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Editorial

We are happy to publish the fourth Issue (Volume-2, No.-2) of the Sonargaon University (SU) Journal. It is a peer-reviewed journal which is published twice in a year. As mentioned in earlier issues this University has three faculties-faculty of Science and Engineering, faculty of Arts and Humanities and faculty of Business. Authors from this university and also from different Public and Private Universities contribute to this Journal. The present Issue will focus some ideas on Science, Engineering & Business. We are grateful to the founder members of the Trustee Board of the University Engr. Mr. Abdul Aziz and Engr. Mr. Md. Abdul Alim whose supports and guidance have materialized ideas of this Journal. Our sincere thanks to the Vice-Chancellor Professor M. A. Razzaque for his guidance and supports. We also extend our sincere thanks to the reviewer for assessing different papers of the Journal. Thanks, are also to Mr. Md. Abu Hanif, Assistant Registrar & PS to the Vice-Chancellor for cover design and secretarial work and Mr. Md. Rahomat Ali, PS to the Vice-Chancellor for secretarial work.

Finally, but not the least to the editorial board for their kind suggestions and valuable advice.

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Energy Storage in an Impure Paraffin Wax Embedded in the Finned-Annulus of Two Horizontal Tubes: Part-II

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Abstract

This Part-II of the manuscript reports on the unsteady two-dimensional numerical investigations of melting of a paraffin wax (phase change material, PCM) which melts over a temperature range of 8.7°C. The PCM is placed inside a circular concentric horizontal-finned annulus for the storage of thermal energy. The inner tube is fitted with three longitudinal fins which are placed strategically near the bottom part of the annulus to accelerate the melting process. The non-dimensional conservation equations for mass, momentum, and energy are solved employing a staggered control-volume based finite difference method using the previously verified in-house CFD code. Under identical geometrical configuration and operating conditions, the melting characteristics of the finned annulus are compared with the annulus without fins presented in Ref. [1]. The numerical results show that the average Nusselt number over the inner tube surface, the total melt fraction, the total stored energy all increased at every time instant in the internally finned annulus compared to the annulus without fins. This is due to the fact that in the finned annulus, the fins at the lower part of the annulus promotes buoyancy-driven convection as opposed to the slow conduction melting that prevails at the bottom part of the plain annulus. Fins with two different heights have been considered. It is found that by extending the height of the fin to 50% of the annular gap about 33.05% more energy could be stored compared to the bare annulus at the melting time of 82.37 min for the identical operating conditions. The effects of fins with different heights on the temperature distribution are found to be different. The present study can provide some useful guidelines for achieving a better energy storage system and also can aid in the design/optimization of the shell-and-tube LHTES devices.

Keywords: Longitudinal fins, Natural convection melting, Heat transfer, Horizontal finned annulus,

Enthalpy-porosity technique, and Staggered grid.

Nomenclature

 $N u_{avg}$ circumferential average Nusselt number based on cylinder radius

Р

pressure, Pa

Pr

Prandtl number =
$$\frac{\mathbf{v}_f}{\alpha_f}$$

r _i	radius of inner cylinder [m]
r _o	radius of outer cylinder [m]
R _i	dimensionless radius of inner cylinder
R _o	dimensionless radius of outer cylinder
Ra	Rayleigh number = $\frac{g\beta_{PCM} (T_{WALL} - T_{SOLIDUS}) D_i^3 \rho}{\mu_{PCM} \alpha_{PCM}}$
Ra [*]	modified Rayleigh number = $\frac{Ra}{Ste}$
Ste	Stefan number = $\frac{C_P (T_{WALL} - T_{SOLIDUS})}{\lambda}$
Т	temperature [⁰ C]
T _{WALL}	inner cylinder wall temperature [⁰ C]
T_i	initial temperature of the working materials [⁰ C]
t	time
h^{*}	dimensionless enthalpy $= \frac{C_P (T - T_{SOLIDUS})}{\lambda}$
$h^{*}_{\scriptscriptstyle W\!ALL}$	dimensionless enthalpy at the inner wall
h_i^*	initial dimensionless enthalpy in the domain
θ, r	Polar coordinates, degree and m

Greek symbols

 α thermal diffusivity $[m^2s^{-1}]$

$$\beta_f$$
 coefficient of thermal expansion, $-\left(\frac{1}{\rho}\right)\left(\frac{\partial \rho}{\partial T}\right)_P$, K⁻¹

- $v_{f \text{ kinematic viscosity } [m^2 s^{-1}]}$
- ρ density [kg.m⁻³]
- μ dynamic viscosity [kg.m⁻¹.s⁻¹]
- λ latent heat of fusion [kJ.kg^-1]

ΔH nodal latent heat

τ

Fourier number,
$$\frac{t\alpha_{PCM}}{D_i^2}$$

fluid fraction

Subscripts

PCM antiouting	liquid
S	solid
i.	inner cylinde
0	outer cylinder
Superscripts	

* non-dimensional variable

1.0. Introduction

In Ref. [1], the dynamical thermal performance of the horizontal concentric circular shell and tube latent heat thermal energy storage (LHTES) unit is presented. It was found that due to the prevailing conduction mode of heat transfer at the bottom part of the annulus and for the low thermal conductivity of phase change material (PCM), the melting of PCM is very slow which is one of the primary bottlenecks in the applications of such LHTES units. The mushy region, which is bounded by the liquidus (59.9°C) and solidus (51.2°C) isotherms, was almost horizontal in shape and occupied the bottom region at the same depth after the threshold melting time of about 41.18 min for all the three different inner cylinder wall temperatures. In the concentric annulus case, it was noticed that neither the increase in Rayleigh number nor the increase in the melting time affected the conduction dominated zone at the bottom of the annulus (about $\theta \sim 0^{\circ}$ to 45°). How to improve the heat transfer characteristics of the PCM in a LHTES unit, particularly at the lower part is the primary motivation of this part of the study.

To resolve this inefficient heat transfer problem, the present study has specifically focused on the use of fins as a possible heat transfer enhancement mechanism for increasing the storage of thermal energy at the bottom part of the annulus. It is well-known that heat transfer in a horizontal annulus is limited by the heated inner cylinder when the outer cylinder is insulated. The fins can be attached to the outer surface of the inner cylinder to increase the heat transfer

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area. A number of experimental and numerical studies exist in the literature concerning single-phase and multi-phase natural convection heat transfer in an annulus fitted with the various configurations of the fins.

A detail literature review concerning the melting of the phase change material with regard to the energy storage has been reported in Ref. [1]. Therefore, in this part, only the published literature concerning the melting of the PCM in various systems in the presence of internal fins are reviewed. It is to be noted that the thermal conductivity of the PCM particularly of paraffin wax and their mixtures, which have proven to be suitable for low-temperature latent heat energy storage applications, are unacceptably low. During the energy storage process (melting) the effect of the conductivity of the PCM is not very significant since the melting is predominantly controlled by natural convection in the melt. But during the energy retrieval phase, the low thermal conductivity of the PCM drastically reduces the heat transfer to the receiving medium (sink) since the solidified layer which grows on the heat transfer surface (s) offers significant thermal resistance to the conductive mode of heat transfer.

One of the methods for enhancing heat transfer in a LHTES unit is by increasing the heat transfer surface area exposed to the PCM. In this regard, the addition of fins has been suggested and studied by many investigators [2-5]. Agyenim et al., [6] experimentally studied the melting and solidification characteristics of a PCM (Erythritol) in a double pipe heat exchanger where the PCM was placed in three types of the annulus, namely a plain, a circular finned and longitudinal finned annuli. Their temperature measurements in the radial, circumferential and longitudinal directions revealed that in the latter two directions the gradients were below 5% of the temperature gradients in the radial direction and the authors postulated that for the heat transfer analysis, it is not necessary to take into consideration the variations in temperatures in the flow direction of the HTF. The authors further found that the longitudinal finned annulus provided the best thermal efficiency compared to the other two cases. Sciacovelli et al., [7] reported that the heat transfer performance of shell-and-tube LHTES unit could be enhanced by tree-shaped fins. Their results showed that the solidification efficiency is increased by about 24% when fins with two bifurcations were employed. They further reported that the size and number of fins are important for phase change heat transfer characteristics. Hosseini et al., [8] studied the melting of a PCM inside a horizontal tube with longitudinal fins. In their study, they selected fins with two different lengths and their performance was studied for three different Rayleigh numbers (Ra). The fin length was found to have a significant effect on the melting time.

With the increase of fin length, the melting time was found to decrease while the depth of the melt increased. Using the commercial code ANSYS Fluent 13.0, Li and Wu [9] numerically studied the 3D melting and solidification problem of two phase-change materials (PCMs) in a horizontal concentric shell and tube heat exchanger. Of the two PCMs, one was a pure NaNO₃ and the other was a composite of NaNO₃/expanded graphite. A total of six fins each having a length of 2.5 times the diameter of the inner tube was placed at equally spaced angular positions. They found that the thermal energy storage (TES) unit with extended fins resulted in a decrease of about 14% in the full melting/solidification time compared to the TES unit without fins. For the composite PCM, the full melting/solidification time was found to decrease by about 20%.

From the above literature review, it is evident that the aforementioned studies primarily focused on the effect of the shape, size, and a number of fins on the heat transfer characteristics of the PCM in a LHTES unit. All numerical studies have dealt with either pure PCM or pseudopure PCM. In the literature, there is no report on the quantitative analysis regarding the energy storage capabilities of the PCM in a finned-LHTES unit. Therefore, in this study, a commercial paraffin wax as a PCM in finned-annulus is considered. Also, a detailed quantitative analysis of the energy storage is reported here. In order to promote melting in the conduction dominated zone in the lower part of the annulus, three longitudinal divergent radial fins with round tips are attached to the outer surface of the inner cylinder. These fins are placed one at the symmetry plane when the installation angle of the fin (θ) is equal to 0⁰, another at $\theta = 30^{0}$, and the third one at $\theta = -30^{0}$ at the bottom part of the annulus. The fin heights inside the annulus are arbitrarily set to 30% and 50% of the annulus gap ($L = r_0 - r_i$).

Three different fixed wall temperature (Tw) boundary conditions are selected for an initial Stefan number of zero. For the convenience of discussion, the fin height of 30% of the annulus gap (H = 0.3L) will be referred to as the short-finned annulus and the fin height of 50% of the annulus gap (H = 0.5L) will be referred to as the long-finned annulus. Through the analysis of the comprehensive heat transfer mechanism of heat conduction and natural convection heat transfer combined with the calculations of the melt fraction (f_L), the total stored energy, and the surface-averaged Nusselt number on the inner tube, all as a function of melting time are provided. A comparison between the finned-annulus and a bare annulus is also given. The results of this study can provide a reference for strategically arranged fins, based on which more efficient LHTES unit could be designed.

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2.0.Mathematicalmodel

Figure 1 shows the two-dimensional physical model of a LHTES unit which has the same geometrical configuration as that depicted in **Fig.2**.in Ref. [1]. In this study, three internal fins are attached to the outer surface of the inner tube at the bottom part of the annulus. The volume located between the two cylinders is filled with the PCM. The thermo-physical properties of the PCM are listed in **Table.1** in Ref. [1].**Figure 1** shows the cross-section of a horizontal annulus with three longitudinal divergent round tips fins. Two heights of a fin are selected. Each fin has a height (H) of either 16 mm (named as longfin) or 9.6 mm (named as shortfin). The thickness of the above-mentioned fins is given in **Table.1**. The cylinder walls and the fins are assumed to be highly conducting. For the sake of presentation, for the Part-I study [Ref. (1)], the LHTES unit will be called plain annulus while in the present study the LHTES unit will be called finned annulus. Since the physical domain is symmetric about the vertical centerline of the outer tube, the right-half of the annulus gap is chosen as the solution domain which is presented by the blue color in **Fig.1**.



Fig. 1. Schematic view of the cross-section of the finned annuluswhere the blue part representing the computational domain.

It is found that for a plain annulus presented in Ref [1], the cross-sectional area of the annulus gap is 72.38 cm^2 , which has hold 5.718 kg of PCM when the length of the cylinder is 1.0 m. For a finned annulusthough the embedding internal fin increases the heat transfer area, but the volume of the fins reduces the amount of PCM in a LHTES unit. It is calculated that for a long-finned heat exchanger 5.6624 kg of PCM fills the annular gap whereas for the short-finned annulus 5.6885 kg fills the annular gap. Thus, in this study, it will be investigated how the reduction of the amount of PCM due to the presence of the embedded fins will bring benefit regarding the storage of energy by reducing the conductive thermal resistance at the bottom part of the annulus.

2.1. Numericalformulation

The conservation two-dimensional equations in cylindrical coordinates $(r-\theta)$ in the general form can be written as follows:

$$\frac{\partial(\rho_r\phi)}{\partial t} + \frac{1}{r}\frac{\partial}{\partial r}\left(\rho_r r u\phi - \Gamma_\phi r \frac{\partial\phi}{\partial r}\right) + \frac{1}{r}\frac{\partial}{\partial\theta}\left(\rho_r v\phi - \frac{\Gamma_\phi}{r}\frac{\partial\phi}{\partial\theta}\right) = S_\phi \tag{1}$$

Where φ , Γ_{φ} , and S_{φ} are the general dependent variables, the generalized diffusion term, and the source term, respectively. The values of φ corresponding to mass, momentum and energy equations are 1, u, and v, and h. The associated variables Γ_{φ} and S_{φ} for all of the transport equations can be obtained by comparing the corresponding conservative equation for the variable φ .

The model assumptions, governing equations for laminar melt velocity and enthalpyin the r- θ coordinates for the phase-change problem along with the associated boundary conditions all are provided in Ref [1].To conserve the space these are not repeated here. An additional energy balance equation in the dimensional form for the solid fins can be writen as follows:

$$\frac{\partial(\rho_r C_P T)}{\partial t} = \frac{1}{r} \frac{\partial}{\partial r} \left(\frac{K}{C_P} r \frac{\partial(C_P T)}{\partial r} \right) + \frac{1}{r} \frac{\partial}{\partial \theta} \left(\frac{K}{C_P} \frac{1}{r} \frac{\partial(C_P T)}{\partial \theta} \right)$$
(2)

The non-dimensionalized conservative form of the energy equation for solid finis as follows:

$$\frac{\partial \Box^*}{\partial \tau} = \frac{\alpha_{Fin}}{\alpha_{PCM}} \frac{1}{R} \frac{\partial}{\partial R} \left(R \frac{\partial \Box^*}{\partial R} \right) + \frac{\alpha_{Fin}}{\alpha_{PCM}} \frac{1}{R} \frac{\partial}{\partial \theta} \left(\frac{1}{R} \frac{\partial \Box^*}{\partial \theta} \right) - \frac{\partial \nabla H^*}{\partial \tau}$$
(3)

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To improve the melting rates, aluminum is chosen for its high thermal conductivity as the fin material for both short and long solid fins. The physical properties and dimensions of the solid aluminum fins are listed in **Table.1**.Detailed solution procedure, code validation, grid and time independent tests, definitions of various quantitive items, all areavailable in Ref [1, 10].

Properties, symbol	Value [units]
Thermal conductivity (solid) (k)	0.1799 [kW / (m-K)]
Density (solid) (ρ)	2712.6 [kg/m ³]
Specific heat (solid) (C _P)	0.96 [kJ/(kg-K)]
Width of the radial divergent solid fins	evalian se entre sectores e traiti
Thickness (at base)	1.0472[mm]
Thickness (at tip)-for long-fin	1.8849[mm]
Thickness (at tip)-for short-fin	1.5498]

1 able.1. Flipsical properties and unexpess of the solid aranimum r	Fable.1	. Physical	properties and	thickness of	oftl	ne solid	aluminum	fit
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2.1. Results and discussion

In order to gain a better understanding of the role of the fins during the melting process, the process parameters such as the Prandtl number, radius ratio, inner cylinder wall temperatures and the initial Stefan number were all kept the same as the plain annulus studied in Ref [1]. In this section, the effect of the main process parameters, such as the inner tube wall temperature, the height, and the shape of the fin attached to the inner tube will be presented and discussed in detail. A comparison also will be made between the plain and fin annulus. It is to be mentioned here that in this numerical investigation of natural convection dominated melting of an impure PCM a lot of results have been generated. It is a challenge to present those results in a concise and meaningful manner so that the readers can easily understand the studied melting phenomena influenced by the different parameters. In this regard, a total of four cases is selected which are listed in Table 2. Because of the vertical symmetry along the θ -direction, a right-half of the domain is simulated in this study.

Table.2.Computational cases studied (Pr = 40.15, diameter of the inner cylinder, $D_i = 0.04$ m, diameter of the outer cylinder, $D_o = 0.104$ m).

Case	Geometry	Initial	Inner tube wall	Rayleigh	Stefan	Melting
elaile t	da etc. natrara	temperature	temperature	number	number	time (t)
, santa	st. Dr. 201 A.	of PCM	$(T_w)(^{\circ}C)$	(Ra)	(Ste_w)	(min)
Alia	a (alla), asarina	$(T_i) (°C)$	Acpros Ilaw sobal		ie Nieji Mater	ili ga istan in
1	Long-finned	51.2	69.9	1.09×10^{6}	0.2116	t=20.59,
	annulus					t = 41.18,
2	Long-finned	51.2	74.9	1.38×10^{6}	0.2682	t = 61.78,
151	annulus	net notroph	et de sourcearder			t = 82.37
3	Long-finned	51.2	79.9	1.67×10^{6}	0.3248	i ar Eisteri
latin se	annulus	ali anto de en	-18 u Jaan - dai		ale ju ank h	an si ni firia
4	Short-finned annulus	51.2	79.9	1.67×10^{6}	0.3248	of Asia Nav Africa - Contario

3.1. Cases (1-3) of Table 2: Temperature fields in the long-finned annulus.

Figures 2(a-d) display the transient progression of the isotherms within the right half of the cross-section of the long-finned annulus for four different time instants for case 1. The blue color region represents the mushy zone area which is bounded by the liquidus $(59.9^{\circ}C)$ and the solidus $(51.2^{\circ}C)$ isotherms. Above the liquid interphase in the unit, all isotherms are presenting the temperatures of the melted PCM. Initially, the commercial paraffin wax melts near the inner cylinder due to conduction mode of heat transfer but as the melt layer starts to grow the convection heat transfer gradually takes over. Starting from the bottom fin placed at the symmetry axis ($\theta = 0^{\circ}$), the melt gains heat and moves along the wall of the inner cylinder until it reaches the second fin at $\theta = 30^{\circ}$. At this point, the melt is forced to bend and flows downward along the second fin. The melt in between the fins is trapped and is unable to follow the contour of the outer cylindrical surface. This is mainly due to the blockage effect by the fins in the long-finned annulus. The lower surface of the second fin transfers heat only by conduction, preventing melt movement from the bay. The upper surface of the second fin enhanced the melt flow by convection adjacent to the inner cylinder wall.

Because of the high thermal conductivity of aluminum, the two fins quickly attain the inner cylinder wall temperature. Due to the temperature difference, heat exchange takes place between the fins and the melt and solid PCM by conduction and convection in between the fins and around the fins. The continuous heating of the downward moving melt faces an upward force near the tip of the second fin, causing deceleration of the downward motion. As the melt approaches near the top of the inner cylinder the flow starts to bend and move downward along the outer cylinder. For a fixed inner cylinder wall temperature, with the progress of the melting time, the melt temperature inside the annulus increases, as a consequence the buoyancy force decreases.

The beneficial effect of the fins in the concentric annulus can be seen by comparing among the Figs 2(a-d) and Figs. 5(a-d) (refer to Ref [1]). It is evident from these figures that for finned annulus the mushy region propagates with time much faster and gets thinner at the bottom part of the annulus compared to the plain annulus. The reason for this behavior is due to the greater convection currents in the melt at the bottom annulus zone created by the fins. The distorted melting front around the fin tip is also observed. The progress of isotherms in between the fins can be seen to have taken parabolic shape, indicating the blockage effect created due to the fins. The local heat transfer rate is high in the blockage region. Below the middle part of the annulus, closely packed isotherms are found at a longer melting time (t = 82.37 min) which results in a high heat transfer rate in this region.



(a) Time = 20.59 min

(b) Time = 41.18 min

(c) Time = 61.78 min (d) Time = 82.37 min

Fig. 2. 2-D views of the changes of the isotherms with time during the melting in a long-finned annulus for case1.

Due to the fact that Ra is relatively high in case 2 compared to case 1, the buoyancydriven convection manifests a bit earlier and is stronger in comparison to the previous case. The movement of the mushy region represents the progression of melting inside the annulus. In Figs. 3(a-d), it is found that due to the transferof additional heat in this case from the inner cylinder wall compared to case 1, the mushy region marches on in the gravitational direction. These local positions of the isotherms also indicate the difference between the low and high Ra. The blockage effect of the fins is evident up to the time instant of 41.18 min and beyond this time the blockage effect seems to have been eliminated.



(a) Time = 20.59 min



(b) Time = 41.18 min







(d) Time = 82.37 min

Fig. 3. 2-D views of the changes of the isotherms with time during melting in a long-finned annulus for case-2.



Fig. 4. 2-D views of the changes of the isotherms with time during melting in a long-finned annulus for case-3.

Compared to the previous two cases as Ra increases further in case 3, the convective motion of the melt is intensifying as is evidenced by the temperature distributions inside the annulus, depicted in Figs. 4(a-d). When Ra increases, the more closely packed isotherms found inside the annulus for a fixed time instant indicates that the local heat transfer rate is enhanced in this region. These densely packed isotherms also move toward the lower part of the annulus with the increase of melting time. The position of the mushy region is shifted more downward compared to cases 1 and 2, due to the increased convection. The blockage effect of the fin at $\theta = 30^{\circ}$ is prominent here up to the melting time of 20.59 min only.

3.2. Quantitativeanalysis

3.2.1. Average Nusseltnumber ($N\overline{u}_{avg}$) for cases (1-3) of Table 2 for the long-finned annulus

The surface-averaged Nusselt number ($N\overline{u}_{avg}$) against dimensionless melting time for cases (1-3) of Table 2 for a long-finned LHTES unit are given in Fig. 5. This figure shows that the average Nusselt number decreases in three stages. The trend of the graph is similar in nature to those seen in the plain annulus case shown in Fig. 8 (refer to Ref [1]). The $N\overline{u}_{avg}$ is the maximum at the beginning of the melting process when the temperature difference between the inner cylinder wall and PCM is the greatest due to the conduction dominated heat transfer. With the heating going on, the melting of the PCM around the outside of the inner tube increases, as a result, the temperature of the melt approaches to that of the inner tube wall temperature and hence reduces the temperature gradient therein, consequently the $N\overline{u}_{avg}$ is decreased with a sharp negative slope, as can be seen in Fig 5, at the beginning stage of the melting process.

Meanwhile, in the intermediate stage, although the natural convection effect is intensifying with time the gap between the inner cylinder wall and the solid PCM is also increasing. Thus, the beneficial effect of natural convection is reduced by the negative effect of the extended liquid layer of the PCM between the tube wall and solid PCM. The latter factor is responsible for the gradual decrease in the slope of $N\overline{u}_{avg}$ versus time curve in the second stage. With the progression of melting, all the three curves decay more gradually compared to the second stage and this is because as the melt gains heat from the inner cylinder wall it gets

thermally stratified and proceeds towards the thermal equilibrium state. A threshold time of about 41.18 min is found for each case in the graphs $N\overline{u}_{avg}$. After this time in all the three cases (1-3) the $N\overline{u}_{avg}$ is reduced significantly. The increase in Rayleigh number increases the average Nusselt number as expected. The higher Rayleigh number corresponds to the higher inner tube wall temperature and thus transfers more heat from the inner tube wall to the PCM due to the increase of the thermal gradient which has resulted in strengthening the natural convection in the annulus.

The extended fins greatly increase the heat transfer area, which improves the heat transfer efficiency from the inner cylinder wall to the PCM. Thus, the LHTES unit with fin performs better than the unit without fin (Fig. 8 in Ref [1]). The placement of the fins at the bottom part of the annulus reduces the heat resistance which occurred due to the conduction dominated heat transfer there. Therefore, for the finned annulus, a lower surface-averaged Nusselt number is obtained after a certain time instant, compared to that of the plain annulus.



Fig. 5. Changes of the surface-averaged Nusselt numbers on the inner circular cylinder with melting time for cases (1-3) in the long-finned LHTES unit.

3.2.2. Transient evolution of melt fraction (f_{I}) and the total stored energy for cases (1-3) of Table 2 for the long-finned annulus

Transient evolutions of the total liquid volume fraction and the total stored energy for cases (1-3) for the long-finned annulus are given in Figs. 6 and 7, respectivelyfor three different Rayleigh numbers. Comparisons of the three cases indicate significant variations in each of the above quantities for a fixed time span. There is a threshold time beyond which the rate of increase of the above quantities diminishes significantly for all the three cases. This time is seen to be about 41.18 min for the studied LHTES unit and is found to be identical to the plain annulus case.

Fig. 6 shows a very similar trend to the temporal $N\overline{u}_{avg}$ graphs(refer to Fig. 5). The rate of melting shows three stages in each of the three cases similar to the $N\overline{u}_{avg}$ graphs. The reason behind this is explained in the previous paragraph. At the time instant of 82.37 min, the melt fraction is found to be approximately 0.95, 0.96, and 0.97 in the long-finned annulus for the three cases (1-3). In case of the plain annulus, for the above time instant, the melt fraction is about 0.73, 0.74, and 0.75 for the corresponding cases (refer to Fig. 9 in Ref [1]). For the case of the finned annulus at the melting time of 82.37 min, about 30 % more PCM is melted compared to the plain annulus and the later statement is found to be true for all the three cases (1-3).



Fig. 6. Changes of the cumulative total liquid fractions with melting time for cases (1-3) in the long-finned LHTES unit.

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Fig.7 shows that the amount of stored energy is enhanced considerably with the increase in melting time and for the higher values of Ra. At an elapsed time of 41.18 min, the total stored energy is 532.14 kJ/m for case 1, 590.67 kJ/m for case 2, and 639.69 kJ/m for case 3 (Fig. 7), which in comparison to the melting time of 20.59 min, is only 21.0 %, 18.63 % and 17.77 % greater, respectively. On the other hand, for case 1, after an elapsed melting time of 41.18 min, the total stored energy is only 10.24 % and 5 % higher for the subsequent two additional incremental time span of 20.6 min. For case 2, it is only 7.51 % and 2.22 % higher, whereas, for case 3, the increment is about 4.45 % and 1.22 %, respectively for the two subsequent time spans of each of 20.6 min. From the above analysis, it is observed that after the time instant of 41.18 min, the buoyancy-driven convection becomes weaker and weaker with time and the thermal distribution in the shell gradually tends to reach the homogeneous condition. At the end stage of melting, quite a long time is required for storing even a little amount of energy compared to the beginning and intermediate stages. Furthermore, it is observed that the rate of the incremental trend of total stored energy for a higher value of Ra is less compared to the lower value of Ra. This is because of the fact that at a higher value of Ra, the conduction mode of heat transfer takes over the convection at an earlier stage, and as a result, a less amount of sensible energy is stored.





In comparison to the plain annulus (Fig. 10 in Ref [1]), it is found that at a melting time of 82.37 min in the long-finned annulus about 32.87 % for case 1, 33.65 % for case 2, and 33.05 % for case 3 more energy is stored. The shell–tube LHTES unit with attached fins holds 2,8312 kg of PCM which is 0.0279 kg less compared to the plain annulus. Despite the less amount of PCM in a finned annulus, it stores significantly more energy due to the increased rate of the heat transfer process.

3.2.3. Comparison of the temperature distributions and on the total cumulative stored energy between case3 and case4.

To examine the influence of the height of the fin on energy storage system, two different heights of the fins are considered. In the earlier discussed case, case-3, the fin height is 50 % of the annulus gap (H = 0.5L) and in case 4, the fin height is considered to be 30 % of the annulus gap (H = 0.3L). Thus, due to the different heights of the fins, the shape of the annulus gap between cases 3 and 4 is altogether different. Figures 8(a-d) representing case-4 show a similar trend in terms of the temperature fields as in case3. Due to the change in height of the attached fin, the strength of natural convection which has a predominant effect on the energy storage during the melting process has varied and this is particularly true after the initial conduction dominated period. In general, the increase in the fin surface area, which is employed to enhance the heat transfer into the PCM, has increased the melting rate. The convection flow is also accelerated by the increase of fin height which can clearly be seen from the temperature fields prevailing in Fig. 4(a-d).



Fig. 8. 2-D views of the changes of the isotherms with time during the melting in a short-finned annulus for case4.

All of the temperature distribution figures show that this accelerated heat pushes the mushy region more downward than does the short-finned annulus. An inspection of the temperature isotherms clearly indicates the effect of blockage in between the short fins. From Figs. 8(d) and 4(d), it can be seen that at the melting time of 82.37 min, the total melted fraction for the short-finned, and for the long-finned annulus is 0.93, and 0.97, respectively. The enhanced strength of the natural convection inside the long-finned annulus which in turns has led to a higher rate of melting.

A comparison of the total stored energy between the two cases is shown in Table 3. It is seen that more energy is stored for case 3 compared to case 4 at every instant of time. At the final simulated melting time of 82.37 min, about 4.36 % more energy is stored in the long-finned annulus (case 3) compared to the short-finned annulus (case 4). In short-finned annulus, the total energy storage is enhanced remarkably up to the melting time of 41.18 min and after this time period, the thermal energy storage slows down similar to the long-finned annulus.

In comparison to the plain annulus (Fig. 10 in Ref [1]), in the short-finned annulus, the total stored energy is about 21.6 % higher at the melting time of 82.37 min for the Rayleigh number of $Ra = 1.67 \times 10^6$ and for $Ste_i = 0$, suggesting that a stronger overall convection effects are at play during the melting process for the short-finned annulus.

Table.3.	The cumulatively stored total energy (kJ/m) for case3 (long-finned annulus) and for
	case4 (short-finned annulus) for four different time instants.

		Geometr	у			Melting tim	ne (min)	
					20.59	41.18	61.78	82.37
Total	stored	energy	in	long-finned	526.01	639.69	668.13	676.25
annulu	s(kJ/m)				i			
Total	stored	energy	in	short-finned	491.01	595.19	630.51	648.02
annulus	s(kJ/m)	5						

Therefore, in terms of energy storage, the long-finned annulus is always preferable for the melting process than the short-finned annulus.

4.0. Concluding remarks

In this work, the effect of the geometrical configuration of the LHTES unit with and without extended fins is systematically studied. From the present comprehensive 2-D CFD modeling study the following conclusions can be drawn:

- [1]. The amount of melt is increased as the melting process continues for all the studied LHTES devices i.e., for all the cases.
- [2]. At the early stage of melting, the conduction heat transfer dominates the melting process for all cases. Then with the progression of melting, in the top region of the annulus, a pear-shaped thermal plume is observed due to the initiation of the natural convection in the melt.
- [3]. As the melt flows along the inner tube it gains heat, as a result, the density of the liquid PCM decreases compared to the solid PCM which manifests in the increased strength of the buoyancy-driven convection in the top region, and thereby the melting in the top part of the annulus is much fastest than in the other regions at each elapsed time.
- [4]. For a fixed time instant and for a fixed initial temperature of the solid PCM, an increase in the Rayleigh number increases the melting of PCM due to the increase in the intensity of natural convection, particularly at the top part of the annulus.
- [5]. For a fixed initial temperature of the solid PCM, the surface-averaged Nusselt number decreases with the increase in the melting time in three stages. At the first stage of melting the reduction rate is remarkably high compared to the intermediate and last stages due to the intensified natural convection therein. In the latter two stages, the rate of the decease of the average Nusselt number slows down due to the gradual attainment of the thermal stratification. With the increase in the Rayleigh number, the averaged Nusselt number increases.
- [6]. The high thermal conductivity of aluminum fins at the lower part of the annulus play an important role in the melting process by generating strong convective and conductive modes of heat transfer. The finned cylinder, with identical boundary conditions as the plain annulus, does promote more heat transfer and bring about totally different melting patterns. The presence of fins increased the energy storage of the heat exchanger by increasing the melting rate of the PCM compared to the plain geometry.

[7]. When the fin height is taken into consideration, it is observed that the longer fins show a betterthermal performance than the shorter fins.

From this study, it is revealed that for a horizontal double pipe storage system a good way to enhance the latent heat thermal storage capacity is by placing long fins with high thermal conductivity at the lower part of the annulus.

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An Empirical Study on Determining the Association Between Micro Finance and Poor's Access: Evidence from Pakistan

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Abstract

The aim of this research paper is to investigate the relationship between the impacts of micro finance on poor people's access. This study consists of quantitative methodology. The aims of these methodologies are to find a feasible solution of the problem. This study also provides a guideline to the beginner research questions as following. What are the problems during access? What are the problems related to mechanism and procedure for obtaining micro finance? Stratified random sampling techniques were used to get a total of 96 respondents. Data were collected through semi structured close ended interviews, questionnaires, observations and documentary reviews. On the basis of these findings the government takes interest and supports the microfinance sector and their main initiatives are microfinance ordinance 2001 and also providing a guideline to the policymaker on the basis of finding they can remove the problem which are facing by poor peoples during micro finance procedure.

Keywords: Gender, Micro Finance, Investment,

JEL Classification: G23, Z13

1.0. Introduction

Micro finance defines as the economic and monetary provision of financial service to the peoples. This service includes saving and credit; many of institution providing payment and insurance services to the poor peoples. Micro finance refers to a small loan which is commonly utilized for working capital. The micro finance easy consideration of borrowers and play a role for creation of investment opportunity and provision of surety substitutes such as personal group guarantee, obtaining the micro loan based on best repayment performance of debt capacity. Micro finance also activities also system for recognized the system loan disbursement and its monitoring. It is complicated process for the poor peoples to obtained small loan. But nowadays several microfinance institutions established to resolve the problems related to get

microfinance but micro finance is particularly for those peoples who engaged in small level of business. These institutions are the organizations the main objective of these institutions to provide micro credit and loan service to the poor peoples for self-employments and provide financial assistance to invest capital in small business and generate income activities. On the other side, Micro finance is not integral part of the commercial banking industry or government system. But they are also taking part into informal commercial banking such as Non-Government organization (NGOs). Furthermore micro finance, formal credit schemes do not typically take gender into account in practice; they tend to be biased towards men. It is the male dominant household which is usually approached and registered for the provision of institutional credit. Most of poor people's are protecting themselves from poverty, therefore they want to increase their source of income and also increase the right path out of hunger by shaking hand to micro finance.

The basic purpose of these to get ordinary life and take the benefit for education, to bridge a cash flow gap or to take the advantage of investment opportunity, micro finance may be the initial step in contravention of the poverty cycle. Micro loan is very beneficial and helpful for poor people because of it they are getting more money to acquire assets, goods and services for business at small level. Unlike the high society's member for the purpose of better health care, residential place, and sending their children to a well reputed schools, colleges, and universities. The availability of financial services is just like a shock absorber to meet uncoordinated accidental emergencies, financial, economic or business risks on business cycle, or the sudden disastrous events like earthquake, famine, flood etc. And also a sudden loss of any of the family members that can push a poor family into destitution.

Micro finance also provides help to enhance the outreach of the existing NGOs and social organizations. Not only is the government of Pakistan but World Bank also the major contributor to the PPAF project. At the start of PPAF, an agreement was signed with five Partner Organizations i.e. Agha Khan Rural Support Program, Taraqee Trust, National Rural Support organization, Family planning association of Pakistan and Kashif foundation to disburse Rs. Five billion over the next five years to reduce the poverty. According to survey by Pakistan micro finance network in 2009, there are 20 to 30 Million clients who want to take Micro Finance services in Pakistan. PPAF has been started by the government of Pakistan to give the short term loan for one year to the people to start small scale business. Khushali Bank, Bank of Khyber, Rural Support Program and non-trading concerns like Islamic relief micro project etc. are also important microfinance provider institution in Pakistan.

2. Literature Review:

Pakistan is common Muslim country of the world and for a Muslim country only micro finance cannot help at all. In opposite Islam fixed prescribe ratio of 2.5% as Zakat (Obligatory tax in Muslim law) which is must paid every year on different possession of assets or cash or others [1]. Provident and Zacharia Formation and accessing group as collateral is the most important reasons for the micro finance which is relatively and comparatively affordable to other loans because the customer may use it for the purchase of domestic plant assets such as plant, electricity equipment and furniture etc. Sometimes this kind of formation of group and load is cause of the problem for the poor with the respect to access to micro finance. Most of the time they can't back payment at the right time. It makes the problem in groups for one member [2]. It is for the reason that the bunch security system shows the positive preference to high earners. Moreover, instantaneous family unit requirements are met out of group loans but circulation of generative activities are used by many people [3]. General people can take access to micro finance in the figure of salaried loads. In context of South Asia especially Pakistan, poor people doing work on daily basis and they don't have permanent job. They have also limited resources and work category [4]. The main reason is education and they are failed to get loans because personal employer guarantee or collateral conditions, so it's difficult to take salaried loans [5].

Some places have some good relation with employer. For the reason they are getting low class job like peon, security guards, driver and others low cadre jobs who can't provide guarantee to the employee for the micro finance loans or salary loans [6]. Any how they manage the guarantee but for the less mount of salary they can't easily assessing this credit [7]. Because less amounts of salary and load rules of the financial institute is loan should be four times of the net salary draw by the employees. As a poor employee, they are getting low amount which is not fillup their business or farming requirement to the anticipated scope [8]. Credit accessibility by the poor is an important factor in determining the effectiveness of micro finance banks in poverty reduction [9]. Our study location is Bank, Customer, credit terms and condition and distinguishing of customers. Lots of bank changed there banking systems for the micro finance with collaboration NGO such ABN Amro, Deutche and some internation bank contributing credit for the micro finance activities like CITI BANK Montgomery and Weiss, (2005) [10]. Lots of statistics shows for the friendly loan system, rich people are taking loan as compared to the poor people Coleman (2010)[5]. Access to Micro finance and age had a negative but significant relationship (Khalid, 2003), Zeller (2000), Parker and Nagarajan (2001),

Shaw, J. (2004) Khandkr (2001), Provident J. Dimosol and Zacharia S. Masanyiwa (2002), Shahzad Ahmad, Muhammad Sajid Naveed and Abdul Ghafoor (2004), Pitt and Khandker (2002) [9,11,12,13,14,15,16,17]. Friendly access to MFIs helped the poor people to produce self-employment chances, Managerial skills, productivity, and positive cash influxes and reduce the consumption cost etc. which in turn enabled them to increase their income level and other socio economic assistances like education and health care [18].Some study shows MI has positive relationship or impact with borrower higher monthly income after accessing to credit. Shaw (2004) and Saunders M;Lewis, p.; Tronhill, A. (2007) studied two microfinance institutions in Sri Lanka and showed that the less poor clients' micro business that accessed loans from micro finance programs could earn more income than those of the poor does [13,19].

2.1. Objectives of The Study:

- To investigate the relationship between microfinance and poor access.
- To identify the cause and effect between microfinance and poor access.

3.0. Statement of The Problem:

The problem under study was to investigate the role and impact of micro finance on poor's access. Micro finance is one of the main source of funding for poor's because it helps the poor's to start their business and will become an entrepreneur. It is really important to analyse the role of micro finance in backward areas like D. I. Khan because the people of such area can get a lot of benefits from micro financing and they can move towards prosperity. There are number of studies done on the concept in different geographical areas throughout the world but no such study is conducted in Pakistani context, especially in D. I. Khan. So current study is helpful to solve the problem that either micro finance can lead the D. I. Khan poor society towards better living standard.

3.1. Research Hypothesis:

This research study is based on the following hypothesis:

- H0 = Micro finance has no impact on poor's access to Micro finance in the study area.
- H1 = Micro finance has impact on poor's access to Micro finance in the study area.

H0 = MF = 0

$$H1 = MF = 0$$

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4. METHODOLOGICAL FRAME WORK:

i. Data Collection

For this study we included the farmer and businessman in Dera Ismail Khan's district, Pakistan. For the huge amount of population it very difficult to contact to each and every member of population. We are select limited area for this study purpose but density area. we are considered 96 sample respondents and analysis the cost and benefit. To give maximum chance of selection to each and every member of the population, stratified sampling method was used by the researcher.

ii. Method of the Data Source

We are collected data though questionnaire mode for the study. Our questionnaire as used as a research tool. We are selected density area, as a populated area we always try to avoid meager response, we are done questionnaire by self from the different town and regions and all is filled by responders. Sometimes we ask the question and write down on the sample answer because of most of the farmer isn't literate. Primary data collected during the course of this research study was subjected to statistical analysis by using SPSS version 11.

iii. Modeling

In the Business Administration, Social sciences and management discipline, most of the time using the Linear Model and using ordinary least square is much popular analytical tool (Cleary & Angel 1984). Linear model most of the time science base statistic.

Researcher Used ordinary least square to predict a function that relates dependent variable (Y) to independent variables (x1, x2, x3...xn)

This linear function that can be shown as:

$$Y = a + bX_i + e_i$$

Where-

Y = Dependent variable,

a = Constant, b = Slope of line,

 X_i = Independents variables,

 $e_i = Error term$

Model Access to Micro finance:

Y = a + bX1 + bX2 + bX3 + bX4 + bX5 + bX6 + bX7 + bX8 + bX9 + ei

Where,

Y=Access, a=Constant, X1=Gender, X2=Age, X3=Occupation, X4=Experience, X5=Family Size, X6=Marital Status, X7=Credit, X8=Investment, X9=Education ei=Error term.

iv. Data Analysis and Interpretation:

Table.1 shows on five out nine independent variable i.e Age, Gender, occupation, family size and experience where had insignificant impact R2=.318 on the access to MF shows slight change in all of the independent variable and its takes approximately 32% change in the access to MF where marital status, investment, education, credit amount this four independent variable had significant impact on access to MF. **Table.1** significant impact p=.000 of dependent variable and for the independent variable collectively at F=4.465 overall.

Model	R	R ²	Adjusted R ²	F	Sig.
1	.564	.318	.247	4.465	.000
Independent	Un star	ndardized	Standardized	S 2. 1	
variables	Coefficient		coefficient	Т	Sig.
	В	Std. error	Beta		
(Constant)	37.409	7.908		4.730	.000
Gender	.675	1.797	.037	.376	.708
Age	054	.107	062	501	.618
Occupation	2.071	2.447	.089	.846	.400
Experience	033	.167	026	200	.842
Family size	.128	.318	.042	.404	.687
Marital status	4.160	2.204	.213	1.888	.062
Credit amount	.000	.000	-1.080	-4.973	.000
Investment	.000	.000	.954	4.120	.000
Education	554	.184	329	-3.010	.003

Table.1: Different variables on Access to Micro finance impact (Regression)

v. Gender

Table.2 shows in gender insignificant impact p=.715, t-test using on access of MF. Table 4 shows Access of MF with correlation of gender as found about 16%.

Variables	F	Sig.	t- values	Df	Sig.(2- tailed)
Gender	.754	.388	366	94	.715
Occupation	.149	.701	-1.499	94	.137
Marital status	3.241	.075	-2.307	94	.023

Table.2: Different variables on Access to Micro finance using t-test impact

This table is showing that the gender had equal access to micro finance because both know information regarding to obtain credit loan and they well know how to get micro finance loan.in this research area males can go easily to any financial institution and get information how to get and other matter related to micro finance rather than female.

vi. Occupation

Table.2 shows access of MF on occupation and its insignificant impact p=.137. Table 4 figure out access of MF and 13% correlation between with occupation and MF. Our study area was on farming and small business and occupation was respondents on that. Those are (farmer and businessman) accessing MF required information to get credit, bases of credit, interest rate, procedure to get credit and others qualities had no change to any one occupation in the research location.

vii. Marital Status:

Table.2 shows marital status significant impact p=0.023 in the basis of study area. Between the Marital status correlation access 14% Table-4. Researcher found from the respondents data, married person mainly taking higher responsibility to support the family. They have lack of finance but most of the person wanted to improve the business but need more investments. Most of the poor respondents has to depend upon MF. So they had need to know information about interest rate, credit provision and others to take interest in their business. About loan, leading institution might be ready to provide those information effectively.

Variables	Levels	Sum of square	Df	Mean square	F	Sig.
Age	Between	na an a	R at p		dan sa	
i Gritter (j. 1944)	Groups	74.645	2	37.323	.484	.618
i koʻngariyan koʻrkan	Within	al this name of 200	9 8 4 J 1	1987 - 23v	1.1.5	acti ba
	Groups	7174.261	93	77.143	t in Alter	20.25 MOS
	Total	7248.906	95			
Experience	Between				. 335	est a sign
ice i the se	Groups	636.829	3	212.276	2.954	.037
	Within	na de la serve	28.97 - 23	and a set	e merce la de	da. ^{Co}
and a star	Groups	6612.077	92	71.870	an shuar n	i star
	Total	7248.906	95	adur e ser	al 2 ol 8	urit Apar
Family size	Between		æ			
	Groups	786.054	3	262.018	3.730	.014
lare de la comp	Within	Territoria Territoria		- 1. 1 Å.	an e	
	Groups	6462.852	92	70.248		
	Total	7248.906	95			
Credit	Between				1.1.1.1.1.1.1.1.1.1.1.1.1.1.1.1.1.1.1.	
	Groups	1479.113	2	739.557	11.920	.000
	Within	2				
	Groups	5769.793	93	62.041	nen är Linn Korr	· · · ·
	Total	7248.906	95			
Investment	Between	2				
	Groups	290.157	2	145.078	1.939	.150
	Within					
	Groups	6958.750	93	74.825		
	Total	7248.906	95	-		
Education	Between					
	Groups	453.173	4	113.293	1.517	.204
	Within					
	Groups	6795.733	91	74.678		
	Total	7248.906	95			· · · ·

Table.3: Different variables on access to Micro finance using ANOVA impact

viii. Age

Table.4 showing that there is insignificant impact p=.618 (Table 3) on access to micro finance using ANOVA. Correlation of age with access to micro finance was found approximately -16% (Table 4). Because the age group of the study area either lower, upper or middle had equal access to MF. The figure point of this reason was they had all information and honor to get MF. They knows how to take this, they have ability to pay interest and procedures to get financial loan.

Experience

On the access of MF in the study areas experience significant impact p=0.037 Table 3. Table 4 shows that -15% aprix was correlation of experience access. Researcher found from the respondents data, married person mainly taking higher responsibility to support the family. They have high interest to improve the business and extent their resources in better way.

Variables	Pearson Correlation	Effect	Sig.(2-tailed)
Access & Gender	0.161	+ve	.116
Access & Age	0.155	+ve	.132
Access & Education	-0.107	-ve	.298
Access & Occupation	0.129	+ve	.211
Access & Experience	-0.154	-ve	.135
Access & Family size	0.038	+ve	.716
Access & Marital Status	0.140	+ve	.175
Access & Credit	-0.321	-ve	.001
Access & Investment	-0.209	-ve	.041

Table.4: Correlation of different independent variables and access to micro finance.

ix. Family size:

The above table showing that there is significant impact p=0.014 (Table 3) on access to micro finance. Correlation of family size with access to micro finance was almost 4% (Table 4). All the family members had access to micro finance.

x. Credit

The above table showing that there's significant impact p=.000 (Table 3) on access which means that respondents had received the amount of loan whatsoever they had applied for. They utilized that amount of credit for their genuine purposes in order to get maximum output.

The correlation of credit with access to micro finance was -32 % approximately (Table 4). In this research all the respondents had responsibilities to support their family therefore they wanted to enhance their business therefore they needed most of poor people's dependent on micro finances the leading institutions provide all require information to the borrower about interest rate provision and source etc.

xi. Investment

The above table showing that there is insignificant impact p = .150 (Table 3) on access to micro finance and correlation of investment with access to micro financé was about -21% (Table-4) which showing that investment had not used properly.

xii. Education

Table.3 shows education had insignificant impact p=.204 on access to MF using by ANOVA. Table 4 shows -11% aprix correlation of education with access to MF. Because the age group of the study area either lower, upper or middle had equal access to MF. The figure point of this reason was they had all information and honor to get MF. They knows how to take this, they have ability to pay interest and procedures to get financial loan.

5.0. Results, Discussions and Findings

Using Linear Regression Model had positive significant impact at all and MF has found strongly correlated with access of MF at R=0564 & R2= 0.318. For access of micro finance (MF) they have positive significant with marital status and investment. Most of the time married person are giving full of attention of the access of MF. It's proved that if any one invest more amount then they are get more output, so that to create good will in the MFIs book. There is also shows that negative significant impact with credit amount and education. Irrespective of prerequisite of respondents, each and every respondent had equal access to micro finance. Have positive insignificant impact of access of Gender, Occupation and family Size, so it's proved that those are playing greater role of accessing of Micro Credit but not importance given to above factors. Negatively insignificant impact on access to micro finance and they have less experience on that, so they have no access of micro finance. But at all MF has positive relation and impact on poor's access who are the living on poverty line, MF help to cope up from the hazardrial moments.
6.0. Conclusion

The micro finance easy consideration of borrowers and play a role for creation of investment opportunity and provision of surety substitutes such as personal group guarantee, obtaining the micro loan based on best repayment performance of debt capacity. Micro finance also activities also system for recognized the system loan disbursement and its monitoring. It is complicated process for the poor peoples to obtained small loan. But nowadays several microfinance institutions established to resolve the problems related to get microfinance but micro finance is particularly for those peoples who engaged in small level of business. Our research location area MF is granted and community of the people have positive respect for the MF because its most of the time reduce the poverty, improving the financial condition, improving the standard of living with extended current business condition. Most of the people paying the principal and interest though installment. At all MF has positive relation and impact on poor's access who are the living on poverty line, MF help to cope up from the hazardrial moments. Lots of the respondents are argue that the micro finance interest rate is so high but study shows that main problem to get loan or accessing the micro finance (MF) is collateral or personal guarantee.

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Community Based Approaches to Disaster Risk Reduction in Bangladesh

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Abstract

Bangladesh is disaster prone country and community participation is most effective way to cope up disaster risk. As a disaster prone country every year thousands of live and resources has been destroying at the time of tornados, river bank erosions, cyclones, tidal bores, landslides and earthquakes etc. Every year those kind of natural hazard are affecting in our country. Basically, Bangladesh is surrounded by thousands of river, Himalayan range andBay of Bengal are creates punitive situation for thelarge number of people in theapart of Southern. For the sustainable development, we need to minimize impact of natural disaster. On the others hand prevention of rate of natural disasters prejudiced by natural causes may be impossible but we can reduced it by proper planning, management, human cooperative participation and through awareness. For the realization of this situation, the government of Bangladeshlooks disaster management plan and program for the mitigation of disaster and foreign agency like EU, UN, JICA etc. doing work with government and also with national NGO to minimize the disaster risk for sustainable development. This study analyzes the approaches to disaster management bymasscommunity participation andalso has some recommendation after disaster based on literature review.

Keyword: Risk Reduction, Community Participation, Disaster management, Sustainable development.

1.0. Introduction

Bangladesh is under development and disaster prone country. The area of this country is 148,460 sq km[1] and total population 157 million[2]. Due to geographic location Bangladesh suffering various types of natural Disaster like cyclone, flood, landslide drought etc regularly and frequently. For the purpose damaging economic infrastructure, livelihoods, assets and employments. Disaster also introduced by human like climate change problem.

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It's already effected and making sea level change. Researcher already predict at the 21 century possible sea level will rise of 0.3 - 2.5 m (2017)[3]. As a result low land deltaic south Asian country will go under water in near future. Due to cause of natural disaster economic losses total about US \$3,313 billion at the period of 2000-2017 (**Fig.1**) all over the world and millions of people lost their living house [4]. Recent eras most developing world has undergone momentous changes for the disaster management, especially reduction of human lives loss as a consequence climate change. It's not only hampering the specific country but also affecting all over the world. In the situation Bangladesh taking extreme experience regarding of climate change.



Fig. 1:Source: Statista, Global economic losses from natural disasters 2000-2017

Bangladesh is located in coastal areas and most of the cyclone are hunted in the coastal zone. It's claimed millions of lives and caused the huge amount loss at the period of 1960 and 2017. 1970 cyclone took 500000 human life and damaged one billion US dollars property, another cyclone hited on coastal zone at 1991 and its takes .14 Million people lost lives and damage more than two billion of dollar property. 1960, 1961,1963,1964,1965,1966,1969,1988 to 2017. Also took millions of life and billions of dollarproperty damages. At the year of 1998, hunted the flood of the 52 districts of the country, its took 1517 human lives and 1998 flood took 918 lives. Those flood damages billions of dollar property and also hamper the Bangladesh economy at the same time. Another flood at the season of 2004, which is the reason for an economic misfortune of about US \$ 2.3 Billion [5-9]. As far as GDP, this misfortune was not as much as what the world's poorest nations

looked amid the 1985– 99 debacles – lost 13.4% of consolidated GDP. In any case, the misfortune in Bangladesh added up to a tremendous advance in reverse being developed endeavors [10]. The floods in 2007 immersed around 36% of the aggregate region in 57 out of 64 areas and influenced no less than 4.5 million individuals.Tornadoes of 14 April, 1969, 11 April, 1974, 01 April, 1977 and 26 April, 1989 to 2017 caused restricted destruction, both regarding lives and properties [11]. In view of the outrageous weakness of the general population different administrations of the legislature of Bangladesh have built up an institutional foundation to manage common perils and their potential misfortunes.

Customarily, the catastrophe administration approach in the nation has been neglected to successfully manage the issues of disaster loss. In introduce time, non-basic measures and also pre-calamity relief and readiness are activities that perceive the parts of various partners (government, nearby groups, NGO/CBOs, media, the private area, the scholarly world, neighboring nations, and donor communities). For instance, the Disaster Management Act of 1998 recognizes the limit of influenced populaces (GOB, 1998) [12]. The GOB developed 2500 typhoon covers and 200 flood shelters and 482 little, medium and extensive water and flood control ventures (Dewan, 2015)[13] however just 99 flood shelters are dynamic (IFRC, 2014)[14] for departure of individuals presented to approaching violent wind and in addition floods.

2.0. Methodology

Relevant secondary data and information from various official sources collected to support the study such as project documents, annual reports, official statistics, official regulation documents, grey literature and journal articles.

2.1. Conceptual framework

2.1.1. Disaster

Disaster is a sudden, calamitous, distressing, or ruinous effects of a disastrous event by which the working of a general public or a group including far reaching human, material, financial or economical condition etc. are genuinely interrupted. The ability to adapt utilizing its own particular assets of the affected society or group is surpassed by it.

2.1.2. Disaster management

Disaster management is a process of getting prepared to improve the impacts and to mitigate the risk of disaster involving emergency operation and rebuilding the society after the occurrence of devastating disaster (Tan, 2009).

It is associated with various factors and it is obvious for us to have good understanding about the disaster. Hazard is characterized as the likelihood of the event of an unsafe marvel at a given place inside a given timeframe. Then again, vulnerability is characterized as the level of defenselessness to a peril, or the absence of ability to ingest the effect of a risk and recoup from it [15]. Hazard is dependably not disaster but rather when the structural and non-structural frameworks of influenced zone are excessively flimsy, making it impossible to adapt to these dangers at that point risk transform into disasters. Fundamentally, peril like flood, cyclone, dry spell, tsunami and so forth are meteorological hazard yet as indicated by UNDP this kind of danger get the state of calamity when vulnerable populaces don't have the capacity to battle it and who can't adapt to it [16]. The administration alone can't and won't have the capacity to legitimately oversee and handle a wide range of disasters with its apparatus without dynamic cooperation by the general population of any nation, a common theory given by policy makers, experts and professionals.

Failures of top-down effective disaster management approach to reduce the risk of disaster are the evident of that notion. As a result, various researchers and stakeholders feel that the opportunity has already come and gone to receive another technique that will include vulnerable individuals specifically in the arranging and execution of mitigation, preparedness, response, and recovery measures. Because these groups are the best to judge their own vulnerability and they are fit for settling on the best choices with respect to their prosperity. This theory, includes nearby level individuals, pioneers and group to give important administrations and co-ordinations to their casualties amid and after debacle has been energized both in the created and creating nations and propelled the age of Community-Based Disaster Management (CBDM) methodology.

2.1.3. Emergency response

Emergency response incorporates the basic administrations and exercises that are attempted amid the underlying effect or in the consequence of a disaster. It also includes protection of properties from further damage and saving of lives.

2.1.4. Vulnerability

Vulnerability alludes to an arrangement of overall and considerable conditions that antagonistically influence the capacity of a man, gathering or group to counteract, alleviate, plan for and react to dangerous occasions and recuperate from effect of natural hazards which is connected to physical factors, as well as to a scope of social, monetary, cultural and political elements.

2.1.5. Preparedness

Preparedness is an expansive term that covers the exercises planned in premonition of a catastrophe to guarantee that fitting and viable move is made before to adapt to the disaster and to lessen the loss of lives and properties. These measures incorporate the disaster plans, the preparation of responders, the upkeep of human, material and money related assets and the foundation of government funded instruction and data framework.

2.1.6. Prevention

There is a familiar saying "prevention is better than cure" that incorporates the measures taken to hinder the event of a disaster. Regardless, it isn't conceivable to keep the event of catastrophic events completely yet the degree of its harms can be diminished.

2.1.7. Recovery

In normal sense, recovery may be defined as getting back of something that has been lost amid the event of any odd circumstance. But, in disaster management it alludes to the exercises that are taken after the underlying effect to create financial and ecological conditions that are decimated by disaster for accomplishing ordinariness, that is, calamity recuperation exercises are identified with the restoration of pre-catastrophe social and monetary routine arrangement of money related and different administrations to the casualties and to repair of annihilated properties.

2.1.8. Mitigation

Minimization of the dangerous impacts of hazards and diminishing the magnitude of disaster through some important exercises that can happen previously, amid and result of debacle and cover of all periods of disaster management is called mitigation [17]. In brief flood, cyclone, drought, tidal surge, tornado, chilly wave, stream disintegration, arsenic contamination of ground water are assented as disaster when it transforms into unsafe occasion and influences a specific domain and the influenced individuals of that zone who are not ready to adapt to it. In actuality, disaster management is considered as an approach that joins prevention, preparedness, mitigation, emergency response and recovery to adapt to hazardous circumstance made by previously mentioned natural disasters [18].

2.1.9. Major Disasters and their consequences in Bangladesh

Bangladesh, a low-lying deltaic country in South Asia confined by a lot ofrivers system with long coastline, is significantly exposed to different sorts of destructive natural disasters

which negatively impacts 136.7 million people inside its 147,570 sq. km area. The country has experienced 200 disastrous occasions causing loss of more than 600,000 lives, a considerable number of domesticated animals and leaving prolonged mischief to property, quality of life and livelihoods since the freedom in 1971.

Year	196	1961	1963	196	1965	196	196	1970	197	197	1985
	0	ND:		4	2	6	9		3	4	
				1.1	2	- 1 - E E					
Number	811	1146	1152	196	2015	850	75	50000	183	50	1106
of Death	9	6	0		2			0			9
. F.		1.4.2				A 18 7 2		- 15			
Wind	210	146	203	NA	210	146	NA	223	122	162	154
Speed										~~	
								. 9 J	a ta d		

Table.1: Different Types of Natural Disasters Occurred in Bangladesh

Year	1986	1988	1989	1990	1991	1994	1995	1996	1997	1998
Number of Death	12	9590	573	132	138958	170	172	545	410	253
Wind Speed	100	162	NA	102	225	200	100	70	225	112

Year	2007	2008	2009	2013	2015	2016	2017
Number of Death	4234	15	197	17	132	25	24
		9 ¹			an l		
Wind Speed	250	80	95	85	75	NA	117
_							

Source: Wikipedia and Bangladesh Meteorological Department 2017

3.0. Damage and Losses

The southwest coast of Bangladesh was the main focus of Cyclone Sidr. Bagerhat, Barguna, Patuakhali and Pirojpur- the four out of thirty districts were assigned as "Severely affected" due to the damage and loss from the Sidr. Khulna, Madaripur, Shariatpur, Barishal, Bhola, Satkhira, Jhalakathi and Gopalgonj were the eight moderately affected districts. About one million people were seriously affected and 4 out of 2.3 million family units were affected to some degree by the effects of this devastating Cyclone.

Sector	Sub-Sector	Disaster Effects (BDT Million)		Disaster Million)	Disaster Effects (US \$ Million)		
7		Damage	Losses	Total	Damage	Losses	Total
Social Sectors		4482	1453	5934	65	21.1	86
294. ¹ . 1. 1. K.	Health and Nutrition	169	1038	1206	2.4	15	17.5
	Education	4313	415	4728	62.5	6	68.5
Infrastructure		71064	2130	73194	1029.9	30.9	1060.8
	Housing	57915		57915	839.3		839.3
	Transport	8006	1725	9731	116	25	141
5	Electricity	576	359	935	8.3	5.2	13.6
	Water and Sanitation	157	46	203	2.3	0.7	2.9
- 6 ¹	Urban and Municipal	1696		1696	24.6		24.6
2	Water Resource Control	4918		4918	71.3		71.3
Productive		1734	32083	33817	25.1	465	490.1
Sectors	Agriculture	1472	28725	30197	21.3	416.3	437.6
	Industry	262	2035	2297	3.8	29.5	18.2
	Commerce	n Na sala a	1258	1258		18.2	0.9
	Tourism		65	65		0.9	6.1
Cross-Cutting		420	0	420	6.1	0	6.1
Issues	Environment	420	5	420	6.1	Para da seren	6.1
TOTAL		79904	35665	115.569	1158	516.9	1674.9
Sourse: Estimate	s by JDNLA Team						L

Table.2: presents an overall summary of the damage and losses

The quantity of passings caused by Sidr is evaluated at 3,406, with 1,001 as yet absent, and more than 55,000 individuals supporting physical wounds. Enhanced counteractive action measures, including an enhanced anticipating and cautioning framework, seaside afforestation ventures, tornado sanctuaries, and banks are credited for bringing down setback rates than what

might have been normal, given the seriousness of the tempest. A large portion of the devastation and related social and financial misfortunes came about because of the unforgiving tempest conditions and the consequent disappointment of a broad bank framework.During the occurrence of Cyclone Sidr, the Government of Bangladesh, accompanied by worldwide specialists, embraced a complete harm and loss, and requirements evaluations to find out the degree of the harm caused by the tempest, and to characterize an extensive and achievable recuperation design. The Joint Damage, Loss, and Needs Assessment (JDNLA) evaluated the summation of damage and losses to be Bangladesh Taka (BDT) 115.6 billion (US\$ 1.7 billion) caused by the cyclone. **Table.2** displays a general rundown of the harm and misfortunes separated by sectors.

3.1. Significant paddy losses at sub-national level

3.1.1. Floods in March and April 2017

Serious flash floods over northeastern piece of the nation were activated by the substantial rains in late March and early April. It affected approximately 850 000 households and caused severe damage to food crops, housing and infrastructure, including bridges and roads. Sylhet, Moulvibazar, Sunamgonj, Habiganj, Netrokona and Kishoreganj were the most affected districts. Official estimates says that about 220 000 hectares of products, for the most part to the prepared to-be gathered "boro" paddy crop in low-lying territories were severely damaged by the floods in April. The flood influenced regions represent under 1 percent of the aggregate national wheat generation and for this reason the floods marginally affected the general 2017 wheat yield.

3.1.2. Floods in July 2017

Heavy monsoon rains in late June and July caused the fundamental northern and northeastern streams of Bangladesh to flood, which triggered flash floods and landslides and it brought about far reaching immersions in the low-lying territories. Sylhet and Moulvibazar were just recovering from the April floods and then they faced the floods in July and were affected the most. Rangourm, Kurigram, Sirajgonj, Jamalpur, Lalmonirhat, Bogra, Nilphamari and Gaibandha were also affected. The official estimates says that 1.6 million people (some 338 500 households) were affected, 100 000 houses were damaged, schools, roads, bridges and embankments were destroyed. "Aus" paddy crop (represents about 7 percent of the annual output) was in late development stage, the planting of "aman" (represents about 38 percent of the annual output) had just started at the time of floods. The Government assessments reported that about 40 000 hectares of cropped land was immersed and thus it is said that the effect of the floods on standing crops was constrained.

3.1.3. Floods in August 2017

Heavy rains in August again hit the northern part of the country and it caused rivers to overflow. It resulted in severe floods in 31 out of the country's 64 districts. The information from the Network for Information, Response and Preparedness Activities on Disaster (NIRAPAD) of Bangladesh states that the livelihoods of about 6.8 million people were affected and housing and infrastructure were significantly damaged by the flood. According to preliminary estimate, people lost 16 000 hectares of crops and this flood also damaged 560 000 hectares of standing crops partially. "Aman" rice paddy in low-lying zones is probably going to be influenced the most, however an extensive assessment of the August flood damage to food crops isn't accessible yet.

4.0. National Plan for Disaster Management 2010-15 [19]

As indicated by the National Plan for Disaster Management 2010-15, the vision of the legislature is to diminish the danger of individuals, particularly poor people and the distraught, from the impacts of regular, ecological and human incited risks, to a sensible and adequate helpful level, and to have set up an effective crisis reaction framework equipped for taking care of substantial scale catastrophes. The Plan envisages a group of broad-based strategies:

1. The management of both risks and consequences of disasters would be involved by the disaster management. Counteractive action, crisis reaction and post-catastrophe recuperation would also be included.

2. The local community will be involved for readiness program for securing lives and properties, which would be a noteworthy core interest. Nearby government bodies will also be involved, which would be an essential part of the strategy. It is self-reliance, which should be the key for preparedness, response and recovery.

3.It should provide a high need to non-auxiliary moderation measures, for example, community disaster preparedness preparing backing and public awareness; a coordination of basic alleviation with non-basic measures would be required.

4.1. The scope of the Plan includes

a. Break down the normal and man-made calamity dangers, which includeenvironmental change to their kin and society, economy and framework, so that it can be identified thatwhere and when these dangers are probably going to happen and in what recurrence.

b. Recognize by additionally nitty gritty investigation who and what are vulnerable against the event of these threats and how these are probably going to be influenced by them.

c. Look at what measures are possible to avoid event of the disaster events, (probably not going to be conceivable on account of the natural phenomenon however conceivable on account of man-made debacles and ecological debasement), what should be possible to alleviate the impacts of disasters and environmental degradation can be set up in suspicion of these.

d. Inspect where duties regarding counteractive action, alleviation and preparedness planning and activity should lie in the Government, non-government associations (NGOs) and the private division.

e. Make arrangement in the national spending plan for subsidizing of exercises, which identifies with Disaster Reduction and a possibility store to meet the prompt needs of catastrophe help, at all regulatory levels of the organization.

f. Make sure that the costs of calamity help and post-fiasco recuperation are supervised and encouraged by a high state board of trustees to keep up a vital separation from duplication or waste over the scope of donor agencies, including government, national and widespread NGOs and the private fragment.

g. Make sure of forming a compelling framework inside Government, which can connect and arrange the procedures of planning and the administration of sustainable development, environmental management and fiasco lessening.

5.0. Disaster Management Practices in Bangladesh Perspective

Disaster management in independent Bangladesh has undergone a complex process of development that's why it develop a workable system of disaster management as Bangladesh is one of the worst victim of natural disasters. In Bangladesh, disaster management program is the mix of both the improvement of physical framework and non-basic practices [20]. Development of physical infrastructure means construction of flood and cyclone shelters for emergency resort, and building of flood protection embankments, sluice gates, waste channel, and controllers as security measures against immersion by tsunamis, storm-surges and flooding, and foundation of crisis task focus. Action and strategies, preparedness and co-ordination among the actors are mainly involved in the non-structural practices. It is a procedure of adoption associated with national disaster management policy, disaster management enactment, arrangement of training program and workshop disaster management plan;, and introduction of institutional framework of disaster management with

the foundation of Disaster Management Bureau, efoundation of boards and advisory groups at the national, district, upazila and association levels [21]. The Government of Bangladesh (GoB) has taken some initiatives to reduce disaster intensity likeawareness raising effort, preparing program in a debacle readiness, community medical aid, cyclone shield support, establishment of drinking water, sustenance storerooms, social wellbeing program, development of cyclone and flood covers, erection of surge insurance dikes, adoption of catastrophe administration design, advancement of institutional structure and improvement of solid, straightforward and reasonable cautioning framework that is connected to neighborhood, territorial and national data framework.

5.0.1. Aim of Community-Based Disaster Management in Bangladesh

Alleviating vulnerabilities and strengthening individuals' ability to manage risks and adapt to fiascos is the main vision of CDBM. The community will able to address the problems related to disaster and mitigation measures in the existing system for disaster management in the country that covers activities at normal times for important disaster management aspects like mitigation/prevention, preparedness, response and recovery. The local capacity and preparedness measures will be improved by developing program and support from the group in arranging and executing the projects.

5.0.2. Considerations for implementation of CBDM

According to Yodmani the consideration are:

- 1. The central role inlong-term and short-term disaster management belongs to the local community and thus the focus must be on them in case of disaster management.
- 2. CBDM must increase a community's capacities and their resources to reduce Disaster risk or vulnerability, and coping strategies should also be improved and strengthened.
- 3. Linkages to the development process should be established by CBDM and they should also improve the personal satisfaction of most by far of the needy individuals and of the common habitat.
- 4. CBDM adds to individuals' strengthening and it influences their lives. They can appreciate the advantages of a sound domain.
- 5. The role and interests of community must be recognized, because it is a key resource in disaster reduction.
- 6. A multi-sectorial and multi-disciplinary and trans-disciplinary approach must be applied.

7. Being an including and dynamic structure, the execution of CBDM must be observed, assessed and adjusted to fuse more up to date components.

5.0.3. Stumbling blocks in Community Participation

From the study it is proved that without simultaneous participation of community it is very painstaking to cope with natural disaster but customary reasoning of group, bureaucratic state of mind of government authorities, shortage of assets and pervasive socio-social standards and values made it extremely gigantic task. The major hindrances that pave the way of community participation in disaster management are outlined below:

a. Primitive notion that distribution of relief materials among the victims is the solely duty of government as well as deliberate agencies during the period of disaster. But this culture must be eradicated from the society.

b. The associated administrators are not willing to acknowledge the conclusion of illiterate however savvy and experienced nearby individuals in strategy cycle.

c. Financial assistance is fundamental component of disaster management though Bangladesh endorsed yearly portion of US\$ 12 million yet this sum isn't sufficient [22]. Moreover, the national and neighborhood deliberate organizations have lack of satisfactory money related assets to operate community based program because of shortage of assets.

d. Nonattendance of basic gathering, absence of co-appointment, disarray of locale of work, absence of shared trust and regard and so on are constraints of community participation.

Ladies would prefer not to leave their habitation and take protection in people in general structures amid disaster arrangement of social course of action is the establishment of purdah or female isolation. Routine with regards to purdah limits the portability of women and confinement of sanitation facilities for women out in general structures is another limit. That are the great barrier to women participation in disaster management.

6.0. Community coping strategy to disaster

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To face the various disasters community undertake multi steps to cope with the severity of disaster individually. The Disaster Management Bureau set up first milestone by conducting research on the issue and implementing the objectives to reduce disaster risk and loss. Moreover, six workshops on disaster preparedness were organized by DMB for community leaders in the year of 2003.

6.0.1. Creation of public awareness

This tool is very important in disaster management because there are some superstitions about women participation that can be eradicated by creating awareness among the people. In June 2000, Pulong-Pulongsa (barangay gatherings) was begun in to engage the generalpopulation. It has been intended to set up a community radio stationto empower the people through information dissemination and informative/educational programs. Programs on cultivating methods and new innovations, medicinal services, job, and an intuitive program that would fill in as a stage for community-local government discourse and money related help has been looked for from and submitted by Congressman Mon fort.

6.0.2. Proper utilization of climate information

Information on climate is very essential for preparedness and reducing disaster related losses. Convenient climate determining is the pressing need as a consequence community radio station was set up to communicate time-relevant and exact data and warnings amid crises and specialized help is given by the Philippine Atmospheric, Geophysical and Astronomical Services Administration (PAGASA). Community-based flood forecasting and warning in collaboration with PAGASA help in recognizing risks and measures to decrease the danger.

6.0.3. Appropriate prevention and mitigation measures

The allotment of National government assets to LGUs is controlled by an equation that successfully expects to enhance the personal satisfaction at all thickly populated zones granting half of the assets as indicated by populace measure, 25% via arrive territory and 25% separated similarly between every single (neighborhood legislature of similar classifications [23]. Nonetheless, the World Bank contends that 'the sums exchanged bear no important relationship to the real cost ramifications of lapsed capacities. Nor do they consider the limit of nearby governments is to raise their own particular assets or to complete regressed capacities. Shifting levels of financing are really drawn down contingent upon the rate of disasters in a specific year in light of the fact that distinctive LGUs confront differing use requests as to catastrophic events at specific focuses in time, depending both on their defenselessness to disasters and LGUs feel obliged to utilize such subsidizing in full cost-recuperation extends, a training which could oppress interest in a fiasco anticipation and relief ventures. Moreover, land can be exempted from arrive charges which gather to LGUs if catastrophic events legitimately or physically counteract change, utilize or development of that land [24].

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6.0.4. Showing Mutual respect

Keeping in mind the end goal to guarantee co-ordination, appropriate administration, general prosperity of affected individuals every single civil agencies and military organization must have respect for each other.

6.0.5. Timely communication

For achieving the desired fruit or goal, legitimate and opportune correspondence amongst civil and military organization is a genuinely necessary tool.

6.0.6. Regular basis specialized Training

Without training, it is hard to make out the mitigation measures and annual preparedness among the affected people even though most of them are illiterate.

7.0. Conclusion and Recommendations

Disaster management in Bangladesh is an important phenomenon for the sustainable and meaningful development as Bangladesh is a natural disaster prone country by its geographical location. Government alone cannot cope with the disaster for this need community participation with their opinion and ensuring interest in each phase of strategy cycle, rose on the scenery of prevailing methodology however it is extremely hard to anticipate the approaching risk and the financial conditions and the logistic support facilities. But there are some problems related to community participation which must be solved by social workers as they have broadened organizes in groups, they know about group assets and probability of neighborhood pioneers and are furnished with important learning for tending to complex circumstance resulting in crisis at local and national levels. Because of climate change more trained as well as devoted social worker need for post disaster situation. Moreover, more funds have to be allocated in disaster management sector by the government. Government authorities need to surrender bureaucratic disposition and must be more individuals amicable so that CBDM program can become a successful. Nonstructural measures should be enhanced for flood management. Weather forecasting and cautioning framework ought to be sufficiently arranged and timely done. For this need expert and trained personnel which can be generated by training on regular basis. Seminars, consultations and public discussions are necessary tools for providing education and counseling services. Giving emphasis on building more strong infrastructures for shelter during disaster. At the end, it is urgent to bring disaster prone areas under feasible communication system for the reduction of disaster period losses.

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Effectiveness of Using Slag as Coarse Aggregate and Study of its Impact on Mechanical Properties of Concrete

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Abstract

Traditional coarse materials like stone chips, brick chips are very costly. Huge amount of stone chips are being withdrawn regularly from different sources. As a result one day the amount of stone chips will be gradually finished possessing a great threat to the concrete construction sector. Industries which use ferroalloys, fabricates a large amount of slag as by product every year. This iron slag deals with third class hazardous waste category that requires a large place for dumping. Solid waste slag is transformable into resources for sustainable construction works which is also environment friendly. Perk of using low iron slag as coarse aggregate has immense effect on both environment and economy. By this means environmental pollution due to the waste slag can be minimized significantly and also there will be a solution of filling the paucity of natural aggregate in the construction industry. In this paper we observed the strength properties of slag incorporated concrete with different mix ratio. The proportion of stone chips and slag used in this investigation as coarse aggregate are 100:0, 90:10, 80:20, 70:30, 60:40, 50:50, 40:60, 30:70, 20:80, 10:90 and 0:100. A total of 396 specimens (4*4*4 cube) were cast using plain water in normal environmental temperature and kept for the periods of 7 days, 14 days, 28 days and 6 months respectively due to curing purposes. W/C ratios were varied as 0.60, 0.50 and 0.42 for making 20MPa, 30MPa and 40MPa concrete respectively and compressive as well as tensile strength were evaluated after specific exposure periods. The strength results of the specimen provide some important information regarding strength development of slag-aggregate concrete as computed as conventional concrete.

Keywords: coarse aggregate; concrete; compressive strength; curing period; slag; tensile strength; w/c ratio.

1.0. Introduction

In Bangladesh, aggregates have huge demand mainly for road and concrete constructions. It is becoming a matter of headache due to the unavailability of coarse aggregate for construction purposes. Various waste management strategies have been developed to find out the alternative of coarse aggregates for specific need. Natural resources are diminishing worldwide while at the same time the waste production rate from the industry is increasing by a considerable amount.

There are two important methods of sustainable development for construction and compensation the scarcity of natural resources -(1) the use of nonconventional and unique materials and (2) recycling of waste materials. Construction industry consumes natural resources and hence, environment gets polluted day by day. Main scope of sustainable construction is to reduce this large negative environmental impact. Waste management is a complicated and demanding dilemma which has negative impacts on both the habitants and the climate. Different Industries generate different kinds of environmentally hazardous waste by-products which initiates storage problem of wastes. Such waste by-products have been used in significant amounts by various infrastructure developing companies as raw materials in a sustainable way as always.

Using slag as coarse aggregate in concrete mixtures has two benefits – (1) reduces greenhouse gases and (2) helps in producing eco-friendly material. There are silicates, alumino-silicates, and calcium-alumina silicates in slag which is an inactive and non-metallic waste material. An important characteristic of molten slag is that if it consumes enough sulphur from the mixture then around 20% of slag by mass is produced during the production of iron. If we are able to use the slag in place of natural stone chips then we can successively obtain a material to replace the coarse aggregate, which is eco-friendly and cost effective. Hence there is a growing need to find the alternative solution for the slag management. In the present study, it is proposed to study the effect of addition of waste slag in concrete mixture.

2.0. Study Scope

In this experiment, 20MPa, 30MPa and 40MPa grades concrete were taken for a water cement ratio of 0.60, 0.50 and 0.42 correspondingly for the replacement of 0, 10, 20, 30, 40, 50, 60, 70, 80, 90 and 100 % of crumbled coarse aggregate mixed with slag materials. Properties like compressive as well as tensile strengths were studied for these concrete mixes for the specific curing periods of 7 days, 14 days, 28 days and 6 months.

3.0. Materials and Methods

3.1. Cement

Ordinary Portland Cement (OPC) which is ASTM type 1 and in line with ASTM C-150 was taken throughout the experimental investigations as binding element. Properties and chemical compositions of Ordinary Portland Cement (OPC) are given in Table-1 and Table-2 respectively.

3.2. Fine Aggregate

In this experiment, sand went through 4.75 mm sieve and contained on 0.015 mm sieve was used as fine aggregate. Natural sand collected from regional areas used in the concrete mixture.

Characteristics	Unit	Value
Specific gravity	a and an arts crows a	3.15
Fineness modulus	%	2.5
Standard consistency	%	27.5
Initial setting time	minutes	167
Final setting time	minutes	203
Compressive strength	N/mm ²	46.27

Table.1: Properties of Ordinary Portland Cement (OPC)

Table.2: Chemical compositions of Ordinary Portland Cement (OPC)

Chemical compound	Amount (%)
Calcium Oxide, CaO	64.5
Silicon Dioxide, SiO ₂	20.6
Aluminum Oxide, Al ₂ O ₃	6.4
Ferric Oxide, Fe ₂ O ₃	4.5
Magnesium Oxide, MgO	1.2
Sulfur Trioxide, SO ₃	1.7
Insoluble Residue	0.5

3.3. Coarse Aggregate

Table.3: Physical properties of coarse aggregate

Properties	Unit	Value
Specific gravity	-	3.22
Fineness modulus	-	8.01
Crushing value	%	26.37
Impact value	%	30.75
Water absorption	%	1.63

In this experiment, locally available stone chips which passed through 20 mm sieve was used as coarse aggregate. The test results on coarse aggregate are presented in **Table.3**.

3.4. Slag

Slag from the local steel making plant was collected and mixed with concrete in this experiment. Chemical compositions of slag are given in Table-4. Average masses of chemical analysis during certain intervals are given in the table. In the laboratory some positive influences of using slag as aggregate are found, for example:

- Reliable quality.
- Impurities like chlorides, organic matters, clay and shells cannot be found in slag. These
- impurities may reduce the strength and sturdiness of concrete over time.
- Slag helps in increasing strength of materials over time.
- Does not generate alkali-aggregate reactions.

Compound	Mass (%)	Compound	Mass (%)
CaO	50-57	Fe	15-19
Fe ₂ O ₃	10-13	SiO ₂	9-11
MnO	4-5	P ₂ O ₅	3.2-2.3
MgO	1-2	Al ₂ O ₅	1.4-0.7
S	0.12-0.1	K ₂ O	0.04-0.01
Na ₂ O	0.04-0.02		

Table.4: Chemical analysis of steel slag

3.5. Mix Proportions

Table.5: Mix proportions of control mixes

Ingredients (Kg/m ³)	20140	2010	101 (1)
$(1 \text{ Kg/m}^3 = 0.143 \text{ lb/ft}^3)$	20MPa	30MPa	40MPa
Cement	576	518	665
Water (W/C ratio 0.60, 0.50 and 0.42)	346	259	280
Mass of normal coarse aggregate	7618	7618	7618
Mass of slag	7618	7618	7618
Mass of fine aggregate	978	1035	890
Total weight	17136	17048	17071

A balanced mixture of slump 4 ± 1 in. $(100 \pm 25 \text{ mm})$ was used to prepare mixture proportions for the concrete of 20MPa, 30MPa and 40MPa grade for water cement ratio of 0.60, 0.50 & 0.42 correspondingly by following IS-10262-2009 standard of mix design. Details of mixture proportions for balanced mixes are given in **Table.5**.

4.0. Results and Discussion

4.1. Compressive Strength

Compressive strength of various types of mortar made with different coarse aggregate replacement level by slag has been graphically presented in Fig.1 to Fig.3. In total 330 blocks were tested for compressive strength test. Fig.1 shows that for 20MPa, 7 days strength of the mix 40 and 60 has increased by 4% each. For 30MPa of the mix 30, 40, 50, 60 and 70 has increased by 7%, 4%, 3%, 11% and 2% respectively. For 40MPa of the mix 40 has increased by 6%. Fig.2 shows that for 20MPa, 14 days strength of the mix 40, 50 and 70 has increased by 5%, 1% and 4% respectively. For 30MPa of the mix 30 and 40 has increased by 6% and 4% respectively. For 40MPa of the mix 30, 40 and 50 has increased by 1%, 5% and 6% respectively. Fig.3 shows that for 20MPa, after 28 days of curing strength of the mix 10, 20, 30, 40, 50, 60 and 70 has increased by 9%, 5%, 13%, 18%, 8%, 15% and 10% respectively. For 30MPa of the mix 30, 40 of 50, 60 and 70 has increased by 4%, 7%, 1% and 3% respectively. For 40MPa of the mix 30, 40, 50 and 70 has increased by 4%, 7%, 1% and 3% respectively. For 40MPa of the mix 30, 40, 50 and 70 has increased by 4%, 7%, 1% and 3% respectively. For 40MPa of the mix 30, 40, 50 and 70 has increased by 4%, 7%, 1% and 3% respectively. For 40MPa of the mix 30, 40, 50 and 70 has increased by 4%, 7%, 1% and 3% respectively. Is0 days compressive strength data shows almost similar trend. This study has pointed out that steel slag could be a good stand in for coarse aggregate to improvise the compressive strength of concrete apparently as well as it can be concluded that strength gaining rate is lower for the higher grade of mortar.

4.2. Tensile Strength

Fig.4 to **Fig.6** shows the variation of tensile strength of different grades of mortar with different slag content as partial replacement of coarse aggregate for various curing ages. In total 165 blocks were tested for tensile strength test. Fig.4 shows that for 20MPa, 7 days strength of the mix 40 has increased by 3%, 14 days strength of the mix 30, 40, 50 and 60 has increased by 1%, 8%, 6% and 7%, 28 days strength of the mix 10, 20, 30, 40, 50, 60 and 70 has increased by 3%, 5%, 8%, 11%, 8%, 11% and 5% respectively. **Fig.5** shows that for 30MPa, 7 days strength of the mix 30 and 40 has increased by 7% and 4%, 14 days strength of the mix 30, 40 and 50 has increased by 2%, 3% and 2%, 28 days strength of the mix 30 and 40 has increased by 2% and 3% respectively. Fig.6 shows that for 40MPa, 7 days strength of the mix 40 and 50 has increased by 4% and 2%, 14 days strength of the mix

40, 50 and 70 has increased by 5%, 6% and 2%, 28 days strength of the mix 30, 40, 50 and 70 has increased by 2%, 4%, 5% and 2% respectively. Thus it is seen that tensile strength gaining is relatively faster for lower grade mortar as compared to higher grade in case of longer curing period.



Fig.1. Compressive strength variation vs. percent replacement by slag of coarse aggregate for curing



Fig. 2. Compressive strength variation vs. percent replacement by slag of coarse aggregate for curing age of 14 days







Fig. 4. Tensile strength variation vs. percent replacement by slag for 20MPa



Fig. 5. Tensile strength variation vs. percent replacement by slag for 30MPa



Fig. 6. Tensile strength variation vs. percent replacement by slag for 40MPa

5.0. Conclusion and Recommendation

• Slag mixing with mortar having various amount of coarse aggregate replacement level up to 70% showed satisfying outcomes for both compressive and tensile strength.

- The study presents that using steel slag instead of natural coarse aggregate at all the percent, helped in improving compressive strength of concrete by 1 to 18%.
- Meanwhile tensile strength improved by 1 to 11% at the particular percent replacements of coarse aggregate with waste steel slag.
- Steel slag costs almost half of natural aggregates. So it is cost-effective to use the waste byproduct coming from steel industry.
- Behaviour of slag as an accelerator need to be experimented. In this research, Type I Ordinary Portland Cement (OPC) was used. It is recommended to find out the effect of slag on other types of cement.

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Strength Variation of Concrete Between Cylindrical and Cubical Specimen Due to Various Proportion of Ingredients

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Abstract

The objective of this research was to determine the relationship between compressive strength of cubes and cylinders that were produced and cured in Laboratory of Sonargaon University. The study is based on the comparison of experimental results between M-10, M-15 and M-20 grade concrete made with stone chips. Theoretical study was done on factors that affect the workability and gaining of strength of concrete. General slump test was done for each of these three grades of concrete mix to determine workability of concrete. Cylinder and cube specimens were moulded in laboratory and cured at preferred temperature and condition, and then cubes and cylinders were tested at different ages to determine their compressive strength. The cylinder-to-cube strength ratio was found to be a value of 0.80 and is slightly lower than the average ratio of 0.87 obtained by researchers in other countries (Rong, W.H., 2012). It is also found that, in average, the strength of Cube specimen is 1.25 times stronger than Cylinder specimen. According to determined results further recommendations and limitations are also assorted.

Keywords: Concrete, Compressive Strength, Strength Ratio, Different ratio of ingredients, Slump test.

1.0. Introduction

The compressive strength applying most important role in durability of structure. The design parameters depend upon various influencing factors such as specimen size and shape, application of loading, matrix porosity and transition zone porosity [1]. Compressive strength of concrete is important because the main properties of concrete, such as elastic modulus and tensile strength, are qualitatively and quantitatively related to this property. It is also important in structural design, because load-bearing capacity of structures is related to the concrete compressive strength. Concrete strength in structures is typically estimated by casting smaller specimens from the same concrete and crushing them in the laboratory. Most countries have their own standards for concrete compression testing, which differ in many ways but probably most significantly in type of specimen used. Cylindrical specimens — 150 mm (6-in.) in diameter by 300 mm (12-in.) in height — are used in

Australia, Canada, France, New Zealand and the United States. Bangladesh also follows this specification for testing. Cube specimens (150 or 100 mm) are used throughout much of Europe, including Great Britain and Germany. This study surveys the literature and test on the relationship between cylinders and cube-shaped specimens of concrete, covering the areas- testing standards and procedures, factors affecting the cylinder strength/cube strength & comparing the strength test result of both specimens. The aim of this study was to get a specific idea about the gaining of strength of concrete with change of time and difference in strength due to shape of cylinder and cube. Laboratory tests were carried out to get the compressive strength of concrete.

2.0. Literature review

From the very beginning of civilization remarkably used construction material is concrete. Concrete has been used as building material for epochs. It is by far the most extensively used construction material today. We can hardly find any aspect of our daily lives that does not depend directly or indirectly on concrete [2]. As the use of concrete has become a common practice in various applications for many decades, especially for high rise buildings, long span, bridges and repair and rehabilitation works. It is important to have confidence in the suitable and applicability of current testing practices. The 28 days compressive strength of concrete determined by a standard uniaxial compression test is accepted universally as a general index of concrete strength. The two of the most significant parameters that effect the result of concrete compressive strength due to its rupture features are size and shape of test samples [3][4].

To determine the compressive strength of concrete two standard methods are renowned all over the world. These are the testing to failure of cylinder and cube specimens. In the application of uniaxial compressive strength test, which is usually employed for the quality control process of concrete, the type and dimensions of the specimens considerably affect the test results. Due to the size effect, the relative strength of specimens varies at different dimensions [5]. National codes and specifications in North America, France, Japan, Australia, and New Zealand define the cylinder as the standard specimen. In Great Britain, Germany and other European countries, cube specimens of 100 mm and 150 mm are used.[1] [4][6][7][8][9]. For normal concrete and HSC, the concrete compressive strength test results from cube specimens are generally higher than cylinders specimens [10][11]. As states in BS 1881, the compressive strength of concrete gained by cylinder specimens is equal to 0.8 times of the compressive strength gained by cube specimens. However, in fact, this ratio is not always precise in the applications [1][10].

In case of normal concrete, cube specimens produce 20-25% higher concrete compressive strength, with a decrease difference either at higher or increase compressive strength is generally assumed [4].

3.0. Methodology

Laboratory work procedure is initiated after a good literary study on this similar work done previously. The following steps are followed for this research.

- ▼ Study of previous work.
- \checkmark Collection of materials.
- ▼ Specimen making in laboratory.
- ▼ Slump test of concrete mix.
- ▼ Curing of specimen & Data collection.
- ▼ Calculation and result analysis.

During laboratory work, three separate mixes of concrete prepared for M10, M15 and M20 grade with stone chips, sand, cement and water. W/C ratio was fixed at 0.45 for all three mixes. Dimension of mould for cylinder specimen was 8"deep x 4" diameter [Fig. 1] and for cube specimen was four square inches (4"x4") [Fig. 2]. After making concrete mix, slump test of each grade has been performed. After 24 to 36 hours of casting, the molds were removed and the specimens were cured in water at room temperature.



Fig.1. Dimension of cylindrical specimen mold.



Fig.2. Dimension of cubical specimen mold

The standard allowable slump is needed to ensure the workability. However, the allowable slump data is shown in **Table.1.** It was much needed in this case because if the concrete is not workable the test results will be faulty and almost impossible to compare. Hence, the slump test results of different grades of concrete are given in **Table.2**.

Allowable slump in Inch	Workability
0-1	Very Low
1-2	Low
2-4	Medium
More then 4	High

Table.1: Allowable slump value chart

Table.2: Slump test result of different grade of concrete

Grade of concrete	Water/cem ent ratio	Slump test result in inches	Workability
M20 (1:1.5:3)	0.45	2.8	Medium
M15 (1:2:4)	0.45	3.4	Medium
M10 (1:3:6)	0.45	4.2	High



Fig.3: Universal Testing Machine

Each set of specimens contains 2 cylinders and 2 cubes of each ratio. Total 36 specimens were made. Compressive strength test of concrete using Universal Testing Machine [Fig. 3] was done at 7days, 14 days and 28 days' time interval of specimen casting date. 12 specimens for each M20, M15, and M10 grade of which, 2 cylinders and 2 cubes of each ratio were tested after 7 days of casting. Same procedure followed for 14 days and 28 days strength test. All results are noted to the following chart. Compressive strength test results of M20, M15 and M10 grade from the experiment are shown in Table.3, Table.4 and Table.5 respectively.

	Grade M20 (1:1.5:3)									
Cylinder					Cylinder/ Cube					
Days	SL.	Strength (Psi)	Avg. Strength	Days	SL.	Strength (Psi)	Avg. Strength	Ratio		
7	1	2500	2400	7 Days	1	2300	2600	0.92		
Days	2	2300			2	3000				
14	1	2700	2700	14 Dave	1	3800	3200	0.84		
Days	2	2800	2700	14 Days	2	2600				
28	1	2600	2800	28 days	1	3700	3400	0.82		
days	2	3100	2000	20 days	2	3100				

Table.3: M20 strength variation

Table.4: M15 strength variation

Grade M15 (1:2:4)												
Cylinder				Cube				Cylinder/ Cube				
Days	SL.	Strength (psi)	Avg. Strength	Days	SL.	Strength (psi)	Avg. Strength	Ratio				
7	1	1700	1700	7 Days	1	1900	- 1900	0.89				
Days	2	1800			2	. 2000						
14 Days	1	2300	2100	14 Days	1	2900	- 2700	0.78				
	2	2000			2	2600						
28 days	1	2300	2400	28 days	1	2700	- 2800	0.86				
	2	2500			2	2900						

Table.5: M10 strength variation

Grade M10 (1:3:6)												
Cylinder				Cube				Cylinder/				
Days	SL.	Strength (Psi)	Avg. Strength	Days	SL.	Strength (Psi)	Avg. Strength	Cube Ratio				
7 Days	1	1000	900	7 Days	1	1300	- 1300	0.69				
	2	900			2	1300						
14 Days	1	1100	1100	14 Days	1	1600	1600	0.68				
	2	1200			2	1600						
28 days	1	1300	1300	28 days	.1	1900	- 1800	0.72				
	2	1400			2	1800						

4.0. Results and discussions

Graphs were drawn to express the relationship of compressive strength of concrete and time which have been shown in [Fig. 4] for M20, [Fig. 5] for M15 and [Fig. 6] for M10 grade.



Fig. 4: M20 Age vs. Strength graph

Since, at first concrete sets, hardens and then gains strength with time, concrete strength has assumed zero for zero age. Strength variation of cylinder and cube is clearly notified from the following graphs. These graphs have also been shown that concrete strength is gradually increasing with time.



Fig. 5: M15 Age vs. Strength graph



Fig.6: M10 Age vs. Strength Graph

From the strength test results, it was found that the Concrete Cube made of ratio 1:1.5:3 achieved the highest strength of 3400 psi by 28 days. It was also found that the Concrete Cylinder made of ratio 1:1.5:3 achieved the second highest strength of 2800 psi by 28 days. It is also found that, in average, the strength of Cube specimen is 1.25 times stronger than Cylinder specimen. Accepting the experimental variations and procedural errors from the standard, it may be assumed that achieving the design strength

within 28 days, indicating its suitability of successful using in actual construction work. But it is also observed that, though M20 is good in strength, but all three grades are also good in strength according to non-workable strength category. Also, all of three are good in strength and workability from the point of view of where the concrete is to be used. In this study, only three most widely used grade of plain concrete i.e. M20, M10 and M15 were used. For better understanding of this study other grade of concrete should be used. In this study, w/c ratio was taken as a fixed value, it is recommended to use different w/c ratio for better understanding of the compressive strength of concrete.

5.0. Conclusions

From the above discussion, it is clear that M20 concrete has achieved maximum compressive strength among three mix proportions in both cube and cylinder test. The average cylinder to cube strength ratio was found 0.8 which is slightly lower than the average ratio 0.87 reported by Neville. It is also found that the strength of cube specimen is 1.25 times stronger than cylinder specimen.

6.0. Acknowledgments

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Social Networks: Perceived Impact on Student's Academic and Personal Life

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Abstract

The present study attempts to explore usage of social networking sites among the students andtheir perception toward the impact of these sites on their academic and personal life. For conducting the study, a sample of 500 students from different colleges and universities of Gopalganj districtin Bangladesh was constructed through convenience sampling technique. Data were collected through a questionnaire survey, following direct interview method. Different published articles, books, websites, and conference papers also helped the researchers to take insight into this study. Frequency distribution and Pearsoncorrelation analysis were conductedusing SPSS15 version software. The results of the study indicated that majority of the students, using social networks, are in the age group of 18-20 years and use these sites up to 5 hours a day for studying, chatting, and watching videos. Social networks affect the students' academic and personal life positively when they use these sites for studying and learning purposes and negatively when they use at late night, ignoring personal, family, and social activities. Thus, excessive and imbalanced use of these sites is making students disobedient, frustrated, aggressive, and isolating them from family tie and real life. Results of Pearson correlation analysis showed that age and level of education are positively correlated with the usage of social networks, whereas gender is negatively correlated. The findings of this study are tentative and may be used as inputs for future research on social networks. As such, the study will be significant for the students, ICT policy makers, educational policy makers, and the other researchers.

Keywords: Student, social network, positive influence, and negative influence.

1.0. Introduction

Social network is a web-based service, enabling individuals to construct a semi-profile within a bounded system and articulate a list of other users with whom they share connections and views [3]. The most popular social networking sites frequently used by an individual are Facebook, Twitter, Instagram, MySpace, IMO, Viber, Messenger, WhatsApp,Google +, Skype, YouTube, Academia.edu, and LinkedIn. The use of these online sites among the students is becoming more
popular and fashionable because these sites allow them to have access to information, group discussion, resource sharing, and entertainment [6]. However, online social networking sites have both positive and negative consequences on the students' academic and personal life. More than 50% of the students use a social networking site several times a day for uploading or downloading photos or videos, getting information regarding their career or academic work, chatting with friends, watching online movies, and doing research [1].But when the students use these sites as a leisure activity, it may have negative impact on their academic performance [17]. Students, generally, disclose homework, questions, and interchange course materials, leading to lower grade point average (GPA) [19]. Moreover, when they use slang language in text message, it affects their writing skills, spelling, and grammatical understanding [17]. Besides, who use it on a regular basis may have more stomach aches, sleeping problems, anxiety, depression, and isolate from real life [14, 18].Moreover, excessive use and abuse of these sites (e.g., posting abusive photos, videos, and articles) cause moral decadence, mental disorders, and aggressive tendencies among the users[14, 16]. However, the effect of the usage of social networking sites depends on the types of these sites student is using. Students having self-discipline, self-regulation, human adaptability, and human capacity are positively affected by the informative use of internet, while having drastic impact of recreational use of internet on them [13].

Thepresent study will mainly focus on the usage of social networking sites and the perceived positive and negative impact on the academic and personal life of the college and university students of Gopalganj district in Bangladesh. For this, the total study report has been divided into five sections. The first sectiondiscusses the related past studies, the second sectiondiscusses the data and methodology used in this study, the third sectiondiscusses the data analysis and results, the fourth sectionprovides the discussions and suggestions on the major findings, and finally, the fifth section discusses the conclusions and recommendations.

1.1. Objectives of the study

The main objectives of the study are stated below:

- To examine usage level of social networking sites among the students of Gopalganj district in Bangladesh.
- To examine students' perception toward the impact of social networking sites on their academic and personal life.

2.0. Literature review

Helou& Rahim [2] conducted a study on the influence of social networking sites on the student's academic performance. According to this study, social networking sites have created a new social dimension, where individuals can increase their social awareness by keeping in touch with old friends, making new friends, dispensing new data or products, and gathering information in other aspects of everyday life.

Boyd & Ellison [3] identified in a study that teenagers and Youngers have embraced these sites as a way to connect with their peers, share information, reinvent their personalities, and showcase their social lives. Dwyer et al. [4] conducted a study titled 'Trust and Privacy Concern within Social Networking Sites: A Comparison of Facebook and Myspace'. The findings of this study revealed that social networks enable students to participate online for many purposes, such as strengthening communication and maintaining relationships, sharing knowledge and experiences, collaborating on relevant topics, and asking for advice or assistance.

Zwart et al. [5] identified the benefits of using social networking sites, including creation of room for creativity among students, encouraging greater social interaction, reducing barriers to group interaction and communications, and increasing the technological competency levels of its users. In a study, Yunus et al. [7] argued that students can gain more vocabulary and improve their writing skills; can exchange of assignments, resources, and discuss on academic work and other issues by social networking sites. Thus, the positive effects are helping students to improve their knowledge and social skills [6].

There is a negative relationship between time spent by the students on social networks and their academic performance. Students, using social networking sites in classrooms, would have lower academic performance [8-10]. A study conducted by Wang et al. [6] indicated that 57% of 102 students who use social networking sites reduces their productivity and performance. Students might disclose homework questions and interchange course materials [11].

A study conducted by Owusu-Acheaw& Larson [13] showed that majority (96.6%) of the respondents do not use the social-media sites for academic purpose. 74.2% respondents thought that use of social networking sites may not bring any improvement in the academic performance. Moreover, students, spending more time on social networking sites without having their meal, suffer from illness [12]. Larry D. Rosen [18] conducted a study on social networking's good and bad impacts on kids. The major findings of the study revealed that the excessive users of these sites show more narcissistic tendencies, antisocial behaviors, mania, and aggressive tendencies.

Based on the past studies, social networks help the students build and maintain relationship; improve social, communication, technological, and writing skills; improve academic performance and career [2-7]. While, excessive use of this sites lowers the students' academic performance and causes illness, stomach aches, insomnia, anxiety,depression, narcissism, madness, and aggression [6, 8-10, 12, & 18]. So, it can be said that most of the past studies focused on the effects of social networks on the students' academic performance and very few focused on the impact of these sites on the students' personal life and moral values. The present study focuses on the effects of social networks not only on the students' academic life but their personal life and how they go for moral decadence, such as disobedience, frustration, anger, and isolation from family tie and real lifethrough using these online sites.

3.0.Data and methodology

3.1. Research design

The research design adopted for the study is descriptive in nature because this design enables the researchers to provide a secure, reliable, accurate, and correct data and information that are important to assess the usage level of social networking sites among the students and theperceived impact on the students' academic and personal life.

3.2. Population of the study

The population of the study consists of the Higher Secondary Certificate (HSC), undergraduation, and graduation level students of Gopalganj district in Bangladesh.

3.3. Sample size and sampling technique

The sample size of the study consists of 500 respondentsfrom 6 colleges and universities of Gopalganj districtin Bangladesh, such as Bangabandhu Sheikh Mujibur Rahman Science & Technology University, Government Bangabandhu University College, Sheikh Fajilatunnesa Women' University College, N.Haque College of Business & Technology, Hazi Lal Mia City University College, and Chandradigholia Poly Technique Institute. Convenience sampling technique was designed to collect these data and information.

3.4. Data collection method and its structure

A well-structured questionnaire titled "Usage of Social Networks: A Study on the College and University Students in Bangladesh" was designed to gather data and information from the respondents. The questionnaire was divided into three sections, such as section-i, section-ii, and section-iii. Section-i provided respondents' demographic information, such as age, gender, educational status, and so on. Section-iicontained the questions, indicating why students use social networking sites and their perception and usage. Section-iiiincluded the questions, indicating social networking sites' influence on the students' academic and personal life.

3.5. Sources of data

Data were collected from both primary and secondary sources. Primary data were collected through a questionnaire survey. Five pointlikert scale was used to conduct the survey, where 1 stands for strongly agree, 2 for agree, 3 for neutral, 4 for disagree, and 5 stands for strongly disagree. Secondary data were collected from different websites, published articles in the journals, conference papers, and books.

3.6. Data analysis software

The collected data were coded and analyzed by the well-known software, i.e., Statistical Package for Social Science (SPSS) version 15.0. Frequency distribution and Pearson correlation analysis were conducted through the software.

4.0. Results

Table.1below shows that 4.6% of total respondents are in the age group of 15-17 years. 47.6% belong to the age group of 18-20 years. 37.2% respondents' age ranges from 21-23 years and 10.6% from 24 years to above. Among 500 respondents, 52.6% are male and 47.4% are female. 17.8% of the students have completed their Secondary School Certificate (Equivalentto'O'Level), 70.6% have completed their HSC(Equivalent to 'A' Level) and are studying at different universities for completing under-graduation program, and 11.6% are graduate students.

The **Table.2** below shows the usage level of social networking sites among the college and university students of Gopalganj district in Bangladesh. Among 500 respondents, 79.2% said that they use social networking sites up to 5 hours a day, 15.4% from six to ten hours, and 5.4% spent more than 10 hours a day in using social networks.

Particulars	Frequency	Percentage
Age	newslein B	o sin in t
15-17	23	4.6
18-20	238	47.6
21-23	186	37.2
More than 23	53	10.6
Total	500	100.0
Gender		
Male	263	52.6
Female	- 237	47.4
Total	500	100.0
Level of education	na na chena (in ch	the sector.
HSC (Equivalent to 'A' Level)	89	17.8
Under-graduation	353	70.6
Graduation	58	11.6
Total	500	100.0

Table.1: Characteristics of the Study Population, (n=500)

Source: Field Study

The college and university students use social networking sites for both personal and educational purposes. This study implies that 6.0% students use social networking sites only for studying purpose; 1.2% for studying and playing games; 6.6% for studying and watching video; 21.4% for studying and chatting; 1.4% for playing games and watching video; 4.0% for playing games and chatting; 8.8% use for watching video and chatting; 3.0% for studying, playing games, and watching video; 4.0% for studying, playing games, and chatting; 25.4% for studying, watching video, and chatting; 1.0% for playing games, watching video, and chatting; and 17.2% use social networks for studying, playing games, watching video, and chatting with others.

We found different types of social networking sites being used by the students in Bangladesh. Among 500 respondents, 105 (21%) respondents use only Facebook, 22.4% use Facebook and YouTube, 13.2% use Facebook and Google+, 8.2% use YouTube and Google+, 35.2% use Facebook, YouTube, and Google+. So, majority of the respondents use Facebook, YouTube, and Google+. This study found that different individuals and groups motivate students to use social networking sites. 58.4% students are motivated by their friends; 7.4% by their friends and teachers;

5.8% by their friends and family members; 9.2% by their friends and relatives; 4.2% by their teachers and family members; 2.0% by their teachers and relatives; 2.8% by their family members and relatives; 1.4% by their friends, teachers, and family members; 1.8% by their friends, teachers, and relatives; 4.0% by their friends, family members, and relatives; 0.2% by their teachers, family members, and relatives; and 2.8% by their friends, teachers, family members, and relatives.

Different types of mediums and devices are used by the students to access social networking sites. This study revealed that 61.2% of total students use Smartphone to have access social networking sites; 8.6% use Laptop; 10.6% use Smartphone and Desktop; 16.2% use Smartphone and Laptop; and 3.4% use Smartphone, Laptop, and Desktop to access the social networking sites.

Table.2: Usage Level of Social Networks among the Students in Gopalganj District, Bangladesh, (n=500).

Particulars	Frequency	Percentage
Usage (in hours) of social networks in a day:		
Less than or equal to 5 hours	396	79.2
6-10 hours	77	15.4
More than 10 hours	27	5.4
Total	500	100.0
Purpose of the usage of social networks:	 •• \$\$ \$\$ \$\$ \$\$ 	
Only studying	30	6.0
Studying and playing games	6	1.2
Studying and watching video	33	6.6
Studying and chatting	107	21.4
Playing games and watching video	7	1.4
Playing games and chatting	20	4.0
Watching video and chatting	44	8.8
Studying, playing games and watching video	15	3.0
Studying, playing games and chatting	20	4.0
Studying, watching video and chatting	127	25.4
Playing games, watching video and chatting	5	1.0
All	86	17.2
Total	500	100.0
Type(s) of social networks used:		
Only Facebook	105	21.0
Facebook and YouTube	112.	22.4
Facebook and Google+	66	13.2
YouTube and Google+	41	8.2
Facebook, YouTube, and Google+	176	35.2
Total	500	100.0
Who motivate students to use social networks?		1
Friends	292	58.4
Friends and teachers	37	7.4
Friends and family members	29	5.8
Friends and relatives	46	0.0

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Teachers and family members	21	4.2
Teachers and relatives	10	2.0
Family members and relatives	14	2.8
Friends, teachers, and family members	7	1.4
Friends, teachers, and relatives	9	1.8
Friends, family members, and relatives	20	4.0
Teachers, family members, and relatives	1	0.2
All	14	2.8
Total	500	100.0
Types of mediums used to access social networks:	na pha stàise	COLAR ST
Smartphone	306	61.2
Laptop	43	8.6
Smartphone and Desktop	53	10.6
Smartphone and Laptop	81	16.2
All	17	3.4
Total	500	100.0

Source: Field Study

As shown in **Table.3**, age is positively correlated with the usage (in hours) of social networks in a day, purpose of the usage of social networks, type(s) of social networks used, who motivate students to use social networks?, and types of mediums used to access social networks. Age has statistically significant impact on the usage (in hours) of social networks in a day and types of mediums used to access social networks. It means that respondents with different age groups use social networking sites in different ways.

		Usage (in hours) of social networks in a day	Purpose of the usage of social networks	Type(s) of social networks used	Who motivate students to use social networks?	Types of mediums used to access social networks
2	Pearson Correlation	.115(**)	.023	.025	.067	.182(**)
	Sig.(2-tailed)	.010	.604	.577	.134	.000
Age	Sum of Squares and Cross- products	23.522	30.318	14.802	73.192	87.520
	Covariance	.047	.061	.030	.147	.175
	N	500	500	500	500	500

Table.3: Correlation between Age and Social Networks Usage, (n=500)

- * Correlation is significant at the 0.05 level (2-tailed).
- ** Correlation is significant at the 0.01 level (2-tailed).

The **Table.4** below shows that gender is negatively correlated with the usage (in hours) of social networks in a day, purpose of the usage of social networks, type(s) of social networks used, who motivate students to use social networks?, and types of mediums used to access social networks. There is a statistically significant impact of gender on the purpose of the usage of social networks, type(s) of social networks used, and types of mediums used to access social networks.

Table.5 shows that level of education is positively correlated with the usage (in hours) of social networks in a day, purpose of the usage of social networks, type(s) of social networks used, types of mediums used to access social networks and negatively correlated with who motivate students to use social networks? Level of education has statistical significant impact on the type(s) of social networks used and types of mediums used to access social networks. It indicates that respondents with different levels of education use different social networking sites in different ways.

		Usage (in hours) of social networks in a day	Purpose of the usage of social networks	Type(s) of social retworks used	Who motivate students to use social networks?	Types of mediums used to access social networks
a start a	Pearson Correlation	081	143(**)	127(**)	018	143(**)
n for a f _{ar} ba	Sig. (2-tailed)	.071	.001	.004	.688	.001
Gender	Sum of Squares and Cross-products	-11.094	-125.586	-50.654	-13.184	-46.040
an Si	Covariance	022	252	102	026	092
	Ν	500	500	500	500	500

Table.4: Correlation between Gender and Social Networks Usage, (n=500)

* Correlation is significant at the 0.05 level (2-tailed).

** Correlation is significant at the 0.01 level (2-tailed).

		Usage (in hours) of social networks in a day	Purpose of the usage of social networks	Type(s) of social networks used	Who motivate students to use social networks?	Types of mediums used to access social networks
	Pearson Correlation	.014	.068	.125(**)	004	.091(*)
	Sig.(2 tailed)	.749	.126	.005	.928	.043
Level of	Sum of Squares and Cross-products	2.122	64.718	53.402	-3.208	31.520
education	Covariance	.004	.130	.107	006	.063
	N	500	500	500	500	500

Table.5: Correlation between Level of Education and Social Networks Usage, (n=500)

* Correlation is significant at the 0.05 level (2-tailed).

** Correlation is significant at the 0.01 level (2-tailed).

From **Table.6**, it is found that 51.2% of the respondents 'Strongly Agree' and 36.0% of the same 'Agree' that they use social networks for learning purposes. 81.2% of the students agree that use of social networks provides them with ample opportunities to share news and promote activities. Nearly 79% of the respondents agree that they use social networks to do educational activities and more than 85% of the same believe that use of social networks in academic and learning purposes enhances academic performance. 44% of the students agree that they are having offensive comments and e-mails from unknown sites and links. Nearly 38% of the respondents agree and 36% of the same disagree that they always say 'No' to their family members and friends while using social networks.

More than 35% of the students agree and nearly 47% of the same disagree that they ignore home works while using social networks. Nearly 44% of them are in agreement and 37% of the same are in disagreement that they always get up from bed at late morning for using social networks at late night. Nearly 45% of the respondents agree that they always use social networks though their parents forbid them from using these.

Table.6: Perception about the Impact of Social Networks among the Students, (n=500).

Particulars	Strongly agree N (%)	Agree N (%)	No comment N (%)	Disagree N (%)	Strongly disagree N (%)
I use social networks in learning purposes	256 (51.2)	180 (36.0)	37 (7.4)	7 (1.4)	20 (4.0)
The use of social networks provides	li fisionali intere	r séi to iditt	Techina terreta	San varys	enshiseg201
ample opportunities to share news and	143 (28.6)	263 (52.6)	75 (15.0)	16 (3.2)	3 (0.6)
promote activities					
I use social networks to do educational activities	166 (33.2)	228 (45.6)	43 (8.6)	59 (11.8)	4 (0.8)
Social networks usage in academic			-		
purposes improves my academic	275 (55.0)	153 (30.6)	31 (6.2)	24 (4.8)	17 (3.4)
performance	ensiden offi	a anti thi		udali di tra	
Offensive comments and e-mails are		त्तर स्टब्स् हाझ र			13
sent to me frequently from unknown	71 (14.2)	149 (29.8)	115 (23.0)	117 (23.4)	48 (9.6)
sites and links	ta she fiy	a vjeta stra V	e good in the start	e no punte la	
I always say 'No' to my family and	70 (14.0)	110 (02.9)	121 (26.2)	109 (21 6)	72(14.4)
friends while using social networks	/0 (14.0)	119 (23.8)	151 (20.2)	108 (21.0)	72 (14.4)
I ignore home works while using	(1 (12 2)	117 (02.4)	90 (17 9)	155 (21.0)	79 (15 6)
social networks	01 (12.2)	117 (23.4)	09 (17.0)	155 (51.0)	78 (13.0)
I am always late to get up from bed	92 (1 <i>C</i> 4)	126 (27.2)	07 (10 4)	126 (27.2)	40 (0.8)
for using social networks at late night	82 (10.4)	130 (27.2)	97 (19.4)	130 (27.2)	49 (9.8)
I always use social networks though	41 (8 2)	192 (26 4)	102 (20.6)	100 (20.0)	74 (14 9)
my parents forbid me from using these	41 (8.2)	182 (30.4)	103 (20.0)	100 (20.0)	/4 (14.0)
I have more friends in social networks	128 (25.6)	166 (22.2)	95 (17.0)	78 (15 6)	12 (9 6)
than I have in real life	128 (23.0)	100 (33.2)	85 (17.0)	78 (15.0)	43 (8.0)
I always become frustrated and angry	117 (22.4)	175 (25.0)	05 (10.0)	71 (14 2)	12 (9 1)
when social networks are unavailable	117 (23.4)	175 (55.0)	95 (19.0)	/1 (14.2)	42 (8.4)
Excessive use of social networks are	08 (10 6)	150 (20 0)	120 (24.0)	04 (19 9)	29 (7 6)
keeping me aloof from family tie	98 (19.0)	130 (30.0)	120 (24.0)	94 (10.0)	38 (7.0)
Excessive use of social networks is	88 (17.6)	160 (32.0)	116 (22.2)	100 (21.8)	27 (5 4)
isolating me from real life	00 (17.0)	100 (52.0)	110 (23.2)	109 (21.8)	27 (3.4)

Nearly 59% of the respondents agree that they have more friends in social networks than they have in real life and more than 58% of the same are in agreement that they always become frustrated and aggressive when social networks are unavailable. Nearly 50% of the respondents are in agreement that social networks are keeping them aloof from family tie. Finally, nearly 50% of the respondents agree and more than 27% of the same disagree that social networks are isolating them from real life.

5.0. Discussion

In this section, we are going to investigate and highlight some major findings we got from our survey results. One of the main objectives of our study was to determine the usage level of social networking sites among the students. The findings of Table.2 will examine and justify this objective. The Table.2 indicates that most of the students (79.2%) use Facebook, YouTube, and Google+ up to 5 hours a day and they access to these online sites through their Smartphones because Smartphones are very much available to them. But the percentage of the students (only 6%) in the use of social networks in learning purpose only is very poor though the past studies and the present study showed that use of online social networking sites in learning purposes improves the students' academic performance. Another important finding from Table.2 was that more than 58% of the students are influenced by their friends to use social networks. According to the study conducted by Khan [15], most of the students (67.3%) use social networking sites due to their friends' influence. One of the main reasons behind this might be that during academic life, students love spending more time with their friends. That's why friends are the most influential people among other people living around you and these friends may influence your life style, behavior, liking and disliking and thus, contribute significantly to shape a good or bad personality. So, it can be said that the friends, using social networking sites with bad purposes, may also persuade them (the students) to do so and vice-versa. According to [13], students having self-discipline and self-regulation are positively affected by the social networks. So, we are recommending the users of social networks (the students) to be very careful in selecting friends and spend time with the friends having self-discipline and self-regulation because they may also teach them (the students) how to be self-disciplined, self-regulated, and well-balanced in using social networking sites.

The findings of **Table.3** and **Table.5** indicate that student's age and level of education have direct relationship with the usage of social networks; while, according to **Table.4**, gender has no direct relationship with the usage of social networks. Another main objective of our study was to investigate

the students' perception toward the social networking sites' impact on their academic and personal life. In this case, the findings of **Table.6** will help justify this objective. As shown in **Table.6**, most of the students (more than 87%) agreed that they use social-media sites for learning purposes and more than 85% believed that the use of social-media sites improves their academic performance. But according to a study conducted by Owusu-Acheaw & Larson [13], nearly 97% of the students do not use social networking sites in learning purposes and more than 74% believed that social networks do not enhance their academic performance. The **Table.6** also shows that social networks cause moral degradation of the students, such as disobedience, depression, aggression, and dispersion from family tie and real life. This moral decadence of the students might be due to the abuse, imbalanced and excessive use of online social networking sites. Larry D. Rosen [16, 18] also supported that excessive use of these sites cause mental disorders among the users. So, the students should ensure proper time management in using these sites.

Finally, throughout the discussion, we suggest some recommendations that can facilitate integrating social networks into the students' both academic and personal lives. We anticipate that the findings and recommendations of the present study will help the students improve their academic performance and moral values through social-media sites.

6.0. Conclusions and future study

The present study indicates that students can improve their academic performance by using social networks in learning purposes, such as exchanging academic and career related information, communicating with teachers and friends for academic purposes, discussing new topics, conducting research, submitting assignment, and asking for advice or assistance. Besides, the students use social networks for recreational purposes also, such as chatting and gossiping with friends, watching videos, playing games, and making new friends. Social networks affect the students' academic and personal life negatively in case of excessive use of these sites, such as suffering from online bullying, ignoring home works, and saying no to their family members.

For academic and personal development, the researchers are recommending the students not to use social networking sites during their class time, late night, and ignoring their personal, family, and social activities rather they should ensure proper time management and should be balanced, self-regulated, and self-disciplined in using these sites. Moreover, age limitation and introducing National Identity Card (NID) in using social networks may ensure control use of social networks among the students in Bangladesh.

Though this study is significant in the context of Bangladesh, however, it has some limitations. Survey was conducted over only 500 students from different colleges and universities of Gopalganj district only. So, a future study might be required with the inclusion of many more colleges and universities of other districts and divisions with large sample size. Moreover, the study is limited to only Facebook, YouTube, and Google+ but social networks consist of many more, such as Twitter, LinkedIn, Instagram, Academia.edu, and so on. So, future study might be conducted with more diverse types of social networks.

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Modified Roof-Top Garden as a Tuned Mass Damper for Vibration Control of Building Structure Under Earthquake Excitation

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Abstract

Tuned Mass Damper(TMD) is very popular to mitigate the vibration of the structure under any type of random loadings like as Wind or Earthquakes. This research work mainly focuses on to modify the roof- top garden as a passive vibration controlling devices (RTGD) using the same principle of TMD.One of the important features of TMD is using huge mass to create the inertial force against earthquake forces. This passive energy dissipation system is not neededany additional mass because the mass of roof garden used as a TMD mass which is come from the mass of soil and plants. The roof and roof-top garden have been isolated by springs which have been given the spring force and also installed a viscous damper to provide the damping force against earthquake forces. Partially saturated soil condition of roof top garden has been taken to avoid the detuning effect. The obtained structural response under different earthquakes proved that this system is one of most capable to mitigate the Earthquake vibration and can be easily used in practically for building thestructures.

Keywords: Tuned Mass Damper, RTGD, Vibration Control, Earthquake.

1.0. Introduction

The high-rise buildings, long-span bridges, towers and others modern structures are growing up frequently nowadays, those structures are very susceptible to random forces like earthquakes, winds and waves loads. Those forces create excessive vibration whose have a devastating effect on a civil structure that's why the engineers and researchers are a very concern to save the structures and keep the deflection within desired limit. The researcher already invented some controlling devices to reduce the effects of random force effect on a structure like Tuned mass damper (TMD), Tuned Liquid Damper (TLD), Base- Isolator and Others. Among that device, TMD is considered as the most popular and commonly passive control device for mitigating the dynamics response of structures due to effectiveness, robustness and relatively easy installation [1,2]. Although TMDs have been installed in many buildings around the world, such as the CN tower at Toronto,

1975 and Shanghai World Finance Center at Shanghai, 2008, the 660-ton TMD installed at the top of the Taipei Tower at Taiwan, 2004 is considered as the largest and most known TMD [2]. The use of TMDs was studied as a control technique, focusing on the directions of research in the US in structural control [1]. Many investigations have been carried out regarding the mathematical formulations, numerical applications, and response of TMD-controlled systems [3,4]. TMDs are used in buildings not only to control the dynamic response under lateral loads but also to mitigate the torsional behavior of extremely torsional coupled buildings [5,6]. The seismic response of severe torsional coupled buildings was investigated by conducting a large-scale parametric study to obtain the optimum values for the parameters of a TMD system, such as the location of the added mass damper, tuning frequency ratio, tuning mass ratio, and tuned damping ratio [5].



Fig.1: 3D Structural Model of 20-Stories Building by OpenSees

For mitigating wind or earthquake induce vibration Passive TMD [7,8,9] has been applied to control the vibration under random excitation but the uses of this device are rare due to their effectiveness to impulse loads being conditional upon adoption of larger mass ratio [10]. Instead of recurring to cumbersome metal or concrete devices, this paper suggests meeting the conditions by turning to TMDs non-structural masses that are available a top of the buildings.

TMD need huge masses to meet the desired effect of controlling the vibration under earthquake force, this research suggests to use non-structural mass as a TMD mass which is already available on the top of building a structure in form of roof top garden. So, in specific, this is the very promising solution to meet the mass demand of TMD as well as this mass help for gardening to meet some environmental demands.

1.0. Research Methodology

A twenty-story building with roof top garden has been considered for analysis under different Earthquakes. The structural elements and other consideration have been discussed in section 3. To design the roof top garden damper, the natural frequencies and others modelparameters are needed for uncontrolled (without spring and damping device)structure. To effective design of RTGD, first, remove the roof top garden from the top and modal analysis has been done to get modal parameters of theuncontrolled structure. Using those parameters RTGD has been designed and installed (Details in sec 2.2). After design RTGD equation of motions (Details in Sec 2.1) have been developed for controlled(with RTGD damper) structure for analyzing thestructure. Then different earthquakes have been selected (Details in sec2.3) for analyzingthe performance of RTGD. Total analysis has been performed in OpenSees software platform. After gathering result of theanalysis, the performance has been checked by comparing different point of views. Compared results proved that the building with RTGD has been performing well under random vibrations.

2.1. Equation of Motion of Structure with the RTGD

The twenty-story building has been modeled with RTGD has been shown in figure 1 and the governing equation of motion can be written as:

$$M\ddot{x} + C\dot{x} + Kx = -M\ddot{x_a}(1)$$

where x, \dot{x} , \ddot{x} and $\ddot{x_g}$ respectively represents the displacement, velocity, acceleration and ground acceleration vectors of the system relative to the base point.

The dimension of the matrix can be presented as $(N + 1) \times 1$. Where N is number of story (Degree of freedom) of uncontrolled structure and (N+1) resepent matrix dimension with RTGD.*M*,*C* and,*K* are the mass, damping and stiffness matrices respectively.

Where the matrix dimension is $(N + 1) \times (N + 1)$.

M,*C* and *K*,are as follows:

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$$M = \begin{bmatrix} M_{sN \times N} & 0_{N \times 1} \\ 0_{1 \times N} & m_{d_{1 \times 1}} \end{bmatrix}_{(N+1) \times (N+1)}$$

$$C = \begin{bmatrix} C_{sN \times N} & 0_{N \times 1} \\ 0_{1 \times N} & c_{d_{1 \times 1}} \end{bmatrix}_{(N+1) \times (N+1)}$$

$$K = \begin{bmatrix} K_{sN \times N} & 0_{N \times 1} \\ 0_{1 \times N} & k_{d_{1} \times 1} \end{bmatrix}_{(N+1) \times (N+1)}$$

where, M_s , C_s , and K_s are the mass, damping and stiffness matrices of the uncontrolled structure respectively, having a matric dimension of $N \times N$. In addition, m_d, c_d and k_d are the garden mass, damping and stiffness, respectively.

2.2. Design of RTGD

The roof top garden dampers are design base on modal parameters. To get the natural frequency and other modal properties of building eigenvector and eigenvalue analysis have been carried out. Moreover, effective modal mass is also obtained from the modal analysis. In this research, only first modal vibration has been considered to control, that's why to design damper stiffness and damping value the first modal properties has been taken. There are three types: Dry soil, partial saturated and fully saturated of the soil of soil condition can happen in different weather condition. In this paper, the partially saturated condition has been considered to calculate the mass of roof top garden. Den Hartog (11) equations is performed to obtain the optimum frequency ratio and damping ratio of the top garden damper with considering the mass of roof top garden under partially saturated soil condition. The Den Hartog equation to get the optimum frequency and damping is provided below:

$$\alpha_{opt} = \frac{1}{1+\mu}$$
(2a)
$$\xi_{opt} = \sqrt{\frac{3\mu}{8(1+\mu)}}$$
(2b)

Where, μ is the ratio of mass between roof top garden mass and modal mass of 1st mode. α_{opt} is the frequency ratio and ξ_{opt} is the optimum damping ratio.

The required spring stiffness (K_d) and Damping (C_d) is obtained from following equation,

$$K_{d} = m_{d} (\alpha_{opt} \omega_{s})^{2}$$

$$C_{d} = 2\xi_{opt} (\alpha_{opt} \omega_{s}) m_{d}$$
(3)
(4)

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Where, m_d is the mass of roof top garden under partial saturated condition, ω_s is the 1st atural frequency of uncontrolled structure which has been obtained from modal analysis without onsidering roof top garden.

2.3. Applied of Ground Motion

This present study, four types of ground motion as acceleration has been applied to evaluate performance the roof top garden damper systems in the building structure. One of ground motion is Sine wave which has signal frequency 0.332 Hz (1st modal frequency of uncontrolled structure) with amplitude 1. Besides that, three different types of the earthquake, such as El-Centro, California, and North-Ridge are considered. All the acceleration is executed as a time history. The motive behind to apply several earthquakes are the different earthquake contains various frequencies. As a result, every passive controlling system gives the best performance where the time history signal had to optimize the design of the controlling system. Application of ground motion and its PGA and time interval is given below in **Table.1** and **Fig.2** Depicts the time history analysis of applied ground motion.

Table.1 Time history data of ground motion

		El Contro	North-Ridge	California
	Sine Acceleration	EI-Cenuo	North Ridge	•
	(F=0.332 Hz)	Earthquake	Earthquake	Earthquake
	1000	2500	2000	2000
Load steps	4000	2300	2000	
Time interval (sec)	0.01	0.02	0.01	0.01
	1	0.348	0.343	0.158
PGA(g)	1	010 10		



(a) Time history and FFT of El-Centro Earthquake

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3.0. Numerical Example

In this study, a twenty-story building is considered with 5% structural damping ratio to analyze the seismic response. The building has modeled in finite element modeling using OpenSees. Three bays with 6 m and each story height with 3 m has been considered for this structure. Materials property and element details have been provided in Table 2-3. Rayleigh damping(12) approach has been used to calculate the damping of the uncontrolled structure.

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From the modal analysis, the 1stmodal(natural) frequency is obtained and value is 2.4 rad/sec. To calculate the mass of RTGD partially saturated has been considered which have unit weight 13.22 N/m^3 . The RTGD property (mass, spring stiffness and damping) has been calculatedusing the equation 2, 3 and 4and provided in **Table.4**. The total stiffness and damping is divided among the sixteen column joint because in every column joint one spring and damping device has been installed. The spring location is marked in plan view of building which is mention in **Fig.3a** and spring damper shown in **Fig.3b**.

Item	Value	Unit
Modulus of Elasticity(E)	2.486? 1010	Ра
Poisson's Ratio	0.2	
Density	23563.122	kg/m ³
Shear Modulus G	1.036? 1010	
Compressive Strength of concrete (fc')	27579032.	Ра

Table.2: Materials Details of structure

Table.3: Element Details of Structure

Item	Width(mm)	Depth (mm)
Beam	300	500
Column	600	600
Floor Slab or roof		162.5
Roof Top Garden slab		200

Table.4: Roof Top Garden Dampers properties

Item	RTGD properties
Mass (Kg)	575075
Stiffness(N/m)	2029054
Damping(N-Sec/m)	616969.4



Fig.3: Spring damper device locations and details

In Fig.4, the building model of Open Sees is represented. Fig.4(a), represents an uncontrolled twenty story building with roof top garden. Fig.4(b), illustrates a twenty-story building with roof top garden damper as a functioning tuned mass damper (TMD). The columns of roof top garden in uncontrolled structure has been replaced with the springs and viscous dampers. After modeling the structure with and without RTGD the El-Centro, California and Northridge earthquakes has been applied as a time history function. One directional excitation has been performed. Newark's method has been used for time history analysis.



a) Uncontrolled Model

b) Controlled Model

Fig.4: Transfer Model from Uncontrolled to Controlled in OpenSees

4.0. Results and Discussion

To establish the effectiveness of the roof top garden damper (RTGD), the different types of structural responses were compared. The comparisons of the uncontrolled and controlled responses for displacement, base shear force, and frequency response, are shown in Fig. 5 to7. From these figures, it is clear that the RTGD is capable of controlling fundamental vibrational mode under earthquake excitations. A modal analysis was carried out after the design and installation of RTGD, to determine the effect of the RTGD with respect to the modal parameters. In Table 5 natural frequency of uncontrolled and controlled structure has been mentioned.

Mode No.	Uncontrolled (Hz)	Controlled (Hz)
First Mode	0.338	0.454
Second Mode	1.055	1.252
Third Mode	1.885	2.181

Table.5: Natural frequencies (Hz) of the uncontrolled and controlled structures.

Fig.5 shows the displacement response of the structure under sine wave acceleration. Sine wave acceleration has been created with signal frequency 0.3382 Hz which is the first modal frequency to create the resonance effect on the structure. From the resulting displacement, it can be clearly observed that under this signal, the uncontrolled displacement is huge about 277.00 cm under the condition partial saturated roof top garden soil whereas controlled displacement is 32.822 cm. It is clear that this structure cannot be sustained under this sine wave or if the same kind of earthquake will impose to this structure but when the roof top garden is modified and used to control vibration, displacements is mitigated significantly and structure might be sustaining.





Fig.6 shows the result of top floor displacement for the uncontrolled structure and the structure controlled by the RTGD when subjected to the El-Centro, California, and North-Ridge ground motions. From the obtained results, it was observed that the uncontrolled maximum displacement of the structure was 34.76 cm whereas controlled displacements were 15.96 cm for the El-Centro. And under the California earthquake, the uncontrolled displacement was 4.40 cm, but the controlled displacement was 2.23 cm correspondingly. Moreover, the Northridge earthquake also applied with previously mention conditions to get the dynamic responses of the structure, in that case, the uncontrolled maximum displacement is 54.64 %, 49.52 % and 40.17 % under for the El-Centro, California, and North-Ridge earthquakes, respectively. The average RTGD stroke length was 22.02 cm, 3.59 cm and 5.01 cm which is an acceptable limit for the El-Centro, California, and North-Ridge earthquakes, individually.







b) Top floor Displacement under the California Earthquake



 c) Top floor Displacement under the North-ridge Earthquake
 Fig.6: Top floor displacement of the Uncontrolled structure and the controlled structure by RTGD under different Earthquakes

Fig.7 shows the time history response of the base shear for the uncontrolled structure and the structure controlled by RTGD for different earthquake excitations. From the time history response of each curve of the earthquake, it is clear that the RTGD is capable of reducing the base shear force effect of the structure under a broad range of earthquake excitations. The maximum uncontrolled base shear force is 5620 kN, 864.1 kN, and 2060 kN under El-Centro, California and Northridge earthquakes respectively whereas the controlled shear forces are 3641kN, 709.2 kN and 1547 kN. The percent reduction in the maximum base shear force was 32.21%, 18.00 % and 24.90 % for the El-Centro, California, and North-Ridge earthquakes, respectively.



a) Base shear forces under the El-Centro Earthquake





Fig.8 shows the results of the acceleration frequency response curve for the uncontrolled structure and the structure controlled by the RTGD under the El-Centro, California and North-Ridge Earthquakes, and Sine wave signal (where the signal frequency 0.3328Hz). The maximum first modal frequency response amplitudes of the uncontrolled structure were 73.09 dB,17.17 dB, 9.30 dB and 11.18 dB, whereas controlled amplitude was 0.95 dB, 3.5 dB, 0.52 dB and 2.06 dB under the El-Centro, California, North-Ridge Earthquakes, and the Sine acceleration, respectively. The performance demonstrated that the RTGD is one of the capable devices of controlling modal frequencies of the uncontrolled structure.



FRF curve under the El-Centro a)



Fig.8: Frequency response curves under different excitations

5.0. Conclusions

This work proposed a new vibration control system, which was modified the roof top garden as a Tuned Mass damper which was able to control dominate modal vibrations under random vibration conditions like earthquakes or wind forces. This damper system is called the Roof Top Garden Damper (RTGD). The roof top garden mass is used as a damper mass so additional mass did not require in this system. This system can be served as a roof top garden as well as a damper for mitigating the vibration of building the structure at the same time. The damper stiffness and damping were design under partially saturated soil conditions of roof top garden. The modeling of the structure and the simulation were carried out using OpenSees. Accordingly, the proposed RTGD has a great potential of achieving very satisfactory, innovative vibration control performance. To evaluate the performance of the RTGD, the test results of the structure controlled with the RTGD were compared with those obtained for an uncontrolled version of the same structure.

The following conclusions can be drawn out from the trend of the results of this study.

- The RTGD was significantly more efficient and practical solution for reducing the response of the building. The results indicate there was a remarkable reduction in the maximum top displacement under earthquake excitations.
- The dominant mode shape amplitude of the building was primarily considered to select the locations of the dampers. The design and installation of the RTGD focused on the modal parameters of the first mode which carried about 85 % of the structural mass.

- The rate of response reduction in the uncontrolled top displacement was 54.64 %,49.52
 % and 40.17 % for the El-Centro, California and North-Ridge earthquakes, respectively.
- The base shear response reduction rate of the uncontrolled structure was 32.21%, 18.00 % and 24.90 % for the El-Centro, California, and North-Ridge earthquakes, correspondingly.
- The amplitude of the frequency response reduction for first mode frequency was about 98.70%,79.62%, 94.62% and 81.57% under the El-Centro, California, Northridge earthquakes, and the sine wave, respectively. These results clearly indicate that the RTGD is capable of controlling frequency earthquake forces.

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Scenario of Safety Issues Prevailing Accident in Rural Engineering Workshop in Bangladesh

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Abstract

Safety is the condition being protected against any hazardous situation and any other type of failure, error and accidents. As a developing country our technology is growing day by day. But the man who works to develop this technology and works in different industries, factories and rural engineering workshops is deprived of their required safety. The safety issues provided for the workers are not properly maintained in Bangladesh. Almost no safety is provided for the workers in rural engineering workshop in Bangladesh and for that they are suffering from various problems such as financial, physical, social, spiritual, occupational etc. Many accidents have already been taken place due to not providing enough safety to the workers. Therefore, safety must be provided minimizing accident hazards and risks. The workshops safety situation in Bangladesh is very severe by international standard. An overview of the prevailing accident problem characteristics and some working safety priorities that should be addressed with due urgency are briefly discussed in the paper. In this paper an attempt has been made to highlight the workers safety issues in rural engineering workshops in Bangladesh.

Keywords: Safety Issues, Socio-Economic Development, Rural Engineering Workshop, Occupational Safety, Safety Management.

1.0. Introduction

A workshop is a part and parcel of any engineering section. Small and Medium Size Enterprises (SMEs) having less than 50 employees comprise the majority of enterprises in many countries, and they employ $40 \sim 90\%$ of the total work force [1].Small enterprises are essential for job creation and economic growth [2] because of their clients centered and focus on local or regional needs and thus play a vital role in communities [3].There is no doubt that rural engineering workshops play a vital role in our socio-economic development. But safety issue is a crucial question here. An alarming no of accidents and cases of illness are reported per annum in rural engineering workshops. Most of the accidents are originated by illiteracy, rowdiness or misuse of machinery and equipment [4]. The owners and workers both are responsible for these accidents. They take the safety issues very lightly and sometimes neglect it willingly. On the other hand, child labor is a threatening issue. Illegal

conditions of the environment of workplace are so murky and offensive. Otherwise the workplace is too small for an operation. In their man, machine and material stay almost in contact. The employer must take reasonable care to protect his employees from risk of foreseeable injury, disease or death at work by the provision and maintenance of a safe place of work, a safe system of work and reasonably competent fellow employees [5]. Efforts to prevent accidents and deaths are extremely relevant because of their relationship to the integrity of the human being and the survival rate of the companies [6]. From a political and financial point of view, the importance of small companies is becoming more and more noticeable [7]. Many engineering processes are dangerous and these consist of different activities like cutting, casting, soldering, welding, etc. Additionally, some activities consist of the use of venturesome materials and chemicals. What is more, even the foremost basic and easy activities will doubtless be dangerous if allotted victimization inappropriate tools, materials, and ways. Altogether cases, the right tools and protecting equipment ought to be used and proper coaching ought to be provided. Additionally, safety warnings and notices ought to be conspicuously placed within the geographical point. access to areas wherever venturesome processes turn up ought to be restricted and thoroughly controlled so only fittingly trained personnel is present. Additionally, the storage of venturesome materials (chemicals, hot substances etc.) needs special care and effective access management.

Productive health and safety management in tiny engineering workshops is concerning distinctive the foremost frequent and high risks and adopting the correct precautions, taking account of time, cash and resources [8]. Generally speaking, all employers and employees have the same occupational health and safety (OHS) rights and obligations [9]. The data was collected during this study associated with commercialism scenario, employment and labor issues and connected particularly to occupational safety, health and working surrounding, cautions at work, pointers in promoting the event of safety standards at work in rural engineering workshops in Bangladesh. Various activity ways like reportable work injuries, hospital treated work injuries, and survey based mostly estimates of labor injuries might provide totally different estimates of the quantity of labor injuries [10].

The cases of labor injuries enclosed during this study are so the less severe injuries, within the sense that they solely embrace injuries inflicting temporary absence from work. The effort and type of occupational health and safety (OHS) management system does significantly affect the injury rate. Studies on Occupational Health and Safety Management Systems (OHSMS) have proposed methods for increasing organizational efficiency together with the confrontation of this reality of many work accidents to improve the operations of companies and their interaction with the

society [11]. This study aimed to supply an outline of occupational health and safety management in rural engineering workshops.

2.1. Questionnaire development

A form was developed comprising check-box queries and open-ended queries. The form was divided into four sections that coated:

- i. Information about the workshop
- ii. Enquiry the accidents and workers condition data
- iii. Condition of workshops and workers
- iv. Occupational health and safety regulations

The adjustment of the questionnaire was made following the comments

2.2. Types of workshop

The counted workshops were small sized rural engineering workshop in Bangladesh. Which were

- i. Automobile service center
- ii. Welding shop
- iii. Lathe shop
- iv. Air cooler & refrigerator service center
- v. Wood shop
- vi. Painting workshop
- vii. Fiber & glass workshop
- viii. Electronic device service center
 - ix. Saw mill (cutting and processing wood)

2.3. Procedures

A cross-sectional non-experimental design was used for this study. From January 2017 to May 2017, here prepared the survey in the two districts (Jessore, Khulna) in Bangladesh. It also tried to contact to the owner of different rural engineering workshop and the victim of different types of accident. Based on the type of workshops and the questionnaire that we did the survey. Finally, 80 small size rural engineering workshops were investigated for obtaining the questionnaire. All most 85% of these workshops were road side workshops. The survey was designed to capture the common injury that occurred in rural engineering workshops as identified by safety science based on online database. Then, the survey was designed to identify the common nature of injuries, parts of body

affected by injuries, causes of injuries. The survey was furnished to gather information from five major sections consisting of 35 items: (a) causes of injury (table 1); (b) nature of injuries (table 2); (c) occupational injury socio-demographic category (table 5); (d) occupational injuries in work related category (table 6); and (e) working conditions. We asked to report any injuries or experience of accident while working for the current operation.

2.4. Data analysis

Data from the form were hinted and analysis. Percentages were used.

3.0. Results

3.1. Accident statistics

There are many accidents and cases of injuries reported every year in the small engineering workshops. Almost two-third of all such accidents arise from the movement of people, goods and vehicles around the workshops and out of it. Of these "movement" accidents are about half involve lifting and moving goods and other half involving slips, trips and falls and hitting stationary or moving plant and equipment. "Non-movement" accidents mostly arise from the use of machinery, this account for 10 to 15% of all accidents. Electrical accidents are common and they frequently have the potential for more serious injuries. The most common occupational diseases are dermatitis, deafness, asthma and vibration white finger, and back, hand, arm, shoulder and neck problems. In any particular workshop risks which are relevant should be assessed. Those likely to be of most concern includes movement of people, goods and vehicles around the workshop, particularly manual handling, machinery safeguarding, hazardous substances, particularly metalworking fluids, degreasing solvents and dust or fume from welding, brazing, soldering, coating and painting, noise and vibration.

Besides these reasons there are many other causes for accidents such as poor lighting, electrical hazards, fire hazards, poor exhaust ventilations, human carelessness etc. Unguarded and badly maintained plant and equipment are obvious causes to injuries. However most of the common causes of accidents are falls on slippery floors, poorly maintained stairways scaffoldings and obstructed passageways in overcrowded workplace. The costs of accidents and ill health to small engineering workshops may be high. Many employees are 'key'workers whose loss through injury or ill health severely disrupts production and lowers profitability. The overall condition and different cause for accidents in rural engineering workshops were investigated. The accident statistics of workshops were classified by number of injured workers by different causes is shown in **Table.1**. From this tabel it is seen that most of injuries in rural engineering workshop are caused by machinery and then by

handling and carrying equipments. The accident statistics of workshops were classified by nature of the injury is shown in **Table.2**

Total number of injured	26
person(investigated)	
1.Handling and Carrying	7 (27%)
2.Falling objects	5 (19%)
3.Slipping and tripping	2(8%)
4.Machinary	10 (38%)
5.Falls from height	2 (8%)
6.Workplace transport	0 (0%)

Table 1: Injuries to rural engineering workshop by accident.

Table.2: Nature of injury for 26 interviewed injured wrokers.

Nture of injury	Number (%)
1. Amputation, laceration	3 (11.53%)
2.Contusion	2 (7.69%)
3.Dislocation, facture	5 (19.23%)
4. Hernia, rapture	2 (7.69%)
5.Sprain/strain,joint inflamination	9 (34.61%)
6.Scratch, abrasion	1 (3.84%)
7.Brun, multiple, miscellaneous	4 (15.38%)

The accident statistics of workshops were classified by number of injured workers in different workshop is shown in **Table.3**. It is seen that most of accidents are taken palce in welding shop, automobile service centre, lathe shop, electronic devices service centre and wood shop. The accident statistics of survey classified by absences of workers is shown in **Table.4**. It is seen that due to accidents the function of the workshops are hampered severely and workers are absent for several days due to this. This affects the functionality of the workshop significantly.

Types of workshop	Numbers of	Injured workers (%)	
	workshop		
1.Automobile service center	12	3 (11.53%)	
2. Welding shop	14	5 (19.23%)	
3.Lathe shop	12	6 (23.07%)	
4. Air-conditioner & refrigeration service center	4	1 (3.84%)	
5.Wood shop	10	2 (7.69%)	
6.Painting shop	6	0 (0%)	
7.Fiber & glass workshop	5	2 (7.69%)	
8.Electronic devices service center	10	4 (15.38%)	
9.Saw Mill	7	3 (11.53%)	

Table.3: Numbers of injuried workers in different types of rural engineering workshop by accident.

Table.4: Accident statistics classified by absecence of workers in the workshop.

Accident case	Number (%)
1.≤1 day lost case	6 (23.07%)
2.> 1 day lost case	5 (19.23%)
3.Disability case	4 (15.38%)
4. Fatal case	4 (15.38%)
5. Scikness case	7 (26.92%)

3.2. Conditions of workers & workshops

In Bangladesh the occupational safety of rural engineering workers is not well organized. The owners are employing male workers with below 30 years of ages at the rate of 65% and the upper being 35% while the percentage of female workers is negligible. The most remarkable fact is that the percentage of child (age below than 15 years) workers in rural engineering workshop are minimum 30%. The owner of that workshop prefers them to take the opportunity of their poverty and also their wages are cheap. They are also deprived of their basic education. Their average working hour was 8.0 h/day (31%) and 48 h/week. Regarding a number of holiday/weeks, maximum workers had one day, two days holiday was rear. Most of the day workers had little time to lunch or breakfast. They were working from morning to till night most of the days. Most engineering workshop arranged several welfare facilities for workers namely. There was not arranged clean

drinking water, suitable eating places separated from operation area, clean and good sanitation of toilet facilities, washing basins and proper resting areas inside the workshop. It is very important that the workshops provide necessary welfare facilities for workers. Out of 80 rural engineering workshops studied, the workers were exposed to work by hazardous chemicals, excessive noise, working at dangerous elevation, in hot place, in confined space, low fresh air circulation, inadequate lighting quality, with excess vibration etc. The workers are not trained enough to the proper use of tools and machines in the engineering workshops which may cause injury to the operators. Percentage of unskilled workers and illiterate worker is high. Different types of rural engineering workshops were observed and different cases of accidents were investigated. Injured and non-injured people are divided into two categories firstly socio-demographic and secondly work-related category. And these categories are divided into some sub-categories. So that table 4 and table 5 is related to factors of occupational injuries in different types of workshop in socio-demographic category and work-related category.

		Injured	Non-injured
Factors		workers (total	workers (total
		26)	248)
age	< 30 years	17 (65%)	108 (44%)
	\geq 30 years	9 (35%)	140 (56%)
Material status	Unmarried	15 (58%)	156 (62%)
	Married	11 (42%)	92 (38%)
Educational level	Illiterate/basic	20 (77%)	176 (71%)
	education		
ta tan	College/technical	6 (23%)	72 (29%)

Table.5: Data for factors of occupational injuries in socio-demographic category.

		Injured workers	Non-injured workers
Factors		(total 26)	(total 248)
Job category	Unskilled	18(69%)	104(41%)
	Skilled	8(31%)	144(59%)
Duration of work(years)	<10	16(62%)	139(57%)
	≥10	10(38%)	109(43%)
Working hours/week	>48	8(31%)	177(72%)
	≤48	18(69%)	71(28%)
Workplace supervision	No	17(65%)	150(60%)
	Yes	9(35%)	98(40%)
Machinery &	Poor	15(58%)	172(69%)
maintenance			
	Good	11(42%)	76(31%)
Health and safety	No	21(81%)	188(76%)
	Yes	5(19%)	60(24%)

Table.6: Data for factors of occupational injuries in work related category.

Reviewing these two tables that the perception about the rural engineering workshop is found and which is very woeful. Some pictures are given below which shows the hazardous situation of workshops.



Fig.1: Worker is doing gas welding without safety





In **Fig.1** shown that a worker is doing gas welding without safety. His dress is lungi (one kind of Bengali dress) which is long loose. That kind of dress is too much dangerous for any kind of machining
operations. In **Fig.2** it is viewed that a child is working in workshop. He was working there during two years.



Fig.3: Victim of workshop accident

In **Fig.3** it is noticed that a victim of workshop accident. He lost his one finger because of blasting the air trunk of truck. These types of accidents are very common in rural engineering workshop in Bangladesh. Every year many people suffer from this type of accidents largely. One of the reasons of that type of accidents is not to use proper safety measures and the workers are not trained enough to the correct use of equipment's and machines in the engineering workshops which may cause injury to the operators. Special safety measures and cares should be taken to minimize this type of fatal accidents.

4.0. Results and discussion

In engineering workshops accidents are unfortunately too common. They vary in degree from trivial to, in exceptional circumstances and facilities. The health and safety of people at work is covered by a variety of acts of parliament, each act containing a book of laws and regulations which govern the way in which work may be done in the workplace and the processes, operations and equipment employed to do the work. This case-control study of risk factors for injuries in rural engineering workshops recognized a number of work environment features that were connected with injury occurrence. The risk factors confirmed in multivariable regression models were high physical workload, machine-paced work or inability to take a break when tired, lack of training, absence of a lockout program, being new on the job, and being male. Overtime is considered important for workers in rural engineering workshops because they wanted to have more income. If the owners do

not provide overtime work, they might move to other places causing a high turn-over rate due to low take home pay. It can be seen that workers in workshops have to work very hard, for approximately 11 h/day on average, if they do overtime jobs. The results showed that most of the enterprises did not have a suitable eating place for workers; thus, workers had to bring some food for lunch or had to find a place to eat outside. The number of workshops which had a fire extinguishing training, fire drills and fire evacuation training were too low. We carried out environmental monitoring for dust, heat, noise and lighting for those workshops and found most of them complied with the law only in some parameters. Those workshops therefore still need to improve their working conditions.

Improvement of safety condition of rural engineering workshop is a multi-disciplinary task and does not occur by itself. One fundamental step should be taken by Bangladesh government and which is created an organization dedicated to initiating and coordinating safety activities for rural engineering workshop. These organizations will investigate the safety condition and give them the licenses. To ensure occupational safety and to develop the safety issues some policy should be taken which are given below.

National Policy:

i. Safety management should be encouraged.

ii. National occupational safety and health policy.

Government Organizations:

i.

Establish autonomous occupational safety institute.

ii. Establish national occupational safety and health council.

Employers Organizations:

i. Training, awareness and motivation of employer regarding workplace safety and health.

Labour Union:

- i. Encourage more bipartite approach.
- ii. Expand union activities to all occupational sectors.

Legislation:

- i. Update the laws and reduce inconsistencies.
- ii. Increase effectiveness of the law focusing on rural engineering workshop.
- iii. Encourage employment of occupational health service specialists, safety inspectors in every local zone.
- iv. Introduce safety audit.

Training organization:

i. Develop and strengthen institutional capacity to provide education and training related to occupational safety and health.

National Statistics:

- i. Develop active data collection system.
- ii. Establish occupational diseases surveillance.
- iii. Establish national and regional accident and occupational diseases database.

In Bangladesh most of the workers are illiterate. So, it is very much important to give them at least primary knowledge about their work and safety measurements to be performed in their workshop. Suitable clothing is a very important factor in an engineering workshop. Overall and protective clothing should be sufficiently loose in order to allow easy body movement but not so loose that they interfere with engineering task and activities. Maintenance and equipment must be regularly serviced and maintained by appropriately trained and experienced personnel.

These not only reduce the chances of a major breakdown leading to loss of production, it lessens to chance of a major accident caused by a plant failure. Equally important is attention to such details as regularly checking the stocking and locating of First Aid Cabinets and regularly checking both the condition and location of fire extinguishers. All those checks must be logged. But before all of these recommendations the first work is to grow up the vigilance of the owners, the workers and the government. If we can ascertain the occupational safety of the workers and the safety condition of the workshop then it will help to progress our country, to improve our social value and to achieve a good international reputation.

5.0. Conclusion

This paper consists of safety condition of rural engineering workshop in Bangladesh and occupational safety of workers. It was found that many rural engineering workshops are prone to accidents and casualties. Here occupational safety refers mainly to needs the workers. But the owners have no concern about their safety and their workshop environment. On the other hand, they want to enjoy benefits with increased production. The field of rural engineering has the ability to make the noticeable contributions to achieve an improved occupational safety system by maintaining safety issues and the law. As large number of people are working in rural engineering workshop and they serve us to meet our daily needs so they should provide with sufficient safety measures. Laws should be implemented and followed strictly. If we want to improve our economy the condition of the workers

must be improved and they should be facilitated by their basic needs otherwise we will lose our potentiality and our economy will be hammered. So, it is very important as a developing country to pay heed to the concerns about rural engineering workshops. Thus, we can improve life style of people, social values, and economical condition.

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A Review on Renovation of Gas Turbine to Improve Efficiency by Using Compressor Water Wash

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Abstract

The ability to predict the behavior of a turbine engine and optimize its performance is important in economic, thermal and condition observation studies. Fouling is one of the major sources of compressor deterioration. So, the paper presents an analysis of the effectiveness of online and offline compressor washing using numerous purity grade waters and industrial washing detergents. From gas turbine axial compressor blades fouling dirt of blade surface was obtained at numerous field sites. To see the composition and consistency of typical blade surface fouling materials the dirt was analyzed. An exemplary dirt formula and blade coating procedure was formulated so comparative tests can be performed using numerous cleanup fluids. To see the capability or benefits of any liquid a spray nozzle upstream of the blade test section was used for cleaning blades with five totally different cleaning liquids. In different residue experiments the impact of high-purity water versus regular water on fouling dirt was conjointly studied. Results showed that an important means of cleaning compressor blade is spraying cleaning fluid into a flowing air stream. Every of the fluids were ready to clean the test blade at each low and high air velocities and at totally different blade incident angles. The Results showed that compressor blade washing is primarily a mechanical work and does not rely on the kind of fluid used for washing. The results also showed that almost all of the cleaning happens shortly when the cleaning fluid is introduced into the flow stream. As the cleaning fluid is evaporated, the dirt aloof from the blades might redeposit in different areas. To optimize the performance of turbine engines, it is therefore suggested that operators ought to perform a mix of mechanical device hand cleanup, offline and on-line cleaning at the same time.

Keywords: Off-line nozzle system, On-line nozzle system, Degradation, Fouling, Dispersion Fields.

1.0. Introduction

Gas Turbines (GTs) have wide range of commercial applications. Gas turbine engine was designed originally for aircraft. Due to its weight and small sizes, the GT has become an appreciated machine for other applications such as industrial and power generation [1]. Proper maintenance and operating practices can significantly affect the level of performance degradation and thus time between repairs or overhauls of a GT [2-6]. Gas turbine cleanup was created within, the period of time by crank soak washing and/or by injecting solid compounds equivalent to nutshells

or rice husks at full speed with the unit on line. This methodology of on line washing by soft erosion has primarily been replaced by wet washing since the introduction of coated axial compressor blades for corroding corrosion protection. From the point of view of application, the GT's compressor is affected by the environmental conditions of the site [7-8]. With increasing operating time, degradation of the compressor manifest in the form of reduced performance [9]. The major cause of reduction in compressor efficiency and inlet air mass flow is fouling [9]. Moreover, un-burnt solid cleansing compounds and ashes can also cause blockage of subtle turbine engine blade cooling systems if ingress into the turbine air cooling stream. At the start of the introduction of compressor wet cleansing within the 1980's [10], time intervals between on line cleaning and also the combination with off line cleaning had to be established. Gas turbine performance degradation is inevitable like alternative machinery that operates incessantly in associate surroundings that's full of all sought-after of impurities. Operation of a GT at steady outputs will cause deposition from the combustion gas on the blades. Deposits cause output and potency to call in reducing the potency of energy transfer and eventually limiting the flow of the combustion gases.

However, with applicable air inlet filtration system and schedule compressor water wash turbine performance improvement might be achieved. Optimum performance of turbine would result into greater power output, reduced heat rate, improved engine life cycle and reduced maintenance value. This fouling considerably affects the gas compressor's mechanics performance and potency, thus, forcing the operator to often close up the unit for offline water-washing of the compressor. As an alternative, on line cleaning technologies are developed to wash the compressor throughout operation to reduce turbine shutdowns and optimize accessibility [11]. Performance analysis is applied to each rotating and stationary components of the GT. it's one condition monitoring technique that permits the optimum time for restorative maintenance to be calculated, wherever the deterioration may end in enhanced fuel consumption or in reduced output or each. The correct construction and operation of the components of GT plants are also necessary for proper understanding and monitoring [13]. To realize associate improved understanding of the effectiveness of on-line cleansing technologies, specifically the dirt removal and redeposit processes, variety of tests of fouled blades mounted in an exceedingly high-speed structure were performed.

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2.0. Description

2.1. Model & design description

2.1.1. Turbine

STAGES: 3 SPEED: 3000 R.P.M.

Gas Turbine mainly divided in three sections:

- · Compressor
- · Combustion system
- · Turbine

2.1.2. Compressor

Gas turbine compressors consume approximately 60% of the overall cycle energy during operation [14]. The axial flow compressor consists of compressor rotor and also the enclosures Casing. The compressor casing consists of inlet Guide Vanes, seventeen stages of rotor and stator balding, and a couple of exit guide vanes. In the compressor air is compressed in stages by series of alternate rotor and stator airfoil-shaped blades. The rotor blade provides the force required compressing the air in every stage and stator blade guides the air so it enters the subsequent rotor stage at correct angle. The compressed gas exits through the compressor discharge casing to the combustion chambers. Figure 1 and 2 [11] shows the compressor stages without and with coated rotor blades. Compressor degradation are caused by three major factors which include change in airfoil surface quality, increased tip clearance and changes in airfoil geometry [12].



Fig.1:Compressor Stages[11]



Fig.2: Compressor Stages (with coated rotor blades) [11]

2.2. Compressor cleaning process

2.2.1. Off-line nozzle system

Off-line cleaning with an appropriate cleaner will result in more intensive cleaning at crank speeds. Depending on the kind of fouling, the cleaning cycle can be repeated to improve the cleaning effect with the aim to achieve a further increase in output and efficiency. If practicable under the existing operating conditions, off-line cleaning should be performed once per month or on appropriate occasions (but at least 4 to 6 times per year) [6].

2.2.2. On-line nozzle system

This technique is generally done throughout GTs base-load operation with the IGVs within the totally open condition. The wash water resolution is delivered to the turbine unit at the correct pressure temperature and flow to clean the turbine.DM water is to be used for all washing. This water must have less than 5 PPM dissolved solids; less than 0.5 PPM sodium plus potassium, and have a P^H between 6.5 and 7.5. General turbine should be running at full speed and not in method of shutting down. The inlet guide vanes must be in the fully open position. Load must be reduced by 5% if operation at base loads. The on-line nozzle system includes nozzles that area unit mounted on the inner cone upstream of the spider that supports the compressor bearing within the casing. The hollow cone spray nozzles within the on-line nozzle system generate a water spray that covers the total device height. On-line nozzles area unit connected to a distribution ring line mounted within the inner cone. The process of water wash system is shown in fig 3 [14].



Fig.3 :Pictorial Representation of water wash system[14]

2.3. Performance

2.3.1. Wash skid

Presence of impurities in the ingested combustion air made the compressor blade to become fouled [15]. The water tank is loaded by a permanent supply connection. Filling the water tank with not mineralized water is performed automatically using a solenoid valve. Detergent is filled into the mixing tank. The detergent filling process is done by the means of an electrically driven drum. Pump is part of the wash skid hardware. The permanent not mineralized water connection allows for supplying the mixing tank with not mineralized water [6]. Optionally, transport containers for cleaning agent and antifreeze can be mounted above the not mineralized water and mixing tank.



Fig.4: Water Wash Line [14]

A centrifugal pump is provided on the one hand to prepare a homogeneous mixture of not mineralized water and cleaning agent and antifreeze rinsing fluid in the mixing tank, by using a solenoid valve and to prepare a homogeneous mixture of not mineralized water and antifreeze Rinsing fluid in the water tank via another solenoid valve. On the other hand, this pump forwards the cleaning fluid through the solenoid valves at the skid output connections and then to the both nozzle systems. Figure 4 [14] shows the water wash line and figure 5 [15] shows the water flow trough the blades.



Fig.5 : Water Flow through the Blades [15]

2.3.2. Performance of Compressor Cleaning:

The consequence of dirty compressor blades includes rougher surfaces, higher turbulence levels, deteriorating flow patterns, reduced cross section of flow, higher compressor outlet temperatures and lower compressor outlet pressures, thus lower compressor efficiency. A frequent compressor cleaning has two positive effects on the compressor.

Optimization Parameters

- Water Temperature
- Water Pressure
- Water Droplet Size
- Water Volume
- Nozzle Placement and Dispersion Fields.

2.4. Field of application

2.4.1. Estimating and costing

This subject covers the assorted aspects of estimating of quantities of things of works concerned in washing, water and sanitary works, moving works and irrigation works. This additionally covers the speed analysis, valuation of properties and preparation of reports for estimation of varied things. At the tip of this course the client shall be able to estimate the material quantities, prepare a bill of quantities, build specifications and prepare tender documents. Client should also be able to prepare worth estimates.

Types of estimates:

-Preliminary or Approximate Computing

- Special repair estimate
- Revised estimate
- Supplementary estimate

Preliminary or Approximate computing: Pipe line, Pump, Motor, Water Tank, Get valve, Non-Return valve, Detergent, Water Heater, DM Water

Table.1: Preliminary or Approximated Estimation & Costing of Different Accessories

Name	Specification	Cost
Pipe line	3"×200' SS	260/ft
Name	Description	Cost
Pump	Tusaco pump, 50Hz 3 phase	2,50,000/-

Water Tank	2000 liters	3,50000/-
Get valve	4"	10,000/-
Non-Return valve	7m3/hr	16,000
Detergent Tank	210×4=840 liters	6,00000/-
Water Heater	34 KW ,4pcs	60,000/-
DM Water	2000 liters	4,00000/-

2.4.2. Customer Benefits

The Advanced compressor cleanup System upgrade (ACCS pro) will be an economical suggests that to assist you to enhance the performance of turbine plant. Figure 6 [16] shows the operational experience of optimizes washing system. There showed a comparison of gas turbine output deterioration without on-line washing system and installation of new gas turbine system. Benefits may include:



Fig.6: Operational Experience of Optimizes Washing System [16]

- i. Avoidance of power loss up to 4% of maximum performance.
- ii. Avoidance efficiency loss due to reduced compressor fouling.
- iii. Fuel saving through keeping the specific heat rate.
- iv. Increased availability and reliability of your gas turbine to deliver maximum power at base load.

- v. Less water and detergent consumption during on-line wash due to optimized nozzle numbers and design compared to the traditional Siemens system (approx. 30% less water and approx. 25% less detergents).
- vi. Uncomplicated use of cleaning agents and antifreeze rinsing fluids (all Siemens released cleaning agents and antifreeze rinsing fluids can be used for the ACCS pro system without any restrictions).
- vii. Automatic skid with interconnection to instrumentation and control system for information and signal exchange including operator's visualization and on-line wash control (optional).

Optional Compressor Wash Prediction (COWAP) analyzer module allows visualization and prediction of performance losses and performance recovery, thereby determining the optimal timing for an off-line wash. Figure 7 [7] shows the power output and efficiency which predicts the performance recovery by compressor off-line cleaning.





3.0. Conclusion

This paper shows a comprehensive overview of controlling axial compressor fouling and washing of gas turbine. It also presents the causes and effects of compressor fouling. Regular cleaning of compressor has become certain so as for the company for maximizing its economic gains, optimizing its instrument utilization and credibility. The installation of top-quality filtration system solely reduces the amount of dirt into turbine however important amount penetrates through the filter overtime and cling to the axial blade in accordance with fouling mechanism,

as mentioned during this work. Though, industrial improvement incorporated in filtration system like filter self-cleaning system solely elongate filter life usage however large dirt accumulates on the filters that shows the amount of particulate that are present within the mass flow of air consumes by the engine and inside the turbine water volute. Combination of offline and online washing usually gives the best results in helping operators to cope with the operating problem. Plant productivity and profitability can be improved by careful monitoring of compressor performance.

Nomenclature

GT	: Gas Turbine
COWAP	: Compressor Wash Prediction
TDM	: Thermodynamic Diagnostic
CC	: Combined Cycle
HP	: Horse Power
KW	: Kilo Watt
SS	: Stainless Steel
AISI	: American Iron & Steel Institute
TW	: Thermo-well
WW	: Water Wash
DM	: De-mineralized
PPM	: Permutation Parity Machine
PH	: Potential of Hydrogen
LPM	: Liters Per Minute
h	: Specific Enthalpy, kJ·kg ⁻¹ k ⁻¹
р	: Pressure, kPa
Т	: Température, K
t	: Celsius Température, °C
V	: Volume, m ³

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How Do Domestic Products Help Branding Bangladesh Globally?

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Abstract

This paper showed how nation branding can help Bangladesh capture the global market with the help of its domestic products. The study was qualitative in nature and based on secondary data only. This study found that nation branding can help the country increase its reputation. Bangladesh can brand the country and perform the nation branding in the outer world through its different domestic products, such as culture, tourism, exports industry, and public figures. These can brand and represent Bangladesh in the global market and thus, can bring more economic growth and more investments by branding the core products of our country to the foreign countries. According to this study, RMG sector, the tourist sector, the local brands of Bangladesh, and the famous public figures are working together to build the popularity of Bangladesh and improve the brand value at the global market. To create Bangladesh as a happening nation to the outer world, our country and local brand should increase its advertising and global promotional activities to create a strong brand value of the country.

Keywords: Nation Branding, Global Branding, Domestic Products, and Bangladesh.

1.0. Introduction

1.1. Background of the study

Nation branding refers to developing an identity for a nation that consists of several elements of national accounts, including foreign direct investments, exports, culture, sports, migrants, international relations, and many other aspects [12]. To reach the customers, a company may have multiple strategies among which branding is the most crucial one because the companies, at present, give emphasis on branding that represents their products and services to the world [2]. For example, the 'Aarong', a renowned Bangladeshi brand, whose tag line for its dairy products is "Milk for Good" and that of the 'Pran' is "Nature, the best source of nutrition". What comes to minds by the tag 'Milk for Good'? Definitely 'Aarong'; this is called branding. These things are also same for a country too. A country can be well recognized and focused in the global arena with the help of nation branding process [4]. AL Ries [21], a famous writer, market specialist, and the Chairman of the "Ries & Ries", an Atlanta-based consulting firm said, "Marketing is not selling. Marketing is building a brand in the

mind of the prospect". Al Ries well said that creating confidence among the consumers to the respective products is very important as creating a brand value is important for a company's image. Definitely, marketing is not only marketing but something more that can create a strong image of a country in the workplace through branding [21]. The American Marketing Association (AMA) defines the term brand as "a name, term, sign, symbol of design or a combination of them, intended to identify the goods and services of one seller or group of sellers and to differentiate them from those of the competitors. As the economy of Bangladesh is moving on with the vision 2021 and the country is getting ready to be a middle-income county, the global product branding is very significant to help it capture the international market. Recently, Bangladesh has become eligible to be listed as a developing country and this is recognized by UN [10]. Therefore, this study focuses on local branding with the perspective of some local dominating products, brands, and industry; difficulties and way-out of converting local branding into global branding, and how nation branding can help Bangladesh capture the global market with its domestic products.

1.2. Research Question

The research question surfaced from the literature review is 'How do domestic products help branding Bangladesh globally?'

1.3. Objectives of the study

This study focuses on the domestic products, branding Bangladesh globally. A brand of a country represents its culture, values, norms, people's attitudes, and so on. More specifically, it can be said that this article will focus on how nation branding can help Bangladesh to capture the global market with the help of its domestic products. The objectives of this study arrived from the research question are as follows:

- ? Developing a conceptual framework about Branding Bangladesh
- ? Capturing global market through domestic products branding
- ? Drawing up the importance of nation branding for Bangladesh
- ? Identifying difficulties and way-outs for global branding

1.4. Methodology of the study

For this article, qualitative research strategy was designed as no statistical data were collected by the researchers. In this study, the researchers used the secondary data, which were collected from various articles published in journals, books, newspapers, and websites.

2.0. Literature review

As per the study of Aveline [3], today is the age of globalization and it has forced the marketers to envisage global branding. Because of their commonness and pervasiveness, it is imperative to address a successful branding strategy to achieve sustainable competitive advantage in today's rapidly changing global markets. So, it is indispensable to understand brand, trace the significance of global branding, and discuss the issues pertaining branding of Bangladesh through a successful implementation of Vision 2021. Keller [13] said that a brand is something that resides in the minds of consumers. Brand is defined as a name, term, sign, symbol or design, or a combination of them intended to identify the goods or services of one seller or group of sellers and to differentiate them from those of competitors [16].

According to Keller [13], recognizing that brands represents one of their most important intangible assets. Firms are increasingly looking to leverage their brands across geographical boundaries and regions. Three keys for global brand success are defined here:

(i) Understanding the global consumer context;

- (ii) Building a solid global marketing foundation; and
- (iii) Striking a balance in global brand management.

A brand's symbolic meaning originates with its underlying purpose and is expressed as a field vibration that radiates from the very core of a company. Keller and Lehmann [14] perceived that global branding is the strategy, which is used to lift up local products into the global markets. According to Keller [13] a powerful brand strategy combines the logic and the magic mix of rational and emotive elements that, together, combine to give a brand engagement, connectedness, distinction, and focus:

- **Resonance** How will people react?
- **Resilience** How strong is the strategy competitively?
- **Results** What difference will it make?
- **Resolution** How will the new strategy galvanize people from the inside-out?
- Radiation Will it spread? Are the ideas in this strategy capable of great mobility?
- **Redefinition** Is it radical? Does it have stretch?
- Recognition Does it still have the brand's DNA?

Anholt [2] proposed a concept of branding hexagon, where he distinguished six main factors influencing country image. Nation branding focuses on the nation as a whole through its people, culture, heritage, investment, immigration, governance, exports, and tourism. Kaneva [12] assumed that nation branding refers to developing an identity for a nation that consists of several elements of national accounts, including foreign direct investments, exports, culture, sports, migrants, international relations, and many other aspects. Anholt [2] perceived that nation branding involves a holistic and well-concerted effort to highlight the key competitive advantages offered by the nation. The vision of Bangladesh incorporates participatory democracy, efficient, and honest governance, which will transform Bangladesh into a major commercial hub through creating a competitive economic environment sustained by a well-trained and skilled workforce [7]. The Vision 2021 has already helped the country in nation branding by making it eligible as a developing country in the eyes of UN [10].

3.0. Conceptual framework

The following conceptual framework has showed that tourism, culture, people, and exporting industry can brand Bangladesh in the global market through improving images and awareness about Bangladesh.



4.0. Branding Bangladesh through domestic products

The government of Bangladesh has a huge role to play in this regard. It is the duty of our marketers to brand our achievements to the world. The impact of nation branding affects our entire economy and the standard of living of the citizens concerned [6]. As a nation, the people of Bangladesh have to realize that the very concept of nation branding is not only for foreigners, rather we, the people of the country, are the biggest stakeholders of this concept. Without our support and embodiment of the brand identity, all nation-branding efforts will be futile. The manufacturers of the products have to remember that nation branding needs effort, time, dedication, and persistence and they must ensure adequate capacity building, improvement in productivity, healthy industrial relations, professional management, and new export destinations and communicate with international audience to implement Bangladesh Vision 2021 through Branding Bangladesh [19].

4.1. Exports industry of Bangladesh: The future global brand!

4.1.1. RMG sector of Bangladesh

Bangladesh is one of the most prominent emerging economies in the current world. One of the best sectors of Bangladesh to earn foreign currency is the garment sector. In the year of 2012, the garments sector earned around \$19 billion dollars and \$30186.62 in the Fiscal Year (FY) 2013-14. The industry provided 80% of the total export that is around \$24 billion. It proved that the garments sector is truly the largest industry in this penurious country [11]. Bangladesh is in the second place after China in exporting readymade garments around the world. According to the McKinsey and Company, a worldwide recognized consultancy firm, the exports volume of the readymade garments of Bangladesh could be doubled in the next 10 years. Several reasons like unpredictable customer demand, market variation, intense competition, lack of price variation, and low barrier to enter the industry make the garments sector one of the most competitive business sectors around the world [17].

So, in which sector, Bangladesh can go ahead in branding is the RMG (Ready Made Garments) sector. It would not be hard to say that Bangladesh, in near future, is going to capture leading position of branding in the RMG sector. Recently, the manufacturers and retailers are concentrating on developing branding based on apparel and textile industry to meet the sustainable customer demands and profitability. And it's true that only global branding can help get more market share in the international market, which can lead our country to be a strong economical based holding country [11].

4.1.2. Aarong: A dominating local brand in Bangladesh

Today, Aarong is in the top position in the handcrafted products retail business. Aarong is making a brilliant contribution to develop the industry of handcrafted products all over Bangladesh. It is now beyond of being just a retail business. Today, Aarong is promoting the handmade traditional products not only in the country but also in the international market [1]. According to Yasmin [26], Aarong is not only a traditional brand of handicraft products but also they take good care of the design of the products to make them convenient, maintain quality, and make the products in a mix of traditional and contemporary demand of the customers. For their outstanding performance in handicraft and making the products globally known, Aarong received the prestigious 'Best Brand Award' in 2009 and the 'Most Effective Outdoor Communication Award' from the Brand Forum. They also won the respected UNESCO Seal of Exchange for their handicraft products [26]. This organization is helping Bangladesh move towards the prosperity through nation branding by selling Bangladesh's traditional products in the abroad. Many foreigners know Bangladesh only for Aarrong and thus, showing interest to use other Bangladeshi (BD) products, helping Bangladesh to capture a strong place in abroad or global market.

5.0. Tourism sector of our country

For the last 10-12 years, Bangladesh is concentrating on capitalizing the tourism sector. Bangladesh has enormous natural sites that can be used for establishing tourism sector. Many ancient archeological sites enrich the history of Bangladesh, such as the Paharpur Buddhist Monastery, Mahasthangarh, Mainamati, and so on [20]. Recently, UNESCO declares Paharpur as world Heritage site [5]. Dhaka itself has some special sites like Lalbagh Kella, Ahsan Manjil, Satgambuj Mosque, Dhakesswari Mandir, and so on. These places can do branding of Bangladesh to the world tourists. People can recognize our country easily when they remember memories and views of these places.

Bangladesh is a river based country that is surrounded by rivers and forests. Cox's Bazar is the longest unbroken sea beach in the world. The length of the beach is 120 kilometers consisting miles of sands. There is also the largest mangrove forest in the world, namely the Sundarbans where the Royal Bengal Tiger can be found. The wildlife of Sundarbans may amaze the tourists with its vastness of 6000sq km and cross connections of rivers and streams [5].

6.0. Culture of Bangladesh

Our cultural facts and heritages should be highlighted all over the world. The rest of the world already knows some of them. The Ekushey February considered as the International Mother Language Day. Pohela Boishakh, an event enriched with cultural factors, should also get recognition around the world [25]. To do the branding of Bangladesh, we should consider the food and cuisine. The culinary tradition of Bangladesh is distinctive and delicious. The spices and masalas are very much different from other countries. The primary food is the steamed rice served with curries, vegetables, lentil soups, fish, meat, and so on. The people of Bangladesh prefer sweets made from milk. Some of the most famous sweets are Rosogolla, Chom-Chom, Kalo Jam, Rashamali, and so on [15]. There are almost 40 types of fresh water fish available all over the country. That is why Bangladesh is considered as a fish protein dominant country. Freshwater fish is also produced privately in huge areas. Besides the freshwater fish, saltwater or sea fish are also playing important role in the food market of Bangladesh. Hilsa is considered as the national fish and it is considered as the Icon of Bangladeshi food. In Pohela Boishakh, people eat Panta-Ilish as a tradition [25].

Cuisine and food culture may represent the country and the perception of the people. Bangladesh should use this cuisine factor to network the country to the rest of the world for the nation branding. On the other hand, our local saree Jamdani is also a symbol of our country for the outer world. Hilsa & Jamdanihs got recognition by receiving Geographical Indications (GI) from the Department of Patents, Designs and Trademarks (DPDT) [23]. These products can represent our country name in the global market through nation branding.

7.0. People: Representatives of Bangladesh

Bangladesh has many names that can represent the country to the world. Some of them dedicated their lives for the country, while at present, some are making their place internationally. These people play an important role in case of branding the nation into the eyes of global market. The Father of the nation, Bangabandhu Sheikh Mujibur Rahman, was one of the reasons behind the victory of a nine-month bloody liberation war. His daughter, Sheikh Hasina, the current Prime Minister of Bangladesh, has been one of the iconic politicians of the country. Under her government, Bangladesh has become a developing country. She became the ninth most powerful women politician in the list of Forbes. In 2017, Sheikh Hasina marked her place in the "Women Presidents and Prime Ministers" book as a women politician of Bangladesh. In 2017, this woman has been declared as 'Mother of Humanity' by British media brands [9]. People from other country recognize Bangladesh with the name of Sheikh Hasina.

As an entrepreneur, a banker, economist, and socialist, Muhammad Yunus is also recognized all around the world. As a result of introducing micro finance and micro credit idea, he won the prestigious Nobel Peace Prize in the year 2006 along with his founded organization, i.e., Grameen Bank. They won the Nobel Prize under the title of "Efforts through Micro Credit Economic and Social Development from below" [22]. After winning the Nobel Prize, Muhammad Yunus also won the US presidential Medal of Freedom in 2009 and in 2010, won the 'Congressional Gold Medal'. He is also known as good public speaker, who gave many valuable speeches in different countries to represent Bangladesh. In the field of sports, Shakib Al Hasan is representing the country as an international cricket player who is continuously ranking the top position in all formats of ICC cricket, including ODI, Test, and T20 [8]. This man is branding Bangladesh through playing and performing well in different leagues and clubs of other countries.

8.0. Difficulties and way-out of achieving global branding

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Rahman (2015) mentioned in his writing published in the famous local newspaper -The Daily Star- that creating a global brand is very tough because of some tragic and difficulty events [24]. Now, it is the right situation to make a re-brand of Bangladeshi products and associate those with positivity to make it internationally recognized. But, the people and organizations related with rebranding or branding Bangladesh must remember that it will not be a piece of cake. There will be different and critical curves to explore and develop such a design that will help maintain a sound relationship among the associates of branding [18. Industries related with branding and rebranding must understand that a drastic change needs to be happened to successfully and positively place Bangladesh in the international market. It will help them make a global product and catch international market. But, the people and organizations related with rebranding or branding should keep in mind that a product may be sold well in the national market, but it could be worthless in the international market. That is why, making a global product and brand is essential to enter the international market [18].

8.1. Centre of excellence: Its strategy to convert local brand into global brand in Bangladesh

For example, in Bangladesh, the boutique industry mainly focuses on the major festivals rather than targeting daily demands. In order to develop branding of Bangladesh, a new era has begun because of the development of the 'Centre of Excellence'. The Centre of Excellence will focus on creating next generation workers with proper knowledge and training. These workers will help industries make value added and globalized products and capture international market through building a good image and branding [18].

9.0. Conclusions and recommendations

9.1. Conclusions

The concluding remarks indicate that all the famous companies in the world have earned market share through good services and branding strategy and it is also the same in case of Bangladesh and its industries. Many of our local products, such as garments and apparels, leathers, medicine, and so on are being exported with the names of Aarong, Walton, Pran, Square, Beximco, and so on. This is possible only for the good branding strategy of these organizations, which include good products, services, keeping promises through quality and good communication with the present and potential customers. So, to be a market capturer in the global market and fulfill the vision 2021 of Bangladesh, a good branding strategy with good products and services should be developed. The ending of this article claims a quote from 'Philip Kotler', father of marketing. He said, "A good brand gets developed historically, not overnight".

9.2. Recommendations

Through reviewing several secondary sources of data, the authors of this study recommend the followings:

- To be a global market leader and strong competitor in the global market, Bangladeshi companies should remember that a positive branding strategy creates a positive image and confidence in the customers' minds about products and services.
- Bangladesh is accomplishing satisfactory performances in the economic indexes. At this moment, creating positive feelings through the combination of good products and environment among the global investors and the stakeholders is a pre-requisite in increasing the Foreign Direct Investment (FDI).

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- Increased advertising and promotional activities are needed for the tourism sector to encourage tourists to visit Bangladesh.
- The local brands of Bangladesh also must emphasize on the field research to create the brand value of products of the companies.

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A Review on Renovation of Gas Turbine to Improve Efficiency by Using Compressor Water Wash.

Nation Branding: Branding Bangladesh Using Global Branding Strategy with the Help of Domestic Products. Tonny Tabassum¹ Mainul Hasan² Latifa Begum^{3*}

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