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Road Construction Material Quality, Pavement Performance and Service Life in Nigeria: Evidence from Civil Engineering Projects

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Abstract
Premature road deterioration remains a major challenge to sustainable infrastructure development in Nigeria. This study assessed commonly used road construction materials based on durability, strength and resistance to failure; examined factors influencing their effectiveness; and determined the relationship between material quality and road lifespan. A quantitative cross-sectional survey design was adopted. Data were obtained from independently collected responses of 82 records. Responses were measured on a five-point Likert scale and analysed using means, standard deviations, Cronbach's alpha, Pearson correlation and multiple regression. Cement concrete recorded the highest performance rating (M = 4.49, SD = 0.86), followed by crushed stone aggregates (M = 4.40) and granite chippings (M = 4.38). Inadequate supervision (M = 4.60, SD = 0.80), inadequate compaction (M = 4.59), poor maintenance culture (M = 4.56) and failure to follow design specifications (M = 4.56) were the most influential factors affecting material effectiveness. The measurement scales demonstrated high internal consistency (a = 0.930–0.982). Material quality had a strong positive relationship with perceived road lifespan ($r = 0.694$, $p < 0.001$). The regression model was statistically significant and explained 90.9% of the variance in road-lifespan perceptions ($R^2 = 0.909$; $F = 259.603$, $p < 0.001$). The study concludes that durable, tested and specification-compliant materials, supported by effective supervision, compaction, drainage and maintenance, are essential for improving road lifespan in Nigeria.

Keywords: *Road construction materials; Material quality; Pavement durability; Road lifespan; Nigeria.*

1.0 Introduction

Road infrastructure plays a central role in national development by supporting the movement of people, goods and services and connecting communities to markets, employment and essential services. In Nigeria, where road transport is the dominant means of inland movement, the condition of roads directly affects economic activities and public safety. However, many roads develop potholes, cracks, rutting and other forms of failure before reaching their intended design life. These failures increase transportation and maintenance costs and reduce the value of public infrastructure investment (Ukor et al., 2023). Pavement performance refers to the ability of a road to retain acceptable strength, safety and riding quality under traffic and environmental conditions. Its service life represents the period during which it performs effectively before major rehabilitation becomes necessary. Road lifespan is influenced by material quality, pavement design, traffic loading, climate, drainage, construction methods and maintenance practices (Khichad & Vishwakarma, 2025). Therefore, road failure cannot be attributed to one material or construction activity alone; it usually results from the interaction of several technical and managerial factors. The quality of road construction materials is especially important because each pavement layer performs a specific structural function. Asphalt, bitumen, aggregates, laterite, gravel, stabilised soil, sand, stone dust and cement concrete must possess adequate strength, durability and resistance to crushing, weathering, abrasion and moisture damage. Khichad and Vishwakarma (2025) observed that material properties, traffic conditions, pavement type and environmental exposure jointly influence pavement deterioration. Similarly, Tanyıldızı et al. (2024) found that aggregate characteristics significantly affect the strength and durability of rigid pavement materials.

Aggregates form a major part of asphalt and concrete pavement mixtures. Their strength, particle shape, cleanliness and gradation influence load distribution, mixture density and resistance to surface failure. Weak or poorly graded aggregates may break down under repeated traffic loading and contribute to rutting, ravelling and cracking. Recent studies have shown that aggregate type and treatment affect pavement strength, moisture resistance and long-term performance (Khan, Ram, & Patel, 2024; Tanyıldızı et al., 2024). Bitumen serves as the binding material in flexible pavements and provides flexibility and resistance to water penetration. Nevertheless, its performance depends on temperature, traffic loading, ageing and compatibility with aggregates. Bitumen that is too soft may cause bleeding and rutting, while excessively stiff or aged bitumen may increase pavement cracking. Improving binder properties can enhance resistance to

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deformation, ageing and moisture damage (Khan et al., 2024; Arinkoola et al., 2025). Cement concrete is widely recognised for its high compressive strength, rigidity and ability to distribute heavy traffic loads. However, its durability depends on cement quality, water–cement ratio, aggregate characteristics, proportioning, joint detailing and curing. Poor-quality aggregates or inadequate curing may cause cracking and loss of strength. Khan, Ram, and Patel (2024) confirmed that aggregate treatment and characteristics influence the mechanical performance and durability of pavement concrete. The condition of the subgrade is equally important because it serves as the foundation of the pavement. A road constructed on weak, highly plastic or moisture-sensitive soil may fail even when the surface materials are of acceptable quality. Ukor et al. (2023) found that subgrade materials along failed sections of the Enugu–Onitsha Expressway had high liquid limits, low California bearing ratio values and inadequate durability.

These properties fell below Nigerian specifications and contributed to pavement failure. This shows that material quality must be considered across all pavement layers, not only at the surface. Water and inadequate drainage are also major threats to road durability. Water infiltration reduces subgrade strength, weakens the bond between bitumen and aggregates and encourages stripping, cracking and deformation. Kavitha et al. (2024) reported that saturated granular subbase materials exposed to heavy wheel loads experienced reduced strength, severe deformation and shorter pavement life. They also found that aggregate gradation, porosity and fine-particle content affected the drainage capacity of granular pavement layers. Construction practices determine whether the expected properties of materials are achieved in the field. Proper compaction improves pavement density, strength and resistance to deformation, whereas poor compaction increases permeability, settlement, rutting and cracking. Yao and Song (2023) identified compaction quality as essential to infrastructure stability and longevity. Harries and Böhm (2024) also demonstrated that construction processes influence compaction success and the mechanical behaviour of asphalt layers. The effectiveness of road materials is further influenced by supervision, workmanship, laboratory testing, compliance with specifications, storage, funding and procurement practices. High-quality materials may still perform poorly when mixing proportions are incorrect, temperatures are uncontrolled or pavement layers are inadequately compacted. Yao and Song (2023) argued that conventional quality-control methods based on limited sampling may not adequately identify variations in material properties and compaction across a construction site. Maintenance is another important determinant of road lifespan. When cracks, blocked drains and surface defects are not addressed promptly, water enters the pavement and minor defects develop into structural failures. Khichad and Vishwakarma (2025) emphasised that regular condition assessment and performance prediction are necessary for planning cost-effective maintenance and rehabilitation.

Although Nigerian road-failure research has generated important evidence on failed pavement sections, subgrade conditions, drainage deficiencies, traffic loading and the suitability or stabilisation of specific materials (Ugbe et al., 2022; Ukor et al., 2023; Falowo, 2023; Avwenagha et al., 2024; Oladejo et al., 2024; Obasaju et al., 2025; Nwaejigh et al., 2026), much of this evidence is site-specific or concentrates on isolated geotechnical or material variables. Comparatively limited empirical work has examined, within one analytical framework, how professionals jointly evaluate material quality, the performance of commonly used road-construction materials, and construction-management factors such as supervision, compaction, specification compliance, drainage and maintenance in relation to road lifespan across Nigerian civil engineering projects.

This study advances the existing literature by integrating these dimensions in a single survey-based model and by testing their relationships with perceived road lifespan using reliability analysis, Pearson correlation and multiple regression. In doing so, it shifts the emphasis from diagnosing individual failed road sections alone to assessing the combined material and implementation conditions that practitioners associate with durable pavement performance. The study therefore assesses commonly used road materials based on durability, strength and resistance to failure; examines the factors influencing their effectiveness; and determines the relationship between material quality and perceived road lifespan, with the aim of supporting better material selection, quality control, supervision and maintenance practices for more durable roads in Nigeria.

2.0 Methodology

2.1 Research Philosophy

The study was guided by the positivist research philosophy. The principal constructs in this study are material quality, material performance rating, factors affecting material effectiveness and road lifespan. They were operationalised using structured questionnaire items and numerical rating scales. This allowed the research to summarise response patterns and examine statistically whether higher material-quality assessments were associated with stronger road-lifespan assessments.

2.2 Research Approach

A deductive, quantitative approach was adopted. The deductive component began from the established engineering expectation that stronger, durable and properly tested road materials should be associated with improved pavement performance and longer service life. The questionnaire then translated this expectation into measurable statements concerning strength, resistance to water and weathering, quality control, compaction, drainage, supervision, maintenance and road deterioration. The quantitative approach enabled the use of frequencies, percentages, means, standard deviations, reliability analysis, Pearson correlation and multiple regression.

2.3 Sampling Technique and Sample Size

Purposive and convenience sampling procedures were used. Purposive sampling was appropriate because respondents needed relevant knowledge or experience in road construction. Convenience access was involved because the electronic questionnaire was distributed through available professional contacts and networks. The sample size used for the main descriptive, correlational and regression analyses was 82 records. The sample covered civil engineers, highway engineers, a site engineer, a quantity surveyor, a construction manager, a laboratory technician and another road-sector role. Experience ranged from less than five years to twenty years, providing views representing both early-career and experienced professional profiles. Table 1 shows the composition of the sample size.

Table 1: Composition of the analytical sample

Characteristic	Category	Frequency	Percentage
Gender	Male	67	81.7
Gender	Female	15	18.3
Qualification	HND/Bachelor degree	59	72.0
Qualification	Master degree	15	18.3
Qualification	PhD	4	4.9
Qualification	OND/NCE	4	4.9
Experience	Less than 5 years	33	40.2
Experience	5-10 years	34	41.5
Experience	11-15 years	7	8.5
Experience	16-20 years	8	9.8

2.4 Instrument for Data Collection

Data were collected with a structured questionnaire administered through Google Forms. The instrument contained closed-ended demographic items, five-point agreement statements, five-point material-performance ratings, multiple-response questions and open-ended questions. Table 2 shows the structure of the questionnaire.

Table 2: Structure of the questionnaire

Section	Content	Number of fields	Response format
A	Respondent and professional characteristics	7	Categorical
B	Use, durability, strength and failure resistance of road materials	13	Five-point agreement scale
C	Performance ratings of ten road materials	10	Very Poor to Very Good
D	Factors influencing material effectiveness	16	Five-point agreement scale
E	Material quality and road-lifespan indicators	14	Five-point agreement scale
F	General ratings, most durable material, multiple-response and open-ended questions	8	Categorical, multiple-response and text

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2.5 Measurement and Operationalization of Variables

Agreement items were coded as Strongly Disagree = 1, Disagree = 2, Undecided = 3, Agree = 4 and Strongly Agree = 5. Material ratings were coded as Very Poor = 1, Poor = 2, Fair = 3, Good = 4 and Very Good = 5. Higher scores therefore represented stronger agreement or more favorable material assessment. The criterion mean was 3.00. Means of 3.00 and above indicated agreement or favorable assessment, while means below 3.00 indicated disagreement or unfavorable assessment

2.6 Method of Data Analysis

2.6.1 Descriptive Statistics

Frequencies and percentages were used for demographic characteristics, categorical questions and selection of the most durable material. Means and standard deviations were used to summarise material ratings, material-performance statements, factors influencing effectiveness and road-lifespan indicators. Mean scores were ranked from highest to lowest.

2.6.2 Pearson Product-Moment Correlation

Pearson correlation was used to determine the direction and strength of linear relationships among material quality, material rating, effectiveness factors and road lifespan. The coefficient was computed as:

$$r = \frac{\sum[(X-\overline{X})(Y-\overline{Y})]}{\sqrt{\sum(X-\overline{X})^2 \sum(Y-\overline{Y})^2}} \tag{1}$$

Where:
r = Pearson correlation coefficient; Xi = material-quality score of respondents i; Yi = road-lifespan score of respondents i; X¯ = mean material-quality score; Y¯ = mean road-lifespan score; Xi−X¯ = deviation of an individual material-quality score from its mean; Yi−Y¯ = deviation of an individual road-lifespan score from its mean; n = number of respondents; ∑ = summation sign.

Statistical significance was evaluated at $\alpha = 0.05$ using the analytical sample size of 82. Effect sizes were interpreted cautiously because the measures captured professional perceptions and the analytical records were not all independent field submissions.

2.6.3 Multiple Linear Regression

Multiple linear regression was used to estimate the joint and unique contribution of three predictor constructs to perceived road lifespan. The specified model was:

$$Y = \beta_0 + \beta_1 X_1 + \beta_2 X_2 + \beta_3 X_3 + \varepsilon \tag{2}$$

Where:
Y = predicted road-lifespan score; β_0 = regression constant or intercept; β_1, β_2 and β_3 = regression coefficients; X_1 = material-quality score; X_2 = material-performance rating; X_3 = effectiveness-factor score; ε = random error term.

3.0 Results and Discussion

3.1 Reliability and Composite Descriptive Statistics

Table 3 shows that all four scales exceeded the conventional reliability threshold of 0.70. The alpha coefficients ranged from 0.930 to 0.982, indicating excellent internal consistency. The high coefficients imply that the items within each scale measured closely related dimensions. The composite means ranged from 4.20 to 4.45, demonstrating generally favorable assessments and strong agreement. The material-quality scale recorded the highest dispersion (SD = 1.09), suggesting greater variation in respondents' views about strength, durability and resistance characteristics.

Table 3: Reliability and descriptive statistics of the study constructs

Construct	Items	Mean	SD	Cronbach alpha
Material quality characteristics	7	4.20	1.09	0.965
Evaluation of construction materials	10	4.28	0.63	0.930
Factors affecting material effectiveness	16	4.45	0.80	0.977
Road lifespan indicators	14	4.45	0.88	0.982

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3.2 Assessment of Commonly Used Road Construction Materials

Figure 1 shows cement concrete had the highest mean rating (M = 4.49, SD = 0.86), this may be attributed to its high compressive strength, rigidity and resistance to repeated traffic loading. Khan et al (2024) similarly reported that concrete durability depends largely on aggregate quality and treatment. Followed by crushed stone aggregates (M = 4.40, SD = 0.66) and granite chippings (M = 4.38, SD = 0.73), also received high ratings because of their strength and resistance to crushing and abrasion. This agrees with Tanyıldızı et al. (2024), who found that aggregate properties significantly influence pavement strength and durability. Asphalt and gravel each recorded a mean of 4.37. Sand ranked lowest, although its mean remained favorable (M = 3.95, SD = 0.99). The relatively low standard deviations for crushed stone aggregates and gravel show greater consensus about their performance, whereas the higher deviations for sand and laterite indicate more varied field experiences.

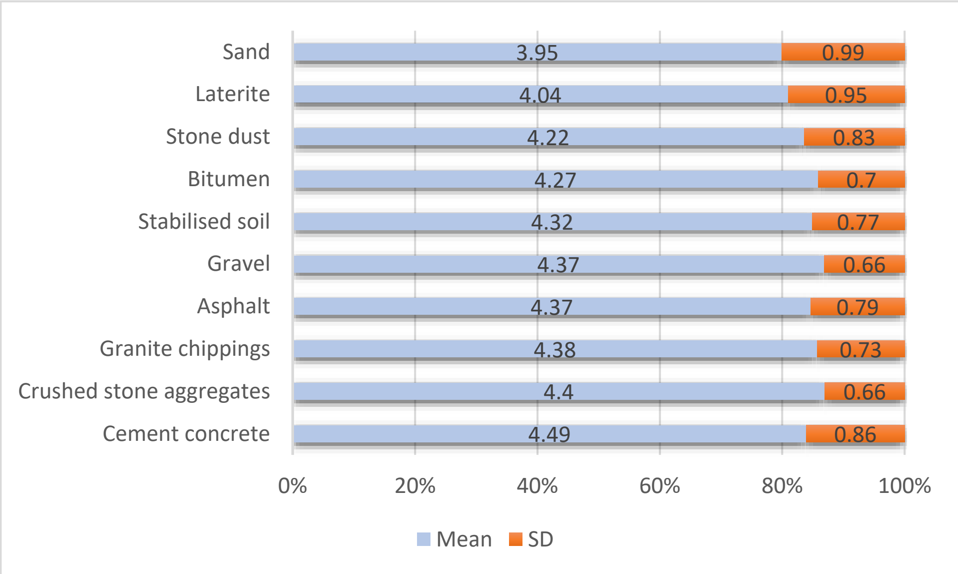

Figure 1: Assessment of road construction materials

Figure 2 shows cement concrete was selected as the most durable material by 40.2% of respondents, followed by asphalt (28.0%) and crushed stone aggregates (18.3%). This pattern is consistent with the high mean ratings in Table 4.2. The result suggests that strength, rigidity and resistance to repetitive loading shaped respondents' perception of durability.

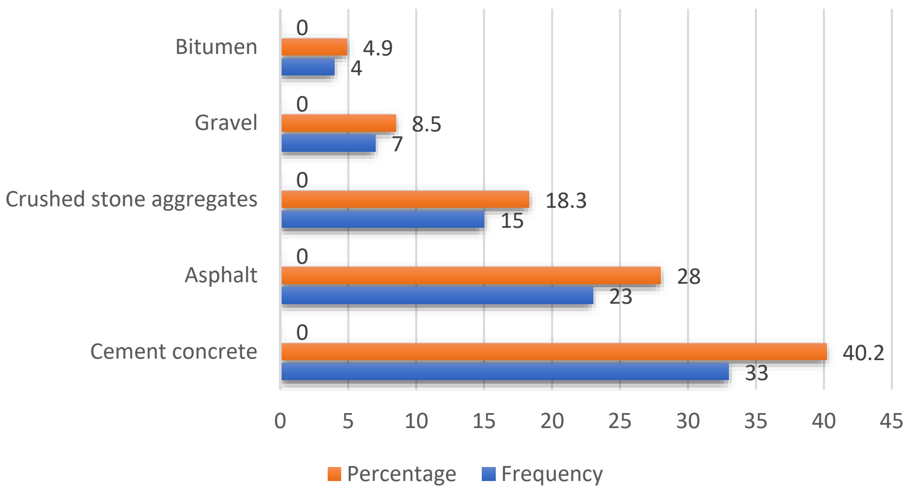

Figure 2: Material identified as most durable

The leading position of cement concrete is supported by recent experimental evidence. Abiola et al (2024) demonstrated that properly proportioned concrete pavement incorporating suitable aggregate systems can achieve high impact resistance, mechanical strength and durability. Their findings reinforce the present respondents' perception that concrete provides a strong and durable pavement solution, particularly where

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heavy loading and long service life are important. The favourable ratings for crushed stone aggregates, granite chippings and gravel similarly reflect the structural importance of aggregate strength, grading and resistance to weathering. Avwenagha et al (2024) found that superficial Niger Delta soils were unsuitable as base or sub-base in their natural condition but improved to sub-base quality after stone-dust stabilisation. This supports the present finding that crushed mineral materials and stone dust can improve pavement-layer competence when they are appropriately selected and tested. The finding that asphalt and bitumen were highly rated is also consistent with Usanga et al (2023), who showed that binder modification can improve asphalt rheology, rutting resistance, fatigue behaviour and moisture susceptibility. Their study demonstrates that asphalt performance depends not merely on the presence of bitumen but on binder quality, mixture design and resistance to environmental loading.

This aligns with respondents' agreement that asphalt durability depends largely on the quality of bitumen and aggregates. Laterite received a good but comparatively lower rating. This should not be interpreted to mean that laterite is inherently unsuitable. Esharive et al (2024) reported that tested laterites from the northern Anambra Basin had favourable gradation, density and California Bearing Ratio values for subgrade and sub-base applications. Conversely, Tamba et al (2026) warned that the use of unsuitable empirical stiffness parameters for tropical lateritic gravels can produce inadequate pavement thickness and early failure. Taken together, these studies support the present result: laterite can perform well, but its suitability depends on location-specific testing, moisture response, compaction and design application.

3.2 Factors Influencing Material Effectiveness

All sixteen factors recorded means above 4.00. Inadequate supervision ranked first (M = 4.60, SD = 0.80), closely followed by inadequate compaction (M = 4.59, SD = 0.80). Poor maintenance culture and failure to follow design specifications shared the third position (M = 4.56, SD = 0.80). Inadequate funding and poor drainage also recorded very high means. Although corruption and poor procurement ranked last, their mean of 4.28 shows that respondents still considered them important as shown in figure 3. The prominence of supervision, compaction and specification compliance shows that effective materials can still perform poorly when construction control is weak. Falowo (2023) found that recurrent failure along the Owo-Ikare highway was associated with inadequate pavement thickness and the absence of shoulder drainage, even though some subgrade indicators met minimum requirements. This finding directly supports the present respondents' emphasis on design compliance, supervision and drainage rather than attributing failure only to the nominal type of material used. The importance of compaction and laboratory testing is also supported by Obasaju et al (2025), whose integrated geophysical, mineralogical and geotechnical investigation linked persistent pavement instability to weak, clay-rich subgrade conditions. They reported significant improvement in strength after lime stabilisation and curing. Their results demonstrate why material characterisation, compaction tests, CBR evaluation and appropriate stabilisation are essential before pavement layers are accepted. Poor drainage, heavy rainfall and moisture exposure were major concerns in the present study.

Nwaejigh, Aghamelu, and Nweke (2026) similarly identified inadequate drainage, intense rainfall, poor subgrade, substandard materials and excessive axle loads as interacting drivers of rutting, cracking and potholes in southeastern Nigeria. Falowo (2023) also associated highway failure with inadequate drainage. These recent Nigerian studies corroborate the view that water infiltration weakens pavement layers and accelerates deterioration where drainage is deficient. The significant role of excessive traffic load agrees with Oladejo et al (2024), who found that repeated stress from heavy vehicles contributed to recurrent failure on the Ibadan-Oyo road even after maintenance or reconstruction. The authors recommended axle-load regulation and, where appropriate, stronger pavement configurations. The present respondents' assessment therefore reflects a broader interaction: material strength must be matched with actual traffic loading and supported by enforcement and maintenance. Funding and maintenance culture were also highly ranked.

Nwaejigh et al. (2026) observed that insufficient maintenance funding compounds geotechnical and climatic problems. This suggests that durable pavement delivery requires life-cycle financing, not only initial construction expenditure. Without routine inspection, drainage clearing and timely rehabilitation, minor defects can progress into expensive structural failures.

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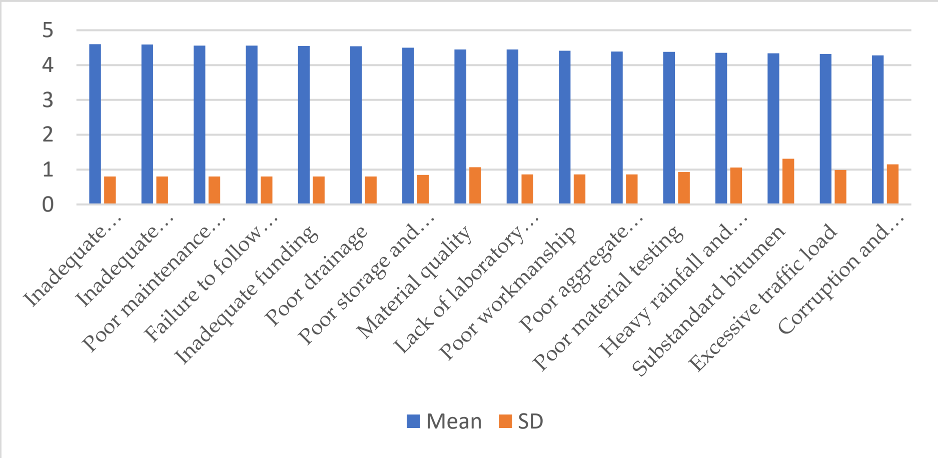

Figure 3: Factors influencing the effectiveness of road construction materials

3.3 Material Quality and Road Lifespan

The highest-rated statement was that substandard materials increase maintenance costs (M = 4.65), followed by the contribution of good-quality aggregates to pavement stability and strength (M = 4.63). The overall road-lifespan scale mean of 4.45 indicates strong agreement that material quality is associated with long-term road performances shown in Table 4. The overall road-lifespan mean of 4.45 showed strong agreement that good-quality materials improve road durability and reduce premature deterioration. Respondents particularly agreed that substandard materials increase maintenance costs, while tested materials and good-quality aggregates improve pavement strength and stability. This supports Tanyıldızı et al. (2024), who established that aggregate properties significantly influence pavement strength and durability.

Table 4: Perceived effects of material quality on road lifespan

Road-lifespan statement	**Mean**	**Agreement (%)**
Substandard materials increase maintenance cost	4.65	95.1
Good-quality aggregates improve pavement stability and strength	4.63	90.2
Tested and approved materials reduce maintenance problems	4.54	95.1
Poor-quality materials contribute to early deterioration	4.46	90.2
Durable materials reduce the frequency of repairs	4.45	90.2
High-quality materials last longer than poor-quality materials	4.45	90.2
Strict material quality control improves road lifespan	4.45	90.2
Poor laterite quality weakens the sub-base	4.45	85.4
High-strength materials withstand heavy traffic	4.40	90.2
Water-resistant materials prevent potholes and cracks	4.37	90.2
Road failures are often linked to poor material quality	4.37	90.2
Material quality directly affects road lifespan	4.35	90.2
Proper material selection improves long-term performance	4.35	85.4
Proper bitumen quality improves asphalt lifespan	4.34	90.2

3.4 Correlation Analysis

Table 5 shows that material quality had a strong positive relationship with road lifespan ($r = 0.694$, $p < 0.001$). The evaluation of construction materials was also strongly related to road lifespan ($r = 0.778$, $p < 0.001$). The strongest association was between recognition of effectiveness factors and road-lifespan perceptions ($r = 0.937$, $p < 0.001$). The null hypothesis stating that there is no significant relationship between road construction material quality and road lifespan was therefore rejected.

Table 5: Pearson correlation matrix

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Variable	1	2	3	4
1. Material quality	1.000			
2. Material rating	0.532	1.000		
3. Effectiveness factors	0.728	0.695	1.000	
4. Road lifespan	0.694	0.778	0.937	1.000

The positive material quality-lifespan relationship supports the engineering principle that pavement performance is governed by the mechanical and durability properties of its constituent layers. Ugbe et al (2022) linked failed road sections in the western Niger Delta to the mineralogical and geotechnical characteristics of subgrade soils. Avwenagha et al. (2024) likewise showed that material competence differs between subgrade, sub-base and base applications, and that stabilisation can improve performance. These studies support the present correlation by showing that unsuitable or insufficiently treated materials create vulnerability within the pavement structure. The strong association involving effectiveness factors indicates that respondents viewed quality assurance, drainage, supervision, compaction and maintenance as part of the material-performance system. Nwaejigh et al. (2026) reached a similar integrated conclusion: pavement failure results from interactions among material, geotechnical, climatic, construction and socio-economic conditions. The correlation should therefore not be interpreted as proof that one isolated material characteristic determines lifespan; rather, quality works through design, construction control and the service environment.

3.5 Multiple Regression Analysis

The regression model was statistically significant, $F(3, 78) = 259.603$, $p < 0.001$, and explained 90.9% of the variance in perceived road-lifespan scores ($R^2 = 0.909$; adjusted $R^2 = 0.905$) as shown in Table 6. Material rating was a significant positive predictor (B = 0.343, beta = 0.245, $p < 0.001$), while effectiveness factors produced the strongest unique contribution (B = 0.834, beta = 0.758, $p < 0.001$). Material quality was not independently significant after the overlapping predictors were controlled (B = 0.010, beta = 0.012, $p = 0.805$) as shown in Table 7. All VIF values were below 5.00, indicating no serious multicollinearity problem. The estimated regression equation was:

Road lifespan = -0.778 + 0.010(Material quality) + 0.343(Material rating) + 0.834(Effectiveness factors).

The non-significant material-quality coefficient does not contradict its significant bivariate correlation. It indicates that much of its association with lifespan was shared with the broader material-rating and effectiveness constructs. In practical terms, perceived material quality appears to influence lifespan most strongly when considered together with testing, supervision, compaction, drainage, specification compliance and maintenance.

Table 6: Multiple regression model summary

R	R squared	Adjusted R squared	F	Model p-value
0.953	0.909	0.905	259.603	< 0.001

Table 7: Regression coefficients

Predictor	B	SE	Beta	t	p-value	VIF
Constant	-0.778	0.211	-	-3.690	<0.001	-
Material quality	0.010	0.040	0.012	0.248	0.805	2.13
Material rating	0.343	0.067	0.245	5.143	<0.001	1.94
Effectiveness factors	0.834	0.065	0.758	12.908	<0.001	2.96

3.6 Study Limitations and Future Research

A key limitation of this study is that the evidence is based on professionals' perceptions captured through a cross-sectional questionnaire rather than direct laboratory testing, instrumented pavement evaluation or field measurement of the sampled roads. The reported relationships therefore show how respondents perceive the association between material quality, construction practices and road lifespan; they should not be interpreted as direct causal estimates of measured pavement deterioration or service life. In addition, the purposive and convenience sampling approach may limit the extent to which the findings can be generalised to every road project or road agency in Nigeria. Future studies should triangulate professional perceptions with project-specific field and laboratory data, including material gradation and strength tests, California Bearing Ratio, in-situ density and compaction results, asphalt or concrete core tests, drainage-condition assessments, pavement-condition surveys and, where feasible, deflection or structural-capacity measurements. Longitudinal studies that follow roads from construction through service would further clarify how supervision, compaction, drainage, traffic loading and material properties interact to influence objectively measured deterioration and service life.

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4.0 Conclusion

This study assessed road-construction materials, factors influencing their effectiveness and the relationship between material quality and road lifespan in Nigerian civil engineering projects. Cement concrete emerged as the highest-rated material (M=4.49,SD=0.86) and was identified as the most durable by 40.2% of respondents. It was followed by crushed stone aggregates (M=4.40,SD=0.66), granite chippings (M=4.38,SD=0.73), asphalt (M=4.37) and gravel (M=4.37). Sand ranked lowest but still recorded a favourable assessment (M=3.95,SD=0.99).

The major factors affecting material effectiveness were inadequate supervision (M=4.60,SD=0.80), inadequate compaction (M=4.59), poor maintenance culture (M=4.56), failure to follow design specifications (M=4.56), inadequate funding (M=4.55) and poor drainage (M=4.54). These findings demonstrate that pavement durability depends on both material characteristics and the quality of construction and management practices.

The overall road-lifespan score was high (M=4.45,SD=0.88). Material quality had a strong positive and statistically significant relationship with perceived road lifespan ($r=0.694, p<0.001$); therefore, the null hypothesis was rejected. The regression model was statistically significant and explained 90.9% of the variation in road-lifespan perceptions ($R2=0.909$, adjusted $R2=0.905$, $F=259.603$, $p<0.001$). Effectiveness factors were the strongest predictor ($\beta=0.758, p<0.001$), followed by material-performance ratings ($\beta=0.245, p<0.001$).

The study concludes that high-quality materials contribute significantly to longer-lasting roads, but their benefits depend on adequate supervision, compaction, testing, drainage, maintenance and compliance with design specifications. An integrated quality-management approach is therefore necessary to reduce premature pavement failure and improve the sustainability of road infrastructure in Nigeria.

For policymakers and road agencies, the findings point to the need for enforceable quality-assurance procedures that make supervision, material testing and compliance checks mandatory at critical construction stages. Agencies should strengthen independent site supervision, require documented approval of pavement materials before use, and link interim payment certificates to verified compliance with design specifications and test results. Compaction control should be treated as a hold-point activity: layer placement should not proceed until field-density or other specified compaction requirements have been achieved and recorded, with failed sections reworked before subsequent layers are placed.

For contractors, greater emphasis should be placed on consistent layer thickness, moisture conditioning, equipment calibration, workmanship and continuous compaction monitoring rather than relying only on the nominal quality of supplied materials. Drainage should also be treated as a structural component of pavement performance; side drains, culverts, shoulders and outlets should be properly constructed, protected from blockage and inspected before project handover. Road agencies should complement these construction controls with routine drainage clearing and condition-based maintenance so that water-related defects, cracks and local failures are corrected before they progress into major pavement deterioration. These actions directly reflect the high ranking of inadequate supervision, inadequate compaction and poor drainage in the study and provide practical priorities for extending road service life.

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