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Geotechnical Investigation and Rehabilitation of Road Distresses in Jigme Namgyel Engineering College

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Abstract— *A subjective assessment was carried out to study and evaluate geotechnical parameters of road subgrade in Jigme Namgyel Engineering College. A total of 1.93 km of road length was taken for assessment of subgrade soil. The study area is divided into six sections based on the visual perceptive and identified distresses along the road network. Each section is divided into three or four sampling stations with three samples from each station. The geotechnical parameters were obtained through geotechnical investigations that includes Dynamic Cone Penetration Test, Atterberg's Limit test, Standard Proctor test, In-situ moisture content test and specific gravity test. The soil type from each section of the road is being classified based on the prescribed standards of Unified Soil Classification System (USCS) and American Association of State Highway and Transportation Officials (AASTHO). The results were analyzed to identify the conditioning factors for deterioration of the pavement and impact of pavement layer, soil type and terrain on the performance of the pavement. The functional failures constituting constructional defect was identified as one of the main contributors for the failure of the pavement. The degree of distresses were compared with some of the standard rating criteria and most of the distresses were found to contribute to the poor performance of the pavement. The measures taken to resolve the pavement deterioration based on index properties of the soil and California Bearing (CBR) of the subgrade were to design a pavement of suitable thickness are per guidelines of Indian Road Congress (IRC) for critical sections and prepared an estimate cost for resurfacing of road network in Jigme Namgyel Engineering College.*

Keywords— Sub-grade, Distresses, Atterberg limit, California bearing ratio, Dynamic cone penetration, USCS, AASHTO, IRC, CBR

1. INTRODUCTION

Geotechnical Engineering is a branch of civil engineering that deals with engineering properties of earth materials. The knowledge of geotechnical engineering is not limited to civil engineering purposes but it is widely being used in military, mining, petroleum, and other engineering disciplines that are concerned with constructions occurring on the surface or within the ground. Basically, geotechnical engineering is the study of behavior of soils under the influence of loading forces and soil water interactions.

Before the execution of any construction works on the ground, it is of prime importance to understand the soil parameters. The subgrade constitutes the foundation materials for the pavement structure as highway pavements ultimately rest on the native soil which is termed as sub grade. Hence, the performance of the pavement is affected by the characteristics of the sub grade. And one of the major functions of a highway pavement is to reduce the stresses transmitted to the sub grade to a level which the soil will accept without significant deformation.

It is also important to note the basic characteristics of soils and the engineering properties of the soils depend among others on the geological processes and mechanics of soil formation i.e. origin and formation of soils and mode of transportation or deposition.

The study on geotechnical investigation was carried out to study/obtain information on the physical properties of soil to check the stability of road sub grade in Jigme Namgyel Engineering College for the purpose of recommendation for road repair and maintenance work as the road is in poor condition with many observable distresses.

2. LITERATURE REVIEW

As per Kumar et al. (2001) **[1]** sub grade soil should be non-expensive in nature having more than 8%. Besides CBR% test various other tests such as Atterberg limit test, moisture content test, compaction tests and specific gravity test are also important to conduct for identifying the causes of

flexible pavement failure.

According to Panchal & Kumar, (2015) **[2]** design of the various pavement layers is very much dependent on the strength of the sub grade soil over which they are going to be laid. Sub grade strength is also depending on the basic properties of the soil. Subgrade strength is mostly expressed in terms of CBR (California Bearing Ratio). Weaker subgrade essentially requires thicker layers whereas stronger sub grade goes well with thinner pavement layers.

Dunganaa and Dubjur, (2016) **[3]** carried out a study on present condition of farm road pavements in Bhutan. Three farm roads, each in Phuentsholing, Tsirang and Paro were selected for the study, taking into considerations the road environment parameters. The results were analyzed to identify the conditioning factors for deterioration of the pavement of farm roads. The constructional defect was identified as one of the main contributors for the failure of the pavement of farm roads.

The study area was chosen due to the poor road conditions exhibiting the signs of structural and subgrade failure which can later lead to increase in the cost of maintenance, operation and construction. The selected road network is divided into six sections based on the visual perceptive, length of the road and presence of distresses. From every section, several sampling stations have been established to take the samples for study. The study area is being divided into six sections as shown in Fig. 1. The details of eachsection are shown in Table 1.

3.2 Preliminary survey

The preliminary survey for this research covers the following procedures.

- Visual inspection and identifying of various distresses in JNEC road network.

- Dividing the road network into various sections.

- Recording the attributes of major road distresses for different sections of road.
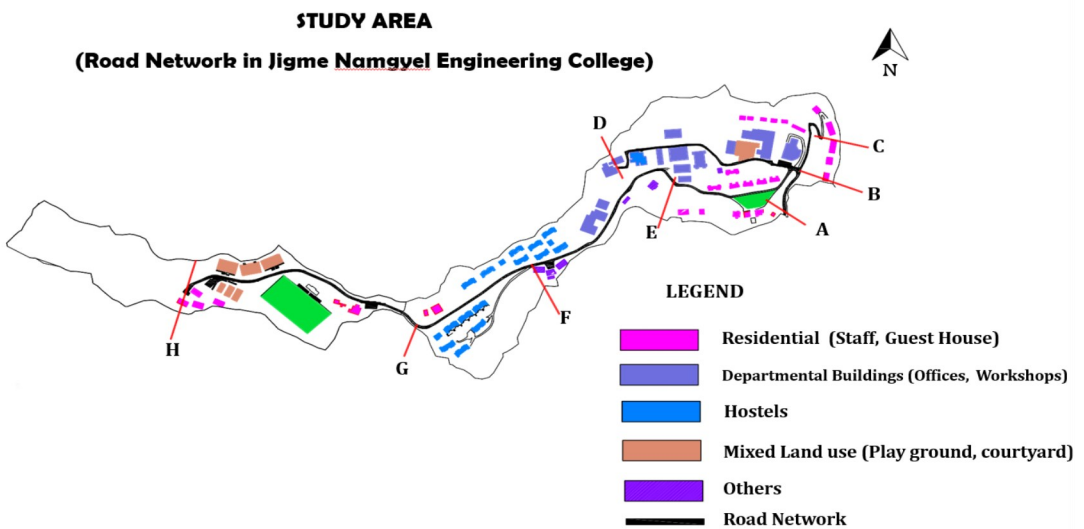

Fig.1. Study Area

3. METHODOLOGY

3.1 Study Area

The study area is at Jigme Namgyel Engineering College which is located at a height of 800 meters (2,600 feet) above sea level at the west end of Dewathang town under Samdrup Jongkhar.

- Identification of areas for establishment of sampling stations along different sections of road.

Major pavement distresses in the road networks of Jigme Namgyel Engineering College are identified as follows:

`Table 1`: Details of study Area

Section	Road Length (m)
Section 1 (A-C) (College gate to Parking Lot)	250.7
Section 2 (B-D) (Junction near IT building –Mechanical Engineering Department)	400.61
Section 3 (B-E) (Junction near IT building – Carpentry Workshop)	250.29
Section 4 (E-F) (Carpentry Workshop – Dining Hall)	360.06
Section 5 (F-G) (Dining Hall – New Guest House)	250.07
Section 6 (G-H) (New Guest house – Staff Residential Parking Lot)	415.62

Pot-holes- Pot holes are small bowl-shaped holes developed on the surface layer of flexible pavements, generally after the rains. Formation of potholes is the most common type of distress or defect along the pavement of college which were devel-

Fig. 2. Potholes

oped due to wearing of bituminous surfacing.

Raveling- Raveling is the progressive breakdown (roughening) of the slab to depths commonly of 6mm to 12mm. Raveling is the ongoing separation of aggregate particles in a pavement from the surface downward or from the edges inward.

Fig. 3. Raveling

Edge Cracking- Crescent-shaped cracks or continuous cracks that intersect the pavement edge and are located within 2 feet of the pavement edge, adjacent to the unpaved shoulder. The most common cause for this type of crack is poor drainage conditions and lack of support at the pavement edge as a result, the underlying base materials settle and become weak.

Fig. 4. Edge cracking

Alligator Cracks-Alligator cracking is a load associated structural failure. The failure can be due to weakness in the surface, base or sub grade; a surface or base that is too thin; poor drainage or the combination of all three. It often starts in the wheel path as longitudinal cracking and ends up as alligator cracking after severe distress.

The affected areas calculated for each section by road distresses are represented by a graph as shown in Figure 6

Fig. 5. Alligator Crack

3.3 Geo-technical Investigation

The geo-technical investigation in six sections were conducted following the guidelines of USCS which provides a suitable data ranges for different soil test performed on soil samples.
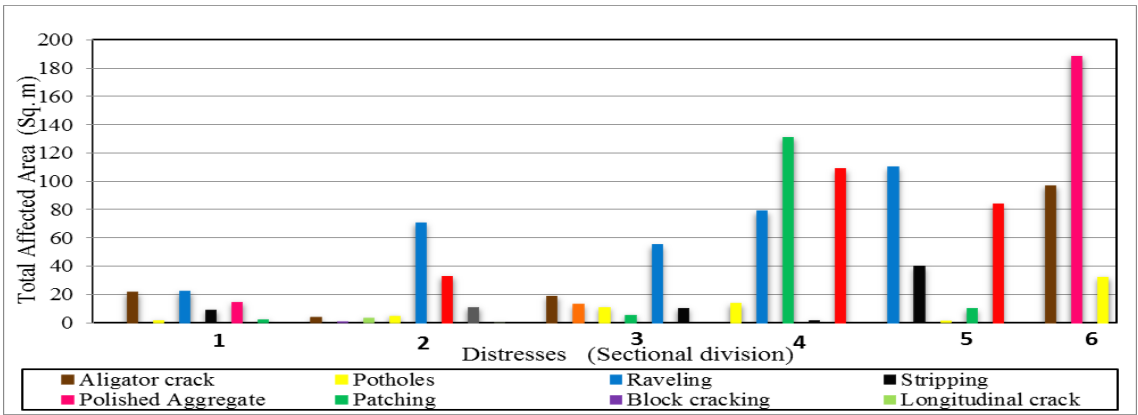
Fig. 6. *Graphical Representation of Distresses*

Determination of index properties of soil through laboratory tests on soil samples and CBR values through filed test were carried out for different sections.

3.3.1 Field Test

Dynamic Cone Penetrometer

Dynamic Cone Penetration (DCP) testing is one of many forms of in-situ soil characteristic tests that are designed to assess soil density and also used to measure the strength of in-situ soil. It also provides the thickness and location of subsurface soil layers. With the help of DCP, CBR value can be calculated using the correlation as

Log_{10} CBR = 2.48 – 1.057 log_{10} (DCPI)……..(i)

CBR method is the most reliable means of evaluating the strength of the subgrade and construction materials and estimating the required thickness of pavement to satisfy a given loading.

3.3.2 Laboratory Test

The laboratory test involves various test on soil samples for determination of index properties of soil which involves the following.

In-situ moisture content

The natural water content also called the natural moisture content is the ratio of the weight of water to the weight of the solids in a given mass of soil. This ratio is usually expressed as percentage. The objective of in-situ moisture content is to determine the natural water content of the given soil sample which is also used in determining the bearing capacity and settlements in the soil. Nevertheless, it gives an idea of the state of soil in the field.

Plasticity Index

Plasticity Index is the numerical difference between the liquid limit and the plastic limit of the soil and indicates the magnitude of the range of the moisture contents over which the soil is in a plastic condition as defined by the tests. The liquid and plastic limits are both dependent on the amount and types of clay in a soil, but plasticity index is solely dependent on the amount of clay present.

Plasticity Index (Ip) = LL – PL………..(ii)

Grain-size distribution

This test determines the particle size distribution of soil from the coarse sand size down to fine silt and clay size. The data for particle size distribution test is used to determine suitability of soil for road construction.

Compaction (Standard Proctor Test)

This test is used for the determination of the mass of dry soil per cubic meter when the soil is compacted over a range of moisture contents, giving the maximum dry density at optimum moisture content. Thus, this test provides the compaction characteristics of different soils with change in moisture content. This is achieved by densification of soil by reducing the air voids. The dry density is maximum at the optimum water content.

Table 2. *CBR Values*

Sl. No.	Section	Samples	CBR value (%)
1	1	S-1	14.7
		S-2	31.8
		S-3	13.2
2	2	S-1	14.3
		S-2	10.5
		S-3	8.1
		S-4	19.2
3	3	S-1	13.1
		S-2	14.4
		S-3	20-8
4	4	S-1	42.7
		S-2	43
		S-3	18.6
5	5	S-1	13.1
		S-2	16.9
6	6	S-1	25.9
		S-2	31.4
		S-3	21

3.4 Data Representation

As per the result obtained from the various soil tests conducted and having compared with the various standard range the value obtained are shown in Table 2 and Table 3.

4. RESULT

The result interpretation from Table 2 and Table 3 shows that all the soil parameters are within the permissible range of USCS. Few soil parameters have a deviation from the prescribed ranges but due to its negligible percentage differences, the values can be considered for analysis. Thus, the result obtained showed that the subgrade soil has not much effect in the failure of pavement. Functional failure is dominant in all road sections. Hereby, it can be concluded that the possible causes of functional failures could be due to;

- Poor drainage system.
- Poor road maintenance and monitoring system.

- Increase in traffic volume.
- Improper mix-ratio of pavement materials of existing road.

Section 3 and 4 falls under the most critical conditions. These sections were suffering from high degree of pavement distresses and requires immediate rehabilitation strategies.

5. RECOMMENDATION

All the pavement sections are deteriorated by various road distresses with poor drainage system which has led to increase in maintenance cost, vehicle operation cost and construction cost. The following are the recommendations based on data obtained from various road sections.

5.1 Complete design of road according to IRC-37

For designing of flexible pavement of Access Road for mountainous terrain, the following data are required.

Based on the design requirement, flexible pavement for critical sections 3 and 4 were designed as shown in Fig. 7. Fig. 8 provided an isometric de-

Table 3. *Laboratory Test Results*

Sl.No.	Samples	Compaction Proctor Test	In-situ moisture	Plasticity Index	Sieve Analysis Test
	S-1-1	OMC=22.67 MDD = 1.6	27.41	8	Cc= 0.62
1	S-1-2	OMC = 21 MDD =1.69	23.9	3.8	Cc= 0.93
	S-1-3	OMC = 27.5 MDD =1.45	29.3	13.17	Cc= 0.89
	S-2-1	OMC = 31.9 MDD =1.42	27.94	11.45	Cc= 0.83
2	S-2-2	OMC = 30.8 MDD =1.38	31.84	16.67	Cc= 0.86
	S-2-3	OMC = 29 MDD=1.50	33.77	17.57	Cc= 0.90
	S-2-4	OMC = 25.1 MDD =1,61	28.02	6.23	Cc= 0.94
	S-3-1	OMC = 13 MDD =1.81	15.24	8.07	Cc= 0.91
3	S-3-2	OMC =17 MDD =1.8	21.55	5	Cc= 0.76
	S-3-3	OMC = 26.5 MDD =1.45	26.35	10.58	Cc = 0.86
	S-4-1	OMC = 24 MDD =1.55	23.97	11.46	Cc= 0.68
4	S-4-2	OMC = 19 MDD =1.68	18.6	14.05	Cc= 0.81
	S-4-3	OMC = 12.6 MDD =2.03	12.89	3.02	Cc= 0.85
	S-5-1	OMC=20.06 MDD =1.72	18.18	8.5	Cc= 0.60
5	S-5-2	OMC = 25.5 MDD =1.52	33.56	18.88	Cc = 0.69
	S-6-1	OMC = 17.7 MDD =1.75	17.21	9.65	Cc = 0.78
6	S-6-2	OMC = 18.3 MDD =1.69	19.50	9.39	Cc= 0.74
	S-6-3	OMC = 34.7 MDD =1.42	37.71	26.36	C c= 0.76 C u= 2.41

Table 4. Design Data

Sl.no	Description	Design value	Unit	Remarks
	Single Lane Carriageway			
1.	Initial traffic in the year of completion of construction	30	CV/day	
2.	Traffic Growth Rate per Annum	7.5	Percent	Assumed as per IRC-37
3.	Design Life	15	Years	For Access road as per IRC-37
4.	Vehicle Damage Factor	0.5		For Hilly Terrain as per IRC-37
5.	Distribution Factor	0.6		
6.	Design CBR of Sub grade Soil	8.0	Percent	

iling of the designed road as per IRC standard. The designed pavement incorporates an improved drainage system to reduce the water infiltration into pavement structure.

5.2 Resurfacing of the pavement

The resurfacing for all the sections can provide smooth vehicle movements in the college and the estimate for resurfacing had been worked out as shown in Table 5.

The estimation for overall work comes out to be

Table 5. *Quantity of materials*

Sl. No	Materials	Unit	Quantity
1	Bitumen 80\100	Tonnes	25.41
2	Sand	cu.m	52.5
3	Crushed Rock (12.5 - 6mm)	cu.m	210

Nu.14,25,550.00/-. as per BSR. (In words: Ngultrum Fourteen Lakhs Twenty-Five Thousand Five Hundred Fifty only)

6. DISCUSSION

From this experimental study, following conclusions can be made:

- Based on preliminary survey, it was found out that two sections fall under the most critical conditions. These sections were suffering from high degree of pavement defects and the sections identified were Section 3 and Section 4.

- The major distresses identified in Section 3 and 4 were alligator cracking, pot holes, raveling and edge cracking. The optimal rehabilitation method is either improving the drainage systems or to do the resurfacing of defective length of the pavement with a new pavement design of adequate thickness.

- For sections 1, 2, 5 and 6, complete resurfacing of the road with improved drainage systems can be carried out or total removal of the soil in the damaged area and replacing it with the soil having uniform gradation and strength to prevent the soil from excessive moisture infiltration.

- Since, complete road design demands huge investments, road surfacing with proper drainage systems can improve the performance of the road.

- Constant monitoring in road and drainage condition is essential in critical sections.

- The geotechnical data and suggested design of pavement can be a source of reference to the college in future.

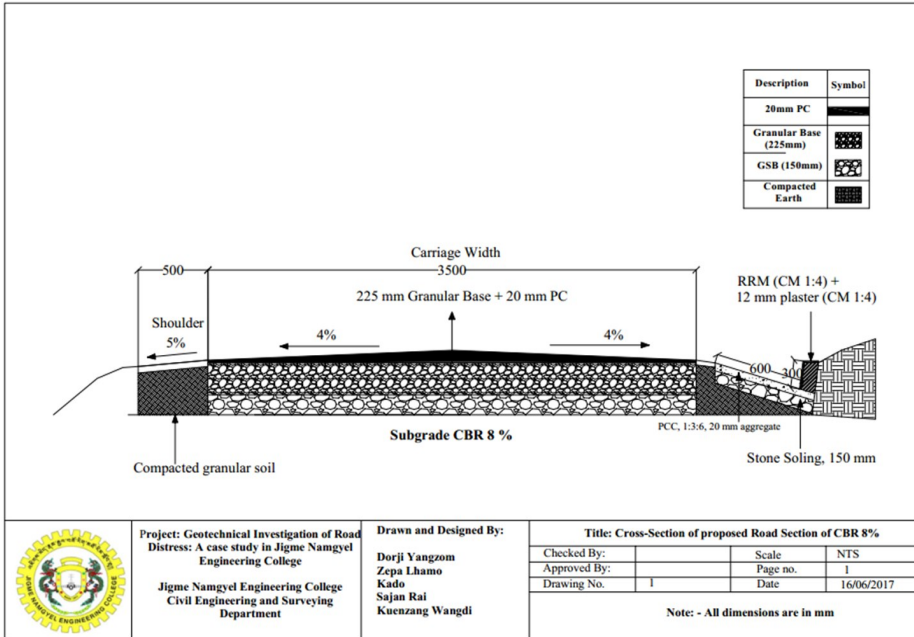## 7. ACKNOWLEGEMENT

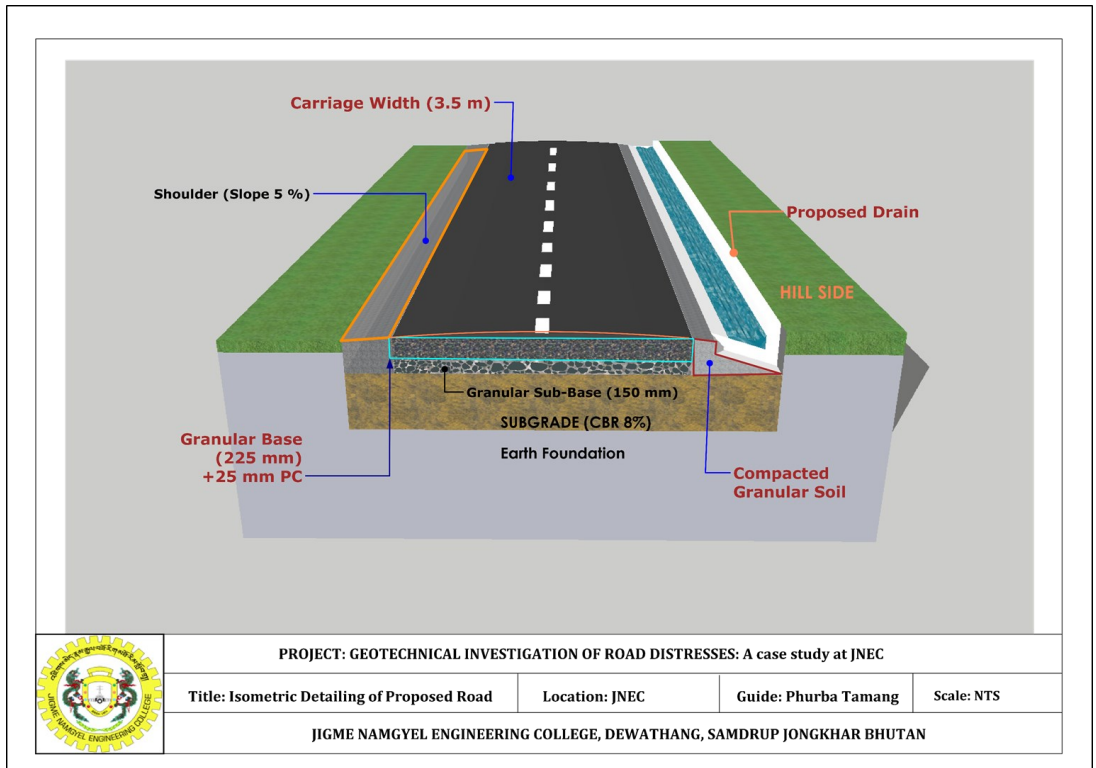**Fig. 7.** *Cross-section of Flexible Pavement*

Fig. 8. *Isometric Detailing of Proposed Road*

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RESERVOIR SITE SELECTION USING GIS IN DEWATHANG

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Abstract

This study examines the location of suitable water reservoir site using the application of the Geographical Information System (GIS). Water scarcity is one of the biggest challenges in Dewathang community. The reserved water can be used for water supply. Digital Elevation Model (ASTER30m) was used to characterize the factors responsible for reservoir site selection. To assign weights to each criterion, the pairwise comparison method based on Analytical Hierarchy Process (AHP) was adopted described by Malczewski, (1999). Based on the selected criteria such as slope, hill shade, watershed, contour, settlement and catchment, five sites for a reservoir was suggested without analyzing the geological effect. By comparing this GIS-based model with prior research and guideline from the literature, the accuracy and effectiveness of this model was evaluated. By formulating these concerns into a single procedural model, it is hoped that designers can use this work to accompany the decision making process during site selection and cost analysis.

Keywords—Digital Elevation Model (DEM), Geographic Information System (GIS), georeferencing, digitizing & geological effect.

1. INTRODUCTION

Water is one of the most important elements on earth. It is one of the resources that cannot be generated but only be preserved and it can be done through construction of reservoirs. Choosing a suitable site is a crucial phase in reservoir construction. GIS is computer based systems that handle the attribute data as well as spatial data where geographical information is an important characteristic. The major part of group work was done on the Deori River which is located in the narrow gauge of the western side of Dewathang community. In the selection of a site for reservoir constructions, certain factors must be considered. These factors have to capture certain variables or constraints in the determination of a suitable site for a reservoir. A raster based GIS was employed to implement the criteria using the Pair Wise Comparison (PWC) method. The PWC method produced potential sites. The outcomes indicated that the developed criteria were sensitive to physical, environmental and economic settings on the study area.

2. METHODOLOGY

A. Study area

Dewathang (Dzongkha: བདེ་བ་ཐང་) is a Gewog under Samdrup Jongkhar District, Bhutan. Dewathang is one of the significant place due to historical events associated with the area during British rule in Indian the late 19th and early 20th centuries.

The major part our project work was done in the Deori River which is located in the western side of Dewathang community. This river act as a boundary that divides Dewathang and Orong.

The latitude and longitude of Bhutan is as following:

Latitude 27.5142° N

Longitude 90.4336° E

The latitude and longitude of Samdrup Jongkhar is as follows:

Latitude 26.8015° N

Longitude 91.5584° E

The latitude and longitude of Dewathang is as follows:
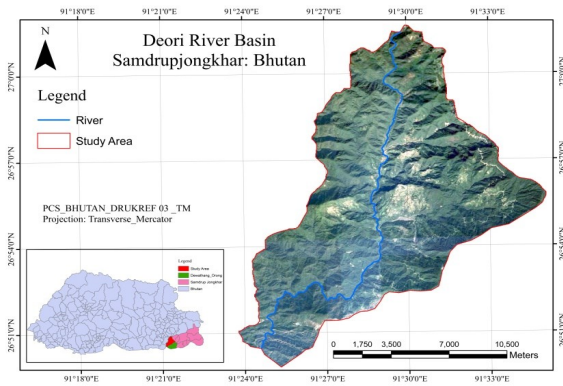
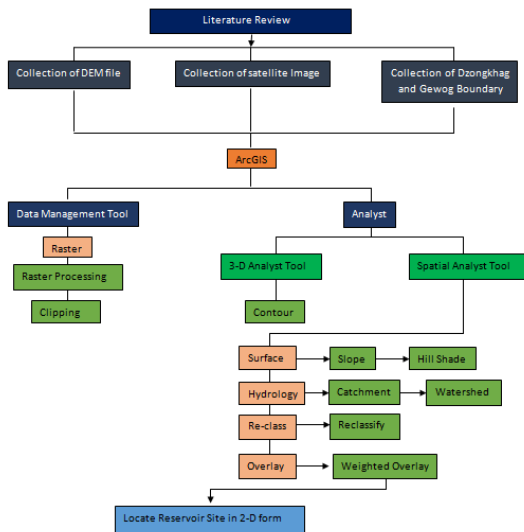Latitude 26.9280° N

Longitude 91.6306°E

Fig.1. Study area

Fig. 2. Methodology flow chart

TABLE I : *Computation of the criterion weights*

Criteria	S	H	CA	W	C	SA	Weight
S	0.285	0.181	0.250	0.307	0.307	0.250	0.263
H	0.142	0.090	0.062	0.076	0.076	0.062	0.081
CA	0.142	0.181	0.125	0.076	0.076	0.250	0.151
W	0.142	0.181	0.250	0.153	0.307	0.062	0.176
C	0.142	0.181	0.250	0.072	0.153	0.250	0.186
SA	0.142	0.181	0.062	0.307	0.076	0.125	0.148

TABLE II : *Weights of the factors*

Factor Selection	Criteria For Selection	Weight-age
Slope	More than 30 degree	26%
Hill shade	Southern Area are Suitable	8%
Catchment Area	Primary level is suitable	15%
Watershed Area	Greater Area is suitable	18%
Contour	Steep area is suitable	19%
settlement	Nearest to Settlement	14%

B. Selection of criteria

The Pairwise comparison method based on Analytical Hierarchy Process (AHP) was adopted to assign weights to each criteria described.

TABLE III : *Random consistency index (RI)*

n	1	2	3	4	5	6	7	8	9	10
RI	0	0	0.58	0.90	1.12	1.24	1.32	1.41	1.45	1.49

C. ESTIMATION OF THE CONSTITUENCY RATIO

The maximum allowable ratio or standard consistency ratio is 0.10 and it should be less than maximum allowable ratio. If CR > 0.10, then some pairwise values need to be reconsidered & the process is repeated until the desired value of CR < 0.10 is reached.

$$Y_{max} = (0.272 \times 3.5) + (0.09 \times 9.5) + (0.215 \times 5) + (0.137 \times 8) + (0.134 \times 11) + (0.172 \times 6.5)$$

$$CI = (Y_{max} - n)/n - 1$$

$$= (6.599 - 6)/ (7 - 1)$$

$$= 0.1198$$

$$CR = CI/RI$$

$$= 0.1198/1.24$$

$$= 0.09 < 0.10$$

The CR value of 0.08 which is less than acceptable maximum CR value recommended in AHP. Hence, the Pairwise comparison is accepted.

3. MAPS, CROSS SECTION & PROFILING

A. Slope

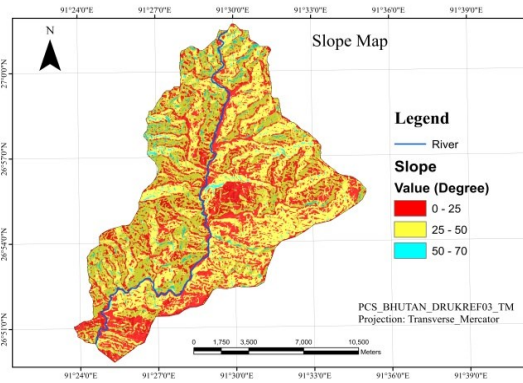Slope represents the rate of change of elevation for each DEM cell. The favorable area for the pro-

Fig. 3. Slope map

should have steep slope to assure the small crest length of the reservoir and accumulate more water.

B. Contour

Contours are the best verification of the topography, if the contours appear to be congested,
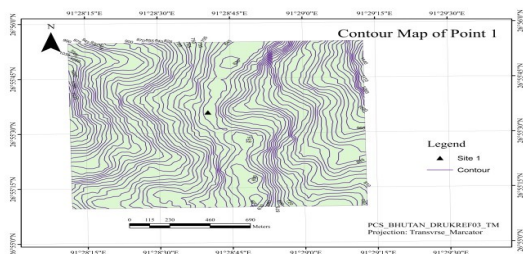
Fig. 4. Contour map of site 1
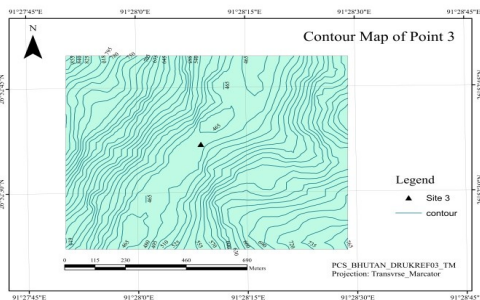
Fig. 5. Contour map of site 2
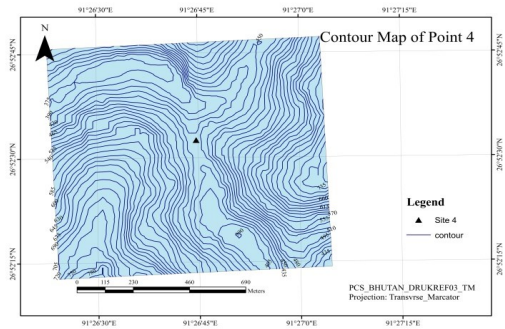
Fig. 6. Contour map of site 3
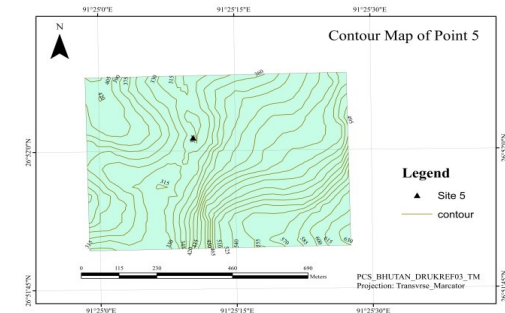
Fig.7. Contour map of site 4

steeper will be the slope and high gradient will accumulate more water.

C. Watershed

Drainage pattern of the watershed explain the main sub-basins which control the gathering of water to the main valleys.
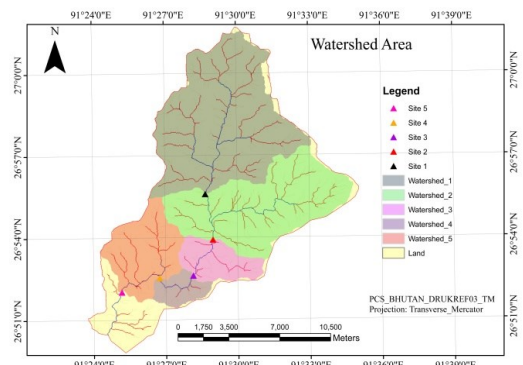
Fig.8. Watershed map
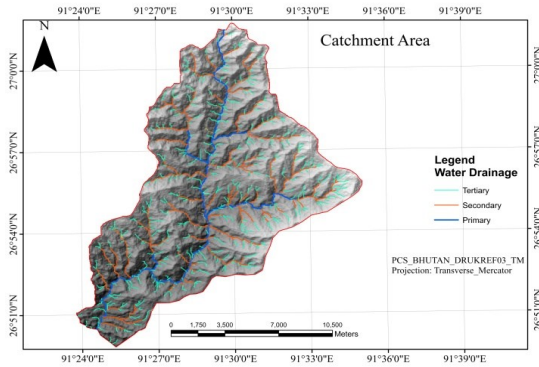
Fig. 9. Catchment area map

D. Catchment area

In this map, the tertiary order represented by the valley which does not branches, when two branches connected together to form secondary order and the maximum order is the primary order. Therefore, for the suitable reservoir site, primary order is
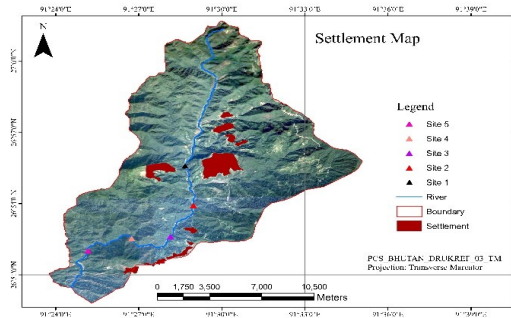

Fig. 10. Settlement map

best applicable as it has more volume.

E. Settlement

The criteria for identifying potential site areas is that the site should be greater than 0.5 km from a settlement for a household to easily access it and less than 5 km from settlement to prevent destruction of property and dislocation of the citizenry in the situation where flooding occurs.

F. Hillshade
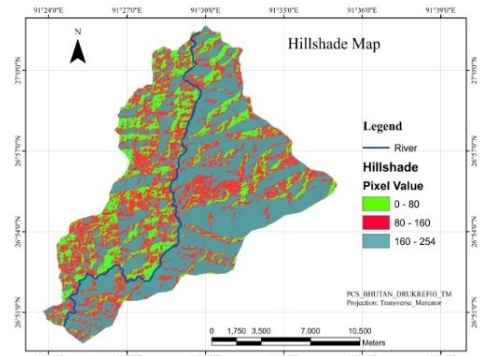
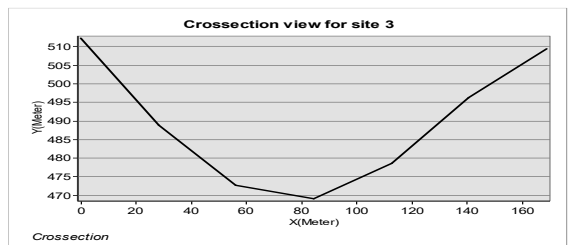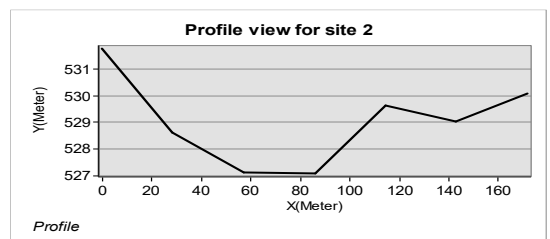Hill Shade map indicates relative slope, hill, or mountains. From this map, we can find the local illumination and whether the cell falls in a shadow or not.
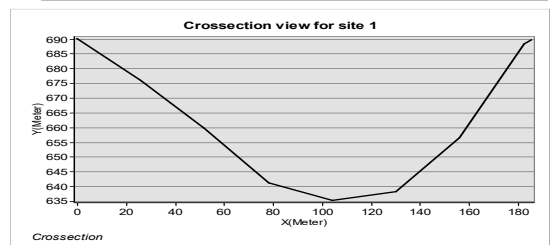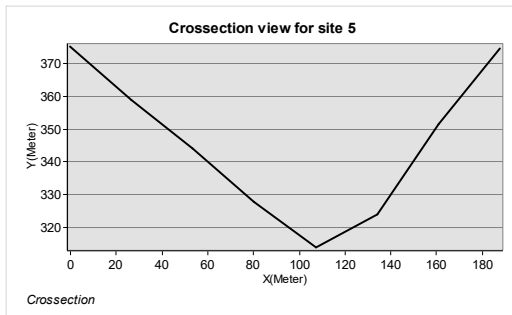

Fig.12. Cross section view and Profile views

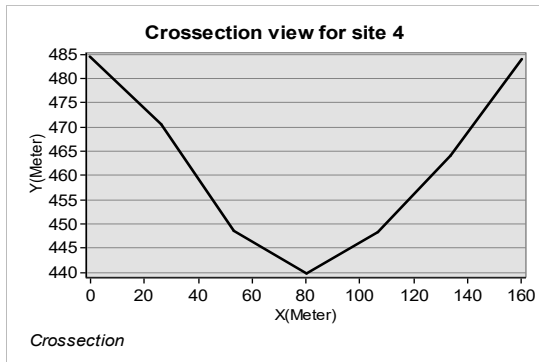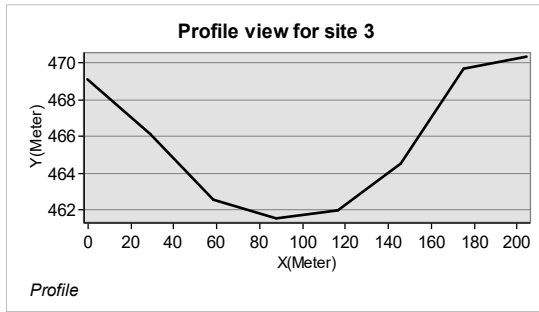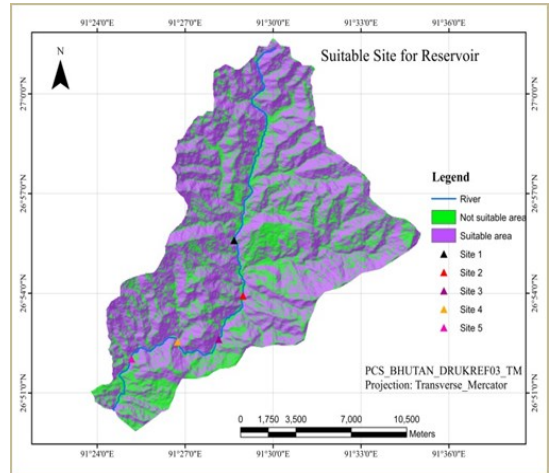Fig.14. Five suitable sites

Fig.13. Cross section view and Profile views

G. Cross section and Profiling

Cross sectional profiles of the identified reservoir sites will close to form a reservoir. Boundary of the reservoir has been demarcated by maximum level of same elevation on both sides of the river.

H. Suitable site

From the above analysis, five potential reservoir sites have been identified which hydrological, settlement, cross section, profile and slope wise favorable
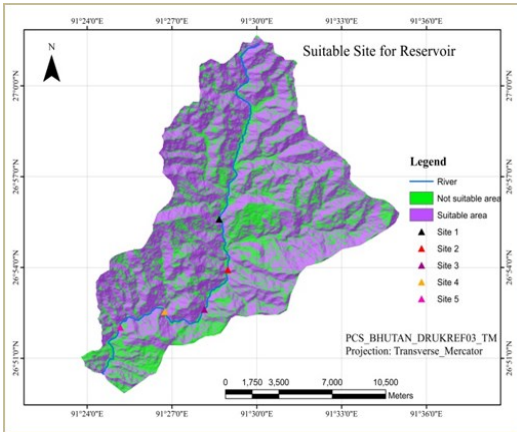
5. RESULTS AND DISCUSSION

Slope is the key factor in hydropower generation as high gradient will accumulate more water and vice versa. Therefore, steep slope causes small dam crest length and more water in less time. Wa-

	Coordinates			Suitability Weightage
	E(m)	N(m)	H(m)	
Site 1	91°28'40.01"	26°55'35.66"	636.4994	26%
Site 2	91°28'58.43"	26°53'56.02"	535.0966	16%
Site 3	91°28'8.60"	26°52'37.13"	470.4509	17%
Site 4	91°26'44.49"	26°52'32.52"	438.4051	29%
Site 5	91°25'10.17"	26°52'1.42"	319.2856	12%

TABLE IV : *Coordinates & suitability weightage*

tershed area of the river gives high yield such that adequate runoff is available for storage. The topog-

raphy of the site should be such that the reservoir has a large capacity to store water. Therefore, from the above analysis, five potential reservoir sites have been identified which hydrological, settlement, cross section, profile and slope wise favorable.

6. CONCLUSION

This study demonstrates that space technology can be used to analytical approach for reservoir site selection. According to the different factors and analyses, five sites were selected to build reservoir. Designers can use this work as a reference to construct the reservoir but the performances of this study should be enhanced furthermore by integration of climatic data and geological data.

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An integrated approach for updating cadastral maps of Dewathang using remote sensing data

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Abstract— An integrated approach for updating cadastral map of Dewathang under Samdrup Jongkhar District using Remote Sensing data" is one of the approach to update the way of doing cadastral survey with less resources. This project aims to update the Cadastral Map of Dewathang using Remote Sensing Data through comparative analysis between the existing cadastral map done using total station and remote sensing data and updating the cadastral map of Jigme Namgyel Engineering College. In order to achieve the aims and objective of the projects, the high resolution Geo-Eye Satellite Image of 0.5meter resolution and existing cadastral map of Dewathang are the important data used. Soft wares such as LisCAD 11.2, ERDAS Imagine 2014 and ArcMap 10.2.2 were used to process and integrate the satellite image with an existing cadastral map of Dewathang and updated.

I. INTRODUCTION

To support national development initiatives, Bhutan needs more comprehensive topographic and cadastral mapping. In many fields, ranging from environmental management to land and infrastructure development, and from town planning to forestry and agriculture, progress has been impeded by a lack of medium-scale maps. Cadastral survey is branch of surveying profession that is concerned with land management, and more specifically with issues of land ownership, measurement and delineation of property boundaries. While Cadastral surveying also deals with establishment and re-establishment of real property boundaries. In Bhutan, cadastral surveying and mapping using total station and global positioning system (GPS), is the most common practice, however it is expensive, time consuming and labor extensive. But now, technology advancement has shown new approaches of cadastral surveying and mapping using remote sensing data such as satellite imageries with high resolution can also be used for cadastral surveying and mapping. Significantly, using remote sensing data (satellite image) for cadastral surveying has proved to be important technique of cadastral mapping and updating for land administration and management with less resources.

This project is undertaken to update the cadastral map of Dewathang under Samdrup Jongkhar District using remote sensing data (Geo-eye satellite image) of 0.5 meters' resolution using ERDAS and ArcGIS as a processing software unlike total station survey and cadastral mapping in the recent days. Updating the cadastral map of Dewathang using remote sensing data involves multiple photogrammetric process in the ERDAS software such as geo-referencing through ground control point provision after which Digital Elevation Model (DEM) is generated and ortho-photo rectification is carried out in the ERDAS software. Over-lay analysis is processed in the ArcGIS software to check and valid the accuracy of the map and its area then digitized to produce new cadastral map using satellite image in the ArcGIS showing the boundary with area of the land parcel of individual owners of the land and updating the cadastral map.

II. METHODOLOGY

A. Study area

The study area ranges from latitude 910 26' 35"E to 910 28' 35''E and longitude 260 50' 55"N to 260 51' 45''N. It includes the Jigme Namgyel Engineering College, the Army camp areas and some of the villages nearby though the final update was done for the JNEC campus only. This area was chosen so as to minimize the time consumption, unnecessary data collection, expenditure and with the aim of updating JNEC map.
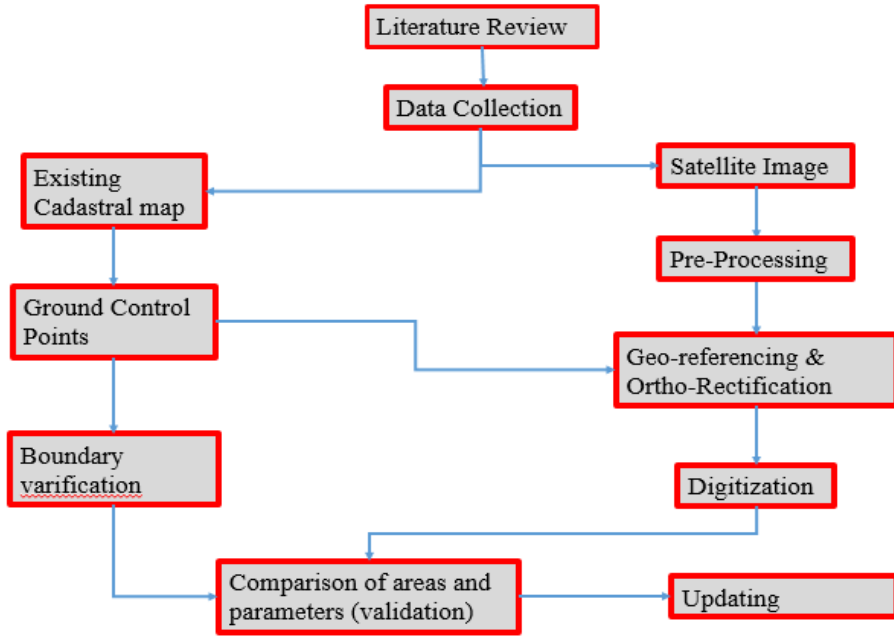
Fig.1. Methodology

Fig.2. Study Area

B. Methodology

The project was carried out based on the following methodology.

C. Data Collection

The data required for the project were an existing cadastral map of Dewathang, coordinates of the GCPs and the remotely sensed data (satellite image). It was acquired from the NLCS on request through the college management.

D. Determining GCPs

The GCPs were required in order to geo-reference and ortho-rectifying the satellite image. The GCPs that was in the form of LisCAD file was transformed to KML file to view in Google earth in order to locate it on the real ground.

E. Traversing

Usually, the GPS receiver is used to generate the coordinates of the required point. Since it was not available, in order to determine the coordinates of the building corners, the traversing was done by orienting the TS using two existing control points in order to geo- reference and ortho-rectify the stereo- pair satellite images. In order to geo-reference the satellite image, four locations of the study area were chosen. The selected areas are JNEC campus,

Sl. No	Name of the Place	Easting	Northing	Height
1	JNEC Campus	395480.570	2973060.198	812.142
2	Rekhey	398073.258	2973795.452	757.913
3	Dungsam	396495.563	2971726.327	447.533
4	Coal Mining	393590.879	2972338.677	678.963

TABLE I. COORDINATED FOR GEO-REFERENCING

Dungsam, Rekhay and Coal Mining site.

F.   Pre-Processing

1)   Pan-Sharpening: "Pan Sharpening" is shorthand for "Panchromatic sharpening". It means using a panchromatic (single band) image to "sharpen" a multispectral image. In this sense, to "sharpen" means to increase the spatial resolution of a multispectral image. A multispectral image *contains a higher degree of spectral resolution than a panchromatic image, while often a panchromatic image will have a higher spatial resolution than a multispectral image. This process is usually carried* out in order to differentiate the features on the ground easily and clearly.

Fig.3. Pan-sharpened Image (0.5m resolution)

2)   Ortho-Rectification: Geometric distortions are present in satellite images caused by satellite platform and its elliptic movement around the earth, due to the imaging sensor (parameters like focal length instantaneous field of view, panoramic

Fig.4. Ortho rectified image

view, and the oblique viewing system in some cases), and due to the earth rotation, curvature, and topographic relief etc. Ortho-rectification is the geometric transformation of an image in which image displacements due to sensor orientation and terrain are corrected to the projection of a map co-ordinate system. The accuracy of an ortho-rectified image and its assigned geo-referencing information is dependent on DEM and the quality of the sensor model.

III.   RESULT AND DISCUSSION

A. Integrating Existing Cadastral Map and Satellite Image

The ortho-rectified satellite image is integrated with the existing cadastral map so that we can maintain the accuracy with the help of existing cadastral map as well as update the map by looking at the features from satellite image which would make the surveying easy. Through this integrated data, we can do the pre-planning and reconnaissance survey without having to go to the real

Fig.5. Integrated Existing Cadastral Map and Satellite Image

ground field with much effort.

B.   Area Comparison

The areas found using the TS has been compared with the area found by the process digitizing, with the help of the stake holder in HRSI. Though we can see the features clearly up to the certain extent and make out the rough position of the points and lines of the boundaries, it is found that the satellite
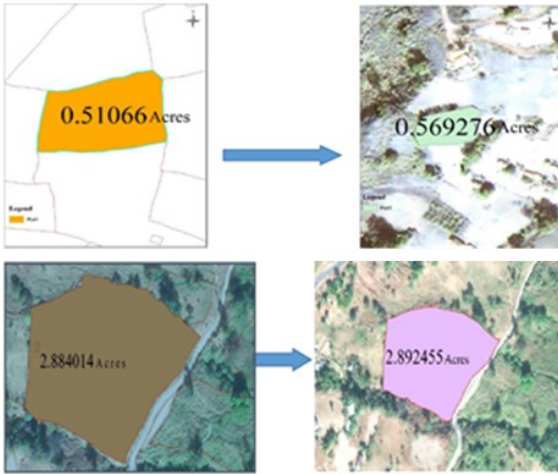
Fig.6. Area Comparison

image alone cannot reach the accuracy of the survey done using TS.

The cadastral survey by direct digitizing the satellite image is not recommended as it cannot meet the accuracy that is needed for the cadastral map. Even if by chance the area remain same, the parameters will divert from the true boundaries.

C. Area Division

With the help of integrated cadastral map and satellite image, we can do the further cadastral survey without having to spend much time, expenses and labors in visiting the field. We can use the existing cadastral map as the reference and divide the land as per the stake holder's wish of shape and size by looking at the ground features from the satellite image. This way, a surveyor and a stake holder can do the boundary division without having to involve the whole crew and without having to go to the field. The weather conditions or road problems won't be a problem if this method is applied. It will lead to the efficient and easy way of doing the cadastral survey.

The coordinates can also be extracted and used by the method of stake out or from GPS in case the stake holder need to construct a monument for easy verifying of the boundary dividing the areas.
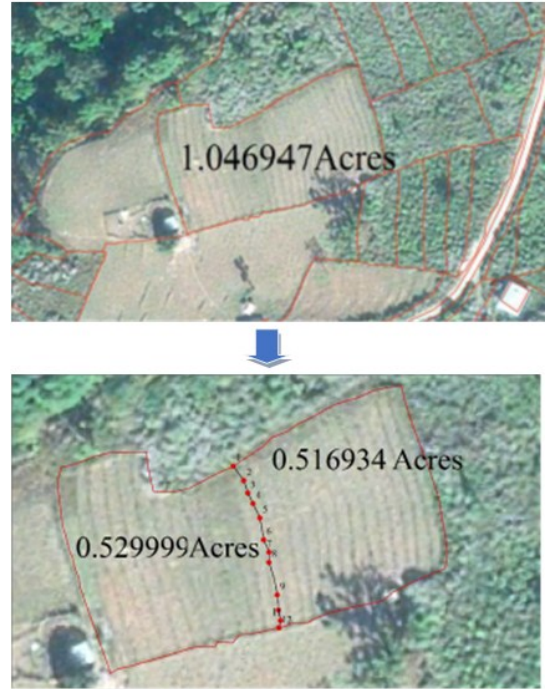

Fig.7. Division of Land

TABLE II. COORDINATES OF NEW BOUNDARY POINTS

ID	X (Easting)	Y (Northing)
1	397794.610	2973032.143
2	397797.256	2973028.487
3	397798.253	2973025.400
4	397799.554	2973022.792
5	397801.240	2973019.214
6	397802.226	2973013.727
7	397803.538	2973010.583
8	397803.560	2973008.095
9	397805.548	2972999.963
10	397805.865	2972996.155
11	397806.394	2972993.547
12	397806.022	2972991.661
8	397803.560	2973008.095
9	397805.548	2972999.963
10	397805.865	2972996.155

D. Updating

The surveyors cannot most often update the cadastral map or features up to date as expected because of various reasons such as time limit, budget shortage and transportation problem in remote are-

as where road is not reached. Therefore, with the help of latest satellite images, the map can be updated easily in a short period of time, without having to waste much time and cash on transportation and surveying with the whole crew.

E. JNEC Campus Map

The JNEC campus was also updated as a part of a project and it is uploaded in Google Map, then provided a link with the JNEC website. Here after, anyone who never visited the campus or anyone who wish to have a general idea on the college campus can go to the link www.jnec.edu.bt and view the map
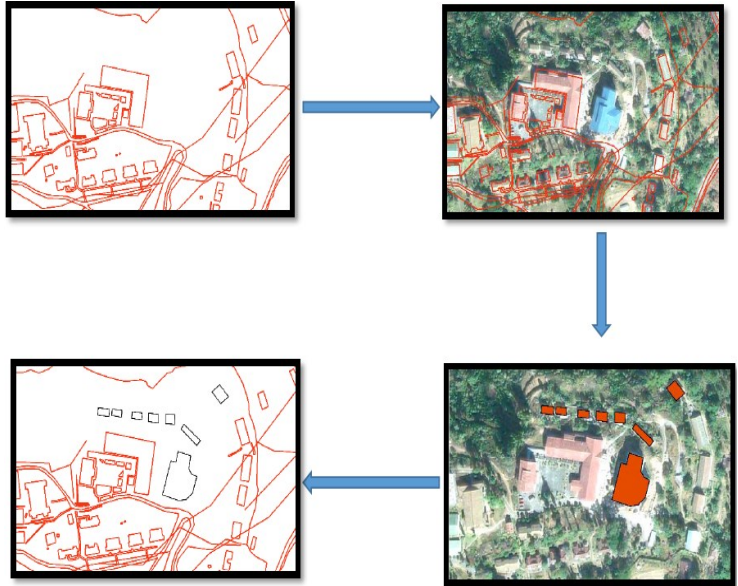

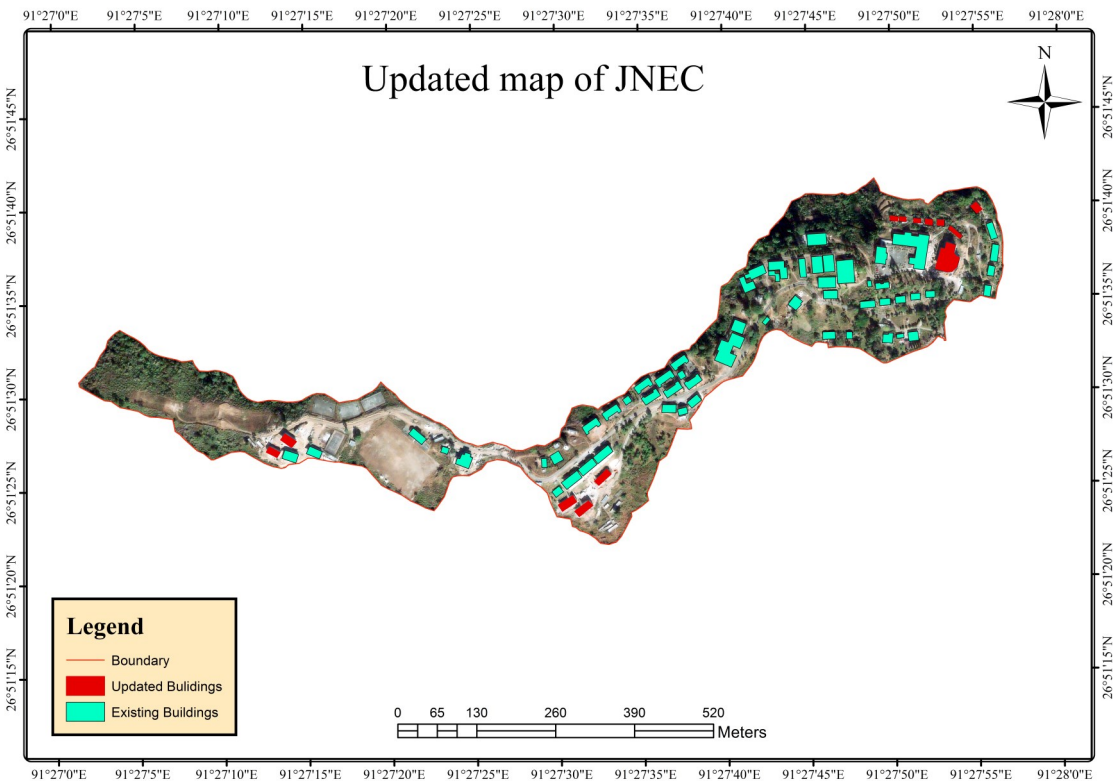
Figure 8. Process of Updating the Map

Figure 9. Updated JNEC Map

di-

rectly by clicking the link CAMPUS MAP. It shows all the residential buildings, academic buildings, administrative blocks, hostels, and any other structures that are present in the campus. It will be a good guidance especially for the visitors and new students who have never come to this campus. The viewer can also click on the structure on the map and get information about that particular structure with side view images. They can have the control over the type of view they want. The view can be

Figure 10. Updated JNEC Map

switched to the satellite image view to see the image clearly.

V. ACKNOWLEDGEMENT

This project, "An integrated approach for updating cadastral map of Dewathang using Remote Sensing Data" would not have been successful without the support and help from the mentioned individuals:

We would like to acknowledge Jigme Namgyel Engineering College for providing us the opportunity to work on the project for the learning purpose and getting the experience. We would like to thank National Land Commission Secretariat (NLCS) for providing us the required data for our project and we are also grateful to Mr. Lobzang Dorji, Head of Civil Engineering and Surveying Department and Mr. Thongley, Project Guide for looking into our needs and requirements, Mr. Namgay Dorji for the check and correction of this report and Mr. Sonam Jamtsho for providing the internet services and making our works available in JNEC web page. We would also like to extend our heartfelt gratitude to Mr. Tenzin Norbu, Mr. Sanjit Kumar Bhattarai, and Mr.Indra Bdr. Chhetri for their guidance and help for the smooth flow of our project.

Lastly, we would like to thank Mr. Dorji Wangchuk for rendering us help in transportation of instruments from place to place for field work and Mr. Bhim Bdr. Ghalley for lending us the lab keys till the end of the project. Without the help and supports from the mentioned individuals above, it would not have been possible for us to complete the project on time and bring this project into this shape.

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Smart Car Parking

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Abstract

Nowadays technology has become an inevitable part of our lifestyle. Automated systems have eased the toil for doing the same work and have drastically saved resources and money. One of the marvels of the technology is automobiles, but apart from its rewarding utility, the automobiles have increased safety and parking concerns. The number of vehicles in the country is recurring and there are problems and concerns regarding parking space and fees collection. The vehicles are also source of air pollution and government is trying to reduce and manage parking system in towns area [1]. Some of these problems can be solved by proposed project smart car parking system. This system can automatically display the parking timing of particular vehicle and display total parking fee payable [2]. This system aims to reduce human efforts and create fair judgment while paying parking fee by automating the process of car parking and parking fee display. This in turn would prove to be useful in reducing time and manual operation [3].

Keywords— AT89C52, RFID reader; L293D IC; Proteus; Kiel complier.

I. INTRODUCTION

In the current situation, number of vehicles are increasing rapidly and there is parking problems in towns and cities. Car parking fees collection system is also introduced in some towns in Bhutan such as in Thimphu, Gelephu and Phuntsholing.

The main working of the system is based on RFID card and it is interfaced to AT89C52. Then the motor driver is connected to gate of parking, to open or close by rotating the driver in forward or in reverse direction [4]. The AT89C52 is also inter-face with LCD to display the output that is total parking fee and time. There is a buzzer at entry point to indicate that car has entered parking areas.

The automatic parking system will control the location and number of cars entering in parking areas [5]. Car parking systems have been around almost since the time cars were invented. In any area where there is a significant volume of traffic, there are car parking systems. Car Parking systems were developed in the early 20th century in response to shortage of space for vehicles.

There are several advantages of employing a car park system for urban planners, business owners and vehicle drivers.

They offer convenience for vehicle users and efficient usage of space for urban-based companies. Automated car park systems save time, money, space and simplify the often-tedious task of parking.

II. PROBLEM STATEMENT

The number of vehicles in the country is recurring and there are problems and concerns regarding parking space and fees collection.

Most of the car parking lots are not run efficiently nowadays. This means that on busy days' drivers may take a long time driving around a car park in order to find a free parking space. There are also arguments and problems while paying parking fees in town areas.

III. SOLUTION

In order to deal with this problem, car parking system is implemented to reduce the time and provide parking spaces. This system also calculates the parking fee automatically and display in LCD and reduces traffic problems that occurs in town areas.
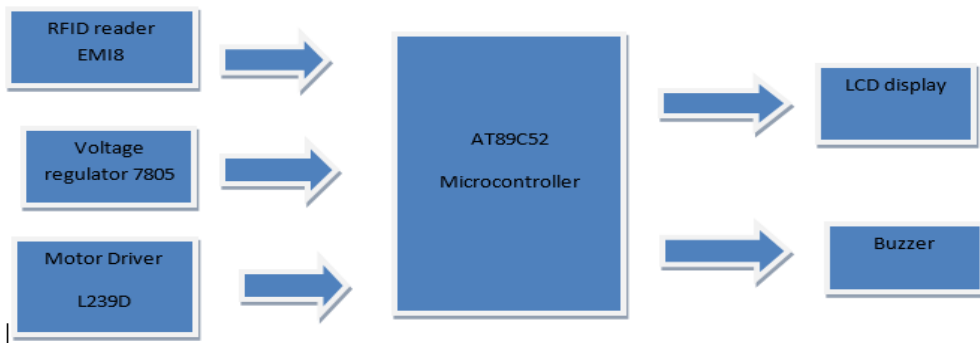
Fig.1. Block diagram

IV. SYSTEM DESIGN

The proposed project consists of RFID reader, motor driver L293D IC, Microcontroller(AT89C52), LCD display and buzzer.

To all component 5 volt regulated DC power supply is provided except for motor driver IC is provided with 12V DC supply.

A. Working of the system

AT89C52 microcontroller is the heart of the system with is connected with 11.0592MHz oscillator to provide with pulse to system. The RFID reader will read the 12 character of RFID card, if the card is vialed then car can enter to parking lot. When card is show to RFID reader if it is valid buzzer will make short beep sound and gate with automatically open and close as car get inside.

If the card is not valid to system, then buzzer will make long beep sound with indicate that car is not allowed to get inside the system. When the card is registered to system it will display in LCD the available parking space left from total space and decrement parking space by 1[6].

When the car comes back again RFID card is need to show to the RFID reader, this time parking space is increment by 1 and gate automatically close and open.

As car comes out the LCD displayed the total time duration car has been parked and total amount of parking fee needed to pay to system.
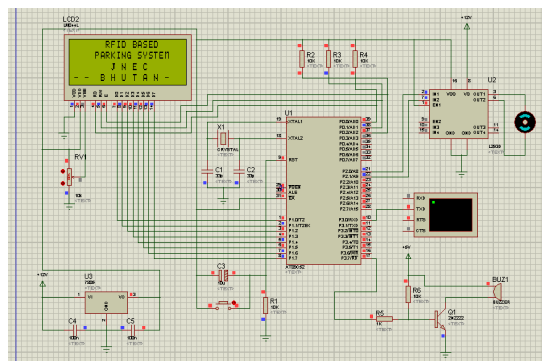

Fig.2. simulated circuit diagram of system

V. SOFTWARE IMPLEMENTATION

Keil is both complier and program developer. The proposed project uses μvision3 to develop the program code and compile it. Keil has features for program building, source code editing, and program debugging. This made comfortable to the simulate embedded circuit diagram that is developed in Proteus software. Programs are developed individually for every unit. After programming individually for every unit all programed are compile together. The program is run many times and errors are edited. Then program is converted in Hex code to dump into a IC.

The proposed projects circuit is design using ptoteus software 7.1. It is design part by part of individual unit and combined together. RFID reader is interface as sensor unit, microcontroller as control unit and LCD as display unit. RFID reader is also interface with microcontroller as sensing unit to the system. TX terminal of RFID is connected to RX terminal of control unit. Crystal oscillator is interface with control unit to give clock pluses.
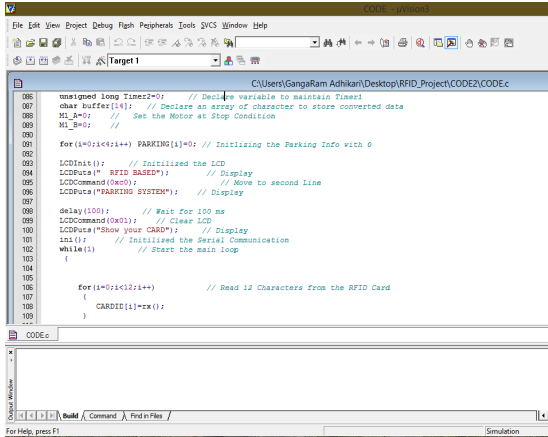
Fig.3. Developing program using keil software and debugging in it.

Fig.4. Hardware development.

VI. HARDWAREIMPLEMENTATION

After simulating in software using program it is been tested on breadboard. Then it is also tested on PCB and finally designed as hardware. After designing series of tests has been performed and the output efficiency has been found 90% and above. Over all circuit is provided with 12-volt DC and to small part like ICs other components are provided with regulated 5-volt supply.

VII. RESULT ANALYSIS

These two tables show the test of valid and invalid RFID card. The tests came effective because the door is opening and closing automatically when valid card is shown to system. For the invalid card system does not register to get inside where gate will not open and close automatically.

The test conclude that system is function efficiently and effectively. To find parking space for driver it takes almost five minutes. By using this system, it takes at the most 7 seconds and system is so secured.

TABLE.I Test for valid card.

| Valid card	Gate function	Time duration	Total fee	Message displayed by LCD
Card 1	Open and close automatically	1 minute	Rate x time= Nu.5	Register to system
Card 2	Open and close automatically	1 minute	Rate x time= Nu.5	Register to system

TABLE II. Test for invalid card

Invalid card	Gate function	Message displayed by LCD	Total fee
Card 1	Does not open and close	Sorry invailed card	NU.0
Card 2	Does not open and close	Sorry invilad card	Nu.0

TABLE. III. Effectiveness test for valid card

Test No.	Yes	No
1	yes	-
2	yes	-
3	Yes	-
4	yes	-

TABLE IV. Efficiency test for valid card

Test No.	Time required to read one card (second)
1	7
2	6
3	5
4	7
5	7

Efficiency test graph
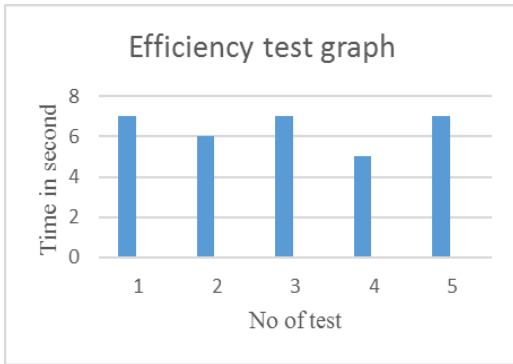
VIII. FUTURE SCOPE

As of now our system is semi-automatic and only limited to 10 users in a particular parking lot. It can be connected with PC and made fully automatic which can accommodate many users. Real time clock can be added to a system to display time continuously. [7] GSM module can be used to transfer data to PC which enables remote data collection and transfer. To transfer data for a longer distance, IOT (Internet of Things) can be used to collect data and information. [8]

IX. CONCLUSION

It is time consuming to search parking spaces and also not secured to park vehicles everywhere. This all are solved by the proposed project. The proposed project came out as an efficient and effective method of car parking in a systematic way. The system can calculate time and parking fee automatically and display in LCD [9]. This also manage vehicles in town areas properly and efficiently. It reduces human efforts and create fair judgment while paying parking fee by automating the process of car parking.

X. ACKNOWLEDGEMENT

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Quadrifilar Helix and Yagi-Uda antenna for thumbnet

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Abstract— National Oceanic and Atmosphere Administration (NOAA) consists of group of manmade satellites. These satellites operated at approximately 137.5 MHz frequency and provide weather data continuously. The data also helps humanity in disaster management since the satellite launch. The satellite ground stations are which are responsible for downloading the images are costly. In this research, the satellite receiver is designed with the help of Real Tech Software Defined Radio (RTL SDR), Quadrifilar Helix Antenna (QHA) and Yagi-Uda antenna. QHA and Yagi-Uda antenna were constructed and designed under mountainous environment; both improved the received signal strength at site (Dewathang Latitude of 26º51' and Longitude of 91º27'). The signals were modified and reconstructed using a SDR Sharp (generic software of RTL-SDR) and were decoded to receive the latest weather image using WXTOIMG. This paper describes how this setup provided a cost-efficient solution for receiving NOAA data in local Dewathang environment. Quardifilar Helix Antenna (QHA) and Yagi-Uda antenna are famous for the thumbnet due to its high gain, cost- effective design, and basics property of the antennas like simulated design, physical design and gain has been discussed in this paper. This work proves the simple method to design QHA with high gain of 16dB out of 5.75dB of ideal case. It supports that whenever we increase the spacing between directors from 0.1□ to 0.5□ and the spacing between the reflector and the driven element from 0.1□ to 0.25□ of Yagi-Uda antenna the gain vary slowly form 10.6 dB to 14.5 dB. The result should be the antenna with improved gain and these antenna should improve the quality of thumbnet.

Keywords— QHA; Yagi-Uda antenna; Thumbnet.

I. INTRODUCTION

The satellite communication through analog communication system is expensive method, waste the resources and less flexibility. Thumbnet, a small one's earth station, eliminate the shortcoming of the analog communication system and proves to be the interesting system. It opens up the space to build a virtual earth station by anyone anywhere [1]. It is composed of Real Tech Software Defined Radio (RTL-SDR) chipset, computer and an antenna. [2] In order to avail these facilities, the need to build antenna grow to the unprecedented degree this paper extensively discusses on this matter. The Thumbnet helps enthusiasts, explore and utilize free signals of earth at the low cost for Radio Technology, engineering and space, earth and its phenomena. These antennas for the thumbnet system requires low-cost materials, simple and inexpensive fabrication techniques and this helps in establishment of Thumbnet Radio station at Jigme Namgyel Engineering College (JNEC).

The Thumbnet installed in JNEC, was lying underutilized because an appropriate antenna wasn't implemented which was designed to receive these free signals, have immunity to a quality reception of the signals throughout the years. This limits to the optimum utility of the thumbnet. There for QHA and Yagi-Uda antenna at 137.5 MHZ is designed to improve the thumbnet system.

This paper presents the designs of the QHA and Yagi-Uda antenna for satellite communication at 137.5 MHZ, radiation pattern and physical dimension are discussed. [3]

In this paper QHA is designed and simulated. [4] and [7] The Yagi-Uda antenna is designed, optimized and simulated. [5] and [6] In this paper we present a new QHA and yagi-uda antenna at frequency of 137.5 MHZ and the proposed antenna is verified using the numerical techniques and experimentation.[5] and [6]

The QHA and Yagi-Uda antena is constructed and is integrated with the thumbnet. Number of free signals is available and the images of the earth is trapped. [1]

This work proves the simple method to design QHA with high gain of 16dB out of 5.75dB of ideal case. It supports that whenever we increase the spacing between directors from 0.1⊡ to 0.5⊡ and the spacing between the reflector and the driven element from 0.1⊡ to 0.25⊡ of Yagi-Uda antenna the gain vary slowly form 10.6 dB to 14.5 dB.

II. RELATED WORK

Study had been carried on approximation and numerical analysis on parameters of the helical antenna at frequency of 5.8 GHz.[7] The satellite receiver is designed using RTL-SDR and QHA. [1] The helix antenna can be regarded as loop and straight-wires antenna. The circularly polarized helical antenna can be designed by varying the circumference and the spacing of the helix. The gain can be increased by using four numbers of helixes. [8] The QHA is designed for the reception of the polar orbiting satellite signals. The factors that encounter in while designing the antenna were considered. The elongation factor was considered for the practical design of the antenna. [5] The dimensions of the elements and the spacing between the elements of Yagi-Uda antenna is experimentally observed and came up with the range of dimensions and the spacing. [4] The location and the length of directors and reflector are critical. The basics of designing methods are discussed. [6]
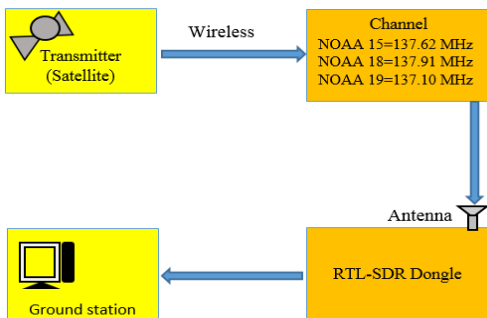
II. SYSTEM MODEL

Fig.1. System model

The NOAA satellites send the free signals containing the information about the weather and earth. These signals were transmitted wirelessly. The antenna designed receive these signals. The RTL SDR is used to tune the frequency of the signals and these signals are modified and reconstructed using a SDR Sharp (generic software of RTL-SDR) and are decoded to receive the latest weather image using WXTOIMG.

III. PROBLEM STATEMENT

The Thumbnet installed in JNEC, was lying underutilized because an appropriate antenna wasn't implemented which was designed to receive these free signals, have immunity to a quality reception of the signals throughout the years. This limits to the optimum utility of the thumbnet. The real satellite makes use of the devices that are costly, bulky and unavailable. This setup provided a cost-efficient solution for receiving NOAA data. There for QHA and Yagi-Uda antenna at 137.5 MHZ is designed to improve the thumbnet system.

IV. SOLUTION

QHA and Yagi-Uda antenna are best suited for the thumbnet. Dimension of the Ideal QHA is calculated and simulated in the 4NEC2 and it was used to compare it with the designed antenna. Accordingly, dimension of the QHA is calculated considering physical factors. The antenna is constructed and tested using antenna trainer kit available in the lab. Likewise, the dimensions of the elements in the Yagi-Uda antenna is calculated. The gain and the directivity of the antenna are optimized by changing the spacing between the elements of the antenna. [4] The antenna is designed using the dimensions of the selected simulation. The antenna is then tested in the lab using the trainer kit and implemented with the Thumbnet package.

$$L_{ax} = \frac{f_1 \lambda}{2(\sqrt{(n\pi R)^2 + 1} + R)}$$

V. ANALYSIS

This formula was used for calculating the dimension. The physical factors such as elongation factors and fractional division of resonant frequency are considered.

The dimension of the Yagi-Uda antenna is obtained using the following observations:

Reflector = 5% more than driven element,

Director = 5% less than driven element.

The spacing between the elements is varied between followings ranges.

The spacing between directors range from 0.1λ to 0.5λ .

The spacing between the reflector and the driven element range from 0.1λ to 0.25λ .
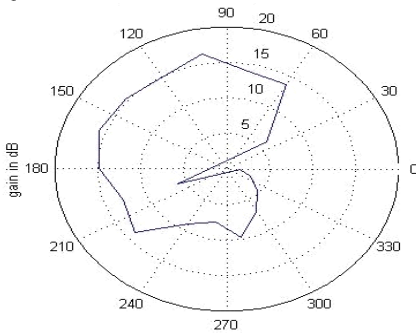
The radiation pattern obtained while testing in the lab for QHA is:

Fig.2. Radiation pattern in horizontal plane for QHA.

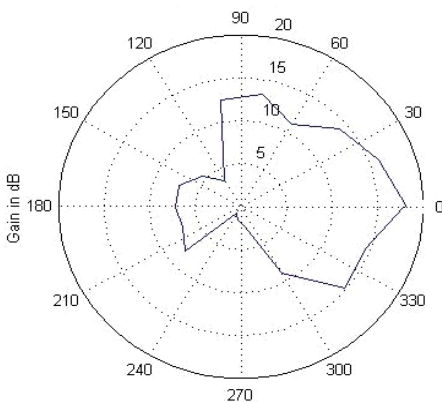The radiation pattern obtained in the test for Yagi-Uda antenna is:

Fig.3. Radiation pattern for Yagi-Uda antenna in horizontal plane

The physical antennas are then implemented with the thumbnet. The Thumbnet could receive number of the free signals and download the images of the earth.
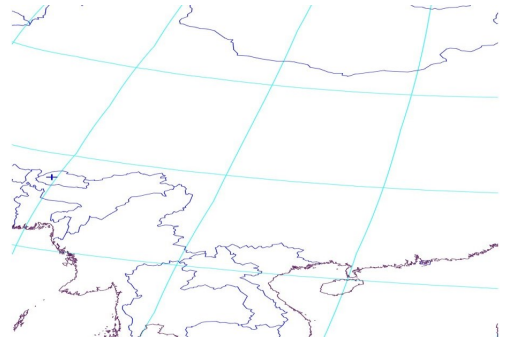

Fig.4. Image of part of the earth

VI. DESIGN AND SIMULATION

The QHA has helical parts and it constitute an imaginary cylinder of resonant material such as copper. Following formula are used to calculate the dimensions of QHA. [5]

$$L_{ax}=\frac{f_1\lambda}{2(\sqrt{(n\pi R)^2+1}+R)}$$

Where,
L=Length of the helical component

$$L^2=L^2_{ax}+(2\pi nr)^2 \qquad (2)$$

L_{ax}=Length of the cylindrical axis
R/r =Radius of the cylinder

n=Number of turns in the helix
S=Spacing between the helix
F = operating frequency

The helical antenna is designed based on antenna parameters considering the parameters' formulae from (K.D Prasad and Mathew N.O Sadiku, 2007) [7]

H = *N x S*

Where

N=Number of loops

S=Spacing between the loops

H= height of the antenna

mum gain obtained is 5.73 dB. The radiation pattern is circularly polarized. *Fig.5,* represents the radiation pattern in horizontal plane.
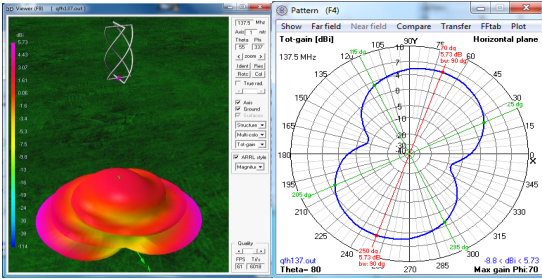

Fig.5. Radiation pattern for QHA in 3D and 2D

The elongation factor is experimentally observed and plotted in the graph. [7] From this the elongation radius of 12 millimeters (mm) for inner loop and 15 mm for the outer loop were taken as designed value.

The height of the antenna was chosen and the dimensions are calculated without considering the elongation factor for ideal antenna. The antenna is simulated using the calculated dimensions and the above results were obtained. *Fig.5,* represents the radiation pattern in 3-dimensions (D). The maxi-

The dimensions obtained for the QHA antenna after considering elongation length are:

When the elongation factor is considered the length of the helical components increase. The length of the helical components affects the pa-
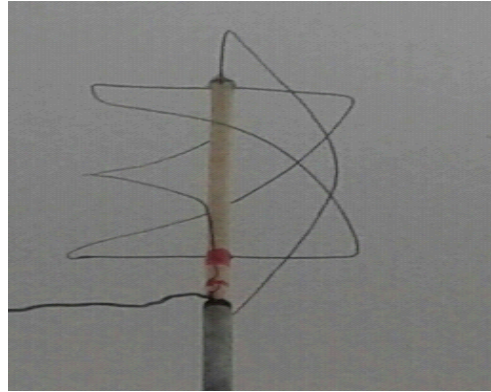

Fig.6. model of QHA

rameters of QHA antenna.

TABLE : DIMENSIONS OF QHA

Parameters	Calculated dimension		Dimension for ideal antenna		
	Inner loop (m)	Outer loop (m)	Inner loop (m)	Outer loop (m)	
Length of cylinder helix (L/H)	0.700	0.730	0.700	0.730	
Length of helical component (Lax)	0.86905	0.911	0.843	0.891	
Number of turns (N)	0.46	0.4525	0.486	0.507	
Spacing (S)	1.512	1.6131	1.44	1.44	
Diameter of lower element (D)	0.308	0.3212	0.308	0.3212	
Diameter of upper element (D)	0.308	0.3212	0.308	0.3212	
Length of curve helix	0.019	0.025	0.000	0.000	

The calculated values were used for construction of QHA. The 2.354 m long copper wire with diameter of 2.5 mm is connected to make into rectangle and bends at corners were considered for inner loop of QHA. The higher element was rotated 180º. The 2.464 m long copper wire with same diameter was connected to make into rectangle and bends at corners were considered. The higher element was rotated 180º. The helixes were fixed on the chlorinated polyvinyl chloride pipe. After the construction, the antenna is tested in the lab. The antenna trainer kit available in the lab was used for test. The constructed antenna was used as the receiving antenna. The transmitting antenna used was dipole antenna because the

(*Fig.2,*) was obtained. It has the maximum gain of 16.93dB. The input current of 85.4 µA was used. The distance between two antennas is 1.5m. The circularly polarized radiation pattern could be obtained.

The dimensions of the elements and the spacing between the elements of Yagi -Uda antenna was experimentally observed.
According to the observations, the dimensions of the Yagi-Uda antenna obtained is:

The following spacings between the elements in the Yagi -Uda antenna were selected:

The antenna with the calculated lengths and the selected spacing between the elements was

TABLE : LENGTH OF ELEMENT OF YAGI-UDA ANTENNA

Element of Yagi-Uda antenna	Length(m)
Reflector	1.144
Driven element	1.09
Directors	1.034

QHA is not available in the lab and it is circularly polarized antenna. The above radiation pattern

TABLE : SELECTED SPACING SECOND AND THIRD DIRECTORS

Spacing between reflector element and second director=1.526	Spacing between second director and third director in meters.			
	0.436	0.654	0.872	1.09
Gain	11.9	12	12.1	11.8

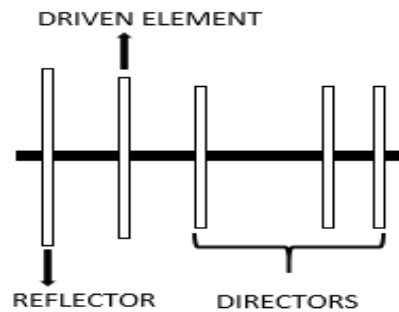
Fig.7. Radiation pattern for Yagi-Uda in 3D and

Fig.8. Yagi-Uda antenna

sim-

ulated. *Fig.7*, shows Radiation pattern in 3-D for Yagi-Uda antenna. The gain obtain is 12dB. It is observed that the side lobes in the radiation pattern are less. Fig.7, represents the radiation pattern for Yagi-Uda antenna and the maximum
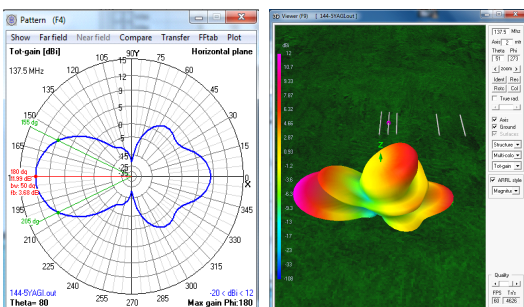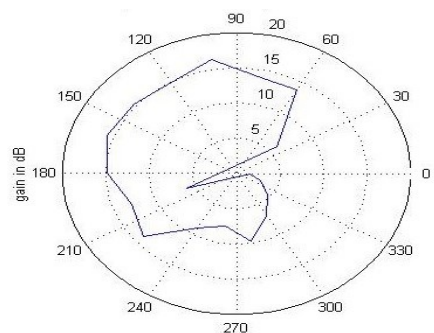

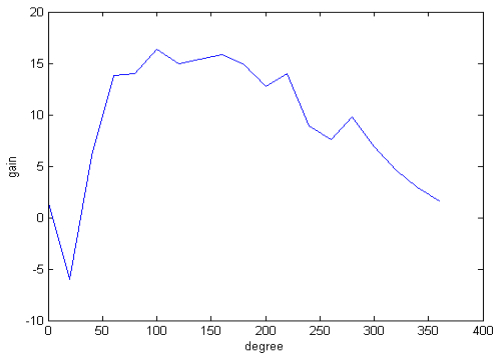Fig.9. Radiation pattern in horizontal plane for QHA Helix antenna

Fig. 10. Variation of gain with the angle of

gain it has is 11.99dB.

The dimensions calculated and the spacings selected were used to construct the antenna. The
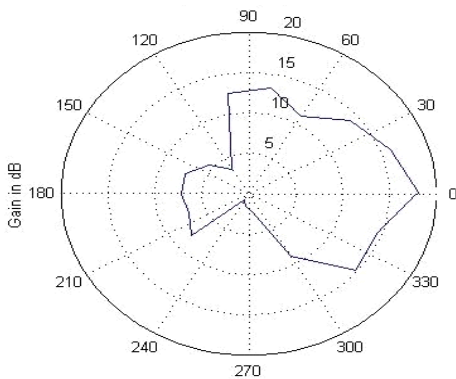

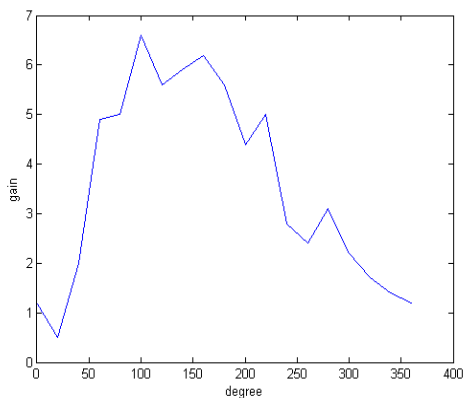Fig.11. Radiation pattern for Yagi-Uda antenna in

Fig.12. Variation of gain with angle of rota-

copper wire of diameter 2mm is used to construct the antenna. The array of the elements of the antenna is placed on the beam of wood. The antenna is then tested in the lab.

VIII. EXPERIMENTATION

The antennas designed are tested using the antenna trainer kit available in the lab. Following results were obtained.
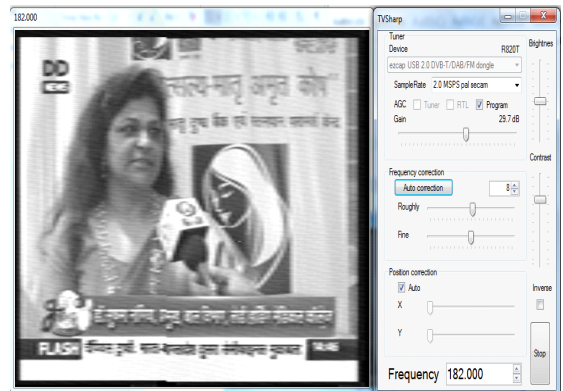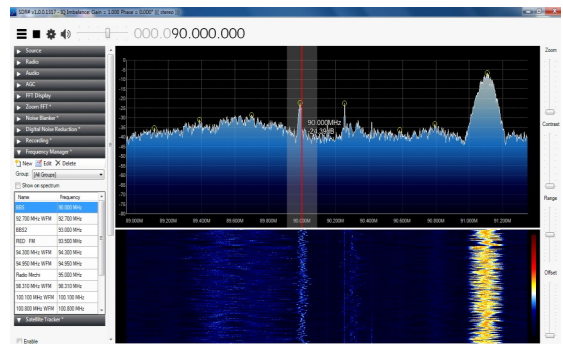

Fig.13. TV channel received in PC

Fig.14. Numbers of audio channels received

It is concluded that when the antenna is placed at the different angle it doesn't radiate uniformly. The radiation increases as the gain increase 150º and decreases as angle increase further. Antenna does not radiate uniformly.

It is concluded that that the antenna has

high directivity gain. The antenna radiates to the direction when it is rotated at the angle of 100º. The gain varies less in the Yagi-Uda antenna. And the gain for the Yagi-Uda antenna is less compared to the QHA.

It is concluded that the QHA has higher gain than the Yagi-Uda antenna and hence the QHA antenna does better in thumbnet.

The following channels and the image of the earth (*Fig.4,*) are received by the thumbnet when the antennas are used with thumbnet.

IX. CONCLUSION

To run thumbnet, the antennas used for thumbnet were studied and required parameters and design aspects were identified. The antennas most suited for the Thumbnet are QHA and the Yagi-Uda antenna. For QHA the dimensions of antenna considering the elongation factor are calculated. These dimensions are used in constructing the practical antenna. The ideal QHA with the dimensions obtained without considering elongation factor is simulated to compare it with the practical antenna. The antenna is designed in the 4NEC2.

The Yagi-Uda antenna is optimized between the ranges of spacing between the elements in 4NEC2. Accordingly, the antennas are constructed practically and tested in the lab as per the availability of materials. These antennas are used with thumbnet. Free signals could be received, both audio and visual, and images of the earth could be trapped. In order to improve the quality of the antenna designed, it can be tested with ideal antenna and further modified. Number of the antennas can

be designed to improve the quality of the thumbnet in our place.

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Harmonic Distortion Analysis of MV Substation

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Abstract - Harmonic disturbances are one of the disturbances in power system which affects power quality. This paper presents the amount of harmonics presents in 132/33 kV substation. The modeling of 132/33 kV substation is carried out in Matlab/Simulink environment. The waveform obtained is analyzed by Fast Fourier Theorem which gives the total harmonic distortion in percentage. Total harmonic distortion obtained are compared with and without harmonic filter. The possible corrective methods to reduce and mitigate the harmonic in power system are discussed.

Keywords; harmonics, power quality, non-linear load, FFT

I.   INTRODUCTION

In present days, concern about the power quality is increasing due to the troubles induced in end-user loads such as malfunctioning, overheating, and shortening life span of the equipment and machines. With the advancement and widespread use of power electronic equipment in compact fluorescent lamp, computers, printer, television, fax machines and so on. Due to non-linearity of this loads, they introduces disturbances in current and voltage in the power system.

Power quality disturbances includes voltage sags/swells, flickers, harmonic distortion, impulse transient and interruption.

Voltage dip; it is the reduction in voltage level for a short term of less than half a second.

Voltage sag; it is the decrease in the voltage level with

the amplitude ranging from 10-90% and duration of half cycle to 1 minute.

Voltage swells; it is the increase in the rms value of voltage of more than 10% of the nominal voltage at the power frequency for duration of 0.5 cycles.

Voltage spikes, impulse or surges; it is a very brief increase in the voltage value.

Voltage transient; they are temporary, undesirable voltage that appears on power supply line. These are high over-voltage disturbances (up to 20kV) that last for a very short time.

Harmonics; it is the component of distorted waveforms the frequencies of which is the multiplication of fundamental frequency.

Flickers; it is continuous and rapid variation in the magnitude of load current and voltage. It is dimming of light, usually due to rapid changes in voltage on a distribution system

II.   HARMONIC DISTORTION

Harmonic distortion results due to operation of non-linear load and faults in power system. Harmonic distortion level can be identified by harmonic spectrum with magnitudes of individual harmonic component by total harmonic distortion. The modelling of the substation in Matlab/Simulink with non-linear loads, waveforms obtained and total harmonic distortion in percentage are shown in fig 1.

In fig. 1, a block diagram of 132/33 kV substation for modeling in Matlab/Simulink is shown. The model consist of three phase source, three feeders stepped down to 33 kV with help of 5 MVA star-delta transformer. Three 33 kV feeders are outdoor. Four 11 kV feeders are indoor which is step down by 2.5 MVA star delta transformer.
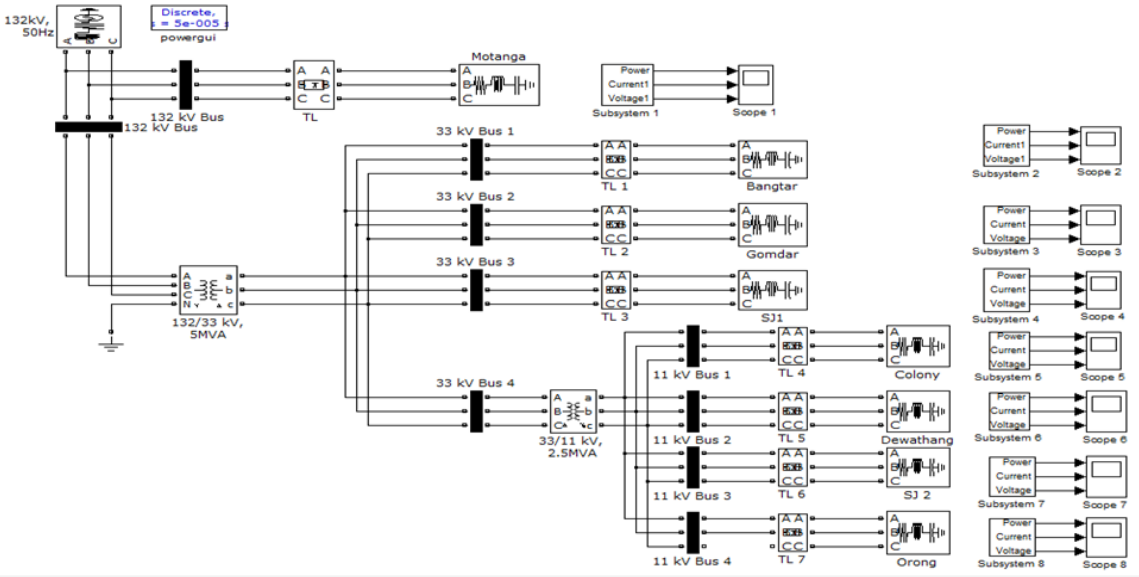
Fig.1. Block Diagram of 132/33 kV substation

Fig. 2 represents waveform of simulation without fault or non-linear load. Without fault or non-linear load, waveform obtained is pure sinusoidal. A 0.2 second simulation time is set to run the simulation. The waveform obtained are in the sequence of power, current and voltage.

The single phase non-linear load model developed in Simulink model is shown in fig. 3.It is used to simulate the disturbance caused by single phase nonlinear load. The model consists of 132kV, 50Hz three phase source feeding through 132/33kV, 5MVA delta/wye transformer to a load. There are instantaneous scope located at 132 kV and 33 kV bus for measurement of voltage. A 0.2 second simulation time is set to run the model.
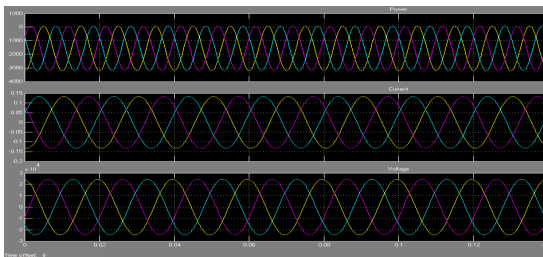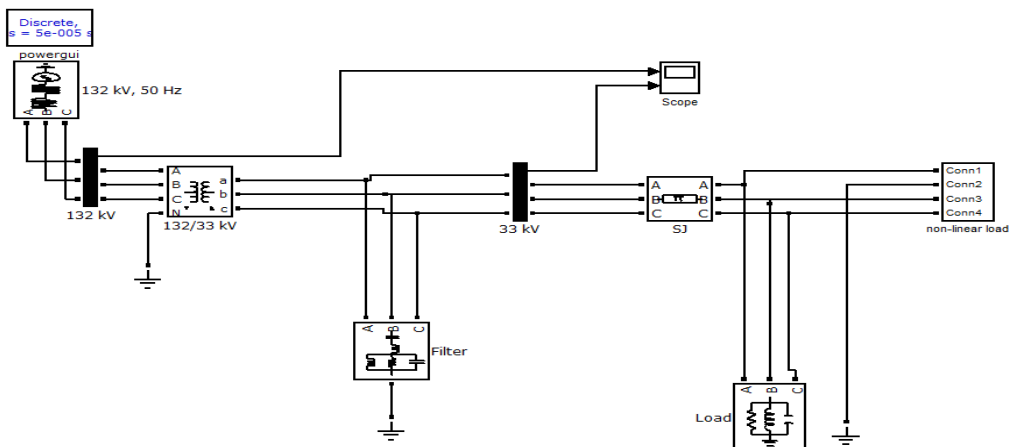

Fig.2. Sinusoidal Waveform

Fig.3. Simulink model of single phase non-linear load with Harmonic Filter
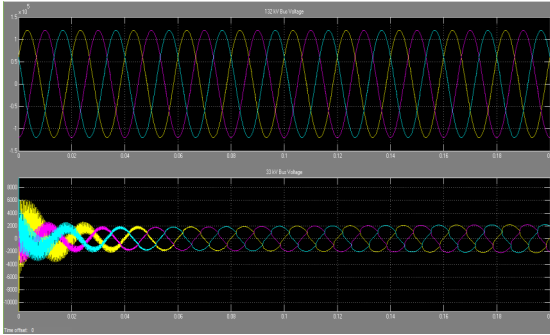
Fig.4. waveform distortion without filter

The fig. 4 shows the harmonic waveform due to single phase non-linear load without the harmonic filter. To visualize harmonic distortion, the simulation time is set at 0.2 second so that 10 cycles will be simulated and fig. 5 shows the total harmonic distortion present in the feeder due to the non-linear load. The total harmonic distortion obtained due to non-linear load is 49.43%.
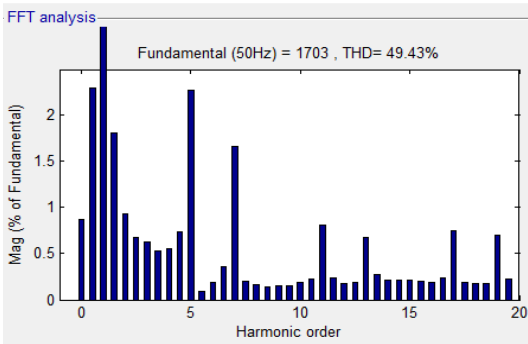
Fig.5. THD without Harmonic Filter

Due to the use of harmonic filter in the feeder, the magnitude of the waveform obtained without filter has been reduced as minimum as possible. And the percentage of total harmonic distortion due to non-linear load has been reduced to 59.70% as shown below in fig. 6.

Fig.7 shows the 33 kV feeder with non-linear load with DSTATCOM. DSTATCOM is a compensating reactive power source that is applied in power system to reduce power quality disturbances such as sags, surges, flicker and harmonics. DSTAT-COM produces an inductive current (leading) as it

Fig .6. Reduced total harmonic distortion

consists of inductance of coupling transformer.
Reduced total harmonic distortion with DSTAT-COM connected in a system is shown in the fig.8. With DSTATCOM, THD is reduced to 4.03% from 49.43 % which shows that it is more effective in reducing harmonics in a system.
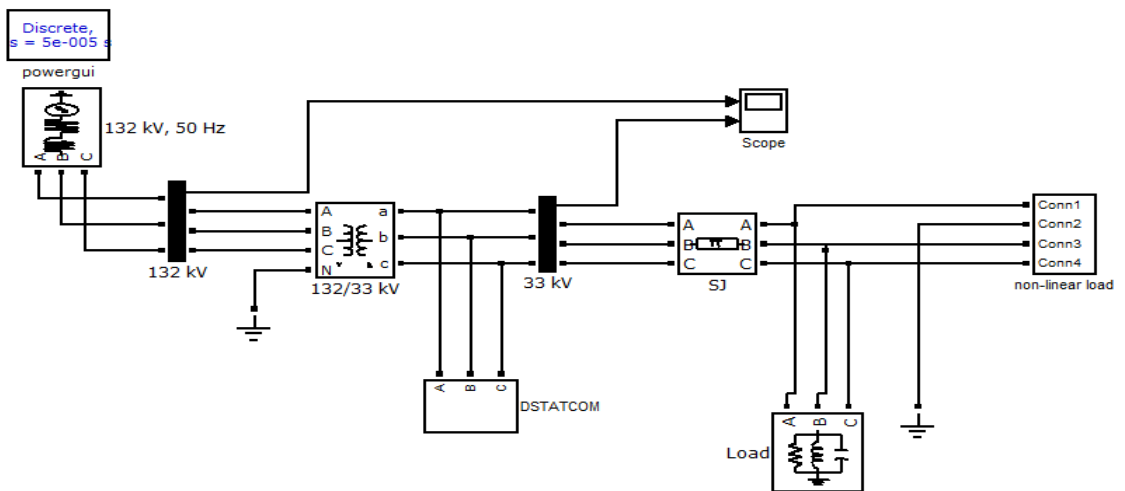
Fig .7. simulation diagram of non-linear load with DSTATCOM
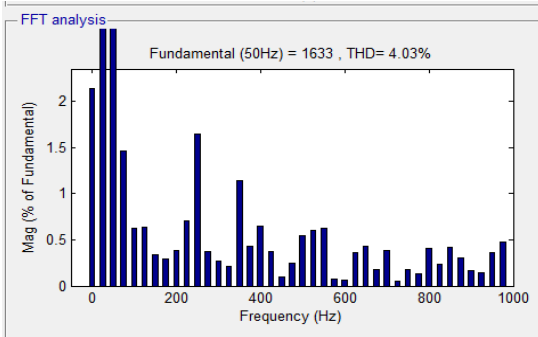
Fig. 8. Reduced THD of non-linear load with DSTATCOM

phase of the line is 4.54% as shown below in fig. 11.
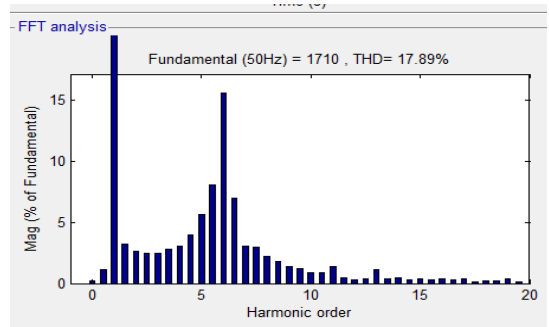
When a three phase harmonic filter is connected in the feeder, the harmonic distortion has been reduced to 3.26% as shown below in fig. 12.

Similarly the total harmonic distortion in Y phase of the line due to the fault is about 9.63% as shown below in fig. 13.
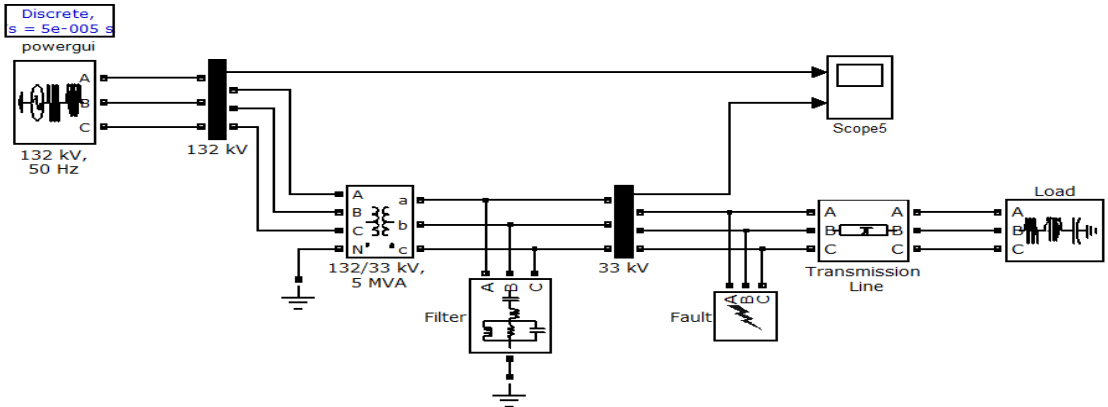
Fig. 9. Simulation diagram of 33 kV feeder under fault with filter

The simulation model of 33 kV feeder is shown in fig 9. The simulation time of 0.2 second is used for running the model. For observing the harmonic distortion in the feeder, fault is created at different points and the waveforms are observed respective-
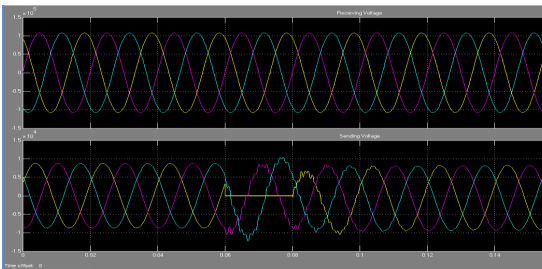
Fig.10. Distortion in waveform due to L-G fault

ly. The fault timing is set at 0.06 to 0.08 seconds. Due to the creation of fault, each phase experiences a distortion as shown in fig. 10.

The harmonic distortion obtained when there is no filter being used in the feeder is different for different phases. The harmonic distortion produced in R
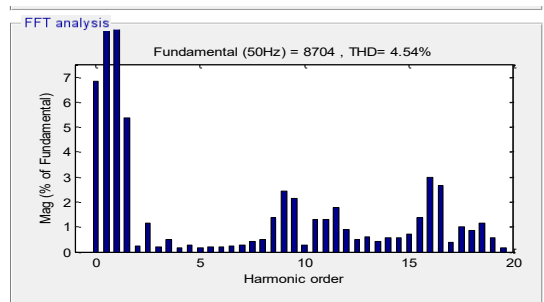
Fig.11. Total Harmonic Distortion in R phase due to L-G fault
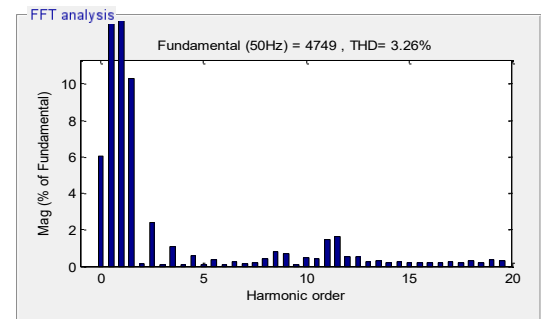
Fig.12. Reduced THD in R phase

46
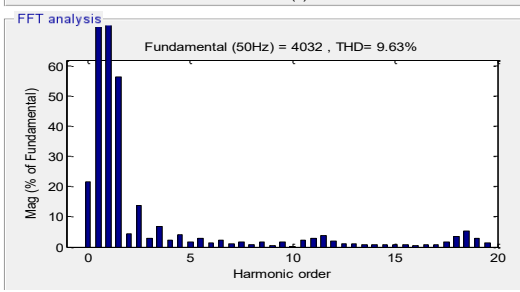
Fig.13. Total Harmonic Distortion in Y phase due to L-G fault

And the content of harmonic distortion reduced when connecting filter is 6.63% as shown in figure 14.
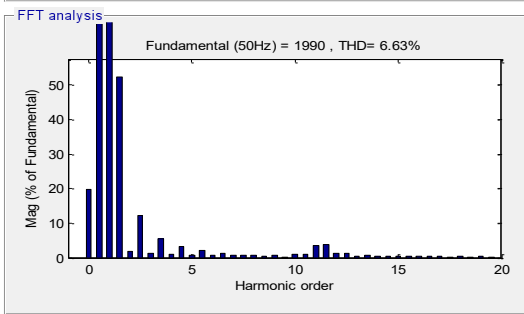
Fig.14. Reduced THD in B phase

Fig.15 shows the feeder with DSTATCOM. DSTATCOM is connected in parallel with a transmission line and it generates or absorbs reactive power. It improves power system performances.

Table 1. Reduced THD with DSTATCOM under fault conditions

Sl/No	Phase	THD Without DSTATCOM (%)	THD With DSTATCOM (%)
1	Red	22.00	2.12
2	Yellow	8.76	0.01
3	Blue	7.36	0.01

point of common coupling without the need of large external reactor or capacitor bank.

The THD level of disturbed voltage waveform using FFT analysis is shown in table 1. When DSTATCOM is connected to the system, the THD level of R phase, Y phase and B phase gets reduced to 2.12 %, 0.01 % and 0.01 %.

Table 2 shows the effectiveness of filter and DSTATCOM to reduce harmonics in a system under fault condition. When harmonic filter is con-

Table 2. Comparison of reduced THD with filter and DSTATCOM in fault condition

Sl/ No	Phase	Reduced THD with Filter (%)	Reduced THD With DSTATCOM (%)
1	Red	10.58	2.12
2	Yellow	2.02	0.01
3	Blue	1.85	0.01

Fig.15. Simulation diagram of 33 kV feeder under fault with DSTATCOM

DSTATCOM controller provides voltage support by generating or absorbing reactive power at the

nected in the system, THD of the phases has been reduced as shown above.

Table 3. Comparison of THD with filter and DSTATCOM in non-linear load

Sl/No	Reduced THD with Harmonic Filter (%)	Reduced THD with DSTATCOM (%)
1	17.89	4.03

Table 3 shows the comparison of a THD reduced by harmonic filter and DSTATCOM. The THD reduced by harmonic filter is 17.89% whereas that of DSTATCOM is 4.03%.

CONCLUSION

In power system, noon linear loads are the main causes of harmonic distortion. So, in this work, we analyzed the performance of harmonic filter and DSTATCOM under fault condition and non-linear load using FFT analysis. From above two measures, DSTATCOM is

found to be more efficient as it can reduce maximum amount of distortion on the system compared to the harmonic filter.

ACKNOWLEDGEMENT

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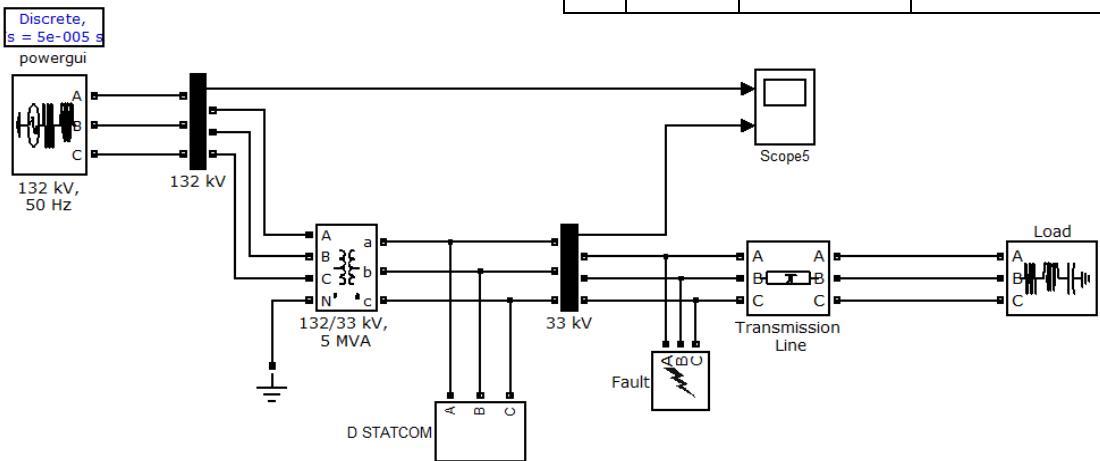[1] P. Saxena and R. Chaudhary, "Harmonics Modeling, Activity Analysis of Equipments with Switch Mode Power Supply and Reduction on Matlab/ Simulink," *Adv. Electron. Electr. Eng.*, vol. 3, no. 4, pp. 503–508, 2013.

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Analysis of Technical Losses in 33 kV Feeder

A case study of Nyelang Sub-station to Electricity Service Division, Samdrup Jongkhar (ESD Samdrup Jongkhar)

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Abstract - Energy losses occur in the process of supplying electricity to the consumers in the form of technical and non-technical losses. Technical losses occur due to dissipation of energy in the conductors, equipment used in transmission of energy (i.e., transformers, Circuit breakers, insulators, CTs & VTs) and distribution of power to consumer premises. These technical losses are inherent in a system and can be reduced to an optimum level. This paper presents an analysis of technical losses in 33 kV feeder between Nyelang sub-station to Electricity Service Division, Samdrup Jongkhar (ESD, Samdrup Jongkhar) in Bhutan. The technical losses occurring in this feeder will be calculated, analyzed and simulated through ETAP. Basically, this paper focus on the transformer losses and line losses.

Keywords- Technical loss; ETAP; Line loss; Transformer loss; Load flow

I. INTRODUCTION

Electricity has become one of the basic necessities to all the modern equipment and machinery invention as well as for operation. However, a high electrical power cannot be generated anytime at any place as and when required for one's consumption. Thus, the power generated is transmitted through transmission lines via grid and then distributed to the consumers. The power is stepped up or down by means of transformers to the required voltage level. The power then reaches the sub-station and is distributed to the consumer's premises.

Power distribution is the most important link in the process of supplying electricity. Various losses are encountered during the distribution and it also affects the economy of the country. Losses cannot be eliminated but it can be reduced to some extent.

This paper is mainly focusing on analysing the losses and recommending suitable remedies to reduce the technical losses on 33 kV feeder from Nyelang-substation to ESD, Samdrup Jongkhar

Many researchers and authors have done research or calculated the losses of the feeders. Some have also simulated using various software. Alamin have presented the technique used to calculate the technical and non- technical losses and the reasons for those losses in Sudan in his paper. Narong and his allies have discussed on technical loss through calculation and PSS/Adept program. Adegboyega have done a case study on the power loss where they have complied a five years' data and calculated the power loss and average power loss. Sarang & J.G. have discussed on calculating the power loss i.e. technical loss using load factor and load loss factor on the distribution system by using accurate 24 hours' data. Mohsin and his colleague have done the real-time study on technical losses in distribution system where they have considered sub transmission line loss, distribution line loss, station line loss, station line loss and secondary services losses.

In this paper, analysis of technical loss for 33 kV feeder of Nyelang to ESD, Samdrup Jongkhar is done. For this transformer losses and line losses have been considered. The modelling and simulation of the feeder is carried out in ETAP software using the data collected from Nyelang substation and ESD, Samdrup Jongkhar, Bhutan. The load flow results have also been presented and discussed.

MODELLING OF NYELANG SUB-STATION (132/33 KV) IN ETAP SOFTWARE
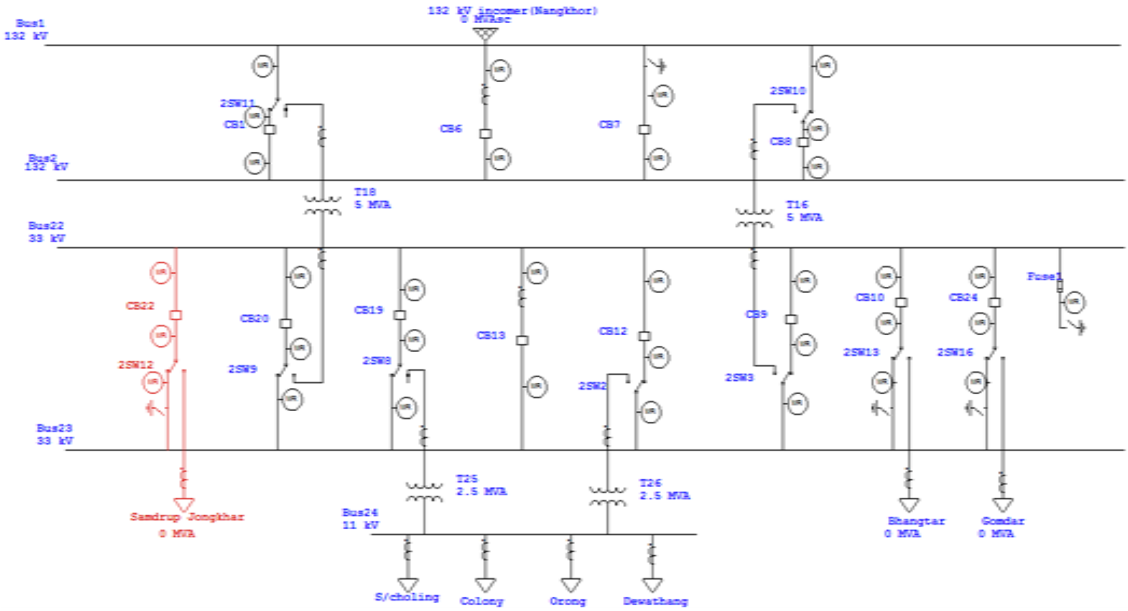
Fig. 1. Single line diagram of Nyelang sub-station

Fig. 1 shows the single line diagram of Nyelang sub-station. It shows the Power Grid which supplies power to 132 kV Bus 2. During charging of feeder only one of 5 MVA transformer supply power to Bus 22 while other is standby unit. Incoming source to the sub-station is 132 kV from Nangkhor substation and there are seven outgoing feeders. Out of all outgoing feeders the 33 kV feeder of Samdrup Jongkhar is chosen for the case study of technical losses.

The fig. 2 shows the model of single line diagram of 33 kV feeder of Samdrup Jongkhar which is modelled in ETAP software for load flow analysis. The length of the feeder is 14.896 km and in between the 250 kVA transformer is tapped to distribute the supply to the villagers (Shedra). The length of the tapped feeder is 33.35 m. The load on the 2.5 MVA transformer of ESD is 2.42 MVA and the load on 0.250 MVA of Shedra distribution transformer former (33/0.44 kV) is 0.15 MVA.

The fig. 3 shows the load flow of 33 kV feeder in ETAP software. It shows various power flow in different branches which make easier to visualise and analyse feeder characteristics. From the figure we get the visual flow of powers from the source to loads and it also shows the division of power according to load. The load flow result also displays the voltage level on the bus and power losses in the various transformers and lines. For example, in 5 MVA Nyelang substation transformer, loss is indi

cated as [0.008 MW, 0.099 MVAr] and power loss in the Samdrup Jongkhar line (SJ line) is [0.018MW-0.016 MVAr]. ETAP automatically uses the Newton Rapson Method for load flow calculation.
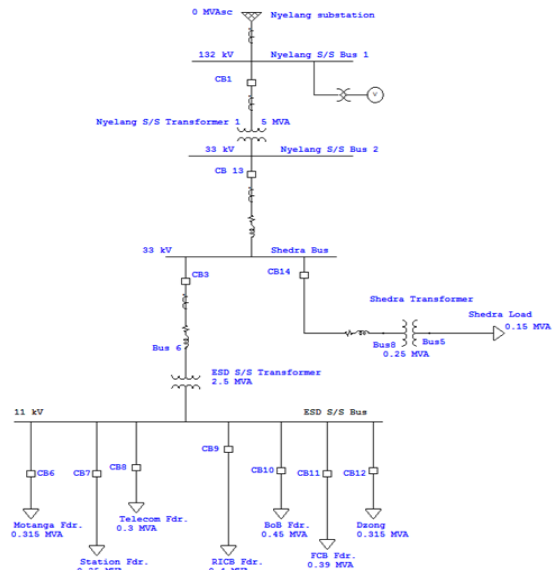
Fig. 2. Single line diagram of 33 kV feeder of Samdrup Jongkhar

The table 1, is the report of load flow done in ETAP software. The result shows the power flow in different loads from buses and it also shows the MVAr and ampere rating of the buses. The real
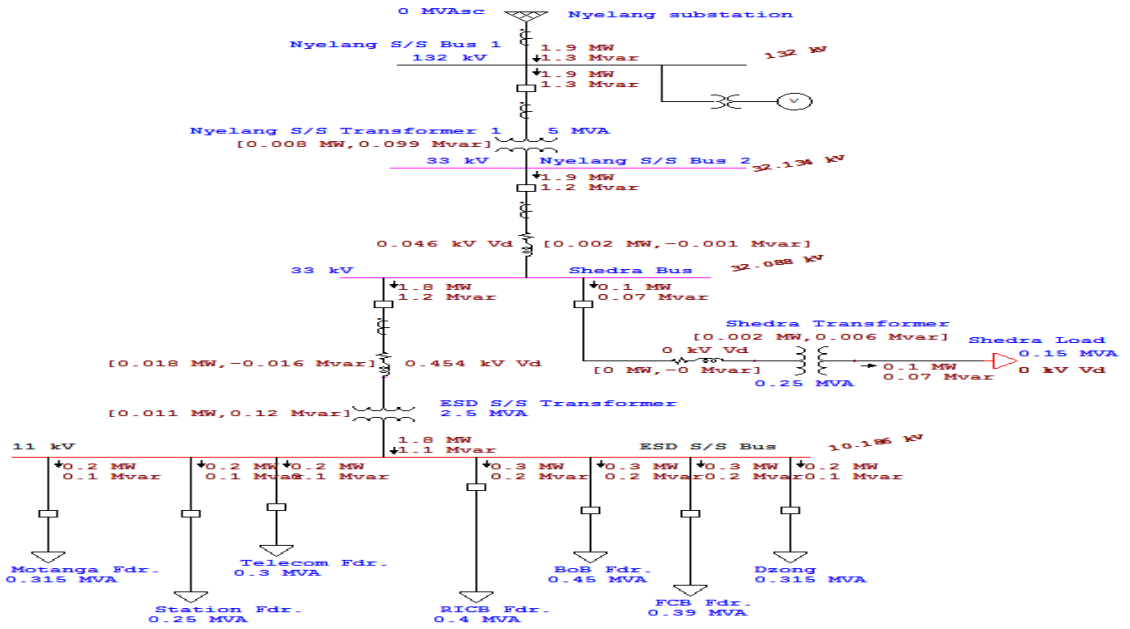
Fig. 3. Load flow analysis diagram of 33 kV feeder

power on swing bus that is Nyelang SS Bus 1 is 1.940 MW and the reactive power is 1.335 MVAr and the power factor is 82.4% which is very low. A positive value of active power (MW) and reactive power (MVAr) indicates that power flow into the buses whereas the negative values indicate that the power flows out of the buses. From the above result, it is found that there is no bus with load mismatch of more than 0.1 MVA.

In the table. 2 shows the losses in different branches of the distribution line and transformers connected along the line. It also shows the power flow in MW and MVAr into and out of the buses with positive and negative values respectively. From above report, the total losses in the lines and transformers is 41.3 kW and 208.1 kVAr respectively. Positive losses indicate the power factor of the load is leading. Conversely, negative losses indicate that power factor of the load is lagging. The last column in the result indicate the voltage drops in percentage. Maximum voltage drop occurs in ESD Sub Station Transformer, i.e., 3.26% (1.046 kV) and the least voltage drop occurs in Shedra line with negligible value due to short distance between tapping and distribution transformer (250 kVA).

III. CALCULATION OF LOSSES IN TRANSFORMER AND LINES

1.   Transformer losses

The core and copper loss occurred in transformer. Core losses are caused due to alternating flux in the core of transformer and copper losses occur due to ohmic resistance of the transformer. The following relations are used to calculate the technical losses of transformer.

$$P_{loss} = \frac{P_i \times No. \ of \ transformer \ on \ feeder \times 24 \times No. \ of \ days}{1000} \ (kWh)$$

$$Copper \ loss = \frac{P_c \times No. of \ transformer \ on \ the \ feeder \ \times LF^2 \times 24 \times No. of \ dsys}{1000} \ (kWh)$$

$$LF = \frac{Unit \ sent \ out \ (kWh)}{1.723 \times Line \ Voltage \times Max. \ Amp \times PF \times 24 \times No. of \ days}$$

where, P_i= rated iron loss

P_c= rated copper loss

LF= load factor

In the Table 3 the monthly transformer losses of different ratings of transformer in 33 kV feeder. The iron losses in transformer are approximately constant because the iron loss depend on voltage and frequency therefore the voltage and frequency

Table 1. Load Flow Result

Bus ID	kV	Voltage % Mag.	Ang.	Generation MW	MVAr	Load MW	MVAr	Load Flow ID	MW	MVAr	Amp	%PF
Bus5	0.415	94.126	-3.6	0	0	0.114	0.068	Bus8	-0.114	-0.068	196.4	86.0
Bus 6	33.000	95.860	-2.3	0	0	0	0	Shedra Bus	-1.796	-1.179	39.2	83.6
								ESD S/S Bus	1.796	1.179	39.2	83.6
Bus 8	33.000	97.236	-2.0	0	0	0	0	Shedra Bus	-0.116	-0.073	2.5	84.5
								Bus5	0.116	0.073	2.5	84.5
ESD S/S Bus	11.000	92.598	-4.9	0	0	1.784	1.059	Bus 6	-1.784	-1.059	117.6	86.0
• Nyelang S/S Bus 1	132.000	100.000	0.0	1.940	1.335	0	0	Nyelang S/S Bus 2	1.940	1.335	10.3	82.4
Nyelang S/S Bus 2	33.000	97.374	-1.9	0	0	0	0	Shedra Bus	1.932	1.235	41.2	84.3
								Nyelang S/S Bus 1	-1.932	-1.235	41.2	84.3
Shedra Bus	33.000	97.236	-2.0	0	0	0	0	Nyelang S/S Bus 2	-1.930	-1.236	41.2	84.2
								Bus8	0.116	0.073	2.5	84.6
								Bus 6	1.814	1.163	38.8	84.2

• Indicates a voltage regulated bus (voltage controlled or swing type machine connected to it)

\# Indicates a bus with a load mismatch of more than 0.1 MVA

Table 2. Summary of Branch Loss

CKT/Branch ID	From-To Bus Flow MW	MVAr	To-From Bus Flow MW	MVAr	Losses kW	kVAr	% Bus Voltage From	To	Vd % Drop in Vmag
Shedra Transformer	-0.114	-0.068	0.116	0.073	1.8	5.5	94.1	97.2	3.11
SJ Line	-1.796	-1.179	1.814	1.163	18.2	-15.6	95.9	97.2	1.38
ESD S/S Transformer	1.796	1.179	-1.784	-1.059	11.2	120	95.9	92.6	3.26
Shedra line	-0.116	-0.073	0.116	0.073	0	-0.1	97.2	97.2	0
Nyelang S/S Transformer 1	1.94	1.335	-1.932	-1.235	8.2	99.5	100	97.4	2.63
Nyelang S/S to Shedra	1.932	1.235	-1.93	-1.236	1.9	-1.2	97.4	97.2	0.14
					41.3	208.1			

Table 3. Calculated Transformer Losses in 33 kV Feeder

TRANSFORMER LOSSES (kWh)						
Months	5MVA		2.5 MVA		0.25 MVA	
	Iron loss	Cu loss	Iron loss	Cu loss	Iron loss	Cu loss
January	4627.68	5382.84	2313.84	2691.42	409.2	651
February	4179.84	7494.93	2164.56	3500.58	382.8	819.47
March	4627.68	6076.01	2239.2	3024.08	409.2	731.46
April	4478.4	7009.49	2239.2	3384.94	396	847.73
May	4627.68	8545.79	2313.84	4272.89	409.2	1033.53
June	4478.4	9634.94	2239.2	3750.62	396	1165.23
July	4627.68	9665.43	2313.84	4832.71	409.2	1168.94
August	4627.68	9379.06	2313.84	4832.71	409.2	1134.3
September	4478.4	4800.79	2239.2	4267.38	396	580.61
October	4627.68	6513.24	2313.84	3256.62	409.2	875.99
November	4478.4	6534.42	2239.2	3376.12	396	790.27
December	4627.68	3798.13	2313.84	1899.07	409.2	459.35
Total	54487	84835	27243	43089	4831	10257

is constant in transformer while the copper losses are varying as it depends on the load and the load is always varying in the feeder. The transformer with higher kVA rating has higher losses as compared to lower kVA rating transformer. From the calculation, it is found out that the copper losses are more during summer season because the loading is more during summer season.

Copper loss is directly proportional to square of load factor. Therefore, higher the load factor higher the copper loss and lower the load factor lower will

be the copper loss. It is also proportional to number of days and hours. The total transformer loss in terms of kW is equal to 25.64 kW.

The table.4 shows the copper and iron losses of each transformer. It is calculated based on peak load, power factor and peak current on monthly basis.

Table 4. Data used and calculated parameters

Sl. No	Month	Data Used			Calculated Value	
		Energy (MW)	Power (MW)	Power Factor	Current (A)	Load Factor
1	Jan	487.199	1.3	0.97	23.45	0.5
2	Feb	511.75	1.26	0.96	22.96	0.58
3	March	466.333	1.19	0.97	21.68	0.53
4	April	492.729	1.18	0.97	21.28	0.58
5	May	509.08	1.09	0.96	19.86	0.63
6	June	619.022	1.41	0.96	25.69	0.68
7	July	588.998	1.19	0.96	21.68	0.67
8	Aug	684.051	1.4	0.96	25.51	0.66
9	Sept.	670.46	1.41	0.96	25.69	0.48
10	Oct	612.176	1.5	0.95	27.62	0.55
11	Nov	610.025	1.47	0.95	27.09	0.56
12	Dec	608.937	1.96	0.95	36.09	0.42
Total		6860.76	16.36	11.52	298.6	6.84
Average		571.73	1.36	0.96	24.88	0.57

2. *Line Losses*

The line losses are the voltage drop along the line proportional to current due to impedance characteristic of the conducting material.

$$Line\ loss, W = \frac{N(I^2 \times R \times L)}{1000} \ (kW)$$

Where:
W = Power loss in watts
N = no. of Phases
R = Resistance of line per kM
I = Current in Ampere
L = Length of line in meter

Total Technical loss = Transformer losses + line losses
= (139322.27 + 70258.1 + 15089.08) + 52359.87)
= 277029.32 kWh

Average Technical loss = 23085.776 kWh

IV. CONCLUSION

This paper presents calculation of technical loss on transformer and 33 kV feeder. Behaviors of conductor and transformer has been observed by using ETAP software load flow analysis based on real time data. The losses occurring in the 14.896 km line exceeds its allowable level. The result obtained in flow analysis is evident that transformer and line losses contribute the major losses of technical losses. The losses are being analyzed and calculated and using ETAP software. The research is beneficial in understanding about the technical losses and its effect on distribution line. Therefore, this paper presents the method and formula to calculate the transformer and line losses and losses are being analyzed.

Table 5. Calculated Line Losses of 33 kV Feeder

Line losses (year 2016)									
Month	*Peak Power (MW)*	*Re-sistance (Ohm)*	I_1 *(Amps)*	I_2 *(Amps)*	$I_3 = I_1-I_2$	W_1 (kWh)	W_2 *(kWh)*	W_3 (kWh)	$W_T=W_1+W_2+W_3$ *(kWh)*
January	1.3	0.25737	23.45	2.13	21.32	409.2	0.09	354.88	3958.17
February	1.26	0.25737	22.96	2.09	20.87	368.88	0.08	3180.7	3549.68
March	1.19	0.25737	21.46	1.95	19.51	342.24	0.07	2986.6	3310.87
April	1.18	0.25737	21.28	1.93	19.35	324	0.7	2829.6	3153.67
May	1.09	0.25737	19.86	1.81	18.05	290.16	0.02	848.16	1138.34
June	1.41	0.25737	25.61	2.33	23.28	475.2	0.1	4096.8	4572.1
July	1.19	0.25737	21.69	1.97	20.66	349.68	0.07	3050.4	3400.15
August	1.4	0.25737	25.51	2.32	23.18	483.6	4.02	4196.2	4683.78
Sept	1.41	0.25737	25.69	2.34	23.35	482.4	0.1	4125.6	4608.1
October	1.5	0.25737	27.62	2.51	25.11	572.88	0.12	4925.3	5498.28
Nov	1.47	0.25737	27.07	2.46	24.61	532.8	0.12	4579.2	5112.12
Dec	1.96	0.25737	36.09	3.28	32.81	967.2	0.21	8407.2	9374.61
Total		3.089	298.29	27.12	272.1	5598.24	5.7	43581	52359.87
Average			24.86	2.26	22.68	466.52	0.48	3631.7	4363.32

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Securing Windows Server Against Common Threats

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Abstract−Network security is a rising issue in all major organizations due to the explosive growth of the Internet users. Moreover, the Internet is the main source for an organization as well as for the hackers to breach the network security. This project was carried out to secure Window Server from common threats. In this project, common attacks are performed such as access attacks and site spoofing using different tools. Furthermore, this project also contains the techniques such as deploying a zone-based firewall, blocking port number and implementing access control list to secure from those common attacks.

Keywords: Windows Server, hacker, Zone-based firewall, firewall.

I. INTRODUCTION

The project "Securing Windows Server against Common Threats" focuses on the methods used to secure Windows Server against common threats. In order to secure Windows Server, common attacks are performed on Windows Server to access the control over the server.

As technology has progressed so much that it would be no surprise if a computer is hacked. On a personal level, the network security includes only the downloading and installation of anti-virus software and firewall settings. However, when the same problem arises in a business organization, then the solution cannot be as simple as in the personal computer network. As the risks are many in a business organization, there should be a complete system dedicated to securing the networks stated by Hamby (2014) [1].

Since the organizations mostly focus on growing their business, so those organizations forget the network security and take the network security for granted, stated by Hamby. Because of this reason, they tend to predict that their organization's resources are very secure. But they are not aware of the security loopholes from where the attackers can easily get into the organization network.

Therefore, this project provides some of the methods used by the hackers to do the common attacks that the current organization faces and showcase the techniques to secure from those attacks.

Research by Bhardwaj and Singh (2011) [2] found that spoofing and man-in-the-middle attack (getting access to the network) are the most common attacks performed by the hackers. Based on this study, common attacks such as access attack and site spoofing are carry out using the Metasploit tool and Social Engineering Toolkit.

II. RELATED WORKS

The project, "Securing Windows Server against Common Threats" is about the hackers attacking the Windows Server to gain access and securing the server from different types of attacks. With the increase in the use of technologies, the risks of losing the confidential information of an organization have also increased. The risks of losing confidential information come when there is an increase in the number of users throughout the world.

When the number of hackers increases, the most expensive and prolific victims of hacking will be the businesses. Businesses are many times targeted for their customers' personal and financial data and often are targeted by their own employees, whether disgruntled or just opportunistic. So, the security is must in order to run the business successfully. According to Steinberg, the CEO of Green Armor Solutions [3], "Poor security can also

give a way for the hackers to hack easily". In line to it, the study carried out by Jahoda (n.d.) [4] states that most of the organizations are being hacked daily throughout the globe due to their poor security. There are some organizations who take the security for granted in order to save their expenditures but in reality, they lose double of what they have earned. Those business runners are unaware of those hackers who are in search of the organizations with poor security. Therefore, the study done by Jahoda and Steinberg shows that the security is must in an organization.

Windows provides many security tools and features, that used to deflect the attacks which are use in this project. These utilities are excellent for hardening a system or for the general configuration management to keep entire environments tuned to avoid loopholes. Most of the organization has started implementing the various servers such as FTP, Web, and DNS as those servers provide the centralized and automated services, which required security. Bajpai (n.d.) [5] stated in his paper that without a server, centralized email systems and backing up company email are difficult and unreliable. In addition, servers also help to make the organization's work easier while providing the reliable services to their customers.

Though the organization can give reliable services by securing their data using the various types of the server but using those servers doesn't protect the information for a lifetime. Therefore, to secure the servers, it is recommended to protect our desktops and laptops using the latest version of antivirus and turning on the firewall stated by Bajpai. Furthermore, making a backup of our important data that are present in servers and protecting our network from penetration are the most important task that needs managed to secure our organization. Server security can also be sustained by providing lease privileges to user to ensure that no one can get access to our websites without any proper authentication.

In this project, two common attacks are performed on Windows Server 2008. The attacks performed are access attacks and site spoofing. The tools used to perform are Metasploit which contains the program named keylogger. According to Shetty (n.d.) [6] "Metasploit is the penetration test-ing tool which is the world's largest Ruby project, with over 700,000 lines of code".

Metasploit is a tool to penetrate into the victim's system and the program used to gain access to the victim's system is a keylogger. Beal (n.d.) [7] defined

keylogger as a computer program that records every keystroke made by a computer user, especially in order to gain duplicitous access to passwords and other confidential information.

Site spoofing or website redirection is another attack that is performed in this project. A site spoofing attack is the type of attack in which the attacker creates a misleading context in order to trick the victim into making an inappropriate security-relevant decision (Felten et al., (1997) [8]. The tool used to perform this attack is Social Engineering Toolkit. White (n.d.) [9] defined the Social Engineering Toolkit (SET) as an act of manipulating people to perform an action which is not recommended to do by legal authorities or agencies.

Russel and Zucker (n.d.) [10] defined the Windows Server as a group of server operating systems designed by Microsoft that supports enterprise-level management, data storage, communications, and applications. The new roles in Windows Server provide a new way for the users to determine how they are implemented, configured, and managed within an Active Directory domain or forest. Moreover, Zucker also stated that the Windows Server such as Windows Server 2003, Windows Server 2008, Windows Server 2012 have focused on the stability, security, networking, and various improvements to the file system. Because of this reason, most of the organization has implemented the Windows Server. Despite Windows Server having the security features yet, it doesn't prevent the hackers getting into an organization. In order to secure the Windows Server, the organization has to harden the security by using various tools and techniques such as firewalls, windows defender, port blocking and access policies.

III. METHODOLOGY

This project was carry out in the virtual environment using GNS3 and VirtualBox, where different virtual devices were use, such as routers, switch-

es, Windows Server 2008 and Windows 7. VirtualBox was use to install and configure Windows Server (DNS and Web) and Kali Linux. In this project, some common attack are performed and some techniques were used to secure Windows Server from those attacks on a virtual network. Though the project was in virtual, however, it can also be implemented in the real environment using the same procedure, configurations, software, and hardware which we have used in the virtual network.

A. Creating internal and external Network on GNS3

According to (Jameleddine & Abdelwaha, 2014) [11], GNS3 is a graphical network simulator that allows us to design network topologies, combine virtual devices with real devices, and also can be used to simulate networks. It works by using real Cisco ISO images which are emulated using a program called Dynamips.
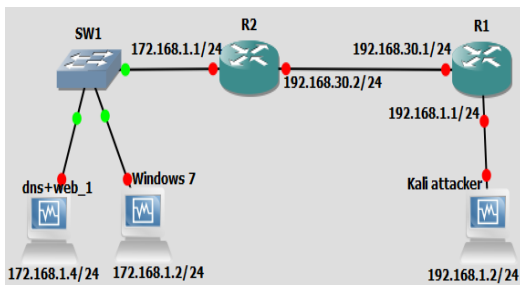

Figure 1: Network Topology

Figure 1 shows the network topology that was used to carry out the project. On GNS3, it shows the internal networks with the network address 172.168.1.0/24 which comprises of Ethernet switch, DNS, Web, one client computer and router which is connected to the external network. Then the DHCP and network address translation were configured on each router for the virtual network (LAN) to get an IP address. On the internal network, it comprises of Windows Server which hosts the DNS and Web server with the IP address 172.168.1.4/24. In the internal network, it also comprises of Windows 7 with the IP address 172.168.1.2/24.

On the external network, it comprises of Kali Linux as an attacker with the IP address 192.168.1.2/24. Kali Linux is connected to the

router and on the router (R2) DHCP is configured so that an attacker can get the IP address dynamically from the router. To enable the data to transfer from external network to internal network and vice versa a routing protocol known as Routing Information Protocol is implemented.

IV. ANALYSIS

A. Testing and Evaluation

To carry out this project, the virtual network was designed using the GNS3. After designing the network, a routing protocol known as RIP is being configured so that data transfers the packets from internal network as well as from the external network and vice versa. To verify whether packets can be transferred from one network to another a command known as ping is used.

Figure 2: Testing and Evaluation

Since the pinging to Windows Server is successful as shown in Figure 2, it shows that the packets are being transferred from Kali Linux to Windows Server.

After performing some common attacks, the firewall known as the Zone-based firewall is used to secure from those attacks. One of the attacks that were performed in this project is the access attack. To perform this attack, a tool known as Metasploit is used. In addition, it contains the keylogger program which is used to capture every keystroke made by the users. The Figure 3 shows that the user has typed "hello everyone, I am Budhi" on her/his system and the same information was captured by the attacker (Kali-Linux)

```
meterpreter > keyscan_dump
Dumping captured keystrokes...
hello everone, i am <CapsLock> <Back> budhi
meterpreter >
```

Figure 3: Access attack

Figure 3 shows the successful performance of the access attacks on Windows Server. So, in order to secure the Windows server from the access attacks, the Zone-based firewall is configured on a router (R2).

After configuring the Zone-based firewall on the internal router (R2), it is verified whether the packets can be transferred from the external network to the internal network using the Ping command.

```
R1#
R1#ping 172.168.1.4

Type escape sequence to abort.
Sending 5, 100-byte ICMP Echos to 172.168.1.4, timeout is 2 seconds:
.....
Success rate is 0 percent (0/5)
R1#
```

Figure 4: Testing

Ping command on the router (R1) can be used to transfer the packets from external network to the Site spoofing or website redirection is another attack that was performed on Windows Server. In order to perform the site spoofing, Ettercap tool is used to redirect the web page www.google.com. The Figure 5 shows that the web page www.google.com is redirected to the attackers (Kali Linux) IP address where a fake web page is being created.

Windows Server which is on the internal network. The Figure 4 shows that the packets could not be transferred to Windows Server which means that the Zone-based firewall is blocking the unauthorized users from transferring the packets. Therefore, this shows that it cannot be pinged hence proving that Windows Server is secure from the access attack

Figure 5: Site spoofing

B. Result

This paper presents the importance of network security in organizations and some of the methods to secure Windows Server from common attacks.

Moreover, common attacks are being performed which are mostly used by the hackers to get access to the Windows Server and the techniques such as deploying a zone-based firewall, blocking port number and implementing access control list are used to secure Windows Server from those attacks. Therefore, this project is successful in securing Windows Server from the common attacks.

V.   CONCLUSION

As computing has evolved, we have seen a move away from innovations in hardware and onto software, and now onto the Internet. Based on history, we see that newer fields of computing are generally the places where hackers have the largest impact. And due to the advanced technology, hacking is seen in programming, in the legal and illegal activities. So, this leads to the conclusion that the impact of hackers is felt mostly in those developed organizations which are to do with the Internet connectivity. The increase in the number of Internet users has given birth to the number of hackers hacking the organization to gain the confidential information.

The project titled "Securing Windows Server against Common Threats" is solely on the methods and the tools used by the hackers in hacking Windows Server and some of the security strategies used to prevent those hackers. In this project, the common attacks such as access attack and site spoofing were performed on Windows Server. After performing the attacks, the solutions were im-

plemented to prevent those attacks. Moreover, some of the tools such as Zone-based firewalls, port blocking technique were used to prevent those attacks. The organizations can use those tools to prevent the common attacks and secure their organization from black hats hackers.

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Study on Cyber Threats and Its Awareness among Students in Jigme Namgyel Engineering College

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Abstract - With the increasing trend in using the Internet for all-purpose among majority the population, the growth of cyber threat is surrounded by the fact that most of the online users are unaware of threats that affect them on a daily basis and how to protect themselves against such threats. The study was mainly focused on providing awareness of cyber threats and the security measures that need to be adopted as an individual to prevent threats in future. The study was conducted by distributing the online and printed questionnaire to the students of all the departments. The overall result of the study indicates that most of the students are being victimized due to the minimal knowledge on cyber threats. Therefore, this study recommends the College to provide additional awareness on such threats and associated risks while using Internet and assists in providing technical help in handling and resolving such issues. The College could also promote workshops, seminars, conferences, and training related to common cyber threats and risks through which the end users can avoid being the victim of such threats.

Keywords- Cyber threats, Information, Awareness, and the Internet

I. INTRODUCTION

The world is fully dominated by the growth of modern technologies such as computers, smartphones, and laptops contributing an easy lifestyle to all the users. Through these technologies, people uses Internet in which the users are globally connected through social networking sites such as Facebook, WeChat, Email, Twitter, and Instagram. The Live Internet Stats, found that out of the total world population, about 40.4% of the population is using the Internet [1].

The Internet is used as a part of work, entertainment, social life, education and for playing games, fulfilling various desires of the people. It is also used for paying bills, online shopping, online banking services, and various other services strengthening the peoples' productivity. However, apart from all those advantages, the Internet also contributes negative impacts to the people introducing various threats without the knowledge of the users. The threats that attempts networks and computers are virus attacks, phishing attacks, password attacks and the hackers [2].

Threats are introduced to the system from visiting the unknown websites that are knowingly or unknowingly connected to untrusted sites. Moreover, responding to fake emails, providing ones' details to fake websites such as online transaction and using corrupted drives also lead to the growth of threats in users' machine.

People using the Internet mostly engage themselves in social networking, gaming, and online shopping. These websites mostly need user credentials to log in and gain access in which the user creates an account by providing their personal information. Moreover, shopping websites possess a more serious threat because they are likely to cause financial harm to the user. Therefore, one can easily understand that the online activities are dangerous if the users are not aware of the existing threats and ways to protect themselves from these Internet threats.

According to the [3], claimed that the users are becoming a regular victim of threats due to the lack of threat awareness. However, users are aware of only the threats that occur frequently because of which the attack is administered to the user's machine. Thus, "Improving the security awareness among the normal users can prevent them becom-

ing the weakest link in any organization or becoming an easy and soft target for the cyber criminals" [4].

II. RELATED WORK

Due to the advancement of modern technology, the rate of Internet dependency increases with the increasing number of population. The Internet is used for educational, social life, entertainment, and gaming. According to the study on the Internet Access and Usage Behavior in the Kingdom of Bhutan, conducted [5] found that among 376 respondents, majority of the people use Internet to seek information, 17.7% for educational, with 14.12% for social life, 15.67% for email services, and 7.64% of the respondents use Internet for entertainment [5].

Threats associated with the use of Internet commonly known as cyber threats get into the devices and generate a negative outcome in the IT environment. A cyber threat is defined as "any circumstance or event with the potential to adversely impact organizational operations (including mission, functions, image, or reputation), organizational assets, individuals, other organizations, or the Nation through an information system via unauthorized access, destruction, disclosure, or modification of information, and denial of service" [6].

It is vital for the users to be aware of cyber threats when browsing the Internet. In the advanced official threat report generated by [3], states that the online users are aware of threats that occur frequently because of which the attackers easily get into their machine. In order to ensure that the online users are aware of the cyber threats, [7], proposed to educate the users about the information security and initiate various programs against the cyber threats.

Online threats are mostly undetectable. The online threats that come through botnets such as viruses, worms, and malware are difficult to detect. It monitors the infected computers from a remote location and sends spam messages causing Denial of Service (DOS) attacks against servers and computers in a network. Moreover, the threats such as viruses, worms, Trojan horses, spyware, and adware comes in the form of malware infecting the personal computers and gain automatic control over the infected systems. The traditional form of online threats called spam, floods computers with an unwanted email that are sent through social networking websites. The threat called pharming threat redirects the URL of legitimate users to the wrong websites infected by the malicious threats and steal the sensitive information of the user [8].

Among all the threats, spam messages are found to be most prevalent in today's world. According to the survey [9], found that from the total of 1000 respondents, 450 (45%) of them received email messages, 500 (50%) of them carelessly open the email they received, and 390 (39%) of them visits the URL of the received emails. This indicates that majority of the respondents frequently receive spam messages in a year.

The cyber threat became the major concern in Bhutan. One of the resource speakers in the workshop conducted in Thimphu, Mr. Jimmy S. Mate commented that in Bhutan, the commercial Internet cafes do not maintain the records of its customers whereby making it easier for the attackers to get into its organization and launch a virus or commit any kind of cyber-crime [10]. It was reported that the Bank of Bhutan was made to transfer 16 million to three different accounts in India, Malaysia, and Thailand through the fake email letter that was supposedly sent from the Royal Audit Authority [11].

There are three ways to avoid cyber threats such as education, training, and awareness, implementing policies and through auditing. The adequate policies should be implemented in an organization for the safety of their employee's personal data and information and its own organization records. To ensure that the users follow the mentioned policies and procedures, audits must be conducted in every organization. The important thing that the users must know is how to handle the tricks that the attackers used to gain access to their personal data. Users must avoid giving its confidential information about the organization via telephone, online

or either in person without the proper authentication [12].

Threats such as phishing and scamming can be prevented by using different tools such as using strong passwords, avoid sharing the information through untrusted sites, monitoring the account and the personal data and removing the personal details such as the date of birth from the public information database [13]. In addition to that, one must frequently enable the firewall, use anti-virus or malware software, anti-spyware, install the latest operating system updates, and use encryption to secure data [14].

Internet users are mostly the students in colleges and the school goers. In Korea, 41.1% of Internet users are the students in colleges, and 29.6% are the people with masters. In China, 67.4% of Internet users are the students from high school and middle schools, and26.1% are the students in colleges. Similarly, in Hong Kong and Macau, 53.9% and 52.5% of Internet users are the students from middle and high schools, and 33.4% and 31.3% are the students in colleges respectively. In Taiwan, 50.8% of Internet user are college students and 39.8% are the students in middle and high schools [15].

III. METHODOLOGY

A. Study Method

The study was conducted with the mixed methods (qualitative and quantitative). The quantitative research method was used as it offers the best tool to emphasize the objective measurements and numerical analysis of data collected through survey questionnaires. Whereas the qualitative research method was used to let the respondents share the relevant views and opinion on cyber threats for further analysis.

B. Procedure and Study Area

The study was conducted amongst the students of Jigme Namgyel Engineering College by distributing the survey questionnaire. We have randomly selected 420 students as our sample size from across the departments. The survey questionnaire was distributed in the form of e-questionnaire as well as in hard paper in order to find out the level of cyber threat awareness in students, and the type of measures if any taken by each respondent to prevent threats and resolve the encountered threats. The total of 301 respondents were given hard copy questionnaire and 119 respondents were based on through online questionnaire.

The questionnaire comprised of 22 questions including both objective and descriptive questions. The questions were based on the use of Internet, password practices, threat awareness, and the measures they have taken if any against common threats. The answered questionnaires were then collected and evaluated for analysis.

A literature review was conducted in order to help better define the scope of the study. Published reports, research papers, Internet sources, and media related to cyber threats and its awareness were examined for the study. We have conducted 15 to 20 literature reviews based on the suggestions given by various authors related to the study. We have highlighted the importance of the study, types of threats encountered globally, cyber threat issues in Bhutan and the measures taken to overcome or prevent the threats.

C. Tool used for Data Collection and Analysis

The collection of data was done by distributing the printed and online questionnaire to the students that were randomly selected across the departments.

The collected data were then analyzed using the Statistical Package for the Social Sciences (SPSS) tool version 20. Using this tool, we have developed a frequency table for each question that shows the number of respondents and the percentage of the re-
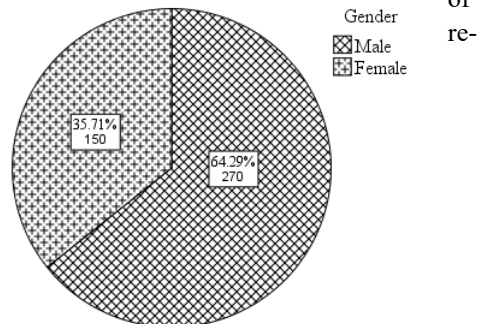

Fig.1. The gender of the respondent

spondents against the answers provided by them. To display the output of the analyzed data, the statistical tool, such as pie chart, bar graph, and line graphs were used.

IV. DATA ANALYSIS

A. Gender Distribution

Fig. 1. shows the information about the number of respondents. The study sample consisted of 420 respondents out of which 270 (64.29%) were male and 150 (35.71%) were female.

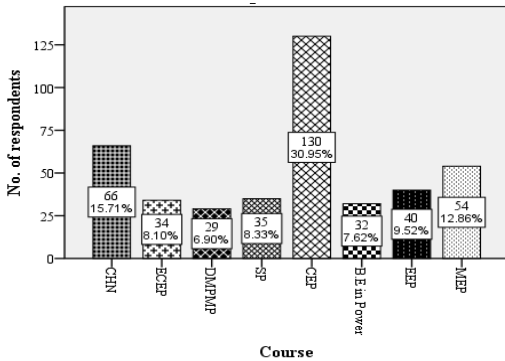### B. Respondents across the departments

Fig. 2. Number of respondents from respective departments

Fig. 2. shows the number and the percentage of the respondents across the departments. Among the total of 420 respondents, 66 (15.7%) were from Computer Hardware and Networking (CHN), 34 (8.1%) from Electronics and Communication Engineering Program (ECEP), 29 (6.9%) from Materials and Procurement Management Program (DMPMP), 35 (8.3%) from Survey Program (SP), 130 (31.0%) from Civil Engineering Program (CEP), 32 (7.6%) from B.E in Power, 40 (9.5%) from Electrical Engineering Program (EEP) and 54 (12.9%) were from Mechanical Engineering Program (MEP) respectively. (9.5%) from Electrical Engineering Program (EEP) and 54 (12.9%) were from Mechanical Engineering Program (MEP) respectively Management Program (DMPMP), 35

(8.3%) from Survey Program (SP), 130 (31.0%) from Civil Engineering Program (CEP), 32 (7.6%)
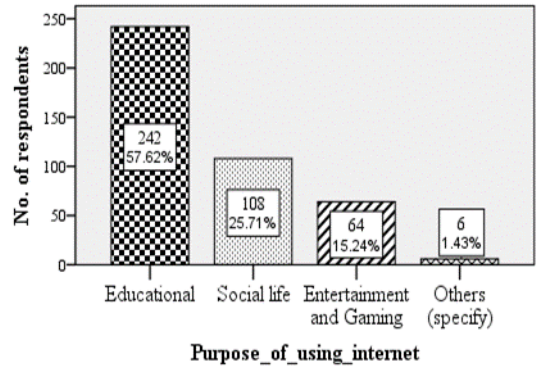

Fig. 3. Major purpose of using the Internet

from B.E in Power, 40 (9.5%) from Electrical Engineering Program (EEP) and 54 (12.9%) were from Mechanical Engineering Program (MEP) respectively.
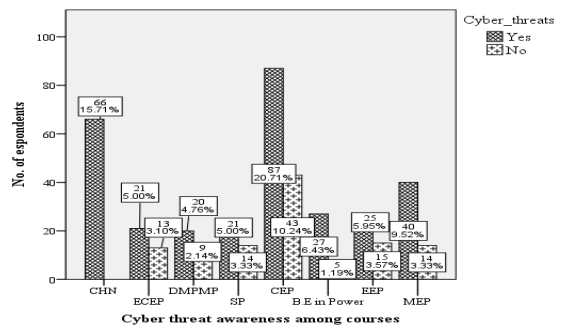

Fig. 4. Respondents aware of cyber threats

C. Major Purpose of Using the Internet

Fig. 3. display the respondents' major purpose of using the Internet. The maximum respondents were using the Internet for educational purpose that is 242 (57.6%) followed by 108 (25.7%) for social life, 64 (15.2%) for entertainment and gaming, and 6(1.4%) for others.

D. Number of respondents aware of cyber threats from different departments

Fig. 6. Malicious program resolution

Fig. 4. displays the number of respondents from different departments (programme) aware of some of the common cyber threats. The table depicts that, among 420 respondents, 307, approximately 73.0% of the respondents were having the knowledge of cyber threats and among that, all the respondents from Computer Hardware and Networking programme were aware of threats. However, 113, approximately 26.9% of the respondents were having no idea about any existing threats.

Fig. 6. depicts that, out of 420 respondents, 356 of the students suspected that the malicious program slows down their devices. So, to resolve those issues, 110 (26.2%) update the device, 102 (24.3%) install and update the antivirus, 70 (16.7%) enable the firewall, and 74(17.6%) avoid visiting untrusted sites.

E.   The best solution to prevent the threats associated with the use of   electronic device and Internet

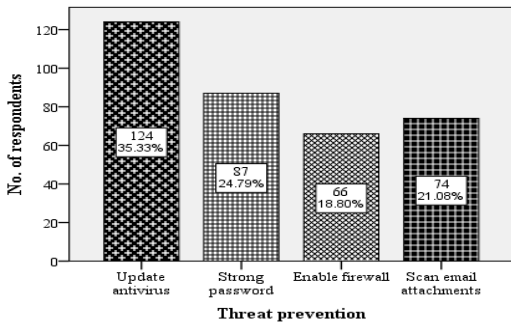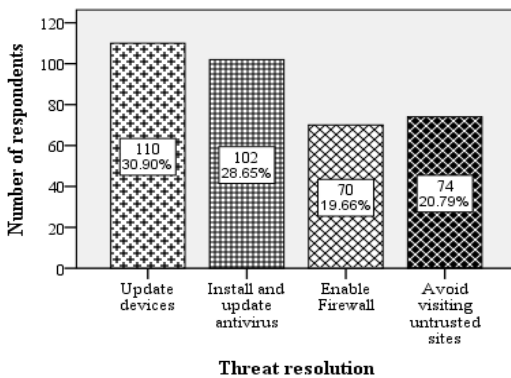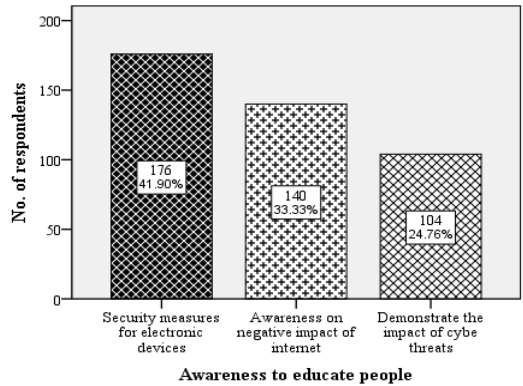*G.   Awareness to educate people*

Fig. 5. Cyber threat prevention

Fig. 7. Awareness to educate people

Fig. 5. display the information about the respondents' opinion to prevent cyber threat issues. Among 420 respondents, a total of 351 respondents came up with various solutions, i.e. 124 (29.5%) came up with a solution to update antivirus, 87 (20.7%) to use a strong password, 66 (15.7%) to enable the firewall, and 74 (17.6%) to scan email attachments.

Fig. 7. display the information about the respondent's opinion on giving awareness to the people on cyber threats. Among 420 respondents, 176 (41.9%) suggested to give awareness on security measures for

the electronic devices, 140 (33.3%) to give awareness on the negative impact of Internet, and 104 (24.8%) to demonstrate the impact of cyber threats.

F.   Ways for resolving the malicious threats

V.   RESULT

Study on Cyber Threats and its Awareness among students in Jigme Namgyel Engineering College test result revealed that majority of the students were surfing the internet for the purpose of education. However, the study indicates that majority of the respondents are aware of the cyber threats but they are still being victimized due to the lack of knowledge on how to handle and resolve the issues with the limited knowledge they have in the field of ICT. Moreover, the study found that majority of the respondents suggest to update the antivirus on

the system and also update the system devices to prevent the threats associated with the use of electronic device and Internet.

VI. CONCLUSION

"The study on Cyber Threats and its Awareness among students in JNEC" was conducted in order to determine the level of cyber threat awareness in students through survey questionnaires. The cyber threat is a disruption to the network or electronic devices caused over the Internet by the unauthorized users to gain access to it. Through this survey, we can conclude that the majority of the student browse Internet to acquire knowledge and information or for educational purpose. However, the level of awareness and knowledge of threats associated with the use of Internet is basically low. Therefore, the awareness in Internet users need to be improved in order to avoid themselves from being victimized.

From the survey that we have conducted, we found that maximum students have more than one social networking accounts and almost half of them uses the same password for all the accounts. Moreover, the password has been shared to their families, and friends which imply that they are not aware of the risk associated with it.

The students use the antivirus program on their computers and laptops, however, the majority of them rarely update it and some of them were having no idea about the activities carried out by this program. Moreover, the students know about the presence of windows firewall, but they usually fail to enable or turn on the application.

The cyber threat is associated with emails and documents and the majority of the students know about it. The respondents also came across the spam messages on their social networking sites. However, the measures to overcome those threats is very limited in them. Therefore, we can conclude that students are more likely to become the victim of various cyber threats such as viruses, worms, phishing attacks, spam messages, and Trojan horses in the near future. So, to sensitize the Internet users on cyber threat awareness is highly recommended.

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Design and Fabrication of Cold Storage

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Abstract- Preserving the horticulture produces in their fresh form demands that the chemical, biochemical and physiological changes are restricted to a minimum by close control of space temperature and humidity. Though the refrigeration is used for the preservation of produce however it is energy intensive, expensive and it is not ecofriendly in nature. Energy crisis and environmental pollution is one of the most important problem, the world is facing now-a-days. Therefore Evaporative cooling is a well-known system to be an energy efficient, inexpensive, ecofriendly and economical means for reducing the temperature and increasing the relative humidity in an enclosure. Problems associated are during power cuts for cold storage leads to an increase in temperature and can result in the loss in quality and value of stored produce. This project proposed the use of cold storage without using electricity for maintaining the shelf life, freshness and quality of perishable produce.

Keywords-cold storage; perishable produce; relative humidity; temperature, energy efficient; ecofriendly; inexpensive; charcoal.

I.   INTRODUCTION

High temperature is the main causes of the perishable produce losses in the developing countries. High temperature accelerates the aging, water loss and rotting. Preserving the horticulture produce in their fresh form demands that the chemical, biochemical and physiological changes are restricted to a minimum by close control of space temperature and humidity[1].Though the refrigerator are one of the commonly used, however it is a single biggest user of electricity and it requires uninterrupted supply of electricity to maintain the temperature and relative humidity which is not always possible.

Cold storage using charcoal is a zero energy cooling system which can be used as an alternative method for storing the perishable produce, which works based on the principle of evaporative cooling methods and it is applicable in electricity inac-

cessible areas. As it eliminates the use of toxic refrigerant, it is an environmental friendly, simple in construction and it is inexpensive.

Appropriate cold storage are therefore required in Bhutan on-farm, for the storage of fresh horticultural produce in remote and electricity inaccessible areas, to reduce losses. Low-cost, low-energy, environmental friendly evaporative cooler is designed to provide an environment which is lower than ambient temperature and at a higher level of relative humidity for the storage of fresh produce [2]. Deterioration of the horticulture produce is directly related to temperature and relative humidity. Though these devices are not typically capable of maintaining temperatures of 2°C to 3°C, they can be significantly cooler than ambient temperature, thereby decreasing the growth of bacteria and increasing the foods' life. Therefore, the aims and objectives of developing cold storage system using charcoal is to provide an inexpensive, energy efficient, environmental friendly and potentially attractive cooling system.

II.   PROBLEM STATEMENT

Agriculture is the foundation of Bhutanese economy. It provides the livelihood base for 69% of Bhutan's total population. Though Bhutan produces large amount of fruits and vegetables throughout the year however, huge amount of vegetables and fruits are being wasted, and some are exported to neighboring state of India. Not many farmers choose to retain and store their produce for a lean season with the fear that; their produce will be spoilt which would fetch them low prices. Farmers only store a few kilograms and non-perishable produce for their consumption and few more as a seed for the following seasons. Though the mechanical refrigeration can be used for storing the perishable produce however it requires uninterrupted supply of electricity which is not always possible, it is expensive and not eco-friendly as it make use of toxic refrigerant. There are many alternative methods to preserve the perishable produce without the use of electricity. Therefore we aim to design and construct the cold storage using M.S sheet, charcoal and water, based on the principle of evaporative cooling system which works without using

electricity can be used as one of the alternatives.

III. EXPERIMENTAL MODEL

A. Design and Fabrication of Model

The cold storage is fabricated using mild steel sheet, charcoal and water which works without electricity for the storage of horticulture produce. It consist of two slightly different size of semi-rectangular box made of mild steel sheet of thickness 1.18 mm, that is outer rectangular box of $(35 \times 40 \times 70.5)$ cm^3 and inner rectangular box of $(30 \times 30 \times 67)$ cm^3 was fabricated by using gas welding. A rectangular box is located one inside another rectangular box maintaining the gap of 5cm and its three sides are filled with charcoal. At the bottom the gap is maintained using M.S square tube of $(3.5 \times 3.5 \times 3.5)$ cm^3 and it is filled with charcoal. Depending on the outside temperature pour the water in order to keep the charcoal moist. When the water in the charcoal evaporates, it causes a drop in temperature across the inner semi rectangular box. A moist charcoal maintains a low interior temperature between 20°C to 25°C for the produce preservation. The specification and modified structure of the 2D design is drawn using AutoCAD 2012 and 3D modeling using Sketch UP 2017 is illustrated in the figure 1.
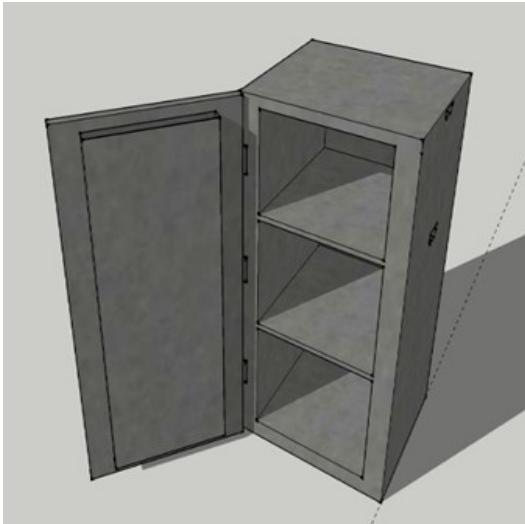

Fig.1. 3D Modelling

The cold storage system works on the principle of evaporative cooling method[3]. When the ambient air from the outside flow over the surface of the storage, the water in the charcoal evaporates removing heat from it. When the hot air contacts over wet surfaces, the rate of evaporation will be

quicker hence improves the cooling effect and maintains interior storage temperature between 20^0C to 25^0C. The efficiency of a cold storage depends on the relative humidity of the surrounding air[4]. Higher the relative humidity of the air, lower will be the temperature and greater will be the cooling effect of the cold storage. In the extreme case of air that is totally saturated with water, no evaporation can take place and no cooling occurs. The efficiency of cold storage is directly related to temperature and relative humidity[5].
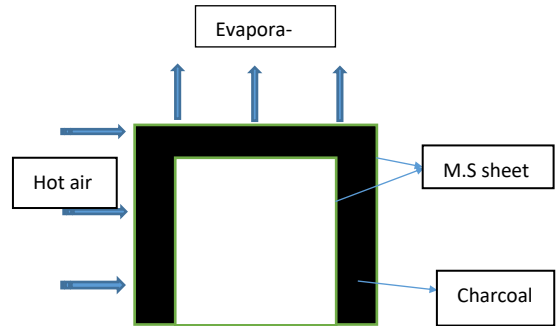

Fig.2. Schematic representation of charcoal based evaporative system

IV. EVALUATION OF PERFORMANCE OF COLD STORAGE

B. Testing Procedure

Conducted the test and evaluate the performance of cold storage with and without product with the help of the two data loggers (4x100-011). The parameters used for the evaluation were atmospheric condition such as temperature and relative humidity inside and outside the cold storage. The experimental study was performed for 1 hour intervals between 1:30 PM to 7:30 PM and from 1PM to
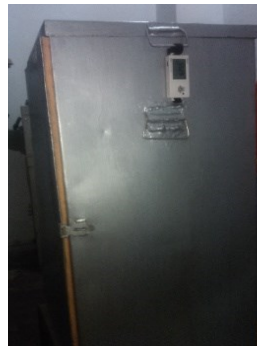

Fig.3. Data Logger placed inside

Fig.4. Data Logger placed outside

Fig.5. Data Logger placed inside with load

Fig.7. Variation of temperature and relative humidity outside cold storage versus time without load

5:30 PM with load and without load respectively by using data logger. The data was recorded at every interval and analyzed using HOBOware data logger software.

C.   Results and Discussion

The desired working model of cold storage without using electricity is designed and fabricated. The performances of the cold storage is evaluated with the help of two data loggers (4x100-011) by keeping one inside and another one outside to record the temperature and relative humidity at 1 hour intervals between 1:30 PM to 7:30 PM and at 30
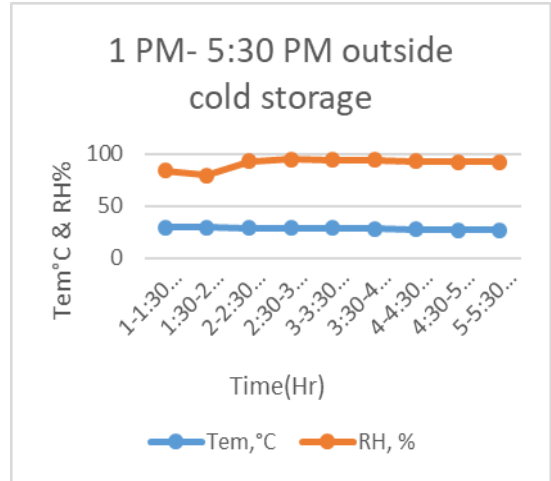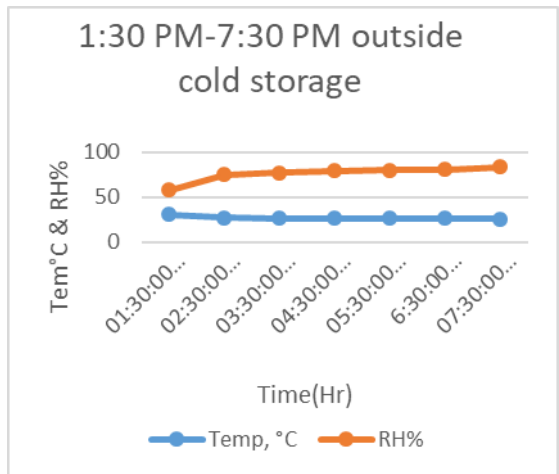

Fig.8. Variation of temperature and relative humidity outside cold storage versus local time
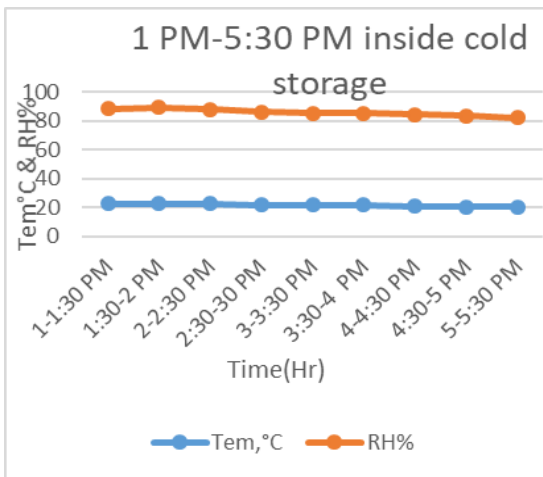

Fig.6. Variation of temperature and relative humidity inside cold storage versus time without load
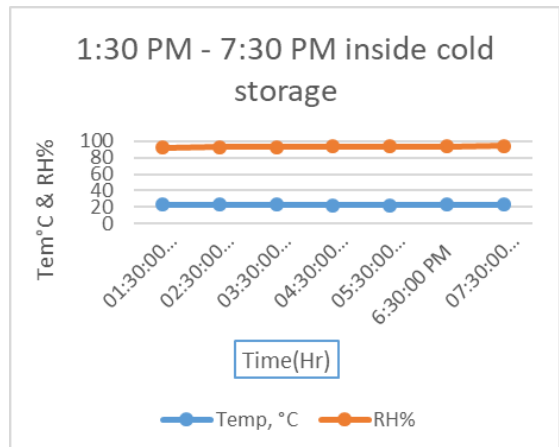

Fig.9. Variation of the temperature and RH with load inside cold storage versus local time.

minutes interval from 1PM to 5:30 PM with load and without load respectively by using data logger. The data was recorded at every interval and analyzed using HOBOware data logger software. The data logger inside the cold storage has shown that the interior temperature is maintained between 20° C to 25°C and also it has shown that the relative humidity increases as temperature decreases. The experimental data are presented as time verses relative humidity and temperature.

The figure above illustrates the temperature and relative humidity of the cold storage. The overall trend of variation of temperature and relative humidity is in a fairly agreed with the results recorded by[5]. The minimum temperature and relative humidity of cold storage without using electricity is 20.65°C and 82.11% respectively. It is considered that the cooling effect of cold storage is directly related to temperature and relative humidity as horticultural produce are stored at lower temperature because of their highly perishable in nature. Warmer the temperature, faster the deterioration, and shorter the storage life of the produce. Conversely cooler the temperature, slower the deterioration and the longer the storage life of the produce. It is also considered that the cooling efficiency of cold storage is affected due to the space between two semi-rectangular boxes which is filled with charcoal, where the moist charcoal converts the warm air into a cool air and maintains the cool interior temperature.

The variation of the temperature and relative humidity versus time in the cold storage is illustrated in figure No. 8 and 9. In both the evaluation the inside temperature of the cold storage is maintained lower than the outside temperature. [6]has designed and constructed a cuboid shaped porous clay container located inside another clay container. The gap between is filled with coconut fibers which is kept continuously wet by supply of water through a flexible pipe at the top. The result of the transient performance test revealed that the cooler storage temperature range over 22°C to 38°C. This indicates that the cold storage fabricated using M.S sheet and the charcoal is more efficient in storing the horticulture produce at lower temperature which helps in retaining their freshness form, taste, an aroma and extends their storage life.

D.   Mechanism of heat transfer

Heat Flow is defined as the energy that is in transit due to temperature difference. Heat Flow is also called as heat transfer, heat exchange, or transfer of thermal energy. The larger the temperature gradient, the higher the rate of heat transfer. There are three modes of heat transfer; radiation, convection and conduction. In the cold storage the heat transfer is through the conduction process.

$$\dot{Q} = \frac{kA}{t}(\Delta T)$$

Q is the heat transferred in Watts (W), k is the conduction coefficient in W/mK, t is the thickness of the solid in meters (m), A is the area in meter (m^2) and delta T is the temperature difference across the solid. The conduction coefficient is a property of the material and can be found in literature or experimentally.

Total Cooling Load = Heat Transfer through The cold $_{storage}$ + Air change load + Product load+ Respiration load

+ Human occupancy + Equipment load

These are the various types of load which is produced in cold storage space by adding these all type of load, give total cooling load and that is required to remove from cold storage[7].

V.   FUTURE SCOPE

To increase the efficiency of the cold storage, one can try increasing the charcoal filled space and use different materials to fabricate the cold storage according to the thermal conductivity. And also one can use the different sealing material for proper sealing.

VI.   CONCLUSION

Experiment concluded that use of the charcoal in the walls of a cold storage can limit the rise in temperature inside and improve the cooling efficiency of the cold storage. As per the data recorded by the data logger, the cold storage fabricated using M.S sheet and charcoal, which works without electricity can maintain the temperature and relative humidity which is favorable for storing the perishable produce. The variation of the temperature and relative humidity inside the cold storage are in a fairly

agreement with the recommended temperature and relative humidity recorded. The experimental results shows that the cold storage using charcoal can preserved the horticulture produce in their fresh form, eco-friendly, and simple in construction can be used in electricity inaccessible area. The test and evaluation are done using data logger (4x100-011) to record the temperature and relative humidity of the cold storage to see the performances of cold storage. The cooling effect of cold storage is greater with decrease in temperature and increase in relative humidity.

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Model of Wind-Based Water Pump using Crank Slotted Mechanism

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Abstract—The exhaustion of non-renewable resources, expanding greenhouse effect and scarcity of fresh water motivated group to use renewable wind energy for pumping the water. The project titled "Model of Wind-Based water pump using crank slotted mechanism" is the conversion of wind energy to pressure energy, a system is developed. This system can be considered as a clean and sustainable energy project. The group used crank slotted mechanism, Fan, Pulley, V-Belt and Piston cylinder in building the system. The fundamental principle of this system is to convert the rotary motion of wind blades into the linear motion. The rotary motion of the fan shaft is transmitted to the crank through V-Belt. The same rotary motion is converted to linear motion by crank slotted mechanism. Thus, the output linear motion is used for driving the reciprocating water pump.

Keywords- Wind energy, pumping of water, crank slotted mechanism, piston pump

I. INTRODUCTION

In the 21st century, global warming and greenhouse effect is the major concern around the globe, leading to climate change.[1] On the other hand, drinking water source is the major crisis.[2] Based on the above-mentioned statement, instigated us for developing a system titled "Model of Wind-Based water pump using crank slotted mechanism". It is an inversion of quick return mechanism developed for converting rotary motion to reciprocating motion. The main reason behind for developing the system is to harness the wind energy which is clean, eco-friendly and abundant in nature. Therefore, in order to use the wind energy, we came up with the system to pump the water, as it is the primary source of life for mankind and one of the basic necessities for agriculture; which still plays a vital role in the economy.[3]

II. LITERATURE REVIEW

Wind power was used as a source of mechanical energy as early as 17th century BC.[4] It was mostly used for pumping water, grinding grain and cutting lumber. In 1854, Daniel Halladay invented a self-governing windmill which automatically turned to face changing wind directions. It automatically controlled its own speed of operation and was used to pump water for cattle and irrigation.[5] Later in 1870's metal windmill was invented which had curved blades which were much more efficient. The use of wind pump became widespread across the world and was mostly used for pumping water for irrigation and drinking purposes. Earlier wind pumps mostly used scotch yoke mechanism, Beam engine mechanism, etc.

In India, the pumps are used by farmers throughout the country to pull in water for irrigation, and currently, rely on diesel generators or India's fossil-fuel-reliant electrical grid for power. Pashupathy Gopalan, the Regional Head of Sun Edison, told Bloomber that 8 million diesel pumps already in use could be replaced right now. And India's Ministry of New and Renewable Energy estimates another 700,000 diesel pumps that could be replaced are bought in India every year.[6]

In the current scenario, people do not have an approach to clean and sufficient water supply. Therefore, this project demonstrates in harnessing clean water supply, which is an effective solution for the identified problem.

III. OVERVIEW OF THE SYSTEM

A. Kinematic Design

Kinematic analysis is the process of measuring the

kinematic quantities used to describe motion. In engineering, for instance, the kinematic analysis may be used to find the range of movement for a given mechanism, and working in reverse, using kinematic synthesis to design a mechanism for a desired range of motion.[7] The Fig 1 given below shows the sequences of power flow in a system to perform its operation.

B.   Constructional Details
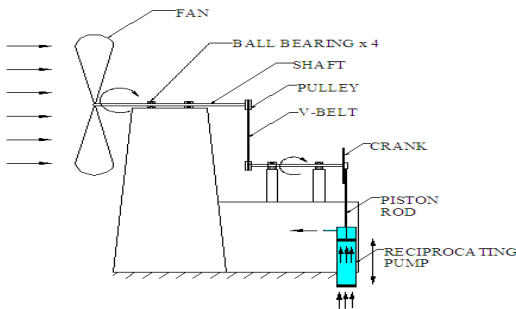
The stand is fabricated by using M.S angle length

Fig 1: Kinematic design of system

116cm and width 2.5 x 2.5cm into a structure of frustum of a square base pyramid. The four numbers of the M.S angle of length 116 cm, 50 cm and 30cm each was cut using the high-speed cutter. After that length of 30 cm x 30 cm and 50 cm x 50cm square frame is fabricated by welding. Nevertheless, for the rigidity of the stand M.S flat of various lengths 60cm, 50cm, 48.5cm are welded crisscross on four faces of the stand. The fan blade is fabricated using an M.S sheet of length 35cm into a shape of the airfoil. Also for the fitting of fan blade with the shaft, an equilateral triangular shaped disc is made using an M.S sheet of length 16.5 cm each side. For the transmission of wind energy from a fan, the shaft is used. It is manufactured by turning the M.S rod in lathe machine to the diameter of 25cm and length of 55cm and 30cm. The V-grooved pulleys are manufactured from an M.S rod of diameter 5cm and length 2.5cm in the lathe machine by the process of taper turning operation. The supporting and mounting of mechanism assemblage, a table is fabricated from the M.S angle of length 53cm width 40cm and height of 51cm. A circular disc of 30cm diameter is made from an M.S sheet. The slotted link is made from the M.S flat of length 38 cm and width 5cm. The 2cm wide slot is made using a milling machine to

the length of 30cm. The piston pump of length 38cm and diameter 5cm is made from PVC pipe of the stroke length of 28cm.

IV. WORKING PRINCIPLE

Wind energy is used to rotate the blades, which in turn rotates the shaft, supported and guided by the two ball bearings. The wind energy (Power) from the fan shaft is transmitted to the crankshaft through a V-Belt drive, thus the rotary motion of fan shaft is converted to the reciprocating motion of piston cylinder arrangement through the slotted link and other associated links, which are the resistant body and produces relative motions.

A.   Quick return motion mechanism

The working of a reciprocating pump is based on the quick return mechanism. When the link is in position 'PM" the piston will be at its bottom dead center. When it is at position "PN" the piston will have reached to its top dead center. Therefore, the pumping of water takes place when the crank rotates through angle C1KC2. The return stroke takes place through the angle C2LC1.

Since the angle C1KC2 is greater than the angle C1LC2, the quick return motion mechanism is obtained since the return stroke is completed within a shorter time than the upward stroke as shown in figure 2.[8]
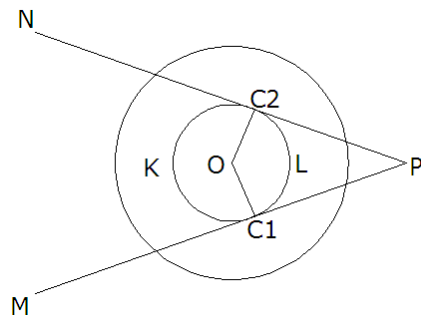

Fig 2: Quick return mechanism

B.   Discharge of a reciprocating pump

For one revolution of the crank, the quantity of water raised up in a delivery pipe is equal to the stroke volume in the cylinder, since it is the single acting pump. The discharge is calculated using the equation given below.[9]

$$Q = \frac{A.L.N}{60} \, cm^3/sec$$

Where

    D = diameter of the cylinder

    A = cross section of the piston or cylinder

    r = radius of crank

    N = RPM of the crank

    L = length of stroke = 2r

TABLE : Discharge and RPM

Sl. No	N (RPM)	Discharge (cm^3/ sec)
1	1	133.51
2	5	667.58
3	10	1335.1
4	15	2002.67

V. CONCLUSION AND FUTURE SCOPE
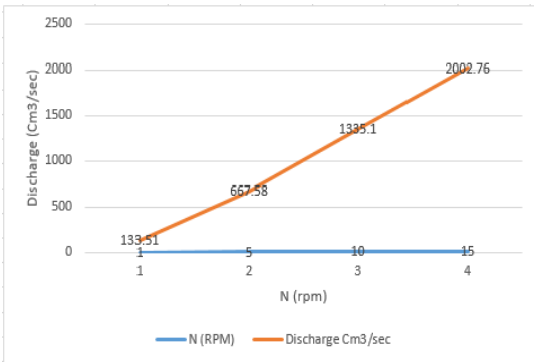
Fig : Discharge Vs RPM

The Wind energy is the most abundant and renewable energy resource. While harnessing the energy, it serves the need for alternate energy. Similarly, this project contributes towards the green environment and assists in controlling pollution, combat climate change; which is a major crisis today. The project "Model of Wind-Based water pump using crank slotted mechanism" is applicable where the speed of wind is high. However, the model also has a scope of building the wind mill higher to generate wind energy. The diameter of pulleys can be varied to have high velocity and to increase the efficiency gears can be used. Further, this can help the regions without the access to electricity, in generating water for their consumption provided the area has a wind power.

As mentioned above the global warming is a major concern and the source of water is drying. Thus, this project has a scope in harnessing underground water.

ACKNOWLEDGEMENT

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DEVELOPING A STANDARD MATERIALS SPECIFICATION FOR JIGME NAMGYEL ENGINEERING COLLEGE

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Abstract

This paper is based on the project, 'Developing a standard materials specification for Jigme Namgyel Engineering college' as a part of the curriculum. The paper is for the purpose of reference, specifically to ease the system of procurement of various departments in the college in specifying the required materials. The papers reflects the process of the developing the specification of materials (tool, equipment, stationary) of the various departments in the college. The sample of the specification design is presented which is the key outcome of the project. The result of the project is expected to minimizes the problem while procuring materials which save cost by getting at the right quality and quantity.

Keywords—Materials, Specifications, Effectiveness

I. INTRODUCTION

The paper titled "Developing a Standard Materials Specification for Jigme Namgyel Engineering College" is mainly to develop as a reference for procuring goods for Jigme Namgyel Engineering College. Specification provides an innovative and imaginative suite of qualification rewarding flair and imagination, and reflecting the contemporary use of materials and information technology. Specifications is to work with the design concepts and materials in ways which recognize the need for wise choices being made in terms of meeting the needs of people, society and the environment. The procurement section of Jigme Namgyel Engineering College was facing the difficulties while procuring the materials due to lack of specifications of materials, so this paper develops a standard materials specifications that are most frequently purchased in JNEC. The revelations of the paper may be useful for the college authorities in decision making while procuring the right

quality product at the right quantity so that college use its resources effectively and efficiently which helps to save cost, energy and resources.

A. Aims and Objectives

The aim of project is to develop specification of materials that are frequently purchased by JNEC.

The objectives of project are as follows:

To collect and gather information on materials in order to be familiar with the specifications in particular of procurement of goods .

To develop the specifications for the items that were collected

To study the types of materials purchased by college Maintaining the Integrity of the Specifications

II. METHODOLOGY

The method adopted for the development of specification is well equipped with the fundamentals of research methodology. The various stages followed for the development of specifications that are frequently purchased by the college are:

Data Collection(store)

Document Analysis (Stock register, ledger book)

Field Visits (SDEBFS Pvt. Ltd)

Consultations(Central store, Head of Departments)

Writing standard specification using Ms-Office (Word, Excel)

Table 1: Sample of Materials Specification

Sl. No	Particular	Specification
1	Ceiling Fan	**Blade Size:** 1200mm **Volt:** 220V **Power:** 100w **Number Of Blade:** 3 **Speed:** 320RPM **Bearing:** Double Ball Heavy Duty
2	Flushing Cisterns	**Feature:** Dual Flush **Type:** Upper Cistern **Toilet Tank Material:** Plastic **Size:** 390*122*420 **Weight:** 2kg **Color:** White **Button Type:** Top Push Button **Input:** Bottom Input Water **Mounting Type:** Wall-Mounted **Volume:** 3L/8L Can be choose Optionally
3	Concrete Drill	**Size:** 2mm **Length:** 50mm **Type:** Masonry Drill **Material:** High Carbon Steal
4	Extension Cord/Socket	**Type:** Extension Cord (Mini) **Grounding:** Standard Grounding **Rated Voltage:** 16A **Theory:** Digital **Socket Pin:** 5 Pin (With Individual On And Off) **Wire:** 5m (Insulated) **Size:** 3*1mm² **Wire Material:** Copper Wire **Plug:** 3 Pin

III. PROCESS OF DEVELOPING SPECIFICATION

Step 1: Planning and analysis

The foundation of a good specification is in planning and analysis which are undertaken which provides a better understanding of the requirement and may reveal alternative solutions.

Step 2: Consultation and information gathering

Developing specifications requires consultation and can be perceived as an evolutionary process involving close and continuous liaison between the end-user, technical officers, project officers/ managers, procurement officers and the specification writer.

Step 3: Writing the specification

While writing specification it's good to use simple, clear language, have define terms, symbols and acronyms, be concise and to seek feedback from someone familiar with the requirement.

Step 4: Vetting the specification and obtaining approvals

Sought approval from the appropriate financial or procurement delegates in the department/agency after vetting the specification but before issuing it.

Step 5: Managing amendments to the specification

The amendment should be authorized by the project manager. The amended specification should

be noted in the project files and all supplier must be given a reasonable opportunity to offer to the new specification.

Step 6: Revising and storing the specification

The specification should be reviewed at the end of the procurement activity to ensure that it effectively defined the goods or services that were actually bought. If areas for improvement are identified, revise the specification with the benefit of hindsight. When the review of the specification has been completed and if it relates to goods or services that are likely to be procured frequently, keep it on file.

IV.MATERIALS SPECIFICATION

The materials specification consist of common materials

(Stationary), tools and equipment's for the benefit of college for different departments. The specification are in detail and the department can refer the specification at time of procuring materials and goods as there was lack of specification of materials while procuring goods.

V.CONCLUSION

Purchase description/specification is called heart of purchase. It describes a production in terms of design characteristics or product quality or both. Design characteristics include dimension, weight, shape, size, surface finish, physical properties, performance and the likes. Quality is the sum total of all properties inherited by a product. Developing a balanced specification requires optimization of views of various departments. The paper focused on developing a standard specification for the material purchased by Jigme Namgyel Engineering College. The revelations of the paper may be useful for the college authorities in decision making while procuring the right quality product for the college so that the college use its limited resources effectively and efficiently. The specification of the materials of the departments which are not specified needs to be taken under consideration in future. Specification of materials are mostly consumable items which are frequently purchased in the campus so it would be better if the upcoming or future students can continue with the work. So

that all materials purchased by JNEC will be covered.

While procuring materials for JNEC, it may make the work of procurement department easier as they can directly refer the specifications when giving supply order. More often it may help the procurement department to save time, which may consume time while searching and developing specifications for a particular items.

In future if the study area could extend to develop more specifications as well as update which are already developed. It may be possible to develop more specifications especially big machines or equipment which are one time purchases as they may be very expensive so improper specifications may result in wastage of resources. Materials keep on updating day by day so there will be changes in specifications as well therefore it would be better if the materials already specified may be updated from time to time. It would be better if college could develop a system based on the specifications which are already developed so that whenever there is changes in the specification of materials they can directly make changes in the system.

VI. ACKNOWLEDGEMENT

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STUDY ON MATERIALS HANDLING AND STORAGE SYSTEM

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Abstract – This paper presents the research carried out on materials handling and storage system in four various organizations in Samdrup Jongkhar region. The study has been carried out with three main purposes such as to evaluate the recent contributions of store department, identification of common issues in material handling system as well as to explore the different methods of handling system used by each organization. The study was conducted through field visits with questionnaire and direct interview from each concerned officials of the said organizations. The finding shows that with the used of modern software system such as SAP has largely contributed in proliferating the revenue of the organization through cost cutting measure. Similarly, the major issues faced by these organizations are insufficient space and skills personnel to handle its materials and storage system. Each organization adopts their own control system to handle their own materials. The BPC uses a SAP application system while the Dungsam Academic School uses BYOB while JNEC uses Tally system. In general, this project presents some of the best practices of materials handling and storage system that can be referred.

Keywords—Material Handling; Storage System; ABC analysis

I. INTRODUCTION

The primary objectives of a store is to provide service to the operating functions and these services cannot be provided without proper "Materials Handling and Storage System". The impact of storage facilities on storage efficiency is to ensure good regular requirement for the organization. Adequate care of materials held within the organization is very important, staff must be well trained in ensuring that materials held within the store are well taken care of storage facilities such as bins, racks, shelves, box pallets, etc. These system must be taken together to create a better design and location of the store which involves planning so that stocks are conveniently grouped and placed for efficient operation. Maximum organizations expenditure is on materials. These materials when acquired are kept in the store and properly documented. Since stock of materials represents money, it is important to research into how these materials are received, kept and issued. Thus materials involving value of money, there should be proper identification undertaken on how the stock is maintained. According to Adaptalift Hyster (2013) "Providing an adequate amount of storage space is vital for the smooth running of a business". Disorganized spaces can cause incorrect use of storage systems. In the research findings the most difficult part faced during storage of materials was insufficient space and lack of qualified or experienced personnel. The group has chosen this topic to highlight the inherent danger and consequence of adopting improper storage and handling of material with a view of providing solution to improve or take necessary corrective measure of storage and handling of materials and employing qualified personnel to handle the store.

A. Aims and Objectives

The aim of the study is to compare the "storage system, materials handling efficiency and to know how materials are being stored and handled in some organization and in Jigme Namgyel Engineering College". This research hence intends to look at the problems associated with the storage and material handling and its efficiency in Jigme Namgyel Engineering College.

Objectives of the project is:

- To evaluate the contributions of store department in an organization.

- To identify common issues related to the methods of materials handling and storage system.

- To study various ways of materials handling and storage system applied by different organizations.

II. METHODOLOGY

This overview of the methodology is the strength that builds a complete structure of the project. The methods used in the project help to create a relationship between the data. So the following methods were used in gathering necessary information.

A. Data Collection

For this project, data were collected through field visit from four organizations namely Bhutan Power

Corporation Limited, Dewathang Medical hospital, Jigme Namgyel Engineering College and Dungsam Academy. Literature reviews and ABC analysis was also part of methodology used in this research.

III. DATA ANALYSIS

It comprises the analysis of questionnaire of the research data. The important analysis of the questions are listed below. Each respondent's view are plotted in graphs to compare data for several individual items or ideas.

A. Application of ABC analysis tools

Always Better Control (ABC) analysis is a way of categorizing the materials on the basis of the quantity of consumption and their relative values. Therefore, the materials are divided into three groups. The materials might be consumed in lower quantities, but their period may be very high, such materials are kept in group 'A'. Similarly, the ma-

terials may be consumed in large quantities but their values may be lower, such materials are kept in group 'C'. In between these two, the materials may be consumption in moderate quantity with moderate price, such materials are kept in group 'B'. The main purpose of using the ABC analysis is to develop policy guidelines for selective controls. From the use of ABC analysis we can find out which organization has which group of materials they have more, the expenses they made to different group of materials and shows which group of materials usually an organization procure and accordingly prepare a proper materials handling and storage systems within the store.

B. Questionnaire Analysis

The above graph its shows 50% of the respondents prefer to use materials handling through sys-
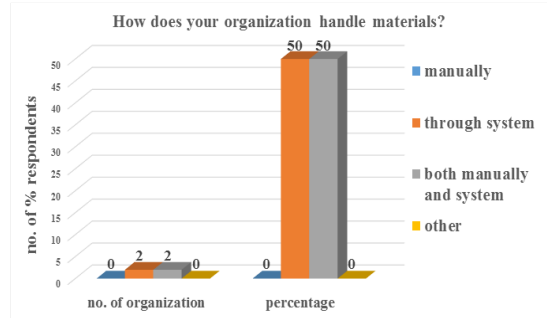

Fig.1. Materials Handling System used in an

tem which include two organization, whereas other 50% prefer to use materials handling through both manual and systems.

The above graph shows 50% of respondents prefer Tally software systems which include two
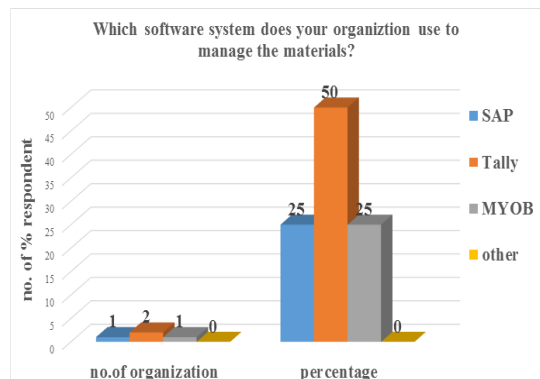

Fig.2. Software system used in an organization

organization, whereas 25% are using system application product (SAP) and other 25% uses Mind Your Own Business (MYOB) a system to record or keep track of the materials.

Negotiation of price is only preferable for C class materials (Minor). For A class (Major) materials e.g. machines which incur a huge cost must undergo tender quotation. This graph shows 50% of respondents are using face to face communication, whereas 25% are over telephones and other sources.

The graph shows 75% of the respondents order the materials when required whereas 25% of the respondents uses their materials that are kept as reserve.

Over 50% of the respondents maintains their own infrastructure whereby 25% maintain their own security personnel and 25% from other sources to mitigate risk of material damage.

Fig.4. Purchase of materials in case of emergencies

Fig.3. Price Negotiation techniques in various organization

100% of the respondents think that lack of insufficient space is the common issues that a store face now and then.

IV.   MAIN RESULTS

Materials handling has greater significant contribution to the organization, country and world in general. A large organization such as BPC can afford to use SAP software system whereas small and medium enterprise uses Tally and MYOB software system to integrate the process function of materials handling and storage system. Even though the software differ from each other they al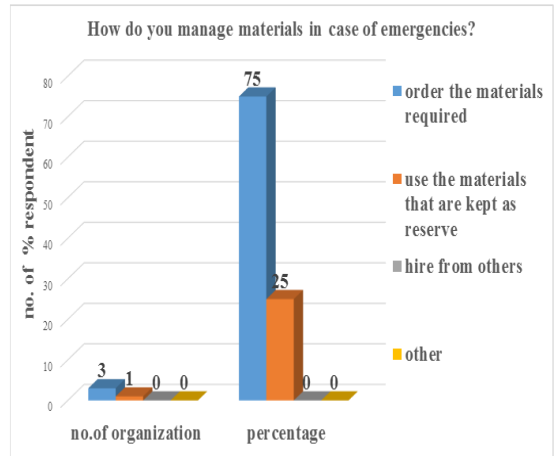l provide functional benefits in materials handling and storage system. The common issues faced by four organization in material handling and storage is in-
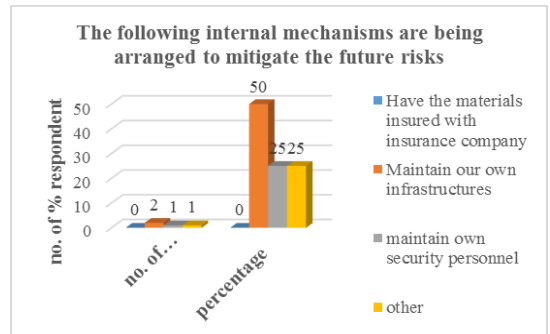

Fig.5. Mechanisms used by organization to mitigate risk

sufficient space in store. Since store department takes care of the assets of the company it is important for a store manager to take necessary steps to safeguard the materials. The materials should be procured depending upon the space of the stores. Physical verification of materials is one of the most important factor to review the materials lifespan. Physical verification which involves actual counting, measuring, weighing of all items in stock is necessary to support the value and accuracy of stock records. ABC analysis tools can provide an opportunity to handle material that are high in value and price so that the productivity of the operation are not affected due to procurement of unnecessary valued items.

V.   CONCLUSIONS

Materials handling today are the life blood of any industry, and no government industry or organ-
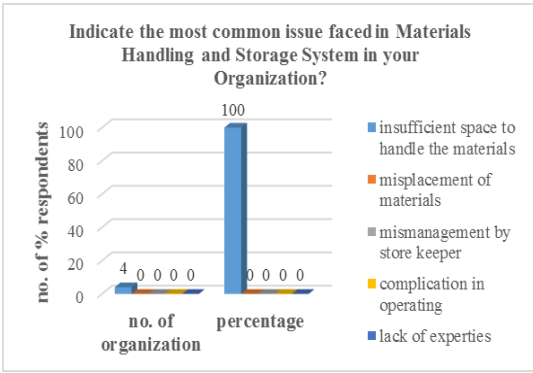
Fig.6. Common issue faced by an organization

ization or private organization operates without them. So materials handling and better storage increase the efficiency and effectiveness of the organization. With this research paper the member found out many significant benefits which result in reduction of the organization operation cost and other expenses that occurred due to mismanagement in stores. By using better materials handling and storage methods organization can save the time, reduce the number of labors and save the space as space now a days are the main elements that impose most cost to an organization. If possible using bar coding and pick to light technology rather than manual picking will help reduce time spent on searching for items. Maintain a separate book as 'Used item' to record items that are used. Before buying any new items surrender the used item to the stores. Record must be maintained whether the used item can be further processed for production activities.

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