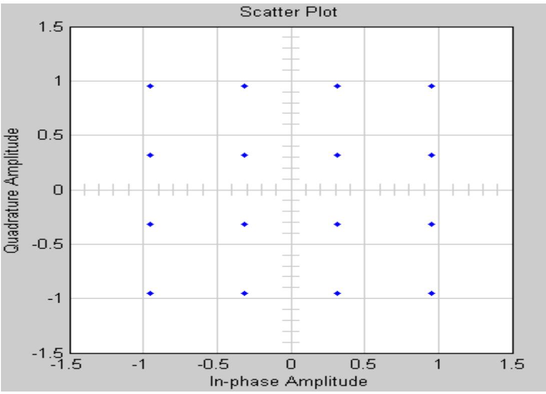

Figure: 10(a) 16-QAM transmitted signal constellation

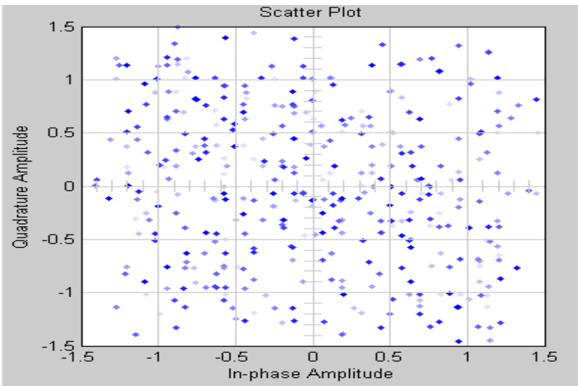

Figure: 7(b) 16-QAM received signal constellation (without equalization)

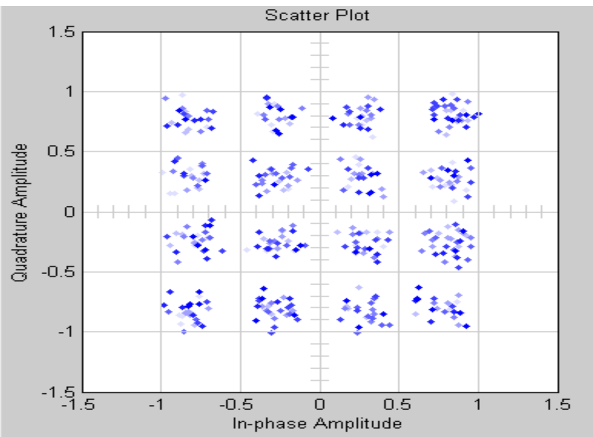

Figure: 7(c) 16-QAM received signal constellation with equalization based on CMA

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RESULTS FOR CONVERGENCE OF 16-QAM AND 8-PSK SIGNLS.

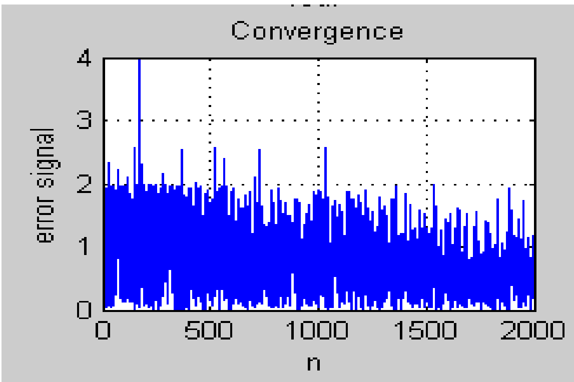

Figure: 11(a): the convergence of equalized PSK signals as studied in terms of error signal against number of samples

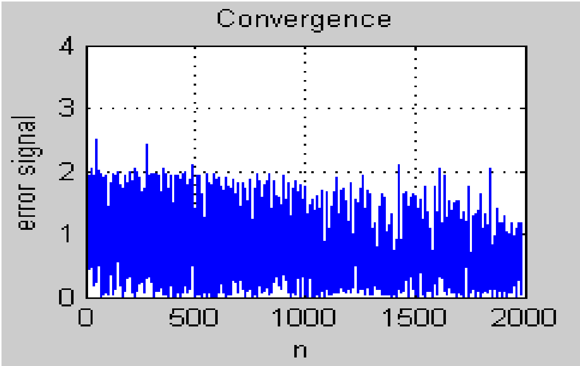

Figure: 8 (b) the convergence of equalized QAM signals as studied in terms of error signals against number of samples

We have also studied the convergence of algorithm for both PSK and QAM signals. Figure: 8(a) shows the convergence of 8-PSK signals, whereas Figure: 8(b) shows the same for QAM signals. It is observed as that the average error for 8-PSK signals was coming out to be 2.75 and average error for QAM signals was coming out to be 2.05, when it is plotted against the number of samples. This shows that error is reduced for QAM signals as compared to PSK signals.

CONCLUSION

The 8-PSK and 16-QAM signals are studied and Constant Modulus Algorithm is applied on these signals and we have seen that Inter Symbol Interference is reduced after equalization. We have also seen that the convergence for QAM signals is greater than 8-PSK signals and thus bit error rate is also reduced for QAM signals.

TABLE 1: Comparison of 8-PSK and 16-QAM

Parameter	8-PSK	16-QAM
Convergence	Moderate	High
Bits/Symbol	3	4
Bandwidth required	$f_b/3$	$f_b/4$
Data Rate	Low	High

f_b is Input data bit rate.

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ISSN 2394 - 9554

EFFECT OF LIME AND FLY ASH ON ENGINEERING PROPERTIES OF EXPANSIVE SOILS

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ABSTRACT

This paper presents a study of the efficiency of lime and fly ash as additives in improving the geotechnical characteristics of expansive soils. An experimental program has been conducted to study the effect of the lime and fly ash content on the free swell index (FSI), plasticity, compaction, compression, swelling potential, swelling pressure and strength characteristics of an expansive soil having high plasticity. Lime was added in the proportion of 3%, 5% and 8% and fly ash was used at the rate of 5%, 10%, 15% and 20% by dry weight of the soil. For strength test, the samples were cured for 3, 7 and 28 days and unconfined compression test was carried out. Result of the study showed improved behavior upon treatment with both the additives. With addition of both lime and fly ash to the soil, plasticity index, free swell index, swelling properties decreases considerably. Strength of the samples increases gradually with proportion of additive and curing period. However, most improvement in strength was observed within 3 to 7 days curing period. Compression index (C_c) of the treated samples decreases for both lime and fly ash stabilized samples. Based on the favorable results obtained it can be concluded that both lime and fly ash can be used for soil stabilization of expansive soils but the effect of stabilization is more in case of lime than fly ash used in this study.

Keywords: expansive soil, lime stabilization, fly ash stabilization

1. INTRODUCTION

Expansive soils are highly problematic because of the susceptibility of these soils to undergo large volumetric changes due to fluctuations in the moisture content. They have tendency to swell when comes in contact with water and shrinks when water content reduces. This property is due to the presence of montmorillonite mineral which have high water retaining capacity. The volume change behavior of the expansive soil causes large uplift pressure and upheaval of structures built on, specifically the light weight structures. Avoiding expansive soils for engineering purposes in some cases may not be practically feasible and hence there is a need for stabilization of the in situ soil or borrow soil if they are used for construction. Expansive soils' swelling potential can be fully eliminated or at least decreased by using some methods. The most widely used stabilization method is adding some chemicals to soil. Lime, fly ash and cement are the most common additives applied for stabilization purpose all over the world from earlier times. The stabilization, especially with lime and fly ash, are common applied methods among the others due its effective and economic usage.

Generally both quicklime (CaO) and hydrated lime [$Ca(OH_2)$] are used for stabilization purpose. The findings from the previous studies show that when lime is added to clay soils in the presence of water, reactions including cation exchange, flocculation and pozzolanic reaction take place. It is stated that, cation exchange and flocculation are primarily responsible for the modification of the engineering properties of clay soils when treated with even a small amount of lime (Bell, 1996). The studies reported in the literature showed that the addition of lime increased the optimum water content and strength, and reduced the swelling potential, liquid limit, plasticity index and maximum dry density of the soil. Bell, 1996; found that the optimum addition of lime needed for the stabilization of the soils is between 1% and 3%, while other researchers suggested the use of lime between 2% and 8% lime by weight. Bell also indicated that further additions of lime do not change the swelling potentials, but enhance the engineering properties of expansive soil.

Fly ash is defined as the material extracted from the flue gases of a furnace fired with coal (Phanikumar et al. 2007). Composition of fly ash varies depending upon type of coal burnt. Fly ash is usually utilized as a pozzolanic material. Mainly two classes of fly ash are used which are class C and class F. Class C fly ash exhibits both pozzolanic and cementitious property while class F have only pozzolanic property. Fly ash can provide an adequate array of divalent and trivalent cations (Ca^{2+}, Al^{3+}, Fe^{3+}, etc.) under ionized conditions that can promote flocculation of dispersed clay particles. Thus, expansive soils can be potentially stabilized by cation exchange using fly ash. Cokca (2001), studied the effect of fly ash for the stabilization of an expansive soil and concluded that the expansive soil can be stabilized successfully by fly ashes. Phanikumar et al. (2007) examined the expansive soil stabilization with fly ashes, and they found out that the addition of fly ash significantly reduces the swelling potential of the expansive soil.

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2. SCOPE OF PRESENT STUDY

The geotechnical properties of a highly expansive clay soil mixed with lime and fly ash has been investigated in this study. Lime is mixed in the proportion of 3%, 5% and 8% and fly ash is mixed in the proportion of 5%, 10%, 15% and 20% by weight of dry mass of soil. Test specimens were subjected to compaction tests, free swelling tests (FSI), swelling potential tests, swelling pressure tests, unconfined compression tests and consolidation tests. Unconfined compression tests were conducted with different curing period of 0, 3, 7 and 28 days to study the time dependent strength development behavior. This paper presents the details and result of the experimental study and also the conclusions.

3. MATERIALS AND METHODOLOGY

The soil used in this study is a highly expansive bentonite clay soil having free swelling index (FSI) of 206% and plasticity index of 99%. The soil is classified as CH according to IS soil classification system. Commercially available hydrated lime having specific gravity of 2.24 is used in this study and fly ash used is a low calcium or class F fly ash having specific gravity 2.15. The index properties of soil, lime and fly and fly ash are given in table 1. Chemical composition of lime and fly ash obtained by conducting SEM EDX test are presented in table 2. In all the tables and figures the soil is designated by symbol “A”, fly ash as “FA” and lime as “L” (i.e. A+10FA represents combination of soil A and 10% fly ash).

Table 1: Index properties

	A	L	FA
Liquid Limit (%)	143	-	-
Plasticity Index (%)	99	NP	NP
Specific gravity	2.67	2.24	2.15
Sand (%)	0	7	15
Silt (%)	52	93	85
Clay (%)	48		

All the index property, unconfined strength tests, swelling tests, consolidation and compaction tests for non stabilized soil are conducted in accordance with relevant IS: 2720 code of practice. IS : 4332 code of practice is followed for conducting above tests on stabilized soil samples with different percentages of additives. For all the unconfined strength tests, swelling potential, swelling pressure tests and consolidation tests, the samples are prepared in its corresponding optimum moisture content and maximum dry density as obtained by standard proctor test.

Table 2: Elemental composition (%)

Element	Lime	Fly Ash
Si	0.09	15.86
Mg	0.48	0.50
O	65.58	70.72
Ca	20.27	0.47
Al	0.11	9.39
Fe	0.08	1.31
K	0.07	0.48
C	13.32	0.68
Na	-	0.14
Ti	-	0.46

RESULTS AND DISCUSSION

Plasticity

Atterberg’ limits of the lime and fly ash treated samples are summarized in table 3. It is seen that both lime and fly ash addition to the expansive soil resulted in decrease of plasticity. Liquid limit decreases and plastic limit increases with percentage increase in additive and overall plasticity index decreases for both lime and fly ash treated samples. Decrease in plasticity can be attributed to immediate cation exchange reactions taken place due to addition of lime and fly ash to the soil sample.

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Compaction

Fig 1-a and fig. 1-b shows moisture content vs dry density curves for lime and fly ash treated samples and corresponding values of OMC and MDD are summarized in table 3. With addition of lime the optimum moisture content (OMC) increases and maximum dry density (MDD) decreases for the soil sample. This is due to cation exchange and flocculation reactions which resulted in increased void ratio of the mix and resulted in lower dry density. Increase in OMC is due to addition of more water held within the flocs as a result of flocculation (Arvind Kumar et al. 2007).

But with addition of fly ash the OMC reduces and MDD increases gradually. This is due to the rounded shaped particles of fly ash which get compacted in the void spaces in between the soil particles thus giving more density and less void ratio.

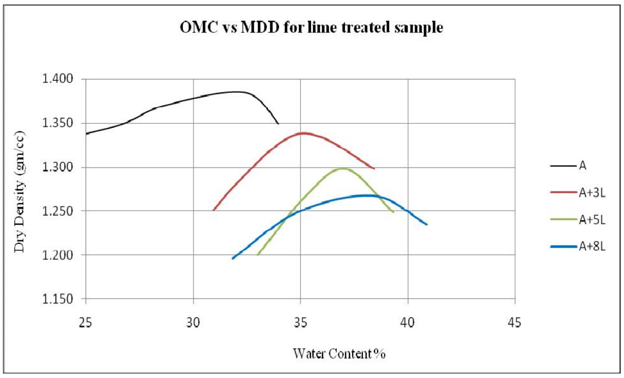

Fig. 1-a

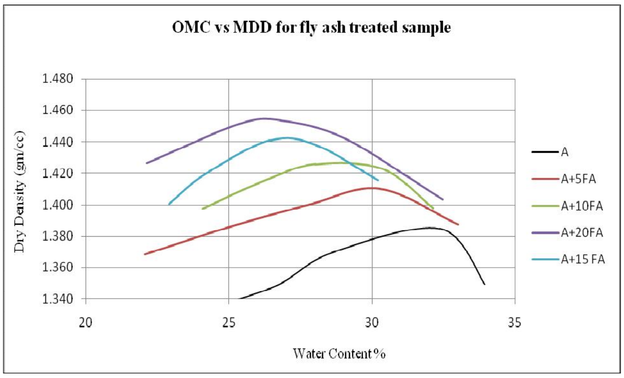

Fig. 1-b

Table 3: Effect of lime and fly ash on various properties

Combination	LL (%)	PI (%)	OMC (%)	MDD (gm/cm^3)	FSI (%)	Swell Potential (%)	Swell Pressure (kg/cm^2)
A	143	99	32	1.385	206	18.93	1.65
A+5FA	139	93	30	1.412	182	15.25	1.35
A+10FA	128	79	29	1.427	159	14.63	1.30
A+15FA	120	70	27	1.442	129	13.90	1.25
A+20FA	107	54	26.5	1.455	103	12.93	1.10
A+3L	127	65	35	1.338	135	7.43	0.65
A+5L	114	45	37	1.300	106	5.27	0.55
A+8L	106	32	38.5	1.267	82	4.39	0.45

Swelling properties

FSI was obtained as the ratio of the difference in the final volumes of soil in water (*Vw*) and in kerosene to the final volume in kerosene (*Vk*) expressed as a percentage. It is written as,

$$\text{FSI (\%)} = \frac{Vw - Vk}{Vk}$$

Table 3 shows variation of the FSI according to the lime and fly ash content. The free swell index decreased considerably with an increase in lime and fly ash content. With addition of 20% fly ash, the FSI decreases by about 50% and with 8% lime, FSI decreases by about 60% from initial value.

Swelling potential has been used to describe the ability of a soil to swell, in terms of change in thickness and swelling pressure is the pressure required to prevent swelling of the sample under inundated condition. For swelling tests, cylindrical specimens were prepared at maximum dry unit weight and optimum moisture content of the soils, soil-fly ash and soil–lime mixtures. About 60mm inner diameter and 20mm height mold was used to prepare a minimum two samples for each combination of soils for swelling tests and the tests are conducted in conventional one dimensional consolidometer.

Table 3 shows values of swelling potential and swelling pressure for different combinations. Fig.2-a and b shows the percentage decrease in swell potential and swell pressure for different combinations of lime and fly ash used. Both the swell potential and swelling pressure decrease with an increase in lime and fly ash content. At low percentages of lime and fly ash, a greater decrease occurred in the swell potential and swelling pressure.

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When the fly ash content is increased to 20%, both the swell potential and swelling pressure decreased by about 32% and 35% respectively. But addition of lime shows greater reduction in swell potential and swell pressure as compared with fly ash. When lime content increased to 8%, both swell potential and swell pressure reduces by about 75%. These results show that lime is more effective in reducing swelling properties of an expansive soil than fly ash used in this study.

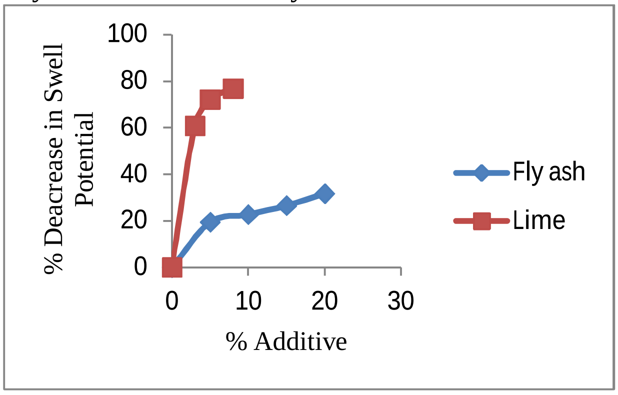

Fig 2-a

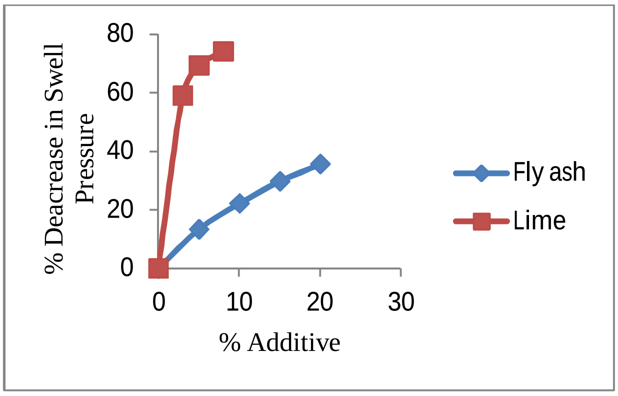

Fig 2-b

Strength properties

Unconfined compressive strength test was conducted to study the strength properties of stabilized soil. After mixing with required amount of water corresponding to OMC, the samples were statically compacted to cylindrical samples of 38 mm diameter and76 mm height. The compacted samples were wrapped in polythene sheets, so as to prevent evaporation, and allowed for curing to the required number of days in desiccators at room temperature. Tests were conducted on samples after curing periods of 0, 3, 14, and 28 days. The UCC test for all the samples were conducted at a strain rate of 1.25 mm/min, as a strain-controlled test and tested till failure.

The stress-strain curves obtained from unconfined compressive strength test is shown below. From fig. 3-a to fig. 3-c, lime treated samples with different curing time is presented. Fly ash treated samples are shown from fig. 4-a to fig 4-d. Distinct time dependent behavior can be seen on the addition of lime and fly ash at all percentages. On addition of lime, soil becomes brittle and the stress strain curve shows stiffer behavior. For all the lime mixed samples maximum strength gain was observed within 3 to 7 day itself and after that strength increases gradually with more curing period. Similar result was also reported by S. Bhuvneshwari et al. (2013). Fly ash treated samples also show increase in strength with curing period but they show less brittle behavior and strength development than lime treated samples.

The untreated soil which had unconfined strength of 1.045kg/cm^2 is increased to 2.342 kg/cm^2, 3.645 kg/cm^2 and 4.057 kg/cm^2 after 28 days of curing for 3%, 5% and 8% lime treatment respectively. For 5%, 10%, 15% and 20% fly ash treated samples these values are 1.364 kg/cm^2, 1.967 kg/cm^2, 2.097 kg/cm^2 and 2.375 kg/cm^2 respectively for 28 days cured sample.

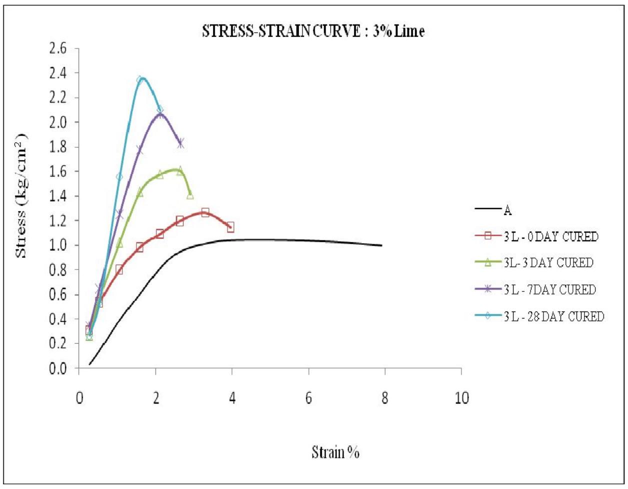

Fig 3a

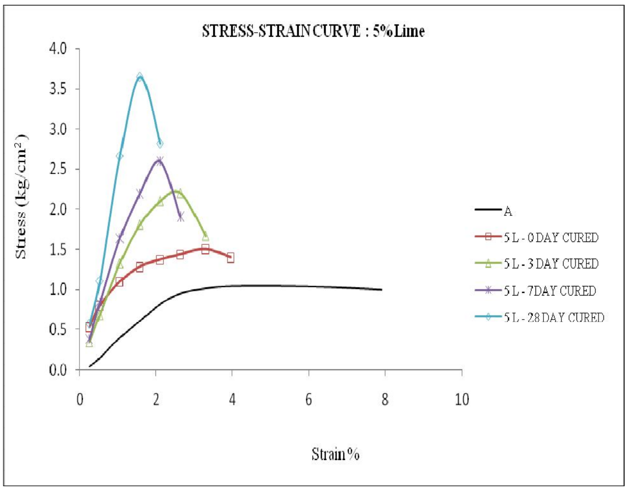

Fig 3b

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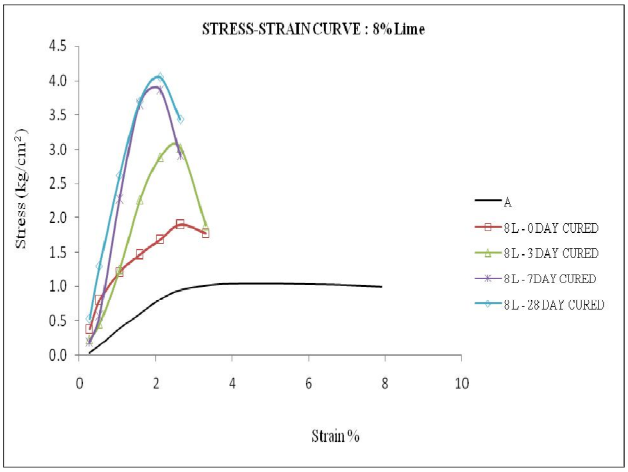

Fig. 3-c

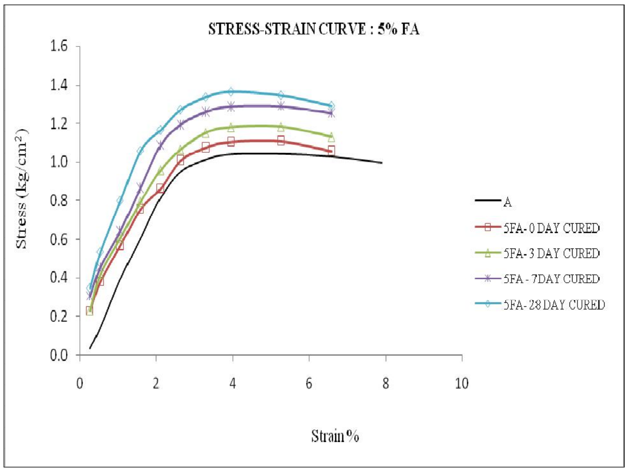

Fig. 4-a

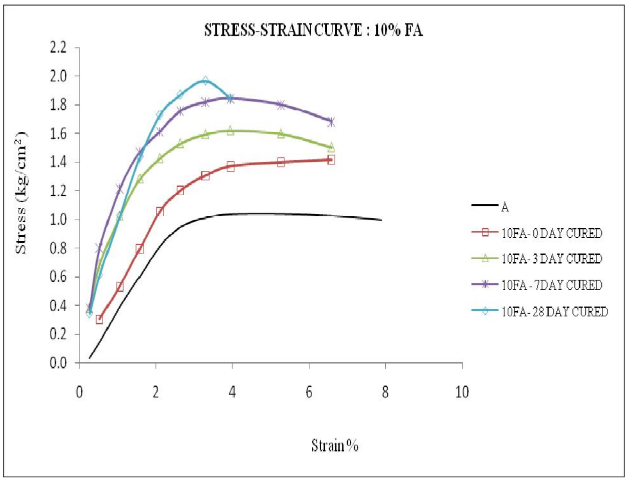

Fig. 4-b

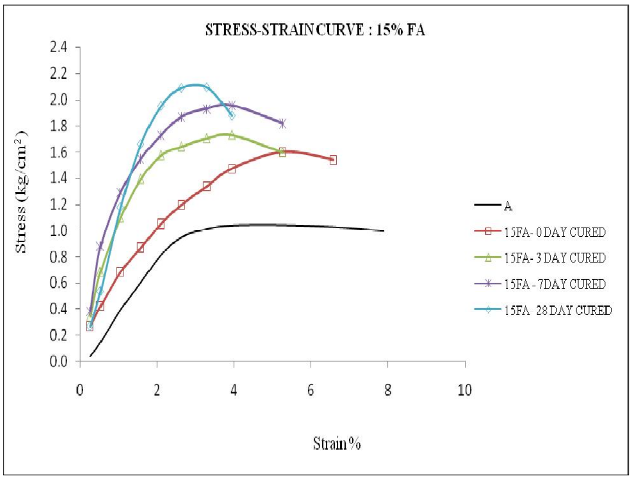

Fig. 4-c

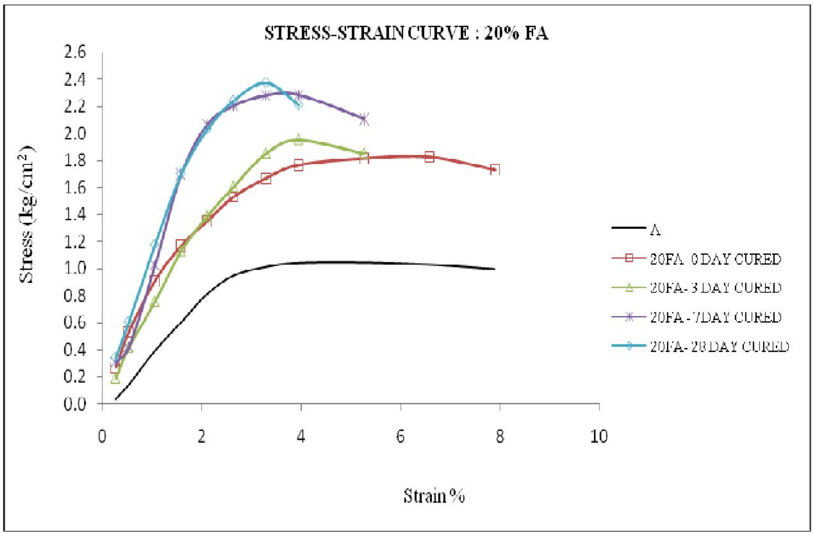

Fig. 4-d

Consolidation properties

Primary consolidation test was conducted in conventional one dimensional consolidometer on both treated and untreated samples. Compression index (C_c), which is the slope of the linear portion of the *e*-log σ curves (Fig.4), indicates the amount of compression undergone by the soil samples. A decrease in the value of C_c is observed for both lime and fly ash treated samples with increasing additive content and it is shown in fig.5. As the lime and fly ash content increased, the clay-lime and clay–fly ash blend would try to resist the compressive loading better and consequently show lesser compressibility characteristics. When treated with 8% lime, C_c value decreased by about 36% and with 20% fly ash, a reduction of 20% in C_c value is observed.

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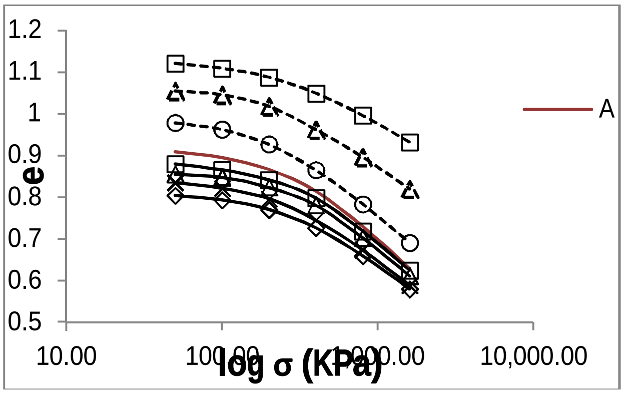

Figure 4: *e*-log σ curves for different cases

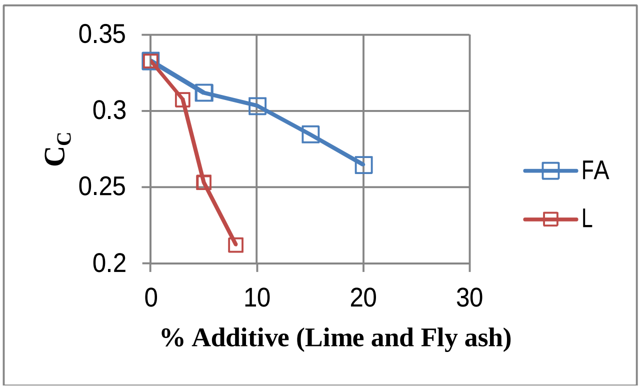

Figure 5: Variation of Cc with different % of additive

4. CONCLUSIONS

Effect of lime and fly ash on engineering properties of an expansive clay soil has been studied. From the test results following conclusions can be drawn.

1. Addition of lime and fly ash reduces the plasticity characteristics of expansive soil. Liquid limit decreases and plastic limit increases with addition of lime and fly ash. Free swell index of expansive soil reduces significantly with addition of lime and fly ash.
2. OMC of expansive soil increases and MDD decreases with addition of lime. However, with fly ash addition MDD increases and OMC reduces with increasing fly ash content.
3. Swelling potential and swelling pressure reduces with addition of lime and fly ash. Both values showed greater reduction in lower percentages of additives. However lime treatment resulted in more reduction in swelling characteristics than fly ash treated samples.
4. Unconfined strength values increases significantly with addition of increasing lime and fly ash content. For lime treated samples maximum gain in strength is observed for 8% lime content and for fly ash treated samples maximum strength is observed for 20% fly ash content. Increases in strength with lime treated samples are found to be more than the fly ash treated samples. Time of curing plays an important role in strength gain property. With curing period strength increases but maximum increase is observed within 3 to 7 days curing period.
5. Lime and fly ash stabilization improves consolidation properties of expansive soil. Compression index reduces with increase in additive content. However decrease in compression index value is more for lime treated samples than the fly ash treated samples.

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International Journal of Research in Science and Technology
Volume 2, Issue 2 (I) : April - June , 2015
ISSN 2394 - 9554

LATERAL LOAD CARRYING CAPACITY OF MICROPILE

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ABSTRACT
Micropiles are small diameter pile (diameter<30cm). They are widely used for foundation rehabilitation, to resist static and seismic loading, in slope stabilisation. As the micropile are of less diameter and having high slenderness ratio, the lateral load carrying capacity of micropile is an important aspect for assessing the performance of micropile. In this present research study, the lateral load carrying capacity of micropile and group of micro piles is studied and analysed in clay soil. The effect of number of micropiles and their spacing in a group of micropiles is found out. The micropile are tested at a spacing's of 3times, 4.5timesand 6 times the diameter of micropile. Single micropile and 4 and 9 number of micropiles are taken in different spacing. It was found that load carrying capacity of micropile increased significantly with the increase in number of piles. Further lateral load carrying capacity also increased with increase in spacing.

Keywords- Micropile, Lateral, Spacing

INTRODUCTION
A micropile is drilled and grouted and is highly reinforced small diameter pile. Micropiles are installed by methods that cause minimal disturbance to adjacent structures, soil, and the environment. They can be installed in access- restrictive environments and in all soil types and ground conditions. Micropiles can be installed at any angle below the horizontal using the same type of equipment used for ground anchor and grouting projects.

Micro-piles can be advantageous for construction in seismic areas, mainly due to their flexibility, ductility and capacity to withstand extension forces. Micro-piles are used to support the foundations of both new structures and existing structures, which have suffered seismic damage (see Pearlman *et al.*, 1993, Juran et al, 2001 and Shahrour and Juran, 2004). Ousta and Shahrour (2001) analysed a single micro-pile and group of micro-piles in saturated soils using a cyclic elastic-plastic constitutive model. Sadek and Shahrour (2004) investigated the influence of pile inclination on the seismic behaviour of a micro-pile group. Wong (2004) investigated the seismic behaviour of micro-piles using different levels of soil non-linearity, load intensities and frequency contents and pile inclinations. The influence of pile head and tip connections on the dynamic response of micro-pile supported foundations was studied by, for example, Sadek and Shahrour (2006) using a 3D finite element scheme and considering both vertical and inclined pile.

A number of reduced scale and full-scale micro-pile tests have been reported in the literature. Yamane *et al.* (2000) conducted lateral and vertical load tests on various full scale micro-piles. Yang *et al.* (2000) tested a single reduced scale micro-pile installed in dry sand on a shaking table. Juran *et al.* (2001) tested a single reduced scale micro-pile, micro-pile groups, and micro-pile networks in the centrifuge. The lateral performance of micro-pile groups and micro-pile networks was assessed in the field by Geosystems, L.P. (2002). Each of the preceding studies has considered various micro-pile inclinations, pile numbers, and loads.

SCOPE OF THE PRESENT STUDY
a) To find out the lateral load carrying capacity of micropile.

b) To find out the effect of spacing's and number of micropile in a group of micropile in lateral load carrying capacity.

Material and Equipment

The materials required for carrying out the model tests were as follows:
a) Clay soil,
b) Cement (OPC) - 43 grade,
c) Water
d) Rod of diameter 4mm used as reinforcement
e) String rod

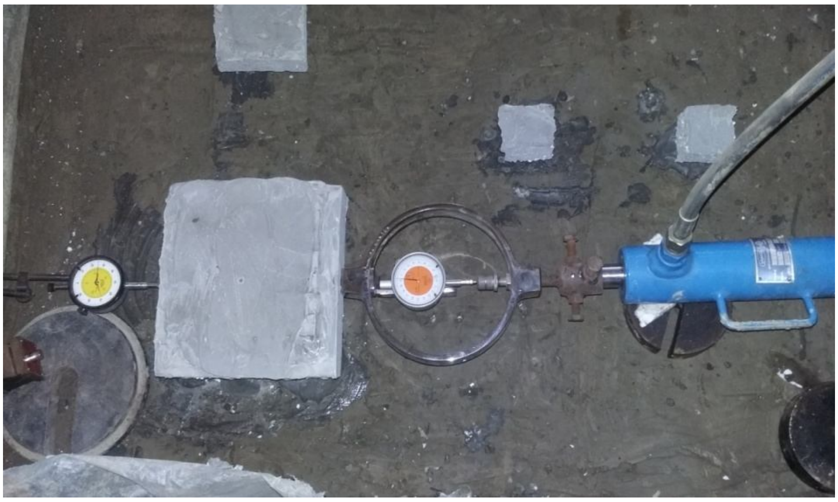
The equipment's used for the construction of the model set ups were as follows:
a) Tank of dimension 1m x 1m x 1m
b) Augers 16mm
c) Injecting (grouting) device

ISSN 2394 - 9554

d) Hydraulic jack
e) Proving ring
f) Dial gauges
g) Stop watch

2. METHODOLOGY

The lateral load carrying capacity of micro pile is studied in a tank of dimension 1m x1mx1m in clay soil. Micropile are having diameter of 16mm and length of 45mm. Single micropile and group of micropile bearing four number of micropile, nine number of micropile are tested in a spacing of 3times, 4.5times and 6times the diameter of micropile. Each micro-pile was comprise of cement grout with water cement ratio of 0.45 and a 4mm diameter concentric steel reinforcement bar extending from the pile head to toe. The water content of the clayey soil is kept between plastic limit and liquid limit and the water content is 45%. Lateral load were applied by a hydraulic jack and measured by proving ring and the corresponding deflection was measured by dial gauge. Lateral load is applied in the middle of the pile cap which is constructed above the ground surface and the corresponding deflection is noted down.



Experimental set up for Micropile lateral load capacity

Diagram showing tank, hydraulic jack, proving ring, dial gauge

Table1: Index properties of Soil

Liquid Limit	62%
Plastic Limit	35%
Specific Gravity	2.43
Coefficient of uniformity (Cu)	2.69
Coefficient of curvature (Cc)	0.71
Optimum Moisture Content (OMC)	31%

 ISSN 2394 - 9554

TEST PROCEDURE

The procedure for the installation of micropiles was explained in a sequential order below:-

1. Positions of the micropiles on the soil block are marked with the help of pins on the plan.
2. Drill holes of 16 mm diameter and 400mm length with the help of auger.
3. The height of the micropile was extended up to 30mm above the ground surface using removable plastic casing of internal diameter of 16mm.
4. Neat cement grout having water: cement ratio of 0.45 was injected into the drilled hole with the help of injecting device.
5. A reinforcement rod of 4 mm diameter is centrally inserted up to the bottom of the micropile.
6. One day after pile casting, pile cap of depth 30mm are constructed above the micropile groups using formworks.
7. Seven days after the installation of micropile, lateral load test are carried out.
8. Loads are applied and increased gradually through the hydraulic jack and is measured by proving ring and the corresponding deflection is noted down at an interval of 5mins.
9. Failure load is finally noted down for different micropile groups.

RESULTS AND DISCUSSIONS

The experimental results obtained from the laboratory tests are discussed in this section. The lateral load carrying capacity of single, four and nine number of micropiles in a group were tested at 3D, 4.5D, and 6D times the diameter of micropile. It is found that load carrying capacity increased significantly with the increase in number of pile at 3d, 4.5d and 6d spacing. Lateral deflection decreases for the corresponding load with the increase of number of pile at different spacing.

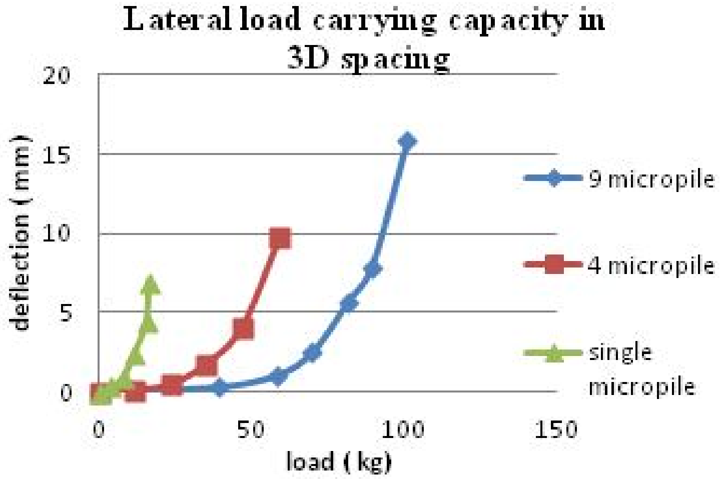
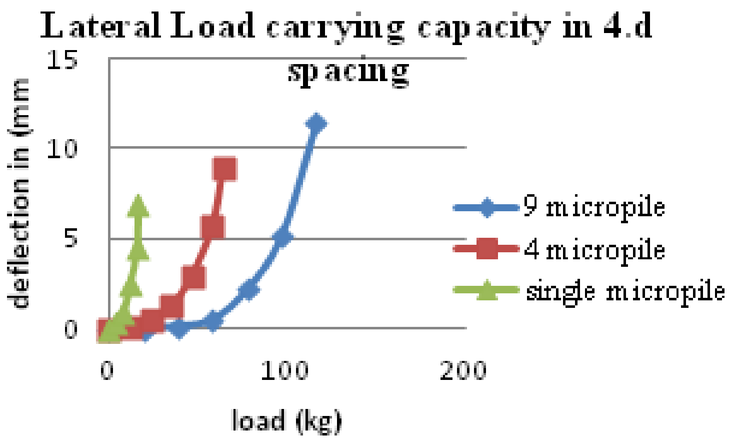


Figure: 1



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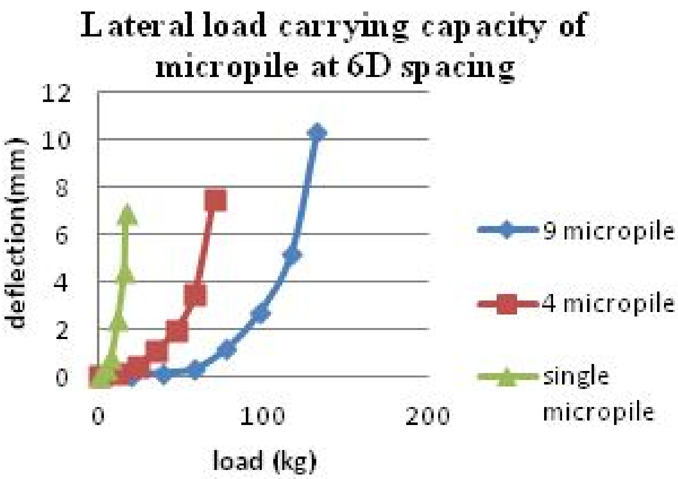

Figure: 3

Further it was found that with the increase in spacing, micropile lateral load carrying capacity increases. Deflection decreases for the corresponding load as the spacing of micropile increases

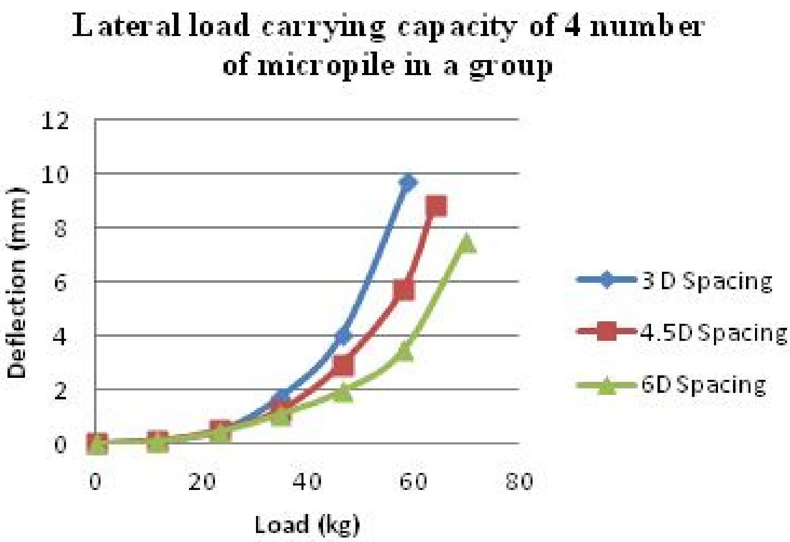

Figure : 4

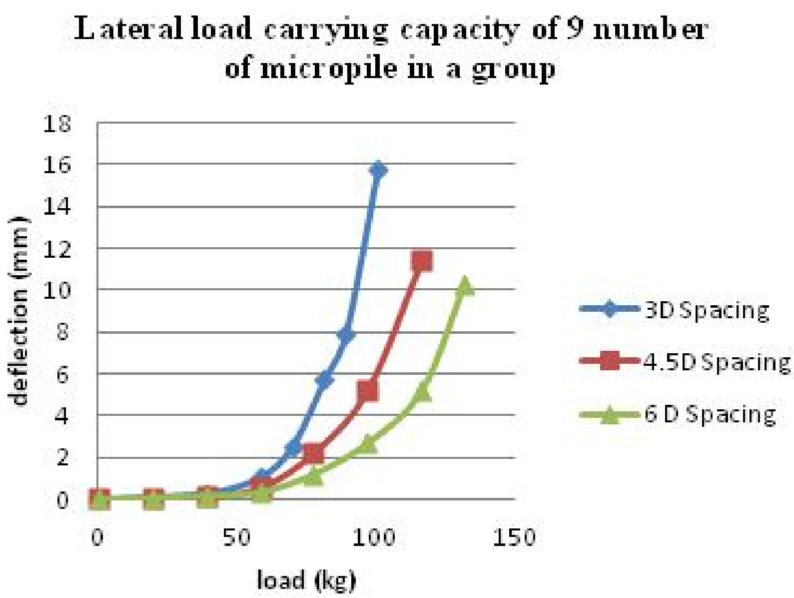

Figure: 5

Failure pattern of clay soil after Micropile group bearing 9 number of pile Lateral load test

CONCLUSION

The paper has presented experimental results for lateral load carrying capacity of micropile at different spacing and different number of pile in a group of micropile. Although there may be some scaling effects, the results of the model tests provide basic information about the lateral load carrying capacity of micropile. Based on the results of model tests, the following conclusions are drawn

1) The total number of piles in a group has significant influence on the efficiency of micropile group. The greater the number of micropile in a group, the greater will be the lateral load carrying capacity.
2) The greater the spacing between micropile in a group, the greater will be the lateral load carrying capacity of micropile. This is due to the fact that the reaction area of the soil behind each micropile is larger; therefore the interaction region among the piles (i.e. the overlapping reaction areas) becomes smaller. Hence the lateral capacity of the group of micropile becomes greater.

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International Journal of Research in Science and Technology
Volume 2, Issue 2 (I) : April - June , 2015
ISSN 2394 - 9554

A STUDY ON PROPERTIES OF HIGH STRENGTH CONCRETE WITH PARTIAL REPLACEMENT OF FINE AGGREGATE WITH MARBLE DUST

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1. ABSTRACT

The marble has been commonly used as a building material since many years. Disposal of the waste materials of the marble industry, consisting of very fine powders and dust, is one of the environmental problems till date. These waste materials can be successfully and economically utilized to improve some properties of hardened high strength concrete (HSC). In this experimental study, the effects of using waste marble dust (WMD) as the partial replacement of fine aggregate material on the high strength concrete have been investigated.

To achieve HSC use of quality materials, smaller water-cement ratio, larger ratio of coarse aggregate (CA) to fine aggregate (FA), smaller size of coarse aggregate and suitable admixtures with their optimum dosages are found necessary to produce HSC. In this study, the targeted strength of concrete was 70 MPa. Different mix designs were prepared with different proportions of silica fume and superplasticizer.

Key words: HSC, WMD, Fine aggregate.

2. INTRODUCTION

Concrete, a composite consisting of aggregates enclosed in a matrix of cement paste including possible pozzolans, which has two major components – cement paste and aggregates. The strength of concrete depends upon the strength of those components, their deformation properties, and the adhesion between the paste and aggregate surface. With maximum natural aggregates, there is possibility of making concretes up to 120 MPa compressive strength by improving the strength of the cement paste, it can be controlled through the choice of water-cement ratio and type and dosage of admixtures. However, with the recent advancement in concrete technology and the availability of various types of mineral and chemical admixtures, and special superplasticizer, concrete with a compressive strength of up to 100 MPa can now be produced commercially with an acceptable level of variability using ordinary aggregates. These developments have led to increased applications of high-strength concrete (HSC) all around the globe. The bottom range of the strength of HSC varies with time and geographical location depending primarily on the availability of raw materials and technical know-how, and the demand from the industry. In spite of the rapid development in concrete technology in recent years, concretes with compressive strength higher than 40-60 MPa is still regarded as HSC. In the North American practice, high strength concretes are those that attain cylinder compressive strength of at least 41 MPa at 28 days. In the state of the art report on high strength concrete, it is defined as concrete having a 28 days cylinder compressive strength of 60 MPa are the HSC.

All natural stones that industrially can be processed as cut to size, polished, used for decorative purposes and economically valuable are marbles. India, Belgium, France, Spain, Sweden, Italy, Egypt, Portugal and Greece are among the countries with considerable marble reserve. India has 40% of total marble reserve in the world. In India 43000 tons of marble have been produced annually and 75% of these production have been processed in nearly 4000 processing plants. It can be apparently seen that the waste materials of these plants reach millions of tons. 3172 thousand tons of marble dust was produced in 2009-2010 in India.so this waste can be utilized in construction industry successfully. Use of marble dust as a partial replacement of fine aggregate in the concrete with addition to it admixtures and pozzolanic materials are also added, properties of concrete can be increased.

3. SELECTION AND USED MATERIALS

The selection of materials for high strength concrete is very important, a low quality material can make a big difference in the strength to be achieved .Materials used in this experiment were locally available and were took carefully to attain the required strength. They were Ordinary Portland Cement (O.P.C), river sand and marble dust, machine crushed granite as coarse aggregate, silica fume as pozzolanic material and conplast Sp 430 as superplasticizer. Potable water was used for mixing and curing.

3.1 CEMENT

Ordinary Portland cement 53 grade was used conforming to IS 8112 – 1989 and physical property are as compressive strength is 49.35 MPa for 28 days test result, specific gravity is 3.14, and fineness as 6%.

3.2 FINE AGGREGATE

River sand conforming to zone-III was used, as per I.S 383-1970. The sand was air dried and free from any foreign material, earlier than mixing.it is sieved and 2.36 mm passed and 1.18 mm retained was used. Physical properties of fine aggregate used are specific gravity 2.68, fineness modulus 2.45, water absorption is 0.80%.

3.3 COARSE AGGREGATE

Crushed granite was used as coarse aggregate. Maximum size of coarse aggregate is 12.5 mm and minimum size is 10 mm. round shaped coarse aggregate was selected to achieve HSC.

3.4 SILICA FUME/MICRO SILICA

A fine particle size and high purity of Silica fume content is used & manufactured by Astrra Chemicals Chennai. Specific gravity is 2.65

3.5 SUPER PLASTICIZER

Conplast Sp 430 is the superplasticizer used. An aqueous solution of sulphonated naphthalene formaldehyde condensates is used. It is manufactured by Fosroc chemicals Ltd.

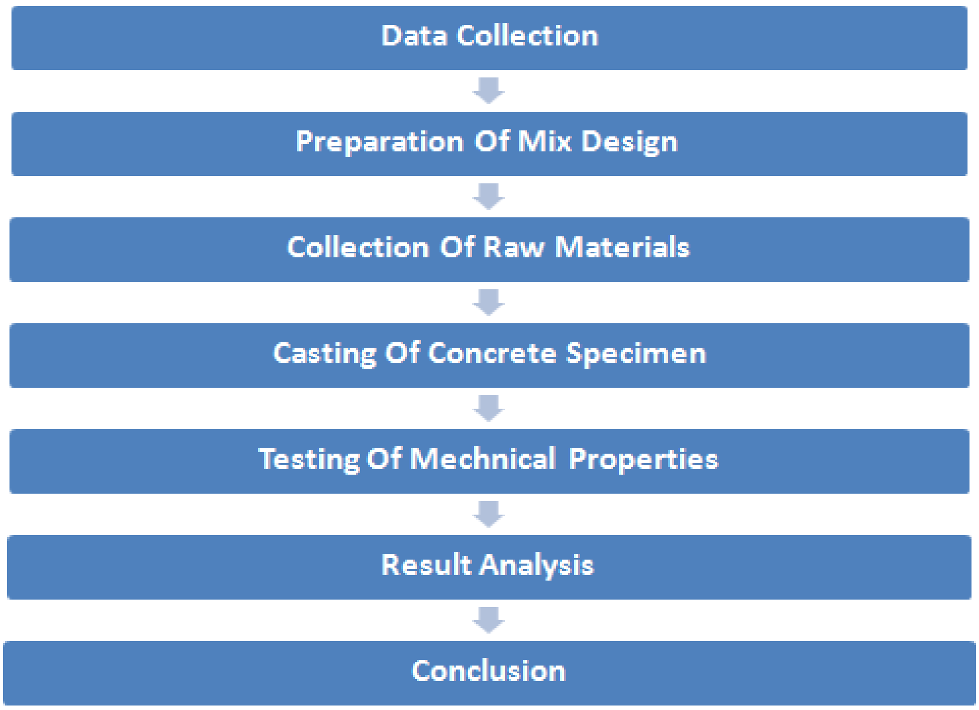
3.6 MARBLE DUST

A fine powder is taken, which is left after the cutting of marble is taken from the downs of leading manufactures in Rajasthan. Specific gravity is 2.62

3.7 WATER

Tap water was used for casting and curing of the concrete specimens

4. METHODOLOGY



4.1 MIX DESIGN

The control mixes were made for M70 grade concretes. The various ingredients used in the mixes are as per table-1.

4.2 CASTING OF SPECIMENS

Casting of Specimens was done by batching of materials, preparation of moulds and placing of concrete in the moulds.

4.3 BATCHING

A proper mix of concrete is essential for the strength of the concrete. Before the concreting, all the mix material were weighed and kept ready for concreting as per design mix proportions.

4.4 PREPARATION OF CONCRETE MOULDS

Concrete moulds were oiled for easy stripping. The moulds for conducting tests on fresh concrete were made ready and inner surfaces were oiled.

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4.5 PREPARATION OF CONCRETE

Concrete was mixed in the pan mixer and dumped in a metal tray placed on a flat surface.

4.6 TESTS ON FRESH CONCRETE

Super plasticizer was used at 1.5% by weight of Cement and Compacting factor was found to be 0.85 with waste marble dust, silica fume has exceeded 2% the mix is found to be not cohesive.

4.7 PREPARATION OF SAMPLES

During the placing of fresh concrete into mould, proper care was taken to remove entrapped air by using a table vibrator to attain maximum strength. Vibrator was used after every 1/3 filling of material into the mould and the top surface was properly levelled at the end.

4.8 DEMOULDING

After levelling the fresh concrete in the moulds, it is allowed to dry for 1 day. To identify concrete specimen marks were done with permanent markers and the specimens were removed from the moulds. The moulds were cleaned and kept ready for next batch of concrete mix.

4.9 CURING

Curing is an important process to prevent the concrete specimens from losing their moisture while they are gaining their required strength. All concrete specimens were cured in water at room temperature for 3, 7 and 28 days. After curing, concrete specimens were removed from the curing tank and air dried to conduct tests on hardened concrete.

5 RESULTS

The results obtained from the experimental investigations are tabulated below. The results have been analysed and the graphs showing the strength variations are plotted. The effect of partial replacement of fine aggregate with marble dust is discussed herein.

A. Compressive Strength

1.1. It has been observed that with addition of marble dust the compressive strength of concrete at 3, 7 days and 28 days are more than that of controlled specimens (Tables 2 & 4).
1.2. It has been observed that the compressive strength of concrete at 3, 7 days and 28 days are maximum with 10% marble dust

B. Flexural Strength

1.1. It is observed that with addition of marble dust the flexural strengths of concrete at 3, 7 days and 28 days are more than that of controlled specimens (Table 3 and 5).
1.2. The flexural strengths of concrete at 3, 7 days and 28 days are maximum with 10% marble dust.

C. Split Tensile Strength

1.1. It has been observed that with addition of marble dust the split tensile strength of concrete at 3, 7 days and 28 days are more than that of controlled specimens (Table.6) for M70 grade
1.2. The split tensile strengths of concrete at 3, 7 days and 28 days are maximum with 10% marble dust for M70 grade

Table 1: Summary of Mix Proportion

Designation	Mix	Water (liter)	Cement (kg)	CA (kg)	FA (kg)	Silica fume /superplasticizer (kg/liter)	Mix design
A	M60	182	520	1258	416	78/5.2	1:0.8:1.60 &0.35 w/c
B	M70	170	680	1088	850	102/6.8	1:1.48:1.60 & 0.30 w/c

Table 2: Test Result of M60 Grade Compressive Strength for 3, 7 & 28 Days

S. No	% MD	Compressive Strength		
		3 days	7 days	28 days
A1	0	27.15	42.14	61.26
A2	05	33.7	49.24	63.11
A3	10	34.87	55.45	68.63
A4	15	29.52	43.97	59.09
A5	20	26.22	35.01	52.52

Table 3: Test Result of M60 Grade Flexural Strength for 3, 7 & 28 Days

S. No	% MD	Flexural Strength		
		3 days	7 days	28 days
A1	0	1.25	4.36	5.82
A2	05	1.66	4.37	5.83
A3	10	0.8	4.47	5.96
A4	15	2.23	2.61	4.01
A5	20	1.71	2.78	3.12

Table 4 Test Result of M70 Grade Compressive Strength for 3, 7 & 28 Days

S. No	%MD	Compressive Strength		
		3 days	7 days	28 days
B1	0	34.88	52.59	71.4
B2	5	38.33	57.62	74.42
B3	10	40.16	55.13	73.90
B4	15	39.42	44.39	70.49
B5	20	38.63	52.5	67.33

Table 5: Test Result of M70 Grade Flexural Strength for 3, 7 & 28 Days

S. No	% MD	Flexural Strength		
		3 days	7 days	28 days
B1	0	2.08	4.75	6.32
B2	5	2.36	4.85	6.13
B3	10	2.97	4.92	6.56
B4	15	2.29	3.54	5.13
B5	20	1.54	2.63	3.45

Table 6: Test Result of M70 Grade Split Tensile Strength for 3, 7& 28 Days

S. No	% MD	Split Tensile Strength		
		3 days	7 days	28 days
B1	0	3.84	4.60	6.15
B2	5	3.91	4.65	6.23
B3	10	4.02	4.94	6.55
B4	15	3.72	4.53	6.01
B5	20	2.57	3.21	4.31

Fig 1 variation of flexural strength of M60 grade

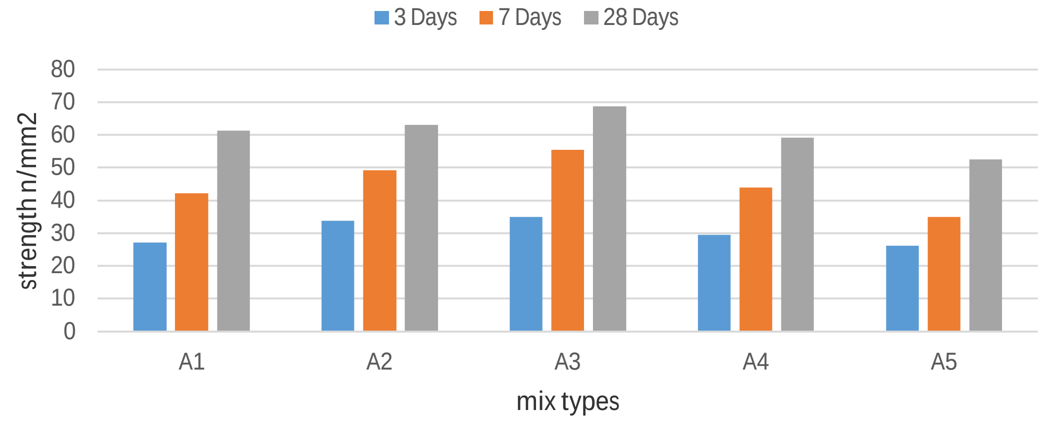

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Fig 2 variation of flexural strength of M60 grade

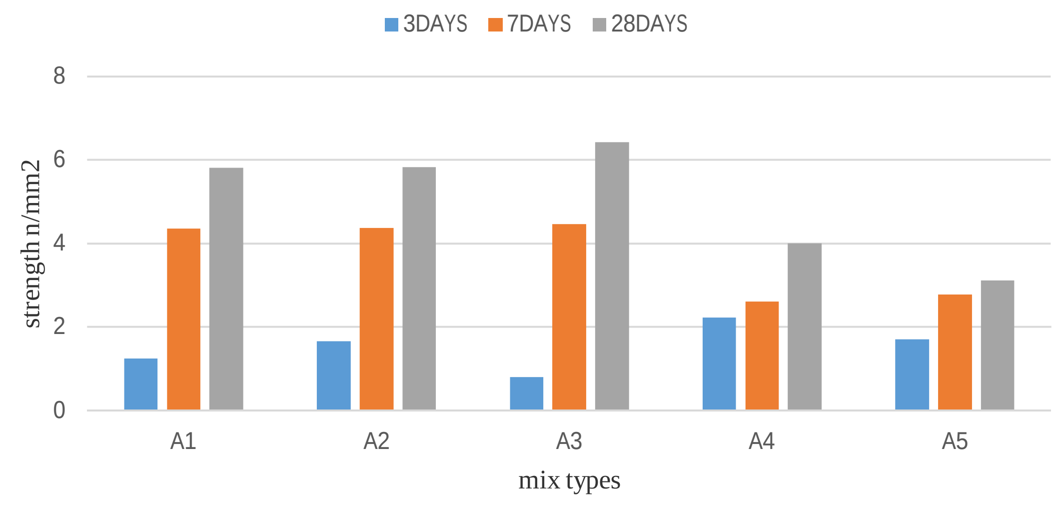


Fig3 variation of compressive strength of M70 grade

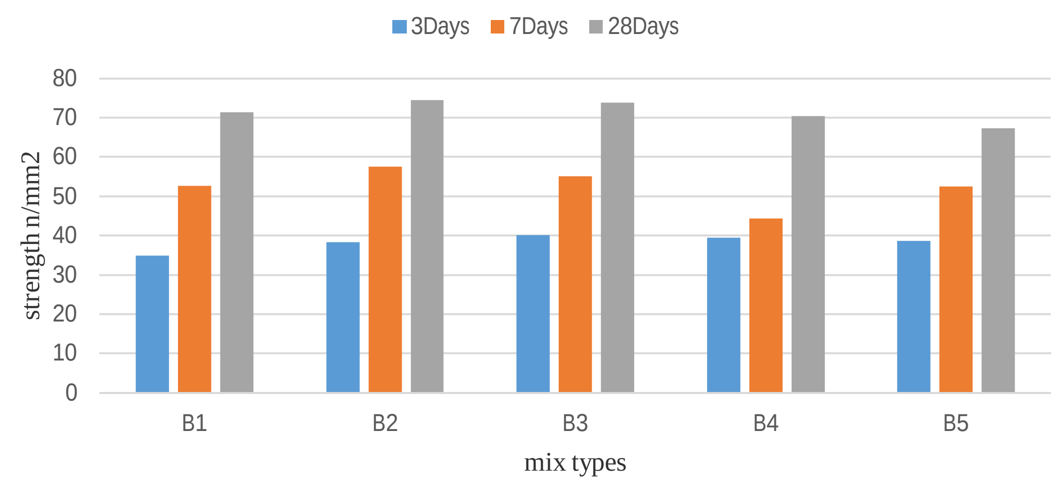
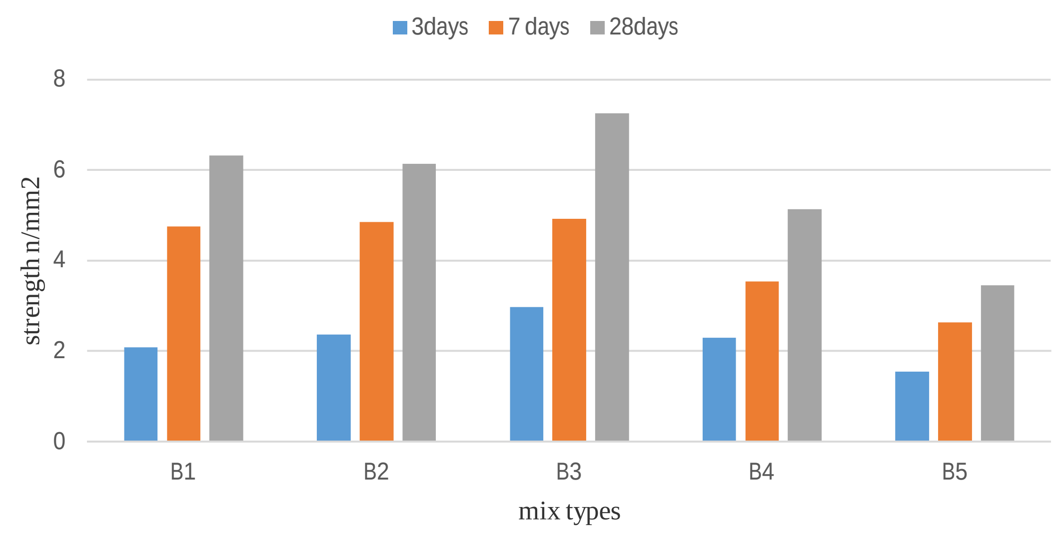


Fig4 variation of flexural strength of M60 grade



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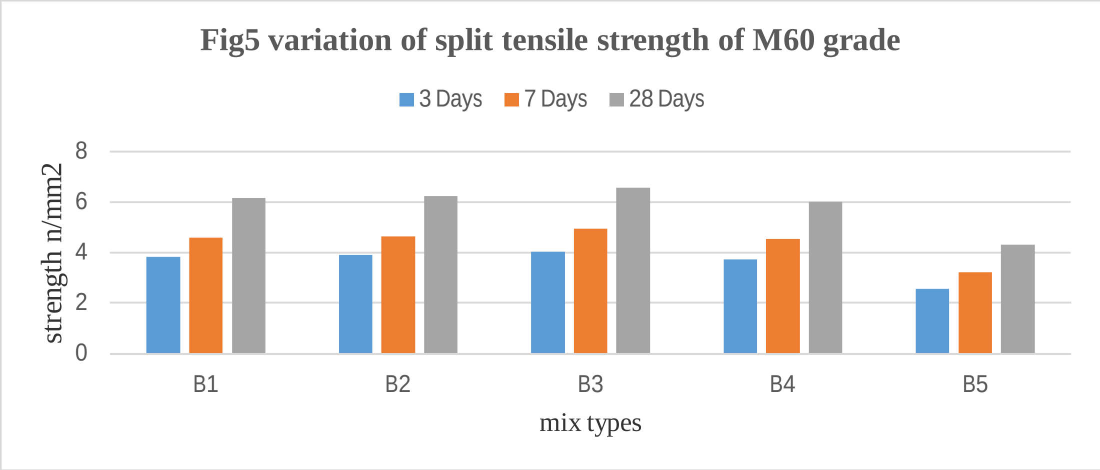

6. DISCUSSION

1. The compressive strength of concrete had shown an increasing trend with the increase in the quantity of Marble dust up to 10% but the increment was stopped when the strength decreased i.e. beyond 10% of marble dust
2. The percentage increase in compressive strength and split tensile strength of concrete with the marble dust at 10% more compared to control concrete.
3. The increase in flexural strength is only 2% compared to control concrete.

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International Journal of Research in Science and Technology
Volume 2, Issue 2 (I) : April - June , 2015
ISSN 2394 - 9554

AN INTEGRATED MEASUREMENT AND MANAGEMENT OF CUSTOMER FACILITIES IN CONSTRUCTION INDUSTRY

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1. ABSTRACT

Customer satisfaction is one of the most important factor in construction industry where the project success is based on the customer. The relation between customer facilities and project performance were investigated by project teams. Customer facilities is said to be either as a goal or measurement tool in the development of quality. The purpose of this study is to explore empirically the customer's main satisfactions and dissatisfactions factors. This paper includes customer satisfaction manual where it shows the feelings of the customer on the particular company which they have selected. This paper also deals with the complaints handling and management as essential for achieving good customer satisfaction and loyalty. As customer facilities it is the most challenging task in both public and private sectors, so it shows the every organization sole purpose. Company's success rate is based on what percentage of their customer's they can keep. It would be a great help if we measure the quality of product and service, by relating the measures of quality to real customer behaviour. Some companies get feedback of customer facilities and satisfaction through their customer facility manual and based on survey of every feedback of customer given companies will be deciding the win or lose percentage in construction industry.

Keywords: Customer satisfaction, Customer facilities management, Customer satisfaction survey.

2. INTRODUCTION

The need for customer facilities in the recent days have been increasing enormously since everyone is looking for the satisfaction. Improving customer satisfaction was identified as one of the most important challenges facing businesses in the 1990s. Thus to serve the customer's there is need to measure the several factors in facilities performance. This paper will discuss some of the important facilities management customer related processes and mechanisms associated with its measurement identified through a series of case studies carried out as part of a customer satisfaction. It is always important to respect customers in construction sector.

Therefore it is important to examine whether and how quality affects supplier profitability as well as how it affects customer satisfaction. Among the potential performance drivers, customer satisfaction has attracted the most attention from both practitioners and researchers. This is not surprising, senior executives from 148 financial services firms ranked customer relations as the most important driver of firm's duration percentage success. So it is said to be major criteria for a firm to consider customer satisfaction in their objectives. Customer satisfaction is the output result for a firm to say that the company product or service has reached to maximum people.

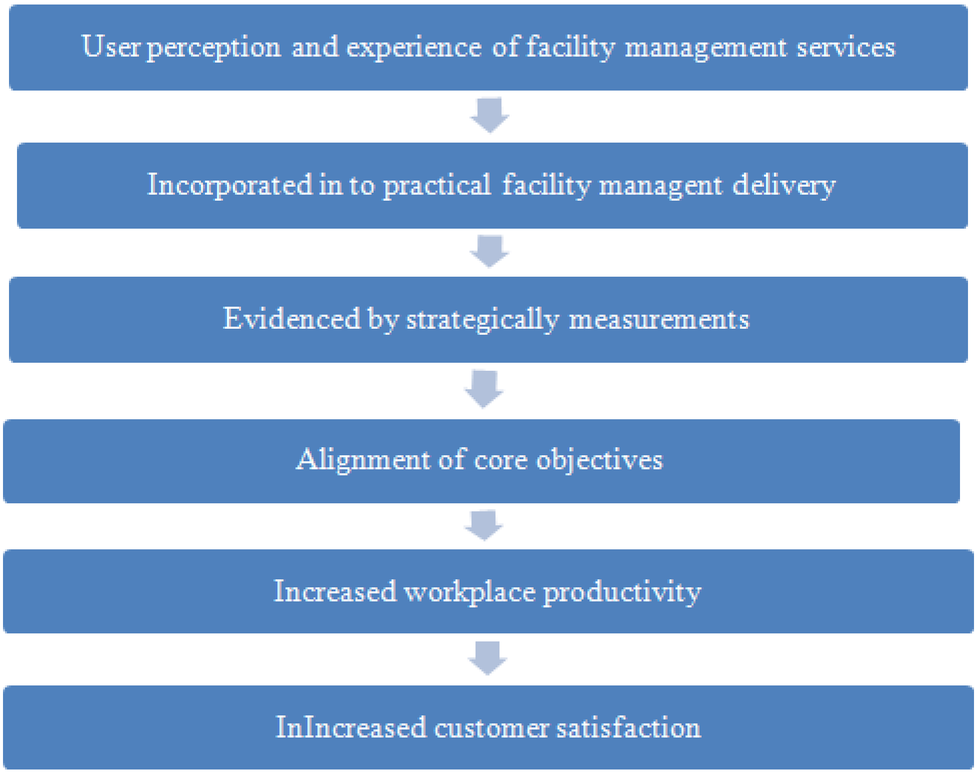
3. PERFORMANCE MEASUREMENT STUDY

As per study, paper states that measurement can be done by taking benchmark in to the consideration, so that we can measure facilities performance. For cost reduction method, benchmarking is essential where the principle of benchmarking is to allow managers to place their performance measurement in context.
Benchmarking is the search for industry best practices that lead to superior performance. In order to achieve this, the basic steps that are fundamental to benchmarking success.

1. Know your operation- evaluate internal operation strengths and weakness.
2. Gain superiority- go beyond the best practices installed and be the best of the best.
3. We should know the strengthens and weakness of the competition.
4. We should be aware of strengths of leaders in the competition.

Above factors may be either internally focused or external focused. so the pressure is on facility management teams that value customer issues such as delivery of product quality. Now it also fails to take into account how an organization works to strategy level as it prefers to worker or workplace perspective. The importance of benchmarking against

1. The best you can find whether within your industry or outside.
2. What is relevant to your customer's view of what is important?
3. That thing that affects financial performance.



However, questions to be asked as an ongoing research project before applying a benchmarking technique are as follows

1. How do customers value the service performance and how is it distinct from the service itself?
2. What are the mechanisms to measure the service performance and how is it measured?
3. How does one differentiate between the appreciation of service provided and the physical environment?

It is important to note that pleasing is a most important thing to follow in construction industry, because it will thought out approach to work beyond more basic requirements and to develop relationships with the customers in long-term. And this paper states that customer satisfaction is not an absolute scenario, it is most depend on interactions, feedback, praise and complaints where complaints have to be solved by checking the error occurred and to be looked on construction and professional point of view.

1. They are for receiving feedback and putting that efforts into improve the plans
2. They play a vital role for preventing compliances and effecting internal competencies for optimizing products and services.
3. They are a useful way of measuring performance and allocating resources to deal with the deficient areas of the business.
4. They are a useful "mirror" for gauging internal performance against competition and best in class organizations.

Many organizations in the present market is based on the only one formulae which is "customer is king" which means whole purpose of the organization is to serve the customers what they need than thinking about higher profits , they are thinking about good will of the organization

3.1 Creating A Customer-Based Culture:

Following a customer based culture nowadays should be accepted as a bare need to conduct business and some organizations would say it is license to practice only. Companies need to say that they are really focused on their customer's needs and actions. There are several statements on papers

1. These statements will say about how the senior managers are keen about the customer based culture and how they are serious about the customer, how senior managers are assisting workers about discipline and degree of seriousness.
2. Customer focus is statement of intent. It signals that the organization is willing to challenge status quo and embrace new concepts and management disciplines. Adopted by world class organizations.

3. It also means creating new systems, procedures and guidelines and adhering to the theme of servicing customer's to people's best ability, by doing the right things right first time and on time.

4. Finally, Customer focus is really a state of mind rather that absolute concept which indicates optimized performance and reaching the pinnacle of success.

Actually they are some basic questions being asked like, who is the customer or what is the customer? it says like customers are the purpose of what we do today and what we do in the future and what we did in past .

3.2 Customer satisfaction versus dissatisfaction

It's simple if companies manage the dissatisfaction it automatically increases customer satisfaction. Customer dissatisfaction is mainly about dealing with complaints you got and realizing that the customers are aware of response. Customers mainly deals with how we go about providing services to them and they compare us with others. So this has to be done to satisfy the customer minds that the company is up to date and using most recent teams. Once we provide them a good service surely they will be curious about our next projects, mouth publicity really does matters so good will of the company is most important when we compare to customer satisfaction.

1. As earlier said, satisfied customers will be willing to share their experience with friends and as same customers who felt dissatisfied with the response will be likely to say more people than the satisfied customers. So dissatisfaction causes more damage than the happiness given by satisfied customers.

2. Further it also differs from one sector to another sector.

3. As per survey, companies which believe in solving with the customer's complaints is extravagant , they have to realize that it costs extra 25 percent to business with new customers.

   Satisfied customers are always interested to come back to do business with the company, at the same time dissatisfied customers will be always willing to go for another industry or company. And also some basic things need to be followed.

1. Products and services should be taken carefully

2. Encourage others to buy from you and

3. Believe that what they buy from you is worth what they pay for it.

Companies need to measure customer satisfaction if they need to achieve long term profit, because without measuring we cannot know the difficulties in certain topic. Some techniques are adopted to measure customer satisfaction.

1. Customer satisfaction survey methodologies,

2. Focus groups to study customer satisfaction issues,

3. Standardized process for measuring customer satisfaction,

4. Various computer software

While doing customer satisfaction survey, several problems are faced like analytical and behavioural where analytical concerns with formal procedures, techniques, systems and behavioural concerns with the attitudes, belief's, perceptions and motivations.

3.3 Why customer satisfaction is important?

A person may called as a market trader will have a full knowledge about what is happening in and out of the company about customer satisfaction , he has to maintain direct contact with the customers so that he will get unofficial data of what is going right or where it is wrong. Such unofficial feedback is most important in any company because it shows how to concentrate on the customer's further .Developing a customer satisfaction programmer is not just about carrying a survey, because survey provides us information where to focus in term of getting high profit and major long lasting improvements need a fundamental transformation in the company.
There are six steps for customer satisfaction program?

1. Who should be interviewed?

2. What should be measured?

3. How should the interview be carried out?

4. How should satisfaction be measured?

5. What do the measurements mean?

6. How to use customer satisfaction surveys to greatest effect?

3.4 Who should be interviewed?
It depends from business to business, product to product, what would I say if we take example as cigarettes it is very clear who should be interviewed. But if we choose the products which is used in home, some parent is going to buy that and it will be used by the kids, so it is little complex to know who should be interviewed.

3.5 What should be measured?
Here we seek the reviews of customers, from that companies will understand what to be measured and what to ask customers about satisfaction like how you are satisfied with Xyz Company, such questions are as follows

1. What is your overall satisfaction with xyz Ltd?
2. How likely or unlikely are you to buy from xyz Ltd?
3. How likely or unlikely would you to be recommend xyz Ltd to a friend or colleague?

Actually questions might be under this category where as

(A) PRODUCT
1. Quality of product
2. Length of life of the product
3. Design of the product
4. Consistency of quality
5. Range of products
6. Processibility of the product

(B) DELIVERY
1. Delivery on time
2. Speed of delivery

(C) STAFF AND SERVICE
1. Courtesy from sales staff
2. Representative's availability
3. Representative's Knowledge
4. Reliability of returning calls
5. Friendliness of the sales staff
6. Complaintresolution
7. Responsiveness to enquiries
8. After sales service
9. Technical service

(D) COMPANY
1. Reputation of the company
2. Ease of doing business
3. Invoice clarity
4. Invoices on time

(E) PRICE
1. Market price
2. Total cost of use
3. Value for money

3.6 How should the interview be carried out?
Survey data has some indicators about customer satisfaction where we can know the sales in the company during the project on going time, they can rise or fall due to reasons. After survey and feedback the view of the company may change. Depth interviews are carried out basing letter of thanks and anecdotal feedback via sales force. As there will be no benchmark data for taking considerations for interview as it do not allow the comparison of one issue to another issue for tracking quantitative survey is required.

3.7 How should satisfaction be measured?

Expression is in many ways, customers express their satisfaction in many ways, if they are satisfied they mostly say nothing than visiting again and again, if we ask them to express it might be in any way, they may say like (very happy, it's ok, yeah its good to be with you) and some may be dissatisfied, these people will express more than satisfied customers. More than this we cannot measure perfectly and get the accurate data so it is better to make a manual or book which can be in written format, so it will be easily understandable to measure the satisfaction/dissatisfaction in the company.

Now the half the story is completed by measuring the customer satisfaction in the company, it is also important to meet the expectations what they give the preferences, why this should be done is, it will bring back the customers again and again to our company to do business. So it is said that second half is more difficult and important than the first half where we only measure customer's satisfaction excluding needs of the every customer. Customer’s views change situation to situation so steps should be taken according to that.

3.8 How To Use Customer Satisfaction Studies To Greatest Effect

Satisfying the customers is the tough task in construction industry until and unless there is a full involvement of top management in the survey and support of management in the survey. As people view's change very frequently the decision towards them should be taken very fast and in favour of them.

As earlier discussed measuring customer satisfaction should not be stopped it should be a never ending process till the project is completed then only we can get long term profits. Samples should be taken to survey, the sample of each survey must be large enough to provide a reliable base and selection of sample must be like earlier surveys.

4.METHODOLOGY

The literatures are studied and reviewed for the factors which influence the customer satisfaction.

5. RESULTS AND DISCUSSION

Analysis of results based on survey, Customer needs are given the major criteria in construction industry, where customers priority changes from one project to another project, companies should focus on the things where customers majorly dissatisfy in projects. Measuring the satisfaction through various ways give companies long term profits.

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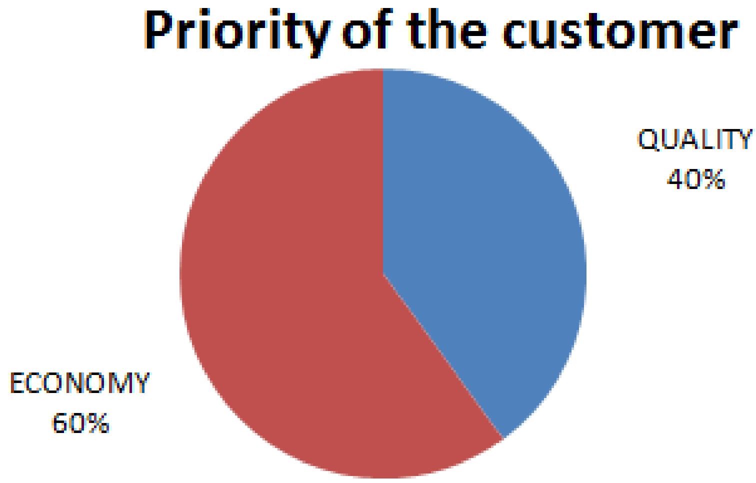
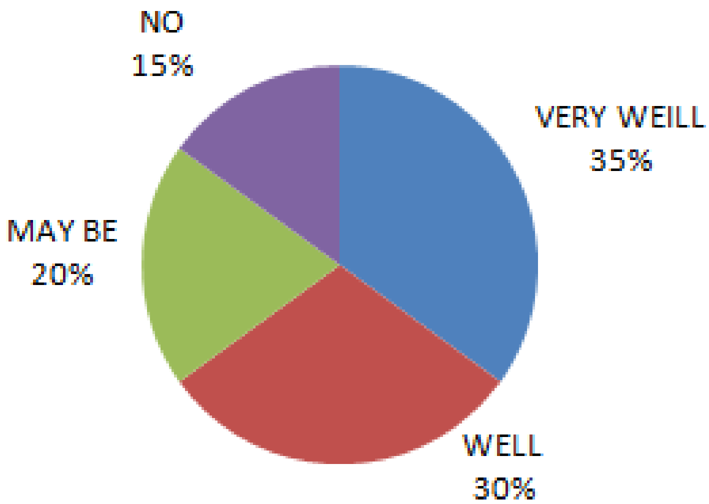
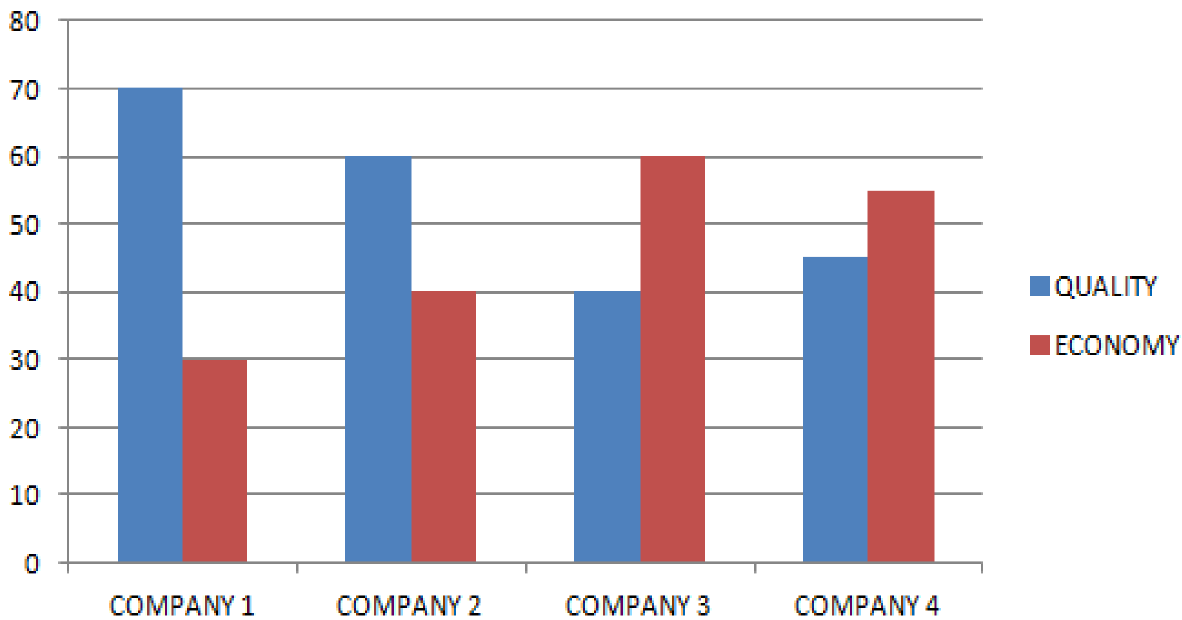
1. What will be the first priority of the customer?



2. Do you think customer satisfaction survey will work in construction industry ?



3. On which basis, Customer will be satisfied in construction industry?



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4. What would customer satisfaction survey improve?

6. CONCLUSION

From the above results, It shows that three dimensional sectors(ECONOMY, QUALITY AND SERVICE) plays a key role in the construction industry. Where Economic product is needed for customer with good quality and service. As discussed customer is king, the company has to perform their steps in construction. For company point of view satisfying the customers is important task as well as getting the long term profits.

Cost is the important factor for one customer in a project, schedule will be the important factor for another customer. Like that the customer who has preferred cost in one project will be looking for schedule in another project and vice versa. So customer changes from one project to one project. Estimating the needs of the customer is not possible without conducting survey.

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International Journal of Research in Science and Technology
Volume 2, Issue 2 (I) : April - June , 2015
ISSN 2394 - 9554

EFFECT OF RAINFALL INTENSITY ON SOIL EROSION AND MITIGATION USING GROUND COVER

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ABSTRACT

Soil erosion is a naturally occurring process on all land. Soil erosion may be a slow process that continues relatively unnoticed, or it may occur at an alarming rate causing serious loss of topsoil. The loss of soil from farmland may be reflected in reduced crop production potential, lower surface water quality and damaged drainage networks. Soil erosion may be effectively reduced by using surface cover like geotextiles, mulching, roots, stems, cutting pieces of plant etc. In this paper effect of rainfall intensity on soil erosion and their mitigation using surface cover. Basically we were used geotextiles as surface cover to control the soil loss. A laboratory experiment was conducted using rainfall simulator with different rainfall intensities of 70 mm/hr., 100 mm/hr. and 125 mm/hr. under varying slope gradients of 10^o, $35^{\,0}$ and 45^0. In this paper, the comparison of soil loss using geotextiles between the surface cover and no surface cover at varying slope gradient and different rainfall intensities. Results reveals that rice straw geotextiles (RSGTs) as ground cover was greatly affected the soil erosion under different rainfall intensities, the rice straw mat (RSM) had significantly reduces the soil loss as compared to the rice straw net (RSN), coco coir net (CCN) and no ground cover (NGC). At any given rainfall intensities, the soil erosion increased when the slope increases.

Keywords: Geotextiles, surface cover, rainfall intensity, slope gradient, soil loss, mitigation.

1. INTRODUCTION

Soil erosion is the process of detachment and transportation of soil particles by erosive agents such as wind, water and gravity. Soil erosion may be a slow process that continues relatively unnoticed, or it may occur at an alarming rate causing serious loss of topsoil. The loss of soil from farmland may be reflected in reduced crop production potential, lower surface water quality and damaged drainage networks. Therefore many attempts have been made to stabilise and restore these damaged slopes by using various techniques, among which biotechnical methods for vegetation, such as hydro seeding (Albaladejo Montoro et al., 2000), are becoming more popular mainly because of their environmental benefits and economic advantages. Vegetation is highly effective in protecting slopes since it is able to reduce runoff and erosion by intercepting rainfall, reducing flow velocity and encouraging infiltration, and stabilize the soil with root systems (Coppin and Richards, 1990; Sanchez and Puigdefabregas, 1994).

Soil erosion is the removal of soil from land surface by running water (Schwab et al. 1981). Although soil erosion is often associated with deterioration or loss of water resources and may well be the most serious and least reversible form of land degradation in tropical environments. Soil erosion may be assessed by applying different methods on various scales. For the purpose of conservation-effective land-use planning, there is strong merit in assessing the extent of both existing and potential erosion. The extent of existing erosion may be determined directly by measuring soil losses from fields (catchments) or parts thereof (sub catchments) both of which are defined by specific boundaries (Hudson 1971).

Geotextile like rice straw mat (RSM) and rice straw net (RSN) to enhance its economic potential and environmental importance. Rice straw geotextiles (RSGT) can be utilized as ground cover for slope stabilization and erosion control. Smets (2009) reported that RSGTs are the most effective geotextiles in reducing runoff and soil loss. Rice straw mat and net are biodegrable, environmentally and eco-friendly material as ground cover for erosion control. When used as ground cover, it will not only stabilize the top soil but also helps in the establishment of vegetation for surface cover and improves soil physical structure and condition when decomposed into organic matter. Most importantly, the development of this technology will open a new opportunity to small farmers as they can sell their rice straw to augment their income. Farmers can also process their rice straw as form of livelihood project, thus, creating jobs in the rural areas.

2. MATERIALS AND METHODS:

2.1 Preparation of RSGTs:

Rice Straw Geotextiles (RSGTs) like that Rice Straw Mat (RSM) and Rice Straw Net (RSN) were prepared by manually.

RSM with thickness of 3 mm to 4 mm, a nonwoven mat was made of individual grid of rice straw interlaid with each other at random direction. It was bound by using rubber latex or thread as binder as shown in fig below.

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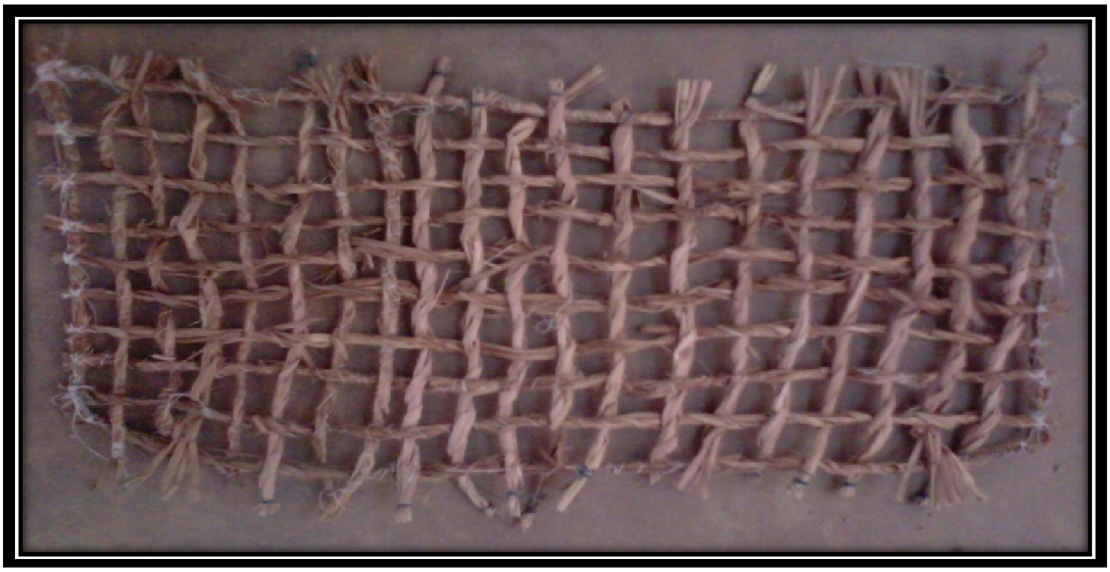
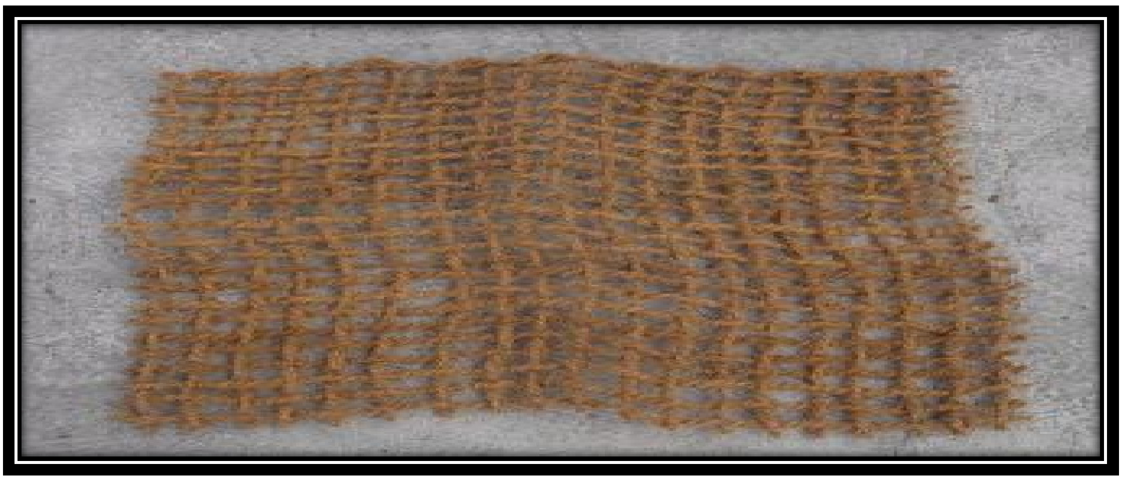
[RICE STRAW MAT

Similarly rice straw net (RSN) was also made of rice straw. Firstly it was made into twine approximately 3.5 mm in diameter by spinning two or more straws. Then two twines were spinning together to form a rope. Finally the straw rope was weaved into net with mesh opening of 15 mm x 15 mm as shown in following fig.



[RICE STRAW NET]



[COCO COIR NET]

2.2 EXPERIMENTAL DESIGN

All experiments were conducted using a rectangular soil test box 400 mm in length, 200 mm in width and 100 mm in depth as shown in fig below. Polyethylene bag was pinned at the downstream end of the soil test box for collecting runoff.

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[SOIL TEST BOX]

3. MEASUREMENT PROCEDURE

Experiment of soil erosion in the laboratory used rainfall simulator. Rainfall intensity in mm/h over the test area was measured before and after the each experiment. Time of experiment for each replicate was 30 minutes. During the simulation process, runoff was allowed to flow towards the downstream end of the soil test box and collected in the soil collector polyethylene bag. The collected runoff was weighed and it was allowed to stand for 18 to 20 hours in order for the sediment to precipitate at the bottom. The sediment was separated and collected through filtration paper. Then the collected soil sample (sediment) was oven dried at 105^0 for 24 hours.

4. RESULTS

Soil erosion under different rainfall intensities

The following Table shows the results of different rainfall intensity with varying slope gradients using geotextiles as surface cover.

Rainfall intensity=70mm/hr.

SLOPE Degree	RSM	RSN	CCN	NSC
10	26.32	35.87	37.38	234.25
30	38.10	74.51	72.41	365.28
45	49.35	86.54	91.01	489.27

Rainfall intensity=100mm/hr.

SLOPE Degree	RSM	RSN	CCN	NSC
10	34.27	42.65	41.23	365.42
30	46.35	77.25	78.36	459.58
45	64.43	97.41	98.72	602.35

Rainfall intensity=125mm/hr.

SLOPE Degree	RSM	RSN	CCN	NSC
10	46.23	105.34	108.25	423.56
30	75.36	172.27	178.29	602.14
45	102.28	205.39	209.21	881.20

RSM=Rice Straw Mat, RSN=Rice Straw Net, CCN=Coco Coir Net, NSC=No Surface Cover

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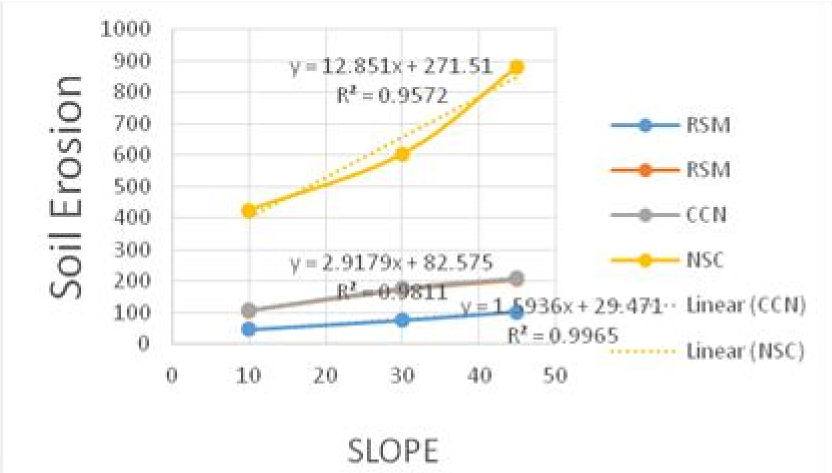
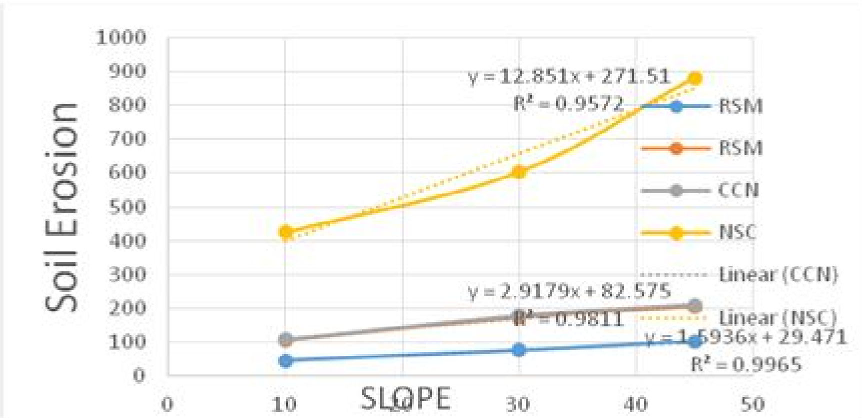
RELATIONSHIP BETWEEN SOIL EROSION AND SLOPE

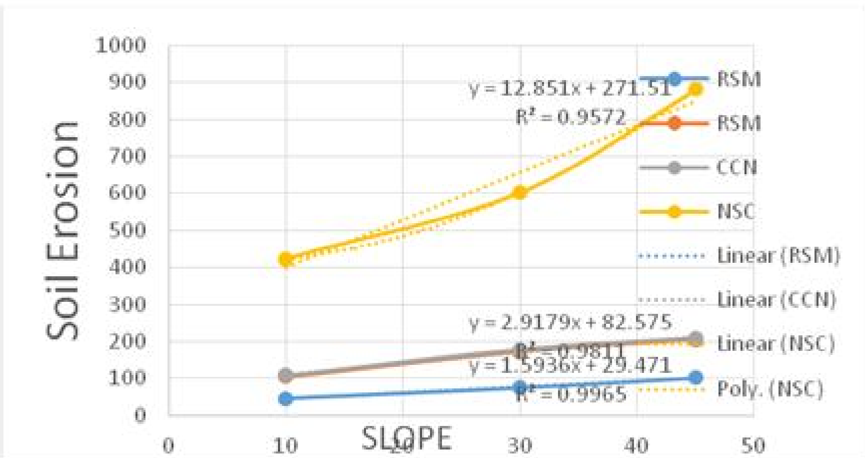
At constant rainfall intensity=70mm/hr.



At constant rainfall intensity=100 mm/hr.



At constant rainfall intensity=125 mm/hr.



5. CONCLUSION

From the above graph, soil erosion was significantly affected by the effect of slope gradients and rainfall intensities. The main effect of geotextiles as surface cover on soil erosion were highly significant. Regardless of the intensity of rainfall applied, the soil test box covered with RSM yielded significantly lower soil loss as compared to the other treatments.

The significantly lower soil loss under RSM could be attributed to the effect of its higher percentage of surface cover. Geotextile with higher percentage of ground cover is more effective in intercepting and reducing the impact action and erosive power of falling raindrops which is responsible in detaching and splashing soil particles.

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International Journal of Research in Science and Technology
Volume 2, Issue 2 (I) : April - June , 2015
ISSN 2394 - 9554

EFFECT OF WATER TABLE ON GROUND RESPONSE ANALYSIS

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ABSTRACT
New seismic design methods for engineering structures have been proposed in recent years. These methods generally do not consider the effect of water table on soil amplification. The location of water table has influence on soil properties such as effective density, shear wave velocity, shear modulus etc, and it also influences the wave propagation through soil medium. The softwares 'EduShake' and 'EERA' are capable of performing the soil amplification analysis along with the effect of water table. In the present paper, the influence of water table on different soil properties obtained from software analysis is studied. For the analysis, borehole data like SPT, density of soil, soil profile etc. are collected for various sites of Silchar (Assam), from reliable source (consultancy cell of Civil Engg. Deptt of NIT Silchar) and the water table is varied along the depth then the parameters are given as input for software analysis. The important results analysed are amplification factor, peak acceleration peak velocity, frequency of maximum amplification etc. The trend of these parameters for each water table location is different and it depend on the local soil profile.

INTRODUCTION
The basic problem to be solved by geotechnical engineer in regions where earthquake hazards exist is to estimate site specific dynamic response of a layered soil deposit. The problem is commonly referred to as site specific ground response analysis or soil amplification, it has seen that the ground motions may be deamplified. A detailed study on soil amplification is important in desigh of earthquake engineering structures, including buildings, retaining structures dams etc. in the past studies of soil amplification the effect of water table has not taken into account. This study deals with the site specific ground response analysis in some locations of silchar (Assam) by considering the effect of water table, using two softwares, EduShake and EERA. Soil properties such as bulk density, effective pressure and dynamic soil properties such as shear wave velocity and shear modulus are used as input values and the analysis is based on one dimensional wave propagation theory.

ONE DIMENSIONAL WAVE PROPAGATION ANALYSIS
One dimensional wave propagation analysis is widely used for ground response analysis as:

- They are believed to provide conservative results
- A large number of commercial programme with different soil models are available for use on personal computers.
- They are time tested. I.e. most design projects in the past designed using this methodology survived the earthquakes.

In the case of strong earthquake motion the stress wave from earthquake focus are propagating nearly vertically when they arrived at the earth's surface. Even if the waves with in the firm ground are propagating in a shallow inclined direction, the waves set up with in the soil by refraction at the inter surface between the firm ground and the soil will propagate nearly vertically (by Snell's law of refraction). These conditions give the justification for using one dimensional analysis.

EQUIVALENT LINEAR ANALYSIS
The non linear and inelastic behaviour of soil is well established in geotechnical engineering. The nonlinearity of soil stress strain behaviour means that the shear modulus of soil is constantly changing. The inelasticity means the soil unload along different path than its loading path, thereby dissipating energy at the points of contact between particles. Rigorous analysis of the mechanical response of soil to any type of loading would require that the stress strain behaviour of each element of soil be tracked directly in the time domain. Nonlinear and hysteretic stress strain behaviour of soil is approximated during cyclic loadings as shown in figure 1

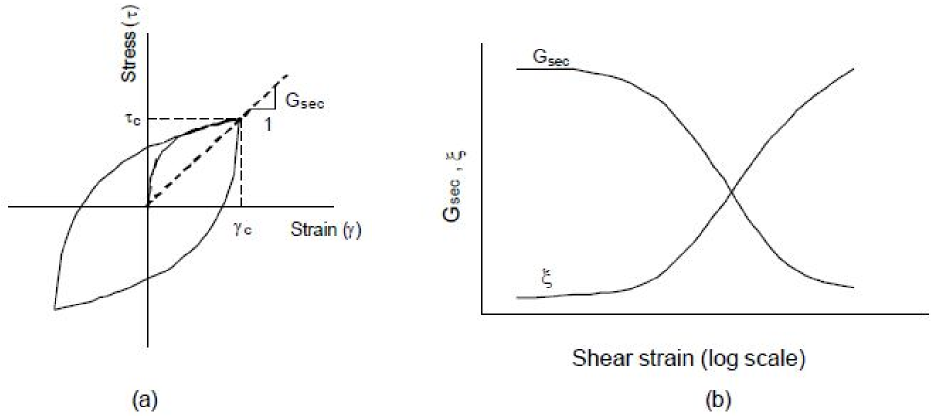

Figure 1 Equivalent-linear model: (a) Hysteresis stress-strain curve; and (b) Variation of secant shear modulus and damping ratio with shear strain amplitude.

The equivalent linear shear modulus ‘G’ is taken as secant shear modulus ‘G_{sec}’ which depends on the shear strain amplitude γ.

$$G = \frac{\tau c}{\gamma c}$$

Where τc & γc are the shear stress and shear strain amplitudes respectively. The equivalent linear’ damping ratio ‘□’ is the damping ratio that produces same energy loss in a single cycle as the hysteresis stress loop of the irreversible soil behavior.

METHOD OF ANALYSIS

Amplifications of soil site responses were simulated using several computer programs that assume simplified soil deposit conditions such as horizontal soil layers of infinite extent. Here the analysis have done with two software’s namely EduShake and EERA. The dynamic soil parameters such as shear wave velocity shear modulus and other parameters such as effective density, effective pressure etc have given as input. A strong motion record obtained at a rock outcrop on Yerba Buena Island in San Francisco Bay during the 1989 is given as input ground motion Loma Prieta earthquake. (Fig 2). For the analysis soil borehole data are collected from various locations of silchar (Assam) through consultancy cell of NIT Silchar.

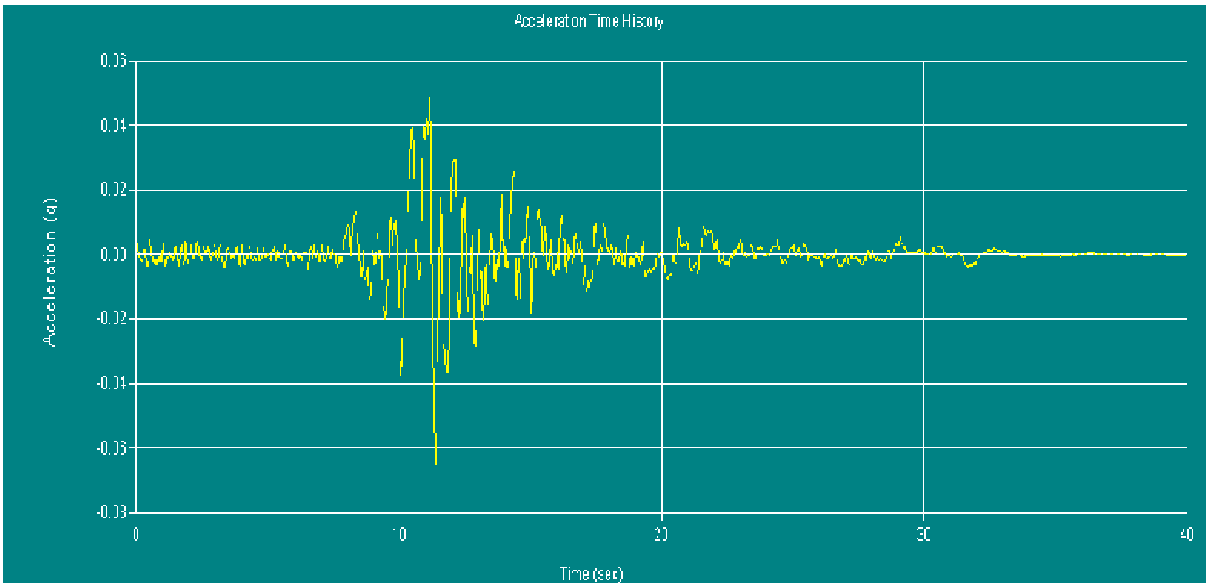

Fig 2; Input ground motion, acceleration time history

The same ground motion has given at the bottom layer of each site for different location of water table and the results are plotted against depth of water table.

EFFECT OF WATER TABLE

The soil characters such as effective density effective pressure wave propagation properties are vary as the location of water table changes. The variation of some important factors due to change in water table is discussed below.

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PEAK ACCELERATION

Peak acceleration is one of the important factor that affect seismic reliability of structure. The most commonly used measure of amplitude of a particular ground motion is peak horizontal acceleration (PHA). The PHA for a given component of motion is simply largest (absolute) value of horizontal acceleration obtained from the accelerogram of that component. Horizontal acceleration have commonly been used to describe because of the natural relationship to inertial forces; indeed the largest dynamic forces induced in certain type of structure, i.e. very stiff structure, are closely related to peak horizontal acceleration. In sandy soil and clayey soil the variation of peak acceleration is different with the changes in water table location. For clayey soil usually, not always, peak acceleration tends to decrease as the depth of water table from ground surface increases. As shown in the figure the peak acceleration is decreasing as the soil changes from saturated state to dry state.

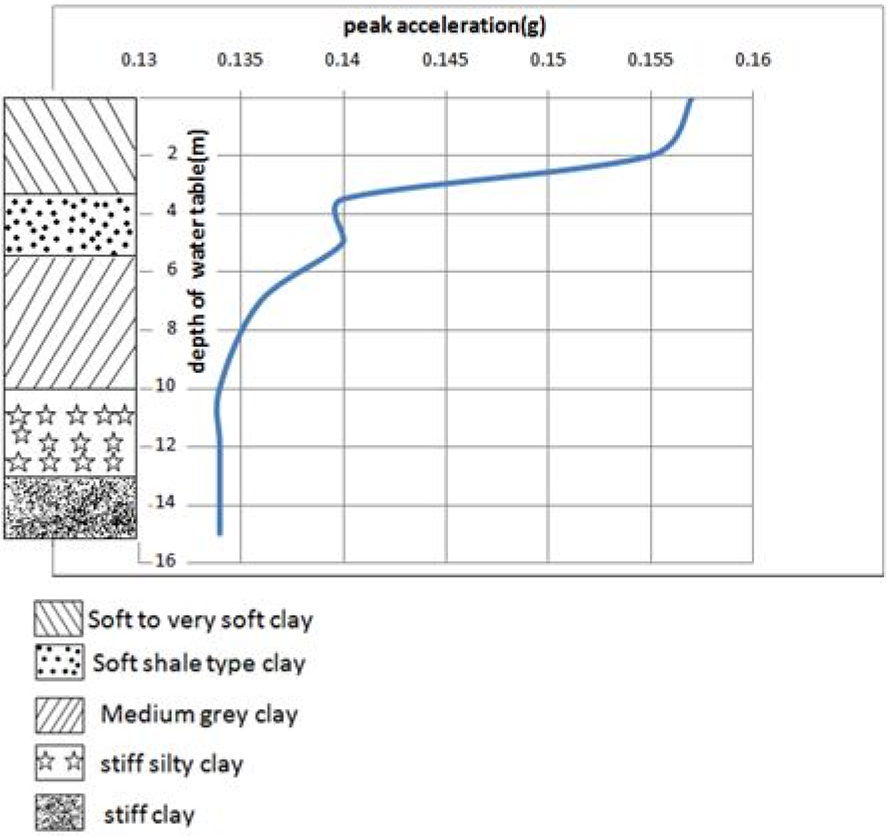

Fig 3; variation of peak acceleration with water table. For clayey soil

When the water table changes through comparitively strong medium the change in peak acceleration is very negligible. For sandy soils this tendancy is just opposite. Sandy soil showing a tendancy to increase the peak acceleration value with increase in water table as shown in fig 4.

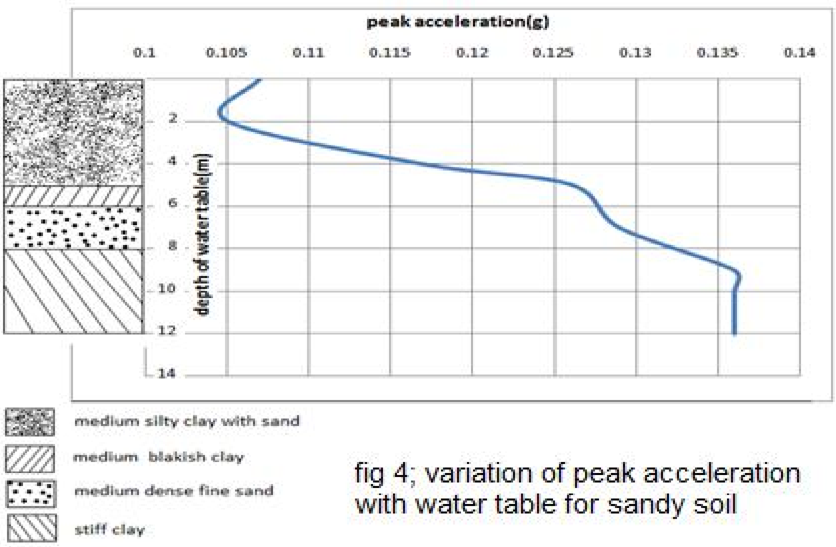

fig 4; variation of peak acceleration with water table for sandy soil

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PEAK VELOCITY

Peak velocity is another useful parameter for charecterization of ground motion amplitude. Since the velocity is less sensitive to higher frequency component of ground motion, the peak horizontal velocity is more likely than peak horizontal acceleration to charecterize ground motion amplitude accurately at intermediate frequenies. For structure or facilities that are sensitive to loading in this intermediate frequency range the peak horizontal velocity may provide much accurate indication of potential for damage than peak acceleration. The changes in peak velocity for different water table location doesn't follow a general trend for clayey and sandy soil. It depends on other local conditions such as relative density, density etc. figure 5 showing the variation of % change in peak acceleration of a layered clayey soil with respect to the dry state of soil.

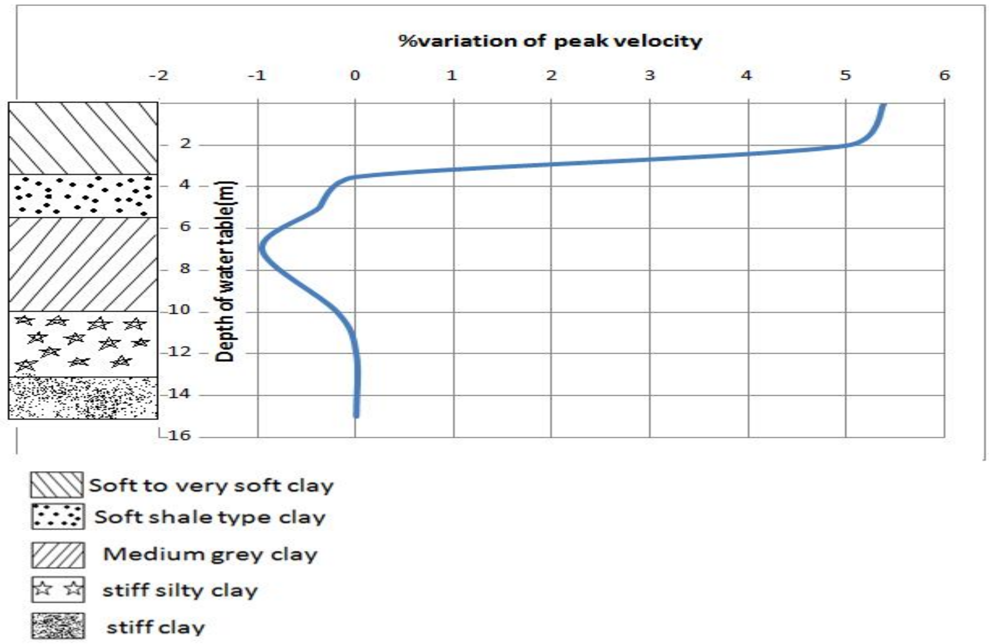

fig 5; % variation of peak velocity with depth of water table

Figure 6 showing the % variation of peak velocity for a layered sandy soil deposit

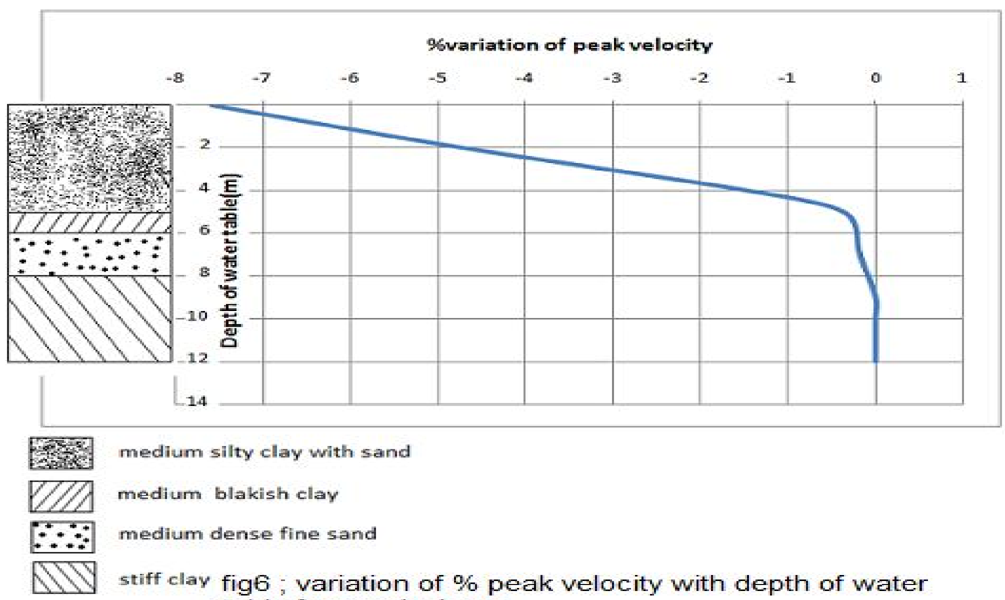

fig6 ; variation of % peak velocity with depth of water table for sandy layer

AMPLIFICATION FACTOR AND FREQUENCY OF MAXIMUM AMPLIFICATION

The charecteristics of local soil deposits can also influence the extent to which ground motion amplification will occure when the specific impedence is constant. The water table also influence the amplification factor and frequency of local maximum amplification. Genarally, not a trend, the maximum amplification factor is decreasing with the depth of water table both in sandy and clayey soils. Frequency of maximum amplification is always showing a tendancy to decrease with increase in depth of water table from ground surface.

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Figure 7 and figure 8 showing a plot between the amplification factor and frequency of same site at different locations of water table

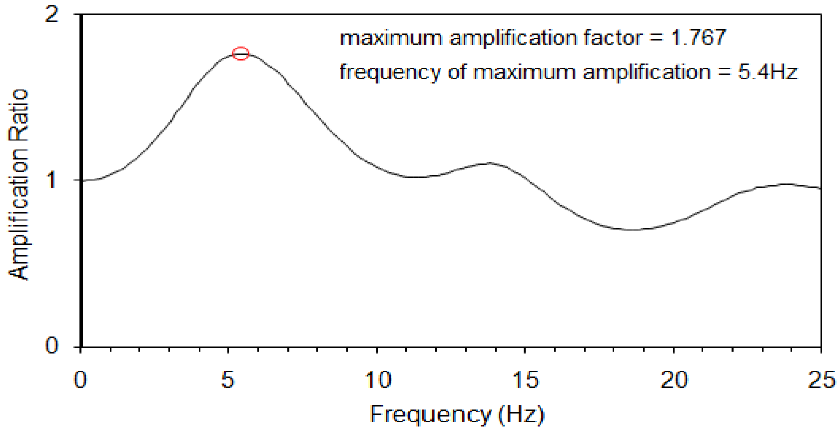

figure 7; grapth of amplification factor against frequency for a site at fully saturation condition

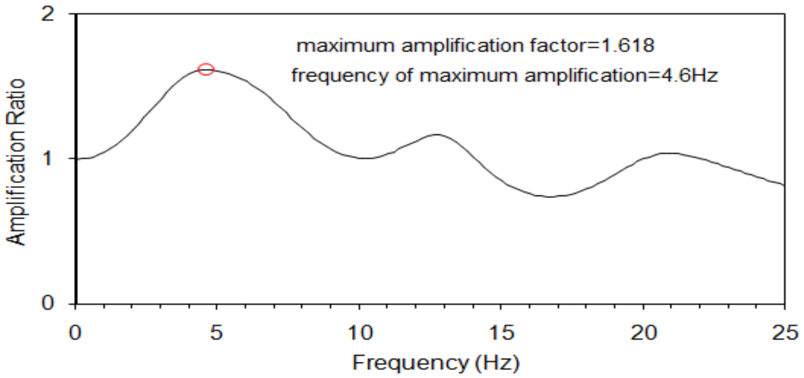

fig 8; graph for amplification factor and frequency for a site when water table is at a depth of 12m

CONCLUSION

This study mainly focused on effect of water table on soil amplification. The site analyzed are various locations of Silchar (Assam). The soil type was clayey and mixture of clay and sand. The effect of water table on various ground motion parameters has been discussed. For each site the ground response analysis will be different and it is depend on various quantities and parameters. From this study it is observed that in site specific ground response analysis the water table has a significant role.

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International Journal of Research in Science and Technology
Volume 2, Issue 2 (I) : April - June , 2015

ISSN 2394 - 9554

ENERGY MANAGEMENT FOR MICRO-GRID USING IMPROVED BAT ALGORITHM

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ABSTRACT

This paper represents the cost-based formulation to determine the operational management of micro grid. The problem is formulated as nonlinear operational management of micro grid solved using improved bat algorithm to minimize the cost and maximize the dispatch simultaneously. Micro grids are a combination of renewable energy sources such as solar, wind with combination of micro-turbine/fuel cell/battery energy storage where in which micro-turbine, fuel cell, grid acts as variables. The forecasted output of PV and Wind turbine is considered. The selection that yields the least cost dispatches are to be selected and system sample load demand for 24 hours has been considered for study.

Keywords: optimization, IBA, load demand

1. INTRODUCTION

A micro grid is essentially a normal transmission and distribution grid, just on a significantly smaller scale. Micro grids are often implemented in the most rural locations. Micro grids are smaller versions of the traditional power grid which is comprised of various alternative energy sources that can serve as a basic tool to reach the desired objectives while distributing electricity more effectively, economically and securely. A Micro Grid is an electrical distribution network consisted of distributed generators and energy storage systems that can operate in grid-connected modes. Micro grids are a combination of renewable energy sources such as solar, wind with combination of micro-turbine/fuel cell/battery energy storage and has to meet the desired objectives like minimize the operational cost, maintain the generation within the boundary limits, meet the load demand by satisfying all the constraints, and Selection of suitable renewable generations to meet the load demand with low cost. The sample forecasted output of solar and wind turbine is considered. Micro-turbine/fuel cell/battery energy storage acts as variable source with the combination of solar and wind power in this paper.

2. PROBLEM FORMULATION

The problem is formulated as non-linear operational management of micro grid problem which compromises of objective function and constraints are described as follows:

Minimize total costs

$$Min \quad F(X) = \sum_{t=1}^{NT} f_t \tag{1}$$

$$f_t = Cost_{grid,t} + Cost_{DG,t} + Cost_{BES,t} + SUC_{FC,t} + SUC_{MT,t} + SDC_{MT,t} + SDC_{FC,t} \tag{2}$$

$$Cost_{grid,t} = \begin{cases} Bid_{grid,t} P_{grid,t} - - - - - - - - - P_{grid,t} > 0 \\ (1 - tax) Bid_{grid,t} P_{grid,t} - - - P_{grid,t} > 0 \\ 0 - - - - - - - - - - - - - - - P_{grid,t} = 0 \end{cases} \tag{3}$$

$$Cost_{DG,t} = Bid_{MT,t} P_{MT,t} u_{MT,t} + Bid_{FC,t} P_{FC,t} u_{FC,t} + P_{i_{PV},t} Bid_{i_{PV},t} + P_{i_{WT},t} Bid_{i_{ET},t} \tag{4}$$

$$SUC_{FC,t} = start_{FC} X \max(0, U_{FC,t} - U_{FC,t-1}) \tag{5}$$

$$SUC_{MT,t} = start_{MT} X \max(0, U_{MT,t} - U_{MT,t-1}) \tag{6}$$

$$SDC_{FC,t} = shut_{FC} X \max(0, U_{FC,t-1} - U_{FC,t}) \tag{7}$$

$$SDC_{MT,t} = shut_{MT} X \max(0, U_{MT,t-1} - U_{MT,t}) \tag{8}$$

The proposed operation problem is subjected to the following constraints:

1. Electrical load balance

To manage a power system operation the basic constraints is to meet the load, the algebraic sum of total power generated by FC,MT,PV and WT and total absorbed or injected power to BES and utility must be same as the load demand. Thus electrical load demand balance can be formulated as:

$$P_{FC,t} U_{FC,t} + P_{MT,t} U_{MT,t} + P_{ipv,t} + P_{iwt,t} + P_{BES,t} U_{BES,t} + P_{grid,t} = P_{Demand,t} \tag{9}$$

2. Dispatchable DG's Constraints

The operating output of each dispatchable units like FC, MT must be in its boundary limits, i.e. within the maximum and minimum generation limits of the desired units:

$$P_{FC\min} \le P_{FC,t} \le P_{FC,.\max}$$
$$P_{MT,\min} \le P_{MT,t} \le P_{MT,\max} \quad (10)$$

3. BES Constraints

Due to limitation of charge and discharge rate of storage devices during each time period the following charge and discharge equations can be written as:

$$W_{ess,t} = W_{ess,t-1} + \eta_{ch\arg e} p_{ch\arg e} \Delta t - \frac{1}{\eta_{disch\arg e}} P_{disch\arg e} \Delta t \quad (11)$$

$$\left(W_{ess,\min} \le W_{ess,t} \le W_{ess,\max}\right)$$
$$\left(P_{ch\arg e,t} \le P_{ch\arg e,\max}; P_{disch\arg e,t} \le P_{disch\arg e,\max}\right) \quad (12)$$

4. Grid Constraints

The grid generation must be strictly between the upper and lower bound of the grid generation limits

$$P_{grid,\min} \le P_{grid,t} \le P_{grid,\max} \quad (13)$$

5. Operating Reserve Constraint

The operating reserve is the generating capacity available to the system operator within a short interval of time to meet demand in case a generator goes down or there is any another disruption to the supply.

$$P_{FC,\max} u_{FC,t} + P_{MT,\max} u_{MT,t} + P_{grid,\max} + P_{BES,t} u_{BES,t} \ge OR_t + P_{Demand,t} \quad (14)$$

Here in this paper the operating Reserve Constraint is 5% of the load demand
$U_{FC,t}$, $U_{MT,t}$, $U_{BES,t}$ represents the off and on state of BES, MT, FC at time t.

3. IMPROVED BAT ALGORITHM (IBA)

3.1 Overview of Original BA

Bat-inspired algorithm is a metaheuristic optimization algorithm developed by Xin-She Yang in 2010. This bat algorithm is based on the echolocation behavior of micro bats with varying pulse rates of emission and loudness. The idealization of the echolocation of microbats can be summarized as follows: Each virtual bat fly randomly with a velocity V_i at position (solution) X_i with a varying frequency or wavelength and loudness A_i. As it searches and finds the prey, it changes frequency, loudness and pulse emission rate r. search is intensified by a local random walk. Selection of the best continues until certain stop criteria are met. This essentially uses a frequency –tuning technique to control the dynamic behavior of a swarm bats, and the balance between exploration and exploitation can be controlled by tuning algorithm- dependent parameters in bat algorithm.
The pseudo-code of the BA is depicted in the following form. Where f^{min} and f^{max} are respectively set to 0 and 2 in this study and α_{BA} and γ_{BA} are constant both of which are set to 0.9.

The Original BA

Initialize the bat population

Calculate the objective function for each bat

WHILE the termination criterion is not satisfied DO

FOR m=1 to NPOP DO

Update the velocity and the position of each bat as follows

$V^{iter}=V^{iter-1}+f^{ter}(Gbest^{iter-1}-X^{iter-1})$

$X^{iter}=X^{iter-1}+ V^{iter}, f^{iter}=f^{min}+rand(.)(f^{max}-f^{min})$

generate the new solution for each bat locally using random walk:

IF rand(.)>r^{iter} THEN

$X^{iter}_{new} = X^{iter}_{new} +£A^{iter}_{mean}(p_{best}-X^{iter})$

ELSE

Generate a local solution around $Pbest^{iter}$

ISSN 2394 - 9554

Increase r^{iter} *and decrease* A^{iter} *as follows:*

$X^{iter}_{new} = X^{iter}_{new} + £A^{iter}_{mean}(X^{iter}_{I} - X^{iter})$

END IF

IF

$X^{iter} = X^{iternew}$

END IF

$A^{iter} = \alpha_{BA} A^{iter-1}$: $r^{iter} = r^{1}(1-exp(-\gamma_{BA}(iter+1)))$

END FOR

END IF

END WHILE

3.2 Self-Adaptive Bat Algorithm:

The main difference between the Normal BAT algorithm and Improved BAT algorithm is the velocity update. The main idea of this update is to achieve an appropriate velocity by distributing the bats in the problem search domain in such a way that the exploration and exploitation are balanced. The velocity update strategy used in this project is as follows:

$$V_m^{iter} = rand(.)V_{m.a}^{iter-1} + (0.3rand(.) + 0.2) f_m^{iter} (Gbest^{iter-1} - X_m^{iter-1}) \quad (15)$$

3.3 Implementation of the suggested algorithm:

Step 1: Define all information available to all DGs and BES: In this step, the input data including DG's data i.e., bid, generating capacity power output of WT and PV, minimum/maximum injectable or absorbable power of grid and BES, bid of grid, utility, limit of BES, electrical load demand should be defined.

Step 2: Generate the initial population randomly

Step3: Select iter=1, Select V_m^{iter} =0

Step 4: Calculate the objective function for initial population using (1)

Step 5: Select the best and worst solution among the individuals

Step 6: Move the population by updating the velocity and frequency individuals(15)

Step 7: Check whether the generated values are able to meet the load demand or not

Step 8: Calculate the cost from the generated variables

Step 9: Check whether the generated values satisfies the constraints using (14)

4. DESCRIPTION OF MG TEST SYSTEM UNDER STUDY, TECHNICAL SUPPOSING AND INPUT DATA

The typical low voltage MG tests system which is depicted in Fig 1. The MG is comprised of different DGs such as MT, FC, PV, WT and also Li-ion BES. All coefficients and production limits which are utilized in the proposed approach are listed in Table 1. The forecasted real time market energy prices, load demand, PV power output and WT power output for 24 h time are portrayed in fig 2,3,4,5.

Table 1: The limits and bids of the DGs, utility and BES

TYPE	Min.power (kW)	Max.power (kW)	Bid (€ct/kWh)	Startup/down cost(€ct)
MT	6	30	0.457	0.96
FC	3	30	0.294	1.65
PV	0	25	2.584	0
WT	0	15	1.073	0
BES	-30	30	0.380	0
UTILITY	-30	30	-	-

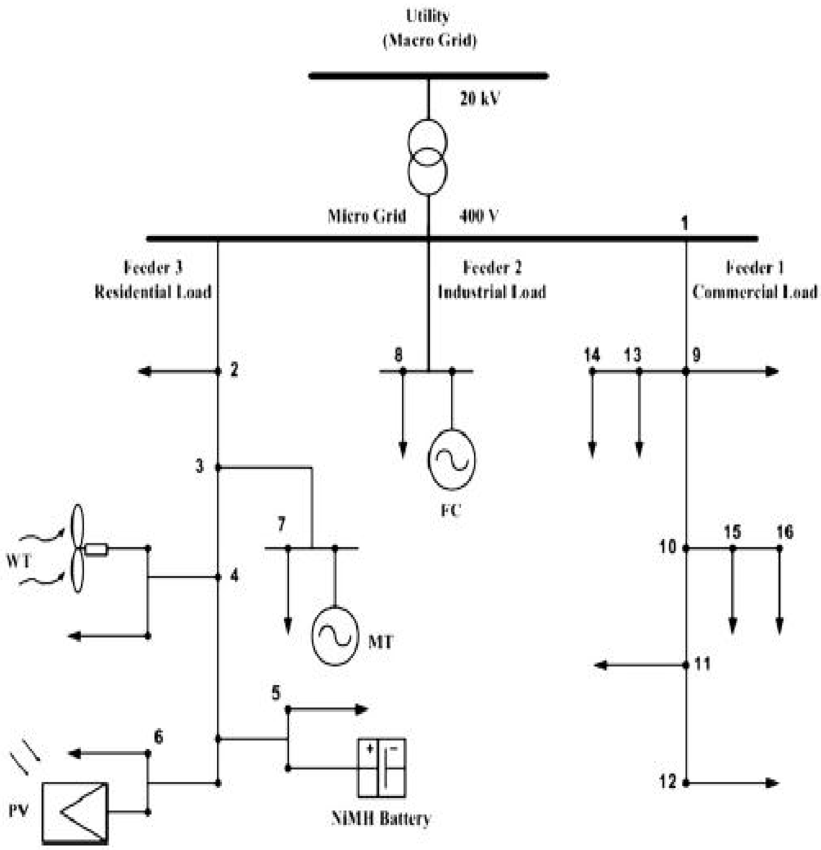

Fig. 1. A typical LV micro-grid.

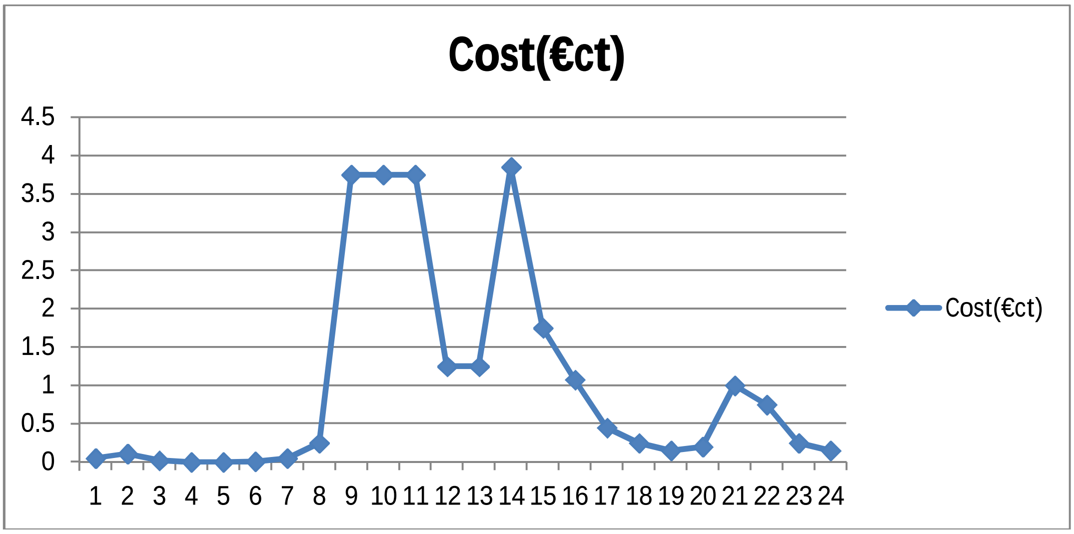

Fig 2: Market energy prices

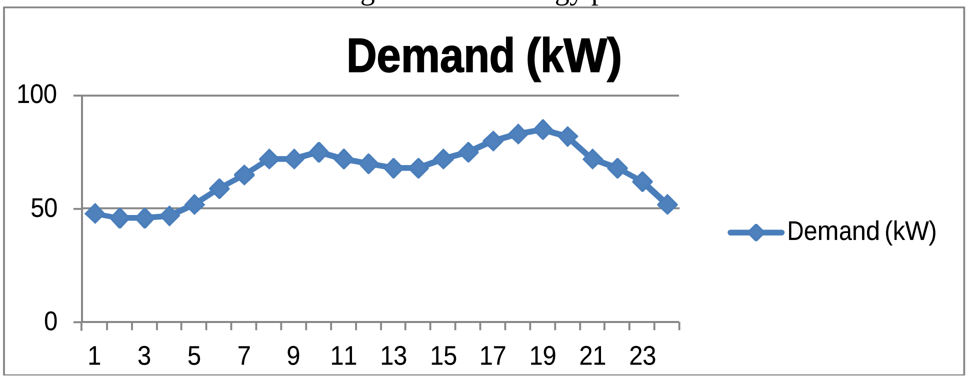

Fig 3: Total load demand for respective hour

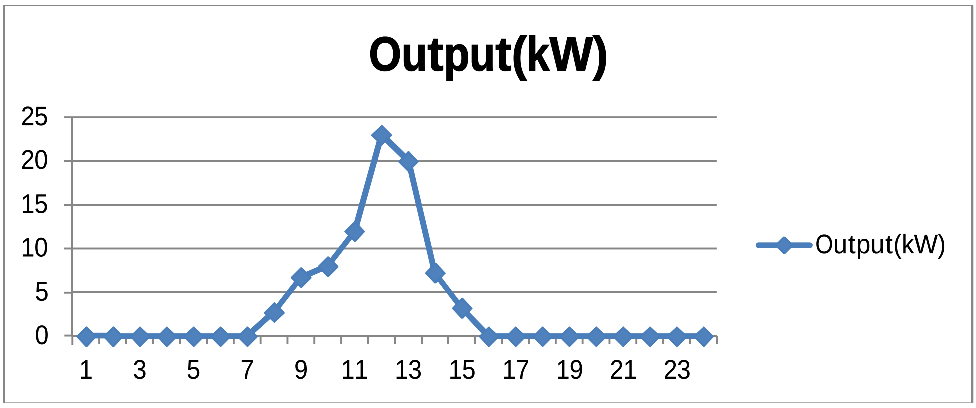

Fig 4: Forecasted output of PV

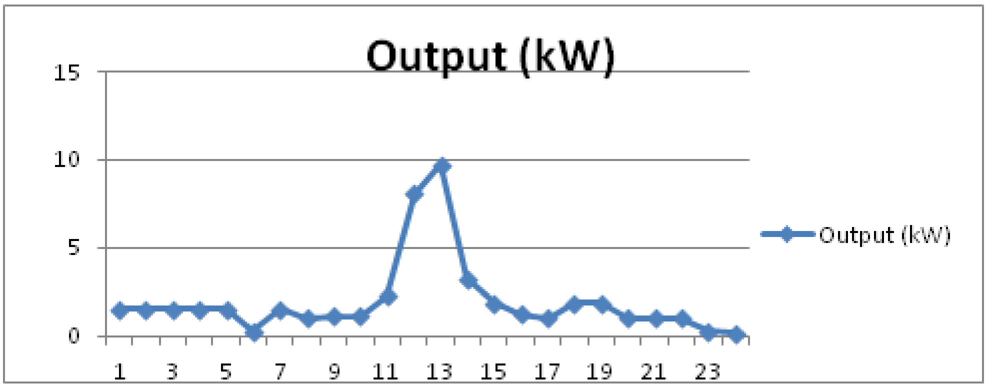

Fig 5: Forecasted output of Wind turbine

5. RESULTS AND CONCLUSION

The obtained cost for the load demand considered using improved bat algorithm, where grid, micro turbine, fuel cell acts as variable sources in combination with forecasted output of wind turbine and pv cell is plotted below for 24 hrs. The total cost obtained is 799.1837

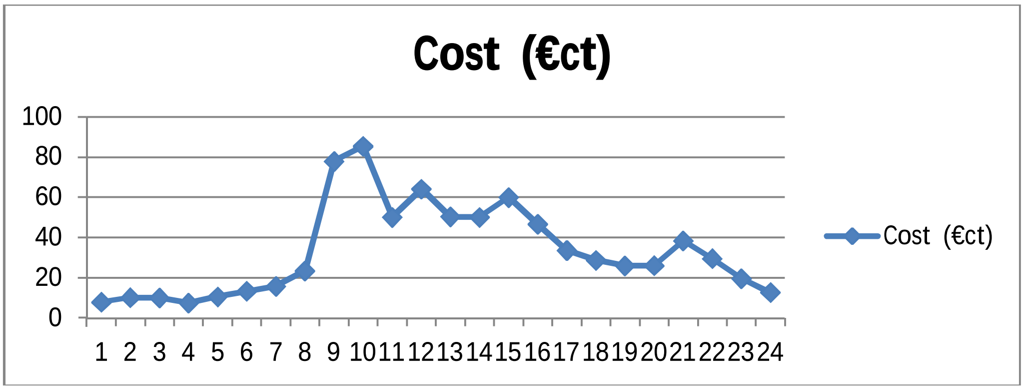

Fig 6: Time vs Cost

In this paper, an efficient framework for MG operation management studies is proposed addressing an appropriate robust and effective meta-heuristic IBA approach in MG operation solving are some of the major functioning's are represented in the paper. There are several selections of DG's so as to get the least cost and maximum dispatches which yields to best results. The selection made here for energy management has been adopted to yield better solution

Future works will concentrate on Operating reserve, battery energy storage system, operating reserve including battery energy storage systems, PV and WT to be variables, with loss and without loss for an unbalanced MG operational management considering simultaneous cost and emission objectives.

Nomenclature

- $B_{grid,t}$, $Bid_{BES,t}$, $Bid_{MT,t}$, $Bid_{Fc,t}$, $Bid_{ipv,t}$, $Bid_{iwt,t}$ are bid of utility,BES,FC,PV,WT at time t, respectively (€ct/kWh)
- $P_{grid,max}$, $P_{grid,min}$ are the maximum and minimum power produced from the utility respectively(kWh)
- $P_{Demand,t}$ is the electrical demand at time t(kW)

ISSN 2394 - 9554

- $P_{BES,max}$, $P_{BES,min}$ are the maximum/minimum power of BES respectively
- $P_{FC,max}$, $P_{FC,min}$, $P_{MT,max}$, $P_{MT,min}$ maximum/minimum power produced by FC and MT
- $Cost_{DG,t}$, $Cost_{BES,t}$ cost of fuel and operating power of DGs and BES at time t, respectively(€ct)
- $P_{grid,t}$, $P_{BES,t}$, $P_{MT,t}$, $P_{FC,t}$, $P_{ipv,t}$, and $P_{iwt,t}$ power of utility, BES, MT, FC, PVand WT repectively(kW)
- $SDC_{FC,t}$, $SDC_{MT,t}$, shut-down cost for FC and MT at time t, respectively (€ct)
- $SUC_{FC,t}$, $SUC_{MT,t}$ start-up cost for FC and MT at time t, respectively (€ct)
- $U_{BES,t}$, $U_{MT,t}$, $U_{FC,t}$ status(on or off) of BES, MT and FC at time t, respectively
- Tax - tax rate of utility power grid

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International Journal of Research in Science and Technology
Volume 2, Issue 2 (I) : April - June , 2015
ISSN 2394 - 9554

REVIEW ON VIBRATION ASSISTED MACHINING AND MAGNETO RHEOLOGICAL DAMPER

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ABSTRACT
Increasing demand for precision miniaturised components made of hard and brittle materials can no longer meet the requirements by conventional machining and advanced machining processes. This paper deals vibration assisted machining and Magneto Rheological Damper.To facilitates high precision machining, vibration is introduced in any of work piece, tool and working medium, which is called Vibration Assisted Machining (VAM). This paper provides a comprehensive review of VAM in conventional machining (turning, milling, drilling and grinding). To control the end mill tool vibration and suppress the chatter, the method incorporates the unique features of a magnetic-rheological fluid, utilizes the damper input current to modify the magnetic field inside the coil of the damper and increase the variable stiffness and produce damping effect.

Keywords- Vibration; Precision machining; VAM; Micro machining; Magneto Rheological Damper

INTRODUCTION
The need for micro featured components with high precision, made of hard and brittle materials such as glasses, lens, advanced ceramics, high strength alloys, mono crystalline materials etc. are required for industries like aerospace, electronics, bio medical, power generation and etc. Hence development of high precision machining in recent years has been focused on machining of micro scale parts with high surface finish. Vibrations are dynamical phenomenon and are present in our daily lives. Vibrations are mechanical oscillations around of a fixed point and define the movement of a mechanical system. Vibrations can be characterized in many ways, there are vibrations with low or high frequencies, and there are unintended vibrations (perturbations) or generated vibrations with known parameters. Vibrations are in many cases destructive, they can be also the disturbance side of a useful work, and can be generated on purpose to do something useful. To analyze the vibrations and the effects produced by these it will be measured the vibration in more points of the system: at the output of the system to compare the measured values with the maximum admissible values, this is the case of noise and perturbation detection. The characteristics of the vibration can be measured at the input of the system to set these at the established values. To test the system how reacts to the different external forces and noises, vibrations must be measured both at the input and the output of the system. A mechanical system with many components vibrates oscillates during his operating time and this can be in most time unintended and leads to breakdowns. For example vibrating motors or belts caused by inadequate fixing. But not all kinds of vibrations are destructive. For example, vibratory feeders, conveyors, surface finishers, ultrasonic cleaners or compactors are often used in different places. Undesirable vibration monitoring can save money, time; can prevent damages and quality losses.

1.1. Causes of mechanical vibrations
Applying an external sinusoidal force to a mechanical system this will move with the same frequency as the force. A real mechanical system is composed on many pieces which are bound in different ways and react in different manner to the force and this differences cause repeating force apparition. Repeating forces are due to the rotation of imbalanced or misaligned components. Imbalance is caused by corroded, deformed, broken parts, gaps, non-uniform material density, and component sizes variation. Misalignments are caused by inaccurate mounting, distortions, bad assembly. Worn pieces cause also force apparition and undesirable vibrations. If the frequency of the force is near to the natural oscillation rate of the system this will vibrate more and more strongly and brings the system in resonance. Repeating force would not be a problem until it begins to cause resonance. Resonance should always be avoided because determines in very short time severe damages. Vibration monitoring helps to find any problems that might be developing helps to detect unwanted vibration and so problems can be prevent in time. In general critical systems or equipments should be monitored in order to avoid unexpected. For example systems that require expensive, lengthy or difficult repairs if broken down, equipments that frequently suffer damages, systems that affect human or environmental safety.

1.2. Vibration analysis
Vibrations are mechanical oscillations and so they can be characterized with amplitude and frequency. Amplitude shows how strongly the vibration is, and frequency shows the oscillation rate of vibration. These two

ISSN 2394 - 9554

provide information to identify the root of vibration. The amplitude is related to the speed of the movement and to the force which cause the vibration. The peak of the amplitude shows the highest speed and the rms value of the amplitude shows the vibration energy. The frequency is related to the condition of the system. Vibration analysis consists of a spectral analysis. The spectrum is a very useful analytical tool because shows the frequencies at which vibration occurs. The information from a spectrum depends on the maximum frequency Fmax and resolution. How high Fmax needs to be is dependent on the operating speed of the system. The resolution of a spectrum establishes the detail in the spectrum. Depending on the user, the measured signal can be displayed as either a velocity waveform or a velocity spectrum. Generally a velocity spectrum is used to find out the component of the vibration signal.

MAGNETO-RHEOLOGICAL DAMPER

This section presents information related to theoretical and practical application of controllable magnetorheological damper. It also gives insight to the approach used in application of MR fluid damper during end milling operation. Magneto-rheological fluids are belongs to smart materials that gives a possibility of modifying the rheological properties such as viscosity, elasticity and plasticity with an application of desired magnetic field in the electromagnetic coil of the damper. The magneto-rheological effects are often greatest when the applied magnetic field is perpendicular to the direction of magneto-rheological fluid flow through the gap. The fluid particles are capable of producing higher yield strength when exposed to magnetization effect. The fluids in which ferrous particles are present are having a magnitude lesser than those of magnetorheological fluid particles i.e. they are 5–10 microns, when compared to 15–60 microns for MR fluid. The fluid composed of base oil which is mineral or silicone based with different percentages of ferrous particles and the particles are coated with an anti-coagulant material. When the fluid is inactive magneto-rheological damper behaves as Newtonian-fluid like behaviour. When magnetic field is applied the ferrous particles which are dispersed in the fluid in the form of tiny magnetic dipoles, these magnetic dipoles align along the stream lines of magnetic flux as shown in Fig 1.

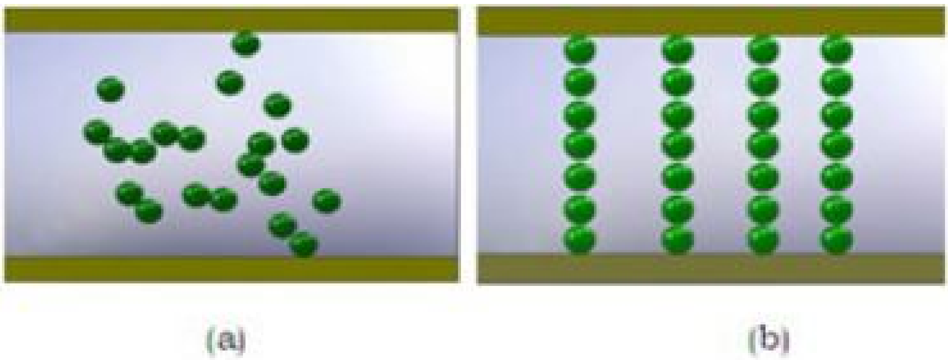

Fig 1: Magnetic-activated fluid (a) Absence of magnetization (b) In magnetization

FEA Model of Magneto-Rheological Damper with an End Mill Cutter

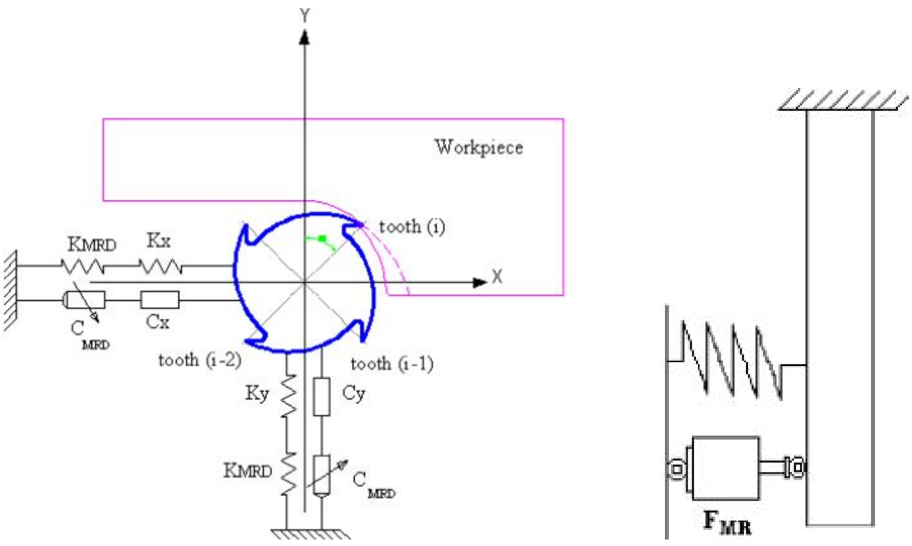

Figure 2.-DOF magneto-rheological damper with an end mill cutter.

In this section modelling of magneto-rheological is developed by using the second law of motion and the mass of the damper is lumped at the nodes. Consider the mass , stiffness and damping matrix of the magneto rheological damper as M_{MR}, C_{MR} and K_{MR} The lumped model of the magneto rheological damper is modelled as mass spring damper system, in this model the stiffness of the accumulator and the air spring are k_1 and k_2 respectively. Cs is the damping coefficient of the end mill cutter, C_{MRD} coefficient of MR damper induced due to magnetic field. In fig 2, the end mill cutter is attached with a magneto-rheological damper. Let m1 and m2 are the masses of the spring and fluid moving in the damper. The damping of the MR Damper will be very little if the damper input current is zero and the k_1 and k_2 are treated in series at that point of time. When the damper input current varies from minimum (0 Amps) to maximum (2 Amps) simultaneously the stiffness of the damper thereby producing the damping force to the cutter. The stiffness of the damper represented as KMR and is given by

$$K_{MR} \geq K_1K_2/(K_1+K_2)$$

CLASSIFICATION OF VAM

The systems that work on VAM principle can be divided into two main classes based on the frequency of vibration:

- Resonant system: This system can only operate at discrete frequencies greater than 20 kHz, and produce displacement amplitudes less than 6 µm.
- Non resonant system: This system can operate at the range of operating frequencies (1 kHz – 40 kHz) as well as amplitudes 10 times greater than the resonant system.

Further these systems can be sub classified as two types based on mode of vibration introduced in tool or work piece, as shown in Fig.1.

- Dimensional VAM: This system operates in a plane parallel to the work piece surface which is in line with the cutting force.
- 2-Dimensional VAM: This system produces an elliptical tool motion, where the major axis of the ellipse is in line with the cutting force and the minor axis is in line with the thrust force. The amplitude of vibration in each axis may or may not to be the same and is described as amplitude of vibration along major axis (A) × amplitude of vibration in minor axis (B) which is represented by A µm × B µm [1].

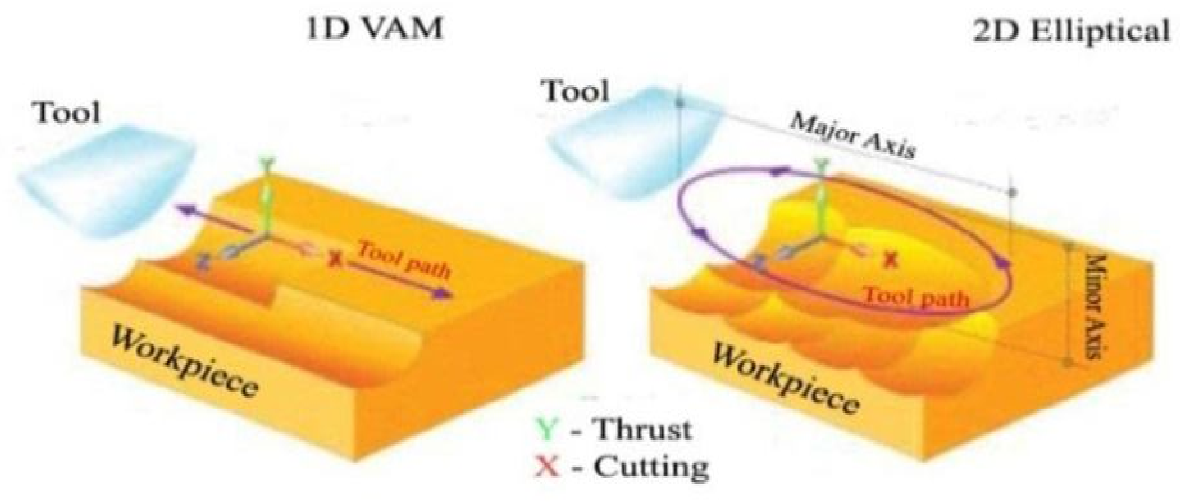

Fig.3. Types of VAM based on modes of vibration (a) 1-Dimensional VAM, (b) 2-Dimensional VAM.

2-D resonant system as shown in Fig.4 (b) induce a circular or elliptical tool motion by producing the supporting structure to vibrate at its resonant frequency in two dimensions. It can be also produced by placing tool away from the centerline of a 1-D VAM system. Typical frequencies are 20–40 kHz with tool path is 3 µm × 3 µm to 8 µm × 4 µm In 2-D non-resonant systems as shown in Fig.4 (c) the linear motion of the piezo stacks is converted into elliptical tool motion by a mechanical linkage. The flexure has an internal cross-shaped void to limit crosstalk between the two directions of motion and to eliminate shear stress in one stack by the motion of the other. The tool path generated is a quasi-ellipse. Typical frequencies are less than 1 kHz with tool path as 5 µm × 4 µm [1].

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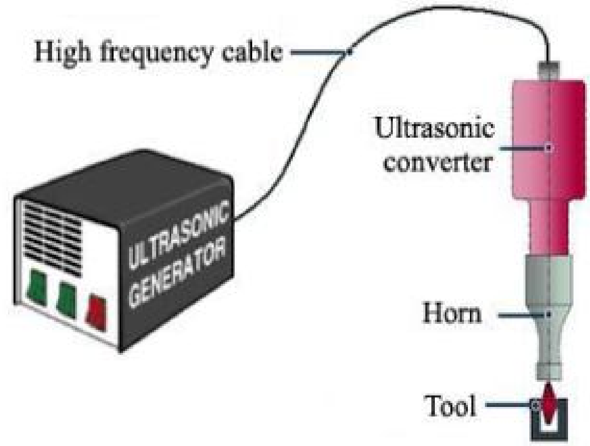

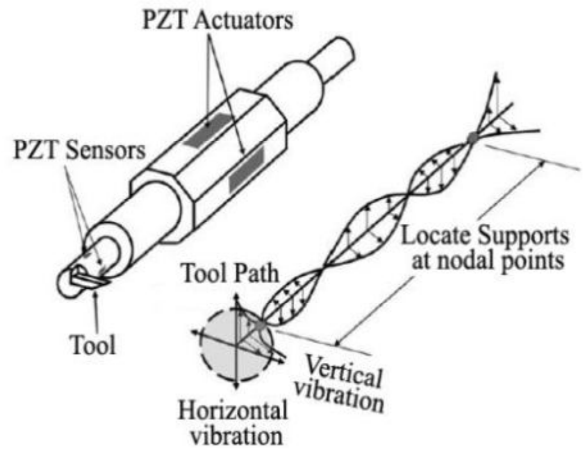

Fig.4 (a) 1-D VAM system. (b) 2-D Resonant system

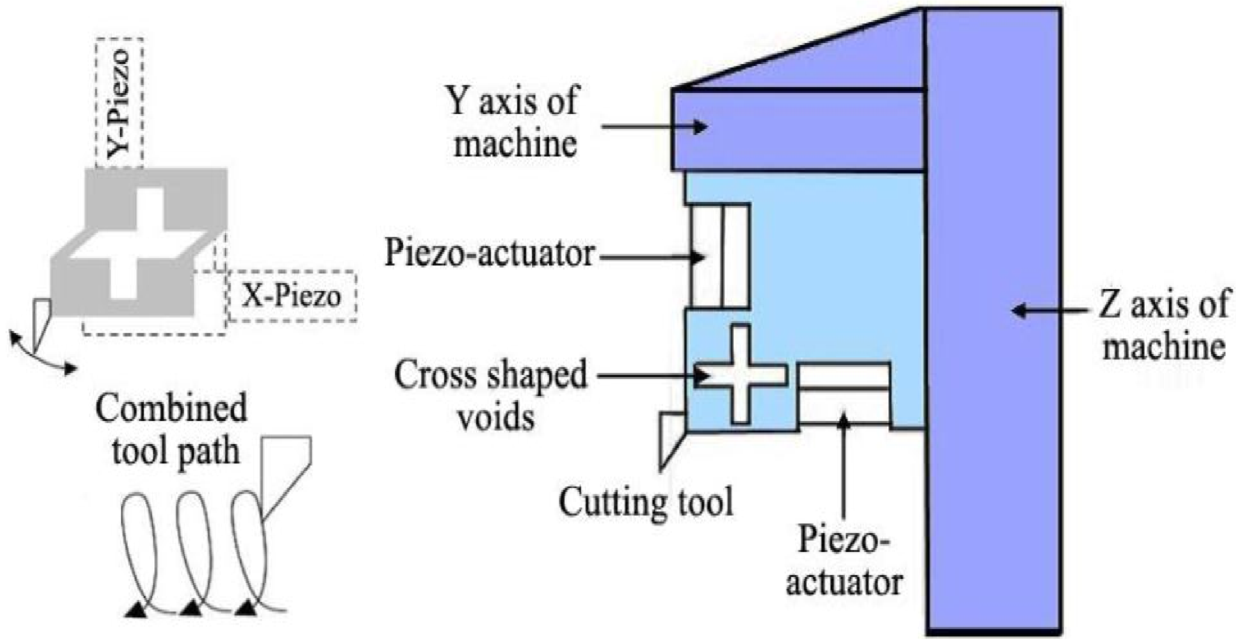

Fig.4 (c) 2-D Non resonant system.

4.1 Servo system of VAM

Resonant 1-D system is the most common type for VAM system used in applications. As shown in Fig.4 (a), an ultrasonic generator uses a piezoelectric or magneto restrictive actuator to create reciprocating harmonic motion with high frequency and low amplitude. A shaped acoustical wave guide booster and horn (sonotrode) amplifies this ultrasonic motion. A cutting tool is attached at the end of the horn, aligned in such a way that the rake face of cutting tool is normal to the direction of vibratory motion. Typical amplitudes and frequencies are 3–100 μm and 20– 40 kHz, respectively.

ULTRASONIC ASSISTED TURNING (UAT)

The ultrasonic assisted turning (UAT) has been found to be very effective in machining of high strength alloys such as titanium alloys and nickel alloys, and difficult to machine condition like diamond turning of ferrous and brittle materials which is to overcome high heat generation and consequent rapid wear of cutting tool edges that occur during conventional turning (CT). Fig.5 (a) shows the stresses induced at conventional and ultrasonic assisted turning. It is clearly observed that in UAT periodic relaxation reduces effective stresses up to 50 %. Fig.5 (b) shows the level of stresses compared in conventional turning as well as in UAT. There is a 40–45 % reduction in cutting forces, the average cutting force drops to 40 % of the conventional cutting as shown in Fig.5 (c) There is a measurable reduction in normal, thrust forces and cutting temperature hence improving the tool life. During UAT less residual stresses are induced in work and quality of the machined surface is improved.

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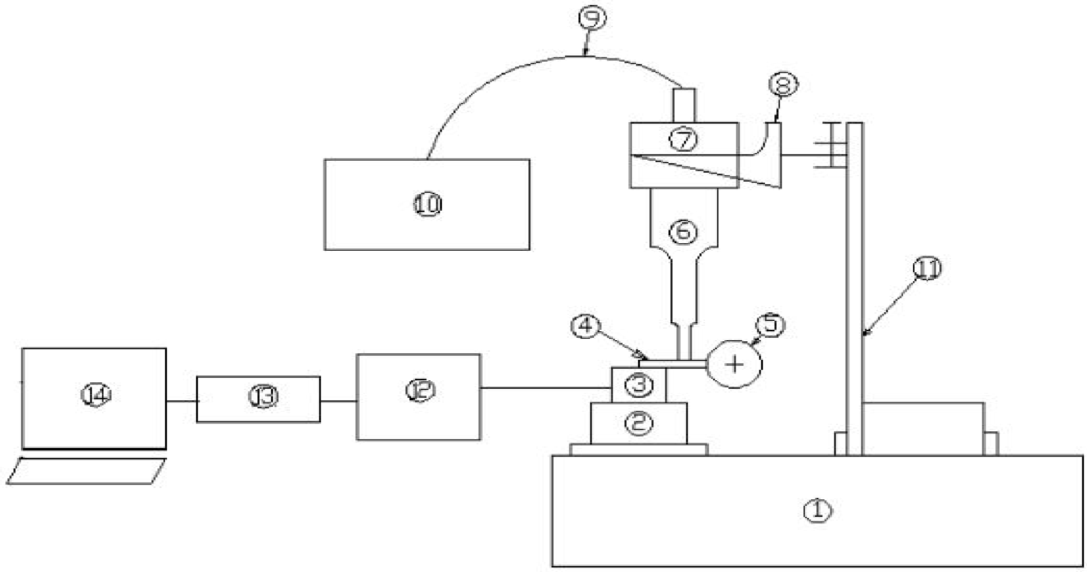

Fig. 5. Schematic Diagram of ultrasonic assisted turning (UAT) set-up.

1. HMT Model NH 26 Lathe.
2. Compound plate
3. Dynamometer (Kistler model 9272)
4. Tool (treated as a cantilever)
5. Work-piece
6. Ultrasonic vibratory tool (UVT)
7. Booster/converter
8. Bracket
9. H. F. Cable with 4 pin coaxially (M) to (F) connector connects 20 kHz high voltages to the converter.
10. Generators
11. L-type holder
12. Charge amplifier model 5070A
13. DAQ
14. PC (CONTROL UNIT)

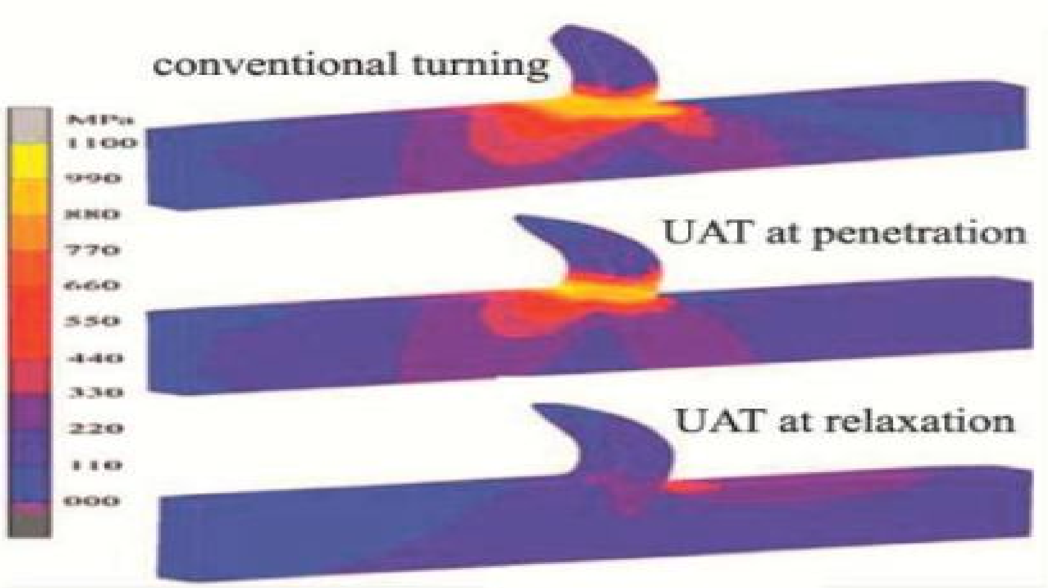

Fig.5 (a) Stress distribution in CT and UAT,

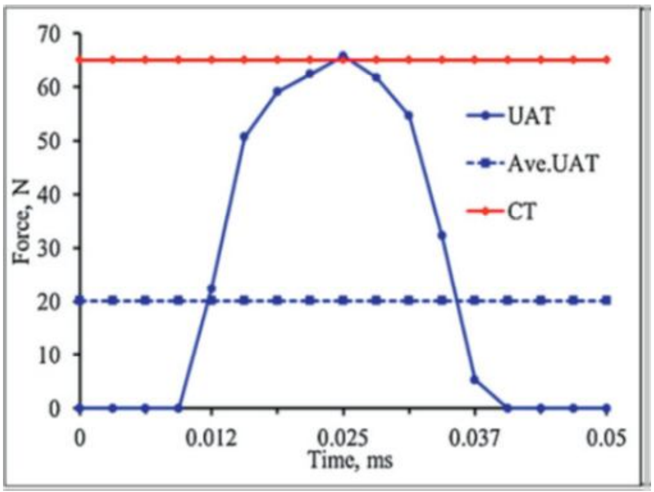

Fig.5 (b) Effect of cutting speed on stresses.

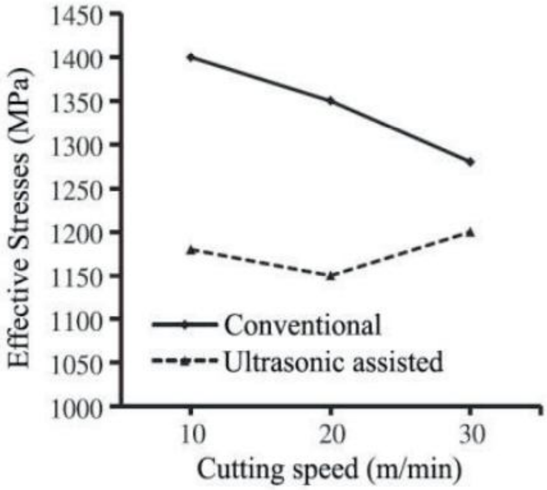

Fig.5 (c) Comparison of cutting forces

VI. DISCUSSION, REASONS FOR IMPROVEMENTS IN MACHINING PROCESS

- **Reduced forces and stresses**

1-D and 2-D VAM mechanisms modify chip geometry as well as interactions between workpiece and the tool rake face results in thinner and shorter chips, hence required average force to remove the smaller volume is reduced. Further the reduced force induces less stresses and periodic separation helps in relieving the stress in hot condition, resulting in improved lubrication. Also tool velocity exceeding the chip velocity produces a reversed tool-chip friction force there by reducing the thrust force.

- **Reduced cutting temperatures**

Periodic tool-work separation provide a gap to dissipate heat between tool and workpiece and better lubrication and cooling effects are achieved compared to conventional machining, where no lubrication occurs at high speed. Further the work-tool contact area varies at several points on the 2-D VAM elliptical path reducing the temperature.

- **Extended tool life**

The reduced forces, stresses and periodic separation help the tool to release stresses which will results in improvement of tool life, especially in case of difficult to machine material. The intermittent contact between tool and work material in VAM reduces, time available for other wear reactions is reduced and allows the tool to cool down considerably.

- **Better surface finish and form accuracy**

VAM uses tool with round-nose tool while avoiding chatter, lower thrust forces decrease the amplitude of tool vibration relative to the workpiece. Uniform alternating cycles between tool and work provide confined uniform cracking and material removal. Lower friction induces lower temperatures and reduced subsurface cracking and also small discontinuous chips lowers surface roughness.

- **Ductile regime machining of brittle materials**

When depth of cut is carefully controlled to a small value many brittle materials behave like ductile materials while machining and producing chips by means of plastic flow with minimal subsurface cracking. Smaller tool forces in VAM reduce the depth below the machined surface to which micro fractures propagate and also increase the depth to which ductile regime machining can be achieved.

- **Suppression of burr formation**

Burr formation is due to the result of instantaneous compressive and bending stresses caused by cutting in the deformation zone at the edges of the cut. These stresses are greatly reduced with the help of VAM and formation of discrete chips which is facilitated by round-nose tool due to less thrust forces.

CONCLUSION

Mechanical system vibration or vibrations transferred through environment cause several damages. Vibration monitoring in critical places can prevent hard faults. It was deduced simple transfer function for two cases if the system is vibrating and if through the base is transmitted a vibration. This research work presents a new method to study the damping effect of magnetic rheological fluid during end milling operation. The following are the

ISSN 2394 - 9554

important conclusions, drawn from the present research work. It has been observed from the results that the yield force increased from 0 to 11.60 N, when the damper input current varied from 0 to 1.2 A. The damping force is produced due to the yield of the magnetic-rheological fluid particles, subjected to a given damper input current. The magnetic-rheological damping force remains constant after reaching the saturation damper input current of 2A. Thereafter, it provides a consistent damping to the end mill cutter. Magnetic-rheological damper piston velocity plays an important role in minimizing the deflection of the end mill tool from its mean position. It is inversely proportional to Bingham number of the fluid. It has been observed that, if the piston velocity decreases the Bingham number increases which indicate chatter since more force is required to be keep the end mill tool to be in its mean position. This indicates that by using MR damper it is possible to achieve a good control over tool vibration and uniform quality product.

The future work consists in the investigation of broader fields of frequency and amplitude. For this reason the specimen and the mounting parts will be reduced in mass, what affects the potential of movement of the vibration table positively. Another approach is to use the vibration table for the machining of high elastic fibers like PBO, PE or Aramid. The vibrations could improve the cutting through the initiation of the additional cutting force caused by the vibrations.

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International Journal of Research in Science and Technology
Volume 2, Issue 2 (I) : April - June , 2015
ISSN 2394 - 9554

STABILISATION OF ORGANIC SOIL WITH FLY ASH

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ABSTRACT

This paper presents an investigation into the stabilisation of organic soils by high lime fly ash. 0%, 5%, 10%, 15% & 20% (m/m) of the soil was replaced with fly ash. Different test samples were prepared mixing the soil sample with fly ash at their respective optimum water contents determined by standard proctor test and the test samples were tested for its unconfined compressive strength after curing for 0, 3, 7, 14 and 20 days. The effectiveness of fly ash use in the stabilization of organic soils and the factors that are likely to affect the degree of stabilization were studied. Unconfined compression test and other geotechnical characterisation tests had been conducted on untreated soil specimens and on organic soil-fly ash mixtures. It was found that, inclusion of fly ash improved the unconfined compressive strength of organic soils, but the amount of increase depends on the type of soil and characteristics of the fly ash. The improvements, appearing with increasing fly-ash content, were attributed to the pozzolanic reaction and pore refinement effect of fly ash as well as its high free-lime content, although the reduction in water content resulting from the addition of dry fly ash solid also contributes to strength gain. The pozzolanic effect appears to diminish as the water content decreases. For most of the soil–fly ash mixtures tested, unconfined compressive strength increases when fly ash percentage is increased.

The main objectives of the present investigation is to assess the usefulness of fly ash as a soil admixture, and focused to improve the engineering properties of soil to make it capable of taking more load from the foundation structures. This study also benefits the effective use of fly ash and thus cost effective method for improving the soil properties.

INTRODUCTION

Fly ash is one of the most plentiful and versatile of the industrial by-products. It is a solid waste product created by the combustion of coal, carried out of the boiler by flue gases and extracted by electrostatic precipitators or cyclone separators and filter bags. Its appearance is generally that of light to dark-gray powder of predominantly silt-size.

Construction on soft organic soils can be problematic because organic soils typically have low shear strength and high compressibility (Edil 1997). Current practice for construction of roadways over organic soil subgrades mostly involve the removal of the organic soil to a sufficient depth and replacement with crushed rock (referred to as “cut and replace”) or preloading to improve engineering properties. Chemical stabilization with binders such as cement, lime, and fly ash can be undertaken rapidly and often at low cost, and therefore chemical stabilization is becoming an important alternative (Keshawarz and Dutta 1993; Sridharan et al. 1997; Kaniraj and Havanagi 1999; Parsons and Kneebone 2005).

Fly ash has been shown to effectively stabilize soft inorganic soils (Ferguson 1993; Acosta et al. 2003; Prabakar et al. 2004; Bin-Shafique et al. 2004; Trzebiatowski et al. 2005), but little is known regarding the effectiveness of stabilizing soft organic soils with fly ash. Organic soils are known to be more difficult to stabilize chemically than inorganic soils (Hampton and Edil 1998; Janz and Johansson 2002). Erdem O.Tastan et al. (2011) have found that unconfined compressive strength of organic soils can be increased using fly ash, but the amount of increase depends on the type of soil and characteristics of the fly ash. Large increases in q_u (from 30 kPa without fly ash to > 400 kPa with fly ash) were obtained for two clayey soils with an Organic content(OC) less than 10% when blended with some of the fly ashes. More modest increases in q_u (from 15 kPa without fly ash to > 100 kPa with fly ash) were obtained for a highly organic sandy silty peat with OC = 27%. J. Prabakar et al. (2003) found that addition of fly ash reduces the dry density of the soil due to the low specific gravity and unit weight of soil. The reduction in dry density can be in the order of 15–20%.

BACKGROUND

CHEMICAL STABILIZATION

When binders such as lime, cement, and fly ash are blended with soil in the presence of water, a set of reactions occur that result in dissociation of lime (CaO) in the binders and the formation of cementitious and pozzolanic gels [calcium silicate hydrate gel (CSH) and calcium aluminate silicate hydrate gel (CASH)]:

$$CaO + H_2O \Rightarrow Ca(OH)_2 \quad (1)$$
$$Ca(OH)_2 \Rightarrow Ca^{2+} + 2[OH]^- \quad (2)$$

ISSN 2394 - 9554

$Ca^{2+} + 2[OH]^{-} + SiO2 \Rightarrow CSH$ (3)
$Ca^{2+} + 2[OH]^{-} + Al2O3 \Rightarrow CASH$ (4)

These reactions are referred to as cementitious and/or pozzolanic reactions that result in the formation of cementitious gels. The increase in strength was found to be roughly related to the type and quantity of possible reaction products (i.e., cement reaction product, CSH for short-term strength and pozzolanic reaction product, CASH for long-term strength gain). These reactions contribute to stabilization of soils in two ways. First, plasticity of the soil is reduced by the exchange of calcium ions in the pore water with monovalent cations on clay surfaces and by compression of the adsorbed layer because of the elevated ionic strength of the pore water.

INHIBITION OF CEMENTING REACTIONS BY ORGANIC MATTER

Organic soils traditionally have been more difficult to stabilize chemically than inorganic soils due to lower solids content, higher water content, lower pH, and chemical interferences that occur in the cementing reactions. When cement, lime, or fly ash (any source of Ca^{2+} ions) is added to organic soils, following the hydration of lime [Eqs. (1) and (2)], released Ca^{2+} ions are likely to be exhausted by the organic matter, which limits the availability of Ca^{2+} ions for pozzolanic reactions. Thus, the amount of CaO in fly ash should be large enough to compensate for the consumption of Ca^{2+} ions by the organic matter in the soil. The possible interactions of organic compounds with pozzolanic minerals (Ca^{2+} or Al^{3+}) or $Ca(OH)_2$ are summarized as follows (Young 1972):

(1) calcium ions can be adsorbed by the organic matter instead of reacting with pozzolanic minerals; (2) organic compounds react with $Ca(OH)_2$ and precipitate, which forms insoluble compounds and limits the availability of Ca^{2+} ions for pozzolanic reactions; (3) alumina can form stable complexes with organic compounds, and calcium ions can also complex with organic compounds; and (4) organic compounds can adsorb on $Ca(OH)_2$ nuclei, which inhibit the growth of nuclei and formation of CSH.

MATERIALS AND METHODS

Soils

The organic soil used in the process was collected from a site which is dumped with organic matter for a long period of time and the soil was collected within 1m from the ground surface. The soil has less specific gravity and maximum dry density compared to other typical soils of the nearby region. The properties of the soil are listed in Table 1.

Table 1: Physical properties of the organic soil.

Soil	OC(%)	OMC(%)	W_L(%)	W_P(%)	G_S	$\gamma_{d\,max}$ (g/cc)
OS	9	41.5	83.5	48.5	1.924	1.099

Note: OS=organic soil, OC=organic content, OMC=optimum moisture content, W_L=liquid limit, W_P=plastic limit, G_S= specific gravity, $\gamma_{d\,max}$= maximum dry density.

Fly Ash

The fly ash used for the stabilisation process is Class C fly ash and the properties are listed in Table 2.

Table 2 : Properties of Fly Ash

Classification	Sp. Gravity	Grain Size Distribution	
		Sand	Silt/Clay
C	2.20	15	85

UNCONFINED COMPRESSION TEST

Unconfined compression tests were conducted on specimens prepared from the soil and soil–fly ash mixtures following ASTM D5102 (ASTM 2009b). The strain rate was 1.25mm/min. Test specimens were prepared by first mixing the dry soil and the dry fly ash at the specified fly ash content on dry weight basis. Subsequently, the amount of water required was added. The mixture was compacted in a steel mould with a diameter of 38 mm and height of 76 mm. The compactive effort for specimen preparation was adjusted in such a way that the same impact energy per unit volume, as in the standard Proctor effort [ASTM D698 (ASTM 2007a)], was applied.

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WORKS AND ANALYSIS

Preparation of Soil Specimens

Organic soil- fly ash mixture specimens were prepared at fly ash contents of 5%, 10%, 15% & 20% (based on dry weight) and the tests were conducted on the OMC of the mixtures. The description of the soil- fly ash mixtures are given in Table 3.

Table 3: Compaction characteristics and description of fly- ash–soil mixtures.

Mixture	FA(%)	Soil(%)	Dry Unit Weight $\gamma_{d\,max}$(g/cc)	Optimum Water Content (%)
SFA0	0	100	0.995	41.5
SFA5	5	95	1.029	38.7
SFA10	10	90	1.13	37.51
SFA15	15	85	1.158	36.235
SFA20	20	80	1.212	34.1

General Effectiveness of Fly Ash Stabilisation

The addition of fly ash to the organic soil effect the unconfined compressive strength of the soil samples and so it increases its strength. The strength of the unstabilised organic soil of about 70 KPa was increased to nearly about 125 KPa, which shows that the magnification factor was not so high because of the interferences of the organic matter in the pozzolanic reactions.

Effect of Fly Ash on OMC and Maximum Dry Density

The addition of fly ash into the soils indicates that the specific gravity of soils mixed with different concentration of fly ash will be changing. The void ratio of soils depends upon the shape of the grains, the uniformity of grain size, and the conditions of sedimentation. The addition of fly ash in soils changes the porosity and void ratio within the range of void ratio of fly ash and soils. So the change in the OMC and maximum dry density will be seen. The variation in Optimum moisture content and maximum dry density with change in fly ash content are shown in fig 1 and fig 2 respectively.

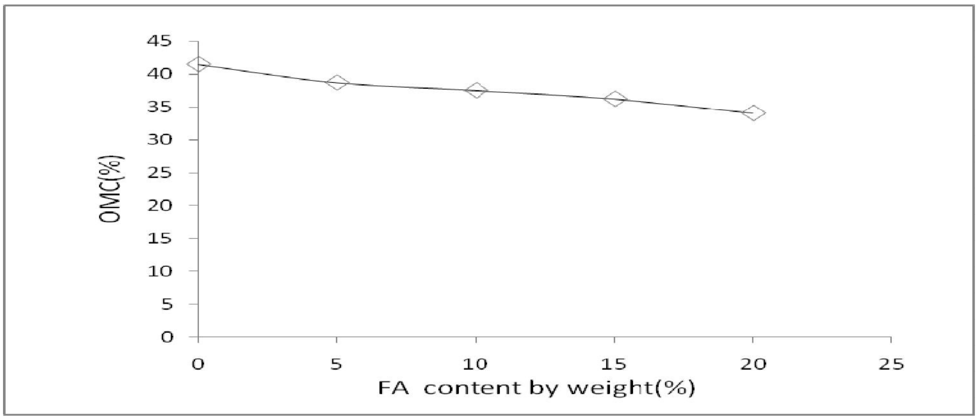

Fig 1: variation of OMC(%) with FA content

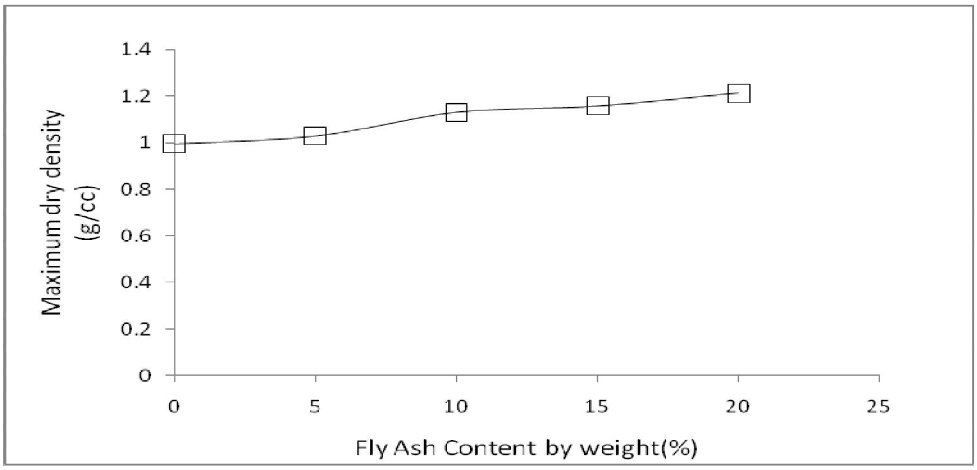

Fig 2: variation of maximum dry density with FA content

Effect Of Curing Time

The specimens prepared from soil-fly ash mixture were tested for its strength on different curing period of 0,3,7,14 and 20 days and the results were compared. The variation of the unconfined compressive strength of the soil- fly ash mixture for different curing period are shown in fig 3.

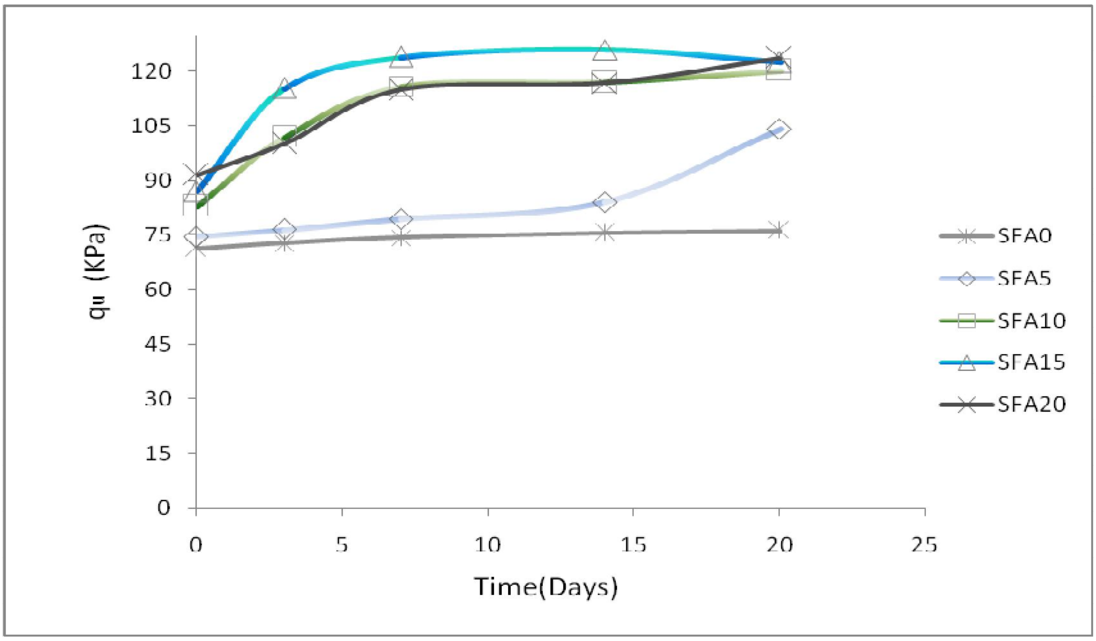

Fig 3: variation of q_u with curing period

CONCLUSIONS

The objective of this study was to determine if unconfined compressive strength of organic soils can be increased by blending fly ash into the soil and if so how much its strength can be magnified. Tests were conducted on four different soil-fly ash mixtures (5%,10%,15% & 20%) for different curing period (0,3,7,14 &20 days). The following conclusions are drawn:

1. After the addition of fly ash into the soil, the maximum dry density goes on increasing and the optimum moisture content goes on decreasing with increase in fly ash content.
2. The unconfined compressive strength of soil-fly ash mixtures are seen to increase with increase in percentages of replacement of soil by fly ash and also with increase in curing period.
3. The strength of the organic soil has been increased but the magnification factor is not so large because of the problems in stabilising due to the interferences of the organic matter in the process as stated above.

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International Journal of Research in Science and Technology
Volume 2, Issue 2 (I) : April - June , 2015
ISSN 2394 - 9554

THE IMPACT OF USER ROLE IN INDUSTRIAL AND AGRICULTURAL SERVICES OF ROBOT APPLICATIONS

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ABSTRACT

This report persents Application of the robots in industrial and agricultural production processes, year after year increased. The robot application is related for its functional justification. Industrial Robots can be used for different applications which simply cut across industrial and personal purposes. They perform different tasks based on how they have been programmed or taught manually. In this paper is presented industrial robot application analysis in serving machine tools.The system is defined at multiple levels of granularity where agents provide services in respect to the current global goal. In Agriculture and forestry, research into driverless vehicles has been a vision initiated in the early 1960's with basic research on projects on automatic steered systems and autonomous tractors (Wilson, 2000). Recently, the development of robotic systems in agriculture has experienced an increased interest, which has led many experts to explore the possibilities to develop more rationaland adaptable vehicles based on behavioural approach. This research also proposed a basic interaction method for humanoid robot to interact with its environment called "groping-locomotion method." This method was applied in the robot control system. The final results demonstrate that implementation such system helps to boost the quality of industrial and agricultural program It is expected that a better adaptability can be achieved by this approach.

Keywords: Manipulator, Endeffector, Mushroom Picking Robot.

1. INTRODUCTION

The implementation and installation of today's service robot applications into industrial processes is a challenging and time taking task that is usually executed by domain experts. Such systems, as e.g.The service robot platform, rob@work 3[1]. In the last years multiple of functionality-rich robot software frameworks were developed to improve reuse during the development process and to lower the entry barrier for new developers. Most notably, Orocos [2], currently call the attention of the robotic community. The efficacy of the technology implies improving of the technical solutions in domain of technological process automation and application of the intelligent systems in various industrial branches as metal product industry. Large numbers of industrial robot application in metal product industry are existed today. Their application are motivated by technical and economical reasons, some of them are in the paper [3,4,5,6]: A combined application of new sensor systems, communication technologies, positioning systems (GPS) and geographical information systems (GIS) have enabled researchers to develop new autonomous vehicles for high value crops in the agriculture and horticulture soctor, as well as for landscape.

Research on humanoid robot is rapidly increased nowadays and has gained more interest especially in the application to built-for-human environment and human-robot interaction. Humanoid robots are the type of robot that practically suitable to coexist with human in built-for-human environment because of its anthropomorphism, human friendly design and applicability of locomotion.

2. INDUSTRIAL ROBOT APPLICATIONS

Industrial robots have a wide range of potential applications in manufacturing systems because they are flexible and programmable themselves. The use of sensors allows the robots to see, hear and smell the environment. The robot controllers can be generally integrated easily into the manufacturing system environment and are capable of communicating with other programmable controllers [7].

2.1 **Main application of industrial robot which are.**

1. Manipulation (pick-and-place).
2. Assembly.
3. Spray painting and coating.
4. Arc welding.
5. Spot welding with pneumatic or servo-controlled gun.

6. Laser cutting and welding.
7. Gluing and sealing.
8. Mechanical finishing operations (deburring, grinding).

2.2 Manipulator

It consists of the base and arm of the robot, including the power supply, which may be electrical, hydraulic or pneumatic. The manipulator is the device that provides movement in any number of degrees of freedom. The movement of manipulator can be described in relation to its coordinate system, which may be cylindrical, spherical, anthropomorphic or Cartesian. Depending on controller, movement can be point-to-point or continuous-path motion this is the main body of the robot; it consists of the links, the joints, and other structural elements. The weight of the robot is roughly 225kg. The IRB1410 robot is equipped with an operating system BaseWare OS. The BaseWare OS control every aspect of the robot, such as motion control, development and execution of application programs communications. The Robot can also be equipped with optional software for application support. The IRB1410 ABB Robot has a payload of 5kg and a working envelop (reach) of about 1.44m [8]. It consists of the base and arm of the robot, including the power supply, which may be electrical, hydraulic or pneumatic. The manipulator is the device that provides movement in any number of degrees of freedom. The movement of manipulator can be described in relation to its coordinate system, which may be cylindrical, spherical, anthropomorphic or Cartesian. Depending on controller, movement can be point-to-point or continuous-path motion.

Fig 1: IRB1410Robot

Fig 2:Material Handling Maniputor

Controller

The versatility of a robot arises from its multi-axis mechanical configuration and the robot controller. The ability to reprogram the robot controller gives the flexibility to the robot to perform a wide range of actions. The controller contains various interfaces with both command devices and sensing units. The controller has to define the trajectory of the robot gripper with time and transform this trajectory, which is in Cartesian coordinates, into its base-frame coordinate system and finally into joint movements. Many of these tasks are to be performed in real time. Several easy-to-use robot programming languages such as VAL, MCL and APT are available.

Tooling

Tooling is what enables the robot to do a particular job. Tooling is sometimes used synonymously with end effectors, although the latter has a more restricted meaning to apply to end-of-arm fixturing to grasp, lift or turn. Tooling on the other hand, has a broader context which can apply to power tools for drilling and grinding, as well as for painting and welding guns. Typical end effectors include electromagnets, hooks, vacuum cups, adhesive fingers and bayonet sockets. There are six basic motions or degrees of freedom, which provide the robot the capability to move the end effectors through the required sequence of motions. The six motions consist of three arm and body motions and three gripper motions. The three arms and body motions consist of vertical traverse, radial traverse and rotational traverse. The gripper motions are yaw, pitch and roll [9].and this is the latest research upto 2015 for industrial robots in operation worldwide

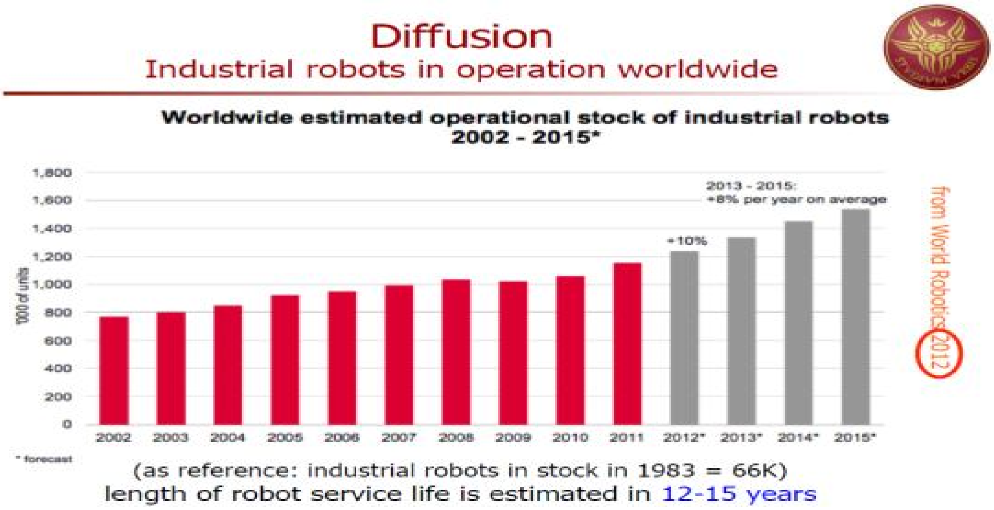

Fig 3: Industrial robots in operation worldwide (This is the latest research upto 2015 for industrial robots in operation worldwide)

2.3 End Effector (spray painting and coating)

End effector is the device at the end of a robot manipulator; it is designed to inter with the environment. This tool is Used perform the programmed application based on the required task. The Spray gun (F-75S) shown in Fig. 3. Is used as, the end effector for the painting robot. The spray gun is suction feed, it has a standard nozzle of Φ1.5mm, the operating pressure ranges from4bar, air consumption of 3.5-6cfm, the paint capacity is 750cc, fluid flow is about 120-160(ml/min), and a spout distance of 200mm. The spray gun is actuated by a 2HP, 1.5KW air compressor. The air compressor has a rated pressure of 8bar, output volume of 188L/Min, 38L tank, and a cylinder of 47mm. The spray gun is actuated by a 2HP, 1.5KW air compressor. The air compressor has a rated pressure of 8bar, output volume of 188L/Min, 38L tank, and a cylinder of 47mm. Paint is any liquid, liquefiable, or mastic composition which after application to subtract in a thin layer is converted to an opaque solid film

Fig 4: F-75S Spry Gun

Acylic enemal paint was used the painting robot process. The following material is needed for any painting process andsome are vitally important for safety purposes; safety glasses, hearing protection, filter mask with organic vapor, spraygun,hose,pressure regulator, paint, solvent, angle grinder with cap brush, wire brush and paint object. The workobject used in the Painting Robot is a wooden board**. [10]**

2.4 Many benefits of robots seem to be most noticeable in productivity, safety, and in saving time and money.

Productivity

- Robots produce more accurate and high quality work.
- Robots rarely make mistakes and are more precise than human workers.
- They can produce a greater quantity in a short amount of time.
- They can work at a constant speed with no breaks, days off, or holiday time.
- They can perform applications with more repeatability than humans.

Safety

 Robots save workers from performing dangerous tasks.

They can work in hazardous conditions, such as poor lighting, toxic chemicals, or tight spaces.

They are capable of lifting heavy loads without injury or tiring.

 Robots increase worker safety by preventing accidents since humans are not performing risky jobs.

Savings

 Robots save time by being able to produce a greater magnitude of products.

They also reduce the amount of wasted material used due to their accuracy.

 Robots save companies money in the long run with quick ROIs (return on investment), fewer worker injuries (reducing or eliminating worker‘s comp), and with using less materials.

The list of the advantages of robots does not end there; they have also created jobs for workers. Many people believe the misconception that robots have taken away jobs from workers, but that is not necessarily true.Robots have created new jobs for those who were once on production lines with programming. They have pulled employees from repetitive, monotonous jobs and put them in better, more challenging ones. [11]

3. AGRICULTURAL ROBOT APPLICATION

The number or agricultural robots, agrobots, is increasing each year. The jobs they can do are also increasing with new technology in hardware and software. Robots are milking cows, shearing sheep, picking fruit, weeding, spraying, and cultivating, they use GPS and sensors for navigation. The new robots are getting smaller and smarter.

3.1 Fungicides

Robots can be used to combat plant diseases that cause a lot of damage to crops. Fungi are the most common causes of crop loss in the entire world. To kill a fungal disease you need a fungicide, a kind of pesticide. Fungal diseases interfere with the growth and development of a crop. They attack the leaves which are needed for photosynthesis and decrease the productivity of the crop and cause blemishes on the crops which make them worth less on the market. After the crops are harvested fungi can grow and spoil the fruits, vegetables, or seeds. Robots can treat plants that have been infected or destroy them if necessary. They could treat just the plants that need it, instead of covering the entire crop with fungicide. [12]

3.2 Herbicide

Another use for robots is in weeding. Robots can pull weeds from around the plants or just cut the tops off. All of the material can be collected by a robot and brought to a composting site limiting the need for herbicides, chemicals that destroy or inhibit the growth of plants. Herbicides are intended to kill weeds but many times also damage the crops [12]

3.3 Mushroom Picking Robot

Mushrooms are a very difficult crop to grow. There is a lot of labor involved. Many mushroom farms are becoming extremely high tech. They use computerized systems and monitor all production phases. The robot mushroom picker is an ongoing research project at the University of Warwick in the UK. See Figure 4

Fig 5**:**Robot Mushroom Picker

Their goal is to develop farm machinery that can reduce the labor costs of producing farm crops, in this case, mushrooms. The robot picks the mushrooms using a small suction cap on the end of its robotic arm. The robot

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has a charged coupled camera on board to tell which mushrooms to pick in a tray or bed, since mushrooms mature at different times during a six to ten week period. It uses the camera to tell the exact size of the mushroom and only pick the correct ones. Mushrooms grow in dark, damp places that are often inhospitable to humans. This makes the robot a perfect choice to work on a mushroom farm. The robots can only work half as fast as a human, but it doesn‟t mind working in the dark, or for 24 hours a day [12].

3.4 Pesticide

Pesticides are used to control insects that can be harmful to crops. They are effective but have many side effects for the environment. Insects also adapt to the toxin in a pesticide and the survivors breed and pass the resistant trait on to the next generation making stronger insects that are harder to kill. Robots could solve this by removing pests from the crops without using chemicals. They might suck them up with a vacuum. A bellow base air system makes a vacuum that doesn‟t require the large amount of power of regular vacuum systems. There are ways to kill the insects without chemicals. The robot could submerge them in a container with water or into one closed up to produce extreme heat in the sun. Microbial fuel cells could be used to reduce the insects to electrical power with bacteria. Pesticides kill everything. Robots could be programmed to rid particular pests and not harm anything else [12]

3.5 Workers in the agriculture industry

Many industrial automation tasks like assembly tasks are repetitive and tasks like painting are dirty. Robots can sometimes easily perform these tasks. Human workers often don‟t like tasks that don‟t require intelligence or exercise any decision-making skills. Many of these dumb tasks like vacuum cleaning or loading packages onto pallets can be executed perfectly by robots with a precision and reliability that humans may lack. As our population ages and the number of wage earners becomes a smaller fraction of our population, it is clear that robots have to fill the void in society. Industrial, and to a greater extent, service robots have the potential to fill this void in the coming years.For, the ratio of robot, to human workers in the manufacturing industry.

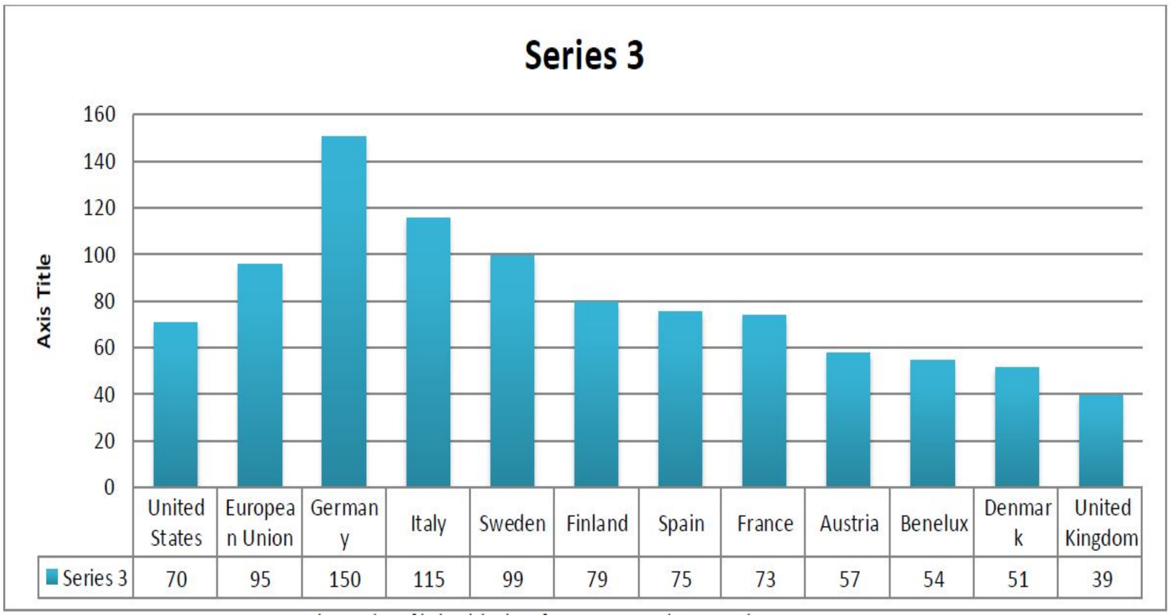

Fig6. Number of industrial srobots for every 10,000 human workers

A second reason for the deployment of industrial robots is the trend toward small product volumes and an increase in product variety. As the volume of products being produced decreases, hard automation becomes a more expensive proposition, and robotics is the only alternative to manual production. Industrial robots account for a $4 billion market with a growth rate of around 4%. Most of the current applications are either in material handling or in welding. Spot welding and painting operations in the automotive industry are almost exclusively performed by robots. See Figure 5.3. Industrial robots are improving in quality and the ratio of price to performance is falling. , while prices have fallen over 40% over the last 15 years, the accuracy and payload rating of robots have almost doubled in the same period.According to the United Nations Economic Commission for Europe (UNECE), there are over 20,000 professional service robots in use today valued at an estimated $2.4 billion (see fig). If personal entertainment robots and domestic robots like vacuum cleaners are included, this number is well over $3.5 billion. The UNECE estimates that the annual sales of service robots (both professional and personal) in 2005 will be around $5B [12]

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4. HUMAN-ROBOT COOPERATION

This research is dedicated to presenting the main research areas that ROBO-PARTNER is investigating for the Integration of humans and robots into a common working environment.

4.1 Human Robot Interaction and safety

The ROBO-PARTNER intends to enable the cooperation of humans and robots, during the execution of the assembly task, at different cooperation levels. Figure 7, shows three cooperation cases that are examined within the project. The first one involves the concurrent execution of different assembly tasks by the robot and the human, while sharing a common workspace. No fences or other physical safety devices need to be present since the robot is always aware of the human presence by utilizing a plethora of force/ vision Presence sensors .This enables it to implement a safety- first behavior. In the second level, the cooperation is mainly carried out at the cognitive level since the mobile robot can provide the operator with the correct assembly parts, thus reducing the time to identify and retrieve them from areas far from the assembled product. The final level of cooperation is the execution of the same assembly task by the robot and the human being in direct physical interaction. This approach enables the combination of human skills, such as perception and dexterity with robot strength, accuracy and repeatability in order for the same task to be efficiently performed. The robot's involvement also permits the automated quality check through the robot sensors. In order for the direct human-robot cooperation concept to be realized, the focus is on implementing control algorithms and multi modal interfaces for the regulation of the part's movement by both operator and robot [13]. For example, the operator is capable of moving the robot TCP (tool center point) bare-handedly, by exploiting the force sensors and standardized voice commands or gestures in order to perform any additional functionality. At the same time, the robot carries the part's payload and through virtual windows ensures the collision free path. In order for Human-Robot Cooperation (HRC) to be achieved, advanced sensorial networks, capable of efficiently fusing the acquired data under the real time process control algorithms, are required. Following this direction, intelligent multimodal interfaces (different physical background) enhanced with new sensorial capabilities, need to be integrated with the use of tactile.

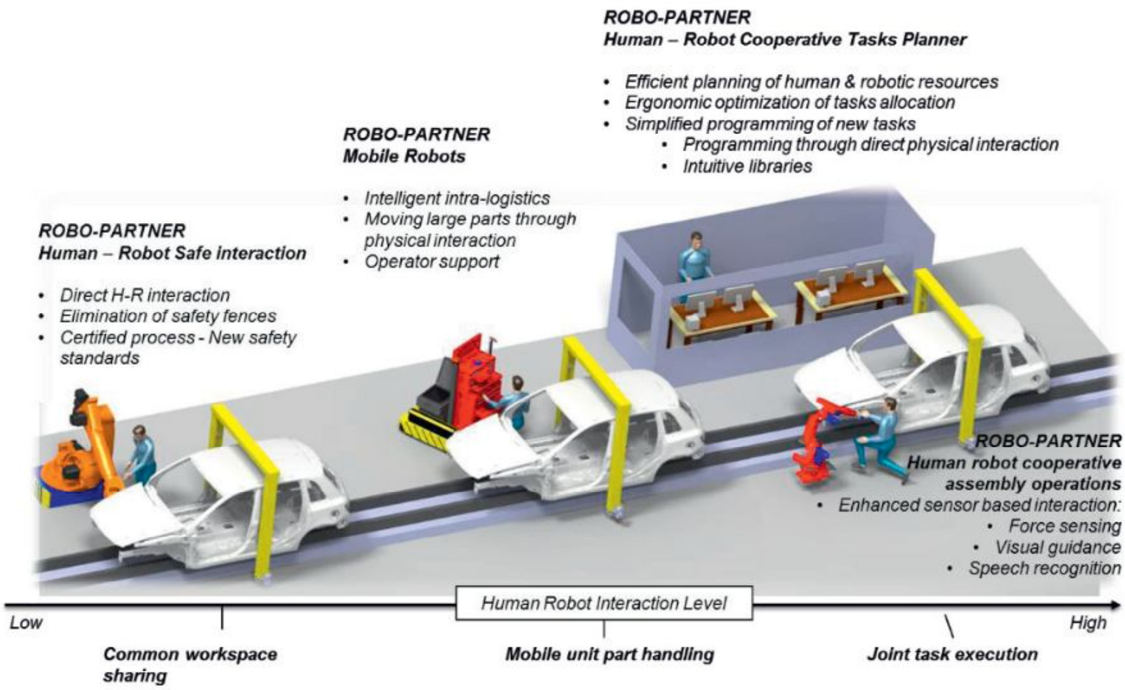

Fig7. Robo-partner productions paradigm in the automotive industry

4.2 Safety

Since industrial robots are normally large, move fast and carry heavy or blunt parts, their collision with a human being may cause severe injuries. Current manufacturing practices require complete physical separation between people and active industrial robots (typically achieved using fences or similar physical barriers) as a precaution to ensuring safety. Given the safety issues that arise from the coexistence of robots and humans, the means of detecting/ monitoring the human presence and adjusting the robots' behavior, need to be researched. Currently, several industrial solutions can be used to offer some sort of fenceless operation (e.g. the SafetyEye camera system however, a lot more are in an embryonic stage and not close to industrial application New approaches for ensuring the safety of people, found in close proximity to robots, in an industrial workcell, involve the automatic adjustment of the robot speed to the detection of humans in there as well as ways of adjusting to the trajectory in real time. Novel approaches for generating alternative robot paths, by considering environmental constraints, such as the ones proposed by [14],[15] need to be introduced for supporting engineers in designing safe processes.The main challenge remains the conformance and certification against the EU legislation and standards (e.g. ISO, DIN etc.) The trends nowadays are towards providing a fenceless intrinsic safety system, by considering the robots' dynamic power, static force, speed etc., as well as the human's reflex actions. Protective safety levels may be ensured through the use of redundant sensors including cameras, ultrasonic or laser range sensors, thermal imaging devices, capacitive or conductive robot skins etc. The most important aspects to be addressed involve:

4.3 Human robot cooperative tasks planner

Under this research area, the scientific focus is given to the derivation of robust methods for determining an efficient planning of assembly/disassembly operations, by utilizing, to the highest possible extent, the capabilities of both humans and robots.

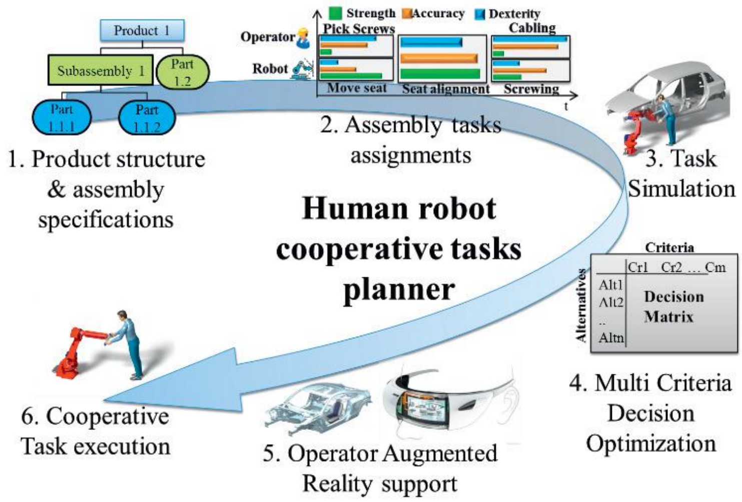

Fig8 ROBO-PARTNER Task planner concept

4.4 Towards this direction, planning tools such as the one in need to encompass the following functionalities

1. Efficient consideration of the product structure and the assembly specifications for the extraction of assembly tasks and the related Srequirements, (physical strength, accuracy, dexterity etc.).
2. Planning of the assembly processes and the assignment of tasks to the most suitable human/robot entities.
3. Exploitation of the human and robot simulation for evaluation of the ergonomics and feasibility of the assignments, in a structured and semi/fully automated way. The challenge is to automatically generate and evaluate the numerous possible combinations of human
4. And robot collaboration scenarios.
5. Evaluation of task assignments against user criteria (e.g. operator and resource utilization, matching of operators' skills to task requirements etc.) by using proven decision making methods. This will ensure that the process be executed in an efficient time and that the skills of each entity be efficiently exploited.
6. Further exploitation of the planning/simulation results in supporting the operators through the integration of the latest technologies, such as Augmented Reality. An example would involve the operator helping a robot to move a part, among obstacles, in the 3D space. The 3D models from the simulation can be used at this time to superimpose the final position of the part on the assembly
7. So that the operator can visualize and confirm its correct [16]

5. CONCLUSIONS

Robot behavior in most of today's industrial environments is controlled from the classical aspect of automatic control. A central system controller governs the assembly process and autonomy within groups of robots or at the level of an individual robot is strictly limited and the developed approach ensures a wide-range potential field of applications not bounded by particular parts. Robots represent ideal platforms for facilitating the

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embodied approach where each unit is a complete entity with acting and sensing capabilities. This paper has set out a vision of how aspects of crop production could be automated in the future. The human robot interaction methods allow the utilization of robots either as assistants or for simple teaching tasks. Future research efforts will extend the application of the framework to new diverse parts as well as deliver novice methods for intelligent adaptive behavior. Our future work will focus on multi-robot assembly in near industrial settings for more complex products.

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International Journal of Research in Science and Technology
Volume 2, Issue 2 (I) : April - June , 2015
ISSN 2394 - 9554

THE BEST UTILIZATION OF GEO THERMAL ENERGY

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ABSTRACT
This paper discusses the use of geothermal energy in our electrical power systems. The paper emphasis there source in conjunction with the ways in which geothermal energy is converted into electrical energy. Geothermal is named comes from two Greek letter "thermal" that means 'heat' and "geo" have means'earth'. Renewable energies are provided by natural resources (sunlight, wind, water, and geothermal heat) through the use of engineering technologies able to collect the energy and to convert it in a more usable form.

Keyword: Introduction, utilization of geothermal energy, sources of geo thermal energy.

1. INTRODUCTION

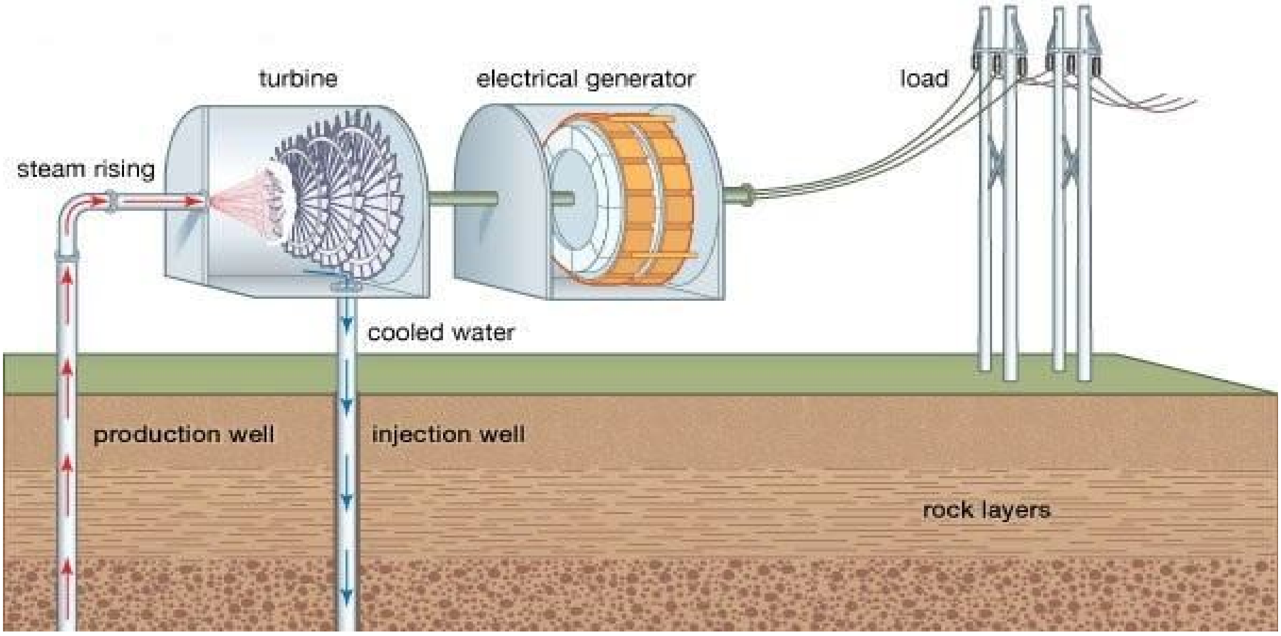
One of the renewable resources is Geothermal which is plentiful, eco-friendly, clean, reliable and renewable energy alternative resources available at beneath of our feet. Only It needs to extract and convert it in to clean energy. In global scenario, developed countries have adopted geothermal energy as major source of energy. In India there is wide scope for utilizations of geothermal resource but India needs to strategically evaluate its supply options to meet its energy requirement. India has high scope in utilizing its geothermal resources. India's ministry of non conventional energy and other geo research centers may pay their attentions towards these renewable resources of clean energy. They can plan for allocating sufficient funds for development and research of technology for usage of those resources effectively. Geothermal energy is plentiful, eco-friendly, clean, reliable and renewable energy alternative resources available at beneath of our feet. The benefits of using geothermal energy as an alternative resource are immense. Renewable, low running cost, capability to provide base load power, and small environmental footprint make this resource a preferred choice among other energy resources. However, considerable research and developments needed to take advantage of this buried wealth. The future use of geothermal energy would depend not only on overcoming technical barriers related to its utilization and the economic viability compared to other energy resources but also on favorable policy initiatives from the government. Geothermal Exploration in India In most Precambrian terrains including India, moderate-to-low temperature hot water spring systems represent the potential geothermal energy resources. This scenario is in contrast to steam and or steam and hot water based geothermal fields under production in other parts of the world, which are located predominantly in quaternary volcanic magmatic settings. One energy sources that has not been exploited at all, is the geothermal energy, which is an enormous, underused heat and power resource that is clean, reliable and home grown. With growing dependence on coal and with increasing environmental problems, India will soon have to start exploiting this source of energy which has a potential of about 10000 MW. Chhattisgarh government has decided to establish the first Geothermal Power Plant of the country in Tatiana area of the Ballarpur district with the help of NTPC. Geothermal energy is one such resource Derived from the Earth's internal heat, which has been catering successfully to both industrial as well as domestic energy requirements in many parts of the world over the\ past few decades. Being abundant, environmentally benign and renewable, it is a preferred choice for an alternative energy resource. Besides conversion to electric power, the direct uses of geothermal heat have the potential to replace Substantial quantities of fossil fuels. Geothermal energy is the use of steam and hot water generated by heat from the Earth to perform work. Some geothermal power plants use steam or hot water from a natural Underground reservoir to power a generator. The heat of the earth's interior generates Damaging and polluting the environment. Earth's temperature increases gradually with depth; at the center reaching more than 42000 C (76000F) .As heat naturally moves from hotter to cooler regions, so earth's heat flows along a geothermal gradient from the surface, where an estimated 42 trillion thermal watts are continually radiated into space. The Bulk of this immense heat supply cannot be particularly captured, because it arrives at the surface at a low temperature. Fortunately, the fundamental geological process known as plate tectonics ensures that some of this heat is concentrated at temperature and depths favorable for its commercial extraction.

2. GEOTHERMAL POWER PLANT

The geothermal power plants are just like the thermal power plants. The only difference is the use for fuel for the production steam for driving the turbine. A conventional thermal power plant generally uses coal as its fuel, whereas heat from the earth is used in geothermal power plant.

2.1 Dry Steam Power Plant

The dry steam plants are the simplest and oldest in construction and design. The geothermal steam of 1500 C or more is used to the turbines.



DRY STEAM POWER PLANT

3. DIRECT UTILISATION

The main types of direct applications of geothermal energy are space heating 52% (thereof 32% using heat pumps), bathing and swimming (including balneology) 30%, horticulture (greenhouses and soil heating) 8%, industry 4%, and aquaculture (Mainly fish farming) 4%. Figure 5 shows the direct applications of geothermal Energy worldwide by percentage of total energy use. The main growth in the direct use sector has during the last decade been the use of geothermal (ground-source) heat pumps. This is due, in part, to the ability of geothermal heat pumps to Utilise ground-water or ground-coupled temperatures anywhere in the world.

3.1GEOTHERMAL ENERGY IN INDIA:

India has about 340 hot springs spread over the country, of this, 62 are distributed along the northwest Himalaya, in the States of Jammu and Kashmir, Himachal Pradesh and Uttarakhand. They are found concentrated along a 30-50-km wide thermal band mostly along the river valleys. Naga-Lusai and West Coast Provinces manifest a series of thermal springs. Andaman and Nicobar arc is the only place in India where volcanic activity, a continuation of the Indonesian geothermal fields, and can be good potential sites for geothermal energy. Cambay graben geothermal belt is 200 km long and 50 km wide with Tertiary sediments. Thermal springs have been reported from the belt although they are not of very high temperature and discharge. During oil and gas drilling in this area, in recent times, high subsurface temperature and thermal fluid have been reported in deep drill wells in depth ranges of 1.7 to 1.9 km.

3.2 LIST OF GEOTHERMAL ENERGY COMPANIES IN INDIA

A. Panx Geothermal
B. LNJ Bhilwara
C. Tata Power
D. Thermax worth NTPC
E. Avin Energy Systems
F. Geo Syndicate Power Private Limited

3.3 Nature of geothermal fields

It is convenient to classify earth's surface into three broad groups.

1. Non-thermal area having a temperature gradient of 10-40 C per Km depth.
2. Semi-thermal areas having a temperature gradient 70C per Km depth.
3. Hyper-thermal area where the temperature gradient are many times greater than in non-thermal areas.

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4. GEOTHERMAL SOURCES

Four general categories of geothermal resource have been identified:

1. **Hydrothermal convective systems**

These are again sub classify systems.

(a) Vapour-dominated or t steam fields.

(b) Liquid-dominated system or wet steam fields.

(c) Hot-water fields.

2. Geopressure resources

3. Petro-thermal or Hot dry rocks

4. Magma resources

4.1. HYDROTHERMAL SYSTEM

Hydrothermal systems are those in which water is heated by contact with the hot rock, as explained earlier

a. **Vapour-dominated System**: In these systems the water is vaporized into steam that reaches the surface in a relatively dry condition at about 200C and rarely above 8 bars. This steam is the most suitable for use in turbo electric power plants, with the least cost.

b. **Liquid-dominated Systems** : In these systems the hot water circulating and trapped underground is at a temperature range of 175 to 315C.When trapped by wells drilled in the right places and to the right depths, the water flows naturally to the surface or is pumped upto it.

4.2. GEOPRESSURED SYSTEMS

These resources occur in large, deep sedimentary basins.the reservoir contains moderatately high temperature water under very high pressure. They are of special interest because substantial amounts of methane are dissolved in the pressurized water and are released when the pressure is reduced.

4.3. HOT DRY ROCKS :(PETRO THERMAL SYSTEMS-)

These are very hot solids rocks occurring at moderate depths but to which water does not have access, because of the absence of ground-water or the low permeability of the rock.

4.4. MAGMA RESOURCES:

These consist of partially or completely molten rocks, with temperatures in excess of 650C, which may be encountered at moderate depths, especially in recently active volcanic regions.

5. HYDROTHERMAL RESOURCE

These are wet resource at moderate depths containing steam and hot water under pressure at temperatures up to about 350C.these systems are further sub divided, depending upon whether steam or hot water is the dominant product. Hydro thermal resources represent only a small fraction of the potential geothermal resources, but they are the only once that have been utilised commercially so far. If the temperature is high enough, the water or steam can be used to generate electricity, otherwise geothermal energy is best supplied to process and space heating.

Hydrothermal resources arise when water has access to high temperature rocks, this account for the description as "hydrothermal".The heat is transported forms the hot rocks by circulating movement. The general geological structure of a hydrothermal convective region is shown in simplified in the molten rocks, raised by earth force is overpaid by an impervious rock formation, through which heat is conducted upward. Above this is a permissible layer into which water has penetrated, often from a considerable distance. The permeability could result from fractures or intergranular pores. The heat taken up by the water from the rockes bellows is transferred by convection to a layer of impervious rocks above. hot water or steam often escapes through fissures in the rock, thus forming hot springs, geysers fumarols, etc.In order to utilize the hydrothermal energy, wells are drilled either to intercept a fissure or, more commonly, into the formation containing the water. most hydrothermal wells range in depth from about 600 to 2100m, although there are some shallower and deeper production wells.

6. VAPOUR DOMINANTS SYSTEMS

As Dry steam from the wells is collected, filtered to remove abrasive particles and passed through turbines, which derive electric generators in the usual manner. The essential difference between this system and a conventional steam turbine-generator system, using fossil or unclear fuel, is that geothermal steam is supplied at a much temperature and pressure.

7. CHARACTERISTICS OF GEOTHERMAL STEAM ELECTRIC PLANTS

A number of environmental effects are characteristics of geothermal steam electric facilities. The steam may contain 0.5 to 5 percent by weight of non-condensable gases which appear in the turbine exhaust. These gases consist mainly of carbon di-oxide with small amounts of methane and ammonia, which are largely harmless in the quantities present. in addition, the gases may contain up to 4or 5 percent of hydrogen sulphide; not only does this gas have an unpleasant odor,it can also be harmful to plant and animal life if it should accumulate. At the geysers, hydrogen sulphide is considered to be a nuisance rather than a hazard. In the past the non condensable gases have been released to the atmosphere where the hydrogen sulphide is gradually destroyed by oxidation. The products, however, are oxides of sulphur which can themselves be harmful at appreciable concentrations. Plans are therefore under way to remove most of the hydrogen sulphide from the gases before they are discharged. The geothermal steam may also contain boron, arsenic; mercury, and other potentially poisonous elements which, together with some if the ammonia, are found in the turbine condensate. These substances must be disposed of in a safe manner. This is achieved at Geysers by the rejection of excess condensate into the ground at a considerable depth.

8. LIQUID-DOMINATE SYSTEMS (WET STEAM FIELD)

In the liquid dominated reservoir, the water temperature is above the boiling point (100C).However because the water in the reservoir is under pressure; it does not boil remains in the liquid state. When the water comes to the surface the pressure is reduced; rapid boiling then occurs and the liquid water “flashes” into a mixture of hot water and steam. The steam can be separated and used to generate electric power in the usual manner. The remaining hot water can be utilized to generate electric power or to provide space and process heat, or it may be distilled to yield purified water. The water comes with various degrees of salinity, ranging from 3000 to 280,000ppm of dissolved solids; and at various temperatures There are, therefore, various systems for converting liquid-dominated system into useful work that depend upon these variables.

9. GEOPRESSURED RESOURCES

Geothermal reservoirs. When the water is brought to the surface and its pressure reduced Drilling for oil and gas has revealed the existence of reservoirs containing salt water at moderately high temperatures and varies high pressures in a belt some 1200km in length. Because of the abnormally high pressure of the water, up-to 1350atm.in the deepest layers; the reservoirs are referred to geopressured. This was observed along the Texas and Louisiana coasts of the Gulf of Mexico. The geopressured hot water reservoirs were apparently formed by accumulation of geothermal heat stored over several million years, in water trapped in a porous sedimentary medium by the overlaying impervious layers. The upward loss of heat is relatively small and there are no obvious surface Indications of deep, high temperature reservoir. In typical Geopressure systems in Texas, the pressures are from 680 to 950 atm. And temperatures from 160 to 200C at depths from 4 to 5km.Higher pressures and temperatures have been measured at greater depths. The amount of dissolved salt in the water varies with the location and depth of reservoir, ranging from very small to about three times that in sea water. A special feature of Geopressure waters is their content of methane. The energy value of the brines thus depends on their temperature. The solubility of Methane in water at normal pressure is quite low, but it is increased at the high pressures of the, the methane gas is released from solution. The gas content of geopressured brine is usually about 1.9 to 3.8cum. gas per cum. Water but higher values have been reported in brief tests. However, the amount of natural gas recoverable economically from geopressured reservoirs is presently unknown.

10. ADVANTAGE OF GEOTHERMAL ENERGY

1. Geothermal energy is versatile in its use.
2. It is cheaper.
3. Geothermal energy delivers greater amounts of net energy from its systems then other alternative or conventional systems.
4. Geothermal energy is the least polluting compared to the other conventional energy sources.
5. The greatest attraction of geothermal energy is its amenability for multiple uses from single resources.

11. DISADVANTAGE OF GEOTHERMAL ENERGY

1. Overall efficiency for power production is low, about 15 percent, compared to 35 -40 percent for fossil fuel plants.

ISSN 2394 - 9554

2. The withdrawal of large amounts of steam or water from a hydrothermal reservoir may result in surface subsidence.
3. Drilling operation is noisy.
4. The steam and hot water gushing out of the earth may contain H2S, CO2, NH3 and radon gas etc.
5. Large areas are needed for exploration of geo-thermal energy as much of it is diffused.

12. APPLICATIONS OF GEOTHERMAL ENERGY:

1. Generation of electric power,
2. Industrial process heat.
3. Space heating for various kinds of buildings**.**

CONCLUSION

India has high scope in utilizing its geothermal resources. India's ministry of non conventional energy and other geo research centres may pay their attentions towards these Renewable resources of clean energy. They can plan for allocating sufficient funds for Development and research of technology for usage of those resources effectively. Geothermal energy is plentiful, eco-friendly, clean, reliable and renewable energy alternative resources available at beneath of our feet. Only it needs to extract and convert it in to clean energy. India has tapped only few percent of these resources, it needs to put efforts and allocate fund for development of the technology to avoid future energy crises.

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