

# **Impact of Atmospheric Pressure on the Productivity of Masons in the construction of Residential Buildings in Warri Area of Niger Delta in Nigeria**

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**ABSTRACT:**The building construction in Nigeria mostly comprises of bungalow residential buildings which are constructed almost entirely with manual labour. Unfortunately, on labour wage structuring issues, the labour regulations of Nigeria do not take into consideration the impacts of environmental factors such as atmospheric pressure on workers remunerations. This research was mounted to avail building construction stakeholders with some environmental Pressure constraints on labour wage estimating. Pilot surveys undertaken at Warri, south-south Nigeria helped establish a hypothesis that stated that there are no significant statistical relationship existing between workmen productivity and atmospheric pressure. As masons stay longer on sites and carry out most of the jobs, they were chosen as a sample to represent the building labour section. Simple and Multiple Correlation analysis tool was used to analyse the collected field data. The following were the highlights of the results;- (i) hourly atmospheric humidity variation has an inverse statistical significant relationship with masons' number of blocks laid/hour (ii) other variables that had significant relationship with workmen productivity were; daily wage and biological age of mason. Based on the findings above, the research concluded that hourly humidity variation had a significant inverse statistical relationship with the productivity of workmen studied. It was recommended that (i) the hourly atmospheric pressure variations should be studied for various geographical zones during revisions of labour wages, mark ups can be introduced to compensate workers working under severe temperature and atmospheric pressure.

**KEYWORDS:**Atmospheric pressure, Productivity, Building Construction, Masons, Residential Building, Warri.

## **I. INTRODUCTION**

The physical stock of housing in Nigeria is one of the nation's principal capital assets. The unique aspects of housing in Nigeria are its density and how it is provided. Majority of the population live in single-family homes. Individuals, private housing developers, and government built most of it on separate plots. Nigeria's housing industry is largely composed of unorganized group of entrepreneurs and individuals who construct housing in their own geographical area, with varying weather conditions across the country, the northern part being dry and low in humidity and the southern part being wet and high in humidity. Various laws, institutions, and public agencies work to ensure that private and public housing is produced safely by builders and delivered efficiently to consumers.

The quantity and type of housing are controlled mostly in the urban areas with less control in the rural areas; the quality of the housing and the inclusive services to be offered are determined by building or housing codes which in most cases are not strictly adhered to. Majority of these housing projects are constructed wholly by manual labour involving both skilled and unskilled workers, most of whom combine different trades as means of livelihood. Consequently, it is not surprising to find labourers in the building industry who are at the same time tailors, farmers and petty traders.

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Financing needed to construct and purchase housing is available from lending institutions though not popular before now, and whose activities are governed by the building regulation and codes. However, majority of new housing in Nigeria are sponsored from private individuals.

The study “An Evaluation of the impacts of atmospheric pressure on the Labour Productivity of Masons” is chosen to establish the nature of existing relationship between masons productivity on site and such factors as (i) atmospheric pressure or humidity (ii) wage of workmen (iii) years of working experience and (iv) years of training (v) biological age of workmen (vi) number of assistants (vii) number of supervisors and (viii) total number of masons working on site.. Therefore, the focus of this research is on how to relate the productivity of mason in terms of numbers of blocks laid/hour/day; area of wall plastered/hour/day to the dynamics of these factors listed above.

## II. OBJECTIVES OF THE STUDY

The objectives of the study are;

1. To determine the productivity of masons under study per hour/day under the varying conditions of atmospheric pressures.
2. To determine the values of the identified environmental conditions of atmospheric pressure during the construction hours.
3. To relate the productivity of workmen hour/day to the corresponding environmental of atmospheric pressure.

## III. COVERAGE OF BUILDING CONSTRUCTION/ PILOT SURVEY

Warri a city in south southern Nigeria is located in Delta State. Warri is a major port city in the Niger Delta and serves as the cargo transfer point between the Niger River and the Atlantic Ocean. Warri is connected to Benin City by a major highway and has its own airport and a population of over 300,000 (2012 estimate).

The human population exceeds the development of transportation, housing, and urban services. The town was chosen as a result of her nature as a major oil town with considerable high incidence of building construction in progress throughout the whole year thereby providing an ideal ground for the study.

Ten sets of data were randomly selected for the pilot survey. The testable variables used were i) numbers of blocks laid, ii) Average day atmospheric pressure, iii) age of mason, iv) years of work experience, v) wage/day, vi) years of training, vii) number of assistants, viii) number of supervisors, and ix) total number of masons working on site. The statistical instrument used was the correlation analysis which analysis the linear relationship between two independent variables.

## IV. METHODOLOGY

### Data Collection

The data for this research was collected from primary source through on the site observation and recording/questionnaires. Specially ruled questionnaires were designed with columns for recording variables such as numbers of blocks laid/hour with the corresponding pressure. Also on the questionnaire are spaces for biological age of the workman under observation, years of training, working experience, number of assistants, numbers of supervisors, wage for the day and the total number of masons working on site. The selection of a workman for observation randomly done. The data collection was carried out on different sites within the town comprising of different sizes and locations and at different times covering the rainy and dry seasons with focus on the two main trades: bricklaying and plastering.

These data were collected with the assistance of some technicians and time clerks who were specially trained for the purpose. Exclusive studies were undertaken on various building sites and the number of observations were made to satisfy a plus or minus 5% error and a 95% confidence interval.

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### Method of Analysis

The data analysis was carried out using a computer program, SPSS-Statistical Package for Social Sciences -Pearson correlation analysis, which estimates the existing statistical relationship between two variables, which are independent and also could be in different units of measurement. The correlation coefficient  $r$  is a measure of the linear relationship between two attributes or columns of data. The value of  $r$  can range from -1 to +1 and is independent of the units of measurement. A value of  $r$  near 0 indicates little correlation between attributes; a value near +1 or -1 indicates a high level of correlation. When two attributes have a positive correlation coefficient, an increase in the value of one attribute indicates a likely increase in the value of the second attribute. A correlation coefficient of less than 0 indicates a negative correlation. That is, when one attribute shows an increase in value, the other attribute tends to show a decrease.

Also, of importance is the P-value. This is the probability, when the null hypothesis is true, that the absolute value of the T-statistic would equal or exceed the observed value (T-value). A small P-value is evidence that the null hypothesis is false and the attributes are, in fact, correlated. A P-value of equal to or less than 0.05 confirms the correlation between the two variables, ie at 95% confidence level.

### Decision Rule

The decision rule used in the research is by taking into consideration both the r-value and p-values as follows for values of  $x$  and  $y$ :

- If  $r = 1$ , then  $x$  and  $y$  are perfectly positively correlated. The possible values of  $x$  and  $y$  all lie on a straight line with a positive slope in the  $(x,y)$  plane.
- If  $r = 0$ , then  $x$  and  $y$  are not correlated. They do not have an apparent linear relationship. However, this does not mean that  $x$  and  $y$  are statistically independent.
- If  $r = -1$ , then  $x$  and  $y$  are perfectly negatively correlated. The possible values of  $x$  and  $y$  all lie on a straight line with a negative slope in the  $(x,y)$  plane.
- If  $p\text{-value} \leq 0.05$ , then the correlation is statistically significant.

**Table 1.00: Experimental coefficients for the pilot survey**

Experiment	Variables	R-Value	R2-Value	P-value	Inference	Observation
Experiment 1.0	Numbers of Blocks Laid/Day vs Daily Atmospheric Pressure	0.08	0.01	0.82	Statistically Insignificant	Very weak linear relationship not enough to conclude that atmospheric pressure affects productivity significantly
Experiment 2.0	Numbers of Blocks Laid/Day vs Biological Age of Masons	-0.59	0.35	0.72	Statistically Insignificant	Very weak inverse relationship not enough to conclude that biological age of mason affects productivity significantly
Experiment 3.0	Numbers of Blocks Laid/Day vs Masons Working Experience	0.02	0.00	0.96	Statistically Insignificant	Very weak linear relationship not enough to conclude that masons working experience affects productivity significantly
Experiment 4.0	Numbers of Blocks Laid/Day vs Wage/Day	1.00	1.00	0.00	Statistically Insignificant	Very strong linear relationship enough to conclude that daily wage affects productivity significantly

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Experiment 5.0	Numbers of Blocks Laid/Day vs Years of Training	0.70	0.49	0.85	Statistically Insignificant	Very weak linear relationship not enough to conclude that years of training affects productivity significantly
Experiment 6.0	Numbers of Blocks Laid/Day vs Number of Supervisors	-0.03	0.00	0.93	Statistically Insignificant	Very weak inverse relationship not enough to conclude that number of supervisors affects productivity significantly
Experiment 7.0	Numbers of Blocks Laid/Day vs Number of Masons Working on Site	-0.14	0.02	0.71	Statistically Insignificant	Very weak inverse relationship not enough to conclude that number of masons working on site affects productivity significantly

Source; Field Study, 2017.

## Research Hypothesis

H0: There are no significant statistical relationships between masons productivity and both the atmospheric pressure and site temperature variations.

H1: There is a significant statistical relationship between masons productivity and both the atmospheric pressure and site temperature variations.

## V. ASSUMPTIONS

The following constitutes the assumptions for the research works;

1. That all masons were working at the same height above the ground level.
2. That the size and weight of the blocks are the same.
3. The sand used for the block laying does have the same weight, moisture content and plasticity.
4. The various construction activities are carried out at the same site over the same general management.
5. That Unionism and ganging up among workmen do not significantly affect productivity of workers under study.
6. That Warri has a representative climatic condition for the entire southern geopolitical zone.

## VI. SCOPE AND LIMITATIONS

The research work covers the productivity of masons in terms of number of blocks laid/hour/day and the area of wall plastered/hour per day related to identified variables and atmospheric pressure. Adequate care and precautions were taken to ensure the accuracy of the data used for the research work; however, the data may have some limitations as follows:

- 1 Limited to the accuracy of the various instruments such as barometer etc used for recording field data.
- 2 The values of wall area plastered may be rounded off to the nearest whole number as the walls may not be straight.
- 3 The results may be limited to the coastal states of the south area since their weather condition greatly varies from what is obtained in the north of Nigeria. Hence, the findings may not be applicable to such states in the far northern part of Nigeria, without modifications.

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**Table 2.0: General Summary of Analysis**

Experiments No.	Variables	R Value	R <sup>2</sup> Value	P Value	Inference	Observations
<b>Experiment 3.01</b>	Hourly Number of Blocks laid Vs Hourly Atmospheric pressure Variation	-0.781	60	0.01	Statistically Significant	Very strong inverse statistical relationship to conclude that the productivity was actually affected with change in atmospheric pressure, as productivity reduces with increase in hourly atmospheric pressure
<b>Experiment 3.02</b>	No. of Blocks Laid/Day vs Average Daily Atmospheric Pressure	-0.496	25	0.01	Statistically Significant	Very strong inverse statistical relationship to conclude that the productivity was actually affected with change in atmospheric pressure, as productivity reduces with increase in pressure
<b>Experiment 3.03</b>	No. of Blocks Laid/Day vs Biological Age of Mason	-0.812	66%	0	Statistically Significant	Very strong inverse statistical relationship to conclude that the productivity was actually affected with change in age of masons, as productivity reduces with increase in biological age
<b>Experiment 3.04</b>	No. of Blocks Laid/Day vs Working Experience	-0.477	17%	0.009	Statistically Significant	Very strong inverse statistical relationship to conclude that the productivity was actually affected with change in working experience, as productivity decreases with increase in age
<b>Experiment 3.05</b>	No. of Blocks Laid/Day vs Average Daily Wage	0.932	87%	0	Statistically Significant	Very strong linear statistical relationship to conclude that the productivity was actually affected with change in daily wage, as productivity increases with wage increase.
<b>Experiment 3.06</b>	No. of Blocks Laid/Day vs Years of Training	0.39	15%	0.04	Statistically Significant	Very strong linear statistical relationship to conclude that the productivity was actually affected with change in years of training, as productivity increases with increase in years of training.
<b>Experiment 3.07</b>	No. of Blocks Laid/Day vs Number of Assistants	0.686	47	0	Statistically Significant	Very strong linear statistical relationship to conclude that the productivity was actually affected with change in change in number of assistants, as productivity increases with increase in the number of assistants
<b>Experiment</b>	No. of Blocks	0.327	11	0.08	Statistically	Very weak linear statistical relationship

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s 3.08	Laid/Day vs Number of Supervisors				Insignifican t	to conclude that the productivity was actually affected with change in number of number of supervisors, as productivity did not significantly improve with increase in number of supervisors
<b>Experiment s 3.09</b>	No. of Blocks Laid/Day vs Number of Masons on Site	0.542	29	0	Statistically Significant	Very strong linear statistical relationship to conclude that the productivity was actually affected with change in number of masons working on site, as productivity increases with increase in the number of masons on site. This might be due to increase competition, ego needs, etc
<b>Experiment s 3.10</b>	Area of Wall Plastered vs Average Daily Atmospheric Pressure	- 0.648	42	0.01	Statistically Significant	Very strong inverse statistical relationship to conclude that the productivity was actually affected with change in atmospheric pressure, as productivity reduces with increase in pressure
<b>Experiment s 3.11</b>	Area of Wall Plastered vs Biological Age of Masons	-0.76	58	0	Statistically Significant	Very strong inverse statistical relationship to conclude the productivity was actually affected with change in Biological age, as productivity reduces with increase in age of mason
<b>Experiment s 3.12</b>	Area of Wall Plastered vs Masons Working Experience	- 0.664	45	0	Statistically Significant	Very strong inverse statistical relationship to conclude the productivity was actually affected with change in masons working experience, as productivity reduces as masons gets older.
<b>Experiment s 3.12</b>	Area of Wall Plastered vs Daily Wage	0.395	16	0.62	Statistically insignifican t	Very strong linear statistical relationship to conclude that the productivity was actually affected with change in daily wage, as productivity increases with wage increase.

Source: Field Study, 2017.

### VII. GENERAL SUMMARY

The study is basically on the effects of atmospheric pressure on labour productivity of masons in Nigerian residential building construction sites. Other parameters studied were; (i) biological age of mason, (ii) daily wage of mason, (iii) working experience, (iv) years of training (v) number of assistants (vi) number of supervisors and (vii) number of masons working on site. This is aimed at availing building construction stakeholders with some atmospheric pressure constraints on labour wage estimating.

The problem statement for the study was centered on the lack of recognition of the impacts of the effects of atmospheric pressure variation on labour wage structuring and labour regulations of Nigeria on the remuneration of building construction workers.

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The analysis and discussions of the research data indicates the following highlights. (a) There were high correlation ( $R^2$ ) values observed between number of blocks laid/hour and (i) hourly atmospheric pressure variation, with values ranging between 60 – 64%. This means that workmen productivity is statistically related to the two variables tested. (b) There were also high correlation ( $R^2$ ) values between workmen number of blocks laid/day and (i) average daily pressure, (ii) biological age of mason (iii) daily wages of mason, and (vii) number of masons' assistants with values ranging from 47 – 87%, (c) Also, high correlation ( $R^2$ ) values were observed between area of wall plastered and (i) average daily atmosphere pressure, (ii) biological age of mason and (iii) masons working experience with values ranging from 42-58%. (d) However, there was low correlation values observed between (i) area of wall plastered/day vs daily wage with values ranging from 5 – 16% indicating insignificant statistical relationship between these variables.

## VIII. CONCLUSION

(1) Based on the experiments conducted for this study to establish existing statistical relationship between mason's productivity in terms of number of blocks/hour/day and the identified variables of atmospheric pressure.

(a) Hourly productivity of workmen is statistically affected by hourly atmospheric pressure variation as shown by the high  $R^2$  value of 60%.

(b) Daily productivity of workmen is significantly affected by daily atmospheric pressure variation

(c) Daily productivity of workmen is significantly affected by mason's biological age with  $R^2$  66%.

(d) Daily productivity of workmen is significantly affected by working experience, as older workmen had lower productivity than the younger workmen.

(e) Daily productivity of workmen is significantly affected by the average daily wage as shown by  $R^2$  value of 87%.

(f) Daily productivity of workmen is significantly affected by masons years of training, and

(g) Daily productivity of workmen is significantly affected by the number of masons working on site since productivity is improved with competitive atmosphere.

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