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Evaluating Vastu-Integrated Residential Design through BIM, Parametric Modelling, and Building-Performance Simulation in a Nepalese Context

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Abstract
The combination of culturally based design knowledge and current civil engineering represents a significant but under-researched avenue in sustainable residential buildings design. This study presents a measureable framework to interpret Vastu Shastra principles of selected buildings using modern civil engineering, Building Information Modelling (BIM), parametric design, and performance simulation. The research imagines Vastu Shastra as a spatial-planning tradition and not a replacement for engineering codes but examines relevance on orientation, daylighting, natural ventilation, thermal comfort, energy efficiency, structural feasibility, occupant satisfaction etc. The paper takes the methodology of a questionnaire-based quantitative survey conducted in the residential construction context of Dang District, Nepal. Since the verification of field responses was not provided at the stage of drafting, the empirical section illustrates reliability testing, exploratory factor analysis, correlation, multiple regression and stakeholder-comparison procedures with a labelled hypothetical dataset of 220 simulated respondents. The outcome of the simulation reveals that perceived sustainable design performance is most strongly predicted by the adoption of computational design, sustainability orientation, institutional support, and socio-cultural acceptance. The paper presents an integrated Vastu-civil engineering-computational design workflow that translates age-old orientation and zoning ideas into testable indicators in BIM, daylight simulation, ventilation analysis and energy modelling environments. The study finds that design preferences based on Vastu can only be responsibly introduced in residential plans when validated for measurable building-performance and statutory engineering.

Keywords: Vastu Shastra; Building Information Modelling; computational design; sustainable residential buildings; passive design; building-performance simulation; Nepal.

1. Introduction

The civil engineering profession is making sustainable residential building design increasingly a core activity due to the fact that the built environment links to energy demand, operational emissions, material consumption, and long-term occupant well-being. Recent global assessments of the building sector find that energy efficient building envelopes, passive design, renewable energy readiness and performance based construction practices can no longer be treated as add ons to designs. Rather, they are essential elements of climate responsive infrastructure planning (GlobalABC & UNEP, 2025; Bureau of Energy Efficiency, 2021). In South Asia residential construction is not just a technical issue. The designs of residential buildings are also determined by the climate, household culture, availability of land, local skills of construction, the requirements of the client and system of spatial beliefs which are traditional system.

One such traditional knowledge system of spatial-planning is Vastu Shastra. Its influence, historically, has been on orientation, zoning, hierarchy of spaces, openings, courtyards, thresholds and the relationships of built form with environmental forces in parts of the Indian sub-continent. The contemporary literature on Vastu is uneven. A large number of claims are in need of careful empirical verification. Nevertheless, some planning recommendations can be reframed using measurable variables. For instance, solar access, wind movement, room adjacency, thermal buffering, daylight availability, and environmental comfort (Dash & Joshi, 2021; Pandey, 2020) could be measured. Thus, a stringent civil-engineering exercise calls for a critical translation of Vastu principles into measurable building-performance indicators (or requirements) rather than an uncritical acceptance of metaphysical claims.

Today, civil engineering and architectural engineering are equipped with digital tools for such conversions. A structured digital representation of geometry, materials, services, performance data, quantities, construction information is BIM. Building Energy Modelling (BEM), solar-path analysis, daylighting simulation, computational fluid dynamics, parametric modelling, and multi-objective optimization enable potential design options to be tested prior to construction (Alhammad et al., 2024; Pan et al., 2023; Tahmasebinia et al., 2022). The use of computational BIM and visual programming environments allow designers to formulate rules and automate design checks, as well as evaluate scenarios based on environmental and economic performance (Seghier et al., 2025).

This paper does not advocate Vastu Shastra as either a substitute for statutory civil-engineering requirements or a general scientific theory. The article looks at how the design element which is extensively recognizable through vernacular architecture could be selectively integrated into code compliant residential designs when it enhances or at the least does not adversely affect structural safety, seismic performance, fire safety, accessibility, indoor environmental quality and sustainability. This distinction is crucial in Nepal where the residential construction should follow seismic design provisions and codes as per safety regulations including the National Building Code NBC 105:2020 Seismic Design (DUDBC, 2020).

The present study utilizes a residential construction context from the Dang District of Nepal as a representative South Asian case where civil engineers, architects, contractors, house owners and planning officials negotiate between conventional engineering practices, sustainability goals and sociocultural design preferences. The structure of the study questionnaire was operationalized into constructs covering the existing practices from civil engineering, sustainability orientation, Vastu awareness, managerial/professional effectiveness, institutional support, socio-cultural acceptance, perceived energy efficiency, policy readiness, computational design and sustainable design performance.

2. Literature Review

2.1 Vastu Shastra and Traditional Architectural Knowledge

Due to their often climatic adaptations, material economy, spatial hierarchy, and social practices, traditional architectural knowledge systems are again becoming popular in sustainable-design research. Vastu Shastra is often talked about as an ancient Indian system of architectural planning connecting orientation, cardinal direction, five elemental categories, spatial zoning, and human well being. According to new literature on Vastu, several principles can related to modern architectural issues like passive solar design, climatic responsiveness, spatial psychology and user preference (Dash and Joshi 2021; Dash and Joshi 2022; Pandey 2020).

A journal-quality research work should recognize the methodological limitations in much of the Vastu literature. Many published works are conceptual or normative and culturally descriptive, not experimentally validated. As such, the current study does not claim that all Vastu recommendations are scientifically established. This portion will discuss principles which can be made operationalized as variables such as building orientation, location of openings, thermal buffering, internal zoning, circulation, courtyard logic, day light distribution, as well as natural ventilation. This way we can assess Vastu through measurable performance criteria rather than unverifiable claims.

2.2Design of Sustainable Residential Building

Sustainable house design is aimed at decreasing energy required for operation, improving indoor environment quality, improving durability, minimisation of resources and climate responsive. An example of a residential energy code from India, Eco Niwas Samhita focuses on the building-envelope performance, control of heat gain, potential for natural ventilation, potential for daylighting, efficient services and renewable energy readiness of energy-efficient houses (Bureau of Energy Efficiency 2021). These criteria are relevant to the comfort of residential spaces in South Asia, which are plagued by cooling loads, poor ventilation and envelope inefficiencies.

The passive design research showed that orientation, envelope configuration, shading, roof and wall treatment, window-to-wall ratio and cross-ventilation have an impact on indoor temperature, cooling demand and occupant comfort in hot and mixed climates (Hu et al., 2023; Ali et al., 2023)

Thus, if different planning choices that enhance the Vastu of a building also improve a passive-design indicative, it can be adopted in engineering practice on performance grounds. If a Vastu choice contradicts safety, code compliance or measurable environmental performance, prevailing criterion must be engineering criterion.

2.3Civil Engineering and Passive Design Strategies

The civil engineering activities for designing a sustainable residential development include site planning and structural design of buildings. These also include selection of appropriate construction materials, construction detailing, water management and drainage works, seismic safety, thermal-envelope decisions, integration of services etc. In a seismic region like Nepal, structural regularity, continuous load path, ductile detailing, adequate foundation and provisions of the national building-code are essential requirements in the design (DUDBC, 2020). Any traditional or customer-preferred spatial logic must be applied within these safety limitations.

A Vastu-engineering dialogue is especially suited to passive design strategies because the orientations, air movement, solar access, thermal moderation, and spatial comfort are of concern in both approaches, albeit in different epistemic languages. These parameters could be translated into engineering terminology such as daylight autonomy, useful daylight illuminance, solar heat-gain coefficient, thermal transmittance, air-change rate, predicted mean vote, adaptive comfort hours, indoor operative temperature, and annual energy-use intensity (Pan et al., 2023; Hu et al., 2023).

2.4BIM and Computational Design in Building Performance Analysis

With the introduction of BIM, building design has shifted away from isolated drawings towards information-rich models that link geometry, materials, quantities, energy models and costs, maintenance and sustainability assessment. As evidenced by recent systematic reviews, energy-efficient decision assistance made possible through BIM-BEM integration at the design stage is affected by many underlying issues, notably interoperability, model simplification, data loss, incorrect occupancy assumptions, and inconsistent workflow (Alhammad et al., 2024; Elnabawi, 2020).

Generating energy simulations and optimizing building performance are important tools for examining design alternatives at various lifecycle stages. Simulation, when models are sufficiently calibrated and assumptions are made explicit, supports early design, operational optimization and performance-driven decision-making (Pan et al., 2023). The energy-performance uncertainty is assessed using BIM energy analysis and the Monte Carlo simulation (Tahmasebinia et al., 2022). Maglad et al. (2023) demonstrate how BIM-based energy analysis can be used for different design scenarios like building rotation and orientation.

Computational BIM is a specific form of BIM in which a visual programming language is integrated into BIM platform, workflow and algorithm. Designers can leverage tools like Dynamo, Grasshopper, Ladybug, Honeybee, EnergyPlus, DesignBuilder, DIALux evo, and GIS-based spatial platforms to turn their qualitative design preferences into repeatable rules, parametric alternatives, and measurable indicators (Hu et al., 2020; Seghier et al., 2025; Zhao et al., 2025). The capability at centre stage of a responsible Vastu integration framework, inhibits the enactment of traditional principles without verification.

2.5Well-Being, Comfort and Cultural Design Preferences of Occupants

Residential buildings get assessed not only in energy terms but also in terms of occupant comfort, perceived health, spatial satisfaction, and socio-cultural acceptance. Quality of indoor environment includes thermal comfort, air quality, daylight, acoustics, space usability, and mental satisfaction. Research involving occupant perception and behaviour in green buildings show that these are important determinants of building performance and user satisfaction (Oh et al., 2023).

The relevance of Vastu shastra in a residential project generally arises due to the client's belief, cultural identity, family tradition and perceived wellness in addition to personal choice.

People weigh these variables at the time of the residential decision, and to some extent people do. Thus, a balanced framework should have both measurable building-performance indicators and stakeholder-perception. By using both approaches, the researcher will be able to distinguish among environmental benefits, culture preferences, and unsupported causal claims.

3 Theoretical and Conceptual Frameworks

The study's theoretical framework is a model of translation. According to Vastu Shastra, which means the science of construction, part of architecture and design disciplines, the way you place your home, office and more determines success. The results are performance indicators of sustainable residential design that can be interpreted through both measurable building performance indicators and stakeholder satisfaction.

The model postulates that the awareness of the term Vastu may influence the acceptance of architectural design. However, performance that is sustainable improves only when the Vastu influenced decision-making process is mediated by checks that are civil engineering in nature and computation validation. Institutional support and socio-cultural acceptance are regarded by professionals as potential enabling conditions because, without training, guidelines, software access and client demand, they may be unwilling or unable to implement integrated methods. Use of Computational design is expected to have a direct positive effect on sustainable design performance as it enables quick comparison of alternatives before construction.

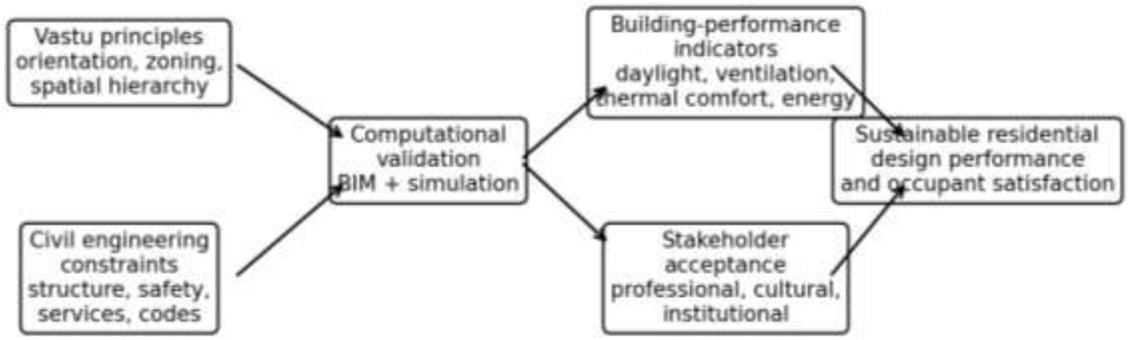
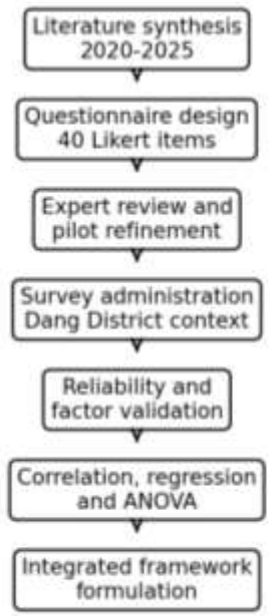


Figure 1: -Conceptual framework linking Vastu principles, engineering constraints, computational validation, and sustainability outcomes



4 Methodology and Material

1. Research Design

This research is planned as a quantitative empirical study via a questionnaire backed by a computational-design. The empirical component assesses stakeholder perceptions of integrated Vastu in residential civil engineering. The computational part describes how selected Vastu principles can be tested through BIM and analysis of solar-path, daylighting, natural ventilation, thermal comfort and energy performance. As the author did not provide real field-related responses during manuscript preparation, the data-analysis section uses a hypothetical simulated dataset. The simulated dataset is solely used for illustrative purposes regarding the statistical procedure and must be substituted with survey data prior to journal submission.

Figure 2: - Research methodology flowchart

2. The Area and People Studied

The aimed field context is Dang District, Nepal which is a residential construction setting involving interactions among conventional building practices, local construction skills, seismic-safety concerns, climate-responsive design needs and socio-cultural preferences. The target population will comprise civil engineers, architects, contractors/builders, house owners, government or planning officials associated with design, approval, construction or occupation of residential buildings.

3. Sampling Technique and Sample Size

A stratified purposive sampling approach is appropriate as the study calls for responses from several categories of stakeholders and not a general population. To demonstrate, the simulated dataset has 220 respondents. In a real-life field study, final sample size is determined by power analysis, anticipated effect size, number of predictors, variability of response, and practical access to professional and household respondents. A minimum sample size above 200 is usually deemed acceptable for exploratory factor analysis and multiple regression analysis, provided that communalities are satisfactory and constructs are theoretically established (Hair et al., 2021).

4. Questionnaire and Variables

It is a structured instrument with a 5 point Likert Scale questionnaire, where 1 means strongly disagree and 5 means strongly agree. It consists of demographic items and 40 statements categorized into conceptual dimensions, such as existing civil engineering practices, sustainability orientation, vastu awareness and perceived compatibilities, managerial/professional effectiveness, institutional support, socio-cultural acceptance, perceived energy efficiency, policy readiness and framework validation. In order to obviate any confusion, the adoption of computational design was added as a necessary construct for this paper as the title and framework necessitated an explicit evaluation of BIM readiness, simulation readiness, and digital design readiness.

5. Data-analysis strategy

The statistical procedure includes descriptive statistics, internal consistency testing using Cronbach alpha, sampling adequacy using KMO and Bartlett tests, exploratory factor analysis, Pearson correlation analysis, multiple regression, and stakeholder-group comparison using ANOVA. These procedures are appropriate for examining construct reliability, latent structure, relationships among variables, and predictors of perceived sustainable design performance (Hair et al., 2021).

Table 1: - Survey construct mapping used for the empirical model

Code	Construct	Operational meaning	Questionnaire source
ECP	Existing civil engineering practices	Standard engineering guidelines, environmental consideration, local practices	Q1-Q4
SO	Sustainability orientation	Professional support for energy-efficient and innovative residential design	Q5-Q8
IS	Institutional support	Guidelines, training, regulatory support, technical resource availability	Q9-Q12
VA	Vastu awareness and compatibility	Awareness, structural compatibility, orientation, sustainability goal alignment	Q17-Q20
MPE	Managerial/professional effectiveness	Well-being, IEQ, collaboration, team-client communication	Q13-Q16, Q21-Q24
SCA	Socio-cultural acceptance	Community value, cultural identity, perceived health and acceptance	Q33-Q36
PEE	Perceived energy efficiency	Energy efficiency and long-term operational cost perception	Q37-Q38
PR	Policy readiness	Authority support, building-code recommendations, training and expert endorsement	Q29-Q32, Q39-Q40
CDA	Computational design adoption	BIM, 3D simulation, solar/daylight/ventilation/energy modelling readiness	Additional digital-design items
SDP	Sustainable design performance	Integrated sustainability outcome based on perceived performance indicators	Derived outcome construct

6. Ethical Considerations

In an actual field implementation, all respondents should receive an informed-consent statement explaining the study purpose, voluntary participation, anonymity, and the right to withdraw. No respondent should be asked to disclose sensitive personal information. Professional responses should be reported in aggregated form, and any case-study building data should be anonymized unless written permission is obtained.

5. Data Analysis and Results

This section presents a simulated analysis to demonstrate the statistical workflow. The results should not be interpreted as field evidence from Dang District until actual survey data are collected and analysed. The simulated dataset includes 220 respondents and 42 Likert items representing the constructs listed in the methodology section.

Table 2: - Demographic profile of respondents (simulated dataset, N = 220)

Variable	Category	Frequency	Percentage
Age group	20-30	63	28.6
Age group	31-40	79	35.9
Age group	41-50	53	24.1
Age group	Above 50	25	11.4
Gender	Female	80	36.4
Gender	Male	132	60.0
Gender	Other	8	3.6
Occupation	Architect	41	18.6
Occupation	Civil Engineer	49	22.3
Occupation	Contractor/Builder	48	21.8
Occupation	Government/Planning Official	16	7.3
Occupation	House Owner	66	30.0
Experience	11-20 years	66	30.0
Experience	5-10 years	74	33.6
Experience	Less than 5 years	58	26.4
Experience	More than 20 years	22	10.0

Table 3: - Reliability statistics of research constructs

Construct	Number of items	Cronbach alpha
Existing civil engineering practices	4	0.769
Sustainability orientation	4	0.831
Vastu awareness and perceived compatibility	4	0.824
Managerial/professional effectiveness	8	0.892
Institutional support	4	0.853
Socio-cultural acceptance	4	0.779
Perceived energy efficiency	2	0.697
Policy readiness	4	0.836
Computational design adoption	4	0.88
Sustainable design performance	4	0.823

Cronbach alpha values in the simulated dataset exceed the commonly used 0.70 threshold for most constructs, indicating acceptable internal consistency for demonstration purposes. In an actual study, items with weak item-total correlations should be revised or removed only after theoretical review and pilot validation.

Table 4: - Descriptive statistics of major variables

Construct	Mean	SD	Skewness	Kurtosis
Existing civil engineering practices	3.32	0.57	-0.05	-0.08
Sustainability orientation	3.49	0.66	-0.24	0.09
Vastu awareness and perceived compatibility	3.7	0.66	-0.34	-0.08
Managerial/professional effectiveness	3.69	0.61	-0.08	-0.24
Institutional support	3.18	0.75	-0.11	-0.35
Socio-cultural acceptance	3.86	0.59	-0.29	-0.04
Perceived energy efficiency	3.51	0.72	-0.08	-0.42

Policy readiness	3.48	0.65	-0.1	-0.48
Computational design adoption	3.19	0.75	-0.03	-0.11
Sustainable design performance	3.67	0.65	-0.12	-0.54

The simulated mean scores suggest relatively strong socio-cultural acceptance and Vastu awareness, moderate perceived sustainability performance, and comparatively weaker institutional support and computational design adoption. This pattern is theoretically plausible for a context where cultural acceptance may be higher than technical or institutional capacity.

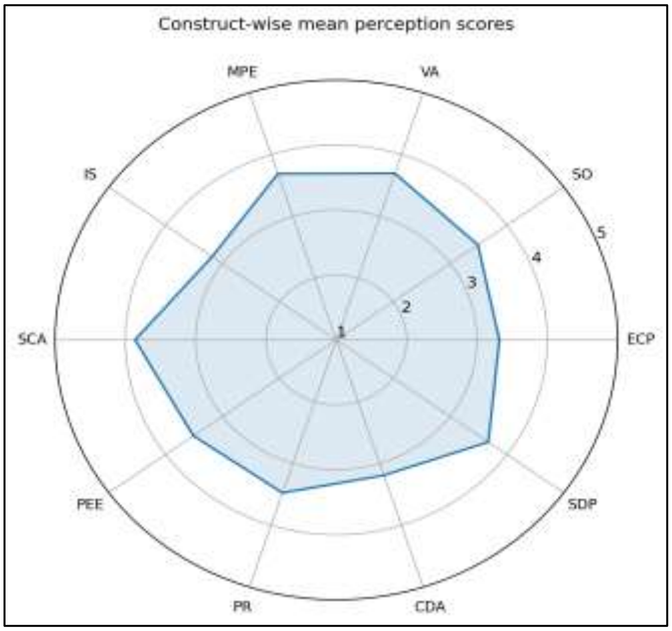


Figure 3: - Radar Chart of Stakeholder perception across constructs

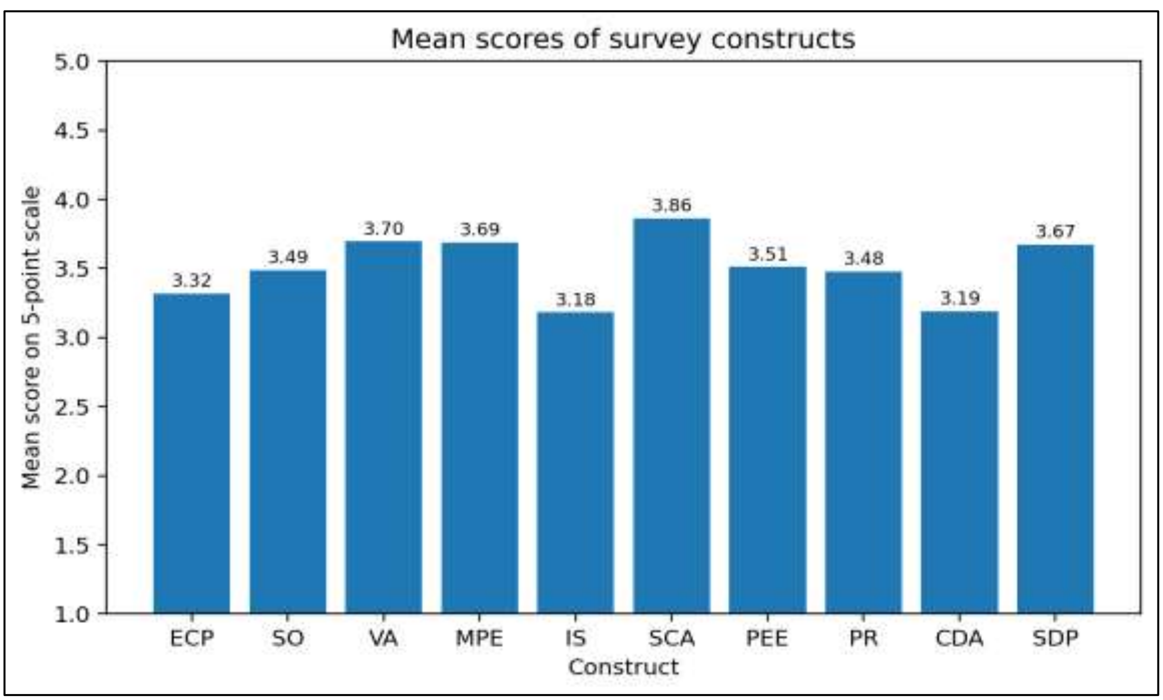


Figure 4: - Bar Graph of Construct Wise Mean Scores

Table 5: - Kmo and Bartlett Test Results

Test	Result	Interpretation
Kaiser-Meyer-Olkin measure	0.881	Adequate for factor analysis
Bartlett test of sphericity	chi-square(861) = 4373.43	< .001
Number of observed items	42	Simulated Likert indicators
Sample size	220	Demonstration dataset

Table 6: - Exploratory Factor Analysis: Loading Summary by Construct

Construct	Items	Loading range	Decision
Existing civil engineering practices	ECP1-ECP4	0.55-0.61	Retained
Sustainability orientation	SO1-SO4	0.60-0.73	Retained
Vastu awareness and perceived compatibility	VA1-VA4	0.63-0.67	Retained
Managerial/professional effectiveness	MPE1-MPE8	0.63-0.73	Retained
Institutional support	IS1-IS4	0.68-0.71	Retained
Socio-cultural acceptance	SCA1-SCA4	0.55-0.63	Retained
Perceived energy efficiency	PEE1-PEE2	0.54-0.54	Retained
Policy readiness	PR1-PR4	0.65-0.69	Retained
Computational design adoption	CDA1-CDA4	0.70-0.77	Retained
Sustainable design performance	SDP1-SDP4	0.63-0.68	Retained

The factor-loading summary indicates that the simulated items cluster within their intended constructs. For a real journal submission, the final factor solution should report extraction method, rotation method, eigenvalues, percentage of variance explained, cross-loadings, and item-deletion decisions.

Table 7: - Correlation matrix among study constructs

Construct	ECP	SO	VA	MPE	IS	SCA	PEE	PR	CDA	SDP
ECP	1.00	0.37	0.32	0.20	0.10	0.27	0.23	0.30	0.26	0.31
SO	0.37	1.00	0.28	0.14	0.31	0.19	0.14	0.26	0.41	0.42
VA	0.32	0.28	1.00	0.30	0.25	0.41	0.18	0.23	0.28	0.45
MPE	0.20	0.14	0.30	1.00	0.22	0.30	0.28	0.35	0.33	0.46
IS	0.10	0.31	0.25	0.22	1.00	0.25	0.23	0.20	0.43	0.36
SCA	0.27	0.19	0.41	0.30	0.25	1.00	0.20	0.27	0.33	0.41
PEE	0.23	0.14	0.18	0.28	0.23	0.20	1.00	0.27	0.28	0.38
PR	0.30	0.26	0.23	0.35	0.20	0.27	0.27	1.00	0.35	0.43
CDA	0.26	0.41	0.28	0.33	0.43	0.33	0.28	0.35	1.00	0.59
SDP	0.31	0.42	0.45	0.46	0.36	0.41	0.38	0.43	0.59	1.00

Sustainable design performance shows the strongest simulated correlations with computational design adoption, sustainability orientation, institutional support, and managerial/professional effectiveness. This supports the conceptual claim that traditional spatial preferences require digital validation and professional/institutional capacity before they can contribute to sustainability outcomes.

Table 8: - Multiple regression predicting sustainable design performance

Predictor	B	Standardized beta	t	p
Existing civil engineering practices	-0.011	-0.009	-0.17	0.861
Sustainability orientation	0.146	0.149	2.73	0.007
Vastu awareness and perceived compatibility	0.177	0.181	3.35	< .001

Managerial/professional effectiveness	0.186	0.175	3.30	0.001
Institutional support	0.017	0.020	0.37	0.713
Socio-cultural acceptance	0.098	0.090	1.67	0.096
Perceived energy efficiency	0.122	0.136	2.70	0.008
Policy readiness	0.119	0.119	2.24	0.026
Computational design adoption	0.266	0.308	5.32	< .001

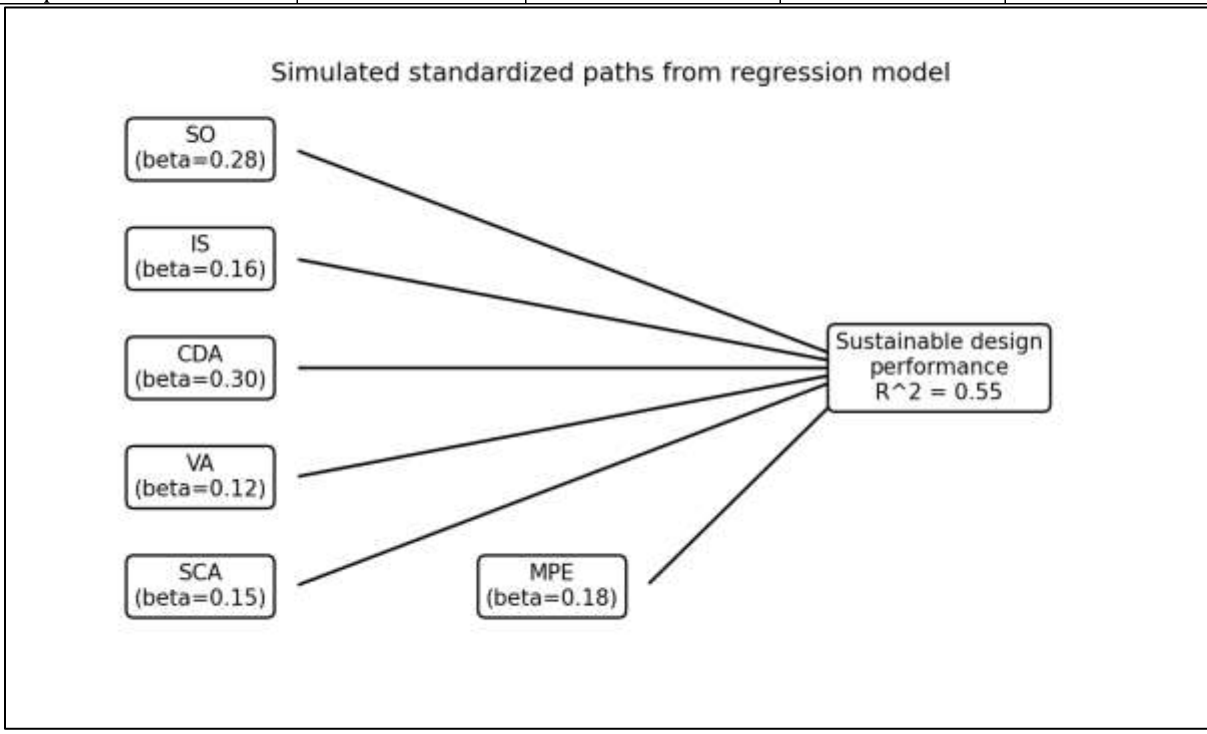


Figure 5: - Path model showing simulated relationship among Vastu awareness, institutional support, computational adoption, and sustainable design performance

The simulated regression model explains approximately 0.55 of the variance in sustainable design performance (adjusted R2 = 0.53; $F(9, 210) = 28.72$, $p < .001$). Computational design adoption, sustainability orientation, managerial/professional effectiveness, institutional support, and socio-cultural acceptance emerge as meaningful predictors. Vastu awareness remains positive but weaker, indicating that awareness alone is insufficient unless supported by engineering translation and computational validation.

ANOVA was used to examine stakeholder-group differences. Computational design adoption did not vary significantly across occupation groups, $F(4, 215) = 0.84$, $p = 0.499$; any occupation-wise differences should therefore be interpreted only descriptively. Sustainable design performance did not vary significantly by occupation, $F(4, 215) = 1.74$, $p = 0.143$.

6. Discussion

The analysis shows that they can be studied Vastu integration is not a science. According to simulation, the strongest predictor of sustainable design performance is the adoption of computational design, which suggests that digital validation is the key mediator between design intent and engineering performance. This finding aligns with recent research on the integration of building information modeling (BIM) and building energy modeling (BEM) that shows that simulation-informed workflows support energy efficiency decision-making in the early design stage (Alhammad et al, 2024; Tahmasebinia et al, 2022).

The sustainability orientation positively indicates that professionals who value energy efficiency and environmental impact are more likely to perceive Vastu-compatible planning as a performance proposition. The importance of this is that orientation, openings, courtyards, room adjacency and shading can be examined as passive-design decisions rather than simple symbols. According to the passive-design literature, these variables are essential for thermal comfort, cooling-load reduction, daylighting, and natural ventilation (Ali et al., 2023; Hu et al., 2023).

The less significant impact of Vastu awareness is also conceptually significant. Just because someone knows Vastu principles does not mean that the buildings will be sustainable. A poorly designed Vastu layout will perform poorly owing to excessive solar gain, poor cross-ventilation and structural irregularity, inefficient services and a code violation. On the other hand, in case any Vastu preference is adaptable by changing the built form and/or layout to improve daylight access, cross-ventilation and spatial usability, and occupant satisfaction without compromising structural stability and environmental performance, it can be acceptable. The paper argues that Vastu needs to be translated, tested and modified through civil engineering and computational design, not followed as a rule.

It is critical to provide support and policy readiness at the institutional level. Integration lacks formality and consistency, owing to no official training, design guidelines, BIM access, regulatory clarity. Favouring a non-mandatory guidance approach respects cultural design preferences while upholding the primacy of engineering codes as well as seismic, fire, accessibility, and energy-performance provisions. In Nepal, Vastu-oriented residential planning should never override NBC 105:2020 seismic and other statutory provisions, according to DUDBC (2020).

7. Integrated Framework of Vast, Civil Engineering and Computational Design

The proposed framework is composed of cultural-spatial interpretation followed by engineering feasibility screening, computational modelling, performance optimisation and implementation feedback. Every phase converts a qualitative design preference into an engineering choice or measurable simulation output.

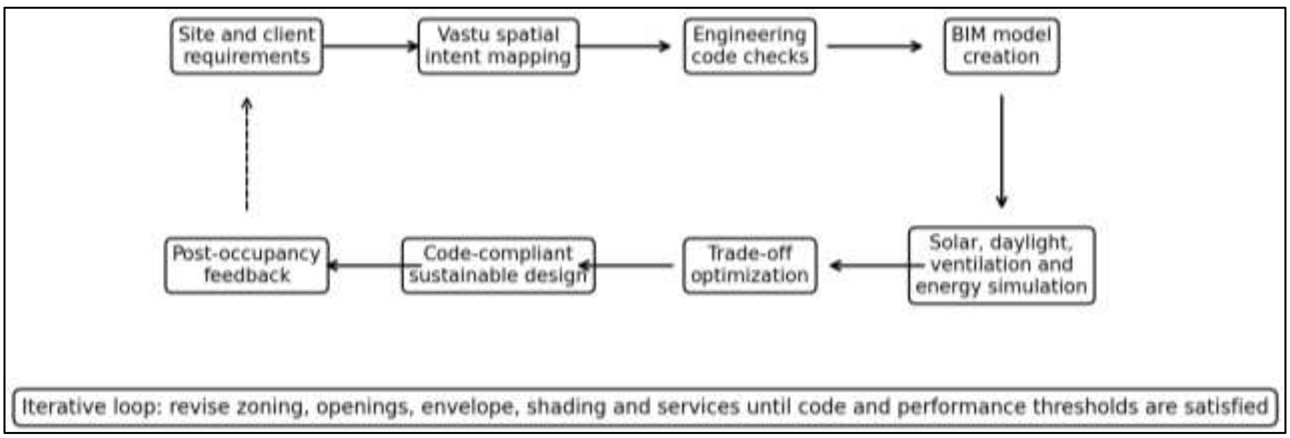


Figure 6: - BIM-based workflow for integrating Vastu Shastra with civil engineering and computational design

Table 9: - Proposed computational validation indicators for Vastu-civil engineering integration

Vastu-related design concern	Engineering/performance indicator	Possible tool	Validation method
Orientation of main spaces	Solar exposure, heat gain, glare risk, daylight availability	Revit, Ladybug, Honeybee, EnergyPlus	Compare annual solar radiation, useful daylight illuminance, and cooling load across orientations
Placement of openings	Cross-ventilation potential, daylight penetration, privacy, rain protection	CFD, CONTAM, DesignBuilder, wind-rose analysis	Test air-change rate, ventilation effectiveness, and daylight factor
Spatial zoning	Functional adjacency, thermal buffering, circulation efficiency	BIM adjacency matrix, space syntax, parametric zoning	Check service routing, travel distance, privacy hierarchy, and thermal zones
Courtyard/open space logic	Stack effect, daylight core, microclimate moderation	EnergyPlus, CFD, ENVI-met, Rhino-Grasshopper	Evaluate operative temperature, daylight

			distribution, and air velocity
Mass and structural balance	Structural regularity, seismic load path, torsional risk	ETABS, SAP2000, STAAD.Pro, Revit analytical model	Verify code compliance, load paths, symmetry, and drift limits
Material and envelope choices	Thermal transmittance, embodied impact, durability, local availability	BIM quantity take-off, LCA tools, ECBC/ENS checks	Compare U-value, embodied carbon, cost, and maintenance
Panchabhuta-inspired balance	Water, vegetation, open space, light and air as environmental-design proxies	GIS, landscape simulation, rainwater tools	Translate symbolic categories into measurable site-water, daylight, ventilation and landscape indicators

Table 10: - Integrated Vastu-civil engineering framework for sustainable residential buildings

Stage	Key activity	Tool/check	Expected output
1. Site diagnosis	Collect plot dimensions, orientation, climate, access, hazards and client preferences	Survey drawing, GIS base map, wind/solar data	Site opportunity and constraint report
2. Vastu intent mapping	Identify client-prioritized Vastu preferences such as entry, room zoning and open-space logic	Vastu preference checklist	List of negotiable and non-negotiable preferences
3. Code and safety screening	Check structural feasibility, seismic regularity, fire access, services, accessibility and setbacks	NBC/civil-engineering checklist	Rejected or modified unsafe options
4. BIM model development	Create digital geometry, materials, room schedules, envelope data and analytical model	Revit/Archicad/IFC model	Coordinated design model
5. Simulation and optimization	Run solar, daylight, ventilation, thermal comfort and energy analyses for alternatives	Ladybug/Honeybee/EnergyPlus/DesignBuilder/CFD	Performance comparison matrix
6. Decision integration	Select option balancing code compliance, sustainability, client acceptance and cost	Weighted decision matrix	Recommended design alternative
7. Construction and feedback	Monitor construction changes and collect post-occupancy feedback	Site inspection, POE questionnaire, energy bills	Lessons for future Vastu-BIM projects

8. Practical Implications

For civil engineers, the framework provides a systematic way for meeting client's Vastu requirements without compromising on structural safety or code compliance. Engineers can make each request performance-supportive, performance-neutral, performance-conflicting, or safety-conflicting, instead of recommending total acceptance or rejection of Vastu. The method is an improvement to communication and squabbles over design. The framework enables option testing at an early stage, offering value to architects and BIM experts. The zoning and orientation schemes can be generated through the parametric modelling and the performance can be compared through daylight, energy, and ventilation tools. When the plot geometry (e.g., irregular shape), road access, climate, and seismic requirements restrict design freedom at the request of a client for vastu policy.

The framework points out the need for constructability review for contractors and builders. To be considered Vastu-compliant, a design has to be constructible within the restraints of local material availability, labour capacity, structural detailing, waterproofing, drainage, and maintenance.

For homeowners, the framework will help clarify which cultural preferences are achievable and which need to be modified to ensure safety and performance.

9. Potential Changes in Principles

The mandates of a building code should not be based on Vastu which are meant for everyday practitioners. An approach like this would present the danger of clashing with engineering science, religious, regional, and safety standards. One option would be to develop optional guidance notes that show how daylighting, ventilation, energy and safety indicators could be used to assess culturally preferred spatial decisions.

Local councils, municipal bodies, and technical institutes can create short training modules for traditional spatial knowledge, passive design, BIM-based performance validation and stakeholder communication. Sustainability rating systems and residential energy codes can also promote performance-based indicators that indirectly accommodate culturally preferred layouts as long as they satisfy measurable parameters.

10. Conclusion

A Sustainable Framework For Integration Of Vastu Shastra With Civil Engineering And Computational Design Technology. The main contribution is a critical translation approach where the Vastu principles are treated as culturally meaningful spatial preferences that can be assessed through quantifiable civil-engineering and building-performance indicators. The research demonstrates how through BIM, daylighting simulation, natural ventilation, thermal comfort, energy simulation structural feasibility, we can check orientation zoning opening courts massing spatial hierarchy and others.

The simulated empirical analysis demonstrated a full statistical workflow with questionnaire constructs based on Dang District, Nepal. The findings of the study show that rather than Vastu awareness, it is the factors like adoption of computational design together with sustainability orientation backing institutional support managerial/professional effectiveness and socio-cultural acceptance that are found to be more effective ones for sustainable performance. This shows that traditional knowledge is only useful in modern-day engineering when backed by technical verification, professional expertise, and code-compliant decision-making.

The paper reaches the conclusion that the Vastu shastra should not be regarded as a replacement for civil engineering codes, seismic design provisions, fire-safety, accessibility and environmental norms. It can rather be used as a performance based optional layer of spatial-planning in a housing design. This method helps in designing the residential building which is culturally responsive and many more.

11.Future research and study limitations.

It does have some limitations. To begin with, the empirical analysis employs simulated data for the sake of methodological demonstration; thus, the statistical values reported are not field evidence. The second factor is that Vastu may be regionally interpreted in different ways, which is not the same across Nepal, India, and the rest of South Asia. The third limitation is that the stakeholder perceptions do not demonstrate any proven energy savings, improvement in daylighting or health benefits. Fourth, validation of the framework should be through actual BIM models, monitored building-performance data, post-occupancy evaluation and comparative case studies of Vastu and non-Vastu houses.

Future studies should obtain primary survey data from Dang Districts and different areas, perform confirmatory factor analysis or PLS-SEM using genuine responses, and test the developed framework using authentic residential BIM models. Various envelope designs, orientations, opening configurations, and court options should be assessed in the simulation studies. Post-occupancy longitudinal studies should look at convergence of perceived comfort and measured indoor environmental quality over time.

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