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Nigerian Commercial Sector Medium Density Fibreboard (MDF) Engineered Wood Load Strain Critiques

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ABSTRACT **Original Research Article**

Due to rarity of information to avert the usual resources loss due to failure associated with using unsuitable medium-density fiberboard (MDF) engineered wood products in Nigerian economy with respect to their strain and deformation at load, technical insights relevant to prevent loss due to choice of improper quality for abundant needs was investigated. Prepared and subjected to test as required by a universal testing machine (UTM), the testometric testing machine were the three most sought after following their identification. From the generated data, chats on Strain at Break (%) and Deformation at Break (mm) of the samples were ensued by computer program. Statistically, MDF Hokusan ability to elongate at break is 35.9526% and 57.8750% better than that of Richard Russel and SKG Nordic respectively, placing MDF Hokusan advantaged. Richard Russel elongation potential over SKG Nordic is just 16.1250%. Empirically also, dynamics of the deformation at break exhibited analogous pattern to strain at break, where MDF Hokusan ability to deform at break is 35.9167% and 57.9066% better than that of Richard Russel and SKG Nordic respectively. Richard Russel deformation at break potential over SKG Nordic is just 16.1790%. These showcases their ductility potentials. This sustainable avant-garde technical understanding on strain at break and deformation at break abilities of medium-density fibreboard (MDF) engineered wood product should be valued by architects, building contractors, engineers, individuals, construction companies as well as furniture makers. Engineers in the Biomedical areas as well as mechatronics equipment developers and Engineers in general can as well utilise this knowledge. Strain at break and deformation at break research works of other engineered wood products not yet available should form future research works.

Keywords: Durability, Elasticity, Elongation, Extension, Flexure Strength, Mechanical Test, Resilience.

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Introduction

Background of the Study

Engineered wood products have been known to offer enhanced mechanical properties, dimensional stability as well as durability that streamline improved energy performance and larger complex structural elements according to (Fasasi, Baba and Ogunmilua, 2024). Engineered wood products, a derivative of wood product are typically obtained through the processes of binding the strands, particles, fibers, or boards of wood together. Ogunwusi, (2012) recorded that forestry products industrial goods exports were relished by Nigeria in the 1950's, 1960's and 1970's. Nigerian engineered wood market was valued at USD 8.81 billion in 2023 and is expected to grow at a CAGR of 3.3% to reach USD 11.05 billion by 2030 as documented by (FMRL, 2025). FMRL, (2025) again, noted that with the global engineered wood market valued at USD 50.2 billion in 2024, it is expected to grow from year 2025 at a compound annual growth rate (CAGR) estimate of 4.5% with projection to reach USD 74.5 billion by the year 2033. As it is extensively used across construction, furniture, and packaging industries wood composite in Nigeria remains a vital engineered wood product. Regretfully, Nigeria presently remains heavily dependent on engineered wood imports despite abundant raw materials and a fast-growing domestic market.

Usually created by the use of wood waste materials and smaller trees, production of engineered wood products, highlights the reduction in the need to fell old-growth forests. Typically engineered to certain specifications resulting in a material that can have diverse applications, they are achieved by the use adhesives. As a help to facilitate optimal processing conditions, comparable composite products can also be made from vegetable fibers using lignin-containing materials as well as chemical additives to enable the integration of polymer and wood flour. Garcia-Garcia, et al. (2018) observed that due to an excellent combination of thermal, mechanical and acoustic properties together with a competitive price, particle and fiberboards usually made of materials like rye and wheat straw, hemp stalks, sugar cane residue e.t.c, are widely used in the building industry as eco-friendly solutions to wood with increasing uses in wall partitions, ceiling boards and thermal insulators e.t.c. More so, (Garcia-Garcia, et al. 2018) noted there is a remarkable improvement of the mechanical properties with combination of the alkali treatment followed by silanization at the production of highly environmentally-friendly engineered fiberboards by hot-press molding using Posidonia oceanica wastes and a partially biobased epoxy resin as binder.

Higher fire hazards could be experienced due to higher chemical heat content and melting properties of composites regardless of all these advantages, when a comparison is made between engineered wood product and solid wood products. Engineered wood product that are fiber-based and particle-based experience humidity-induced warping which is not common in solid woods when exposed to moisture. A strong apprehension with engineered wood product is formed when cheap and commonly used resins in the composites are usually made with urea-formaldehyde bonded products which usually release toxic formaldehyde from the finished products. Obaedo (2024) observing the inflation rate and the prices of building materials in Benin city, analyzed from a correlation analysis and showed that inflation was the most influential factor responsible for increase in the cost of building materials with the inflation rate in Nigeria having a direct relationship with the prices of the building materials thus the cause for the high cost of building materials. Igboekulie, Monye, and Joseph (2022) found that a very strong relationship exists between rate of residential development and building materials prices when the effect of building materials cost on housing development in Owerri, Imo state, eastern region of Nigeria was assessed. Barguma, et al (2022) in the study of inflation trend pattern and its impact on Nigeria's economy reveled that the economy, especially building materials market was badly hit by the inflation with the purchasing power of the Nigerian currency, Naira seen to be decreasing. Despite all these challenges stated, due to remarkable improvement on esthetic and mechanical properties of the resulting engineered wood products, their demand is interestingly noted to be on the rise as projected by the earlier statistics, demanding a prudent use of the resources. As an objective, it becomes imperative to study the strain at break and elongation at break of medium density fibreboard (MDF) engineered wood product in Nigeriaas the technical insight provided will significantly go a long way to prevent heavy loss of revenue due to use of indecorous quality for various needs.

Materials Behaviour, Strain and Deformation

Characteristics that define a material's behaviour under various conditions are their material properties. The deformation or displacement of a material under stress, usually expressed as a ratio of the change in length to the original length in mm/mm expressed as a percentage (%) in materials science is referred to as strain. It is worthy of note that materials response to strain in a number of ways. Reversible deformation is experienced within elastic behaviour (elastic strain) where materials can return to their original shapes after stress or force is removed. Examples of such materials are steel and rubber. Under plastic behaviour (plastic strain), clay and copper deform permanently. This is because their original shapes are lost even with the removal of the force. Fracture is a common experience on materials like ceramics and glass under brittle behaviour. Devices like strain gauges detect changes in electrical resistance or capacitance which is as a result of deformation. Changes in length or displacement are measured by instruments like extensometers. Materials behaviour are described by some key concepts. Hooke's law describes the linear relationship between stress and strain in elastic materials. As a crucial concept, data and understanding of materials strain help in choice of materials in materials selection. Secondly under various loads, strain analysis predicts material behaviour in structural analysis. Lastly, excessive strain can lead to material failure.

Review of Literature

Iloabachie, et al (2017) investigated the effect of particle size on the ultimate tensile strength, flexural strength, density and water absorption characteristics of uncarbonized coconut shell/unsaturated polyester composites of particle size 425 microns sample and 170 microns sample and found that maximum flexural and ultimate tensile strength were attained at 20 wt% for the 425 microns. When performance characteristics and reinforcement combinations of coconut fibre reinforced high density polyethylene (HDPE) polymer matrixes at optimum condition of volume fractions and particle sizes of coconut fibre-filler was studied, coconut fibre reinforced HDPE has 28.6 mega pascal as optimum value for flexural strength, (Ihueze, Achike and Okafor, 2016). Iloabachie, Obiorah, and Anene, (2018), upon the study of the effects of carbonized coconut shell (CS) volume fraction on mechanical properties of unsaturated polyester resin (UPR) composite, noted that flexural strength and elongation at break increased as coconut shell proportion got increased. When critical evolution of surface properties of concrete through measured lightness and absorption was analysed in the study of panel formworks, Courard, et al (2012) noted modification of surface quality was noticed after 80 reuses with marine plywood formworks while changes were observed on surface quality after 50 reuses with oriented strand board (OSB) panels formworks. Akinyemi, Afolayan and Oluwatobi (2016) noted when the properties of developed composite corn cob (CC) and sawdust (SD) particle boards using 100%, 75%, 50%, 25% and 0% variations for both agricultural wastes using formaldehyde as binder at constant volume was studied, that both physical and mechanical properties, the panels with 50% CC had the most preferred performances. Ekundayo, Arum, and Owoyemi, (2022) assessed the flexural strength of glued laminated beams made from local wood species bonded with phenol resorcinol formaldehyde, polyurethane and urea-formaldehyde adhesives and found that the values in glulam beams are significantly higher than the control (custom wood) especially in edgewise direction. Ojo and Idieunmah, (2021) established linear relationship with strength properties of timber, increasing both the compression and shear strengths and even to a reasonable extent the bending strength alongside the age of the timber.

From very recent studies, Ilo, Nwanjoku and Olayeye (2025) found that SGK Nordic had the best ultimate flexural strength of 13.568 N/mm^2, MDF Hokusan (MDF) recorded 1.24 N/mm^2, while Richard Russel had ultimate flexural strength of 12.986 N/mm^2 in a study of flexural strength of medium density fibreboard (MDF) wood composite in Nigerian market. Ilo, Uro, and Edeh, (2025) showed that Plywood EQ attained aggregate average hardness of 459.25 HLD, View Point attained aggregate average hardness of 456.5 HLD while Caledonian attained aggregate average hardness of 407.5 Leeb Hardness Test (HLD), in a hardness test analysis of plywood in Nigerian market. Ilo, Nweke and Nebo (2025) in a hardness test analysis of marine board, results show that Marine Plex attained aggregate average hardness of 364.5 Leeb Hardness Test (HLD), Nplex attained aggregate average hardness of 392.25 HLD while Super-Plex attained aggregate average hardness of 370.75 HLD. Eze, Ilo and Dim, (2025a) showed that in hardness test analysis of medium density fibreboards (MDF) in Nigerian market, Richard Russel attained aggregate average hardness of 545.75 HLD, Hokusan attained aggregate average hardness of 535.75 Leeb Hardness Test (HLD), while SGK Nordiac attained aggregate average hardness of 558.50 HLD. From the hardness test conductedon high density fibreboards in Nigerian economy, (Eze, Ilo, and Dim 2025b) showed that Dabar attained aggregate average hardness of 526.50 Leeb Hardness Test (HLD), Sinoply attained aggregate average hardness of 547.50 HLD while Joubert attained aggregate average hardness of 548.50 HLD. Ilo, Ajibo, and Dim, (2025a) pointed that Viewpoint plywood recorded 4.956 N/mm^2, Plywood EQ recorded 9.467 N/mm^2 while Caledonian, also a make of plywood in Nigerian market recorded 16.973 N/mm^2 as the maximum stress, modulus of rupture (MOR) each of them can withstand while being bent before failing or rupturing in an experimental analysis of flexural strength of wood composite (plywood) in Nigerian commercial sector. Ilo, Nneji and Igede, (2025) found that Joubert (HDF) recorded 15.604 N/mm^2, Dabar (HDF) recorded 32.604 N/mm^2 while Sinoply (HDF) recorded 39.248 N/mm^2 of their flexural strength at peak in a study of the flexural strength of high density fibreboard (HDF) wood composite in Nigerian market. Ilo, Nwachi, and Chukwunyere, (2025) from statistical analysis of wood load strain of high density fibre engineered wood product found that Sinoply ability to elongate at break is 544.89% and 507.44.89% better than that of Dabar and Joubert respectively thereby placing Sinoply at an advantage position while Joubert elongation at break potential over Dabar is just 6.16% higher. Ilo, Ajibo, and Dim, (2025b), while conducting tests on marine board in Nigeria economy, found that Marine Plex marine board plywood had ultimate bending strength of 17.96 N/mm^2, Nplex marine board plywood recorded 21.502 N/mm^{2}while Super Plex marine board plywood had the best flexural strength at peak of 65.84 N/mm^2.

Summarily, from above it is apparent that research has not been directed towards providing technical information on medium density fibreboards (MDF) in Nigerian market with regards to load strain analysis, hence the obvious need for this research paper.

Research Methodology

Material

Research was made in Nigerian market on commonly used and major medium density fibreboard (MDF) engineered wood product samples to value their maximum strain (strain at break potentials. Most common and three major medium density fibreboard (MDF) in top demands in Nigerian market were identified from the survey made. They were selected as samples for test and subsequent analysis. The medium-density fiberboard (MDF) engineered wood product samples were Richard Russel, Hokusanand SKG Nordic. They are represented accordingly in table 1.

In table 1, the samples are marked “a”, “b” and “c” representing Richard Russel, Hokusan and SKG Nordic. They are all prepared according to the requirement by the machine and tested on the machine one after the other.

Table 1: Medium Density Fiberboard (MDF) engineered wood product samples tested

Sample	a	b	c
Make	**Richard Russel**	**MDF Hokusan**	**SKG Nordic**

Equipment

The machine shown in figure 1 a universal testing machine (UTM) the testometric testing machine was use in the test. It works by clamping down on a sample of medium-density fibreboard (MDF) engineered wood product appropriately conditioned as required by the machine and mounted on it for test. Data on the properties of the material including Strain at Break (%) and Deformation at Break (mm) were generated, as the jaw moves down, by the resistive potentials of each sample.

The samples, (a) representing Richard Russel, (b) representing Hokusan and (c) representing SKG Nordic were all tested on the machine one after the other after being prepared diligently according to the requirement by the testometric machine shown in figure 1. The samples were prepared by cutting to the dimensions of 30 mm x 200 mm so as to fit in with the testing machine as required. Operated by moving the jaw of the TESTOMETRIC TESTING MACHINE down to clamp on the workpiece as earlier stated that is the conditioned medium-density fibreboard (MDF) engineered wood product samples, Strain at Break (%) and Deformation at Break (mm) data of the medium-density fibreboard (MDF) engineered wood product samples are evaluated during the process. With computer program the dynamics of the Strain at Break (%) and Deformation at Break (mm) plots for the test are generated from data obtained. The plot being a function of the samples compositions resulting from their nature is obviously a clear indication of the change in length to the original length in a material under load. In this case, the material being the medium-density fibreboard (MDF) engineered wood product samples. The data generated is analysed under results and analysis below.

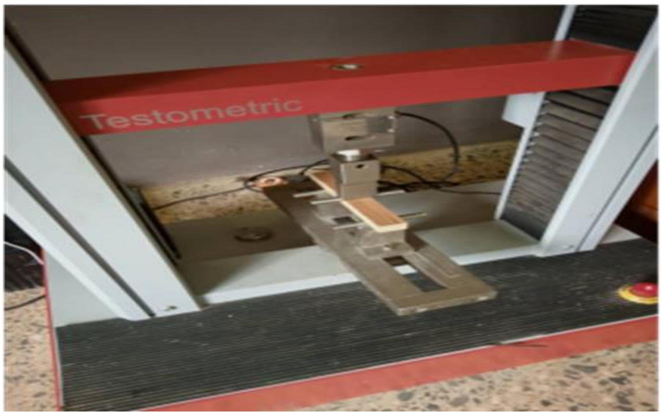

Fig. 1: Testometric machine

Results and Analysis

For each of the samples Richard Russel, Hokusan and SKG Nordic, the chats for strain at break (%), deformation at break (mm) and combined dynamics of the strain and deformation are shown as charts in figures 2, 3 and 4 respectively.

Plots

The figure 2 below is a chart for Strain at Break (%) for the samples Richard Russel, MDF Hokusan and SKG Nordic, Richard Russel attained 0.929% strain at break, MDF Hokusan attained 1.263% strain at break while SKG Nordic attained 0.800% strain at break.

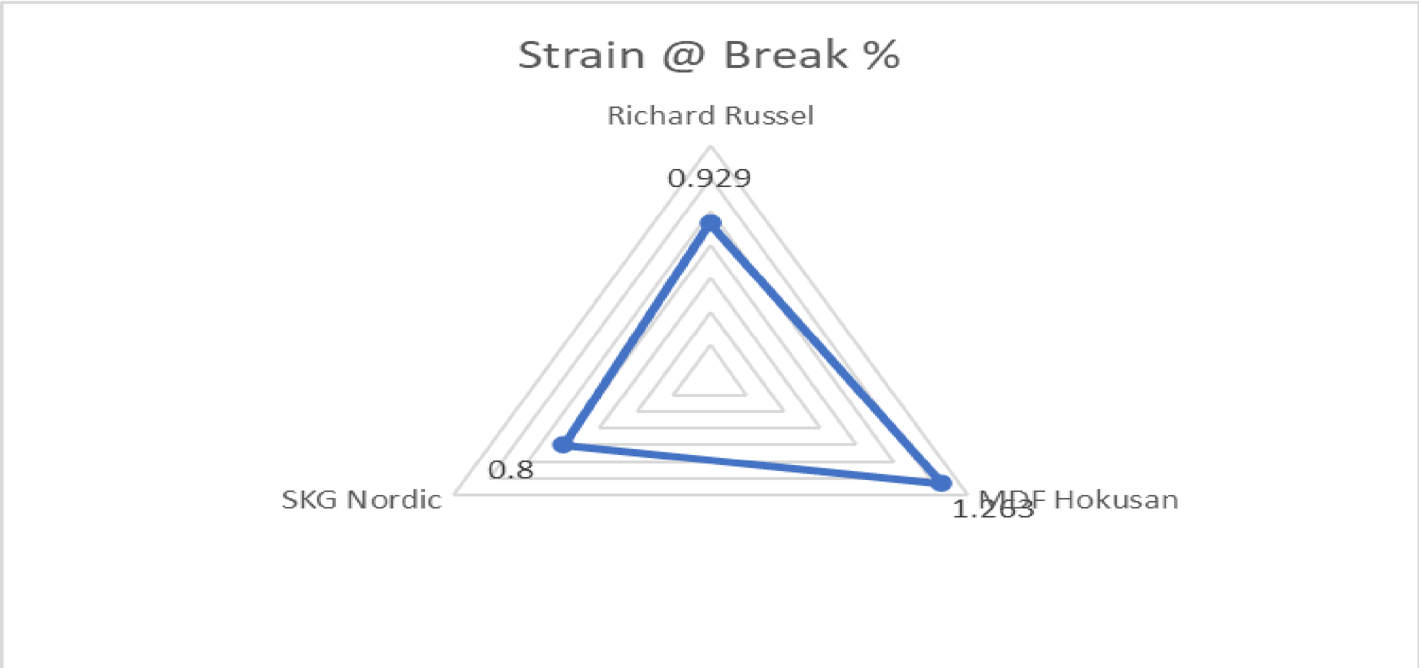

Fig 2: Chart of Strain at Break (%) for Richard Russel, MDF Hokusan and SKG Nordic.

The figure 3 below is a chart for Deformation at Break (mm) for the samples Richard Russel, MDF Hokusan and SKG Nordic. Richard Russel recorded 4.129mm deformation at break, MDF Hokusan recorded 5.612mm deformation at break while SKG Nordic recorded 3.554mm deformation at break.

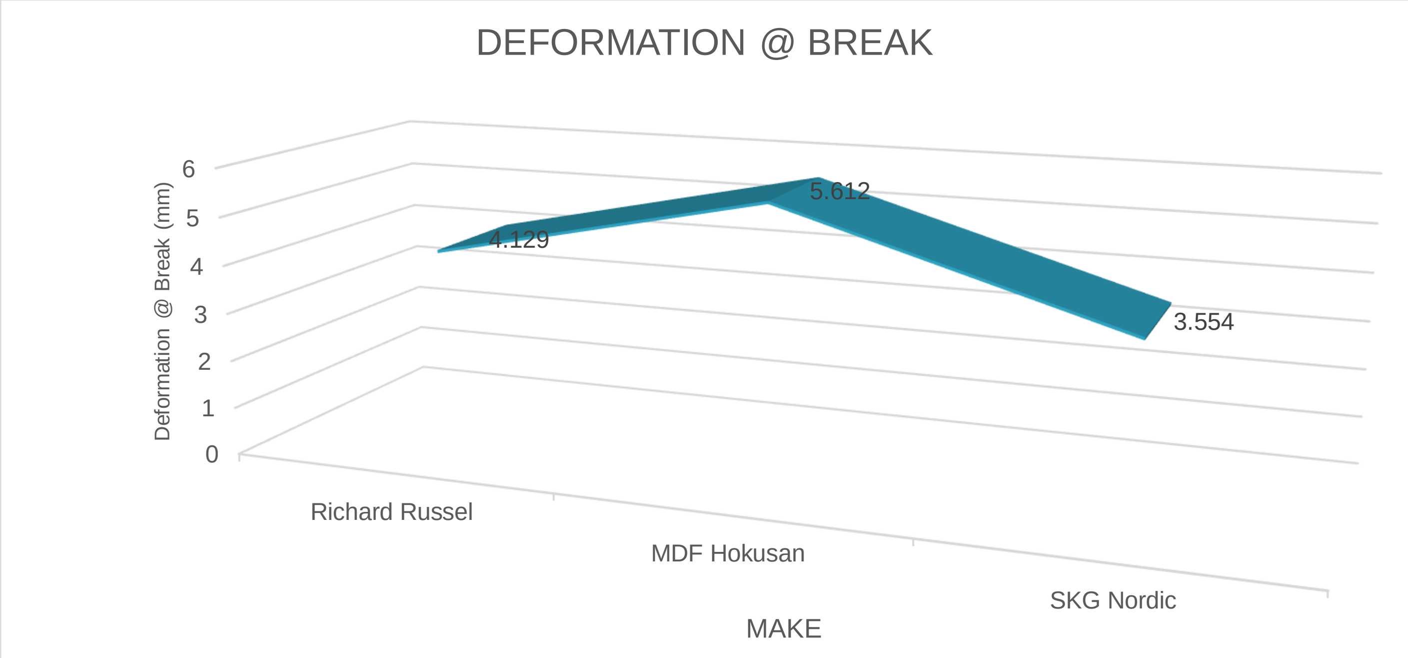

Fig. 3: Chart of Deformation at Break (mm) for Richard Russel, MDF Hokusan and SKG Nordic.

The figure 4 below is a chart for relationship between Strain at Break (%) and Deformation at Break (mm) for the samples Richard Russel, MDF Hokusan and SKG Nordic. A direct relationship is established between the strain and deformation for the samples Richard Russel, MDF Hokusan and SKG Nordicwith series 1 being strain while series 2 being the deformation.

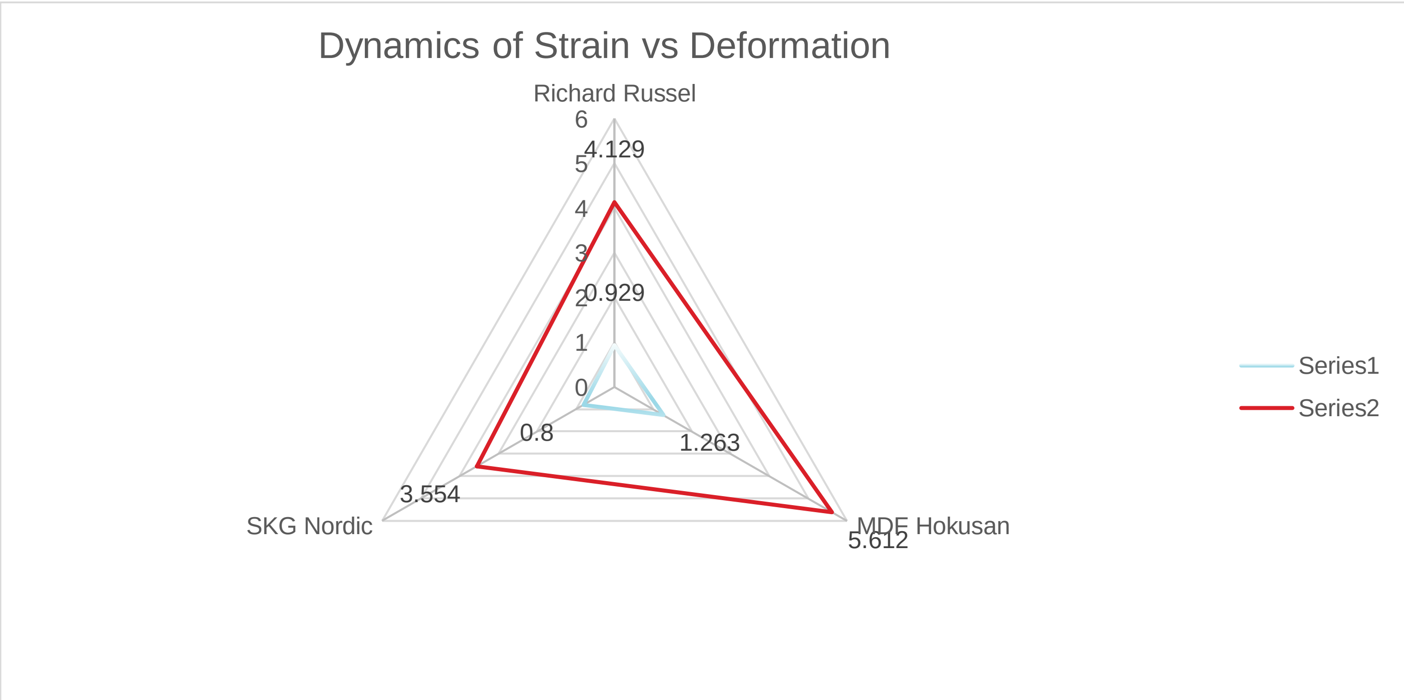

Fig. 4: Chart of Strain at Break (%) and Deformation at Break (mm) for Richard Russel, MDF Hokusan and SKG Nordic.

Conclusion and Recommendation

X-raying the results, arranging them in an ascending order of their Strain at Break (%) for the samples, SKG Nordic achieved strain at break of 0.800%, Richard Russel achieved strain at break of 0.929% while MDF Hokusan achieved strain at break of 1.263%. From statistical analysis, MDF Hokusan ability to elongate at break is 35.9526% and 57.8750% better than that of Richard Russel and SKG Nordic respectively. Richard Russel elongation at break potential over SKG Nordicis just 16.1250%. Again, in an ascending order of their Deformation at Break (%) for the samples, SKG Nordic attained deformation at break of 3.554mm, Richard Russel attained deformation at break of 4.129mm while MDF Hokusan attained deformation at break of 5.612mm. Empirically also, dynamics of the deformation at break exhibited analogous pattern to strain, where MDF Hokusan ability to deform is 35.9167% and 57.9066% better than that of Richard Russel and SKG Nordic respectively. Richard Russel deformation at break potential over SKG Nordic is just 16.1790%. This innovative technical understanding on strain and deformation abilities of medium-density fibreboard (MDF) engineered wood product should be valued by architects, building contractors, engineers, individuals, construction companies as well as furniture makers. Engineers in the Biomedical areas as well as mechatronics equipment developers and Engineers in general can as well utilise this knowledge. Strain at peak and deformation at peak research of other engineered wood products should form future research works.

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