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Editorial

I am Happy to publish the second issue (Volume 1, No. 2) of the Sonargaon University (SU) Journal. As I mentioned earlier it is a pear reviewed Journal which will be published in the two times in a year. I also want to mention here that this University has got three faculties – Faculty of Science and Engineering, Faculty of Business and Faculty of Arts and Humanities. I believe that through this Journal teachers and students of all the faculties will boast their self-confidence. Authors of different papers and not only from this University but also from other public and private Universities. The present issue will focus some ideas on Science, Engineering and Business. We are grateful to the founder members of the trustee board, Engr. Mr. Abdul Aziz and Engr. Md. Abdul Alim whose supports have materialized the idea of this Journal. Our sincere gratitude to the Vice Chancellor Professor M. A. Razzaque for his support and guidance. I also extent sincere thanks to all the reviewers for assessing different papers. Sincere thanks are also extended to the senior assistant editor Dr. Zubair Hasan and the assistant editor Md. Mohshin Reza for their heard work in publishing this Journal. Thanks, are also to Mr. Md. Abu Hanif, Assistant Registrar and PS to the Vice Chancellor and Mr. Md. Rahomat Ali, PS to the Vice Chancellor (2) for Sectorial work. Finally, but not the least to the editorial board for their valuable advice.

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Contents

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Effect of Moving Surface on Aerodynamic Characteristics in NACA0012 Airfoil

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Abstract

This study focuses on the effects of moving surface on aerodynamics characteristics in NACA 0012 airfoil through numerical simulation. Two particular cases are considered: (i) Single moving surface (ii) Double moving surface. When 'single moving surface' is considered, only one moving surface of 10% of the chord length(c) is placed at upper surface of the airfoil starting from 0.05c to 0.15c. When 'double moving surface' is considered, one moving surface of 10% of the chord length is placed at upper surface at position starting from 0.05c to 0.15c and the other moving surface of same size is placed at lower surface at same position. Momentum injection into the flow field moves the point of boundary layer separation in the vicinity of trailing edge of the airfoil. By momentum injection through single moving surface with the surface velocity twice the free stream velocity and for different angle of attack, it is possible to reduce the average drag coefficient by 23.9%, compared with no moving surface. For the same condition with double moving surface, it is possible to reduce the average drag coefficient by 25.9%. For using moving surface, boundary-layer separation is delayed along the chord length on the upper surface of the airfoil. The value of lift coefficient increases slightly for moving surface. For single and double moving surface, average increment of lift to drag ratio are 37.3% and 41% respectively.

Keywords: Moving surface, boundary layer separation, momentum injection.

Nomenclature:

C_d	Drag coefficient
C_p	Pressure coefficient
C_l	Lift coefficient
c	Chord length (m)
U	Free stream velocity (m/s)
u	Moving surface velocity (m/s)

1.0 Introduction

Flow separation around the trailing edge (TE) has significant effects (e.g. lift reduction, drag enhancement, greater fuel consumption as well as lower flight endurance and lower achievable speed) on aerial application. The wake formation attenuates the pressure differential on airfoil, especially at high angle of attack. The application of momentum injection via moving surface in the flow field

energizes the flow field and reduces the adverse pressure gradient and attenuates the wake formation. For the past years, considerable effort had been devoted to the investigation of the application of suction, blowing, vortex generation etc. However, the introduction of moving surface in an airfoil for reducing drag is comparatively a new concept. So, there is a great opportunity in lift augmentation, drag reduction and manipulating other aerodynamic behavior by incorporating moving surface.

A practical application of Moving Surface Boundary Layer Control was demonstrated by Favre [1]. He studied an airfoil with an upper surface formed by a belt moving over two rollers. The separation was delayed until the angle of attack reached to 55 degrees, where the maximum lift coefficient of 3.5 was realized. Mokhtarian et al. [2]. investigated the effect of the shape of the rotating cylinder on the lift coefficient of the airfoil. He used a scooped cylinder on the airfoil leading edge and proved that the resulting lift coefficient was increased for low cylinder speeds. Garni et al. [3] conducted a study where they experimentally analyzed the flow separation over a NACA 0024 airfoil with a leading-edge rotating cylinder. Their results indicated that an increase in the lift coefficient (C_l) when the ratio of the cylinder speed to the free stream velocity was increased. For moving surface velocity 4 times than the free stream velocity, the maximum lift coefficient was 1.6 and the stall angle was approximately 30°. Modi and Deshpande [4] performed experiments to investigate the effect of a rotating cylinder on the leading edge of a Joukowski airfoil. A 37-mm diameter rotating cylinder was positioned on the leading edge of a 370 mm chord airfoil. The pressure coefficient (C_p) plots indicated much lower pressure on the top surface of the airfoil when the ratio of the cylinder's circumferential speed over the free stream velocity increased. Modi et al. [5] investigated the lift coefficient of an airfoil with rotating cylinders. They used both splined and smooth cylinders and compared their effects on the lift coefficient of the airfoil. They concluded that the lift coefficient increased when the ratio of the cylinder speed to the free stream velocity increased. Thom [6] also compared the lift and drag coefficients of rotating cylinders with different end shapes. He concluded that the rotating cylinder with square ends produced higher lift coefficient than the round ended cylinder. But the square ended cylinder also produced higher drag coefficient values. Modi et al. used two rotating cylinders at the front and back of a flat plate [7]. They produced the drag coefficients for different ratios of cylinder speed to the free stream velocity for $0 \leq$ angle of attack $\leq 90°$. They concluded that the rotating cylinders reduced the drag coefficient of the plate as the velocity ratio increased.

In this present research, numerical simulation on boundary layer control is done by moving surface in NACA 0012 airfoil. This simulation is done by ANSYS Fluent 15.0 software by using Transition SST-4 Equation model. The air stream of Mach 0.15 and Reynolds number $3x10^6$ are used

for the analysis. Different moving surface velocity is applied for this present study, while keeping constant free stream velocity of 43.8 m/s. The objectives of this research are: (i) to reduce drag of the airfoil, (ii) to retard the growth of the boundary layer by minimizing the relative motion between the surface and the free stream (iii) to create a region of high suction and thereby accelerates the flow in its neighborhood outside of the boundary layer and (iv) to minimize the adverse pressure gradient and to delay the boundary layer separation.

2.0 Geometry and computational domain

NACA 0012 airfoil is used for the geometry. For single moving surface condition as shown in Figure 1(a), the moving surface starts from x=0.05c and ends at x=0.15c on the upper surface. The length of moving surface is 0.1c. The moving surface angle is 9° with the horizontal. For double moving surface condition as shown in Figure 1(b), the moving surface starts from x=0.05c and ends at x=0.15c on both the upper and lower surface. The moving surface lengths are 0.1c. The moving surface angle in upper and lower surface is +9° and -9° respectively. The computational domain with boundary conditions is shown in Figure 1(c). The domain is discretized by structured mesh having 1,20,000 grids.

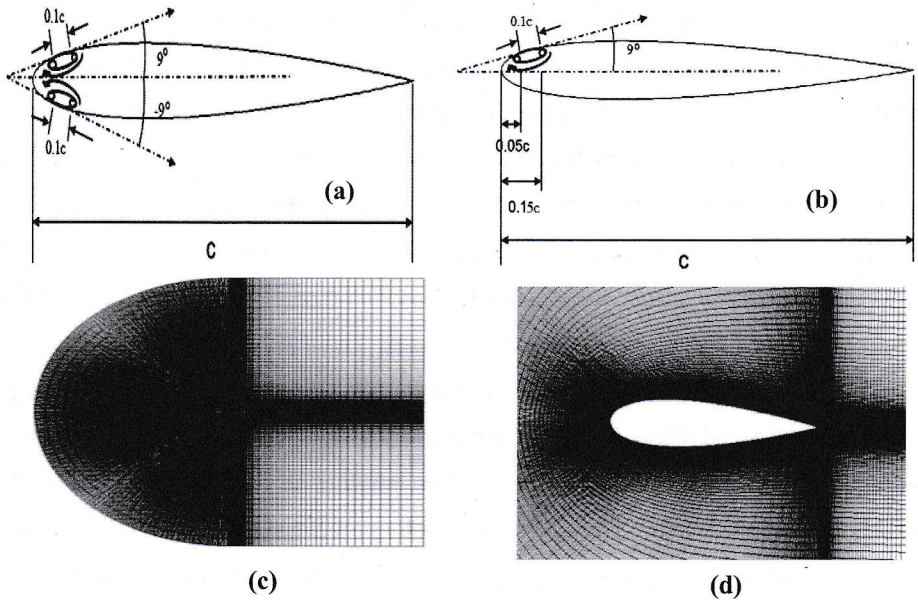


Fig. 1. (a) Geometry of NACA 0012 airfoil with single moving surface (b) Geometry of NACA 0012 airfoil with double moving surface (c) Computational Domain (d) Mesh around the airfoil.

3.0 Numerical method and validation

In the present study, the fluid is air and it is considered as ideal gas. The present numerical computation is performed in ANSYS Fluent 15.0. The flow field is considered to be viscous, incompressible and turbulent. In this paper, the NACA 0012, the well documented airfoil from the 4-digit series of NACA airfoils, is utilized. The free stream temperature is 300 K, which is the same as the environmental temperature. The density of the air at the given temperature is ρ=1.225 kg/m^3 and the viscosity is μ=1.7894×10^{-5} Ns/m^2. For present Reynolds number, the flow can be described as incompressible. This is an assumption close to reality and it is not necessary to resolve the energy equation. Governing equations for present RANS computation are the continuity equation and conservation of momentum equation written in 2-dimensional coordinate system. The governing equations are discretized spatially using finite volume method of second order scheme.

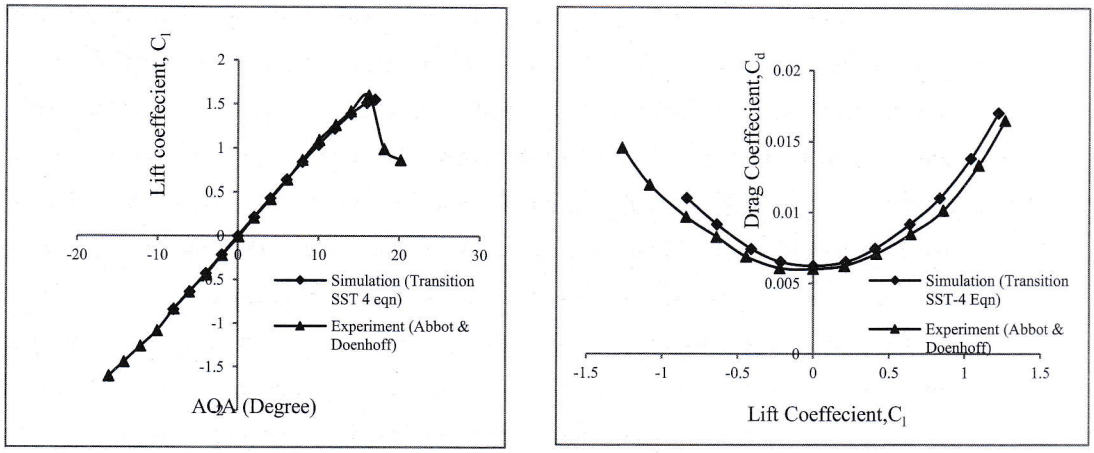
Continuity equation: $$\frac{\partial v_x}{\partial x} + \frac{\partial v_y}{\partial y} = 0 \quad (1)$$

X – Momentum equation: $$\rho\left(v_x \frac{\partial v_x}{\partial x} + v_y \frac{\partial v_x}{\partial y}\right) = -\frac{\partial p}{\partial x} - \left(\frac{\partial \tau_{xx}}{\partial x} + \frac{\partial \tau_{yx}}{\partial y}\right) + \rho g_x \quad (2)$$

Y – Momentum equation: $$\rho\left(v_x \frac{\partial v_y}{\partial x} + v_y \frac{\partial v_y}{\partial y}\right) = -\frac{\partial p}{\partial y} - \left(\frac{\partial \tau_{xy}}{\partial x} + \frac{\partial \tau_{yy}}{\partial y}\right) + \rho g_y \quad (3)$$

For present research, Transition SST-4 Equation Turbulence Model is used. The Transition SST model is based on the coupling of the SST k–ω transport equations with two other transport equations, one for the intermittency and one for the transition onset criteria, in terms of momentum-thickness Reynolds number. The performance of the present computational methods is verified against experimental data. Reynolds number for the simulations is Re=3x10^6 which is same as the reliable experimental data from Abbott and Von Doenhoff [8] in order to validate the present simulation.

Figure 2(a) presents the values of C_d and C_l for different angle of attack are obtained by simulation and are compared with the experimental data from the book of Abbot and Doenhoff [8]. In Figure 2(b), lift coefficient (C_l) is plotted for different angle of attack and compared with the experimental data of Abbot & Doenhoff [8]. From the curve, it is found that values of C_l is almost aligned with the experimental value within the range of angle of attack (AOA) between -8° to 16°. The result of simulation agrees qualitatively and quantitatively with experimental data and hence the code used for the present investigation is valid.



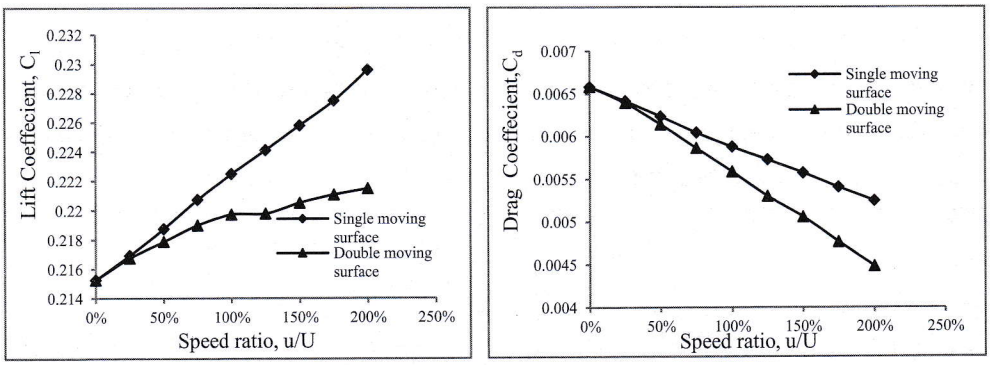
(a) **(b)**

Fig. 2. (a) Variation of drag coefficient (C_d) for different lift coefficient (C_l) (b) Variation of lift coefficient (C_l) for different angle of attack.

4.0 Result and discussion

Figure 3(a) shows that the value of lift coefficient gradually increases with the increase of both single and double moving surface velocity. In the figure, 'u' denotes the moving surface velocity and 'U' denotes the free stream velocity. It can be pointed out that u/U=0 means there is no moving surface. For angle of attack of 2 degree, lift coefficient increases linearly for single moving surface, for double moving surface lift coefficient increases very slowly than that of single moving surface. It is found that initially for low speed ratio up to u/U=0.25, lift coefficient increases at the same rate for both cases. For maximum speed ratio (u/U=2) lift coefficient increases about 6.7% for single moving surface and 2.9% for double moving surface with respect to no moving surface condition. The value of lift coefficient is 3.7% higher in single moving surface than that of double moving surface at maximum speed ratio.

Figure 3(b) shows that the drag coefficient decreases linearly for both cases, but reduction rate is higher for double moving surface. Initially drag coefficient reduces at the same rate for both cases for low speed ratio (u/U=0.25). At maximum speed ratio, the drag coefficient is 15% lower for double moving surface than that of single moving surface. The drag coefficient reduces about 20.3% and 32% for single and double moving surface respectively compared to no moving surface condition.



(a) **(b)**

Fig. 3. (a) Variation of Lift coefficient (C_l) for different speed moving surface, AOA = 2° (b) Variation of Drag coefficient (C_d) for different speed moving surface, AOA= 2°.

Figure 4 illustrates that the values of lift coefficient to drag coefficient ratio (C_l/C_d) gradually increases with the increase of both single and double moving surface speed. But the rate of increase is higher for double moving surface than that of single moving surface. For single moving surface C_l/C_d increases about 33.9% and for double moving surface C_l/C_d increases about 51.1% compared to no moving surface. Initially the rate of increase is almost same for speed ratio up to u/U=0.25 for both cases. At maximum speed ratio (u/U=2), the rate of increase is higher by 13% in double moving surface compared to single moving surface.

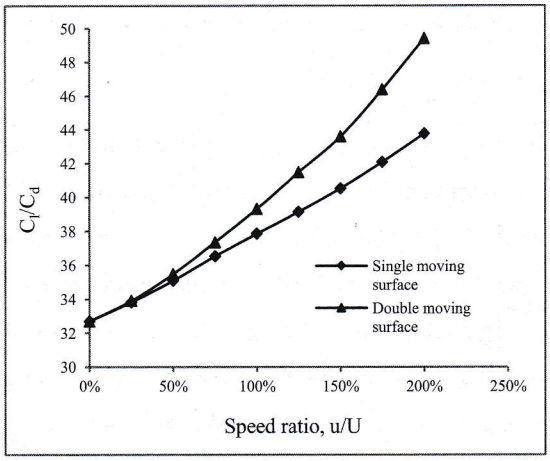
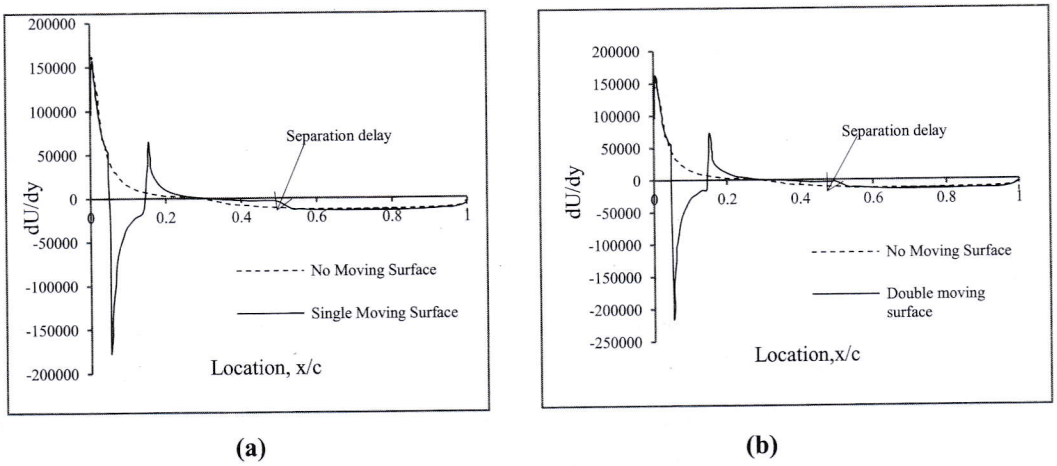


Fig. 4. Variation of Lift coefficient to Drag coefficient ratio (C_l/C_d) for different speed of moving surface, AOA = 2°.

Flow separation begins when $dU/dy \leq 0$. Figure 5(a) illustrates that for single moving surface of velocity u/U=2, separation delays significantly in upper surface of airfoil as momentum is injected into the flow field adjacent to the surface wall. Because of the energy injection the adverse pressure gradient reduces and results in aerodynamic advantage.



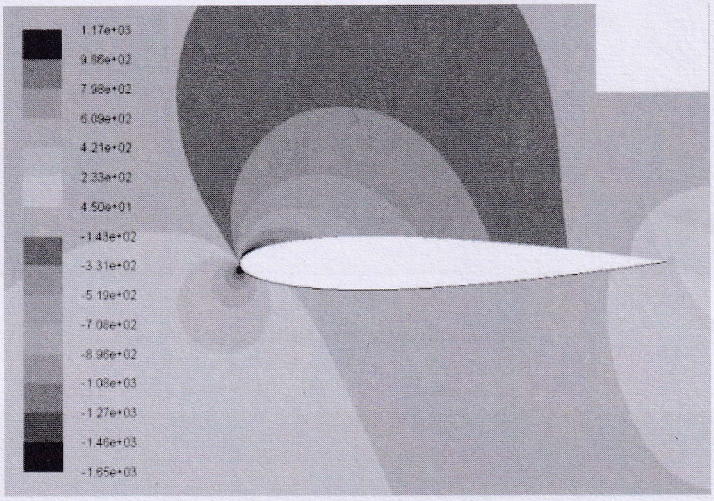
(a) **(b)**

Fig. 5. Variation of differential velocity along y axis (dU/dy) across the airfoil for different wall condition (a) single moving surface (b) Double moving surface.

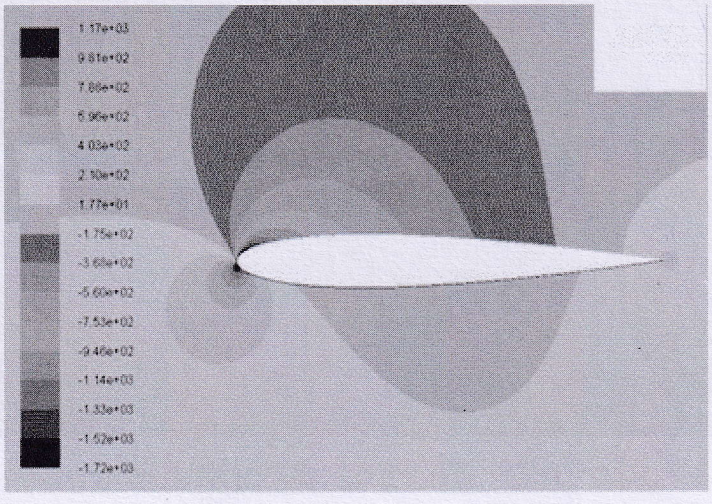
In Figure 5(b), for double moving surface of velocity u/U= 2, it is observed that separation delay is almost same as the case of single moving surface. In both cases, the initial sudden change of dU/dy is due to the momentum injection by moving surface. In the following figures, x is the distance measured along the chord.

Figure 6 illustrates the contours of static pressure variations around the airfoil at different angle of attack and moving surface conditions. In all cases moving surface velocity is considered 200% of free stream velocity. Figures 6(a), 6(b) and 6(c) show the pressure variations around the airfoil. The pressure increases around the lower surface of airfoil and low pressure region increases on the upper surface of airfoil for using single and double moving surface compared with no moving surface at 4° angle of attack. The lowest value of the low pressure region above the upper surface is $-1.14e^{+03}$ Pa and the highest value of the high pressure region below the lower surface is $+2.10e^{+02}$ Pa. In case of 9° angle of attack, Figures 6(d), 6(e) and 6(f) show the increment of high pressure region increases mainly at the leading edge of lower surface of airfoil for using single and double moving surface compared with no moving surface. The lowest value of the low pressure region above the upper surface is $-3.65e^{+03}$ Pa and the highest value of the high pressure region below the lower surface is $+2.97e^{+02}$ Pa.

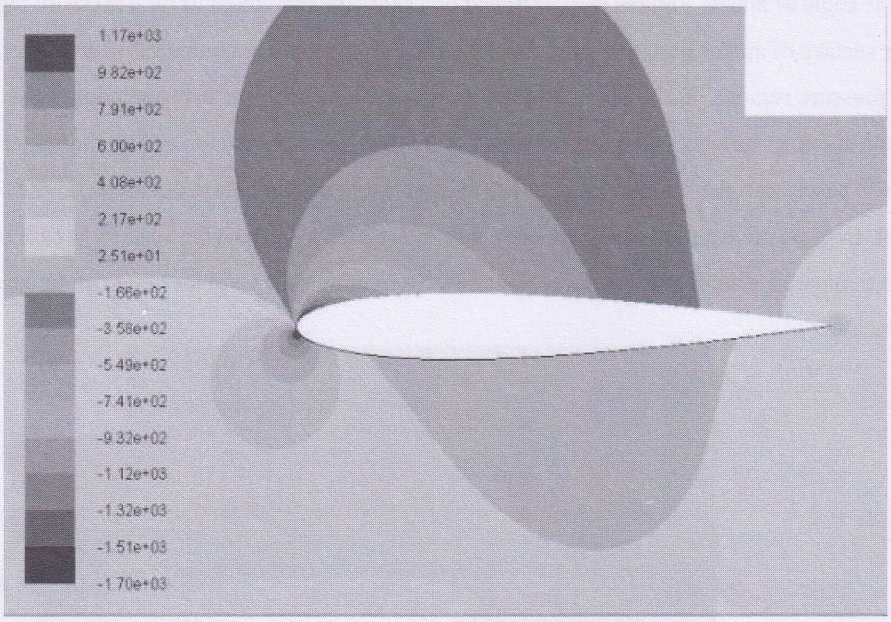
For 14° angle of attack, Figures 6(g), 6(h) and 6(i) show the increment of high pressure region near the lower surface of airfoil for using single and double moving surface compared with no moving surface. Low pressure regions on the upper surface do not change much for using moving surface compared with no moving surface. The lowest value of the low pressure region above the upper surface is -1.48e^{+03} pascal and the highest value of the high pressure region below the lower surface is +1.86e^{+02} pascal. Both positive and negative pressure values are higher for moving surface in case of 9° angle of attack compared with 4° and 14° angle of attack. So moving surface gives better lift in case of 9° angle of attack.



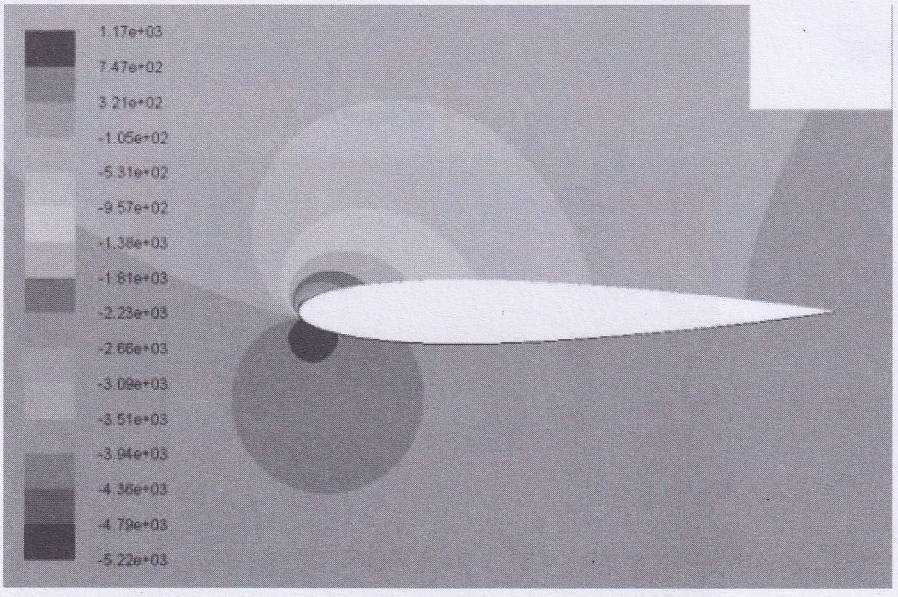
(a) No moving surface (AOA=4°).



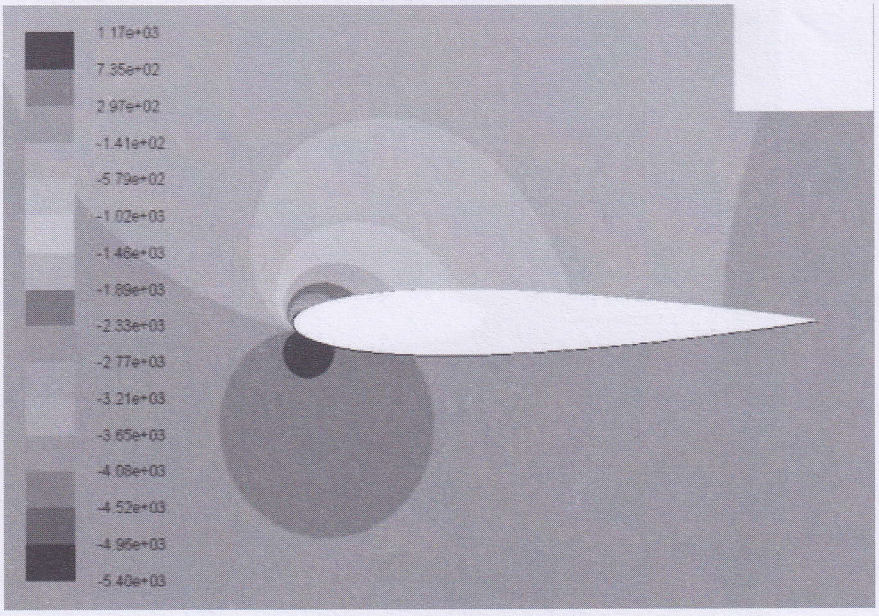
(b) Single moving surface (AOA=4°).



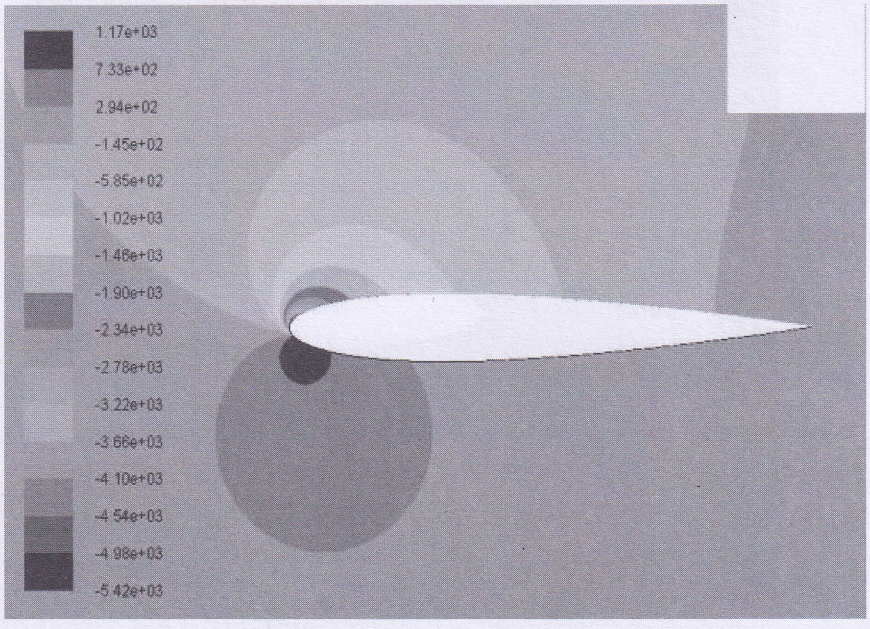
(c) Double moving surface (AOA=4°).



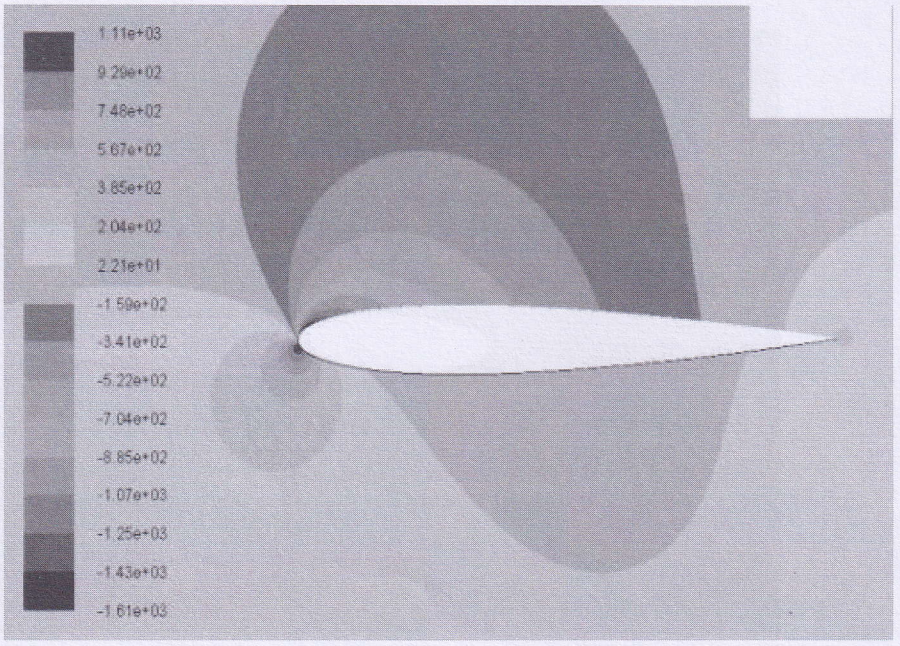
(d) No moving surface (AOA=9°).



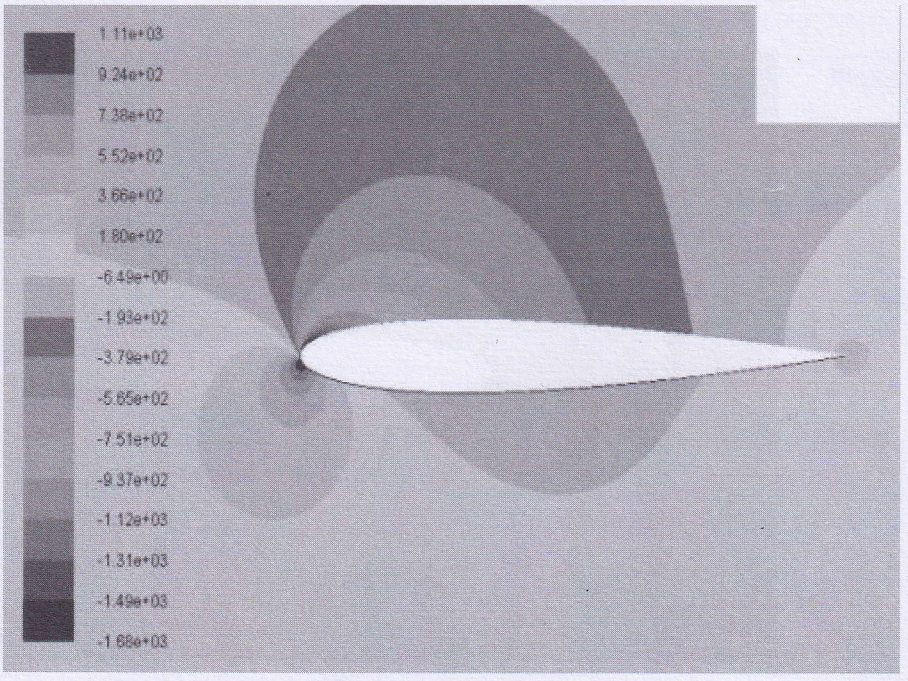
(e) Single moving surface (AOA=9°).



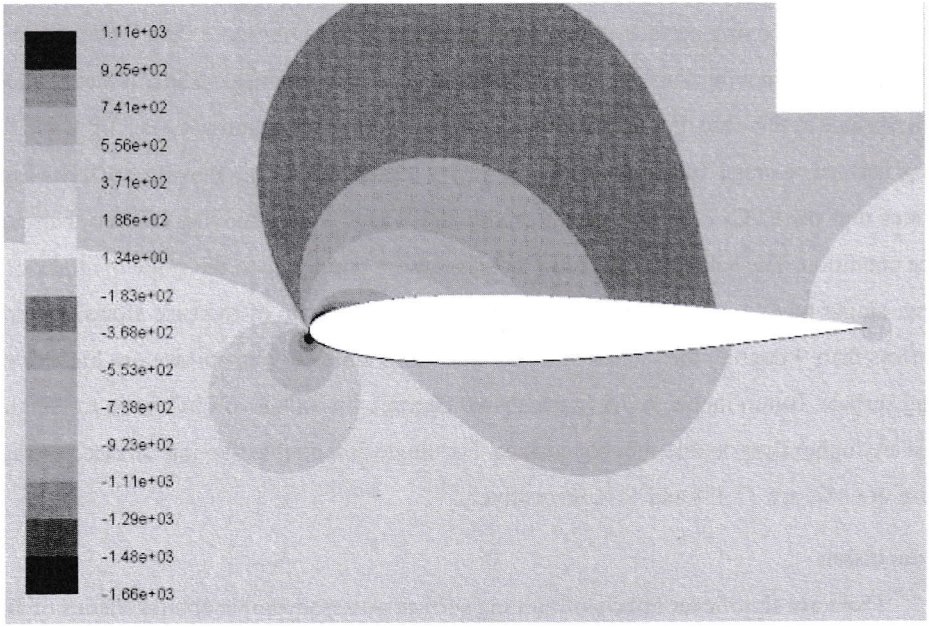
(f) Double moving surface (AOA=9°).



(g) No moving surface (AOA=14°).



(h) Single moving surface (AOA=14°).



(i) Double moving surface (AOA=14°)

Fig. 6. Static pressure contours of airfoil for various conditions.

Figure 7(a) shows that the values of C_d are lower for both single and double moving surface than no moving surface condition for different angle of attack (AOA). But in lower AOA (less than 9 degree) less drag is created for double moving surface, so performance of double moving surface is

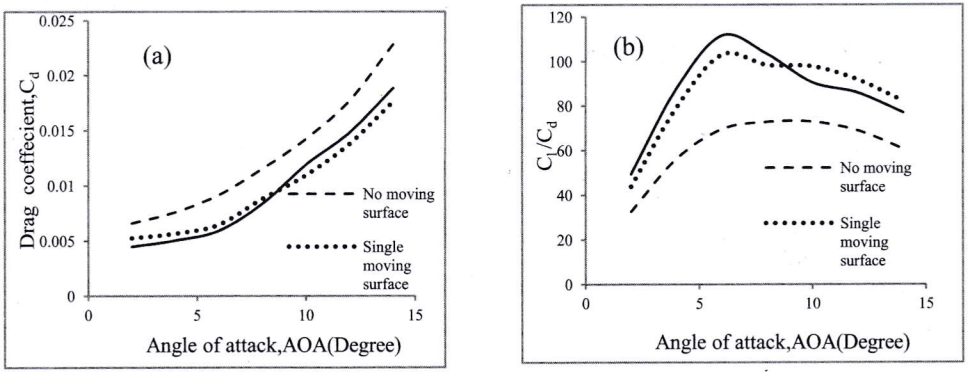


Fig. 7. (a) Variation of Drag coefficient (C_d) for different AOA for no moving, single moving and double moving surface. (b) Variation of Lift coefficient to drag coefficient ratio (C_l/C_d) for different AOA for no.

better than single moving surface in this case. But in higher AOA (more than 9 degree) less drag is created for single moving surface, so performance of single moving surface is better than double moving surface in this case. For single moving surface average reduction of C_d is 23.9% and for double moving surface average reduction of C_d is 25.9% compared to no moving surface. Figure 7(b) illustrates that the C_l/C_d ratio is higher for both single and double moving surface than no moving surface condition. The value of C_l/C_d ratio increases more rapidly up to the angle of attack of 6°. After moving, single moving and double moving surface. that the rate of increase slows down. In lower AOA (less than 9 degree) the values of C_l/C_d ratio for double moving surface are higher than single moving surface. But in higher AOA (more than 9 degree), the values of C_l/C_d ratio for single moving surface are higher than double moving surface. For single and double moving surface, average rate of increase of C_l/C_d are 37.3% and 41% respectively.

5.0 Conclusion

There are significant effects of moving surface on aerodynamic characteristics of airfoil. For using moving surface, boundary layer separation is delayed along the chord length on the upper surface of the airfoil. Momentum injection on the boundary reduces adverse pressure gradient. Drag coefficient decreases more rapidly for double moving surface than the single moving surface. But lift coefficient increases more rapidly for single moving surface than the double moving surface. For different angle of attack, using single and double moving surface average lift coefficient increases by 4.3% and 3.7% respectively. Besides drag coefficient reduces significantly for both single and double moving surface. For lower angle of attack, the performance of double moving surface is better than single moving surface for reducing drag coefficient. In case of higher angle of attack, the performance of single moving surface is better than double moving surface for reducing drag coefficient. For single and double moving surface approximate average drag reductions are 24% and 26% respectively compared to no moving surface. Lift coefficient to drag coefficient (C_l/C_d) ratio increases with the increase of angle of attack and reaches to a maximum value for 6° AOA and then it starts to decline. C_l/C_d ratio decreases more rapidly for double moving surface than the single moving surface after 9° angle of attack. For single and double moving surface, the average increase of C_l/C_d are 37.3% and 41% respectively.

Acknowledgment

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Present Status and Potential Locations of Open Spaces in the Dhaka City Corporation Area: Using GIS Technology

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Abstract

The first plan for the Dhaka city was prepared in 1959.Later Dhaka Metropolitan Development Plan (DMDP) was approved in 1997, and provided the planning policy guideline for Dhaka. Open space is the lungs of any city. It is already recognized that Dhaka has lack of open space which has negative impact on public health, ecology and society. Many problems have been found during deal and conversation with concerned authority to manage this open space properly. In managing the parks and playgrounds the concerned authorities are often confronted with insufficient finance and shortage of trained personnel. There is also lack of proper co-ordination among organizations and institutions and users responsible for the effective operation and maintenance of these open spaces. In this study, an inventory of existing open spaces is prepared from GIS data and field observation. Related data of every existing open space is collected to prepare a GIS based database. Statistical and spatial analysis is performed to derive the status of open spaces based on different parameters. Opinions have been collected from a wide variety of people such as users, nonusers and experts to identify problems related to open space creation, management and maintenance. The present investigation also reveals that the enhancement of the use of different neighborhood, intermediate and large-scale parks & playground in Dhaka City Corporation area would require adequate security, better maintenance and efficient management, landscape development and treatment, various facilities for children. At present the security and better maintenance are required to improve the number of increasing visits of the people.

Keywords: Dhaka, Open Space, GIS, Playground, Maintenance, Geography, Environment.

1.0 Introduction

Open Space is not intensively developed for residential, commercial, industrial or institutional use. The term, "open space," though widely used today, is rather nebulous and can include many different forms, uses, and scales. In the broadest sense of the word, it describes land that is not covered over by buildings. Though open, the land may not necessarily be in a natural or vegetated state. It serves many purposes, whether it is publicly or privately owned. It includes agricultural and forest land, undeveloped shorelines, undeveloped scenic lands, public parks and preserves. It also includes water bodies such as lakes and bays. Open space is being lost at an alarming rate in Dhaka city. When we lose open space, we lose the valuable services that landscape provides including clean air and water, flood control, and recreation opportunities, to name a few. Unplanned transportation is another hazard,

study revealed that pollution level at traffic congestions has considerably improved due to large scale introduction of CNG vehicles in Dhaka city [1]. The quality of the lives of the people in each community in Dhaka depends upon the quality and character of their environment [2]. The study of open space, one of the basic elements of a city system, has considerable importance in Bangladesh. Very few researchers of Bangladesh have made baseline and advanced studies on open spaces, some of them focused on Dhaka. Nilufer studied the allocation, distribution and uses of open space in Dhaka [3]. She also compared standard of open space allocation of Dhaka with that of other countries. Islam (2002) and others examined parks and open spaces in Dhaka city considered their conditions, locations, usage, operation and maintenance [4]. Nahrin and her fellow researchers have also analyzed the existing situation of parks and gardens in old Dhaka [5]. Dhaka, the capital of Bangladesh, a city more than four hundred years old has long been praised by visitors for her greenery and wonderful waterfront. Urban heat effect increases due to huge load of new population in Dhaka [6]. In 1947, Dhaka was calm and quite rural down with less than hundred thousand people living in. But within last few decades it became a noisy and bustling metropolis with more than ten million inhabitants. Dhaka is now considered as one of the most polluted cities of the world [7]. Community facilities have not kept pace with the increase of its population. One of the more acceptable facts about Dhaka is that this city lacks the amount of open space required with inhabitants. Study of Akther et al. [8] reveals that Dhaka cites are enjoying much less open space than required (0.041 acre/1000 persons against 4 acre/1000 persons). Their study also finds that the ratio is declining (0.55 acre/1000 population in 1978). Studies show that open spaces become less attractive to visit. Initiatives are requested to increase green zone with a view to long term benefit [9]. This study tried to find out from the user's point of view, why they feel less attracted to go to open spaces specially parks in Dhaka City Corporation (DCC) Area.

The aim of this study provides a comprehensive idea on the status of open space in DCC areas. It will also explore the possibilities to improve the stock of open space in the city of Dhaka.

The objectives of the present study are stated as follows:

* To measure the frequency of use and availability of services of space in Dhaka.
* To study the existing location, operation, management and their maintenance.
* To identify the major problems and prospects of open spaces.

Fig 1. Location of open spaces in DCC area.

2.0 Material and methodology

This presented study was descriptive cross-sectional study in the department of Geography & Environment of University of Dhaka. During the period from June 2009 to December 2010 with a view to find out the major problems and prospects of open space along with attempt to measure existing condition of enlisted open space of the DCC area. At first required data were collected relating to open spaces from DCC headquarters. Forty parks & nine playgrounds were observed during the field survey (See Fig 1). Data collection was done using a self-administering questionnaire [10]. At First an English version of the questionnaire was developed according to the research objective then it was translated into Bengali for field operation. The questionnaire was divided into 3 parts consisting of personal and socio-demographic characteristics, knowledge and attitude of participant regarding the use of open

space and their thought and concept regarding the advancement of existing facilities. The collected data were stored, checked, verified and then entered into the computer. The analysis was carried out with SPSS (Statistical Package for Social Science), version 17.0. For statistical analysis, univariate, and bi-variate analyses was calculated and map, table and graph were used to interpret the results of the study.

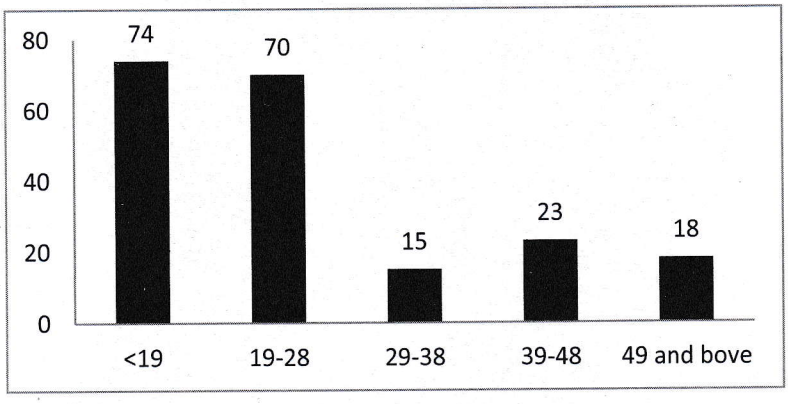

Fig. 2. Frequency of visit by Age group.

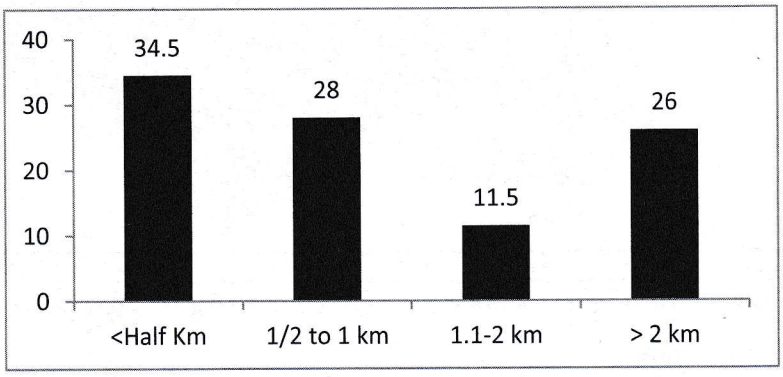

Fig. 3. Percentage of visit with respect to distance to the nearest park.

3. Result and discussion

3.1 Frequency of visit by age group

Majority of the respondents (37%) were below 19 years old (Fig 2). They are basically school going children, the second highest (35%) also students but college going. Very few working (7.5%) class people also go the open space to make refresh their mind.

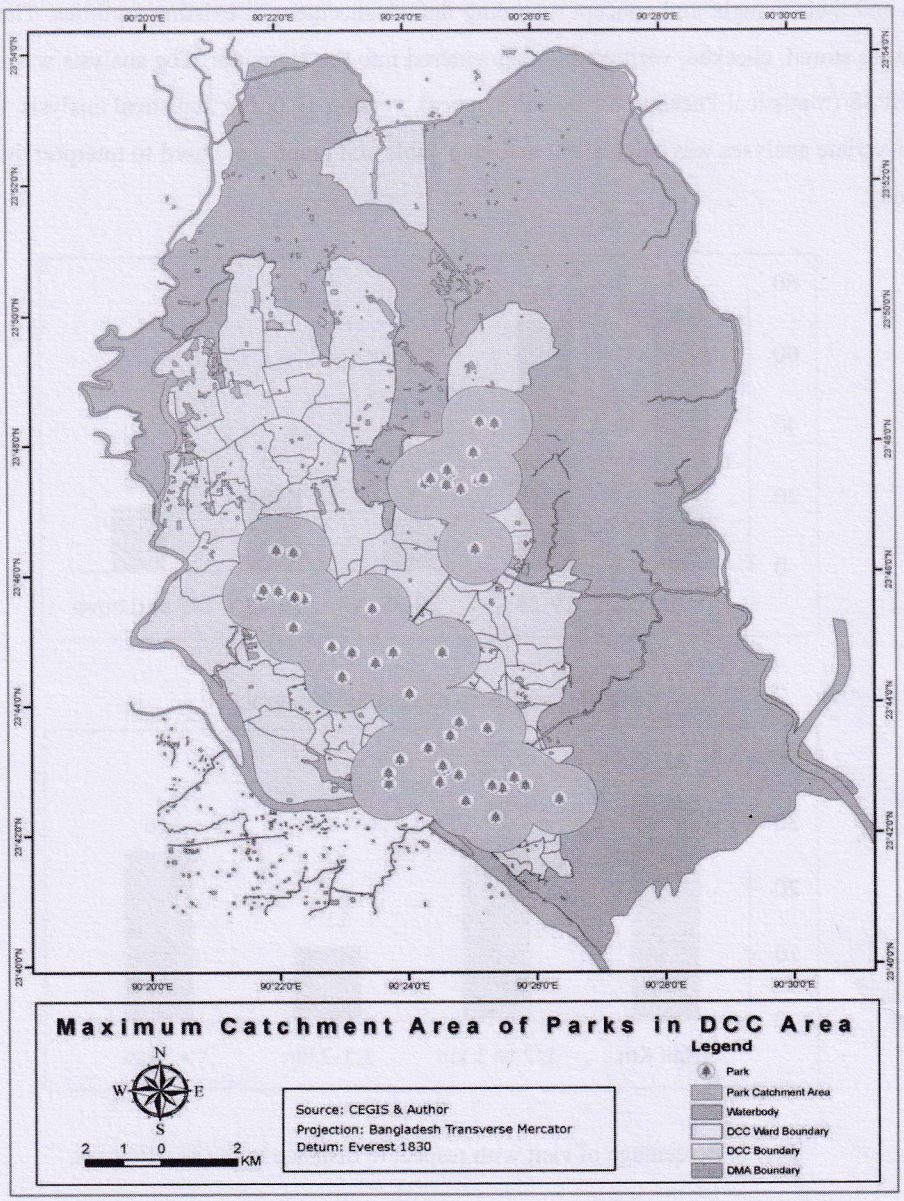

Fig.4. Maximum catchment area of parks in DCC area .

Most of the respondent (34.5%) came from half km away from the facilities. Fig 3 shows that some (26%) people come from more than 2 km away. But they not come regularly; followed by 28% people come from half to one km away. Rest 11.5% participant come from 1.1-2 km away. A map also prepared to show the pattern (Fig 4).

3.3. Frequency of visit: with respect to occupation of the respondents

According to following fig 5, around half of the visitors (48%) who went to the open space were student. Only 5% respondent's occupation was public service and 14% of private service holders never or rarely go to park. Among the business group, only 3 % people go to park but they visit very often.

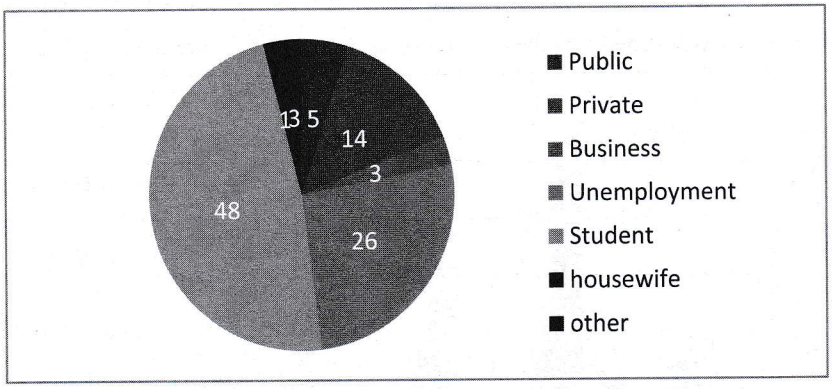

Fig. 5. Frequency of visit with by occupation of the respondents

3.4. Frequency of visit: With respect to gender of the respondents

The diagram (Fig 6) showed that about 18 % female respondents visit the park frequently. 6.3% respondents visit the park once in a week and 8.5% respondents visit the park 1-3 times per week. Out of 47 (23.5%) female respondents only 12 females (25.5%) visit the park rarely and the same the number females never go to the park.

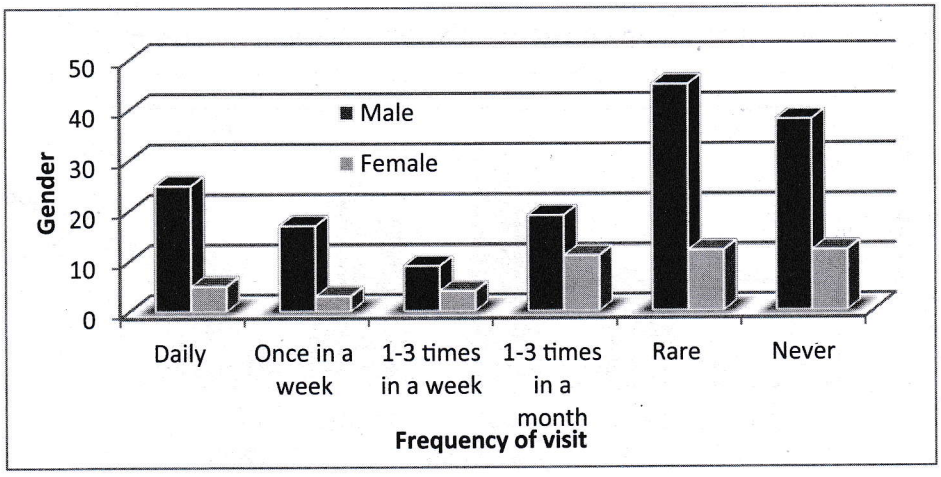

Fig. 6. Frequency of visiting by gender.

3.5 Schedule of visiting: With respect to age group

About 68% of the park visitors visit in the afternoon (Fig 7). About 45% are in the age group of 19-28. It is also true that those who go to the park most of them are in this age group.

The table also shows that most of the respondents, who visit the park rarely, chose the noon period. Some of them (13%) go to the park don't fixed any certain period. They go to the park at any time because they have enough time to go there. Interesting matter is, they are mostly jobless people.

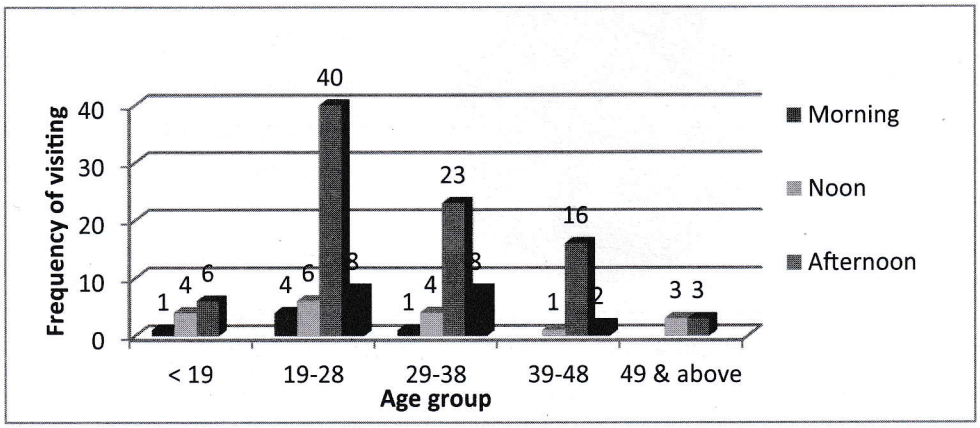

Fig. 7. Schedule of visiting with respect to age group.

3.6 Causes of not using: With respect to age group

About 70% respondents never go to the park due to insecurity (Fig. 8) these problems are associated with local mastan, hijackers, pick-pocketers, drag- addict harassment by hookers and so on. Women feel unsafe both physically and mentally when they visit these open spaces.

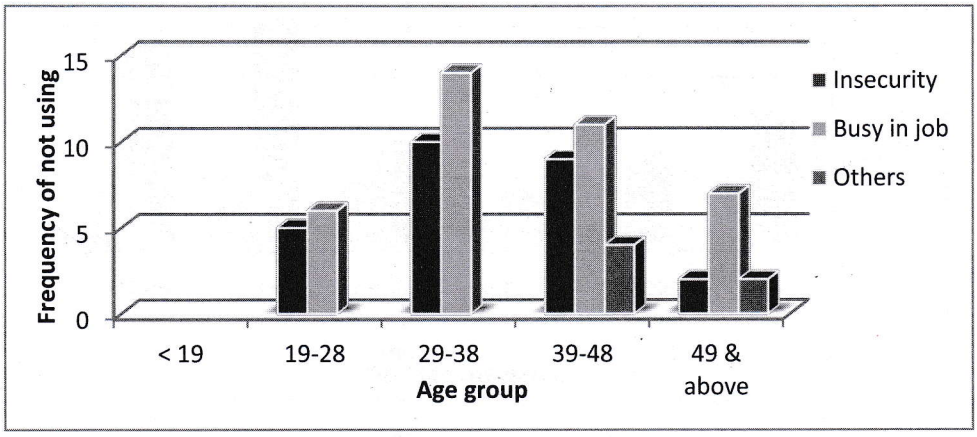

Fig. 8. Causes of not using with respect to age group.

3.7 Proposals of the respondents

31% respondent reveal that in develop a better maintenance system, then existing facilities will by more useful for people (Fig 9). 21.5 % of the respondents mentioned for more security. They are not satisfied with present security system of the parks. For that reason, they never go to the park along with their family. 3% of the respondents asked for improving landscape condition. The respondents who demanded landscape development basically they are environment conscious people.

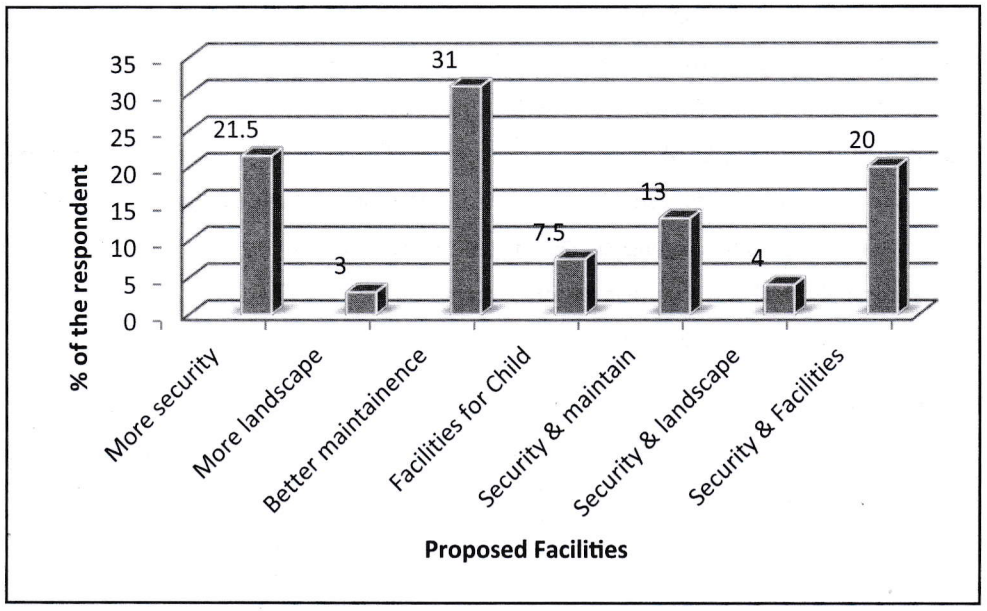

Fig. 9. Proposals of the respondents.

3.8 Observation finding

Open Spaces are created for both physical and Psychological wellbeing of the residents. Many residents use open spaces of the city for physical exercise and jogging purpose. These open spaces are the only source of outdoor recreation for most of the children in Dhaka city. Other than serving the recreational purpose these open spaces are used by low income people for their earning and livings. The overall maintenance of open spaces is not up to standard. The minimum infrastructural facilities necessary for parks and playground are often absent. Many playgrounds are in dilapidated condition, such as Shawamibag park, Bakshi Bazar Children park, Sayedabad Park etc . The problems of security and anti-social activities prevail in many of these Parks. According to Prothom Alo, a vernacular daily, many city parks have been identified as crime zones. These are Karwan Bazar Park (Newage 12 August,2007) English Road Park (Prothom Alo, August 2, 2009) Taz Mahal park of Mohammadpur,

Panthokunza near Sonargaon and Golapbag park (Prothom Alo, August 2, 2009). However, these problems could be overcome through proper management and control but the major threat to open spaces is the continuous pressure of encroachment. Over last few years there are number of incidence of encroachment of open spaces both by public and private bodies. Many of the planned residential areas initially were designed with enough open spaces but later these were transformed to plots and sold out. The reporter of Prothom Alo also identified twelve proposed sites of parks where the proposals have never been implemented by relevant organization and many of these sites are now in the process of transformation for other uses (Prothom Alo, March 4, 2000, pg 12). The incidence of construction of sub-station in Chandrima Uddan is another encroachment of open space, which is a total disregard to existing Dhaka Metropolitan Development Plan (DMDP) regulation. The major parks of the city like Swarwardi Uddaayan, Chandrima Uddayan, Ramna Park, Gulistan Park are not even beyond fear of encroachment. Mahanagar Natto Mancho has been erected on a part of Gulistan park. Together with public and private organizations, private owners are also illegally occupying part of parks or lakes adjacent to their property.

4.0 Recommendation

In Dhaka, parks, playgrounds or open spaces have been disappearing one after another, almost as a matter of course without any protection from the authorities or the expected scale of protest from the city dwellers. This is a city where secondary schools are without playgrounds, and those that possess one are hard put to it to protect their possession from powerful dispossessors.

4.1. Nonstructural measures

4.1.1 Institutional Improvements

4.1.1.1 DCC

According to a DCC estimate, there are 47 parks in the capital city. But most of them are in pitiable condition. It is revealed from the study that DCC has a serious shortage of professionals in planning sector. DCC should improve their capabilities by strengthening their planning department. For this, DCC should implement their proposed organ gram immediately. Separate personnel should be involved to look after the open space planning.

4.1.1.2 Establish open space department

A department with complete responsibility for open space creation, design and maintenance should be established. Geographers, planners, architects, landscape surveyors and gardeners etc. should be incorporated in this department.

4.1.1.3 Trust for open space

A trust can be established by the central government to work for the urban open spaces throughout the country. They will manage fund from alternative sources (Central government, International donation, Public donation etc.) and will help local government to implement their open space related programs & projects.

4.1.1.4 Landscape

Although the condition of landscape in the large parks quite is good, the conditions of the local and neighborhood parks are alarming degraded for not taking proper care about landscape. So, concerned authority should take necessary steps to improve their conditions.

4.1.1.5 Security

Lack of adequate security is the major problem of parks and open spaces. Manpower should be increased for the provision of security.

4.1.1.6 Building construction rules

Building Construction Rules can be a good tool for improving the open spaces between buildings. RAJUK proposed for a new Building Construction Rules in order to improve the openness between buildings. This is a good step to promote private open spaces.

4.1.1.7 Cost recovery

To recover the maintenance cost, ticketing system should ne introduced. But in this respect care should be taken for keeping the price of cost within the limits of mass people. Otherwise, they will lose their interest to visit open space.

4.1.1.8 Regular financing

Because of various political and other pressures, the government often fails to allocate adequate funds for the parks and recreational purposes. So, concerned authority has to face a great shortage of funds. Consequently, they cannot take necessary steps for different improvement programs.

4.1.1.9 Eviction of illegal occupation

Most of the neighborhood parks and playgrounds are occupied by floating people. In some cases, there has developed squatter settlement. Politically powerful persons illegally occupy many neighborhood and intermediate parks. As a result, the total service area decreases. Not only this but also from aesthetical point of view this is very infectious. So, concerned authority should be more alert to prohibit illegal Occupation of parks and open spaces.

4.1.1.10 Age wise facility

To increase the attraction of the visitor's age wise facilities should be provided in the

important large-scale park as visitors are not confined in definite age groups. Different visitors have attraction on different things.

4.1.1.11 Transport facility

Major parks are not very often located within the manageable distance from the mass people. So, transport facility can be provided to attract them at a subsidized price with better and regular service from different location of the city.

4.1.1.12 Land use zoning

Open Spaces should get priority in land use zoning. As there is a serious shortage of open space, zoning should include preservation and conservation of natural open spaces, historical and cultural sites and other environmentally important sites.

4.2 Structural Measures

4.2 .1 Landscapes

The main attraction of any park is landscape. It gives different taste to the users. Plantation is essential for shade and pollution control. Such open green environment attracts human mind. The main elements of landscape are plantation, water body, meaningful sequence of walking ways, hierarchy of open spaces, attractive design features, artificial shedding, topographic condition etc. So, concerned authority should give adequate attention about these features to make the open space more user friendly and their regular maintenance and treatment.

4.2 .2 Utilities

The utility facilities like electricity, drainage, water supply, toilet facility, telephone booths (especially for large scale parks) etc. should provide by the park authority to ensure extensive use of parks.

4.2 .3 Parking facilities

Parking facility is a very important precondition for large-scale parks. A lot of visitors have lost their interest about parks only for lack of proper parking facility. So, adequate parking facility as well as security should be provided.

4.2.4 Access facility

Haphazard access ways create major security problem for large scale parks. So, entry should be in a planned way. In this respect fencing can be very effective.

4.2.5 Games and sports facility

Some users visit the park or open space in search of active recreation. To attract them various types of games & sports facilities for the children as well as adult should be introduced.

5. Conclusion

The government and the city authorities always seemed to have some perverse notions of the city's beautification. In the 21st century it will be futile to criticize the installation of fountains, sodium lights, but why was development and preservation of greenery put in the back burner? One park developed a few years ago at Lake Circus with a walkway fringing the lake is a notable exception for which the authorities may claim credit; but what is the state of nearly fifty parks of the city. From the study, it is clearly evident that Dhaka has a huge shortage of open space.

Like the quantity, the quality of these spaces is also not up to the mark. People are not satisfied with the amenities and facilities provided by the open spaces. The field observation is also discovered this truth. Though some parks maintained by DCC are not bad, but there are some points that should be improved. Statuses of playgrounds are critical in terms of maintenance. Most of them have no basic amenities for city dwellers.

All the metropolitan frills, all the appurtenances of modern urban life are rendered meaningless if children must play in the streets and adults have to travel five miles just for the purpose of inhaling a draught of fresh air. Population of the city is galloping, which is an undesirable phenomenon in itself but cannot be a justification for disappearance of parks and open spaces. Planning, city management and maintenance are more to blame. If there is shortage of land, which we do not dispute, then there are other ways to reclaim the land instead of obliterating the existing parks and greenery. There is more land in private possession, legal and illegal, than is good for any city. City planning was not only flawed but also venal, vicious. In the allotment of Dhaka Improvement Trust (DIT) /RAJUK plots individuals obtained more than one allotment by making false statements and with collusion of officials of those agencies. These plots can be recovered for developing parks and other public utilities.

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Characterizing the Driver Behavior for Non-Motorized Transport in Khulna Metropolitan City

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Abstract

Driver behavior has a great effect in controlling the traffic in any country. In today's life, every human is in hurry to reach their destination like home, office, college, shopping mall, restaurants etc. as quickly as possible. To reach their destination quickly people use vehicles on road use and drive them in faster mode, which results in road accidents. Driver behavior is a major cause for the road accidents. It is known to all that most of the people of Khulna city in Bangladesh are having poor livelihood. This lifestyle often leads the poor people to seek for better chances. As non-motorized vehicle driving is a good option for them as it doesn't need any license or better skill to drive and it is also an effective available option for them, the number of drivers as well as non-motorized vehicles are increasing day by day in Khulna metropolitan city area. The main fact is that people of any age having any experience or without experience can drive a non-motorized vehicle. That's why the controlling issue of this vehicles have risen a lot of questions in the mind of the general people as well as traffic controlling authorities. This study focuses on the behavior of drivers having any age in Khulna city, the controlling process of the behavior and to reduce the amount of traffic congestion and accident caused by the uncontrolled behavior of traffic in Khulna metropolitan city. Accidental data was collected at several points in Khulna city and questionnaire survey was also done at several locations among the road users as well as the drivers. From the graphical results representation, it has been seen that 53.2% of accidents were caused by Rickshaw, 30.6% of them were caused by Van and remaining 16.2% of accidents were caused by Wheelbarrow and others. Therefore, some safety measures and long-term recommendations are made to improve the situation of Khulna city.

Keywords: Non-Motorized Vehicles, Driver Behavior, Accidents, Traffic control, Khulna City.

1.0 Introduction

Currently, in tune with economic growth in every county, the numbers of the vehicles increase every year. At the same time, the number of non-expert drivers also increases rapidly. Since most novice drivers are unskilled, unfamiliar with the vehicle conditions and no awareness of traffic rules and regulations, drivers' personal factors have become the main reasons of traffic accidents. For the safety of the vehicle as well as drivers understanding the modeling of human driver behavior, analyzing of those facts and finding out the problems in a systematic way is very much important. Each year more than 500000 people die in road accidents around the world (Mannan and Karim, 1998). To

address this problem, drive behavior analysis need to be developed. As non-motorized vehicle plays a vital role in the transportation media in any country, it is very important to control the behavior of the driver of non-motorized vehicle. It has been often seen than the amount of traffic congestion is increasing day by day with the increase in the numbers of non-motorized vehicles. From the study of National Highway Traffic Safety Administration (NHTSA), it was found that the errors caused by drivers are the major contributor, which is almost 90% of the crashes examined. This report has been conducted to collect various driver behavior analysis. The driver behavior analysis models will give us details about the users driving styles and patterns. It has also been proved that driving in a safe manner is not only accomplished by driving in a relatively error-free manner with taking all the precautions. Intentional violations, mental conditions, having a mind setup for racing and risk taking are some most important factors of road safety as well (Jonah, 1986; Robertson & Baker, 1975; Schuman et al, 1967). Now the term "Non-motorized vehicle" means the vehicles that has no engine system or motor or additional supportive system that can work like a motor or engine, that means the vehicle is fully controlled by the driver himself and the vehicle is operated by physical means of a person such as Rickshaw, Van, and Wheelbarrow, etc. Non-motorized vehicles are slow moving vehicles and for this reason they often caused problems to other vehicles. When non-motorized vehicles are driven in a busy road such as a highway road it has often been seen that for their slow movement through the road, the other speedy vehicles are compelled to reduce the speeds when they are behind the slow-moving vehicles. That often creates traffic jam in almost all on a sudden in the middle of the road. Sometimes it has also been seen that the speedy vehicles have been failed to control their speed and that's why collision with the slow-moving vehicle often occurs which causes sometimes severe accidents. In some cases, loses of life can be seen. So, it is a matter of great concern that the movement of slow moving vehicles have to be controlled. In a developing country like Bangladesh it is a matter of truth that here laws are not followed. Very often, it has been seen that the road users do not maintain the traffic rules. In most of the cases the people are breaking the traffic rules which is also a common phenomenon in Khulna city. The traffic accident situation in Khulna city as well as Bangladesh is now increasing in such a way that none has the security for their own lives and the loss of lives as well as the damages of property are expected to continue if proper precautions are not taken accordingly by applying proper engineering measures as well as making some hard and fast rules through extensive research and investigations. This situation is very dangerous particularly in metropolitan cities. In Khulna city, there are a lot of traffic points but the slow-moving vehicles cannot be seen to maintain any traffic rules. As there is availability of slow moving vehicles everywhere in Khulna city, the number of slow moving

vehicle is increasing day by day. People often choose non-motorized vehicles to save some money and to travel short distance. So, the demand of non-motorized vehicles is also increasing. It has been a matter of great concern that the drivers of non-motorized vehicles need not to issue any kind of license for their vehicles and so people of any age can become driver overnight. As a result, with lack of proper experience the often drive with rush and hurry without following any traffic rules. This often cause hamper in the movement of other vehicles. In Khulna city, there are many branch roads which meets the main road here and there. So, the movement of rickshaw, van etc. in the main road often cause problem to other vehicles. Moreover, they turn here and there which often cause serious accidents. As there are no individual parking place for them in Khulna city the driver of the slow-moving vehicles parks their vehicles here and there and sometimes in the middle of a road which is very dangerous. Sometimes it also has been seen that there is always a hurry in the mind of the drivers of slow moving vehicles and they always want to make race in the road. They always try to overtake the other running vehicles which often cause severe accidents. So, control of the behavior of the driver is a very important issue in this days. In this situation, keeping eye on the above discussion the following objectives are taken for the present investigation.

i) Traffic rules should me made strict.

ii) Proper punishment should be provided for those who break traffic rules

iii) Non- motorized vehicle lane should be constructed separately from main roads.

iv) Drivers should have made aware of their speed limits as well as traffic rules.

2.0 Material and methods

2.1 Locate of study

At present Khulna is the third-largest city in Bangladesh. It is the in the position of the administrative seat of Khulna district and Khulna division. More than 1.4 million people live here. It is one of the old river ports which is located on the Rupsha river. It is an important hub of Bangladeshi industries which hosts many national companies. It is served by Port of Mongla, the second largest seaport in the country. It is in south-western part of Bangladesh at 22°49′0″N 89°33′0″E, on the banks of the Bhairab and Rupsha rivers. It has a total area of 59.57 km^2 while the district itself is about 4394.46 km^2. It lies south of Jessore and Narail, East of Satkhira, West of Bagerhat and north of the bay of bengal. It is part of the largest delta in the world. In the southern part of the delta lies the Sundarban, the world's largest mangrove forest. The city of Khulna is situated in the northern part of the Khulna district, and is mainly an expansion of trade centers close to the Bhairab and Rupsha rivers. The western boundary of the metropolitan area is formed by Moyuri river. The number of roads are

1215 nos. Khulna city has a land size of 45.65 km^2 and population density is 26287 per km^2 (KDA, 1999). It has a road network of about 1231 km in metropolitan Khulna of which 302 km is bituminous road, 84 km is Water Bound Macadam (WBM), 81 km is Herring Bone Bond (HBB), 95 km is Flat Brick Soling (FBS) and 669 km is earth road (KDA, 1999). The non-motorized vehicles are the most common means of transport in Khulna. The traffic flows on roadway network of Khulna city are heterogeneous. In many parts of Khulna, rickshaw and other non-motorized transport (NMT) account for 60% or more of the overall traffic flow. The number of vehicles at present operating in Khulna city is almost more than 30000, comprising about 14000 non-motorized and 16000 motorized vehicles (Wikipedia). Now for our research 5 different places at Khulna city were taken. They were:

i) Fulbarigate; ii) Daulatpur; iii) Khalishpur; iv) Boyra; v) Ferighat

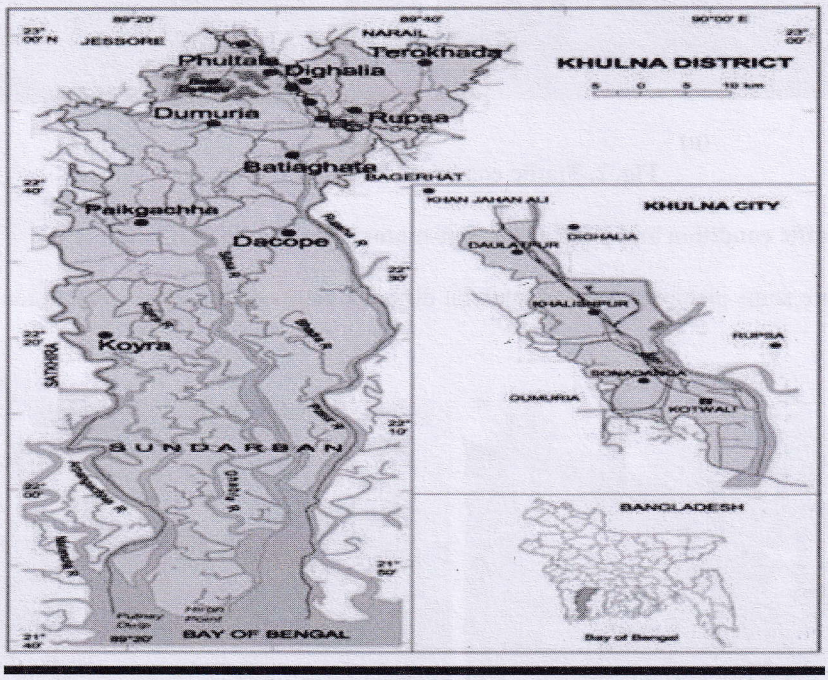


Fig. 1. Map of surveyed areas inside Khulna city.

2.2 Data collection

Field survey was done at different selected points in Khulna city and questionnaire survey was done among the drivers using non-motorized vehicles at randomly selected places in Khulna city. By the questionnaire survey, some important information like the age of the drivers, the percentage of different vehicles moving around the roads and accidental data etc. were known. Some pictures were

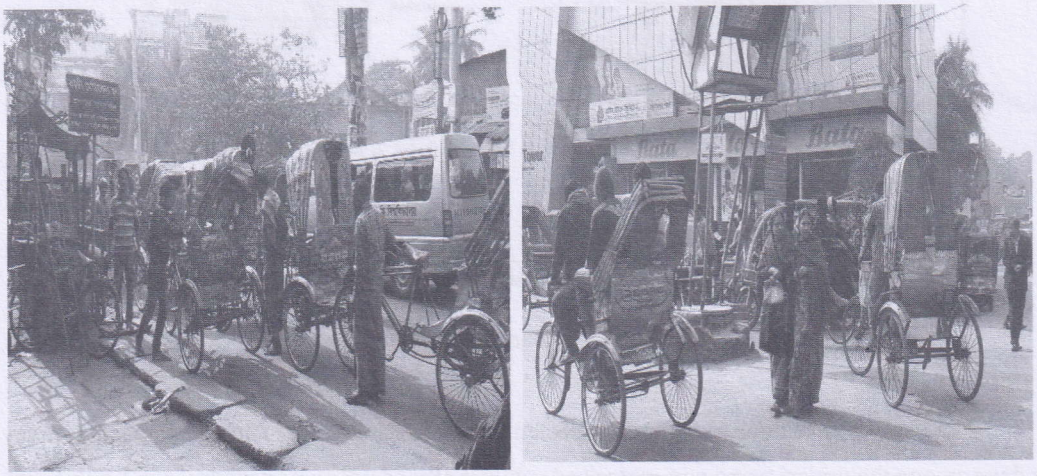
also taken at different points on those surveyed areas showing traffic condition of those areas. All those collected information have been shown in graphical representation.

(a) (b)

Fig. 2. Traffic condition at Fulbarigate.

2.3 Existing traffic condition and practice of Non-motorized vehicles in Khulna city

Here are some pictures taken randomly at different places of surveyed areas inside Khulna City.

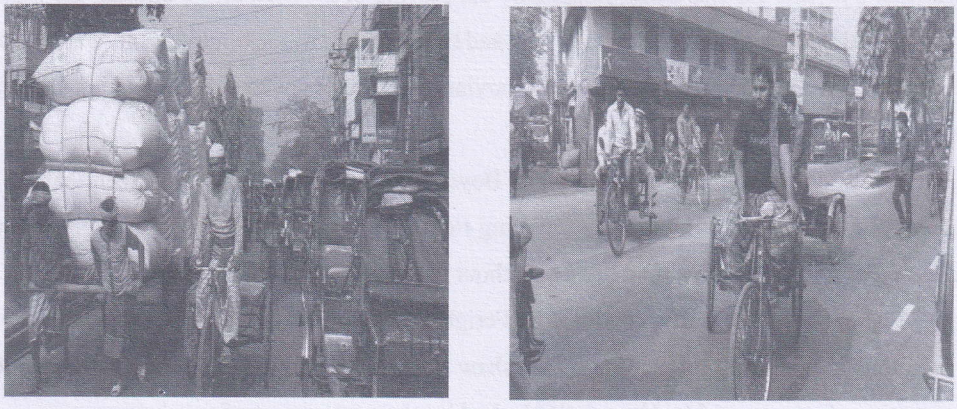


(c) (d)

Fig. 3. Traffic condition at Daulatpur.

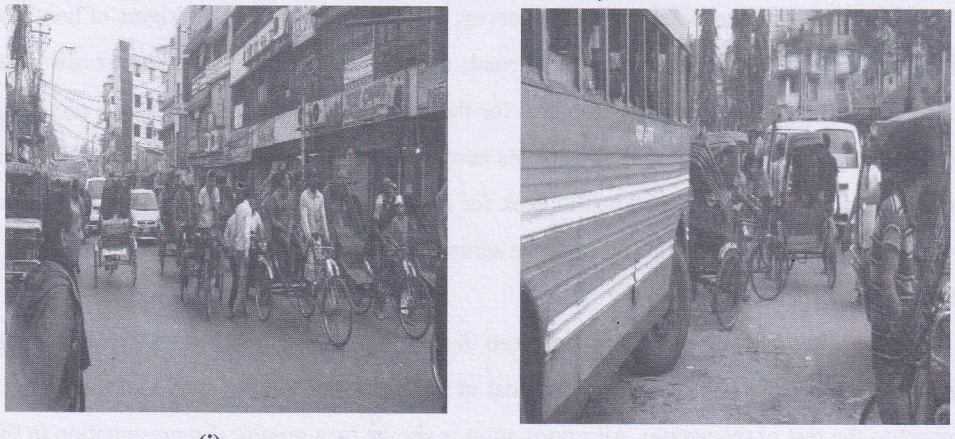
(e) (f)

Fig. 4. Traffic condition at Daulatpur-Khalishpur main road.



(g) (h)

Fig. 5. Traffic condition at Boyra.



(i) (j)

Fig. 6. Traffic condition at Ferighat.

Fig. 2. shows the traffic condition of Fulbarigate. The left fig. (a) shows us that Rickshaws are driven through the footpath which was used by general people. It was looked like the whole footpath was jammed by them. The right fig. (b) shows us that a part of the main road has been blocked totally by van. Those vans were parked here and there, so it created traffic jam in most of the time of the day.

Fig. 3. shows the traffic condition of Daulatpur. In both fig. (c) and fig. (d) it has been seen that traffic jam has been created by unusual driving of non-motorized vehicles. In picture (d) in spite of being a traffic signal post, rickshaw drivers crossed the main road without obeying traffic rules.

Fig. 4. shows the traffic condition of Daulatpur-Khalishpur main road. From Fig. (e) and (f), it has been seen that the regular traffic movement is hampered by the driving of wheelbarrow. Fig. (e) showed that a private car was being stopped by the passing of a wheelbarrow through the main road. Fig. (f) showed that major part of the main road had been blocked by slow movement of a wheelbarrow and beside that wheelbarrow a rickshaw was moving from the opposite direction which shows us the complete breaking of traffic rules.

Fig. 5. shows the traffic condition of Boyra. From fig. (g) it has been seen that the whole main road has been blocked by the slow-moving rickshaw, van and wheelbarrow. Fig. (h) shows us the crossing of a van through a road divider without maintaining any traffic rules.

Fig. 6. shows the traffic condition of Ferighat. In fig. (i) it has been seen that the movement of a local bus is hampered by parking of rickshaw in front of it. In fig. (j) it has been seen that the major portion of a main road had been half blocked by slow movement of rickshaw.

3.0 Results and discussion

From the pictures taken during the survey, it has been seen that the drivers of non-motorized vehicles often create traffic jam in the main roads during the pick hour. As they are always slow in their movement, they often created problems for the motorized vehicles. From those pictures, it also has been seen that they often stop their vehicles here and there without obeying any traffic rules. They often take major portion of a road just to seek for new passengers. In the time of crossing the road, they do not follow any rules. This often cause serious accidents and cause many life losses as well as the loss of properties.

From the field survey, it has been seen that the age of the driver at all over the Khulna city ranges between almost 10 to 65 years. In most of the cases the middle aged and the young people dominate to the rest of the people. All information is shown by a graphical representation in Fig. 7.

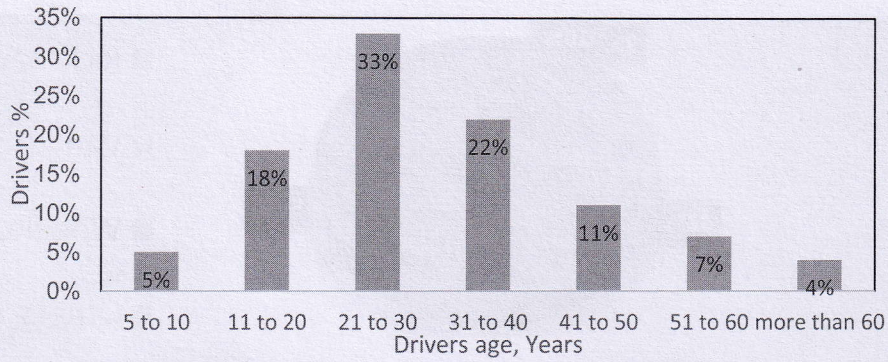


Fig. 7. Graphical representation of age of the drivers.

Because of reckless driving and having no control of the traffic the racing behavior in the mind of the drivers of slow moving vehicles is increasing day by day and that's why the number of injuries and hazardous accidents is increasing. Here are some pie charts showing the accidental contribution of slow moving vehicles at different places of Khulna city.

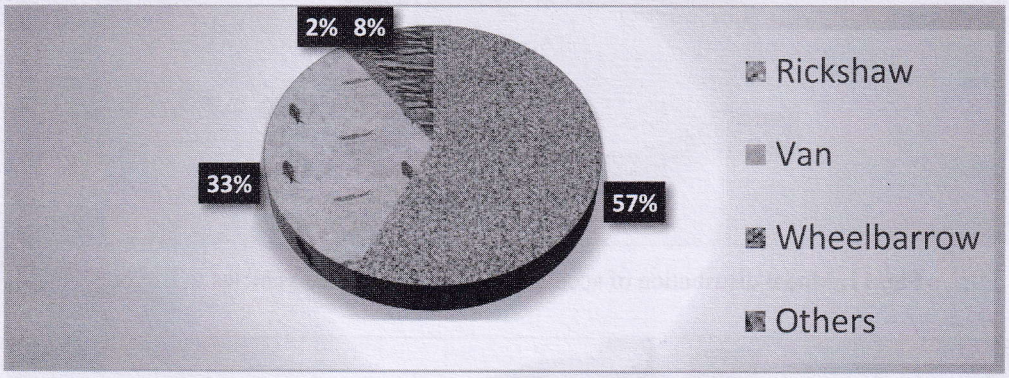


Fig. 8. Modal distribution of accidents by Non-motorized vehicles in Fulbarigate.

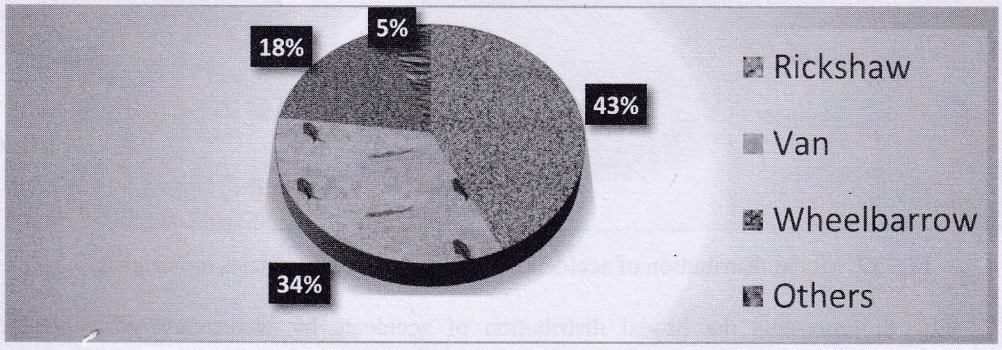


Fig. 9. Modal distribution of accidents by Non-motorized vehicles in Daulatpur.

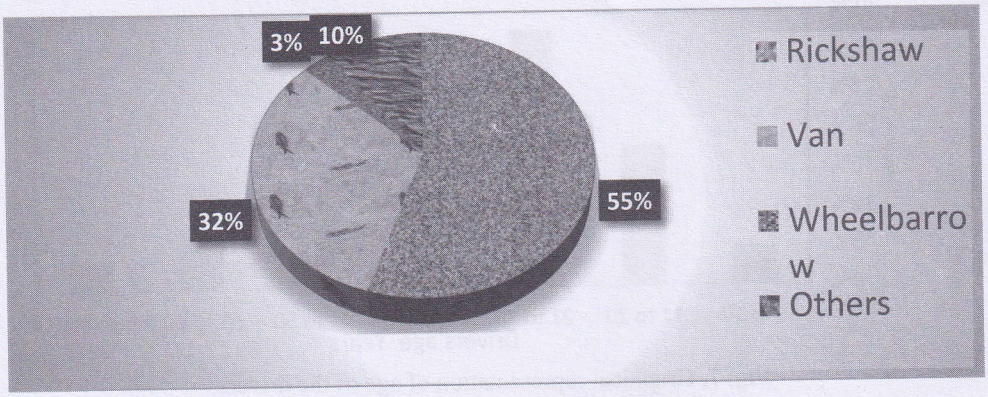


Fig. 10. Modal distribution of accidents by Non-motorized vehicles in Khalishpur.

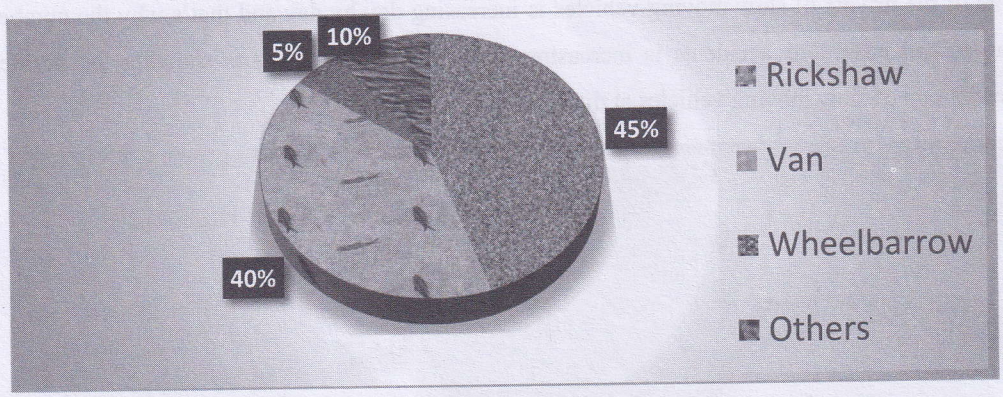


Fig. 11. Modal distribution of accidents by Non-motorized vehicles in Boyra.

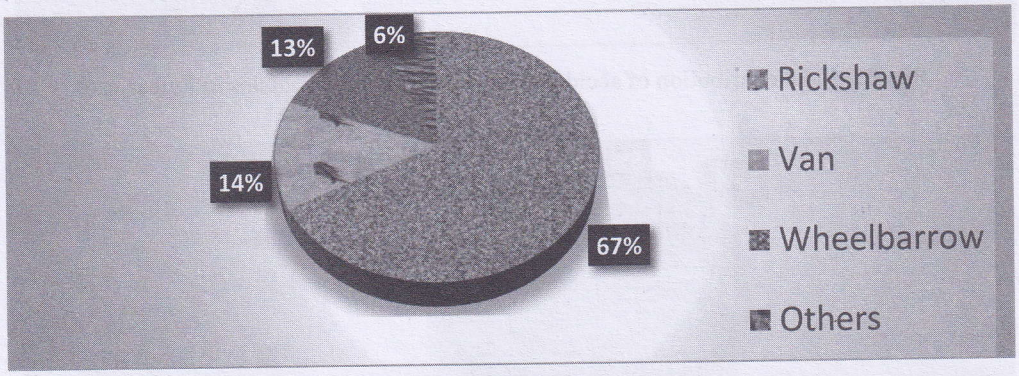


Fig. 12. Modal distribution of accidents by Non-motorized vehicles in Ferighat.

Fig. 8. represents the Modal distribution of accidents by Non-motorized vehicles in Fulbarigate. From the pie chart, it has been seen that 57% of non-motorized vehicular accidents were

caused by rickshaw, 33% of them were caused by vans and the rest were caused by wheelbarrow and others.

Fig. 9. represents the modal distribution of accidents by Non-motorized vehicles in Daulatpur. In this case, most percentage of non-motorized vehicular accidents were also caused by rickshaw, which is almost 43%. On the other hand, 34% of the rest were caused by vans and 18% and 5% of rest accidents were caused by wheelbarrow and others respectively.

Fig. 10. represents the modal distribution of accidents by Non-motorized vehicles in Khalishpur. This case was also dominated by rickshaw accidents which is 55%. Other 32% accidents were caused by vans and rest of 3% and 10% were caused by wheelbarrow and others.

Fig. 11. represents the modal distribution of accidents by Non-motorized vehicles in Boyra. From the chart, it has been seen that major portion of accidents were shared by rickshaw and vans which were 45% and 40% respectively. The rest was shared by wheelbarrow and others.

Fig. 12. represents the modal distribution of accidents by Non-motorized vehicles in Ferighat. Ferighat is the busiest place in entire Khulna city. The pie represents that 67% of non-motorized vehicular accidents were caused in Ferighat only by rickshaw. 14% and 13% of the rest were shared by vans and wheelbarrow respectively. Other causes were 6%.

From those results, it has been seen that most proportions of accidents have been conducted by rickshaw pullers. As the behavior of the rickshaw puller is not at all good in most of the time, they often try to board and unboard passengers here and there that causes traffic jam and most of the time results in accidents. The behavior of van and wheelbarrow drivers are also plays vital role in the case of occurrence of accidents. However, the traffic rules should be more restricted and fines and other effective measures should be taken by the traffic polices so that none can dare to break any traffic rules. Here are some guidelines for safe traffic system that can be very much effective for controlling the traffic of all vehicles.

3.1 Guidelines for safe traffic system design

- Road traffic deaths and serious injuries are preventable, since the risk of incurring injury in a crash is largely predictable and many countermeasures, proven to be effective.
- Make the provision of safe, sustainable and affordable means of travel is a main objective in the planning and design of road traffic systems.
- Preventing pedestrians and cyclists from accessing motorways and preventing motor vehicles from entering pedestrian zones are two well-established measures for minimizing contact between high-speed traffic and unprotected road users.

- Giving priority in the road network to higher occupancy vehicles.
- Road safety is the integral part of road design at planning stage.
- Giving vehicles with many occupant's priority in traffic over those with few occupants is a means of reducing the overall distance travelled by private motorized transport and hence of cutting down on exposure to risk.

3.2 Guidelines for safe planning of road networks

In an efficient road network, exposure to crash risk can be minimized by ensuring that trips are short and routes direct, and that the quickest routes are also the safest routes. Route management techniques can achieve these objectives by decreasing travel times on desired routes, increasing travel times on undesired routes, and re-directing traffic. Some guidelines are given for safe planning:

- Classifying the road network according to their primary road functions;
- Setting appropriate speed limits according to those road functions.
- Improving road layout and design to encourage better use.

3.3 Guidelines for incorporating safety features into road design

- ❖ Higher-speed roads include motorways, expressways and multi-lane, divided highways with limited access. They are designed to allow for higher speeds by providing large radius horizontal and vertical curves, "forgiving" roadsides, entry and exit "grade separated" junctions where there is no contact between motorized and non-motorized traffic and median barriers to separate opposing directions of traffic.
- ❖ Single-lane carriageways in rural areas include many different types of road like: -
- Provision for slow-moving traffic and for vulnerable road users.
- Lanes for overtaking, as well as lanes for vehicles waiting to turn across the path of oncoming traffic.
- Median barriers to prevent overtaking and to eliminate head-on crashes.
- Better highlighting of hazards through road lighting at junctions and roundabouts.
- Improved vertical alignment.
- Advisory speed limits at sharp bends.
- Regular speed-limit signs.
- The systematic removal of roadside hazards – such as trees, utility poles and other solid objects.

- Residential access roads are often designed to achieve very low speeds. Speed limits, usually supported by physical self-enforcing measures to encourage compliance, are normally around 30 km/h, though lower limits are often prescribed.

3.4 Guidelines for Pedestrian and Bicyclist Safety

Although all types of road user are at risk of being injured or killed in a road traffic crash, there are notable differences in fatality rates between different road user groups. In particular, the "vulnerable" road users such as pedestrians and two-wheeler users are at greater risk than vehicle occupants and usually bear the greatest burden of injury. This is especially true in countries like India, because of the greater variety and intensity of traffic mix and the lack of separation from other road users. Some guidelines are given for pedestrian and two-wheeler safety:

- Free left turns must be banned at all signalized junctions. This will give a safe time for pedestrians and bicyclists to cross the road.
- Speed control in urban areas. Maximum speed limits of 50 km/h on arterial roads need to be enforced by police monitoring, and 30 km/h in residential areas and by judicious use of speed breakers, dead end streets and mini roundabouts. In the short term of three years, a target of covering 10% of the roads can be attempted.
- Increasing the conspicuity of bicycles by fixing of reflectors on all sides and wheels and painting them in yellow, white or orange colors.

4.0 Conclusions

From the research, it has been seen that age of most drivers, who are driving non-motorized vehicles in Khulna city lies between 21-40. That is why; sometimes it becomes very tough for themselves to control their mind from sense of racing. From graphical representation, it has also been seen that in average, 53.4% accidents at different places of Khulna city is occurred by rickshaw. Although in recent times the non-motorized vehicles are modified by motors but it is a matter of great concern that the number of non-motorized vehicles are increasing day by day with the increase of population in Khulna city. The number cannot be decreased as the living standard of majority of the people in Khulna city is below poverty line. So as of choice of better livelihood they choose slow moving vehicles. As most of the driver more or less illiterate they don't have any control over their behavior. Strict rules should be made to control their behavior. Besides traffic police have to do their duty with proper concern. They should control the traffic according to proper law. Then the future Khulna city will be a better living place for our next generation.

5.0 Reference

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Fractals Generating Techniques

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Abstract

Fractals Generating Techniques introduce interesting part of Fractals Geometry. In this paper, we introduce some outstanding beautiful images known as Fractals. Our goal is to show techniques to generate some beautiful fractals like Mandelbrot Set, Fractal Trees, Heart Shape Fractal, Julia set, Height Field. We restrict our attention to generate the said spectacularly images considering some techniques such as geometric iteration rules, successive removals etc. Special emphasize is given to consider very new generating functions as well as their suitable initial seeds so that we can see some new fractals after a number of iterations. Necessary programs are considered for all cases. We use Mathematica and Mat Lab to perform programming.

Keywords: Fractal, Iteration, Mandelbrot Set, Heart Shape, Julia set, Height Field.

1.0 Introduction

The term 'Fractal' is fascinating to many people which are none other than the beautiful but complicated images in the nature. Typically, mathematics consists of complicated figures, boring formulas and often monotonous calculation while the fractal geometry brings art in the field of mathematics which gives a different taste of the study. The most interesting thing about fractal is that they give a mathematical description of the existing natural object which often includes very complicated patterns such as coastlines, mountains, ferns, trees or parts of living organisms [1]. Before the invention of computer some people had done a tremendous work on fractals though fractal geometry is closely connected with computer techniques. At first the British cartographers encountered the problem in measuring the length of Britain coast. The actual length of the coastline was approximately half the length of coastline measured on a detailed map [2]. As they looked closer and closer they found more detailed and longer the coastline. Without realizing they had discovered one of the main properties of fractals.

1.1 Historical background

The credit goes to Benoît Mandelbrot for the development of fractal geometry; many other mathematicians preceding him in the century had laid the foundations for his work. Moreover,

Mandelbrot was able to utilize the advancements of computer technology that his predecessors distinctly lacked; however, this in no way diminishes from his visionary achievements. Nevertheless, to make Mandelbrot's work clearer and to establish its connections to other branches of mathematics the works of Karl Weierstrass, Georg Cantor, Felix Hausdorff, Gaston Julia, Pierre Fatou and Paul Lévy undoubtedly helps in a salient way [3].

1.2 Basic idea

The idea of fractals is comparatively new, but the seed was sowed in the 19th century mathematics [3]. A fractal is a fragmented shape that can be subdivides in part each of which at least a reduced size copy of the whole. Mathematically we can generate fractals which are reproducible at any magnification or reduction and the reproduction of each parts looks just like the original, or at least has a similar pattern.

The familiar Euclidean geometry deals with objects which includes integer dimensions such as zero-dimensional points, one-dimensional lines and curves, two-dimensional surfaces like planes, and three-dimensional solid objects such as balls and blocks (e.g. spheres and cubes). However, the objects found in the nature which often have dimensions are not a whole number. And the reason for this is the property called self-similarity.

A fractal is an ongoing pattern. Fractal patterns are infinitely complicated and they are self-similar across different scales. It includes a very simple method to create a fractal. If repeat a simple pattern over and over again continuously we come to end with a fractal. This is an ongoing feedback loop. Driven by recursion, fractals are images of dynamic systems – the pictures of Chaos [4]. Geometrically, they lie in between our familiar dimensions. Fractal patterns are very mush familiar to us as the nature is full of fractals. For example: clouds, rivers, trees, mountains, coastlines, seashells, hurricanes, etc. While the abstract fractals such as the Mandelbrot Set which can be generated by repeating a simple complex function repeatedly.

In this paper, we will describe some of the wonderful new ideas in the area of mathematics known as fractal geometry. As we will see, fractals are incredibly complicated and often quite beautiful geometric shapes that can be generated by simple rules.

The word is related to the Latin verb frangere, which means "to break" [4]. In the Raman mind, frangere may have evoked the action of breaking a stone; since the adjective derived it combines the two most obvious properties of broken stones, irregular and fragmentation. This adjective is fractus,

which lead to fractal. The etymological kinship with "fraction" is also significant if ones interprets "fraction" as a number that lies between integers. Indeed, a fractal set can be considered as lying between the shapes of Euclid [5].

In his founding paper Benoˆit Mandelbrot coined the term Fractal, and described it as follows:

A [fractal is a] rough or fragmented geometric shape that can be subdivided in parts, each of which is (at least approximately) a reduced-size copy of the whole [6].

1.3 Some famous fractals

There are a lot of fractals that have generated by the mathematicians. Among them some most famous fractals are the Sierpinski Triangle, the Koch Curve, and the Cantor Set etc.

Here we discussed another two famous fractals—The Mandelbrot and Julia set.

1.3.1 The man delbrot set

Named after Benoit Mandelbrot, Among the existing fractals the Mandelbrot set is one of the most famous and complicated fractal. Behind this complex picture there is a simple equation. Mandelbrot was playing with the simple quadratic equation $z=z^2+c$ and made the most famous fractal in the history. Both z and c are complex numbers in this equation. In other words, the Mandelbrot set is the set of all complex c such that iterating $z=z^2+c$ does not diverge [6].

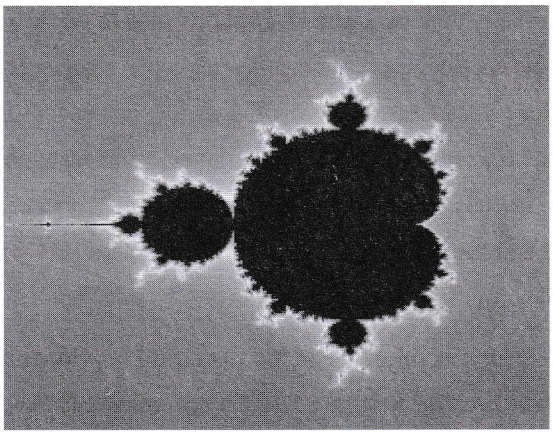

Fig. 1. Mandelbrot Set

To generate the Mandelbrot set graphically, the computer screen is to be considered as the complex plane. Each point on the plane have to tested by the equation $z=z^2+c$. If the iterated z stayed within a given boundary forever that is it converges then the point is inside the set and the point is

plotted black. If the iteration went of control that is it diverges then the point was plotted in a color with respect to how quickly it vanishes.

For instance, let c = 1 gives the sequence 0, 1, 2, 5, 26... and clearly it tends to infinity. Since the sequence is unbounded for 1, so 1 is not an element of the Mandelbrot set. On the other hand if c = i (where i is defined as $i^2 = -1$) gives the sequence 0, i, (-1 + i), -i, (-1 + i), -i, ... which is bounded and so i belongs to the Mandelbrot set.

1.3.2 The Julia set

Another famous fractal which is very closely related to the Mandelbrot set is the Julia set. It was named after Gaston Julia [6,7], during the early twentieth century who studied the iteration of polynomials and rational functions, making the Julia set much older than the Mandelbrot set

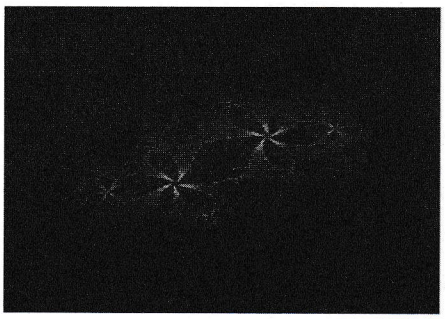

Fig. 2. Julia Set

The remarkable difference between the Julia set and the Mandelbrot set is in the way of iteration. In the case of Mandelbrot set we have to iterate z always starting from 0 and varying the value of c. Where the Julia set iterates for a fixed value of c and varying values of z. That is we can say that, the Mandelbrot set is in the parameter space, or the c-plane, while the Julia set is in the dynamical space, or the z-plane [6,7].

2.0 Methodology

Where Euclidean geometry describes lines, ellipses, circles, etc. with equations, fractal geometry describes objects in terms of algorithms that are sets of instructions on how to create a fractal. One way to describe fractals is through what are called iterated function systems, or IFS [8]. This is the only type of fractal that we shall discuss in detail in this thesis paper. IFS follow the general approach of altering a geometric object in a particular way, leaving multiple smaller objects each of which is similar to the original, and then repeating the process on each of those smaller objects to create even smaller parts, and so on. The fractal is the result of carrying this process out infinitely many times.

* The iterated function systems is used based on fixed geometric replacement rules; may be stochastic or deterministic; e.g., Koch snowflake, Cantor set, Haferman carpet, Sierpinski carpet, Sierpinski gasket, Peano curve, Harter-Heighway dragon curve, T-Square, Menger sponge

* Strange attractor is the method which includes iterations of a map or solutions of a system of initial-value differential equations that exhibit chaos.

* Escape-time fractals is a formula or recurrence relation at each point in a space (such as the complex plane); usually quasi-self-similar; also known as "orbit" fractals; e.g., the Mandelbrot set, Julia set, Burning Ship fractal, Nova fractal and Lyapunov fractal. The two-dimensional vector fields that are generated by one or two iterations of escape-time formulae also give rise to a fractal form when points (or pixel data) are passed through this field repeatedly.

* Stochastic rules generate random fractals; such as the Lévy flight, percolation clusters, self-avoiding walks, fractal landscapes, trajectories of Brownian motion and the Brownian tree (i.e. dendritic fractals can be generating by modeling diffusion-limited aggregation or reaction-limited aggregation clusters).

* A recursive topological algorithm for refining tiling includes finite subdivision rules and this is same as the process of cell division. For instance, the Cantor set and the Sierpinski carpet are generated by iterative processes which includes finite subdivision rules, as is barycentric subdivision [9].

There are some of senses to show techniques to generate some beautiful fractals like Mandelbrot Set, Julia set, Pythagorean Tree, Heart Shape Fractal, fractal Crown, Height Field.
We use some mathematical software's like MATHEMATICA, MATLAB etc. so that we can describe the graphical representation of our mathematical research.

3.0 Experiments & results

Considering different and suitable functions, we have eventually generated some beautiful and natural images. These images include beautiful flowers, household things, ornaments fractal and fractals that result from known and famous mathematical functions or combination of them. On the

basis of MATHEMATICA and MATLAB Program we present here some beautiful and interesting fractals.

3.1 Pythagorean Tree

Several steps for construction of Pythagorean tree are shown below.

We replace each 'branch' of 1st step with a scaled copy of the generator to create 2nd iteration.

Fig. 3. Step 1

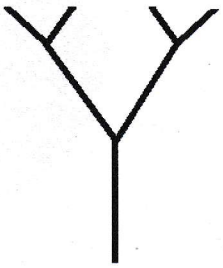

Fig. 4. Step 2

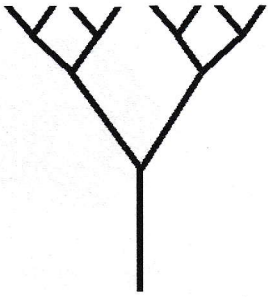

Fig. 5. Step 3

We can repeat this process to create later steps.

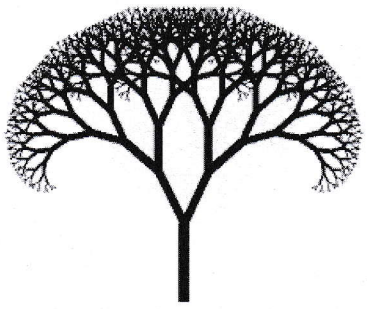

Fig. 6. Final step.

Repeating this process, we can create Pythagorean tree.

3.1.1 MATHEMATICA Program

```
FractalTree[pt : {_, _}, \[Theta]orient_: \[Pi]/2, \[Theta]sep_: \[Pi]/9,
        depth_Integer: 9] := Module[{pt2},
If[depth == 0, Return[]];
          pt2 = pt + {Cos[\[Theta]orient], Sin[\[Theta]orient]}*depth;
          DeleteCases[ Flatten@{Line[{pt, pt2}],
                    fractalTree[pt2, \[Theta]orient - \[Theta]sep, \[Theta]sep,depth - 1],
                   fractalTree[pt2, \[Theta]orient + \[Theta]sep, \[Theta]sep,depth -1]},
                     Null]]
Graphics [fractalTree[{0, 0}, \[Pi]/2, \[Pi]/9]]
```

3.2 Heart Shape Fractal

Generating Function: $320((-x^2z^3 - \frac{9y^2z^3}{80}) + (x^2 + \frac{9y^2}{4} + z^2 - 1)^3) = 0$

The function forms the heart shape in 3D with appropriate MATLAB Code that has been given below.

At 3rd iteration it takes the form of a rectangle rotating about 45 degrees. At 10th iteration it becomes to look like octagonal.

Fig. 7. At 3rd Iteration

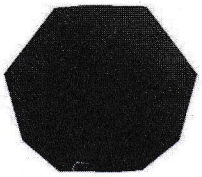

Fig. 8. At 10th Iteration

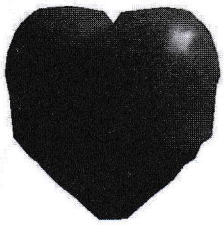

Fig. 9. At 30thIteration

When the iteration number gets the score 100 the function finally produces actual heart shape image.

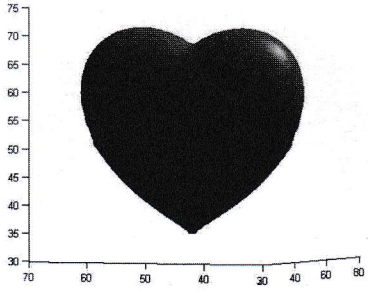

Fig. 10. After 100th iteration

3.2.1 MATLAB Program

```
% set up mesh
n=100;
x=linspace(-3,3,n);
y=linspace(-3,3,n);
z=linspace(-3,3,n);
[X,Y,Z]=ndgrid(x,y,z);
%Compute function at every point in mesh
F=320 * ((-X.^2 .* Z.^3 -9.*Y.^2.*Z.^3/80) + (X.^2 + 9.* Y.^2/4 + Z.^2-1).^3);
%generate plot
isosurface(F,0)
```

```
view ([-67.5 2]);
colormap(flag);
```

3.3 Fractal Crown

Generating Function: $\sum_{k=1}^{14} \frac{e^{i(-a)^k} t}{e^{bk}}$; $a = 0.5; b = \frac{\log 2}{\log 3}$

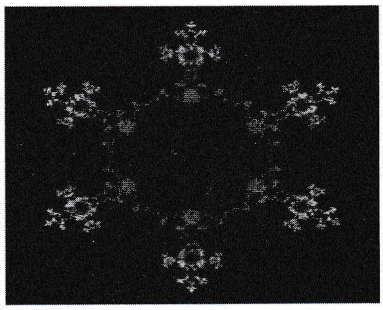

Fig. 11. Fractal crown

3.3.1 MATHEMATICA Program

```
n = 280;
a = 5.0;
b = Log[2]/Log[3];
image = Table[0, {n}, {n}];
Do[w = Sum[E^(I (-a)^k t)/a^(b k), {k, 1, 14}];
{i, j} = Floor[n({Re[w], Im[w]}/1.25 + 0.5)];
image[[i, j]] = Abs[w], {t, -Pi, Pi, 0.001}];;
ListDensityPlot[image, Mesh -> False, Frame -> False]
```

3.4 Generating Mandelbrot set

Fig. 12. G.F. f(z)=z+c, c=-.2+0i

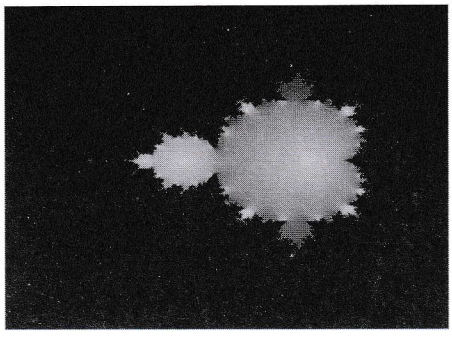

Fig. 13. G. F. $f(z)=z^2+c$, c=-.6+0i

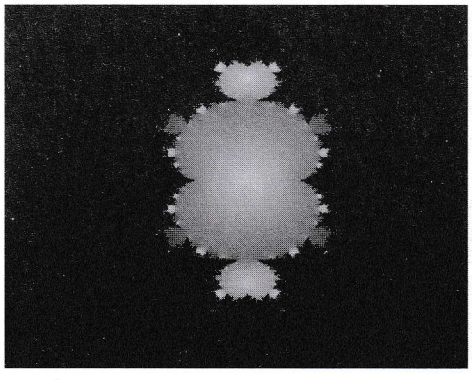

Fig. 14. G.F. $f(z)= z^3 +c$, c=.6+0i

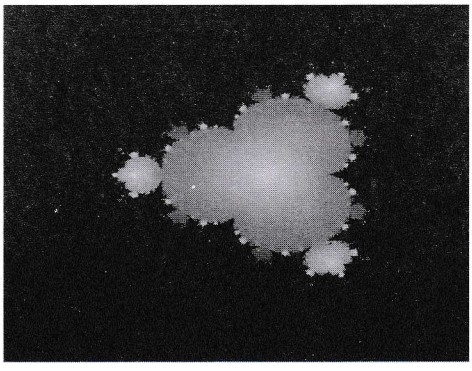

Fig. 15. G. F. $f(z)=z^4+c$, c=-.6+0i

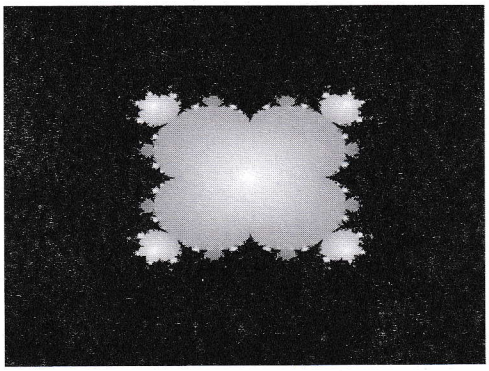

Fig. 16. G. F. $f(z)=z^5+c$, c=-.6+0i

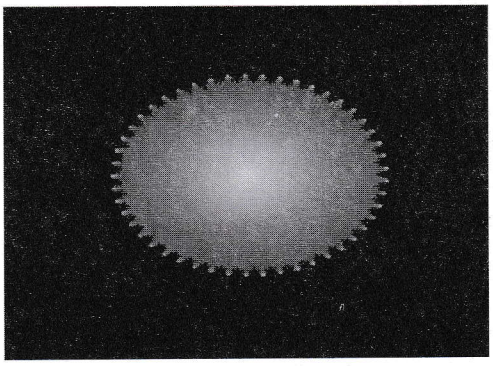

Fig. 17. G. F: $f(z)=z^{50}+c$, c = -.2+0i

3.4.1 MATLAB Program:

```
col=20;
m=400;
cx=-.2;
cy=0;
l=1.5;
x=linspace(cx-l,cx+l,m);
y=linspace(cy-l,cy+l,m);
[X,Y]=meshgrid(x,y);
Z=zeros(m);
C=X+i*Y;
for k=1:col;
Z=Z.^50+C;
W=exp(-abs(Z));
end
colormap copper (256);
pcolor(W);
shading flat;
axis('square','equal','off');
```

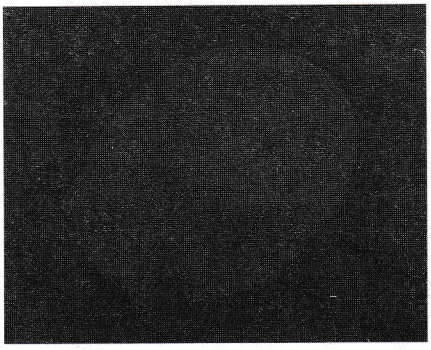

Fig. 18. 1st iteration (when z = 0)

3.5 Generating Julia set

Generating Function:

$f(z) = z^2 + c$ where c = 0.27+0.53i.

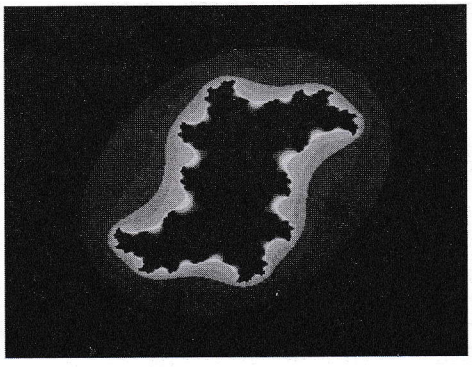

Fig. 19. 10th iteration

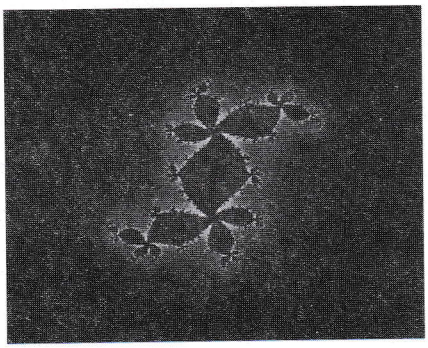

Fig. 20. 50th iteration

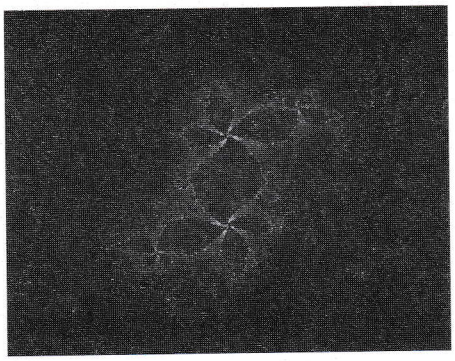

Fig. 21. 120th iteration: Complete Julia set.

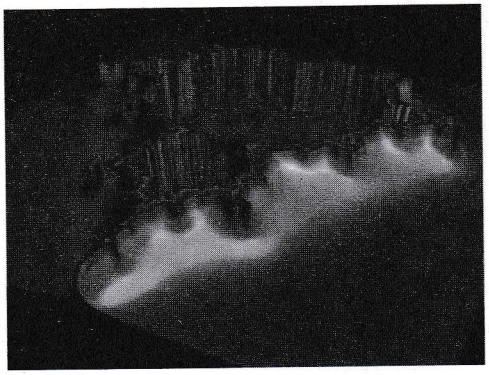

Fig. 22. Mandelbrot set height field.

3.5.1 MATLAB Program:

```
%%% Compute and draw the Julia set
clear;
clc;
%%% Parameters
c = 0.27+0.53i;        % complex number
niter=1;               % number of iterations
th=10;                 % threshold to determine divergence
v=1000;                % resolution (<-> number of points to compute)
%%% Initialisation
r = max(abs(c),2);     % radius of the circle beyond which every point diverges
d = linspace(-r,r,v);  % divide the x-axis
Z = ones(v,1)*d+i*(ones(v,1)*d)';  % create the matrix A containing complex numbers
C = zeros(v,v);  % Julia set point matrix
%%% Compute the julia set
```

```
for k = 1:niter
Z = Z.*Z+ones(v,v).*c;
C = C+(abs(Z)<=r);
end
%%% Figurefigure(21)
clf;
imagesc(C);
colormap(jet);
hold off;
axis equal;
axis off;
```

3.6 Generating Mandelbrot Set Height Field:

Generating Function: $cet = n + \log_2 \ln(R) - \log_2 \ln|z|$

3.6.1 MATHEMATICA Program

```
R = 6;
image = ParametricPlot3D[Module[{z = 0.0, i = 0}, While[i < 100 && Abs[z] < R^2, z = z^2 + xc
+ I yc; i++]; cet = If[i != 100, i + (Log[Log[R]] - Log[Log[Abs[z]]])/Log[2], 0]; {xc, yc,
0.5Min[0.1cet, 1], {EdgeForm[], SurfaceColor[Hue[1 - 0.1cet]]}}], {xc, -2.0, 1.0}, {yc, -1.5, 1.5},
PlotPoints -> 64, Boxed -> False, Axes -> False, DisplayFunction -> Identity];
<< MathGL3d`OpenGLViewer`;
MVShow3D[image, MVNewScene -> True];
```

4.0 Conclusion

Fractals Generating Techniques introduce interesting part of Fractals Geometry. In this thesis, we introduce some outstanding beautiful images known as Fractals. Our goal is to show techniques to generate some beautiful fractals like Mandelbrot Set Fractal, Fractal Trees, Julia set, Pythagorean Tree, Heart Shape Fractal, fractal Crown, Height Field. We restrict our attention to generate the said spectacularly images considering some techniques such as geometric iteration rules, successive removals etc. Special emphasize is given to consider very new generating functions as well as their suitable initial seeds so that we can see some new fractals after a number of iterations. Necessary programs are considered for all cases. We still are failing to consider generating function or suitable initial seed for some fractals though their images exist.

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Improvement of Conventional Electric Heater to Reduce Energy Loss and Its Performance Test

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Abstract

With rapid growth of population and urbanization, the energy demand is increasing day by day. Electrical energy is an important component for developing economy. Only 40% of our population has access to electricity. Due to shortage in supply, it becomes important to conserve electricity. Although there is restriction to use electric heaters, still it is being used in small scale in halls, hostels, messes etc. Conventional electric heater losses heat by radiation through bottom and by conduction through the mortar. Heating is not very effective, if the air gap between the utensils' bottom and coil plate is not optimized. A comprehensive study has been conducted to improve the conventional electric heater to reduce energy loss. Heat loss through the bottom and mortar is reduced by putting thermal insulation and a reflective coating. Three test specimens have been used to carry out the test with an improved heater and a conventional heater. The results reveal that energy can be saved by 35%, 30% and 17% for boiling water, cooking rice and red lentil respectively. Also, aluminum sheet is used instead of white cement and thermal insulation to make the construction simpler and the performance test has been carried out. It is found that when glass wool with white cement is used, save energy is around 30% whereas the same is around 28% when only aluminum sheet is used. Thus, by providing thermal insulation and reflective coating the heat losses from an electric heater can be reduced significantly.

Keywords: Electric heater, Thermal Insulation, Reflective coating, Cooking time, Energy conservation.

1.0 Introduction

Modern world depending upon coal, oil and natural gas for a majority of its energy needs and the prediction that the world will need nearly double its energy resources within several decades; therefore, it is important to conserve energy. There are two kinds of energy sources on which we depend – renewable and nonrenewable. Renewable energy sources are those that are continuously replenished such as water, wind and solar. Non-renewable energy sources, on the other hand, like gas, coal, and oil cannot be replaced within a shorter duration [1]. Therefore, consumption of these sources needs to be controlled to ensure that the limited supply we have will be available to future generations.

Like the rest of the countries of the world, the demand for energy is increasing day by day in Bangladesh. Electricity is the major source of power for most of the country's economic activities.

According to PDB records, the demand of electricity varies between 5500 - 6000 MW daily but it goes up to a maximum of 6700 - 6800 MW during the peak summer [2]. The installed capacity is 8525 MW in 2013 but the highest generation was so far 6350 MW recorded on 04-08-2012. Only 40% of the population has access to electricity grid with a per capita consumption of 136 kW-hr per annum. Overall, the country's generation plants have been unable to meet the demand over the past decade [3, 4, 5]. Also, there are several areas like Khulna, Rajshahi, and Barisal where natural gas supply is not available. In those areas, liquefied petroleum gas (LPG) is most commonly used for cooking purposes. Besides, sometimes electric heaters are used. Although, PDB has banned the use of such electric heaters, still it is used for cooking purposes in small scale in hostels, halls, messes etc. But the people are not aware of the energy loss it causes.

The structure of a conventional electric heater is such that appreciable amount of heat is wasted during cooking. A greater portion of the bottom area of the heater is open to the atmosphere which causes heat loss by radiation. Again, through the inside wall of the heater which is mainly mortar, appreciable amount of heat is lost by conduction. Moreover, the height of the heater body is not to any standard and there is air gap in between utensil's bottom and the coil plate. This causes less heat to receive by the utensil as air acts as thermal insulator which ultimately is a loss of energy. Due to these losses, the heater is needed to keep on completing the cooking operation for a longer period and hence consumes more electrical energy. So, if this heat loss can be reduced, then electrical energy will be saved. The aim of this work is to conserve energy by means of improving the conventional electric heaters by reducing the energy loss and thus the cooking time.

It is obvious that thermal insulation can reduce heat losses in a conventional electric heater [6]. Among various thermal insulators, glass wool may be considered suitable because of its very low thermal conductivity and temperature resistance [7, 8]. Moreover, it is readily available and low cost comparing to other type of insulators. Again, heat loss through the mortar can be reduced by providing a reflective coating. Considering this a light-colored material (say white cement) is chosen as reflective material [9, 10]. On the other hand, the reflectivity of aluminum sheet is around 84% to 98% [11, 12]. Since it provides high reflectivity and use of it makes the construction easier, so it may also be chosen as alternative of white cement coating. In this work both materials have been used and tested.

2.0 Fabrication

2.1 Fabrication of an insulated electric eeater by esing glass gool and ghite cement

At first a box is made using MS sheet, which provides the necessary structure to hold the glass wool insulation surrounding the electric heater base. Both the bottom and surrounding of the heater is

insulated by glass wool. On inside wall of the base, a mixture of white cement, chalk powder and water is brushed so that the mixture acts as a reflective coating. Figure 1 illustrates the thermal insulation and reflective coating.

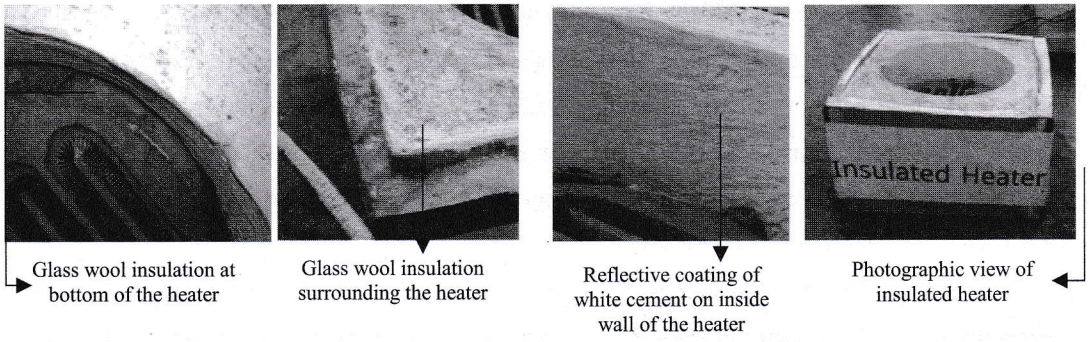

Fig. 1. Detail photographic view of Insulated Electric heater using glass wool, white cement.

2.1 Fabrication of an improved electric heater using aluminum sheet

A piece of aluminum sheet is bend and is placed inside the wall of an electric heater to form the coating as shown in Figure 2. Again, the open bottom area of the heater is covered by another piece of aluminum sheet as shown in figure. Using aluminum sheet instead of glass wool and white cement helps reducing the complexity of the previous construction.

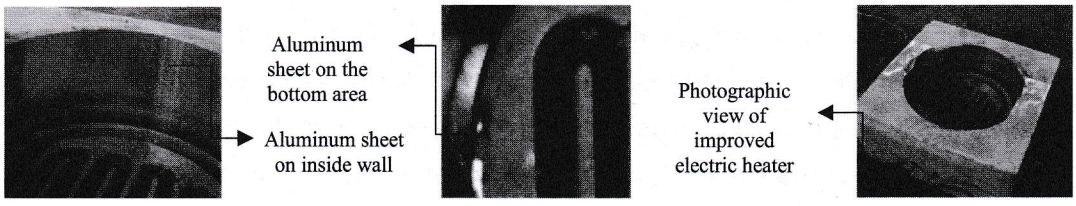

Fig. 2. Photographic view of an Improved electric heater using aluminum sheet and coated areas

3.0 Experimental setup

3.1 Test section for temperature profile along radial and vertical directions

To obtain the optimum height between the coil surface and the utensil, temperature profile for both insulated and bare electric heaters are determined along radial and vertical direction from coil plate surface to a height of 4.5 cm. For this, three thermocouples and three temperature recorders are

used. A wooden frame is fabricated and used to hold the thermocouples along the radial direction and to move the thermocouples vertically easily at different heights. Along radial direction at 0 cm (centre of the coil plate), 5.75 cm and 11.5 cm, three thermocouples are placed to record the temperature. Again, along vertical direction, temperature is determined at six heights from coil plate to the utensils bottom surface. These set-ups are shown in Fig. 3 and Fig. 4.

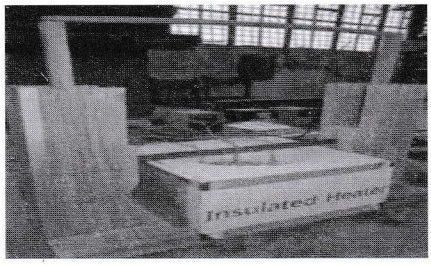

Fig. 3. Test section for temperature profile of insulated heater along radial and vertical direction

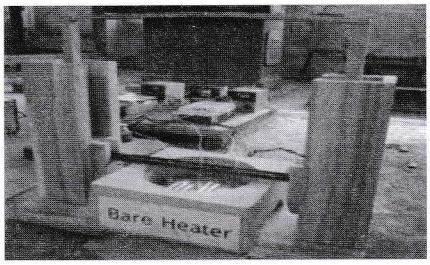

Fig. 4. Test section for temperature profile of bare heater along radial and vertical direction

3.2 Test section for performance tests

Three different specimens - Water, Minicate Rice and Red Lentil have been used for performance tests for both insulated heater and bare heater. In these tests, cooking time, initial water temperature, final water temperature and energy consumption have been measured for both the heaters with the help of stopwatch, thermocouple, temperature recorder and energy meter (as shown in Figure 5). Hence, the percent energy save is achieved. The variation in percent energy save with amount of cooking and hence maximum percentage of energy save is also determined.

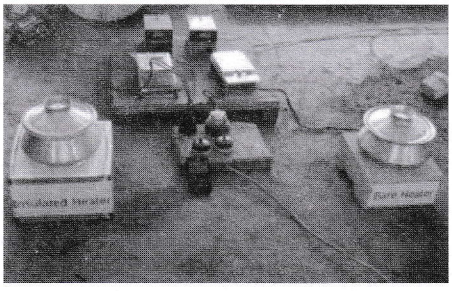

Fig. 5. Test section for performance tests using glass wool insulation and white cement

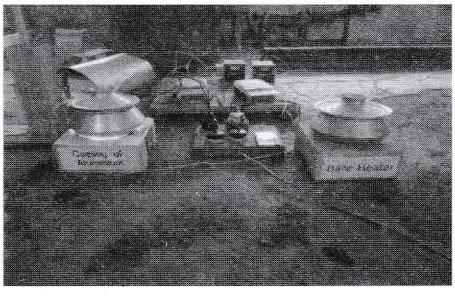

Fig. 6. Test section for performance tests using coating of aluminum sheet

3.3 Test section for Performance Tests using Aluminum Sheet

Instead of glass wool and white cement only reflective coating of aluminum sheet is used afterwards. Then the variation in percent energy save with amount of cooking and hence maximum percentage of energy save is determined. After that, the comparison between the improved insulated electric heater using glass wool and white cement and the improved heater using only aluminum sheet has been brought into picture. This set-up is represented in Fig. 6.

4.0 Results and discussions

4.1 Result for optimum height condition

The temperature profiles along radial direction at three different points are shown in Figure 7 for both the bare and insulated electric heaters. The three points are at 0 cm (centre of plate), 5.75 cm and 11.5 cm along the radial direction. It is evident from the figure that the temperature at various points inside an insulated heater is more than that of the bare heater at the same point. This is because heat loss has been recovered by providing thermal insulation.

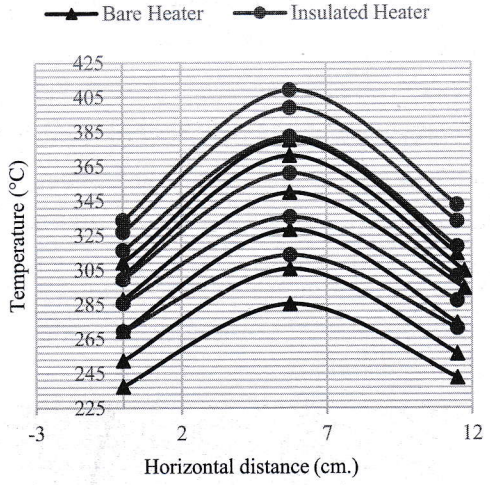

Fig. 7. Temperature Profile along Radial Direction for both Bare and Insulated Heater.

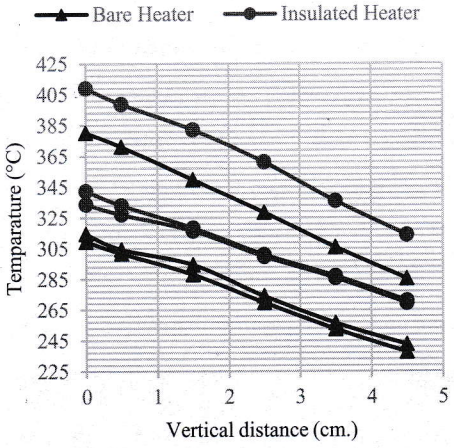

Fig. 8. Temperature Profile along Vertical Height for both Bare and Insulated Heater.

Fig. 7 also represents that temperature at the mid-point is always higher than that at the sides. This might be because of coil density is more at the middle. Figure 8 shows the temperature distribution along the height from the coil plate to the utensils' bottom. At points closer to the coil plate, the temperature is significantly more than that at distances points. This is due to the air gap. As thermal conductivity of atmospheric air is low as 0.024 W/m.K, it acts as an insulator in between

utensils and coil plate. Observing these temperature profiles, it can be concluded that, if an electric heater is insulated and coated then heat energy and electrical energy can be saved. Also, if the distance between utensils' bottom surface and coil plate is reduced, then the utensils will receive more heat because the air gap will be minimized appreciably. So, cooking time will be less and energy will be saved. But care should be taken so that the utensils' bottom must not touch the coil surface to avoid accident.

4.2 Result for performance tests of insulated electric heater

With the three test specimens - Water, Minicate Rice and Red Lentil the performance tests have been carried with bare and insulated heaters as described earlier for several days. In each case, the percentage energy save has been calculated from the observed information during each cooking.

Table 1: Results for energy save (%) by Insulated heater in boiling 800 ml water.

Obs. No.	Energy consumed with Insulated heater (kWhr)	Energy consumed with Bare heater (kWhr)	Energy Save (%)
14.07.2013 (Sunday)			
1.	0.23	0.33	30.30
2.	0.24	0.29	17.24
3.	0.23	0.35	34.30
15.07.2013 (Monday)			
1.	0.23	0.41	43.90
2.	0.24	0.38	36.84
3.	0.26	0.41	36.59
16.07.2013 (Tuesday)			
1.	0.25	0.39	35.89
2.	0.25	0.37	32.43
3.	0.23	0.27	15.00

Table 2: Results for energy save (%) by Insulated heater in cooking 60 gm rice along with 500 ml water.

Obs. No.	Energy consumed with Insulated heater (kWhr)	Energy consumed with Bare heater (kWhr)	Energy saves (%)
18.08.2013 (Sunday)			
1.	0.31	0.45	31.11
2.	0.32	0.47	32.00
3.	0.31	0.44	29.55
19.08.2013 (Monday)			
1.	0.33	0.44	25.00
2.	0.32	0.43	25.58
3.	0.32	0.44	27.27
20.08.2013 (Tuesday)			
1.	0.30	0.43	30.23
2.	0.33	0.45	26.70
3.	0.32	0.45	28.90

In case of water, it is observed that the insulated heater performs better compared to the bare heater for raising the temperature of water to its boiling point. For each observation, 800 ml water has been used as sample. By determining the energy consumption by both heaters, the percent energy save has been calculated.

The insulated heater has reduced heat losses, saved cooking time and for this appreciable amount of energy has been saved. Hence, from Table 1, it is observed that maximum energy save is 43.9% while the minimum save is 15%. From Table 1, it can be concluded that around 35% energy is saved in boiling 800 ml water.

Similarly, performance tests have also been conducted for cooking 60 gm Minicate rice along with 500 ml water. From Table 2, it is seen that maximum save is 32% and minimum save is 25% by using glass wool insulation with white cement coating. It can be concluded that around 27% to 30% energy have been saved in cooking 60 gm Minicate rice along with 500 ml water.

Again, for cooking 50 gm red lentil along with 375 ml water, from Table 3, it is seen that maximum energy has been saved 23.08% and minimum 16%. It can be concluded that around 17% energy has been saved by the insulated heater in this case.

Table 3: Results for energy save (%) by insulated heater in cooking 50 gm red lentil along with 375 ml water.

Obs. No.	Energy consumed with Insulated heater (kWhr)	Energy Consumed with Bare Heater (kWhr)	Energy Save %
18.08.2013 (Sunday)			
1.	0.21	0.25	16.00
2.	0.18	0.23	21.74
3.	0.20	0.26	23.08
19.08.2013 (Monday)			
1.	0.22	0.27	18.52
2.	0.20	0.24	16.67
3.	0.21	0.25	16.00
20.08.2013 (Tuesday)			
1.	0.21	0.25	16.00
2.	0.20	0.24	16.67
3.	0.23	0.28	17.86

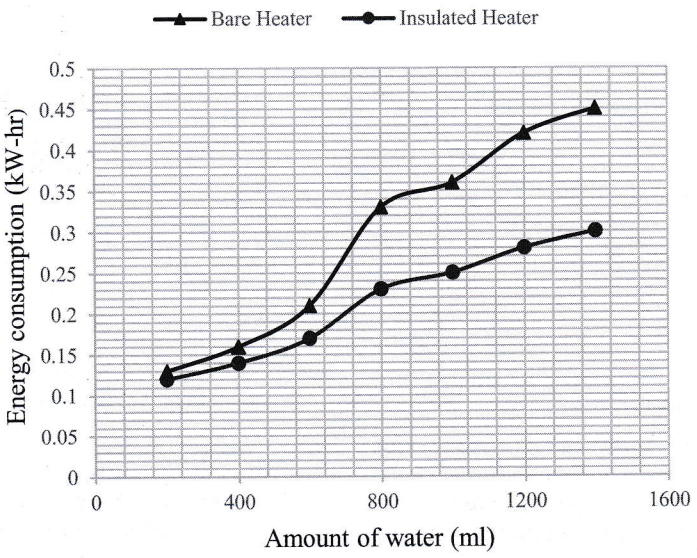

Fig. 9. Energy consumption (kW-hr) with varying amount of boiling water (ml).

4.3 Variation in energy save (%) with cooking-time in case of insulated electric heater

It has been seen that with the change in amount of cooking i.e. cooking time, the percentage in energy save also changes. In Figure 9, these results are shown graphically. It is evident from the figure, that when amount of water is less, the difference in energy consumption with bare and insulated heater is less. With the increase in amount of cooking i.e. amount of water (ml), this difference increases. As a result, when the amount of cooking is less, save in energy (%) is also less; when the amount increases, percent energy save also increases. This is due to the fact that when cooking amount is less, then less cooking time is needed. As a result, heat entrapment inside the insulated electric heater is less for small period and hence save in energy (%) is not so significant. But when amount of cooking increases, the time period also increases. As a result, heat entrapment occurs inside the heater for longer time and hence significant portion of energy is saved.

4.4 Variation in energy save (%) with cooking-time in case of coating of aluminum sheet

As aluminum sheet is appreciably reflective, this has been chosen and applied instead of thermal insulation and white cement coating. This reduced the complexity of construction. With various amount of cooking, the variation in energy save (%) in this case is also observed is illustrated in Figure 10. It shows the energy consumption with both heaters at various amount of boiling water (ml).

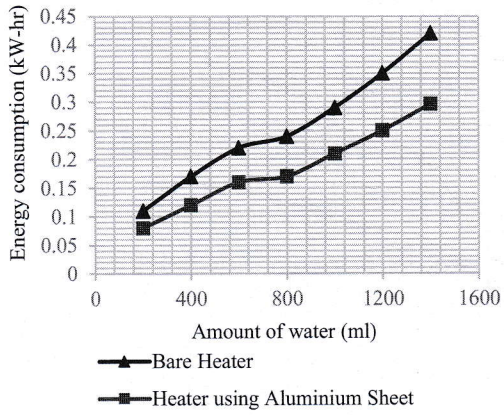

Fig. 10. Energy consumption with varying amount of boiling water (ml) when aluminum sheet is used.

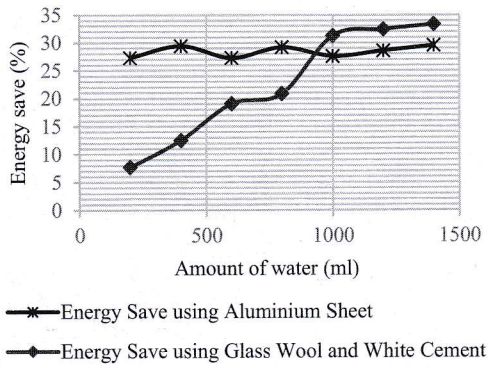

Fig. 11. Comparison in Energy save (%) between aluminum sheet coating and glass wool insulation with white cement coating.

Figure 10 reveals that when aluminum sheet is used as reflective surface on both bottom and inside wall of an electric heater, then the difference between energy consumption with the improved heater and bare heater almost remains same though the amount of cooing material. As a result, percent energy save remains almost same in all cases.

4.5 Comparison of energy save with aluminum sheet vs thermal insulation with white cement coating

Fig.11 illustrates that when heat lost has been recovered by using thermal insulation of glass wool with white cement coating, save in energy (%) has varied from 7.69% to 33.33% for various amount of cooking i.e. amount of boiling water (ml). But when only aluminum sheet has been used, save in energy has varied from 27.27% to 29.52% for same amounts of cooking. So, the application of aluminum sheet provides more stable output than application of glass wool with white cement. Moreover, it makes the fabrication simpler than before.

5. Conclusions

The following conclusions may be drawn from this study:

- Around 30% save in energy is possible if thermal insulation of glass wool with reflective coating of white cement is used.
- If reflective coating of simply aluminum sheet is used, around 28% energy is saved.
- Anyone can use either one of this to reduce energy loss in a heater.

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Effect of Macro Economic Variables on Stock Market Returns- Bangladesh Context

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Abstract

This study explores the relationship among macroeconomic variables and stock market returns in case of Dhaka Stock Market. Macro-economic variables (money supply, interest rate, exchange rate, GDP growth rate and inflation) have taken as independent variable and Stock Market return as dependent variable. The study period was 2001 to 2010. A simple regression analysis is performed to reach the conclusion. The study found that there is no relation between macro-economic variables and Stock Market return. It implies that Stock Market return is not sensitive to changes in the macroeconomic variables.

Key Words: Stock Market Return, Macro Economic Variables, GDP.

1.0 Introduction

Many studies performed in the developed countries regarding the relationship between macroeconomic variables and the stock market returns have been documented over the last couple of decades. Starting with Fama [1] and contributed by Lee [2], Kaneko et al. [3] Mukherjee et al. [4], Booth et al. [5], Mavrides [6], Maysami et al. [7], Sadorsky [8], and Chen [9]. For studies in the developing countries, Ibrahim et al. [10,11] Chen et al. [12], and Janor et al. [13] test the factors of the stock returns using macro-economic variables. Last but not least, by knowing which macroeconomic variables affect the stock market the most, both the personal and corporate investors would be able to proactively strategize their investments according to the change of the monetary policy.

The Dhaka stock market is of special interest as its unique features may trigger a different pattern of stock price movement either from the developed or other emerging economies. From the microeconomic perspective, the Market Efficiency Hypothesis (MEH) and dividend policy are the main issues that distinguish the Malaysian stock market behavior from other countries. For market efficiency hypothesis, Neoh [14], concludes that the U.S stock market is more efficient than the Malaysian. His efficiency measure is based on the fundamental factor of asset pricing. As the U.S firms only takes into account the factors of true value in pricing their stocks, the Malaysian firms includes other non-fundamental factors like bonus issues, etc. Besides, most of the developed markets, the

Malaysian stock market seems to be in the weak form of efficiency in the sense that it does not follow the random walk theory [15-19]. In terms of the dividend policy, an earlier study by Mansor et al. [20] find that the Malaysian market responds to the dividend announcement, but such effect does not hold in a latter study by Yong et al. [21]. This suggests that the dividend signaling effect for the Malaysian stock market is sensitive to a different economic cycle. Unlike Malaysia, the dividend signaling model holds for almost all developed countries [22-28]. From the macroeconomic perspective, studying the interaction of macroeconomic variables and the Malaysian stock market index is our primary interest because of three reasons; i.) Malaysia pursues a trade-led approach to stimulate its economy. ii.) Its equity market development is considered rapidly growing one standard measure of the level of equity market development is the market capitalization to GDP ratio. According to the World Bank, the market capitalization to GDP ratio in 1990 (2000) for Malaysia is 110.4% (127.0%); for Singapore is 93% (165.6%); and for Japan is 96.1% (68.2%) Taken from Pan et al. [30] iii.) Unlike developed countries, Malaysia does not adopt a freely exchange rate system and has more capital control [28]. Against these differences, studying the Malaysian context is important in order to provide a deeper understanding of this subject in enhancing a better decision making for the monetary policy. In terms of the research methodology, we adopt the Vector Autoregressive (VAR) framework by initially looking at the long run and short run relationship between stock market and the macroeconomic variables via the co-integration technique, followed by the Variance Decomposition analysis and Impulse Response Function. The establishment of co-integration analysis has offered an empirical approach in analyzing the relationship between macroeconomic variables and the stock market.

The present study reveals individual and combine effect of macro-economic variables of Dhaka Stock Exchange market from 2001 to 2010.

2.0 Review of literature

There are many researches are done all over the world regarding stock market return. This gives rise to development of international APT. Since then, many studies have looked into the 'exchange rate channel' of monetary policy transmission. Bracker et al. [29], found that macroeconomic variables were significantly influenced by the extent of international stock market integration. As a company's growth depends on domestic macroeconomic condition as well as its major trading partners, the co-movement of macroeconomic variables across countries may influence the movement of stock prices in those countries. Consequently, apart from the traditional variables namely money supply, interest rate, inflation, and reserves, the exchange rate is also one of the macroeconomic factors that could influence stock prices especially in the developed countries.

Previous studies on the macroeconomic determinants of stock returns can be divided into two major categories. The first category is the study to determine the factors affecting stock prices such as Sadorsky [8], Chen [9], Mavrides [6] and Lee [2]. The second category is to examine factors determining stock return volatility such as in Beltratti et al. [31], and Schwert [32]. Both groups are different in terms of the research objectives, methodologies, and most importantly the implications of their findings can lead to different inferences. The former focuses on the stock return, which can be measured by the return on the market indices, sectoral indices or individual stocks. On the other hand, the latter is concerned with the volatility of the stock itself, which can be measured via autoregressive conditional heteroscedasticity (ARCH) model. Since our study falls under the first group, the following reviews of literature center on the dynamic interacttion between macroeconomic variables and the stock returns. Schwert [32], Koutoulas et al. [33], and Maysami et al. [7] show that changes in the macroeconomic variables can predict the stock market movements for the case of the US.

Singapore, and Canada, it can be inferred that the significant influence of the macroeconomic variables on the stock market index is rather empirically proven for the developed countries. Nonetheless, the empirical finding for the case of the developing economies is still a puzzle. Although the existence of a unidirectional causality from economic activities to stock market, there are also a substantial number of studies that show a significant relationship, running from stock market to economic variables. Among others, Fama [1], Kaneko et al. [3], and Janor et al. [13] offer evidence on this issue for the case of the U.S., Japanese and Malaysian stock markets, respectively. However, studies on the European market by Poon et al. [34] and Gjerde et al. [35] reveal insignificant relationships between stock market and macroeconomic variables, be it from stock market to economic activities and vice versa.

Hence, three conclusions can be made. First, changes in the share prices are affected by the changes in macroeconomic performance in the well-developed markets, but results are inconclusive for the emerging markets. Secondly, the predictive role of stock market on macroeconomic activities is inconclusive for both the developed and emerging markets. Thirdly, whether there is a unidirectional or bidirectional relationship between macroeconomic performance and stock market returns for both developed and developing economies is still subject to further research. While the association between stock market and economic activities is quite obvious regardless of its causality direction, a standardized set of macroeconomic variables is not found. Macroeconomic variables selected to examine the determinants of stock market tend to differ slightly across studies. Nevertheless, in general, Ibrahim et al. [11], Booth et al. [5], Wongbangpo et al. [36], Chen [9], Chen et al. [12].

Maysami et al. [7], and Mukherjee et al. [4] reveal that the rate of inflation, money growth, interest rates, industrial production, reserves, and exchange rates are the most popular significant factors in explaining the stock market movement. Mukherjee et al. [4] who propose that changes in both short and long-term rates are expected to affect the discount rate in the similar way. Another monetary policy tool is money supply. How the money supply affects the stock market returns is also a matter of empirical proof. According to conventional economic theory by Fama [1], an increase in money supply leads to an increase in discount rates which in turn, lowers the price of stock, thus conferring a negative effect. However, Mukherjee et al. [4] argue that if an increase in money supply leads to economic expansion via increased cash flows, stock prices would benefit from economic growth lead by such expansionary monetary policy. In the case of Japan, the study shows that money supply is positively related to stock market. Consistently, Maysami et al. [7] support the view of Mukherjee et al. [4] for both long run and short run dynamic interaction between money supply and stock returns for the case of Singapore. Besides interest rate and money supply, inflation can also affect the movement of stock prices.

Theoretically, Asprem [37] put forward that inflation should be positively related to stock return if stocks provide a hedge against inflation. However, empirical studies by Barrows et al. [38], and Chen et al. [12] conclude that inflation has negative effects on the stock market. Under normal circumstances, a rise in expected inflation rate tends to lead to restrictive monetary policies, which would have a negative effect upon stock prices. Nonetheless, as price stability is one of the macroeconomic policy objectives by the Malaysian government and also an expected target of the Malaysian citizens, we believe that the relationship between inflation and stock price is insignificant. Another variable of interest is the exchange rates. Based on 'exchange rate channel' of monetary policy transmission as in Pan et al. [30], a depreciation of the local currency makes exporting goods less expensive and may lead to an increase in foreign demand and sales for the exporting firms. As a result, the value of exporting (importing) firms would increase (decrease). This, however, is only true if the demand for exports and imports are elastic. If the demand for imports is inelastic, the benefit of increased exports would be absorbed by higher prices paid for imports, thus undermining the advantages of depreciation. The 'exchange rate channel' by Pan et al. [30], is consistent with the 'flow oriented' exchange rate model, introduced by Dornbusch et al. [39]. They affirm that exchange rate movements initially affect the international competitiveness and trade position, followed by the real output of the country, and finally affects the current and future cash flows of companies, which can be inferred from the stock price movements. In short, both exchange rate channel and flow oriented model hypothesize that an

- If around 30% energy loss could be recovered every day in each kitchen in those areas where electric heaters are used for cooking purpose then life will change drastically.

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appreciation (depreciation) of a local currency leads to a decrease (increase) in the firm value of exporting firms, and vice versa for the importing firms. Even if a firm does not directly involve in the export import business, Adler et al. [40] show domestic firms that have minimal international activities can still be affected by the exchange rate movements if their input prices, output prices, or product demand depends on the fluctuation of exchange rate. To summarize, the impact of exchange rate on stock price depends on the importance of a nation's international trade in its economy as well as the degree of the trade balance. Empirical studies on the stock market-exchange rate nexus show mixed results. Aggrawal [41] find that exchange rates have positive effects on the stock market. In contrast, Soenen et al. [42] discover an inverse relationship. Using three different exchange rate measures namely real effective exchange rate, nominal effective exchange rate and RM/US$, Ibrahim [10] suggests no long run relationship between stock market and exchange rates in a bi-variate setting for the Malaysian case. However, by including money supply and reserves, he finds some evidence of the long run relationship among the four variables (stock market index, exchange rate, money supply and reserves). His findings also indicate that changes in money supply and reserves affect the stock market index in the short run. Our study differs from him in at least two aspects. First, as his aim is to investigate the dynamic interaction between exchange rate and stock market, ours is to examine the factors of stock market returns. As a result, different theories and variables are involved along the process. Secondly, our study incorporates the data for Dhaka Stock Market, which comprises before and after crisis period. Other than the policy monetary tools mentioned above, the level of real economic activity is also crucial in determining the stock market returns. The most popular measure of real economic activity is the gross domestic product Rahman et al.

The researchers have made an effort to investigate whether the variables (i.e. interest rate, inflation, exchange rate, GDP growth rate) can make a significant effect on stock volatility when they are considering individually as well as combined.

3.0 Objectives of the study

The study is performed to investigate

- The effect of individual macro-economic variable on stock market return.
- The combined relationship among interest rate, inflation, exchange rate, GDP growth rate.

4.0 Methodology

Secondary data sources have been used in this study.

4.1 Sampling design

The following specific judgment has been followed for selecting the sample size.

- The index has been collected from DSE market.
- DSE has different types of indexes such as DSE-20 index, all share price index, general index etc. We have considered only general price index.
- The interest rate is taken weighted average interest rate calculated by Bangladesh Bank.
- The exchange rate has considered only conversion rate between US Dollar and Taka.
- Only national inflation rate has considered for study purpose.
- Bond trading is excluded from the study.

4.2 Study period

The study period is 10 years starting from 2001 to 2010.

4.3 Data collection

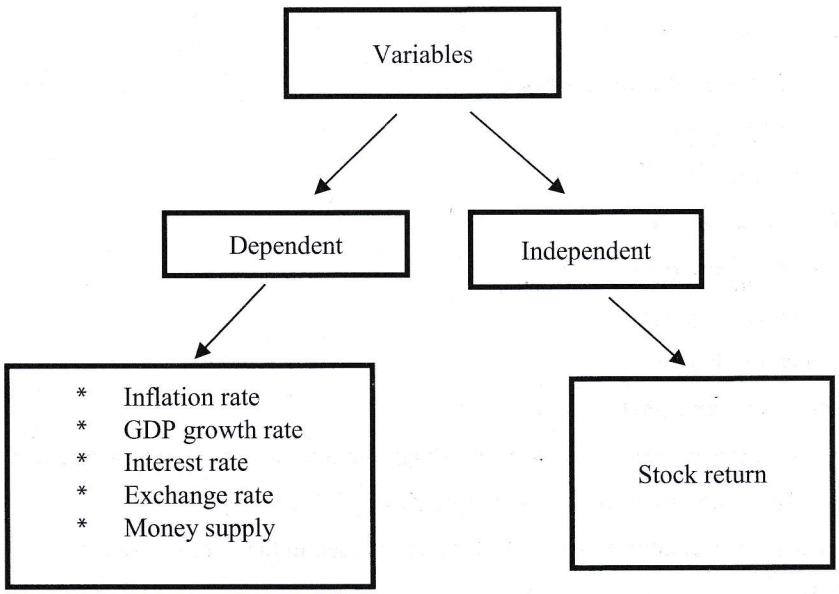
Data is collected from DSE Library, Bangladesh Statistical Bureau, Bangladesh Economic Reviews and published documents of Bangladesh Bank.

4.4 Data analysis:

Data is analyzed by using SPSS 16.0 software.

4.5 Variable identification

Two types of variables have been used namely-Independent variable; and Dependent variable.



4.6 Hypotheses development

Hypothesis-1

H_0: There is no relationship between inflation and returns on share price index.

Hypothesis-2

H_0: There is no relationship between interest rate and returns on share price index.

Hypothesis-3

H_0: There is no relationship between exchange rate and returns on share price index.

Hypothesis-4

H_0: There is no relationship between GDP growth rate and returns on share price index.

Hypothesis-5

H_0: There is no relationship between money supply and returns on share price index.

Hypothesis-6

H_0: There are no relationship among inflation rate, interest rate, exchange rate, GDP growth rate, money supply and returns on share price index.

5.0 Model used

Stock Market Return =f (Inflation rate, Interest rate, Exchange rate, GDP growth rate and Money supply)

For testing hypotheses

$Y=a+b_1x_1+ b_2x_2+ b_3x_3+ b_4x_4+ b_5x_5+e_{ij}$

Where a= Intercept

b_1---------- b_n= Slope coefficients

X_1= Inflation rate

X_2 = Interest rate

X_3 = Exchange rate

X_4 = GDP growth rate

X_5 = Money supply

e_{ij} =Error terms

6.0 Theoretical framework

Interest rate: "The market price at which resources are transferred between at the present and the future. The return of saving and cost of borrowing," Mankiw [42].

Yearly change in interest rate is used. Calculation is used in the following way:

$IR= (IR_t-IR_{t-1})$

Where, IRt = Yearly interest rate in time t

IR_{t-1} =Yearly interest rate in time t-1

Money Supply: It is generally assumed that money supply is determined by the Bangladesh Bank. "By money supply we mean the total stock of monetary media of exchange available to a society for use in connection with the economic activity of the country. According to the standard concept of money supply, it is composed of two elements (a) currency with the public and (b) demand deposit with the public." Changes in money supply are calculated in the following way:

$MS= (M2_t-M2_{t-1})$

Where, $M2_t$= Yearly money supply in time t

$M2_{t-1}$= Yearly money supply in time t-1

Inflation Rate: "Inflation is an increase in the price level" (Mankiw2000). Inflation rate is calculated based on Consumer Price Index.

$IF= \{(CPI_t-CPI_{t-1})/ CPI_{t-1}\} *100$

Where, CPIt= Yearly inflation rate in time t

CPI_{t-1}= Yearly inflation rate in time t-1

Exchange Rate: "The exchange rate is the price of foreign currency" (Gordon 1993). Changes in exchange rate are calculated in the following way:

$ER= (ER_t-ER_{t-1})$

Where, ERt = Yearly exchange rate in time t

ER_{t-1} =Yearly exchange rate in time t-1

GDP Growth Rate: Gross Domestic Product (GDP) is total production of a country. It is calculated in the following way:

$GR= \{(GR_t-GR_{t-1})/ GR_{t-1}\} *100$

Where, GRt = Yearly GDP growth rate in time t

GR_{t-1} =Yearly GDP growth rate in time t-1

Stock Market Return: All share price index is used to calculate stock market return. Stock market return is change of closing all share price index at year t and closing all share price index at t-1. Change in stock market return is calculated in the following way:

$SMR= \{(SMR_t-SMR_{t-1})/ SMR_{t-1}\} *100$

Where, SMRt = Yearly stock market return in time t

SMR_{t-1} =Yearly stock market return in time t-1

7.0 Findings and analysis

7.1 Relationship between inflation and DSE index

Model summary

Model	R	R^2	Adjusted R^2	Std. Error of the Estimate
1	0.157	0.023	-0.097	41.32549

The relationship between inflation and DSE Index is 0.157 that indicates there was a very weak relationship between inflation and DSE Index. Here R^2 is .025 which indicates only 2.5% dependent variable is explained the independent variable.

ANOVA

Model	Sum of square	*df*	Mean square	F	Sig.
Regression	344.470		344.470	0.202	0.665
Residual	13662.369	1	1707.796		
Total	14006.839	8			

The *F*- test ratio indicates that the null hypothesis is rejected. It means that there was relation between inflation and DSE Index in the study period.

Coefficients

Model	Unstandardized Coefficients		Standardized Coefficients	t-value	Sig.
	β	Std. Error	*β*		
(Constant)	1.696	50.397		0.034	0.974
Inflation	3.861	7.213	0.186	0.535	0.607

7.2 Relationship between GDP and DSE index

Model summary

Model	R	R^2	Adjusted R^2	Std. Error of the Estimate
1	0.173	0.030	-0.091	41.21285

The relationship between GDP and DSE Index is 0.173 that indicates there was a very weak relationship between inflation and DSE Index. Here R^2 is .030 which indicates only 3% dependent variable is explained the independent variable.

ANOVA

Model	Sum of square	*df*	Mean square	F	Sig.
Regression	418.846	1	418.846	0.24	0.633
Residual	13587.993	8	1698.499		
Total	14006.839				

The *F*- test ratio suggests that the null hypothesis is rejected. It means that there was no prelateship between GDP and DSE Index.

Coefficients

Model	Unstandardized Coefficients		Standardized Coefficients	t- value	Sig.
	β	Std. Error	*β*		
(Const	-24.278	105.598		-0.230	0.824
ant)	9.236	18.780	0.173	0.497	0.633
GDP					

7.3 Relationship between Exchange Rate and DSE index

Model summary

Model	R	R^2	Adjusted R^2	Std. Error of the Estimate
1	0.328	0.108	-0.004	39.52161

The relationship between Exchange Rate and DSE index is 0.328 that indicates there was a low relationship between Exchange Rate and DSE Index. Here R^2 is 0.108 which indicates only 10.8% dependent variable is explained the independent variable.

ANOVA

Model	Sum of square	*df*	Mean square	F	Sig.
Regression	418.846	1	418.846	0.24	0.633
Residual	13587.993	8	1698.499		
Total	14006.839	9			

The *F*- test ratio suggests that the null hypothesis is rejected. It means that there was no prelateship between Exchange Rate and DSE Index.

Coefficients

Model	Unstandardized Coefficients		Standardized Coefficients	t-value	Sig.
	β	Std. Error	β		
(Constant)	-24.278	105.598		-0.230	0.824
GDP	9.236	18.780	0.173	0.497	0.633

7.4 Relationship between interest rate and DSE index

Model summary

Model	R	R^2	Adjusted R^2	Std. Error of the Estimate
1	0.17	0.029	-0.092	41.23071

The relationship between interest rate and DSE Index is 0.17 that indicates there was a very weak relationship between interest rate and DSE Index. Here R^2 is .029 which indicates only 2.9% dependent variable is explained the independent variable.

ANOVA

Model	Sum of square	*df*	Mean square	F	Sig.
Regression	407.067	1	407.067	0.239	0.638
Residual	13599.772	8	1699.972		
Total	14006.839				

The *F*- test ratio suggests that the null hypothesis is rejected. It means that there was no prelateship between interest rate and DSE Index.

Coefficients

Model	Unstandardized Coefficients		Standardized Coefficients	t-value	Sig.
	β	Std. Error	β		
(Constant)	135.634	220.834		0.614	0.556
Interest rate	-8.978	18.346	-0.17	-0.489	0.638

7.5 Relationship between Money Supply and DSE index

Model summary

Model	R	R^2	Adjusted R^2	Std. Error of the Estimate
1	0.16	0.025	-0.096	41.30668

The relationship between Money Supply and DSE Index is 0.16 that indicates there was a very weak relationship between Money Supply and DSE Index. Here R^2 is .025 which indicates only 2.5% dependent variable is explained the independent variable.

ANOVA

Model	Sum of square	*df*	Mean square	F	Sig.
Regression	356.905	1	356.905	0.209	0.660
Residual	13649.934	8	1706.242		
Total	14006.839				

The *F*- test ratio suggests that the null hypothesis is rejected. It means that there was no prelateship between Money Supply and DSE Index.

Coefficients

Model	Unstandardized Coefficient		Standardized Coefficients	t-value	Sig.
	β	Std. Error	β		
(Constant)	-24.117	114.176		-0.211	0.838
Money Supply	3.123	6.829	0.160	0.457	0.660

8.0 Major Findings

The study discloses the following key points

- The individual effect of macro-economic variables (i.e. interest rate, inflation rate, GDP growth rate, money supply and exchange rate) were not sensitive to stock return during the study period.
- The combined effect also resembles with the individual effect.
- The DSE market was not able to provide the signal of efficient market hypothesis during the study period.

9.0 Conclusion

Stock Market is the economic barometer of any country. In an efficient market, the economic push and pull will reflect in the stock market return. In this article, an initiative to justify the truth. In this study, money supply, interest rate, exchange rate, GDP growth rate and inflation as independent macro-economic variables and Stock Market return as dependent variable have been considered. The study reveals that there is no relation between macro-economic variables and Stock Market return in Dhaka Stock Market. It implies that Stock Market return is not sensitive to changes in the macroeconomic variables. It also alerts the present and prospective investors that Dhaka Stock Market is not an efficient market because it ignores major economic variables.

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An Economic Analysis of Shipping Industry in Bangladesh: Implications for Sustainable Development

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Abstract

Shipping business and industry is as primeval as human civilization. Also in Bangladesh shipping business is very ancient. The economic influence of shipping is undoubtedly great on our economy. But this sector is not as widened as it was expected. This article has explored the probable economic aspects of shipping in Bangladesh. It is expected that the participation of Bangladesh in the economic opportunities created by shipping and maritime activities will have huge benefit for total economic welfares. Policy makers should give more emphasis on shipping industry which is the significant part of blue economy. Private sector engagement in this sector will be beneficial in the long run as without private engagement, this sector will not be boomed. The research is an exploratory research based on secondary data.

Keywords: Shipping and Shipping industries, economic aspect of shipping

1.0 Introduction

The maritime industry includes all enterprises involved in the business of designing, assembling, manufacturing, acquiring, operating, supplying, repairing and/or maintaining vessels or component parts, there of managing and/or operating shipping lines, stevedoring and customs related brokerage services, shipyards, dry docks, marine railways, marine repair shops, shipping and freight forwarding services and similar enterprises. This paper is predominantly concerned with management and operation of shipping industries and its role in the economic development of Bangladesh. It can entitle the movement of cargo by ship from point A to point B, or from port A to port B, or from one country to another.

The maritime industry and its impact occupy a very prominent position in the economy of nations all over the world [1]. The industry in its strict sense embraces all the maritime related business activities which take place within the country's maritime environment. These include offshore economic activities such as fishing, salvage, towage, underwater resources and on-shore economic activities such as port activities, maritime transport (shipping), ship construction, repairs and maintenance activities. Of all these activities, shipping stands out as the greatest boost to a nation's

economic growth and advancement. This is so because all other maritime activities revolve around shipping.

Due to close linkage between shipping activities and economic development, most nations cannot endow to treat it with levity, hence a mindful intervention needed to ensure that the national interest is protected [2]. Shipping as a primary logistics provider is critical in the process of Bangladesh's international trade and economic development. As a mode of transport, shipping provides the cheapest and most effectual modes of moving large dimensions of import and export round the world thereby creating jobs and adding value to the economy [3].

2.0 World shipping industry

The procedure of navigating or engaging in commerce through various types of navigable waters introduces the related idea of shipping [4]. defines shipping as relating to ships, concentration in shipping, shipping affairs, shipping business, shipping concerns [4]. Rolins viewed shipping vessel, as receiving on board a ship for transportation, to have transported by a carrier, to take or draw into a boat, to engage, to serve on a ship. Shipping involves the art of transporting goods, often termed cargo, from one point to another on any spring of water. Shipping could therefore be on land also. Shipping business can be said to be one of the oldest businesses in the world. Historically, it constitutes a major source of political power and territorial influence for "he who rules the sea, rules the world" [5], a fact underscored by the various conquests of the Egyptians, Turkish, Roman, and Spanish, Greek, Portuguese and British empires.

The story of the shipping industry since the Second World War has been one of ingenuity, professionalism, fabulous profits and some miscalculations. Adam Smith, the father of modern economics, viewed shipping as one of the principal stepping stones to economic expansion. In chapter three of the "Wealth of Nations", he claimed that the central force in a capitalist society is the division of labor and the level to which it can be practiced depends largely and crucially upon the size of the market. He saw shipping as a source of cheap transport which can open up wider markets to concentration, offering charges way below every other means of transportation [6].

The shipping industry is closely connected with the state of the global economy. It is complex and notoriously volatile in nature. Shipping being highly dependent on trade flows across the globe has seen cyclic booms and busts following the fluctuations in the world's economy. The recent economic turmoil has resulted in attenuation of container trade as global demand for raw materials and finished goods jumped.

Presently, more than one million seafarers managing around 50,000 internationally trading ships of various types around the globe exist. The basic type of ships includes container ships, bulk carriers, tankers, ferries, cruise ships and specialized ships. General cargo ships made up about 37% of the world's fleet in terms of deadweight tonnage (dwt), 25 % tankers, 14% bulk carriers, 12% passenger ships and 8 % container ships. The remaining 4% includes ships of specialized nature and which cannot be included in the above-mentioned categories.

The registered total world shipping tonnage is in more than 150 nations with Panama leading at 173 million tons followed by Liberia (79 million tons), Bahamas (47 million tons), Marshal Island (38 million tons) and Singapore (37 million tons). Other big registry countries comprise Hong Kong, Greece, Malta, China and USA [7].

The world fleet raised by 3.5 per cent in the 12 months to 1 January 2016 (in terms of dead-weight tonnage (dwt)). This is the lowest growth rate since 2003, yet still higher than the 2.1 per cent growth in demand, leading to a continued situation of global overcapacity.

The situation of countries within global container shipping networks is echoed in the UNCTAD liner shipping connectivity index. In May 2016, the best associated countries were Morocco, Egypt and South Africa in Africa; China and the Republic of Korea in Eastern Asia; Panama and Colombia in Latin America and the Caribbean; Sri Lanka and India in South Asia; and Singapore and Malaysia in South-East Asia.

Diversified countries participate in different sectors of the shipping business, grasping opportunities to produce income and employment. As at January 2016, the top five ship owning economies (in terms of dwt) were Greece, Japan, China, Germany and Singapore, while the top five economies by flag of registration were Panama, Liberia, the Marshall Islands, Hong Kong (China) and Singapore. The largest shipbuilding countries are China, Japan and the Republic of Korea, accounting for 91.4 per cent of gross tonnage constructed in 2015. Most shipbreaking takes place in Asia; four countries – Bangladesh, India, Pakistan and China – accounted for 95 per cent of ship scrapping gross tonnage in 2015. The biggest suppliers of seafarers are China, Indonesia and the Philippines. As countries concentrate in different maritime subsectors, a process of specialization of the industry occurs. As each maritime business locates in a smaller number of countries, most countries host a decreasing number of maritime businesses, albeit with growing market segments in the subsectors [8].

3.0 Overview of shipping industry in bangladesh:

There are three types of shipping services in shipping industry i.e. liner, industry and tramp services. In Bangladesh, these three types of shipping business are operated with the help of domestic

and international shipping companies. MGH group has shipping lines which maneuver their business privately through Yang Ming Line, China Shipping Container Lines, Compania Sudamericane de Vapores (CSAV), Sitara Shipping Lines, Balaji Shipping Lines etc. East Coast Shipping Lines Ltd is one of the most professional shipping agents in Bangladesh. Since the beginning of East Coast Shipping Lines Limited, it has successfully controlled 668 ships which include Oil Tankers, Bulk and Liquid Cargoes, General Import Cargoes, Heavy Lift Cargoes, Dangerous and Hazardous Cargoes Carriers in both the sea ports of Bangladesh [9]. Ananda Shipways Ltd. is close to its extinction of operation. CMA CGM Bangladesh Shipping Limited is a shareholding subsidiary of French container shipping group CMA CGM which has invariably captured a big market of shipping in Bangladesh. Summit Oil and Shipping Company Limited (SOSCL), an enterprise of Summit Group owns 6 coastal oil tankers with an accumulated carrying capacity of 9,600 MT [10]. HRC, a shipping company and the largest private sector Bangladesh flag carrier with 9 container feeder vessels and a total capacity of 4995 TUES [11]. Deshbandhu Shipping Ltd. a sister concern of Deshbandhu Group is the owner of two ocean-going ships named Mv. Golam-E-Mostafa & Mv. Deshbandhu-1. Bashundhara Logistics Ltd of Bashundhara Group has more than 25 coaster vessels and bulk careers which are used to transporting clinker, slag, gypsum, fertilizer, fly ash, cement, jute, rice, sugar, sand, limestone etc. from Chittagong/Noapara/Sylhet/Chatok to various inland riverine termini. Under the banner of Comfort Group of Companies, there are some shipping lines which mainly conduct their shipping business under Bangladesh Petroleum Corporation. Kanta Shipping started its business with transportation of petroleum having 4 coastal oil tankers. Madina Maritime of Madina Group has four ships with a total capacity of 300 m. tons. United Shipping Lines is an important wing of Meghna Group of Industries which provides a comprehensive range of integrated cargo transportation & logistic services to MGI and offers point to point cargo shipment facility and provides services in the offshore sector. The maximum shipping lines either private or public operate their business through Chittagong port as it is the country's major gateway to international trade and perform about 92% of the maritime trade of Bangladesh. The listed shipping line-operators of Chittagong port is shown in the following table with its route, port rotation and deployed capacity:

OPERATOR	ROUTE	PORT ROTATION	DEPLOYED CAPACITY (TEU) TOTAL	OPERATOR	ROUTE	PORT ROTATION	DEPLOYED CAPACITY (TEU) TOTAL
ADVANCE CONTAINER	SGP/BGD	SIN/CGP/SIN	2384	MCC TRANSPORT	SE ASIA/BGD	PTP/SIN/CGP/PKG/PTP	2065
ADVANCE CONTAINER	SE ASIA/BG	SIN/CGP/MNL/SIN	780	MCC TRANSPORT	SE ASIA/BGD	SIN/PTP/CGP/PKG/PTP/SIN	2916
ADVANCE CONTAINER	SE ASIA/BG	SIN/CGP/PEN/SIN	1876	OEL	LKA/BGD	CMB/CGP/CMB	1987
CMA-CGM	SE ASIA/BG	PKG/PTP/CGP/PKG	1157	OEL	SE ASIA/BGD	SIN/PKG/CGP/SIN	2960
GOLD STAR/XPRESS	SE ASIA/BG	SIN/PKG/CGP/PEN/SIN	2410	QC CONTAINER	SE ASIA/BGD	SIN/PTP/PKG/CGP/SIN	956
X-PRESS	SE ASIA/BG	SIN/PKG/CGP/SIN	2936	SAMUDERA	SGP/BGD	SIN/CGP/SIN	2967
HRC SHPP	BGD /LKA	CMB/CGP/CMB	908	X-PRESS	SE ASIA/BGD	SIN/PKG/CGP/SIN	3020
HRC SHPP	MYS/BGD	SIN/CGP/SIN	1179	X-PRESS	LKA/BGD	CMB/CGP/CMB	7884
HRC SHPP	SGP/BGD	SIN/PKG/CGP/SIN	1020	YANG MING	SE ASIA/BGD	SIN/PKG/CGP/SIN	3095
HRC SHPP	SE ASIA/BGD	SIN/CGP/MNL/SIN	528				

Source: *Drewry Maritime Research Report as of January 2011*

4.0 Economic opportunities in Bangladesh shipping industry

The investment climate in Bangladesh shipping industry is directed by the current national economic development policy which has the objective of promoting a strong private focused industry with the government as the enabler. Some of the crucial and definite investment opportunities in the Bangladesh maritime sector especially in shipping are:

4.1 Dry bulk shipping

Dry bulk shipping trade is the strongest shipping in Bangladesh. Chittagong port has handled 48,94,1406 metric tons and 5,839,986 metric tons as import and export respectively in the financial year 2014-15 (Cargo Handling Statistics at CPA, FY: 2014-15). Almost 60% of the total trade is operated under dry bulk shipping. Domestic demand for grains, fertilizers, sugar, cement salt etc. is supported by import. This is expected to continue for a substantial period, predominantly in the grain market where some agronomic factors do not lend themselves to domestic production.

4.2 Tanker shipping

Bangladesh is importing mostly refined oil, lube base oil, crude oil as any other countries in the world. The main user of tanker in Bangladesh is Bangladesh Petroleum Corporation (BPC). Its oil product imports comprise 95 RON gasoline, jet A-1 fuel, superior kerosene, 0.25% sulfur gasoil, 0.05% sulfur gasoil and 180 CST high sulfur fuel oil with maximum 3.5% sulfur content [12].

However, BPC imports maximum of its petroleum by Bangladesh Shipping Corporation. So, private investment in this sector will not be beneficial except some legislative changes.

4.3 Liner/container shipping

Liner shipping services is increasing its circumference day by day. The shipping traffic to Bangladeshi ports carries mainly high valued finished and semi-finished containerized goods. It is not only sustainable, but also expanding considerably as a direct outcome of the economic reforms. Similarly, export trade in agriculture, industrial raw materials and semi-finished goods are experiencing significant growth because of a well-structured fiscal regime on export trade.

4.4 Coastal passenger/cruise services

Passenger service is marginally exploited despite its potentials as a worthwhile alternative to the road mode, especially for coastal taxi of the Chittagong to Cox's Bazar route. Recently Chittagong Port Authority has taken initiative to enhance maritime transport in the aforesaid route for coastal and cruise passenger.

It is expected that the participation of Bangladesh in the economic opportunities created by shipping and maritime activities will have huge benefit for total economic benefits. Investment in this area accommodates foreign and domestic trade through joint ventures. A broad list of the investment corridors with the domestic shipping market includes:

Dry docking; b) Ship repairs; c) Coastal shipping services; d) Trawlers; e) Terminal/jetty infrastructure; f) Offshore construction and fabrication; g) Supply boats to offshore oil fields; h) Crew boats; i) Tug Boats/Anchor handling; j) Cables/pipe laying vessels; k) Dredgers; l) Passengers/ferry services; m) Tourism service.

5.0 Conclusion and recommendation

Shipping has a great importance on Bangladesh economy. One of the major challenges faced by Bangladesh at present is the non-meaningful participation in the shipping industry on which the country depends both for exports and imports. On the other hand, port facilities should be upgraded and modernized for quick discharge of consignments since a ship owner is more interested in timely turnaround of his ship for next engagement and avoid lay time and lay days. Albeit all shortcoming, for the notable development of the economy of Bangladesh, the country needs some proactive actions. By exploring the whole industry, finally we have come up with following recommendations:

a) We need to carefully assess the competitive environment for each maritime subsector which they wish to develop especially the shipping ancillary services.

b) The govt. should consider the value addition of this sector for the total economy including possible synergies and spillover effects into.

c) Policymakers are recommended to identify and invest in shipping sector in which the country may have a comparative advantage. Supporting the shipping sector is no longer a policy choice. Rather, the challenge is to identify and support selected shipping businesses.

d) Private sector engagement in this sector will be beneficial in the long run as without private engagement, this sector will not be boomed.

e) Inland transportation should be emphasized to maximize the transport in cargo, container and passenger. In sequel, it will reduce road and highways congestion.

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Is Microfinance Beneficial or Optimistic

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Abstract

Microfinance has been established targeting access to finance for poor people who are screened out from getting loans from formal financial institutions due to lack of collateral and low creditworthiness. There has undergone a tremendous transformation in all aspects of microfinance, including outreach and portfolio size, proliferation of microfinance through a large number of microfinance institutions, diversification of services, new regulatory regime, contribution in rural development, recognition of microfinance as a major contributor in poverty reduction etc. However, the microfinance sector is facing many challenges regarding institutional capacity, quality and diversity of services, fallout from political and macroeconomic factors, replication of agricultural credit and so forth. The objective of this article is to find out whether microfinance has impact on poverty reduction and economic development at all.

Keywords: Microfinance, NBFI, Collateral, Poverty reduction, Non-financial services.

1.0 Introduction

Microfinance has been described as a root program and strategy for poverty reduction and local, economic and social development of third world countries for the last few decades. Microfinance institutions (MFIs) serve a large percentage of low-income pastoral families in many developing countries. There are a large number of microcredit projects that are in process around the world. International donors, lending agencies and general governments allot billions of dollars for microcredit programs. As the outreach of microfinance is increasing all over the world, the hopes created in the world that microfinance will lead to a poverty free world. Microfinance does not only cover financial services but also non-financial assistance such as training and business advice.

Bangladesh is the motherland of microfinance. There are more than one thousand microfinance institutions in Bangladesh. The outreach of microfinance institutions is also great. So,

this is expected that microfinance has a large contribution in the poverty reduction in Bangladesh. In Bangladesh, microcredit has reached more than 60 percent of its poor (WorldBank2007).

The microfinance movement began in Bangladesh with the work of Nobel Laureate Dr. Muhammad Yunus in the late 1970s, spreading rapidly to other developing countries. Most early microfinance institutions (MFIs), including Yunus's own iconic Grameen Bank, relied on funding from government and international donors, justified by MFI claims that they were reducing poverty, unemployment and deprivation. The model of the Grameen Bank of Bangladesh is the most well-known and discussed model.

1.1 Objectives and questions

The major objective of the study is to find out whether microfinance has impact on poverty reduction and economic development in developing and underdeveloped countries or whether it is opportunistically benefitting itself in the name poverty alleviation.

1.2 Primary or focused questions

- What is the role of microfinance in poverty reduction?
- What is the role and importance of microfinance in social development?
- What is the focus of microfinance on?

1.3 Related questions:

- Does micro-credit reach the poorest?
- Does microfinance contribute to enterprise growth and income?
- Is microfinance an effective strategy to reach the MDG?
- Does microfinance promote economic growth and development?
- Why has microfinance not worked as hoped?
- Is microfinance sustainable?
- What is the link between microfinance institutions and poverty alleviation?

2. Literature review

Microfinance gives access to financial and non-financial services to low-income people, who wish to access money for starting or developing an income generation activity. The individual loans

and savings of the poor clients are small. Microfinance came into being from the appreciation that micro-entrepreneurs and some poorer clients can be bankable, that is, they can repay, both the principal and interest, on time and make savings, provided financial services are tailored to suit their needs. Microfinance as a discipline has created financial products and services that together have enabled low-income people to become clients of a banking intermediary [1].

Microfinance affects household welfare in many areas. The evaluation focused on five primary areas: (i) income, expenditure, and savings; (ii) other financial transactions; (iii) household enterprise and employment; (iv) household assets; and (v) human capital investments. The review is organized around these areas. Since microfinance in general and the project being evaluated in particular, focuses on the impact on poor households, the review also covers the outreach of microfinance on poor households [2].

A couple of reviews of studies dealing with the impact of microfinance have been conducted recently. These reviews highlight the disagreement in the results. Much of the disagreement emanates from the different degrees with which earlier studies have controlled for problems that are now acknowledged to significantly affect impact assessments—nonrandom program participation, nonrandom program placement, and nonrandom dropout (Armendariz de Aghion and Morduch 2005) [3].

Weiss, Montgomery, and Kurmanalieva (2003) reviewed the evidence of the microfinance impact on poverty in Asia and subsequently Weiss and Montgomery (2005) provides an update including studies using Latin American data. They reviewed only more "rigorous studies" and have not covered studies using qualitative or participatory approaches. Weiss and Montgomery (2005) summarized their review by saying that

> *"The conclusion from the early literature, that whilst microfinance clearly may have had positive impacts on poverty it is unlikely to be a simple panacea for reaching the core poor, remains broadly valid. Reaching the core poor is difficult and some of the reasons that made them difficult to reach with conventional financial instruments mean that they may also be high risk and therefore unattractive microfinance clients."*

A similar conclusion was also arrived at by an earlier review in May (2002). Surveying available evidence for Asian countries, he concluded that while there seems to be overall positive

effects on income and education, results differ substantially across countries and programs both in magnitude as well as statistical significance and robustness. In many studies, we have seen different concept and controversy on the contribution of microfinance institution. Aneel Karnani an associate professor of strategy at the University of Michigan's Ross School of Business points out:

> *"Microloans are more beneficial to borrowers living above the poverty line than to borrowers living below the poverty line. This is because clients with more income are willing to take the risks, such as investing in new technologies that will most likely increase income flows. Poor borrowers, on the other hand, tend to take out conservative loans that protect their subsistence, and rarely invest in new technology, fixed capital, or the hiring of labor."*

Microloans sometimes even reduce cash flow to the poorest of the poor, observes Vijay Mahajan, the chief executive of Basix, an Indian rural finance institution. He concludes that

> *"Microcredit seems to do more harm than good to the poorest."*

One reason could be the high interest rates charged by microcredit organizations. Acleda, a Cambodian commercial bank specializing in microcredit, charges interest rates of about 2 percent to 4.5 percent each month. Some other micro lenders charge more, pushing most annual rates to between 30% and 60%. Microcredit proponents argue that these rates, although high, are still well below those charged by informal money lenders. But if poor clients cannot earn a greater return on their investment than the interest they must pay, they will become poorer as a result of microcredit, not wealthier. The fact is, most microcredit clients are not micro entrepreneurs by choice. They would gladly take a factory job at reasonable wages if it were available. We should not romanticize the idea of the "*poor as entrepreneurs*" [4]. It has been said that all economic growth has its origin in saving. Someone has to save, in order to give someone else the opportunity to loan. The economist Milton Friedman has said that

> *"The poor are left in poverty, not because they are lazy, but because they lack access to capital".*

One of the critical factors that prevent development in almost all poor countries is that the poor are excluded from financial services. Access to financial, such as savings, credit, insurance and money transfer, contributes to expanding the individual's choices and ability to respond to

vulnerability is reduced when means that smooth consumption and bridges crises are provided. These kinds of services are rarely accessible through the formal financial sector. Banks generally assume that it is unprofitable to provide small loans and deposits, and therefore avoid the poor as clients. It is believed that the cost and risk of delivering small-scale financial services at the local level is too high for non-subsidized institutions and that the informal financial market meets the demand. Credit is widely available from informal commercial money lenders, but usually at a very high cost to the borrower. Informal commercial lenders often charge a nominal effective interest rate of 10% to 100% a month [4].

The International Labour Organization (ILO) uses a more appropriate term for these people: "own- account workers." Creating opportunities for steady employment at reasonable wages is the best way to take people out of poverty. The ILO states:

"Nothing is more fundamental to poverty reduction than employment."

3. MFIs in Bangladesh

Microfinance in Bangladesh got tremendous popularity over the last more than three decades starting from the pioneering work the Grameen Bank. Bangladesh, with a population of more than 140 million, is one of the most densely populated countries (1061 persons per square kilometer) in the world. Poverty is pervasive here. Almost half of the total population is still living below the poverty line - earning less than $1 a day. The various dimensions of the country's poverty are manifested in terms of inequality in income distribution (in favor of urban areas), wage differentials between the formal and informal sectors, dramatic increases in the cost of living, less than adequate calorie intake by the vast majority of the population, unemployment and internal migration. The government of Bangladesh faces an enormous challenge in reducing poverty. However, the government cannot act alone as it cannot command all the resources, personnel, administrative outreach or expertise necessary to maintain progress in poverty alleviation. The MFIs have taken a key role in poverty alleviation efforts and they have been providing credit to these poor people who lack savings and capital but want jobs in the farm and non-farm sectors. There are more than one thousand MFIs in Bangladesh now. The major MFIs are Grameen Bank, Bangladesh Rural Advancement Committee (BRAC), Association for Social Advancement (ASA), Palli Karma-Sahayak Foundation (PKSF), Padakhep Manobik

Unnayan Kendra (PMUK), Proshika etc. [5]. The case of microfinance, Bangladesh is a good example of non-government organization led operations where the government directly and indirectly provided major policy and material support to make it probably the largest microfinance sector in the world.

4.Goals of microfinance: potential contributions and negative impacts

There seem to be two main approaches within microfinance to achieve goals. Both approaches have the same purpose – to fight poverty through providing financial services to the poor and excluded groups. The goals and their potential contributions and impacts are abridged below:

Goals	Potential contributions	Potential negative impacts
Halving Poverty	loans for enterprise which increase incomes loans for asset acquisition e.g. housing consumption loans, savings, insurance and pensions which decrease vulnerability and increase access to education and health	increasing debt in marginal enterprises encouraging debt for high expenditure on social obligations diverting resources from investment and consumption to interest repayments and savings
Human Rights	access to microfinance services is in itself the human right loans for education and health group-based savings and credit programs which provide a focus for local and national-level organization for lobbying and development of participatory processes regulatory frameworks which increase the accountability of microfinance providers	microfinance services do not necessarily address rights issues increasing economic and social exclusion of the very poor through financial exclusion in badly targeted programs
Women's Empowerment	loans for enterprise which increase women's incomes savings services which increase women's control over their income pension provision which decreases women's long-term dependence on their families group-based programs	increasing women's debt increased pressure on women to take up low-profit activities and increased work burden women used by men as a conduit for loans or loan officers increased pressure on women's existing networks for loan repayment
Urban Development	loans for urban enterprise group based programs provide a focus for organization on informal sector workers	increased saturation of markets through too many borrowers
Environment	loans for environmental enterprises e.g. waste recycling	use of loans for purchase of pesticides and chemicals

Government	group-based programs which provide a focus for increasing political awareness, development of participatory structures and/or organizational basis for leadership training of grassroots representatives	savings and credit programs may detract energies from other forms of local-level organization, particularly for women
Education	loans for education group-based programs combined with literacy (Action Aid-Uganda and Bangladesh)	loans for enterprise where both parents work may increase pressure on children to help with household work or production diversion of NGO energies from training and education to more donor-fashionable and potentially profitable minimalist micro-finance
Health	loans, insurance and accessible savings for health care loans for health care practitioners group-based programs combined with health awareness, including HIV/AIDS	loan repayment and savings may take funds from necessary consumption loan groups and insurance provision may discriminate against AIDS sufferers and other ill people, thus driving certain illnesses further underground
Water	loans for purchase of water technology and sanitation facilities loans to providers of water and sanitation facilities	increased enterprise or agricultural activity may put more pressure on water resources and/or increase pollution

Source: Agriculture and consumer protection [6]

5. MFIs products and product diversification

A lot of financial products are offered by Micro-finance institutions. The microcredit program in Bangladesh rightly began by targeting the rural poor especially women as a development intervention strategy. Microcredit serves not only to meet financial needs but also contributes to other social and institutional development issues such as women's empowerment, bringing the rural poor into an institutional service network and reducing the dependency on informal money lenders. The management system of micro-finance programs has evolved over time but commonly has the following features:

- Women are the main recipients of microfinance services though many MFIs now have male members or clients.
- Group-based lending methodology is the main system of delivery of microfinance services, although commercial banks and a number of MFIs offer loans to individual clients.

- The microfinance sector in Bangladesh is now dominated by NGOs offering microfinance services, collectively known as NGO-MFIs which offer financial services as 'private not-for-profit businesses' but strive to achieve institutional and financial viability as soon as possible
- MFIs are diversifying into other target segments, including near-poor groups, by developing new financial products along with the traditional management system.
- Loans are collateral free but to ensure repayment poor women are organized into groups to take responsibility of repayment.
- Loans are small that is manageable by the poor and repayment are also small collected in weekly installments.
- Instead of coming to the bank the approach takes financial service at the door of the poor, Bank's staff members collect supervise and take care of all management tasks similar to any commercial bank.
- Procedures for loan applications and other administrative steps have been simplified to suit the poor.
- All financial transactions are made in public to eliminate any possibility of corruption or political intervention.
- Experience shows that loan money is normally invested in commonly available activities such as livestock rearing, trading, agriculture production and small processing operations.

In addition to mainstream microcredit, other products include savings product, services for the poor, microenterprise credit, seasonal loan, micro-insurance, extreme poor products, conditional cash transfer, education loan, health & housing loan, training & skill development programs etc.

6. Interest rate structure of MFI products

The interest rate charged on credit products as well as that provided to savings products by major MFIs of Bangladesh are as follows:

Organizations	Interest on Credit (Flat)	Effective Interest Rate on Credit Products	Interest on Savings
ASA	14.4	28.8	Less than 5%
BRAC	15	30	
Grameen Bank	10	20	Regular Savings: 8.5 Time Deposits: 12.5
PKSF Funded MFIs	Hardcore poor: 10 Others: 12.5	Hardcore poor: 20 Others: 25	4
Other MFIs	15	30	5.5
IBBL-RDS	7.5	15	More than 6%

Source: Bangladesh Economy in 2007-08: An Interim Review of Macroeconomic Performance", Dhaka, 2008.

7. Challenges for the MFIs

Bangladesh microfinance sector now has passed beyond doubt the era where studies were conducted to prove its effectiveness but now faces new challenges of other emerging issues In order to make the microcredit program effective for poverty reduction, the government emphasized small entrepreneurship. It also identified the following challenges:

i. Prevalence of high interest rates which are being reduced, but further reduction of interest rate is necessary;

ii. Vicious cycle of microcredit following, where the poor are borrowing from one microcredit organization to repay another;

iii. Microcredit programmes have not been very successful in including the hardcore poor;

iv. Rate of graduation to above the poverty line among the microcredit borrowers is low, indicating persistent dependency on microcredit;

v. Most of the microcredit recipients being women, they bear the increased burden of repayment;

vi. Microcredit organizations compete with each other and often put pressure on the potential clients to borrow;

vii. The profitability of micro enterprises is small and often is not sustainable on a long-term basis because of enterprise decapitalization, saturation of markets for products that are traditionally produced by microcredit borrowers, weak coordination among NGOs and MFIs and a weak financial system [7].

8.The link between microfinance and poverty alleviation

Since its inception, microfinance has evolved as an economic development approach to benefit low-income people in rural and urban areas. Poverty alleviation or reduction is an ultimate goal of most MFIs, with either direct or indirect links to immediate objectives [8].

Since mid-eighties, many studies have been conducted on the impact of microfinance program on poverty. The studies find that microfinance program has benefited the poor in more than one way. The program has improved their living standard through diversification and strengthening of their survival strategies, improving their security, providing access to assets and rights and increasing their self-respect, giving them choices and independence. The access to microfinancial services has enabled the poor to undertake diversified economic activities, which generate flow of income year-round and thus strengthen the survival strategy of the poor. Without microfinancial services, security for the poor rural households would come from patron-client and mutual sharing and borrowing arrangements, which have weakened over the years.

With microfinancial services, the poor households now own and command assets and savings which they can cash or use to meet contingencies without sacrificing their independence, security or peace of mind, by getting into debt. Microcredit borrowers, for example, were able to face the devastating floods of 1998 using their assets and savings. Microcredit borrowers can now depend substantially on their own assets and reserves to meet contingencies and do not have to depend on borrowings from patrons or moneylenders with conditions that had included usurious rates of interests, meeting obligations like free labor, supporting patrons in unjust local feuds and elections, etc. There is self-respect among the borrowers, which had previously been absent. Microfinance program has also empowered its beneficiaries, raised their social and political consciousness which is reflected, among

others, in their increased participation in local government, national elections and social mobilization, activities like building community roads, running health programs and community schools [9].

However, the fact that all the microfinance institutions are working for the poor is not always true. In most cases, it has been seen that the microfinance institutions are doing their businesses with the poor, and poverty alleviation is their nominal policy to expand their businesses. In some cases, it has been also observed that the poor have become poorer with microcredit due to high interest charge as well as high pressure of early loan payment. Again, it has been noticed that some microfinance institutions did not give loans to the rootless on their belief, rather they would give loans only to who had the capability to repay the loans. That is, they would provide loans to those who had collaterals indirectly, not to those who would have been made able to repay the loans by utilizing their skills.

So, side by side with beneficial activities, there are some negative aspects of microfinance that cause the rootless poor not only to lose their present conditions but also to lose their ability to work in an effective and efficient manner [10].

9.The link between microfinance and social impact

Although MFIs' initial objective was not primarily in the social realm, if at all, most MFIs do now identify one or more social goals: women's empowerment, children's school attendance, awareness of and demand for health services, etc. Evidence of the social impact of microfinance in Bangladesh has also been mixed, but again, on balance, suggests that microfinance and the associated activities of MFIs have had positive social effects [10]. Indeed, it often seems as if this fundamentally economic approach has performed best in the social domain. Khandker (2005:266) notes that the earlier WB/BIDS study supports the claim that microfinance programs promote investment in human capital (such as schooling) and raise awareness of reproductive health issues (such as the use of contraceptives) among poor families., and that microfinance helps women exercise power in household decision-making

It is widely recognized that access to credit can often foster social, psychological and even political empowerment. Credit services for the poor, and particularly poor women, reverse their systemic exclusion from access to public or private funds, thus altering systems of hierarchy and power (see, for example, Todd 1996). Access to alternative means of finance can reduce dependency on moneylenders and those who lend money; at the same time, access to institutional credit also can be

used as a bargaining chip to secure informal loans. In general, a leveling of the playing field occurs, allowing the poor to participate more effectively in the social, economic, and political workings of their community.

However, it should be noted that finance alone did not lead to such changes but other developmental and macro-factors have contributed positively or negatively. Overall, the researches have proved the positive impacts of financial services for the poor. Bangladesh microfinance sector now has passed beyond doubt the era where studies were conducted to prove its effectiveness but now faces new challenges of other emerging issues such as continued vulnerability of poor due to external factors, overlapping of microcredit services, impact on microfinance in an era of slow or no growth of economy, and lack of new and more demand-driven products etc.

10.Focus of the MFIs

Apparently, the main focus of the MFIs is on how to alleviate poverty. Most of the MFIs are working with the slogan of poverty alleviation. However, a deeper look into the operation of most MFIs shows us that in the name of poverty alleviation, some MFIs are conducting their profitable businesses. Their clients are the rural, rootless poor who cannot but go to them for microfinance because these people have no access to traditional banking institutions without collaterals. In a sense, they are compelled to apply for the microcredit to the MFIs. And with this opportunity, the MFIs try their best to utilize their resources to the best available sources. In brief, we can say that these MFIs are doing their businesses but fortunately they are helping the rootless people. That is, some MFIs are not based on the objectives to alleviate poverty, but poverty is being alleviated through their activities. So, the behavior of these MFIs is opportunistic, rather than beneficial [10].

11. Overall analysis of the role of microfinance

Today the role of microfinance institutions (MFIs) is controversial for many reasons. Despite the slogan of 'credit for the poorest of the poor', the poorest have not fully benefited from the microfinance revolution of late 90s in Bangladesh. We now examine the overall impacts of microfinance in the following aspects:

11.1 Does microcredit reach the poorest?

Currently micro finance institutions can provide a small percentage of poor people. We have seen many people are not well known of their services. So, a small percentage of people are able to generate their income. A large percentage of people excluded from their services.

Rank	Country Name	Total Borrowers	Number of MFI's	Average Amount Borrowed	Penetration Ratio
1	Bangladesh	24,000,000	70	350,000	35%
2	India	10,700,000	106	100,000	3%
3	Vietnam	5,800,000	12	500,000	11%
4	Indonesia	3,800,000	42	900,000	25%
5	Mexico	3,300,000	40	850,000	14%

Source: Rahman, Aminur (1999). *"Micro-credit Initiatives for Equitable and Sustainable* Development: Who Pays?

In case of Bangladesh, we have seen a little hope regarding this issue. Grameen Bank and BRAC make a positive impact in case of this issue. One study showed that program participants are able to raise 5% of their expense. Extreme poverty among BRAC household also reduces from 20% to 14%.

11.2 Does microfinance contribute to enterprise growth and income?

Storey (1994) notes that policy-makers should consider the dangers associated with the very high failure rates for microenterprises, particularly new start-ups. For example, in Tamil Nadu state in India, one programme study found less than 2% of microenterprises still operating three years after their establishment (George, 2005). In Bosnia and Herzegovina, World Bank researchers found that up to 50% of microenterprises failed within one year of their establishment (Demirgüç-Kunt et al., 2007). As Davis (2007) notes from his work on Bangladesh, such failure can lead to irretrievable poverty.

Generally, the reason behind this failure is: at a primary stage, the growth and income of an enterprise is very low, which does not cover their own need as well as the high interest rate of microfinance institution.

But it is true that microcredit is very effective for an established enterprise. An established enterprise can successfully utilize this microcredit to generate their growth and income.

11.3 Is microfinance an effective strategy to reach the MDG?

No single intervention can defeat poverty. Microfinance is not a panacea for poverty and related development challenges, but rather an important tool in the mission of poverty eradication. In many ways MFIs are helping to reach the MDG. MDGs generally focused on the health care, nutrition, education, environmental improvement, unexpected mortality of children and mother etc. All of these factors can be established successfully when households have increased earnings and greater control over financial services. And the earnings of household can be increased through the effective mechanism of micro finance institutions.

11.4 Does microfinance promote economic growth and development?

Lack of access to credit markets is a major reason why many economies cannot develop. In Latin America, over 360 million people lack access to basic financial institutions. Financial technologies like credit, investment, savings accounts, and insurance are important because they are a form of investment or they protect investments by managing risk. Investment plays a key role in development. In the Solow Growth Model, high levels of saving (investment per worker) lead to faster output growth in the short-run. Changes in the amount of capital per worker change how productive workers are an in economy. For example, Singapore had a 40% saving rate and 5-6% GDP growth from 1960 – 1996. During this same time, Kenya had a 15% saving rate and GDP growth of about 1% [9].

Usually, the lesser-developed economies do not have access to financial technologies because perspective borrowers lack collateral; institutions do not want to pay high monitoring, screening, and enforcement costs; and because risks are very high in populations that suffer from severe illness, malnutrition, and low levels of education.

So, we can say that MFIs give the access opportunity to financial technologies to the poor. But the question is that, how much this opportunity is available for the poor? If MFIs can ensure this availability at reasonable condition then it will promote the economic growth and development

11.5 Why has microfinance not worked as hoped?

We find some reasons for underperformance of MFIs which are as follows:

* Growing dependency of upon micro-credit, coupled with high interest rates, means that a growing proportion of the unstable income of the poor is obstacle to cover interest charges.

* Unsustainable micro credit indebtedness is common place across developing countries.

* Interest rates have not fallen as much as predicted that means it was predicted that after covering high operational cost, interest rate of MFIs will be lower.

* Emphasis on the commercial model with MFIs now required generating high financial rewards for their manners (salaries, bonuses) and owners/shareholders (dividends and capital gains).

* Market saturation and displacement of developing countries tends clients of microfinance in short term micro enterprises neglecting the long-term micro enterprises

11.6 Is microfinance sustainable?

Sustainability in simple terms refers to the long-term continuation of the Microfinance program after the project activities have been discontinued. It entails that appropriate systems and processes have been put in place that will enable the Microfinance services to be available on a continuous basis and the clients continue to benefit from these services in a routine manner. This also would mean that the program would meet the needs of the members through resources raised on their own strength, either from among themselves or from external sources.

By their current position as well as future prospective, most MFIs are sustainable in the long run. Especially in case of Bangladesh, MFIs are more sustainable. However, this kind of sustainability is sometimes questioned in the open place.

12. Recommendations

We recommend some important issues to resolve the problems and challenges of microfinance institutions for better access to finance from the point of view of both institutions and the government.

12.1 For the MFIs

* The major factor of MFIs which hinders the poverty reduction approach is high interest rate. To reduce this rate, MFIs can try to reduce its default risk.

* MFIs should offer interest on savings and savings be made withdrawable.
* Periodical survey is necessary to assess the overall activity and progress.
* Identify the area where it works best.
* Long term entrepreneurial attitude should be grown by training program.
* For the benefit of the poor, credit delivery at the doo-step should continue at a reasonable cost to clients.
* MFIs may take steps like rationalizing the cost of funds by accessing various sources of funds, increasing operational efficiency, involving local small NGOs, etc.

12.2 For the Government

* We know subsidy is not a good solution for the economic development but government should subsidize those area's MFIs which interest rate is relatively high due to high operation cost.
* Government should take some initiative to bring existing bank and insurance company forward to provide these services and to make a competitive market.
* Need both private and public partnership to strengthen the microfinance institutions.
* Every attempt for reducing poverty will be failed if the purchasing power of the poor reduces due to unreasonable and intolerable price hike. So, government should always try to control this fundamental issue.

13.0 Conclusion

Today the role of microfinance institutions (MFIs) is controversial for many reasons. From the very onset, MFIs of Bangladesh expanded in an unplanned way, without any definite policy from the government. It is observed throughout the article that in the name of poverty alleviation, the many MFIs are operating their microfinance business with irrational profits. That is, they are acting opportunistically rather than beneficially. These MFIs are not working to change the luck of the poor people; rather they are utilizing the poor people's money for their own interest and benefits. In true sense, they are the disguised helpers. Overall, the evidence for microfinance shows a limited impact on poverty alleviation. Comparatively lower interest charged on loan, deposit mobilization through voluntary savings, high interest rate paid on deposit, free skill development training facility, less bias

on female member, mandatory insurance program, freedom from political intervention, rationalization of the cost of funds through multidimensional sources, increase in operational efficiency and involvement of local small NGOs should be the major attributes of the policy of the MFIs for poverty alleviation.

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A Comparative Study of Performances of Different Types of Barrier Constructions for Attenuating Low Frequency Noise

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Abstract

Low frequency sounds and vibrations are associated mostly with rotary machines, which are the most common ones, seen from workplaces like factory lathe machines, milling machines, etc., to machineries like pumps, fans, generators etc., to vehicles like cars, trains, airplanes etc., in one words, almost everywhere. When the sound pressure level of these low frequency sounds is not within a tolerable range, it is considered as noise and it must be controlled in order to protect human ear from its hazardous effects. Low frequency noise can be controlled in many ways; one of the ways is restricting the noise from reaching human ear i.e. using barriers. The problem faced by barriers in restricting of low frequency noises is that they have a high wavelength, making them likely to pass through barriers easily and less chance of reflection. Also, the absorption coefficient of a material is inversely proportional to the wavelength, therefore low absorption possibility for low frequency noises. To solve these problems, the mass of the barrier is increased following mass low, which increases cost. In the present study, it has compared the transmission losses due to two types of commonly used barrier constructions, Double layer type barriers and Sandwich type barriers and determined which one has better performance in attenuating low frequency noise. Also, for construction, two different types of absorbing materials, glass wool and PE foam is used to account for material variations.

Keywords: Noise Barrier; Transmission Loss; Low Frequency Noise; Noise Attenuation; Sound Pressure Level, Mass Law, Critical Frequency; Coincidence region

Nomenclature

Notation	Details	Notation	Details
τ	Transmittance	ω_c	Critical frequency of the medium
γ	Adiabatic coefficient	$\Delta\omega$	Frequency bandwidth
u	Velocity of medium particles	B	Bending stiffness per unit area
ρ	Density of the medium	E	Modulus of elasticity
ρ_s	Mass per unit area	t	Thickness of the panel
c	Speed of sound	θ	Angle of incident sound
η	Structural loss factor	θ_{CO}	Coincidence angle

υ	Viscous coefficient of the material	f	Frequency
σ_{rad}	Radiation efficiency	f_c	Coincidence frequency
k	Stiffness per unit area	L_x, L_y	Panel dimensions
ω	Frequency of incident sound		

1.0. Introduction

A single homogeneous barrier needs a thick layer to restrict greater noise. But in many cases, the size of the barrier is a limiting issue. For that reason, compact double layer barriers have been studied for better performance in lesser space. Many have thought of backing the front rigid layer with flexible natural fibrous materials, others have used the fibrous material in between two rigid layers [1-2]. There have been many studies regarding performance of each of the two kinds, but the number of comparative study between them is very few, and the number is even lower if the studies conducted on low frequency noise are only considered. Khedari et. Al. [3] has developed new insulating barriers with Durian (*Durio zibethinus*) peels and coconut (*Cocos nucifera*) coir fibers are used as the raw material to manufacture particleboards. The cost of the barriers is later reduced [4]. Earlier than that, Larbig et. Al. [5] has worked on natural fiber reinforced foam based on renewable resources for automotive interior applications. Multi-layer absorbers [6] have been studied by Lee et al. Nor et al. later did a similar study to find the sound absorption using coconut coir fiber layers [7]. Many other researches on natural fibers for double layer walls have been conducted to identify their effectiveness [8-9].

Over the years, a great deal of research has been carried out in identifying the TL characteristics of different sandwich panel constructions. Bending deformation in a sandwich panel construction [10] has been characterized by Ross et. al. The description of bending rigidity is utilized by Holmer [11] in the development of the coincidence wall design. Manning [12] has studied procedures for optimizing the performance of the coincidence wall and developed expression for the effective damping in panels with 3, 4, and 5 layers. The first effort at describing the effects of the thickness deformation on panel TL is attributable to Lord [13]. Panel dynamics is characterized using a variation approach with assumed displacement fields for the face sheet sand core of a three-layer panel configuration. The face sheet sand core consisted of homogeneous isotropic materials.

Subsequent investigators, Smolenski et. al. [14] has applied essentially the same approach in studying the effects of core compliance on panel TL. The approach of Lord et al. is extended by Moore [15]. This study specifically focuses on low frequency noises as they are the hardest ones to control. In this study, both types have been experimentally studied to identify which one is superior for reducing low frequency noise since both have very good performance for high frequency noise as seen from the previous studies.

2.0. Mathematical modeling

2.1. Transmission loss in single panels

When sound is incident on a surface that is an interface between two mediums having different densities and speed of sound, a portion of the sound is absorbed in the second medium, a portion is reflected back to the previous medium and the rest of the sound is transmitted through the medium. This is shown in the Fig. 1.

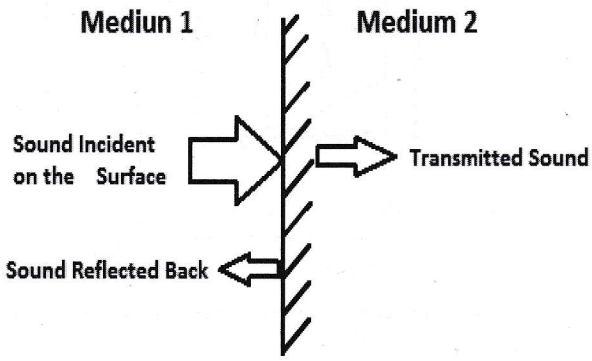


Fig. 1. Transmission of incident sound.

Now, let us consider I_i, intensity of the incident sound, I_a, intensity of the absorbed sound, I_r, intensity of the reflected sound and I_t, intensity of the transmitted sound, then

$$I = I_a + I_r + I_t \tag{1}$$

The transmittance of a medium is given by the ratio of the intensity of sound transmitted to the intensity of the sound incident on a surface,

This equation is valid for normal-incidence transmission losses greater than 15dB and it represents n incident diffusion field with a limiting angle of 78 degrees. A random incidence mass law can also be obtained by averaging equation (6) overall all angles from 0 to 90 degrees. If the normal-incidence transmission loss is defined as TL_o then the random-incidence transmission loss is

$$TL_R = TL_0 - 10log_{10}(0.23TL_0) \quad (8)$$

Likewise, the field-incidence transmission loss may be re-expressed as,

$$TL_R = TL_0 - 5\,dB \quad (9)$$

Equation (9) may also be used to obtain a qualitative understanding of the behavior of panels or barriers at frequencies above the critical frequency. It cannot, however, be used in practice because incident sound waves generally involve a broad range of frequencies and angles of incidence; the latter are generally indeterminate. A close examination of the equation indicates that transmission loss is the minimum when

$$\frac{B\omega^2}{2\rho_0 c^4} sin^4\theta = 1 \quad (10)$$

This condition is referred to as the coincidence condition and it corresponds to a situation where the trace wavelength, ($\lambda/\sin\theta$) of the incident sound wave equals a free bending wavelength, λ_B, at the same frequency. For finite panels, free bending waves only occur at natural frequencies; for infinite panels, they can occur at any frequency. Thus, for finite panels there will be certain coincidence angles, θ_C's, and corresponding coincidence frequencies, ω_C, at frequencies above the critical frequency for which there is very efficient transmission of sound. For finite flat panels, the coincidence frequencies are in fact natural frequencies. From equation (5) and (10),

$$sin\theta_{CO} = \left(\frac{\omega_C}{\omega}\right)^{1/2} \quad (11)$$

At these coincidence angles, the panel transmission loss is obtained by substituting equation (19) into (10). It is,

$$\tau = \frac{I_t}{I_i} \qquad (2)$$

This transmittance is a function of the densities and speed of sound in two mediums and is given by equation,

$$\tau = \frac{4(\rho c)_1(\rho c)_2}{\{(\rho c)_1 + (\rho c)_2\}^2} \qquad (3)$$

Now, transmittance can be used to defined another term called Transmission Loss (TL) which is the measure of how much sound is passing through a medium and it is given by,

$$TL = 10log_{10}\left(\frac{1}{\tau}\right) \qquad (4)$$

The characteristics of a bounded homogeneous barrier are shown schematically in Fig. 2.

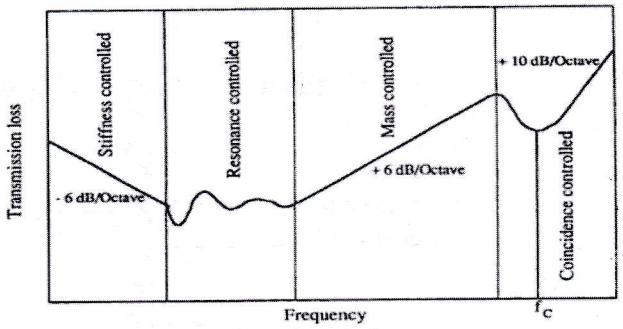


Fig. 2. Transmission loss in a homogenous barrier

There are four regions of interest: stiffness controlled, resonance controlled, mass controlled and coincidence controlled. Because of the fact that the barrier is finite and bounded, it has a series of natural frequencies. It is important to note that these frequencies are not always relevant to sound transmission. If the panel is mechanically excited, or if the incident sound field is not diffuse, then the resonant structural modes control the sound transmission through the barrier. Under these conditions, the addition of suitable damping material would increase the TL. If the barrier is acoustically excited below the critical frequency and the incident sound field is diffuse, then the forced bending waves at

the excitation frequencies dominate the sound transmission through the panel and the resonant structural modes are relatively unimportant.

Again, at frequencies well below the first fundamental natural frequency, it is the stiffness of the material that dominates its sound transmission characteristics. At this region, the addition of mass or damping will not affect the transmission loss characteristics. The transmission loss at this region is given by the equation,

$$TL = 10log_{10}\{1 + (\frac{k/\omega}{2\rho_0 c}cos\theta)\} \quad (5)$$

Where k is the stiffness per unit area and ω is the frequency of incident sound. Doubling the frequency i.e. an octave increase produces a decrease in transmission loss by 6dB. Doubling the stiffness will increase the transmission loss by 6dB.

At frequencies above the first few natural frequencies but below the critical frequency, the response is mass controlled. In that region, the equation of transmission loss is,

$$TL = 10log_{10}\{1 + (\frac{\rho_s\omega}{2\rho_0 c}cos\theta)^2\} \quad (6)$$

Here ρ_s is the mass per unit area. It may be shown from the equation that there is a 6dB increase in transmission loss per octave increase in frequency. There is also a 6dB increase in transmission loss if the mass is doubled. Damping and stiffness do not control the sound transmission loss in this region. This is called the mass law equation.

Equation (6) is valid only for a specific angle of incidence ranging from 0 to 90 degrees. When the incident sound field is diffuse, as is generally the case in practice with the exception of certain confined spaces, an empirical field-incidence mass law is commonly used in place of the opaque-incidence mass law. It is,

$$TL = 10log_{10}\{1 + \eta(\frac{\rho_s\omega}{2\rho_0 c}cos\theta)^2\} - 5dB \quad (7)$$

$$TL = 10log_{10}\{1 + \eta(\frac{\rho_s \omega}{2\rho_0 c} cos\theta_{co})\}^2 \quad (12)$$

At the critical frequency, θ = 90, and the barrier offers no resistance to incident sound waves. At other coincidence angle, the transmission loss is limited by the amount of damping that is present. At angles of incidence that do not correspond to a coincidence angle, the transmission loss is obtained from equation (5). Here, both stiffness and damping limit the transmission of sound through the panel.

Because of random nature of the frequency composition of the incident sound waves and the associated angles of the incidence, equation (5) must be solved by numerical integration procedures to obtain a field-incidence transmission loss for frequencies above the critical frequency. Alternatively, an empirical relationship can be used. It is,

$$TL_R = TL_O + 10log_{10}(\frac{f}{f_c} - 1) + 10log_{10}\eta - 2dB \quad (13)$$

The equation indicates a 10dB increase per octave increase in frequency. It also suggests that structural damping plays an important part in maximizing the transmission loss in this frequency range.

2.2. Transmission loss through a multi-layer barrier

In case of barriers having more than one layer, it is difficult to obtain a universal characteristic equation. There are basically three reasons behind it,

I. Firstly, with addition of each layer, an additional surface interface is introduced, which causes reflection of a portion of transmitted sound which overlaps with the incoming sound wave and creates standing wave. Therefore, coincidence regions far before the end side of the barrier are observed, which cause change in transmission loss characteristics.

II. Secondly, in case of addition of absorbing material with rigid material to form a composite barrier, the equivalent absorption and reflection coefficient is greatly changed for different frequencies.

III. Finally, if the barrier is backed by reflective material, the reflection of sound is increased, decreasing transmission loss.

υ	Viscous coefficient of the material	f	Frequency
σ_{rad}	Radiation efficiency	f_c	Coincidence frequency
k	Stiffness per unit area	L_x, L_y	Panel dimensions
ω	Frequency of incident sound		

1.0. Introduction

A single homogeneous barrier needs a thick layer to restrict greater noise. But in many cases, the size of the barrier is a limiting issue. For that reason, compact double layer barriers have been studied for better performance in lesser space. Many have thought of backing the front rigid layer with flexible natural fibrous materials, others have used the fibrous material in between two rigid layers [1-2]. There have been many studies regarding performance of each of the two kinds, but the number of comparative study between them is very few, and the number is even lower if the studies conducted on low frequency noise are only considered. Khedari et. Al. [3] has developed new insulating barriers with Durian (*Durio zibethinus*) peels and coconut (*Cocos nucifera*) coir fibers are used as the raw material to manufacture particleboards. The cost of the barriers is later reduced [4]. Earlier than that, Larbig et. Al. [5] has worked on natural fiber reinforced foam based on renewable resources for automotive interior applications. Multi-layer absorbers [6] have been studied by Lee et al. Nor et al. later did a similar study to find the sound absorption using coconut coir fiber layers [7]. Many other researches on natural fibers for double layer walls have been conducted to identify their effectiveness [8-9].

Over the years, a great deal of research has been carried out in identifying the TL characteristics of different sandwich panel constructions. Bending deformation in a sandwich panel construction [10] has been characterized by Ross et. al. The description of bending rigidity is utilized by Holmer [11] in the development of the coincidence wall design. Manning [12] has studied procedures for optimizing the performance of the coincidence wall and developed expression for the effective damping in panels with 3, 4, and 5 layers. The first effort at describing the effects of the thickness deformation on panel TL is attributable to Lord [13]. Panel dynamics is characterized using a variation approach with assumed displacement fields for the face sheet sand core of a three-layer panel configuration. The face sheet sand core consisted of homogeneous isotropic materials.

Due to these three cases, the transmission losses are different in multi-layer barriers from single layer barriers. The non-homogeneity of the barrier material makes it difficult to derive any generalized equation since each barrier has different composition. The transmission loss of these barriers can be approximated using equation (6) and (7).

Also, the multi-layer barriers follow the mass law differently from single layer barriers. In case of multi-layer barriers, with addition of each layer, the slope of the mass dominant region is found by adding the slopes of each layer, thus increasing transmission loss at higher frequencies. Again, addition of damping materials will increase the transmission loss if the barrier is acoustically excited and decrease if the barrier is mechanically excited.

2.3. Equation of low frequency mechanical noise:

For a solid vibrating surface, driven or in contact with a prime mover or linkage, radiated sound power (W in Watts) is proportional to the vibrating area S and the mean square vibrating velocity $< v^2 >$, which is given by,

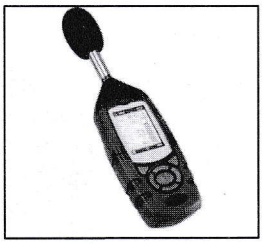
$$W = \rho c S < v^2 > \sigma_{rad} \tag{14}$$

Where, ρ is the air density (kg/m3), cis the speed of sound (m/s) and σ_{rad} is the radiation efficiency.

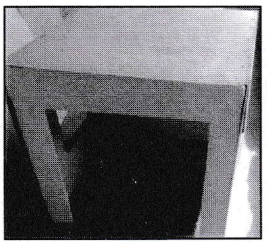
Usually mechanical noise is a low frequency noise having frequency ranging from 100 to 500Hz. In our present study, the focus is to control this low frequency noise. Therefore, the work mainly focuses on mechanical noise.

3.0. Materials and methods

To conduct the experiment of the effect of barriers to transmission loss a noise enclosure, a noise source and a sound level meter have been used. The noise source is placed inside the enclosure and the noise level is measured from outside the barrier. Measurements are done in no barrier and with barrier condition. The differences between these two values are the desired transmission loss. The noise enclosure that was built for this experiment has 3 fixed walls and 1 flexible wall. The flexible wall is the front wall where different noise attenuating barrier panel can be attached with



(a)



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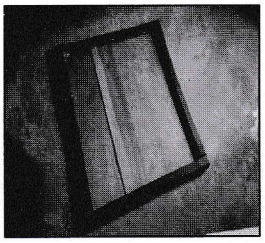


(c)

Fig. 3. (a) Sound Level Meter; (b) The noise enclosure; (c) the removable panel for attaching the barriers CASELLA CEL-62X sound level meter has been used to measure the sound pressure level at different frequency.

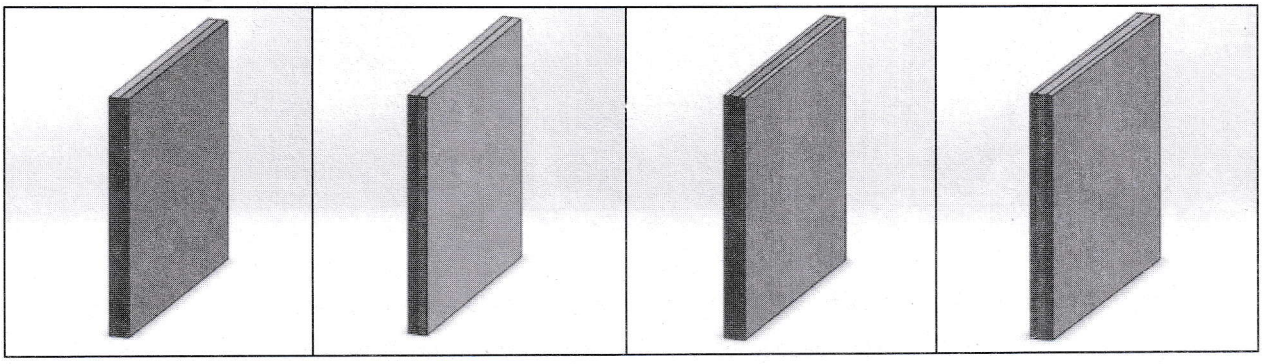
screws and nuts. The fixed walls along with the roof are made of steel sheets. The inner surfaces of them are covered with foam as a noise absorbing material. The dimension of the enclosure is 2ft x 2ft x 2ft. Fig. 3. shows different components of the experimental setup.

4.0. Objective

The objective of this experiment is to observe the transmission loss through barriers of different absorbing materials of different setup of layers. 4 panels are made with 2 different types of construction. Materials used were plywood, glass wool and foam with Aluminum cover. The thickness of every panel has been kept constant at 1 inch for better comparison of transmission loss. The four constructions are,

- Glass wool-backed plywood barrier: ½ inch plywood board was backed with ½ inch layer of glass wool.
- Foam-backed plywood barrier: ½ inch plywood board was backed with ½ inch PE foam layer.
- Plywood-glass wool sandwich barrier: This panel was constructed by keeping a ½ inch glass wool layer between to ¼ inch plywood board.
- Plywood-PE foam sandwich barrier: This panel was constructed by keeping a ½ inch PE foam layer between to ¼ inch plywood board.

The four constructions are shown in Fig. 4 and the materials used in making the barriers are shown in Fig. 5.



(a) (b) (c) (d)

Fig. 4. (a) Glass wool-backed plywood barrier; (b) Foam-backed plywood barrier; (c) Plywood-glass wool sandwich barrier; (d) Plywood-PE foam sandwich barrier

(a) (b) (c)

Fig. 5. (a) Plywood of different thickness; (b) Glass wool; (c) PE foam

During the experiment, the noise source (a drilling machine) is placed in the enclosure. The front wall is kept open i.e. first measurement was done without placing a barrier so that the next data collected with barriers can be compared to it and calculate the transmission loss. The sound level meter is placed 1 meter away from the front wall. The sound pressure level (SPL) meter is set to 1/3 octave bands to capture A-weighted frequency. The SPL meter is switched on and it measures the noise level in decibel and shows in the display. The machine is kept on for about 20 seconds. Later, the data has been collected from the same distance for the same settings of the SPL meter but after placing different

barriers in the front wall. The collected data for different conditions have been taken directly to the PC using USB cable and used for further analysis.

5.0. Results and discussions

Table A-1 in the Appendix shows the Sound pressure level data collected by using different types of barriers in the noise enclosure. The SPL data of in the table is an average of minimum of 7 sets of data measured for each barrier so that the random error possibility is minimized. An interesting thing to notice from the table is that the reduction in SPL is quite high at both lower and higher frequencies and minimum for a frequency near 80Hz to 100Hz. This indicates that the frequency is the first natural frequency of the corresponding barrier. Also, it can be observed that at low frequencies from 50Hz to 630Hz the SPL reduction, which is actually the transmission loss, is very low compared to the higher frequency region ranging from 1000Hz to 20000Hz. This proves that for any type of barrier, the low frequency noise attenuation will always be lower than that of high frequency noise attenuation.

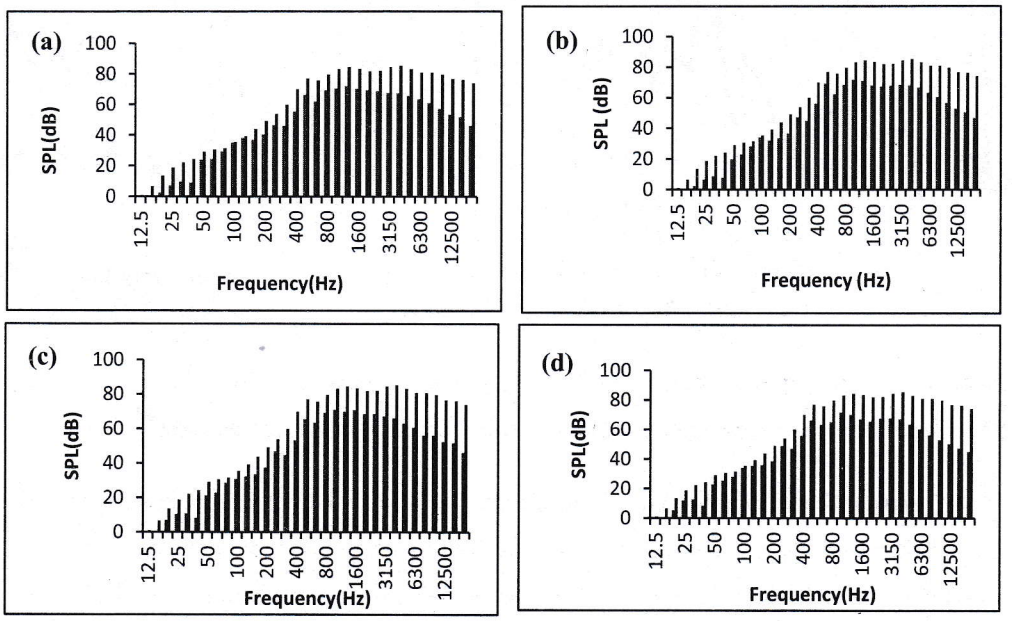


Fig. 6. SPL data for (a) Glass wool-backed plywood barrier; (b) Foam-backed plywood barrier; (c) Plywood-glass wool sandwich barrier; (d) Plywood-PE foam sandwich barrier.

Fig. 6. shows the sound pressure level data collected for different types of barriers and compared with that of no barrier condition. Here, it has focused on the frequency from 100Hz to 500Hz since this is the machine induced low frequency noise and hard to attenuate. Also, we are not ignoring the other high frequency noises since it requires a barrier which is suitable for both cases.

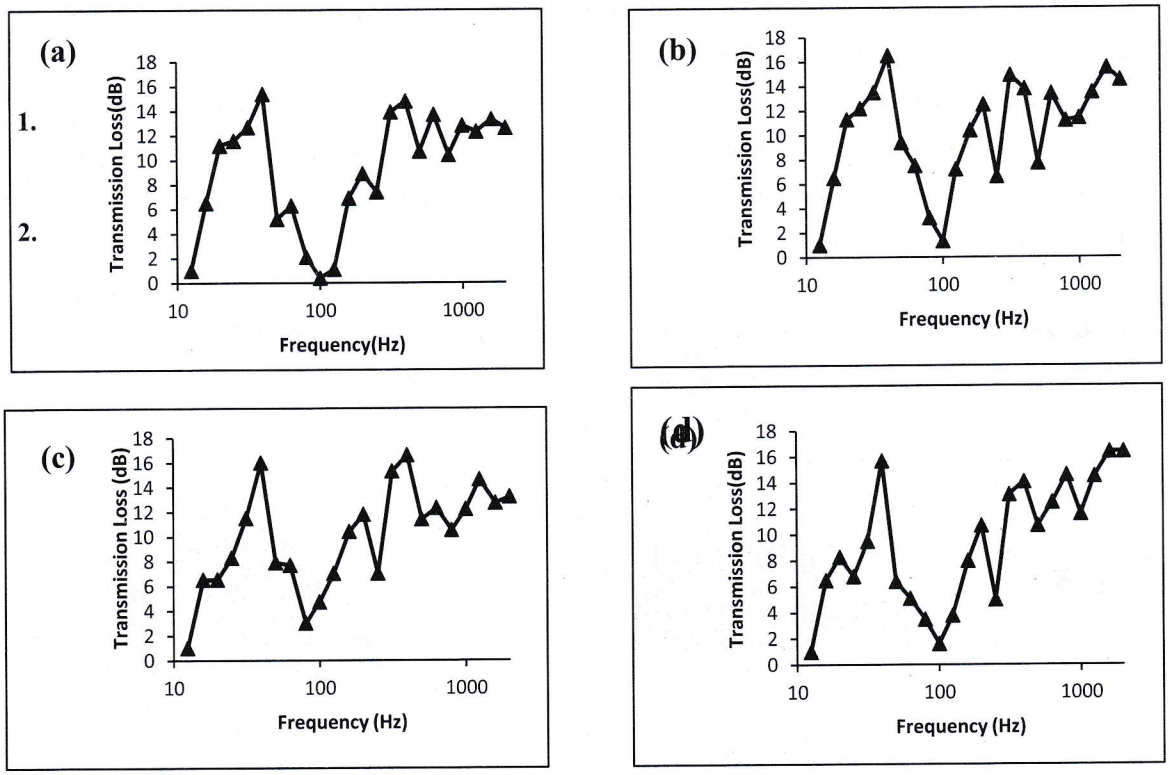


Fig. 7. Transmission Loss characteristics for (a) Glass wool-backed plywood barrier; (b) Foam-backed plywood barrier; (c) Plywood-glass wool sandwich barrier; (d) Plywood-PE foam sandwich barrier

Fig. 7. shows the transmission loss characteristics for different barriers. From this figure, it is evident that for each case, there is a frequency where the transmission loss is minimum and usually it has been seen to be near 100Hz to 125Hz, which is most probably the natural frequency of the barrier where attenuation is usually the lowest.

Fig. 8. is presented to compare results for different barriers within the range of mechanical noise. Machine induced noise is usually within the range 100Hz to 500Hz. It is obvious that at the lowest frequency, 100Hz, transmission loss is the lowest. But that is not true in case for the highest frequency, 500Hz where the transmission loss again starts decreasing gradually.

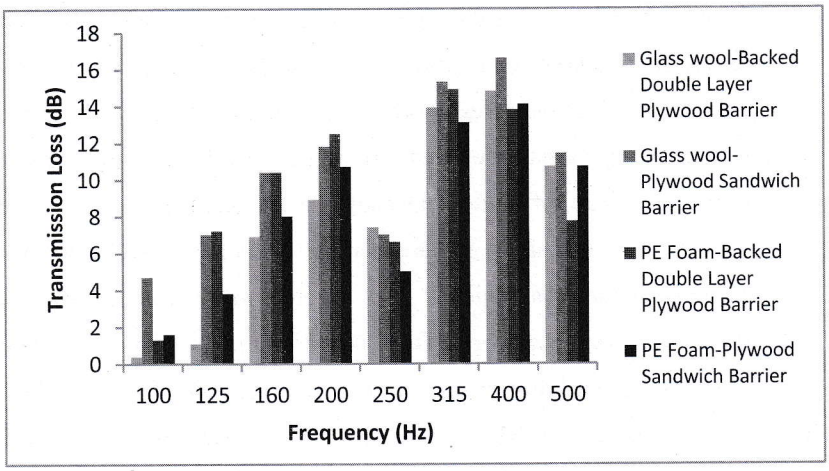


Fig. 8. Comparison of Transmission Loss for all barriers

From this figure, it is found that the transmission loss is the highest for Glass wool-Plywood sandwich barrier except for at frequency 200Hz, where PE Foam backed double layer plywood barrier has better performance. Both Glass wool- Plywood sandwich barrier and PE Foam backed double layer plywood barrier have good attenuation properties throughout the frequency range. On the other hand, Glass wool backed double layer plywood barrier has the minimum transmission loss amongst the four types.

It is also interesting to see that in case of glass wool, the double layer barrier is less efficient compared to sandwich barrier, whereas for PE foam, from 125Hz to 400Hz, double layer is better performing compared to sandwich barriers. However, for higher frequencies, the sandwich barriers are mostly more efficient for both glass wool and PE foam.

6.0. Conclusions

From this experimental study, the following conclusions may be drawn:

i. Transmission loss first rises and then falls almost linearly for 40-63Hz indicating that the later region is stiffness controlled. From 63Hz-1000Hz a fluctuation of transmission loss occurs which resembles the region is resonance controlled. According to transmission loss characteristic curve for a homogenous barrier the next region is mass controlled where transmission loss increases linearly with increase of frequency. In this experiment, higher frequency regions have not been considered. Therefore, the data between 10Hz to 2000Hz is only plotted here, which does not show the characteristics of the mass controlled region. So, it can be assumed that the low frequency region may not follow the mass law characteristics of transmission loss, which it does at much higher frequencies. Also, the possibility of observing coincidence region is not possible from the data representation of our study since it occurs at a much higher frequency range, which is out of scope of this study.

ii. At lower frequencies, Glass wool- plywood sandwich panel works the best, PE foam backed double layer plywood barrier also works considerably well. The other ones have not been found consistent in case of low frequency noise attenuation. This finding is very crucial as the objective of this experiment is to find which barrier has better performance in low frequency machine noise (100-500Hz).

iii. At higher frequencies, however, the performance of Glass wool-plywood sandwich is the best. PE-foam sandwich barrier also works satisfactorily. Glass wool-backed plywood panel and PE-foam backed plywood panel also gives good performance but single and double layer plywood panel has not provided much of attenuation. From this, it may be concluded that if attenuation of both low frequency and high frequency noise is required, cotton-plywood sandwich barrier is recommended since it does well in a wider range compared to double layer plywood barrier.

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Appendix

Table A-1: Transmission Losses for different barriers.

Frequency	No Barrier Condition	Glass wool-Backed Double Layer Plywood Barrier	Glass wool-Plywood Sandwich Barrier	PE Foam-Backed Double Layer Plywood Barrier	PE Foam-Plywood Sandwich Barrier
12.5	1	0	0	0	0
16	6.5	0	0	0	0
20	13.5	2.3	7	2.2	5.2
25	18.7	7.1	10.4	6.5	11.9
31.5	22.2	9.5	10.7	8.7	12.7
40	24.2	8.8	8.2	7.7	8.5
50	29.1	23.9	21.2	19.7	22.7
63	30.5	24.2	22.8	23	25.4
80	31.5	29.4	28.5	28.3	28
100	35.4	35	30.7	34.1	33.8
125	39.3	38.2	32.3	32.1	35.5
160	43.8	36.9	33.4	33.4	35.8
200	49.1	40.2	37.3	36.6	38.4
250	53.8	46.4	46.8	47.2	48.8
315	59.9	46	44.6	45	46.8
400	69.9	55.1	53.3	56.1	55.8
500	76.9	66.2	65.5	69.2	66.2
630	75.7	62	63.4	62.3	63.2
800	79.6	69.2	69.1	68.4	65
1000	83.1	70.3	70.9	71.7	71.5
1250	84.4	72.1	69.8	70.9	69.9
1600	83.4	70.1	70.7	67.9	67
2000	81.8	69.2	68.6	67.3	65.4
2500	82.1	68.7	68.5	67.7	67.4
3150	84.4	67.4	67.3	68.4	67.7
4000	85.3	67.3	66.1	68	67
5000	83.1	65.6	63	66.4	63.4
6300	80.9	63.5	60.6	63	60.2
8000	80.8	60.9	56.1	60.4	56
10000	79.6	57.2	56.1	56.5	53
12500	76.6	53.4	52.6	52.7	50
16000	76.1	51.8	51.9	50.4	47.3
20000	74	46	46.2	46.9	44.8

The Influence of Balance of Payments and Balance of Trade on Exchange Rate in Developing Countries of Asia: A Case Study of Bangladesh, Pakistan and India

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Abstract

The exchange rate is a main dynamic of balance of payment. The balance of payment is bookkeeping of all the transactions made in home and foreign. If exchange rate of a home country represents a weaker currency it will have positively affect the on the balance of payment. A stronger home currency will result deficit balance of payment. Imports of Capital goods and export of primary goods i.e. case of developing countries, it will negative effect on balance of payment. This study was conducted to check the relationship among exports, import, capital goods, consumption, manufacturing, oil prices, balance of trade and exchange rate, balance of payment. In the perspective of developing economies of Pakistan, India and Bangladesh. It was found that this relationship was different in above mentioned countries i.e. in case of Bangladesh the predictor and response variable shows the strong positive regression relation while in case of rest of the economies there was different result. Some of predictors shows weaker regression relationship of variables.

Keywords: Exports, Imports, Trade Balance, JEL Classification: F24, F36, G14

1.0 Introduction

A country balance of payment account keeps track of both its payment to and its receipts from other country. The balance of payment is one of the bookkeeping system for the all payments which are transfer from one nation to other country on the movement of funds between nation (private sector and government) and foreign countries.

The balance-of-payments account uses a normal double-entry bookkeeping system much like to keep a record of payments and receipts. All transactions linking payments from foreigners to country are entered in the "Receipts" column with a plus sign (+) to reflect that they are credits; that is, they result in a flow of funds to county. Receipts include foreign acquisitions of country products such as computers, wheat purchases from foreign tourist's income earned from country investment abroad foreign gifts and pensions paid to country (unilateral transfers), and foreign payments for country assets (capital inflows). All payments to foreigners are entered in the "Payments" column with a minus sign

(-) to reflect that they are debits because they result in flows of funds to other countries. Payments include country purchases of foreign products such as Machinery and cars (imports), Country travel abroad (services), income earned by foreigners from investments in the country (investment income), foreign aid and gifts and pensions paid to foreigners (unilateral transfers), and country payments for foreign assets [1].

2.0. Objective of research

The purpose of this study is to clearly identify the effect of on the country's balance of trade and balance of payments (imports, exports, capital goods, government manufacturing and oil prices) on exchange rate in different emerging and developing countries like Pakistan, Bangladesh, and India. The aim of this study is to critically examine the following areas.

* To check the relationship between exchange rate, balance of payment and balance of trade.

* To check the influence of balance of payment and balance of trade on exchange rate.

3.0 Literature review

The government has been concerning on increasing export and improving the balance of payments for the last few years; result seem to be exactly the opposite of the declared target: the gap between exports and imports has widened [1] by Cheng, et al. Rising oil prices and the import of machinery have severely troubled the balance of trade as the trade deficit reached $3.5 billion in just nine months [2]. Purchasing Power parity does not hold as a long run equilibrium relation, it is an empirical test on Australia's long run real exchange rate [3]. A monetary expansion causes long run depreciation because it is an increase in the supply of the currency, and an increase in expected inflation causes long run depreciation because it decreases the demand for the currency [4]. Short and long-run neutrality results also if wealth consists only of foreign original level. Foreign investment does not give rise to any problems intrinsically different from those created by domestic investment, public or private [5]. Distinct arguments link IMF programs to either higher or lower levels of FDI inflows. IMF programs may prescribe economic reform packages that are conducive to multinational investors, leading to higher levels of economic stability and strong macroeconomic performance. In his 1970 analysis of the world monetary crises, Harry Johnson spoke of the liquidity problem as re-emerging in the late 1960s because of the inadequacy of the IMF provisions 'to provide for growth of international liquidity at a rate adequate to meet the needs of the expanding world economy. Rose estimate the effect

of sovereign debt renegotiation on international trade [6]. Sovereigns may fear the trade consequences of default; because creditors deter default, or because trade finance dries up. Bilateral trade is approximately 8% a year and persists for around 15 years [7].

Pesaran, et al and Pefind indication of a J-curve effect [8, 9]. However, they did article a significant long-run relationship between the trade balance and the exchange rate, indicating that a real devaluation of the U.S. dollar has a promising effect on the U.S. trade balance. Marwah et al. find evidence of an S-curve for both United States and Canada using disaggregated data in an IV and OLS regression for the period 1977 to 1992 [10, 11]. According to their findings, the trade balance firstly declines after devaluation, followed by a trade balance development - the typical J-curve effect. However, after numerous quarters there seems to be a propensity for the trade balance to worsen. This S - curve finding is evocative of the S-shaped response of the trade balance to changes in terms of trade mentioned in Backus, Kehoe and Kydland [12], Bahmani-Oskooee and Alse [13] tested 41 developed and less developed countries for the existence of co-integration and the J-curve effect smearing the Engle-Granger two-step procedure. The results finding showed that the trade balance and real effective exchange rate are co-integrated for only fourteen countries. In the countries exhibiting co-integration, there was some indication of the J-curve effect. Gupta-Kapoor and Ramakrishnan [14] examined the impact of the yen appreciation on Japanese trade balance data with respect to seven major trading partners employing a VECM. The projected impulse response function indicated the existence of a J-curve for Japan. Doroodian et al obtained similar results for Japan [15]. They applied the Shiller lag model to first differences finding support for the J-curve effect. In conclusion, evidence seems to suggest that the J-curve is an empirical Phenomenon, i.e. it may or may not be found in a given country [16]. On the other hand, we are reviewed others online portal like Bangladesh Bank [17], The State Bank of Pakistan [18], Reserve Bank of India [19].

4.0 Research methodology

By developing the hypothesis, we will find the balance of trade's movement with four large-scale variables and balance of payment variables with exchange rate. The significance between exchange rate movements and its effect on balance of trade variables and balance of payment will be tested with the help of co multivariate regression and co-integration method. We will clearly study the concurrent effect on each variable and fluctuation each corner of balance of trade and balance of payments. To see this effect more critically we have widened scope of our study to five different

economies different corners of the world including USA, UK, China, India, Pakistan and Bangladesh. The time duration taken for this study is 30 years from 1978 to 2008.

4.1 Regression analysis of Bangladesh

Balance of trade has been removed from the equation.

The regression equation is Exchange rate = 48.9 + 0.00852 exports (m) - 0.00104 imports (m)
+ 0.00304 capital goods + 0.0205 consumption - 0.0114 manufacturing
- 0.276 oil prices

Table 1: Effect on the Exchange Rates.

Predicator	Coef	stDev	T	P
Constant	48.891	5.955	8.21	0.000
Imports	-0.001039	0.001285	-0.81	0.436
Manufacturing	-0.011354	0.0032220	-3.53	0.005
Export	0.008525	0.001285	5.96	0.000
Oil prices	-0.2763	0.1225	-02.25	0.045
Consumption	0.020525	0.005031	4.08	0.002
Capital goods	0.003037	0.002838	1.07	0.308
S=1.732	R-sq = 98.5%	R-sq (adj)= 97.6%	R = 0.71	P=0.000

Source: Bangladesh Bank[17]

The above table reflects the influence of balance of payments on exchange rate of Bangladesh, the variable balance of payment contains exports, imports, capital goods, consumption, oil prices and manufacturing.

Results of the table explains the value of R2 is 98.5% means that there is 98.5% variation in exchange rate of Bangladesh due to balance of payment. The results of the table also indicated that the overall model is significant because the p-value for manufacturing, exports, oil price and consumption were significant as less than 5% while the p-values for the variable imports and capital goods were insignificant as p>5% above.

4.2 Regression analysis of Pakistan

* Balance of trade, exports, imports are highly correlated with other X variables

* Balance of trade, exports, imports have been removed from the equation

The regression equation is

Exchange rates = 18.2 + 0.00778 manufacturing (m $) - 0.703 oil prices

- 0.0124 capital goods +0.000014 Consumption

Table 2: Effect on the Exchange Rates

Predicator	Coef	stDev	T	P
Constant	18.221	3.231	5.64	0.0000
Manufacturing	0.0077777	0.001045	7.44	0.0000
Oil prices	-0.7030	0.3427	-2.05	0.061
Capital goods	-0.12351	0.002016	-6.13	0.000
Consumption	0.00001378	0.00001057	1.30	0.215
S=5.531	R-sq = 89.5%	R-sq (adj)= 86.2%	R =0.54	

Sources: The state bank of Pakistan[18]

In the above table, the coefficient of regression analysis shows that the manufacturing has the more relationship with exchange rates as compared to oil prices, capital goods, consumption etc.

In the above table, the T-test shows that manufacturing is more efficient i.e. 7.44 than others like consumption level i.e. 1.3 and capital goods have the negative efficiency with exchange rate.

P is the significant level of each variable. In the above result the manufacturing has the more significance 0%<10. Which shows highly significance of manufacturing on the exchange rate. Oil prices have the value of P=6.1%<10%. It also shows that significance level of oil prices on the exchange rate is significant. The capital goods having value of P=0%<10% shows significance level. Consumption shows with the less significance level on the exchange rates than other variables. The relationship among exchange rate and manufacturing, oil prices, capital goods and consumption is R-Square=89.5%. which shows high relationship. And R-Square can be adjusted 3.3%.

4.3 Normal probability

The Fig. 1 showed the normal distribution plot for the variables to check out the skewness and kurtosis of the data for Pakistan, if the points on the graph are too close as in above graph the data must be considered normal means properly skewed and having standard peak. So normal probability plot showed that data for Pakistan is normal [13].

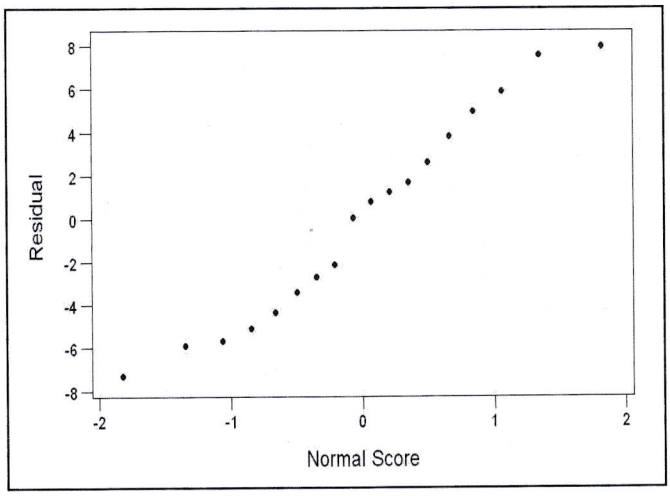


Fig. 1. Normal probability of the residuals (response is exchange).

4.4 Regression analysis of india

- Capital goods, exports are highly correlated with other X variables
- Capital goods, exports have been removed from the equation

The regression equation is Exchange rates = 33.7 +0.000682 imports (m $) +0.000230 manufacturing (m $)

+ 0.00116 balance of trade - 0.782 oil prices - 0.00201 consumption

Table 3: Relationship with Exchange Rates.

Predicator	Coef	St. Dev	T	P
Constant	33.65	13.55	2.48	0.029
Imports	0.0006816	0.0003259	2.09	0.058
Manufacturing	0.0002301	0.0004069	0.57	0.582
Balance of trade	0.0011563	0.0003455	3.35	0.006
Oil prices	-0.7821	0.2844	-02.75	0.018
Consumption	-0.002010	0.001101	-1.83	0.093
S=4.482	R-sq = 83.4%	R-sq (adj)= 76.4%	R=0.65	

Sources: Reserve Bank of India [19]

The data was collected from reserve bank of India and the above table indicating that the coefficient of regression analysis shows that the B.O.T has the more relationship with exchange rates as compared to oil prices, manufacturing, consumption, Imports etc.

In the above table, the T-test shows that B.O.T is more efficient i.e. 3.35 than others like consumption level i.e. -1.83 and oil prices and consumptions have the negative efficiency with exchange rate, imports and manufacturing has the efficiency of 2.09 and 0.57 respectively.

P is the significant level of each variable. In the above result the B.O.T has the more significance 0.6%<10 Which shows highly significance of B.O.T on the exchange rate. Oil prices have the value of P=1.8%<10%. It also shows that significance level of oil prices on the exchange rate is significant. The consumption having value of P=9.3%<10% shows significance level. Manufacturing shows with the less significance level on the exchange rates than other variables. The relationship among exchange rate and manufacturing, oil prices, capital goods and consumption is R-Square=83.4%. which shows high relationship. And R-Square can be adjusted 7%.

4.5 Normal probability plot residuals

The Fig. 2 showed the normal distribution plot for the variables to check out the skewness and kurtosis of the data for India, if the points on the graph are too close as in above graph the data must be considered normal means properly skewed and having standard peak. So normal probability plot showed that data for India is normal.

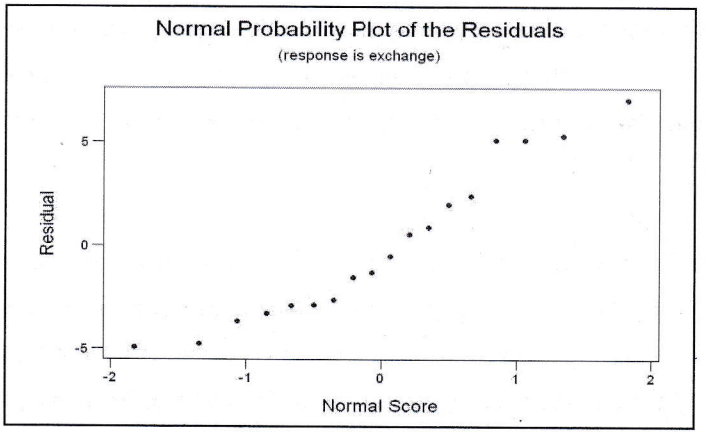
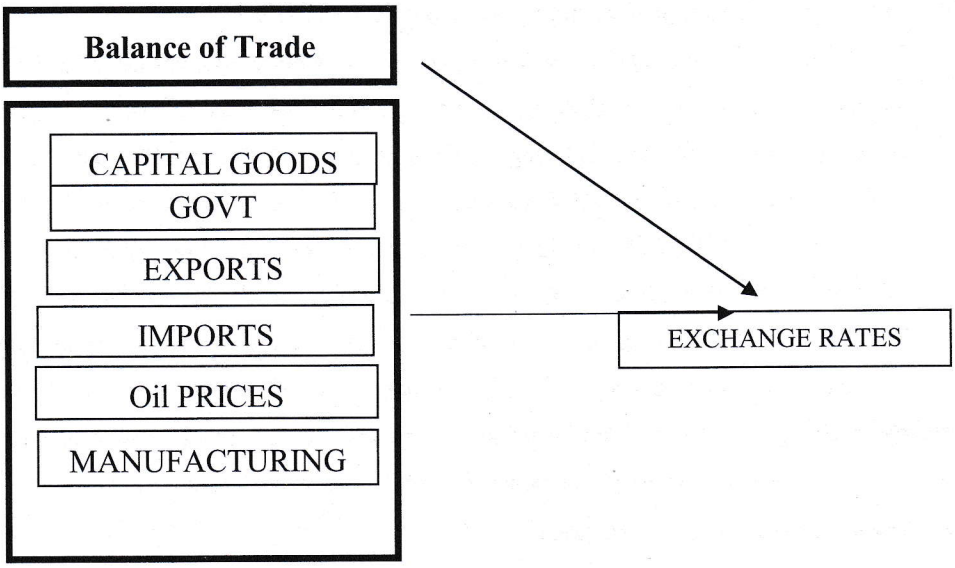


Fig. 2. Normal probability of the residuals (response is exchange).



Scheme 1. that interrelation with exchange rate.

The Scheme 1 shows that interrelation with exchange rate. Every countries exchange rate depending on those sub part.

5.0 Independent variables :

5.1 Balance of trade:

Balance of trade in developing country Bangladesh, India, Pakistan are in deficit continually its very strange because basically those are an agricultural country and majority of population relay on agriculture near about 70% of population but some other economic factors also effect the balance of trade.

5.2 Balance of payments

The balance of payments defines as measure the payments that flow between other countries with individual country. The balance of payment is used to summarize the all economic transaction of the country during a specific year or period. The balance of payment uses to measure the import and export of goods and services financial capital as well as financial transfer all the payments liabilities and obligation received from foreigner balance of payments is one of the major indicators of the country.

5.1.1 Manufacturing growth rate:

Manufacturing growth rate also the second source of export that is textile, industrial and sports industry. Many of MNCs operate and the also source of export but other way MNCs; long term impact is go beyond opposite to balance of trade.

5.1.2 Exports

The export of goods plays an imperative role in the economic development of a country and signifies one of 1the most important sources of foreign exchange income. Exports not only ease the pressure on the balance of payments but also create employment opportunities. They can increase intra-industry trade, help the country to integrate in the world economy and reduce the impact of external shocks on the domestic economy Increases in the volume of exports always support the current account balance. However, this increase must be greater than the volume of imports. If the volume of exports increases at the same proportion or less than imports then this increase in the exports will not support the current account balance [14]

5.1.3 Imports

Imports of a country depend upon the domestic production capacity. If the local producers are unable to produce enough to satisfy the domestic demand, then increased imports are required to fill this gap. High volume of imports as well as concentration of imports on capital products are some of the main causes for current account deficit.

5.1.4 Capital goods

In the economic realm, "capital goods" is a specialized term which refers to real objects owned by individuals, organizations, or governments to be used in the production of other goods or commodities.in in capital good include equipment, tools, factories, and furthermore several buildings which are used to produce the product for consumption. In Pakistan and Bangladesh, the capital goods growth industry has more merit and it would be a deep business sureness on the economic performance in Pakistan the correlation between GDP and capital goods was highest during 2016.

5.1.5 Government consumption level

Total consumption is the factor that has a negative sign, point out that an increase in the consumption level will decrease country Exchange rate and lower the consumption will enhance the exchange rate. There is a hypothesis that exchange rate and consumption of country has a negative relationship.

5.1.6 Oil prices

The contribution of oil price has significant for the country exchange rate. The effect of oil price would be both positively and negatively on the account balance of the country therefore this is hypothesis that there has a relationship of oil prices with exchange rate.

6.0 Dependent variables:

The exchange rate also defines as (also known as the foreign-exchange rate, forex rate or FX rate) and between two currencies specifies how much one currency is value in terms of the other. This is the value of foreign nation's currency in term home nation .in addition the exchange rate of Pakistan as It is the value of a foreign nation's currency in terms of the home nation's currency. The exchange rate of Pakistan as compared to other currencies varied with the passage of time due to the different situation such as economical political etc. [6]

7.0 Conclusions

From the above analysis, it was concluded that there is strong positive correlation exists among all the research variables of all the countries under the study as their R-value is positive and greater then 0.5, so on the basis of this result objective one was achieved. Current study also uses multiple regression model to check the cause and effect relationship of independent and dependent variables and result of regression reveals that there is strong significant impact of Balance of trade and balance of payment on exchange rates of India, Bangladesh and Pakistan with R2 values 83.4%, 89.5% and 98.5% respectively with the p-values less than 0.05, so it reflects that the regression also having significant impact. Based on regression results objective 2 is also achieved.

When the theoretical work applied on different economies then this process generates different finding include Pakistan, India and Bangladesh all are developing countries. But predictors have different impact on BOP and Exchange rate. Balance of trade, exports, imports are highly correlated with other X variables in Pakistan therefore balance of trade, exports, imports have been removed from the equation. Because they have a minimal impact on the Exchange rate. In case of Bangladesh the chosen theoretical framework has best fit. It has shown a stronger positive relationship. Indian economy shows capital goods, exports are highly correlated with other X variables capital goods, exports have been removed from the equation. Because although there was a stronger relation amongst capital goods and exports but minimal impact on BOP and Exchange Rate. Usually the results were found as being normal and some conflictions has been mentioned.

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SNR Estimation Technique of the AWGN Channel by Second and Fourth-Order Moments (M_2M_4)

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Abstract

The goal is to find the "best" estimate of the SNR in a digital receiver with the least cost. Generally, SNR estimates are generated by averaging observable properties of the received signal over a number of symbols. The performances of various signal-to-noise ratio (SNR) estimation techniques reported in the literature are compared to identify the "best" estimator. The SNR estimators are investigated by the computer simulation of baseband binary phase-shift keying (PSK) signals in real additive white Gaussian noise (AWGN) and baseband M-ary PSK signals in complex Additive white Gaussian noise (AWGN). Some known estimator structures are modified to perform better on the channel of interest. It investigates, therefore, both types of estimators and quantifies by example the improvement in performance achievable by using known data rather than error-corrupted recovered data. Estimator structures for complex channels are examined.

Keywords: Signal-to-noise ratio (SNR), Phase-shift keying (PSK), Additive white Gaussian noise (AWGN), Phase Shift Keying (PSK).

1.0 Introduction

Modern wireless communication systems often require knowledge of the signal to noise ratio (SNR) at the receiver. For example, SNR estimates are typically employed in power control, mobile assisted handoff and adaptive modulation schemes. The rapid development of these applications in the last decade has led to an intense search for accurate and low complexity SNR estimators. The problem of SNR estimation may be considered for data-aided (DA) scenarios, where known transmitted data is used to facilitate the estimation process, and for non-data-aided (NDA) scenarios since the periodic transmission of known data limits system throughput. The basic problem was first introduced in the 1960s by [1] and [2]. However, decreasing hardware costs and increasing demands for pushing system performance to the achievable limits make an investigation of SNR estimation techniques timely.

The search for a good signal-to-noise ratio (SNR) estimation technique is motivated by the fact that various algorithms require knowledge of the SNR [3, 4] for optimal performance if the SNR is not constant. The performance of diverse systems may be improved if knowledge of the SNR is

available. Past engineering practice has often used an estimation of the total signal-plus-noise power instead of estimation of the SNR since it is much easier to measure total power than the ratio of signal power to noise power (or noise power spectral density).

1.1 Quadrature phase shift keying (qpsk)

QPSK is the digital modulation technique. QPSK is a form of PSK in which two bits are modulated at once, selecting one of four possible carrier phase shifts; For example, the four possible pairs of bits can be represented 10, 00, 01 and 11 as follows:

$$S_0\ (t) = \sqrt{2}A_c \cos\left(2\pi f_c t + \frac{\pi}{4}\right) \quad \text{For bit pair 11}$$

$$S_0\ (t) = \sqrt{2}A_c \cos\left(2\pi f_c t + \frac{3\pi}{4}\right) \quad \text{For bit pair 01}$$

$$S_0\ (t) = \sqrt{2}A_c \cos\left(2\pi f_c t - \frac{\pi}{4}\right) \quad \text{For bit pair 10}$$

$$S_0\ (t) = \sqrt{2}A_c \cos\left(2\pi f_c t - \frac{3\pi}{4}\right) \quad \text{For bit pair 00}$$

Where, $0 \leq t \leq T$. That is, the carrier is transmitted with one of four possible phase values, $\pm\pi/4, \pm 3\pi/4$, with each phase corresponding to a unique pair of bits as shown in the figure.

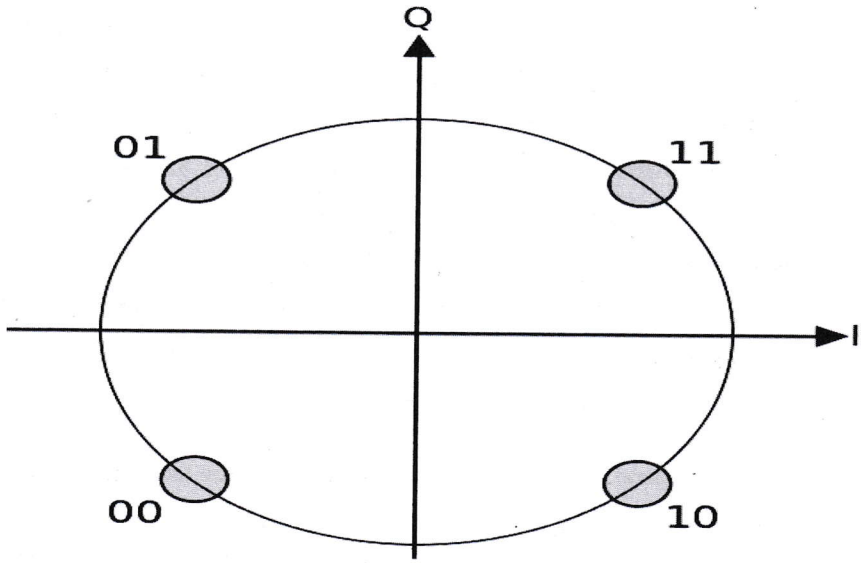

Fig.1.1. Constellation diagram of QPSK

QPSK perform by changing the phase of the In-phase (I) carrier from 0° to 180° and the Quadrature-phase (Q) carrier between 90° and 270°. This is used to indicate the four states of a 2-bit binary code. Each state of these carriers is referred to as a Symbol. QPSK is a widely used method of transferring digital data by changing or modulating the phase of a carrier signal. In QPSK digital data is represented by 4 points around a circle which correspond to 4 phases of the carrier signal. These points are called symbols. QPSK modulation consists of two BPSK modulations on in-phase and quadrature components of the signal.

2.0 Quadrature amplitude modulation (QAM)

QAM has fast become the dominant modulation mechanism for high-speed digital signals. QAM is a modulation technique which conveys data by changing some aspect of a carrier signal or the carrier wave (usually a sinusoid) in response to a data signal. In the case of QAM, the amplitude of two waves, 90° out of phase with each other (in quadrature) are changedd (modulated or keyed) to represent the data signal.

QAM is both an analog and a digital modulation scheme. It conveys two analog message signals or two digital bit streams, by changing (modulating) the amplitudes of two carrier waves, using the amplitude shift keying (ASK) digital modulation scheme or amplitude modulation (AM) analog modulation scheme. The two carrier waves, usually sinusoids are out of phase with each other by 90° and are thus called quadrature carriers or quadrature components hence the name of the QAM. The modulated waves are summed, and the resulting waveform is a combination of both PSK and ASK or (in the analog case) of phase modulation (PM) and amplitude modulation (AM). In the digital QAM case, a finite number of at least two phases and at least two amplitudes are used. PSK modulators are often designed using the QAM principle but are not considered as QAM since the amplitude of the modulated carrier signal is constant. QAM is used extensively as a modulation scheme for digital telecommunication systems. Arbitrarily high spectral efficiencies can be achieved with QAM by setting a suitable constellation size, limited only by the noise level and linearity of the communication channel.

2.1Constellation diagram of 16 -QAM

In 16- QAM modulation technique one sixteen possible signals is transmitted during each signaling interval T, with each signal uniquely related to pairs of bits. Each symbol contains four bits. The 16-QAM can be expressed as

$M = 2^n$

Where, n = 4 no. of bits of each symbol.

The 16-state quadrature amplitude modulation includes two I values and two Q values are used, yielding four bits per symbol. The constellation diagram of 16-QAM modulation technique is shown in the figure.

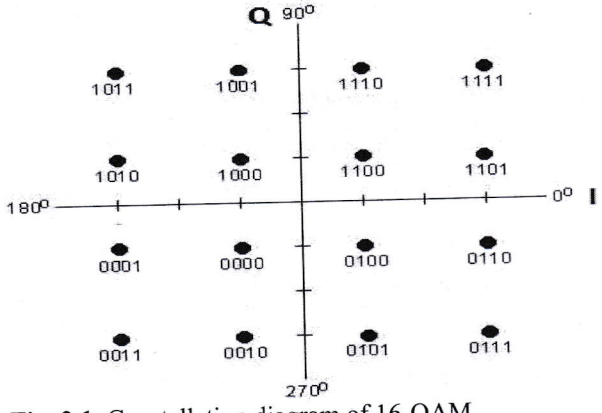

Fig. 2.1. Constellation diagram of 16-QAM .

Table 2.1. Carrier phase and amplitude of 16-QAM

Symbol Transmitted	Carrier Phase	Carrier Amplitude
0000	225°	0.33
0001	255°	0.75
0010	195°	0.75
0011	225°	1.0
0100	135°	0.33
0101	105°	0.75
0110	165°	0.75
0111	135°	1.0
1000	315°	0.33
1001	285°	0.75
1010	345°	0.75
1011	315°	1.0
1100	45°	0.33
1101	75°	0.75
1110	15°	0.75
1111	45°	1.0

The 16-QAM modulation offers twice higher spectral efficiency than QPSK and further reduces the required symbol rate to obtain the equivalent overall bit-rate, albeit, at the expense of an increased required OSNR, and worse performance in the linear and nonlinear transmission regime. A QPSK signal has 6.8dB lower required Optical Signal to Noise Ratio OSNR than 16-QAM signal for the same symbol rate of 28Gbaud, and also 3.8dB lower required OSNR for the same bit rate of 112Gbit/s. The 16-QAM will also have reduced tolerance towards nonlinearity than QPSK because of the presence of 3 intensity levels and, hence, higher peak-to-mean ratio. The DSP for 16-QAM signals is more complicated than for QPSK, in particular, adaptive equalization and carrier phase estimation. To date, few techniques have been proposed to generate 16-QAM signals. Perhaps the most prominent generation technique involves the synthesis of two 4-level electrical signals to drive the two arms of an I-Q modulator. In the simplest implementation, an IQ modulator is driven by two electrical signals with equally spaced amplitude levels over the linear part of its transfer function. In such configuration, the equally spaced electrical amplitude levels are linearly converted into the optical domain creating two 4-state amplitudes shift keyed (4-ASK) signals. An alternative to equally spaced amplitude levels is to pre-distort a 4-level electrical driving signal in order to drive an I-Q modulator over $2V\pi$. Although in both cases the generated 4-ASK signal contains equally spaced optical levels, the latter configuration allows to exploit the full modulation depth of the modulator and suppress the noise in some of the 16-QAM symbols, albeit, at the expense of increased transmitter complexity. 16 QAM techniques are used in microwave digital radio, modems, DVB-C, DVB-T.

3.0 SNR estimation technique

The SNR of interest is the ratio of the discrete signal power to discrete noise power at the input to the decision device at the optimal sampling instants. In the following, "SNR" denotes this ratio of discrete powers. If a matched filter (MF) is employed at the receiver, the SNR ρ as defined here is related to the ratio of the symbol energy-to-noise power spectral densityE_s/N_o by $\rho = 2E_s/N_o$for real channels and$\rho = E_s/N_o$ for complex channels. Simulated QAM and QPSK signals in complex AWGN are used to investigate the performances of the second- and fourth-order moments (M_2M_4) estimator.

3.1 Second- and fourth-order moments (M_2M_4) estimator

An early mention of the application of second- and fourth-order moments to the separate estimation of carrier strength and noise strength in real AWGN channels was in 1967 by Benedict and Soong [6]. In 1993, Matzner [7] gave a detailed derivation of an SNR estimator which yielded similar

expressions to those given in [6]. In 1994, Matzner et al. [8] rederived the estimator for real signals using a different approach. We sketch the derivation provided in [7] for complex channels below and then show how the estimator can be modified for application to real channels using the same approach.

Let M_2 denote the second moment of y_n as

$$M_2 = \mathrm{E}\{ y_n y_n^* \}$$

$$= \mathrm{SE}\{|a_n|^2\} + \sqrt{\mathrm{SN}}\,\mathrm{E}\{a_n w_n^* \} + \sqrt{\mathrm{SN}}\,\mathrm{E}\{w_n a_n^* \} + \mathrm{NE}\{|w_n|^2\} \quad (1)$$

And let M_4 denote the fourth moment of y_n as

$$M_4 = \mathrm{E}\{ (y_n y_n^*)^2\}$$

$$= \mathrm{S}^2\mathrm{E}\{|a_n|^4\} + 2\mathrm{S}\sqrt{\mathrm{SN}}\,.\,(\mathrm{E}\{|a_n|^2 a_n w_n^* \} + \mathrm{E}\{|a_n|^2 w_n a_n^* \}) + \mathrm{SN}.\,(\mathrm{E}\{a_n w_n^*)^2\} +$$

$$4\mathrm{E}\{|a_n|^2|w_n|^2\} + \mathrm{E}\{(w_n a_n^*)^2\}) + 2\mathrm{N}\sqrt{\mathrm{SN}}(\mathrm{E}\{|w_n|^2 a_n w_n^* \} + \mathrm{E}\{|w_n|^2 a_n w_n^* \}) +$$

$$\mathrm{N}^2\mathrm{E}\{|w_n|^4\} \ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots (2)$$

Assuming the signal and noise are zero-mean, independent random processes, and the in-phase and quadrature components of the noise are independent, (1) and (2) reduce to

$$M_2 = \mathrm{S} + \mathrm{N} \qquad \ldots\ldots\ldots\ldots\ldots\ldots (3)$$

and

$$M_4 = \mathrm{k_a S}^2 + 4\mathrm{SN} + \mathrm{k_w N}^2 \quad (4)$$

respectively, where $k_a = E\{|a_n|^4\}/E\{|a_n|^2\}^2$ and $k_w = E\{|w_n|^4\}/E\{|w_n|^2\}^2$ are the kurtosis of the signal and the kurtosis of the noise, respectively. Solving for S and N, one obtains

$$S = \frac{\mathrm{M_2(k_w - 2)} \pm \sqrt{(4 - \mathrm{k_a k_w})\mathrm{M_2^2} + \mathrm{M_4(k_a + k_w - 4)}}}{(\mathrm{k_a + k_w - 4})} \qquad (5)$$

and

$$N = \mathrm{M_2} - \mathrm{S} \qquad (6)$$

The estimator formed as the ratio of S to N is denoted the M_2M_4 estimator. As an example, for any M-ary PSK signal $k_a = 1$ and for complex noise $k_w = 2$ so that from equation (5) and (6) the result is

$$\rho M_2 M_4, complex = \frac{\sqrt{2\mathrm{M_2^2} - \mathrm{M_4}}}{\mathrm{M_2} - \sqrt{2\mathrm{M_2^2} - \mathrm{M_4}}} \qquad (7)$$

On the other hand, for the 16-QAM signal, $k_a = 1.32$ and for complex noise $k_w = 2$ so that from equation (5) and (6) the result is

$$\rho M_2 M_4, complex = \frac{\sqrt{2M_2^2 - M_4}}{M_2\sqrt{0.68} - \sqrt{2M_2^2 - M_4}} \quad (8)$$

The estimator is of the in-service type and has the advantage that carrier phase recovery is not required since it is based on the second and fourth moments of the signal. As a moments-based estimator, it does not use receiver decisions and so is not labeled as a DA estimator. In practice, the second and fourth moments are estimated by their respective time averages for both real and complex channels of N symbols as

$$M_2 = \frac{1}{N}\sum_{n=0}^{N-1} |y_n|^2 \quad (9)$$

And

$$M_4 = \frac{1}{N}\sum_{n=0}^{N-1} |y_n|^4 \quad (10)$$

3.2Proposed technique for 16-QAM

The constellation diagram and circle representation of 16-QAM technique are given below. The coordinates of first (inner) circle are $(1 \pm j)$ and$(-1 \pm j)$. The coordinates of second (middle) circle are $(1 \pm 3j)$, $(-1 \pm 3j)$, $(3 \pm j)$ and$(-3 \pm j)$ and the coordinates of the third (outer) circle are $(3 \pm 3j)$ and$(-3 \pm 3j)$.

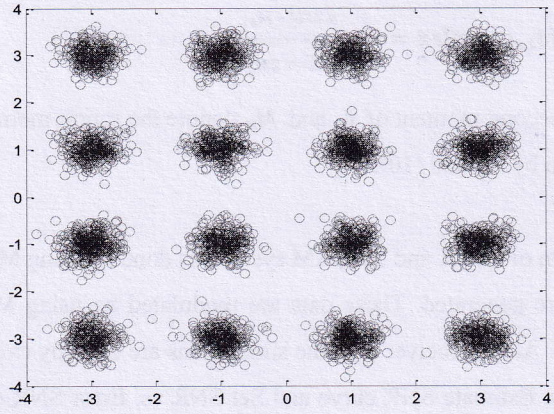

Fig. 3.1. Constellation diagram of 16-QAM.

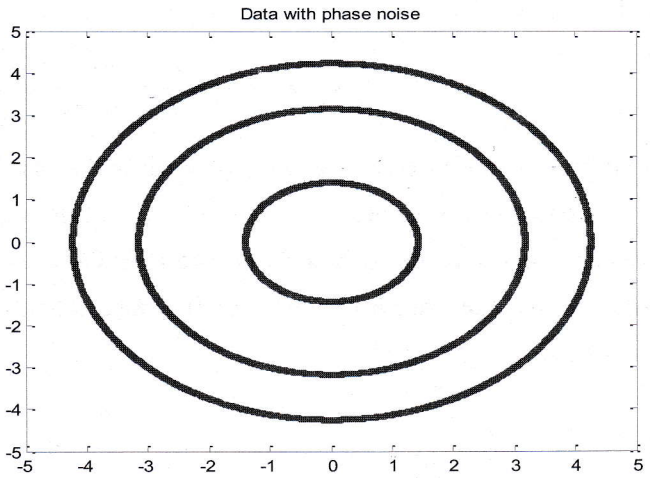

Fig.3.2. Circle representation of 16-QAM

When the SNR is high such as (17 or above) dB than the middle circle of 16-QAM is taken into consideration to estimate the SNR but the formula is used of QPSK

$$\rho M_2 M_4, complex = \frac{\sqrt{2M_2^2 - M_4}}{M_2 - \sqrt{2M_2^2 - M_4}} \quad (11)$$

When the SNR is low such as (16 or below) dB than the formula of 16-QAM is taken into consideration to estimate the SNR

$$\rho M_2 M_4, complex = \frac{\sqrt{2M_2^2 - M_4}}{M_2\sqrt{0.68} - \sqrt{2M_2^2 - M_4}} \quad (12)$$

Where M_2 denote the second moment of y_n and M_4 denote the fourth moment of y_n. the expression of these moments is given by (9) and (10).

4.0 Simulation setup

The simulation of QPSK and 16-QAM systems is done by using MATLAB software. At first, 50,000 random data are generated. These data are modulated by using MATLAB command. Then AWGN noise is added. At the receiver end, the simulations are done by existing formula & determine Error. The Set SNR vs. Estimate SNR curve and Set SNR vs. Error SNR curve are also constructed. The sequence of the function of simulation can be represented as follows:

RANDOM DATA GENERATION
MODULATION QPSK **or** 16-QAM
AWGN NOISE ADDITION
ESTIMATE SNR BY EXISTING FORMULA
ERROR CALCULATION
RESULTS

4.1 Simulation results

The simulation for SNR estimate of M_2M_4technique is used to reduce the Signal -to-Noise Ratio (SNR) error of transmitted signal. The simulation results for M_2M_4 SNR estimation technique are shown in the following figure.

4.1.1 Simulation result by using M_2M_4 QPSK estimator

The performance curves of Second- and Fourth-Order Moments (M_2M_4)QPSK technique shown in the following simulation result. From this simulation we can calculate the error in dB with respect to set SNR in dB vs. estimate SNR in dB curve and Error curve of this technique shown in the following fig. 4.1 and 4.2. This technique is preferable at low as well as high SNR. The estimate SNR is close to the set SNR hence error in this case close to zero db.

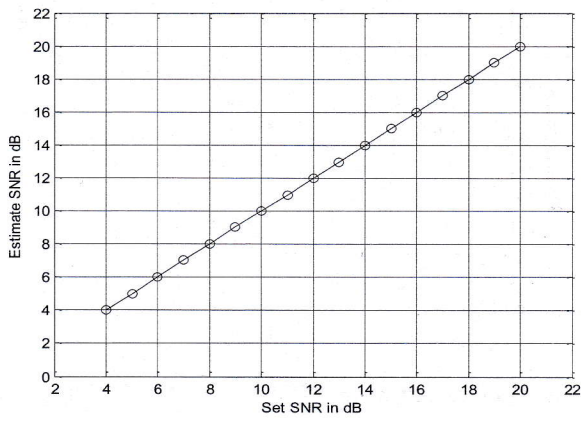

Fig. 4.1. Set SNR vs. Estimate SNR curve of M_2M_4QPSK technique

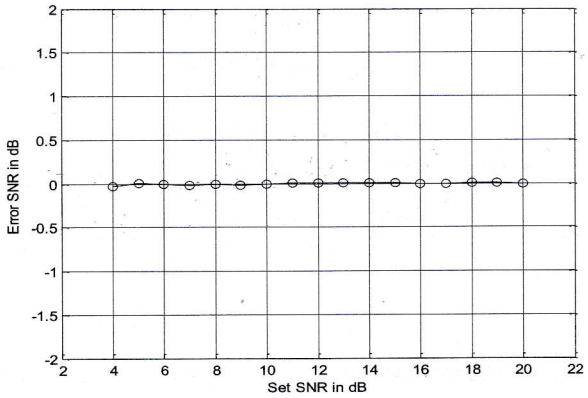

Fig. 4.2. Error curve of M_2M_4QPSK technique

4.1.2 Simulation result by using M_2M_4 16-QAM estimator

The performance curves of$M_2M_4$16-QAM technique shown in the following simulation result. From this simulation we can calculate the error in dB with respect to set SNR in dB vs. estimate SNR in dB curve and Error curve of this technique shown in the following fig. 4.3 and 4.4. This technique is preferable at the SNR which is less than 16 dB

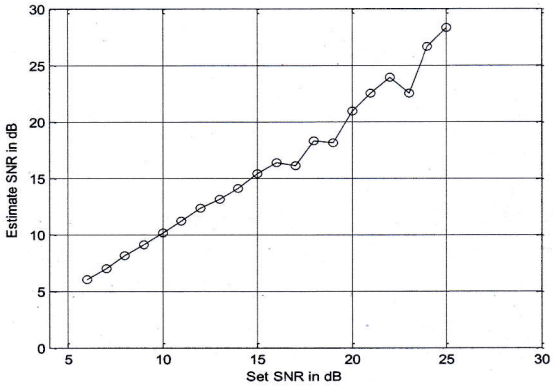

Fig. 4.3. Set SNR vs. Estimate SNR curve of $M_2M_4$16-QAM technique

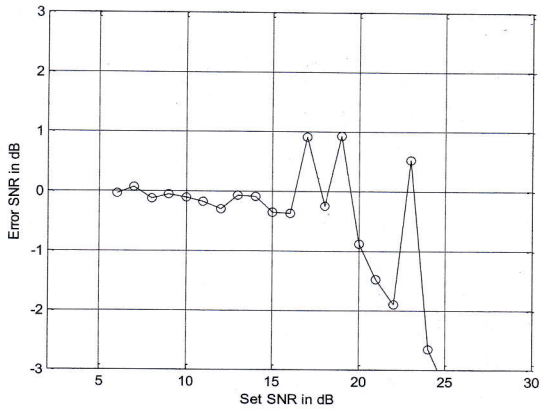

Fig. 4.4. Error curve of $M_2M_4$16-QAM technique

4.1.3 Simulation result by using $M_2M_4$16-QAM (inner circle) estimator

The performance curves of $M_2M_4$16-QAM (inner circle) technique shown in the following simulation result. From this simulation we can calculate the error in dB with respect to set SNR in dB vs. estimate SNR in dB curve and Error curve of this technique shown in the following fig. 4.5 and 4.6. This technique is not preferable at low as well as high SNR. The estimate SNR is much smaller than to the set SNR hence error in this case is very large.

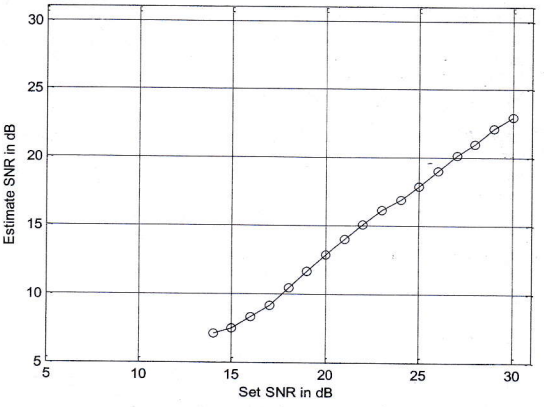

Fig. 4.5. Set SNR vs. Estimate SNR curve of $M_2M_4$16-QAM (inner circle) technique

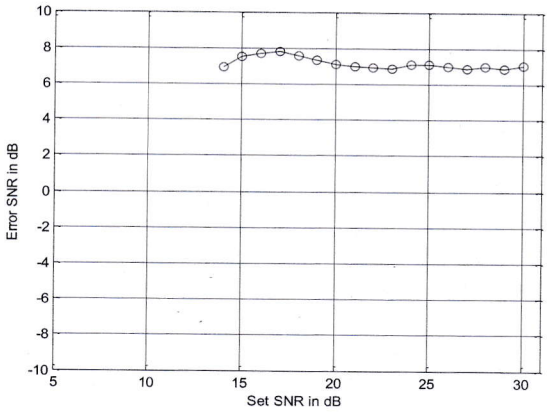

Fig. 4.6. Error curve of $M_2M_4$16-QAM (inner circle) technique

4.1.4 Simulation result by using $M_2M_4$16-QAM (outer circle) estimator

The performance curves of $M_2M_4$16-QAM (outer circle) technique shown in the following simulation result. From this simulation we can calculate the error in dB with respect to set SNR in dB vs. estimate SNR in dB curve and Error curve of this technique shown in the following fig. 4.7 and 4.8. This technique is not preferable at low as well as high SNR. The estimate SNR is much larger than to the set SNR hence error in this case is very large.

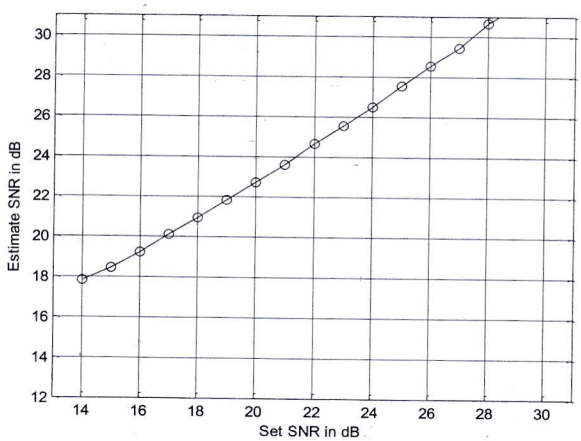

Fig. 4.7. Set SNR vs. Estimate SNR curve of $M_2M_4$16-QAM (outer circle) technique

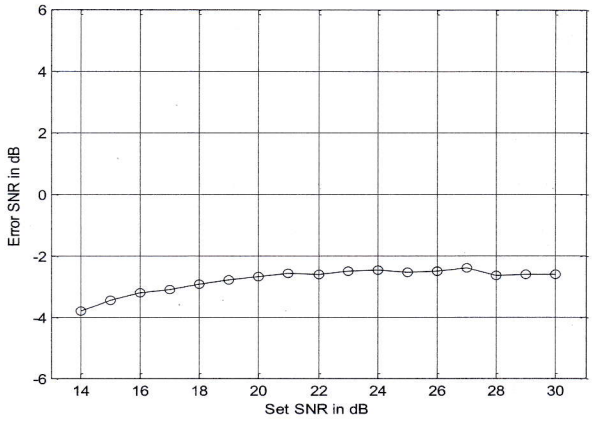

Fig. 4.8. Error curve of $M_2M_4$16-QAM (outer circle) technique

4.1.5 Simulation result by using $M_2M_4$16-QAM (middle circle) estimator:

The performance curves of $M_2M_4$16-QAM (middle circle) technique shown in the following simulation result. From this simulation we can calculate the error in dB with respect to set SNR in dB vs. estimate SNR in dB curve and Error curve of this technique shown in the following fig. 4.9 and 4.10. This technique is preferable at high SNR. The estimate SNR is close to the set SNR at high SNR (above 16dB) hence error in this case close to zero dB.

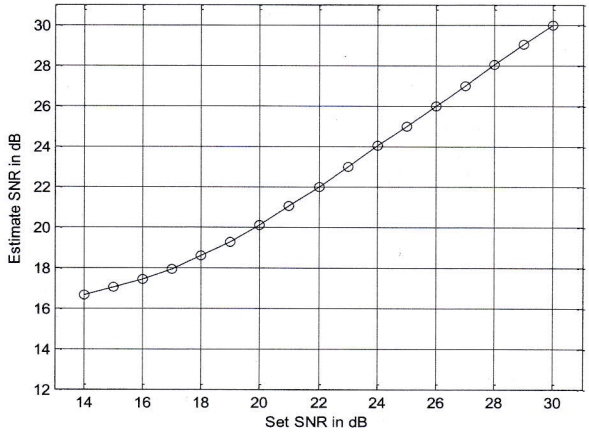

Fig. 4.9. Set SNR vs. Estimate SNR curve of $M_2M_4$16-QAM (middle circle) technique

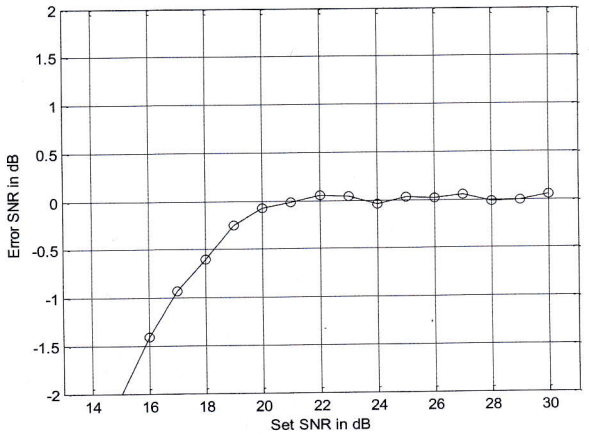

Fig. 4.10. Error curve of $M_2M_4$16-QAM (middle circle) technique

4.1.6 Simulation result of a proposed (hybrid) technique for 16-QAM:

The performance curves of proposed (hybrid) technique for 16-QAMshown in the following simulation result. From this simulation, we can calculate the error in dB with respect to set SNR in dB vs. estimate SNR in dB curve and Error curve of this technique shown in the following fig. 4.11 and 4.12. This technique is preferable at low as well as high SNR. The estimate SNR is close to the set SNR hence the error in this case close to zero dB.

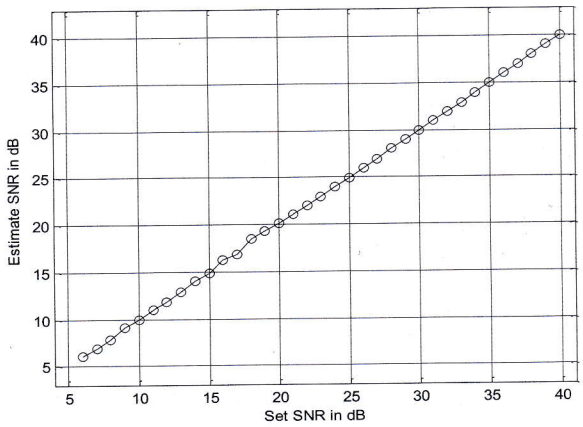

Fig. 4.11. Set SNR vs. Estimate SNR curve of hybrid technique

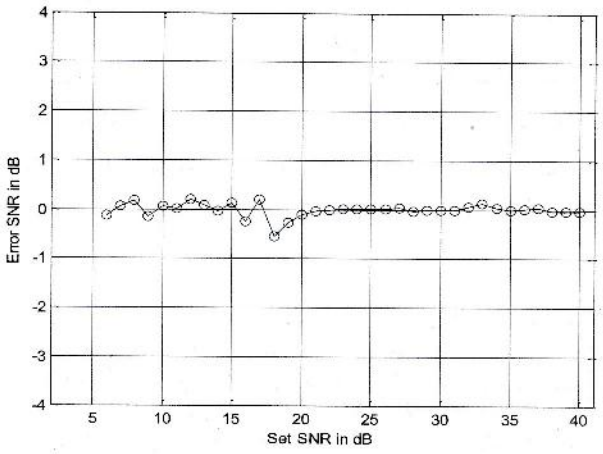

Fig. 4.12. Error curve of hybrid technique

5.0 Conclusion

This paper has considered the problem of SNR estimation in linear and time-invariant (LTI) AWGN channels. The estimator M_2M_4 is asymptotically efficient at high SNR. The M_2M_4 estimator is easy to implement, a hardware implementation ofthe M_2M_4 estimator is described in [13].The performance of the M_2M_4 estimators was analytically computed with and without channel polynomial order mismatch. Simulation results have been presented to investigate estimator performance for AWGN channels. Theoretical analysis has shown that the accuracy of SNR estimation should not degrade due to the channel's time variation. The M_2M_4 the estimator is based on higher-order moments, the comparison between M_2M_4 and proposed technique for 16-QAM is given below.

SNR estimation techniques	SNR	Error
M_2M_4 QPSK	Suitable at any SNR	Close to zero
M_2M_4 16-QAM	Suitable at low SNR (1dB-16dB)	Low at low SNR
M_2M_4(16-QAM middle circle)	Suitable at high SNR (above 17dB)	Low at high SNR
M_2M_4(16-QAM inner circle)	Not Suitable at any SNR	High
M_2M_4(16-QAM outer circle)	Not Suitable at any SNR	High
Proposed technique for 16-QAM	Suitable at high & low SNR	Close to zero

5.1 Future work

There remain several issues that can be used as starting points and/or central themes for future studies. For future work, it would be a good task to optimize the error and increase the modulation order of 16-QAM. We can also extension our analysis for higher order modulation such as 32-QAM, 64-QAM, and 128-QAM.

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