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Research Papers

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STORAGE AREA NETWORK

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ABSTRACT
A storage area network is a set of interconnected devices (for example, disks and tapes) and servers that are connected to common communication and data transfer infrastructure such as Fibre Channel. Fibre channel have been common implementation for data storage in enterprise data centers. As the size of the storage area network tends to grew along with geographical distribution leading to distributed storage area network, also known as large fabric, the network seems to exhibit scaling and stability issues. To determine the scaling and stability issues of a large fabric, an adequate tool is required. The tool is usually a discrete event simulator since an analytical or hardware simulator tool would not be able to handle the large size of the storage area network and model in detail.

1. INTRODUCTION

A storage area network is defined as a set of interconnected devices such as disks and tapes and servers that are connected to a common communication and data transfer infrastructure such as Fibre Channel. The common communication and data transfer mechanism for a given deployment is commonly known as the storage fabric. The purpose of SAN is to allow multiple servers access to a pool of storage in which any server can potentially access any storage unit. Clearly in this environment, management plays a large role in providing security guarantees and sequencing or serialization guarantees.

2. BENEFITS OF SAN

SANs evolved to address the increasingly difficult job of managing storage at a time when storage usage is growing explosively. With devices locally attached to a given server or in the server enclosure itself, performing day to day management tasks become extremely complex backing up the data in the datacenter requires complex procedures as the data is distributed amongst the nodes and is accessible server outgrows its current storage pool, storage specific to that server has to be acquired and attached even if there are other servers with plenty of storage space available. Other benefits can be gained such as multiple servers can share data, backing up devices can be done by transferring data directly from devices without first transferring it to a backup server. So why use yet another set of interconnected technologies? A storage area network is a network like any other (for example LAN). A SAN is used to connect many different devices and hosts to provide access to any device from anywhere. Existing storage technologies such as SCSI are tuned to the specific requirements of connecting mass storage devices to host computers. In particular, they are low latency, high bandwidth connections with extremely high data integrity semantics. Network technology, on the other hand is tuned more to providing application- to –application connectivity in increasingly complex and large scale environments.

3. STORAGE NETWORK AREA COMPONENTS

As previously discussed, the primary technology used in storage area networks today is Fibre Channel. This section provides a basic overview of the components in a fibre channel storage fabric as well as different topologies and configurations open to Windows deployments.

3.1 Fibre Channel Topologies

Fibre Channel has three configurations:

a) Point –to- Point
b) Fibre Channel Arbitrated Loop(FC-AL)
c) Switched Fibre Channel Fabrics(FC-SW)

a) Point –to-Point

Point-to-point fibre channel is a simple way to connect two (and only two) devices directly together, as shown in Figure 1 below. It is the fibre channel equivalent of direct attached storage (DAS).

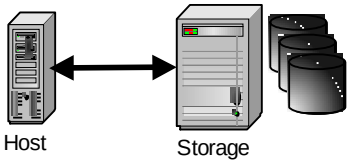

Figure 1: Point to point connection

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From a cluster and storage infrastructure perspective, point-to-point is not a scalable enterprise configuration and we will not consider it again in this document.

b) Fibre Channel Arbitrated Loop

A fibre channel arbitrated loop is exactly what it says; it is a set of hosts and devices that are connected into a single loop, as shown in Figure 2 below. It is a cost-effective way to connect up to 126 devices and hosts into a single network.

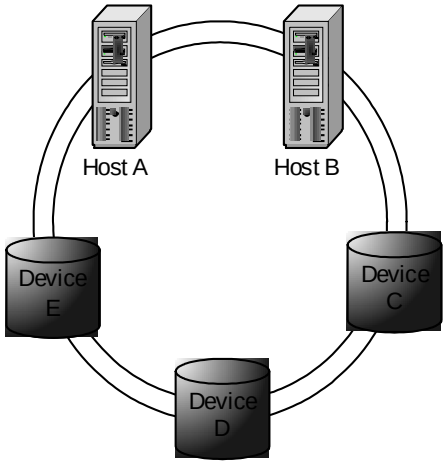

Figure 2: Fibre Channel arbitrated loop

Devices on the loop share the media; each device is connected in series to the next device in the loop and so on around the loop. Any packet traveling from one device to another must pass through all intermediate devices. In the example shown, for host A to communicate with device D, all traffic between the devices must flow through the adapters on host B and device C. The devices in the loop do not need to look at the packet; they will simply pass it through. This is all done at the physical layer by the fibre channel interface card itself; it does not require processing on the host or the device. This is very analogous to the way a token-ring topology operates.

Figure 3 below shows a schematic of the wiring for a simple arbitrated loop configuration.

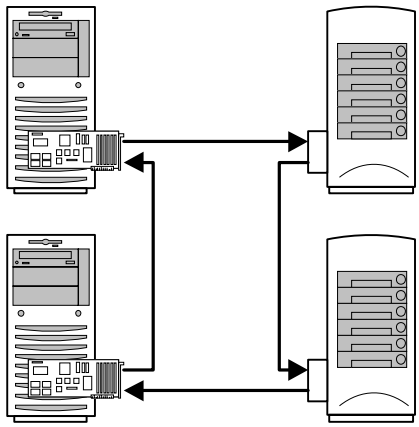

Figure 3: FC-AL wiring schematic

With larger configurations, wiring a loop directly can be very cumbersome. Hubs allow for simpler, centralized wiring of the. Communication in an arbitrated loop can occur in both directions on the loop depending on the technology used to build the loop, and in some cases communication can occur both ways simultaneously.

Loops can support up to 126 devices, however, as the number of devices on the arbitrated loop increases, so the length of the path and therefore the latency of individual operations increases.

c) Switched Fibre Channel Fabric

In a switched fibre channel fabric, devices are connected in a many-to-many topology using fibre channel switches, as shown in Figure 4 below. When a host or device communicates with another host or device, the source and target setup a point-to-point connection (just like a virtual circuit) between them and communicate

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directly with each other. The fabric itself routes data from the source to the target. In a fibre channel switched fabric, the media is not shared. Any device can communicate with any other device (assuming it is not busy) and communication occurs at full bus speed (1Gbit/Sec or 2Gbit/sec today depending on technology) irrespective of other devices and hosts communicating.

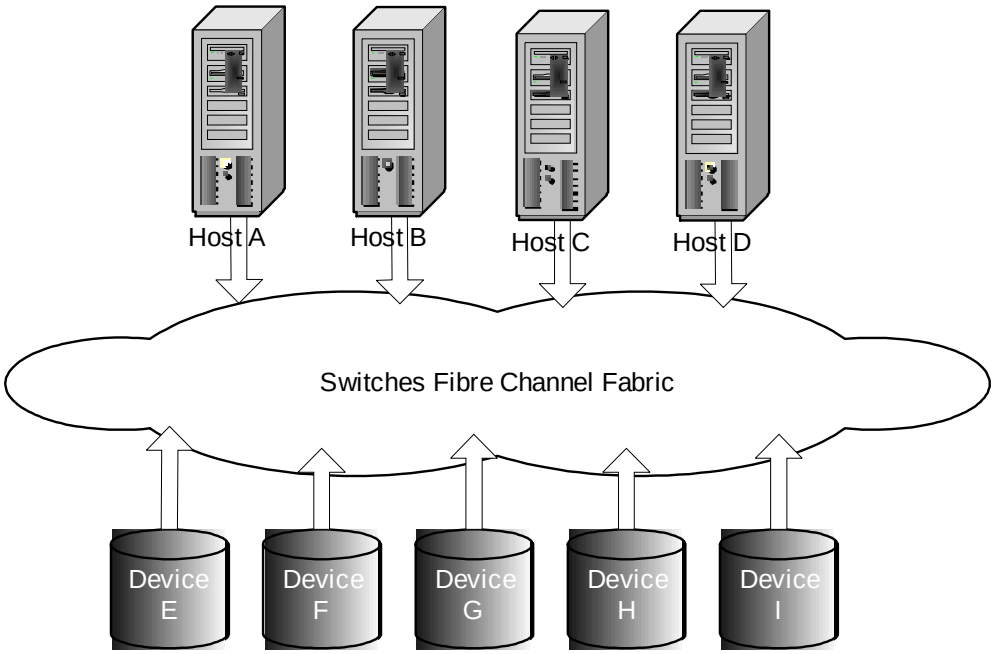

Figure 4: Switched Fibre Channel fabric

When a host or device is powered on, it must first login to the fabric. This enables the device to determine the type of fabric (there is a set of characteristics about what the fabric will support) and it causes a host or device to be given a fabric address. A given host or device continues to use the same fabric address while it is logged into the fabric and the fabric address is guaranteed to be unique for that fabric. When a host or device wishes to communicate with another device, it must establish a connection to that device before transmitting data in a way similar to the arbitrated loop.

3.2 Host Bus Adapters

A host bus adapter (HBA) is an interface card that resides inside a server or a host computer. It is the functional equivalent of the NIC in a traditional Ethernet network. All traffic to the storage fabric or loop is done via the HBA.

HBAs, with the exception of older Compaq cards and early Tachyon based cards, support both FC-AL and Fabric (since 1999). However, configuration is not as simple or as automatic as could be supposed. It is difficult to figure out if an HBA configures itself to the appropriate setting. On a Brocade fabric, it is possible to get everything connected, however, some of it might be operating as loop and still appear to work. It is important to verify from the switch side that the hosts are operating in the appropriate mode.

3.3 Hubs, Switches, Routers and Bridges

Thus far, we have discussed “the storage fabric” as a generic infrastructure that allows hosts and devices to communication with each other. As you have seen, there are fundamentally different fibre channel topologies and these different topologies use different components to provide the infrastructure.

3.3.1 Hubs

Hubs are the simplest form of fibre channel devices and are used to connect devices and hosts into arbitrated loop configurations. Hubs typically have 4, 8, 12 or 16 ports allowing up to 16 devices and hosts to be attached, however, the bandwidth on a hub is shared by all devices on the hub. In addition, hubs are typically half-duplex (newer full duplex hubs are becoming available). In other words, communication between devices or hosts on a hub can only occur in one direction at a time. Because of these performance constraints, hubs are typically used in small and/or low bandwidth configurations.Figure 5 below shows two hosts and two storage devices connected to the hub with the dark arrows showing the physical loop provided by the hub.

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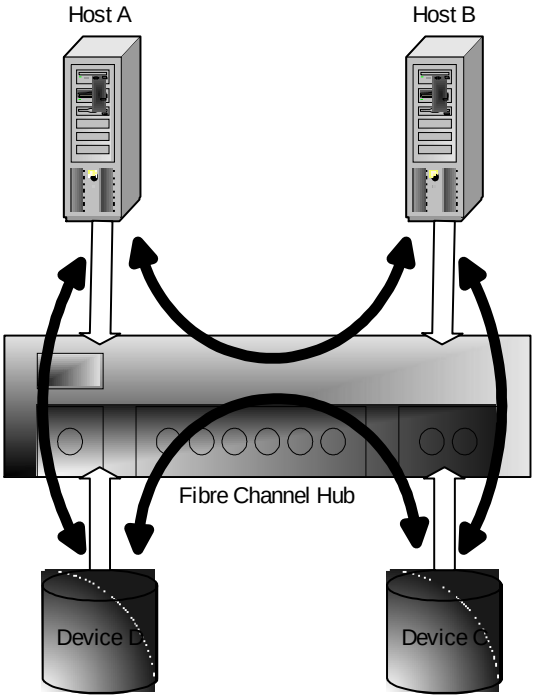

Figure 5: FC-AL hub configuration

A typical hub detects empty ports on the hub and does not configure them into the loop. Some hubs provide higher levels of control over how the ports are configured and when devices are inserted into the loop.

3.3.2 Switches

A switch is a more complex storage fabric device that provides the full fibre channel bandwidth to each port independently, as shown in Figure 6 below. Typical switches allow ports to be configured in either an arbitrated loop or a switched mode fabric.When a switch is used in an arbitrated loop configuration, the ports are typically full bandwidth, bi-directional allowing devices and hosts to communicate at full fibre channel speed in both directions. In this mode, ports are configured into a loop, providing performance, arbitrated loop configuration.

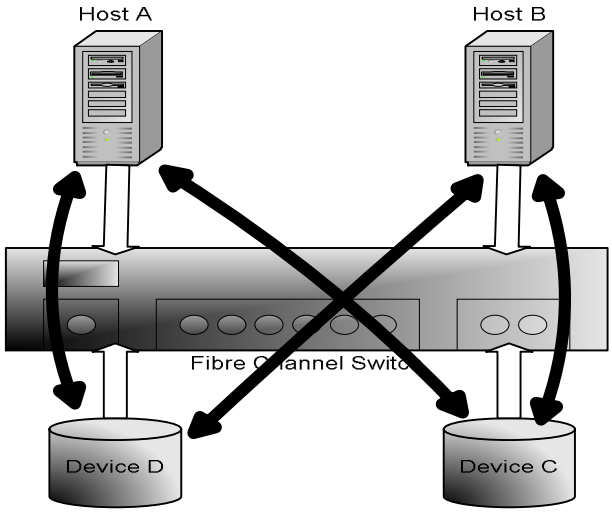

Figure 6: Switched fibre configuration

Switches typically support 16, 32, 64 or even 128 ports today. This allows for complex fabric configurations. In addition, switches can be connected together in a variety of ways to provide larger configurations that consist of multiple switches. Several manufacturers such as Brocade and McData provide a range of switches for different deployment configurations, from very high performance switches that can be connected together to provide a core fabric to edge switches that connect servers and devices with less intensive requirements.

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Figure 7 below shows how switches can be interconnected to provide a scalable storage fabric supporting many hundreds of devices and hosts.

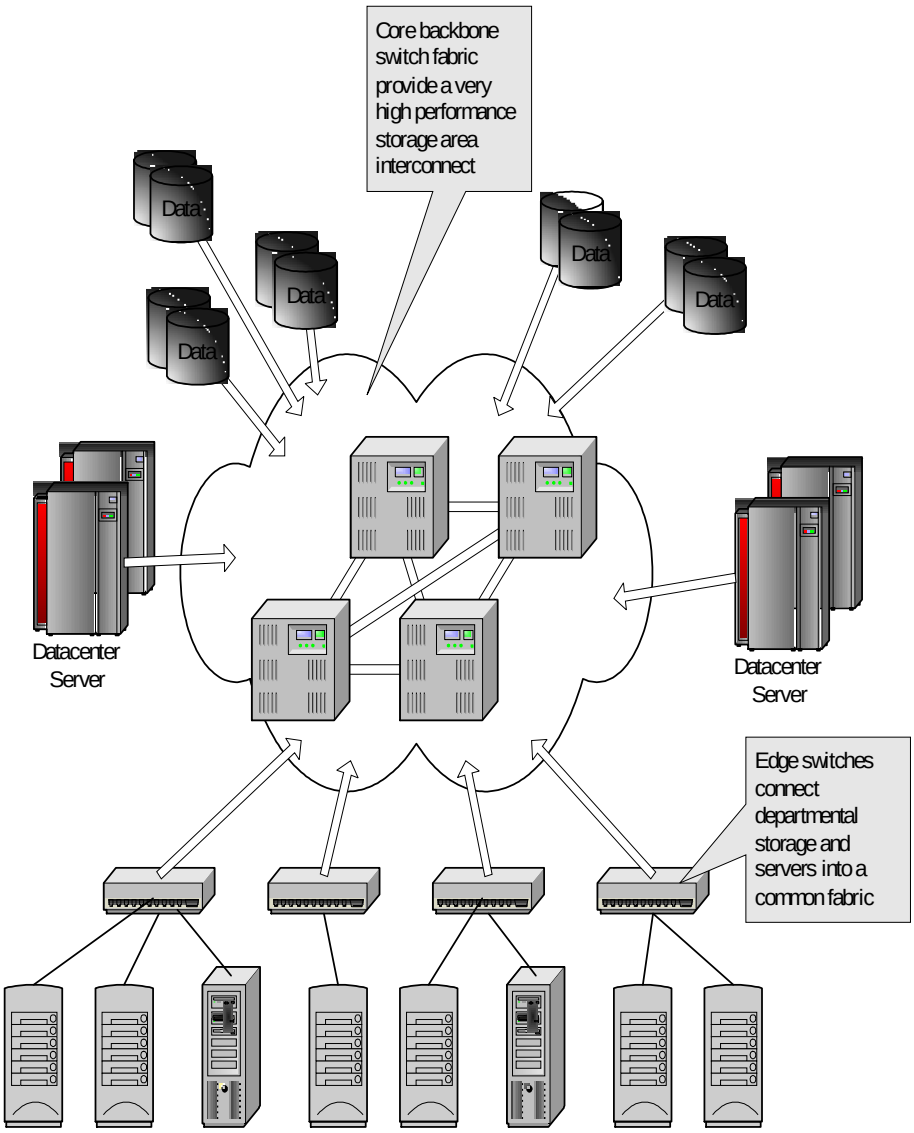

Figure 7: Core and edge switches in a SAN fabric

The core backbone of the SAN fabric is provided by high performance (and typically high port density) switches. The inter-switch bandwidth in the core is typically 8Gbit/sec and above. Large data center class machines and large storage pools can be connected directly to the backbone for maximum performance. Severs and storage with less performance requirements (such as departmental servers) may be connected via large arrays of edge switches (each of which may have 16 to 64 ports).

3.3.3 Bridges and Routers

In an ideal world, all devices and hosts would be SAN-aware and all would interoperate in a single, ubiquitous environment. Unfortunately, many hosts and storage components are already deployed using different interconnect technologies. To allow these types of devices to play in a storage fabric environment, a wide variety of bridge or router devices allow technologies to interoperate. For example, SCSI-to-fibre bridges or routers allow parallel SCSI (typically SCSI-2 and SCSI-3 devices) to be connected to a fibre network, as shown in Figure 8 below. In the future, bridges will allow iSCSI (iSCSI is a device interconnect using IP as the communications mechanism and layering the SCSI protocol on top of IP) devices to connect into a switch SAN fabric.

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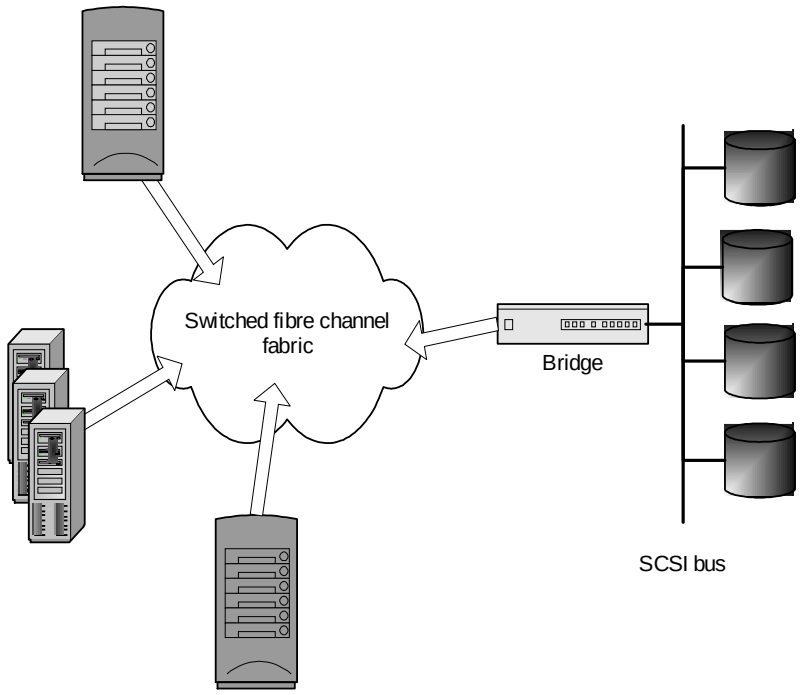

Figure 8: SCSI to Fibre Channel Bridge

4. Storage Components

Thus far, we have discussed devices being attached to the storage bus as though individual disks are attached. While in some very small, arbitrated loop configurations, this is possible, it is highly unlikely that this configuration will persist. More likely, storage devices such as disk and tape are attached to the storage fabric using a storage controller such as an EMC Symmetric or a Compaq Storage Works RAID controller. IBM would refer to these types of components as Fibre RAID controllers.

In its most basic form, a storage controller is a box that houses a set of disks and provides a single (potentially redundant and highly available) connection to a SAN fabric..

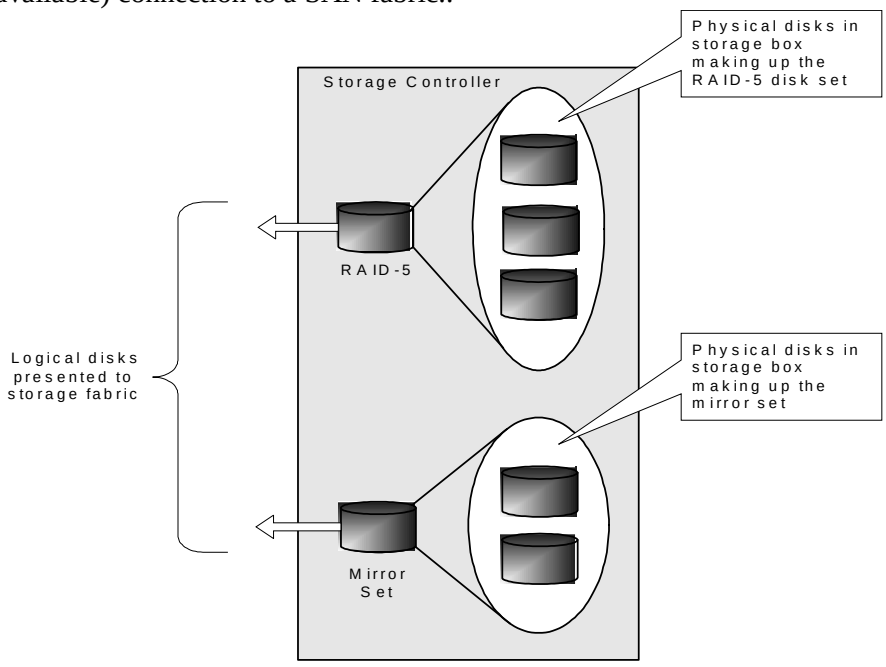

Figure 9: Logical devices

In the example in Figure 9, although there are five physical disk drives in the storage cabinet, only two logical devices are visible to the hosts and can be addressed through the storage fabric. The controller does not expose the physical disks themselves.

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As you can see in Figure 10 below, the storage infrastructure that the disks connect to is totally independent from the infrastructure presented to the storage fabric.

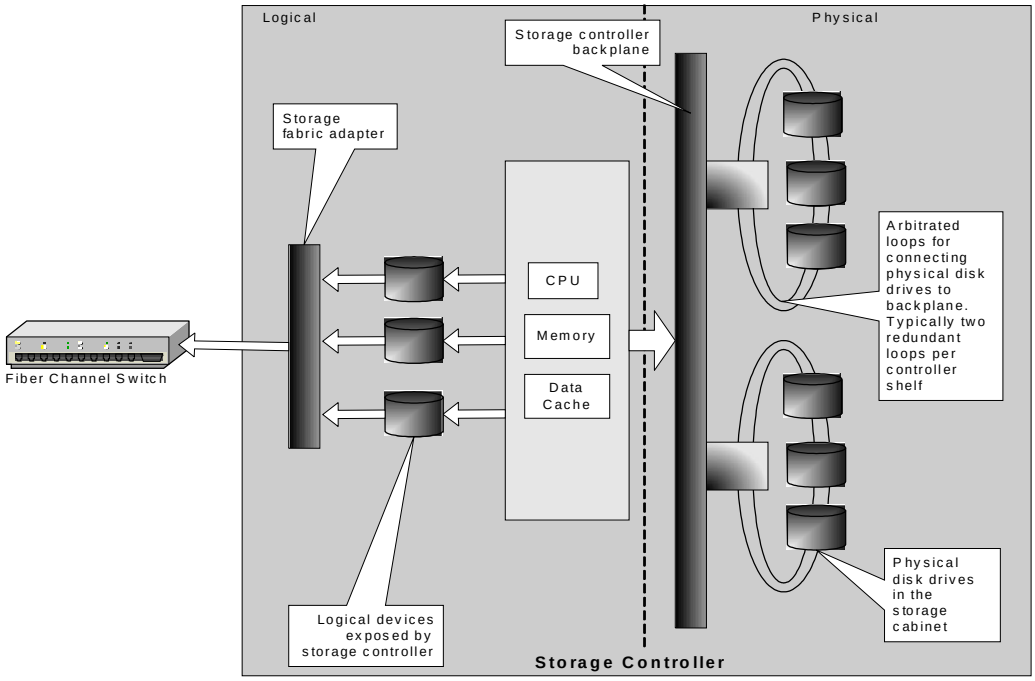

Figure 10: Internal components of a storage controller

4.1 Highly Available Solutions

One of the benefits of storage area networks is that the storage can be managed as a centralized pool of resources that can be allocated and re-allocated as required. This powerful paradigm is changing the way data centers and enterprises are built, however, one of the biggest issues to overcome is that of guaranteed availability of data.

There are many different storage area network designs that have different performance and availability characteristics. Different switch vendors provide different levels of support and different topologies, however, most of the topologies are derived from standard network topology design (after all a SAN is a network, just the interconnect technology is tuned to a given application). Topologies include:

- Multiple independent fabrics
- Core Backbone

4.1.1 Multiple Independent Fabrics

In a multiple fabric configuration, each device or host is connected to multiple fabrics, as shown in Figure 11 below. In the event of the failure of one fabric, hosts and devices can communicate using the remaining fabric.

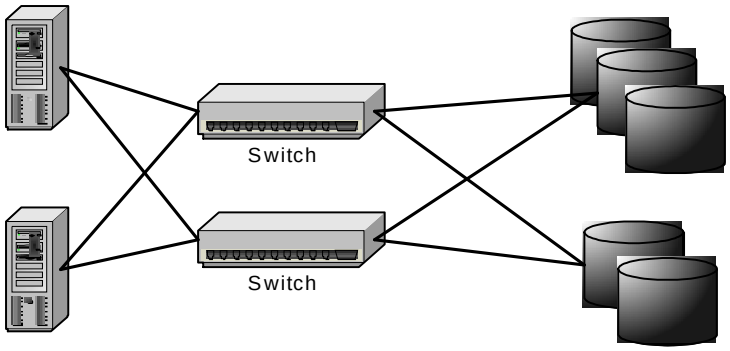

Figure 11: Multiple independent fabrics

4.1.2 Core Backbone

A core backbone configuration is really a way to scale-out a federated fabric environment. Figure 7 shows a backbone configuration. The core of the fabric is built using highly scalable, high performance switches where

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the inter-switch connections provide high performance communication (e.g. 8-10GBit/Sec using today's technology). Redundant edge switches can be cascaded from the core infrastructure to provide high numbers of ports for storage and hosts devices.

5. SAN MANAGEMENT

SAN management is a huge topic on its own and is outside the scope of this document. Different vendors (both vendors that provide SAN fabric components as well as software vendors that provide storage management tools) provide a wide range of tools for setting up, configuring, monitoring and managing the SAN fabric, as well as the state of devices and hosts on the fabric.

6. SUMMARY

Storage area networks provide a broad range of advantages over locally connected devices. They allow computer units to be detached from storage units, thereby providing flexible deployment and re-purposing of servers and storage to suit current business needs. You do not have to be concerned about buying the right devices for a given server, or with re-cabling a datacenter to attach storage to a specific server.

Microsoft fully supports storage area networks both as part of the base Windows platform, and as part of a complete Windows Clustering, high availability solution. One or more server clusters can be deployed in a single SAN environment, along with standalone Windows servers and/or non-Windows-based platforms.

6. REFRENCES

Website

1. IBM TotalStorage hardware, software, and solutions: http://www.storage.ibm.com
2. IBM System Storage: Storage area networks: http://www.-03.ibm.com/servers/storage/san
3. Storage Networking Industry Association: http://www.snia.org

Books

1. IBM TotalStorage: SAN Product, Design, and Optimization Guide, SG24-6384
2. Introduction to SAN Distance Solutions, SG24-6408

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A STUDY ON BEAM - COLUMN JOINT USING SYNTHATICFIBER REINFORCED CONCRETE

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ABSTRACT
Beam and column where bisect is called as joint or link. The act of beam-column joints have long been recognized as a significant factor that affects the overall behaviour of Reinforced Concrete framed structures subjected to large lateral loads. The reversal of forces in beam-column joints during earthquakes may cause distress and often failure, when not designed and detailed properly. One of the techniques of strengthening the reinforced concrete structural members is different fibre additives can be combined with concrete to design for specific applications and optimize mechanical properties which will result in large energy absorption capacity of structural members. fiber reinforced concrete are used to strengthen a variety of reinforced concrete elements to enhance the flexural, shear, and axial load carrying capacity of elements. Hence this paper discusses structural behaviour of Beam and column Joint using recron 3s concrete fiber under static loading

Keywords: beam-column joints, flexural, shear, recron 3s,fiber,crack

INTRODUCTION
During some of the past devastating earthquakes, it was established beyond doubt that beam-column joint acts as one of the weakest links in moment resisting framed RC structures. The behaviour of reinforced concrete frame structures as observed during earthquakes all over the world highlighted the consequences of poor performance of beam-column joints. Further, it was observed that during earthquakes, the exterior joints had suffered more in comparison to the interior ones. A typical case of beam-column joint failure is shown in Fig. 1.1(a) and Fig.1.1 (b). The failure of beam-column joints during past earthquakes opened a new research direction in the field of strengthening of beam-column joints for enhancing seismic safety.

Fig.1.1(a) I-280 Freeway, San Francisco, CA following Loma Prieta Earthquake in 1989

Fig. 1.1(b) 2009 L'Aquila Earthquake [Dr Anna Brignola, University of Genoa]

BEAM-COLUMN JOINT
Beam-column joint may be defined as the portion of the column within the depth of the deepest beam [ACI 352R-02, 2002]. In a moment resisting frame, three types of joints can be identified viz. interior joint, exterior joint and corner joint, which is shown in Fig. 2.1. The severity of forces and demands during earthquake on the performance of these joints needs a better understanding of their behaviour. These forces develop complex mechanisms involving bond and shear within the joint. The joint region is subjected to horizontal and vertical shear forces whose magnitude is typically many times higher than in the adjacent beams and columns.

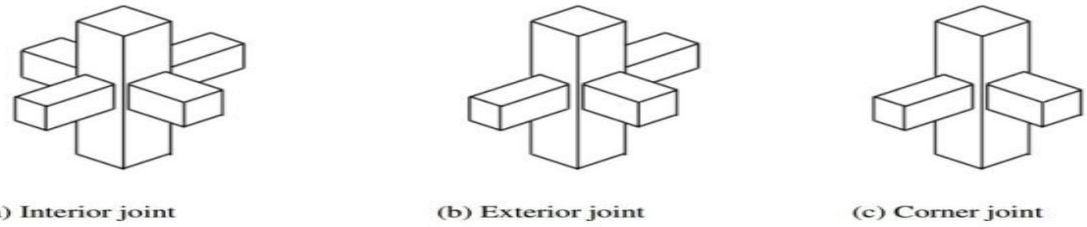

Fig. 2.1 Types of beam-column joints [Uma and Prasad, 2006]

FIBER REINFORCED CONCRETE
Concrete is well known as a brittle material when subjected to normal stresses and impact loading, especially, with its tensile strength being just one tenth of its compressive strength. It is only common knowledge that, concrete members are reinforced with continuous reinforcing bars to withstand tensile stresses, to compensate for the lack of ductility and is also adopted to overcome high potential tensile

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stresses and shear stresses at critical location in a concrete member .Even though the addition of steel reinforcement significantly increases the strength of the concrete, the development of micro-cracks must be controlled to produce concrete with homogenous tensile properties. The introduction of fibers was brought into consideration, as a solution to develop concrete with enhanced flexural and tensile strength, which is a new form of binder that could combine Portland cement in bonding with cement matrices.
Fibers are generally discontinuous, randomly distributed throughout the cement matrices. Referring to the American Concrete Institute (ACI) committee 544 , in fiber reinforced concrete there are four categories namely

1. SFRC - Steel Fiber Reinforced Concrete
2. GFRC - Glass Fiber Reinforced Concrete
3. SNFRC - Synthetic Fiber Reinforced Concrete
4. NFRC - Natural Fiber Reinforced Concrete

3.1. **RECRON 3S FIBER**
Recron 3s fiber are ofpolyester type which belong to SNFRC group. Recron 3s fiber was used as a secondary reinforcement material. It arrests shrinkage cracks and increases resistance to water penetration, abrasion and impact. It makes concrete homogenous and also improves the compressive strength, ductility and flexural strength together with improving the ability to absorb more energy. Use of uniformly dispersed Recron 3s fibres reduces segregation and bleeding, resulting in a more homogeneous mix. This leads to better strength and reduced permeability which improves the durability. The physical properties of Recron 3s fiber are given in

LITERATURE REVIEW
During the last few decades, lots of research was done on strengthening of seismic deficient external beam-column joints. Recent earthquakes in different parts of the world have revealed again the importance of design of reinforced concrete structures with high ductility. Strength and ductility of structures depend mainly on proper detailing of the reinforcement in

Beam-column joints. The flow of forces within a beam-column joint may be interrupted if the shear strength of the joint is not adequately provided. Under seismic excitations, the beam-column joint region is subjected to horizontal and vertical shear forces whose magnitudes are many times higher than those with in the adjacent beams and columns. Conventional Concreteloses its tensile resistance after the formation of multiple cracks. However, fiber concrete can sustain a portion of its resistance following cracking to resist more cycles of loading. Beam-column joints have a crucial role in the structural integrity of the buildings. For this reason they must be provided with adequate stiffness and strength to sustain the loads transmitted from beam and columns. The formation of plastic hinges in columns must be prevented since it affects the entire structure. For adequate ductility of beam-column joints, use of closely spaced hoops as transverse reinforcement was recommended in the ACI-ASCE Committee 352 report (ACI, 2002). Due to the congestion of reinforcement, casting of beam-column joint will be difficult and will lead to honeycombing in concrete (Kumar et al., 1991).

The strength of beam-column joint plays a very important role in the strength of the structure. Large volumes of literatures related to experimental investigation on beam-column joint are available

i) Studies on RC beam-column joint
ii) Numerical Studies
iii) Fiber reinforced concrete

STUDIES ON RC BEAM-COLUMN JOINT
The first experimental study on beam-column joint was conducted in the United States by [3] Hanson and Connor [1967]. Seven exterior beam-column joints were tested under simulated cyclic earthquake loading. Performance of these specimens including moment capacities at first yield of reinforcements, ultimate moment and ductility of the assemblies, maximum beam deflection and anchorage bond stresses of beam reinforcements were reported. The authors concluded that properly designed cast-in-situ RC frames could resist severe earthquakes without loss of strength and moderate earthquakes without damage. These tests became the standard reference for subsequent investigations.

[4] Kuang J.S. and Wong H. F.[2008] Reversed cyclic-load tests are carried out on full-scale reinforced concrete (RC) exterior beam–column joints, which are fabricated to simulate those in as-built RC framed buildings designed to BS 8110. Emphasis of the study is placed on the effects of the types of beam bar anchorage and location of laps in column reinforcement on the seismic behaviour and shear

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strength of RC exterior joints subjected to simulated earthquake load. Shear strength of a beam–column joint predicted by the criterion of initial diagonal cracking is highly dependent on the level of axial loads applied on the column; this model gives very good correlations with all the test data in this study

[5] Hegger Josef et al. [2004] investigated the behaviour of exterior and interior beam-column joints by Nonlinear finite element analysis using ATENA, a software for nonlinear analysis of reinforced concrete structures. The model has been calibrated using the results of the third author ‟s tests. The behaviour of exterior and interior beam -column turned out to be different .The parameters influencing the shear strength are not the same for both types of connections. Different parameters like effect of the material properties, effect of geometry of connection, effect of reinforcement, effect of concrete compressive strength and joint slenderness. The parameters influencing the shear capacity are different for exterior and interior connections. The FE results were compared with the author's experimental results and the good agreement between the two was achieved.

[7] Ehsani and Alameddine [1991] investigated the behaviour of corner joints constructed with high-strength concrete. Twelve specimens were tested in their study in order to examine the recommendations of ACI-ASCE Committee 352 on the design of high-strength ductile moment resisting beam-column joints. The authors showed that the recommendations which were developed for normal strength concrete could not be applied to high-strength concrete frame. They presented new requirements such as allowable joint shear stress and joint confinement for ductile design of RC beam-column joints.

[2] M. Kazem Sharbatdara, et.al [2012]This paper investigates the cyclic experimental behaviour of damaged exterior reinforced concrete beam–column joint specimens retrofitted with the proposed technique using steel elements called steel propane curb. The technique is usable for local and global strengthening of reinforced concrete frames. Four half-scale RC joints were tested under the cyclic loading; two control specimens with the different beam heights were loaded up to their ultimate strength and this was followed by retrofitting of these damage specimens as new specimens and tested again under the same loading system. Experimental results showed that the 25% reduction of beam height due to construction mistake caused increasing in deflection of joint beam, decreasing of ductility and also 33% and 26% decreasing in bearing capacity and energy absorption, respectively. The ultimate load was increased up to 80% and the rigidity decreased degradation of retrofitted damaged joints was significantly in the proposed retrofitting system. And also the energy absorption was enhanced and the cracks were minimized due to a new lateral loading in the beam–column joint region in this upgrading method.

NUMERICAL STUDIES

[8] Kwak and Fillippou [1990] made use of finite element analysis in order to study monotonically loaded reinforced concrete beam-column joints. Their model was capable of representing crushing and cracking of concrete. The authors proposed a new smeared finite element model based on an improved cracking criterion, which was derived from fracture mechanics principles. They also developed a new reinforcing steel model, which was embedded inside a concrete element and could account for the effect of bond-slip. Correlation studies between analytical and experimental results were performed. Several parametric studies were also conducted with the objective of checking the validity of proposed models and identifying the significance of various parameters on the local and global response of reinforced concrete joints.

FIBER REINFORCED CONCRETE

[1] Sinha Deepa A [2012] investigated the different type of fiber can be combined with concrete to design for specific applications and optimize mechanical properties. In this paper the optimum dosage of fibers to get maximum strength for the M 30 grade concrete is found and the properties of concrete i.e workability, compressive Strength, flexural strength are found. Like normal concrete fails in flexure without taking deflection but Fiber Reinforced concrete fails after taking sufficient amount of deflection.

[6] Ganesan N. et al. [2007] described the experimental results of ten steel fibre reinforced high performance concrete (SFRHPC) exterior beam-column joints under cyclic loading. Volume fraction of the fibres used in this study varied from 0 to 1% with an increment of 0.25%. Joints were tested under positive cyclic loading, and the results were evaluated with respect to strength, ductility and stiffness degradation. Test results indicate that the provision of SFRHPC in beam-column joints enhances the strength, ductility and stiffness, and is one of the possible alternative solutions for reducing the congestion of transverse reinforcement in beam column joints. Also, it is possible to reduce the congestion of steel reinforcement in the beam-column joints by replacing part

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of ties in the columns by steel fibres. Load carrying capacity of the joints also increased with the increasing fibre content.

5. EXPERIMENTAL PROCEDURE

The research was conducted through an experimental programme using M30 grade of concrete and M30 grade of fiber reinforced concrete cube test and cylinder test. Therefore, the influence of the recron 3s fiber in percentages will be studied concerning compressive strength and Flexural Strength Testwas done.

Test results

1. Workability Results

	Slump (mm)	Flow test	C.F.(cm)	V.B. test(sec)
Normal	37	44	0.97	5.49
Recron 0.20%	35	45.76	0.932	5.90
Recron 0.25%	31	41.26	0.9376	6.39
Recron 0.30%	21	40.26	0.95	7.3

2. Compressive Strength

COMPRESIVE STRENGTH OF RECRON FIBRE CONCRETE (N/mm2)

	7DAY	28DAY	% increase 7 DAY	% increase 28 DAY
Recron 0.20%	29	38.67	12.73	15.59
Recron 0.25%	37.04	49	49.08	31.55
Recron 0.30%	34.66	41.92	39.53	25.32
Normal	24.85	33.46	-	-

Workability

Workability of concrete is inversely proportional to fiber content. As per the results of the workability test it can be conclude that amount of fiber reduced the workability.

Sample	Flexure Strength 28 days	
	Tone	N / mm2
Normal Mix (M30)	1.11	4.33
Recron – 0.20%	1.42	5.63
Recron – 0.25%	1.72	6.83
Recron – 0.30%	1.4	5.55

LOADING SYSTEMS

Today the earthquake resistant structures are being designed more widely. To understand the behaviour of the structures in the earthquake, the researchers are applying cyclic loading to the building in the laboratory.

Types of loading systems:-The behaviour of building is studied with different types of loads.

1) *Static loading*: - Static means slow loading in structural testing. Test of components: Beams(bending),column (axial),beams and columns
   Purpose of testing:- Determine strength limits
   Determine the flexibility/rigidity of structures

2) *Quasi-static loading:*- Very slowly applied loading in one direction (monotonic)

3) *Quasi-static reversed cyclic loading:*-Very slowly applied loading in both direction (cyclic)
   Purpose of testing:- Determine strength limits
   Determine the flexibility/rigidity of structures

4) *Dynamic (random) loading*:- Shake at the base or any other elevation of the structure shaking similar to that during earthquakes

NUMERICAL STUDIES

7.1. INTRODUCTION

This chapter presents the numerical analyses on RC beam column joints with normal M30 concrete and M30 fiber reinforce concrete using the general purpose finite element software ANSYS 14.5. The study was carried out to simulate the behaviour of these joints under static and Quasi-static reversed cyclic loading. Nonlinear static analysis was carried out for getting prior information about the load at first crack, crack pattern, load and deflection at yielding, ultimate load etc. For all the specimens in order to appropriately

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plan the arrangement of experimental investigation. Results obtained from FE analysis using ANSYS 14.5 have been compared with those obtained utilizing strength criteria. The comparison shows that the results predicted by the numerical studies were slightly higher than those obtained by strength criteria. Moreover, it was also noted that the percentage gain in strength obtained by numerical analysis with respect to that by strength criteria increases as the specimen size decreases almost in all the cases. Thus, it reflects the existence of size effect on the result obtained by numerical simulation.

7.2. NONLINEAR ANALYSIS

Linear structural analysis is based on the assumption that structures undergo small deformations and the material remains elastic with linear load-displacement relationship. The analysis is performed on the initial unreformed shape of the structure. As the applied load increases raising the stress beyond elastic limit, this assumption remains no longer valid since the deformation may cause significant changes in the structural shape. This causes a change in the stiffness matrix leading to nonlinearity in structures. The nonlinearity in an RC element is mainly of two types, viz. Geometricnonlinearity andmaterial nonlinearity. Geometric nonlinearity refers to the nonlinearity instructure or component due to the changing geometry. Geometric nonlinearity may arise due to large strain, large rotation, and stress stiffening. Material nonlinearities are due to the nonlinear relationship between stress and strain implying that the stress is a nonlinear function of strain. Concrete and steel are two constituents of R.C. structures. Out of these two, concrete is much stronger in compression than in tension (tensile strength is of the order of about one tenth of the compressive strength). The tensile stress–strain relationship of concrete is almost linear up to failure, while the stress-strain relationship in compression is nonlinear from the very beginning itself. Since the concrete and steel are both highly nonlinear materials, the material nonlinearity of R.C. structure is understandably complex. The nonlinear analysis of reinforced concrete structures has become very important in recent years. It is advisable to carry out a complete progressive failure analysis of the structure up to collapse to assess all safety aspects of a structure and for finding its deformational characteristics. The development of material models for uncracked and cracked concrete for all stages of loading is particularly a challenging field in nonlinear analysis of reinforced concrete structures. Since the stiffness matrix continuously changes during application of successive loads, the analysis needs to be performed by iterative methods, like direct iteration or the Newton-Raphson method.

7.3. ELEMENT TYPES

In the present FE analysis, all the structural elements were modelled using appropriate finite element from the available element library of ANSYS.Concrete was modelledby 3-D solid element. Reinforcing steel was modelled by a 3-D truss element. The next subsections discuss about all the elements used for modelling of beam-column joint.

7.3.1. SOLID65

SOLID65 is used for the 3-D modelling of solids with or without reinforcing bars (rebar). The solid is capable of cracking in tension and crushing in compression. In concrete applications, for example, the solid capability of the element may be used to model the concrete while the rebar capability is available for modelling reinforcement behaviour. Other cases for which the element is also applicable would be reinforced composites (such as fiberglass), and geological materials (such as rock). The element is defined by eight nodes having three degrees of freedom at each node: translations in the nodal x, y, and z directions. Up to three different rebar specifications may be defined.

The concrete element is similar to a 3-D structural solid but with the addition of special cracking and crushing capabilities. The most important aspect of this element is the treatment of nonlinear material properties. The concrete is capable of cracking (in three orthogonal directions), crushing, plastic deformation, and creep. The rebar are capable of tension and compression, but not shear. They are also capable of plastic deformation and creep.

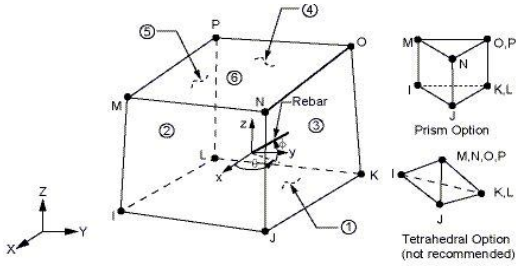

Fig.4.1. SOLID65 Geometry

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7.3.2 LINK180

LINK180 is a 3-D spar that is useful in a variety of engineering applications. The element can be used to model trusses, sagging cables, links, springs, and so on. The element is a uniaxial tension-compression element with three degrees of freedom at each node: translations in the nodal x, y, and z directions. Tension-only (cable) and compression-only (gap) options are supported. As in a pin-jointed structure, no bending of the element is considered. Plasticity, creep, rotation, large deflection, and large strain capabilities are included.

By default, LINK180 includes stress-stiffness terms in any analysis that includes large-deflection effects. Elasticity, isotropic hardening plasticity, kinematic hardening plasticity, Hill anisotropic plasticity, Chaboche nonlinear hardening plasticity, and creep are supported. To simulate the tension-/compression-only options, a nonlinear iterative solution approach is necessary; therefore, large-deflection effects must be activated (NLGEOM, ON) prior to the solution phase of the analysis.

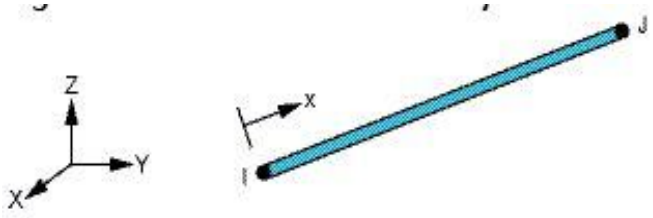

Fig.4.2. LINK180 Geometry

4.3. FINITE ELEMENT ANALYSIS

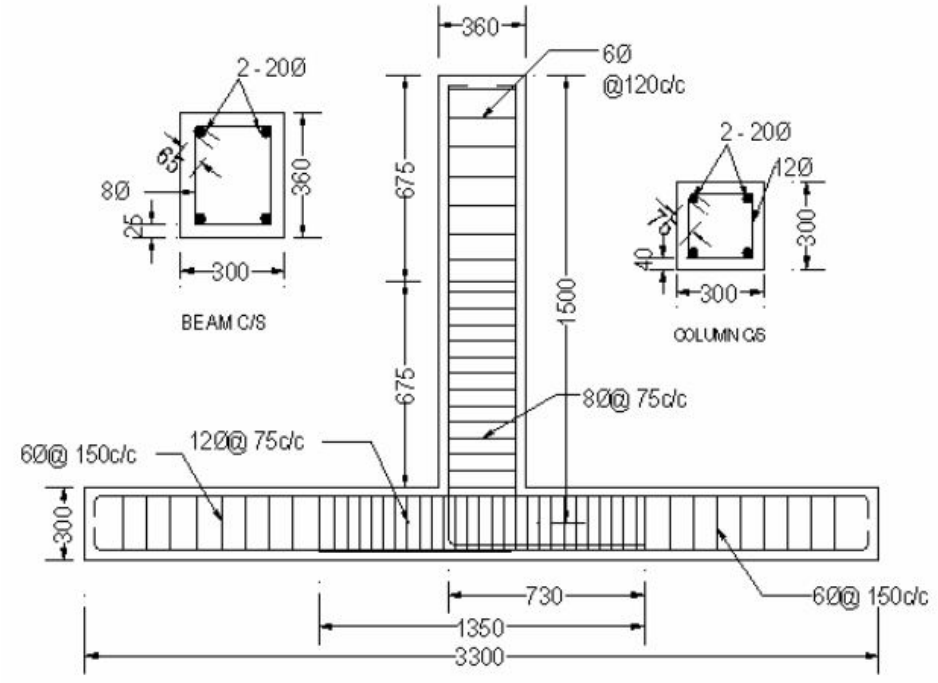

Fig.4.3. Detailing of Beam-Column joint using M30

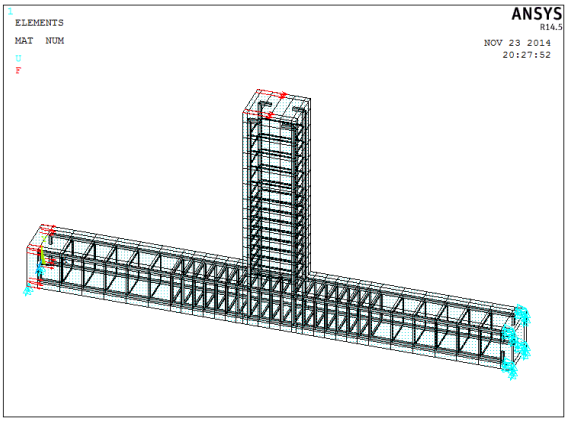

Fig.4.4. Finite element analysis using static load

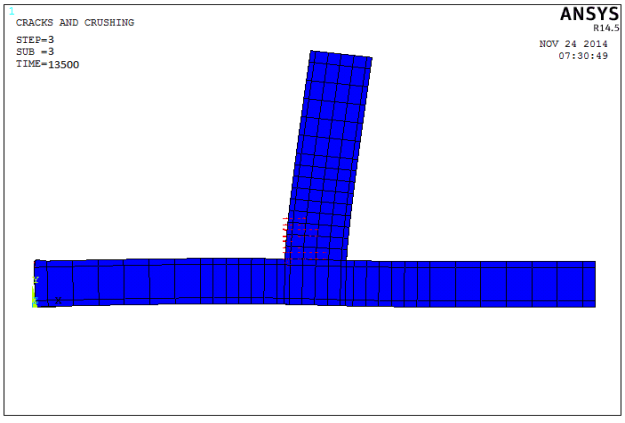

Fig.4.5. First crack coming in a 13.5 KN

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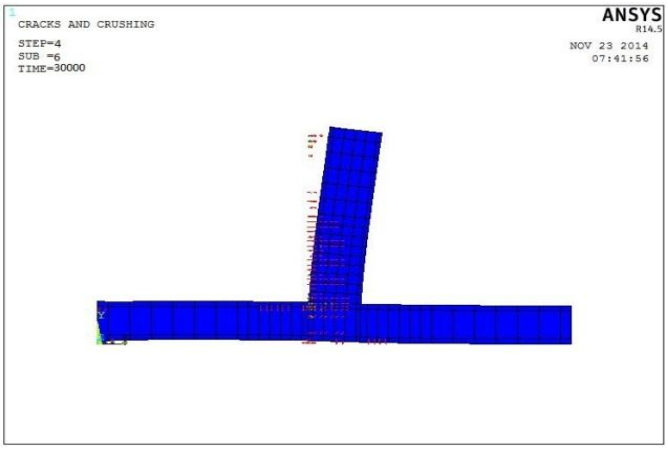

Fig.4.6. Ultimate cracks come in a 30KN

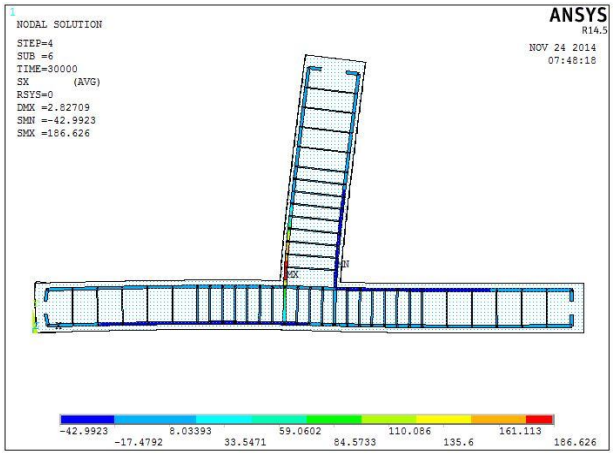

Fig.4.7. Ultimate failure load and ultimate stresses

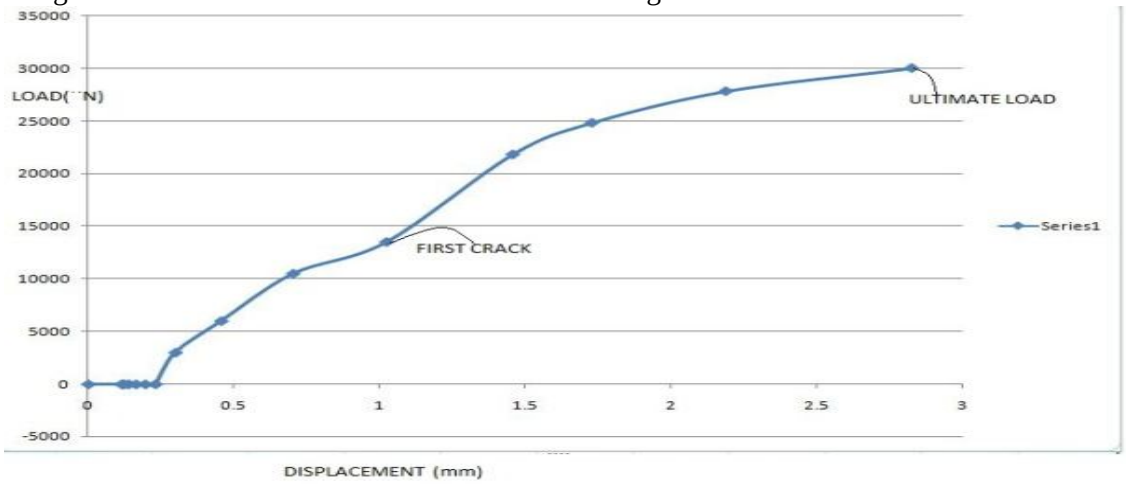

Fig.4.8. Typical Load-Displacement Graph

8. CONCLUSION

A brief review has been made on the existing literature on Beam-Column Joint and fiber reinforced concrete. From literature review it was found that there is lot of scope to carry out further research. The modelling of beam-column joints have been highlighted .If static load increased slowly on the beam then displacement, minimum stress and maximum stress also increases.

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AGRICULTURAL LAND USE SUITABILITY ANALYSIS USING GIS IN CACHAR DISTRICT, ASSAM, INDIA

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ABSTRACT
The sustainable development of agriculture satisfies basic human needs through ensuring proper utilization of existing environmental parameters and natural resources. It is based on maintaining the stability between the productivity factors, agricultural practices and repossession of unused lands. Finite land use planning is a highly required component in formulating sustainable development. The land, water, minerals and biomass resources are currently under over exploitation due to expanding population. In India more than 75% of population depends on agriculture for their livelihood. Agriculture plays a vital role in our country's economy. Advancement of satellite based technologies has brought new set of potentials in different phases of development planning. In this work, an attempt has been made to utilize latest Remote Sensing and GIS technologies for planning land suitability for agricultural crops at a district level.

INTRODUCTION
Agricultural land use suitability analysis is the process of determining the suitability of a given land area for agricultural purpose and the level of suitability of that land. An important part of this process is to determine the factors that affect the suitability of the land for agricultural purpose. Now, in GIS we can integrate all the factors to find the best possible region for agriculture. The Food and Agricultural Organization (FAO 1976) recommended an approach for land suitability evaluation for agriculture in terms of suitability ratings ranging from highly suitable to not suitable based on -

- Climatic data
- Terrain data
- Soil properties

As per FAO the suitability rankings are S1, S2, S3, N1 and N2.
S1-Highly suitable, S2-Moderately suitable, S3-Marginally suitable, N1-Currently not suitable and N2-Permanently not suitable.
Integrated remote sensing and GIS can clearly visualize the spatial distribution of the agricultural land suitability. This new technology can reduce the time and cost in organizing the data in arriving at precise conclusion and decision for planners and decision makers.

STUDY AREA
The study area for this paper is Cachar district which is located at the lower part of Assam. The Barack is the main river of the district and apart from that there are numerous small rivers which flow from Dima Hasao district, Manipur and Mizoram. The district has a population density of 459 inhabitants per square kilometre (1,190/sq mi). Its population growth rate over the decade 2001-2011 was 20.17%. Cachar has a sex ratio of 958 females for every 1000 males, and a literacy rate of 80.36%. It is bounded on the North by Barali and Jayantia hill ranges, on the south by the state Mizoram, on the east by sister district Hailakandi and Karimganj. The district has the longitude of 92° 24' E and 93° 15' E and latitude of 24° 22' N and 25° 8' N.

Fig.1. Study area map.

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AIM AND OBJECTIVES

This main objective of this evaluation is to identify the inherent capacity of a land unit to support a specific land use over a long period of time in Cachar district. Agricultural land suitability classification based on indigenous knowledge is vital to land use planning. Selecting the most appropriate land evaluation technique is therefore very important for current and future land use planning in countries such as India. The other objective of this paper is to develop various thematic maps for the agricultural purposes.

MATERIALS AND METHODS

Land suitability analysis for Cachar district will be carried out using various topographic maps and satellite imagery. Satellite data will be used for preparing land use. Contour maps will be extracted from the topographic map of Survey of India. Secondary data like soil, rainfall, soil depth will be used for the study. The following data will be used for the study

- The Survey of India topographic map.
- Soil map from Indian Institute of Soil Science.
- Remotely sensed data.
- Rainfall data from Central Water Commission.

In this study we will use the weighted overlay methodological approach to integrate all the thematic layers for achieving the designed objectives.

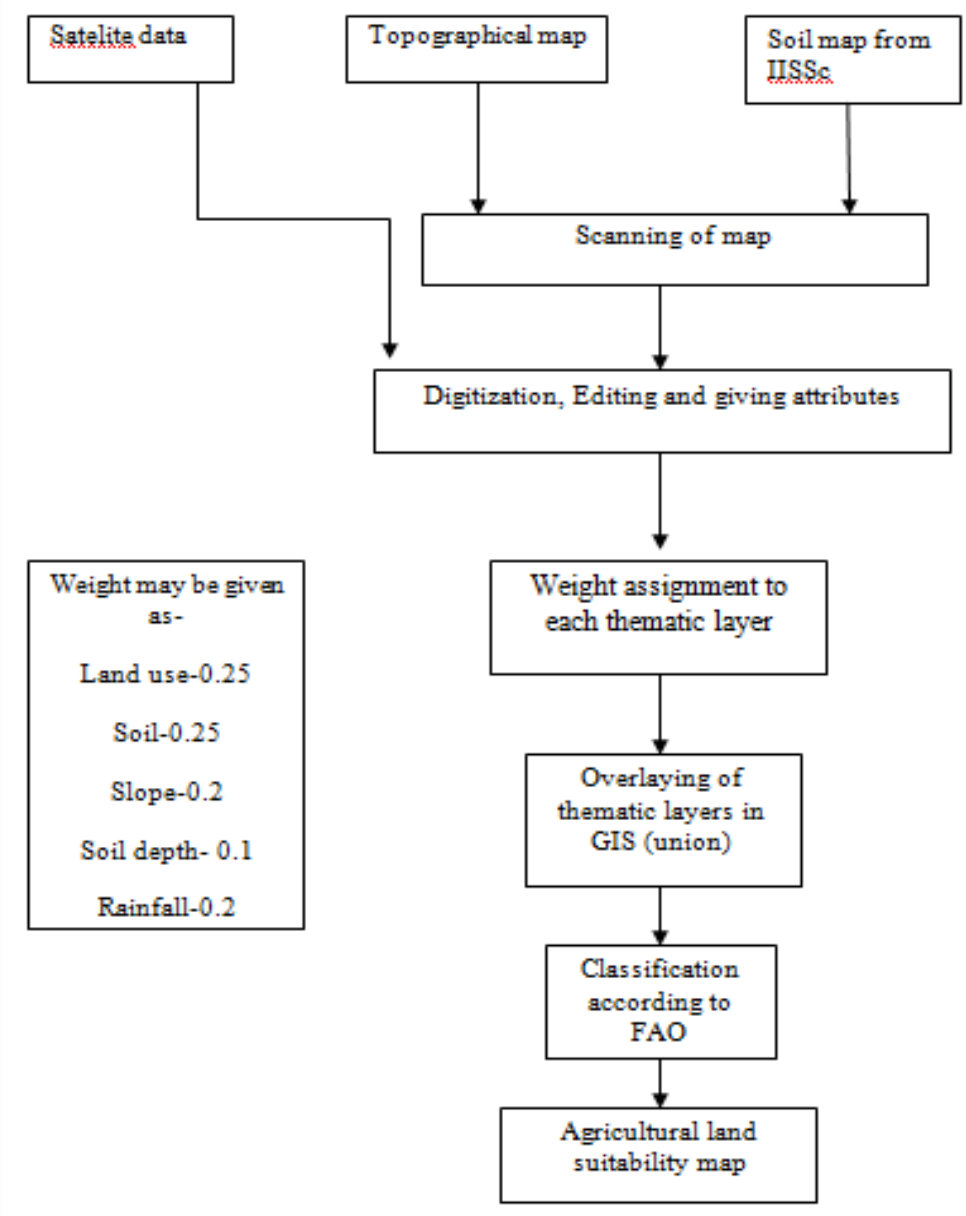

Fig 2. Flow chart of the methodology.

LITERATURE REVIEW

Research studies conducted by pioneering authors on topics related to integrated watershed modeling and management, sustainable development of land-water resource, check-dam suitability using Remote sensing and GIS techniques, pertaining to the study area and elsewhere have been taken into consideration for the study . Notable studies conducted by IMSD (Integrated Mission for Sustainable Development) in 1985, National Remote Sensing Agency (1987, 1988, and 1989), Andhra Pradesh State Remote Sensing Applications Center (APSRAC) in 1989 and Bhagavan and Raghu (2002) have been taken into consideration. These studies using Remote sensing and GIS has dealt with different aspects, from watershed modeling and management to hydrogeomorphological mapping, sustainable development, land use and land cover mapping and implications have been referred for the study.

1. **Gopala Krishna. GVT and Regil. R** studied the sustainable development of agriculture satisfies basic human needs through ensuring proper utilization of existing environmental parameters and natural resources. It is based on maintaining the stability between the productivity factors, agricultural practices and repossession of unused lands. From the study it is found that more than 30% area of the basin is lying under moderate to high suitable areas.
2. . **Halil Akıncı, Ays e Yavuz Özalp, Bülent Turgut** the aim of this study was to determine suitable lands for agricultural use in the Yusufeli district of Artvin city (Turkey), where the current agricultural land in the district center and 3 villages will be completely inundated while the land in 22 villages will be partially inundated due to three large dams currently being constructed. From the study it was estimated that part of merely 8% of the study area is suitable for agricultural production.
3. **A. A. Mustafa, Man Singh, R. N Sahoo, Nayan Ahmed, Manoj Khanna, A. Sarangi and A. K. Mishra** studied Land evaluation procedure given by FAO for soil site suitability for various land utilization types has been used to assess the land suitability for different crops and for generating cropping pattern for kharif (summer) and rabi (winter) seasons in Kheragarah tehsil of Agra. The study finds that A total of 9 crops were evaluated for growing in the study area out of which 4 crops (mustard, sugarcane, wheat and barley) belong to rabi season whereas 5 are kharif crops (pearl millet, maize, cotton, rice and sorghum).
4. **Jadab Chandra Halder** studied a qualitative evaluation of land to determine land suitability in Ghatal block, Paschim Medinipur district, West Bengal for rice and wheat cultivation based on four pedological variables, like Nitrogen-Phosphorus-Potassium (NPK) status, soil reaction (pH), Organic Carbon (OC) and soil texture that are mandatory input factors for crop cultivation. The result indicated that only 12.71% of agricultural land is highly suitable for rice cultivation whereas 7.78% of agricultural land is highly suitable for wheat cultivation in the study area.
5. **S. Bandyopadhyay, R. K. Jaiswal , V. S. Hegde & V.Jayaraman** studied a land suitability evaluation in a watershed has been carried out through close examination of the indicators of land suitability. The parameters taken into consideration were soil texture, organic matter content, soil depth, slope and land use/land cover.From the study it was found that About 15% of the area is rated as good to fair for agriculture. A very large portion of the area (70%) comes under moderate to average agriculture land potential. Poor to non-suitable lands which constitute 15% of the total area.

CONCLUSION

Various studies carried out in several areas of sustainable agricultural management/development in India by integrated use of aerospace data and GIS have clearly indicated that Remote Sensing and GIS technology are very effective tool for suggesting action plans /management strategies for agricultural sustainability of any region. This research effort sought to establish a prototype spatial model in land evaluation for agriculture using GIS. It will demonstrate that using GIS it is easy to determine sites that are best suited for growing agriculture.

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ASSESSMENT OF SKID RESISTANCE VALUE ON BITUMINOUS MIX SAMPLE

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ABSTRACT
This present study discuss the use aggregate texture of North-East India used the testing of skid resistance value. As skidding has identified as common factor for road accident and it is a surface properties of pavement so it is mainly related to several properties of pavement factors like aggregate texture (micro-texture and macro-texture), contamination effects (like oil, water plastics or rubber), age of pavement and polishing effect of pavement. Various apparatus are designed and has been used to determine the value of the skid resistance property of a pavement surface under dry and wet conditions. One of very common apparatus so called as British Pendulum Testing Machine (ASTM E303-93).

The pavement throughout its life should have some friction to facilitate the car wheels on pavement surface. The following samples have to be prepared to test to assess their skid resistance value under various conditions. Skid resistance studies were conducted for different binder content and under aggregate gradation. From the results, significant drop of skid resistance are recorded when the bitumen content increases, four samples are prepared at 4.5%, 5.5%, 6.5%, and 7%. Effect of the micro-texture on skidding resistance was analyzed with desired gradations used.

Keyword: Skid Resistance, Bituminous Sample, British Pendulum Tester.

INTRODUCTION
Road accidents have been the nation concern. In India, where more than 85% of transportation takes place on the road transportation network (RAI) so in that case the comfort and safety are of prime importance for any transportation agencies. Factors contributed to road accidents can be categorized into three main categories. These are the human, vehicle and road. While considering the factor road, one of major component is called skidding. A part of accident will happen due to lack of skid resistance over the pavement surface and the tires. There are several factors that contribute to the road accidents. Skid resistance is the most important frictional characteristic of the pavement surface which controls the steering of vehicles. It's a measure of frictional characteristics of a pavement surface. Skidding will happen when the pavement surface does not provide adequate friction to the tire especially in wet condition.

Loss of skid resistance affects driver's ability to control vehicle especially at road intersection. In addition to increasing the stopping distance while braking, lower skid resistance reduces steering control ability as both braking and steering depend on tire-pavement friction. For a give type of tire and road, the wheel is begin to slide, the drivers control over the vehicle is drastically reduced, and then in such condition vehicles is said to be "skidding". Its frictional resistance offered by the pavement surface to sliding tires called skid resistance.

LITERATURE REVIEW
Skid resistance occurs when a vehicle brakes, accelerates, or maneuvers of vehicles during which the frictional force exceeds the limiting values that can be generated at the tire and pavement surface interface (Kennedy et al, 1988). Micro-texture of the exposed aggregates is important in the design of non skid flexible road surfaces, can be examined microscopically, but for routine purpose, its generally assessed by measurement of the coefficient of friction determined by a British pendulum rubber slider moving over a prepared sample of the bituminous mixes (Croney, 1991). Figure 1 shows the classification of the road surface texture. As per survey conducted by TRRL, Dry pavement surfaces are usually not slippery, but there are lots of things that can make a pavement surface slippery which sometimes worst than wet surface. Slippery may also develop from surface contamination, such as the oil or many types of loose particles (TRRL, 1969). Various factors that influence the skid resistance values with the magnitude of their effect are given in Table 1.

Table 1: Factors affecting the Skid Resistance of pavement (Asphalt Institute, 1983)

Factors	Types
Climate	Seasonal Variation (wet/dry cycles) Temperature
Surfacing	Coarse aggregate type (asphalt surfacing) Contamination: Dust, rubber, oil etc Texture depth (sand patch)

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Traffic	Daily flow of commercial vehicles braking, Acceleration, centrifugal force

Adequate surface friction must be provided on a pavement, so that loss of control does not occur in normally expected situations, when the pavement is wet (Huang, 2004). Skid resistance is a measure of the resistance of the pavement surface to sliding or skidding of the vehicle. Minimum values are suggested by the TRRL 1969 for the skid resistance under different situation tested by Portable pendulum tester in Table 2.

The texture of the aggregate, especially the coarse aggregate contributes to the skid resistance of the pavement. The use of varying textures will influence the skid resistance. For normal bituminous paving, the larger rough aggregate sizes govern the skid resistance. These are texture of two types: 1. Micro-texture and 2. Macro-texture, these both the texture are important in determining the overall skid resistance. Friction measurements have become an important tool in the management of pavement surfaces (Choubane et al. 2004). The friction-related properties of a pavement depend on its surface texture characteristics. These characteristics, as previously stated, are known as macro-texture and micro-texture (Kummer and Meyer 1963).

This polishing is due to the horizontal forces applied by the vehicle tires on the pavement surface. Under these forces, the protruding aggregates are worn off, polished, or abraded, thus reducing surface micro-texture and macro-texture (Kennedy et al., 1990). The higher the polished stone value, the more resistant the aggregate is to polishing. Moore (1972) in an attempt to explain the friction phenomenon between tire and pavement, showed that frictional forces in comprised primarily of adhesive and hysteresis components as shown in Figure 1 (Choubane et al., 2004). During sliding on a wet pavement, a complex interplay between adhesion and hysteresis forces contributes to vehicle stopping distance. The adhesion relates to the actual contact area between the tire and the traveled surface as well as the shear strength of the interface (Choubane et al., 2004). The adhesion friction is dominant until critical slip occurs. Typically, at driving speed on wet pavement, the adhesion accounts for two-thirds of the resistance force.

Macro-texture refers to the larger irregularities in the road surface (coarse-scale texture) that affect the hysteresis part of the friction. These larger irregularities are associated with voids between aggregate particles. The magnitude of this component will depend on the size, shape, and distribution of coarse aggregates used in pavement construction, the nominal maximum size of aggregates as well as the particular construction techniques used in the placement of the pavement surface layer (Noyce et al., 2005; National Asphalt Pavement Association, 1996).

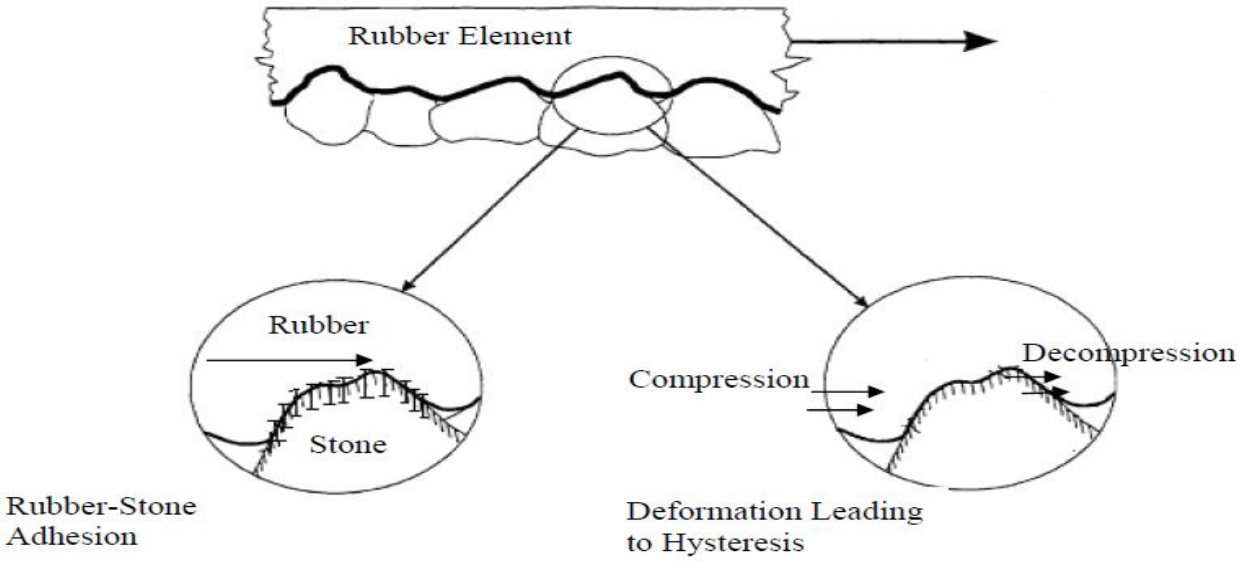

Figure 1.Schematic Plot of Hysteresis and Adhesion (Choubane et al., 2004)

Harish H.S et al (2013) conducted the research to have better understanding the pavement surface phenomenon on the field due to dry and wet seasonal change and effects of polishing of aggregate. They tested the skid measurement over the road surface contaminations. He concluded that skid resistance value shows increasing trends with the increase in texture depth. Kamran et al (2013) studied different quarries of aggregate effect on pavement surface frictional properties. Aggregate polishing was simulating by polishing machine, surface texture profile and statics friction coefficient were taken in consideration. They concluded the different PSV for

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different aggregate quarries It can also be conclude that micro-texture can changes the result of effective role of friction over the surfaces.

M.R. Ahadi and K. Nasirahmadi (2013) showed the effect of bitumen content on skid resistance using asphalt sample prepared from the gyratory compactor machine. He had considered the dense and open grade sample for the analysis of British pendulum number analysis and they concluded that the asphalt samples with open grades have responded better than those with dense grades with respect to skid resistance. He also concluded the effect of change of percent in bitumen form optimum bitumen content on British Pendulum Number. For the optimized percentage of bitumen for dense grades Nos. 4 and 5, dense grade No.5 exhibits 10% more than dense grade No. 4. Therefore, the macro-texture is suitable for percentage of optimized bitumen for dense grade No.5.

Figure 2 shows the classification of the surface texture. Both micro and macro texture affect the skid resistance of a pavement. Rough and harsh pavement texture will perform better, while polished and smooth texture will have an adverse effect. Rough surface also has better drainage capability and this can reduce the risk of hydroplaning (Kennedy, et al, 1988). Normal considerations consider the wet surface (during rains) as the most critical level for skid resistance. Hence, skid resistance testing is carried out with the present of water.

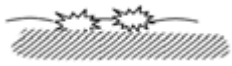
Surface		Scale of Texture	
		Macro	**Micro**
A		rough	harsh
B		rough	polished
C		smooth	harsh
D		smooth	polished

Figure: 2. Classification of texture (Kennedy, et al, 1988)

OBJECTIVE AND SCOPE

a) To determine basic test for suitability of Bitumen and Aggregate.

b) To study the effect of aggregate textures and binder on skid resistance of bituminous mixtures.

c) To analyze the Micro-Texture of bituminous mixes.

The scope of the research covered over the testing and analysis of bituminous mixes surface for the skid resistance value. I have selected one aggregate quarry from the North-East region of India named as Khagrabari Quarry. This study is limited to laboratory test. From the literature study it is clear that there are several factors which affect aggregate polishing and skid resistance.

RESEARCH METHODOLOGY

To achieve the objective mentioned above following procedure has to be followed in step by step. We know that for bituminous sample preparation basic test to be required and after that use of gradation mix for the preparation of Marshall Samples. These samples prepared of size 150 mm diameters and around 50mm depth to be tested for skid resistance value. As per study testing should be done be British Pendulum Testing Machine and this pendulum gives a number called British pendulum number is an indirect measure of skid resistance value. Below figure 3 and figure 4 shows the aggregate quarry and bituminous sample prepared respectively.

The tests have to be conducted in three parts:

a) Basic Test of aggregate and bitumen for suitability checking.

b) Preparation of Marshall Sample desired mix gradation.

c) Measurement of skid resistance analysis.

d) Data analysis and comparisons.

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Table: 2. Suggested minimum values of 'skid resistance' (measured with the portable tester) (TRRL, 1969).

Category	Type of site	Minimum skid resistance (surface wet)
A	Difficult sites such as: • Roundabouts • Bends with radius less than 150m on unrestricted roads • Gradients 1 in 20 or steeper of lengths greater than 100m • Approaches to traffic lights on unrestricted roads	65
B	Motorways, trunk and class 1 roads and heavily trafficked roads in urban areas (carrying more than 2000 Veh per day)	55
C	All other sites	45

Figure 3.Khagrabari Quarry

Figure 4.Bituminous Mix Samples

RESULT ANALYSIS

For the recommended gradations as per surfacing layer for following sampled prepared and tested under portable pendulum tester and their results are in block diagram. Table 3 shows that the result of aggregate and bitumen.

Table: 3. Basic test results of Aggregate and Bitumen Materials.

Aggregate Test	Laboratory Values	Bitumen Test	Laboratory Values
Impact Test	24.5 %	Penetration value	67
Specific gravity Test	2.7	Softening Point Value	45
Loss angles abrasion test	28 %	Specific Gravity	1.01

Aggregate Test Result Bituminous Test Values

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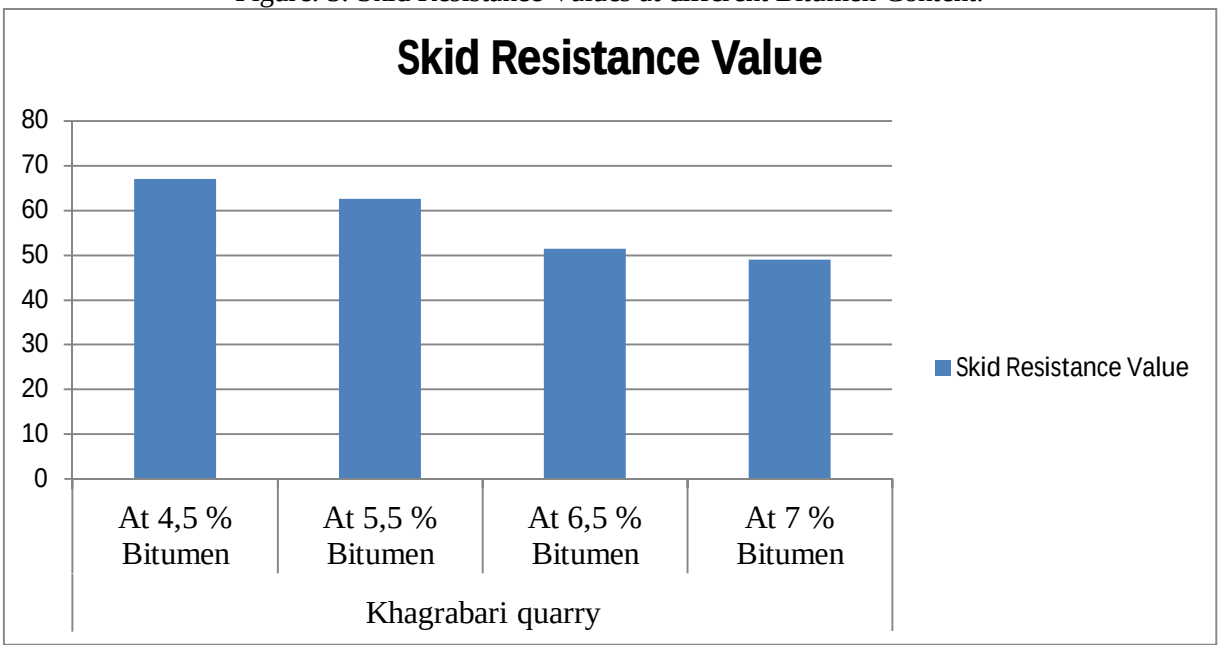
Figure: 5. Skid Resistance Values at different Bitumen Content.



Skid Resistance values

CONCLUSIONS AND FUTURE WORK

As per my laboratory testing continue for various types of aggregate and bitumen types including penetration test, specific gravity test, impact test and so on. This test gives suitability for choosing the materials. I have found the skid resistance values at different bitumen content for the Khagrabari aggregate quarry. Further texture classification and skid testing should be continue to classified the materials use for better pavement surface for long live serviceability under various climate region and traffic speed conditions. So as per values suggested by the TRRL-1969, I have reached at following concluded point these are given below:

1. These quarry use for preparing sample at 4.5 % bitumen gives desirable skid resistance value able to use in difficult sites.
2. These quarry use for preparing sample at 7 % bitumen gives low skid resistance value and generally avoidable in large traffic condition but can be used for small trafficking road.
3. These quarry satisfy the all requirement specified by TRRL, 1969.

ACKNOWLEDGEMENT

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DESCRIPTIVE ANALYSIS OF AGE DIFFERENCES IN GAP SELECTION BY PEDESTRIANS AT UNCONTROLLED ROAD SECTIONS

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ABSTRACT
Pedestrians form an integral part of urban transportation system. Among road users, pedestrians are those whose continued trajectory is the less constrained by the environment and by the regulation rules. Consequently pedestrian crossing is a complex issue in road transportation system, specifically at uncontrolled sections where is no control on pedestrian road crossing. Due to lack of designated crossing points on road or improper road geometry, most pedestrians are forced to cross at random unpredictable locations. As such, they create confusion and risks to themselves and to drivers as well. Road accident statistics reveal that improper gap acceptance during crossing is a major contributing factor for pedestrian injury and deaths. This paper studies pedestrians' age differences in gap selection during crossing at uncontrolled road sections at Silchar city (Assam state in India). Two age groups were considered (below 40 years) and (above 40 years old) for this study. Field data are collected through video graphic survey during peak hours. Statistical analysis of the data has been carried out, and distribution of gap parameter at different sites are analyzed and presented in the present work.

Keywords: Pedestrian, uncontrolled road, gap, distribution.

INTRODUCTION
Making decisions about when it is safe to cross roads in relation to available traffic gaps is a complex everyday task, implicating sensory, perceptual, cognitive and executive functions. When crossing a road, pedestrians have to detect traffic, determine whether the time remaining before a vehicle reaches them is long enough for crossing, and adapt their action to the continuous perception of oncoming vehicles. The essential ability is to determine the available time (depending on time gaps between vehicles) and relate it to the time needed to cross (depending on environmental factors such as road width, and personal factors such as walking speed and ability to accelerate). In principle, crossing is possible if the available time is greater than the crossing time. An incorrect decision taken by any road user will result in an accident. This may be especially difficult for older pedestrians to select the proper gap to cross the road which resulting to fatal and serious-injury crashes. Fontaine and Gourlet (1997) showed that 38% of the 1289 cases of pedestrian deaths between 1990 and 1991 in France concerned people more than 65 years old. This figure increased to 51% in 2004 (ONISR, 2005). International accident statistics also indicate very high rates of fatal and serious-injury crashes for older pedestrians (NHTSA, 2001; OECD, 2001).

In Indian cities the traffic on the roads is highly heterogeneous in nature encompassing vehicles with a wide range of static and dynamic characteristics. There are more than ten different types of vehicles present in the traffic on major roads of Indian cities. All these different types of vehicles move on the same road space occupying any position on the road depending on availability of free space at a given instant of time without complying to any lane discipline. This heterogeneity in traffic and jaywalking behaviour of pedestrian leads to severe conflicts with motorized vehicles and results in a decline of pedestrian safety. This complexity of interactions between pedestrian and vehicular traffic increases mostly at uncontrolled road sections.

Worldwide, more than 270,000 pedestrians die in traffic accidents annually, a share of 22% of all traffic casualties. The situation in India is no different. The share of fatal accidents in the total is up from 18 percent in 2003 to 25% in 2012. Higher rates were observed in urban areas. Delhi records an average of five road accident deaths per day - four of these are of pedestrians mainly older pedestrians due to unsafe road crossing decisions and two-wheeler riders. In India, 54 % of all traffic fatalities in Delhi and 80% of all non motorized fatalities in Mumbai were pedestrians (Mohan, 2004; Grebert, 2008). The pedestrian and bicycle fatalities in India is 27.4% (MoRTH, 2010). North East India has a high rate of accidents and deaths in relation to number of vehicles on the road. 50.4% deaths in Assam caused by road accidents, the state has crossed even the national average of 36.4% for 2013. In India pedestrians' injury and deaths are very high and these are for poor decisions or risky behaviors exhibited during road crossings. In such conditions, it becomes imperative to study the crossing behavior of the pedestrians which is vital in pedestrian vehicle interaction and increasing pedestrian risks. It should be studied in terms of gaps maintained between the two users to minimize the risk.

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BACKGROUND

Various researchers have examined the effects of pedestrians' age differences on gap acceptance. These are discussed below:

Cohen *et al.* (1995) examined the pedestrian road crossing behaviour at 7m wide road at uncontrolled road section where only islands were present in the centre of the road, no zebra crossing, traffic lights and police control were provided. They examined pedestrian demographic behaviour while crossing the road. Age and sex both were estimated from the pedestrian's appearance and attire. They found that younger people accept smaller gap than older person. The accepted gap for age group of (16-30) lay between 3-5 s, (31-45) age group accepted 4-7 s and above 60 group accepted 5-8 while crossing the road. Das *et al*. (2005) examined the behaviour of pedestrians willing to cross a stream of traffic at signalized intersections. At each intersection the movement information included the direction of the crossing, the time of arrival at the intersection, the time that crossing begins, the times of arrival at and departure from the median, and the time at which crossing was completed. They analyzed the revealed preference data based on video recording from every intersection and found that children and younger people accepted gaps were rejected by the older persons. Lobjois and Cavallo (2006) examined the age-related differences in street crossing decisions. They conducted two simulated road crossing task with two factors, effects of vehicle speed and time constraints on gap selection. The street crossing device was based on the INRETS Sim2 driving simulator. It consisted of a portion of a street, an image-generation and projection system, and a response recording system. The experimental road, which was 4.20m wide, was drawn directly on the floor of the experimental room. The images were generated by a Silicon graphics ONYX2 workstation connected to a PC for controlling the traffic scenes. The PC was also used to generate realistic 3D sound rendition and record the participants' responses. The participants' crossing times were measured in two conditions: half of the participants performed the time-constraint task before the no-time-constraint task; the other half did the opposite. The first experiment showed that when there was a time constraint, all age groups selected a shorter time gap for the higher speed and many unsafe decisions had been taken for higher speed. In second experiment, which had no time constraint, young pedestrians operated in a constant-time mode regardless of speed, whereas older pedestrians accepted shorter and shorter time gaps as speed increased and made more unsafe decisions. From this study, they concluded that for older pedestrians, speed influenced the decision-making not only when there was a time constraint but also when there was not. Oxley *et al.* (2007) did an experimental study of age differences in gap selection decisions in a simulated road crossing environment. A simulated road environment of moving traffic generated from data files from a mid-range driving simulator was used. They selected three age groups such as younger (30-45 years), young old (60-69 years) and older (> 75 years) and investigated the age differences in the ability to choose safe time gaps in traffic in a simulated road crssing task. They observed that a large proportion of the older group (> 75 years) decided to cross the virtual road when in fact it was unsafe for them to do so. On the other hand, the young and younger-old participants generally made safe crossing decisions, very few of them left unsafe safety margins. From this experiment, they concluded that for all age groups, gap selection was primarily based on vehicle distance and less so on time-of-arrival. Rastogi and Chandra (2013) examined the pedestrian road crossing behaviour at 17 locations. The study locations were midblock sections, divided roads and undivided roads. The video camera was installed at the selected pedestrian crossing in different locations in such a way that it captured the pedestrians waiting on the curb as well as the approaching vehicles. From that video they analyzed pedestrian demographic behaviour. They concluded that female pedestrians were more safety conscious on road crossing so the accepted gaps of female was more than male. They also observed that young pedestrians accepted fewer gaps than middle aged and old aged pedestrians. The average accepted gaps of these three age groups were 8.14 s, 8.72 and 8.83 respectively.

METHODOLOGY

4.1. Study Locations

Sites were selected where pedestrian traffic is enough, traffic flow is continuous, effective width of the road is uniform throughout the length considered. Two uncontrolled road sections of Silchar city were chosen: Link Road (coded "A") and Premtala Road (coded "B"). Table 1 shows the road condition of these two sites:

Table 1. Road Conditions of two sites.

Parameter of Road	Link Road	Premtala Road
Road Code	"A"	"B"
Width	5.5 m (on side of the median)	8.5 m

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No of lanes	4 lanes 2 way divided road	2 lanes 1 way undivided road

4.2. **Data collection and extraction**:
Video graphic method was used in this study. At each location recording is done for six hours during the working day in normal weather conditions. The video camera viewed a total of 20 m length along longitudinal direction at each location for data collection where the pedestrians were crossing the road. The width of the road sections and length covered by video camera were measured using a measuring tape. The data recording of traffic gaps accepted were based on two time points: At the first point, when the vehicle was just entered in marked entry position and pedestrian was just ready to set foot on the street. In the second point, the head of the vehicle has just passed through marked exit line indicating the pedestrian's crossing path. Therefore, the traffic gap accepted was calculated as the difference in seconds between the two time points. Only these pedestrians' data were extracted from video that actually crossed the street, either immediately or after several attempts (i.e. accepting the first traffic gap available or rejecting several gaps before crossing). Congested traffic flow conditions were completely eliminated. At road "A" the pedestrian crossing data were collected on one side of the median and for road "B" the complete width of the carriageway was considered.

4.3 Descriptive analysis:
Descriptive analysis was carried out to estimate the central tendency, dispersion and distribution of the accepted gaps. The analysis was carried out using SPSS package and various descriptive parameters like mean, standard deviation, skewness, etc were estimated. Statistical significance at 95% confidence interval was tested between two age groups at each location.

5. Data analysis and Discussions
The accepted gap on various sites with respect to age groups is estimated and suitable distribution is fitted to the data. The details of analysis are given in Table 2 for all sites and typical fitted distribution functions are shown in figures (1-6).

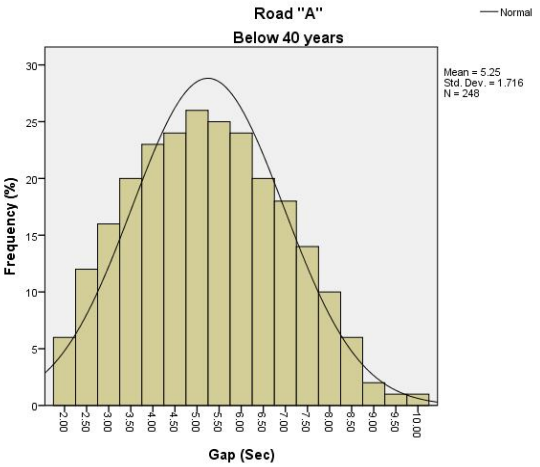

Figure: 1. Below 40 years at Road "A"

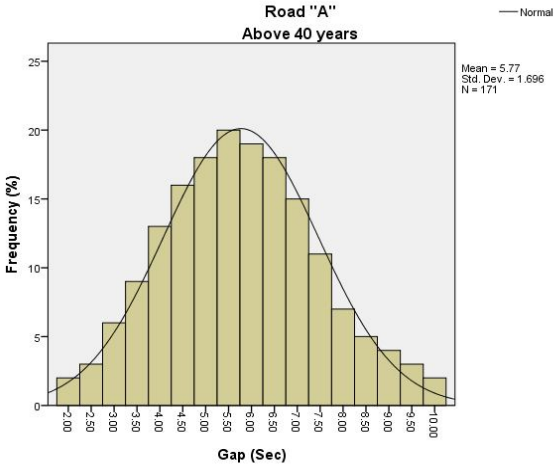

Figure: 2. Above 40 years at Road "A"

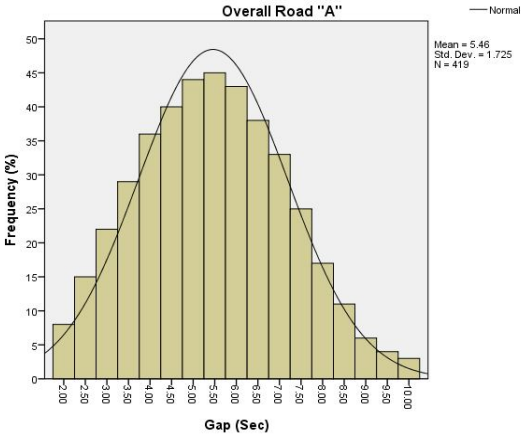

Figure: 3. Overall distribution at Road "A"

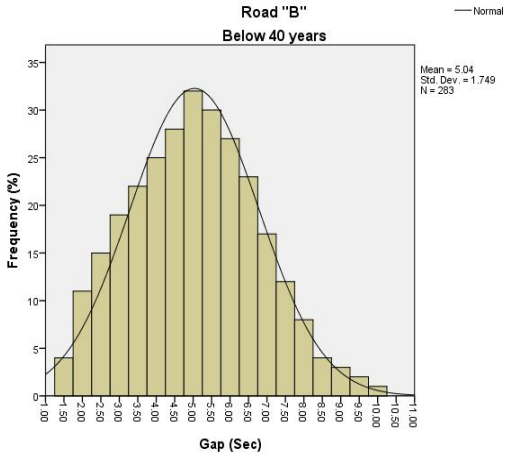

Figure: 4. Below 40 years at Road "B"

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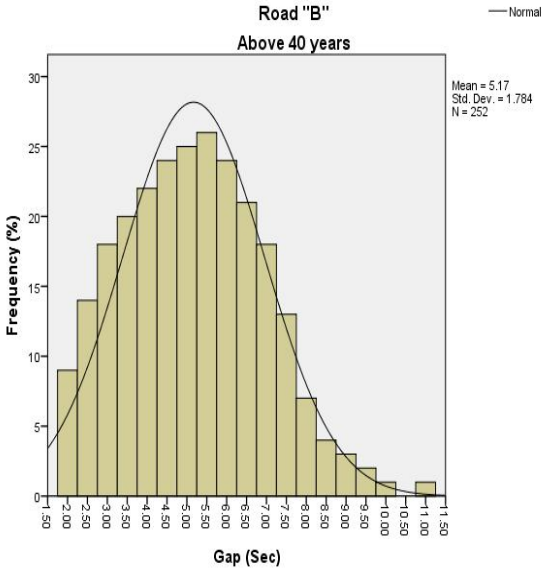

Figure: 5. Above 40 years at Road "B".

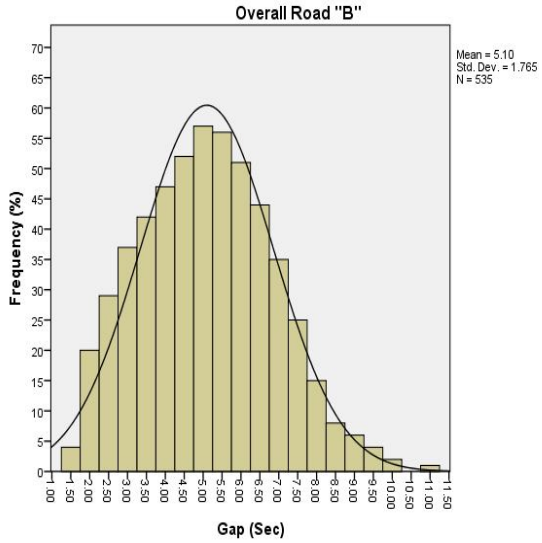

Figure: 6. Overall distribution at Road "B"

Table 2. Descriptive parameters with significant test.

Road	Age Groups	Sample	Mean (sec)	Standard Deviation	Skewness	Kurtosis	S-W test
"A"	Below 40 years	248	5.25	1.716	0.175	-0.609	0.002*
	Above 40 years	171	5.77	1.696	0.191	-0.285	0.102
	Overall	419	5.46	1.725	0.171	-0.467	0.005*
"B"	Below 40 years	283	5.04	1.749	0.180	-0.391	0.05
	Above 40 years	252	5.17	1.784	0.298	-0.267	0.01*
	Overall	535	5.10	1.765	0.239	-0.326	0.01*

P* < 0.05

The time gap data were classified based on the age groups. The sample size was taken 248 (below 40 years old) and 171 (above 40 years old) pedestrians for 4 lanes 2 way divided road. For 2 lanes 1 way undivided road, sample size was taken 283 for (below 40 years old) and 252 (above 40 years old) pedestrians. The results showed that below 40 years old pedestrians accepted shorter gaps than older pedestrians at both the roads for their longer crossing times resulting from their slower walking speed as shown in Table 2. Similar results were reported by Cohen *et al.* (1955) also, but it was not discussed with respect to the classification of the carriageway. The difference between the time gaps accepted by two age groups was decreased when carriageway changed from divided road to undivided road. In the case of 2 lanes 1 way undivided road, an increase in the width of the road and traffic volume had resulted in acceptance of relatively lower time gaps. But the change was very less because both the roads were uncontrolled in respect of traffic.

From analysis, all distributions were found skewed positively, that indicating that most pedestrians preferred safety margin. The maximum time gap accepted by the pedestrians was found to be more than 11sec. This happened when traffic was low. Minimum time gap was found to be 1.5sec, indicating a very risky crossing due to heavy traffic.

An S-W normality test was performed at 95 % confidence level among two age groups (below 40 years old and above 40 years old) that has been shown in Table 2. A statistical significant difference that is ($p < 0.05$) was found for above 40 years old pedestrians at road "B". In 4 lanes 1 way divided road traffic was low and the gap accepted was found to be higher for both the age groups. No significant difference found for both age groups at this location. But in case of 2 lanes 1 way undivided road (road "B"), road width and traffic volume both are more compared to Road "A", which indicating a risky road crossing for pedestrians above 40 years old.

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CONCLUSIONS

An analysis on pedestrian gap is carried out in this paper using the pedestrians' age differences in gap selection. Out of two study locations Link Road (road "A") showed higher mean of accepted gap. This is a four lanes two way divided road of width 5.5m (on side of the median). In both study locations above 40 years old pedestrians' gap acceptance are higher than below 40 years old pedestrians. Pedestrians above 40 years old, take longer walking times demanded larger gaps.

Analysis of gap data indicated pedestrian gap acceptance followed normal distribution for both age groups at road "A" and below 40 years old pedestrians at road "B". There was no statistical significant difference in the gap acceptance for both age groups at road "A". Pedestrians above 40 years old take unsafe crossing maneuvers when traffic is high.

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EVALUATIONOF OVERALLLEVEL-OF-SERVICEOF PEDESTRIAN IN CITY AREA OF SILCHAR

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ABSTRACT
The objective of this study is to evaluate the overall pedestrian level-of-service (LOS) based on pedestrians' flow characteristics and pedestrians' perception of comfort and safety in the roadside environment.A significant number of pedestrians were requested to give ratings for eachfactors based on their experiences at the actual sites which was used to get the real time response of people in road environment. People of across all genders and age group participated in the survey and most of the questions were rating based. A field survey was conducted tocollect geometric, operational and traffic characteristics of sidewalks. After segmenting the data it was analyzed by using Highway Capacity Manual (HCM) method of pedestrian LOS analysis and Correlation Matrix method of analysis to evaluate the overall pedestrian LOS of three different roadway segments in the city of Silchar, Assam and three deferent pedestrian LOS were observed.This study explains a method for the estimation of pedestrian LOS and also identifies the factors affecting pedestrian level-of service LOS at city areas.

Keywords: Pedestrian Level of Service, Pedestrian Facilities, Pedestrian Safety, Performance Measure,Walking Conditions.

INTRODUCTION
For some time, transportation engineers and planners have paid attention primarily to the motorized transportation system. Even today, the motorized transportation system receives an overwhelming priority over systems that serve the needs of non-motorized users such as pedestrians. However, in recent years, emphasis has been placed on multimodal approaches in order for the challenges of congestion, air quality, infrastructure concurrency and quality of life to be met. Many communities started promoting walkability concepts through education and infrastructure improvements. The latter, created the necessity of measuring the performance of the facilities that serve pedestrian traffic in order to determine quality of operations, existing deficiencies, needs for improvements and priority setting. One of the most common approaches used to assess transportation facilities is the concept of Level-of-Service (LOS).

Since the pedestrian environment is multi-dimensional, the pedestrian in the roadside environment is subjected to a set of several factors significantly affecting his or her perception of safety, comfort, and convenience. Measurement of these factors is necessary to evaluate the pedestrian facilities and evaluation methods are needed to understand how well a particular street accommodates pedestrian travel. In order to appropriately plan for more walkable environments, methods are required that allow planners and decision-makers to effectively identify and assess the elements of the built environment that support or detract from walking. The quality of the pedestrian environment has been measured for many years using the Level-of-Service (LOS) approach. The LOS for pedestrian facilities is influenced by a lot of factors and different pedestrians have different perceptions on the LOS.

OBJECTIVE AND SCOPE
The objectives and scope of this research study reported in this paper are:

1. Evaluation of the existing transportation infrastructure for pedestrians.
2. To determine the present pedestrian LOS on the basis of pedestrian flow characteristics and real-time pedestrian perception.
3. To outline suitable criteria, that will be helpful for current context to evaluate the overall measurement of pedestrian LOS.

1. LITERATURE REVIEW
To represent an integrated picture of facilities for pedestrians, it is important to review, compile, and organize the current state of researches that assess pedestrian LOS. The literature review is focused on the review of earlier studies regarding pedestrian level of service at roadway segments and the basic elements of each methodology are described below.

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IRC -103-1988
IRC-103-1988 specifies the provision of pedestrian crosswalks at all important intersections and at locations where substantial conflict exist between vehicular and pedestrian movements. Adequatevisibility, freedom from obstructions, and sufficient space for waiting are other important requirements provided in IRC for the location of crosswalks (IRC-103-1988).

Dixon L.
He proposed a pedestrian LOS evaluation criterion which involves the provision of basicfacilities, conflicts, amenities, motor vehicle LOS, maintenance, and travel demand management, and multimodalprovisions. There was no qualitative environmental assessment relating to walkability. This seems to be best suitedto footpath assessments, applicability to intersections was uncertain (Dixon 1996).

Mozer D.
According to this method, the suitability of roadway segments for pedestrians is based on four (4) primary variables: walkarea width-volume, walkarea-outside lane buffer, outside lane traffic volume, outside lane motor vehicle speed, plus three secondary factors: walkarea penetrations, heavy vehicle volumes and intersection waiting time. For each primary variable, a "stress level" (SL) is measured and set on a scale of 1 to 5. The SLs are added and then averaged to determine the overall pedestrian LOS (A-E). It should be noted that evaluations are made mid-block on a discrete segment of the facility (Mozer, 1997).

Highway Capacity Manual (HCM) 2000
The primary performance measure for assessing the pedestrian LOS, HCM considered a simplified body ellipse. According to the HCM method, the average pedestrian walking speed (m/s), that is determined by the average time that is required for a pedestrian to cross a certain distance, including delays. Once determined, the average walking speed is cross-referenced with a table (shown in Table 1) to define the pedestrian LOS (A-F) (HCM, 2000).

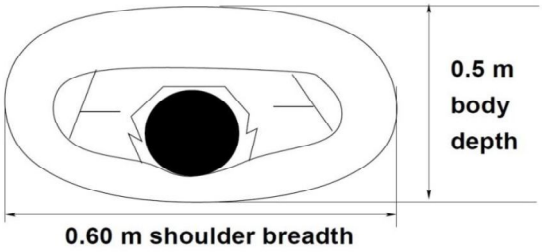

Fig. 1: Pedestrian body ellipse

Table 1: PLOS categories in HCM (2010)

LOS	Average Space (m^2/P)	Related Measure		Comment
		Flow Rate (P/min/m)	Average Speed (m/s)	
A	>5.6	≤16	>1.30	Ability to move in desired path, no need to alter movements.
B	>3.7-5.6	>16-23	>1.27-1.30	Occasional need to adjust path to avoid conflicts.
C	>2.2-3.7	>23-33	>1.22-1.27	Frequent need to adjust path to avoid conflicts.
D	>1.4-2.2	>33-49	>1.14-1.22	Speed and ability to pass slower pedestrians restricted.
E	>0.75-1.4	>49-17	>0.75-1.14	Speed restricted, very limited ability to pass slower pedestrians.
F	≤ 0.75	variable	≤0.75	Speed severely restricted, frequent contact with other users.

Jaskiewicz F.
This method evaluates the pedestrian LOS on a roadway segment based on nine qualitative evaluation measures: (i) enclosure/definition, (ii) complexity of path network, (iii) building articulation, (iv) complexity of spaces, (v) overhangs/awnings/varied roof lines, (vi) buffer, (vii) shade trees, (viii) transparency and (ix) physical components/condition. A simple rating scale of 1 (=very poor) to 5 (=excellent) is applied, to assess the degree to which certain target areas conform to the nine evaluation measures. The scores are then aggregated and averaged to obtain an overall pedestrian LOS (A-F) (Jaskiewicz, 2000).

Gallin N.
This method is used for assigning a LOS grade on a roadway segment, based on eleven (11) factors classified as follows: design (path width, surface quality, obstructions, crossing opportunities, support facilities), location (connectivity, path environment, potential for vehicle conflict) and users (pedestrian volume, mix of path users, personal security). For each of these factors a score is given (0-4) as it relates to the roadway segment under investigation. After multiplying each score with its relative weighting, the total weighted score (for all the 11 factors) is then cross-referenced with a table to determine the actual pedestrian LOS (A-E) (Gallin, 2001).

Landis B. et al.
A mathematical model was proposed by Landis based on five variables: lateral separation ofpedestrians from motor vehicle traffic, presence of physical barriers and buffers, outside lane traffic volume, motorvehicle speed, and vehicle mix. Although this mathematical model evaluates a roadway segment, it does not includeintersections. However, they believe that intersection conditions have a significant bearing on pedestrians and ameasure must be developed that includes conditions at intersections (Landis et al., 2001).

Florida Department of Transportation (FDOT)
For assessing pedestrian LOS, the FDOT developed a model that was based on the same study as the model of Landis et al. For that reason, the two models take into consideration the same variables and the only difference is concentrated on the constant term and the variables‟ coefficients (Q/LOS Handbook, 2002).

Muraleetharan T. et al.
They used conjoint technique to combine the factors affecting pedestrian LOS. Total utility from the conjoint analysis represents an overall value, which specifies how much a user puts on a product or service. Even though this study proposed a method to determine overall LOS, it does not include all the factors affecting pedestrian LOS (Muraleetharan T. et al., 2004).

From the literature review discussed in this section related to pedestrian LOS analysis in this study, it is found that there is lot of scope to carry out further research on the overall evaluation of pedestrian LOS methodology shown by various researchers. Questionnaire based field survey method was found to be an efficient and adequate technique for collection of necessary data required for analyzing pedestrian LOS. Correlation matrix method of analysis was found to be suitable in order to define the current qualitative pedestrian LOS. A field survey was carried out for determining quantitative pedestrian LOS based on Highway Capacity Manual, 2000.

SURVEY DESIGN

For qualitative assessment of the sidewalk facilities a questionnaire-based survey was conducted. The pedestrians on roads were asked a set of questions as provided in appendix A. The questionnaire was designed aiming to determine the level of service based on psychometric scaling technique.For collecting the geometric information and the pedestrian flow characteristics data a field survey was carried out using the measurement tools and a video recording devise.

A total of 168 pedestrians in 3 different locations in Silchar city were interviewed in this study. The pedestrians were asked the questions on sidewalks and their responses were recorded by the surveyor. Many a times the questions were translated in the local language for better understanding by the responded.

METHODOLOGY

First method that was used to measure the qualitative PLOS is Matrix Correlation technique for finding out different weightage of various factors that effects on the overall level of service for different pedestrian facilities.

The key step by step procedures for applying methodology for determining performance measures and level of service for the study area are:

I. Formations of the correlation matrix by help of data analysis tool in MS excel, from the set of questionnaire based real-time survey data.

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II. The survey data is then normalized for calculating the weightage for each factors/variables

III. Calculation of weightage from the normalized data is shown in equation 1:
Weightage from normalized data:

[Wi] = [Normalized survey data] x [Maxm value of correlation coefficient for respective factors] (Eqn. 1)

IV. The overall qualitative Pedestrian LOS is then calculated by using the general objective function, i.e.Overall Pedestrian LOS (Y) = Σ Wi Xi (Eqn. 2)
Where, Wi = Weightage of each factors/variables.

Xi = Mean of the pedestrian rating data provided for respective factor/variables.

V. In order to determine the limits of Pedestrian LOS the best and worst conditions were chosenand the respective Ymax&Ymin was obtained by considering maximum and minimum value of X. The difference between the Ymax&Ymin was determined and they were divided by the number of intervals.

VI. Next starting from minimum Pedestrian LOS score by consecutively adding the interval was obtain the boundary limits of the respective Pedestrian LOS category is determined. By comparing the value obtained i.e. Y, with the Pedestrian LOS ranges of respective locations, the current Pedestrian LOS of the respective locations is determined.

Second method is based on HCM (2010) to determine the present PLOS on sidewalks uses by the pedestrians. HCM recommended the following procedure to compute the PLOS depending on the pedestrian flow characteristics:

Step 1: Determine the effective walkway width

$$We = Wt - Wo \quad \text{(Eqn. 3)}$$

Where,We = effective walkway width,
Wt = total walkway width at a given point along walkway, and
Wo = sum of fixed-object effective widths and linear feature shy distances at a given point along walkway.

Step 2: Find out the average pedestrian speed

By analyzing the data from video graphic survey we can find out the average pedestrian speed.

Step 3: Calculation of Pedestrian Flow Rate

$$Vp = \frac{V15}{15x\text{We}} \quad \text{(eqn. 4)}$$

Where,Vp = pedestrian unit flow rate (p/min/m),
V15 = peak 15-min flow rate (p/15-min), and
We = effective walkway width (m).

Step 4: Calculation of Average Pedestrian Space

$$Ap = Sp / Vp \quad \text{(eqn.5)}$$

Where,AP= pedestrian space (m2/p),
Sp= pedestrian speed (m/sec), and
Vp= pedestrian flow per unit width (p/m/sec).

Step 5: Determine LOS

By comparing the analyzed pedestrian flow characteristics data with the table of pedestrian LOS provided by HCMgot the current pedestrian LOS.

DATA ANALYSIS

The gender distributions of the respondents are indicated in figure 1, 2 and 3 for the different locations as mentioned in the figure. The gender participation is found to be almost similar in all the locations. The slight variation observed may be due to variations in the land uses in these locations.

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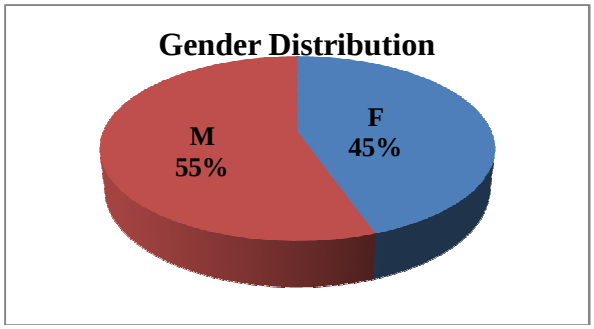

Fig.2: Gender Distribution at location 1

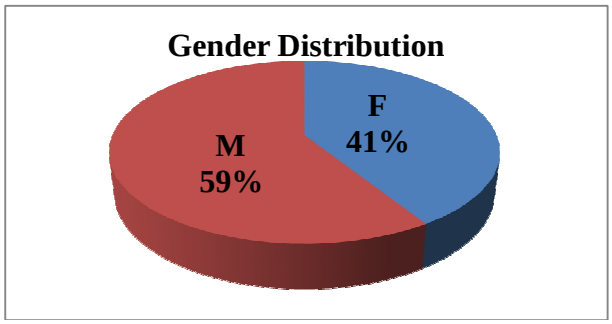

Fig.3: Gender Distribution at location 2

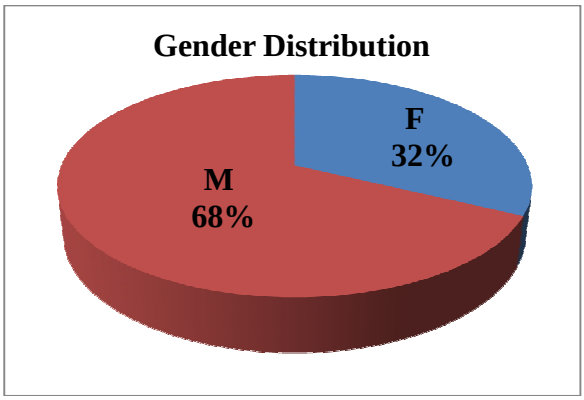

Fig.4: Gender Distribution at location 3

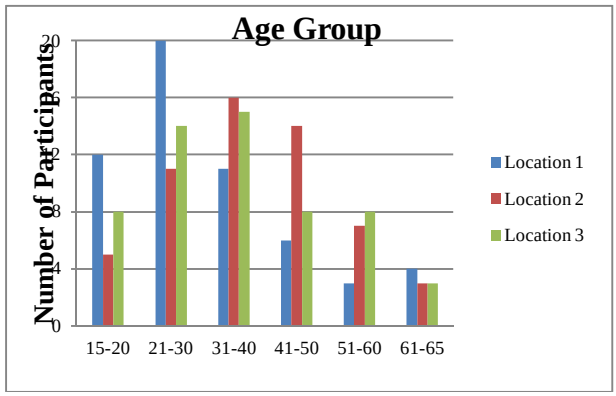

Fig.5: Responded Age Group at three Locations

Similarly the age group distribution is indicated in fig. 5. The maximum respondents are found to be in the range of 20-40 years

RESULT AND DISCUSSIONS

After analyzing the data, observed results are discussed in this section. The data obtained from the questionnaire survey is further used to prepare the correlation matrix by the application of data analysis tool in MS excel. The table-2 shows the correlation matrix for location 1. The data are then normalized and Table-3 shows the normalized data and the maximum correlation coefficient for respective factor/variable for location 1. Similarly, the correlation matrixes and normalized matrix of other two locations are also prepared and analyzed.

The data collected from geometric and video graphic survey is also analyzed and the different pedestrian flow characteristics of all three locations are found for evaluation of quantitative pedestrian LOS of particular locations.

Table 2: Correlation Matrix for Location 1.

	1.a	1.b	1.c	1.d	2.a	2.b	2.c	3.a	3.b	3.c	3.d	4.a	4.b	4.c
1.a	1													
1.b	0.27	1												
1.c	0.21	0.39	1											
1.d	0.25	0.17	0.42	1										
2.a	0.22	0.16	0.11	0.17	1									
2.b	0.1	-0.24	0.16	0.36	-0.03	1								
2.c	0.16	0.38	0.14	0.43	0.45	0.01	1							
3.a	0.15	-0.22	0.11	-0.01	-0.11	0.32	-0.3	1						
3.b	0.09	0.13	0.17	0.04	0.32	0.01	0.154	0.111	1					
3.c	0.11	-0.14	0.01	0.1	0.39	0.01	0.171	-0.04	0.18	1				
3.d	0.25	0.33	0.51	0.28	0.02	-0	0.086	-0.05	0.11	0.228	1			
4.a	0.29	0.14	0.32	0.18	0.1	0.24	0.152	0.075	-0.07	0.274	0.24	1		
4.b	0.14	0.08	0.38	0.31	0.39	0.16	0.183	-0.22	0.11	0.348	0.17	0.266	1	
4.c	-0.1	0.1	0.32	0.15	-0.09	0.39	0.139	-0.05	0.04	-0.18	0.09	0.18	0.223	1

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Table 3: Normalized Matrix for location 1.

	Normalized Survey Data																
	1.a	1.b	1.c	1.d	2.a	2.b	2.c	3.a	3.b	3.c	3.d	4.a	4.b	4.c		Correlation Coeff. (Max. Value)	W i
1.a	0.021	0.039	0.025	0.036	0.036	0.029	0.032	0.036	0.025	0.039	0.021	0.025	0.036	0.021		0.2892974	0.12967
1.b	0.029	0.043	0.025	0.029	0.039	0.029	0.029	0.032	0.046	0.046	0.036	0.032	0.032	0.029		0.3944365	0.28305
1.c	0.036	0.046	0.0321	0.043	0.032	0.043	0.036	0.036	0.046	0.039	0.036	0.032	0.036	0.039		0.4215963	0.16229
1.d	0.025	0.036	0.0321	0.036	0.025	0.021	0.029	0.018	0.021	0.018	0.021	0.029	0.032	0.029		0.4332652	0.11642
2.a	0.029	0.029	0.0286	0.032	0.032	0.029	0.029	0.032	0.032	0.029	0.036	0.036	0.043	0.039		0.4513593	0.13604
2.b	0.036	0.032	0.0464	0.046	0.032	0.039	0.043	0.032	0.032	0.032	0.036	0.029	0.046	0.036		0.3892176	0.159
2.c	0.032	0.032	0.0214	0.032	0.032	0.025	0.025	0.021	0.025	0.025	0.046	0.043	0.036	0.032		0.1829031	0.13034
3.a	0.039	0.032	0.05	0.05	0.036	0.039	0.043	0.039	0.039	0.036	0.032	0.036	0.039	0.025		0.1106557	0.16399
3.b	0.039	0.036	0.0321	0.032	0.036	0.039	0.043	0.036	0.043	0.039	0.029	0.046	0.039	0.039		0.178051	0.15819
3.c	0.032	0.025	0.0286	0.032	0.039	0.029	0.029	0.032	0.025	0.029	0.032	0.046	0.032	0.05		0.3483149	0.14065
3.d	0.039	0.046	0.0393	0.043	0.043	0.039	0.036	0.039	0.046	0.043	0.036	0.046	0.043	0.029		0.2441754	0.17335
4.a	0.039	0.046	0.0393	0.046	0.046	0.039	0.032	0.046	0.036	0.046	0.039	0.046	0.039	0.036		0.2657489	0.17836
4.b	0.029	0.039	0.0214	0.032	0.036	0.032	0.025	0.025	0.032	0.025	0.032	0.036	0.036	0.05		0.2232211	0.13855
4.c	0.039	0.043	0.0321	0.036	0.036	0.043	0.039	0.032	0.039	0.036	0.046	0.032	0.043	0.036		0.3223756	0.16123

Table 4 shows the qualitative pedestrian LOS category ranges and it is observed that location 1scores 5.483 which is in LOS ‘D’. Similarly for location 2 the score is 9.197 and for location 3 the score is 6.754 which comes into LOS category ‘B’ and ‘C’ respectively.

Table 4: Pedestrian LOS category ranges

LOS Category	**LOS Range**		
A	9.370796	To	11.15571
B	7.585882	To	9.370796
C	5.800967	To	7.585882
D	4.016053	To	5.800967
	2.231139	To	4.016053

Table 5: Pedestrian LOS as per HCM 2000

Location	**Average Space (m^2/P)**	**Related Measure**		**LOS**	**Comment**
		Flow Rate P/min/m)	**Average Speed (m/s)**		
1	1.2	38	1.13	E	Speed restricted, very limited ability to pass slower pedestrians.
2	4.2	18	1.28	B	Occasional need to adjust path to avoid conflicts.
3	1.8	46	1.16	D	Speed and ability to pass slower pedestrians restricted.

Table 5 showing the current pedestrian LOS of these three locations based on pedestrian flow characteristics as per HCM 2000. From the available pedestrian space, flow rate and speed data observed, location 1 comes into Pedestrian LOS category ‘E’, location 2 comes into LOS ‘B’ and location 3 comes into LOS ‘D’.

CONCLUSION

The term called ‘overall LOS’ indicate both quantitative and qualitative LOS of an area. In this study, forestimation of quantitative pedestrian LOS, the method suggested by HCM 2000 is used andfor qualitative evaluation of pedestrian LOS, Correlation Matrix method of factor analysis is used. After analysis by using both the above mentioned method, location 1 needs to be urgent modification.Though the vehicular traffic as well as

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pedestrian traffic is very high on this road, still there is no separation of footpath from the carriageway. The sidewalk width, footpath surface, comfort and walking environment have eroded over a period of time. Whereas location 2 indicates that the pedestrian LOS of that roadway corridor has most of the necessary pedestrian facilities and they are at good service conditions and location 3 is indicating that the road segment is lacking from a good and safe pedestrian facilities and services.

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LABORATORY STUDIES OF BITUMINOUS MIXES USING RECLAIMED ASPHALT MATERIALS

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ABSTRACT
Reclaimed Asphalt Pavement Material, commonly known as RAP obtained from deteriorated pavement used in hot mix asphalt (HMA) mixtures has evolved into a regular practice in various countries across the globe. Use of these abandoned materials is not only economical but also environmentally sound. Incorporating RAP in bituminous mixes has been favored over virgin materials in the light of increasing cost of bitumen, scarcity of sound aggregates and the burning need to preserve the environment.

In the present investigation, RAP samples were collected from a deteriorated pavement in Silchar, Assam. An effort has been made to combine 10%, 20% and 30% RAP material with virgin aggregates and 60/70 grade bitumen. In this study, RAP to virgin aggregate ratio has been adopted as 10:90, 20:80 and 30:70. The mixing is done in the laboratory manually in a heating pan, heated to a temperatureof 160˚C. Marshall Stability and Flow Value tests are carried out on the recycled mix and the results are compared with virgin mixes. All the specimens are tested for the Dense Bituminous Macadam-II (DBM-II) gradation as per Ministry of Roads, Transport and Highways (MORTH-4th revision).

Keywords: Dense Bituminous Macadam-II, Hot mix recycling, Marshall Stability, Mix Design, Reclaimed Asphalt Material.

INTRODUCTION:
Reclaimed asphalt pavement (RAP) is the term given to aged materials from abandoned pavements containing bitumen and aggregates. It constitutes a "treasure trove" of preprocessed roadbuildingmaterials. These materials are generated when bituminous pavements are removed for construction, resurfacing, or to obtain access to buried utilities. When properly crushed and screened, RAP consists of sound and well-graded aggregates coated by asphalt cement.

Using Reclaimed Pavement Materials is a logical and effective way to conserve the depletion of resources like good soil, good quality aggregates and asphalt.Recycling asphalt pavement makes sense from both environmental and economic point of view. When designed with proper techniques, recycled pavements perform similar and in some instances even better than fresh mixes.

Several methods of recycling, such as hot mix recycling, hot in-place recycling, cold mix recycling, cold in-place recycling, and full depth reclamation, have evolved over the last few years. Hot mix recycling is one of the most popular pavement rehabilitation techniques. It involves a process in which rectification of asphalt pavement surface distress is done by softening the existing surface with heat, mechanically removing the pavement surface, mixing it with a rejuvenating agent, possibly adding fresh bitumen and/or aggregate, and replacing it on the pavement without removing the recycled material from the pavement site.RAP content between 10 and 30% are basically used in hot recycled bituminous mixes.

Large number of studies have been reported on structural performance of recycled mix in comparison to virgin asphalt mix.Some studies indicate that the amount of RAP used inthe recycled mix greatly affects the property of the mix whereas, other studies indicate that mix property is not affected much by the quantity of RAP used Someresearchers have foundthe indirect tensile strength of recycled mix to be satisfactory or better, or even poorer than the conventional mix.According to some studies, recycled mix has a greater resistance to fatigue and rutting than virgin mixes whereas some other studies show that there is no significant difference between the fatigue and rutting behavior of recycled and fresh mix.

LITERATURE REVIEW
Various literatures have indicated that the performance of recycled mixes is similar and in some instances better than that of the conventional mixes.

Al-Qadi*et al*. (2007) studied the interaction between aged and virgin asphalt binders inRAP to investigate the performance of recycled mixture. They found that rutting resistance has been improved by the use of RAP but thefatigue and thermal performance has been inconsistent. They also found that typicallyfatigue resistance is improved due to the stiffer nature of a recycled mixture, but thisis only found in constant strain testing. At higher blending percentages, the results are highly unpredictable. Thermal resistance is typically lowered because of the stiffer nature of the recycledmixtures.

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Guthrie *et al*. (2007)evaluated the effects of RAP content on the shear strength ofbase course materials using the CBR test. Two RAP samples and twotypes of aggregate were acquired for the test. Specimenswere prepared at RAP percentages of 100%, 75%, 50%, 25% and 0%(virgin mix) for each combination of RAP and aggregate samples. The test results indicated that with an increase in RAP content,theshear strength decreased.

PietroLeandri*et al*. (Elsevier 2012)conducted a study of Sustainable High Performance Bituminous Mixtures for wearing coursescontaining a significant percentage of RAP(25.6%). They came to the conclusion that the RAP improves the mechanical characteristics of themixture as well as the resilient modulus and the indirect tensile strength. They also found that use of RAP reduces the viscous strains accumulation and the water sensitivity.On the other side, despite of an increase in stiffness, the use of RAP reduces ductility, thus worseningthe fatigue resistance of the mixture.

Shunyashree*et al*. (Nov 2013)conducted laboratory studies on the effect of use of recycled materials on Indirect Tensile Strength of Asphalt Concrete mixes using crumb rubber modified binder (CRMB-55). They observed that the Marshall Stability and bulk density of AC mixesinitially decreased and further increased with the increasein RAP aggregates. Percentage of VMA and OBC decreased with the increase of RAP aggregates in asphalt concrete mixes, whereas percentage of VFB increased anddecreased as the RAP content was increased. Indirect Tensile Strength of AC mixes wasfound to be increased by 52.73%, 38.09%, 28.64%, 30.97% for 30, 40, 50 and 60% RAP content.

Vijay B.G. *et al.*(2014) carried outlaboratory studies on Dense Bituminous Macadam-Grade II RAP mixes with RAP content of 35% using different Bituminous Binders (VG-10, VG-30 and Crumb Rubber Modified Bitumen-55). Based on the experimental result and after analyzing the results, they came to the conclusionthat the basic tests conducted on virgin and recycled aggregates indicated that they satisfied all the requirements (as per MORTH- IV revision.) Also, DBM-II mixes prepared with RAP materials of 35% showed higher stability values when compared with the conventional mixes. Other Marshall properties were also within the specified limits. Among the three binders which were used, the crumb rubber modified bitumen(CRMB-55) obtained maximum stability both for conventional and RAP mixtures.

From the above researches, it can be seen that use of recycled materials results in substantial savings. Thus an effort has been made to study the performance of RAP mixes with virgin mixes.

OBJECTIVE OF THE STUDY

The basic objective of the study is:

1. To carry out the blending and mix design for 10%, 20% and 30% RAP mixes with virgin mixes as per MORTH (4^{th} revision).
2. To evaluate the changes in Marshall properties namely stability and flow valuefor mixes with varying percentage of RAP(10%, 20% and 30%).

METHODOLOGY

RAP samples intended to be recycled are collected from a deteriorated pavement in Silchar, Assam. Fresh bitumen 60/ 70 grade and aggregate samples conforming to DBM-II are collected. The physical properties of fresh aggregate specimens andvirgin bitumen are determined. The aggregates and binder of the RAP samples are separated by using the Centrifuge Bitumen Extractor as per ASTM D2172, IRC: SP 11 –1988 (Appendix - 5). The aggregates found after extraction are also tested for their suitability.

Further sieve analysis is carried out to find out the gradation of the aged aggregates present in the RAP sample as per MORTH (4th revision). The gradation specification of Dense Bituminous Macadam (Grade-II) has been adopted as per MORTH(4^{th} revision) for developing the recycled mix.

Fig.1. Collected RAP materials

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To prepare recycled mixes, collected RAP is broken into pieces and added to fresh aggregates at varying percentages (10%, 20% and 30%), and then heated to higher temperature. To this mixture, pre-calculated amount of hot fresh binder is added. This mixture is mixed well to produce the recycled mix.
The principle of the Marshall stability is the resistance to plastic flow of cylindrical specimens of a bituminous mix loaded on the lateral surface i.e. it is the load carrying capacity of the mix at 60˚C ,measured in KN. Marshall design method is used for the mix design.Approximately 1200 gm of the recycled mix ispoured into Marshall mould, and then compacted with Marshall hammer with 75 blows on each face. The moulds are weighed both in air and in water for estimating the volumetric parameters. They are then kept in water bath at 60˚C for half an hour and then tested for Marshall flow and stability values using Marshall apparatus.

The Marshall Stability Value and Flow value at the average value of bitumen content are checked with the Marshall mix design criteria as per MORTH(4^{th} revision).

RESULTS AND ANALYSIS

The binder content of the procured RAP sample is found to be 4.4%. Gradation of Reclaimed aggregates after extraction is done and they comply with the DBM-II specifications as per MORTH (4^{th} revision).

Table -1: Combined Gradation for RAP Material and Fresh Aggregate in DBM-II mix

IS sieves (mm)	Cumulative % weight of total aggregate passing the IS sieves	0% RAP	10% RAP	20% RAP	30% RAP
37.5	100	100	100	100	100
26.5	90-100	95.16	92.4	91.67	92.38
19	71-95	83.67	74.81	74.79	75.71
13.2	56-80	68.33	60.185	60	60.71
4.75	38-54	46.34	45.92	46.04	46.67
2.36	28-42	35.16	40	40	40.72
0.3	7-21	14.167	14.07	13.96	14.76
0.075	2-8	5.16	5	5	5.47

Table 2: Comparison of Marshall Properties

Properties	Fresh Mix (0% RAP)	10% RAP	20% RAP	30% RAP	Criteria as per MORTH
Stability,KN	13.132	19.997	21.983	22.116	9KN min
Flow,mm	3.3	3.3	3.5	3.6	2-4

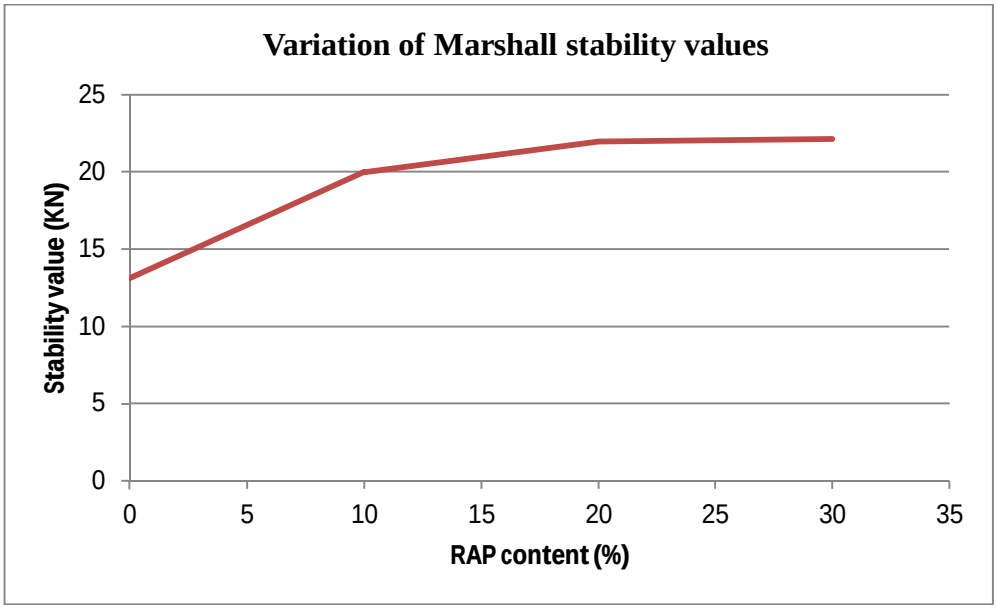

Fig.2. Comparison of Marshall Stability Values for different percentage of RAP mixes

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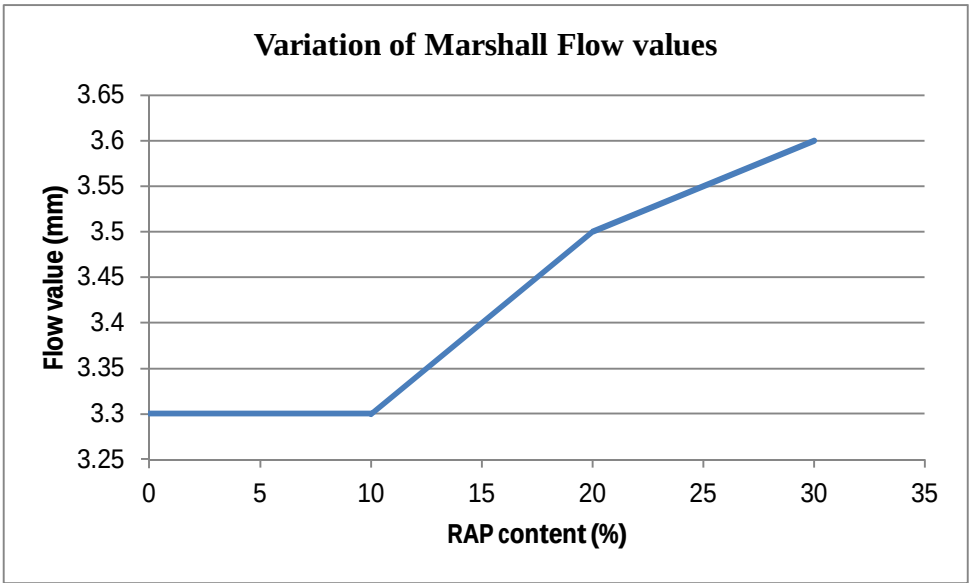

Fig.3. Comparison of Marshall Flow Values for different percentage of RAP mixes

CONCLUSIONS

The index tests conducted on fresh and extracted aggregates indicated that they satisfied the requirements as per MORTH(4th revision). It can be seen that the stability and flow values increased with an increase in RAP content. This indicates that addition of RAP materials gives more stability and less deformation compared to virgin mixes. Thus it is preferable to use RAP upto 30 % for better stability, less deformation and less costs.

FUTURE WORK

A cost analysis will be done to see the variation of cost with 0% RAP and 10%, 20% and 30% RAP.

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MODEL UPADATING OFSCALED - MODEL OF A REINFORCED CONCRETE COLUMN BASED ON PHYSICAL PARAMETER

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ABSTRACT
The present work is attributed to develop an updated finite element (FE) model of Reinforced Concrete (RC) column with the help of analytical results obtained from numerical model of it and with the help of experimental time - history data acquired from the experimental model of the same. It also represents a theoretical and experimental ambient modal analysis as well. The aim here is to model updating of a scaled - model of RC column through changes in physical parameters such as moment of inertia, Poisson's ratio, thickness and so on.Using such parameters, the model is likely to be adjusted more accurately and its connectivities will be preserved. The differences of modal properties obtained from analytical and experimental model has been considerably reduced after updating. This report explores the possibility of achieving a most correct finite element model of the structure that can reveal the actual dynamic properties of an existing structure from time - history data collected for it.

INTRODUCTION
The model updating refers to the modification of an analytical (usually, finite element (FE)) model of the structural system such that the predicted response of the updated analytical model are consistent with the experimental data and is being used in structural reliability, structural analysis and structural health monitoring applications.

In Civil Engineering field, model updating has become a big concern for civil engineers nowadays in their design. Before that, civil engineers pay more attention to static analysis in their design but some incidents happen where one of the famous oscillation incidents was the great Tacoma Narrow Bridge in Washington State. A steady wind led the bridge to ultimate destruction of this fine structure only few months after the completion. It became the object of scrutiny for structural engineer and none of them want to repeat the costly mistake in future [1]*.

However, the use of Finite Element (FE) updating method has first been adopted in the aircraft industry in 1950s where FE models of complex aeroplane structures has been taken and updated. Gradually, this method gained popularity in other engineering and research field. The life period of most of the civil infrastructure decreases with the passage of time. It is certainly because of damages caused in it with time as well as due to certain unfortunate natural calamity or events like an earthquake, storm, etc. The life of such structures can be enhanced at certain time by strengthening of the damage locations in structure. There are difficulties in locating the location and amount of damage in the complex structures by primal techniques like non - destructive techniques (NDT) of damage detection. Therefore, Vander Auweraer (2001), Yam et al., (2004), Yan et al., (2004), Doebling et al., [2 - 5] came with the techniques of vibration based damage detection in the structures. The Finite Element Method (FEM) was first initiated in aerospace industry by Courant in 1943 [6] which can be found in 2

the literature of applied mathematics. Courant performed the numerical analysis using Ritz method of analysis at that time. Model updating through the choosing of different parameters iteratively and parameter estimation techniques have been developed to improve the analytical FE model using estimated modal data. However, there is possibility of arises uncertainty in difference between the response of an analytical model and actual response of the structure. The difference arises mainly from two types of uncertainties like modeling error or due to the presence of noise during the execution of experimental test.

2.1 INTRODUCTION

2 Experimental Case Study
The aim of research is to identify the material and updating model of a scaled reinforced concrete (RC) column, by comparison of numerical model frequency response functions (FRFs) and tested model frequency response functions (FRFs) and by observing changes in the identified modal parameters taking in to the account uncertainties due the measurement as well as modelling error. For this research purpose the pull on testing has been performed on the scaled RC column model and vibration data has been collected.

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2.2 Description of specimen

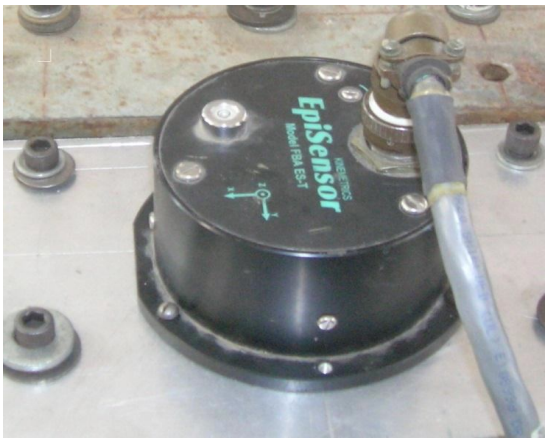
A scaled RC column specimen has been constructed in the laboratory. The section of the column is considered as 0.09 m x 0.09 m and the height of the column is taken as 1.5 m. The soil compliance has not been taken into account and therefore, a reinforced concrete pedestal is provided at the base of the RC column which acts as the foundation of the RC column structure. The concrete used is M50 which is the product of SikaRepRMicrocrete - 4 [25]. The compressive strength achieved after 28 days curing is 50 MPa. The modulus of elasticity and fresh concrete density for the Micro Crete - 4 are as 32 kN/mm2, 2700 kg/m3. The rebar used as longitudinal and shear reinforcement are of Fe415 grade with diameter of 8 mm and of Fe250 grade with diameter of 3.25 mm, respectively.

2.3Experimental Set – up

The test equipment includes two accelerometers, a data acquisition system (Granite Instruments by Kinematrics) with inbuilt data processing and a computer installed with software for controlling the data acquisition system and to give the output as the processed data. The accelerometers were installed at the top and bottom of the RC column to record the vibration data of the structure. Shake table test were performed on the column model in the laboratory. The shake table test has been performed on the model in longitudinal and transverse direction and data has been collected through the data acquisition system. Figure 2.1 shows a schematic view of the RC column and the location of the sensors whereas Figure 2.2 shows the granite installed data acquisition system.

(a) (b)

FIGURE 2.1 Experimental set - up (a) Schematic view RC column model in the laboratory (b) Location of the sensor placed at top of the RC column



(c)

FIGURE 2.1(c) Location of the sensor placed at bottom of the RC column

2.4 Experimental Data

Experimental test was conducted in free - free condition. The experimental data were obtained via shake table testing using a data acquisition system with inbuilt data processing and a computer installed with software for controlling the data acquisition system. Two piezoelectric accelerometer model 2222c (0.5g) was attached to the structure by using wax. Acceleration ground motion history were given to structure and therefore, the output obtained was.

Total sample points in time series data = 37000
No of samples per seconds = 200
Therefore,
Time duration = 37000/200

= 185 seconds
Sample frequency (df) =1/time duration
=1/185 seconds
=0.0054054 Hz
Sample frequency (df) =0.00540 Hz

2.5 Experimental Modelling and Analysis using ARTeMIS Extractor

The experimental model has been prepared in ARTeMIS software [27] in which operational modal analysis has been carried out to obtain experimental modes and damping properties of the structure. The descriptions of different items required for construction of column model in ARTeMIS are given in Table 2.1. The sampling frequency was 200 Hz. There were two data set format and each format should contains .asc file. The configuration file should kept in terms of *cfg file format. There were 8 numbers of nodes, 12 number of lines and 12 number of surfaces in the geometry.ARTeMIS Extractor is effective in modal identification from response only and identification of structure under real operating condition.

TABLE 2.1 Description of different items and data required for analysis in ARTeMIS

Item	Description
General:	
Author	
Configuration File	k2.cfg
Geometry:	
No. of Nodes	8
No. of Lines	12
No. of Surfaces	12
Data:	
No. of Data Sets	2
No. of Reference Transducers	1
Sampling Interval	0.005 s
Sampling Frequency	200 Hz
Nyquist Frequency	100 Hz
No. of Estimated Modes by:	
Frequency Domain Decomposition (FDD)	14
Enhanced Frequency Domain Decomposition (Enhanced FDD)	5
Unweighted Principal Component (UPC)	0
Principal Component (PC)	0
Canonical Variate Analysis (CVA)	0

ARTeMIS Experimental Analysis Result

The raw data obtained from ambient vibration test for the RC column has been imported in ARTeMIS and operational modal analysis was performed. To estimate the dynamic characteristics such as natural frequencies and corresponding mode shapes, the Frequency Domain Decomposition (FDD) pick - picking technique were applied. The drawback of FDD is that it does not allow us to extract damping properties of the structure. Hence on the later stage, to extract the damping properties, the Enhanced Frequency Domain Decomposition (EFDD) pick - picking technique were employed. Table 2.2 shows the experimental natural frequencies and corresponding damping ratios of the RC column. The different mode shapes for the RC column in longitudinal,

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transverse and torsional direction respectively are presented in Figure 2.2. Table 2.2 shows the experimental natural frequencies and corresponding damping ratios of the RC column.

TABLE 2.2 Experimental frequency and damping obtained from ARTeMIS

Mode number	Frequency (Hz)	Damping Ratio (%)
1	7.813	1.658
2	8.105	1.84
3	42.541	1.403
4	44.234	0.3332
5	90.675	0.7751

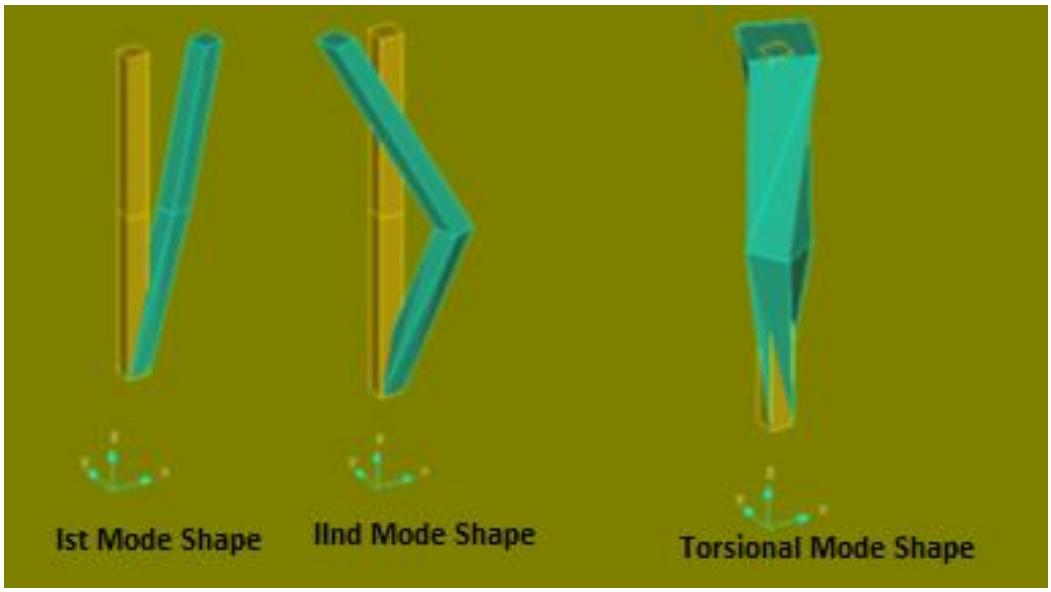

FIGURE 2.2 Mode Shapes for a Scaled – Model of RC Column in ARTeMIS

3 NUMERICAL CASE STUDY

3.1 Introduction

The main objective of the case study is to examine the performance of the structure from numerically. The purpose of the numerical case study is to construct the same structure numerically with help of any software and compute the Mode Shapes, Natural Frequency, FrequencyResponse Function and Model Updating.

3.2 Finite Element Modeling of the Scaled – Model of RC column

The analytical FE model for RC column has been made using Mechanical APDL (ANSYS) 14.0 software [26]. The model is comprises of 256 nodes and 251 elements where the bottom part has been fixed and upper part is free.

Some assumptions were made on this RC column which were:

1. The concrete strength for the RC column is 50 N / mm2 and it gives the elastic modulus of 32 x 103 N / mm2. Poisson ratio and density are 0.15, 00027 N / mm3. The damping has been considered as 5%.
2. The cross - sectional area of the column are 90 mm 90 mm and the height is considered as 1500 mm.
3. The element of column was assigned as SOLID65 and Link 180 in ANSYS. SOLID65 in ANSYS has a concrete behavior whereas Link 180 shows the rebar behavior and is well suited to model irregular meshes.
4. The element is defined by two fifty six (256) nodes having three degrees of freedom at each node: translations in the nodal x, y, and z directions. The element also has plasticity, creep, swelling, stress stiffening, large deflection, and large strain capabilities.
5. As for the boundary condition, the column has been fixed at it base whereas upper portion was free.

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6. To form the geometry and to connect the different node points, element attributes option has been used in ANSYS rather than using the free meshing. The Figure 4.1 shows geometry of the numerical model.
7. Modal Analysis in ANSYS was done with subspace extraction mode and five modes were extracted from the analysis

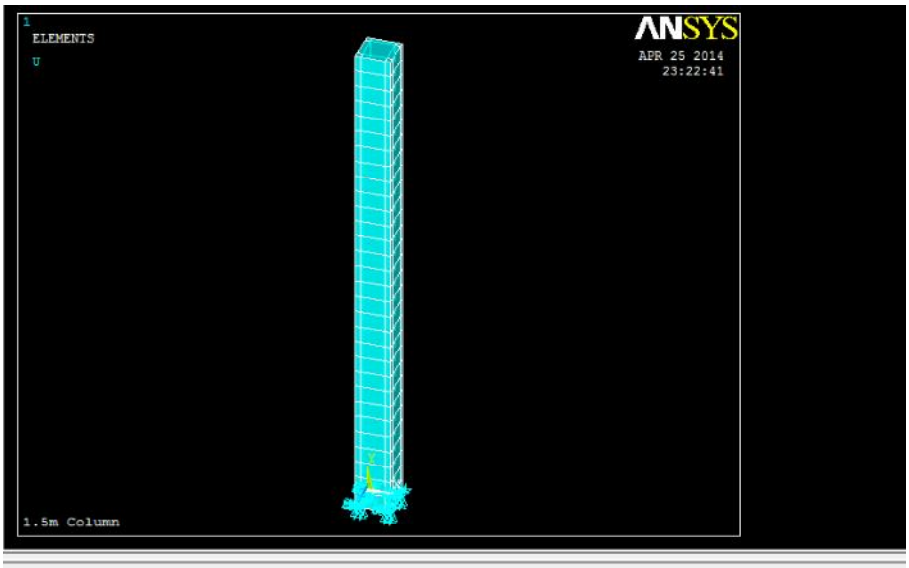

FIGURE 3.1 Analytical FE Model

3.3 Results of Analysis

The Modal analysis has been analyzed to obtain the analytical natural frequencies and corresponding mode shapes. On the later stage, the natural frequencies and mode shapes obtained from the three-dimensional FE model will be compared with those measured from the experimental results. A set of structural parameters are then to be selected and need to be update using the updating procedure as presented in the chapter (5). The results of finite element analysis are given in Table 3.1. The different mode shapes obtained for different natural frequencies are given in Figure 3.2.

TABLE 3.1 Analytical Frequency and Mode Shapes for FE Model

Mode number	Frequency (Hz)	Damping Ratio (%)
1	7.1467	5
2	7.1467	5
3	43.988	5
4	43.988	5
5	92.454	5

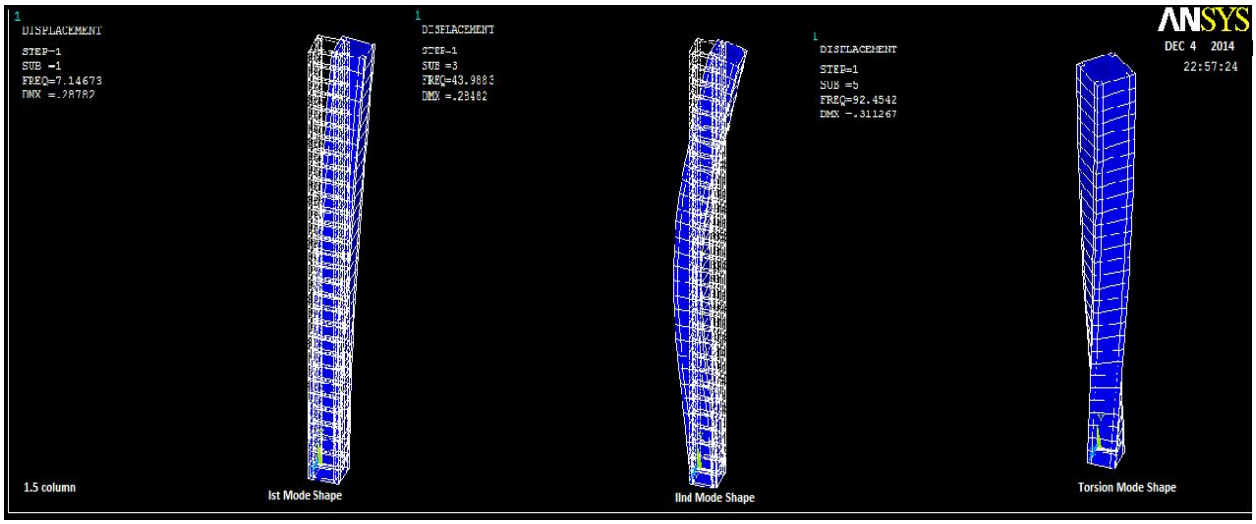

FIGURE 3.2 Mode Shapes for a Scaled – Model of RC Column in ANSYS

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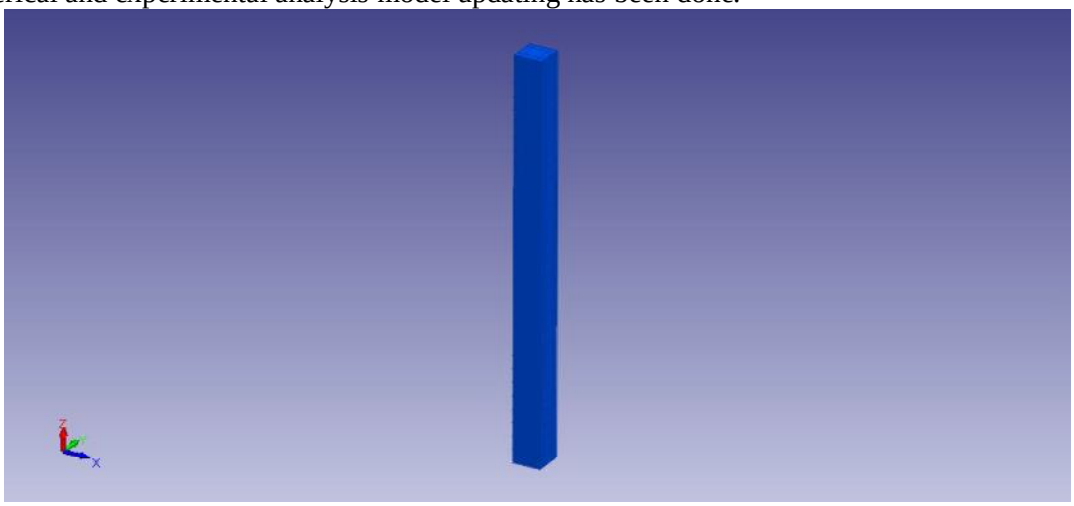
4 MODEL UPDATING

Because of the different limitations and assumptions in the two approaches, the finite element model and the experimental modal model have different advantages and disadvantages. The finite element model provides information on dynamical behavior of the structure while the experimentally-derived model contains information from actual structure. Generally, it is believed that more confidence can be placed on experimental modal data than on the finite element model. Therefore, in order to determine the spatial properties of the structure which can reproduce the whole characteristics of the test structures (measured or unmeasured), reconciliation processes including model correlation and model updating, must be performed. Model updating can be defined as the adjustment of an existing analytical model in the light of measured vibration test. After adjustment, the updated model is expected to represent the dynamic behavior of the structure more accurately.

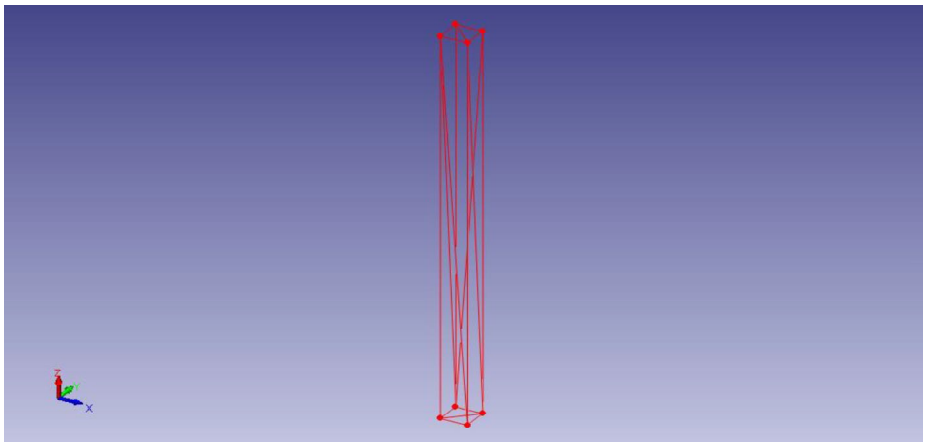
4.2 Importing of FE and Experimental Model in FEMtools

Both the FE and Experimental model has been imported into FEMtools. The Figure 4.1(a) and 4.1(b) shows the imported FE model and Experimental model in FEMtools. Finally, after importing both the data that obtained from numerical and experimental analysis model updating has been done.



(a)

FIGURE 4.1 (a) Imported FEA in FEMtools



(b)

FIGURE 4.1 (b) Imported EMA into FEMtools

5.13 Selection of sensitivity parameters in FEMtools

The FE model updating has been done using the selection of model parameters iteratively. The updating parameters selected are

- Young's modulus of elasticity (E)
- Bending moment of inertia (Iz)
- Structural element damping (GE)
- Density (ρ)

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The updating parameters are further divided into two sequences
Sequence 1:
- Bending moment of inertia (Iz)
- Structural element damping (GE)
- Young's modulus of elasticity (E)
- Density (ρ)

Sequence 2:
- Young's modulus of elasticity (E)
- Density (ρ)
- Structural element damping (Iz)
- Bending moment of inertia (GE)

The normalized sensitivity for the above selected parameters has been found out for both the modes using software. Among all the parameters, the structural element damping (GE) shall be kept as a global and rests are to be fixed as local in FEMtools. After updating of the model error between the analytical and experimental natural frequency should reduce to less than 1 (%).

Model Updating Results

TABLE 5.1 Comparison of Natural Frequency between FEA and EMA before Updating

Mode No	Initial FEA Frequency (Hz)	Initial EMA Frequency (Hz)	Error (%)	MAC (%)
1	7.1467	7.813	-10.04	98.1
2	7.1467	8.105	-4.33	99.4
3	43.988	42.541	-9.63	91.1
4	43.988	44.234	-3.51	90.0
5	92.454	90.675	-4.94	99.6

Table 8.1: Computational effort for physical parameter.

S. No.	Parameter	Change Introduced	Prediction
1	h	[+15 %]	[+14.90]
2	E	[+8%]	[+8.2]
3	ρ	[+10]	[+9.6]
4	v _	[+10]	[+8.5]

TABLE 5.2 Comparison of Natural Frequency between FEA and EMA after Updating

Mode No	Updated FEA Frequency (Hz)	Updated EMA Frequency (Hz)	Error (%)	MAC (%)
1	7.0167	7.607	-2.59	99.9
2	7.0194	8.105	1.87	99.8
3	43.1281	42.541	-0.01	92.2
4	43.288	44.234	-0.02	96.6
5	93.597	91.675	0.57	99.3

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CONCLUSION

In the present study, issues related to model updating of a model of RC column were addressed. The significance of modal analysis through modal testing on RC column structures created opportunity to compare the accuracy of dynamic measurements. The repeatability of finding dynamic characteristics had enhanced the performance of modal analysis and provided a high level confidence in instrument measurements and analysis procedure.

Based on the overall studies through theoretical, experimental modal analysis and after model updating of the selected structures, conclusions can be drawn as follows:

1. The experimental dynamic properties of the selected model have been successfully obtained from the ambient modal analysis compared with the finite element analysis.
2. Modal updating has been carried out in the finite element analysis by referring to the experimental testing results with the help of FEMtools.
3. In the FEMtools modal parameters has been chosen in two sequences, sequence I and sequence II for model update.
4. Finally, after updating the model, it has been observed that the discrepancy in result between analytical FE data and experimental modal analysis data has been reduced.

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PREDICTION OF BEARING CAPACITY OF BORED CAST- IN SITU PILE

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ABSTRACT
An axially loaded pile tests have been carried out on 0.6m diameter bored cast in-situ piles in clayey silt soil with decomposed organic matter upto minimum depth of 11m.This paper presents an FEM model for simulating these field axial load tests embedded in such soils using PLAXIS 2D. The simulation is carried out for a single pile with an axial load at pile top, so as to evaluate the settlement of the pile. The vertical load versus settlement plots on single pile is obtained from field tests and are compared with the finite element simulation results using PLAXIS 2D, showing reasonable agreement. Different approaches for estimating the bearing capacity of piles from SPT data have been explained and compared. Statistical and probability approaches were engaged to verify the SPT predictive methods with the log-normal distribution in order to predict the degree of scattering of uncertainty.

Keywords: Pile Bearing Capacity, Standard Penetration Test, Finite Element Method, Standard Deviation.

INTRODUCTION
Pile foundation is one of the most popular forms of deep foundations. Piles are generally adopted for structures in weak soils, characterized by low shear strength and high compressibility, as well as in good soils, in cases where structures are subjected to heavy loads and moments[1].The maximum settlement of the pile and its ultimate load bearing capacity are the governing criterion in the design of axially loaded piles. These are evaluated by carrying out a number of theoretical and numerical approaches. Bearing capacity of piles can be determined by four approaches:

i. By the use of static bearing capacity equations
ii. By the use of SPT and CPT values
iii. By field load tests
iv. By dynamic test

Static analysis methods estimate shaft and base resistances separately and differently. For shaft resistance, in cohesive as well as non-cohesive soils, considerable uncertainty and debate exist over the appropriate choice of the horizontal stress coefficient, Ks. Design guidelines based on static analysis often recommend using the critical depth concept. However, the critical depth is an idealization that has neither theoretical nor reliable experimental support, and contradicts physical laws. In recent years, the application of in-situ testing techniques has increased for geotechnical design. Standard Penetration Test (SPT) is one of the most common and economical field tests used during ground investigation. Apart from its main applications in soil characterization, SPT *N* value has also been extensively used for designing structural foundations and other earth structures, particularly, for the bearing capacity of piles (Meyerhof, 1976; Shioi and Fukui, 1982; Decourt, 1995; Robert, 1997).

This paper presents the results of a field test carried out on an axially loaded pile and attempts to study the pile behaviour under an axially loads using a two-dimensional finite element model. The bearing capacity of piles are estimated using direct and indirect methods and highlights the importance of predicting uncertainty which can be estimated from statistical parameters.

BEARING CAPACITY OF PILES USING PENETRATION DATA
Several researchers have proposed several theories to estimate the bearing capacity of pile foundations in sandy soil using mechanics of statics [Janbu(1976), Meyerhof (1976), Vesic (1977), Coyle and Castello (1981)]. Few correlations have also been proposed for estimating the pile bearing capacity using dynamic methods [Murthy (1999)]. In spite of the mechanistic approaches, the most popular method of estimating the bearing capacity of piles still pertain with the use of penetration test data, either Standard Penetration Data (SPT) or Cone Penetration Data (CPT).

The Standard Penetration test (SPT) is a common in-situ testing method used to determine the subsurface soil profile and their geotechnical engineering properties. Due to its simplicity of execution (apart from the difficulty in repeatability), a field engineer finds the method to be one of the most amiable and reliable one. Pile capacity determination by SPT is one of the earliest applications of this test that includes two main approaches,

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direct and indirect methods. Direct methods apply N values with some modification factors. Indirect SPT methods employ a friction angle and un-drained shear strength values estimated from measured data based on different theories. Soil parameters are obtained from SPT results, and the methodology of pile bearing capacity estimation is the same as for the static methods.

For layered clay soil, where the cohesive strength varies along the shaft,

$$Pu = Qu + Tu = q_u A_b + \Sigma(fsp\Delta L)$$

Where q_u is the unit ultimate end bearing capacity of the soil at the level of the pile tip, A_b is the bearing area, fs is the unit ultimate soil-pile adhesion strength, and p is the pile perimeter at the segment ΔL. The term $\Sigma(fs.p.\Delta L)$ is the total load capacity contributed by the pile shaft in skin-friction calculated as the summation of the side shear forces along the pile's embedment length L. Using different approaches as estimated by Meyerhof (1976) and Vesic (1977),the indirect values are obtained. .Although there are some problems on the explicit interpretation of the results of SPT, this test is the most frequent in-situ test in geotechnical practice because of its simplicity and affordable costs.

DETERMINATION OF PILE BEARING CAPACITY BY SPT (CASE STUDY)

By performing a 50m borehole at the site of National Institute of Technology, Langol, a region in Lamphelpat, Imphal, Manipur. The soil stratigraphy and SPT values along with depth is shown in Figure1. The groundwater table is 0.45m below the ground surface.

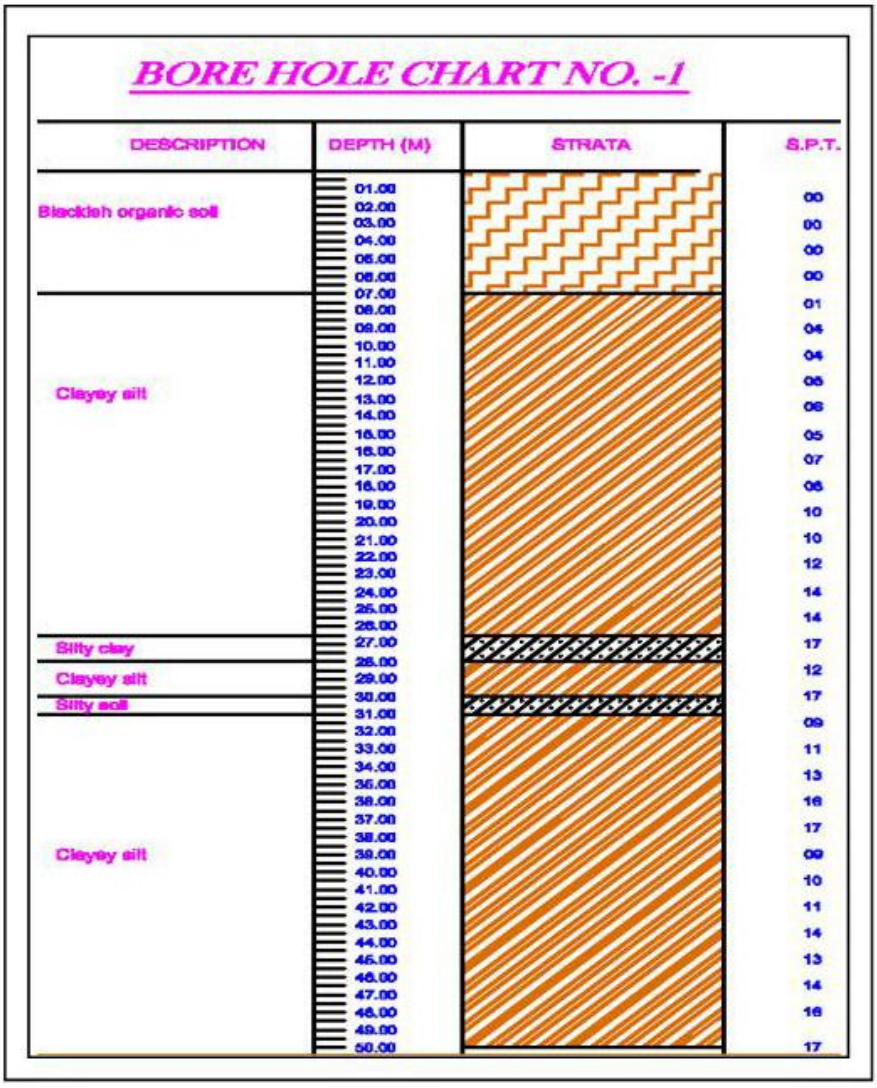

Fig.1: Borehole Considered

Based on the SPT data above, the bearing capacity of a bored pile (L=26m, D=0.6m), is determined by the methods mentioned as given in Table1 below

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Table1: SPT direct methods for prediction of pile bearing capacity in the present study

Method	Unit base (Qb) and Unit shaft resistance (Qr)	Remarks
1. Aoki and De'Alencar (1975)	Qb(MPa)=(k/1.75)Nb Qs(kPa)=(ak/3.5)Ns	**Nb:** Average of three values of SPT blows around pile base **Ns:** Average value of N around pile embedment depth For sand: a=14, k=1 For clay: a=60, k=0.2
2. Bazara and Kurkur (1986)	Qb(MPa)=nbNb Qs(kPa)=nsNs	**Nb:** Average of N between 1D above and 3.75D below pile base, Nb<=50 **Ns:** Average value of N around pile embedment depth nb=0.06-0.2 ns=2-4
3. Decourt (1995)	Qb(MPa)=kbNb Qs(kPa)=α(2.8Ns+10)	Driven and bored piles in clay :α=1 Bored piles in granular soils :α=0.5-0.6 Driven piles in sand: Kb=0.325 Bored piles in clay: Kb=0.08 Driven piles in clay: Kb=0.1 Bored piles in sand: Kb=0.325

VALIDATIONS

In order to validate the program, a pile load test has been analyzed. The bored cast-in situ pile considered in this study is of diameter (D) 0.6m, length 26m.The site soil considered in this study is shown above in the fig. Reaction load test (by compression) was done as per IS : 2911 (PART – IV) 1985 in which reaction load was applied on the pile top (after preparation f pile top) by means of a hydraulic jack against rolled steel joist capable of providing reaction and settlement was recorded by two or four dial gauges of mm sensitivity, each position at equal distance around the pile and held by datum bars resting on immovable support at minimum distance of 1.5D meter times from the edge of the pile. The rolled steel joist was loaded by putting suitable size of wooden joists transversely and wooden planks on it and sand bags filling about 30 to 35 kg weight around 2700 nos. of bags on the platform. The reaction for the jack was obtained from a kentledge placed on a platform supported clear of the test pile. The center of gravity of kentledge was tried to be kept on the axial of pile and the load applied by hydraulic jack was made co – axial with this pile.

The field results have been compared with the PLAXIS 2D.In PLAXIS 2D, 15 noded triangular element has been chosen which results in a two-dimensional finite element model with two translational degrees of freedom per node. The 15-noded triangle provides a fourth order interpolation for displacements and the numerical integration involves twelve Gauss points. The pile is made up of reinforced cement concrete and the behaviour is assumed to be linear-elastic. The Mohr-Coulomb model can be considered as a first order approximation of real soil behaviour. This elastic perfectly plastic model requires 5 basic input parameters, namely Young's Modulus, E, Poisson's ratio, μ, cohesion, c, friction angle, ϕ and dilantacy angle, Ψ. This is a basic, well-known soil model. Figure below shows the generation of a mesh and deformations when loads of 55T is applied.

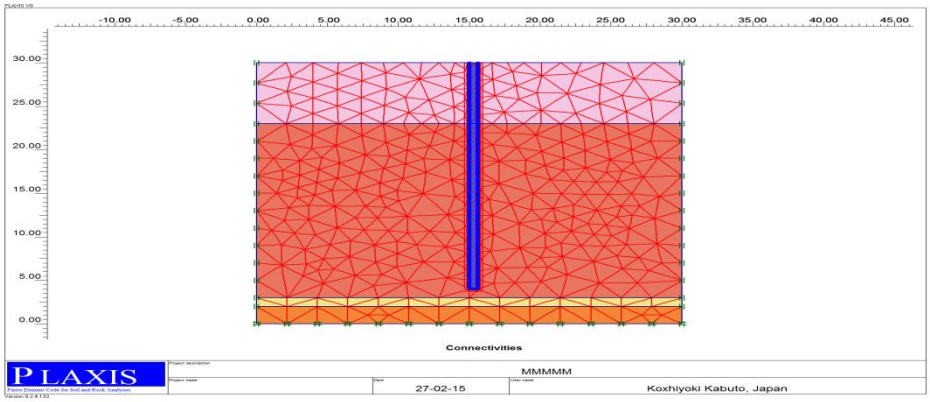

Fig.2: Mesh Generation

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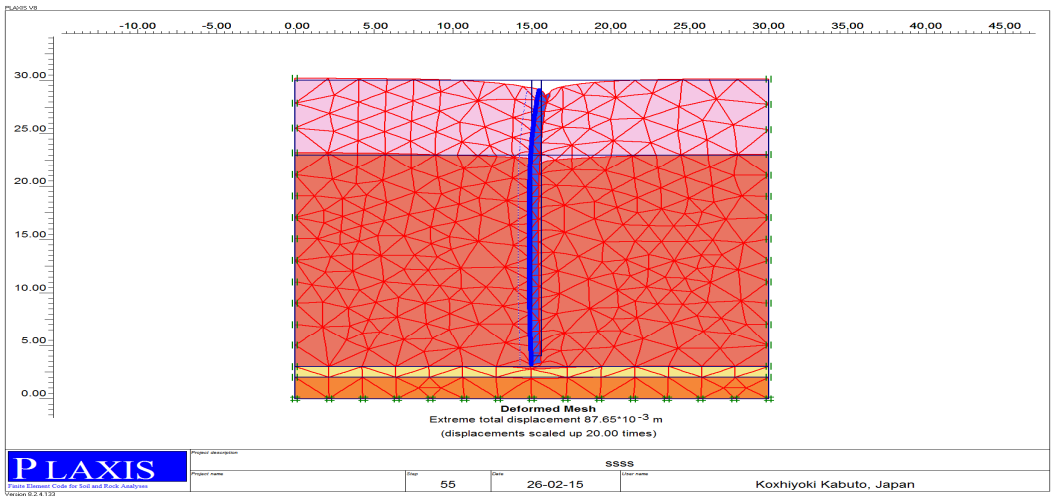

Fig.3: Total Deformation Mesh

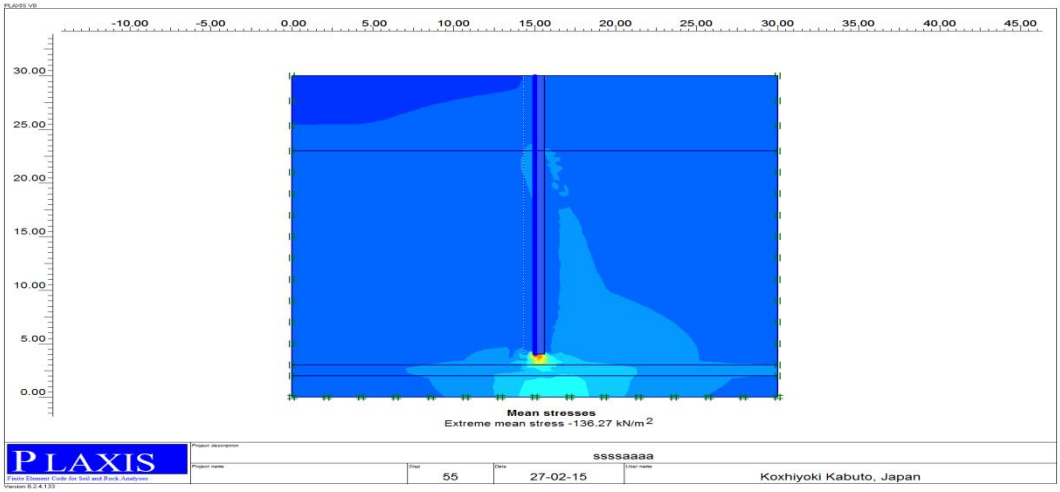

Fig.4: Total Stresses

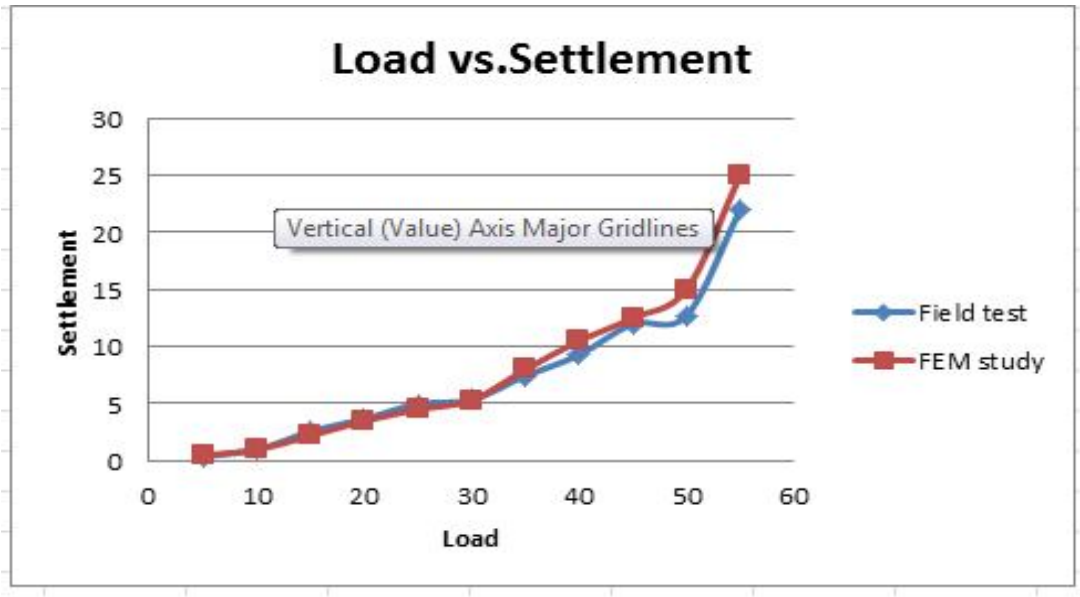

Fig.5: Comparison of Load vs. settlement graph

From Figure above, it is shown that the curve obtained using PLAXIS 2D simulations is close to field test results. This implies that numerical simulation is applicable with the field test by predicting a good results.

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The pile bearing capacity can either be estimated by Direct and Indirect methods employing an in-situ tests. The results as estimated are given in table below considering both methods.

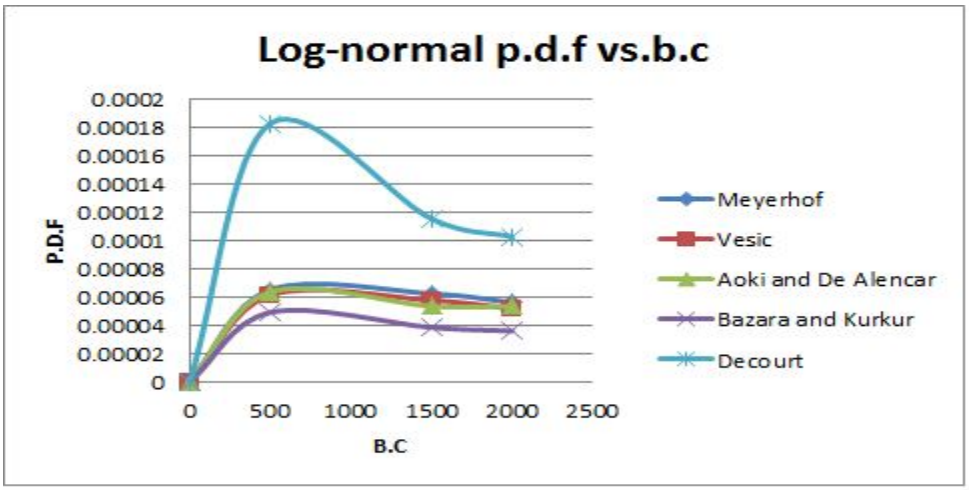
Table 2. Bearing Capacity of bored piles (L=26m,D=0.6m)

Borehole	Bearing capacity methods(k N)				
	Indirect methods		Direct methods		
	Meyerhof(1976)	Vesic(1977)	Aoki and De'Alencar(1975)	Bazara and Kurkur(1986)	Decourt(1995)
Borehole1	1521.31	1593.77	1513.43	1844	672.40

Based on this analysis, Bazara and Kurkur prediction is highly overestimating. This is due to ignoring the plug effect in pipe piles that are categorized as low displacement piles in this method .Among the five SPT methods, the prediction by Decourt is conservative.

Statistical and probability approaches were engaged to verify the SPT predictive methods. The log normal distribution can be employed to evaluate the performance of the pile capacity prediction method [5].Probability density function with log normal distribution have been considered to compare different approaches of pile bearing capacity. This distribution was used to evaluate the different methods based on their prediction accuracy and precision. These results indicate that Meyerhof method has a better precision than others in predicting the pile bearing capacity which can be estimated from standard deviation.

Fig.6: Log-Normal Distribution P.D.F vs Bearing capacity



For a statistical set of data, standard deviation is a measure of the degree of the degree of scattering. The more the standard deviation, the higher is the degree of scattering which indirectly points out to the degree of uncertainty. So, from among the five SPT methods, Bazara and Kurkur[3] has the high degree of scattering as compared to others.

CONCLUSION

Determining the bearing capacity of piles is an interesting subject in geotechnical engineering. The complex nature of the embedment ground of piles and lack of suitable analytical models for predicting the pile bearing capacity are the main reasons for the geotechnical engineer's tendency to peruse further research on this subject. Among different common methods, pile load testing can represent reasonable results, but such tests are expensive, time-consuming, and the costs are often difficult to justify for ordinary or small projects. Direct bearing capacity predicting methods for piles are developed based on in-situ testing data, especially SPT and CPT, having applications that have shown an increase in recent years. SPT test is the most frequent in-situ test in geotechnical practice because of its simplicity, easy performance, short time, and low cost.

A comparison of both direct and indirect methods have been employed along with the field test comparison with numerical analyses. The results of the comparison demonstrate that Bazara and Kurkur[3] method has a high degree of scattering as compared to others.

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THE BEST PRACTICE OF END-TO-END ERP IMPLEMENTATION – A CASE STUDY ON AUTO-COMPONENT MANUFACTURING UNIT

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ABSTRACT
Information technology (IT) resources drive today's corporate machinery. Organizations try to optimize their procurement practices to customer satisfaction, through IT-enabled business solutions. Over the last 15 years corporate had taken a big leap of faith with ERP and Supply Chain Management Solutions. The sad story however, is that more than 90 percent of the companies that have implemented ERP have not had a truly successful implementation the first time around.

The primary focus of this paper is bring out the key implementation challenges that organizations face today, and how an end-to-end ERP Implementation, as an effective strategy can mitigate these challenges so as to ensure efficiency of processes with proper information flow. In many an ERP Implementations it has been found that there is very less or no synchronization between the expectations of customer (client /end-user) wants and what implementer delivers, since customer experiences the first look and feel of the ERP configuration only at the testing phase. This paper brings about template-based implementation strategy, wherein the importance of sanctity of the legacy data is continuously maintained. This paper also presents the SAP's SME template-base implementation methodology successfully adopted at an automobile component manufacturing company in Maharashtra to bring to light its advantages over the traditional methodology and the churned benefits in the form of faster and happier ROI to the organization.

Key Words: ERP, End-to-End, Template Approach, Legacy Systems, AS-IS, TO-BE, Process Blueprint, Training Matrix, Three-way Match

1.0 INTRODUCTION

The application of Enterprise Resource Planning has been around in the corporate usage since 1960s. This concept is result of a thorough and experiential metamorphosis of the MRP in the 1960s around the manufacturing circles of the developed world. Through continuous innovation and research, ERP has evolved from automated processes to Material Requirement Planning (MRP), and then to Manufacturing Resource Planning II (MRP II). It not only gives a financial view of all the processes and activities (as it was mythic earlier), but also a manpower view, a raw material view, and a machine uptime and maintenance view. After that, it has integrated all departments in an enterprise, and became the ERP we know today. Recently, ERP has been extended beyond the enterprise and is called extended ERP or ERP II. The Indian ERP market is expected to grow at a CAGR of 25.2% over the next five years. According to the study, the market was $83 million in 2004, and is forecasted to be over $250 million in 2009. With the country remaining a low cost economy, they are battling against declining prices and a squeeze on their margins. These challenges drive manufacturers to realize that business decisions should be based on real-time information, resulting from synchronized business and production processes, says the study. The majority of Indian manufacturing companies are small by global standards, requiring easy-to-use ERP solutions to meet their specific process requirements, including localization needs to address the continually evolving tax and statutory requirements.

The primary focus of this paper is bring out the key implementation challenges that organizations face today, and how an template based end-to-end ERP Implementation, as an effective strategy can mitigate these challenges so as to ensure efficiency of processes with proper information flow. The paper brings out importance of sanctity of the legacy data, which is continuously maintained in this strategy. This paper also presents the SAP's SME template-base implementation methodology which was successfully adopted in an automobile component manufacturing company in Maharashtra to bring to light its advantages over the traditional methodology and the churned benefits in the form of faster and happier ROI to the organization.

1.1 OBJECTIVES OF THE STUDY

(i) To bring out the key challenges of ERP Implementation

(ii) To discuss the significance of end-to-end ERP Implementation Strategy

(iii) To explain and highlight the adoption of template-based ERP Implementation Strategy through a case study on automobile component manufacturing company.

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1.2 METHODOLOGY OF THE STUDY

The paper draws extensively from the secondary sources for the review of literature on the concept of end-to-end ERP Implementation and the template-based ERP Implementation strategy. This paper then tries to superimpose the rich "ERP implementation" experience of M/s. Zensar Technologies Limited, Pune with a very pertinent case study to illustrate and reinforce the template-based methodology and the benefits churned out from such methodology.

1.3 CHALLENGES OF ERP IMPLEMENTATION

The benefits of an ERP application are limited unless it is seamlessly integrated with other information systems. Most of the challenges organizations face today are not relating to application of software or automation of processes, but relating to integration of ERP to their existing set-up. Hence the crucial understanding here is success of ERP implementation depends on the success of ERP integration.

1.3.1 Integration of ERP Modules

Packaged ERP software consists of many functional modules (production planning, inventory control, financial and HR). Organizations tend to install modules from the same ERP vendors in the initial ERP implementation. Not all companies will purchase all ERP modules from a single ERP vendor (Oracle, PeopleSoft etc.). The implementation of ERP systems could last many years. The integration of ERP modules could be either the integration of modules from different vendors, or the different versions of the modules from the same vendor. In SAP, a prospective user can buy all modules, which are automatically integrated. But originally, SAP was sold for min 50 users (price tag of Rs. 10 million & above) which small companies could not afford. Hence, they went in for other packages, which sold individual modules and lesser number of users. To take care of competition, SAP brought in scaled down versions All-in-One and Business One to cater to the smaller companies.

1.3.2 Integration of E-Business Applications

E-business practice is the combination of strategies, technologies and processes to electronically coordinate both internal and external business processes, and manage enterprise-wide resources. E-business software systems generally fall into four categories: Enterprise Resource Planning (ERP), Customer Relationship Management (CRM), Supply Chain Management (SCM) and Knowledge Management (KM). To get the most out of ERP systems, ERP should be tightly integrated with other e-business software - Supply Chain systems, CRM, knowledge management, B2B exchange and e-commerce storefront on the Internet. Nowadays, ERPs like Oracle and SAP have brought out E-Business Suites by integrating E-Business Software into their packages.

1.3.3 Integration with Legacy Systems

Over the years, legacy systems have accumulated vast amount of data vital to the survival, operations, and expansion of corporations and non-profit organizations. Integration of ERP systems with legacy systems is more complex than the integration of ERP modules and Integration of e-business Applications. It routinely requires the installation of third-party interface software for the communication between ERP software systems and legacy systems. Second generation ERP systems use relational database management systems (RDBMS) to store enterprise data. Data conversion from legacy systems to RDBMS is often a time-consuming and tedious process. While most interface software provides API for ERP to access legacy systems, some vendors offer integration module that automates or accelerates the transformation of legacy application logic and data into reusable components with XML, SOAP, J2EE and .NET interfaces, while SAP Netweaver provides a seamless and smooth cross-platform integration.

1.3.4 Inefficient Project Planning

ERP implementation starts with project planning - setting project goals, identifying high-level business requirements, establishing project teams and estimating the project costs. Many ERP Projects fail due to inefficient project planning resulting in losing the opportunity to re-evaluate the project at great details. If the ERP project is not justified at the planning phase, organizations shouldn't hesitate to cancel the project.

1.3.5 Lack of Phased Approach

It is important to break an ERP project down to manageable pieces by setting up pilot programs and short-term milestones. Dependent on the IT experience, some organizations choose the easiest piece as the pilot project, while others may implement a mission-critical application first. However, choosing the easiest piece is not that easy since priority is compromised for easiness. The pilot project should strike a balance between easiness and priority, since; both demonstrate the benefits of ERP and help gain hands-on ERP implementation experience.

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1.3.6 Data Conversion

Second generation ERP systems use relational database management systems (RDBMS) to store enterprise data. If large amounts of data are stored in other database systems or in different data formats, data conversion is a daunting task, which is often underestimated in ERP implementations. A two-hour data conversion task could be turned into two-month efforts as the result of DBA group's lack of technical experience and management's incompetency or ignorance. With Template based implementation, the first task before start of the project is to capture the relevant data so that ERP implementation is carried out smoothly.

1.3.7 Lack of Organization Commitments

The involvement of ERP implementation goes far beyond IT department to many other functional departments. The commitment and smooth coordination from all parties is the key to the success of ERP project especially the top management. The commitments come from the understanding of how ERP can benefit each functional department. For example, if the warehouse staff isn't completely sold on the inventory control module's benefits, they may not input the kind of usage data that is essential to the project's success. The traditional implementation methodologies seldom enable the user-departments to elicit what they actually expect as an outcome from the system. At times, it so happens that the end-user experiences the first look and feel only at the testing phase.

2.0 TRADITIONAL ERP IMPLEMENTATION

This refers to the full process of an SAP implementation -- from project preparation to go live and support. The stages are: project preparation, blueprinting, realization, and final preparation and go live and support, which are integral part of the Accelerated SAP implementation methodology (ASAP) administered by SAP. The primary issue of ERP implementation is to find a match between flexibility often required by the business and the rigidity usually imposed by the ERP system. This issue is aggravated in a cross organizational context because the rigidity of the ERP system is imposed by built-in assumptions about business semantics, business processes, business communication channels and business goals. If these hidden assumptions do not match the business, the business will experience the ERP system as rigid and unsuitable for business requirements. The above issue to a large extent is solved when organization adopt end-to-end ERP implementation. This enables the organization to view ERP System as a consistent, singular view of the business at any point of time and in reconciling and removing inaccuracies in the data available with its various functional facets like accounts, stores and purchasing, sales, production, controlling. The imperatives of low cost, high quality, and speed in decision-making, are the ultimate goals of any implementation and hence the systems and processes that would earn reputation of being a company should be innovative and 'easy-to-do-business-with'. The following are the highlights of the End-to-End ERP Implementation methodology.

Steps of Traditional Implementation	Business Evaluation Process
Scope	Understanding and deciding what modules of SAP need to be implemented
AS-IS	Taking a stock of the existing business processes
TO-BE	Mapping existing business processes to SAP. This helped in understanding the gaps between the AS-IS and To-BE processes, and the steps that needed to be taken to narrow these gaps.
Process Blueprint	By assessing the gaps between the AS-IS and TO-BE processes, a process blueprint was prepared, which documented in detail the scope of business scenarios, business processes, the steps followed by every process, and the requirements of the solution implementation. This phase also included extensive training and handholding on SAP for helping the employees understand SAP's capabilities.
Realization	In this phase, configuration of different modules and fine-tuned the processes as defined in the process blueprint.
Testing	All the key users do extensive testing to check if there were any problems in the various modules for handling different functions. This also included testing and training the various users on the new system.
Go Live	After thorough checking of the systems was done, the SAP system was commissioned for going live.

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However, practical experiences say that the traditional implementation methodology state above has the following disadvantages.

- There are no best practices adopted
- The As IS and To Be study are based on few individuals who form the initial level of interaction.
- The users get a look and feel of SAP after 6 months of the start of the project.
- Change requirements of configuration comes only during testing period
- Data Collection is taken up during testing and creates enormous problems since configuration is not pertaining to data.

To avoid all the above problems, SAP came up with the idea of collection of best practices in various industries and based upon that creation of templates. However, template methodology adoption to large-scale industries is very difficult. Hence, SAP came up with a version of SAP called All-in-One, which can cater to SMBs (small and medium scale business). With this All-in-One version, SAPs best practices are adopted by partners in coming up with a template for specific verticals –like auto, pharmaceuticals, textiles etc. In the templatized version high priority is given to data collection as well as high-level demonstration to users based on their data so that users can appreciate what they can get out of SAP. Another major breakthrough about this methodology is the reduction of implementation time, which is reduced to 16 to 18 weeks instead of the traditional 32 to 36 weeks. In paragraph 3.0 the template-based methodology is explained in detail.

3.0 TEMPLATE-BASED END-TO-END ERP IMPLEMENTATION

A template is pre-designed document or data file formatted for common purposes such as a fax, invoice or business letter. If the document contains an automated process, such as a word processing macro or spreadsheet formula, then the programming is already written and embedded in the appropriate places. A template is an application that is programmed by filling in predefined fields and/or answering questions. Template-based applications provide a fast way to develop an application, but are not as flexible as custom programming. The scope of the application is limited to the options built into the template by the template developer. It becomes a custom document after filling in the blanks with your data. The template-based approach to ERP implementation is designed to provide a successful format to ERP implementing, as well as a "jump start" to projects via the use of pre-defined, flexible practices and standards. These standards are applied to any implementation and include the important points required to ensure the integrity of the integrated enterprise system function. By utilizing a template approach there is an ability to take firm control over the project from the very outset. Without a doubt, templates and automation tools are a key way to reduce cost, time and risk on ERP projects. SAP calls these "accelerators" in their methodology tools such as AcceleratedSAP and ValueSAP. Listed below are the 7 steps are that form part of the template approach. Each of the steps mentioned here are very broad and generally require a series of different management tools in order to achieve the ultimate goal.

3.1 Define the ROI attainable, and therefore the budget

There are obviously many areas from which an accurate savings could then be calculated given some variables beforehand. Once the saving has been calculated we can then look at defining exactly what our budget may be able to be set at. A saving of $100,000 allows us a spending limit of $1,000,000 if we are intent on a 10% ROI for example. With such steps included in the template approach, part of the focus is to allow clients, or potential clients, some level of control over the entire process. This needs to begin with expectations of pricing and return on investment targets.

3.2 Define the tactical goals of the implementation

The tactical goals are those that we also want to achieve apart from the ROI. However in order to better focus the overall implementation efforts there is a need to tie these with the overall ROI. It is important to note that finishing on time and on budget are not tactical implementation goals. They are givens. We do not at any time set out to fail in this crucial area. For example, if one of the ROI goals is to achieve a 10% reduction in inventory levels (the movement of raw materials to the production shop floor). Then we would be advised to address this requirement in the tactical goals.

3.3 Define the operating environment of the business

The operating environment of the business forms the base of the requirements statement we will need to define through this process. During this step we need to be defining what the physical and corporate environment factors are that affect our selection of system. Operating context definitions may include, but are definitely not restricted to. How many sites are we going to implement the system in? What systems exist today that will need to stay in place? (Therefore what are the interfacing / integrating requirements?) What is the IT platform of our

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corporation? How do our people work? (shift arrangements, local or remote sites etc), What are our equipment classification types? (Many or few?) What are the current and future requirements for reliability focused functions such as condition monitoring? This area is obviously a large one and one that needs to be treated seriously as it forms the base, along with our ROI and cost statements, of our overall efforts.

3.4 Define the steps required to achieve the tactical goals

This part of the process is, without doubt the most laborious and difficult area of any implementation template. This includes a vast number of areas all covered under the one heading. It is also the area where there exists the majority of waste in the implementation process. Many of the arguments are repeated time and time again in each project. Business Rules and Work Processes provide a sound backup in framing this step. Business rules refers to a series of standards within the organization with regards to how we are going to manage a given function in a generic and homogeneous manner. On the other hand Work processes refer to all the processes within the organization.

3.5 Define the Training Matrix and plan for Delivery.

As a consequence of the previous steps we should have arrived at a point whereby we have our roles of people who need to interact with the system defined. From here we are able to determine the training matrix for the implementation process. This is something that needs to be considered very carefully as it all too often leads to either the success or failure of the implementation effort. A crucial part of the training matrix is the development and deployment of training focusing on the processes we have defined in the previous step. We have experienced many times that processes are created after an implementation. Often we are trying to adapt the organization to the requirements of the system instead of the other way around. This is without a doubt one of the key elements of ERP failure.

3.6 Define the management team, their required interactions and the Project Plan

There are basic rules to an implementation project; however most of these circle around the themes of involvement and empowerment of the implementation team. Depending on the size and scope of the project the design and interrelations of the team required would change markedly. Some of the important consideration here are; Interfaces / Integration points with other systems, Migratory data should be recognized and a plan created for the management of this, Processes have been re-defined to ensure the implementation of best practice management processes, Training requirements have been defined and have been planned out in terms of which role require what training is required for what roles, Key implementation information regarding size of project, team members identified and other critical information.

3.7 Constant reviews and measurement against project objectives and timeframes

This stage is better stated as "Planning for Success" the project does not end until the benefits are realized and the "new" maintenance focus is both implemented and embedded within the corporate culture. For this reason there needs to be the usual raft of project controls during the project to mark critical stages and points of control. But there also needs to be the planning of post project points of control. In these control points we can realize self-audits of the system, of the project, of the amount of change that has occurred and perhaps future possibilities for dramatic change.

4.0 CASE STUDY ON AUTO COMPONENT MANUFACTURING INDUSTRY

4.1 Overview

To substantiate the template-based End-to-End implementation methodology, we present here a success story of an Automobile Component manufacturing company for the 2-wheeler and 4-wheeler segments. The company also manufactures consumer durables but their main line of business is auto-components. The company has 12 plants located spread across Maharashtra and Greater Noida.

4.2 Need for an Integrated Business Solution

To efficiently process and monitor customer demand across the group at Corporate Office level. To device a uniform pricing structure and centrally processed Materials Management. To update, track and monitor inventory status. To practice shop floor activity control. To ensure a sound cost control mechanism and profitability analysis, monitor new product development activity. To establish a transparent and efficient Management Information System for reporting purposes.

4.3 Challenges and Objectives of the Company

4.3.1 Challenges

The major challenge for the company was to have all its multi-location manufacturing activities be brought under one roof for better functioning and improving product delivery for better customer satisfaction.

The main challenges in Manufacturing were to know the orders under process and their status. In addition, Capacity Analysis, Plant Utilization, OEE, Scrap and Rework details, adherence to quality standards, Product Cost analysis, Inventory usage, Monitoring subcontract activities, recording of New Product Development activities also had to streamlined. The company also wanted to monitor the counter for tools and accordingly plan and conduct the preventive maintenance.

The challenges in Customer Demand Management were to know the status of the Customer order under process. Others include Sales projection for the individual units and the group. Status of outstanding orders for each plant and division was also considered as an important activity for reporting. Status on Customer Returns in order to activate faster completion of the returns cycle was another challenge. Product pricing structure improvisation.

The challenges in Materials Management were to keep the check on raw material rate and rate comparison. Ensuring timely issue of the right quantity of material to the production function. Establish the *three-way-match*, which involves Purchase Order – Goods Receipt – Invoice Receipt for effective functioning of the procurement process. Monitoring the status of every Purchase Order and reducing in follow-up cost. Measuring supplier performance (Vendor-rating mechanism). Inventory status and its availability. The challenges in New Product Development were to know the status of development activity and the deadline monitoring.

4.3.2 Objectives

The objective of the company was to have integrated system to meet the aforesaid challenges within a single controlling system and to further provide real-time, accurate data for analysis using Business Intelligence so as to have a competitive edge in the market.

4.4 Template-based End-to-End Implementation Methodology

The complete implementation process was carried out in five phases.

Phase	Activities carried out
1. Pre-project Activities	❖ Knowledge Transfer of the existing business processes ❖ Testing of the templated business process by the implementer based on existing data which is collected from the client ❖ Finalize the statement of work
2. Project Preparation	❖ Configuration of the Organization Structure ❖ Delta configuration to arrive at the desired solution ❖ Generation of test scripts based on the data
3. High Level Demo	❖ System demonstration with client data and identification of gaps – missing business solutions and ABAP requirements ❖ Training the core team and Business Process Owners
4. Gap closure and System Testing	❖ Gap closure ❖ Integration testing ❖ User training by core team
5. Deployment and Go Live	❖ Cut over plan ❖ Master data and opening balances uploading
6. Post Implementation Support	Absorption of the solution into their processes and sustainability

The template was pre-configured based on Best practices of the industry worldwide as well as specific to India. Based on our experience, we found that 85% of business processes remained the same and 15 % was the variation, which were be taken up in gap closure, hence the implementation was faster. Additional advantage was that data availability was ensured at the start of the project. More significantly user awareness about the outcome of the SAP project was instilled in them at the beginning of the project. Overall, the template methodology proved faster, fixed time, fixed scope, proven and resulted in lower TCO for the company.

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ADVANTAGES TO THE COMPANY

- ‘Start Quick and simple’ - Grow into total solution over time
- ‘WYSIWYG’ (*what you see is what you get)* approach to deploy solution
  - Proven pre-configured end –to-end business solution
  - 85% business scenarios mapped
  - Training on live SAP system
- ‘Deploy as you grow’ approach to enrich your solution
  - Scalability, depth and breadth – integration with new dimension products as well as other ERP & legacy systems

4.5 MISSION ACCOMPLISHED

With the SAP R/3 4.7 installed, the implementation team worked on the challenges to meet Objectives and mapped the Business process within a single controlling area using the template-based implementation methodology.

In manufacturing, the complexity of process was resolved by adopting make-to-stock strategy, which allowed planning independently and any sales order generated would consume the requirement. MRP run were executed. Capacity analysis was possible for the individual work center and for the group of work center. Order Types defined based on the manufacturing process and the product group, helped in identifying the load and status. Online quality inspection recording was made possible through the inspection lot generated for the production order and keeping the check on the process. Product cost comparison of standard vs. actual could be performed. Planned vs. actual material consumption helped in analyzing the BOM. Material stock at subcontract is tracked, monitored and made available. With detailed online production order confirmation OEE report was possible with varied selection criteria for individual plant or group of plants. With the linking of PRT to the routing counter, the routine center was updated as soon as the production orders were confirmed. Moreover, wear-and-tear and damages to PRT were traceable well in advance and hence preventive maintenance plan could be meticulously adhered. With the solution provided in manufacturing, group heads has better control on the shop floor activity for the distanced located plants.

In Customer Demand Management, Sales order was generated from the central sale department to all the plants and the execution were done by the individual plants. Daily sales plan and the fulfillment were available at any time to the Head of Marketing. Customer-wise sales analysis was available instant. Sales team performance was available, which helped in supporting the team to perform better and achieve the targets. Customer returns material recording with reason were possible, which helped in improving the quality and customer satisfaction.

In Material Management with SAP it was possible to establish a central material department, which looked after the rate negotiation and supplier relation. Contracts were created controlling area and plants did the scheduling. With the inventory status availability in all plants, it was then possible for the Material Head to support the plant which was running short of material by transferring the material from the plant which had sufficient coverage or the non-moving / slow moving stock. With the solution provided for Supplier Rating, it was possible to identify the supplier, performing below the benchmark and initiate to take corrective action in bringing them to the benchmarked levels. In meeting the challenges for tracking the Product Development activity, we provided the solution to maintain APQP (*Advanced Product Quality Planning)* and FMEA (*Failure Mode Effect Analysis).*

4.6 SAP IMPLEMENTATION

The implementation of FI, CO, SD, MM, PP, PM and QM was done in 5 months for the main plant and 3 additional plants. The template methodology proved a success. The implementation of FI, CO, SD, MM, PP, QM and PM modules started during mid February ’04 went for live on September 10th ’04 and by October 1st ’04 it had finished the implementation of FI, CO, SD, MM.

5.0 SUMMARY AND CONCLUSION

Overall, when a customer (client) decides in favour of ERP implementation, he does it with the thought that it is a panacea for all his problems. Normally, the IT people bring up this proposal to the top management and the hence it is thought of as an IT project. Wherever, the IT people have been given the responsibility of handling ERP implementation, either the implementation has taken unduly long time or failed. This is addition to the long drawn traditional implementation, where most of the times, the people who were involved in the project initially are never there. This has resulted in failure in the ERP implementation.

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However, with the template methodology, the users and top management see at the start itself what they can get out of the system as well as EDP people are used only for programming but the project control is with the line managers, the success rate has increased. Since the Template methodology is scalable, companies follow the policy of starting small and then expanding their ERP implementation to other locations. With this in view, ERP implementation has got a much better acceptance and the success rate of implementations have increased

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DESIGN OF A VILLAGE ROAD USING FLEXIBLE PAVEMENT, RIGID PAVEMENTS AND INTERLOCKING CONCRETE BLOCK PAVEMENTS -A CASE STUDY

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ABSTRACT
Flexible pavement, Rigid pavements and concrete block pavements are vastly used now-a-days over as they are much efficient throughout their life cycle. The IRC guidelines for the design of Rigid pavements, IRC: SP: 62-2004 use soil sub-grade strength, traffic loading and temperature differential as the governing parameters. The IRC guidelines for design of pavement using concrete block Paver, IRC: SP: 63-2004 use soil sub-grade strength and traffic loading as the design parameters. To compare the cost between different types of pavements, it is necessary to ensure that they are designed for the same traffic loading and soil conditions. A stretch of 1 km is designed using flexible pavements consisting reclaimed material, rigid pavement and interlocking concrete block pavement in same condition and their cost is computed. The cost includes construction cost and a fixed maintenance cost. The feasible of them is then found out.

Keywords— Flexible pavement, Reclaimed material, Rigid pavement, Interlocking concrete block pavement, Traffic loading, Sub-grade strength

INTRODUCTION
Existing asphalt pavement materials are commonly removed during resurfacing, rehabilitation, reconstruction operations. Once removed and processed, the pavement material becomes reclaimed asphalt pavement (RAP), which contains valuable asphalt binder and aggregate. Recycling asphalt pavement creates a cycle of reusing materials that optimizes the use of natural resources. Reclaimed asphalt pavement (RAP) is a useful alternative to virgin materials because it reduces the need to use virgin aggregate.

The two most important factors of pavement design are soil sub-grade strength and traffic loading. Depending on these two, the thickness of the pavement is affected. The flexible pavement is designed as per IRC: 37-2001, the concrete pavement is designed as per IRC: SP: 62-2004 and the interlocking concrete block pavement is designed as per IRC: SP: 63-2004. The cost is found out using Delhi Schedule of Rates 2014. The maintenance cost for 10 years is added to both, according to IRC norms. Though there are four types of concrete pavements, out of these, the Plain Jointed Concrete Pavement is taken into consideration for the design as per IRC-58-2002.

The width of the carriageway is 7 m with 0.50 m shoulders on both the sides. The design parameters used are as per IRC 73-1980. The CBR value of the soil taken for design is found out to be 4%, and Traffic surveys were conducted on the project road and traffic volume counts were conducted for 21 days, 24 hours and the number of commercial vehicles plying on the road was recorded. From the traffic volume counts, the number of commercial vehicles 150/day in both directions were considered in the pavement design. Design traffic was calculated with this survey data, as per IRC: 37, 2001; and it founded 7.2 MSA (million standard axle).

DESIGN OF FLEXIBLE PAVEMENT USING RECLAIMED MATERIAL
An extreme case was first considered in which RAP was blended with virgin aggregates only, that is, without any new virgin asphalt binder being introduced. The purpose of this procedure is to find out to what extent the aged asphalt will “get away” from the RAP particles under pure mechanical blending. Because the virgin aggregates were all coarse materials whereas the RAP particles were all screened by sieve, they were easily separated after the mixing.

Three RAP proportions, 30%, 40%, and 50%, were considered. The blending was performed at 190°C, and the mixing time was 3 min. This blending condition was considered to be more favorable for a uniform mixture than the actual plant mixing in which both the mixing temperature and mixing time will be below 190°C and 3 min. Some laboratory test was conducted to examine that, if reclaimed materials used in flexible pavement whether it is suitable or not and some basic properties were being justified. 30%, 40% and 50% reclaimed materials are blended with virgin materials and the test result shown below-

1. Aggregate Impact Value- Aggregate impact value test is commonly carried out to evaluate the resistance to impact of aggregates. Maximum permissible limit is 30%.
2. LOS Angeles Abrasion Value- Maximum permissible limit is 40%.
3. Combined Flakiness and Elongation Index- Maximum permissible limit is 40%.

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TABLE 1 : Laboratory test result for reclaimed material.

NAME OF TEST	30 % RAP			40% RAP			50 % RAP		
	sample 1	sample 2	sample 3	sample 1	sample 2	sample 3	sample 1	sample 2	sample 3
LOS Angels Abrasion Value	36.5	37	36.5	35	36	35.5	36	34	34.5
Aggregate Impact vale	26	27	25.5	25	26.5	24	25	23.5	24
Combined Flakiness and Elongation Index	33	32	34.5	34	33	31.5	34	33.5	32

Thickness Design

According to IRC-37, 2001; guidelines the design thickness for the flexible pavement was computed. For design traffic 7.2 msa and CBR vale 4% the total thickness of the flexible pavement is 660 mm which consists of four different layer with different thickness.

1. Sub base – 315 mm
2. Base – 250 mm WBM
3. DBM (Dense Bituminous Macadam) – 70 mm
4. SDBC (Semi dense Bituminous Macadam) – 25mm

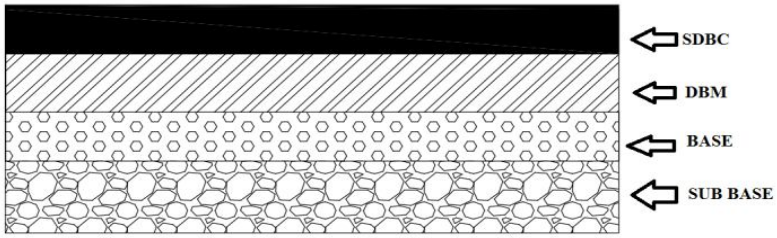

Figure 1: Typical cross section of Flexible Pavement

DESIGN OF RIGID PAVEMENT

Rigid pavements have high rigidity of the concrete slab. The concrete slab transfers the load into larger area. Generally depending on the strength of the soil, the base/sub base layer is decided. A typical cross section of a rigid pavement considered in this study in shown in Figure 2.

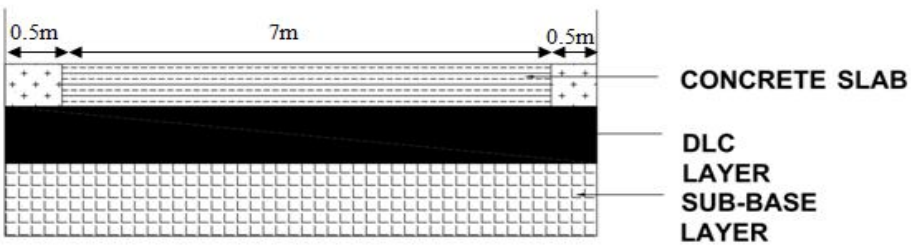

Figure 2: Typical cross section of concrete pavement

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Thickness design

The factors that affect the thickness design of rigid pavements are traffic loading, sub-grade soil, moisture and temperature differential. In this study the two most important parameters, sub-grade soil, traffic loading and the temperature differential are considered. According to IRC method of rigid pavement design, cement concrete layer should not be laid directly over a sub-grade with modulus of sub-grade reaction k, less than 6 kg/cm^3. We have found the CBR of the soil sample to be 4%. The equivalent value of sub-grade reaction for a soil sub-grade with CBR value of 4% is 2kg/cm^3. We have used a DLC sub base layer of 100 mm thickness as the soil is having k value less than 6 kg/cm^3. Temperature differential as per ZONE II of IRC is considered.

The thickness of rigid pavement is designed for failure and then checked for the critical combination of load stresses and temperature stresses. The adjustment in thickness for traffic loading and temperature differential is done. Dowel bars and tie bars were designed for all the pavements as per IRC guidelines. The dowel bars used are of 25 mm at 30 cm centre to centre distance of length 45 cm each. The tie bars used are of 10 mm at 33cm centre to centre distance of 34 cm each. The concrete used is of grade M 20. The following combination is used.

RIGID PAVEMENT COMPOSITION	
CONCRETE SLAB(mm)	250
DLC(mm)	75
WBM(mm)	100

DESIGN OF INTERLOCKING CONCRETE BLOCK PAVEMENT

Interlocking Concrete Block Pavement (ICBP) is also known as semi rigid pavement as its rigidity lies between the rigidity of flexible pavement and rigid pavement. Generally, depending on the strength of the soil and traffic condition, the thickness of the base/sub base layer and the bedding sand is decided. A typical cross section of a rigid pavement considered in this study in shown in Fig 3.

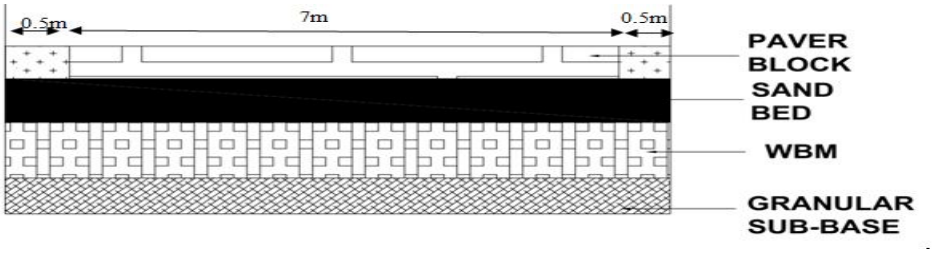

Figure 3: Typical cross section of ICBP pavements

Thickness Design

ICBP is designed as per IRC: SP: 63- 2004 guidelines.
The following combination is used

ICBP COMPOSITION	
PAVER BLOCK(mm)	80
SAND BED(mm)	40
WBM(mm)	250
GRANULAR SUB-BASE(mm)	300

RESULTS AND DISCUSSION

Initial cost of Flexible Pavement with reclaimed material –

1. 50 % RAP - 1,59,69,116.5 /-
2. 40 % RAP - 1,70,74.592 /-
3. 30 % RAP - 1,82,69225.5 /-

Maintenance cost of Flexible Pavement in both cases - 5 lakhs (for 10 years).
Initial cost of Rigid pavement (Plain Jointed) – 2.41 crore
Maintenance cost of rigid pavement- 2 lakhs (for 10 years)
Initial cost of ICBP- 2.68 crore

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Maintenance cost of ICBP-3 lakhs (for 10 years)

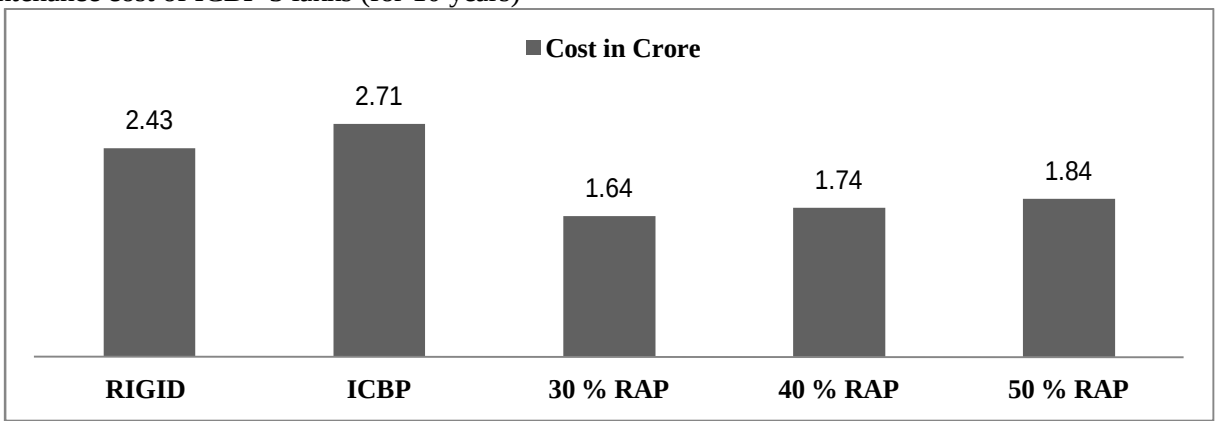

Figure 4 : Cost comparison of different type pavements

CONCLUSION

The following conclusions are drawn from this study:

a. For soil having CBR<5 and traffic ranging from 5-10 MSA, flexible pavement will be more cost efficient economically. Moreover rigid pavement will have more compressive strength over ICBP and Flexible pavement. The maintenance cost of rigid pavement is also less and it has higher longevity.

b. As the percentage of reclaimed material in mix increasing the cost decreases. However use of more percentage of reclaimed material may be effect the strength of pavement structure.

c. From aesthetic point of view ICBP will be more suitable.

d. Results presented in this paper represent only the materials under the test conditions in this study. It should also be mentioned that the mixtures in this study may not reflect the majority of mixtures used by the HMA industry. More complete analyses are recommended to cover a wide variety of materials under various conditions.

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E-DISASTER ANALYSIS(DISASTER MANAGEMENT USING TWITTER ANALYSIS)

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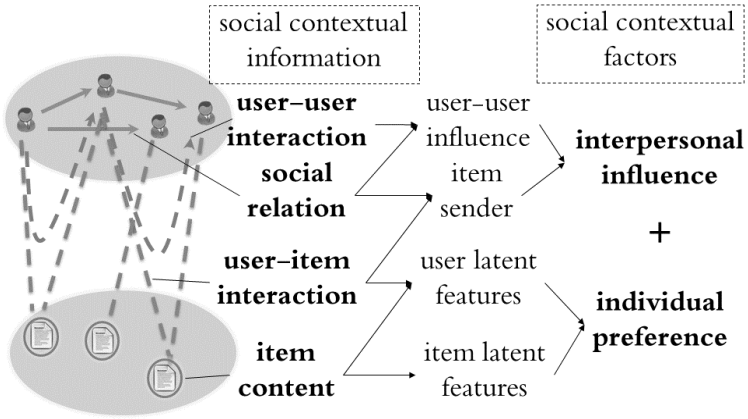
ABSTRACT

Information generated by social networks demands effective recommender systems(twitter server) to give useful results.Earlier techniques become unqualified because they ignore social relation data; existing social recommendation approaches consider social network structure, but social contextual information has not been fully considered. It is significant and challenging to fuse social contextual factors(individual preference and interpersonal influence)which are derived from users' motivation of social behaviors into social recommendation. In this paper, we investigate the social recommendation problem on the basis of psychology and sociology studies.. We first present the particular importance of the two contextual factors in online behavior prediction. Then we propose amatrix factorization method to fuse them in latent space. We conduct experiments on both Facebook style bidirectional and Twitter style unidirectional social network datasets.

INTRODUCTION

Social network users produce large volumes of information,which makes it necessary to utilize highly accurate recommender systems to support them in finding useful results. Earlier collaborative filtering techniques do not consider social relations, making them difficult to provide exact recommendations.Recently,proposed a framework of social recommender systems that made use of social relation data.However, in this work,both social relation structure and contextual factors are fully considered. It is significant and challenging to fuse social contextual factors from thecontextual information and amalgamate them into a integrated recommendation framework.



(Ref) A novel framework for social recommendation.Meng Jiang,Peng Cui, Fei

(**Fig**) shows the entire social contextual information which can be derived from links on social networks. In this paper we consider Twitter, when a user receives a tweet that is posted by one of his friends (the sender), he usually reads its content to see whether the item is interesting. We can get this knowledge from item content and user-item interaction information. In this situation, the user cares about who the sender is and whether the sender is a close friend or authoritative. If more than one friend sends him the same tweet, he may read it more responsively. This knowledge can be learnt from social relation and user-user interaction information. Both of these aspects are important for the user to decide whether to adopt (e.g., share, retweet) the item. The above can be viewed as two contextual factors namely individual preference and interpersonal influence.

Individual preferenceis indicated that individuals are to some extent influenced by others' behaviors, rather than making decisions independently.Interpersonal influence makes user behaviors more complex and thus increases the unpredictability of the item adoption. Therefore, only when individual preference and interpersonal influence are properly fused into recommendation, uncertainity can be reduced and quality improves.

This framework is based on a probabilistic matrix factorization method to combine individual preference and interpersonal influence to improve the accuracy of social recommendation. More definitely, we factorize the user-item interaction matrix into two intermediated latent matrices including user-item influence matrix and user-item preference matrix, which are produced from threeobjective latent matrices: user latent feature matrix, item latent feature matrix, and user-user influence matrix. Moreover, as we can partially witness individual preference and interpersonal influence based on previous user-item and user-user interaction data.

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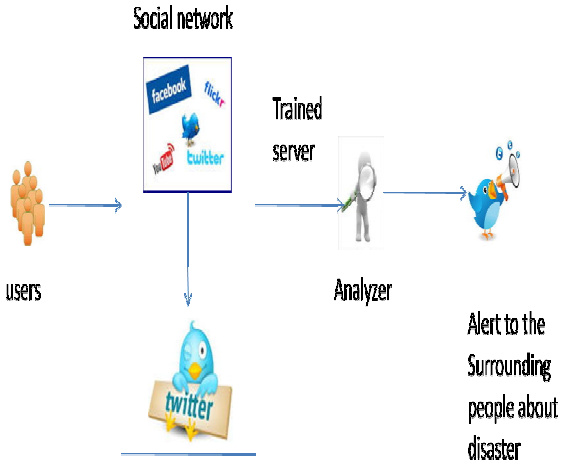
RELATED WORKS

In this segment, we analysis several major approaches to recommendation methods. Content-based filtering and collaborative filtering have been widely used to help users find out the valuable information. Matrix factorization methods have been proposed for social recommendation due to their efficiency in dealing with large datasets.Content-based filtering introduces the basic idea of studying the item content for the ranking problem. It rank candidate items by how well they match the topic interest of the user as their preference. Collaborative filtering methods, which comprises of memory-based and model-based methods.The memory-based approaches calculate the similarity between all users based on their ratings of items. The model-based methods learn a model based on patterns recognized in the ratings of users. Collaborative filtering only utilizes user-item interaction information, but it is notuse full of social relation and social rich knowledge including user profiles and detailed item content.

Model

In this section, we introduce details of our social contextual model based on matrix factorization.First, we formally define the problem of social recommendation. In our model, we suppose that whether a user adopts an item on social networks is determined by three aspects:(1) item content: what the item tells about, (2) useritem interaction: what items the user likes, and (3) social relation and user-user interaction: who the senders are.The users can only receive items from their friends as social networks usually do. In our case, we know the item content, user behaviors over the items, and the interactions between users. From these previous data, we can derive the item content representation,individual preference,and interpersonal influence. We compute the user-user preference similarity matrix, item-item content similarity matrix, and user-user interaction matrix.Though the accuracy of similarity matrices depends on how LATENT ANALYSIS performs on previous data, it is fair towards competing methods in experiments to share knowledge from these matrices.

With the hypothesis that the similarities in observed spaces are consistent with the latent spaces, we regularize the three latent spaces by observed matrices (social contextual factors) in that: (1) the users that are similar in user latentspace have similar preferences (2) the items that are similar in item latent space V have similar descriptive (3)high interpersonal influence in the influence latent space generates frequent interpersonal interactions;(4) the product of user latent space and item latent Spacecorresponds to the users' individual preference on the items; (5) the Hadamard product of interpersonal influence and individual preference is proportional to the probability of item adoptions.As the model performance is evaluated by root meansquare error (RMSE) on the test set, we adopt a probabilisticlinear model with Gaussian observation noise.



CONCLUSION

We conducted extensive experiments on two large real-world social network datasets, and showed that social contextual information can greatly boost the performance of recommendation on social network datasets.The algorithm used in this project is general and can be easily adapted according to different real-world recommendation scenarios.

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HAND GESTURE RECOGNITION USING AN ANDROID

Dr. S. Padmapriya, S. Vignesh and N. Siddharth

ABSTRACT
In the field of image processing it is very interesting to recognize the human gesture for general life applications.Android has a growing selection of applications which can be acquired by users by downloading and installing the application. Hand gesture recognition is very popular for interacting between human and machines. It is nonverbal way of communication. This paper aims to recognize 15 basic hand gestures. We are going to deploy an Android Application to establish the communication between normal person and deaf dumb person. Deaf& Dumb person will show the hand gestures to android camera and communicate to the server to process hand gesture images via Android application. Server will transmit the corresponding values to the android phone and the voice is played accordingly. In addition to this, The Heart Beat Rate of the person can also be monitored using heart beat sensor.SMS alert is triggered to the Guardian in case of emergency.

Keyword: Android, hand gesture recognition, image processing.

INTRODUCTION

Gestures are mainly used by the people when communicating with each other, pointing gestures are especially interesting for communication and is perhaps the most intuitive interface for selection. They open up the possibility of intuitively indicating objects and locations, e.g., to make a robot change direction of its movement or to simply mark some object. This is particularly useful in combination with speech recognition as pointing gestures can be used to specify parameters of location in verbal statements. Gesture

Recognition is a topic in computer science and language technology with the goal of interpreting human gestures via mathematical algorithms. Gestures can originate from any bodily motion or state but commonly originate from the face or hand. Gesture recognition can be seen as a way for computers to begin to understand human body language, thus building a richer bridge between machines and humans. It enables humans to communicate with the machine and interact naturally without any mechanical devices. There has been always considered a challenge in the development of a natural interaction interface, where people interact with technology as they are used to interact with the real world. A hand free interface, based only on human gestures, where no devices are attached to the user, will naturally immerse the user from the real world to the virtual environment.

I. PROPOSED ALGORITHM

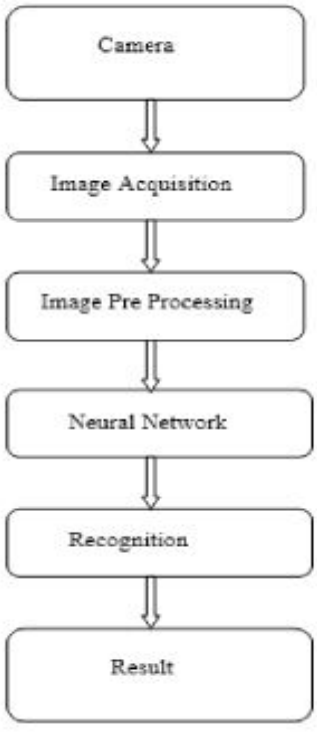

Fig. 1. Block Diagram of Hand Gesture Recognition Model

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II. BACKGROUND

A. Hand Gesture Recognition

Gesture recognition is a topic in Information technology. Gestures can originate from any bodily motion or state but commonly originate

From the face or hand. Gesture recognition can be seen as a way for computers to begin to understand human body language, thus building a richer bridge between machines and humans. Gesture recognition enables humans to communicate with the machine (HMI) and interact naturally without any mechanical devices. Gesture recognition can be conducted with techniques from computer vision and image processing. Gestures of the hand are read by an input sensing device such as an android device.

B. Android

An operating system for smart phones, tablets and laptops from the Google-sponsored Open Handset Alliance. With myriad models to choose from, Android is the leading mobile platform worldwide. Android is a Linux OS, and Android apps are programmed in Java. Users download applications from Google's Play Store (formerly Android Market), the Amazon App store and other online sources.

C. Image Processing

Imageprocessing is a method to convert an image into digital form and perform some operations on it, in order to get an enhanced image or to extract some useful information from it. It is a type of signal dispensation in which input is image, like video frame or photograph and output may be image or characteristics associated with that image. Usually ImageProcessing system includes treating images as two dimensional signals while applying already set signal processing methods to them. It is among rapidly growing technologies today, with its applications in various aspects of a business. Image Processing forms core research area within engineering and computer science disciplines too.

D. Sobel Edge Detector

The Sobel operator is used in image processing to detect edges of an image. The operator calculates the gradient of the image intensity at each point, giving the direction of the largest possible increase from light to dark and the rate of change in that direction. The result therefore shows how ”abruptly” or “smoothly” the image changes at that point, and therefore how likely it is that, that part of the image represents an edge, as well as how that edge is likely to be oriented.

III.SYSTEM DESIGN

A. Image acquisition

Image acquisition is the first step in any vision system, only after this process you can go forward with the image processing. In this application it is done by using IP Web Cam android application. The application uses the camera present in the phone for continuous image capturing and a simultaneous display on the screen. The image captured by the application is streamed over its Wi-Fi connection (or WLAN without internet as used here) for remote viewing. The program access the image by logging to the devices IP, which is then showed in the GUI.

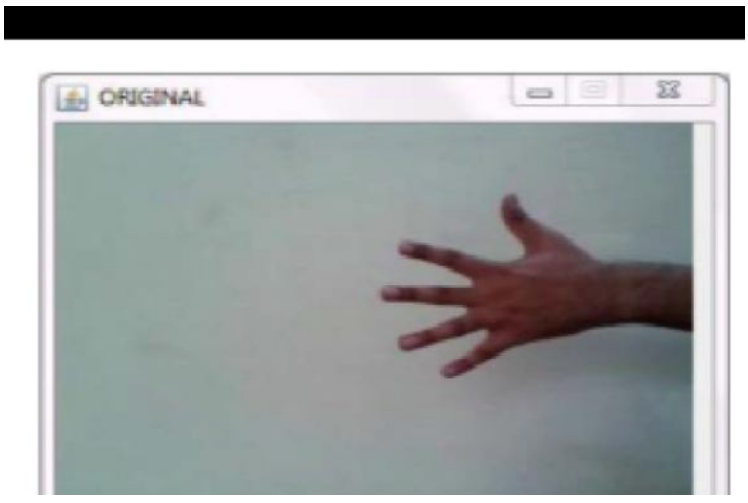

Fig. 2. Original Image captured from Android device

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B. Image pre-processing:edge detection

In this program the edge detection technique used is Sobel edge detector. The image captured is then passed through Sobel filter.

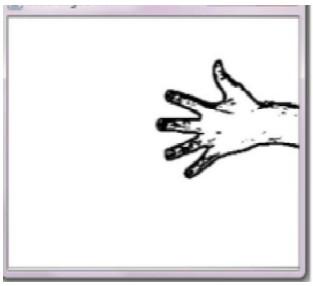

Fig. 3. Sobel Edge Filtered Image

C. TRAINING DATA

Another main part of this work is the integration of a feed-forward back propagation neural network. As described earlier the inputs for this neuronal network are the individual tokens of a hand image, and as a token normally consists of a cosines and sinus angle, the amount of input layers for this network are the amount of tokens multiplied by two. The implemented network just has one input, hidden and output layer to simplify and speed-up the calculations on that java implementation. For training purpose the database of images

Located on the disk is used. It contains 6 different types of predefined gestures. These are basic hand gestures indicating numbers zero to five. The implemented network just has one input, hidden and output layer to simplify and speed-up the calculations on that java implementation. For training purpose the database of images located on the disk is used. It contains 6 different types of predefined gestures. These gestures are first processed and then the tokens generated are passed to the network for training purpose. This process of training network from images is done automatically when the application is initialized .Gestures are shown in figure 4.

Fig.4.Database of Gestures

IV. RECOGNITION

Recognition is the final step of the application. To fill the input neurons of the trained network, the previous calculated tokens discussed in section D are used. The number of output neurons is normally specified by the amount of different type of gestures, in this case it is fixed to 6. All other behavior of the network is specified by the normal mathematical principals of a back propagation network as discussed in section E. It gives

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percentage of recognition to each gesture with highest percentage closely matching and lowest to the farthest matching and the closest match is considered as the result.

V. TESTING

Figure 4 shows the screenshot of the screen when the application is started. Figure 5 shows the screen during the process of gesture recognition.

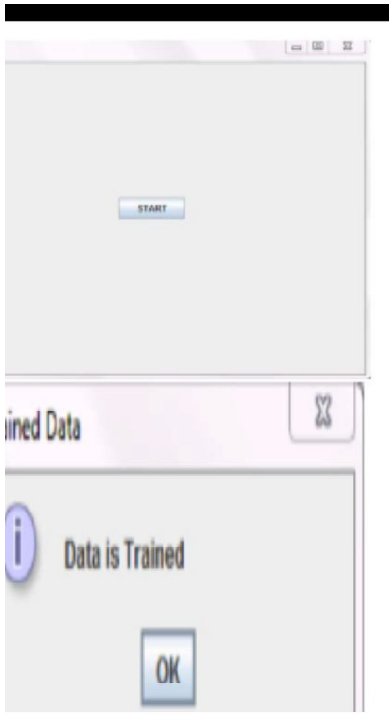

Fig 5. Initialization of the program

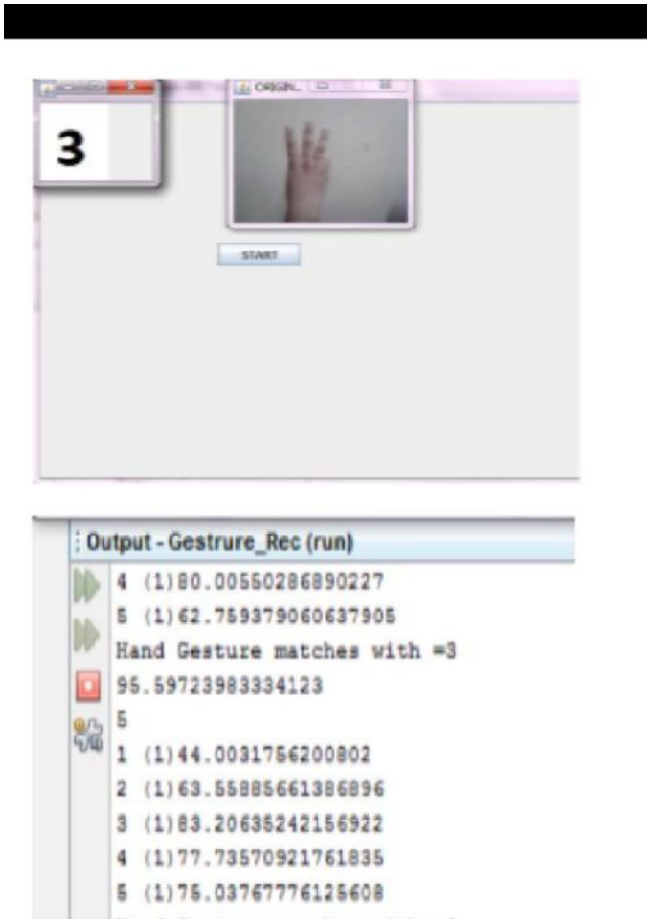

Fig. 6. Testing of Application

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VI. RESULTS

To test the application, gestures are made by three different people. Some of the gestures are closed or have different orientation. The statistical summary of the results is as follows

Gesture	Number of Images	Recognized	Recognition Rate
1	38	28	73.68421053%
2	38	30	78.94736842%
3	36	24	66.66666667%
4	35	25	71.42857143%
5	38	37	97.36842105%

Table I: Recognation Rate of 5 Gestures Using Android

VIII. CONCLUSION

This system is useful for communicating with a deaf and dumb person. The system database has sign gestures of size of176X144 pixels so that it takes less time and memory space during pattern recognition. The recognition rate of all gestures in between 70-80% which is an acceptable range. Overall accuracy of this system is 77% (approx).In future we can use a custom camera instead of the Ip Web Cam app which will further enhance the success rate of the system. Other different type of gestures can also be made part of the database. Try to eliminate noises from background to improve the accuracy rate.

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Y-MONITORING (Tracking calls for Youth)

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ABSTRACT
This thesis describes about developing an android application for the parents which help in analyzing their ward's activities using a smart phone. In latest trend, usages of huge desktops have been replaced by smartphone and iPhone. There are many applications that provide users with the information about the locality he/she wants to visit. In this application, the parent is provided with the information about to whom their ward is speaking and sending messages.

Keywords: Android, Smartphone ,GPS

INTRODUCTION
The first Android smartphone came out in 2008 and rapidly became a major challenger to the iPhone, due to its availability from multiple carriers.By 2011, Android outsold every other smartphone.The large screens on many Android models have been an extremely popular feature.

Android holds nearly an 85% market share of the smartphone market. With over 1 billion Android devices already activated, Android is defining the future of all over computing and shaping the way we interact with the world around us.

Android software development is the process by which new applications are created for the **Android operating system**. Applications are usually developed in Java programming language using the Android **Software Development Kit** (SDK), but other development environments are also available.

In this paper,We develop an android Application which monitors their ward's activities and send an automatic SMS alerts to their parents.There are certain activities this app monitors such as sms monitoring, call monitoring,call duration monitoring,accessing of illegal websites and location tracking.

We set certain constraints with the expectation of privacy. When these limits/constraints set are exceeded, then an automatic sms alert is sent to ward's parent through ward's phone. This application is deployed into an android smart phone. Here we use MySQL server as a Back End. MSAccess is used as a tool for the database.

OVERVIEW
To overcome the illegal issues of ward's activites this application has been developed using smart phone technology.

CRISIS ANALYSIS
In the system,there is no exact metholody to track their ward's activities.They aren't able to locate calls and observe the received SMS of their ward's mobile which will let their ward's in huge problem and also they're not able to support their ward's . We can map out the ward's mobile location using GPS system but can't find out what the ward's are doing in their mobile.

SOLUTIONS TO THE CRISIS
We develop an android application which is very useful for the parents to monitor their ward's activities.This application help the parent's to keep tracking the activities of their ward.The android application designed is used to access the service made available by a server. The major advantage of this application is that the parents' are able to secure their ward's without involving in any unwanted activities and waste time.

MOBILE CLIENT
An Android mobile is an client application that access a service made available by a server. The server is often run on another computer, in which case the client access the service by the way of a network. The phrase was first functional to devices that were not capable of running their own programs, but could interact with remote computers via a network. To send the SMS to the parents,the parent number should be registered in the ward's phone.In these application their ward's detail has to be submitted such as name password and other details to the server during the registration phase. All this information is stored in the database via server for future purpose.

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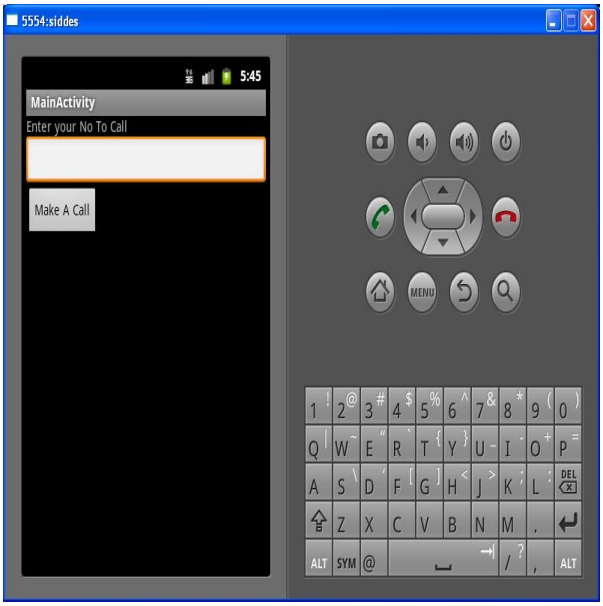

SERVER

A server is a computer program which runs to serve the requests of client programs in this application. Thus, the server performs some computational task for the clients. The clients either run on the same computer or connect through the network.Here the Server acts as the main source for the client. Server is responsible for maintaining all the client information. So the server will process the ward's request and get the concerned data from the database.

CONSTRAINTS

The following constraints are,

- Call monitoring.
- SMS monitoring.
- Call duration monitoring.
- Illegal websites.
- Location tracking.

CALL MONITORING

In Call monitoring, the server will monitor all the calls in the wards' mobile phone. If the ward receives or makes calls more than the specified number of calls from the same number, an automatic updating will be done in the database. If it exceeds the limit and constraint the database will automatically send an SMS to their parents.

SMS MONITORING

In SMS monitoring, the server will monitor the messages that are sent & received by the ward, so that if they receive more than the specified number of messages, the server will keep track of the number and update that number in the database. The database will automatically store the data and send the SMS to their parents.

CALL DURATION

MONITORING

In Call duration monitoring, the server will monitor the call duration of the phone calls received by the ward, so that if they speak more than the specified time of the call duration, the server will keep track of the number and update that mobile number in the database and automatically send the duration SMS to their parents.

ILLEGAL WEBSITES

For accessing of Illegal websites, the websites are blacklisted and white listed according to parental guidance. The Blacklisted websites are Social sites , torrents , videos which have adult content…The White listed websites are some of the search engines , educational sites , organizational websites , etc….When the ward access these blacklisted sites , an Automatic SMS alert is generated and is triggered to the concerned parent number.

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TABLES & FIGURES

CONSTRAINTS	LIMITATIONS
SMS	10 Messages
Call duration	10 Min
Missed calls	5 Calls
Illegal websites	Blacklisted

LOCATION TRACKING

When a parent make a call to their ward an Automatic SMS alert is generated and the location is triggered to their parent number. The parent will receive the SMS in the form of URL. When the URL is clicked using their network, the google map will show the exact location of their ward.

CURRENT PROCESS

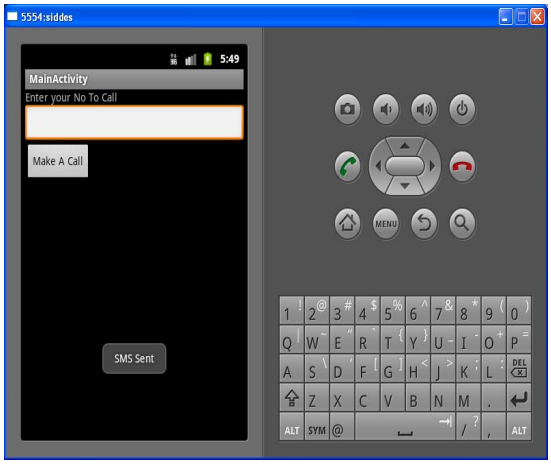
The application (apk) is installed in the ward's android mobile phone. This application works in Android version 2.3 & above. The ward's mobile needs an internet connection. It is connected to the server through GPRS connection. The server recognizes the ward when he registers his name & password in the application during the registration phase. When the registration is over, the server's IP address is entered into the ward's android mobile by the parent. The assigned IP address is given in the ward's mobile which is used for server recognization. The server starts to monitor the ward. A data card is connected to the server which provides the Internet connection. Each and every activity of the ward using the mobile is maintained as a database in the android mobile as well as in the server. The server is administered by the parent. Therefore an alert message is generated in ward's mobile and is sent to parent mobile. The application which is installed in the ward's mobile is secured by a third party application so that it cannot be uninstalled by the ward. The application gets refreshed for every 24 hours.

OUTLINE

The server is used to maintain all the records of the mobile client. When a call is made or received, the request is first analyzed by the server and gives permission to perform the required operation. Counters are set for each constraint with its limitation. A database is maintained. The server is connected with the database through the JDBC (Java Database Connectivity) connectivity. When a third party makes call/sends a message to the ward for the first time, it gets stored in the database. If the ward receives call again from the same third party , then the server verifies both the numbers and increases the counter value. If another person makes a call/sends message then it maintains a separate database for it and assigns the counter values accordingly. In this way the mapping is done. These operations happen even when the ward make calls or send messages. The counter values gets refreshed every 24 hours.

AUTOMATIC SMS ALERT

If the particular Ward makes / receives more number of calls & messages then an automatic SMS alert will be triggered and send to the concerned ward's parent's mobile number. The similar operation is carried out when the wards views any illegal websites which are black listed. The SMS is triggered from ward's mobile to parent mobile when the counter values exceed the limits.



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ADVANTAGE
The location tracking have been developed in this android application with the help of google map.

CONCLUSION
Y-Monitoring (Tracking calls for Youth) android application is created which is very useful for the parents to track their ward's activities. The ward can be secured from the illegal use of mobile phones with help of this application.

ACKNOWLEDGMENTS
This paper has benefited from conversations with many different people – far more than can be acknowledged completely here. Still we would like to particularly thank Dr.S.PADMAPRIYA,HOD,IT for his guidance and support.

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STUDY OF CLOUD MIGRATION WITH ITS CHARACTERISTIC, FEATURES AND BENEFITS

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ABSTRACT
From the most promising area of networking, the concept of using the services of cloud computing is on a great consideration nowadays. As a result it's a crucial time for corporate IT leaders to know their opportunities, innovating their creations on a higher level and utilizing their resources for new great challenges. Cloud computing potentially aims in making an organization more agile and cost effective. Keeping in way all the advantages that a cloud accommodates in its working, still the decision makers have a difficult eye on 'how' and 'why' to adopt cloud. This paper discusses some of the important concerns that a corporate developer might have before radically shifting to use the services provided by the cloud and also gives an enlighten solutions to those concerns.

Key Words: Standardization , Migration, taxonomy , interoperability

INTRODUCTION

The process of transitioning all or part of a company's data, applications and services from on-site premises behind the firewall to the cloud, where the information can be provided over the Internet on an on-demand basis. While a cloud migration can present numerous challenges and raise security concerns, cloud computing can also enable a company to potentially reduce capital expenditures and operating costs while also benefiting from the dynamic scaling, high availability, multi-tenancy and effective resource allocation advantages cloud-based computing offers.

Cloud migration is the process of moving data, applications or other business elements from an organization's onsite computers to the cloud, or moving them from one cloud environment to another. Cloud migration sometimes involves moving data or other business elements between cloud environments, which is known as cloud-to-cloud migration. The process of transitioning to a different cloud provider is known as cloud service migration. In any case, successful migration to a service provider's environment may require the use of middleware, such as a cloud integration tool, to bridge any gaps between the vendor's and the customer's (or other vendor's) technologies.

Transitioning to the cloud or between cloud environments presents the usual IT issues, but the problems are compounded by having data stored and managed remotely, by external organizations and often in multiple locations. Among these issues are special considerations for privacy, interoperability, data and application portability, data integrity, business continuity, and security.

CHARACTERISTIC OF DATA MIGRATION

1. Commercial relation exists between clouds

2. Transmission of mass data

3. Many workers which execute transmission process concurrently

Services of cloud migration: Cloud Migration Services provides a safe, seamless and rapid migration of your cloud-ready applications as

- Migrate physical and virtual servers
- Migrate one server or entire application suites
- Supports Windows and Red Hat Linux applications
- Supports moves to CSC Cloud Compute , CSC Biz Cloud and CSC Biz Cloud VPE
- Get expert guidance and hands-on support throughout the migration process.
- Avoid business and IT disruptions.
- Accelerate the process of moving to the cloud.

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DO YOU UNDERSTAND THE RISKS OF MIGRATING?

Market place

Despite all the hype, the dominant delivery model for software is still the on-premise one. This means there may be resistance from customers to adopt the service, preferring instead an on-premise solution. You could be too early. Or you may need to offer both a cloud computing service and an on-premise solution.

Sales profile and pricing

Selling a Cloud Computing service may be easier as the traditional barriers put up by IT evaporate. Customers can be up and running in hours, not months. However, the large up front license payments have been replaced by far lower annuity payments. Customer projects may now start as smaller pilots and grow over time.

Commercial Arrangements

The traditional on-premise world was simple. Customers paid for a perpetual license for the software and some form of optional annual "support and maintenance" agreement. But the vast majority of the costs were up front as part of the implementation project.

With cloud computing, things are changing fast. The offerings are maturing, and although there are some common threads, there are also many loose ends. There are different charging models, varying from free or ad-funded with little or no support through to managed services with on going annual, quarterly or monthly costs.

Product development

In a pure cloud computing model, the service is only available when you are connected to the Internet, so you may need to provide an offline capability.

Hosting

A cloud computing solution needs to be hosted. There are a wide range of options. You can host it. You can find a co-locator that provides a "home" for servers that you own, or you could run your application on a full hosting provider (PaaS). Sometimes the architecture of your solution determines which options are available. If you have a legacy application with a proprietary database, you may not be able to use Amazon or Microsoft Azure. Instead you will be forced to own and run some of the infrastructure. Finally, do you have the skills in house and commitment to run a 24 x 7 hosting operation?

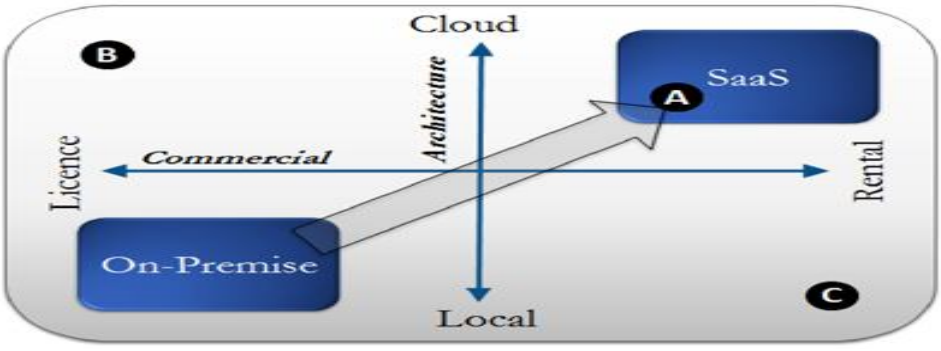
Growing Customer Expectations

With growing acceptance of cloud computing by customers, there also comes an increasing awareness and expectation about the delivered service. Buyers are being educated about the Smart Questions they should ask, and this increases the requirements on you to deliver a quality service that takes into account issues such as whether you need geo-redundancy for data centers, what legal and geopolitical issues apply to where data is stored, and the expected service Levels, especially where free services such as Hotmail and Gmail are expected to be 24/7. New generations of end users are emerging from schools and colleges. They have grown up around technology that is now ubiquitous. It has driven a very different lifestyle and expectation.

Strategic options

You need to establish where you are in terms of architecture and commercial model in the diagram at right. Then work out where your customers would like you to be.

The diagram shows that the strategy should be considered along two dimensions. The horizontal is the commercial aspect. How are you charging? The vertical is how much of the solution is hosted in the Cloud. So bottom left is classic ISV 'shrink-wrapped' software. Top right is a new Web 2.0 Cloud darling. The question is how far along the arrow to Point A do different elements of your application need to be, and over what time frame. In the interim, can you go via Points B or C to satisfy customer demands?



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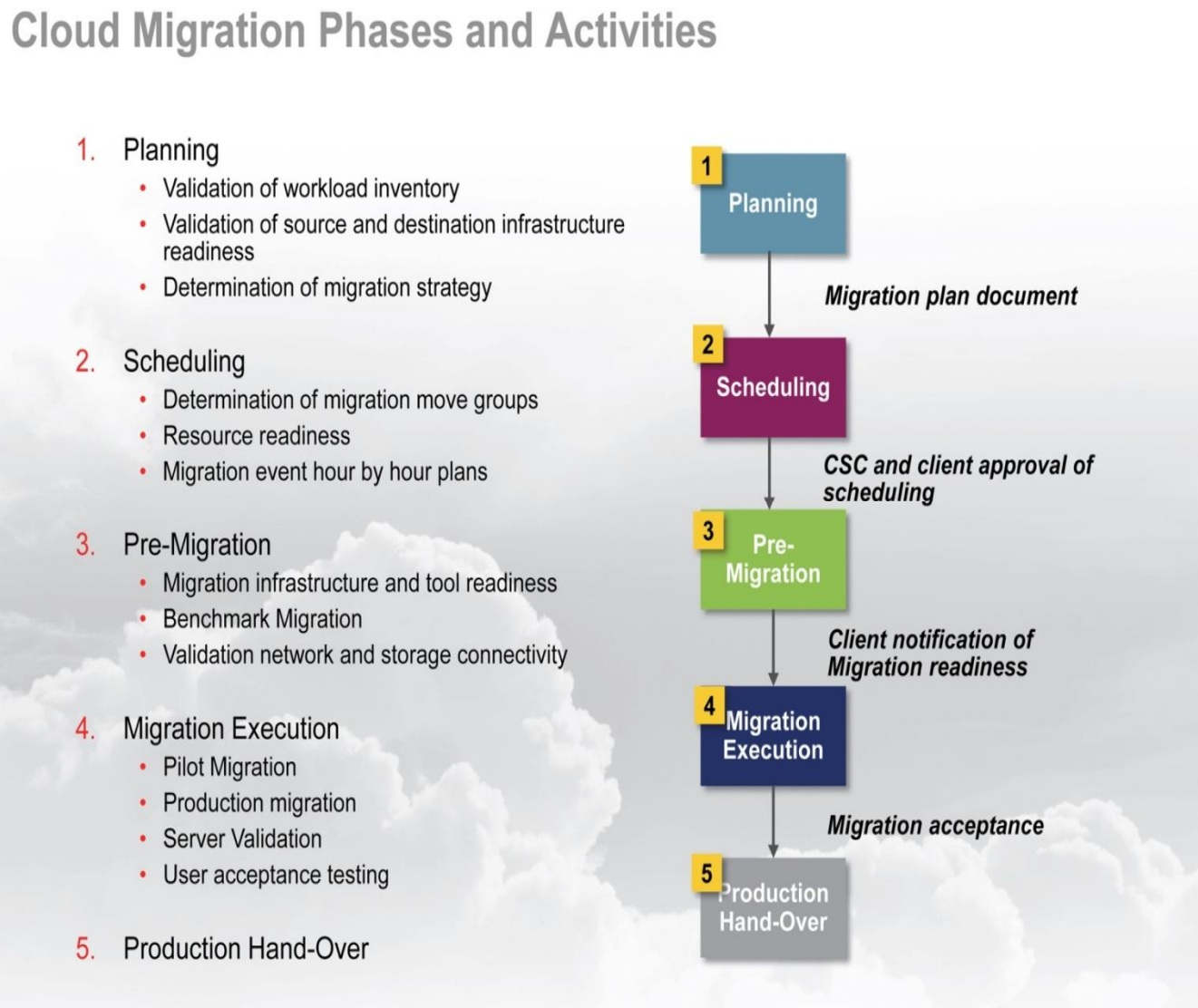
Point B is where elements of your solution are cloud based and are functionality driven. Point C is a charging mechanism and is driven by an OpEx vs CapEx discussion or lack of immediate budget.

MINIMIZE CLOUD MIGRATION RISK WITH OUR FIVE PHASE PROCESS

Our migration service includes a benchmark migration to prove out the timing, migration process and network and storage connectivity. It also includes a pilot migration on a predefined application set that validates the migration.



KEY FEATURES OF THE CLOUD MIGRATION SERVICES

- Integration into the client's cloud service catalog and store front enabling immediate access and operation in a cloud environment
- No upfront capital costs and no long term contracts to worry about
- You control the scheduling
- Management of multiple geographic server migrations simultaneously

Migration of entire environment including the file system, permissions, attributes, as well as compression and encryption settings

BENEFITS OF CLOUD MIGRATION

The Cloud encourages experimentation and business risk taking. This is because the cost and time to validate these ideas can be drastically reduced through the sheer scalability the Cloud has to offer businesses. While risk taking in the past has required much in the way of hardware and software investment, the Cloud allows to build an application on a platform that is completely scalable from the smallest of instances to the largest. Small companies can start up, and large business can roll out innovative new ventures, without prohibitive costs, delay or risk.

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CONCLUSION

This review reveals that cloud migration research is still in early stages of maturity, but is advancing. It identifies the needs for a migration framework to help improving the maturity level and consequently trust into cloud migration. This review shows a lack of tool support to automate migration tasks. This study also identifies needs for architectural adaptation and self-adaptive cloud-enabled systems. Cloud migration is the process of partially or completely deploying an organization's digital assets, services, IT resources or applications to the cloud.

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ANALYSIS OF SPRING BACK EFFECT IN PRODUCTION OF SEAMLESS TUBES

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1.1 ABSTRACT

Different diameter and sectional tubes form an important segment of Indian Seamless tube market. The dissertation work brings out the problem of Spring-back effect on sectional seamless steel tubes faced in production. The work will perform the analysis & modification to be done on land width of Die in controlling the spring back of sectional seamless steel tubes. The work also includes the quality assurance measures taken during the production of sectional seamless steel tubes.

This yashashri tubes pvt.ltd is specialized in production of the seamless tubes. It Manufactures tubes for most diversified applications like domestic and export applications, e.g. Automobile axles, structural systems, Commercial Vehicles, Two-Three Wheelers, Bearings, Oil industry, Petrochemical Industry, Refineries, Fertilizer plant, Boilers, Heat Exchangers, Pressure vessel, Hydraulic and Pneumatic Cylinders, etc .It also exports the seamless tubes to U.S.A., Europe, Gulf countries etc.

The plant is devised for manufacturing of seamless tubes from input round bars or ingots, various rolling mills are installed to produce seamless tube in hot and cold condition.

Tubes made by joining together the ends of a flat strip are known as welded tubes. Seamless tubes manufactured by hollowing out solid heated billets in a Piercing mill and then cold drawing process continued. Cold drawing is the process of reducing the dimensions of sectional tubes as per required size. Both the tension & compression acts on the tubes. So required thickness of tube is achieved.

Keywords: Springback, cold drawing, seamless tubes

1.2 INTRODUCTION

It is proposed to study the dimensional changes in the sectional seamless tubes. The study will be confined to tubes of thickness 2mm and above. When the sectional tube is drawn through a die of average nominal dimensions, it is generally observed some dimensional variation due to elastic spring back. The spring back depends upon the land width of the die and the design of the plug used for cold drawing.

In the present study, it is proposed to study the effect of any one or two sizes with land widths of 5 or 10mm, which will be studied theoretically using analysis software to analyze the effect of design changes in the die and plug angles, land width etc. To arrive at the best possible combination to achieve dimensional stability and least spring back, this will be well within the permitted dimensional specifications.

Review of various research papers from 1962 shows that Parameters affecting the spring back are Die and plug land, Die and Plug angles ,Material of the tube, Die & Plug material ,Lubrication and friction.

Generally the major contribution to the spring back is based on the length of the die and plug land. The die and plug entry angles are made optimum based on maximum cross section reduction with minimum load

1.3 FINITE ELEMENT METHOD

The finite element method is a numerical analysis technique for the approximate solutions to the varieties of engineering problems. The finite element analysis method is originated as a method of stress analysis method. Finite element procedures are used in design of buildings, aircrafts, ships, spacecrafts, electric motors and many other sectors which deal with stress, heat flow, fluid flow, etc. The finite element procedure produces many simultaneous algebraic equations, which are generated and solved by using computer software's available like ANSYS, IDEAS etc.

The studies of springback analysis were done of the tube in ANSYS 10.0. In first study the land was taken 5 *mm* on die and spring back was measured, while in second study the land portion was taken equal to 10 *mm*.

Then the comparisons of springback in the tubes were done and also compared with the experiment. In both the cases model was modelled as half model as shown in fig 1. The material for the die and the plug was D3 steel, which is generally tool steel, which contains high carbon & high chromium in it. In this analysis the die and the plug was assumed to be rigid with high young's modulus.

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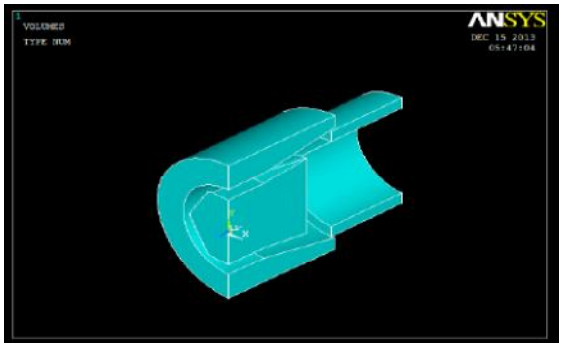

Fig.1. 3D model of die and plug

The mesh was used as the mapped brick type mesh. Which is as shown in fig 2 .The element type for die, plug, and the tube was use as solid 95. The contact was defined between the die and tube and between plug and tube using target 170, and contact 174 respectively which is as shown in Fig.3.

A symmetric boundary condition is applied to the side faces of the die, plug, and tube. The die, plug is constrained to move in any direction; the plug is given a displacement in X direction so that it passes completely through the die. A Multi linear isotropic property was selected for the tube material.

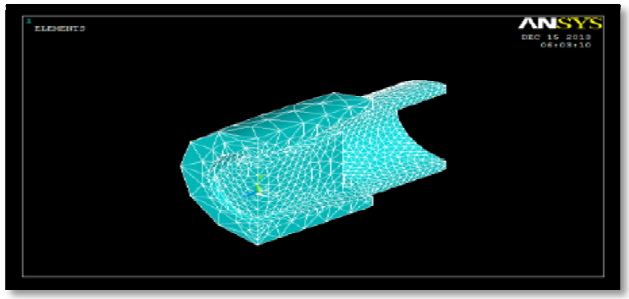

Fig.2.Meshed model of die ,plug and tube assembly.

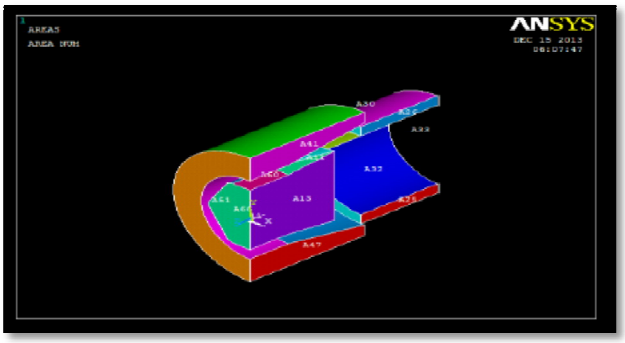

Fig.3.Contact pair simulation.

1.4 RESULTS AND DISCUSSIONS

In order to check the design safety of tubes to avoid failure it is necessary to obtain stress plot from simulation. Von misses stress is maximum stress induced at particular point which is obtain for 10 mm die land as shown below.

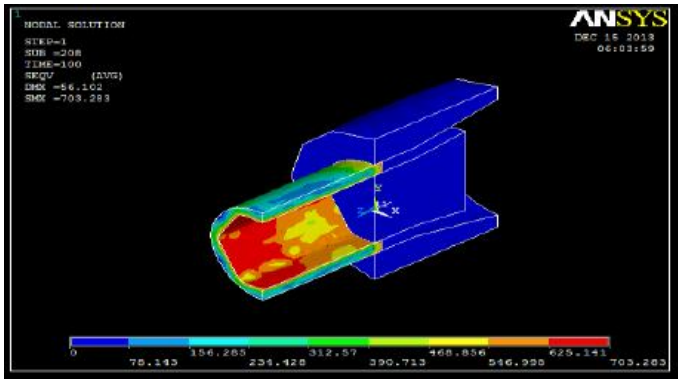

Fig.4.Von misses stress plot

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Above von misses stress plot from fig.4.shows that maximum stress induced is 703.283 which is well below the ultimate stress value thus is no braking of tube takes place. As stress strain curve is given as input for simulating material properties of various materials like ST-52 for tube. Stress strain curve is obtain from ANSYS general postprocessor as shown below in fig.5

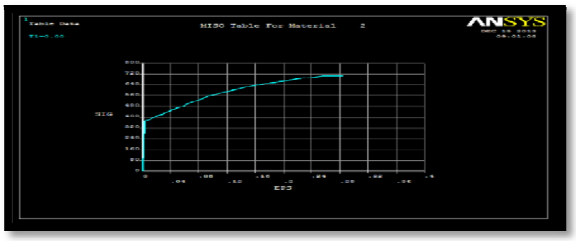

Fig.5.stress strain plot from ANSYS

It is clear from stress strain plot that cold drawing of tube is simulated properly showing multilinear elastic property. A detailed simulation of cold drawing process for tubes has been done to study the spring back effect. The actual drawing angles and die land length is used while modelling the process .

Sr. No.	Node	X	Y	Z
1	9686	0	12.3913	25.573
2	10490	0	9.63094	25.573
3	8686	0	-9.63111	25.573
4	8685	0	-12.3923	25.573
5	10626	-10.836	0.00200	25.573
6	9656	0	12.7136	-3.4095
7	10494	0	9.65198	-3.37033
8	8690	0	-9.65186	-3.3596
9	8714	0	-12.7146	-3.395

Following results are given by the general post processor of ANSYS 10 for both die land . As shown in table .I

Table I. The displacements of X,Y,Z coordinates for 10 mm die land using ANSYS. Similar results are obtained for 5 mm die land which is tabulated as below in table II.

Table II. The displacement of X, Y, Z Coordinated for 5mm die land using ANSYS.

Sr. No.	Node	X	Y	Z
1	9686	0	12.3352	20.8
2	10490	0	9.623434	20.8
3	8686	0	-9.634	20.8
4	8685	0	-12.3352	20.8
5	10626	-10.839	0.0011234	20.8
6	9656	0	12.7244	-8.39936
7	10494	0	9.65328	-8.38063
8	8690	0	-0.65368	-8.37031
9	8714	0	-12.7239	-8.38641

Table III. ANSYS result comparison of 5 and 10 mm land

Die Land	A/F	Thickness	OD	Spring back
10 mm	19.3017	3.06215	25.426	0.0261
5 mm	19.3068	3.066	25.4483	0.0483

Above table III. Shows that spring back was minimum for 10 mm die land as compared to 5 mm die land.

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Table IV. Comparison of theoretical, experimental and analytical result for 10 and 5 mm die land.

Die land	Dimensions	Theoretical	Experimental	ANSYS
10 mm	A/F	19.30	19.285	19.2620
	A/C	22.17-22.29	22.317	21.6738
	O/D	25.35-25.45	25.42	25.426
5 mm	A/F	19.30	19.28	19.2574
	A/C	22.17-22.29	22.35	21.679
	O/D	25.35-25.45	25.44	25.448

From the theoretical, experimental and ANSYS result of 10mm and 5mm land it is clear that elasticity recovery is minimum for 10 mm also experimental result obtain are found in good agreement with ANSYS result as shown in table 3.4

1.5 GRAPHICAL RESULT

Spring back variation of tube drawing process against die land for both experimental and ANSYS can be shown more clearly with the help of graphs as shown in fig.6 and 7 as below

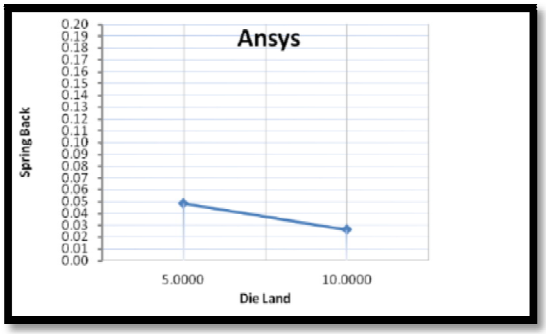

Fig.6 springback vs. die land using ANSYS

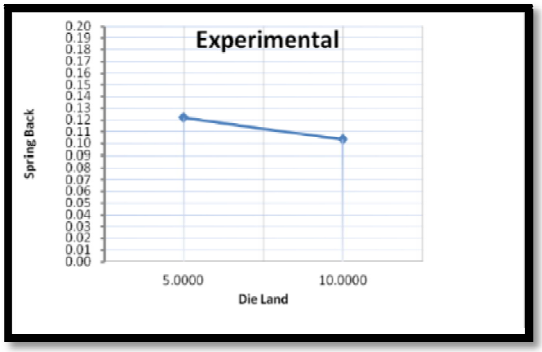

Fig.7 springback vs. die land using ANSYS experimental.

Form the above table and graph it can be concluded that the simulated results are in good agreement with the experimental and theoretical result for both 10 and 5mm die land also springback is minimum in 10 mm die land.

1.6 DISCUSSION ON RESULT

- Both experimental and ANSYS result shows that the springback is minimum for 10 mm land as compared to 5 mm land also table 3.4. shows that theoretical, experimental and ANSYS result of 10 and 5 mm die land are in good agreement with each other.
- The dies and plugs are designed to ensure the minimum spring-back in tubes various measurements where taken for spring-back and wall thickness is tabulated
- The maximum stress induced in the hexagonal tube was found to be 703 MPa. This is well below the ultimate stress limit of tube material. Hence tube will not brake or crack in the process of manufacturing.
- Stress - time plots of various nodes are obtained showing the ability of FEA tool to simulate the various variations of stress at various points during tube drawing.

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- Stress-strain plot obtain using ANSYS shows non linear behaviour of tube material is simulated successfully by using FEM.
- Experimental studies are to be limited to a minimum, because the use of each die set is very costly. The comparison of theoretical and experimental studies will lead used to a further directions for die and plug design for cold drawing the sectional seamless tubes.

1.7 CONCLUSSION

- 3D modelling of the tube drawing process helped in visualization and conceptualization the modelling saves the research time and minimizes the risks of design failure.
- When the sectional tube is drawn through a die of average nominal dimensions, it is generally observed some dimensional variation due to elastic spring back.
- Simulation of the process helps to check the design of dies plug as well helps to visualised the formation of hexagonal shaped tube.
- Simulation helps to predict the metal formation as well as gives the idea of region of high stress formation. This is helps used to check or correct the design of die and plug.
- The simulation helps to predict the dimensions and the spring back of the tube.
- The spring back measured was found in an agreement with the experimental studies.
- The end effect found in the simulation was also found in experiment.
- The FEM analysis can also be used for predicting the dimensions of the actual process. Hence results minimising failures.
- The simulation techniques can also be used for validation of die and plug design when used for sectional tubes formation such as rectangle, square, hexagonal, oval, elliptical, octagonal etc.

FUTURE SCOPE

With reference to the above work done, it is proposed to study the dimensional change in the sectional seamless tubes, mainly rectangular or square cross sections. The study will be confined to tubes of thickness 6 mm and above. The dimensions to be selected will be among.

Square tubes 101.6 x 101.6, 120 x120 and 140 x 140, rectangular tubes 101.1 x 50.8, 120 x 80, 160 x 80.

Present study deals with variation of die land while keeping die angle of 11^{o} . in future variation of die angle can be study for optimum design . Stress analysis is to be done and the stresses acting at various key points can be validated.

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IMPLEMENTATION OF BUS TRACKING AND SERVER REPORTING WITH BUS QUERYING SYSTEM TO MINIMIZE WAITING TIME

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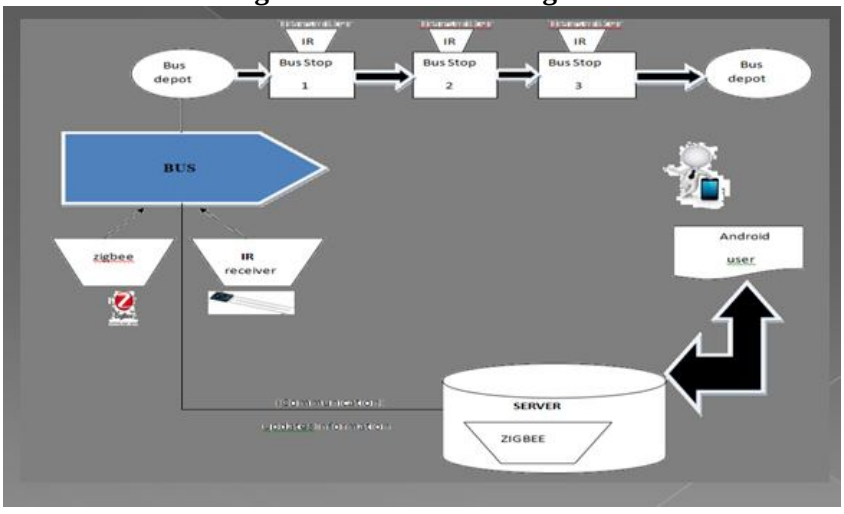
ABSTRACT
In the recent years, the modern cities encountered several problems such as traffic jam, public transportation service.The development of the modern cities is rapidly increasing .The people does not know about the bus timings because of traffic jam. So people may aware of the timing of the bus at the same time they must know bus details and also known where it is located. The main objective of the Project is to Track the Bus. IR receiver is a main device which is connected in the bus module, to get the details about the location of bus. Each and every Bus stand is having IR transmitter which is transmitted the IR rays continuously and the bus mode receives the waves from IR transmitter while attaining the bus stand. The location of the bus is found, which is communicated to the Coordinated Node through Zigbee transceiver. User will send the request to the Coordinator Node through SMS. The Coordinator Node will store the Vehicle Location as well as it receives the User Query through GSM and responds back to the User regarding the Vehicle's Current Location.

Keywords— Bus arrival time detection, IR sensing, Smart phone, Zigbee based tracking.

INTRODUCTION
Public transport, especially the bus transport, has been well developed in many parts of the world. The bus transport services reduce the private car usage and fuel utilization, and assuage traffic clogging.When traveling with buses, the travelers usually want to know the accurate arrival time of the bus. Excessively long waiting time at bus stops may drive away the anxious travelers and make them reluctant to take buses. Nowadays, most bus operating companies have been providing their timetables on the web freely available for the travelers. The bus timetables, however, only provide very limited information (e.g., operating hours, time intervals, etc.), which are typically not timely updated. Other than those official timetables, many public services (e.g., Google Maps) are provided for travelers. Although such services offer useful information, they are far from satisfactory to the bus travelers.For example, the schedule of a bus may be delayed due to many unpredictable factors (e.g., traffic conditions,harsh weather situation, etc). The accurate arrival time of next bus will allow travelers to take alternative transport choices instead, and thus mitigate their anxiety and improve their experience. Towards this aim, man commercial bus information providers offer the real-time bus arrival time to the public we present a novel bus arrival time prediction system based on crowd-participatory sensing. We interviewed bus passengers on acquiring the bus arrival time. Most passengers indicate that they want to instantly track the arrival time of the next buses and they are willing to contribute their location information on buses to help to establish a system to estimate the arrival time at various bus stops for the community. This motivates us to design a crowd-participated service to bridge those who want to know bus arrival time (querying users) to those who are on the bus and able to share the instant bus route

Information (sharing users). To achieve such a goal, we let the bus passengers themselves cooperatively sense the bus route information using commodity mobile phones.

Fig-1: Architechtural diagram



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SYSTEM DESIGN

We portray the key apparatus of the system design. We illustrate the challenge in the design and execution, and present several technique to handle with them.

System Overview

There are 3 major components.

Querying user. As depicted in Fig. 2 (right bottom), a querying user queries the bus arrival time by sending the

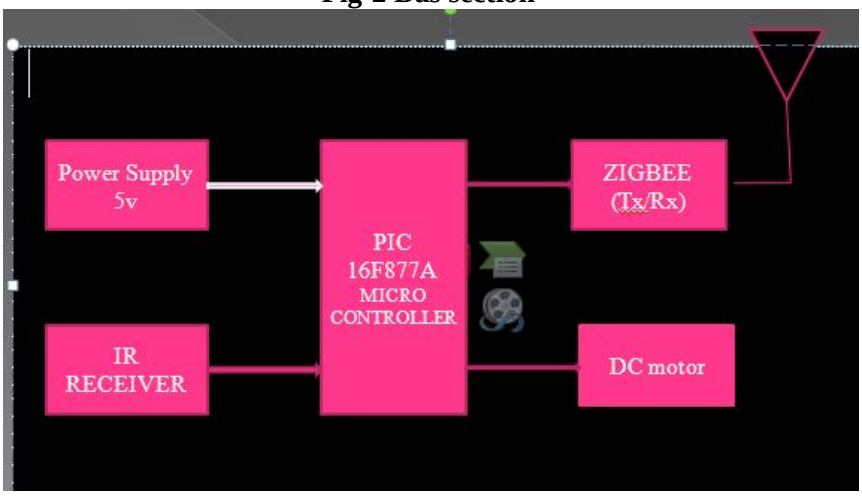
Fig.1. System architecture. request to the backend server. The querying user indicates the interest bus route and bus stop to receive the predicted bus arrival time.

Sharing user. The sharing user on the other hand contributes the mobile phone sensing information to the system. After a sharing user gets on a bus, the data collection module starts to collect a sequence of nearby cell tower IDs. The collected data is transmitted to the server via cellular networks. Since the sharing user may travel with different means of transport, the mobile phone needs to first detect whether the current user is on a bus or not. As shown in Fig. 1,the mobile phone periodically samples the surrounding environment and extracts identifiable

Features of transit buses. Once the mobile phone Confirms it is on the bus, it starts sampling the cell tower sequences and sends the sequences to the backend server. Ideally, the mobile phone of the sharing user automatically performs the data collection and transmission without the manual input from the sharing user.

Backend server. We shift most of the computation burden to the backend server where the uploaded information from sharing users is processed and the requests from querying users are addressed. Two stages are involved in this component.In order to bootstrap the system, we need to survey the corresponding bus routes in the offline pre processing stage. We construct a basic database that associates particular bus routes to cell tower sequence signatures. Since we do not require the absolute physical location reference, we mainly war-drive the bus routes and record the sequences of observed cell tower IDs, which significantly reduces the initial construction overhead. The backend server processes the cell tower sequences from sharing users in the online processing stage. Receiving the uploaded information, the backend server first classifies the uploaded bus routes primarily with the reported cell tower sequence information. The bus arrival time on various bus stops is then derived based on the current bus route statuses.

Fig-2 Bus section



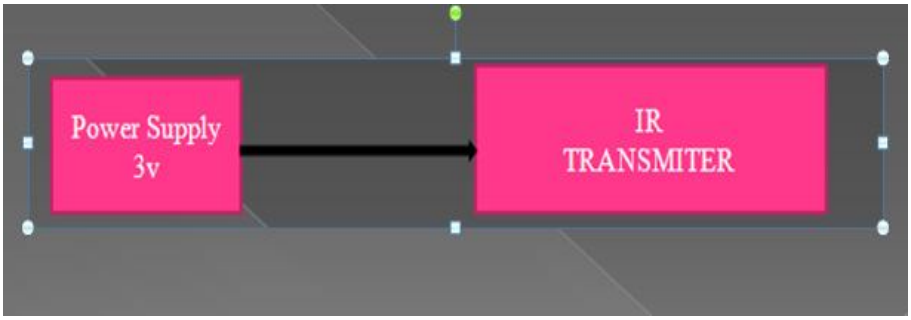


Fig-3 Bus stop section

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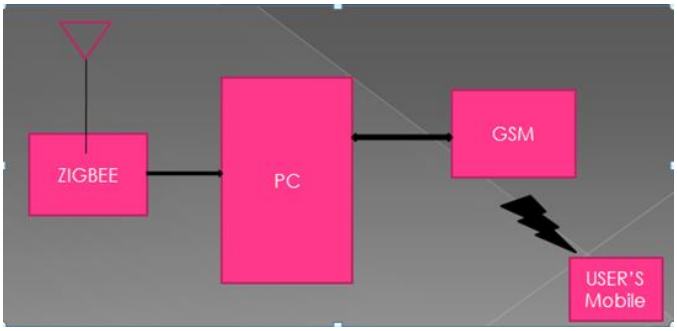

Fig-4 Bus monitoring section

BUS DETECTION

During the on-line giving out stage, we use the mobile phones of sharing passenger on the bus to record the cell tower sequence and transmit the data to the backend server. As aforesaid, the mobile phone should intelligently sense whether it is on a public transit bus or not and collect the data only when the mobile phone is on a bus.

Audio Detection

When a passenger taps the transit card on thereader, the reader will send a short beep audio response to indicate the successful payment. In our system, we choose to let the mobile phone detect the beep audio response of the card reader, since such distinct beeps are not widely used in other means of transportation such as non-public buses and taxis.

Accelerometer Detection

For the audio detection technique, there may be false positives in our daily lives. Some similar beep signal may exist in other scenarios when users are tapping other types of cards like the cash card and employee's card. In some noisy environments, the background sound or music may cause false positives. These kinds of false positives do not influence the system performance because the collected data can be filtered out at the backend server using bus classification algorithm.

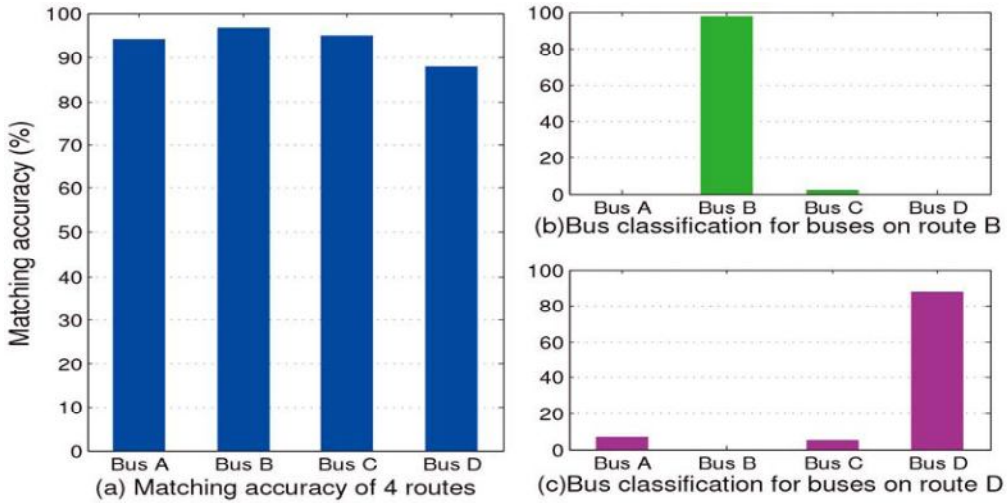

Fig 2-bus classification accuracy **Ref**-*Pengfei Zhou, Student Member, IEEE,2014*

The audio detection module is running all the time on mobile phones. We test the audio indication based bus detection method with various scenarios, and the experiments show encouraging results for bus detection

METHODOLOGY

One zigbee is attached to the bus and the other zigbee is attached to the server.IR Transmitter installed in that Bus Stop will Transmit a Signal to the IR Receiver installed in the Vehicle.The Vehicle will be moving in route where IR Transmitters are installed on all along the route.This Vehicle communicates with the Every IR Transmitters installed in the Bus Stop. Corresponding Bus Stop ID is transmitted to the Server. Android Mobile user can send the request of his / her Source and Destination of the Route so that the Server will identify the Nearest bus and the Time taken for the us bus to reach the requested stop. So that the Mobile user can plan his / her Travel according to the timing of the arrival of Bus. Once User sends the request to the Server about the Destination, Server will update with Nearest Bus, Arrival Time and Distance between User and the Vehicle to the Android User. User can Plan the Travel accordingly.

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CONCLUSION

We are Developing an Android based User Interface for Fetching the Nearest available Bus, its Time to reach the Source and the Distance which will surely avoid the waiting time for Android User. Future work includes how to encourage more participants to bootstrap the system because the number of sharing passengers affects the prediction accuracy in our system. This common issue of crowd-sourced solutions is largely influenced by the penetration rate and popularity of the services. One may actively promote the service to reach a critical penetration rate so as to ensure that at least one sharing user is on the bus willing to report the bus status.

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AUTHORIZED THIRD PARTY AUDITING AND INTEGRITY VERIFICATION IN CLOUD COMPUTING

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ABSTRACT
Storage-as-a-Service offered by cloud service providers is a paid facility that enables organizations to outsource their sensitive data to be stored on remote servers. Cloud service provider may be vulnerable to attack. So it is necessary to check the integrity of data in cloud server. We propose Ranked Merkle Hash Tree (RMHT) to ensure fine grained data updates. To ensure security for the uploaded data we encrypt the data before uploading the cloud server. Similarly, while retrieving data from cloud, it is decrypted and sent to user. In the proposed system, block level operations can be performed easily, i.e. data owner can add and edit the data available in cloud server. Proposed scheme offers not only security and flexibility, but also significantly lower overhead for big data applications with a large number of frequent small updates, such as applications in social media and business transactions.

Key Terms: Cloud computing, big data, data security, ranked merkle hash tree, authorized auditing, fine grained data update

1. INTRODUCTION

Cloud computing is being intensively referred to as one of the most influential innovations in information technology. With resource virtualization, cloud can deliver computing resources and services in a pay-as-you-go mode, which is envisioned to become as convenient to use similar to daily-life utilities such as electricity, gas, water and telephone in the near future. These computing services can be categorized into Infrastructure-as-a-Service (IaaS), Platform-as-a-Service (PaaS) and Software-as-a-Service (SaaS). Many international IT corporations now offer powerful public cloud services to users on a scale from individual to enterprise all over the world; examples are Amazon AWS, Microsoft Azure, and IBM SmartCloud.

Although current development and proliferation of cloud computing is rapid, debates and hesitations on the usage of cloud still exist. Data security/privacy is one of the major concerns in the adoption of cloud computing. Compared to conventional systems, users will lose their direct control over their data. The problem of integrity verification for big data storage in cloud is studied. This problem can also be called data auditing when the verification is conducted by a trusted third party. From cloud users' perspective, it may also be called 'auditing-as-a-service'.

In a remote verification scheme, The Cloud Storage Server (CSS) cannot provide a valid integrity proof of a given proportion of data to a verifier unless all this data is intact. To ensure integrity of user data stored on cloud service provider, this support is of no less importance than any data protection mechanism deployed by the Cloud Service Provider (CSP), no matter how secure they seem to be, in that it will provide the verifier a piece of direct, trustworthy and real-timed intelligence of the integrity of the cloud user's data through a challenge request. It is especially recommended that data auditing is to be conducted on a regular basis for the users who have high-level security demands over their data.

2. SCOPE OF PAPER

The objective of this project is to support for small dynamic updates, benefits the scalability and efficiency of a cloud storage server. It is aimed to propose a scheme, which utilizes a flexible data segmentation strategy and a Ranked Merkle Hash Tree (RMHT). Also to address potential security problem in supporting public verifiability to make the scheme more secure and robust, authorization process for Third-Party Auditor (TPA) is incorporated.

2.1 CLOUD SERVICES

Everyone has an opinion on what is cloud computing. It can be the ability to rent a server or a thousand servers and run a geophysical modeling application oSn the most powerful systems available anywhere. It can be the ability to rent a virtual server, load software on it, turn it on and off at will, or clone it ten times to meet a sudden workload demand. It can be storing and securing immense amounts of data that is accessible only by authorized applications and users. It can be supported by a cloud provider that sets up a platform that includes the OS, Apache, a MySQL™ database, Perl, Python, and PHP with the ability to scale automatically in response to changing workloads. Cloud computing can be the ability to use applications on the Internet that

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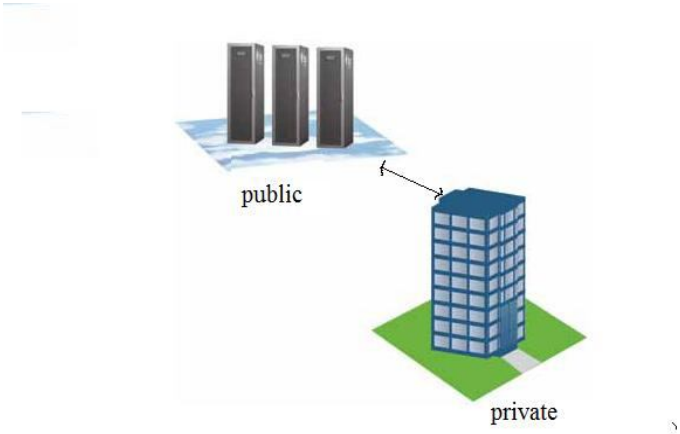
store and protect data while providing a service - anything including email, sales force automation and tax preparation. It can be using a storage cloud to hold

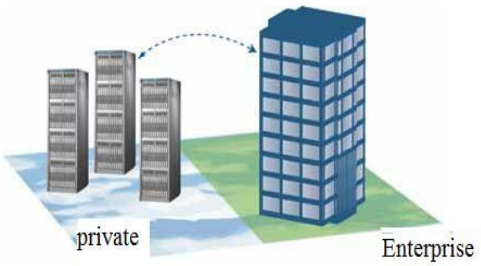
Application, business, and personal data. And it can be the ability to use a handful of Web services to integrate photos, maps, and GPS information to create a mashup in customer Web browsers. There are many ways in which computational power and data storage facilities are provided to users, ranging from a user accessing a single laptop to the allocation of thousands of compute nodes distributed around the world. Users generally locate resources based on a variety of characteristics, including the hardware architecture, memory and storage capacity, network connectivity and, occasionally, geographic location. Usually this resource location process involves a mix of resource availability.



A public cloud provides services to multiple customers, and is typically deployed at a colocation facility.

2.8 PRIVATE CLOUDS

Private clouds are built for the exclusive use of one client, providing the utmost control over data, security, and quality of service (Figure 4). The company owns the infrastructure and has control over how applications are deployed on it. Private clouds may be deployed in an enterprise datacenter, and they also may be deployed at a colocation facility.



Private clouds may be hosted at a colocation facility or in an enterprise datacenter. They may be supported by the company, by a cloud provider, or by a third party such as an outsourcing firm.

2.9 HYBRID CLOUDS

Hybrid clouds combine both public and private cloud models. They can help to provide on-demand, externally provisioned scale. The ability to augment a private cloud with the resources of a public cloud can be used to maintain service levels in the face of rapid workload fluctuations. Hybrid clouds introduce the complexity of determining how to distribute applications across both a public and private cloud. Among the issues that need to be considered is the relationship between data and processing resources. If the data is small, or the application is stateless, a hybrid cloud can be much more successful than if large amounts of data must be transferred into a public cloud for a small amount of processing.

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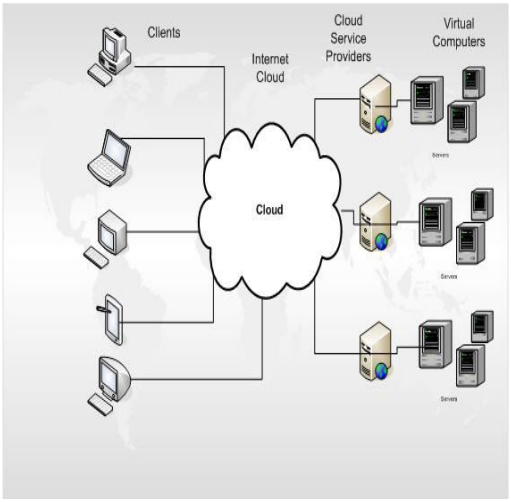
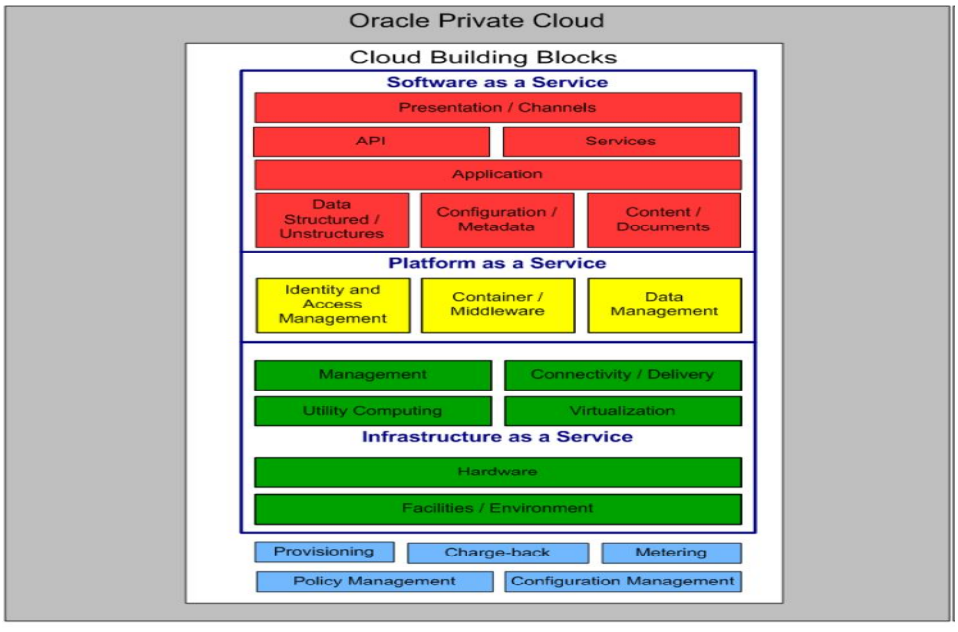
2.10 CLOUD COMPUTING ARCHITECTURE



2.11 DIFFERENT LEVELS OF CLOUD COMPUTING

Cloud computing is typically divided into three levels of service offerings: Software as a Service (SaaS), Platform as a Service (PaaS), and Infrastructure as a service (IaaS). These levels support virtualization and management of differing levels of the solution stack.



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2.12 SOFTWARE AS A SERVICE

A SaaS provider typically hosts and manages a given application in their own data centre and makes it available to multiple tenants and users over the Web. Some SaaS providers run on another cloud provider's PaaS or IaaS service offerings. Oracle CRM on Demand, Salesforce.com, and Netsuite are some of the well known SaaS examples.

2.13 PLATFORM AS A SERVICE

Platform as a Service (PaaS) is an application development and deployment platform delivered as a service to developers over the Web. It facilitates development and deployment of applications without the cost and complexity of buying and managing the underlying infrastructure, providing all of the facilities required to support the complete life cycle of building and delivering web applications and services entirely available from the Internet. This platform consists of infrastructure software, and typically includes a database, middleware and development tools. A virtualized and clustered grid computing architecture is often the basis for this infrastructure software. Some PaaS offerings have a specific programming language or API. For example, Google AppEngine is a PaaS offering where developers write in Python or Java. EngineYard is Ruby on Rails. Sometimes PaaS providers have proprietary languages like force.com from Salesforce.com and Coghead, now owned by SAP.

2.14 INFRASTRUCTURE AS A SERVICE

Infrastructure as a Service (IaaS) is the delivery of hardware (server, storage and network), and associated software (operating systems virtualization technology, file system), as a service. It is an evolution of traditional hosting that does not require any long term commitment and allows users to provision resources on demand. Unlike PaaS services, the IaaS provider does very little management other than keep the data centres operational and users must deploy and manage the software services themselves--just the way they would in their own data centre. Amazon Web Services Elastic Compute Cloud (EC2) and Secure Storage Service (S3) are examples of IaaS offerings.

2.15 ARCHITECTURE IMPLICATIONS AND PRINCIPLES

To take full advantage of the benefits of Cloud computing, there are a number of architectural implications that should be observed.

3. RELATED WORKS

Existing system auditing scheme have various properties, potential risks and inefficiency such as security risks in unauthorized auditing requests and inefficiency in processing small updates still exist. Whenever processing the small units of update it will process the whole block of files where the data need to update. Because of this process there is increase in computation overhead over big storage in cloud. In this system causes unauthorized auditing process, user data is unsecure, computation overhead, Updates the whole block of data if it is a small of large data.

Proofs of Retrievability (POR) and its first model for data auditing. Unfortunately, this scheme can only be applied to static data storage such as archive or library. Provable Data Possession (PDP) schemes offer 'blockless verification' which means the verifier can verify the integrity of a proportion of the outsourced file through verifying a combination of pre-computed file tags which they call Homomorphic Verifiable Tags (HVTs) or Homomorphic Linear Authenticators (HLAs). Improved PDP scheme, The first PDP scheme based on skip list that can support full dynamic data updates is proposed. Unfortunately Public Auditability and variable-sized file blocks are not supported by default. BLS signature Wang, et al. proposed a scheme based on BLS signature that can support public auditing and full data dynamics, which is one of the latest works on public data auditing with dynamics support. This scheme lacks support for fine grained update and authorized auditing. A Random Masking Technology on top to ensure the TPA cannot infer the raw data file from a series of integrity proofs. In their scheme, they also incorporated a strategy first proposed to segment file blocks into multiple 'sectors'. The use of this strategy was limited to trading-off storage cost with communication cost. Overall the existing system are security risks in unauthorized auditing requests and Inefficiency in processing small updates

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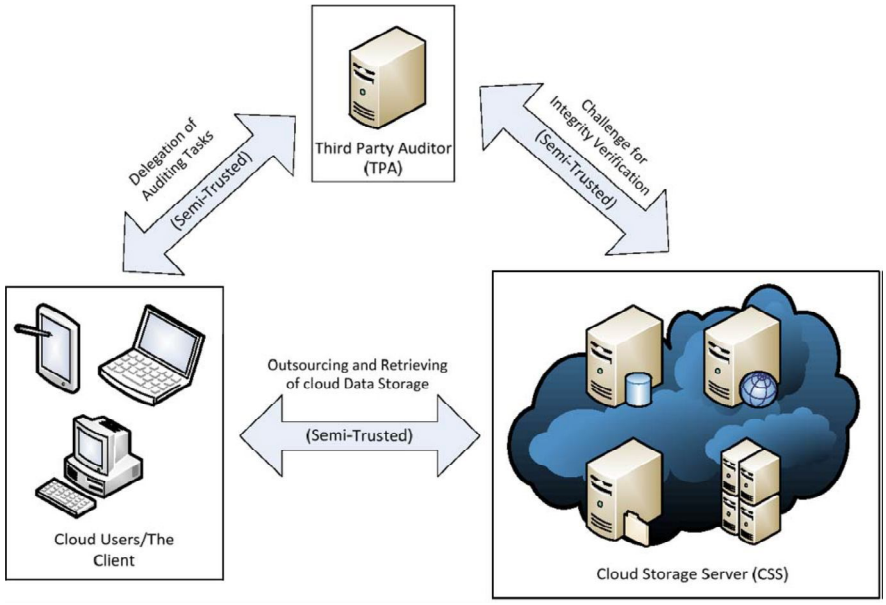

Relationship between the participating parties in a public auditing scheme

4. PROBLEM ANALYSIS

4.1 CLIENT REGISTRATION

An entity, which has large data files to be stored in the cloud and relies on the cloud for data maintenance and computation, can be either individual consumers or organizations. Client upload file, which is divided into parts and file blocks are added to the cloud server. TPA which has expertise and capabilities that clients do not have, is trusted to assess and expose risk of cloud storage services on behalf of the clients upon request.

4.2 CLOUD STORAGE SERVER

The Cloud Storage Server (CSS) is considered to be the untrusted server. The data owner upload data is stored in the cloud server, as the server can turn malicious any time, it is considered to be untrusted. Thus data owner perform encryption for their own data and uploads to cloud.

4.3 SETUP PHASE

The client will generate keying materials via KeyGen and FileProc, then upload the data to CSS. Different from previous schemes, the client will store a RMHT instead of a MHT as metadata. Moreover, the client will authorize the TPA by sharing a value sigAUTH. According to the preemptively determined segmentation requirement SegReq, segments file F into blocks, i.e., F is segmented into a total of l blocks, with the i^{th} block having si segments. In our settings, every file segment should of the same size.

4.4 DYNAMIC DATA OPERATION

The explicitly and efficiently handle fully dynamic data operations including data modification, block insertion for cloud data storage. Note that in the following descriptions, we assume that the file F and the signature have already been generated and properly stored at server. The root metadata R has been signed by the client and stored at the cloud server, so that anyone who has the client's public key can challenge the correctness of data storage.

4.5 INTEGRITY VERIFICATION

The Cloud Storage Server (CSS) performs the client's fine-grained update requests via Perform Update, then the client runs Verify Update to check whether CSS has performed the updates on both the data blocks and their corresponding authenticators (used for auditing) honestly. The client asks TPA for its ID FID (for security, FID is used for authorization only). TPA will then return its ID, encrypted with the client's public key. The client will then compute sigAUTH=Sigssk(AUTH||t||VID) and sends sigAUTH along with the auditing delegation request to TPA for it to compose a challenge later on.

4.6 CHALLENGE

TPA runs the following GenChallenge algorithm. GenChallenge (Acc; pk; sigAUTH): According to the accuracy required in this auditing, TPA will decide to verify c out of the total l blocks. Then, a challenge message chal ={$sig_{AUTH,}$ $\{VID\}_{PKCSS}$, {I, vi}} is generated where VID is TPA's ID, I is a randomly selected subset with c elements and vi is c randomly-chosen coefficients. Note that VID is encrypted with the CSS's

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public key PKCSS so that CSS can later decrypt $\{VID\}_{PKCSS}$ with the corresponding secret key. TPA then sends challenge to CSS.

4.7 PROOF GENERATION

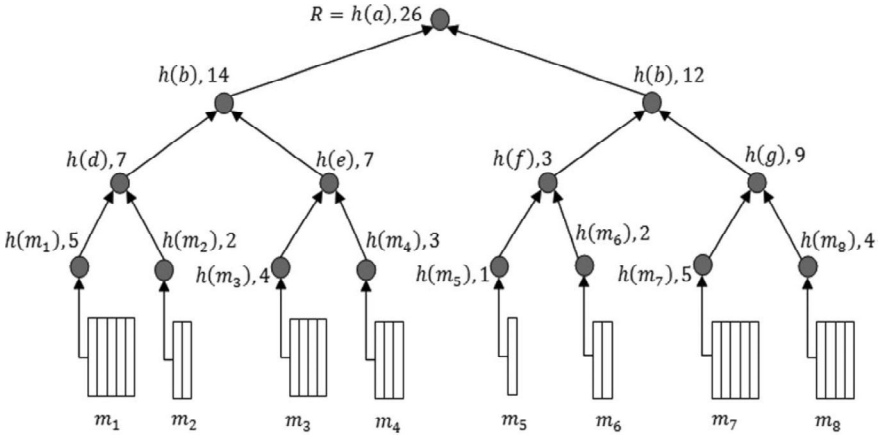
After receiving challenge, CSS will run the following GenProof algorithm. GenProof(pk,F, sigAUTH,F, chal). CSS will first verify sigAUTH with AUTH, t, VID and the client's public key spk, and output REJECT if it fails. Otherwise, CSS will compute and compose the proof P, then output P. After execution of this algorithm, CSS will send P to TPA.

5.OUR SCHEME

Here a public auditing scheme based on BLS signature and Merkle Hash Tree(MHT) that can support fine-grained update requests. Compared to existing schemes, our scheme supports updates with a size that is not restricted by the size of file blocks. Our scheme incorporates an additional authorization process with the aim of eliminating threats of unauthorized audit challenges form malicious or pretended third-party auditors, which we term as 'authorized auditing'. We investigate how to improve the efficiency in verifying frequent small updates which exist in many popular cloud and big data contexts such as social media. Accordingly, we propose a further enhancement for our scheme to make it more suitable for this situation than existing schemes. It is more secure and Robust, Less computation overhead, here the size is not restricted, only the updated data only processed and authorized auditing.

5.1 RANKED MERKLE HASH TREE (RMHT)

The Merkle Hash Tree (MHT) has been intensively studied in the past. In this paper we utilize an extended MHT with ranks which we named RMHT. Similar to a binary tree, each node N will have a maximum of 2 child nodes. In fact, according to the update algorithm, every non-leaf node will constantly have 2 child nodes. Information contained in one node N in an RMHT T is represented as fH; rNg where H is a hash value and rN is the rank of this node. T is constructed as follows. For a leaf node LN based on a message mi, we have H ¼ hðmiÞ, rLN ¼ si; A parent node of N1 ¼ fH1; rN1g and N2 ¼ fH2; rN2g is constructed as NP ¼ fhðH1kH2Þ; ðrN1 þ rN2Þg where k is a concatenation operator. A leaf Example of a rank-based Merkle hash tree (RMHT).



Example of a rank-based Merkle hash tree (RMHT).

node mi's AAI Wi is a set of hash values chosen from every of its upper level so that the root value R can be computed through fmi;Wig. For example, for the RMHT demonstrated in Fig. 2, m1's AAI W1 ¼ fhðm2Þ; hðeÞ; hðdÞg. According to the property of RMHT, we know that the number of hash values included in Wi equals the depth of mi in T.

To achieve small dynamic updates, the proposed scheme utilizes a flexible data segmentation strategy and a ranked Merkle hash tree (RMHT). To address a potential security problem in supporting public verifiability to make the scheme more secure and robust, which is achieved by adding an additional authorization process among the three participating parties of client, CSS and a third-party auditor (TPA).Analyze different types of fine-grained dynamic data update requests on variable-sized file blocks in a single dataset. This is the first method to propose a public auditing scheme based on BLS signature and Merkle hash tree (MHT) that can support fine-grained update requests.

Better support for small dynamic updates, which benefits the scalability and efficiency of a cloud storage server. Proposed scheme supports updates with a size that is not restricted by the size of

file blocks, thereby offers extra flexibility and scalability compared to existing schemes .For better security, proposed scheme incorporates an additional authorization process with the aim of eliminating threats of unauthorized audit challenges from malicious or pretended third-party auditors, which is called as 'authorized auditing'.

6. CONCLUSION

In this system, proposed a formal analysis on possible types of fine-grained data updates and proposed a scheme that can fully support authorized auditing and fine-grained update requests. Based on this scheme, it is also proposed a modification that can dramatically reduce communication overheads for verifications of small updates. Theoretical analysis and experimental results have demonstrated that the proposed scheme can offer not only enhanced security and flexibility, but also significantly lower overheads for big data applications with a large number of frequent small updates such as applications in social media and business transactions.

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TRUSTABLE COMPUTING ON DATA CENTRE NETWORKS

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ABSTRACT
Multicast benefits data center group communication in both saving network traffic and improving application throughput. Reliable packet delivery is required in data center multicast for data-intensive computations. However, existing reliable multicast solutions for the Internet are not suitable for the data center environment, especially with regard to keeping multicast throughput from degrading upon packet loss, which is norm instead of exception in data centers. We present RDCM, a novel reliable multicast protocol for data center network. The key idea of RDCM is to minimize the impact of packet loss on the multicast throughput, by leveraging therich link resource in data centers. A multicast-tree-aware backup overlay is explicitly built on group members for peer-to-peer packet repair. The backup overlay is organized in such a way that it causes little individual repair burden, control overhead, as well as overall repair traffic. RDCM also realizes a window-based congestion control to adapt its sending rate to the traffic status in the network. Simulation results in typical data center networks show that RDCM can achieve higher application throughput and less traffic footprint than other representative reliable multicast protocols. We have implemented RDCM as a user-level library on Windows platform. The experiments on our test bed show that RDCM handles packet loss without obvious throughput degradation during high-speed data transmission, gracefully respond to link failure and receiver failure, and cause less than 10% CPU overhead to data center servers.

Key Terms- Data centre networks, reliable multicast, backup overlay,AIMD algorithm

1. INTRODUCTION
Networking is emerging as an attractive Internet \service model[1],[2]. Giant data can be sended, shared, connection to different host and provide to offer various kinds of connection. Group communication widely exists in data centers, from-end delay sensitive application, to back-end bandwidth-hungry infrastructural computations. Application example including direct searching queries to a set of indexing servers [3], distributing executable.

Group communication widely exists in data centres hosting cloud computing [4], [5]. Multicast benefits group communications by both saving network traffic and improving application throughput. Though network-level multicast in the Internet bears a notorious reputation during the past two decades for deploying obstacles and for many open issues such as congestion control, pricing model, and security concern, recently there is a noticeable resurgence of it, e.g., the successful application of IP multicast in IPTV networks [6], enterprise networks, etc. The managed environment of data centres also provides a good opportunity for multicast deployment. However, existing multicast protocols built in data centre switches/servers are primarily based on the multicast design for the Internet. Before the wide application of multicast in data centres, we need to carefully investigate whether these Internet-oriented multicast technologies can well accommodate data centre networks.

In this paper, we study the critical requirement of the reliable multicasting data centre. Typical access switches can hold no more than 1500 multicast group states [7]. Packet loss in the data centre network is possible in the several reasons. First, current data centres are built by commodity servers/switches for economic and scalability reasons [10], [12], [8], [9], [11]. Packets can get lost from node/link failure in the fragile multicast trees. Second, traffic is quite busty and unpredictable in data centre networks [7].packet loss can be 12% in maximum possibilities. Since it is difficult to reactively schedule multicast flows to low-utilized links, traffic congestion and consequent packet loss can occur at anyplace in the multicast tree. Third, the server population in data center is usually very large. The larger size the multicast tree is, the higher probability a packet gets lost during transmission.

Previous reliable multicast protocols for the Internet can be generally divided into two categories, i.e., network-device assisted and end-host based. The former category, represented by PGM [22] and ARM [23], requires assistance from network devices to achieve reliable data delivery. But the technical trend of data center design is to use low-end commodity switches, which are not supposed to bear much intelligence, for server interconnection [11]. Hence, the latter category of solutions, which put all the reliable multicast intelligence onto end hosts, seem to be more suitable for data center networks. The typical proposals include SRM [18], RMTP [19], TMTP [20], LBRM [21], etc. Though these protocols have been proposed for long, the managed

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environment and rich link resource in data center networks offer unique opportunities for us to revisit the design space. We pay specific attention to the multicast throughput during packet repair, which is important for the task finish time of many cloud applications

Trustable computing in data centre network protocol we designed is an end-host based protocol. Observing that current data centres are built with high link density, for each multicast group we explicitly construct a multicast-tree aware backup overlay upon group members.

To avoid traffic in the server the data can be retrieved from the nearest client or peer having the data. The main advantage of the of this approach is the traffic in the network is reduced. Second, the node/link failure happens affect the entire packets receiving, this can overcome using the backup overlay. Third, the packet loss from traffic congestion in the multicast tree, backup-overlay based packet repair can alleviate the congestion in hot spots and thus enhance the multicast throughput.

Building the backup overlay is one of the core technical challenges in data network center. We carefully organize the backup overlay in such a way that each receiver is responsible for repairing packets to at most two other receivers, no matter how large the group size is. The multicast sender retransmits a packet only when all receivers lose it. The control-state exchange and overall repair traffic are also limited. Besides, the backup overlay can help detect and identify highly congested or failed links, assisting in reconstruction of the multicast tree and backup overlay.

Data Center Network realizes congestion control, by accommodating the sending rate of the multicast sender to the traffic status in the network. The traffic sending rate is controlled to be no higher than the receiving rate at the lowest receiver. The congestion control mechanism is also TCP-friendly, in the sense that the lowest receiver achieves the throughput as if a TCP unicast connection were running between itself and the sender. We choose a window based congestion control in data center network. Each individual receiver maintains a congestion window, the size of which is updated using the AIMD (additive increase multiplicative decrease) algorithm.

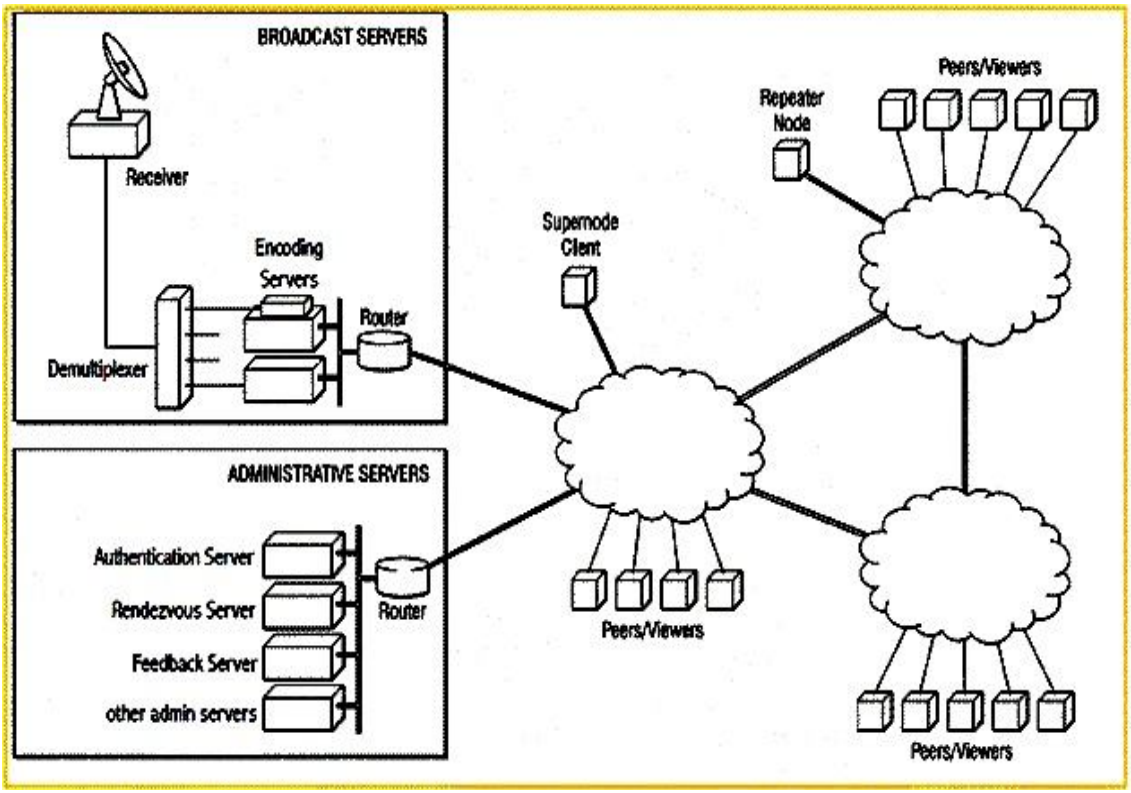

Fig. 1. Architecture

2. BACKGROUND AND DESIGN RATIONALE

In this section, we discuss the background and design rationale of reliable multicast in data center networks.

2.1 Data Center Multicast

One-to-many group communication is common in modern data centers running cloud based applications. Multicast is the natural technology to benefit this kind of communication pattern, for the purposes of both saving network bandwidth and reduce the load on the sender. Services such as Facebook and Twitter are

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essentially supported by multicast-centric architectures [17]. For web search services, the incoming user query is directed to a set of indexing servers to look up the matching documents [3]. Multicast can help accelerate the directing process and reduce the response time. Distributed file system is widely used in data centers, such as GFS [7] in Google, HDFS [6] in Hadoop, and COSMOS in Microsoft. Files are divided into many fix-sized chunks, say, 64 MB or 100 MB. Each chunk is replicated to several copies and stored in servers located in different racks to improve the reliability. Chunk replication is usually bandwidth hungry, and multicast- based replication can save the inter-rack bandwidth. In map-reduce like cooperative computations [4]–[6], the executive binary are delivered to the servers participating the computation task before execution. Multicast can also speed up the binary delivery and reduce the task finish time.

Though multicast is supported by most network devices (routers, switches) and end hosts, it is not widely deployed in the Internet due to many technological causes, such as the pricing model, multicast congestion control, security concerns. For the same reason, modern data centers rarely enable multicast protocols. To avoid the traffic redundancy in group communications, one possible solution is to divide the network into VLANs, and use broadcast within each VLAN. For example, for map-reduce like jobs, we can easily configure the workers for the same job in one VLAN, and perform broadcast within the VLAN to deliver the executable binary. However, there are two problems for this approach. First, the VLAN tag space is quite limited. There can be at most 4k VLANs since the VLAN tag ID is 12 bits [35]. But the potential number of multicast groups in data center can be very large, especially considering the file chunk replication groups. Second, dynamical group member join/leave is common, e.g., creating new workers/VMs to handle failure in map-reduce jobs. It has a high cost to dynamically reconfigure the VLANs in response to group membership change.

However, multicast does not have the limitations above. The IP multicast address space can support hundreds of millions of groups, and can naturally embrace group member dynamics. Therefore, we argue that IP multicast (or more generally, network-level multicast) is the preferred choice to support data center group communication, especially considering that we can leverage the managed environment of data centers to overcome the open problems for IP multicast in the Internet. However, current multicast protocols implemented at switches and servers are primarily Internet oriented. Before the wide deployment of multicast in data center networks, we need to carefully investigate whether these multicast protocols can well embrace the data center environment. In this paper, we focus on a specific problem for data center multicast, i.e., reliable data delivery. Reliable packet delivery is important fordata center multicast, because packet loss ratio in data centers can be high when traffic rate is high. Fig. 1 shows the packet loss ratio in a 1Gbps link in our small data center test bed composed of 20 servers. We find that when the traffic rate is lower than 400Mbps, there is almost no packet loss. However, the packet loss ratio grows significantly with higher traffic rate. When the traffic rate reaches the full link capacity, the packet loss ratio can be as high as 0.8%.

2.2 Data Center Network Architecture

In current practice, data-center servers are connected by a tree hierarchy of Ethernet switches, with commodity ones at the first level and increasingly larger and more expensive ones at higher levels. It is well known that this kind of tree structure suffers from many problems [14], [15]. The top-level switches are the bandwidth bottleneck, and high-end high-speed switches have to be used. Moreover, a high-level switch shows as a single-point failure spot for its sub tree branch.

Using redundant switches does not fundamentally solve the problem but incurs even higher cost. To overcome the limitations of tree structure, recently many new data center architectures are proposed [14], [8], [9]. A consistent theme in these new architectures is that several levels of low-end commodity switches are used to interconnect a massive number of servers.

The major difference among the proposals lies in the way how switches are interconnected and how servers are connected to switches. Every server uses a 1G link to connect a ToR-level switch. Each ToR-level switch uses two 10G uplinks to connect two aggregation level switches respectively. Aggregation-level switches and intermediate-level switches are connected as a complete bipartite graph using 10G links. In BCube [9], each server uses ports to connect switches from different levels.

Any two switches are not directly connected. Note that the link density in these modern data center networks is very high. Hence, there are many equal-cost paths between any two servers. For instance, in a Fat-Tree structure composed of -port switches, there are core-level switches, which equals to the number of paths between any two servers. In VL2, if -port 10G switches are used for interconnection, the number of equal-cost paths between any two servers is . In a BCube network, where is the number of switch ports and is the number of server ports, the number of equal cost shortest paths between two servers is typically . If we relax the path length requirement,

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the candidate paths between BCube servers is even more. The rich link resource in data center networks exposes both new challenges and opportunities for data center protocol design [10].

2.3 Design Rationale

Due to the essential unreliability of UDP-based multicast transmission, reliable mechanism should be introduced to guarantee the successful packet delivery to multicast receivers. We target at single-source multicast, in which a single sender distributes data to a number of interested receivers. Note that the most bandwidth-efficient data delivery structure for IP multicast is the tree structure, which utilizes the least number of links for a multicast group. Considering the rich link resource in typical data center networks, it makes sense to build multiple trees for a group to accelerate the data distribution process [9], [24]. Though, tree is still the basic structure for managing data delivery. There are several challenges for designing reliable multicast in data center environment. Fragile Multicast Trees:

In considerations of economical cost and scalability, current data centers are built upon a large number of commodity switches and servers. Failure is norm instead of exception in such networks [8], and the multicast tree is quite fragile. Any node/link failure in the multicast tree can pause packet delivery to downstream receivers. Reliable multicast requires gracefully handling node/link failure during packet transmission. Traffic Bursty in Data Centers: It has been shown that traffic is quite bursty and unpredictable in data center networks [12].Whenthe group size is large, traffic congestion can occur anywhere in the multicast tree, resulting in frequent packet loss. When transmitting the repair packets, the multicast throughput will degrade significantly if the repair packets compete for the network bandwidth with regular packets in the multicast session.

Design Intelligence: The low-end commodity switches used in current data centers usually contain quite limited routing states, small buffer space as well as low programmability. These switches are not supposed to bearmuch multicast intelligence, except the basic multicast packet forwarding. Hence, network-device assisted reliable multicast solutions are not suitable for data center environment. To address the challenges above, we design RDCM, a novel reliable multicast protocol for data center networks, by leveraging the managed environment of data centers, the rich link resource in data center networks, as well as the topological characteristics of modern data center networks. RDCM makes the following design choices. First, RDCM uses a central controller to build the multicast tree, since data center is usually a managed environment controlled by a single organization. This kind of centralized controller is widely adopted in modern data center design. For instance, in Fat-Tree [14], a fabric manager is responsible for managing the network fabric. In VL2 [8], a number of directory servers are used to map the AA-LA relationship. The emerging Open Flow [16] framework also uses a controller for routing rule decision and distribution. In RDCM, we call the controller multicast manager. All the group join/leave requests are redirected to the multicast manager. The multicast manager calculates the multicast tree based on the network topology and group membership, and configures the forwarding states on switches/servers. Second, RDCM takes a peer-driven approach to packet repair, leveraging the rich link resource in data center networks.

If the source retransmits the repair packets along the multicast tree, the repair packets will compete for the link bandwidth with normal packets in the multicast session. RDCM, instead, repairs lost packets among receivers by P2P unicast. Given the rich link

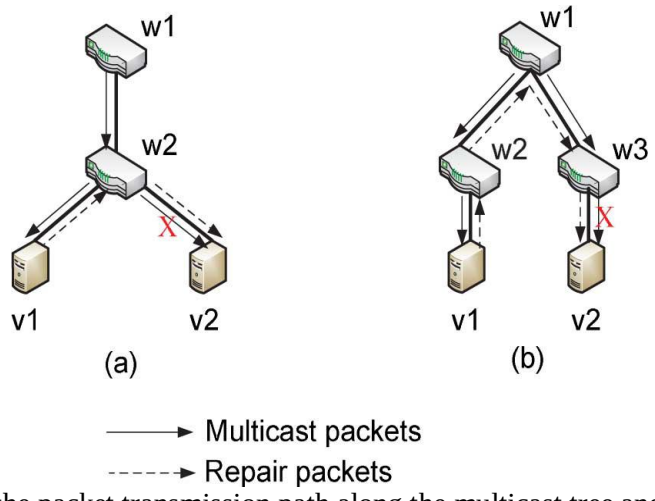

Fig. 2. Examples to show the packet transmission path along the multicast tree and the packet repair path. In (a), the packet is transmitted only once in each link. In (b), the packet is transmitted twice in the link . However, it can be avoided if the unicast repair path can bypass the multicast tree.

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resource and multiple equal-cost paths between any two servers in data center networks, the packet repair paths has high probability to be disjoint with the multicast tree, which we will further elaborate in Section 3. Third, RDCM explicitly constructs a multicast-tree-aware repair structure to improve the packet repair efficiency, which we call backup overlay. Peer-driven unicast has also been used for packet repair in some Internet-oriented reliable multicast schemes, such as Bimodal Multicast [28], Lightweight Probabilistic Broadcast [29] and Ricochet [30]. However, the managed environment of data centers and the regular topology provide the unique opportunity for building a topology aware overlay among receivers for packet repair.

Compared with gossip-based packet repair schemes, explicitly constructing the backup overlay can help achieve repair isolation, control the individual repair burden and reduce the overall repair traffic, all of which favor enhancing the multicast throughput. All the switches are oblivious to the backup overlay. Note that RDCM basically designed for generic data center topologies. In what follows, we primarily use BCube as an example when presenting the design details, and carry on simulations as well as experiments. But they can be easily extended to other data center networks.

3 DESIGN

In this section, we present the design of Trustable computing in data center network.

3.1 Design Overview

As presented in Section 2, Trustable computing puts all the design intelligence to data center servers and uses peer-driven unicast for packet repair. In order to not degrade the multicast application throughput, it is desired that no link transmits the same packet more than once. The packet delivery in the data center network is the designed in such a way of multicasting of the files on the network. The packet delivery is being reduce in the reduction of the traffic is carried out using the shortest path of the data request of the same network under same server. This AIMD (additive increase multiplicative decrease) is being used for the reduction of the traffic on the network.

Fortunately, as we described in Section 2, modern data center networks tend to have rich link resource and multiple equal-cost paths between servers. Hence, the unicast packet repair path has high probability to bypass the multicast tree. For example, in a Fat-Tree network with 48-port switches, there are typically 576 paths between two servers. Hence, if weuse unicast packet repair and randomly choose a core-level switch, the repair path has a probability of to bypass the core-level switch used in the multicast tree.The probability is also high to bypass the low-level switches in the multicast tree. In a typical BCube network, between any two servers, there are shortest paths and parallel shortest paths. Consequently, when using unicast for packet repair, with a probability higher than that the repair path bypasses the multicast tree.

Overall, there are several advantages to transmit the repair packets in a peer-to-peer unicast way in richly-connected data center networks. First, the repair burden on the multicast source is reduced. Second, when node/link failure occurs in the multicast tree, transmission pause can be avoided. Third, given link congestion in the multicast tree, the congested link will not be exacerbated by repair packets. Existing Internet oriented reliable multicast protocols using peer-driven packet repair usually take a gossip way [28]–[30]. However, data center network builds an explicit multicast-treeaware backup overlay by leveraging the managed environment and the topological information of data center networks. Using the backup overlay, the packet repair responsibility among receivers is determined. Hence, we can both achieve repair isolation and avoid duplicate replication. Data Center Network gracefully handles link/switch failures by adjusting the multicast tree and the backup overlay. Data Center Network also realizes congestion control to accommodate the source sending rate to the traffic status. In the following subsections, we present the backup overlay construction, packet repair scheme, failure handling, as well as the congestion control mechanism in data center network, respectively.

3.2 Backup Overlay

In RDCM, the multicast manager not only builds the multicast tree for a group, but also constructs a backup overlay on the multicast tree for reliable packet delivery. A backup overlay is composed of a number of overlay rings. Each branching node, i.e., the one with more than one children, in the tree, has a corresponding overlay ring. The overlay ring for a level- (starts from 0 at the lowest leaf level) branching node , denoted as , is called a level- overlay ring. If node has children nodes in the tree, is composed of receivers. The receivers are selected from each branch rooted from . If is one of ’s children in the tree, the downstream receiver of chosen to join is called the overlay proxy for , denoted as .Hence, the length of an overlay ring is bounded by the number of switch ports in data center network. Within an overlay ring, each receiver has an overlay successor and an overlay redecessor.

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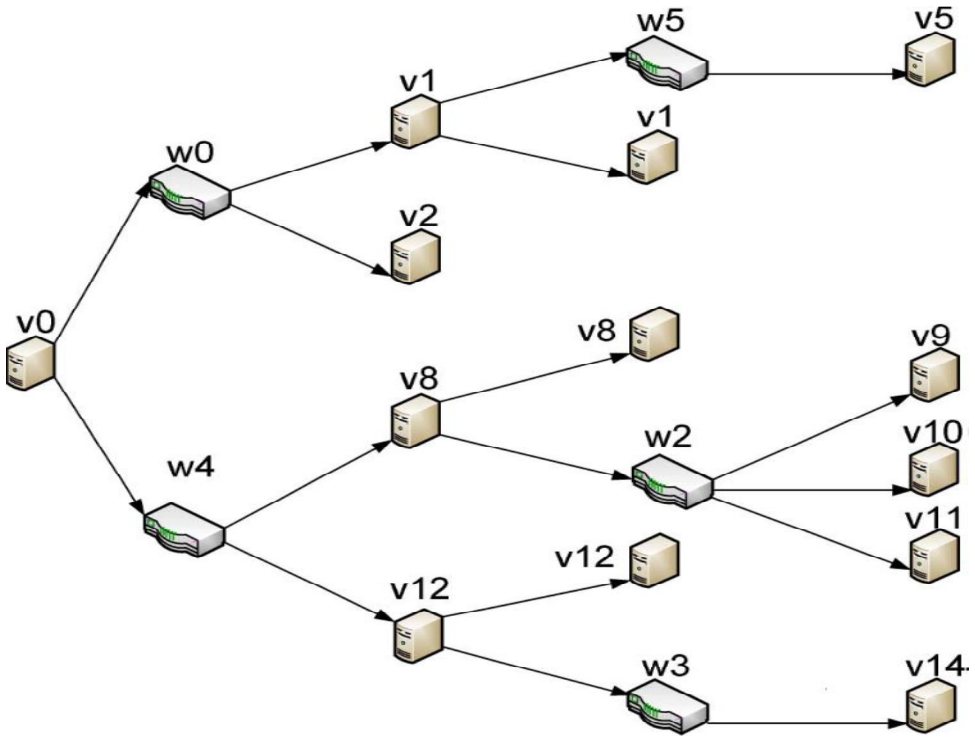

Fig. 3. A multicast tree in BCube network

In addition, is called the tree parent for , is called the overlay parent for , and the receivers in are called the overlay children for . Specifically, the sender is the overlay proxy for itself. It joins no overlay ring but it is both the tree parent and the overlay parent for the highest-level overlay ring in the backup overlay. The sender is v0 , and the receiver set is{v2,v3,v5,v8,v11,v12}. The multicast tree1 is shown in Fig. 3. Note that for a BCube server which is both a receiver and a forwarder in the multicast tree, it is regarded as a switch connecting a child receiver of itself, such as .

The backup overlay upon the multicast tree. There are 7 overlay rings, each corresponding to a branching node in the multicast tree. For instance, the overlay ring is composed of two receivers, and , which are the overlay proxies for (switch) and (switch) respectively. is the tree parent for . (receiver) is the overlay proxy for and thus the overlay parent for . and in are both the overlay children of . Within , and are both the overlay predecessor and overlay successor for each other. illustrates the whole procedure to build the backup overlay for a multicast tree . It takes a bottom-up way, i.e., from lowest-level branching tree nodes up to the sender. The overlay ring for a tree node is constructed only after the overlay rings for all its children nodes are constructed. Then, if has only one child, no overlay ring is built for it.

Otherwise, for each of ’s children, say , its overlay proxy is selected from its downstream receivers which has joined the least overlay rings; and all the overlay proxies for ’s children. We first construct the overlay ring for the lowest-level branching node , which is composed of the three receivers, namely, and . It is called a level-1 overlay ring. Then there are three level-2

1. The algorithm to construct the multicast tree is beyond the scope of this paper.
The algorithm describe about the multicasting of the data resources in the data centre packet in the multicasting network. This Disjkstra algorithm is used for the finding the minimum path for the data or the packet to be downloaded. This algorithm gives the shortest path from the host requested to the destination host. This uses the reduction of the data traffic on the networking. this the reduction of the traffic also increase the delivery time of the packet delivery. This is also used to reduce the packet loss of the data. The backup overlay upon the multicast tree. There are 7 overlay rings, each corresponding to a branching node in the multicast tree. For instance, the overlay ring is composed of two receivers, and , which are the overlay proxies for (switch) and (switch) respectively. is the tree parent for . (receiver) is the overlay proxy for and thus the overlay parent for . and in are both the overlay children of . Within , and are both the overlay predecessor and overlay successor for each other. illustrates the whole procedure to build the backup overlay for a multicast tree . It takes a bottom-up way, i.e., from lowest-level branching tree nodes up to the sender. The overlay ring for a tree node is constructed only after the overlay rings for all its children nodes are constructed. Then, if has only one child, no overlay ring is built for it.

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TABLE 1
Algorithm 1: MT4HD

Input: A network graph G=(V,E), source node s, and multicast receivers sorted by the demands M⊆ V
Output: A multicast Tree T. $txRate_{req}(i)$ for ∀i ∈ T

1: T ← ∅ ∪ {s}
2: $txRate_{req}(s) \leftarrow maxDemand$
3: Set a level to each node with BFS
4: **for** l = 1; l < $maxLevel$; l = l + 1 **do**
5: S ← {node v|v belongs to level l}
6: $M_S \leftarrow M \cap S$
7: **While** M_S not empty **do**
8: m ← $\text{argmax}_{i \in M_S} demand(i)$
9: **for** ∀ edge e = (i, j) ∈ E **do**
10: **if** j ∈ T and i ≠ $parent$(j) do
11: cost(e) ← infinite
12: **else if** $demand(m) - txRate_{req}(i) < 0$ **do**
13: cost(e) ← 0
14: **else do** cost(e) ← $demand(m) - txRate_{req}(i)$
15: **end if**
16: **end for**
17: path ← Dijkstra (s, m, cost)
18: **for** ∀ node i ∈ path\m **do**
19: **if** $txRate_{req}(i) < demand(m)$ **do**
20: $txRate_{req}(i) \leftarrow demand(m)$
21: **end if**
22: **end for**
23: $M_S \leftarrow M_S - \{m\}$
24: **end while**
25: **end for**

3.3 Packet Repair Scheme

Packet repair in RDCM is carried on in a peer-to-peer way on the backup overlay. Packet Acknowledgement: Each packet is assigned with a sequence number. Areceiver acknowledges a packet in the following way. First, when receives packet , either from the multicast tree or from the backup overlay, it sends an ACK for to both the overlay predecessor and the overlay parent in its leaf overlay ring. Second, when receives the ACK for from its overlay children for the first time, it sends an ACK for to both the overlay predecessor and the overlay parent in its proxy overlay ring. All ACK packets are unicast. The hierarchy fashion of ACK is also used in RMTP [19]. An example, when receives the packet , it sends the ACK for to and , which are its overlay predecessor and overlay parent respectively in its leaf overlay ring, .

When receives the first ACK for packet for a packet from one of its overlay children in overlay ring (either or), it sends an ACK for to and , which are the overlay predecessor and the overlay parent respectively in its proxy overlay ring, . In this way, in the leaf overlay ring a receiver joins, it receives ACK for each packet only from its overlay successor in the ring. If a receiver joins a proxy overlay ring, it also receives ACK for each packet from its overlay successor in the ring as well as its verlay children. The sender receives ACK only from its overlay children. Note that the number of overlay children for a receiver is bounded by the number of ports in a switch, say, , which is usually a small constant. As a result, a receiver/sender receives at most ACKs from other receivers, independent of the group size. ACK implosion is thus effectively avoided in RDCM. In practice, to further reduce ACK messages exchanged, a receiver can choose to send one ACK for multiple packets, instead of acknowledging each one in a separate packet.

Repair Window: Every receiver maintains a repair window for packets received from both the multicast tree and the backup overlay. Packets within the repair window are buffered. The upper bound of the repair window is the highest sequence number among the packets received. The lower bound of the repair window at a receiver is moved up if all the following conditions are satisfied for the corresponding packet . First, has received . Second, has received ACK for from its overlay successors of all the overlay rings it joins.

Third, has received an ACK for from one overlay child if it joins a proxy overlay ring. Hence, each receiver only needs to wait for at most 3 ACKs before moving the window up and releasing the buffer.

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Specifically, the sender also has a repair window. Since it is the overlay parent for the highest-level overlay ring, the repair window is moved up when receiving an ACK for the corresponding packet from any overlay child. Packet Repair: In RDCM, repair packet is either unicast within an overlay ring or multicast by the sender. We first discuss packet repair within overlay rings. Each receiver is responsible for packet repair to its overlay successors in all the overlay rings it joins. If a receiver detects that its overlay successor has lost a packet (by timing out for the ACK), it immediately transmits the repair packet. From Theorem 1, every receiver is responsible for repairing packets to at most two other receivers, no matter how large the group size is. Hence, the repair burden for an individual receiver in RDCM is quite low. It not only balances the repair loads on receivers, but also disperses the repair traffic to the whole network. When a packet gets lost in the incoming link of a level node in the multicast tree, all the downstream receivers of will lose the packet. In this case, will receive the repair packet from the level-( ) overlay ring it joins. After that, each downstream receiver of transmits the repair packet to overlay successors after receiving it. In this way, the repair packet can be distributed to all the downstream receivers of . In the example of Fig. 7, assume a packet is lost in the incoming link to , then all downstream receivers of will miss the packet. Then, , the overlay proxy for , will receive repair packet from via the level-4 overlay ring it joins, . Note that buffers the packet because it does not receive ACK for the packet from . The repair packet is unicast and is probable to bypass the incoming link to in the multicast tree. After receives the packet, it repairs it to in the level-2 overlay ring of . Then repairs to . Next, sends the packet simultaneously to and . Finally, repairs to in the level-2 overlay ring of , and all the downstream receivers of receive the repair packet. When the sender receives no ACK for a packet from its overlay children, all the receivers should lose this packet based on our design. Then the sender multicasts the repair packet to the whole tree. But this case should rarely occur.

Repair Traffic: In a typical backup overlay, most overlay rings are formed by leaf nodes in the multicast tree. Note that in the overlay rings formed by leaf nodes, the neighbouring nodes are usually connected to the same switch and are only two hops away. For example, the overlay rings , , , and in Fig. 7. Compared with the most traffic-saving packet repair method using multicast (or scoped multicast), our repair scheme only doubles the overall repair traffic for receivers experiencing packet loss. But we require no intelligence from switches to realize complete repair isolation. Besides, when severe packet loss occurs and a large number of packets are repaired on the backup overlay, RDCM can help adjust the multicast tree to a new one, as presented later.

Repair Latency: The repair latency in RDCM can be higher than other reliable multicast schemes. But it is limited for two reasons. First, when a receiver joining two overlay rings receives a repair packet, it simultaneously sends out the packet to both its overlay successors in the two overlay rings, and thus the repair packet is transmitted in parallel on the backup overlay. Second, dominant hop-by-hop repairs occur in the lowest-level overlay rings as we depend tree-based multicast, which crosses only two physical links. The time needed to detect packet loss also accounts for repair latency. But the number of hierarchies in the RDCM ACK is usually small because the diameter in modern data center networks is low. Note that RDCM is primarily designed for data-intensive applications in data centers, in which application throughput is more important than end-to-end latency. Hence, we argue that the repair latency in RDCM is acceptable for the applications it is intended to support.

3.4 Tree and Backup Overlay Adjustment

In RDCM, the multicast tree and the backup overlay are adjusted upon receiver dynamics, as well as node/link failure in the multicast tree.

Receiver Dynamics: When receiver dynamics occur, including receiver join, receiver leave or receiver failure, the multicast tree is reformed based on the updated membership. RDCM also adapts the backup overlay to the added/deleted members. When a new receiver joins a multicast group, the multicast manager inserts the receiver to an appropriate position in the multicast tree. Then, the backup overlay is recalculated according to the new tree. When recalculating, RDCM minimizes the changes to the existing backup overlay.

Typically, we only need to update the overlay ring for the branching tree node which adds a branch for the new receiver. The new receiver starts to get data from the multicast tree and the buffer of its overlay predecessors in the back overlay. Note that RDCM does not guarantee that newly joined receiver can receive the data from the first byte of the multicast session before its join. When a receiver leaves the multicast session, the multicast manager deletes the leaving receiver from the multicast tree. The backup overlay is updated by changing the overlay ring for the branching tree node which deletes a branch for the leaving receiver.

RDCM continues to transmit data to other receivers alive. For graceful receiver leave, the leave message is directed to the multicast manager, and it is easy to adjust the multicast tree and backup overlay. When receiver

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crash happens, RDCM tries to detect the failed ones. The detection is easy to conduct by the backup overlay. Every receiver joins at least one overlay ring in the backup overlay and acknowledges the received packets to its overlay predecessor. Suppose is the overlay successor of in an overlay ring. When it timeouts for to receive ACKs from , transmits repair packets to . If fails in the packet transmission via backup overlay, it is an indication that has failed. Then, sends a receiver failure message to the multicast manager, and the backup overlay will be accordingly adjusted.

Link Failure: When a multicast receiver gets all the packets from the backup overlay for a period of time, it is an indication that switch/link failure occurs in the multicast tree. Fortunately, RDCM can help detect and identify failed links in the multicast tree, and both the multicast tree and the backup overlay can be adjusted. We let each receiver monitor both its overlay successor . When finds that receives all the packets from the backup overlay (it is feasible since is responsible for packet repair to), it sends a link failure report to the multicast manager. In this way, for a failed link in the multicast tree, only one receiver is responsible for sending the link failure report, no matter where the failed link lies.

For instance, when the link fails, is responsible for sending the report. The tree adjustment message from contains the identity of . When the multicast manager receives the report, it infers the failed link as follows. At first it assumes there is a single link failure. The report implies that the tree parent for the overlay ring including both and , say, tree node , works well. Then, the failed link set is inferred to be composed of the links from node down to the first branching node or along the multicast tree. The failed link can be any one from this set, and not beyond. So the inference has zero false negative. We cannot further identify the exact failed link from the set.

The multicast manager kicks all the links in this set off the data center topology, and accordingly updates the multicast tree as well as the backup overlay. The rich link resource in data center networks can tolerate the possible false positive of the failed link inference. An example. When the multicast manager receives a link failure report from containing the identity of , it implies that is working well and the failed link set is inferred as { , }. Then, the two links are deleted from the data center topology. The multicast tree and the backup overlay are recomputed. If a link failure report is triggered by multiple link failures instead of a single one, we cannot guarantee that the adjusted tree above contains no failed links. However, in this case, another link failure report will be triggered and the tree can be further adjusted. Our backup overlay avoids transmission pause during the tree-switching period given that data center topology is not partitioned. The multicast manager maintains a global set to record the failed links inferred by link failure reports, and the information is shared among all the multicast groups. The failed links in the global set can be periodically activated to utilize the recovered ones. Of course, link failure information can also be obtained in out-of-band ways and integrated into RDCM to help adjust the multicast tree and the backup overlay.

Repair Window Management when Switching Overlay Rings: When the backup overlay is adjusted, the overlay rings a receiver joins can also change. If the receiver exits all the previous overlay rings and joins new overlay rings, there may exist a problem on repair window management. For example, a receiver previously joins one overlay ring .Now it exits and joins a new overlay ring . Assume the overlay predecessor of in is , while that in is . If exits immediately after joining , may fail to receive its lost packets because has already released them in its repair window. To solve this problem, we let still lie in after joining , until when it can receive lost packets from in the new overlay ring. However, when a receiver crashes, its overlay successors may not be able to receive some lost packets. In this case, the affected receivers send specific requests to the multicast sender for these lost packets.

3.5 Congestion Control

RDCM realizes congestion control, by accommodating the sending rate of the multicast sender to the traffic status. The traffic sending rate at the multicast sender should be no higher than the receiving rate at the lowest receiver. To be TCP friendly, we let the lowest receiver achieves the throughput as if a TCP unicast connection were running between itself and the sender. For scalability consideration, the rate estimation algorithm is running at each individual receiver instead of at the sender. There are two basic congestion control approaches, namely, rate based and window based [31]. In rate based congestion control, each receiver calculates the receiving rate as the TCP throughput under the same packet loss ratio. However, this approach requires measuring the end-to-end delay between the sender and receiver. Accurately measuring the end-to-end delay is quite difficult in data center networks, since the delay is in the order of micro-seconds, which can be sensitive to various server/network conditions (e.g., the processing time in the sender/receiver). The measurement will also introduce significant burden on the sender.

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Therefore, we prefer window based congestion control in RDCM. Each individual receiver maintains a congestion window, the size of which is updated using the BIC (Binary Increase Congestion Control) algorithm [37]. Packet loss is used as the signal for congestion. Note that most repair packets traverse data center links other than the multicast tree in RDCM, hence the repair packets have no/little contribution to the congestion on the multicast tree. As a result, for a receiver whose congestion window size is , if the maximum sequence number received is , the highest expected sequence number within the next RTT is set as . All the receivers report the highest expected sequence number to the multicast sender, and the sender sends out packets to accommodate the slowest one. The congestion window on an RDCM receiver should be smaller than the repair window, because the repair window also needs to maintain the repair packets.

Let's consider the case if repair packets pass the multicast tree. Then the repair packets should also be accounted in the congestion window. Hence, the highest expected sequence number in the next RTT on a receiver is , where is the number of lost packets below . It is easy to get that there is > . Compared with the packet repair schemes traversing the multicast tree, RDCM relaxes the constraints on the packets sent out by the multicast sender, and naturally enhances the multicast throughput. Ideally, each receiver can immediately detect packet loss when it occurs, update the congestion window, and send to the sender. But in practice, the delay in detecting packet loss (depending on the length of timer) will result in some "lag" in responding to the congestion. The lag can cause further congestion and packet loss. But longer buffering queues in switches can mitigate the problem and help improve multicast throughput.

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