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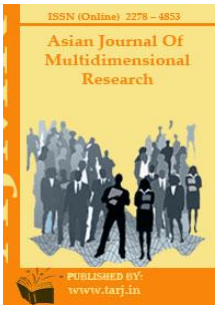

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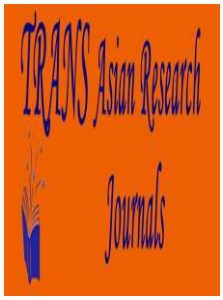

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ROCKBOLTING THE EVALUATION OF THE DESIGN PRINCIPLE FOR LOAD CONDITIONS

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ABSTRACT

This article presents the standards of underground rockbolting. This paper discussed about underground loading conditions, natural pressure zone around an underground opening, selection of rockbolt types, determination of bolt length and spacing, factor of safety, and compatibility between support elements. Different types of rockbolting used in engineering practice are also mentioned. The general principle of selecting strong rockbolts is valid only in conditions of low bearing capacity of rocks. A natural pressure arch is formed in the rock at a certain distance behind the tunnel wall. Rockbolts should be long enough to reach the natural pressure arch when the failure zone is small. The bolt length should be at least 1to1.5m beyond the failure zone. Finally, rockbolts should be compatible with other support elements in the same support system in terms of bolt length and spacing, maximum allowable displacement, factor of safety and energy absorption capacities.

KEYWORDS: *Bolt Length And Spacing, Bearing Capacity, Factor Of Safety, Pressure Arch, Rockbolting*

I. INTRODUCTION

Rockbolt is the most widely used support element of the underground mines and civil engineering. Rockbolting design is based on experience, field practices and the types of rock bolt along with the length and spacing of rockbolt. Attempts are made in this article to summarise the design principles and methodologies hidden in rockbolting practise, which include the relationship between the in situ stress state and rockbolt types, the concept of pressure zone, determination of bolt length and spacing, factor of safety, compatibility between support elements and different types of rockbolts. Since rockbolts were first used for ground support in underground excavations (e.g. Panek, 1964; Coates and Cochrane, 1970; Lang, 1972; Barton et al., 1974; Schach et al., 1979; Farmer and Shelton, 1980; Crawford et al., 1985; Stillborg, 1994). Choquet and Hadjigeorgiou (1993) provided a review on this topic in their paper on the design of ground support.

II. UNDERGROUND LOADING CONDITION

2.1, LOW IN SITU STRESS CONDITIONS

Rock blocks in the roof of an underground opening are prevented to fall as far as a high longitudinal stress exists in the rock. However, they would fall under gravity in low in situ stress conditions. In locations of ground surface, the rock often contains well-developed rock joint sets. The rock joints sometimes are open, which is an indication that the in situ rock bearing capacity is low in the rock. The rock support in low stress rock is to prevent rock blocks from falling. To do so, the maximum load exerted on the support elements, such as rockbolts, is the deadweight of the potentially falling block. This is a load-controlled condition. The rockbolts must be strong to bear the dead load of the loosened rock block. Therefore, use of a factor of safety, defined by the strength of the support system and the dead load of the rock is appropriate for rock support design in a load-controlled condition.

This is essentially the design principle in structure mechanics, which states that the load applied to a structure should not be higher than the strength of the structure, i.e. the strength-to-load ratio that is called the factor of safety, should be larger than 2. This design principle is valid for underground constructions where the total load on the construction structures is usually known dead load. In shallow underground openings, this principle is also valid since the maximum load on the rock support system is the deadweight force of loosened rock.

2.2, HIGH IN SITU STRESS CONDITIONS

It observed in a deep depth mine that the number of geological discontinuities in the rock mass became less and the discontinuities were less opened in depth. For instance, at a depth of 1200 m, it was observed that all of the few discontinuities exposed on an excavation face were completely closed. Therefore, it can be said that the rock mass quality is improved at depth because of the reduction in the number of geological discontinuities. However, the in situ rock stresses increase with depth increase. At depth, the major instability is no longer fall of loosened rock blocks but rock failure caused by stress. High stresses could lead to two consequences in underground openings: large failure in soft and weak rock and rock burst in hard and strong rock. It was observed in some mines strain burst usually occurred below a depth of 500 m and became intensive below 1200 m. Rock failure is unavoidable in high stress conditions. The rock

support at depth is not to equalise the dead load force of loosened blocks but to prevent the failed rock from disintegration. In high stress rock masses, the support system must be not only strong but also deformable to deal with either stress-induced rock squeezing in soft and weak rock or rock burst in hard and strong rock.

III. TYPES OF ROCK BOLT

The suitable types of rockbolts for a given rocks are associated with the loading condition in the rock mass. In the case of a load-controlled condition. The strength of the rockbolts is the most important parameter for the selection of types of bolts. The basic requirement is that the strength of the rockbolts must be higher than the load on the bolts. The appropriate types of rockbolts under load-controlled conditions are fully encapsulated rebar bolts, thread bar bolts and cable bolts. In high stressed weak and soft rock, the excessive deflection needs to be accommodated. The general approach to deal with rock squeezing is to use ductile rockbolts in conjunction with other types of ductile surface retaining elements such as mesh. Split set is the typical rockbolt for this purpose in the mining. Split set can displace significantly, but it cannot much restrain the rock deformation because of its low load-bearing capacity. Its main function is to avoid disintegration of the jointed rock mass. An active measure to stabilize squeezing rock is to provide a high support resistance to restrain the rock deformation on the one hand, while the support elements in the support system must be deformable on the other hand. Rock burst is an instability issue in overstressed hard and strong rock. The goal of rock support in such conditions is to absorb the kinetic energy of the ejected rock. Energy-absorbing rockbolts should be used in burst-prone rock masses. The higher the load bearing capacity of the energy-absorbing rockbolt is the less the ejected rock displaces.

3.1, Friction Type Rock Bolts

Roll formed steel tubing with a welded ring at the driving end. Installed in pre-drilled holes with the same rock drill. Ease of installation and low cost makes this a popular rock bolt.

3.2 Deformed Grouted Bar Bolts

Installed with either cement or polyester resin. Ease of installation makes this a popular rock bolt. Cost of bolts and resins make these bolts more expensive than most.

3.3 Shepherds Crook Bolt

Installed in pre-drilled hole. This bolt provides effective support in areas prone to seismic events or high stress changes. Often used to hang pipe or cables.

3.4 Sling Type Eyebolt

Bolt installed in a pre-drilled hole using a wedge. Used for the suspension of air and water columns, ventilation

columns, electrical cables.

3.5 Mechanical Anchor Bolts or Expansion Shell Bolts

Used in most Canadian mines. Installed in a pre-drilled hole using the same rock drill to torque up the nut on the bolt to proper tension. Low cost makes this a popular bolt.

IV. DESIGN PRINCIPLE

Determination of bolt length and spacing has been a topic for discussion probably since rockbolts were first used for ground support in underground excavations (e.g. Panek, 1964; Coates and Cochrane, 1970; Lang, 1972; Barton et al., 1974; Schach et al., 1979; Farmer and Shelton, 1980; Crawford et al., 1985; Stillborg, 1994). Choquet and Hadjigeorgiou (1993) provided a review on this topic in their paper on the design of ground support. The following presented are the principles for the determination of bolt length and spacing that are used in the practice of rockbolting to date. From the point of view of operation, the bolt length should be less than half of the opening height for roof bolts and half of the span for wall bolts in order to avoid installation difficulties:

$$L_b \leq 0.5H \text{ (for roof bolts)} \quad (1a)$$

$$\mathbf{L_b \leq 0.5B \text{ (for wall bolts)}} \quad (1b)$$

Where L_b represents the bolt length, H is the opening height, and B is the opening span. The bolt length is also associated with the bolting principle. In the case that the failure zone is limited to a relatively small depth.

The bolt length should be at least 1 m longer than the depth of the failure zone, i.e.

$$L_b \geq df + 1 \quad (2)$$

Where df is the depth of the failure zone. In the case of a vast failure zone, the bolt length is short, varying from 2 m to 3 m, but its upper limit is governed by Eq. (1). For tunnels excavated in moderately jointed hard rock

masses, the Norwegian Road Authority proposed the following formula to determine the length of un-tensioned bolts in the central section of the tunnel for the purpose of suspending the failure zone (Statens vegvesen, 2000):

$$Lb = 1.4 + 0.184B \quad (3)$$

In practice, the bolt pattern in systematic bolting is such that the in-row spacing and the distance between rows are equal. The bolt spacing, s, is recommended to be in the range from 1 m to 2.5 m. However, rock joint spacing should be also taken into account when the bolt spacing is determined. A rule of thumb is to set the bolt spacing equal to 3-4 times the mean joint spacing in the case of a mean joint spacing in the range of 0.3-1 m, i.e.

$$S = (3\text{-}4)e \quad (4)$$

Where, **"e"** represents the mean joint spacing.

In the case of a vast failure zone, the Norwegian Road Authority recommends the use of relatively short tensioned rockbolts to establish an artificial pressure zone in the failure zone. The bolt length is still estimated using Eq. (3), but the bolt spacing is recommended to be smaller than 3 times the mean joint spacing, i.e.

$$S \leq 3e \quad (5)$$

It is required that the rockbolts interact with each other and an interaction zone is formed in the bolt-reinforced rock party. Assuming that the reinforcement angle of a single rockbolt is 90^0, the thickness of the interaction zone, t, is related to the bolt length (Lb) and spacing (S) as follows:

$$t = Lb - S \quad (6)$$

The bolt length is usually short, 2-3 m, in this type of rockbolting. The thickness of the interaction zone is required to be at least 0.5Lb in order that a strong enough artificial arch can be established in the broken rock. This requirement leads to a bolt spacing that should be less than half of the bolt length, i.e.

$$S \leq Lb/2 \quad (7)$$

In the design stage of an underground rock excavation, bolt length and spacing are often determined with the help of empirical methods recommended in various rock mass classification systems. In the Q rock mass classification system(Bartonetal.,1974), the bolt length and spacing can be found in a chart based on the Q-value of the rock mass and a geometrical parameter called the equivalent dimension (Barton and Grimstad, 2014). The equivalent dimension is defined by the span of the excavation and a coefficient describing the intended use of the excavation (road tunnel, underground station, etc.). In the rock mass rating (RMR) system by Bieniawski (1989), bolt length and spacing, as well as other types of support measures, are empirically recommended in a table for five classes of rock mass quality.

V. FACTOR OF SAFETY

Rock blocks in the roof may become loosened in shallow tunnels wherein situ rock stresses are low. The loosened blocks tend to fall under gravity. The load exerted on the rockbolts is equal to the dead load of the falling blocks. In this load-controlled condition, the factor of safety (FS) for rockbolting is defined as

$$FS = \frac{\text{Load capacity of the bolts}}{\text{Total load on the bolts}} \quad (8)$$

In this case, a safe rock support requires that the load on the bolt is less than the strength of the bolt, i.e. FS > 1.

It is required that the factor of safety is in the range of 1.5-3 in rockbolting design.

5.1, FACTOR OF SAFETY IN SQUEEZING ROCK

Rock deformation can be significantly large in tunnels excavated in highly stressed soft and weak rock because of major rock failure. The essential driving power for the rock deformation is the strain energy released from the rock mass after excavation. The greater part of the released strain energy is dissipated in rock fracturing, which in turn brings about rock deformation. In extremely poor rock conditions, the large rock deformation may lead to rock collapse.. In squeezing rock, it is more relevant to define the factor of safety with displacements rather than load and strength. It is required, from the point of view of stability, that the displacement of the tunnel wall at equilibrium, Ueq, has to be smaller than the critical displacement, Uc, beyond which uncontrollable rock collapse would occur. The factor of safety for the rock support, FS, is thus defined as

$$FS = Uc / Ueq \quad (9)$$

It must be pointed out that the critical displacement Uc is difficult to be quantified even with the help of numerical modelling. Beyond displacement Uc, the rock mass becomes unstable and calculation iterations would become non-convergent in numerical modelling.

VI. CONCLUSIONS

The strength of rockbolts is the key parameter for rockbolting design in low stress rocks. Rockbolts should be deformable in addition to the requirement of high strength in high stress rocks. Rockbolts are energy absorbent in squeezing and jointed rock conditions. There exists a natural failure zone immediately outside of the actual failure zone in the rock surrounding an underground excavation. In the case of a shallow failure zone, the rockbolts should be long enough to reach the failure zone. In the case of major failure zone, short rockbolts are tightly installed to establish within the failure zone and long cables are anchored into the natural failure zone. Determination of the bolt length and spacing is associated with the methodology of rockbolting. In the case of the anchorage of rockbolts in the natural pressure zone, the bolt length should be at least 1.5 m beyond the failure zone. In the case of establishing an artificial pressure zone, appropriate bolt lengths are approximately 3m in mine drifts and upto 7m in large -scale hydropower caverns. Bolt spacing is more important than bolt length in this case. The principle is that the bolt spacing guarantees that the rockbolts interact with each other. The appropriate bolt spacing is 1 m for 3 m long bolts and less than 1.5 m for 7-m long bolts. The rockbolting design is based on the dead load of falling blocks and the strength of the rockbolt in low rock stress locations. The maximum allowable displacement and the ultimate displacement capacity of the rockbolt should also be taken into account. The rockbolts in a rock support system should be compatible with other support elements with respect to displacement and high strength capacities.

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TECHNICAL STUDY OF THE RISKS ACCOMPANIED WITH THE GEOTECHNICAL ASPECTS IN LARGE CIVIL ENGINEERING PROJECTS

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ABSTRACT

All civil engineering projects (buildings, roads, bridges, dams, tunnels and water tanks ..) are constructed on , with, or in the ground. Engineers are required to identify and avoid the major risks posed by ground conditions. During the last decade there has been an increasing societal concern on sustainable developments focusing on the conservation of the environment, the welfare and safety of the individual and at the same time the optimal allocation of the available natural and economical resources of society. This problem complex may easily be realized to be a complex decision problem highly influenced by the possible consequences of our actions and the probabilities that these consequences will occur – the product of which is known as the risk. This presentation provides an overall view of risks posed by ground giving examples from real case histories. The impact of geotechnical risk is well understood by most ground engineering

practitioners but the problem and methods for mitigation are frequently misjudged or undervalued by other construction professionals. The main focus of this paper is to mitigate geotechnical risk is restricting the integration of geotechnical risk management within overall project risk management and the construction industry is missing out on opportunities to minimize ground related failures.

KEYWORDS: *Civil Engineering, Geo technical risks, Geo technical risk management*

I. INTRODUCTION

Risk management concerns the analysis, assessment and decision-making in regard to the risks involved in a given activity or associated with a given hazard. The risk management process includes the joint consideration of all uncertainties prevailing the problem and all possible consequences.

Several important tasks are lying ahead, not least in the area of civil engineering. As always new civil engineering projects should be planned, designed and executed in a cost optimal manner taking into consideration the benefit of the projects as well as the possible adverse consequences such as loss of lives, damage to the environment and of course the direct costs. Future safeguarding, maintenance and decommissioning of the infrastructure of society will even more likely demand an intensified focus on risks. Not least in the view of the seemingly ongoing and expected climatic changes and the enormous efforts they may initiate to safeguard our existing infrastructure. The methods of risk and reliability analysis in civil engineering, mainly developed during the last three decades, are increasingly gaining importance as decision support tools in civil engineering applications. Their value in connection with the quantification and documentation of risks and the planning of risk reducing and mitigating measures is by now fully appreciated in the civil engineering profession. In the time to come the importance of risk and reliability methods will increase for the civil engineer– a fact reflected by the increasing normative and legislative requirements for the documentation of acceptable risks in the planning and execution of civil engineering activities. Risk and reliability analysis is in fact a multi-disciplinary engineering field requiring a solid foundation in one or several classical civil engineering disciplines in addition to a thorough understanding of probability, reliability analysis and decision analysis.

The modern Society is installed in structures and buildings constructed by Civil Engineers and it constantly uses these structures to live, work, exchange, communicate. The significant feeling of safety of our Western societies is probably partially based on the fact that a given number of risks affecting the structures in which we live and work has been correctly anticipated and tackled by engineers who provided satisfactory designs against most probable risks. Historically, civil engineering is the first engineering activity. Beside houses and buildings, impressive symbolic and religious buildings such as the Egyptian pyramids (4540BP) constitute significant engineered structures. Old engineered structures include roads and bridges and fortifications as the China GreatWall (started 2700 BP).

II. THE SAFETY OF STRUCTURES

Resulting from a very long trial and error process that started with the first known historical structures that have been built many centuries ago, engineers found a way to guarantee the safety of structures through the progressive development of relevant mechanical models that are

supposed to adequately reproduce their behaviour. Basically, the idea of the contemporary mechanical approach is that the materials that constitute the structure and on which the structure is founded have a maximum mechan- ical resistance above which they break. Engineers do their best to ensure that the forces induced in these materials once assembled within the structure are low enough to avoid breakage. Beside gravity, it is difficult to predict other mechanical forces that will affect structures. They come from natural hazards such as wind, earthquake, sea waves or river flood. Recent developments in statistical analysis obviously provide a method of predicting more precisely the hazards to be faced by the structures, but they need to be efficient a sufficiently rich data base gathered by rigorous observation along a significant period of time.

It is difficult to completely identify the exact nature and properties of the ground on which structures are built. As other materials, soil and rocks have maximum admissible resistance and may fail if higher forces are applied. They are also variable in nature, and even slight changes in their properties between two points may have significant consequences on the stability of the structure. It is not always possible to completely identify and control the properties of the material used or concerned (steel, masonry, concrete, soil, rock).

Once probable dangerous mechanical actions are supposed to be known, it is difficult to know how forces distribute along the structures, because structures are complex in nature and because the models used are hence not completely adapted.

Once the structure is built, reasonably adequate maintenance dispositions may be altered by new aggressive mechanical, physical or chemical phenomenon (unexpected corrosion of steel, alkali-reaction in concrete) that threaten and sometimes may condemn the structure.

Other features that include financial and societal aspects also characterize the civil engineering structures and their safety Their failure can be very dangerous for the human, natural or man-made environment As in other cases, such an example led to intense thinking in terms of risk analysis, structure behavior, correcting measures and preventive dispositions. Beside the consideration of natural hazards in relation with the resistance of structures, the human factor, including terrorists behavior, is to be accounted for more and more seriously. However, it is a fact that all similar buildings are definitely unable to resist to such attack and that no correction measure exists. In such case, the only solution is preventive protection. Another conclusion drawn was that the effect of fire on structures and buildings materials had to be taken into account more deeply, leading to significant research programs in many developed countries. Intense investigations are presently carrying out in this topic, together with a reassessment of the safety of all tunnels presently in function.

III. THE FAILURE OF CIVIL ENGINEERING STRUCTURES

The failure of civil engineering structures has still been examined with utmost attention by engineers. Probably because they were the source of major accidents involving significantly high numbers of victims, dams have been examined in terms of safety with particular attention.

IV. ABOUT THE IMPACTS OF FAILURES

The gravity of a failure is related to the possible occurrence of lost in human lives and properties, i.e. it is unconsciously analysed in terms of vulnerability. In a natural way, a failure that does not significantly and directly affect the social environment does not significantly interest the Society through the media. Logically, it is considered as a technical problem for specialists with no significant impact. Conversely, when dramatic failures with significant impact involving loss of

lives occur, people attempt to elaborate some technical analyses of the failure. This phenomenon is amplified by the media that sometimes provide exaggerated or even false technical interpretations.

V. NEW TECHNOLOGIES AND NEW RISKS

In bridges, optimisation was achieved by increasing the span of the bridge, through an optimisation of a given technique and the development of novel techniques (use of steel, reinforced concrete, prestressed concrete, high performance concrete).

New technologies are associated with other physico-chemical actions that are not completely known at the beginning. Unexpected phenomenon may affect noticeably the lifespan of the structure. Among other examples, this was the case of strip corrosion for reinforced concrete, in a geotechnical innovation called Reinforced Earth, corrosion under stress for prestressed concrete and alkali-reaction in concrete.

Obviously, adopting a new technology is still corresponding to a new risk due to unknown phenomena, with probably higher level of risk associated with more sophisticated 11 techniques.

VI. SAFETY, RISK AND RELIABILITY MANAGEMENT

Many of the accidents could have been prevented with greater attention to safety and reliability in the design, construction and maintenance processes. Additionally, the growing technical complexity of large engineering projects and the public concern regarding their safety and reliability have aroused great interest in the development and application of safety assessment procedures.

The objectives of the research on engineering safety risk and reliability management are to

I. Develop and apply more rational and sustainable safety, reliability and decision-making techniques and methods to facilitate safety and reliability analysis so that safety and reliability aspects can be taken into account in engineering design, construction and maintenance processes.

II. Develop the advanced procedures for minimizing risks by improved design aspects, construction and maintenance strategies based on safety and reliability assessment. Several workshops have been delivered to transfer the research results to civil, offshore oil & gas, nuclear, transportation, railway, road, bridge and other industries.

The research theme focuses on

- target risk and reliability
- Safety-cost analysis based decision making
- Life cycle analysis
- Uncertainty analysis
- Safety-critical software assessment
- Dynamic and static finite element analysis, and
- Overall safety case preparation for industry

VIII. CONCLUSION

Some particularities of risk issues in civil engineering have been presented and illustrated. Obviously, their importance in terms of risk is probably not completely integrated in the Society. Natural hazards that may threaten civil engineering structures are difficult to predict, but engineers progressively managed in ensuring a satisfactory level of safety of the structure. For various reasons described in the text and that also include the effects of human behavior, periodic catastrophes occur. The conclusions drawn from their detailed analysis allow to improve the safety of structure in an attempt to reduce the level of risk "as low as reasonably achievable".

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SOIL ANALYSIS FOR IDENTIFYING THE IMPORTANCE OF SOIL QUALITY ASPECTS AND DETERMINING THE SOIL INDICATORS

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ABSTRACT

Soil examination gives data which can be utilized to enhance soil ripeness through administration. The degree to which soil ripeness can be enhanced relies upon the inalienable properties of the site – soil texture1, mineralogy, incline also, atmosphere. Soil structure2 is likewise key to plant execution as it influences the capacity of plant roots to get to accessible supplements. In this Technical Leaflet we investigate a portion of the fundamental certainties drawn from inquire about and viable experience about soil investigation with a view to making the best utilize of accessible data. It merits recollecting that plant tissue examination can likewise be valuable, particularly for follow components.

KEYWORDS: *Soil, Testing, Soil Density, Electrical Conductivity, PH, GIS*

I. INTRODUCTION

The first and most critical step in soil testing is collecting a soil sample. A soil analysis can only be as good as the sample sent to the laboratory. It is important to recognize what a tiny portion of a field is actually analyzed in the laboratory. For example, a 1 lb soil sample collected from a 5 acre field represents just 1/10,000,000 of the field! Therefore, it is vital that the soil sample be representative of the entire field.

The most common and economical method for sampling an area is composite sampling, where sub-samples are collected from randomly selected locations in a field, and the sub-samples are composited for analysis. The analytical results from composite sampling provide average values for the sampled area. The actual number of sub-samples depends on field size and uniformity. Generally, a larger field or a less uniform field should be more intensively sampled than one that is small and uniform. No less than 5 sub-samples should be taken from a sampled area, and 15 to 25 are preferable.

Alternatively, areas can be grid-sampled in a regular pattern. Each sample is analyzed separately, so that variability in soil properties can be determined. With data provided by grid sampling, maps of soil test values can be constructed. This information can be entered into a geographical information system (GIS) and combined with additional geospatial data, such as soil texture, crop yields, leaf analyses, etc. and used in precision agriculture systems for variable application of fertilizers and other crop inputs. This is a much more expensive method of soil analysis because of the large number of analyses required, although it provides valuable information about geospatial uniformity which can be used in precision agriculture.

Ideally, samples should be collected with a soil probe or auger (a small shovel or trowel can also be used), to the depth of tillage (usually 6 to 8 inches) or to the effective rooting depth of plants. Deeper samples may be collected for evaluation of subsoil properties, such as salt or nitrate accumulation. It is helpful to sample to the same depth each time a soil is sampled, so that year to year samples can be directly compared to monitor changes over time. Each sub-sample should be approximately equal in size. The sub-samples should be placed in a clean plastic bucket and mixed thoroughly. The desired sample amount is then removed from the bucket and the remainder discarded. Check with your testing laboratory to find out how large a sample they require.

The area or size of the field sampled is dependent upon management practices. Sample the smallest unit that will be managed separately. For example, if a field has two distinctly different sections, perhaps one half level and the other sloped, then sample the two areas separately, and fertilize each half separately to obtain optimum results. However, if each half of the area will not be fertilized or managed individually, there is no need for separate sampling. A single, representative sample will be less expensive and just as useful. Sample the smallest management unit. Soil samples should be air-dried or taken to a test laboratory as soon as possible. To dry a soil sample, spread the soil out in a clean, warm, dry area, and let it dry for two to three days. It is best not to heat or dry soil samples in an oven because soil chemical properties may be altered. to a laboratory for analysis. Soil samples can be refrigerated for several days if they cannot be dried immediately.

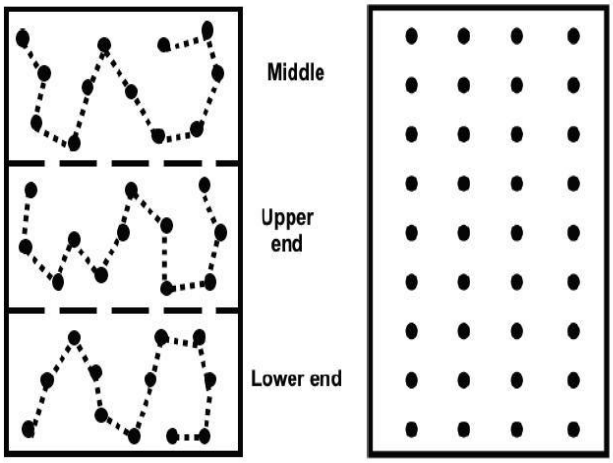

Figure 1. On the left: dividing and sampling scheme for a sloped field with distinct upper, middle, and lower areas. Circles represent sub-sample locations which are composited for each of the three areas. On the right: grid-sampling a field. Each sample is analyzed separately to evaluate field variability.

Fig.1 Soil Different Stage

II. METHODS

The present study deals with the analysis of soil samples from sugarcane field which were collected in a period 2009 - 2010 from Manjari, Hadapsar and Phursungi villages situated towards SE of Pune city and this region is affected by the solid waste disposal as well as industrial effluents. This study was primarily focused on testing of soil quality from 12 representative sampling stations and the analytical results were expected to be representative for the entire field. The surface contaminated soil material were removed using spade or khurpi (Gupta, 2007) and for sampling V shaped holes were dug for collecting a uniform 2 cm thick slice of soil up to a depth of 22cm. which were collected in a plastic bucket. Samples collected were thoroughly mixed on a piece of clean cloth, air dried and the lumps were broken using wooden pestle and mortar (Tandon. 1993).

Particles were disaggregated, crushed and sieved with 10 mesh diameter, stored in glass bottles and labelled. PH values were determined using Equiptronics pH meter as described by Jackson (1967). For this 20 g soil sample was mixed with 40 ml distilled water in 1: 2 ratio. The suspension was stirred intermittently with glass rod for 30 minutes and left for one hour. The combine electrode was inserted into supernatant and pH was recorded.pH value as a measure of the hydrogen ion activity of the soil water system and expresses the acidity and alkalinity of the soil. It is a very important property of soil as it determines the availability of nutrients, microbial activity and physical condition of soil.

Electrical conductivity (EC) expresses ion contents of solution which determine the current carrying capacity thus giving a clear idea of the soluble salts present in the soil. The electrical conductivity of a soil samples was determined on an Equiptronics digital electrical conductivity bridge for which 20g soil was added in 40ml distilled water. The suspension was stirred intermittently for half an hour and kept it for 30 minutes without any disturbances for complete dissolution of soluble salts. The soil was allowed to settle down and then conductivity cell was inserted in solution to take the reading to record the EC values. Organic matter is useful in supplying nutrients and water to the plants and also provides good physical conditions to the plants. The quantity of organic carbon in the soil was estimated by using modified Walkey-

black method (Walkey and black, 1934) as described by Jackson (1967). 1g finely ground dry soil sample was passed through 0.5mm sieve without loss and was taken into 500ml conical flask. To this 10ml of 1N potassium dichromate and 20ml con. H2SO4 were added and the contents were shaken for a minute and allowed to set aside for exactly for 30 minutes and then 200ml distilled water, 10ml phosphoric acid and 1ml diphenylamine indicator were added. The solution was titrated against standard ferrous ammonium sulphate till colour changes from blue violet to green. The blank titration was also carried without soil. In soils available phosphorus is found as orthophosphate in several forms and combinations but only a small fraction of it may be available to plants. Available phosphorus was estimated by Olsen‟s method (Olsen *et al*, 1954) modified by Watanbe (1965). The reagent for Olsen‟s P was 0.5 M NaHCO3 (pH 8.5) prepared by dissolving 42g NaHCO3 in distilled water and made up to 1 lit. The pH was adjusted at 8.5 with 20% NaOH solution. 2.5g of air dried soil was weighed into 150ml Erlenmeyer flask, 50ml of Olsen‟s reagent (0.5 M NaHCO3 Solution, pH 8.5) and one teaspoonful of activate charcoal were added. The flasks were shaken for 30 minutes and contents were filtered immediately through Whatman filter paper (No. 41). 5ml of the filtrate was taken out by pipette into 25ml of volumetric flask and was neutralized with 1: 4 H2SO4 using p-nitrophenol as indicator and the volume was made up by adding distilled water. After addition of few crystals of stannous oxalate blue colour developed and intensity of blue colour was read in photoelectric colorimeter within 10 minutes at a wavelength of 730nm.

A blank was run without soil. Potassium in soil water has been estimated by flame by preparing the standard solutions of potassium (ppm) and feeding the diluted extract in flame photometer for recording the reading for standard and sample with K filter. Micronutrients like Cu, Zn, Fe, Mn are estimated by using Atomic Absorption pectrophotometer employing standard methods (Trivedy and Goel, 1984). Micronutrients include iron, manganese, zinc, copper, boron, chlorine and molybdenum. The term refers to plant‟s needs, not to their abundance in soil. They are required in very small amounts but are essential to plant health in that most are required to speed up plant‟s metabolisms. They are generally available in the mineral component of the soil and the method commonly used for determination of available micronutrients in soil samples is by Lindsay and Norvell (1978) This method consists of use of DTPA (Diethy lenetria mine pentaacetic acid) as an extracting which has been widely accepted for the simultaneous extraction of micronutrients like Zn, Cu, Fe Mn in neutral and alkaline soils. Most commonly used method for available boron is hot water extraction method as given by Berger and Truog (1939) which has been modified by (Gupta, 1967) in which boiling the soil with water is employed. The extracted boron in the filtered extract is determined by azomethine-H colorimetric method.

III. SOIL ANALYSES

After soil samples are received at a laboratory, a number of tests can be performed. A general understanding of soil testing will help you know how the results can be interpreted and to appreciate the accuracy of analytical results.

Soils supply most of the mineral nutrition for higher plants through the plant‟s root system. The root system extracts nutrients from the soil over a long period of time; two to three months for most annual crops, years for perennial crops. In contrast, a soil test determines the soil‟s nutrient supplying capacity by mixing soil for only a few minutes with a strong extracting solution (often an acid or a combination of acids). The soil reacts with the extracting solution, releasing some of the nutrients. The solution is filtered and assayed for the concentration of each nutrient. The

nutrient concentration is then related to field calibration research that indicates the yield level reached with varying soil nutrient concentrations. This method works very well for some nutrients, but is less accurate for others, for example those nutrients supplied largely from organic matter (OM) decomposition such as nitrogen and sulfur. This is primarily due to the difficulty of estimating or predicting the rate at which OM will decompose and release these nutrients in plant-available forms.

Individual analyses included in a „standard" or „routine" soil test varies from laboratory to laboratory, but generally include soil pH, and available phosphorus (P) and potassium (K). They sometimes also include available calcium (Ca) and magnesium (Mg), salinity, and often include an analysis of OM content and soil texture. Most laboratories offer nitrogen (N), sulfur (S), and micronutrient analyses for additional cost.

The methods used to test soils vary depending on chemical properties of the soil. For example, tests used for measuring soil P are quite different in the acidic soils common in the southeastern U.S. than those used in the alkaline soils of the southwest. Analysis of southwestern soils with methods tailored for acidic soils will provide erroneous results. Therefore, it is important to be aware of the methods used by test labs, and to select methods that are regionally appropriate. Local laboratories will generally use methods appropriate for your soils and your laboratory should provide you with test method information. A listing of local soil test laboratories may be found in the University of Arizona publication, "Laboratories Conducting Soil, Plant, Feed or Water Testing" (AZ1111).

IV. COOPERATIVE EXTENSION

Nutrient levels are usually expressed on a mass (weight) basis using units of parts per million (ppm). These can be converted to a molar basis by dividing ppm by the molecular weight to get mmol/L (for liquids) or mmol/kg (for solids). Another useful unit for expressing nutrients is centimoles of charge per kilogram of soil (cmolc/kg). To calculate cmolc/kg, divide ppm by the molecular weight and then multiply this value times the charge on the nutrient ion. Older literature uses meq/100g, which is identical to cmolc/kg.

4.1 STANDARD SOIL TESTS

4.1.1PH

Soil pH is a measure of the acidity or alkalinity of a soil. The term pH applies to solutions, so the analysis must be conducted on a soil/water mixture. The soil sample is mixed with water, allowed to equilibrate for at least an hour, and then the pH measured. Several factors affect pH measurement. Primary among these is the salt concentration of a soil (a salt is any molecule that, when placed in water, separates into positively and negatively charged components or ions). The salt concentration of a soil may vary with the season or with fertilizer application, and is generally greater immediately following fertilizer application than before. The result may be an apparent pH drop up to one-half a pH unit.

When samples are collected frequently or at various times of the year it may be noted that pH values tend to increase and decrease, seemingly at random. This can lead to questions regarding the reliability of soil pH measurements, but the fluctuations may be due to changes in soil salt levels and do not usually present a serious problem in the use of the analysis. Some laboratories measure pH in a dilute salt solution to mask salt-induced variations. This method gives lower pH values for which the laboratory should provide interpretation guidelines. Arizona soils are

generally alkaline (high pH), and pH adjustment is not a common practice. In most other parts of the country, ground limestone is routinely added to soil to raise soil pH. In those parts of the country, "lime requirement" (amount of lime required to adjust the soil pH to a desired level) is determined. This test is not needed for alkaline Arizona soils.

4.1.2 Electrical Conductivity (EC)

Electrical conductivity (EC) of a soil extract is used to estimate the level of soluble salts. The standard method is to saturate the soil sample with water, vacuum filter to separate water from soil, and then measure EC of the saturated paste extract. The result is referred to as ECe and is expressed in units of DeciSiemens per meter (dS/m). Older literature will likely use units of millimhos per centimeter (mmho/cm), which are identical to dS/m. Some test laboratories use different soil: water ratios, and use a multiplication factor to convert results to an ECe equivalent.

EC is a very reliable test for soil salinity, and this is a routine test in the arid southwest. However, in wetter climates EC is not a standard test so, if soil samples are sent to a laboratory in another part of the country, EC may have to be specifically requested.

4.1.3 Nitrogen (N)

Nitrogen analyses are not difficult to conduct, but interpreting results can be problematic. This is because a major portion of soil N is contained in the soil OM. Plant availability of organic N is dependent on OM breakdown, which is difficult to estimate. Therefore analyses of "total N", a sum of all forms of soil N, including organic N, are not routinely conducted. Instead, N in the nitrate form (NO3-N) is assayed. Nitrate is directly available to plants, so this test provides an indication of short term N availability. However, NO3-N can be quickly lost from soil, either leached past the rooting zone, or lost to the atmosphere in gaseous forms.

Nitrate analyses can provide an accurate determination of the N available to plants at the time of soil sampling, although this may not provide reliable information concerning N availability later in the growing season. If soil N analysis is to be used for making fertilizer recommendations, soil samples should be collected either shortly before planting time or during the growing season.

The extractant used to remove NO3-N from the soil is not particularly important because of its high solubility. Some laboratories extract NO3-N from soil with a salt solution, such as potassium chloride (KCl). However, other laboratories in the southwestern U.S. measure NO3-N in the same extract used to measure soil P (see below) to reduce analysis costs. Results from these two kinds of extractants are directly comparable.

4.1.4 Phosphorus (P)

Most soil P is tightly bound to soil particles or contained in relatively insoluble complexes. The P-containing complexes in alkaline soils are very different than those in neutral or acidic soils. The amount of P removed during soil extraction is very much dependent on the nature of P complexes and on the specific extractant used, so it is critical that P extractants be matched to soil properties.

The Olsen or bicarbonate extractant, a dilute sodium bicarbonate solution, is used to extract P from calcareous, alkaline, and neutral soils, and is appropriate for Arizona soils. In contrast, most other P extractants, such as the Mehlich extractants, are suited for acidic soils, and may not

be suitable for arid-region soils. If an appropriate extractant is selected, P analysis is a reliable and useful soil test. On a soil test report, the analysis may be reported as PO4-P. **4.1.5 Potassium (K), Calcium (Ca), Magnesium (Mg), and Sodium (Na)**

The four major exchangeable cations in arid-region soils are K, Ca, Mg, and Na. All except Na are essential plant nutrients; however Na is included here because it plays an important role in soil physical properties. Soil Na level is needed for calculations of cation exchange capacity (CEC) and exchangeable sodium percentage (ESP), discussed later.

An ammonium acetate extractant is used to extract exchangeable K, Ca, Mg, and Na from arid-region soils, but it does not extract less plant-available forms. Some difficulty may be encountered in soils containing Ca or Mg carbonates (calcareous soils) because the ammonium acetate extraction may remove some Ca or Mg from these minerals along with the exchangeable forms. In these situations, the analytical results may indicate slightly elevated levels of these nutrients. Some laboratories adjust the pH of the ammonium acetate extractant to 8.5 to minimize this error. However, this is not usually a large problem and K, Ca and Mg tests generally provide excellent estimates of plant available levels of these nutrients.

V. CATION EXCHANGE CAPACITY (CEC)

Cation exchange capacity is often estimated by summing the major exchangeable cations (K, Ca, Mg, and Na) using units of cmolc/kg. Most laboratories do not routinely conduct a separate analysis for CEC, but use the ammonium acetate extractable levels of these elements (discussed above) for this calculation.

5.1 Exchangeable Sodium Percentage (ESP) and Sodium Adsorption Ratio (SAR)

ESP and SAR are measures of soil Na content relative to other soil cations. ESP is the concentration of Na divided by the CEC. As described above, the CEC is often estimated as the sum of the major exchangeable cations, so ESP = Na/(K+Ca+Mg +Na), in units of cmolc/kg. SAR is roughly comparable to ESP, but is a ratio of Na to Ca plus Mg. For this calculation, concentrations of Na, Ca, and Mg are measured in a saturated paste extract (see discussion of EC, above). The equation used for calculation of SAR is: where concentrations are in units of mmol/kg or mmol/L. SAR and ESP are both very useful measures of the influence of Na on soil properties. The choice between the two is based largely on the type of extraction used for cation analyses. SAR can be used with either soil or water samples, whereas ESP is applicable only with soils.

5.2 Free Lime

Free lime is a measure of soil carbonates (salts of CO32-). When combined with an acid, carbonates release gaseous CO2. The test usually performed for soil carbonates is semi-quantitative. A weak acid solution is applied to the soil sample, and the degree of „fizzing" or release of CO2 gas is determined visually and categorized as „none", „low", „medium", or „high".

VI. OPTIONAL SOIL TESTS

6.1 Sulfur (S)

Sulfur, like N, may be contained primarily in the soil OM, but plants absorb only the inorganic sulfate (SO42 -) form. Measuring total soil S does not provide a good estimate of S plant availability because rates of release from OM cannot be accurately predicted. Instead, S in the sulfate form is a more common measure. Sulfate can be extracted from the soil with several extractants, including water or weak salt solutions. Analysis of SO4-S is relatively easy, but it usually provides a measure of immediately available S, and not the soil‟s long-term ability to provide S to a growing plant. Some desert soils contain large quantities of sulfates, in which case sulfate analysis gives a good indication of the soil‟s ability to supply S.

VII. CONCLUSION

Soil analyses can provide information that is important for maximizing nutrient use efficiency and agricultural productivity. A historical record of soil properties provided by long-term soil testing is useful for determining the effectiveness of fertilizer management strategies in maintaining soil fertility and sustainable agricultural productivity. Soil testing is also a useful tool for indentifying the causes of nutrient related plant growth problems.

Soil sampling is the critical first step in a soil testing program. The second is selection of a laboratory that will utilize analysis procedures appropriate for regional soils and conditions. However, an understanding of the accuracy and limitations of individual procedures and of the meaning of soil test results is essential. This publication provides information on these components of a soil testing program. The last steps, interpreting soil analysis values and developing a fertilizer management program, are crop specific and sometimes dependent on additional soil and climatic properties, and are beyond the scope of this document.

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PROPOSED SOLUTION OF E-WASTE MANAGEMENT AND A NEW ENVIRONMENTAL CHALLENGE OF E-WASTE MANAGEMENT

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ABSTRACT

Focal issue of the present investigation is electronic-squander (e-squander) which is developing as another natural test for 21st century. The quick development of the electronic and IT industry, show purchaser culture, expanding rates of utilization of electronic items have prompted shocking ecological outcomes. E-squander, while reusing, might be perilous in light of poisonous quality of a portion of the substances it comprises of. A portion of the waste has been demonstrated to contain numerous growth causing operators. The results and lethality is because of release of lead, mercury, cadmium, beryllium and other dangerous substances. Created nations trade this loss as gift to creating nations. China and India, where ecological models are low, are the greatest beneficiaries of e-squander which, much of the time, is handled unlawfully. The ecological weight of e-squander is conceived by individuals who live in creating nations, particularly China and India, which forms the most extreme measure of e-squander.

Regardless of different laws and orders in created nations, the e-squander engagement is uncontrolled. The present investigation centers around the impact of use, dumping and reusing of the electronic waste on the indigenous habitat.

KEYWORDS: *E-squander, Mercury, Cadmium, Unlawfully*

I. INTRODUCTION

Globalization and information technology are being widely recognized as main drivers of the human civilization in the later part of twentieth century and the 21st century. The Information Technology (IT) has been the power house of the global economy particularly since early 1990s. Software and hardware part of IT has touched most of the parts of social, technical, economic and natural environment. Exponentially increasing production of computer hardware has posed major challenges of proper disposal of the waste (e-waste) produced by this industry. Current study focuses on the effect of usage, dumping and recycling of the electronic waste on the natural environment. The paper has five sections. In the introduction section size of the global and Indian electronics market (particularly computers) has been presented. Next section is born out of hazardous impact of different chemicals disposed in environment in the process of computer usage, disposal and inefficient recycling. The third section brings out the dynamics of international trade, environmental regulations and technology transfer issues for comprehensive understanding of e-waste issues mainly caused by computers. The fourth section describes the case of India in this regard which has been presented in the above mentioned broader context. The paper is concluded with discussion, conclusion and recommendations for better management of e-waste.

II. RECENT STUDIES

Level headed discussion proceeds over the refinement amongst "item" and "waste" gadgets definitions. A few exporters are blamed for intentionally leaving hard to-reuse, out of date, or non-repairable gear blended in heaps of working hardware. Protectionists may widen the meaning of "squander" gadgets with a specific end goal to shield residential markets from working auxiliary gear. The high estimation of the PC reusing subset of electronic waste can help pay the cost of transportation for a bigger number of useless pieces than can be accomplished with show gadgets, which have less piece esteem. In A 2011 report, "Ghana E-Waste Country Assessment", found that of 215,000 tons of gadgets imported to Ghana, 30% were spic and span and 70% were utilized. Of the utilized item, the investigation reasoned that 15% was not reused and was rejected or disposed of.

- USA discards 30 million computers each year and 100 million phones are disposed of in Europe each year
- The Environmental Protection Agency estimates that only 15-20% of e-waste is recycled, the rest of these electronics go directly into landfills and incinerators
- An estimated 50 million tons of E-waste are produced each year.
- The United States is the world leader in producing electronic waste, tossing away about 3 million tons each year
- China already produces about 2.3 million tons (2010 estimate) domestically, second only to the United States

- Legal framework, proper collection system missing.
- Imports regularly coming to the recycling markets.

III. ELECTRONICS: THE GROWING INDUSTRY

Worldwide electronic gear generation has developed from $225 billion of every 1980 to nearly $1 trillion out of 2000, which likens to a compound normal yearly development of 7.7 percent in the course of recent years. In 1980, half of all gadgets frameworks were produced in North America, one quarter in Europe and the adjust split amongst Japan and whatever remains of Asia. The PC was simply developing and the change to computerized broadcast communications exchanging was going all out. An emotional move underway administration happened throughout the following ten years.

A few elements added to this quick move in worldwide electronic gear creation. Amid the 1980s, the Japanese economy was the envy of the world. Gross domestic product per capita had ascended from $5,000 in 1960 to $15,000 in 1980, and by 1990 had come to $22,000. Through the organizations like Sony, Panasonic and so on of Japan had turned into the reasonable pioneer in advancement of buyer electronic items and high volume modern electronic get together. The blend of developing indigenous request, worldwide shopper hardware item

administration, and numerous times of interest in assembling innovation and limit absolutely profited overall gadgets makers amid the 1980s.The last ten years have spawned enormous change in the global economy and in the electronics industry because of:

A. Democratization of Eastern Europe and the integration of the EU economies, B. An increasingly pragmatic commercial orientation by China,

C. Rapidly increasing economic growth elsewhere in Asia, D. The longest economic expansion in the USA,

III. Low cost production from Japan and
IV. The bursting of the “bubble” economy

Asian generation has kept on flourishing, outperforming $200 billion out of 2000 and records for in excess of 20 percent of aggregate creation around the world. Asian generation of gadgets is to a huge degree trade driven. However, venture was engaged to serve the PC business, cell phone generation, and also satisfaction of quickly developing local interest for customer and modern hardware. This has supported the assembling base for proceeded with extension. China India, Brazil and other creating nations are assuming an expanding part in the IT showcase. IT related industry is required to grow 11% of every 2006. Over the most recent five years (1995-2000), the Indian IT industry has recorded a CAGR (Compounded Annual Growth Rate) of in excess of 42.4 for every penny, which is twofold the development rate of IT ventures in a considerable lot of the created nations. Throughout the decade the business has grown in excess of 150 noteworthy equipment players, upheld by more than 800 subordinate units and little time merchants occupied with sub congregations and hardware producing. This has expanded the introduced base to in excess of 5 million PCs and as on December 31, 2000, the entrance rate to in excess of 5 PCs for every 1,000 individuals.

IV. FORMS OF E-WASTE

Electronic Waste (e-squander) is the term used to depict old, end-of-life electronic machines, for example, PCs, PCs, TVs, DVD players, cell phones, mp3 players and so forth which have been discarded by their unique clients. In fact, electronic waste is just a subset of WEEE (Waste Electrical and Electronic Equipment). As per the OECD any machine utilizing an electric power supply that has achieved its end-o f-life would go under WEEE. Recognizing its advantages upheaval this segment presents darker reality of data innovation. Exceptionally speed of advancement that lies at the core of PC maker prompts the item out of date quality. The truth of PC life cycle uncovers a dangerous life cycle. The dull side of high mechanical improvement of electronic industry, particularly PC innovation, is uncovered as dirtied drinking water, squander releases that reason damage to angle, birth surrenders, high rate of premature delivery and growth among group laborers. Quick changes in PC innovation and the rise of new electronic merchandise, the developing reliance on data innovation, expanding rates of utilization of electronic items have prompted awful ecological results. This innovative advantages and blast in the market prompt broad utilization of electronic products, particularly PCs. This is turning the substance of the business and on the whole frame an issue of electronic waste the level of waste that is innovation related is developing at a disturbing rate. In a current report scientists found that the volume of e-squander is expanding by 3 - 5% every year, which is just about three times quicker than the metropolitan waste stream is developing for the most part (2). The life expectancy of a PC has contracted from four or five years to around two years Electronics, the biggest and quickest developing assembling industry on the planet, forcefully advances a culture of quick oldness and expanded utilization. A lot of perilous chemicals are available in PC and other electronic products. The poisonous quality is because of lead, mercury, cadmium, hexavalent chromium (ChromiumVI), brominated fire retardants, plastic, PVC and so forth. A run of the mill PC screen may contain in excess of 6 percent lead by weight. As a rule, PC and electronic types of gear are entangled get together of in excess of 1000 materials, few of them are exceptionally lethal, for example, chlorinated and brominated substances, poisonous gases, photoactive and organic dynamic materials acids plastics and plastic added substances (Clean PC battle). Every PC show contains a normal of 4-8 pound of lead (MCC: 1996). Screen glass contains around 20 percent lead by weight. At the point when these segments are unlawfully arranged and pulverized in landfills, the lead is discharged into nature, representing a risky heritage for present and who and what is to come. Around 70 percent of the substantial metals including mercury and cadmium, found in landfills originate from electronic types of gear disposed of by the clients. These substantial metals and different perilous substances found in gadgets things, pollute ground water and posture ecological and general wellbeing dangers, (Poison PC and Toxic TV) A solitary segment of PC squander, Cathode Rays Tube (CRTs), has risen as the main edge of dangerous waste at the neighborhood, state, national and global level. CRTs are the glass Picture Tubes in PC screens and other video show gadgets that increase and concentrate high vitality electrons shaft to make the pictures, which we at last find in our screens. To shield shoppers from radiation harms, the glass in CRTs contain lead compasses which is roughly 20 percent of every CRT. Lead is a case of substantial metal, a metallic component that is in unadulterated shape overwhelming. Lead is to a great degree harmful, might be taken into the body, where they tend to join with and repress the working of specific compounds. A moment sum can have serious physiological or neurological impacts. (Lead in nature). Lead has a tendency to amass in nature and has high intense and constant consequences for plants, creatures and microorganisms. It makes harm the focal and fringe sensory system,

blood framework, kidney and conceptive framework in human. It likewise influences endocrine framework and mental health among the kids. (E-squander India Report, 2004). Mercury utilized as a part of switches, circuit sheets and in level board shows is discharged into the earth when copied or refined into the earth. Thus Beryllium is utilized as a part of each electronic get together which is discharged into the earth through clean outflow, amid pounding, cutting and copying tasks. Circuit board and plastic packaging having brominated fire resistant are wellspring of dioxins and furans.

Carbon dark in printers and toner is class 2b cancer-causing agent and beryllium, ordinarily utilized as a part of mother sheets and finger cuts, is a wellbeing danger. Beryllium has, as of late, beenclassified as a human cancer-causing agent as introduction to it causes lung growth. (Sending out Harm, 2002) BFRs are among a gathering of terrible performing artists particularly known as constant natural contaminations. Creature tests have demonstrated that some of these chemicals influence thyroid capacity, have estrogenic impacts, and act through a similar receptor-interceded pathways as does dioxin, which is among the most intense creature cancer-causing agents known. Further, preservationists charge that hardware recyclers have not by any means deal with the unique ecological issues that they say are inborn in the productive utilization of BFRs in e-squander plastics. "There are by and by no investigations on a definitive destiny of BFRs when they are softened or consumed in reusing or cremation applications. A more intensive take a gander at some of electronic waste uncovers that normally utilized reusing practices can hurt the earth more than the waste itself. Examination led by a few spots found that the specialists frequently utilized corrosive shower and different metals, washing the deposit specifically in to adjacent waterways and other water bodies. Part that can't be reused are sent to landfills or consumed in the open, discharging extra poisons in the earth. Expansion of life expectancy is the key system in dealing with the extent of condition affect. Social and money related powers for PC squander administration requires proficient association amongst open and private segments and also arranged exercises between researchers, business people and approach creators around the globe. As per Xinhua News Agency, China has created about 1.1 million tons of ewaste every year since 2003, including 5 million TV sets, 4 million iceboxes, 5 million clothes washers, 5 million PCs, and a huge number of cell phones and it will keep on piling up. Greenpeace evaluates that by 2010, there will be 178 million new PC clients in China alone. The U.S. National Safety Council predicts that in that nation alone between 315 million and 680 million PCs will wind up out of date inside the following couple of years. The waste will contain in excess of 2 billion kg of plastic, 0.5 billion kg of lead, 1 million kg of cadmium, 0.5 million kg of chromium and about 200,000 kg of mercury. Tree huggers likewise stress that with the prominence of new fluid gem show innovation, an expanding number of old screens utilizing cathode beam tubes are winding up in the waste. The transfer issue with respect to the a huge number of original cell phones are today‟ s developing test. • Total evaluated e-squander produced from PC , TV, cooler and clothes washers is 1,46,180 tones and is relied upon to go up to around 1,600,000 by 2012.(CII,2006)

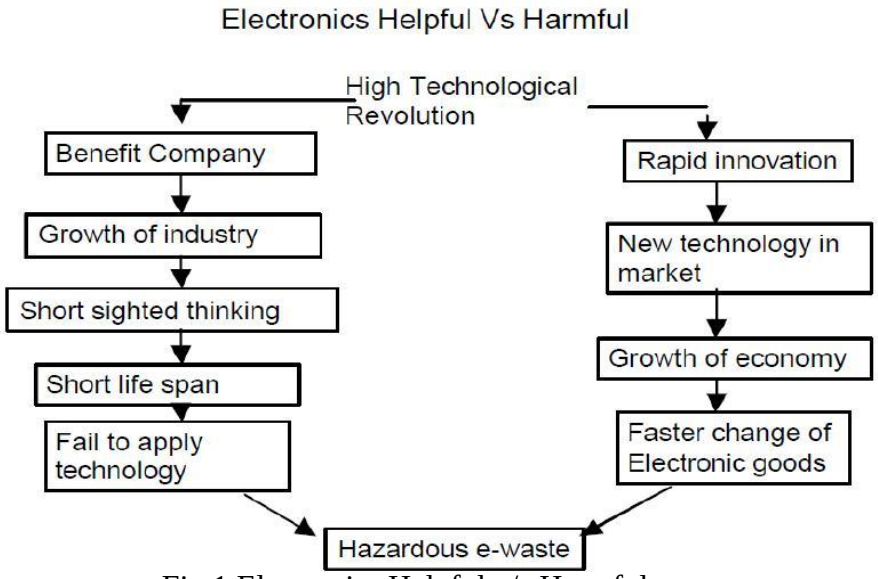


Fig 1 Electronics Helpful v/s Harmful

V. REASONS OF THE FLOW OF E-WASTE TO DEVELOPING COUNTRIES

Due to lower environmental standards and working conditions in China and India, ewaste is being sent to these countries for processing – in most cases illegally. Uncontrolled burning and disposal are causing environmental problems due to the methods of processing the waste. The labor-intensive nature of electronic waste recycling, abundant, cheap and skilled labor force and generation of huge profits for local governments causes the authorities to turn a blind eye to this practice. Thus, they serve as passive encouragement to its spread. It is more convenient and also economical to export e-waste to the third world countries like India, rather than managing and incurring high environmental and economic cost.

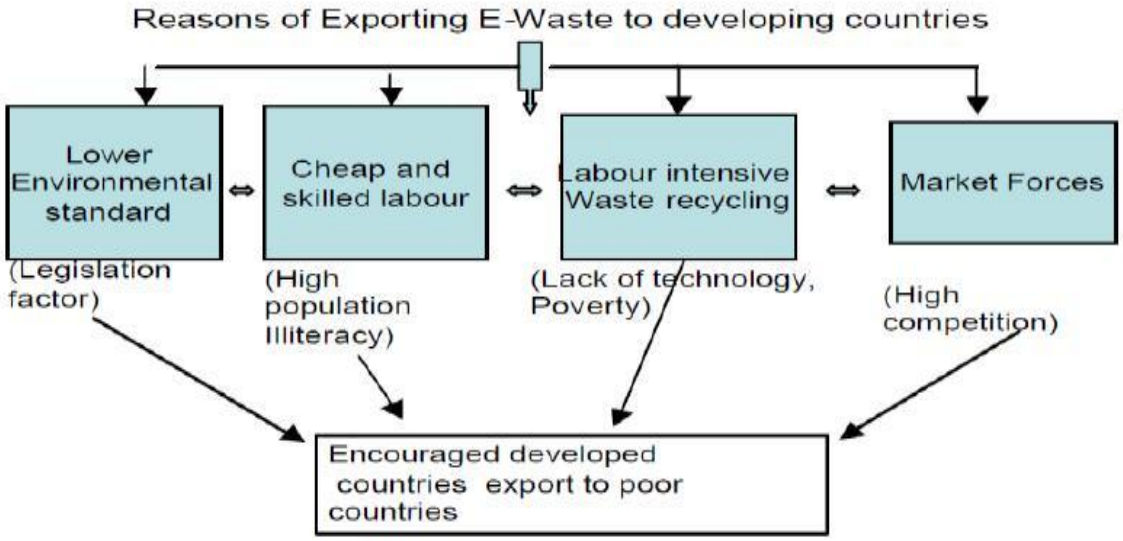


Fig. 2 Reasons of Exporting E-Waste to developing countries

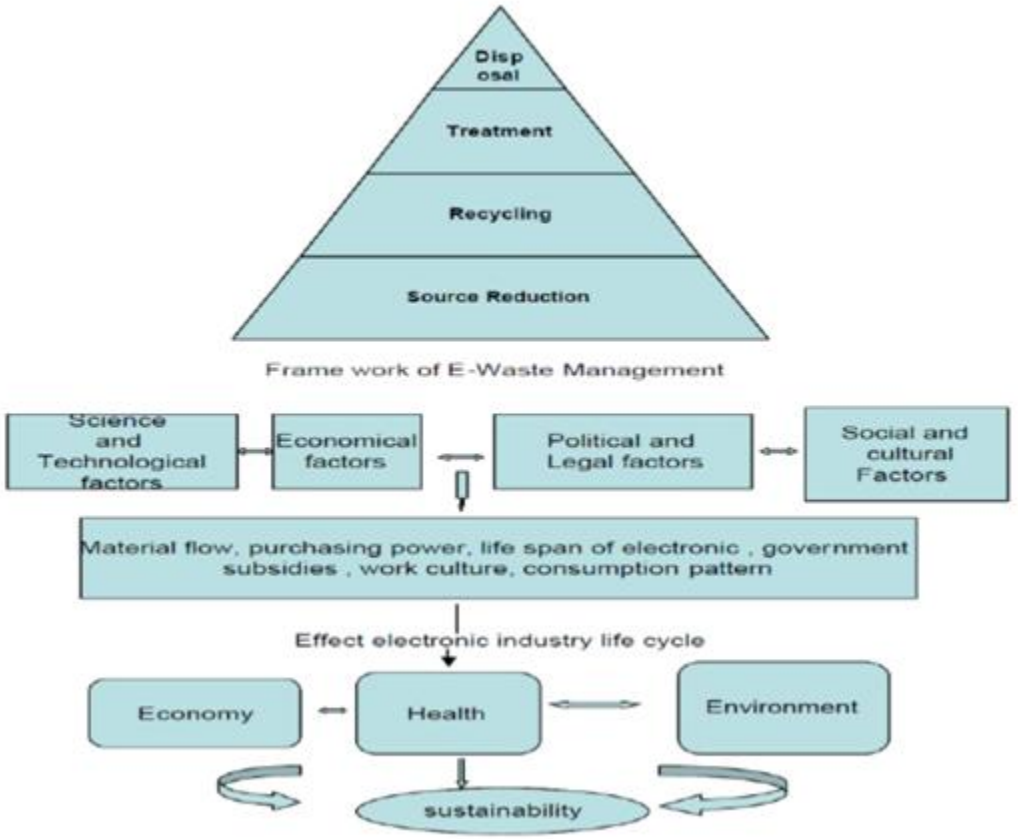
Various departments of the government, public as well as private sectors are responsible for fast feeding of old electronic appliances such as computers, telephones, mobile phone, etc, into the

waste stream. Other sources of e-waste are retailers, individual households, foreign embassies, PC manufacturing units, players of the secondary market, and imported electronic scraps from other countries. Individual households have the least contribution in generating of IT product obsolescence. Most Indian households prefer to pass their obsolete technology to near and dear ones or exchange it from the retailer. It is the illegal dumping of junked computers from other parts of the world that generates the biggest part of the e-waste In India; the mountains of e-waste have not yet manifested themselves. This is because of the propensity not to throw away equipment, even if it is obsolete, till it becomes totally unserviceable. But, in the younger generation, this attitude is changing and the throwaway culture of the west is slowly permeating into the country. Another factor limiting generation of e-waste in India is that we do not have a sizeable IT hardware manufacturing infrastructure as yet. We also commenced large scale computerization a bit late in this country, compared to the developed countries.

VI. TOTAL AMOUNT OF E-WASTE IN INDIA

- Around 1,050 tonnes of electronic scrap is being produced by manufacturers and assemblers in a single calendar year.
- In a single month, there is a reported case of import of 30 metric tonnes (MT) of e- waste at Ahmedabad port.
- The minimum number of computers procured by an average scale scrap dealer is 20-25 per month.
- The approximate number of scrap dealers specializing in electronics, in and around Delhi, is more than 40. This figure also includes large scale dealers who handle thousands of PCs per month.
- Approximately 1.38 million personal computers become obsolete every year.
- The IT and IT enable services are expanding at a faster rate in and around the national capital region like: Delhi, Gurgoan and Noida. Over the last five years, the Indian IT industry has recovered a compound annual growth rate of more than 42.4 %, which is almost double the growth rate of IT industry in many of the developing countries. Indian configuration of PC per 500 people is going to change to 1 for 50 by 2008.
- The total WEEE generation in India has been estimated to be 1, 46,180 tonnes per year based on selected EEE tracer items. Almost 50% of the PCs sold in India are products from the secondary market and are re-assembled on old components. The remaining market share is covered by multinational manufacturers (30%) and Indian (22%) brands.
- Mumbai currently tops the list of major cities with e-waste.
- Foreign companies helping Indian importers bypass government regulations to bring in the goods for recycling.
- Bangalore may be generating 10,000 to 15,000 tonnes of e-waste every month, according to industry sources. The Karnataka State Pollution Control Board has put it at 10,000 tonnes a month. Along with discarded obsolete hardware, many western countries are selling off their e-waste as scrap and some of this reach scraps dealers in this city. Metal components and some of the outer casings are resold, while the rest of the computers are dumped haphazardly.

VII .POLLUTION PREVENTION HIERARCHY



VIII. CONCLUSION

Most waste is inherently dangerous. It can degrade to produce leachate, which may contaminate ground water, and create landfill gas, which is explosive. In addition, because of the dangers associated with landfill sites, there are now very strict requirements on the construction, operation and aftercare of such sites. Most planning authorities want a worked out quarry to be used for landscaping rather than a landfill site which no one wants in their „back yard" . Product design must be employed to help to minimize not only the nature and amount of waste, but also to maximize end-of-life recycling. Manufacturers, retailers, users, and disposers should share responsibility for reducing the environmental impacts of products. Adopt product stewardship approach i.e. a product-centered approach should be adopted to preserve and protect environment.

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EVALUATION OF CONCRETE MIX DESIGN METHODS AND THE STUDY OF VERIFICATION FOR WORKABILITY

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ABSTRACT

The process of selecting suitable ingredients of concrete and determining their relative amounts with the objective of producing a concrete of the required, strength, durability, and workability as economically as possible, is termed the concrete mix design. The proportioning of ingredient of concrete is governed by the required performance of concrete in 2 states, namely the plastic and the hardened states. If the plastic concrete is not workable, it cannot be properly placed and compacted.The property of workability, therefore, becomes of vital importance. The compressive strength of hardened concrete which is generally considered to be an index of its other properties, depends upon many factors, e.g. quality and quantity of cement, water and aggregates; batching and mixing; placing, compaction and curing. The cost of concrete is made up of the cost of materials, plant and labour. The variations in the cost of materials arise from the fact that the cement is several times costly than the aggregate, thus the aim is to produce as lean a mix as possible. From technical point of view the rich mixes may lead to high shrinkage

and cracking in the structural concrete, and to evolution of high heat of hydration in mass concrete which may cause cracking. The actual cost of concrete is related to the cost of materials required for producing a minimum mean strength called characteristic strength that is specified by the designer of the structure. This depends on the quality control measures, but there is no doubt that the quality control adds to the cost of concrete. The extent of quality control is often an economic compromise, and depends on the size and type of job. The cost of labour depends on the workability of mix, e.g., a concrete mix of inadequate workability may result in a high cost of labour to obtain a degree of compaction with available equipment.

KEYWORDS: *Ingredients, Compaction, Aggregates*

INTRODUCTION

I. REQUIREMENTS OF CONCRETE MIX DESIGN

The requirements which form the basis of selection and proportioning of mix ingredients are :

a) The minimum compressive strength required from structural consideration

b)The adequate workability necessary for full compaction with the compacting equipment available.

C) Maximum water-cement ratio and/or maximum cement content to give adequate durability for the particular site conditions

d) Maximum cement content to avoid shrinkage cracking due to temperature cycle in mass concrete.

II. TYPES OF MIXES

2.1. Nominal Mixes

Advertisements In the past the specifications for concrete prescribed the proportions of cement, fine and coarse aggregates. These mixes of fixed cement-aggregate ratio which ensures adequate strength are termed nominal mixes. These offer simplicity and under normal circumstances, have a margin of strength above that specified. However, due to the variability of mix ingredients the nominal concrete for a given workability varies widely in strength.

2.2. Standard mixes

The nominal mixes of fixed cement-aggregate ratio (by volume) vary widely in strength and may result in under- or over-rich mixes. For this reason, the minimum compressive strength has been included in many specifications. These mixes are termed standard mixes. IS 456-2000 has designated the concrete mixes into a number of grades as M10, M15, M20, M25, M30, M35 and M40. In this designation the letter M refers to the mix and the number to the specified 28 day cube strength of mix in N/mm. The mixes of grades M10, M15, M20 and M25 correspond approximately to the mix proportions (1:3:6), (1:2:4), (1:1.5:3) and (1:1:2) respectively.

2.3. Designed Mixes

In these mixes the performance of the concrete is specified by the designer but the mix proportions are determined by the producer of concrete, except that the minimum cement content can be laid down. This is most rational approach to the selection of mix proportions with specific materials in mind possessing more or less unique characteristics. The approach results in the

production of concrete with the appropriate properties most economically. However, the designed mix does not serve as a guide since this does not guarantee the correct mix proportions for the prescribed performance. For the concrete with undemanding performance nominal or standard mixes (prescribed in the codes by quantities of dry ingredients per cubic meter and by slump) may be used only for very small jobs, when the 28-day strength of concrete does not exceed 30 N/mm . No control testing is necessary reliance being placed on the masses of the ingredients.

V. FACTORS AFFECTING THE CHOICE OF MIX PROPORTIONS The various factors affecting the mix design are:

3.1. Compressive strength

It is one of the most important properties of concrete and influences many other describable properties of the hardened concrete. The mean compressive strength required at a specific age, usually 28 days, determines the nominal water-cement ratio of the mix. The other factor affecting the strength of concrete at a given age and cured at a prescribed temperature is the degree of compaction. According to Abraham's law the strength of fully compacted concrete is inversely proportional to the water-cement ratio.

3.2. Workability

The degree of workability required depends on three factors. These are the size of the section to be concreted, the amount of reinforcement, and the method of compaction to be used. For the narrow and complicated section with numerous corners or inaccessible parts, the concrete must have a high workability so that full compaction can be achieved with a reasonable amount of effort. This also applies to the embedded steel sections. The desired workability depends on the compacting equipment available at the site.

3.3. Durability

The durability of concrete is its resistance to the aggressive environmental conditions. High strength concrete is generally more durable than low strength concrete. In the situations when the high strength is not necessary but the conditions of exposure are such that high durability is vital, the durability requirement will determine the water-cement ratio to be used.

3.4. Maximum nominal size of aggregate

In general, larger the maximum size of aggregate, smaller is the cement requirement for a particular water-cement ratio, because the workability of concrete increases with increase in maximum size of the aggregate. However, the compressive strength tends to increase with the decrease in size of aggregate. IS 456:2000 and IS 1343:1980 recommend that the nominal size of the aggregate should be as large as possible.

3.5. Grading and type of aggregate

The grading of aggregate influences the mix proportions for a specified workability and water-cement ratio. Coarser the grading leaner will be mix which can be used. Very lean mix is not desirable since it does not contain enough finer material to make the concrete cohesive.

The type of aggregate influences strongly the aggregate-cement ratio for the desired workability and stipulated water cement ratio. An important feature of a satisfactory aggregate is the uniformity of the grading which can be achieved by mixing different size fractions.

3.6. Quality Control

The degree of control can be estimated statistically by the variations in test results. The variation in strength results from the variations in the properties of the mix ingredients and lack of control of accuracy in batching, mixing, placing, curing and testing. The lower the difference between the mean and minimum strengths of the mix lower will be the cement content required. The factor controlling this difference is termed as quality control.

IV. MIX PROPORTION DESIGNATIONS

The common method of expressing the proportions of ingredients of a concrete mix is in the terms of parts or ratios of cement, fine and coarse aggregates. For e.g., a concrete mix of proportions 1:2:4 means that cement, fine and coarse aggregate are in the ratio 1:2:4 or the mix contains one part of cement, two parts of fine aggregate and four parts of coarse aggregate. The proportions are either by volume or by mass. The water-cement ratio Is usually expressed in mass

4.1 Factors to be considered for mix design

- The grade designation giving the characteristic strength requirement of concrete.
- The type of cement influences the rate of development of compressive strength of concrete.
- Maximum nominal size of aggregates to be used in concrete may be as large as possible within the limits prescribed by IS 456:2000.
- The cement content is to be limited from shrinkage, cracking and creep.
- The workability of concrete for satisfactory placing and compaction is related to the size and shape of section, quantity and spacing of reinforcement and technique used for transportation, placing and compaction.

V. PROCEDURE FOR MIX DESIGN

1. Determine the mean target strength f from the specified characteristic compressive strength at 28-day f and the level of quality control.

f = f + 1.65 S

Where S is the standard deviation obtained from the Table of approximate contents given after the design mix.

2.Obtain the water cement ratio for the desired mean target using the empirical relationship between compressive strength and water cement ratio so chosen is checked against the limiting water cement ratio. The water cement ratio so chosen is checked against the limiting water cement ratio for the requirements of durability given in table and adopts the lower of the two values.

3. Estimate the amount of entrapped air for maximum nominal size of the aggregate from the table.

4.Select the water content, for the required workability and maximum size of aggregates (for aggregates in saturated surface dry condition) from table.

5.Determine the percentage of fine aggregate in total aggregate by absolute volume from table for the concrete using crushed coarse aggregate.

6. Adjust the values of water content and percentage of sand as provided in the table for any difference in workability, water cement ratio, grading of fine aggregate and for rounded aggregate the values are given in table.

7. Calculate the cement content form the water-cement ratio and the final water content as arrived after adjustment. Check the cement against the minimum cement content from the requirements of the durability, and greater of the two values is adopted.

8. From the quantities of water and cement per unit volume of concrete and the percentage of sand already determined in steps 6 and 7 above, calculate the content of coarse and fine aggregates per unit volume of concrete from the following relations:

Where V = absolute volume of concrete

=gross volume (1m) minus the volume of entrapped air S = specific gravity of cement

W = Mass of water per cubic metre of concrete, kg C = mass of cement per cubic metre of concrete, kg

$$V = \left[W + \frac{C}{S_c} + \frac{1}{p}\frac{f_a}{S_{fa}}\right] \times \frac{1}{1000}$$

$$V = \left[W + \frac{C}{S_c} + \frac{1}{1-p}\frac{C_a}{S_{ca}}\right] \times \frac{1}{1000}$$

p = ratio of fine aggregate to total aggregate by absolute volume

f_a C_a= total masses of fine and coarse aggregates, per cubic metre of concrete, respectively, kg, and **S_{fa} , Sc_a = specific gravities of saturated surface dry fine and coarse aggregates, respectively**

9. Determine the concrete mix proportions for the first trial mix.

10. Prepare the concrete using the calculated proportions and cast three cubes of 150 mm size and test them wet after 28-days moist curing and check for the strength.

1. **Prepare trial mixes with suitable adjustments till the final mix proportions are arrived at.**

VI. MIX METHOD OF ACI, BS , SSA AND HCS

6.1 AMERICAN CONCRETE INSTITUTE (ACI) MIX DESIGN METHOD

Summarizes the steps of the design using the American Concrete Institute mix design method. The method adopts few assumptions as follows;

1. The mix consistency, expressed in either the slump test, VeBe test or the compacting factor, depends solely on the water content regardless of the mix proportions.
2. The optimum ratio of the bulk volume of coarse aggregate per unit volume of concrete depends solely on the nominal maximum size of the coarse aggregate and the fine aggregate grading.
3. The characteristic strength of the concrete mix may be defined using the available degree of control during the production of concrete, the standard deviation and the percentage of defects.
4. The method does not differentiate between different types of hydraulic cements or different types of aggregates.

6.2 BRITISH STANDARD (BS) MIX DESIGN METHOD

Illustrates the steps of the design using the British Standard mix design method. The method adopts few assumptions as follows;

1. The method is applicable to Ordinary Portland cement (type I), Rapid-Hardening Portland cement (type II) and Sulphate Resisting Portland cement (type V).
2. The method differentiates between crushed and uncrushed aggregate since the difference in the behaviour is quite significant. It ignores the grading of the coarse aggregate providing that it satisfies the BS 882-1973. However, it considers the grading of the fine aggregate as it will affect the degree of workability of the concrete mix.
3. The water content in the concrete mix is affected solely by the required degree of workability, expressed in either the slump test or VeBe test, for a particular nominal maximum size of the particular type of coarse aggregate, regardless of the mix proportions.
4. The optimum ratio of the bulk volume of coarse aggregate per unit volume of concrete depends on the nominal maximum size of the coarse aggregate and the grading of the fine aggregate.
5. The characteristic strength of the concrete mix may be defined using the available degree of control during the production of concrete, the coefficient of variation and the percentage of defects.
6. The method adopts a hypothetical concrete mix with moderate cement content with w/c ratio of 0.5, well compacted, properly cured, cast with different types of cement and coarse aggregate and tested at different ages. The optimum water/cement ratio may be defined using this hypothetical concrete mix and the characteristic strength of the concrete mix.

6.3. SPECIFIC SURFACE AREA (SSA) MIX DESIGN METHOD

The Specific Surface Area method is referred to as Ain-Shams University mix design method the steps of the design using the Specific Surface Area mix design method. The method adopts few assumptions as follows;

1. The compressive strength of the concrete mix depends on the specific surface area of the combined aggregate for a given cement content and degree of workability. The range at which the optimum compressive 2 strength is achieved ranges between 22-26 cm /gm, the higher the cement in the mix, the lower the optimum specific surface area.
2. The water content is directly related to the specific surface area of the combined aggregate for a given cement content and degree of workability.
3. Although the experimental basis of the method was carried out using ordinary portland cement, it assumes that the relation in not sensitive to the type of cement.
4. The method is applicable to any type of coarse and fine aggregates providing that the shape factor can be easily calculated as the ratio between the percentage of voids in loose and fully compacted aggregate.
5. The degree of workability was defined in loose terms such as low, medium and high workability and was not related to any of the standard tests.

6.4. HIGH-STRENGTH CONCRETE (HSC) MIX DESIGN METHOD

Shows the steps of the design using the High-Strength Concrete mix design method . The method adopts few assumptions as follows;

1. The method uses irregular gravel or crushed granite with two nominal maximum sizes and natural sand at a fixed mixing ratio of 30% sand in the combined aggregate. It assumes that choosing suitable mix proportions and aggregate with high ceiling of strength will achieve high strength concrete.
2. The required mix is defined with a reference number that is defined using the characteristic strength, the cement type, the type of coarse aggregate and the age of the concrete at which the strength is required.
3. The water/cement ratio depends on the characteristic strength of the mix, the cement type, the aggregate type and the required degree of workability that is well defined using either the slump cone test or the compacting factor.
4. The aggregate-to-cement ratio depends on the same factors as the water/cement ratio and the nominal maximum size of the aggregate and the water/cement ratio. Although aggregate-to-cement ratio is of secondary influence on the concrete strength, it was noted that the leaner the concrete mix the higher the strength.
5. Similar to the BS mix design method, the characteristic strength of the concrete mix may be defined using the degree of control available during the production of concrete, the coefficient of variation and the percentage of defects.

VII. CRITICAL COMPARISON BETWEEN CONCRETE MIXES

The results, presented in Table 2, may lead to the following remarks;

1. The ACI mix design method produced a mix with fine aggregate-to-cement ratio of 1:1. It may be regarded as coarse aggregate bonded together with rich mortar. The design proportions had led to the minimum water/cement ratio thus confirming to the stiff mix requirements. Since, the mix design method accounted for the air entrapped voids, it had led to the lowest wet density. Yet, it was still within acceptable limits.
2. The BS mix design method produced a mix with the lowest cement content. This implies that it would be the most economic mix. Yet, the method resulted in the highest water content. Thus it is expected to produce the highest workability. The method resulted in the highest density suggesting that it will possess sufficient strength and durability.
3. The SSA mix design method produced a mix with moderate proportions and was pretty much similar to the BS mix. Yet, it was the easiest mix design method since it needs very limited computational efforts. The method produced the highest coarse aggregate content due to the specific surface area requirements of the combined aggregate.
4. The HSC mix design method resulted in a mix that is pretty much similar to the ACI mix. Yet, it is the richest mix implying that it is an uneconomic design. Special care should be taken to reduce the effect of shrinkage due to the high cement content. As was expected, the mix produced the highest wet density suggesting higher strength.

VIII. CONCLUSION

The concrete mix design is an art and is not an automatic procedure. It requires a lot of experience knowledge about the ingredients and the methods of mixing, placing, compaction, curing, etc. As a rule, the concrete properties depend on the properties of its ingredients. The more information the designer engineer knows about the ingredients and their properties, the more accurate the concrete mix "design" would be. The report leads to the following conclusions:

1. All the concrete mix design methods seemed to be just an intelligent guess about the relative share of the concrete constituents in the mix. This may be due to the variation in the interpretation of the ingredients' properties among the methods, especially the aggregate and the different assumptions implied in each mix design method. Thus, it was expected that the design reached by each method would differ from the others.
2. Concrete mix design is not a theoretical process and can not be 100% automated. A comprehensive computer code "CONMIX" was built to carry out the design by means of four different methods. It may be used to facilitate the mathematical computations that is required in the design process. The computer code may help in the design process by trying different scenarios and speeding up the calculations.

However, the engineering sense and experience were essential in understanding the design.

3. It was obvious from "CONMIX" results that each mix design method gave concrete properties substantially different from the other methods. Yet, the target strength, the required workability and all the concrete main input properties were kept constant. This may be due to the different assumptions implied in each mix design method.
4. The experimental results of the fresh concrete, for all the mix design methods, were in excellent agreement with the required workability. This may be due to the well-defined degree of workability in "most" methods.
5. All the four mixes had led to a higher 28-days strength than what was expected. The mean strength of the concrete mix should be higher than the minimum strength. In addition, this may be due to the vigorous quality control, good compacting and optimum curing that was easily achieved in a laboratory environment and on the small batches used for each mix.
6. The results from this small verification study can not be generalized unless a comprehensive experimental program is carried out to check different strength requirements at different degrees of workability. The designer engineer is advised to exercise good care when using any of the mix design methods and to use their results only after checking them with trial mixes. Trial mixes and successive adjustment to the concrete mix were essential in any concrete mix design. They are the only accurate and available way to achieve the desired concrete mix although it seems to be a non-scientific design.
7. The durability requirements were ignored in all methods except in the ACI method that specified a certain percentage of air entrained voids for air-entrained concrete. The report had dealt with the concrete mix design from the point of view that concrete with adequate strength would be durable enough under normal conditions of exposure. Durability is vital in hardened concrete subjected to any of the common deterioration problems. It is advised to develop an expert system based on the recommendations of the ***ACI Guide to Durable***

Concrete to help the designer engineer speed up the design process based on durability and strength requirements.

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GLOBAL NEED FOR OPTIMIZATION OF ENERGY & COST EFFECTIVENESS BY USING AAC BLOCKS IN BUILDING CONSTRUCTION AND INFRASTRUCTURE INDUSTRY

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ABSTRACT

Red bricks are one of the most pre-eminant construction material used for construction. The carbon dioxide emissions in the brick manufacturing process have been certified as a relevant factor to global warming. Therefore, it becomes necessary to focus more on pursuing environmental solutions for greener environment. To fulfill this objective, new construction materials can be used for construction. One such material i.e., AAC blocks can be used as an alternative material for construction. Autoclaved Aerated Concrete (AAC) Blocks are made out of Fly ash, Cement, Lime, Gypsum, Aluminium Powder & Water. Making these blocks does not cause any environmental pollution. Talking about AAC blocks, we can say that these blocks are smooth and almost 8 times bigger than the normal bricks and yet, lighter than the normal bricks by a huge margin, thus reduce construction time and cost. This paper highlights the comparative

statistical analysis of cost effectiveness of AAC blocks over traditional red bricks by using STADD-PRO software. The use of AAC blocks gives an eventual solution to the construction industry about the environmental related issues. The advantage of the AAC blocks in terms of light weight, high strength to weight ratio, better heat and sound insulation, lower coefficient of thermal expansion, environmental impact, low cost, and no use of top soil for production indicates that this product can be a very good replacement to burnt clay brick or fly ash brick. From the experimental results, it is observed that the compressive strength of AAC block is comparatively more than traditional bricks and the density of AAC block is comparatively less which helps in reducing the dead load of structure. It is found that upto 15 to 20%, the cost of construction can be reduced by using AAC blocks. Since the AAC block is more durable, economical and friendly to our environment than we can use AAC blocks as smart construction material. This paper investigates sustainability of AAC block by evaluating its structural properties.

KEYWORDS: *AAC, Clay Brick, Fly Ash Brick Wall, Glass Fiber Reinforced Gypsum(GFRG) Panel , PFRFC.*

I. INTRODUCTION

There are two types of walls in a house non-load bearing and load bearing. **Non-bearing walls** divide the internal space into rooms but carry no load. The role of **Load bearing wall** as dividers, but they also carry the load of the structure. These serving as important structural elements, bearing walls transfer the weight of the roof and upper floors to the foundation. All outer walls are bearing walls. They support the roof at the ends of the joists. The interior bearing walls support the floors and dead loads. They support the joists at midpoint. A non-load bearing wall is a wall that does not carry any gravity loads from the building, hence doesn‟ t accept any weight besides its own. A partition wall is a non-load-bearing wall that divides any interior space. Partition walls include static walls built onto the existing framed walls in the space or moveable features that slide on rails or roll on casters. A structural frame of reinforced concrete or steel can support the loads of the floors and roof, and also of the non-load bearing walls. The outer walls then perform all the 'enclosure' functions. Each wall panel also transmits its own weight and resists wind and seismic loads, but only those that act on the panel itself.

Partition walls are useful for changing the arrangement and functionality of a space. Following ways partition walls can be used:

1. Constructing separate workspaces in a large office space.
2. Providing a quieter reading or tutoring space in a classroom or library.
3. Separating a common bedroom into two distinct areas for additional privacy.
4. Partitioning an apartment to separate the sleeping and living areas.
5. Using pre-fabricated walls and screens to hide storage space.

Partition wall may be purpose-designed and constructed or may be flexible systems, and can combine openings, windows, doors, ducting, pipe work, plugs, wiring, skirting and so on. Frame constructions may include insulation to prevent the passage of sound or fire between adjacent spaces. It is important therefore that the top and bottom of the wall are appropriately sealed against the floor and ceiling, and where a raised floor or suspended ceiling is present, it is important to consider the possible for „flanking‟ through the voids above and below. Internal

wall partitions, also known as office partitioning, is usually made of plasterboard or varieties of glass. Hardened glass is a common option, as is low-iron glass.

II. LITERATURE REVIEW

The following are the previous research review based on Non-Load Bearing wall based on Different Materials.

2.1. Autoclaved Aerated Concrete (Aac) Block

Habib et al (2015) found that in this research, generation method of hydrogen gas was used for the aeration process. In this gasification method, a finely powdered aluminum powder was added to the slurry of Ordinary Portland cement with different percentages such as 0.05%, 0.1%, 0.15%, 0.2%, and 0.25%. To determine the effect of aluminum powder on the final product properties, some test has been conducted such as density, water absorption and compressive strength test. However, it was observed that the concrete having 0.15% aluminum powder contributes in the strength gaining process of aerated concrete. **(1) Miao et al (2015)** found that the reinforced concrete shear wall in self-thermal insulating system of AAC block can avoid the internal surface dew condensation on walls by pasting thermal-insulating places and plastering thermal-insulating mortar materials. The construction treatment of pasting heat-thermal plates outside concrete shear wall and smearing thermal-insulating mortar can avoid the inner surface condensation trouble of AAC block self-thermal insulation system wall. **(12) Rathi et al (2015)** found that Compressive strength of AAC blocks is comparatively more than traditional clay brick. These are suitable for walls in RCC framed building. Utilization of fly ash leads to the reduction in the cement consumption in the product which results in reduction of greenhouse gases. Density of AAC block is 1/3 that of traditional clay brick and there is no more change in wet condition. It helps in reducing dead load of structure. Cost of construction reduces by maximum up to 20 % as reduction of dead load of wall on beam makes comparatively lighter members. As both side face of AAC block wall are plane, thickness of plaster is very less, and so there is substantial reduction up to 50% in requirement of cement and sand for plaster work. AAC is manufactured from common and abundant natural raw materials, therefore it is extremely resource-efficient and eco - friendly. **(22) Saiyed et al (2015)** found that only natural materials are used in the process of manufacturing AAC block. This process produces no pollutants or by-products. AAC is totally free of poisonous or injurious substances. AAC a very eco-friendly building material and system. In the process manufacturing Low energy is required, low raw material consumption, ease of use in construction, and better indoor air quality. **(8)**

2.2. Clay Brick

Kaushik et al (2007) found that modulus of elasticity of masonry is found to vary between 250 and 1100 times the prism strength of masonry. An average value of 550 times the prism strength is proposed in the present study. The compressive strength of masonry was found to increase with the compressive strength of bricks and mortar. The trend was more prominent in case of masonry constructed with weaker mortar. Therefore, using a mortar grade of higher strength than required may not always produce high-strength masonry. Masonry with lime mortar was found to undergo about 50% more compressive deformation than that constructed using mortar without lime, while the reduction in compressive strength was only about 13% when lime mortar was used. Therefore, adding lime to mortar is a recommended practice in masonry construction. **(9) More et al (2014)** found that the clay burnt bricks manufactured with fly ash and rice husk ash had similar appearance when compared to the conventional clay bricks. The clay bricks having

fly ash as an admixture showed the best performance, having a compressive strength of about 23% greater than that of conventional bricks. The percentage of water absorption for these bricks was found to be more than that of conventional bricks but still within the prescribed maximum limit as per Indian Standards. (Maximum allowable water absorption as per Indian Standards is 20%) Hence fly ash can be used as an admixture with clay bricks. **(3)**

2.3. Fly Ash Brick Wall

Kumar et al (2014) found that Structure of the bricks was found to be compact, homogeneous and free from any defects like holes, lumps etc. as compared to normal bricks. The average absorbed moisture content of clay bricks and fly ash bricks are found to be 11.93% and 9.77% respectively. Thus there is net 18.10% decrease in moisture absorbed for fly ash bricks as a part to clay bricks. **(18) Mistry et al (2011)** found that as compare to conventional brick masonry prism compressive strength it is between 13.75 kg/cm2 to 121.80 kg/cm2 at 28 days strength. While FaL-G brick prism strength is 88.83kg/cm2 for cement mortar (1:6) and 85.05 kg/cm2 for fly ash mortar (1:6) just in 14 days. It can be increased up to 135 kg/cm2 to 145 kg/cm2 at 28 days. According to case study the fly ash bricks with conventional masonry work have 28% saving in cost with common red brick and conventional masonry work. The masonry work with new technology Rattrap bond in fly ash bricks have 33% saving in cost as compared to common bricks. **(20) Patel et al (2013)** found that increase the percentage of the fiber in brick the compressive strength of the brick is increase and the water absorption of the brick is decrease. In this experimental work 1% fiber addition in the brick gives the maximum strength 5.86 N/mm2after 21 days. Increase the percentage of glass fiber strength of the brick is increase but the cost of the brick is also increase. The maximum higher strength brick cost is 11.4 Rs. per number of brick. Cost of this brick is high but if we use this brick mix for the replace as PCC (Plain Cement Concrete, BBCC (Brick Bat Cement Concrete), RCC (Reinforced Cement Concrete) at plinth level and also it can be used in compressive element so the cost of the PCC, BBCC and RCC is decreases. **(15) Sumathi et al (2014-2015)** found that the brick specimen of size 230mm x 110mm x 90mm were cast for different mix percentage of Fly ash (15 to 50%), Gypsum (2%), Lime (5 to 30%) and Quarry dust (45 to 55%). However, the specimens have been tested for seven mix proportions.

The mechanical properties such as compressive strength were studied for different mix proportions, at different curing ages. From the results it was inferred that, among the seven proportions the maximum optimized compressive strength is obtained for optimal mix percentage of Flyash-15% Lime-30% Gypsum-2% Quarry dust-53% as 7.91 N/mm². **(23)**

2.4. Glass Fiber Reinforced Gypsum(GFRG) Panel

Janardhana et al (2015) found that axial load carrying capacity of unfilled GFRG wall panels, of various widths when subjected to eccentric loads, is estimated using numerical analysis. The lateral load carrying capacity of panels is also estimated. A basic procedure has been suggested for assessing in plane flexural strength of concrete filled wall panels. For a given force demand, reinforcement required for a concrete filled GFRG wall panels can be obtained using interaction diagram that has been developed. Using simple approach, the capacity of unfilled panels under shear load is estimated. It is also established by comparing the results of finite element buckling analysis with the available experimental results, that failure of the GFRG wall panel does not occur. Due to buckling, on account of in-plane axial and shear loads, as the critical loads are much higher than the actual capacities. **(13) Liu et al (2010)** found that a new GFRG wall,

named M-GFRG wall, which intended to erect small high-rise residential. Considerations on M-GFRG walls show that they can erect building fast like GFRG wall in prefabricated method. The following conclusions of its lateral deformation feature are derived from the elastic FEM analysis. The lateral stiffness of M-GFRG wall is a little smaller than that of reinforcing concrete shear wall, but it still is enough rigid for the small high-rise building. The elastic analysis shows that the M-GFRG wall is possible to be used in the small high-rise residential. But it still needs more theory analysis and experiment research for engineer application. **(25) Manjummekudiyil et al** found that GFRG Panels are light weight building material which can be used as walls and roof slab. Phospho-Gypsum, which is bi-product of fertilizer industry, can be effectively used in the production of panel. Compressive strength of GFRG Panel was obtained as 1.25 N/mm2. Water absorption value is obtained as 1.225%. **(6)**

Shukla et al (2016) found that the lengthwise reinforcement has no significant effect on shear response of concrete filled GFRG panels. Therefore, panels with starter bars as reinforcement could be used for which shear failure controls the design. Axial load has a similar effect on the shear strength of the walls. As a result, the type –one connection (starter bar) is acceptable for GFRG wall building if failure is due to shear strength of the wall.

However, these conclusions are only valid for shear prevailing wall panels. They are not valid for the walls with flexural deformations, for which the continuity of reinforcement is substantial. **(2)**

2.5. Paper Fiber Reinforced Foam Concrete(PFRFC) Panel

Fadila et al (2008) found that waste paper is suitable to reinforce foam concrete in term of flexural strength and noise absorption, but it not appropriate for foam concrete caused by increasing the density. The best percentage of Paper Fiber is 10 % of mix volume, because without any admixtures it could achieve the strength almost similar to the strength of 20% PFRFC that have been added by admixtures. Paper Fiber has very high ability in absorption of water. However, it absorption ability give the other advantages in absorbing noise. **(16) Mohd et al** observed that various sampling and testing of specimen and identified collected data have been discussed with a purpose to carry objective attainment of this research of study. Marginally the paper fiber provides a lot of benefit to increase the strength of concrete mixture, as new material for the concrete or cement composite to go along with economical construction material, and other excellence competent to be exploited accurately. **(7) Rai et al (2014)** found that Fiber is added in concrete to improve ductility and its post-cracking load-carrying capacity. The most important effect of fiber reinforcement in concrete is not to strength but also for flexural toughness of the material. Fiber reinforced concrete is generally made with a high cement content and low w/c ratio. Plain concrete fails abruptly once the deflection corresponding to the ultimate flexural strength is exceeded, on the other hand, fiber-reinforced concrete continues to withstand considerable loads even at deflections significantly in additional of the fracture deflection of the plain concrete.**(4) Zakaria et al (2015)** found that it is concluded that the natural fiber has potential to be used in composites for any different purpose. Various aspects of fiber reinforced composites have already been investigated and achieved the best result reported by previous researchers. Natural fiber when used as an aggregate in cement composite production can contribute in making the material and as a result: the structure enhancing the environment in a friendly manner. Recycling or such wastes as a sustainable construction material comes into view as a feasible solution not only to solve pollution crisis but also as cost-effective solution for designing of green buildings concept. **(14)**

2.6. Polymer Pre-Cast Panel

Mackechnie et al found that by using the concrete itself as the insulating material, we are improving the use of the material. This would also save the use of other insulating mediums that are not ideal in terms of energy efficiency and prevent the full thermal mass of concrete being utilized. These panels have been designed using recycled materials or by-products from other industries. The concept is therefore to build from our waste instead of putting it into landfills. Portland cement production is a high energy process that could be replaced by using inorganic polymer binder instead of Portland cement. This would prevent a large value of CO2 emission to be released. **(11)**

Rajaieh et al (2013) observed that to respond the residual requirement and with regard to population growth trend, economic condition and reaching to consistent development, construction industrializing is one of the effective solutions. We will be encounter a noticeable reduction in cost of wall operation, building dead load, environmental pollution, energy consumption in produce and building beneficiary and operation speed increment and effective infrastructure and ease of mechanical and electrical implementation by utilizing of these panels in operation of building internal and external partition walls. **(10)**

2.7. Recycled Glass Wall

Bhandari et al (2013) found that compressive strength of OPC mortar for 1, 3, 7 and 28 days for standard sand was observed to be greater than that of local sand (Wainganga sand) for control mix. The use of waste glass aggregate usually reduces the water demand. With the addition of waste glass aggregate, density of mortar increases. Water absorbed is less by cubes containing waste glass aggregate as compared to control mix cubes.

Gautam et al (2012) found that use of waste glass as fine aggregate replacement, the strength is found in 28 days, to slightly increase up to 20% replacement level. Marginal decrease in strength is observed at 30 to 40% replacement level of waste glass with fine aggregate. **(19)**

Krishnamurthy et al (2013)found that the thermal conductivity increased with the increasing in percentage of crushed recycle glass. Crushed recycle glass has a good and excellent potential in construction industry not only in reducing energy costs and effects of global warming by recycle the glass but to provide good insulation in concrete especially for use in tropical country. **(17)**

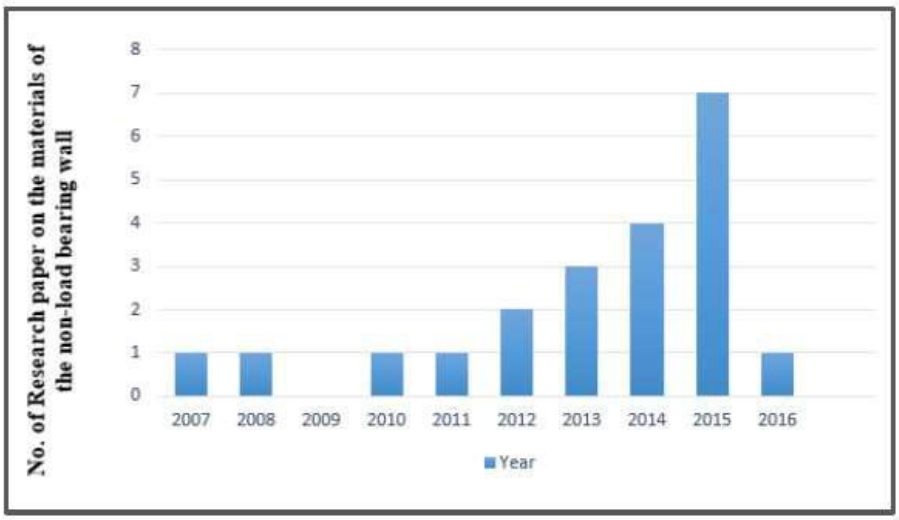

Figure1. ***Historical Development in the Area of Non-Load Bearing wall based on Different Materials used in Construction***

Figure2. *Different Materials used in Non-Load Bearing wall*

Figure2. ***Different Materials used in Non-Load Bearing wall***

III. CONCLUSIONS

Based in Literature Review the following conclusions are drawn:

1. Utilization of fly ash leads to the reduction in the cement consumption in the product which results in reduction of greenhouse gases. Cost of construction reduces by maximum up to 20 % as reduction of dead load of wall on beam makes comparatively lighter members. (22)
2. Only natural materials are used in the process of manufacturing AAC block. This process produces no pollutants or by-products. AAC is totally free of poisonous or injurious substances. AAC a very eco-friendly building material and system. **(8)**
3. The compressive strength of masonry was found to increase with the compressive strength of bricks and mortar. Masonry with lime mortar was found to undergo about 50% more compressive deformation than that constructed using mortar without lime. **(9)**
4. The clay bricks having fly ash as an admixture showed the best performance, having a compressive strength of about 23% greater than that of conventional bricks. **(3)**
5. The average absorbed moisture content of clay bricks and fly ash bricks is found to be 11.93% and 9.77% respectively. Thus there is net 18.10% decrease in moisture absorbed for fly ash bricks as a part to clay bricks. **(18)**
6. As compare to conventional brick masonry prism compressive strength it is between 13.75 kg/cm2 to 121.80 kg/cm2 at 28 days strength. While FaL-G brick prism strength is 88.83kg/cm2 for cement mortar (1:6) and 05 kg/cm2 for fly ash mortar (1:6) just in 14 days. It can be increased up to 135 kg/cm2 to 145 kg/cm2 at 28 days. **(20)**

7. With increase the percentage of the fiber in brick the compressive strength of the brick is increase and the water absorption of the brick is decrease. Increase the percentage of glass fiber strength of the brick is increase but the cost of the brick is also increase. **(15)**
8. The lateral stiffness of M-GFRG wall is a little smaller than that of reinforcing concrete shear wall, but it still is enough rigid for the small high-rise building. The elastic analysis shows that the M-GFRG wall is possible to be used in the small high-rise residential. **(25)**
9. Compressive strength of GFRG Panel was obtained as 1.25 N/mm2. Water absorption value is obtained as = 225%. **(6)**
10. The best percentage of Paper Fiber is 10 % of mix volume, because without any admixtures it could achieve the strength almost similar to the strength of 20% PFRFC that have been added by admixtures. **(16)**
11. Fiber is added in concrete to improve ductility and its post-cracking load-carrying capacity. The most important effect of fiber reinforcement in concrete is not to strength but also for flexural toughness of the material. Fiber reinforced concrete is generally made with a high cement content and low w/c ratio. **(4)**
12. The use of waste glass aggregate usually reduces the water demand. With the addition of waste glass aggregate, density of mortar increases. Water absorbed is less by cubes containing waste glass aggregate as compared to control mix cubes. **(5)**

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ANALYZING THE FACTORS INVOLVED IN CONCRETE FAILURE

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ABSTRACT

Concrete and steel are materials commonly used in building construction. Concrete is formed by mixture of aggregates which are sand and stone, and bonded together by water and cement with proper ratio. Steel is a material that is manufactured under carefully controlled condition by which its properties are determined in a laboratory. Combining concrete and steel gives increased strength to resist heavy loads to increase the lifetime of the structure. Even though concrete and steel give many advantages on building, they can also cause failure to the structure because of the impropriate procedure work, and lacks of efficient control and monitoring mechanism. The exceptional durability of portland cement concrete is a major reason why it is the world's most widely used construction material. But material limitations, design and construction practices, and severe exposure conditions can cause concrete to deteriorate, which may result in aesthetic, functional, or structural problems. Concrete can deteriorate for a variety of reasons, and concrete damage is often the result of a combination of factors. The authors

made an attempt to review the potential causes of concrete deterioration and the factors that influence them Corrosion of reinforcing steel and other embedded metals is the leading cause of deterioration in concrete. When steel corrodes, the resulting rust occupies a greater volume than the steel. This expansion creates tensile stresses in the concrete, which can eventually cause cracking, delamination, and spalling.

KEYWORDS: *Civil Engineering, Cement concrete, Corrosion, Steel, Portland cement*

I. INTRODUCTION

Concrete is one of most durable manmade materials, but even this old industry workhorse has its weaknesses. Exposure to harsh weather, reactions with common elements, and poor construction can all lead to concrete failure.

Concrete degradation may have various causes. Concrete can be damaged by fire, aggregate expansion, sea water effects, bacterial corrosion, calcium leaching, physical damage and chemical damage (from carbonatation, chlorides, sulfates and distilled water). This process adversely affects concrete exposed to these damaging stimuli.

Corrosion is not the only source of failure. Many other sources cause deterioration on reinforced concrete structures; this must be kept in mind and understood well when an inspection is undertaken. These sources of failure include:

- Unsuitable materials
- Unsound aggregate
- Reactive aggregate
- Contaminated aggregate
- Using the wrong type of cement
- Cement manufacturer error
- Contaminated aggregate
- Using the wrong type of cement
- Cement manufacturer error
- Wrong type of admixture
- Substandard admixture
- Contaminated admixture
- Organically contaminated water
- Chemically contaminated water
- Wrong kind of reinforcement
- Size error of steel bars
- Improper workmanship
- Faulty design
- Incorrect concrete mixture (low or high cement content and incorrect admixture dosage)
- Unstable formwork
- Misplaced reinforcement
- Error in handling and placing concrete (segregation, bad placing, and inadequate compacting)

- curing incomplete
- Environmental factors
- Soil alkali
- Seawater or sewage
- Acid industry
- freezing and thawing
- Structural factors
- Load exceeding design
- Accident as ballast load or dropped object
- Earthquake load

II. TYPES OF CRACKS IN CONCRETE AND TYPICAL CAUSES

Cracks can be broadly classified as either active or dormant. If they are active, they show some movement in direction, width or depth over a measured period of time. If the cracks are dormant, they remain unchanged. Some dormant cracks are of no danger, but if left unrepaired, cracks provide channels for moisture penetration, which can lead to future damage. For guidance onv patching dormant cracks,

- Cracks can be more specifically classified based on three factors: 1) direction, 2) width, and 3) depth of the crack. They may be longitudinal, transverse, vertical, diagonal or random. They may range in size from less than 1 mm (fine) to between 1 and 2 mm (medium) to over 2 mm (wide).

The following are some cracks classifications and a brief description.

- Pattern Cracking: Fine openings in regular pattern usually due to inconsistent volume of concrete which is lower near the surface.
- Checking: Shallow openings, closely and irregularly spaced. Hairline Cracking: Small cracks, randomly placed, in exposed areas.
- D-Cracking: Fine cracks at close intervals in a progressive random pattern.
- Cracks can occur in hardened or unhardened concrete and may be caused by some of the following conditions:
- Shrinkage cracking: A crack that occurs only in unhardened concrete. It is often seen as relatively straight lines running parallel with the span of the floor.
- Plastic cracking: A type of shrinkage crack that also only occurs in unhardened concrete. It is seen as diagonal lines in the top of a slab. It is often caused by rapid drying of the surface due to delays in applying the curing membrane.
- Settlement cracking: Caused by local restraining of unhardened concrete around reinforcement or some other obstruction.
- Structural cracking: Usually a result of corrosion of the reinforcing steel or structural over stressing.
- Tension cracking: Only occurs in reinforced concrete and is caused by elongation of the reinforcement in tension zones. It is sometimes seen around columns in flat slabs and on beam soffits near the middle of a span.
- Rust cracking: The most common and most serious cause of structural cracking caused by inadequate reinforcement cover. It gradually develops at varying rates over time depending upon the degree of protection offered by the concrete cover.

- Thermally-induced cracking: Results from stresses produced by temperature changes.

III. CONCRETE DURABILITY PROBLEMS IN STRUCTURES

Concrete durability problems in structures can be due to environment to which the concrete structure is exposure or due to internal causes within the concrete.

The following conditions cause the concrete durability problems in structures:

- Temperature
- Moisture
- Physical factors
- Chemical factors
- Biological factors

Durability of concrete in structure occurs due to above factors which cause weathering in concrete, abrasion or chemical reaction with concrete or reinforcement.

Durability problems in concrete structures related to environmental causes include the following: steel corrosion, delamination, cracking, *carbonation*, sulphate attack, chemical attack, scaling, spalling, abrasion and cavitations.

IV. DURABILITY PROBLEMS DUE TO TEMPERATURE

Concrete contracts and expands due to change in temperature. Concrete expands when temperature increase and contracts when temperature decreases. The effect of these expansion and contraction will not be in unrestrained concrete member. But when a concrete is restrained by connecting members such as columns, beams, slabs, foundations etc, these changes produces significant stresses in concrete which lead to development of cracks.

V. WARPING OF CONCRETE DUE TO TEMPERATURE CHANGE

Concrete exposed to temperatures greater than 95°C (203°F) can have significant effects. These effects are caused due to change in volume of cement paste and aggregates. Cement paste shrinks at high temperature due to dehydration while aggregates expands. The net result of high temperature on concrete is expansion. Therefore, exposure to very high temperatures (i.e. fire) will result in concrete spalling, particularly when the concrete is exposed to high temperatures for a long time.

Factors such as moisture condition of concrete, types of aggregates and their stability, cement content, duration of exposure to high temperature, rate of change in temperature, age of concrete and support conditions etc affects the durability of concrete at high temperature.

VI. CONCRETE DURABILITY PROBLEMS DUE TO MOISTURE

Concrete expands or swells due to increase in moisture and contracts when moisture reduces. These changes in moisture in concrete cause it to swell and shrink. When concrete starts to dry, shrinkage first occurs at the surface of concrete. This shrinkage of concrete at the surface will develop tensile stresses on concrete surface which leads to cracks. If a section of the concrete is restrained, and if concrete joints are not provided, major random cracks may develop.

Shrinkage of reinforced concrete is less than the shrinkage of plain concrete. The difference depends on the amount of reinforcing steel used. Steel reinforcement restricts but does not prevent drying shrinkage. The concrete will crack if the shrinkage strain of the concrete exceeds the limiting tensile strain of the concrete.

VII. PROBLEMS IN CONCRETE DUE TO MOISTURE

The three main problems with moisture and concrete are as follows:

- Carbonation
- The moisture cycle
- Contaminants

VIII. PHYSICAL FACTORS AFFECTING CONCRETE DURABILITY

Many times with the age of concrete, concrete surface is subjected to wear due to sliding, impact, scraping etc. In case of hydraulic structures, the action of the abrasive materials carried by flowing water generally leads to erosion of the concrete. Another cause of damage to concrete in flowing water is cavitation.

Abrasion in concrete is caused by the sliding or scraping of equipment across the concrete. Abrasion damage to concrete may also be caused by subjecting the concrete to abrasive materials (such as sand) that are carried by wind or water.

Tests on concrete results indicate the following facts:

- That abrasion resistance is clearly related to the compressive strength of the concrete.
- Strong concrete has more resistance than weak concrete.
- Since compressive strength depends on the water-cement ratio and adequate curing, a low water-cement ratio and proper curing of the concrete are necessary for abrasion resistance.
- Hard aggregates are more abrasion resistant than soft aggregates.
- Steel-trowelled surfaces resist abrasion more than a surface that is not trowelled.

Cavitations in concrete occurs when a high-velocity, flow of water (or any other fluid) suffers an abrupt change in direction or velocity.

IX. BIOLOGICAL FACTORS AFFECTING DURABILITY

Concrete may be damaged by live organisms such as plants, sponges, boring shells, or marine borers. Rotting seaweed has been known to produce sulfur. Sulfur can be easily converted to sulfuric acid. The presence of sulfuric acid on concrete leads to concrete disintegration.

X. CHEMICAL FACTORS AFFECTING CONCRETE DURABILITY

Durability of concrete is affected by chemical reaction due to chemical interactions between aggressive agents present in the external environment and the constituents of the cement paste. Among the exceptions are alkali-aggregate reactions which occur between the alkalies in cement paste and certain reactive materials when present in aggregate, delayed hydration of crystalline CaO and MgO if present in excessive amounts in Portland cement, and electrochemical corrosion of embedded steel in concrete.

Chemical reactions in concrete results into increase in porosity and permeability, decrease in strength, and cracking and spalling. Sulfate attack, alkali-aggregate attack, and corrosion of

embedded steel etc due to chemical reactions in concrete are responsible for deterioration of a large number of concrete structures. Concrete structures in coastal and offshore structures are exposed to chemical and physical processes of deterioration, which aptly demonstrate the complexities of concrete durability problems in practice.

Salt in the surrounding ground, ground water, or air diffuses into the concrete. Steel corrosion results in an increase in the volume of the corroded portion of the reinforcing steel bar. This increase in steel volume causes the concrete to crack and to disintegrate.

XI. FACTORS AFFECTING WORKABILITY OF CONCRETE

Each and every process and materials involved in concrete mixing affects the workability of concrete. Workability of concrete is measured in terms of ease with which it can be mixed, transported to construction site, placed in forms and compacted. It is easy to work with a highly workable concrete as it can be easily mixed, transported, placed and compacted.

Workability and strength of concrete are inversely proportional. When workability of normal concrete increases, the strength of concrete decreases which affects the durability of concrete. Factors which affect workability of concrete are:

- Cement content of concrete
- Water content of concrete
- Mix proportions of concrete
- Size of aggregates
- Shape of aggregates
- Grading of aggregates
- Surface texture of aggregates
- Use of admixtures in concrete
- Use of supplementary cementitious materials

The primary materials of concrete are cement, fine aggregates (sand), coarse aggregates and water. Many times admixtures are used in concrete to enhance its properties. Therefore, properties of these materials and their content affect the workability of concrete. Following are the general factors affecting concrete workability:

XII. CEMENT CONTENT OF CONCRETE

Cement content affects the workability of concrete in good measure. More the quantity of cement, the more will be the paste available to coat the surface of aggregates and fill the voids between them. This will help to reduce the friction between aggregates and smooth movement of aggregates during mixing, transporting, placing and compacting of concrete. Also, for a given water-cement ratio, the increase in the cement content will also increase the water content per unit volume of concrete increasing the workability of concrete. Thus increase in cement content of concrete also increases the workability of concrete.

XIII. TYPE AND COMPOSITION OF CEMENT

There are also effect of type of cement or characteristics of cement on the workability of concrete. The cement with increase in fineness will require more water for same workability than the comparatively less fine cement. The water demand increased for cement with high Al_2O_3 or C_2S contents.

XIV. WATER / CEMENT RATIO OR WATER CONTENT OF CONCRETE

Water/cement ratio is one of the most important factor which influence the concrete workability. Generally, a water cement ratio of 0.45 to 0.6 is used for good workable concrete without the use of any admixture. Higher the water/cement ratio, higher will be the water content per volume of concrete and concrete will be more workable.

Higher water/cement ratio is generally used for manual concrete mixing to make the mixing process easier. For machine mixing, the water/cement ratio can be reduced. These generalised method of using water content per volume of concrete is used only for nominal mixes. For designed mix concrete, the strength and durability of concrete is of utmost importance and hence water cement ratio is mentioned with the design. Generally designed concrete uses low water/cement ratio so that desired strength and durability of concrete can be achieved.

XV. MIX PROPORTIONS OF CONCRETE

Mix proportion of concrete tells us the ratio of fine aggregates and coarse aggregates w.r.t. cement quantity. This can also be called as the aggregate cement ratio of concrete. The more cement is used, concrete becomes richer and aggregates will have proper lubrications for easy mobility or flow of aggregates. The low quantity of cement w.r.t. aggregates will make the less paste available for aggregates and mobility of aggregates is restrained.

XVI. SIZE OF AGGREGATES

Surface area of aggregates depends on the size of aggregates. For a unit volume of aggregates with large size, the surface area is less compared to same volume of aggregates with small sizes. When the surface area increases, the requirement of cement quantity also increase to cover up the entire surface of aggregates with paste. This will make more use of water to lubricate each aggregates. Hence, lower sizes of aggregates with same water content are less workable than the large size aggregates.

XVII. SHAPE OF AGGREGATES

The shape of aggregates affects the workability of concrete. It is easy to understand that rounded aggregates will be easy to mix than elongated, angular and flaky aggregates due to less frictional resistance. Other than that, the round aggregates also have less surface area compared to elongated or irregular shaped aggregates. This will make less requirement of water for same workability of concrete. This is why river sands are commonly preferred for concrete as they are rounded in shape.

XVIII. GRADING OF AGGREGATES

Grading of aggregates have the maximum effect on the workability of concrete. Well graded aggregates have all sizes in required percentages. This helps in reducing the voids in a given volume of aggregates. The less volume of voids makes the cement paste available for aggregate surfaces to provide better lubricating to the aggregates.

With less volume of voids, the aggregate particles slide past each other and less compacting effort is required for proper consolidation of aggregates. Thus low water cement ratio is sufficient for properly graded aggregates.

XIX. SURFACE TEXTURE OF AGGREGATES

Surface texture such as rough surface and smooth surface of aggregates affects the workability of concrete in the same way as the shape of aggregates. With rough texture of aggregates, the surface area is more than the aggregates of same volume with smooth texture. Thus concrete with smooth surfaces are more workable than with rough textured aggregates.

XX. USE OF ADMIXTURES IN CONCRETE

There are many types of admixtures used in concrete for enhancing its properties. There are some workability enhancer admixtures such as plasticizers and super plasticizers which increases the workability of concrete even with low water/cement ratio. They are also called as water reducing concrete admixtures. They reduce the quantity of water required for same value of slump.

Air entraining concrete admixtures are used in concrete to increase its workability. This admixture reduces the friction between aggregates by the use of small air bubbles which acts as the ball bearings between the aggregate particles.

XXI. USE OF SUPPLEMENTARY CEMENTITIOUS MATERIALS

Supplementary cementitious materials are those which are used with cement to modify the properties of fresh concrete. Fly ash, fibers, silica fume, slag cements are used as supplementary cementitious materials.

The use of fly ash in improves the workability of concrete by reducing the water content required for same degree of workability or slump value.

The use of steel or synthetic fibers in concrete reduces the workability of concrete as it makes the movement of aggregates harder by reducing the lubricating effect of cement paste.

The workability of concrete is reduced and increased based on the quantity of silica fume. The use of silica fume in concrete can improves workability when used at low replacement rates, but can reduce workability when added at higher replacement rates. Silica fume are used as pumping aid for concrete when used as 2 to 3% by mass of cement.

The use of slag cement also improves workability but its effect depends on the characteristics of the concrete mixture in which it is used.

XXII. CONCLUSION

With so many causes and types of cracks, it can be difficult to identify which cracks or defects indicate a more serious structural issue and which are simply architectural. Many cracks are caused by either overloading, corrosion, shrinkage, or poor workmanship. When looking at a specific cracking pattern or defect in concrete, sometimes the cause can be attributed to a specific reason. Other times the pattern may have multiple causes leading to its current state. In better understanding some of the causes of concrete cracks as well as different cracking pattern types, engineers, construction managers, and others may be able to avoid major structural catastrophes. If concrete is cracking when it should not be, it needs to be identified quickly and repaired before a structural failure.

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ANALYSIS OF SEISMIC RESPONSE OF CONTINUOUS CURVED BRIDGE ISOLATING WITH THE TRIPLE FRICTION PENDULUM

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ABSTRACT

In past earthquakes, most of the damages of the bridges occurred due to the failure of the bearings and substructure. Selection of isolation bearings for a curved bridge is a challenging task because of the complexity involved in curved bridges compare to straight bridges. In the present study a simplified lumped mass modal of curved continuous bridge is used foe investigation. The seismic response of the curved bridge with friction pendulum bearing (FPS) and Triple friction pendulum bearing (TFPS) is investigated under near fault ground motions. The response quantities of interest are the base shear, deck acceleration, bearing displacement

and Hysteresis behavior. In order to verify the efficiency of FPS and TFPS in the curved bridge, comparison between responses of curved bridge isolated with FPS and TFPS and Non-isolated bridge has been made. The dynamic analysis has been carried out by using SAP2000 software. From the study, it is observed that the TFPS is more effective as compared to FPS in curved bridge subjected to near fault ground motions.

KEYWORDS: *Curved Bridge, Friction Pendulum System, Seismic Isolation, Triple Friction Pendulum System.*

I. INTRODUCTION

The use of horizontally curved bridges is very important now days, especially to avoid congested traffic and also to solve the limited space requirement in urban traffic conditions. The only problem with these types of bridges is the significant amount of torsion which makes it difficult for design. From the study of damages caused by past earthquakes, it has been found that the performance of bridges is generally governed by the performance of bearings and substructure. Efficiency of isolation bearings, especially in case of curved bridges is important and selecting a proper isolation bearing is also an important task. This paper presents a study of the seismic response of a seven-span continuous curved bridge [1] with two types of isolation bearings that is FPS and Triple friction Pendulum System (TFPS). From the literature survey, it is concluded that there is lack of research is found particularly in seismic analysis of curved continuous bridge with TFPS. The objectives of the study are:

1. To investigate the behavior of TFPS in curved continuous bridge under the near field ground motions.
2. To compare the response of curved continuous bridge with FPS and TFPS in order to verify efficiency of the TFPS.
3. To compare the response of non-isolated bridge and isolated bridge in order to show the effectiveness of base isolation devices.

II. ISOLATION DEVICES

Different types of isolators are now available. However, the present study is limited to a comparative assessment of the seismic performance of the two types of devices viz. FPS [2]and TFPB [3].

The FPS is a sliding-based seismic isolator [4] with a restoring mechanism. The FPS provides resistance to service load by friction. Once the coefficient of friction is overcome an articulated slider moves over a spherical surface which causes the supported mass to rise and provides the restoring force for the system. Friction between the articulated slider and the spherical surface generates damping. The Coulomb damping generated through sliding friction provides energy dissipation in the bearings.

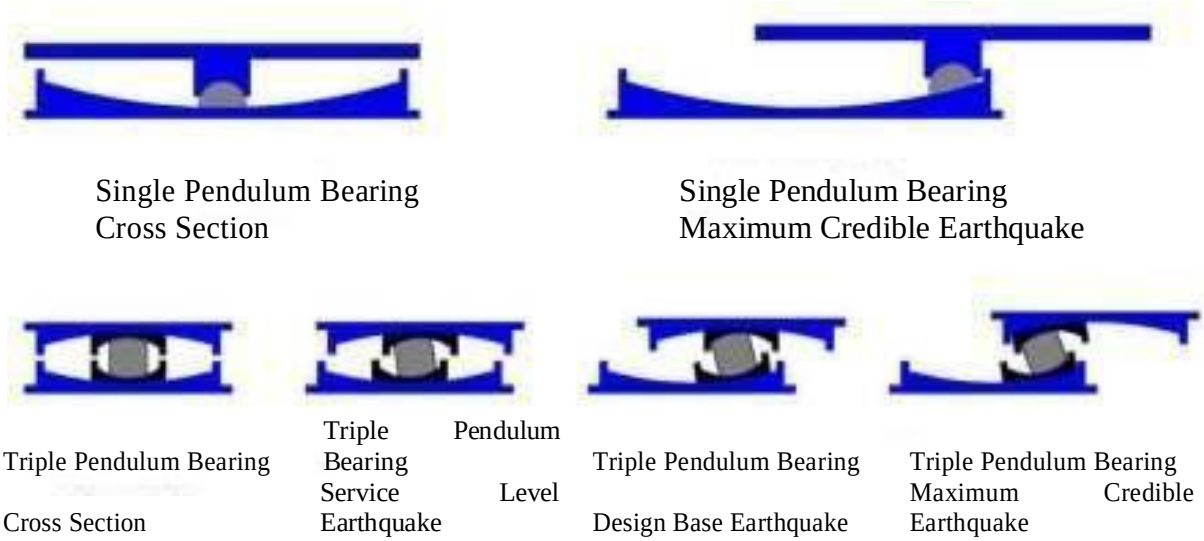


Figure 1. The possible position of FPS and TFPS bearing

The Triple Friction Pendulum bearing offers better seismic performance, lower bearing costs, and lower construction costs as compared to conventional seismic isolation technology. The properties of each of the bearing's three pendulums are chosen to become sequentially active at different earthquake strengths. As the ground motions become stronger, the bearing displacements increase. At greater displacements, the effective pendulum length and the effective damping increase, resulting in lower seismic forces and bearing displacements.

Series models and new element for TFPS is available in structural analysis programs SAP2000. In present study special element is used for modelling triple friction pendulum bearing. Series models of FPS for modelling TFPS also give appropriate overview of behaviour of TFPS [5]. This was observed in experimental testing and is also predicted analytically [6]. Sliding on the inner spherical recess of the slide plate occurs in the initial stage of motion, then stops when sliding begins at the outer sliding interface, and subsequently starts again when the slide plate contacts the displacement restrainers.

Three parameters are important for the design of the isolation bearings viz. the period of the isolated structure, the damping of the isolation system and the level of ground movement. In the present study the performance of different bearings has been compared.

III. MODELING OF BRIDGE

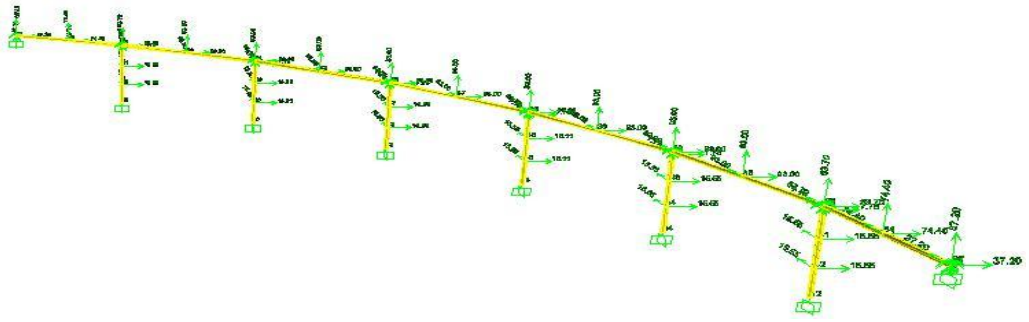


Figure 2 Lumped mass modal of curved bridge in SAP2000

A continuous single-chamber box girder curved bridge has been considered. The total length of the curved bridge is 165 m with two end span of 20 m and five intermediate spans of 25m. The radius of curvature of the bridge is 150 m. The cross-sectional area of the box-girder is 3.1 m^2. The longitudinal moment of inertia and transverse moment of inertia of the box-girder is 0.60 m^4 and16.58 m^4, respectively. The pier has a solid circular section with cross-sectional area of 1.7671 m^2 and moment of inertia of 0.2485 m^4. The height of the pier is 11 m. The structure has been modelled using the SAP2000 software as lumped mass at discrete point as shown in Fig. 2. The superstructure and the piers have been modelled using beam elements with mass lumped at discrete points. The piers are resting on rock; these have been modelled as fixed at the base. The abutments have been assumed to be rigid. The isolation bearings have been modelled as NLlink elements. For modelling purposes, bilinear force-deformation relationship with yield force, yield displacement, elastic stiffness, and post-yield to elastic stiffness ratio has been considered for all the isolation bearings. Three earthquakes are used for analysis as shown in Fig.3.

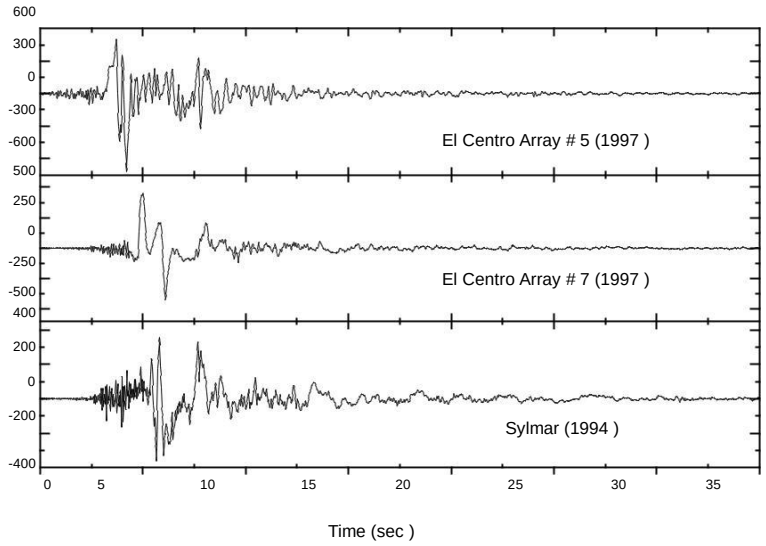


Figure 3. Near field ground motion used in study

IV. PROPERTIES OF FPS AND TFPS

TABLE 1. MECHANICAL PROPERTIES OF FPS AND TFPS FOR LATERAL DIRECTION

Parameters	FPS	TFPS			
		Outer Top	Outer Bottom	Inner Top	Inner Bottom
Effective Stiffness (kN/m)	968.2916	1694.3523	1694.3523	1694.3523	1694.3523
Effective Damping	0	0	0	0	0
Elastic Stiffness (kN/m)	240900	525380.6	525380.6	525380.6	525380.6
Friction Coefficient, Slow	0.05	0.065	0.035	0.015	0.015
Friction Coefficient, Fast	0.05	0.13	0.07	0.03	0.03
Rate Parameter (sec/m)	43	100	100	100	100
Net Pendulum Radius (m)	1.5546	2.0955	2.0955	0.1905	0.1905

Stop Distance (m)	0	0.4572	0.4572	0.0508	0.0508

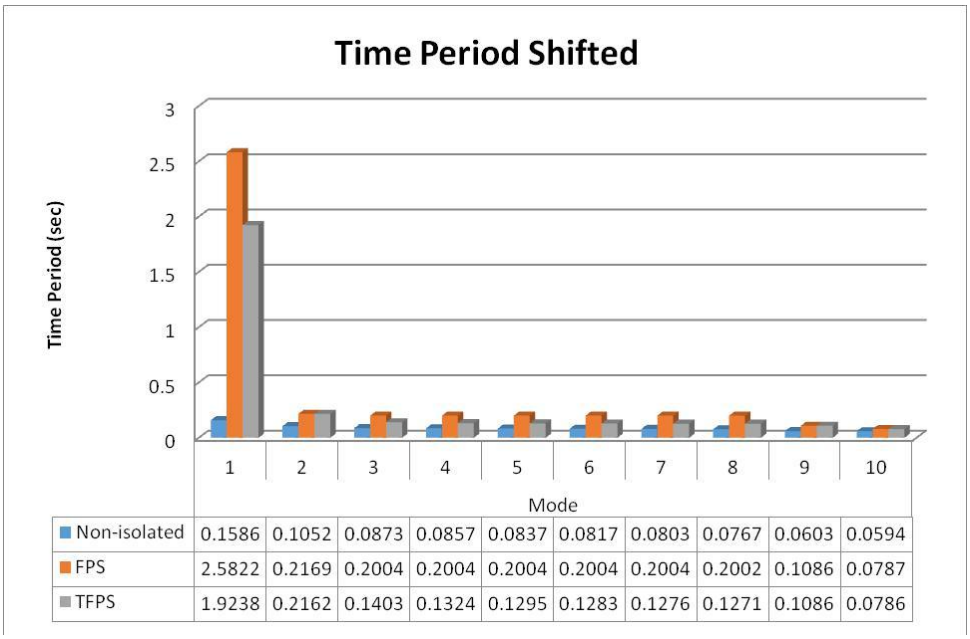
Above mentioned properties of FPS are calculated by using the equation given in [7] and for TFPS directly taken as shown in table TABLE 1. The vertical stiffness of both the isolators is assumed higher compare with lateral one. Some of the assumptions are made like time period of the isolator are 2.5 sec.

VII. RESULTS

The response of the curved bridges with the FPS bearing, TFPS bearings with Non-Isolated Bridge has been determined for three different near field ground motions as shown in Fig.3. The natural period of the isolated structure and damping of the isolation device are the most important parameters affecting the response of the structure. In the present paper the isolation time period of the isolation bearings have been considered as 2.5 sec.

TABLE 2 RESPONSE OF BRIDGE IN ISOLATION AND NON-ISOLATION CONDITION.

Response	Non-Isolated	FPS	TFPS	Percent Reduction (%) for FPS	Percent Reduction (%) for TFPS	Remark
Base Shear (kN)	643.70	516.91	313.45	19.70	51.31	El Centro Array #5
	-531.27	-424.84	-265.24	20.03	50.07	
	593.41	443.57	324.68	25.25	45.29	El Centro Array #7
	-596.64	-384.52	-271.39	35.55	54.51	
	465.14	685.06	327.34	32.10	29.62	Sylmar
	-774.82	-525.00	-431.89	32.24	44.26	
Deck Acceleration (m/sec2)	8.70	3.08	1.48	64.56	82.98	El Centro Array #5
	-6.46	-2.50	-1.66	61.29	74.38	
	6.04	2.85	1.63	52.77	73.03	El Centro Array #7
	-5.05	-2.86	-1.67	43.31	67.02	
	8.55	2.99	1.52	64.99	82.19	Sylmar
	-12.14	-2.95	-1.59	75.69	86.91	



	1	2	3	4	5	6	7	8	9	10
Non-isolated	0.1586	0.1052	0.0873	0.0857	0.0837	0.0817	0.0803	0.0767	0.0603	0.0594
FPS	2.5822	0.2169	0.2004	0.2004	0.2004	0.2004	0.2004	0.2002	0.1086	0.0787
TFPS	1.9238	0.2162	0.1403	0.1324	0.1295	0.1283	0.1276	0.1271	0.1086	0.0786

Figure 4. Shifting of time period from Non-isolated to Isolated Bridge

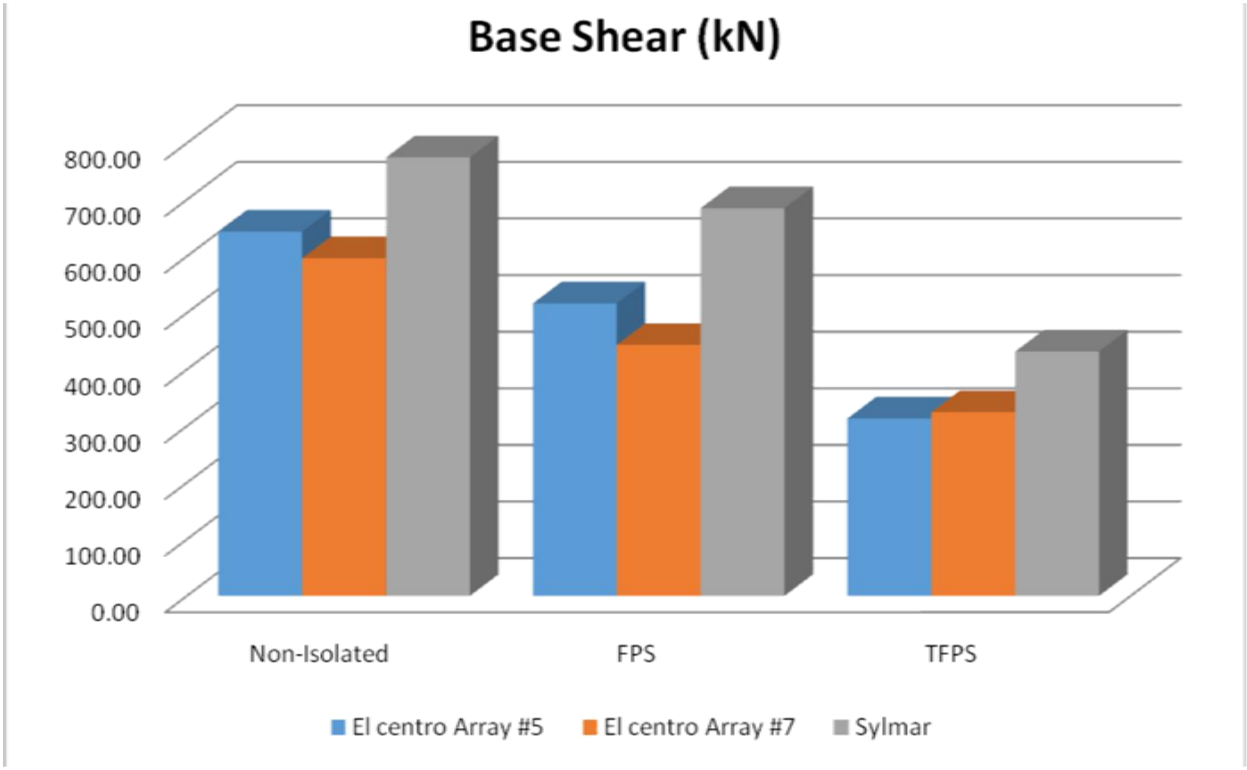


Figure 5 Peak response of base shear in isolated bridge with FPS, TFPS and Non-isolated condition

In case of responses, the resultant of the responses in the one longitudinal horizontal direction is considered. This is because, the considered bridges are curved bridges and the resultant of the response of perpendicular horizontal directions can be more effective from design consideration of bridges.

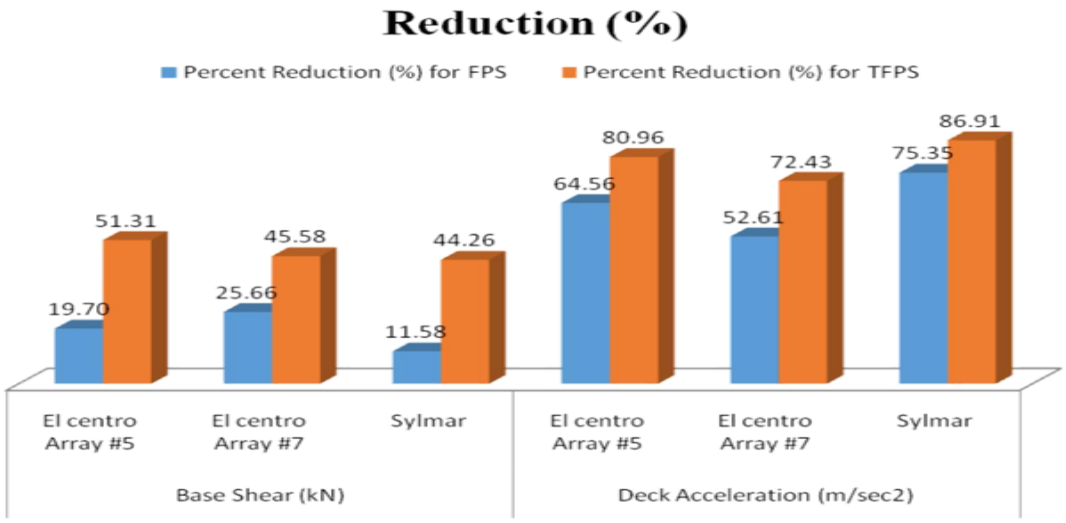


Figure 6 Peak response of deck acceleration in isolated bridge with FPS, TFPS and Non-isolated condition.

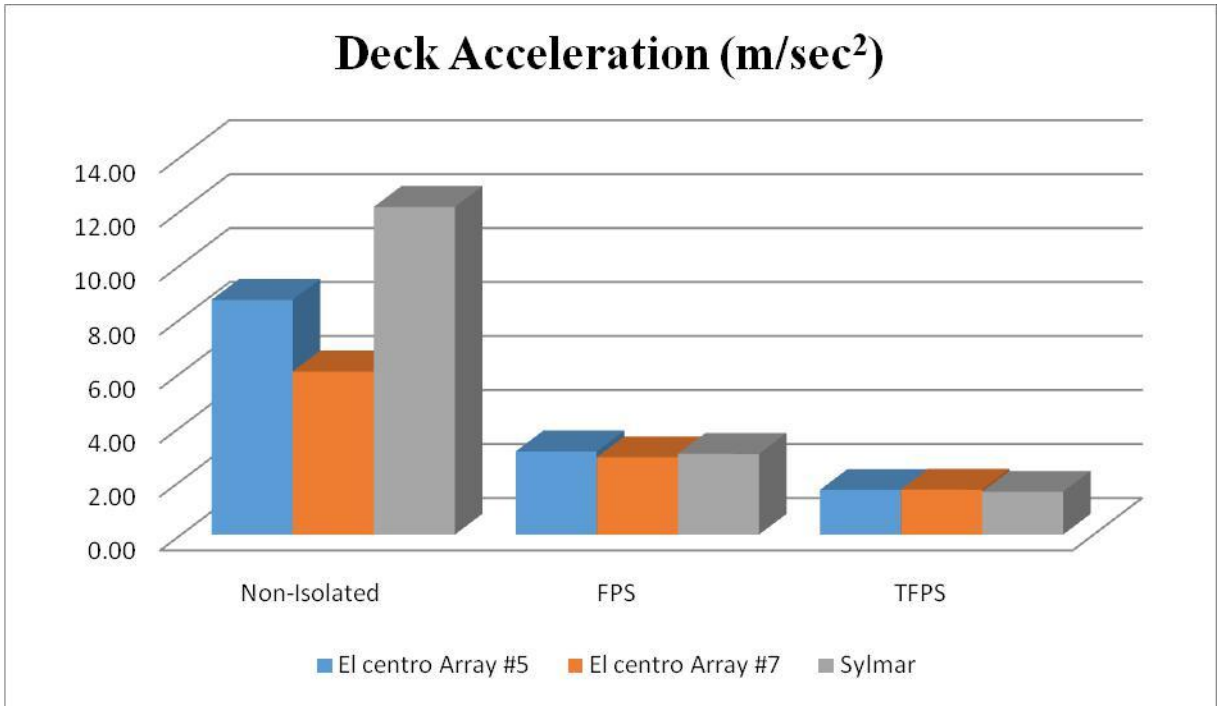


Figure 7 Reduction in base shear and deck acceleration in bridge with FPS and TFPS

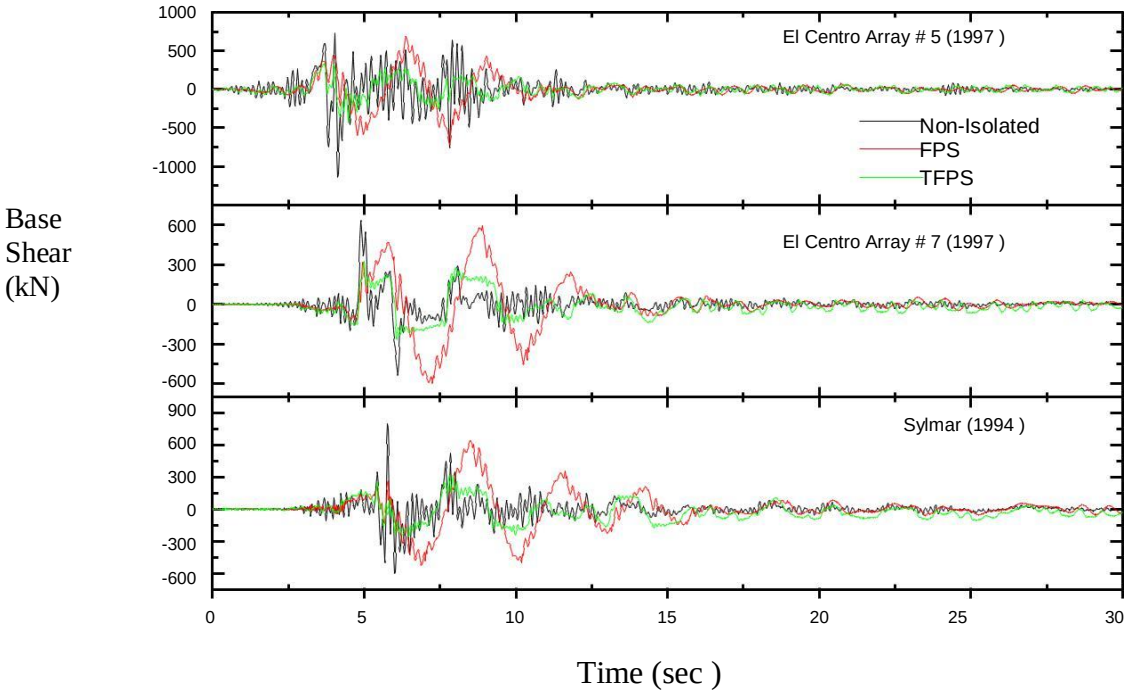


Figure 8 Time variation of base shear in Non-isolated and isolated bridge with FPS and TFPS.

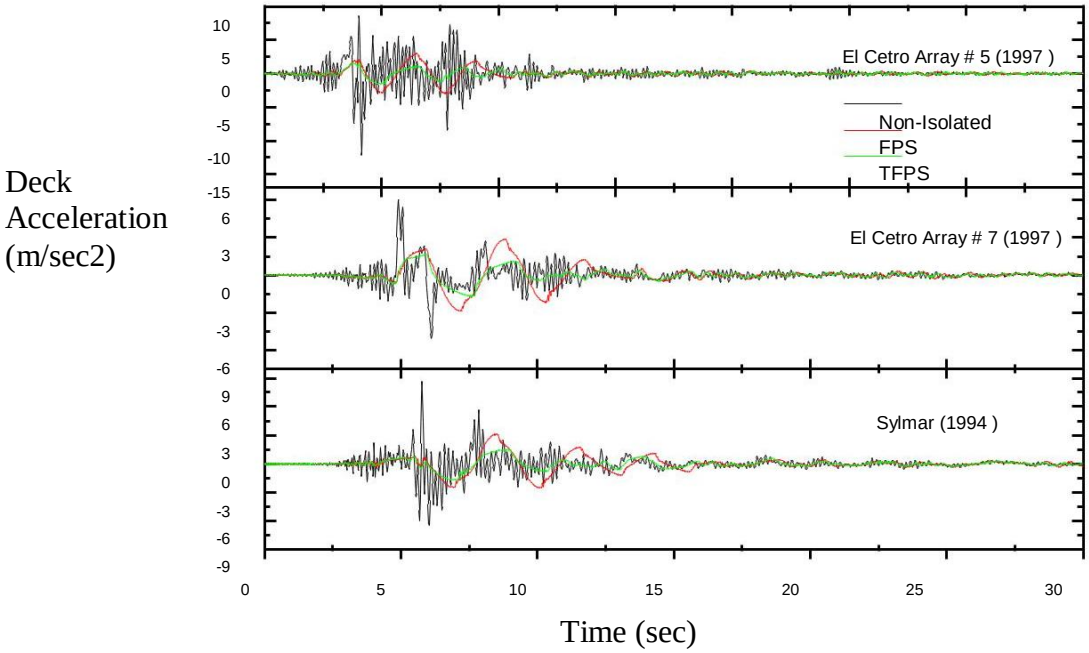


Figure 9 Time variation of base shear in Non-isolated and isolated bridge with FPS and TFPS.

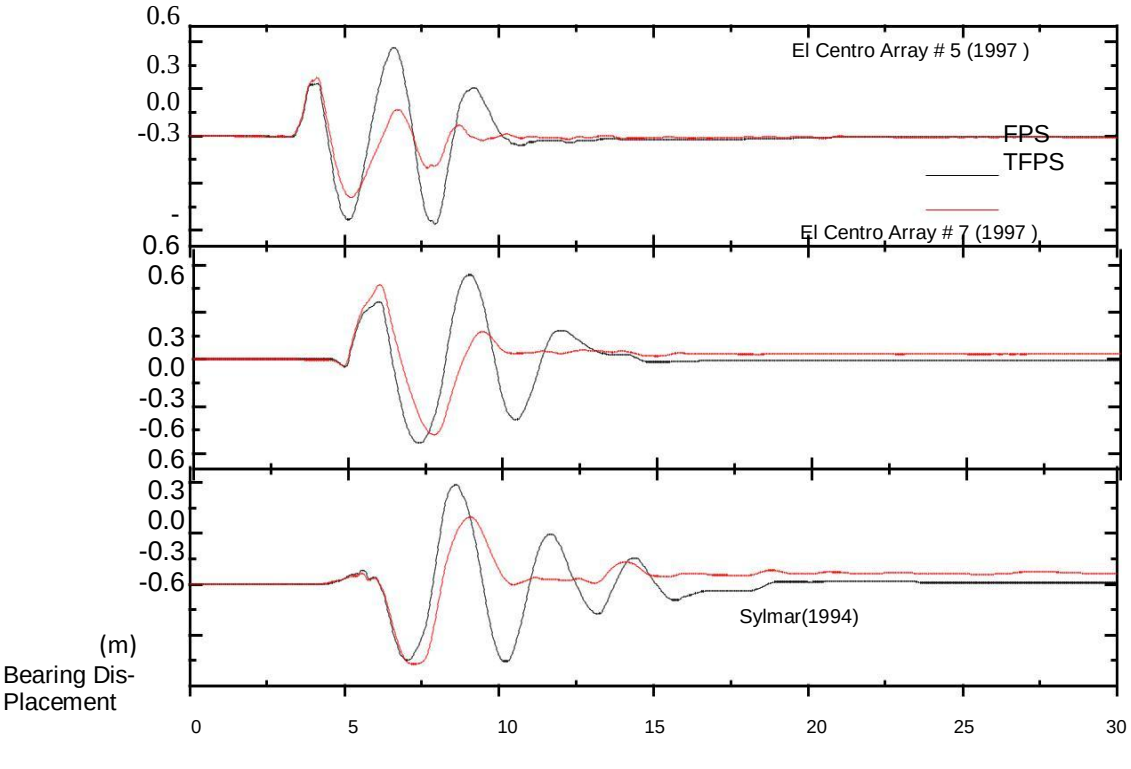


Figure 10 Bearing displacement of bridge with FPS and TFPS.

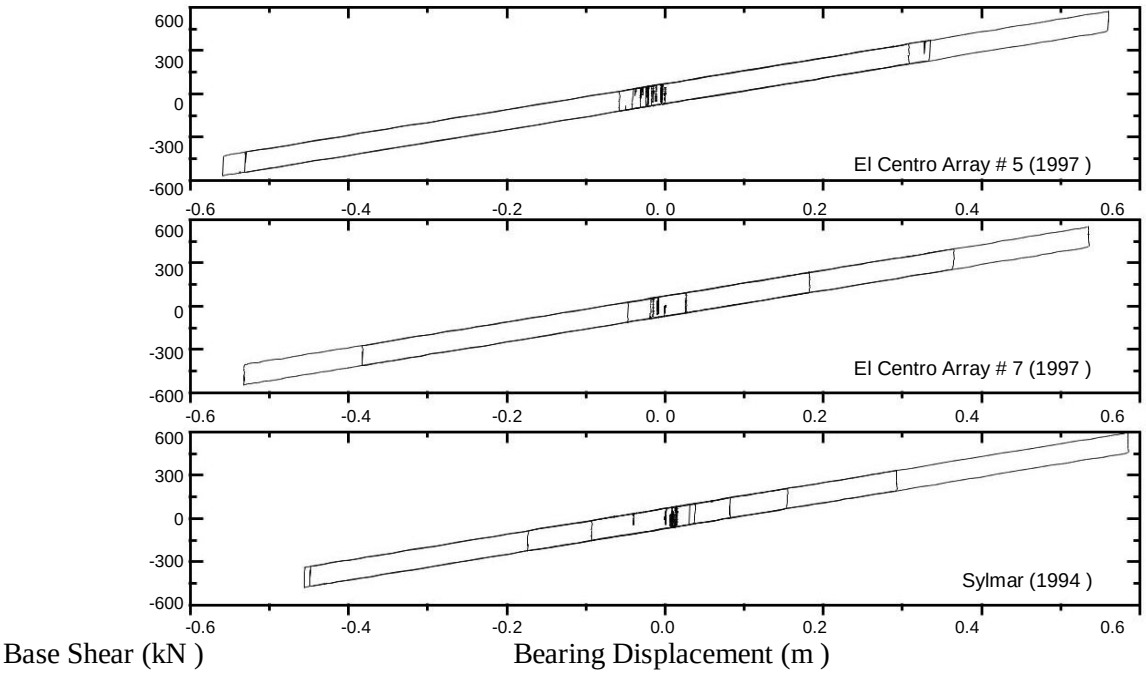
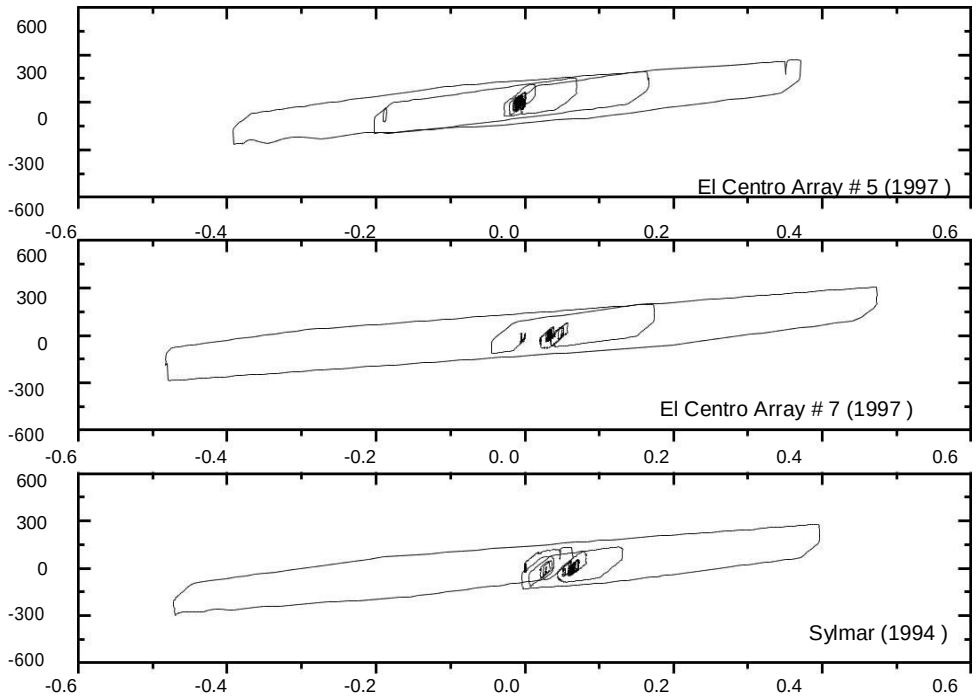


Figure 11 *Hysteresis behavior of isolated bridge with FPS.*



Base Shear (kN) Bearing Displacement (m)

Figure 12 Hysteresis behavior of isolated bridge with TFPS.

VIII. CONCLUSIONS

This paper investigated the effectiveness of the curved continuous bridge with seismic isolator, FPS and TFPS. SAP2000 used evaluating the response isolator and bridge by using fast nonlinear analysis method. On the basis of the results, conclusions are made as:

1. Fast nonlinear analysis in SAP2000 produced results with acceptable accuracy in the study.
2. The Force-displacement relationship of bridge under three real earthquake ground motion have been shown in Figure 11, Figure 12, based on the area which is accumulated by the devices TFPS dissipate more energy compare to FPS and work up to design based earthquake.
3. Response of the curved bridge for base shear and deck acceleration shows the reduction of 45% to 80% which is as expected from the isolated structure. TFPS gives larger reduction compare to FPS.
4. Fundamental time period is shifted from 0.158 (non-isolated bridge) to 2.5 (FPS) and 1.98 (TFPS) which enhance the overall response of the curved bridge.

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DEVELOPMENT OF P-M INTERACTION CHART FOR CONCRETE FILLED TUBE (CFT) COMPOSITE COLUMNS

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ABSTRACT

The manual calculation for P-M interaction diagram for steel-concrete composite columns is laborious and time-consuming. Moreover, no attempts have been made in developing interaction chart of composite columns consisting of steel section, concrete and reinforcing steel. Therefore, an attempt has been made for developing P-M interaction chart for composite column with axial load and uniaxial bending. The paper presents a simplified method for development of P-M interaction chart for composite columns. The method can be used for plotting chart of composite column by solving equation for different points of chart. In order to study the effect of various

parameters on the P-M interaction chart, parametric study has been also carried out. The parameters considered are percentage of steel, gross sectional area and shape of the column. P-M interaction charts for composite column has been developed for different reinforcement percentage (varying from 1% to 6%), for square column size (which is varied from 150 × 150 mm to 1200mm × 1200 mm) and circular column diameter (which is varied from 230 mm to 1200 mm).

KEYWORDS: *Composite Column, Concrete Filled Tube (CFT), Interaction Chart.*

I. INTRODUCTION

A steel concrete composite column consisting of steel section, concrete and reinforcing steel is generally used as a load bearing member in a composite frame structure. The composite column is mainly of three types which are shown in Fig. 1 [1].

1. Fully concrete encased hot rolled steel section (ReferFig. 1(a))
2. Partially concrete encased hot rolled steel section(ReferFig. 1(b))
3. concrete filled tube section of hot rolled steel (ReferFig. 1(c and d))

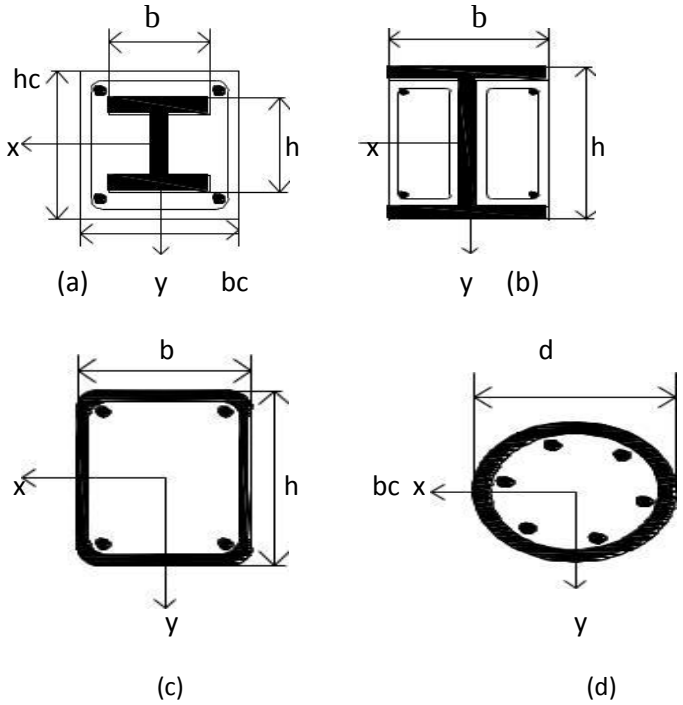

Fig.1 Different types of composite columns

Concrete filled steel tube columns are used in many earthquake resistant structures, columns in high rise buildings, bridge piers subject to high strain rate from traffic and railways decks.

There is few information available on development of P-M interaction chart for composite column. Therefore, in order to provide assistance to current research and engineering, it is necessary to develop the P -M integration chart for the composite column.

The objective of present study may be summarized as:

i. To develop simply method for development of P-M interaction chart
ii. To develop interaction chart for composite column with axial load and uni-axial bending
iii. To carry out parametric study in order to study the effect of various parameters

II. LITERATURE REVIEW

Gouwens [2] developed simplified design aids for rectangular columns. Rodriguez and Aristizabal-Ochoa [3] presented a general method that determines the biaxial interaction diagrams for any orientation of the neutral axis of a reinforced concrete (RC) short column of any cross section under axial load and bending about two axes. Panchal [4] developed a software for composite slab, beam, column with pre and post processing facilities in VB.NET. All design checks were incorporated in software. In the software full and partial connections and transverse reinforcement were also considered. Author also prepared a database of steel section with properties. Ketema and Taye [5] presented unified approach for the procedure of establishing design charts for concrete-filled steel tubes under uniaxial bending and prepared valuable charts for hexagonal and octagonal shape composite columns. Thakkar [6] presented a scheme for development of interaction curves for damaged and retrofitted columns enabling more accurate evaluation of the capacity of the column, before and after retrofitting. Gediya & Koradia [7] worked on design of concrete encased steel section. Authors developed a load versus moment interaction charts for different steel section in composite column by using a simple excel program. Kwon et al. [8] described development of the direct strength method (DSM) for concrete-filled tubular (CFT) sections.

Very few attempts have been made for the development of P-M interaction charts for Concrete filled tube composite columns. In order to provide assistance to current research, there is a real need to develop interaction diagrams for Concrete filled tube composite columns of various shapes.

III. METHODOLOGY

A typical load-moment interaction chart represents the relationship between axial load capacity and the ultimate bending moment capacity of a given column cross section. Using design interaction curve for a given column section, quick judgment as to whether or not the section is safe can be made.

The interaction diagrams of reinforced concrete (RC) rectangular columns have been investigated extensively by numerous researchers and included in the text books. But, there is no provision in Indian standard code covering composite columns. So, method to develop interaction charts for the composite columns based on Euro Code 4(2004) has been proposed. Two methods are available for calculations. The first one is general method which can be applied to columns of asymmetric cross-section as well as to columns whose section varies with height and second method is a simplified method which is based on simple European buckling curves for composite columns. Here, second method is considered as it is applicable to the majority of practical cases.

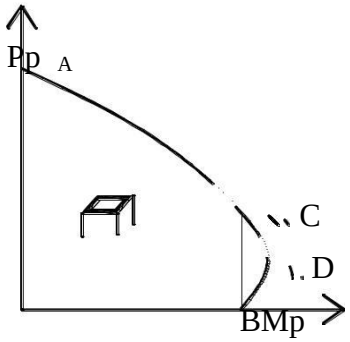

Fig.2 Interaction chart for composite column.

Fig. 2 shows an interaction curve drawn using simplified design method suggested in the EC 4. At point A, axial force resistance is maximum and moment resistance is zero. So, point A makes section for compression resistance only.

$$P_p = P_A = A_a p_y + A_c p_{ck} + A_s p_{sk} \quad (1)$$

where,

$$p_y = \frac{f_y}{\gamma_a}, \quad p_c = \frac{f_{ck}}{\gamma_c}, \quad p_s = \frac{f_{sk}}{\gamma_s}$$

The provisions contained in IS: 456 - 2000 are often invoked for design of composite structures. Extension of

IS: 456 - 2000 to composite columns will result in the following equations.

$$p_y = 0.87 f_y, \quad p_{ck} = 0.4 f_{ck}, \quad p_{sk} = 0.67 f_y$$

$$M_A = 0 \quad (2)$$

At point B, axial force resistance is zero and plastic moment resistance is as per equation.

$$P_B = 0 \quad (3)$$

$$M_B = M_p = p_y (Z_{pa} - Z_{pan}) + 0.5 p_{ck} (Z_{pc} - Z_{pan}) + p_{sk} (Z_{ps} - Z_{psn}) \quad (4)$$

where,

$$Z_{pa} = t h_n^2$$

$$Z_{pc} = b Z_{pcnc} = \frac{h_n^2}{Z_{psn}} - Z_{pan}$$

At point C, axial force resistance and moment resistance of the sections are given as

$$P_C = A_c p_{ck} \quad (5)$$

$$M_C = M_p = p_y (Z_{pa} - Z_{pan}) = 0.5 p_{ck} (Z_{pc} - Z_{pan}) = p_{sk} (Z_{ps} - Z_{psn}) \quad (6)$$

At point C, the tension area of concrete is same as the compression area of the concrete so the moment resistance of section is same as point B so value of M_B and M_C is same for section. So, compression region in the section creates some internal force which is same as plastic resistance to compression of the concrete only.

At point D Moment resistance of the section is maximum and axial force resistance is half of point C.

$$P_D = 0.5 A_c p_{ck} \quad (7)$$

$$M_D = M_p = p_y (Z_{pa}) = 0.5 p_{ck} (Z_{pc}) = p_{sk} (Z_{ps}) \quad (8)$$

Where, Z_{pcn} and Z_{psn} are depend on value of h_n.

For Major axis bending

$$h = \frac{A_c - P_{ck} - A_s' (2 - p_{sk} - p_{ck})}{}$$

$$n = 2b_c p_{ck} - 4t(2 p_y - p_{ck}) \quad (9)$$

For circular tubular section substitute $b_c = d$

For minor axis bending the same equations can be used by interchanging h and b as well as the subscripts x and y.

Condition must be satisfied for section for moment resistance of section.

$$M \le 0.9 \mu M_P$$

Where, μ is moment resistance ratio

For axial compression resistance of section

$$\chi p_P > p$$

Where, χ is reduction factor for column buckling

$$\chi = \frac{1}{\left(\phi + \{\phi^2 - \lambda^2\}^{\frac{1}{2}} \right)}$$

$$\phi = 0.5\left[1 + \alpha(\lambda - 0.2) + \lambda^2\right]$$

So these conditions must be satisfied for a safer section.

IV. NOTATIONS

A_a,A_s,A_c - Cross-sectional area of steel section, reinforcement and concrete b - Breadth of section

b_c - Breadth of column

h_c - Depth of column

h - Depth of section

d - Diameter of section

E - Modulus of elasticity of section

f_{sk} - Characteristic strength of reinforcement

f_y - Yield strength of steel

f_{ck} - Characteristic strength of concrete

p_y,p_{sk},p_{ck} - Design strength of steel section, reinforcement and concrete h_n - Depth of neutral axis from the middle line of the cross-section M - Moment applied on section

P - Axial force applied on section

M_p - Plastic moment resistance of the section

P_p - Plastic resistance to compression of the cross section P_c - Axial resistance of concrete t - Thickness of element

Z_p - Plastic section modulu

Z_{psy},Z_{pay},Z_{pcy} -Plastic section modulus of steel section, reinforcement and concrete about their own axis Z_{psn},Z_{pan},Z_{pcn}- Plastic section modulus of steel section, reinforcement and concrete about neutral axis

χ– Reduction factor buckling

α_c - Axial resistance ratio due to concrete

μ- Moment resistance ratio

Y Safety factors for different materials

χ Slenderness ratio

V. EXAMPLES OF INTERACTION CHARTS FOR CONCRETE FILLED TUBES

Developed charts for different cross-sections and different percentage of steel are shown in Figs. 4 to 6.

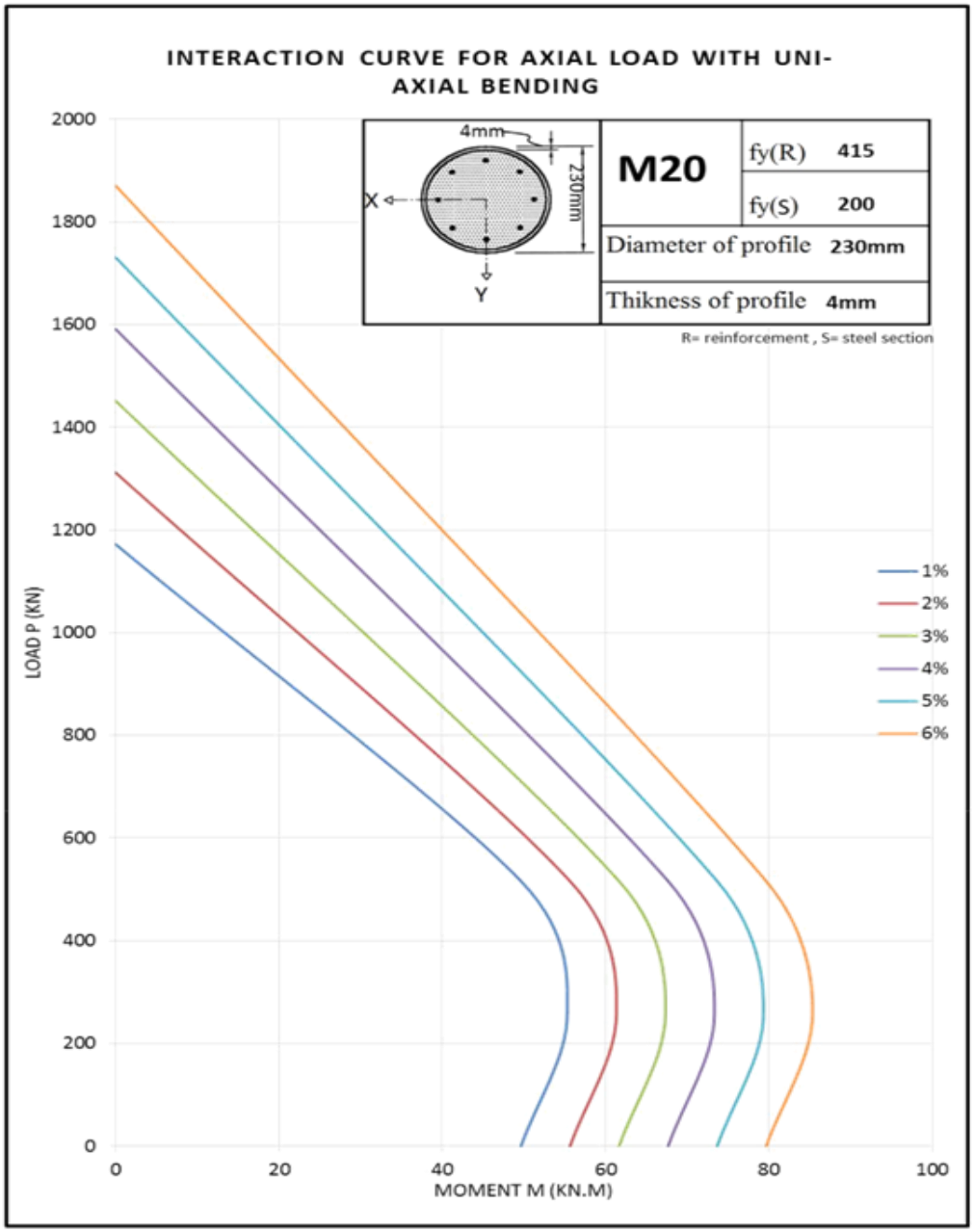

Fig.3 P-M interaction curve for circular section of 230mm diameter

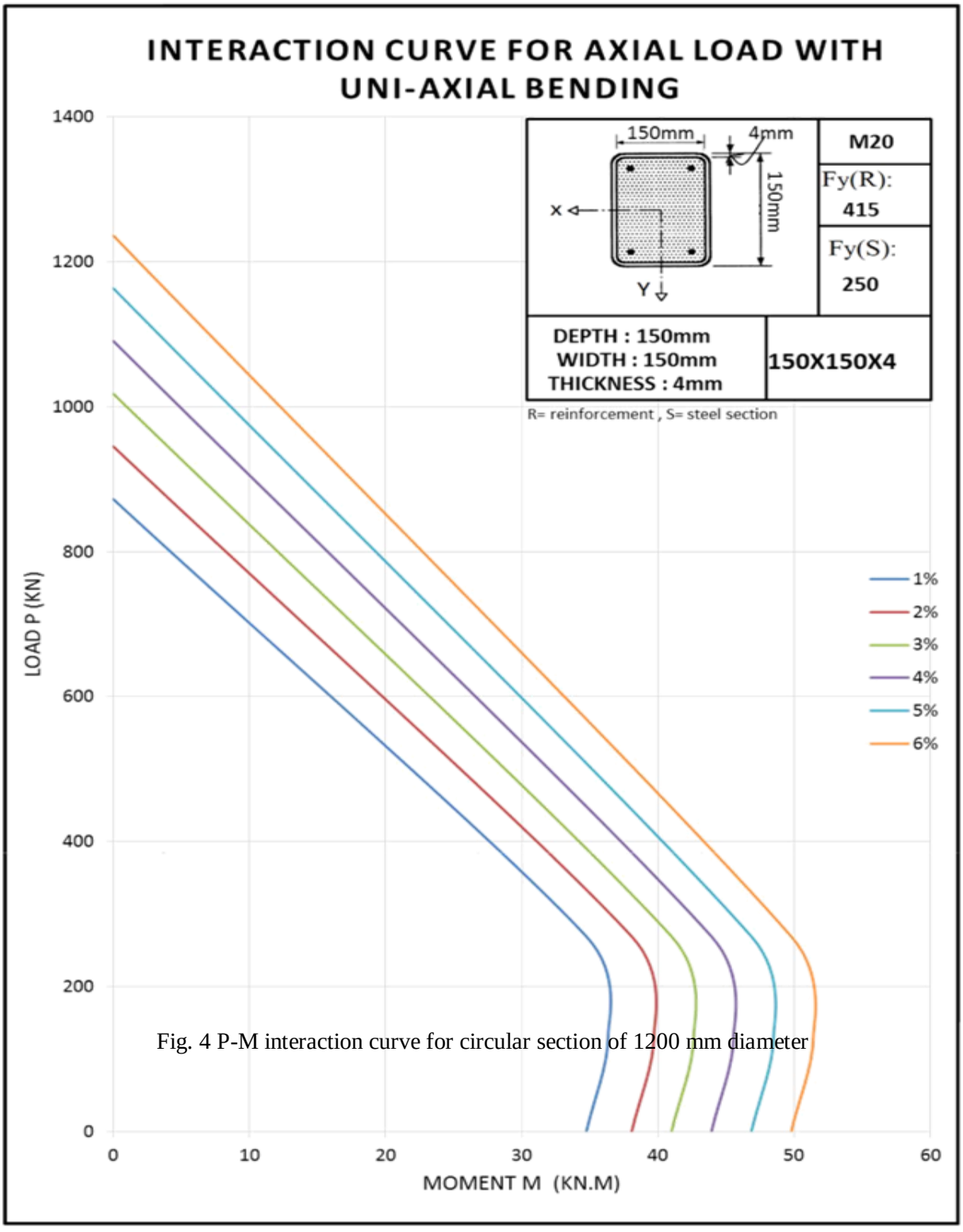

Fig. 4 P-M interaction curve for circular section of 1200 mm diameter

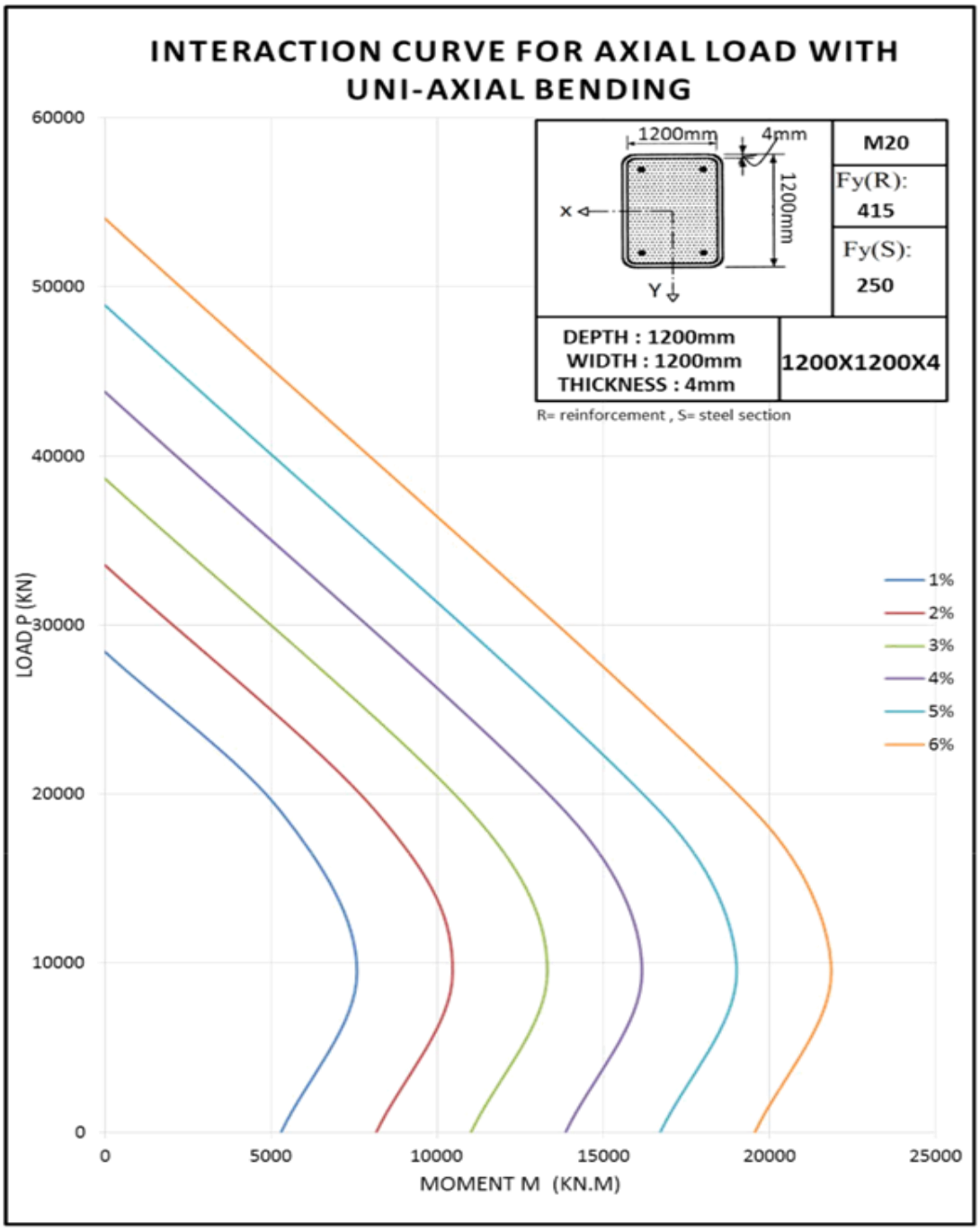

Fig. 5 P-M interaction curve for square section of 150 mm × 150 mm

Fig. 6 P-M interaction curve for square section of 1200 mm × 1200 mm.

V. CONCLUSIONS

1. Interaction charts of composite column for Concrete filled circular steel tube and Concrete filled rectangular steel tube type of sections using help of Eurocode 4 (2004), EN 1994-1-1:2004 has been enveloped.
2. Moment capacity and axial load carrying capacity of composite column can be directly found out from these charts for a desired percentage of reinforcing steel.
3. These charts eliminate manual calculations for finding out moment and axial load carrying capacity of composite columns mentioned above. It saves lots of time.

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ANALYZING THE DATA TRANSMISSION IN FIBER OPTICS FOR LONG DISTANCE COMMUNICATION

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ABSTRACT

Multiterabit/s, ultrahigh-speed optical transmissions over several thousands of kilometers on fibers are becoming reality. The group velocity dispersion (GVD) imposes severe limit on information carrying capacity of optical communication systems. By choosing appropriate pulse shape highly stable light pulses known as solitons are generated when effect of GVD is balanced by self-phase modulation (SPM). Erbium laser amplifier has become one of the important components indispensable in optical fiber communication for its high gain, high pumping efficiency, polarization-independent and small crosstalk between signals, etc. The transient characteristic of the EDFA is an inevitable phenomenon based on the mechanism of EDFA amplification by stimulated emission of radiation. The application of solitons in communication systems opens the way to ultrahigh-speed information superhighways. Transmission speed of order of Tbit/s can be achieved if optical amplifiers are combined with WDM in soliton based communication systems. The simulation results for Soliton order N=1 and N=3 are obtained using OptSim Software.

KEYWORDS: *Dispersion, GVD, Soliton pulses, SPM.*

I.INTRODUCTION

The need of communication is an all-time need of human beings. For communication some channel is needed. Fiber is one channel among many other channels for communication. Optical Fibers are thin long strands of ultra-pure glass or plastic that can transmit light from one end to another without much attenuation or loss. Fiber optic systems transmit using infrared light, invisible to the human eye, because it goes further in the optical fiber at those wavelengths. Figure 2 shows the windows use by optical fiber communication. In the future, optical fiber communication will occupy the leading position in the communication's industry inevitably as its large capacity, long distance, security and good performance of adaptability.

While as a representative, Erbium laser amplifier has become one of the important components indispensable in optical fiber communication for its high gain, high pumping efficiency, polarization-independent and small crosstalk between signals, etc. However when a bunch of light pulses pass through an optical amplifier, the former pulse will have some impact on the amplification behavior of the latter one, even when it is a single light pulse, the leading edge will also affect the amplification behavior of the Trailing edge, which is an inevitable phenomenon based on the mechanism of EDFA amplification by stimulated emission of radiation, known as the transient characteristics of the EDFA.

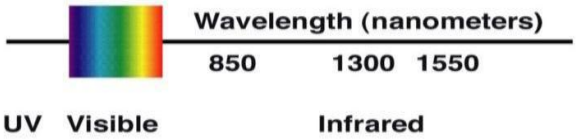

Fig.1: Light Used In Fiber Optics

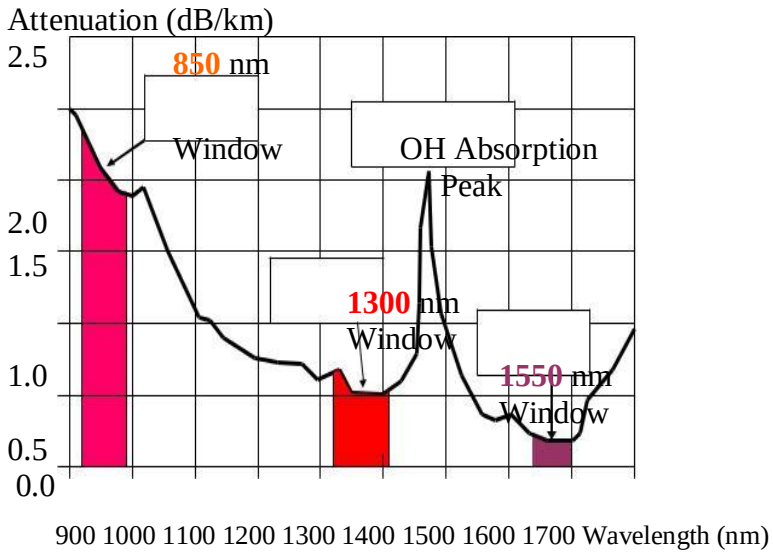

Fig.2: Optical fiber windows [1]

Advantages of optical fiber Communication [1]

- Long distance transmission due to low attenuation (order of 0.2 db/km) thereby reducing number of repeaters (cost & complexity).
- Large information capacity due to wider bandwidth.
- Small size & low weight resulting in ease of installation.
- Immunity to electrical interference because of dielectric material.
- Enhanced safety since they do not have ground loops sparks, etc. However, laser light can damage eye.
- Increased signal security since the optical signal is well confined within the fiber.
- Low cost as compared to copper (as glass is made from sand. The raw material used to make of is free….)
- Zero resale value (so theft is less)

Disadvantages of optical fiber Communication [1]

- OFC is delicate so has to be handled carefully.
- Communication is not totally in optical domain, so repeated electric -optical -electrical conversion is needed.
- Optical amplifiers, splitters, MUX-DEMUX are still in development stages.

Dispersion Phenomenon

Dispersion represents a broad class of phenomena related to the fact that the velocity of the electromagnetic wave depends on the wavelength. In telecommunication the term of dispersion is used to describe the processes which cause that the signal carried by the electromagnetic wave and propagating in an optical fiber is degraded as a result of the dispersion phenomena. This degradation occurs because the different components of radiation having different frequencies propagate with different velocities.Dispersion types are

1. Mode dispersion
2. Chromatic dispersion

- Waveguide dispersion (optical)
- Material dispersion.(Group velocity, group velocity dispersion GVD)
- Polarization dispersion

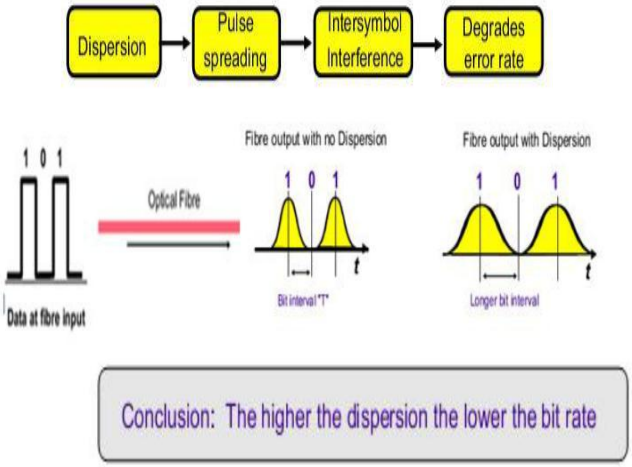

Fig.3: Dispersion in optical fiber [2]

The dispersion phenomenon is a problem for high bit rate and long haul optical communication systems. An easy solution of this problem is optical solitons–pulses that preserve their shape over long distances. Soliton based optical communication systems can be used over distances of several thousands of kilometers with huge information carrying capacity by using optical amplifiers. The application of solitons in communication systems opens the way to ultrahigh-speed information superhighways[3]. Transmission speed of order of T bit/s can be achieved if optical amplifiers are combined with WDM in soliton based communication systems.

II.SOLITON BASED TRANSMISSION

Soliton [6-10] term refers to the special kinds of waves that can propagate undistorted over long distances and remain unaffected after collisions with each other.

- Generally when one pulse is designated to represent '1' digit, the format is called RZ (Return to Zero).
- On the other hand if two (or more) pulses are connected when a sequence of '1' appears, the format is called NRZ (Not Return to Zero).
- In addition, if the '1' pulse is allowed to have two type of pulses with opposite phases; these format is called duo-binary.
- Soliton format primarily uses one soliton to represent '1' digit
- These formats are illustrated below.

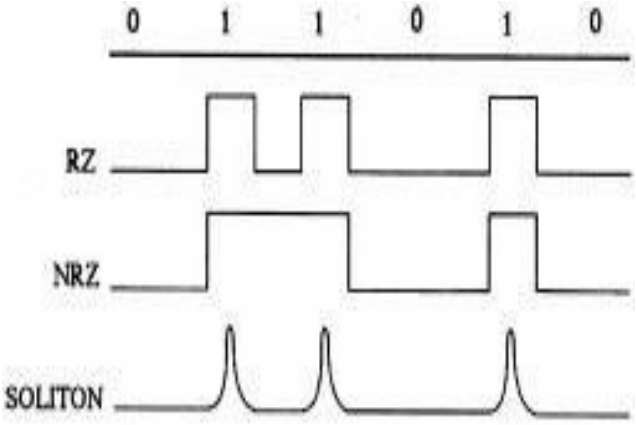

Fig.4: Various modulation formats for information transfer in fibers [4]

Information Transmission

A digital bit stream can be generated by two distinct modulation formats i.e., non-return-to-zero (NRZ) and return-to-zero (RZ). The solution of NLS equation for soliton holds only when individual pulses are well separated. This can be ensured by keeping soliton width a small fraction of the bit slot. To achieve this, RZ format (Figure 5) has to be used instead of NRZ format when solitons are used as information bits.

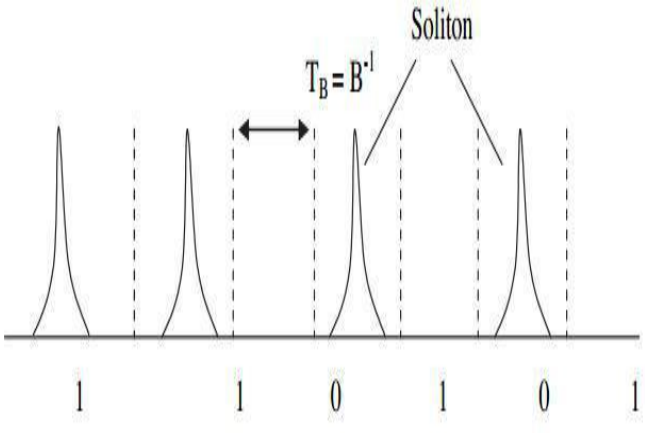

Fig.5: Soliton bit stream in an RZ format [

The bit rate B and the width of the bit slot T_B can be related as

$$B \quad \frac{1}{B} \quad \frac{1}{2S_0 \ _0} \qquad (1)$$

Where $2S_0=T_B/T_0$ is the normalized separation between neighbouring solitons.

Soliton in Optical Fiber

The purpose of this example is to demonstrate the propagation of soliton pulse in optical fiber. The existence of solitons in optical fibers is the result of a balance between the chirps induced by fiber dispersion characterized by GVD (Group-Velocity Dispersion) coefficient β2and fiber nonlinearity characterized by SPM (self-phase modulation) coefficient γ. Analytically soliton is a solution of nonlinear Schrodinger equation describing pulse propagation in optical fiber and can be derived as[5]:

$$A\ z, tN \quad p_0 Sech\ t / T_0 \quad \exp \quad j \qquad (2)$$

Where P_0- soliton peak power, T_0- pulse width,Z_0- soliton period, N- soliton order. Soliton period defined as

$$0^2 \qquad (3)$$

The optical pulse which corresponds to N=1 is called fundamental soliton. Pulses with N>1 are called higher-order solitons. Soliton order parameter N depends on the balance between dispersion and nonlinearity and is defined as:

$$0^2$$

$$^2_0 \qquad \left| \quad \right| \quad (4)$$

$$2$$

The layout for generation of the solitons is shown in Figure 6. It consists of pulse generator (mode-locked laser), single-mode lossless fiber, and waveform and spectrum analyzers. The fiber is assumed to be lossless to demonstrate ideal soliton propagation.

III.SIMULATION AND RESULTS

Figure 6 shows the layout for fundamental soliton N=1and its simplified block diagram is shown in fig.7.The simulation is done in OptSim software. For given n_2=2.6e-20 m^2/W, A_{eff}=60 um^2, and λ=1550 nm - γ=1.75e-3 1/m/W. The fiber length is set to one soliton period, which for given parameters is Z_0= 27.525 km. Initial pulse has a sech shape and FWHM pulse width is 33 ps, corresponding to T_0=18.7 ps. Pulse power for fundamental soliton is 32.7 mW and for 3rd order soliton 293.4 mW. Figures 8 to 12shows soliton pulse evolution (in time and frequency domains) in fiber along one soliton period for N=1andFigures 14 to 18 showssoliton pulse evolution (in time and frequency domains) in fiber along one soliton period for N=3.By comparing the input and output figures we can say that soliton pulse shapes are exactly same after 27.525Km distances.

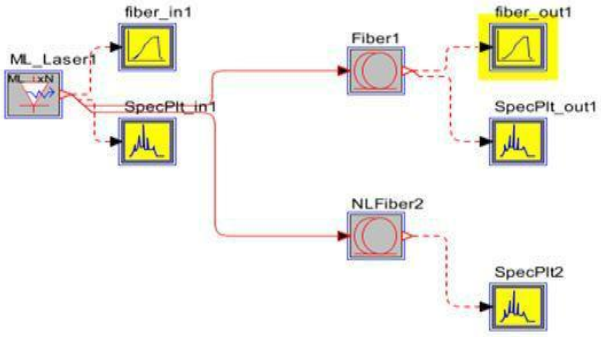

Fig.6:Layout for soliton, N=1

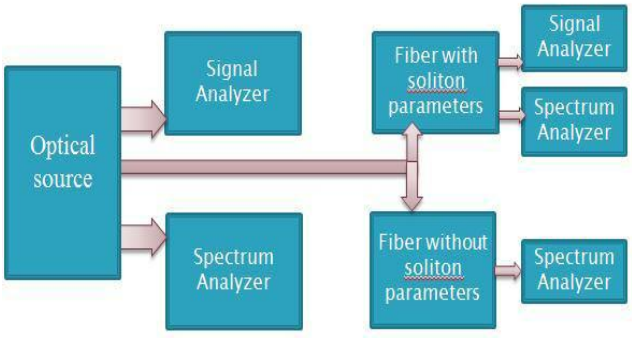

Fig.7: Simplified Block diagram of Layout for soliton, N=1

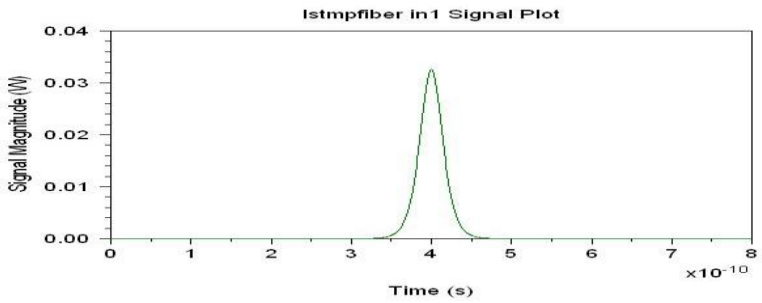

Fig.8: Input signal in time domain (N=1)

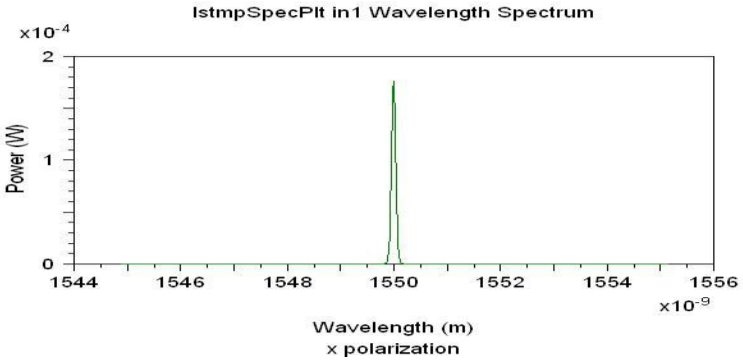

Fig.9: Input signal in frequency domain (N=1)

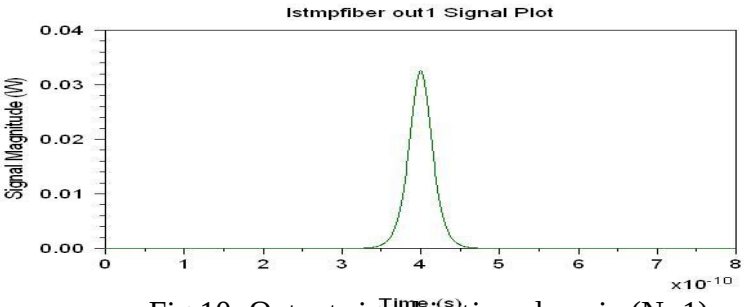

Fig.10: Output signal in time domain (N=1)

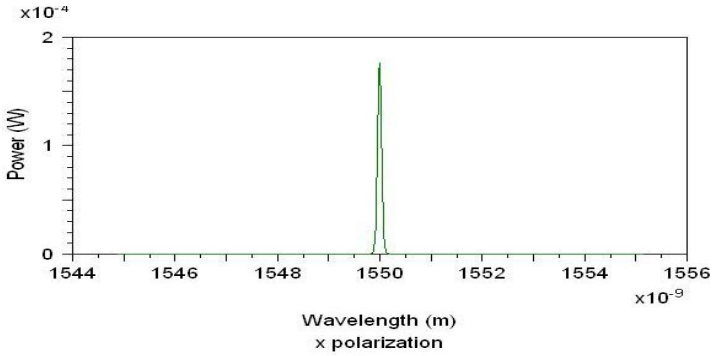

Fig.11: output signal in frequency domain (N=1)

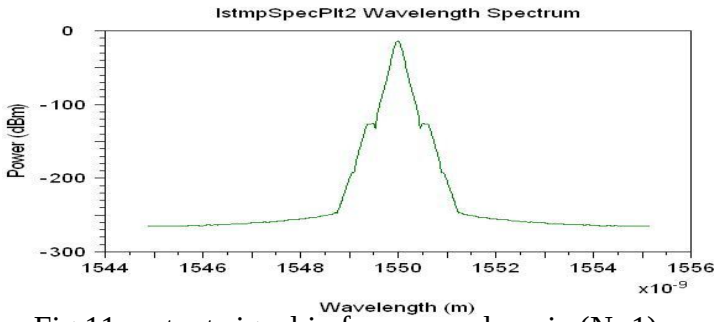

Fig.11: output signal in frequency domain (N=1)

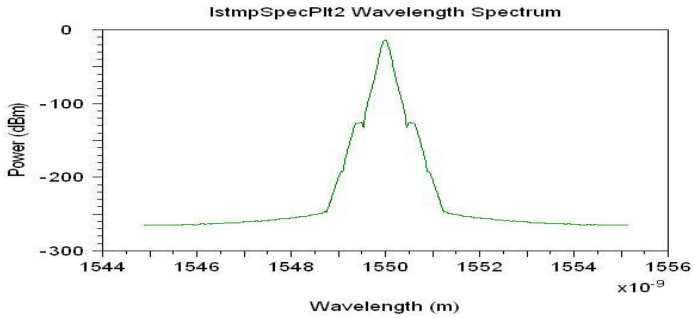

Fig.12: Output signal in frequency domain (without soliton parameter) (N=1)

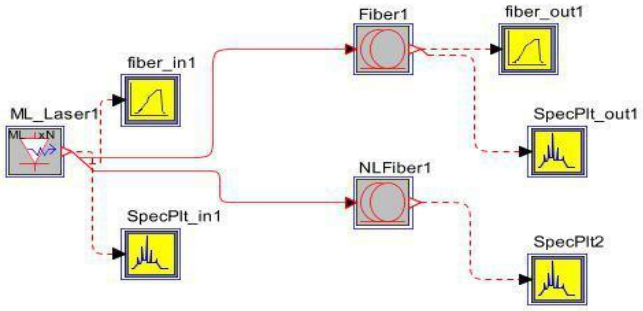

Fig.13:Layout for soliton, N=3

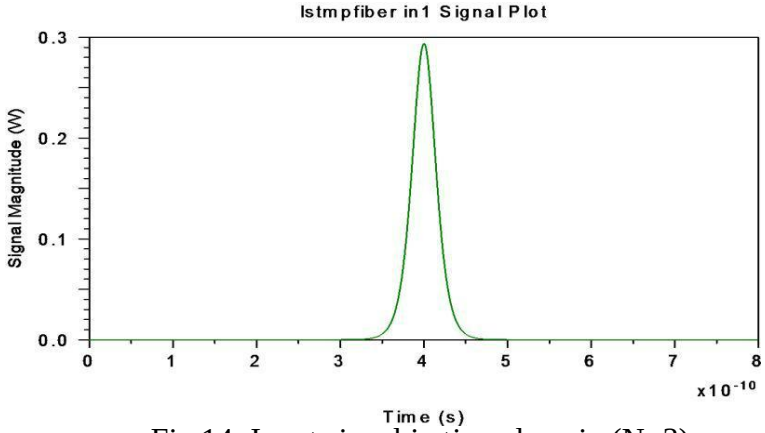

Fig.14: Input signal in time domain (N=3)

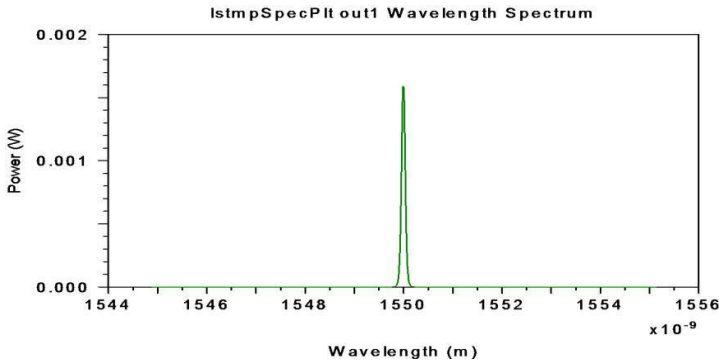

Fig.15: Input signal in frequency domain (N=3)

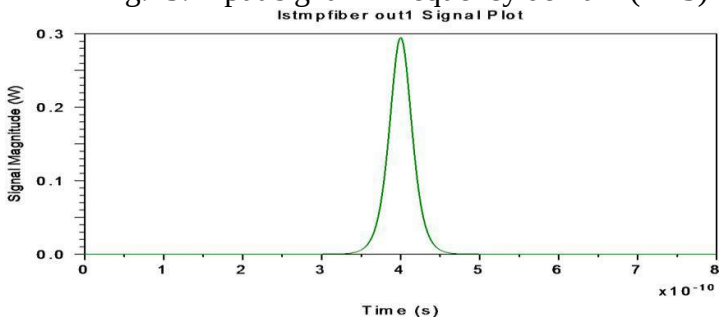

Fig.16: Output signal in time domain (N=3)

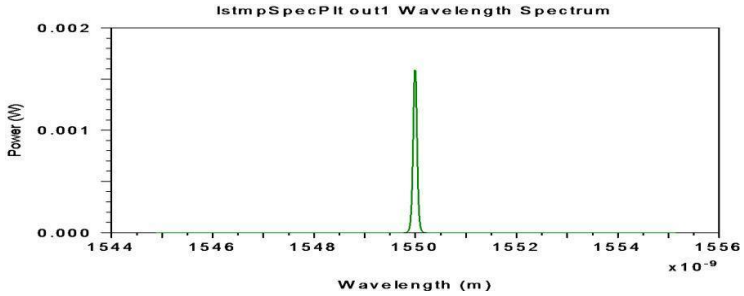

Fig.17: output signal in frequency domain (N=3)

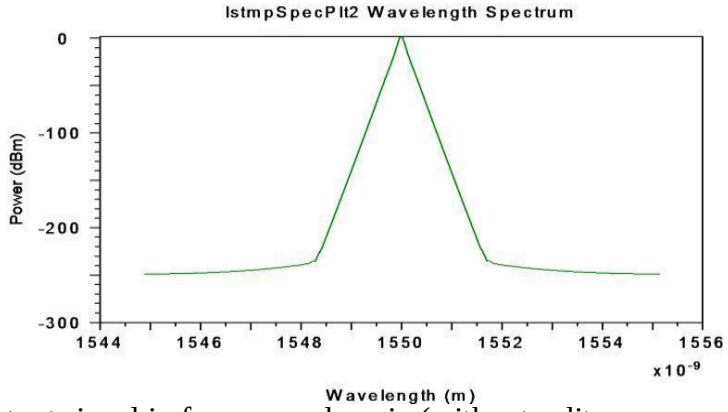

Fig.18: Output signal in frequency domain (without soliton parameter) (N=3)

IV.CONCLUSION

Soliton based optical fiber communication systems are more suitable for long haul communication because of their very high information carrying capacity and repeater less transmission. Soliton pulses does not affected (by dispersion) after long distance communication. By checking the result of layout for fundamental soliton (N=1& 3 both) we can say that soliton pulses shape having similar shape after travelling 27.525Km distances. For N=3 source peak power is increased as compare to N=1.

V. ACKNOWLEDGEMENTS

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FABRICATING AIR DRIVEN ENGINE TO ANALYZE DESIGN AND TESTING OF VARIOUS PARAMETERS

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ABSTRACT

The Air Driven Engine is an eco-friendly engine which operates with compressed air. An Air Driven Engine uses the expansion of compressed air to drive the pistons of an engine. An Air Driven Engine is a pneumatic actuator that creates useful work by expanding compressed air. There is no mixing of fuel with air as there is no combustion. An Air Driven Engine makes use of Compressed Air Technology for its operation The Compressed Air Technology is quite simple. If we compress normal air into a cylinder the air would hold some energy within it. This energy can be utilized for useful purposes. When this compressed air expands, the energy is released to do work. So this energy in compressed air can also be utilized to displace a piston

KEYWORDS: *Engine, Compressor, Connector and Roller operated pneumatic valve*.

I. INTRODUCTION

At first glance the idea of running an engine on air seems to be too good to be true. Actually, if we can make use of air as an aid for running an engine it is a fantastic idea. As we all know, air is all around us, it never runs out, it is non-polluting and it is free.

An Air Driven Engine makes use of Compressed Air Technology for its operation. Compressed Air Technology is now widely preferred for research by different industries for developing different drives for different purposes. The Compressed Air Technology is quite simple. If we compress normal air into a cylinder the air would hold some energy within it. This energy can be utilized for useful purposes. When this compressed air expands, the energy is released to do work. Prefabricating and Testing of Air Driven Engine, So this energy in compressed air can also be utilized to displace a piston. This is the basic working principle of the Air Driven Engine. It uses the expansion of compressed air to drive the pistons of the engine. So an Air Driven Engine is basically a pneumatic actuator that creates useful work by expanding compressed air. This work provided by the air is utilized to supply power to the crankshaft of the engine.

In the case of an Air Driven Engine, there is no combustion taking place within the engine. So it is non-polluting and less dangerous. It requires lighter metal only since it does not have to withstand elevated temperatures. As there is no combustion taking place, there is no need for mixing fuel and air. Here compressed air is the fuel and it is directly fed into the piston cylinder arrangement. It simply expands inside the cylinder and does useful work on the piston. This work done on the piston provides sufficient power to the crankshaft.

II. MATERIALS

THE COMPONENTS AND ENGINE

2.1 The Engine

The basic engine that we have used in the project is a normal two stroke petrol engine. The details of the engine are as follows: Make: Kinetic, Displacement: 60 cc., No. of cylinders: 1

We only needed a simple piston-cylinder arrangement with an outlet and an exhaust. But as we know a normal two stroke engine contained several ports and it also had the spark plug which we didn‟t require. So, several modifications had to be done on the engine to

2.2. Suit our purpose.

The modifications comprised of:

Closing the transfer port

Closing the inlet port

Removing the spark plug from the cylinder head

Providing an inlet at the place of the spark plug

Providing a suitable connector at the cylinder head

The transfer port was to be sealed to provide maximum sealing of the piston-cylinder arrangement so that the chances of escape of air from the cylinder can be avoided. We made use of m-seal and araldite to seal off the transfer port. First a fine quantity of m-seal was filled in the transfer port fully except for a small clearance to apply araldite. Then the m-seal was allowed to

solidify. After that araldite was applied in another layer and was allowed to solidify. Thus the transfer port was closed with the help of the adhesives.

Figure 2.2 Cylinder Block

The inlet port also was required to be closed to avoid mild chances of leakage. It was much easier to close the inlet port. The inlet port contains a Reed valve at its start. This valve is basically a non-return valve. So if we screw it tightly there wouldn't be chances of escape of air through the inlet port. This was carried out to close the inlet port. There is no combustion taking place in an Air Driven Engine. So naturally there is no need for the spark plug. So the spark plug is removed from its respective position that is on the top of cylinder head. It would be great if we provide the inlet for compressed air at the position of the spark plug as it is better to let the air enter from the top of the piston. So the connector which is used to connect the pipe from the compressed air tank has to be fixed at the position of the spark plug. The connector contains an R1/2 thread of BSPT standard. So we tapped the same thread on the cylinder head at the position of the spark plug. Then the suitable connector was fixed on the cylinder head.

Figure 2.3 Cylinder Head

III. AIR COMPRESSOR

An air compressor is a device that converts electrical power or gas into kinetic energy by pressurizing and compressing air, which is then released in quick bursts. There are numerous methods of air compression, divided into either positive-displacement or non-positive displacement types .

Figure 2.4 Compressor

Positive-displacement air compressors work by forcing air into a chamber whose volume is reduced to effect the compression. Piston-type air compressors use this principle by pumping air into an air chamber through the use of the constant motion of pistons. They use unidirectional valves to guide air into a chamber, where the air is compressed. Rotary screw compressors also use positive-displacement compression by matching two helical screws that, when turned, guide air into a chamber, the volume of which is reduced as the screws turn. Vane compressors use a slotted rotor with varied blade placement to guide air into a chamber and compress the volume. Non-positive-displacement air compressors include centrifugal compressors. These devices use centrifugal force generated by a spinning impeller to accelerate and then decelerate captured air, which pressurizes it.

The air compressors seen by the public are used in 5 main applications:

- To supply a high-pressure clean air to fill gas cylinders.
- To supply a moderate-pressure clean air to supply air to a submerged surface supplied diver.
- To supply a large amount of moderate-pressure air to power pneumatic tools. For filling tires.
- To produce large volumes of moderate-pressure air for macroscopic industrial processes (such as oxidation for petroleum coking or cement plant bag house purge systems).

Most air compressors are either reciprocating piston type or rotary vane or rotary screw. Centrifugal compressors are common in very large applications. There are two main types of air compressor's pumps: Oil lubed and oil less. The oil less system has more technical development, but they are more expensive, louder and last less than the oiled lube pumps. But the air delivered has better quality. The best choice depends of the application that the user needs.

3.1. Specification of compressor:

Type: Reciprocating air compressor

Cylinder: 1

Tank: 100 Lt.

A reciprocating compressor is a positive displacement compressor that uses pistons driven by a crankshaft to deliver gases at high pressure. In single stage reciprocating air compressor the entire compression is carried out in a single cylinder. If the compression is affected in one end of the piston & cylinder then it is known as single acting & if the compression is affected in both ends of piston & cylinder then it is known as double acting reciprocating air compressor. The opening & closing of simple check valve (plate or spring valve) is depend upon difference in pressure, if mechanically operated valves are used for suction & discharge then their functioning is controlled by cams. The weight of air in the cylinder will be zero when the piston is at top

dead center, if we neglect clearance volume. When piston starts moving downwards, the pressure inside the cylinder falls below atmospheric pressure& suction valve/inlet valve opens. The air is drawn into the cylinder through suction filter element. This operation is known as suction stroke. When piston moves upwards, compresses the air in cylinder & inlet valve closes when pressure reaches to atmospheric pressure. Further compression follows as the piston moves towards the top of its stroke until, when the pressure in the cylinder exceeds that in the receiver. This is compression stroke of compressor. At the end of this stroke discharge/delivery valve opens & air is delivered to receiver. When it is double acting reciprocating air compressor, suction stroke is in process at one end of piston while at same time discharge stroke is in process at other end of piston. In simple word we can say that suction & compression took place on both end of piston & cylinder in double acting reciprocating air compressor.

IV. ROLLER OPERATED PNEUMATIC VALVE

The roller lever valve with idle return only switches if the movement of the trip cam on the roller lever is in a certain direction. The valve is used as a limit switch for the "position sensing" Care should be taken ensure that the valve is fitted in in the correct direction. Likewise, this type of valve can be used either in the normally open or normally closed position. In the case of normally open position only port 1& 3 need to be inversely connected to normally closed position. The head of valve with roller lever actuator can be can be positioned by 180 degrees.

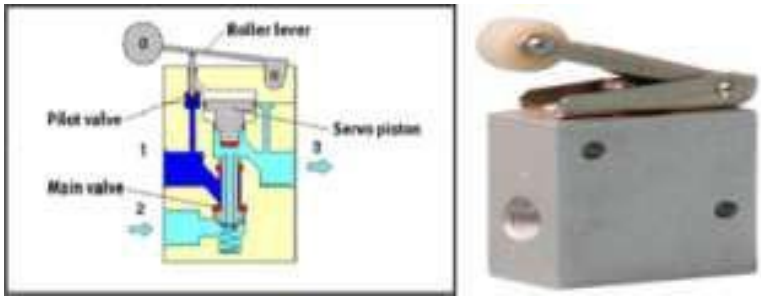

Figure 2.5 3/2 Roller operated pneumatic valve

The roller lever valve is actuated when the roller lever is pressed, for example by the cam of a cylinder. After release of the roller lever, the valve is returned to its initial position.

4.1. Specification

a. Design – Poppet Type , Lever Operated 2) Port / Position – 3/2

b. Pressure Range – 0 – 800kPa (0-8 Bar)

c. Normal Flow rate – 80 l/min

V. VALVE ACTUATION SYSTEM

The valve actuation system is the system used to actuate the valve mechanism. The valve here used is a 3/2 Roller Operated Pneumatic valve. This valve we used here is an always closed valve. This valve works only when force applied to roller by cam / other arrangement to it.

Figure 2.6 Valve Actuation arrangement

The roller lever valve is actuated when the roller lever is pressed by valve actuating cam arrangement as shown in fig. Then the valve opens and the pressurized air is allowed to enter the cylinder of the engine. Thus the engine works.

VI. FLOW CONTROL VALVE AND CONNECTORS

Flow Control Valves are used to reduce the rate of flow in a section of a pneumatic circuit, resulting in a slower actuator speed. Unlike a Needle Valve, Flow Control Valves control flow in only one direction, allowing free flow in the opposite direction. A finely threaded stem allows gradual adjustment of the amount of controlled flow passing through the valve. Flow enters port 1, travels through an orifice sized by the tapered stem and out port 2. The Flow Control features a by-pass check which then allows rapid free flow from port 2 through port 1

Figure 2.7 Flow Control Valve

Function of a flow control valve is self –evident from its name. A flow control valve regulates the rate of air flow. The control action is limited to the air flow passing through the valve when it is open, maintaining a set volume per unit of time Specification

1) Medium Dry, Lubricated / Unlubricated
2) Maximum Operating Pressure – 10 bar 3) Ambient Temperature – 5-60degree C
3) Connection – ¼

6.1. Connectors:

Figure 2.8 Connector

Connectors are used to connect the pipes with the components used in this project. The type of connector used is one touch male connector which has an internal hexagonal socket.

6.2. Coupling

Figure 2.9 Coupling with connector

A coupling is a very short length of pipe or tube, with a socket at one or both ends that allows two pipes or tubes to be joined, welded, brazed or soldered together. Alternatively, it is a short length of pipe with two female National pipe threads (NPT) or two male or female British standard pipe threads.

6.3. PU Tube:

Polyurethane (PUR) tubing is made from the highest quality, 100% virgin raw materials available and has a hardness specification of Shore A98. It is ether based to provide excellent hydrolysis, oil and cold resistance. Polyurethane tubing is strong, flexible, and offers superior kink resistance compared to other tubing. With its extremely tight outside diameter tolerance,

Figure 2.10 Polyurethane Tube

The pipe system is used to connect the components involved in the passage of the compressed air. Here polyurethane pipes are used of diameter of 8 mm, 10 mm and length of 2m. They are made of hard and flexible material so that they are able to pass the compressed air more efficiently and are highly flexible. These pipes are able to withstand high pressure and so are used to transport compressed air. They are perfectly suited to be inserted to the one touch male connector

VII. VALVE TIMING

The converted compressed air engine has been tested fora set of three valve timings. In the first case, the inlet and exhaust cam are set in symmetric in angle in both side of TDC and BDC respectively. The inlet cam gives a

lift of 18mm to the follower. When the piston is at TDC the inlet valve is at fully opened condition and as the compressed air starts entering into the chamber, the valve has to close the inlet port of 10mm diameter before the piston reaches BDC. To ensure the complete closure of the 10mm inlet port, the inlet follower is given a movement of 18mm. When the crank is at 20

degrees after TDC, the closure of the inlet port is started by the valve and it is completely closed when the crank is at 45degrees after TDC. During this period the inlet port remains fully closed and no air is allowed to pass through the inlet port. The inlet port starts to open and allow the air to pass into the cylinder just 45 degrees before the TDC and reaches its maximum opening condition 20degrees before TDC. The exhaust port is at fully closed condition when the piston is at TDC and the exhaust valve starts to open the exhaust port just 75 degrees after TDC. For the next 210degree rotation of the crank, the exhaust port is kept at fully opened condition and the air is allowed to leave the chamber. The exhaust follower is given a displacement of 15mm to completely close the outlet port of 10mmdiameter. Exhaust valve starts to close the outlet port just75 degrees before TDC and it is moved to completely closed condition just when the piston is at TDC. Valve Timing Diagram 3With the modification a second valve timing was tested with inlet valve starts to open at 25º before TDC and fully open at TDC. The total opening time remains the same at 40º of cam rotation. The exhaust valve starts to open at 60º before BDC and closed after 30º of cam rotation before the piston reaches the TDC. With the modification a third valve timing was tested with inlet valve starts to open at TDC and fully open at 25º after TDC. The total opening time remains the same40º of cam rotation. The exhaust valve starts to open at30º before BDC and closed when the piston reaches the TDC

VIII. TESTING

8.1. Testing Apparatus

For load testing our air engine; we made the testing apparatus our-self consisting of brake drum, spring balance, rope and holding frame.

Figure 4.1: Brake Drum

The brake drum of our testing apparatus was made by slightly modifying the clutch disc of our engine itself and coupled it to the crankshaft. The spring balance is held in place to the main frame through a hole drilled into it. The rope is then tied to the hook of the spring balance. The other end of the rope is circled over the brake drum by a single loop in clockwise direction. The weight placing base is attached to the loose end of the rope. Extra care is taken in order to make sure that the spring balance, the rope and the weights are in straight line.

8.2. Testing principle

8.3. Brake Power

Brake horsepower is the measure of an engine's horsepower without the loss in power caused by the gearbox, alternator, differential, water pump, and other auxiliary components such as power steering pump, muffled exhaust system, etc. Brake refers to a device which was used to load an

engine and hold it at a desired RPM. During testing, the output torque and rotational speed were measured to determine the brake horsepower. Horsepower was originally measured and calculated by use of a brake drum connected to the engine's output shaft. Brake power is the power produced by the engine as measured by the brake drum.

Brake power „BP" = * * *

Where;

w1 = weight added in kg, w2 = load shown in spring balance in kg, N = speed in RPM,

d = diameter of rope in mm, D = diameter of brake drum in mm g = gravitational constant.

When the engine starts running and gained speed; no load readings of pressure in BAR as indicated by the pressure gauge on the compressor and the speed of the brake drum in RPM as indicated by the tachometer is taken down.

This process is repeated for different values of pressure ranging between 1bar and 9bar and the corresponding readings of speed of rotation are noted.. The readings thus obtained are tabulated in the tabular column.

Figure 4.3 Observations after Testing

WEIGHT	1	2	3	4	5	6	7	8
NO LOAD	344	413	456	484	513	533	545	563
.5	314	384	430	450	476	508	516	526
1	300	363	412	440	465	480	485	490
1.5	210	268	381	400	441	459	469	474
2	202	210	374	385	425	450	460	465
2.5	-	-	312	332	375	420	436	452
3	-	-	300	326	354	363	381	421

Figure 4.4 Testing Image

IX. RESULTS AND DISCUSSIONS

The engine has been tested with compressed air of 8 bar pressure. In the first design of the valve timing diagram, the engine starts running with the opening of the compressed gas line. But after a full cycle the engine gradually slows down and eventually stops. This may have occurred due to the fact that in the return stroke, the inlet valve opens before TDC. This acts against the piston

in the return stroke and eventually slows down the engine. In the second valve timing design, the engine starts running after the compressed air has started to flow into the engine cylinder. But after several full cycles the engine again slows down and stopped. In this case, the inlet valve is started to open before TDC. As the compressed air started to flow into the engine cylinder, before the piston reaches TDC in the return stroke, the compressed air again pushes the piston back in the return stroke. Thus the engine again slows down and stopped. In the third valve timing design, the engine starts running with compressed air flow into the cylinder. This time, the engine runs for half an hour before the pressure of the compressed air dropped below a certain limit. The rpm of the engine has been measured and is found to be 600 rpm

Sample calculations

Pressure at 8 bar and 3 kg load

Torque = (w1-w2)*[(D + d)/2]*g= (3-0.1) *[(0.12+0.012)/2]*9.81

Brake power „BP" = *___ * *

BP = (2*π*438/60) *[(0.12+0.012)/2]*(3-0.1)*9.81 W

=45.86 * 0.132 * 2.9 *9.81 watts

=172.22 watts

Performance Characteristics:

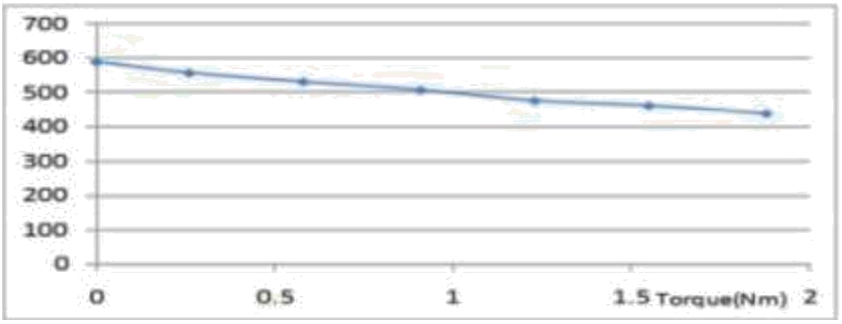

Figure 5.1 Pressure versus speed

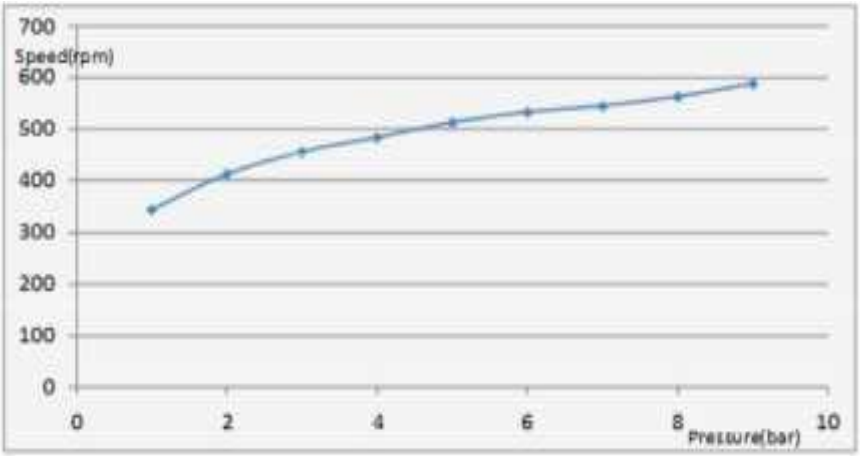

Figure 5.2 Torque versus speed

X. CONCLUSIONS

In Air Driven Engine, the speed is bound to increase with increase in the inlet pressure. The speed versus torque characteristics shows a negative linear variation. The brake power is observed to increase with increase in the inlet pressure.

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Asian Journal of Multidimensional Research (AJMR)

(Double Blind Refereed & Reviewed International Journal)

UGC APPROVED JOURNAL

DESIGN CONSIDERATION FOR 90 DEGREE STEERING SYSTEM IN CONVENTIONAL SEDAN CARS

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ABSTRACT

The advanced new technology has led to various modifications in the automobile sector. There is no hard and fast formula to calculate the turning circle but it can be calculated using this; Turning circle radius= (track/2) +(wheelbase/sin (average steer angle)). Zero degree turning radius of a vehicle implies the vehicle rotating about an axis passing through the centre of gravity of vehicle i.e. the vehicle turning at the same place, where it is standing. No extra space is required to turn the vehicle. So vehicle can be turned in the space equal to the length of the vehicle itself. This technology exists in heavy earth movers like excavator which consists of two parts i.e. the upper part cabin and lower part crawler chain. The upper part of excavator can rotate about its centre, so that the direction of cabin can be changed without changing direction of lower part. Conventional steering mechanism involves either the use of Ackerman or Davis steering systems. The disadvantage associated with these systems is the minimum turning radius that is possible for the steering action. This difficulty that is associated with the conventional methods of steering is eliminated by employing a four wheel steering system. In this system, the wheels connected to the front axles are turned opposite to each other, and so are the wheels connected to the rear axle. The wheels on the on left half vehicle rotate in one direction and the ones on the right half of the vehicle rotate in the opposite direction. This arrangement of the wheels enables the vehicle to turn 360 degrees, without moving from the spot, i.e. the vehicle has zero turning radiuses.

KEYWORDS: *Conventional, Arrangement, Radiuses, Mechanism*

I. INTRODUCTION

In highly populated areas it can be difficult to find available parking spots. Frequently parking spots are located on the side of the road, leaving the driver with no choice but to attempt parallel parking. In general it is considered to be a rather challenging maneuver. Since parallel parking

requires driving backwards it becomes difficult to coordinate the correct motion of the car. Some drivers have to perform multiple corrections before they park the car properly. In the worst case an accident can occur. A car that can perform parallel parking by itself would save drivers time, especially those that are not very good with parallel parking. In addition cars that can parallel park autonomously in a reliable manner would most probably reduce the number of accidents related to parking. The objective of our work is to implement parallel parking using a car like robot[4]. The robot that we used is of type pioneer 3. We restricted the motion of the robot to model the motion of a car. Using our model we present a solution to the autonomous parallel parking problem

II. STEERING MECHANISMS

2.1 About Hydraulic Power Steering technology is the older one of the two and has been put to use for decades. Unlike earlier systems, modern hydraulic units are speed sensitive and work differently when the car slows down or builds up speed. Hydraulic Power Steering uses belt-driven power steering pump, which creates pressure. The pressurised fluid is then forced into a cylinder for assisting the steering movement. When the driver turns the steering wheel, it opens up the turning the wheels one-way or the other[5].

2.2 About what is Electric Power Steering?

Electric Power Steering or EPS on the other hand is less complicated and more reliable in the long run. This system uses electronics instead of hydraulics. The whole mechanism works with the help of a control unit with some sensors and an electric motor. When the steering wheel is turned, the motor uses electricity to assist the steering moments required to turn the wheels. At high speeds it makes the steering damping stiffer, therefore making the steering feel „heavier" or „weighted" and in turn, safer.

2.3 Components

1Rack and Pinion: Rack The rack of the steering gear is a circular bar with teeth cut across a part of its length. The steps followed during the generation of rack are as follows: Developing a Virtual Prototype of a Rack and Pinion Steering (RPS) System

Fig-1: Rack and Pinion Pinion

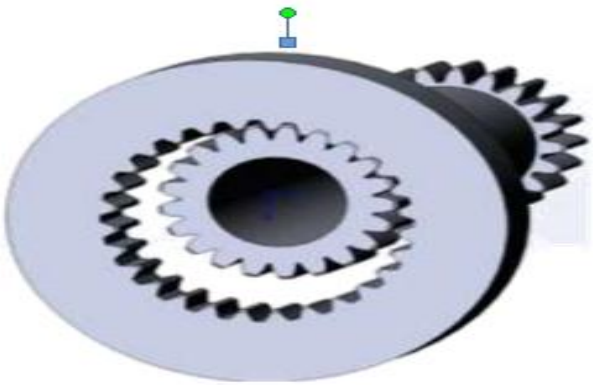
The generation of pinion in ADAMS is done in a manner similar to the gear shaping process (Merritt, 1971). The gear shaping and hobbing are similar in their principle of involute generation. The hobbing is a continuous generation process where the hob is continuously fed into the workpiece, whereas, the gear shaping is an intermittent process where the cutter rack makes series of cut on blank. For each cutting instance during shaping, the rack and blank are moved through a small incremental displacement, as if 72 N. Kamble and S.K. Saha they are in

mesh. At the end of rack-stroke, it is withdrawn from the blank and brought to the original position. The principle of gear shaping is used while modelling the pinion in ADMAS.A cylinder of nominal diameter is made first. The pitch diameter of the pinion blank and the line of symmetry of the rack are separated by the amount of profile shift. The cylinder and the cutter rack is oriented to the required helix angle of the pinion.

2.4 Bevel Gear: Two important concepts in gearing are pitch surface and pitch angle. The pitch surface of a gear is the imaginary toothless surface that you would have by averaging out the peaks and valleys of the individual teeth. The pitch surface of an ordinary gear is the shape of a cylinder. The pitch angle of a gear is the angle between the face of the pitch surface and the axis.The most familiar kinds of bevel gears have pitch angles of less than 90 degrees and therefore are cone-shaped[1]. This type of bevel gear is called external because the gear teeth point outward. The pitch surfaces of meshed external bevel gears are coaxial with the gear shafts; the apexes of the two surfaces are at the point of intersection of the shaft axes. Bevel gears that have pitch angles of greater than ninety degrees have teeth that point inward and are called internal bevel gears.Bevel gears that have pitch angles of exactly 90 degrees have teeth that point outward parallel with the axis and resemble the points on a crown. That's why this type of bevel gear is called a crown gear.Miter gears are mating bevel gears with equal numbers of teeth and with axes at right angles.

Fig-2:Bevel Gear

2.5 Internal Gear: A hub gear, internal-gear hub, or just gear hub is a gear ratio changing system commonly used on bicycles that is implemented with planetary or epicyclic gears. The gears and lubricants are sealed within the shell of the hub gear, in contrast with derailleur gears where the gears and mechanism are exposed to the elements. Changing the gear ratio was traditionally accomplished by a shift lever connected to the hub with a Bowden cable, and twist-grip style shifters have become common[2].Hub gear systems generally have a long and largely maintenance-free life though some are not suitable for high-stress use in competitions or hilly, off-road conditions. Many commuter or urban cycles such as European city bikes are now commonly fitted with 7-speed gearhubs and 8-speed systems are becoming increasingly available. Older or less costlyutility bicycles often use 3-speed gear-hubs, such as in bicycle sharing systems. Many folding bicycles use 3-speed gear-hubs. Modern developments with up to 14 gear ratios are available.[4]



2.6 Chain Drive: Chain drive is a way of transmitting mechanical power from one place to another. It is often used to convey power to the wheels of a vehicle, particularly bicycles and motorcycles. It is also used in a wide variety of machines besides vehicles[4].

2.7 Sprocket: A sprocket or sprocket-wheel is a profiled wheel with teeth, cogs, or even sprockets that mesh with a chain, track or other perforated or indented material. The name 'sprocket' applies generally to any wheel upon which radial projections engage a chain passing over it. It is distinguished from a gear in that sprockets are never meshed together directly, and differs from a pulley in that sprockets have teeth and pulleys are smooth.[5] Sprockets are used in bicycles, motorcycles, cars, tracked vehicles, and other machinery either to transmit rotary motion between two shafts where gears are unsuitable or to impart linear motion to a track, tape etc.

III. CALCULATIONS

Rack and Pinion

Addendum=m=1.8mm
Dedendum =1.25*m=2.mm
Clearance=0.25m=0.5mm
Working depth=2m=4mm
Whole depth=2.25m=4.5mm
Tooth thickness=2.1416mm
Tooth space=1.5708m=3.1416mm
Fillet radius=0.4m=0.8mm
Bevel Gear
m = 2mm
Zp = 28
Zg = 28
b = A0 /3 = 39.58/3 = 13.2mm
dp = m Zp = 56mm
dg = 56 mm
A0 = 19.79*m = 19.79*2 = 39.58
ha = 1 * m = 2
hf= 1.2 * m = 2.4 mm
Yp = 45
Yg = 45

3.1 Internal Gear Selection of Internal Gear to support pinion

This a non standard gear fabricated on laser machine as per our requirement

Diameter = 240 mm

No of teeth = 60

Pitch = 5 mm,

Matching to pinion Module = 2,

Matching to pinion

Gear ratio = 2.88 3.4

3.2 Chain Effort applied

By human both legs = 200 N ,Mass of ShaftM = 2 kg ,W = 9.81 N ,Total breaking load on chain = 200 + 9.81 = 209.81 N For load ,F = 209.81 N ,Selecting Chain -06 B All Data ,F = 8900 N > 209.81 N pitch -9.525mm roller diameter,d1=6.35 mm width, b1=5.72 mm ,transverse pitch pt=54.85 mm z1=44 z2=18 approximate centre distance, a= 600 mm for practical feasibility and may change in the fabrication. No of links, Ln=2 * ( ) + 1+ 2 2 + 1− 2 2 2 ∗ ( ) = 159.66 = 160

3.3Sprocket For Used

Chain no.06 B For Z=18 All Data From Table 14.6 of Textbook of "Design of machine elements" by V. B. Bhandari For Z=18 From table no 14.1 Pitch, P=9.525 Width between inner plates , b1=5.72 Roller diameter, d1=6.35 mm

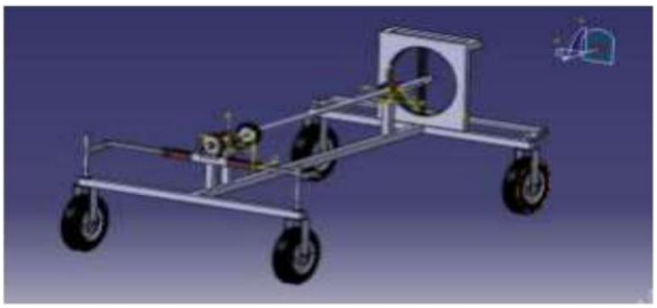
Transverse pitch pt=10.24 pitch circle diameter D= sin □ (180/) =54.85 mm Top diameter (Da) (Da)max=D+1.25p-d1=60.4 mm Root diameter , Df=D-2r1 4.

IV.CONSTRUCTION

The main components are bevel gear, rack and pinion, internal gear, wheels, chain sprocket, bearings, steering wheels. In this vehicle we used this arrangement to turn the wheel at 90 degree in a steady state condition. Shaft plays an important role of transmitting power from rack and pinion to internal gear. Here we use ackerman steering mechanism for front wheels and rear wheels follow their motion.

V. WORKING PRINCIPLE:-

In this model, we are transmitting power manually i.e by chain and paddle system. Here we are using chain and paddle arrangement only for transmitting power to wheels. As we rotate steering wheel, bevel gear will give power and motion to rack and pinion and then accordingly shaft will rotate. Internal gear is used for support where we used sun and planet gear.



Advantages:-

- Safety
- Comfort
- Control over car
- Improved traction and handling
- Able to transmit torque to all four wheels

VI. CONCLUSION

A vehicle featuring low cost and user friendly steering mechanism has been introduced. This paper focused on a steering mechanism which offers feasible solutions to a number of current maneuvering limitations. A prototype for the proposed approach was developed by introducing separate mechanism for normal steering purpose and 360 steering purpose. This prototype was found to be able to be maneuvered very easily in tight spaces, also making 360° steering possible.

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Asian Journal of Multidimensional Research (AJMR)

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TRANS Asian Research Journals

INVESTIGATING THE EFFECTS OF GREASE TRAP OIL WITH BIODIESEL IN COMBUSTION INGNITION ENGINE AND IDENTIFYING THE VARIOUS PARAMETERS

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ABSTRACT

The present process deals with preparation of grease entice was made from Grease seed as a substitute fuel for diesel engines and its usability was investigated as pure oil and as a mix with fuel. A combustion injection (CI) diesel was tested victimization diesel, grease entice, and blends of Grease entice and diesel in several proportions. a large vary of engine masses and Grease trap/diesel ratios of 20/80% (S20), 50/50% (S40), and 80/20% (S60) by volume were thought of the subsequent parameters were determined, brake thermal potency (BTE), BSFC and CO and CO_2 emissions. No major variation in brake thermal potency and bsfc were veteran up to the S20 mix ratios. But, the superior blends shows deterioration in potency and fuel consumption concerning ten to twenty fifth. At low load operations, CO2 emission with blends was under that of diesel, whereas, at high masses, CO2 emission became higher with the next share of Grease entice within the blends. However, CO emission with mixs was a lot of above that of diesel; the upper the proportion of grease entice within the blend, the upper the CO_2 emission.

KEYWORDS: *CO emission, s_2o, CI Engine, BTE, BSFC*

I. INTRODUCTION

Due to the depletion of fossil fuels there's a good demand for the choice fuels which can kind the supply of future fuels. additionally there square measure considerations kind environmentalists that there's a rise in warming because of emission of GHG of (i.e co2) from fuel and diesel vehicle .Thus they're major reasons to adopt renewable energy within the style of biodiesel, each in transport sector within the service of the state. during this analysis study hemorrhage of grease entice that is additionally popularly called bio diesel, as ready by using transeterification of grease entice with wood spirit and catalyst KOH. numerous blends of grease alkenes organic compound (BSEC) were tested in 4s CI engine and engine performance results obtained were

compared with information obtained from pure diesel(HSD).Study report one.5 to 4WD will increase in brake thermal efficiency(BTE).With BSEC blends. The brake power values were comparable to those obtained from HSD. With biodiesel blends important addition in emission of hydrocarbons still a smoke/ (particulates) was detected.NOX emission with BSEC blends were ascertained to be somewhat higher as compared to diesel. Since bio diesel is sulphur free fuel, no NOX emissions were created.

Execution and outflow investigation on CI motor with sesame oil biodiesel mixes at various fuel infusion weight was talked about. The investigation is done on the Computerized Variable Compression proportion multi fuel coordinate infusion water cooled motor. The investigation is done at consistent pressure proportion (16.5) of the motor. At first we have done the benchmark tests, which are with diesel at three fuel infusion weights 190, 210 and 230bar, and afterward try is rehashed with various proportions of sesame oil biodiesel mixes (20%HSD, 40%HSD, 80%HSD, and 100% Without motor alterations (i.e. at 210 bar standard motor weight) 20%HSD gives the best outcomes both in execution and emanations HSD. At 100% HSD demonstrates the best outcomes both in execution and emissions [1].

The utilization of sesame oil bio diesels mixes as fuel for pressure start motors. At greatest load condition B20, B40 and B60 mixes produce17.54, 19.4 and 21.3% lower HC outflow individually than flawless diesel fuel. At half load condition, B30 and B40 create 36.5 and 41.23% less CO discharge than diesel. This is expected to the total and stable ignition of the biodiesel, which contains more number of oxygen molecules. At greatest load, B40 and B60 mix create 19.6 and 22.13% higher NOx discharge than flawless diesel fuel. For half load condition, these mixes create 18.46 and 29.05% higher NOx discharge than diesel fuel.variation of fumes gas temperature with various burdens for various biodiesel mixes and diesel. The mixes of biodiesel gives bring down CO and unburned hydrocarbons than the flawless diesel, this is because of the accessibility of O2 content which thus create higher fumes gas temperature than slick diesel fuel [2]. While using Oil-based powers have not just brought about the fast exhaustion of regular vitality sources, however, have additionally caused extreme air contamination. As one of most encouraging sustainable and clean option fuel, biodiesel has been broadly examined as of late for CI motors. This examination researches execution, emanations and ignition attributes of a diesel motor fuelled with squandering vegetable oil included with diethyl ether as an added substance biodiesel. The Experimental Investigation into Biodiesel in Cobustion Ingnition Engine by Using Grease Trap Oil trials performed in a solitary chamber coordinate infusion, 4-stroke, air cooled framework running with diesel(D100) and diesel/biodiesel mixes containing 10% (B10), 20% (B20) and 30%B(30) biodiesel powers. The tests led at two distinctive infusion weights 200 and 240 bar. Brake warm productivity of biodiesel was more prominent than the diesel at different load condition. Brake warm effectiveness of B20 at 240 bar was 23.40 % higher as contrasted with various mixes and diesel at full load condition. The consequences of the analysis demonstrated that BSFC of 240bar was more prominent than 200bar, and the fuel utilization of the B20 at 240bar was 16.48% lower at full load condition. According to the outcome, CO and CO2 emanation for the biodiesel were lessened, and HC outflow was higher when contrasted with diesel at various load conditions. NOx discharge for B10 at 200bar was 35.71% most reduced when contrasted with diesel and biodiesel at different load condition [3].

The essential target of this examination was to decide the connection between operational factors and oil slick recuperation rates, by performing a full-scale oil slick recuperation test utilizing an

oleophilic drum skimmer. Model tradable oleophilic skimmer drums with aluminum, polyethylene and Neoprene surfaces were manufactured and tried at the field scale at the Ohmsett-National Oil Spill Response Test Facility. This consider decided the impact of the recuperation surface material, oil properties, oil spill thickness, temperature and drum rotational speed on the oleophilic drum skimmer recuperation rates. It was discovered that the choice of the recuperation surface material can expand the recuperation rates up to 20%.The expansion in oil spill thickness from 10 to 25 mm prompted up to two times higher recuperation rates for a gooey oil, yet did not have any detectable impact on the recuperation rates of light oil [4].

The basic focus of this examination was to choose the association between operational factors and oil spill recovery rates, by playing out a full-scale oil spill recovery test using an oleophilic drum skimmer. Display tradable oleophilic skimmer drums with aluminum, polyethylene and Neoprene surfaces were fabricated and attempted at the field scale at the Ohmsett-National Oil Spill Response Test Facility. This consider chose the effect of the recovery surface material, oil properties, oil slick thickness, temperature and drum rotational speed on the oleophilic drum skimmer recovery rates. It was found that the decision of the recovery surface material can grow the recovery rates up to 20%.The development in oil slick thickness from 10 to 25 mm provoked up to two times higher recovery rates for a gooey oil, yet did not have any perceivable effect on the recovery rates of light oil[5].

II. MATERIALS

In this work Grease blends is mixed with bieed oil as shown in Figure 1. The engine performance was tested on the kubato engine its tractor engine at different loads from (0KG,2KG,4KG,6KG,8KG,10KG.) for diesel and grease trap methyl esters blends of (B20, B40,B60) by volume.

Figure 1 Grease trap & Oil blends

The yield of 98% some can be obtained with 1:6 molar ratio between bleed oil NAOH, reaction time of 60 minutes and reaction temperature of 60%C·

III. EXPERIMENTAL INVESTIGATION

Figure 2 Kubota Engine

TABLE 1 SPECIFICATION OF THE ENGINE TEST RIG

SNO	DESCRIPTION	DETAILS
1	ENGINE	KUBOTA TRACTOR
2	GENERAL DETAILS	VERTICAL, FOUR STROKE, CI, WATER-COOLED, THREE CYLINDER, HAND START
3	BORE×STROKE	86.5mm×110mm
4	CUBIC CAPACITY	762cc
5	COMPRESSION RATIO	17:5
6	RATED OUTPUT	6.2KW @ 1800 rpm
7	FUEL INJECTER PRESSURE	20.5-21.5 MPa
8	INJECTION TIMING	23° BEFORE TDC
9	NO OF VALVES VALVE TIMING INLET VALVE OPENS BTDC INLET VALVE OPENS ABDC EXHAUST VALVE OPENS BBDC	2 4.5° 35.5° 35.5° 4.5°
10	GOVERNER TYPE CLASS OF GOVERNING	MECHANICAL, CENTRIFUGAL TYPE B1

In order to fabricate the grease trap prototype, the material and tool selected should be appropriate to be used. It is all started with part modelling in CATIA software drawing and later converted into drafting documents in which an important drafting file like isometric, orthographic and exploded views. In making the active grease trap, the material known as plastic Perspex is used in fabricating this prototype because of its transparency and durability. Meanwhile, the connection between the Perspex is done using the plastic glue and silicone which is used to prevent leakage as well as to strengthen the bond connectivity.

The experimental set up consists of a three cylinder CI engine, air metering unit, fuel measuring equipment, exhaust gas analyzer and thermocouples with temperature indicator. All the tests with the different blend like B10, B20, B40 and B60 will conduct for varying engine speed and with varying load on the engine. Tests will be carried for 210 bar original fuel injection pressure and injection timing of 27 C before top dead centre. The engine is coupled with a single phase. The conditions will maintain throughout the experiment for different fuels. After the baseline test with diesel, no load test will conduct for three batches of bio diesel prepared with different blends.

The fuel prepared for testing purpose will B10 (10% bio diesel + 90% diesel), B20 (20% biodiesel + 80% diesel), B40 (50% biodiesel + 50% diesel) and B60 (100% biodiesel). The specific fuel consumption will be calculated by measuring the time taken for a fixed volume of fuel to flow into the engine. The torque will be measured using swinging field electrical dynamometer. The engine speed 1800 (rpm) will be measured by an electronic digital counter. The parameters break's thermal efficiency and brake specific fuel consumption will calculate from measurement data. The exhaust gas temperature will measure by using an electronic digital indicator with the iron-constantan thermocouple. Emission analysis will be carrying for an exhaust gas emissions particulate matter, SO2, UBHC, and CO. A levelling bulb was used to adjust all gas volume measurements to atmospheric pressure.

IV. RESULT AND DISCUSSION

4.1. NOX VS Brake Power

Table 2 indicated the Nox vs break power obtained from the experimental research.

TABLE 2 NOX VS BRAKE POWER

x/y	D	B20	B40	B60
0	80	49	31	20
0.9	170	39	28	40
1.8	260	60	40	78
2.7	290	90	220	120
3.6	360	170	280	290
4.5	470	290	280	360
5.4	540	320	310	410

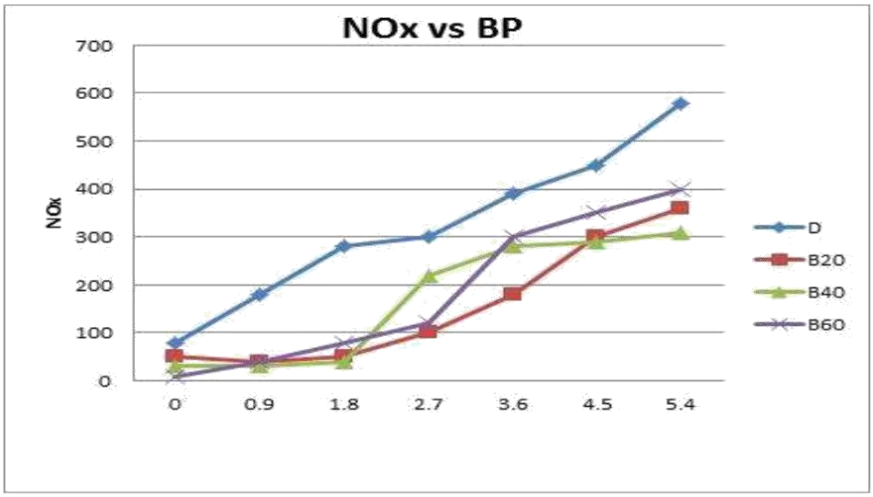


Figure 3 Nox VS Break Power

It can be noticed that the variation of NOx with respect to brake power. For all load the NOx emissions were found to be drastically reduced for all blends from the Figure 3 NOx emissions were reduced due to lower heat release rate due to lower calorific values which lowers the combustion temperature.

V. CARBON MONOXIDE VS BRAKE POWER

Table 3 shows the corbondioxide vs break results obtained from engine test rig.

TABLE 3 CO VS BREAK

x/y	D	B20	B40	B60
0	0.06	0.04	0.05	0.02
0.9	0.06	0.05	0.02	0.03
1.8	0.04	0.06	0.03	0.04
2.7	0.04	0.06	0.04	0.04
3.6	0.03	0.05	0.03	0.03
4.5	0.03	0.04	0.03	0.03
5.4	0.02	0.03	0.02	0.02

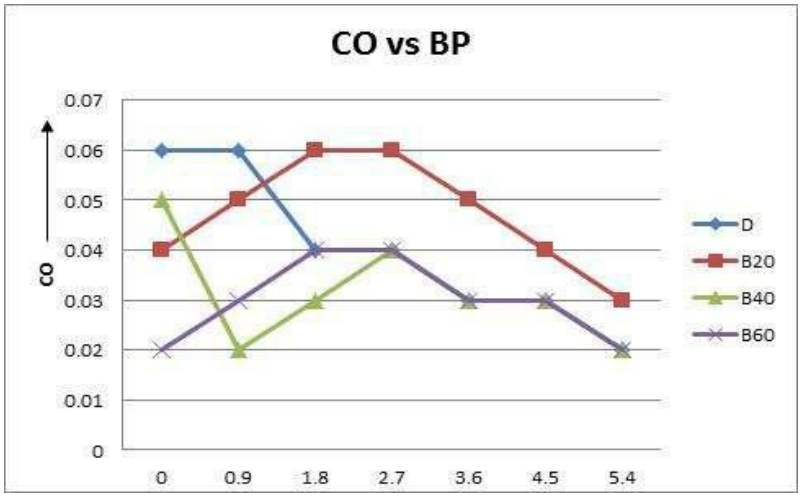


Figure 4 CO s brake power

The variation of carbon monoxide with brake power. From 4 all the blends of some showed reduced CO emissions at peak loads. The trend shows low of CO emissions from lower load conditions to peak load conditions. Some blends acted in similar to that of mineral diesel.

VI. BTE VS BRAKE POWER

Table 4 shows the break thermal efficiency obtained from the test rig

TABLE 4 BTE VS ENGINE POWER

x/y	D	B20	B40	B60
0				
0.9	14	15	15	15
1.8	22	23	23	22
2.7	25	26	26	26
3.6	27	27	27	27
4.5	28	28	29	26
5.4	29	29	30	28

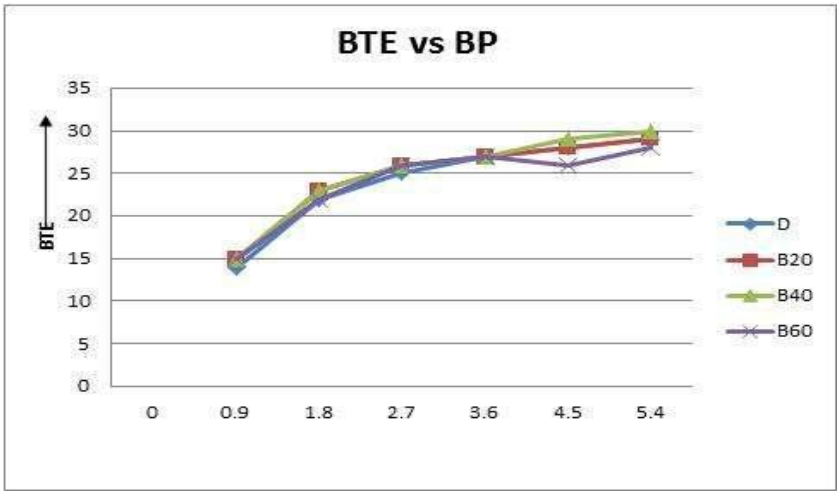


Figure 5 BTE vs BP

The variation of break thermal efficiency with break power. From the readings in the Table 4. At peak load, the break thermal efficiency for diesel is found to be 29% while that for GREASE is 30% as shown in Figure 5. The may be attributed to be better combustion occurrence in Engine. The some contains oxygen which may have facilitated better combustion

VII. SMOKE VS BRAKE POWER

Table 5 shows the smoke against the break power

TABLE 5 SMOKE VS BREAK POWER

x/y	D	B20	B40	B60
0	28	10	11	11
0.9	29	20	19	21
1.8	30	30	22	30
2.7	43	34	30	31
3.6	59	43	32	33
4.5	70	51	40	40
5.4	79	60	43	43

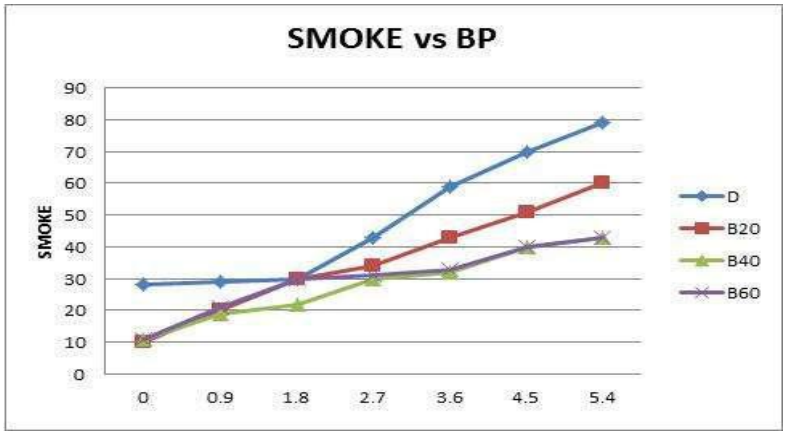


Figure 6 Smoke vs Break power

In case of various blends of some blends being tested by smoke meter, the smoke was drastically it will low in case of some. As the load increases smoke also increases but very less compared to mineral diesel as shown in Figure 6.

VIII. HC VS BRAKE POWER

TABLE 6

x/y	D	B20	B60
0	30	230	120
0.9	40	170	80
1.8	50	150	75
2.7	60	120	70
3.6	70	110	65
4.5	70	100	65
5.4	80	100	60

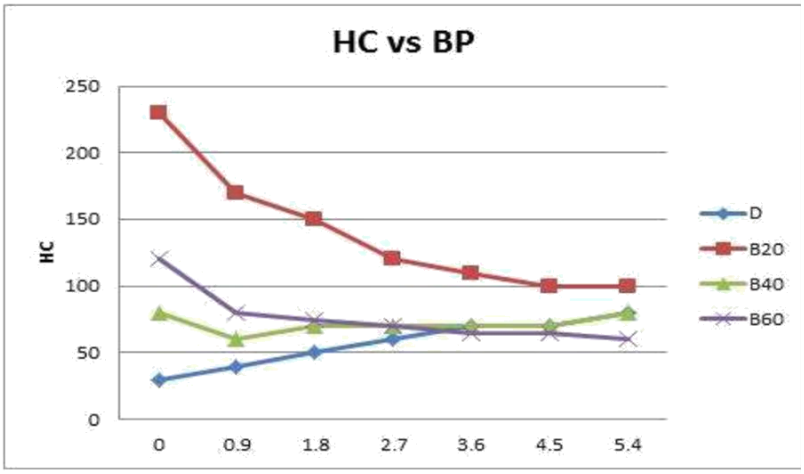


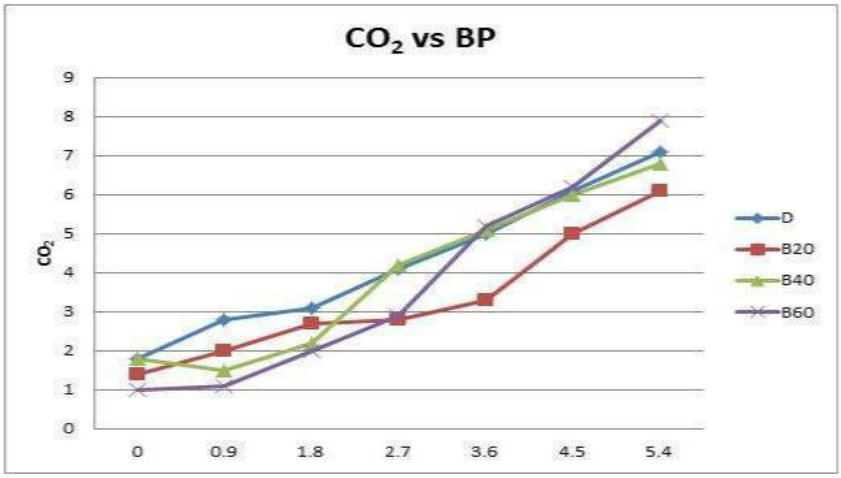
Figure 7 Hydro carbon Vs Break power

The variation of unburnt hydrocarbon emissions with brake power. HC emissions were found to increase for all the types of blends as shown in the Figure 7. But the B40 blend was having similar emission trend with respect to mineral diesel. Due to higher viscosity and density of SOME, the fuel flow rates are higher. Higher fuel entry in combustion chamber may create richer mixtures at localised spots in the combustion chamber which may remain unburnt. Due to lesser calorific value, combustion temperatures are also less which may trigger UNHCS.

IX. CARBON DIOXIDE VS BRAKE POWER

TABLE 7

x/y	D	B20	B40	B60
0	1.8	1.4	1.8	1
0.9	2.8	2	1.5	1.1
1.8	3.1	2.7	2.2	2
2.7	4.1	2.8	4.2	2.9
3.6	5	3.3	5.1	5.2
4.5	6.1	5	6	6.2
5.4	7.1	6.1	6.8	7.9



The variation of carbon dioxide with load. The carbon dioxide emission of some were in slightly reduced to mineral diesel as shown in Figure 8. The CO_2 emission decrease with increase in Ester on content in diesel emission were found to be close to diesel emission in case of B40 blend.

X. CONCLUSIONS

Burning of oil trap oil mixed energizes otherwise called biodiesel fuel, in a bad position free and motor operation smooth. Execution attributes of sesame methyl ester (BSEC) mixed powers are comparable with higher BTE and BP esteems at full/top load conditions. UBHC outflows are less when contrasted with diesel (HSD) however NOx emanations are higher. These outcomes are on expected lines. Oil trap methyl ester (BSEC) fuel arranged by means of transeterification is of prevalent quality. The conclusions got from introduce test examinations to assess execution and discharge attributes on electronic four stroke single chamber diesel motor fuelled with diesel-oil trap oil mixes with Ethanol and EHN as added substances are abridged as takes after.

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ANALYTICAL STUDY AND STATIC ANALYSIS OF STRESS IN INTERNAL COMBUSTION ENGINE PISTON IN ASPECT OF DIFFERENT MATERIALS

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ABSTRACT

Piston is one of the most important part in a IC engine, It acts as a disc which reciprocates within a cylinder. The main function of the piston of an IC engine is to receive the impulse from the expanding gas and to transmit the energy to the crankshaft through the connecting rod. As a result of combustion of fuel takes place inside engine cylinder; high temperature and pressure are developed in the cylinder. Consequently high thermal and structural stresses are developed in the piston. If these stresses exceed the designed values, the piston may fail. ***AIM OF STUDY-*** *Keeping these considerations in mind, 3D model of piston is designed in the designing Software called "SOLIDWORKS". Solidworks also gives us the freedom to do analysis on the piston, so static analysis is done in same software. In this study analysis is done considering different Aluminium alloys. A Comparison is made of results to find out the best material with the reference of useful factors like von mises stress, von mises strain and displacement were obtained.*

KEYWORDS: *Displacement, Engine piston, Factor of safety, FE Analysis, Solidworks, von mises stress, von mises strain.*

I.INTRODUCTION

A **piston** is a component of reciprocating engines. It is the moving component that is contained by a cylinder and is made gas-tight by piston rings. In an engine, its purpose is to transfer force from expanding gas in the cylinder to the crankshaft via a piston rod or connecting rod. Pistons are cast from aluminium alloys. For better strength and fatigue life, some racing pistons may be forged instead. Early pistons were of cast iron, but there were obvious benefits for engine balancing if a lighter alloy could be used. To produce pistons that could survive engine combustion temperatures, it was necessary to develop new alloys such as Y alloy and Hiduminium, specifically for use as pistons. There are many aluminium alloys have been

developed for manufacturing piston. In this study Finite element analysis of piston is carried out for 2 aluminium alloys named as Al 6061 & Al 7050. And a meaningful comparison is made to find the suitable material for piston.

Soniya kaushik et al [6], (2013) carried out an analysis and found that Aluminium alloy 7475-T761 is best material for the piston among Al 7475-T761, Al 6061, Al LM25.

Mr. Jadhav Vishal et al [7], (2016) performed a static analysis and concluded that AL-GHY1250 aluminum alloy material for piston is better than standard alloy material. So, further development of high power engine is possible by using this material.

Isam Jasim Jaber et al [4], (2014) A FE analysis was done considering three material Al alloy 4032, AISI 4340 Alloy steel and Titanium Ti-6Al-4V (Grade 5) and clarified that maximum stress intensity is on the bottom surface of the piston crown in all the materials, Maximum temperature is found at the centre of the top surface of the piston crown. And concluded that material Al alloy 4032 is the best suitable material for the piston.

Lokesh Singh et al [8], (2015) found that the design parameter of the piston with modification gives the sufficient improvement in the existing results. And The minimum factor of safety is greater than unity so our design of piston is safe under the applied loading conditions.

II. MATERIALS AND THEIR PROPERTIES

Materials and their properties for piston are mentioned below.

TABLE NO.-1

Material	**Elastic modulus (N/mm^2)**	**Density (Kg/m^3)**	**Yield strength (Mpa)**	**Tensile strength (Mpa)**	**Poison Ratio**	**Thermal conductivity (w/(m-k))**
Al 7050 T7451	72000	2830	470	525	0.33	157
Al 6061	69000	2700	227.53	240	0.33	154

III. DESIGN OF PISTON

During designing a piston, the following points should be taken into consideration:

- It should have enormous strength to withstand the high gas pressure and inertia forces.
- It should have minimum mass to minimize the inertia forces.
- It should form an effective gas and oil sealing of the cylinder.
- It should provide sufficient bearing area to prevent undue wear.
- It should disperse the heat of combustion quickly to the cylinder walls.
- It should have high speed reciprocation without noise.
- It should be of sufficient rigid construction to withstand thermal and mechanical distortion.
- It should have sufficient support for the piston pin.

The piston is designed according to procedures and specifications given in machine design and design data book. Dimensions are calculated and these are used for modeling the piston in SOLIDWORKS as shown in Fig.1.

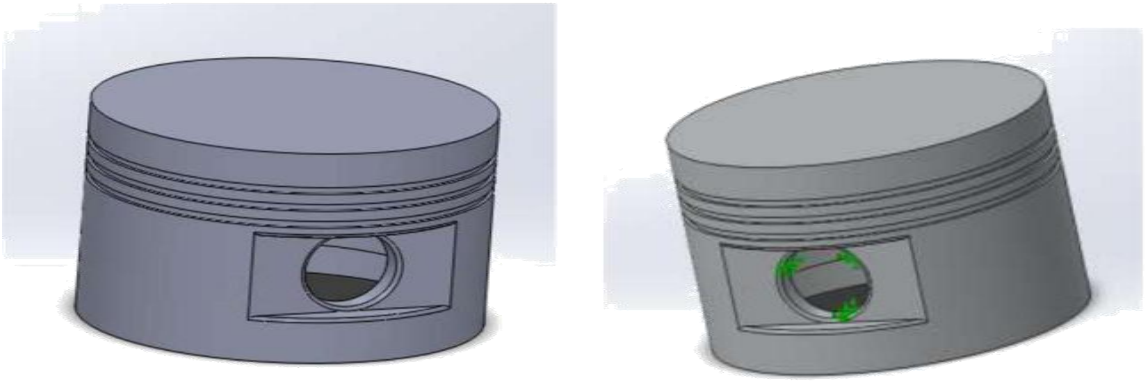


fig.1: 3d model of piston

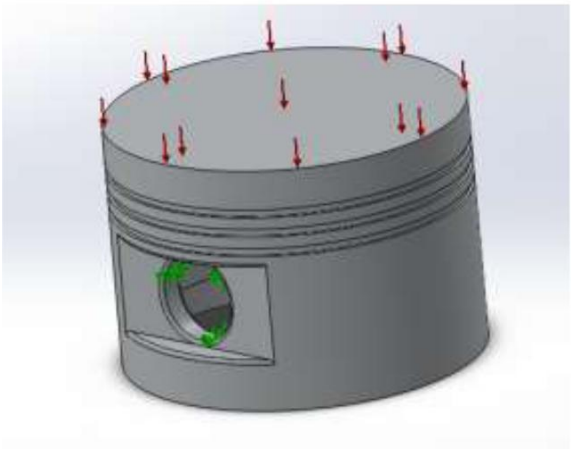


fig.2: piston in loading condition

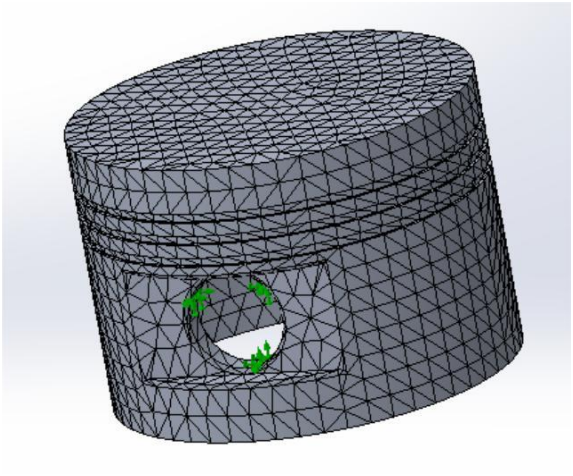


fig.3: mesh model of piston

IV. STATIC STRESS ANALYSIS OF PISTON

A 3D model is developed in designing Software SOLIDWORKS. And a finite element analysis is being done on this piston. For this purpose the boundary conditions are necessary to define.

V. BOUNDARY CONDITION

The maximum explosive pressure is taken as 8 Mpa, and it acts uniformly on the piston head. Because the piston will move from TDC to BDC with the help of fixed support at pin hole. Coupling restraints are imposed on two points on the bottom of piston in order to eliminate the revolving of the piston around the piston pin. The three freedom degrees of the piston pin are restrained to let the piston in a static condition for analysis purpose.

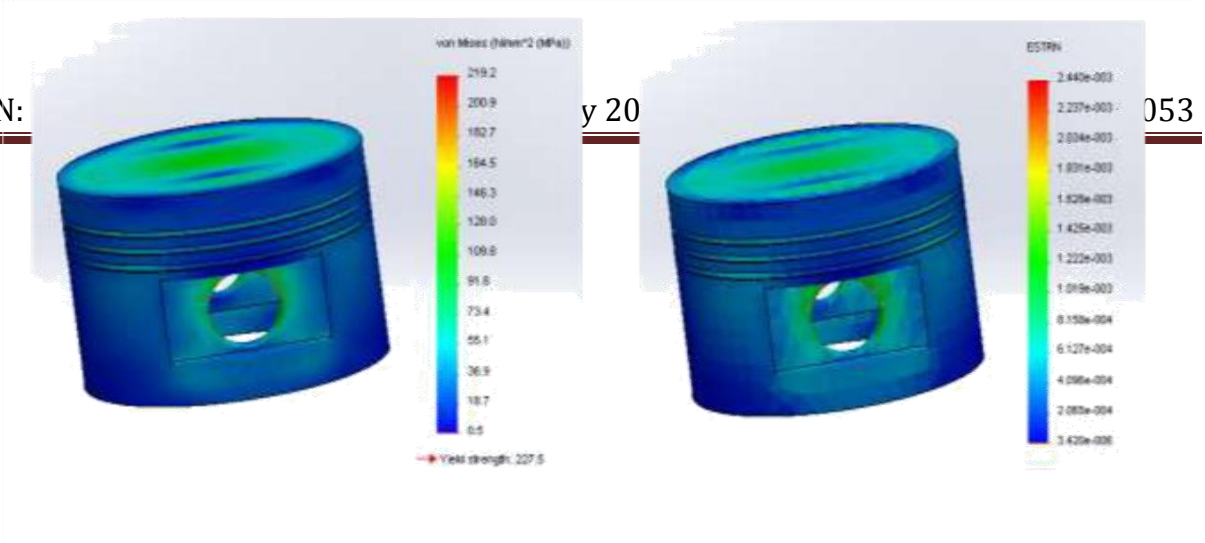


fig.4: von mises stress for Al 6061

fig.5: von mises strain for Al 6061

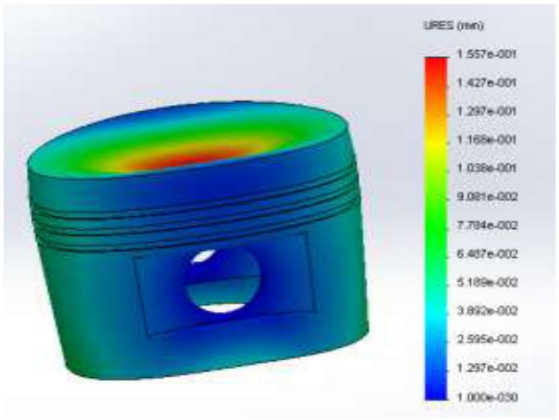


fig.6: deformation for Al 6061

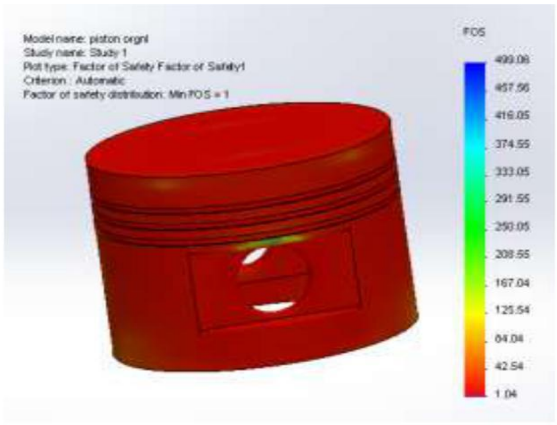


fig.7: factor of safety for Al 6061

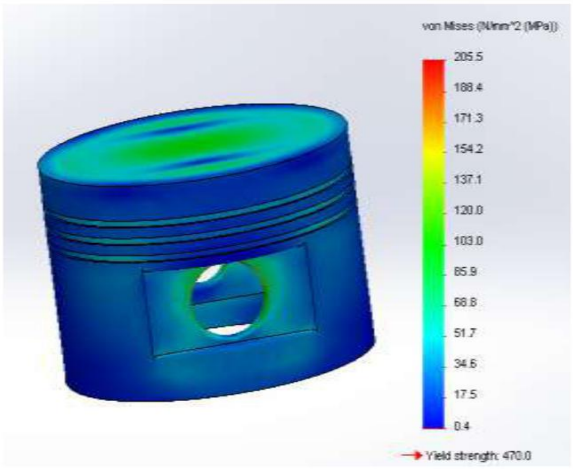


fig.8: von mises stress for Al 7050 T7451

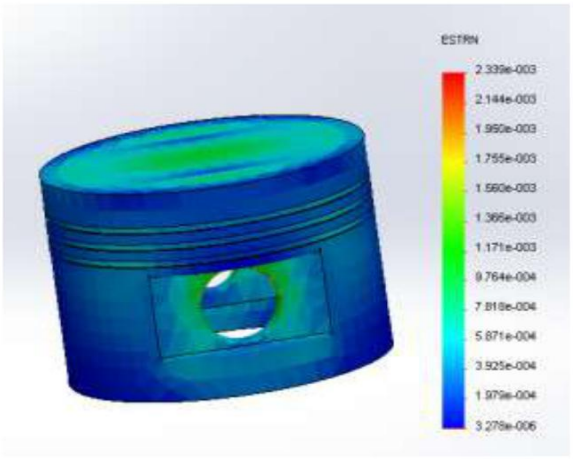
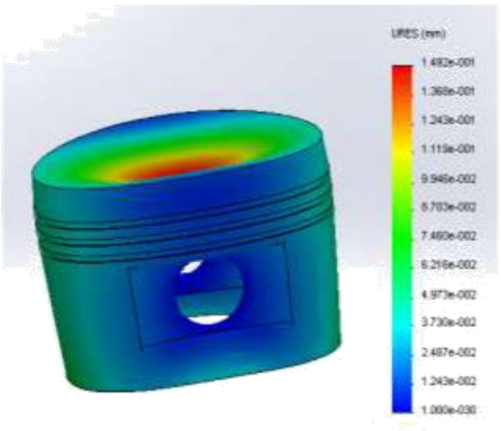


fig.9: von mises strain for Al 7050 T7451



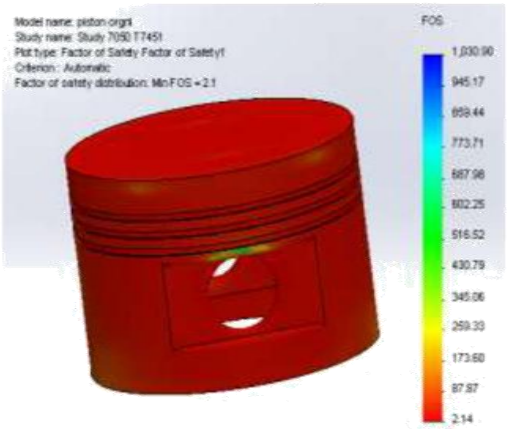


fig.10: deformation for Al 7050 T7451 **fig.11: factor of safety for Al 7050 T7451**

VI. RESULTS AND DISCUSSION

The values of total deformation, von-mises stress, von mises strain and factor of safety of two aluminum alloys Al 6061 & Al 7050 T7451 are listed below in table.

TABLE NO.-2

S. No.	Parameter	Al 6061	Al 7050 T7451
1	Max. Von mises Stress (Mpa)	219.2	205.5
2	Max. Von mises Strain	0.0024	0.0022
3	Max. Deformation (mm)	0.1557	0.1492
4	Minimum Factor of safety	1.04	2.14

It is cleared from the above figures that maximum von mises stress occurs at piston's crown surface, which is 219.2 Mpa for Al 6061 and 205.5 Mpa for Al 7070 T7451. And minimum von mises stress occurs at the piston skirt's lower region, which is 0.5 Mpa for Al 6061 and 0.4 Mpa for Al 7070 T7451.

It is also cleared from the above figures that maximum von mises strain occurs at piston's crown surface, which is 0.0024 mm for Al 6061 and 0.0022 for Al 7070 T7451. And minimum von mises strain occurs at the piston skirt's lower region, which is 0.00000342 for Al 6061 and 0.00000327 for Al 7070 T7451.

It is noticed from the analysis's results that maximum deformation occurs at piston's crown surface, which is 0.1557 mm for Al 6061 and 0.1492 mm for Al 7050 T7451. And minimum

deformation occurs at piston skirt's lower region, which is 1.0e-30 mm for Al 6061 and 1.0e-30 mm for Al 7050 T7451.

VII. CONCLUSIONS

In the view of above discussion, following conclusion can be made.

(A) Maximum von mises stress, Maximum von mises strain and Maximum deformation are minimum in Piston of Al 7050 T7451 alloy in comparison of Al 6061.

(B) Maximum stress, maximum strain and maximum displacement occur at the crown of the Piston.

(C) Piston design is safe for Al 7050 T7451 alloy based on the yield strength & ultimate strength.

(D) The minimum factor of safety of Al 7050 T7451alloy is more than Al 6061 so our design of piston is safe under the applied loading condition.

By observing the above views it can be concluded that Al 7050 T7451 is the suitable material for using in production of Piston.

VIII. FUTURE PLAN

In this work static structural analysis is done. For getting more clear and better results we can do Thermal Analysis also in next study.

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IDENTIFYING THE FUTURE TESTING & TECHNOLOGY METHODS USED IN AUTOMATIC SELF DRIVEN CAR

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ABSTRACT

Now a days, driving is very critical to the peoples as there rapid increasing in vehicle traffic. On the other hand as traffic increases the possibilities of accidents also increases result people scares to travel. Most of the people like physically handicapped, having blur vision, children's and due to age factor they don't dare to drive the vehicle. In new generation of cars the system becomes so advance that it is moving from mechanical to the electric and electronic system technologies as it reduce the human efforts. In this report, we show about the technologies used in cars and how they can change the strategy of driving so that people can trust. Trusting of people accelerates the development which is also safe, quick, low cost and reliable to the people. Even these technologies reduce all the human inputs nearly up to 99.00 %. So we are discussing about the vehicle which made autonomous from automated by using various technologies, classification of vehicles, description of technologies, how they works and how human input and the possibilities of accidents reduced. On the second hand, it is also necessary to review the people about the methodologies of testing of these vehicles. In this we learn about the vehicle testing related methods, vehicle functional testing and the system validation approach. At last we discussed about the conclusion and the future aspects of autonomous vehicles.

KEYWORDS: *Automobile, Autonomous, Safety, Technology, Testing*

I. INTRODUCTION

Autonomous means Self Governance, Autonomous Vehicle which drives by itself. It is the next revolution of automotive industry and have impact reaches most aspects of our lives, like it has lower mobility cost as it increases the efficiency, consumes lower energy resource i.e., renewable sources which helps to reduce the emissions, gives personal freedom for those who currently cannot drive because of age, blindness, fear of traffic accidents and fatalities which increasing day by day or by other reasons. Some technologies are already used in cars and the development

is continued but still people don't know about them and they fear to adopt it, reason lack of trust. Many systems are evolved in India, but as of 2018 no cars are permitted on public roads were fully autonomous as people requires vehicles which is ready to take control at any time.[1]

The goal of this paper is to bring attention towards these great advances which currently used in automotive field and to adopt this crucial and highly beneficial technology without any misconceptions. Driver error is the most common cause of accidents due to lack of decision, response and attention during driving and when the human brain is replace by technologies it naturally improves the driving as they have faster response to take decision.

An autonomous vehicle also called Un-manned grounded vehicle, a robotic vehicle that designed to travel between destinations without human operations. It is well qualified and fully capable to sense the environment and to navigate itself without any human input, only the destinations from origin are to be set by human.

An Autonomous cars use a variety of techniques to detect their surrounding such as Radar, Laser Lights, Global Positioning System (GPS), Computer Vision and Advanced Driver Assistance Systems (ADAS) and several sensors. These control systems interprets the sensory information to identify obstacles, gives navigation paths and relevant signage, as well as they allow for taking decisions. They are capable to analyze the sensory data to distinguish between other cars moving on the road which is useful to eliminate accidents and they make plan for choosing another path to reach the desired locations in less time as possible which is a great advantage for human. Furthermore, as the great precision of automatic systems available in vehicle they could improve traffic flow, increases highway capacity and reduce the traffic jams.

An autonomous car not only moves freely without any communication connection to the cloud or other vehicles. They are interconnected with Vehicle-To-Vehicle (V2V) for better approach to reach in case of emergency also, Vehicle-to-Infrastructure (V2I) for upcoming traffic signals, Vehicle-To-Network (V2N) for traffic queues nearly up to 5 kilometers ahead and Vehicle-To-Pedestrians (V2P) for people walk away. These interconnections are necessary to make the car more advances and it makes the people trustworthy to adopt it. [2]

After the buildup of these cars, system safety and testing is the next challenge for autonomous driving and to assured it, they must be highly précised and accurate to the surrounding models. Hence the testing process is done to cope with this in such a way that they should be able to take the decisions in different modes of failure and when the dangerous situations of the real world are happened. There are many approaches which we are going to discussed for driving test of vehicle. These methods are very useful to test the scenarios and it is enough sufficient to make the vehicle legal in the country after fulfill the needs of autonomous drive. In the world, Nevada, US became the first jurisdiction in year of 2011, which is allowed to use the self-driving cars on public roadways. Also several companies are developing and done the testing on it include Google, Volvo, Volkswagen, BMW, Ford, Mercedes Benz, Audi and many of them get the positive results as a single accident is occurred during one of the infrequent occasion is arrived when a human is driving. After the repetitions of testing, at last another test of over 1000 miles was completed successively without any human instruction. Finally the commuters are allowed to do other things while travelling such as working, reading or sleeping.

In this report, I review about the car technologies and how they make it fully autonomous. Also I review about the existing test methods of autonomous driving, functioning, verification and

validation. It will be helpful for safe and quick reproducible testing at low cost and accelerates the future development.

II. AUTONOMOUS CARS

In this section, we are discussing about the technologies used in vehicle which makes it fully autonomous, all these technologies are interconnected to the monitoring device it collects the sensory data and interprets it. First of all, **LIDAR** (Light Detection and Ranging) called "Heart of the system" a sensing technology located on the roof of vehicle, put the laser in every direction and calculate the time it takes for the light to bounce back which measures the distance between the car and object, repetition of this occurs by doing so it creates a 3D map of the car's surrounding, its range is up to 60 meters. It is necessary to understand the environment for the system so it takes the decision about where to move or stop. When the map is created by LIDAR it correlates with GPS receiver which tracks the altitude and location of system. After this second technology, called **AGVS** (Automated Guided Vehicle System)[3] is located on the dashboard of the car; it helps to guide the occupant and to navigate the vehicle automatically. The map is pre-installed in memory of monitor and by using GPS (global positioning system) vehicle knows the traffic flow, highway capacity, time to travel the distance and which one path is better to drive. Only the origin and destination is to be select by the occupant and then the decision is taken by the fully autonomous vehicle automatically. Even when the car is empty, we can call the car by android or by other predefined gadgets to system at any place to receive us. This could be possible when the navigation is provided to the system. We discussed that the vehicle knows it's surrounding by using LIDAR and the path is followed by the prediction using AGVS navigation system.

Now the major query is arrived that how the vehicle moves on desired path with or without occupants without any human input, how the vehicle maintains the speed or stop when the obstacle is come in front of it, how the vehicle keep itself on the lane, how the vehicle stabilize itself during motion on non-uniform paths, how the vehicle park itself at parking spot or places after it drops the occupants and at last "Is the autonomous car is safe for human being ? " when it moves in the real world. These queries are solved when remaining technologies is described.

The third one technology is called **ACC** (Adaptive Cruise Control) system[4] which helps to vehicle move on desired path chosen by AGVS system and it does not only moves the car constantly, it increases and decreases the speed of car, automatically re-accelerates when the vehicle is stop and maintains the proper distance in same lane to avoid collision. The distance is set by cruise control switch in manual but in fully autonomous it is already preset. Technology behind this is LIDAR, sensors located around vehicle (nearly up to 12 or more), cameras-connected to monitor. Vehicle moves when the LIDAR sends the information to the monitor to accelerate the vehicle when the path is cleared and the throttle sensor controls the throttling/actuator device which is responsible for engine rpm; more the throttle angle is more the vehicle achieves speed, when the obstacle arrives it sends the message to slow down or to stop the vehicle and then brakes are applied.

At the same time when the vehicle gets acceleration, the fourth technology called **LKS** (Lane Keeping System) is participated. This is a mechanism which is designed to keep the vehicle on lane by detecting the line markings on the road surface so the vehicle doesn't tends to move outside. The device used is very high tech protected Laser or Infrared Sensor or camera to detect the markings mounted on the top of windshield or at both sides of bumper. They send the virtual

image of road to the monitor to analyze and after it recognize to steer the vehicle and also to take the turn, turning radius is given by this system; this simulation of data and command is done in microseconds. In partial autonomous vehicle, LDWS (Lane Departure Warning System) is used in place of LKS, as it is designed to warn the driver when the vehicle moves out of its lane in different ways. Like when your car leaves your lane, system will give you warning signal usually an audible sound with flashing lights to get your attention, if still you did not take any action then another signal of vibration on steering wheel and on driver seat is occurs and at last when no response is given by you in time the safety system is activated and brakes are applied automatically to stop the car itself.

When the vehicle moves, takes turn or achieves top speed it is necessary to consider the problems of directional instability, drifting, under/over steer of vehicle also rollover effects, yawing effects and other side or wind forces (gust) which leads to loss of control; to avoid this the another fifth technology called **ESC** (Electronic Stability Control) an active vehicle safety system is activated simultaneously with other technologies during driving.

ESC works with the traction control system as driving safety system when the vehicle shows a tendency to leave the driver's intended path i.e., under/over steer or exceed a lateral acceleration threshold, the system intervenes by selectively applying appropriate brakes to get better align of vehicle and in fully autonomous it assist the vehicle to maintain itself. Behind this on wheel is speed sensor, on steering angle sensor and on center of vehicle the rotational sensor is used to analyze the motion of vehicle in stability control system. The movements is recorded by these sensors and the data is send to the monitor for analyze then monitor monitoring the actuators by sending the interpreted data to stabilize the vehicle.

Note – ESC take the charge of monitoring side-to-side motion around a vertical axis, whereas Traction control takes the charge of monitoring front-to-back motion. If the traction control system detects wheel slippage, the ESC sensor will pick up the direction of slide. Another side when there is a difference found between steering wheel angle and the direction of car sliding, then ESC activated to work with traction control system in such a way that it engage the Anti-Lock Brake System at the proper wheel/wheels and it control the throttle to reduce the speed of the vehicle.

Generally, a car might take five seconds to decelerate from speed 100 kilometer per hour under ideal conditions, but nowadays we need to stop spinning of vehicle within a second or less than a second. To achieve this, the next technology called **ABS** (Anti-Lock Braking System) [5] is used; it monitors the speed of each wheel to detect locking and reduces the stopping distance to avoid collision. Hence ability of stopping the vehicle is improved.

In Partial Autonomous Vehicle or Manual Driving when sudden brakes are applied it will release the brake pressure for a moment and then provides the optimum brake to each wheel. This process repeated several times in short duration of time, also it enhances the steering control during sudden stops as vehicle is steer easily at high speeds. In Fully Autonomous Vehicle, when the obstacle is come in front of car which is detected by LIDAR, the controller sends the command to release the braking pressure it is done by pump, when the pressure is released (via brake line) to the valves (implemented on wheel hub) they opened and force exerts on the spinning wheel which causes vehicle to stop. Here, monitor decides the breaking force i.e., either it slows down the vehicle or to stop vehicle, depending on the surrounding of vehicle as sensors senses at all times.

Note – Occupants inside vehicle feels pulsing when the ABS is in operation; this comes due to rapid closing and opening of valves. Some ABS systems can cycle up to 15 times per second.

At last when occupant reached at destination they must be sincere about "If vehicle should be fully autonomous then where and how the vehicle is parked?"

To overcome from this situation the another technology called **APGS** (Advance Parking Guidance System) is used to guide the vehicle at parallel parking places (At the corner of roads) or to park the vehicle at parking spots like in Lexus LS 460 L. In partial autonomous vehicle, the driver has to find the parking space using AGVS in navigation screen to tell the vehicle where it should go this is to be chosen in parallel parking place. In fully autonomous vehicle, no need to find the parking place it find itself and parked at the parking spot by using advance technology includes AGVS, GPS, IR, surrounding Cameras etc.. Vehicle needs space to park up to 10 feet or longer than the car. Occupant also parks the vehicle at their own place they only need to set their parking place in their navigation system so that vehicle knows the parking. At last occupant only calls the vehicle by predefine gadgets when he wants drive.

Finally, from beginning to end we discussed about autonomous driving by this we committed that autonomous driving is safe and it is able to tell us about any ethical problem or any technical obstacles if comes during driving then for occupants safety the **Airbags**[6] are implemented on the dashboard and on the doors of car which keeps driver safe even when vehicle collides. Airbags are used to reduce injuries as they prevent the chest and head of occupants occurs from collision. It is simple and clever because bags are inflated (due to chemical explosion causes release of harmless gas, this inflates the bag at speed of approximately 300 kilometers per hour which is very faster comparing with car crash speed) and then deflated by holes at edge when occupant pushed against the bag. Also for safe drive purpose in autonomous cars, **Adaptive High Beam** and **Automotive Night Vision System**[7] is in built to project high/mid/low beam of headlights or dippers automatically when the intensity of light if come in front of vehicle during night drive and the night vision system is used for better view for occupants it uses IR, Laser, etc..

III. TESTING METHODS

Before autonomous drive it's necessary to test the autonomous vehicle for safe drive as all vehicles should be eligible for crash test. In this section, we discuss about driving testing related methods, testing of functional system and last method of evolution testing.[2]

Note - "loop" is a computer language command which is used for repeating cyclic process and "simulation" means testing of program to gain a desired action or behavior.

First step, millions of line codes, equations and algorithms are used and tested by using different software's by this software testing is done. Then it is implemented in the hardware namely installation chips, arduinos, controllers and in memory of computer, this step is further tested to observe the working of system actuators, sensors or vehicle components it called as simulation test. Both steps are repeated many times so named as "X-in the loop" where X refers to either software or hardware. In short form they called SIL and HIL. X-in the loop is responsible for receiving or sending the data from surrounding of vehicle to the monitor of vehicle to perform action and vice-versa. After implementation of equipment a single autonomous vehicle is prepared for testing and when it is done perfectly they are connected to another vehicle to create communication cloud like V2I, V2V, V2P, V2N etc. this is the third step and last step is done

when the vehicle driving test is performed successfully with or without obstacles and then in real traffic.

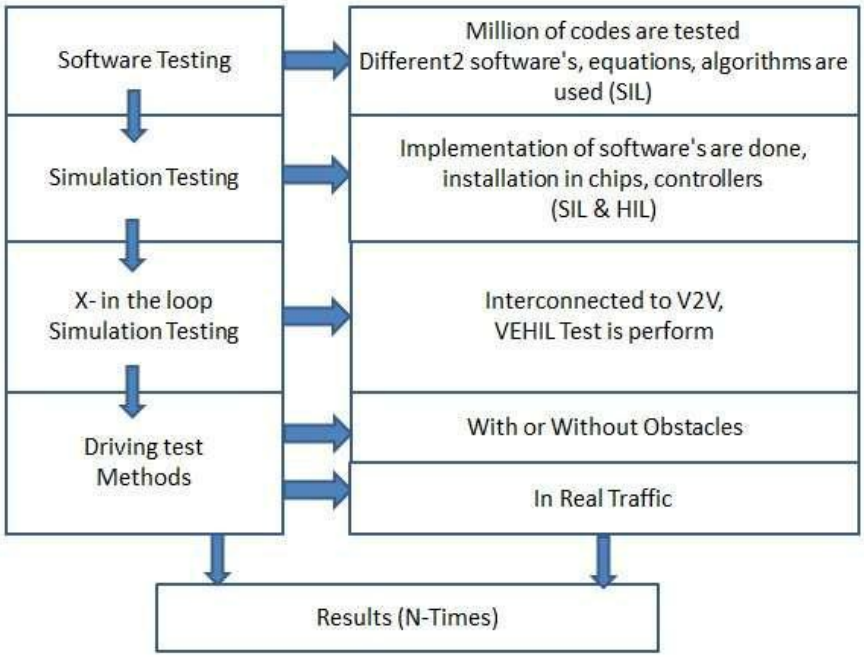

Fig 1 – Testing Related Methods Flow Diagram

After creating the communication cloud between vehicles the testing of functions is done to check the model of an autonomous vehicle which depends on the driver behavior, sensor and actuator followed by this autonomous system model. It consist the Perception, Decision and Action Layer. Now a day, advanced and new technologies, such as adaptation and learning, the existing test/validation methods are insufficient. These new challenges require considering established technologies like formal verification it is done when models data are compared with the real data to evaluate or compare the performance by both datasets with the help of statistical characteristics.

The first step of the functioning test is perception layer which is responsible for the acquisition of all data comes from environment through vision or radar or all other sensors used near actuators. After it they merge to a unique fusion map. By physical tests, software test or HIL simulation test, both the various sensors and environment perception layer are tested. The assessment criteria are obtained, including the state and errors of the posture and localization, the detected pedestrians, lanes, traffic signals and lights, other vehicle and other related elements. When the perception layer of the autonomous car is completed the data is transferred to the system where it takes the decision "What to do?" The ability to take these decisions is pre-installed to the system according to the situations of real environment. The n cases of situations are pre-setted to the module so that it cannot be confused to take it. Further optimizing this data acquisition it interprets all the incoming data to generate a reasonable output to the Action Layer. The Situational Assessment are defined to the chip in categories of short and long term planners; they should influence each other to avoid short term decisions which do not accomplish the overall goal. Artificial Intelligence algorithms are commonly used in the Decision Layer mainly due to the highly non-linear behavior of real environment such as Neural Networks, Machine

Learning, etc. Majority to take decision is like to vary the speed or to stop whenever any obstacle is come in the front of car. Many of the vehicles are able to overtake the car even they decide to move continue after the vehicle stopped like during intersection of roads, and following the traffic signals, it avoid the collision. The driving system reaction characteristics are used for indicators, including reaction time and operating correctness etc. After taking decision this navigation layer function test is done by driving test and simulating. It performs the higher level of tasks related to driving such as controlling the global objectives, trajectory planning, efficiency and commodity, taking into account the driving conditions. The Path planning error is used for assessment criteria; evaluate the capability of the algorithms to avoid collisions with other objects, at any time.

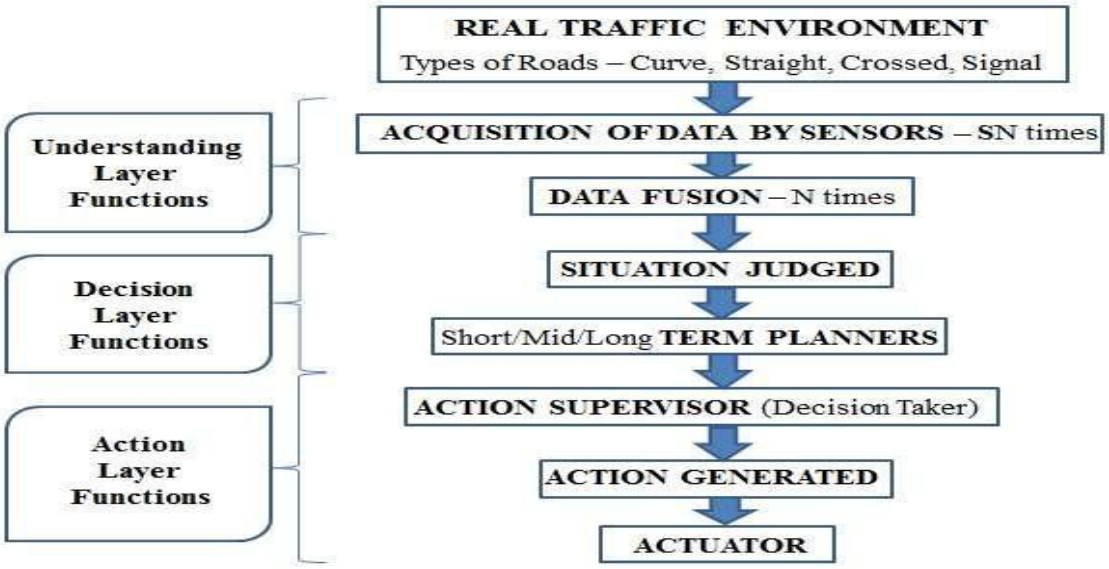

Fig 2 - Functional Flow Testing

At last, Action layer test is done. Sensors like actuators are tested about their response and how they behaves after they receive the command from decision layer via navigation system to take the action by supervisor, it sets up the abstract decision into set points to be fed by the actuators controllers. The action generator denotes the system controllers and performs the low-level actions in the actuators, also monitoring the feedback variables to further process the new actuating variables. The control level is the lowest level, i.e. the physical control of the vehicle, i.e. the sensors and actuators of the driver's model. It is evaluated by test drive or simulation ways. The vehicle trajectory deviation, acceleration and jitter are used to evaluate this module.

For the validation of the autonomous vehicle system various steps are taken the simplest approach is to allow the vehicle to complete the specified task at different level of complexities so it has to become more ability to avoid the errors of system, failure of decision, taking the proper navigation and avoidance of collision. It can be done by tremendous algorithms evaluation. By analyzing autonomous driving functions, lists of simple function test cases are selected and assembled into different testing processes, which are further abstracted as driving tasks sets. By analyzing specific driving tasks sets, autonomous driving functions can be evaluated. Autonomous driving tasks tests are carried out under different simulation or real environments. By a formal evaluation process, including tests design, recording and evaluation

and completion verification, all driving tasks completion are finally evaluated with different task complexity property and different environment complexities.

Based on these autonomous driving testing practices and other related works, we summed up an Autonomous Vehicle evolutionary design and testing comprehensive flow.

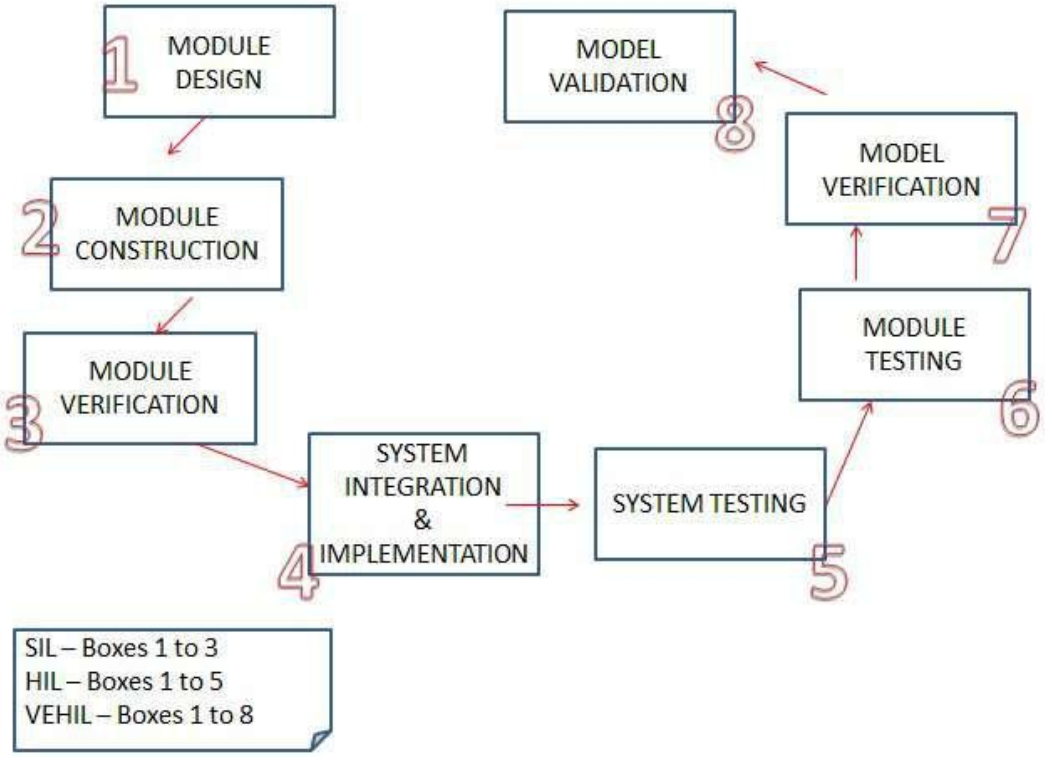

Fig 3 – Vehicle Design and Validation Flow

Finally, when these testing methods are successfully done the flow of testing in real traffic taking several cases are to be held after the succession of these tests its validation is completed.

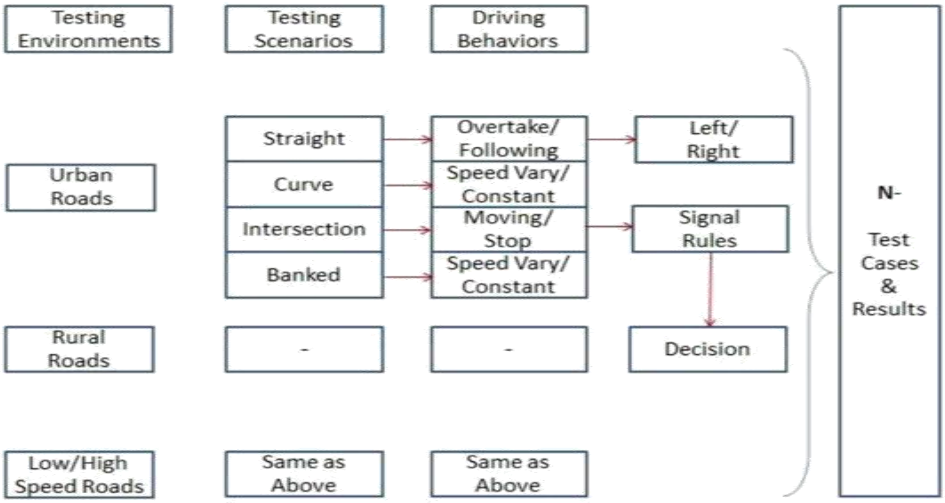

Fig 4 - Real Time Testing Cases & Techniques

IV. CONCLUSION AND FUTURE ASPECTS

If the sensors of the car are the eyes, the processing unit is the brain. Processors take all the data collected by the sensors and turn it into actual driving. We might think that machines would naturally be better at driving than humans, with faster responses, automatic decision-making, and an infinite amount of attention and stamina. However, cars still need to "learn" how to drive because it's an offline process. The following technologies could provide moderate to high benefits to older drivers like lane departure warning, forward collision warning, parking assist systems, navigation assistance and adaptive cruise control system only if proper training is provided to human to operate it. We conclude that they are too early in development to be able to assess the benefits for older drivers. Many of these technologies are available today in vehicles, while some of the technologies are under development and are expected to be available in the near future. Also we conclude that the autonomous vehicle is still in the infancy stage. There is a considerable road to travel before maturity, implementation, and mass-market release are achieved. The path is still problematic, facing several challenges. Perception of the environment remains the biggest challenge to reliable, smooth, and safe driving. There is a long list of research questions covering a wide scope that will need to be addressed and answered, including but not limited to customer acceptance, societal impacts, communication technologies, ethical issues, planning, standards, and policy. Software challenges such as system security and integrity have also emerged as serious issues to be addressed. These in turn have a number of policy implications including the challenge for policymakers to streamline and regulate many diverse vehicles with different operating constraints. It is also of paramount importance for policymakers to ensure that drivers understand these vehicles' capabilities and can operate them safely. One of the challenges ahead is to connect several intelligent vehicles to each other. In this report, we shed light on transport related themes that are directly or indirectly and positively and negatively affected by emerging autonomous vehicle technology. Examples are land use, safety, vehicle-kilometer-traveled, parking, variation of demand, and fuel consumption.

In the near future, autonomous vehicle will be an indispensable part of modern transport systems. Furthermore, in light of such rapid changes in intelligent transportation systems, the education system must without question, align itself with these emerging technologies. Traffic engineering schools must reform their curricula to ensure that they cover more diverse subjects including communication technologies, software development, electrical engineering, and environmental and energy sustainability.

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I offer my sincerest gratitude to my guide Dr. Brajesh Tripathi, who has supported me from the preliminary to the concluding level with his patience and knowledge. I encouraged by my sister Mrs. Shraddha Srivastava, without her this report would not have been completed.

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CLOUD STORAGE DATA PROTECTION THROUGH RANDOMIZE SECURE TAG GENERATION PROCESS

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ABSTRACT-

Cloud computing is computing is pictured as the cutting edge innovation. It is an Internet based innovation where quality administrations are given to clients including information and programming, on remote servers .Cloud registering is additionally called Data re-appropriating as an outsider gives stockpiling administrations to client. This is more financially savvy for the client as there is no need of buying costly equipment and programming for information stockpiling. Prior to information out sourcing can end up conceivable, the information supplier needs to ensure that the information is secure, have the capacity to make exchanges, and the exchanges should likewise be secure and not unmistakable to the information supplier. In this paper, we will talk about current methods for verifying customer's information on remote cloud server. This paper point is to talk about and examine how accomplish alleviation for Cloud computing security hazards as a fundamental advance towards getting secure and safe condition for distributed computing. Cloud computing is a decent stage for research and application of information mining, for the reason that it gives incredible limits of capacity and figuring, great asset the executives based on virtualization and asset sharing model, and complete administration framework. Be that as it may, examination on information mining in distributed computing condition is still in its early stages

KEYWORDS: *Cloud computing, Cloud security issue, Support vector machine, Cloud, integrity, confidentiality, outsourcing*

I. INTRODUCTION

Distributed computing signifies a noteworthy change by they way we store data and run applications. Presently Instead of running projects and information on an individual work station, everything is facilitated in the "cloud"— a mutual pool of PCs and servers got to by means of the Internet. Distributed computing gives the office to get to every one of the archives and application from anyplace on the planet and enables numerous gathering individuals to team up

from various areas. One of the greatest component of distributed computing which is broadly utilized is Data stockpiling capacity. A few free and solid online capacity administrations accessible to the clients are Microsoft Sky Drive, Apple iCloud ,Google Drive, Amazon S3, Drop box and Gspace. As we become more acquainted with such a large number of points of interest of distributed computing however everything has a few upsides and downsides both and distributed computing isn't a special case. There are a few questions in clients mind before moving towards distributed computing.

As the utilization of distributed computing winds up broad, security of the redistributed client information turns into a critical research subject.

The parameters that are thought about for information security are Confidentiality, Integrity, and Availability. The issue of re-appropriating information faces the accompanying hindrances:

Confidentiality: - Can we confide in some outsider and offer our private information with them? Does our information stay classified over cloud? Despite the fact that a specialist co-op gives the assurance of securing the protection of client information, actually the information is physically situated in some nation and is liable to the neighborhood tenets and guidelines. A portion of the nations enabled the seller to get to the client's Data as per their guidelines and Regulation. Under such conditions it ends up critical for the client to guarantee the security of their information before putting the information over cloud.

Accessibility: - Does the information that we have put away on cloud would be accessible at whatever point we required it for example Accessibility of information. At the point when client is completely depended on information put away at distributed storage, it ends up fundamental that it would be effectively gotten to.

Integrity: - The information re-appropriating party must offer assurance to the client that the information that they have put away on cloud would not be changed or adjusted by any unapproved client.

These are a few questions which come in the brain of each client or association who needs to change to distributed computing. In this paper, we will examine a few systems utilized for giving security of information stockpiling in distributed computing.

1.1 BENEFITS OF CLOUD COMPUTING

The factors that make more companies to move cloud are

- Improves Flexibility
- Reduces the maintenance cost like no need of licensed software fee for each system, the purchase of new hardware and software is reduced.
- Access to the application can be done anytime, anywhere provided that they should be connected to internet.
- Scalable
- Disaster Recovery
- As the services are based on ”Pay per use” ,capital expenditure can be reduced
- User Friendly Environment
- Quick Deployment
- Less Energy Consumption

II. RELATED WORKS

Many of the researches have been done till so far in which different security techniques have been discussed.

In, a data protection model was proposed where data is encrypted using Advanced Encryption Standard (AES) before launching in the cloud, which ensured data security. Data encryption is traditionally used to provide confidentiality while outsourcing data to cloud service provider. Hacigumus et al. discusses a method for executing queries over encrypted data, at the cloud service provider's site and suggests splitting a query into two parts, namely the server query and client query. The server query is executed over the encrypted data at the service provider side and the other part over the result of server query, at the client side.

Hore et al. describes techniques for building privacy preserving indices on sensitive attributes of a relational table, and provides an efficient solution for data bucketization.

Agrawal et al. highlights the benefits of using the order preserving Encryption scheme(OPES) for querying numeric data.

Private Information Retrieval (PIR) was first discussed in [5]. PIR protocol hides the queries performed by the user on a public database, stored on a set of servers. The PIR

protocol provides the privacy of user queries which tends to hide the user's intensions from the service provider.

After that a new protocol Symmetric Private Information Retrieval (SPIR) has been developed.

Its main concern was the privacy of user data.

One of the most widely used techniques for data outsourcing is Secret Sharing techniques. Shamir's Secret sharing [6] method and Rabin's Information Dispersal [7] Algorithm (IDA).

III METHODOLOGY

Classification is an important mission in data mining, and probably has become the most studied data mining task. In this task, the goal is to predict the value of a specified goal attribute (called the class attribute) based on the values of other attributes (called the predicting attributes).

Generally speaking: With pairing based cryptography each attribute is represented as a group element. By virtue of the bilinearity property it allows for two independent sets of operations to be performed upon a set of group elements representing each Pi 2 P. These operations hide the secret exponent among the group elements such that when the result of these operations are combined if the conditions are right the secret exponent to be recovered. These conditions are dictated by the LSSS.

The precise use of LSSSs to hide and recover the secret exponent is dependent not only upon the placement of the predicates within the PBE scheme but also upon the exact predicate used. For the remainder of this section, a general overview of how LSSSs are used as part of both CP and KP schemes. Section 8.5 provides a concrete example of how one can use LSSS precisely as

3.1 Cipher text-Policy

with CP schemes a message will be encrypted under an access policy A and can be decrypted from a key that is derived from a set of attributes S. The use of LSSS within CP schemes can be

seen as LSSS in its standard form. Encrypt The LSSS is used to generate piece vectors, from the secret exponent, for each group element that represents an attribute Pi 2 P as de

Recall from Section 7.3.2 that with CP schemes a message will be encrypted under an access policy A and can be decrypted from a key that is derived from a set of attributes S. The use of LSSS within CP schemes can be seen as LSSS in its standard form.

Encrypt The LSSS is used to generate piece vectors, from the secret exponent, for each group element that represents an attribute Pi 2 P as defined in A. These vectors along with a description of the LSSS are stored alongside the encrypted message.

Key Generation With the generation of decryption keys each user is assigned a set of attributes represented as a set of group elements modified by some random secret value.

Decrypt During decryption the LSSS, described in the cipher-text, will only reconstruct the secret exponent if an authorized set of attributes can be found within the elements of the decryption key.

Key-Policy

With Key-Policy schemes, a message will be encrypted under a set of attributes S and can be decrypted using a key that is derived from an access policy A. The use of LSSS deifiers from its standard use.

Encrypt After the message has been encrypted the secret exponent is hidden among a set of group elements that have been derived from each Si 2 S, the encryption key. These elements along with a description of S are stored along side the encrypted message.

Key Generation When generating the decryption key, the LSSS is used to distribute a secondary secret value among each attribute Pi 2 P from A. The resulting piece vectors and description of A are returned as the decryption key.

Decrypt With decryption the LSSS, taken from the decryption key, will only reconstruct the secret exponent if an authorized set of elements exists within the elements stored alongside the cipher-text.

IV. CLOUD ENVIRONMENT LAYERS

Cloud computing attracts many managers and organizations. There are many similar terminologies that are usually utilized for describing cloud computing, these terms such as: distributed, grid, cluster, virtualization, on-demand, utility, and software-as-a-service. In other words, cloud computing refers to end -users connecting with applications running on sets of shared servers, often hosted and virtualized, instead of a traditional dedicated server.

A. Deployment Models The deployment models can be categorized into four categories namely Public cloud, Private cloud, Hybrid cloud and Community cloud [6]. These categories will be described in details as follows:-

• **Public Cloud,** this model is owned by an organization for selling the cloud services and the design of infrastructure is made in order to be available for industries, organizations and businesses.

• **Private Cloud**, this model is managed by the organization itself or by a third party. Private cloud may be either off or on premises. The major characteristic of this model is that the infrastructure of the cloud is private, in addition to its availability to a single organization.

• **Hybrid Cloud, this model** is similar to the private cloud as it is managed by third party or by organization itself and may exist off or on premises. But the cloud infrastructure may combine two or more clouds (public, private or community).

• **Community Cloud, this model is similar to the previously mentioned private and hybrid cloud** as the organization or third party are allowed to manage it and also exists off or on premises. But in community cloud, multiple organizations with common interests, requirements, or considerations share the infrastructure.

The security of the cloud needs testing, it is important for organizations that want to ensure the optimal product before distributing it. The results are used in finding out security weakness points and to patch them before the occurrence of penetration. However organizations' lack of time and resources, computer related crime is usually on the rise. Consequently penetration investigators (testers) have to reduce the amount of resources. This motivates testers to widely adopt automatic tools, as it is demonstrated by the continuous release of platforms finalized to automate this process, discovering gaps in compliance, verifying secure Configurations, finding holes now before somebody else does, Report problems to management and testing new technology.

V CONCLUSION

Cloud Computing embodies the as-a-Service paradigm and allows for services to be provided en masse to consumers. The problems associated with the use of cloud based services can be summarized by the unknown risk profile and unknown expectation of privacy sees Section. When service users push data to the cloud they need to rely upon Cloud Service Providers (CSPs) adhering to their remit, and doing so dutifully. However, when looking to build solutions to protect data in the cloud it is important to remember that for the service user the CSP can be trusted, albeit at arms length see Section. The threat models presented in illustrate that threats to data occur both in the domain of the service user and the domain of the CSP. Traditional privacy models are too user-centric and CSP-fearing when trying to address the problem of protecting. A privacy model centered around Kafka's The Trial helps to address this problem, this privacy model indicates that when protecting one's data one should also have control over its use rather than solely preventing its collection: CSPs and service users need to work together.

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DATA STORE PROCESS ON CLOUD USING DATA MINING ALGORITHMS STORE AND RETRIEVAL PROCESS UNSTRUCTURED DATA

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ABSTRACT-

Cloud computing is computing is pictured as the cutting edge innovation. It is an Internet based innovation where quality administrations are given to clients including information and programming, on remote servers. The current study has taken concepts and methods from Information Retrieval and Text Mining. Each corpus (solution pattern) is represented as a graph. A graph consists of nodes. In the current study, these nodes are regular expressions. By taking the right order of regular expression, a graph is presented as a pattern in the un/semi-structured data... Cloud computing is a decent stage for research and application of information mining, for the reason that it gives incredible limits of capacity and figuring, great asset the executives based on virtualization and asset sharing model, and complete administration framework. Be that as it may, examination on information mining in distributed computing condition is still in its early stages

KEYWORDS: *Cloud computing, text mining Cloud security issue, Support vector machine, Cloud, integrity, confidentiality, outsourcing*

I. INTRODUCTION

The web is growing everyday and contains huge amounts of data. Users are provided with many tools for searching relevant information. Keyword searching, topic- and subject browsing, and other techniques can help users to find relevant information quickly. Index search mechanisms allow the user to retrieve a set of relevant documents. Sometimes however these search mechanisms are not sufficient. The amount of available data is increasing rapidly, which makes it difficult for humans to distinguish relevant information. Gaining new knowledge, retrieving the meaning of (partial) text documents and associate it to other knowledge is a major challenge.

Text mining is an solution that allows combination and integration from separated information source. With text mining it is possible to connect previously separated worlds of information.

The web has a huge amount of resources, whereby the resources can be available at anytime. The environment is very volatile, because the content can change (e.g. add, remove or change resources). The web consist of linked content, because of the linking parts its collaborates.

1.1 Problem description

Finding relevant information in unstructured data is a challenge. The data is unknown in terms of structure and values. The lifecycle of each part of data is in a specific domain, whereby a domain expert is available for a priori knowledge.

1.1.1 Collaborative environment

Al the data is (geographically) spread over multiple domains. Whereby the environment consists of more than one domain and they have the intention to collaborate. Users are physically located at different places exchanging knowledge and share information by interacting. Nowadays collaborative environments have the characteristics of being a complex infrastructure, multiple organizational sub-domains, information sharing is constrained, heterogeneity, changes, volatile, and dynamic.

1.1.2 Domain- and privacy restrictions

Each domain can have its own privacy restrictions. A domain has its own standards in communication, and interaction, data storage, data structures, and culture. Another item are the privacy restrictions, domains have their own policies and restriction.

1.1.3 Retrieving relevant information

The main problem is retrieving *relevant* information from multiple domain resources. Figure 1-1 gives an overview of multiple domains with cross-domain information sharing. Each domain consists of multiple manifests, where by these manifest can change from structure in time. Each domain expert tries to create a structure or pattern by hand with his/her a priori domain knowledge. However, this is done by hand. Each domain administrator does this for his domain for fulfilling the goal of retrieving rich information from manifest in a readable structure. When there is the need for collaboration in connecting and coupling two domains for creating a shared conceptualization the domain experts have to perform the job together. By communication and creating a conformity, reducing the noise of interacting, and both physically and virtual different worlds are connected in creating a holistic environment.

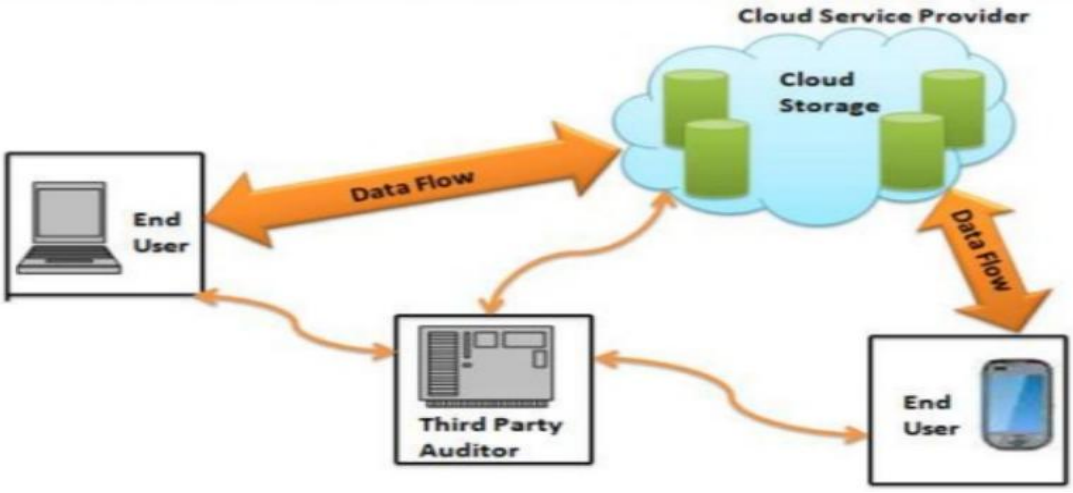

Figure 1.Data Transfer between two device over the cloud

1.2 Single domain

At this moment, a domain administrator creates a structure from a manifest whereby rich information is retrievable. The set of manifest will change over time in structure (volatility), so the domain administrator is adaptive and changes the old structure in a new fit on the changed set of manifest. Al this is done by hand.

1.3 Multiple domains

Each domain has its own structure, but they want to interact and collaborate with other domains. By creating a contact moment with the responsible domain administrator, they create a confirmation about the relevancies in their structures, so relevant information is retrievable from both worlds.

II. RELATED WORKS

2.1 Information Retrieval & Extraction

In daily life, humans have the desire to locate and obtain information. A human tries to retrieve information from an information system by posing a question or query. Nowadays there is an overload of information available, while humans need only relevant information depending on their desires. Relevance in this context means returning a set of documents that meets the information need.

Information extraction (IE) in computing science means obtaining structured data from an unstructured format. Often the format of structured data is stored in a dictionary or an ontology that defines the terms in a specific domain with their relation to other terms. IE processes each document to extract (find) possible meaningful entities and relationships, to create a corpus. The corpus is a structured format to obtain structured data.

Information retrieval is an old concept. In a physical library books are stored on a shelf in a specific order e.g. per topic and then alphabetic. When a person needs information on a specific topic, he or she can run to the shelf and locate a book that fits the most to his or her needs. With the advent of computers, this principle can also be used by information systems. Well-known information-retrieval systems are search engines on the web. For instance, Google tries to find a set of available documents on the web, using a search phrase. It tries to find matches for the

search phrase or parts of it. The pre-processing work for the search engines is the information extraction process; to create order in a chaos of information. Google crawls the web for information, interprets it, and stores in a specific structure so that it can be quickly accessed when users are firing search phrases.

2.2 Data mining

Data mining consists of an iterative sequence of the following steps, see figure 2

1) Data cleaning (to remove noise and inconsistent data)

2) Data integration (where multiple data sources may be combined)

3) Data selection (where data relevant to the analysis task are retrieved from the database)

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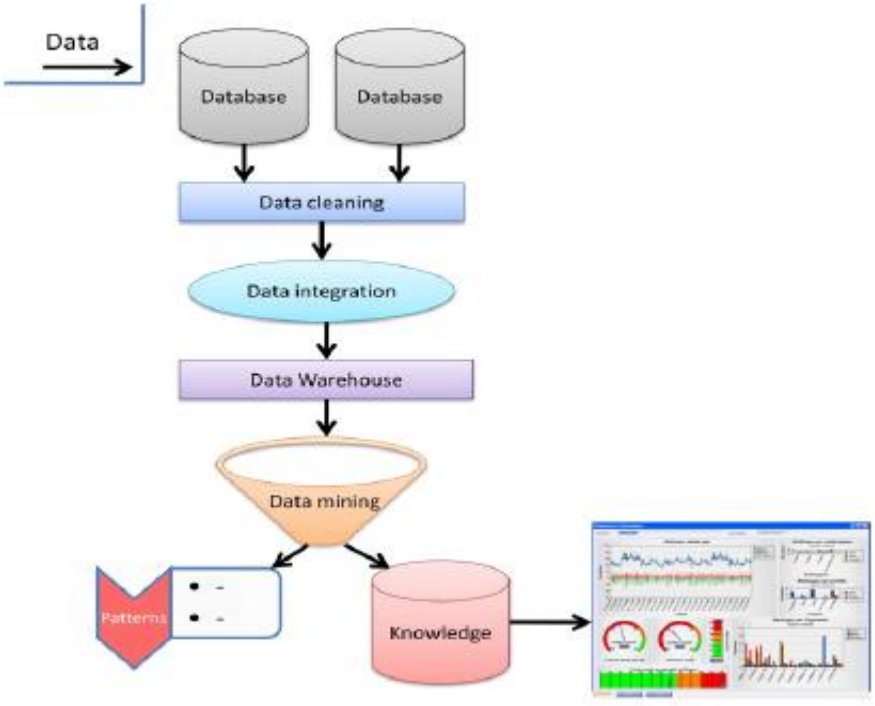

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III METHODOLOGY

Classification is an important mission in data mining, and probably has become the most studied data mining task. In this task, the goal is to predict the value of a specified goal attribute (called the class attribute) based on the values of other attributes (called the predicting attributes).

Generally speaking: With pairing based cryptography each attribute is represented as a group element. By virtue of the bilinearity property it allows for two independent sets of operations to be performed upon a set of group elements representing each Pi 2 P. These operations hide the secret exponent among the group elements such that when the result of these operations are combined if the conditions are right the secret exponent to be recovered. These conditions are dictated by the LSSS.

The precise use of LSSSs to hide and recover the secret exponent is dependent not only upon the placement of the predicates within the PBE scheme but also upon the exact predicate used. For the remainder of this section, a general overview of how LSSSs are used as part of both CP and KP schemes. Section 8.5 provides a concrete example of how one can use LSSS precisely as

3.1 Cipher text-Policy

with CP schemes a message will be encrypted under an access policy A and can be decrypted from a key that is derived from a set of attributes S. The use of LSSS within CP schemes can be seen as LSSS in its standard form. Encrypt The LSSS is used to generate piece vectors, from the secret exponent, for each group element that represents an attribute Pi 2 P as de

Recall from Section 7.3.2 that with CP schemes a message will be encrypted under an access policy A and can be decrypted from a key that is derived from a set of attributes S. The use of LSSS within CP schemes can be seen as LSSS in its standard form.

Encrypt The LSSS is used to generate piece vectors, from the secret exponent, for each group element that represents an attribute Pi 2 P as defined in A. These vectors along with a description of the LSSS are stored alongside the encrypted message.

Key Generation With the generation of decryption keys each user is assigned a set of attributes represented as a set of group elements modified by some random secret value.

Decrypt During decryption the LSSS, described in the cipher-text, will only reconstruct the secret exponent if an authorized set of attributes can be found within the elements of the decryption key.

Key-Policy

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Encrypt After the message has been encrypted the secret exponent is hidden among a set of group elements that have been derived from each Si 2 S, the encryption key. These elements along with a description of S are stored along side the encrypted message.

Key Generation When generating the decryption key, the LSSS is used to distribute a secondary secret value among each attribute Pi 2 P from A. The resulting piece vectors and description of A are returned as the decryption key.

Decrypt With decryption the LSSS, taken from the decryption key, will only reconstruct the secret exponent if an authorized set of elements exists within the elements stored alongside the cipher-text.

IV. CLOUD ENVIRONMENT LAYERS

Cloud computing attracts many managers and organizations. There are many similar terminologies that are usually utilized for describing cloud computing, these terms such as: distributed, grid, cluster, virtualization, on-demand, utility, and software-as-a-service. In other words, cloud computing refers to end -users connecting with applications running on sets of shared servers, often hosted and virtualized, instead of a traditional dedicated server.

A. Deployment Models The deployment models can be categorized into four categories namely Public cloud, Private cloud, Hybrid cloud and Community cloud [6]. These categories will be described in details as follows:-

• **Public Cloud,** this model is owned by an organization for selling the cloud services and the design of infrastructure is made in order to be available for industries, organizations and businesses.

• **Private Cloud**, this model is managed by the organization itself or by a third party. Private cloud may be either off or on premises. The major characteristic of this model is that the infrastructure of the cloud is private, in addition to its availability to a single organization.

• **Hybrid Cloud, this model** is similar to the private cloud as it is managed by third party or by organization itself and may exist off or on premises. But the cloud infrastructure may combine two or more clouds (public, private or community).

• **Community Cloud, this model is similar to the previously mentioned private and hybrid cloud** as the organization or third party are allowed to manage it and also exists off or on premises. But in community cloud, multiple organizations with common interests, requirements, or considerations share the infrastructure.

The security of the cloud needs testing, it is important for organizations that want to ensure the optimal product before distributing it. The results are used in finding out security weakness points and to patch them before the occurrence of penetration. However organizations' lack of time and resources, computer related crime is usually on the rise. Consequently penetration investigators (testers) have to reduce the amount of resources. This motivates testers to widely adopt automatic tools, as it is demonstrated by the continuous release of platforms finalized to automate this process, discovering gaps in compliance, verifying secure Configurations, finding holes now before somebody else does, Report problems to management and testing new technology.

V CONCLUSION

Cloud Computing embodies the as-a-Service paradigm and allows for services to be provided en masse to consumers. The problems associated with the use of cloud based services can be summarized by the unknown risk profile and unknown expectation of privacy sees Section. When service users push data to the cloud they need to rely upon Cloud Service Providers (CSPs) adhering to their remit, and doing so dutifully. However, when looking to build solutions to protect data in the cloud it is important to remember that for the service user the CSP can be trusted, albeit at arms length see Section. The threat models presented in illustrate that threats to data occur both in the domain of the service user and the domain of the CSP. Traditional privacy models are too user-centric and CSP-fearing when trying to address the problem of protecting. A privacy model centered around Kafka's The Trial helps to address this problem, this privacy

model indicates that when protecting one's data one should also have control over its use rather than solely preventing its collection: CSPs and service users need to work together.

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ON PERFORMANCE OF DATA MINING ALGORITHMS TO MANAGEMENT SYSTEMS FOR DATA EXPLORATION

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ABSTRACT-

Data Mining (DM) is the science of extracting useful and non-trivial information from the huge amounts of data that is possible to collect in many and diverse fields of science, business and engineering. Due to its relatively recent development, Data Mining still poses many challenges to the research community. New methodologies are needed in order to mine more interesting and specific information from the data, new frameworks are needed to harmonize more effectively all the steps of the mining process, new solutions will have to manage the complex and heterogeneous source of information that is today available for the analysts. Cloud computing is a decent stage for research and application of information mining, for the reason that it gives incredible limits of capacity and figuring, great asset the executives based on virtualization and asset sharing model, and complete administration framework. Be that as it may, examination on information mining in distributed computing condition is still in its early stages.

KEYWORDS: *Cloud computing, text mining Cloud security issue, Support vector machine, Cloud, integrity, confidentiality, outsourcing*

I. INTRODUCTION

The extraction of useful and non-trivial information from the huge amount of data that is possible to collect in many and diverse fields of science, business and engineering, is called Data Mining (DM). DM is part of a bigger framework, referred to as Knowledge Discovery in Databases (KDD) that covers a complex process from data preparation to knowledge modeling. Within this process, DM techniques and algorithms are the actual tools that analysts have at their disposal to find unknown patterns and correlation in the data.

Typical DM tasks are classification (assign each record of a database to one of a predefined set of classes), clustering (find groups of records that are close according to some user defined metrics) or association rules (determine implication rules for a subset of record attributes). A

considerable number of algorithms have been developed to perform these and others tasks, from many fields of science, from machine learning to statistics through neural and fuzzy computing. What was a hand tailored set of case specific recipes, about ten years ago, is now recognized as a proper science.

It is sufficient to consider the remarkable wide spectrum of applications where DM techniques are currently being applied to understand the ever growing interest from the research community in this discipline. Started as little more than a dry extension of marketing techniques, DM is now bringing important contributions in crucial fields of investigations. Among the traditional sciences we mention astronomy, high energy physics, biology and medicine that have always provided a rich source of applications to data miners . An important field of application for data mining techniques is also the World Wide Web . The Web provides the ability to access one of the largest data repositories, which in most cases still remains to be analyzed and understood. Recently, Data Mining techniques are also being applied to social sciences, home land security and counter terrorism.

The amount of data that it is typically necessary to deal with. Huge, enormous, massive are the terms most commonly used to refer to volumes of data that can easily exceed the terabyte limit;

• Data are generally distributed on a geographical scale. Due to its dimension, but also for other reasons (i.e. privacy, redundancy), data cannot in general be assumed to be placed in a single site. Rather, DM systems have to deal with inherently distributed input sources;

• DM algorithms are often complex both in time and space. Moreover, the complexity of such algorithms depend not only on external properties of the input data, like size, number of attributes, number of records, and so on, but also on the data internal properties, such as correlations and other statistical features that can only be known at run time;

• Input data change rapidly. In many application domain data to be mined either are produced with high rate or they actually come in streams. In those cases, knowledge has to be mined fast and efficiently in order to be usable and updated.

• DM often supports decision-making process. In this case real-time constraints hold and the request for rapid and efficient results is strong.

Figure 1.Data Transfer between two device over the cloud

1.2 Single domain

At this moment, a domain administrator creates a structure from a manifest whereby rich information is retrievable. The set of manifest will change over time in structure (volatility), so the domain administrator is adaptive and changes the old structure in a new fit on the changed set of manifest. Al this is done by hand.

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Each domain has its own structure, but they want to interact and collaborate with other domains. By creating a contact moment with the responsible domain administrator, they create a confirmation about the relevancies in their structures, so relevant information is retrievable from both worlds.

II. RELATED WORKS

Classification is an important mission in data mining, and probably has become the most studied data mining task. In this task, the goal is to predict the value of a specified goal attribute (called the class attribute) based on the values of other attributes (called the predicting attributes).

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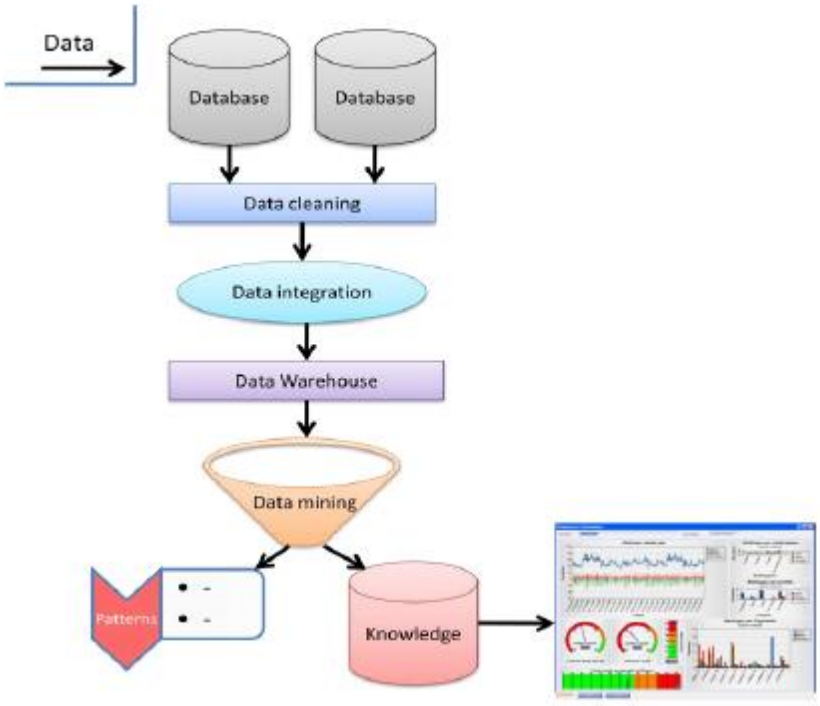

Figure 2 Data mining process

2.2 Web mining

The Web is a rich source of information. An exponentially increasing set of multimedia documents, a huge amount of computational and storage resources, used to manage such documents, the related access patterns by a correspondingly increasing set of users. Extracting useful knowledge from this apparently endless mine of information, is a challenge that has been faced at many levels.

One of the possible application of the so called Web Mining, i.e. DM on web data, is to analyze data relative to user navigation sessions on a web server. Such sub-domain of Web DM is called Web Usage Mining and is aimed at developing personalization or recommendation systems. For such systems to be effective, the concern on performance impose the utilization of efficient techniques, able to extract and use valuable knowledge during the web server normal functioning with a limited overhead over its standard operations. Web Usage Mining (WUM) systems are typically composed by two parts. An offline analysis of the server access logs, where suitable categories are built, and then an online classification of active requests, according to the offline analysis.

III METHODOLOGY

Adaptive Frequent Set Mining: the DCI algorithm We introduce here the DCI algorithm and illustrate how with its design we face the issues sketched above. Its pseudo-code is reported in Algorithm . As Apriori , at each iteration DCI builds the set Fk of the frequent k-itemsets on the basis of the set of candidates Ck.

However, DCI adopts a hybrid approach to determine the support of the candidates. During the first iterations, it exploits a counting–based technique, and dataset pruning (line 7), i.e. items which will not appear in longer patterns are removed from the dataset. The pruning technique is

illustrated in more detail in Section 2.4.3. As soon as the pruned dataset fits into the main memory, DCI starts using an optimized intersection–based technique to access the in-core dataset.

Input: D, s

1: F1 = first scan(D, s,&D2); // find frequent items and remove non-frequents from D

2: F2 = second scan(D2, s,&D3); // find frequent pairs from pruned dataset

3: k = 2;

4: // until pruned dataset is bigger than memory...

5: while (Dk+1.size() > memory available()) do

6: k + +;

7: Fk = horizontal iter(Dk, s, k,&Dk+1); //... keep the horizontal format

8: end while

9: // switch to vertical format

10: dense = Dk+1.is dense(); // measure dataset density

11: while (Fk 6= ;) do

12: k + +;

13: if (dense) then

14: Fk = vertical iter dense(Dk, s, k); // dense dataset optimization

15: else

16: Fk = vertical iter sparse(Dk, s, k,&Dk+1); // sparse dataset optimization

17: end if

18: end while

Algorithm 1: Direct Count and Intersect – DCI

Input: M, {L}, {A}, u

Output: A list {S} of suggestions

1: page idu = Identify Page(u); s Retrieves the id of the URL u by accessing a trie built on top of all of the existing URLs.

2: session id = Identify Session(); s Using cookies.

3: page idv = Last Page(session id); s Returns the last page visited during the current session.

4: PW = A[session id];

5: if (!Exists(page idu, page idv, PW)) then

6: s pages (u,v) are not present in an active session

7: M[page idu, page idv]++;

8: if ((Wuv > MinFreq) ^ (L[u] 6= L[v])) then

9: MergeCluster (L[u], L[v]); s Merges the two clusters containing u and v.

10: end if

11: end if

12: if (! Exists (page idu, PW)) then

13: M[page idu, page idu]++;

14: New L = Cluster (M,L, page idu);

15: L = New L;

16: end if

17: push (u, PW);

18: S =Create Suggestions (session id,L);

19: return(S);

Algorithm 2 Inputs are the co occurrence matrix M

Algorithm 2: The SUGGEST algorithm. Inputs are the co occurrence matrix M, the list of clusters L, the active user session A, the user request u.

Input: session id, page idu, A[session id], L : L[page idu] = cluster id.

Output: An updated clustering structure.

1: ret val = L; clust=L[u];

2: C = {n 2 [1..|L|] | L[n] = clust};

3: h = pop(C);

4: ret val[h] = h;

5: clust = h;

6: F 6= ;;

7: while h 6= NULL do

8: for all (i 2 G s.t. Whi > MinFreq) do

9: remove(C,i);

10: push(F,i);

11: ret val[i]=clust;

12: end for

13: if F = ; then

14: pop(F,h);

15: else

16: if (C 6= ;) then

17: pop(C, h);

18: clust = h;

19: else

20: h = NULL;

21: end if

22: end if

23: end while

24: return (ret val);

Algorithm 3: The clustering phase.

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PREPARE CLUSTER USING IMPROVED ONLINE K-MEANS ALGORITHM

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ABSTRACT-

A restricted computation model of Online clustering in which data points arrive one by one and clustering decisions can neither be postponed or reconsidered is a non-trivial problem to solve. Associating the objective function of the k-means algorithm to this problem gives an insight into behavior of the clustering method and its application to the online clustering. This paper proposes an improved Online k-means algorithm. Experiments are designed such that the output cluster pattern can be evaluated according to the value of objective function. Results prove the proposal to be better than previous methods of online clustering done using k-means technique.

KEYWORDS: *Clustering, K-means, Offline Data, Online Data, Streaming Data*

I. INTRODUCTION

Clustering is a well-studied problem domain of machine learning with its vast applications in data analyses, image processing, pattern recognition; the clustering techniques are equally sought after by business analysts, scientists and information engineers. Clustering problem can have broadly three types of settings: standard offline setting, streaming model and online clustering. In the standard offline model [1, 2,3] entire data is known a priori to clustering, hence the clustering decisions can be taken very precisely according to well-formulated objective functions. Streaming model [4,5,6] allows a single pass through the data with limited memory. The clustering decisions are output finally when the stream is over. Online clustering [7,8,9] has a model in which the clustering decisions are made as and when data points arrive, which arrive one by one and arbitrarily. This restricted model of online clustering is now most sought after by researchers since it suits many ad-hoc data analysis needs of modern applications.

As the technology develops, much amount of data is produced and injected as a stream for online processing make it impossible for the conventional clustering method to be useful. Such applications require fast yet effective methods for grouping data. Achieving sufficient clustering quality within stimulated time is the major requirement.

The major approach towards online clustering is to extend the existing offline algorithms for the online problem. The k-centres algorithm proposed by Charikar et al [7] used an incremental approach. Online version of Expectation-Minimization is attempted by [8]. Formally provable results of k-means as an online clustering method are proposed in work by Choromanska and Montoloni [9]. Liberty et al[10] also used k-means as basic clustering algorithm but their method is very different from the actual method of k-means. The concept of facility location problem [11] is used to formulate the online clustering problem.

This paper proposes an improvement to the work by Liberty et al. The online clustering algorithm proposed in [10] though based on the classic k-means technique, uses very few concepts of the conventional k-means. This paper proposes to use the objective function of k-means clustering problem and adapt it as the cost of opening a new cluster for the incoming point of data stream. Besides modifying the cost function, the proposed algorithm has an added phase called merging phase which is executed once all data has arrived. The proposed process is linear in size of stream and produces a good quality cluster structure.

The paper can be organized as follows. Section II discusses the proposed online clustering algorithm and the development of idea behind the proposal. Section III discusses the experimental results on some synthetically generated and real-life datasets. Section IV compares the proposal with the work of Liberty et al in terms of cost. Section V concludes the research contribution underlying the future scope of the proposed work.

II. PROPOSED ONLINE CLUSTERING ALGORITHM

A. Liberty et al's contribution Liberty, Sriharsha and Sviridenko [10] proposed the online k-means algorithm. The formal algorithm is listed in Fig. 1.

Algorithm: Online k-means algorithm
Input: V, k
Output: Atleast k+1 cluster formation
Step 1: $C \leftarrow$the first k+1 distinct vectors in V; and n=k+1
Step 2: For each of these yield itself as its cluster
Step 3: $w^* \leftarrow min_{v,v' \in C} \|v - v'\|^2/2$
Step 4: $r \leftarrow 1; q_1 \leftarrow 0, f_1 = {}^{w^*}/_{k}$
Step 5: for $v \in$ the remainder of V do
Step 6: $n \leftarrow n + 1$
Step 7: with probability $p = min(D^2(v, C)/f_r, 1)$
Step 8: $C \leftarrow C \cup \{v\}, q_r \leftarrow q_r + 1$
Step 9: if $q_r \geq 3k(1 + log(n))$, then
Step 10: $r \leftarrow r + 1, q_r \leftarrow 0; f_r \leftarrow 2 \cdot f_r - 1$
Step 11: end if
Step 12: yield: $c = \text{argmin}_{c \in C} \|v - c\|^2$
Step 13: End for

Fig. 1. Online k-means algorithm

The online k-means algorithm aims to split an online arriving stream of data V into relevant clusters. Parameter vv denotes a data point in the entire dataset V whose value is not known since it is an online stream. The algorithm takes as input a parameter kk that denotes the minimum number of clusters that will be formed as output of the algorithm. Hence, atleast kk+1 cluster are formed. The initial point's nnarriving from the online stream of data, equal to kk+1,

are assigned as the initial kk+1 cluster centers in Step 1. These kk+ 1 points constitute the cluster center set CC. The algorithm is not an iterative algorithm, rather conducts in r phases. For rth phase, $ffrr$ denotes the facility opening cost, or precisely, the cost of opening a new cluster and $qqrr$ denotes the number of clusters in rth phase. The distance between each of the points in CC is calculated and the square of the minimum distance divided by $2kk$ is the initial facility opening cost as explained through steps 3 and 4 of the algorithm. Since no proper clusters are formed, the value of $qqrr$ remains nil. New cluster formation is opened with the probability pp which is the actually the minimum squared distance between the entering point vv and the existing cluster centers divided by the cost $ffrr$ of that phase. With each successive phase, cost $ffrr$ is double in value of the previous cost so as to ensure that lesser clusters are opened in later phases. The algorithm moves to the next phase when $qqrr \geq 3kk(1+llllll(nn))$.

B. Development

The Online k-means algorithm is observed to be lacking in two aspects.

• Though it has been named as k-means, the concept of the phrase 'means' is never used. This would clearly affect the overall cluster structure obtained.

• The resultant cluster structure is expected to contain a high noise component. The reason behind this is that some of the initially arriving points may not attract any of the points arriving later in the stream into their clusters. These points can then form very small or singleton clusters.

In the paper, we propose the following improvements related to the above discussed limitations.

• The first limitation is dealt with by updating cancroids at every phase of the algorithm. Updating is done phase-wise and not at every point because the former will add to the time complexity of the algorithm.

• The second limitation is solved by introducing a merging phase in the algorithm after the entire clustering process is over. For this, clusters with very low population are identified and merged with nearest big cluster.

For a subset Si, if

$$|S_i| < \frac{N}{10}$$

Then, subset Si of VV is a noise cluster and hence has to be merged. NN refers to the number of data points in the entire online stream.

C. Proposed Improved Online K-means The discussed improvements can now be incorporated into the online k-means algorithm. The complete description of the proposed Improved Online K-Means algorithm is given in Fig.

Algorithm: Improved Online k-means algorithm

Input: Online stream of data V, parameter k

Step 1: Assign number of data points arriving from the online stream $n = k + 1$ as initial cluster centers forming a cluster center set C.

Step 2: For each of these yield itself as its cluster

Step 3: For first phase or $r \leftarrow 1$, calculate facility opening cost as $f_1 = {w^*}/{k}$, $w^* \leftarrow min_{v,v' \in C} \|v - v'\|^2/2$

Step 4: Number of clusters in first phase, $q_1 \leftarrow 0$,

Step 5: for $v \in$ the remainder of online data stream V do

Step 6: $n \leftarrow n + 1$

Step 7: with probability $p = min(D^2(v, C)/f_r, 1)$

Step 8: $C \leftarrow C \cup \{v\}, q_r \leftarrow q_r + 1$

Step 9: if $q_r \geq 3k(1 + log(n))$, then

Step 10: Change the phase as $r \leftarrow r + 1$

Step 11: Set phase parameters $q_r \leftarrow 0; f_r \leftarrow 2 \cdot f_r - 1$

Step 12: Update the centroids C as means of clusters

Step 12: end if

Step 13: yield: $c = \text{argmin}_{c \in C} \|v - c\|^2$

Step 14: End for

Step 15: For all subsets S_i with $|S_i| < \frac{N}{10}$, merge into nearest big subset.

Fig. 2. Online k-means algorithm

III. EXPERIMENTAL RESULTS

A. Experimental Setup

The proposed Improved Online K-means algorithm is tested on various synthetically generated and real life datasets using the MATLAB computing platform. The complete description of the synthetic and real-life datasets is provided in Tables I and II.

TABLE I. DESCRIPTION OF SYNTHETICALLY GENERATED DATASETS

Dataset	Number of instances	Number of dimensions	Desired Number of classes
A1	3000	2	20
A2	5250	2	35
A3	7500	2	50
S1	5000	2	15
S2	5000	2	15
S3	5000	2	15
S4	5000	2	15
D31	3100	2	31
R15	600	2	15
House(5 bits per color)	34112	3	256
Bridge	4096	16	256
Shuttle	58000	9	7

B. Criteria for evaluation

The performance evaluation of proposed work is done considering the following criteria in mind.

1. ***Ratio of output to desired number of clusters:*** The lesser the ratio, closer the obtained output is towards the desired output. This criterion can be considered only for evaluating an algorithm against the datasets for which ground truth clusters are known. It is better to use this ratio instead of accuracy in context of online clustering when the application may always have a user-defined input for desired number of clusters.

2. ***Cost:*** The proposed algorithm updates the position of centroids at every phase. Once all the data has arrived, the centroids are again updated and small clusters are merged into bigger clusters. The effect of these two changes in the Online K-means algorithm by Liberty et al can thus be observed through value of objective function before the merging of clusters and after merging. Cost of Liberty et al's work is also considered and is entirely different from the cost before and after merging of the proposed algorithm.

In general, a high value of objective function indicates poorer quality of clusters. Reason of high value of the objective function is the high cost of the algorithm on obtaining large sparse clusters as output. If, on the other hand, the output cluster has small dense clusters, the cost will be low.

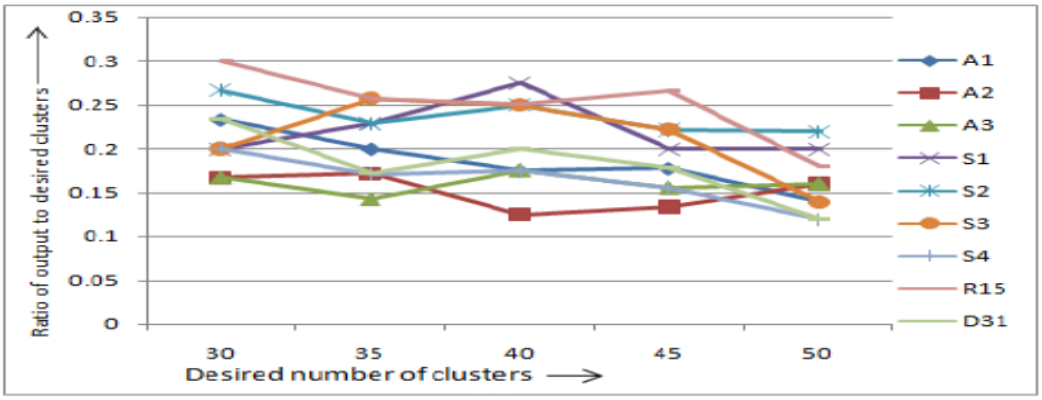
When talking about a non-general case, output clusters are very less in number before merging and in online k-means. In the proposed algorithm, however, none of the data points have been left unclustered so the noise becomes a part of the existing cluster. But the cluster quality is not poor because the number of output clusters after merging is very close to the number of desirable clusters.

C. Results on Synthetic Datasets

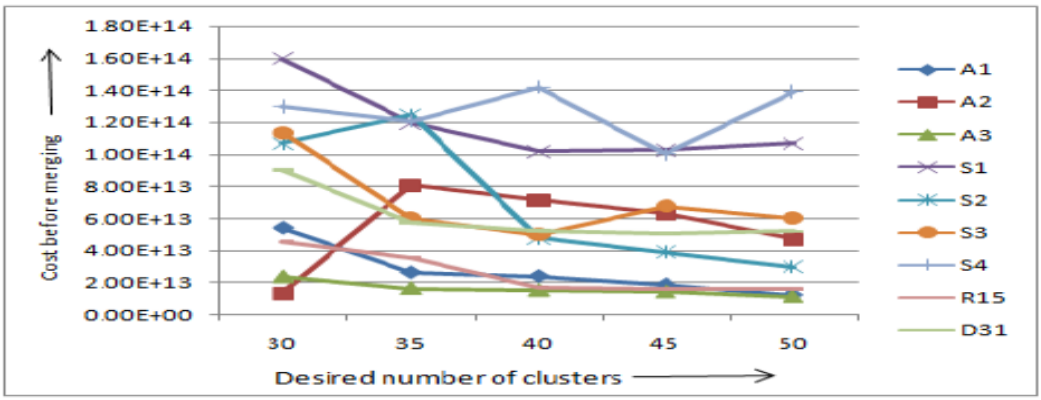
The performance evaluation of the proposed clustering is done with respect to the cost of the algorithm before and after the merging phase and ratio of output to desired number of clusters. Cost is the value of the objective function of SSE of k-means. Experimental results in this section cover the discussed synthetic datasets. The desired number of clusters is varied from 30 to 50 at an interval of 5 for evaluation. Fig. 3

(a)(b)(c) depicts results for the ratio of desired to output clusters, cost before merging and cost after merging.

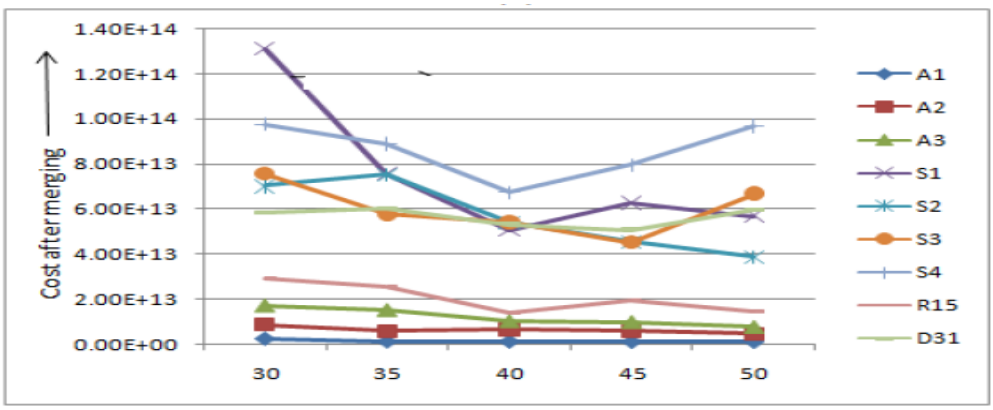
With increasing value of the desired number of clusters, a significant variation in the ratio and cost is observed. The reasons for such variations are large number of cluster formations and correspondingly high rate of merging data points including noise components. However, in each case, with increase of the desired number of clusters, a drop in value of ratio and cost towards a constant value is obtained. This means that the algorithm is returning results as desired consequently. Robustness of the algorithm is thus guaranteed.



(a)



(b)



(c)

Fig. 3. Results on synthetic datasets

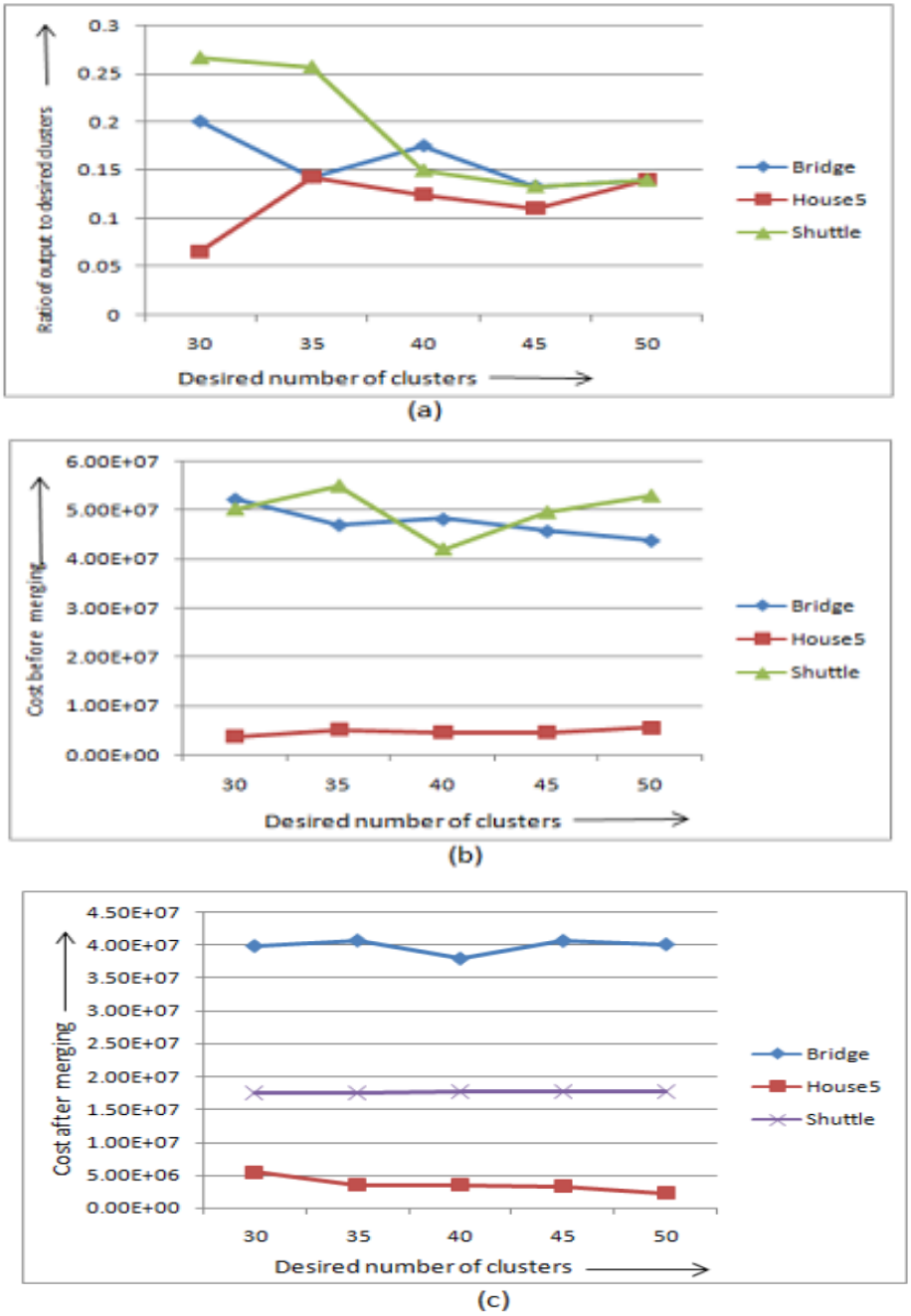


Fig. 4. Results on Real-Life Datasets

Results portray variations with increasing number of desired clusters for ratio and cost before merging values of the proposed algorithm, reason being the same as discussed before. However, almost constant values are observed for cost after merging indicating results near to optimal by the algorithm. Consistency in results again denotes a robust performance of the proposed algorithm.

IV. COMPARISON RESULTS

The proposed algorithm is compared with Liberty et al's work [10] in terms of the cost of the algorithm. The comparison is done dataset-wise for all the synthetic and real life datasets. Cost 1

in the experiments denotes the cost of Liberty et al's work. Cost 2 and Cost 3 refer to the cost of the proposed algorithm before and after the merging phases respectively. Fig.5 depicts the comparison results for all synthetic datasets. Fig. 6 illustrates results of comparison between the proposed and Online k-means algorithm on real life datasets. Taking the general point of view, a reduced cost indicates better performance. The same is illustrated on all synthetic datasets. The cost after merging is very less compared to the other two costs. No two costs are similar for any dataset. An even better performance is observed with increasing desired number of clusters. The results on Bridge and House dataset are as desired favoring the proposed algorithm. A much higher cost after merging in case of Shuttle Dataset indicates cost due to merging all data points including noise components. However, a uniform proportion with increasing desired number of clusters shows consistency and robustness of the proposed algorithm. It further means that the quality of the obtained clusters using the proposed algorithm is not poor.

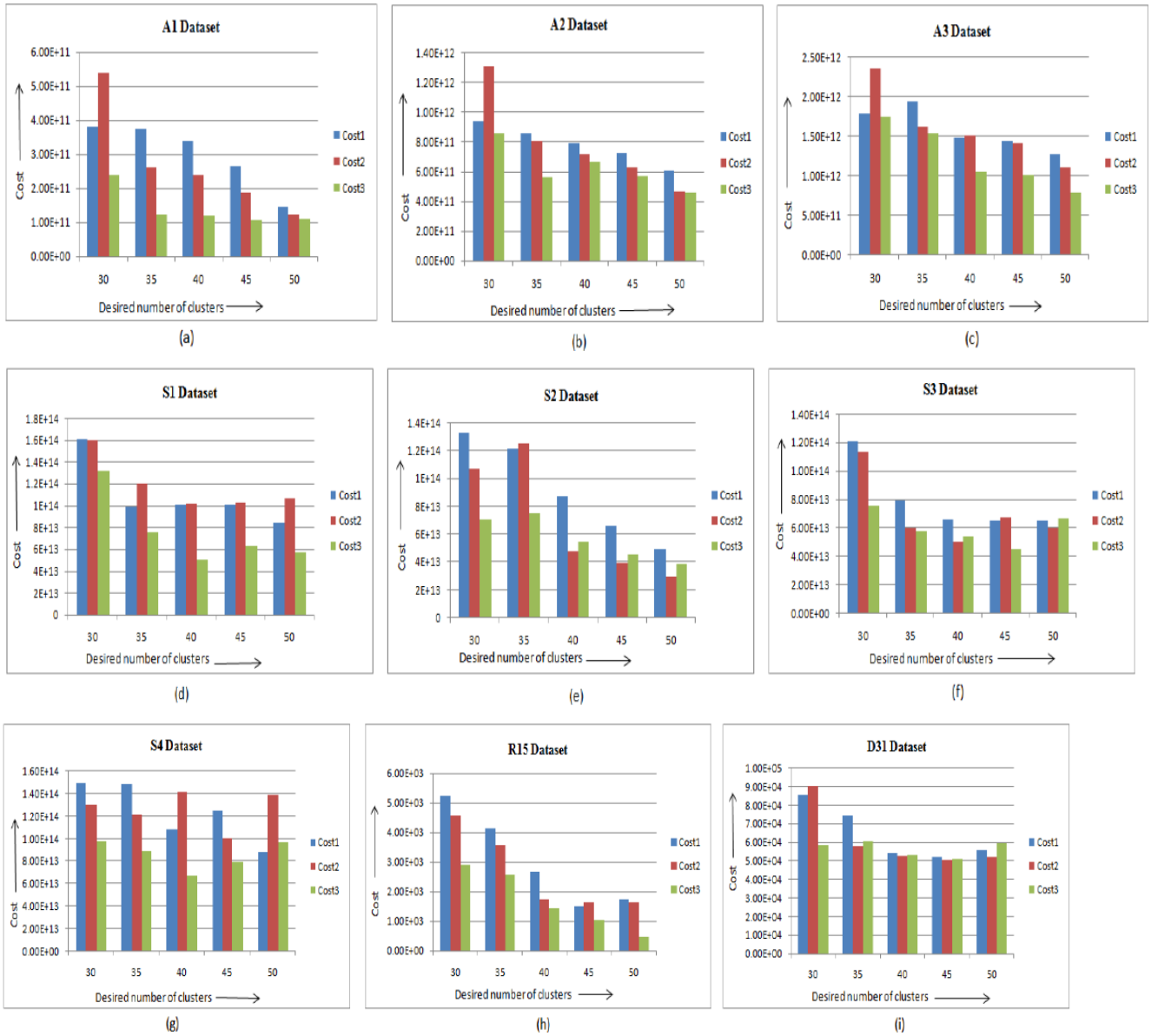


Fig. 5. Results on synthetic datasets (a) A1, (b) A2, (c) A3, (d) S1, (e) S2, (f) S3, (g) S4, (h) R15, (c) D31

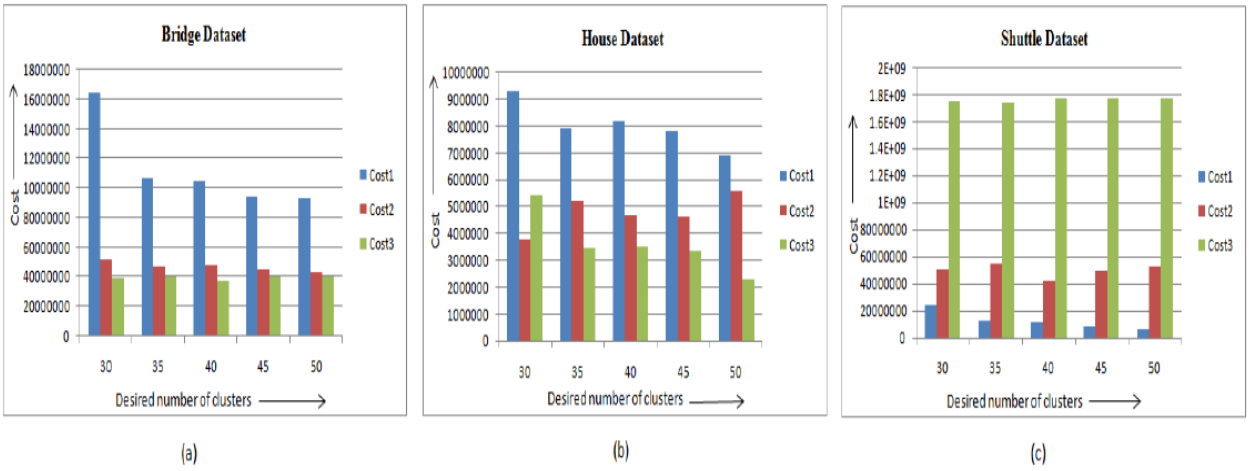


Fig. 6. Results on real life datasets (a) Bridge, (b) House (c) Shuttle

V. CONCLUSION

Online clustering is a non-trivial problem of clustering arbitrary arriving data within a very restricted model. The conventional clustering algorithms that deal with standard offline setting cannot properly deal with online model and simple extensions are not possible. Rather clustering methods for online clustering are to be developed with proper problem formulation and modification to the standard methods. This paper presents an online clustering method based on k-means method in the sense of its objective function formulation. The decision of putting an arriving data point into an existing cluster or creating a new cluster is done similar to facility location problem. Once the cluster decisions have been made, a merging phase picks very small clusters and merges them into the bigger ones. Thus, cluster structure improves and desired number of clusters can be achieved. It doesn't revise all the clusters; rather a very small portion of the cluster output is revised. This is in conformance with the restricted memory model. The behavior of the proposed algorithm according to changing input parameters is studied thoroughly through experiments on popular synthetic and real life datasets. The proposed method shows its robustness and consistency of output against variation in input parameter, making it behave similar to parameter-free algorithms.

One of the major drawbacks of the K-Means algorithm is its inability to detect clusters of shapes other than spherical. Also, the algorithm is limited to handling only numeric data, though extensions of the algorithm to deal with other types of data are available. Likewise, online clustering techniques should be designed as stand- alone techniques that address the issues and detect clusters of arbitrary shapes and deal with categorical and mixed natured data too.

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FOR SELECTION OF HETEROGENEOUS NODES ON BASIS OF ENERGY-EFFICIENT FUZZY-LOGIC IN WIRELESS SENSOR NETWORKS

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ABSTRACT

Wireless Sensor Networks is an aspiring technology when it comes to sensing/monitoring tasks. The field, seeing its applicability in numerous fields, is a continuous research area such that all its limitations can be resolved and performance increased. Among the many issues, the issue considered the most and in the paper is energy efficiency. Clustering is the most plausible solution for the same. Criteria for CH selection directly correspond to the performance of the network. Fuzzy logic for this selection is a much appreciated approach. This paper proposes a fuzzy logic based clustering which includes mobility as a factor for heterogeneous sensor nodes. The protocol, compared with some popular clustering protocols on basis of some criteria give reduced energy consumption and maximum network lifetime as desired.

KEYWORDS: *Wireless Sensor Network, Energy Efficiency, Clustering, Cluster Head Selection, Fuzzy logic*

I. INTRODUCTION

Wireless Sensor Networks are the most efficient technology for tasks like target detection, enemy intrusion, environment sensing, border surveillance to name a few. These are heavily used in various applications like health care, military, defense, security, industrial processes etc. A number of sensors deployed randomly or manually perform the sensing task. The sensed data is transferred to the interested party, formally called as the base station. Each node participating in the sensing has limited resources in terms of energy, memory, processing capability and bandwidth. The nodes run on irreplaceable/non-chargeable batteries which if dead in the middle of a sensing task, causes the failure of the node and the network altogether since a portion of the Region of Interest (RoI) remains uncovered. Relying on a fixed energy supply and performing the three tasks of sensing, processing and transferring, the networks need energy-aware protocols. Whereas individual sensing by nodes add to the energy consumption, nature of node

deployment (random or specific), nature of nodes (homogeneous or heterogeneous), sensing environment (static/dynamic), mode of communication (single/multi hop) are some other factors responsible for the high energy consumption of the network.

A better approach is to assign aggregator nodes responsible for collecting sensed data from a bunch of nearby nodes, aggregate data and transfer it to the BS. With clustering as a direct application of data aggregation, the selection of aggregator nodes is same as finding cluster representatives, formally called as cluster heads in WSNs. Some of the many advantages of clustering are load balancing, reduced message and communication complexity, reduced collisions, reduced failures maximized network lifetime and ensured connectivity. A variety of energy aware clustering protocols have been proposed over the years seeing the benefits of the approach [1,2,3]. Each protocol differs from the other in terms of the selection criteria of cluster heads. Some protocols base their decisions on probability [1,4], some consider energy of nodes [2,5], while the others consider a whole different way of selection. Among one of the ways is applying fuzzy logic to the selection process. Fuzzy logic enables working in real-time environments which is not always practical. Simple fuzzy if-then rules help to evaluate which nodes in the network can be elected as CHs. A set of input variables are fuzzified, evaluated of the output variable is done using fuzzy if-then rules followed by defuzzification of the output variable into a single crisp number. Each variable is taken according to the objective of the clustering and has equivalent fuzzy linguistic variables for the process. A variety of fuzzy logic based cluster head selection techniques have been proposed, some popular being works by [4,6,7,8].

Recently, Julie and Selvi [8] proposed a fuzzy-logic based cluster selection relying on factors like residual energy, mobility factor and transmission range of each node of homogeneous nature. Our proposed protocol extends the fuzzy logic selection of Julie and Selvi on heterogeneous nodes and a dynamic environment. At the end of fuzzy logic based selection, the tentative CH nodes are randomly selected instead of sequential selection based upon a fixed proportion of cluster heads needed in the network. The mode of communication can be single-hop or multi-hop. Reselection is done after every round of the protocol. The scenario taken in consideration is similar to sensing of a filed with sensors placed manually on animals moving randomly in that field.

The organization of the paper is as follows. Section II gives details about the fuzzy logic applied by Julie and Selvi. Section III discusses the characteristics of WSNs considered for the proposal, the working and formal description of the proposed protocol. Section IV lists the experimental results with comparison to various popular static clustering protocols.

II. FUZZY LOGIC IN NFEACS

The fuzzy logic for cluster head selection by Julie and Selvi [8] takes three input variables – Transmission Range, Residual Energy and Mobility Factor to compute output variable Chance. Chance helps decide the network that which nodes can be elected as CHs. Each of the considered input variables have to take an equivalent fuzzy logic variable out of Low, Medium and High. The output variable Chance also has the same three output linguistic variables. Trapezoidal membership is chosen for the high and low linguistic variables whereas for the medium variable, triangular membership function is chosen. The variable high refers to a node with the maximum transmission range > 10 m. A brief description of each of the input and output variables is given below.

The three input variables are

- ***Mobility Factor:*** Mobility factor decides the speed of a sensor node in the network. A high speed may cause movement of the sensor node outside its cluster. A low mobility is therefore required.
- ***Residual Energy:*** Residual energy of a node refers to the remaining energy of a node at any given instant of time. For a node to be a CH, the residual energy should be sufficiently high in order to fulfill the added responsibilities of data collection, aggregation and transfer.
- ***Transmission Range:*** Transmission range refers to the distance uptil which a sensor node can sense the data packet. CHs should possess a high transmission range for easy transfer of data to even a far located BS.

The output variable is

- ***Chance:*** Chance represents ability of a node to be elected as a CH. A higher chance corresponds to a high probability of a node of becoming a CH.CHs are selected based on a defuzzified crisp output value of the output variable.

A set of 16 fuzzy if-then rules are used for computing the chance of a node. Table 1 lists the fuzzy if-else ladder used in NFEACS.

TABLE 1 FUZZY LOGIC IN NFEACS

Mobility factor (speed/sec)	Transmission range(m)	Residual energy(J)	Cluster Head Chance
Low	High	Low	Medium
Medium	Medium	High	High
Medium	Low	High	Medium
Medium	High	High	Low
Medium	Medium	Medium	Low
Medium	Low	Medium	Low
Medium	High	Medium	High
Medium	Medium	Low	High
Medium	Low	Low	Medium
Medium	High	Low	High
High	Medium	High	High
High	Low	Medium	Medium

High	High	Medium	Medium
High	High	Medium	High
High	Medium	Low	Medium
High	Low	Low	Low

III. PROPOSED CLUSTERING SCHEME

3.1 Characteristics of WSNs considered

We consider a scenario of sensing an environment with sensor nodes placed manually on a congregation of animals. The animals move in the provided area (area to be sensed) randomly with different speeds. Each sensor node is having equal energy and transmission range prior to the start of the sensing task.. The effective transmission range may however vary with situations. By situations, we refer to an animal entering a cave, resting under a tree, going underwater where the sensor nodes may not be able to sense or communicate with the nearby nodes. All the animals at the end return to the same end point/base station. From this, the characteristics can be summarized as.

1. Energy of all the sensor nodes is initially the same.
2. All the nodes have to transfer the data to the same BS at the end of the sensing task.
3. All nodes may move around the RoI at a certain speed and the speed of each node may vary.
4. Direction of movement of nodes is arbitrary.
5. Transmission range, same initially, may vary according to different scenarios.

3.2 Proposed Clustering Scheme

Our proposal considers a network with heterogeneous nodes sensing in a dynamic environment. Using a node's residual energy, transmission range and mobility factor and applying fuzzy logic of NFEACS, the chance of a node is computed. Out of the nodes with a high value of chance, only 5% of the total population of nodes is selected as cluster heads. The selection process is done randomly. When a node becomes a CH, it advertises its status to all the nodes lying under its transmission range. On receiving such advertisements, the neighboring nodes or the non CHs decide the cluster which they will be a part of based on which CH is nearest to them. The CHs are then responsible for aggregating the data from these nodes, processing it and sending it to the BS. Transfer of data to the BS can be done directly by a CH or using multiple hops.

Since the nodes are constantly moving, the entire process of election, sensing, aggregation and transfer is repeated after each round of the protocol. With changing rounds, the nodes will have changed positions and the cluster formation will also vary.

IV. SIMULATION RESULTS

4.1 *Simulation Setup*

The proposed algorithm is compared with LEACH [1], CHEF [4] and DUCF [7]. While LEACH is a popular standard clustering protocol, CHEF and DUCF are fuzzy logic based distributed clustering protocols. But all these three protocols have to be adapted for testing in heterogeneous setting of mobile sensor nodes. The characteristics of WSN assumed are already mentioned in

previous section. The simulation parameters of scenarios considered for experiments are listed in Table 2. Every simulated scene has equal height and width and one base station randomly located within the area. For every set of parameters, all algorithms are given 50 runs and the average performance is recorded in the form of following factors.

- ***First Node Die:*** The round at which first node dies is noted to give an idea how fast a node is exploited as compared to others. A lower value indicates highly imbalanced energy consumption.
- ***Half Node Die:*** The round at which half of total nodes die is marked because many researchers hold that network dies when half of the nodes are dead. Thus, this value indicates how long a network is alive.
- ***Rounds:*** The number of rounds executed of an algorithm before the network is dead indicates network life. We assume network is dead when three-fourths of the nodes are dead. A higher number of rounds mean that the protocol runs longer and is indirectly more energy efficient.
- ***Energy Consumption Per Round:*** This is the amount of energy consumed in executing one round of a protocol including the energy consumed by all nodes for communication (transmission and receiving of data and control packets). High energy consumption is not favorable.
- ***Time Consumption Per Round:*** Though time taken by any algorithm to run, as an absolute measure is irrelevant as it differs with implementation style. Yet, for comparison purpose, it can serve as an indicator of computation cost of a protocol.

The radio model of energy of [9] is followed. To transmit bits of message from a node to another, is the transmission energy is the reception energy and is and calculated as For our is taken to be the range of transmitting experiments, node.

The desired percentage of CH in LEACH and CHEF is set to 2% and for DUCF and proposed, it is 5% of total nodes.

TABLE 2 SIMULATION PARAMETERS AND VALUES

Parameters	Values
	4000
	50 nJ/bit
	10pJ/bit
	0.0013 pJ/bit
Initial energy per node	1J
Data packet size	500 bytes
Control packet size	25 bytes
Nodes	100-250
Deployment Area	75X75 m^2 to 200X200 m^2
Maximum Range	16m-22m
Maximum Speed	16 /sec to 22 m/sec

4.2 Results

Experiments are conducted by varying parameters such as the number of nodes, simulation area, range of nodes and the speed of nodes. Correspondingly, performances of the LEACH, CHEF, DUCF and the proposed protocol are evaluated on the basis of the considered factors. Fig 2,3,4,5 and 6 illustrate comparison between the four protocols on the basis of First Node Die, Half Node Die, Number of Rounds, Energy Consumption per Round and Time Consumption Per Round on (a) varying number of nodes, (b) deployment area, (c) Range of nodes and (d) Speed of nodes.

The proposed protocol outperforms the other protocols in each scenario. Highest values of First Node Die, Half Node Die, Number of Rounds and lowest values of Energy Consumption Per Round and Time Consumption Per Round very well portray the efficacy of the protocol.

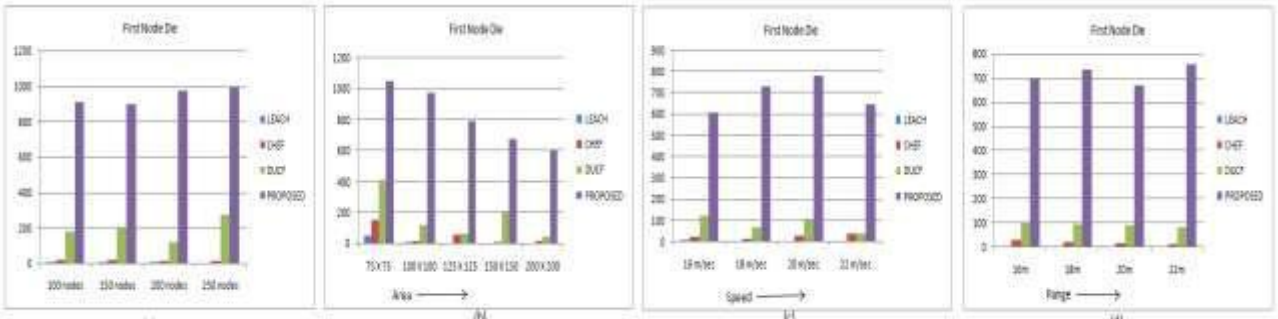

Fig 1 First Node Die values of protocols with changing parameters

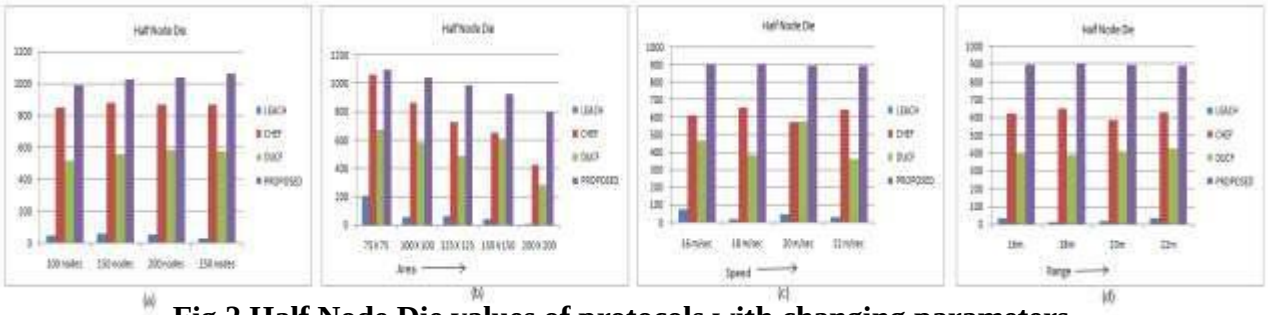

Fig 2 Half Node Die values of protocols with changing parameters

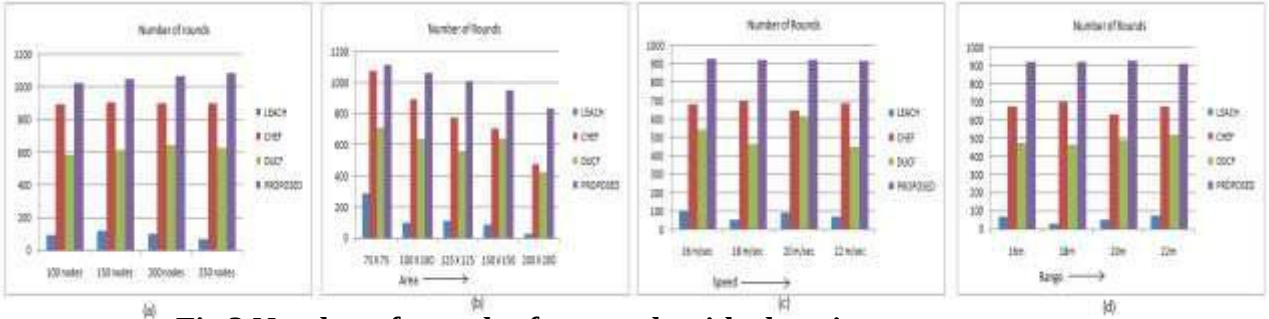

Fig 3 Number of rounds of protocols with changing parameters

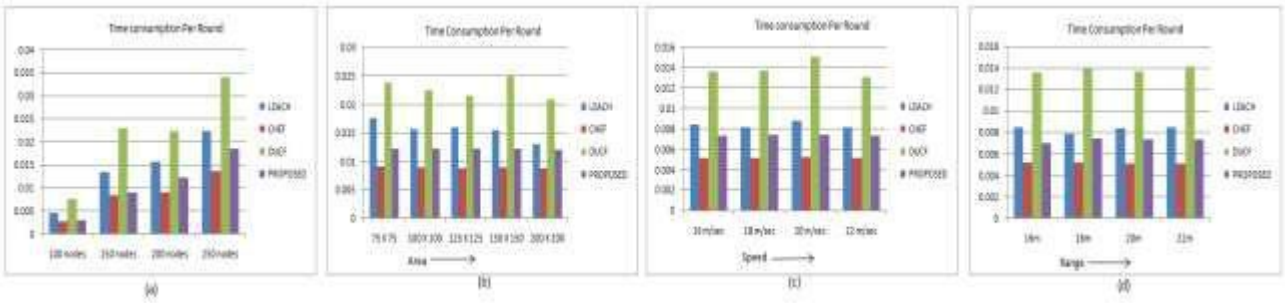

Fig 4 Time Consumption Per Round of protocols with changing parameters

VI. CONCLUSION

Wireless Sensor Networks find an increasing application in many fields. Yet the advancement in hardware technology cannot cross the energy barrier. The limited energy of the sensor nodes requires that routing and communication protocols be developed to ensure balanced energy consumption. A major approach of energy efficient communication protocols is to select CHs which aggregate data of member nodes and send to BS. The selection technique of CHs plays major role in energy consumption pattern of the network. Use of fuzzy logic to decide a node to be elected as CH is rather new. This paper has proposed a fuzzy logic method to select CHs in WSNs which have heterogeneous mobile nodes. Proper fuzzy linguistic variable are taken to consider residual energy, speed and range of a node to decide its chances of being a CH. The popular protocols for static homogeneous nodes like LEACH, CHEF and DUCF are adapted for the setting and compared against the proposal. Simulation experiments in various scenarios prove the proposed protocol to be better than others in all scenarios.

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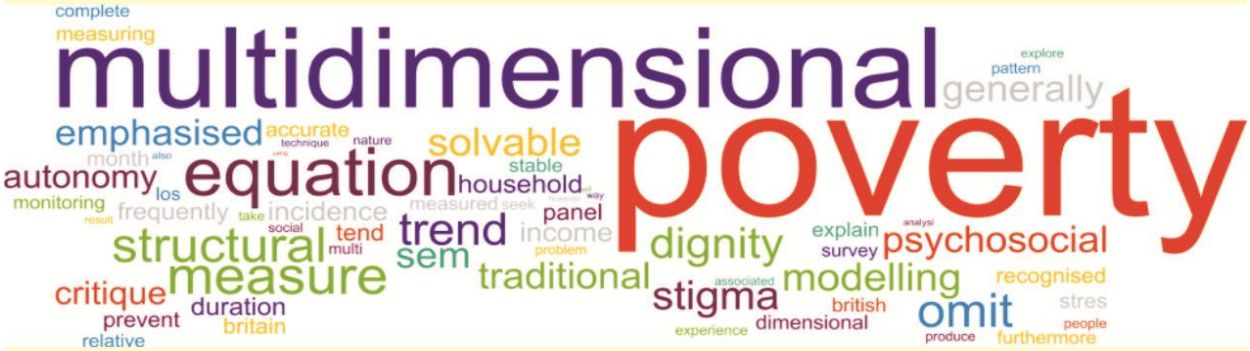

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