A Review On -To Determine Personnel Performance In Repeatability In Mechanical Testing Of Steel Bars

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Abstract- *A repeatability test is an experiment performed to evaluate how repeatable your results are under a set of similar conditions. Fisher's combined probability test and Z core test can be used in such repeatability testing. This paper is about review of repeatability and retesting n proficiency testing of steel bars. Steel bars of various diameter similar batch will be selected and test for predetermined parameters in prescribed environmental conditions in respected standards o universal testing machine. In such case of testing on UTM performance of evaluator, deviation in results is possible to determine.*

Keywords- Repeatability Testing , Testing of Steel bars.

I. INTRODUCTION

A repeatability test is an experiment performed to evaluate how repeatable your results are under a set of similar conditions. When performing a repeatability test, you will want to collect data using the;

a. Same method,
b. Same operator,
c. Same equipment,
d. Same environmental conditions,
e. Same location, and
f. Same item or unit under test.

Essentially, want to collect repeatable results over a short period of time without changing anything (if possible).

According to the Vocabulary in International Metrology (VIM), measurement repeatability is measurement precision under a set of repeatable conditions of measurement.

Furthermore, the VIM defines a repeatability condition of measurement as a condition of measurement, out of a set of conditions that includes the same measurement procedure, same operators, same measuring system, same operating conditions, same location, and same replicate measurement on the same or similar objects over a short period of time.

Defining measurement conditions and collect repeatable results over a short period time so you can evaluate the precision of your process.

PERFORM A REPEATABILITY TEST

To perform a repeatability test step by step. Follow the instructions below to add repeatability test data to your uncertainty budgets.

Here is a list of the steps in this process;

1. Select the measurement function to test,
2. Select the measurement range,
3. Select the test-point(s),
4. Select the method,
5. Select the equipment,
6. Select the operator,
7. Perform the test,
8. Collect the number n of repeated samples,
9. Analyze your results,
10. Save a record of your results (recommended),

Number of sample collections

$$n = \left[\frac{(z \cdot \sigma)}{MOE}\right]^2$$

1. Choose your desired confidence level (z).
2. Choose your desired margin of error (MOE).
3. Multiply the result of step 1 by the value by the standard deviation of the sample set.
4. Divide the result by the margin of error selected in step 2.
5. Square the result calculated in step 4.

although testing of five samples is recommended.

<u>Fisher's combined probability test</u>

(Fisher, 1932) uses the P-values from k independent tests to calculate a test statistic

$$\chi^2_F = -2\sum_{i=1}^{k} \ln[P_i].$$

. If all of the null hypotheses of the k tests are true, then this χ^2_F will have a χ^2 distribution with 2k degrees of freedom.

Fisher intended his procedure to give a 'composite test,' a 'test of the significance of the aggregate' of a number of independent tests (Fisher, 1932, p. 97). It has since been interpreted as a test of whether at least one of the studies being combined can reject its null hypothesis (see, e.g. van Zwet & Oosterhoff, 1967; Westberg, 1985; Rice, 1990). By this interpretation, Fisher's method has much in common with the corrections for multiple corrections that have come into vogue in evolution (Westberg, 1985; and see Rice, 1989). But this is not the original interpretation. Fisher, with typical inscrutability, seems to have intended that the test ask whether the accumulation of information among tests on similar null hypotheses can reject that shared null hypothesis. This seems to be the usage of the test most often applied in evolutionary biology, and this is what we want to explore here Fisher's method, however, does have one significant drawback in this context. It treats large and small P-values asymmetrically. It is easiest to see this problem with an example (see Rice, 1990). Imagine there were two studies on a topic that we would like to combine. One of these studies rejected the null hypothesis with P ¼ 0.001, while the other did not with P ¼ 0.999. Clearly, on average there is no consistent effect in these two studies, yet by Fisher's method the P-value is P ¼ 0.008. Fisher's method is asymmetrically sensitive to small P-values compared to large P-values. The undesirability of this result can be seen when we consider that these results would reject the null hypothesis in favour of contradictory one-tailed alternate hypotheses. As a further example of this asymmetry, remember that high P-values (i.e. near one) would be evidence in favour of rejecting a null hypothesis in favour of the opposite alternate hypothesis. A result of P ¼ 0.99 is as suggestive of a true effect as is a result of P ¼ 0.01. Yet with Fisher's test, if we get two studies with P ¼ 0.01, the combined P is 0.001, but with two studies with P ¼ 0.99 the combined P is 0.9998. One minus 0.9998 is 0.0002. The high P and low P results differ by an order of magnitude, yet the answer should be the same in both cases. This asymmetry results in a bias for results combined from multiple studies on the same null hypothesis. The bias is not normally as great as in these examples, but any bias is undesirable. Fortunately, there are other methods available.

The Z-transform test

The Z-transform test I will consider in detail two alternative methods for combining P-values here: the Z-transform test and the weighted Z-test. These two are closely related to each other; the Z-transform test is the same as a weighted Z-test with equal weight given to all studies. The Z-transform test takes advantage of the one-to-one mapping of the standard normal curve to the P-value of a one-tailed test. By Z we mean a standard normal deviate, that is, a number drawn from a normal distribution with mean 0 and standard deviation 1. As Z goes from negative infinity to infinity, P will go from 0 to 1, and any value of P will uniquely be matched with a value of Z and vice versa. The Z-transform test converts the onetailed P-values, Pi, from each of k independent tests into standard normal deviates Zi. The sum of these Zi's, divided by the square root of the number of tests, k, has a standard normal distribution if the common null hypothesis is true. Thus,

$$Z_S = \frac{\sum_{i=1}^{k} Z_i}{\sqrt{k}}$$

can be compared to the standard normal distribution to provide a test of the cumulative evidence on the common null hypothesis. Clearly this test does not suffer from the asymmetry problems discussed above for Fisher's method. As this test is sometimes called 'Stouffer's method,' here I will write its test statistic as ZS. (The Z-transform test was originally performed by Stouffer et al., 1949 in a footnote on p. 45 of their sociological work on the Army, The American Soldier. This must be one of the most obscure origins of a statistical method in the literature.)

Weighted Z-method

This Z-transform test was generalized (apparently independently of Stouffer et al.'s work and of each other) by Mosteller & Bush (1954) and Liptak (1958) to give different weights to each study according to their power. In the weighted Z-method, each test can be assigned a weight, wi Fisher's combined probability test (Fisher, 1932) uses the P-values from k independent tests to calculate a test statistic

$$Z_w = \frac{\sum_{i=1}^{k} w_i Z_i}{\sqrt{\sum_{i=1}^{k} w_i^2}}.$$

When each test is given an equal weighting, this reduces to the Z-transform procedure. How are these weights to be chosen? Ideally each study is weighted proportional to the inverse of its error variance, that is, by the reciprocal of its squared standard error. For studies that use t-tests, for example, this is done by weighting each study by its d.f.: wi ¼ mi. More generally, the weights should be the inverse of the squared standard error of the effect size estimate for each study. Whether to use the weighted or unweighted version of this test is actually an open question in meta-analysis. On the one hand, it may seem logical that we would want to weight studies with more information more strongly than those with less information. On the other hand, the argument has been made that P-values already weighted by sample size. If the null hypothesis is globally true, then all P-values should be uniformly distributed between 0 and 1 regardless of sample size. When the null hypothesis is false, then for the same effect size the P-value will be smaller for a larger study than for a small study. Thus some (e.g. Becker, 1994) have argued that it is inappropriate to weight studies differentially when combining P-values. The relative value of the two apparently has never been tested, aside from this rather philosophical argument.

Objectives of the Study

1. To understand the concept of Testing, retesting and deviation acceptance parameters in mechanical testing of Steel bars.
2. To perform mechanical testing in prescribed conditions on universal testing machine in respective IS of physical parameters of steel bars.
3. Determine the results in testing and retesting and find deviation in repeatability in testing of steel reinforcing bars of various diameter.
4. Results and discussion on acceptance criteria of repeatability of testing results.

Scope: In proficiency and standardization of testing on universal testing machine, for steel bars with modernization in testing parameters , it is essential personal in testing shall be proficient and effective with least error . This project helps to provide acceptance criteria and check the proficiency accordingly.

II. LITERATURE SURVEY

M. C. WHITLOCK, 2005, The most commonly used method in evolutionary biology for combining information across multiple tests of the same null hypothesis is Fisher's combined probability test. This note shows that an alternative method called the weighted Z-test has more power and more precision than does Fisher's test. Furthermore, in contrast to some statements in the literature, the weighted Z-method is superior to the unweighted Z-transform approach. The results in this note show that, when combining P-values from multiple tests of the same hypothesis, the weighted Z-method should be preferred. [1]

Silvia Caprili, Walter Salvatore, 2018, data coming from a wide experimental test campaign executed on different typologies of steel reinforcing bars representative of the actual European production scenario. Tensile and low-cycle fatigue tests have been executed to assess the mechanical performance of reinforcing bars under monotonic and cyclic/seismic conditions. The effects of exposure to aggressive environmental conditions have been reproduced through accelerated salt-spray chamber. Residual mechanical performance of corroded specimens has been analyzed as function of corrosion indicators such as mass loss and necking. [2]

Eng. Arinaitwe Dismus Nkubana, describes, Rwanda is now in the process of reconstruction and more particularly construction sector is at its climax to meet sustainable development envisaged in its vision 2020, and consequences of this high construction sector growth is the high demand for construction materials more particularly steel reinforcing bars. According to RDB 2014, construction material is the largest and fastest growing component of Rwanda's manufacturing sector and steel products represent 4 of the 11 largest building material imports at 34 million USD/yr in imports. Rwanda Revenue Authority (RRA) also recorded imported steel reinforcing bars 9,613 tons in 2006 which grew to 28,617 tons in 2016, addition to local production of 25,000 tons per year. Most of buildings and other civil engineering structures today are being constructed of reinforced concrete of which steel bars are main reinforcing elements. The quality of these steel bars which are actually backbone of every reinforced concrete structure is not given its due weight in the sense of quality consciousness as most times are used in buildings without being subjected to any quality test. Some building have collapse in Rwanda, while others have developed serious cracks as a sign of structural failure setting huge population of occupants into fears with consequent forced vacation. In addition said failures, there has been quite a number of collapsed buildings in our neighboring countries where these steel reinforcing bars are imported from and investigations conducted have pointed at substandard re-bars as still at large. This in itself causes suspicion in quality of steel reinforcing bars being used in Rwanda. Generally, demand for rebars is very high and the higher the demand the higher the risk of importing or producing substandard products, and the higher the need for quality assessment and control his study therefore assess quality of re-bars available in Rwanda and examines quality control methods and from lessons and experience learnt from other countries and cities more especially Africa and Asia which are similar to Rwanda, identifies strategies that may be deployed to strengthen quality control systems. His study is limited to 12mm and 10 mm diameter samples of steel reinforcing bars from four main sources available in Rwanda and concentrates in Kigali the capital city of Rwanda. [3]

Ejeh, S. P 2012, suggests that the tensile behaviour was investigated for reinforcing steel bars used in the Nigerian Construction Industry; this was done to ascertain the level of conformity of the tested parameters with the standards. A total of thirteen (13) companies operating in Nigeria were considered and (19) nineteen samples selected randomly with each sample containing ten specimens which were used in the tests. Out of the nineteen (19) samples, thirteen (13) were locally produced in Nigeria, while six (6) were imported. Thus, a total of 190 specimens were used for the experiment. It was found that eleven (11) samples out of the nineteen (19) samples examined failed to meet the requirements of BS4449:1997 in respect of the characteristic strength. In case of the Ultimate: Yield ratio, while only one (1) out of the nineteen (19) samples did not record the minimum values of 1.25 as prescribed by the code. [4]

Buliaminu Kareem 2009, studies the tensile and chemical nature of selected locally made steel bars is investigated. Three sizes of the two selected models of concrete reinforcement steel bars, which are ST44-2 and ST66-2, produced in Osogbo steel rolling company of Nigeria, were collected from its quality control section. These samples were machined to a standard tensile test pieces and tensile test was done on it with the use of tensile testing machine. Chemical analysis of the specimen was done. The results obtained were compared with that of the global concrete reinforcement steel bars standards. The results revealed that the selected steel bars are in good agreement with what is obtainable in both local and international standards, except that, in the case of chemical analysis results, percentage carbon content in steel is somewhat low as compared to the foreign similar steel product. [5]

Tavio 2018, suggests that the building codes such as American Concrete Institute (ACI) 318M-14 and Standard National Indonesia(SNI) 2847:2013 require that the ratio of tensile strength (TS) and yield strength (YS) should not less than 1.25. Therequirement is based on the assumption that a capability of a structural member to develop inelastic rotation capacity is afunction of the length of the yield region. This paper reports an investigation on various steel grades, namely Grades 420,550, 650, and 700 MPa, to examine the impact of different TS/YS ratios if it is less or greater than the required value.Grades 550, 650, and 700 MPa were purposely selected with the intention to examine if these higher grades are stillpromising to be implemented in special structural systems since they are prohibited by the building codes for longitudinalreinforcement, whereas Grade 420 MPa bars are the maximum limit of yield strength of reinforcing bars that is allowablefor longitudinal reinforcement of special structural systems. Tensile tests of these steel samples were conducted underdisplacement controlled mode to capture the complete stress-strain curves and particularly the post-yield response of thesteel bars. From the study, it can be concluded that Grade 420 performed higher TS/YS ratios and they were able to reachup to more than 1.25. However, the High Strength Still (HSS) bars (Grades 550, 600, and 700 MPa) resulted in lowerTS/YS ratios (less than 1.25) compared with those of Grade 420 MPa. [6]

SANJAY YADAV , 2008, Author gives the results of the proficiency testing (PT) accomplished for 17 laboratories, accredited by National Accreditation Board for Testing and Calibration of Laboratories (NABL). The measurements were performed in the pressure range 10-70 MPa using pressure dial gauge as an artifact. Only laboratories having best measurement capabilities 0.25 % or coarser than 0.25 % of fullscale pressure were included in this PT. The program started in May 2006 and completed during October, 2007. The comparison was carried out at 10 arbitrarily chosen pressure points i.e. 10, 20, 30, 40, 45, 50, 55, 60, 65 and 70 MPa. The results thus obtained show that out of the total 159 measurement results, 135 (84.91 %) are found in good agreement with the results of the reference laboratory. The relative deviations between laboratories values and reference values are well within 0.15 % for 75 measurement points, 0.25% for 108 measurement points and 0.50% for 148 measurement points. The difference of the laboratories values with reference values are found almost well within the uncertainty band of the reference values at 71.07 % measurement results, within their reported expanded uncertainty band at 62.26% measurement results and within the combined expanded measurement uncertainty band at 84.91 % measurement results. Overall, the results are considered to be reasonably good, being the first proficiency testing for most of the participating laboratories. [7]

Arif Sanjid M , 2008, Surface finish of products indicates the quality of machining process in manufacturing industry. Surface texture measurements provide index of quality of manufacturing stability. National Physical Laboratory, New Delhi, India (NPLI) maintains reference surface roughness standards and measuring equipment and established traceability in surface roughness measurement rendering the surface roughness calibration services. National accreditation board for testing, calibration laboratories (NABL) conducted proficiency testing (PT) program among NABL accredited laboratories for the measurement of surface roughness standard and groove depth. NPLI coordinated the PT Program and acting as reference laboratory among ten accredited laboratories. A technical protocol is designed in line with internationally adopted method. Results are analyzed statistically by arithmetic mean methods. The performance of the laboratories is described using the calculated normalized error (En) value as an index.[8]

Hong Huang , 2011, Author describes the statistical tools such as descriptive statistics, full factorial design and analysis of source of variation were used to identify the potential factors that impact the validity of testing method for determining the strength of cement. The results showed that personal error impacted both accuracy and precision of test greatly. Experimental time associated with temperature fluctuation resulted in strength variation but did not impact the precision of test in all curing ages. Different compactions did not impact the precision of test but resulted in the strength variation on 3 d and 28 d significantly. Different methods for the initial moist air curing significantly impacted the precision of testing method and resulted in the strength variation of cement on 1 d. [9]

III. LITERATURE GAP

This paper is about review of repeatability and retesting in proficiency testing in testing of steel reinforcing bars . Past authors have various studies based on iter-laboratory comparisons in various material as concrete, altman z score, and suggested methods of comparison. This study will further deal with testing of steel bars of various diameter repetedly on UTM in defined environmental conditions and hence comparison of results and determine z-score and acceptability , thereby analising perormance of evaluator.

IV. CONCLUSION

1. Values of testing of steel bars on UTM of physical parameters determined for slected parameters.
2. Results comparison with minimum criteria as selected from mean and standard deviation in steel bars.
3. Repeatability result of same diameter of same batch will be determined and deviation n results of bitumen testing.
4. Acceptability of the testing in repeatability in reinforcing steel bars which will evaluate performance of testing personnel.

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