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Defining and analysing traditional architectural knowledge systems: components and guiding principles in Indian residential architecture through the lens of expertise

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The term 'Traditional Architectural Knowledge Systems' (TAKS) is increasingly prevalent in numerous national and international forums. However, there is no precise definition for the same. The objective of this study was to systematically define the TAKS as useful and applicable for future research. Recognising the need for a vetting process, expert opinion surveys and interviews were conducted to achieve the intended objectives, along with an extensive literature review. Five ancient texts were chosen for comprehensive content analysis: Mānasāraśilpaśastra, Mayamata, Bṛhat-saṃhitā, Samarāṅgaṇa Sūtradhāra, and Manuṣyālayacandrikā. This study establishes a definition of the term TAKS and identifies the guiding principles and components of TAKS concerning residential architecture in the Indian context. The outcome will significantly advance our understanding of the TAKS from a generic perspective and residential architecture in particular. This study will benefit society by helping to restore the essence of lost traditional and cultural values in the era of modernisation and homogenisation.

Keywords: Ancient treatises, Components of TAKS, Guiding principles, Traditional Architectural Knowledge Systems (TAKS)

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The application of traditional wisdom in fields such as medicine, architecture, alchemy, mathematics, chemistry, agriculture, dyeing, weaving, and astronomy has influenced lives and led to extensive knowledge bodies being preserved by communities for generations[1]. Traditional Knowledge Systems have long been profoundly influenced societal norms and practices, and society reciprocally shapes these systems[2]. This study exclusively analysed Traditional Knowledge Systems within the realm of architecture. Traditional Architectural Knowledge Systems (TAKS) were primarily created based on the region's cultural, climatic, topographical, economic, and technological characteristics, and were orally transmitted until they were converted to written documents[3]. In several national and international venues, the term 'Traditional Architectural Knowledge Systems' (TKAS) has become increasingly popular in recent past. Nonetheless, we could not find a precise definition of the term in any of the studies conducted thus far. Hence, it is essential that the term TAKS be defined in the current study in a scientific manner. An expert opinion survey was deemed the most suitable method for this purpose, as it allows the vetting process to be guided by specialized knowledge and consensus of experts. This approach ensures that the definition is refined through informed insights, leading to more accurate and reliable outcomes.

This study explores the TAKS in the Indian context. The historical narrative of India's civilizations dates back to a time ranging from 5000 to 8000 years ago[4]. Regrettably, contemporary architectural designs often fail to integrate TAKS in the Indian scenario. Globalization encourages a standardized method in architectural design, which often diminishes the distinctiveness of regional architectural characteristics in developing countries[5]. Tyrrell[6] argues that neglecting cultural aspects in architectural design has led to buildings failing to embody the distinct climatic and social characteristics of their environments, as evidenced by the widespread influence of international modernism and globalisation. Colonial powers have influenced educational systems by emphasising

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Western knowledge and neglecting local traditions[7]. Modernist philosophies and practices have influenced Indian architecture such that it has moved away from traditional craftsmanship, resulting in the erosion of vital skills and knowledge. Concurrently, the younger generations are less interested in maintaining these practices, which are now at risk of disappearing[8,9]. From the literature analysis, it is clear that the evolution of residential housing types in India signifies a shift from climate-adaptive, community-oriented, traditional houses to standardised, material-intensive modern buildings. Traditional homes, such as Kerala's Nalukettu, Rajasthan's Havelis, and Tamil Nadu's Agraharams, were crafted with passive cooling methods, locally available materials, and designs deeply embedded in cultural and social traditions[3]. The rapid pace of urbanisation, lifestyle changes, and economic influences have led to the prevalence of reinforced concrete structures, high-rise apartments, and mass-produced housing, often neglecting TAKS[10]. This shift has created a disconnection between built environments and their climatic, cultural, and social settings. The issues such as decline of skilled craftsmanship, colonial architectural influences, a Eurocentric education system, lifestyle and attitude changes, and detachment from landscape and ecology further magnifies this divide. To bridge this gap, a hybrid approach that combines TAKS with modern innovations is crucial to ensure ecological sustainability, cultural preservation, and an enhanced quality of life in modern residential architecture.

Several experts have discussed the value of traditional Indian wisdom in the modern world for achieving sustainability in many forums. For example, at the International Conference on 'Communication and Dissemination of Traditional Knowledge' (CDTK-2024), Gupta emphasised the importance of blending traditional architectural principles with contemporary design approaches[11]. Srikonda in the same conference drew attention to the climate-adaptive features of traditional Indian buildings[11]. According to Acharya[12], there are more than 300 texts on architecture in India, written in different languages. Among them are Mānasāraśilpaśastra (1st-millennium CE), Mayamata (in between 5th to 7th century CE), *Bṛhat-saṃhitā* (6th century CE), *SamarāṅgaṇaSūtradhāra* (11th-century) and *Manuṣyālayacandrikā*: (16th century CE). Architectural and town planning fields have benefited greatly in the succeeding decades from these ancient treatises in India[13]. Therefore, these texts were selected for content analysis. Some components and core theories of traditional wisdom were identified from these texts, a questionnaire was prepared, and interviews were conducted with experts. Feedback from experts was used to define the TAKS, add or filter its essential components, and guiding principles. There are differences in climatic, physical, psychological, and cultural characteristics, but the urge for shelters remains universal. The current study is confined to residential architecture, which is a common building typology closely related to society. The outcome of this study also explains how the components and principles of TAKS relate to one another, specifically citing Indian residential architecture.

The primary aim of the study is to methodically establish a definition for the term TAKS which can be useful for subsequent studies. The study proceeds with the following questions,

a) How will the term 'Traditional Architectural Knowledge Systems (TAKS)' be defined?
b) What are the components and guiding principles of TAKS with respect to residential architecture in the Indian context?

The study also attempts to rediscover the ancient Indian repository of the architectural discipline with specific reference to residential architecture. The TAKS includes physical manifestations, rituals, customs, and the cosmic and spiritual dimensions. This research focuses solely on the physical manifestations of the built environment, excluding any examination of construction related ceremonies and rituals.

Materials and Methods

The study began with an extensive literature review of ancient texts and treatises that formed the basis of the TAKS in the Indian context. *MānasāraŚilpaśāstra*, *Mayamata, Bṛhat-Saṃhitā, SamarāṅgaṇaSūtradhāra*, and *Manuṣyālaya Candrikā* were selected for content analysis due to their foundational influence on architectural theory and planning practices in the subsequent centuries. These treatises represent diverse regional traditions and encompass comprehensive guidelines on spatial organisation, materials, rituals, and aesthetics. Many of the factors discussed in the documents which are omitted are derivatives of the core principles presented in the selected works. For example, there

are numerous regional texts and treatises on residential architecture in Kerala, including *Manuṣyālaya Candrikā, Vāstuvidyā, Silparatnam, Tantrasamuchaya, Thachu Shastra* and many others. Among these, *Manuṣyālaya Candrikā* has significantly influenced other texts in Kerala residential architecture. The guiding principles and components extracted from the literature need to be finalised. It was recognised that the vetting process through expert opinion surveys and interviews would be a suitable method for the intended purpose of the study. The literature analysis helped to prepare a questionnaire for the expert opinion survey and interviews. The overall methodology of this study is shown in (Fig. 1).

Methodology for the content analysis of treatises

The selection of treatises and source materials is guided by their relevance to the research topic, availability of translations and commentaries, and practical applicability, with a focus on residential architecture. The methodology for the content analysis of voluminous treatises involves thematic categorisation, identification of specific terminologies, cross-referencing ancient and modern interpretations, and extracting key components and guiding principles from the verses (Fig. 2). The guiding principles and components of the TAKS were derived from studying Sanskrit verses, with English translations and insights from Sanskrit experts were utilised to enhance comprehension.

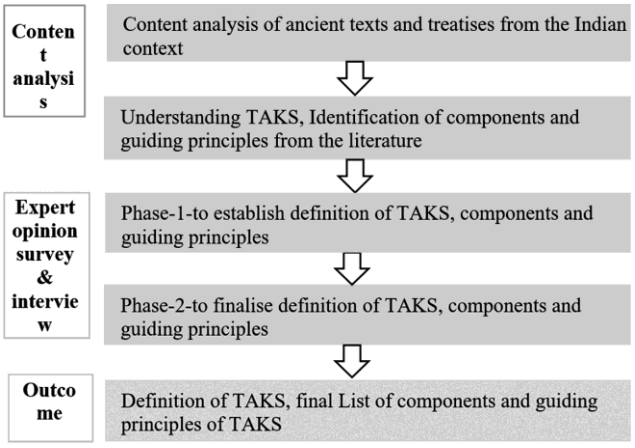

Fig. 1 — Overall methodology

Methodology for the expert opinion survey and interview

A questionnaire for expert opinion surveys and interviews was developed based on the outcomes of the literature analysis. The experts were chosen based on their expertise and contributions to the subject matter. The study was conducted in accordance with ethical guidelines and informed consent was obtained from all participants prior to the survey and interviews. A pre-test was conducted to check the legibility of the questionnaire. Online and offline interviews and surveys were conducted by the selected experts. Figure 3 illustrates the methodology of expert surveys and interviews. The study was conducted in two phases. In the first phase, the questionnaire was designed with two sections: Part 1 contained experts' biographical information and Part 2 contained eight survey questions. After executing the surveys and interviews, the responses were downloaded as Google feedback forms, and the interview data were transcribed. Offline and online data were combined into a data matrix for a detailed analysis. Data analysis was performed based on the responses, resulting in the definition of the TAKS and a list of identified components, guiding principles, and sources of the TAKS.

The phase-2 expert opinion survey and interviews serve as an extension of phase-1. The primary aim was to define TAKS, obtain expert approval, and identify relationships between the components and guiding principles of TAKS. A methodology similar to phase-1 was adopted (Fig. 3). Phase-2 included two queries: determining the relationship between TAKS components and guiding principles and obtaining approval or refinement of the proposed TAKS definition. Like phase-1, this phase was conducted in

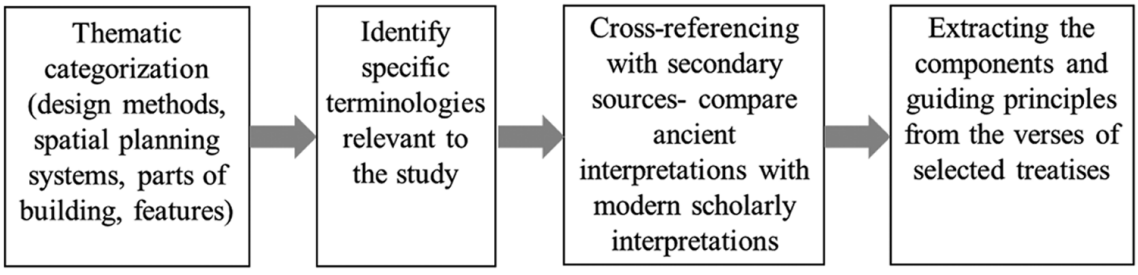

Fig. 2 — Methodology for the content analysis of treatises

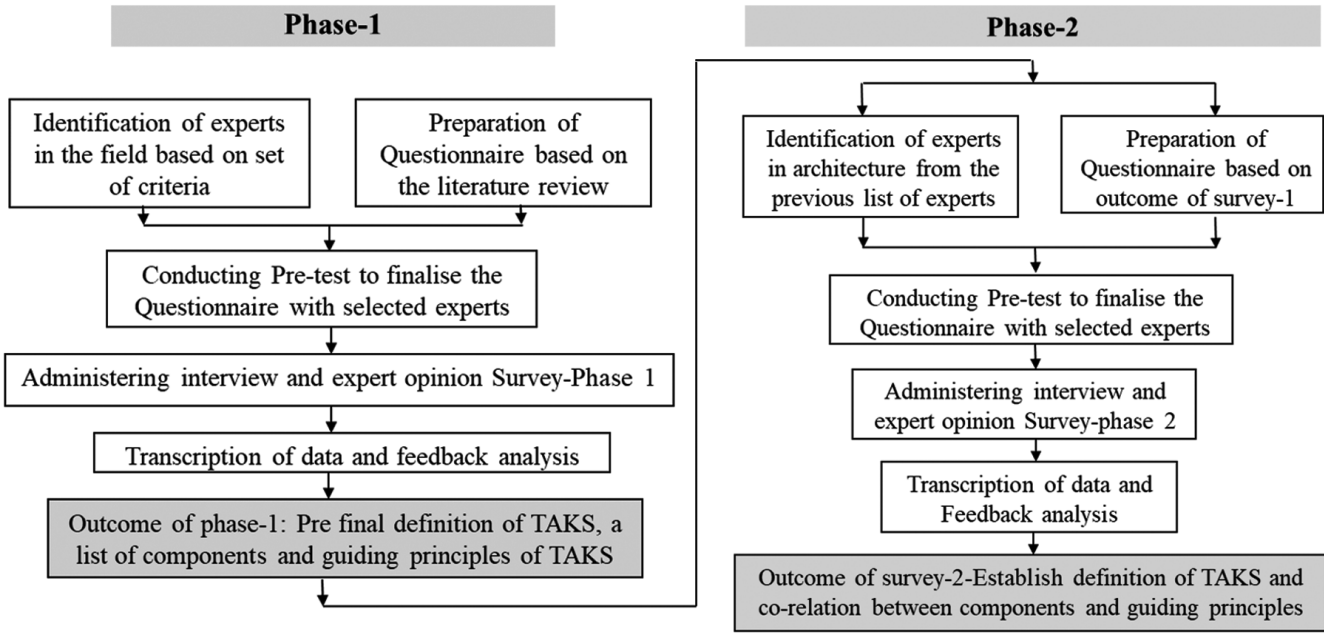

Fig. 3 — Methodology for expert opinion survey & interview

online and offline modes. After the survey, the next steps were to compile data, create a data matrix, and conduct analysis.

Selection of experts

Experts' experience and credentials affect their ability to contribute effectively to the study. The selection criteria included academics who contributed to the TAKS, practitioners who based their work on TAKS, and a minimum of ten years of experience in the domain. A sample size of 30 was chosen, as it raises the confidence interval of the population dataset to justify research conclusions[14]. Therefore, thirty experts were selected for the first phase of the expert opinion survey and interviews, including conservation architects, traditional practitioners, academics, practising architects, Vedic experts, and archaeologists. A judgmental sampling method was adopted for the expert selection. Experts in architecture from the same list were included in Phase 2 of the expert survey and interview because this phase required profound architectural expertise.

Pre-test of the questionnaire

A pre-test of the questionnaire of expert opinion survey phases 1 and 2 was undertaken prior to performing the expert opinion survey to assess the questionnaire's overall legibility so that any modifications, if necessary, could be made. The time taken to complete the expert opinion survey and the difficulty encountered by the respondents were also helpful indicators of how well the respondents understood the concepts behind the questions. The questionnaire for the expert opinion survey was shared with randomly selected experts from the final list of experts and refined questions based on their feedback.

In Phase 1, following the pre-test feedback, the survey description was expanded for clarity, the term ‘influencing factors' of TAKS was revised to 'guiding principles’, and the ranking system was simplified from a numerical order (1 to 8) to three categories: high, medium, and low. In the pre-test of Phase 2 of the expert opinion survey, a summary of phase-1 was included to clarify the process and ensure continuity. The numerical correlation system (1 to 7) was replaced with a tick mark to indicate the correlation, leaving blank for areas that had no correlation. The final questionnaire was refined based on the pretest and is included in the appendix.

Literature review

The design and execution of ancient Indian architecture are connected to profound ecological awareness encoded by the Vedic perspective[15]. UNESCO recognised the Indian Vedic corpus as a rich heritage for preservation. These treatises comprehensively address every aspect of building design and construction, thus forming an inevitable part of the TAKS. From a broad perspective, the content of treatises can be divided into five categories: town

planning; temple architecture; buildings/structures other than temples (including palace complexes, homes, forts, and public buildings); artistic creation (including murals, sculptures, furniture design, and architectural elements); and other issues (selection of building materials and rituals associated with buildings). A thorough analysis of architectural writings revealed that everything from small-scale detail to broad-scale planning concepts was discussed in ancient Indian treatises. This study identified the guiding principles and components of the TAKS and their sources, which will be explained in the following section.

Guiding principles of TAKS from the literary sources

The Cambridge Dictionary defines the 'guiding principle' as an idea with a significant influence on decision making. In this research, the guiding principles of the TAKS were established through a meticulous analysis of Sanskrit texts. This involves translating, interpreting, and contextualizing śloka or verses. The process required grasping the verses' original intent, comparing translations and commentaries, and linking them to architectural practices.

Gomatryaiḥphalapuṣpadugdhatarubhiścāḍhyāsamāprākplavā
Snigdhādhīraravāpradaśriṇajalopetāaśubījodgamā |
Samproktābahupāṃsurakṣayajalātulyācaśītoṣṇayoḥ
Sreṣṭhābhūrādhamāsamuktaviparītāmiśritāmadhyamā ||

This verse from *Manuṣyālayacandrikā*: suggests that land is chosen based on specific criteria, highlighting the significance of understanding climate, geography, and geology.

Sama-sutra-samadasabhavethsarvagrihamśubham|

This verse from *Manasara* on spatial hierarchy and proportions emphasises that symmetry and proportion are essential in creating auspicious architecture that serves as the core of aesthetic principles. In this way, guiding principles of TAKS were extracted based on interpretations of verses in translations of Sanskrit texts such as *Mayamata, Mānasāraśilpaśastra, Bṛhatsaṃhitā, Manuṣyālayacandrikā*:, *SamarāṅgaṇaSūtradhāra*[16-26]. These principles are not explicitly explained in any of the scripts. However, a description of their distinguishing traits assists their recognition. The guiding principles of the TAKS were identified from an extensive literature review as given in Table 1a. An

Table 1 — (a) Guiding principles of TAKS and its key factors

	Guiding principles	Key factors
1	Knowledge of climate	wind flow, solar gain, humidity, precipitation, seasonal variations etc.
2	Knowledge of geography	Earth's surface, environments, and human interactions. covers both physical aspects (landforms, ecology and ecosystems) and human aspects.
3	Knowledge of geology	Earth's structure, materials, processes, rocks, minerals, landforms, soil conditions and groundwater discharge, tectonic movements
4	Knowledge of material resources and method of construction	qualities of building materials, availability, material science, construction techniques
5	Knowledge of socio-cultural aspects	customs, beliefs, ethics, religious thoughts
6	Knowledge of user's needs	requirements of the client.
7	Social systems	caste hierarchy and social stratification – Chaturvarna system
8	Knowledge of economic aspects	financial factors
9	Aesthetics	proportions, measurements, symbolism, detailing and decorations

Table 1 — (b) Components of TAKS and its description

Components		Description
1	*Bhūparikṣā parigrahī*	Investigation and selection of land –Characteristics of land-desirable and undesirable sites.
2	*Kṣetravinyāsaḥ*	fixing boundaries of the plot
3	*Diknirṇāya*	Fixing the orientation of building.
4	*Vāstuvinyāsavidhiḥ*	Analysis of site-determining the cardinal directions, division of plot, vulnerable points
	4.a) vidhivinyāsaḥ	-Zoning using concentric circles.
	4.b.)padavinyāsaḥ	-site dividing into grids.
5	*Vṛkṣavinyāsaḥ*	Selection of trees and position of them in the compound.
6	*Maṇḍalavinyāsaḥ*	Selecting location and fixing buildable area.
7	*Mānabhedayonyadinirṇāya:*	Measurements and proportioning systems.
	7a.) manuṣyapramānaḥ	-Anthropometric study.
8	*śālavidhānam*	Layout and planning of salas (building units).
9	*Gṛhāvayavavidhāya:*	Design and construction of building components.
10	*Kavātabāhyāgehakūpādividhāya:*	Designing and construction of the ancillary structures like well, secondary buildings, gateway, compound wall etc.
11	Dravyānjanā	Characteristics of building materials/material science.

overlap between the attributes of the guiding principles was observed.

Table 2a compares the coverage of various guiding principles across above mentioned treatises. All texts seem to have a comprehensive coverage of all domains, except for knowledge of climate aspects. These texts offer insights into economic aspects, though indirectly, by referencing the social hierarchy, particularly the Chatur Varna system, which is associated with occupation.

Components of TAKS from the literary sources

Verses of treatises were used to identify the components of TAKS concerning residential architecture. 'Component' means a constituent part of a larger whole[27]. In this study, TAKS is the whole, and its constituent parts are 'components'. Table 1b lists the components with terms from ancient texts (Sanskrit) and their descriptions.

Table 2b lists the components of the TAKS concerning residential architecture as outlined in ancient texts. Each row represents a component and each column corresponds to a text. Tick marks (✓) indicate whether a component is addressed in a specific text. By comparing the presence or absence of tick marks across texts for each component, we can discern similarities and differences in their treatment among these texts. From Table 2b, it is clear that *Bhūparikṣāparigrahī, Kṣetravinyāsaḥ, Vāstuvinyāsavidhiḥ, Maṇḍalavinyāsaḥ, Mānabhedayonyadinirṇāya*, and *śālavidhānam* have tick marks across all texts, suggesting that this fundamental aspect is universally covered. These guiding principles and TAKS components must be finalised by conducting a survey and interviews with experts.

Results and Discussion

Through the current survey, feedback was received in both research and practice paradigms. The background information of the experts is shown in (Fig. 4).

The questionnaire began with a query on how experts gained knowledge of TAKS. Three methods were given: oral tradition, gurukul system, and formal education. Oral tradition involves sharing knowledge, cultural beliefs, and stories through spoken words, rather than written texts. For example, in Vishwakarma community, traditional building practices are passed down through hereditary learning and are often communicated *via.*, slokas in the regional language. The Gurukul system is a traditional approach, in which students live with their teachers and acquire design, construction techniques, and sacred principles through practical experience and oral instruction over a specific period. Formal

Table 2 — (a) Guiding principles of TAKS and sources

Guiding Principle \ Texts		Mayamata	Mānasāra śilpaśastra	Bṛhat-saṃhitā	Manuṣyālaya candrikā:	Samarāṅgaṇa Sūtradhāra
Knowledge of	1. Climate	-	-	✓	-	-
	2. Geography	✓	✓	✓	✓	✓
	3.Geology	✓	✓	✓	✓	✓
	4. Material resources	✓	✓	✓	✓	✓
	5. Cultural aspects	✓	✓	✓	✓	✓
	6. Users' needs	✓	✓	✓	✓	✓
	7. Social systems	✓	✓	✓	✓	✓
	8. Economic aspects	✓	✓	✓	✓	✓
	9. Aesthetics``	✓	✓	✓	✓	✓

Table 2 — (b) Identified components of TAKS and sources

Sl no	Component \ Text	Mayamata	Mānasāra śilpaśastra	Bṛhat-saṃhitā	Manuṣyālaya candrikā:	Samarāṅgaṇa Sūtradhāra
1	Bhūparikṣā parigrahī	✓	✓	✓	✓	✓
2	Kṣetravinyāsaḥ	✓	✓	✓	✓	✓
3	Diknirṇāya	✓	✓	-	✓	-
4	Vāstuvinyāsavidhiḥ	✓	✓	✓	✓	✓
5	Vṛkṣavinyāsaḥ	-	✓	✓	✓	-
6	Maṇḍalavinyāsaḥ	✓	✓	✓	✓	✓
7	Mānabhedayonyadinirṇāya:	✓	✓	✓	✓	✓
8	Śālavidhānam	✓	✓	✓	✓	✓
9	Gṛhāvayavavidhāya:	✓	✓	-	✓	✓
10	Kavātabāhyāgehakūpādividhāya:	✓	-	✓	✓	✓
11	Dravyānjanā	✓	✓	✓	✓	-

education refers to any certified program in traditional architecture with a structured curriculum associated with a university. Most experts acquired knowledge through formal education, while others acquired knowledge through multiple modes (Fig. 5a). Piplani[28] identified the sources of TAKS as text, craft skills, and buildings. Literature reviews have also recognised oral traditions as a source. The questionnaire asked experts to rank the TAKS sources by importance in the Indian context. The results are shown in (Fig. 5b). Experts weighted the TAKS sources differently. Of the four sources, 32.1% prioritised craft skills including construction knowledge, processes, and field knowledge. Textual knowledge received 26.8%, and oral traditions received 22.6%. This indicates nearly equal preferences for the four sources. The sub-question aimed to identify other TAKS sources. As the research focused on the physical aspects of the TAKS, responses about folklore, customs, and rituals related to building construction were excluded. The subsequent enquiry aimed to grasp the context-responsiveness of the TAKS. 90% of the experts viewed TAKS as a context-responsive method (Fig 5c).

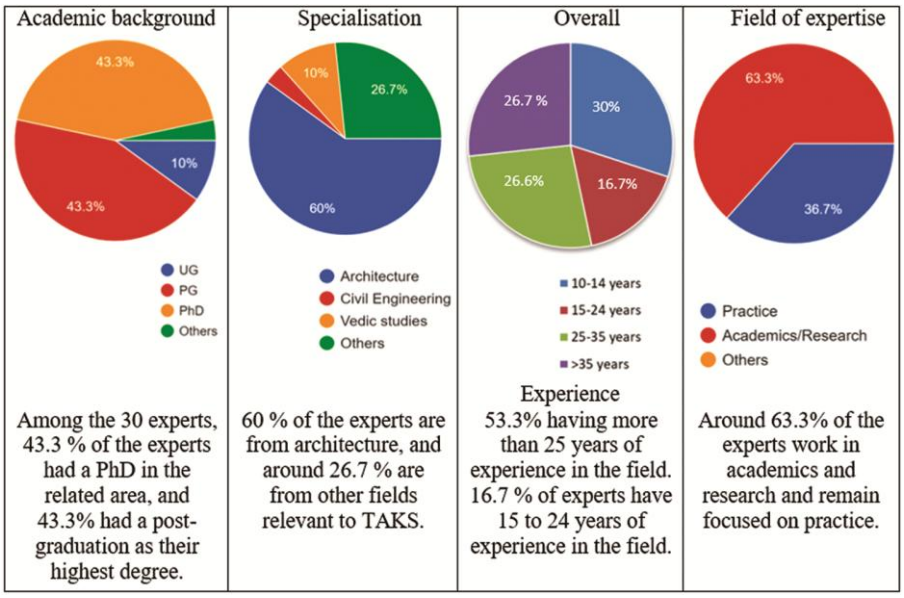

Fig. 4 — Background of the chosen experts

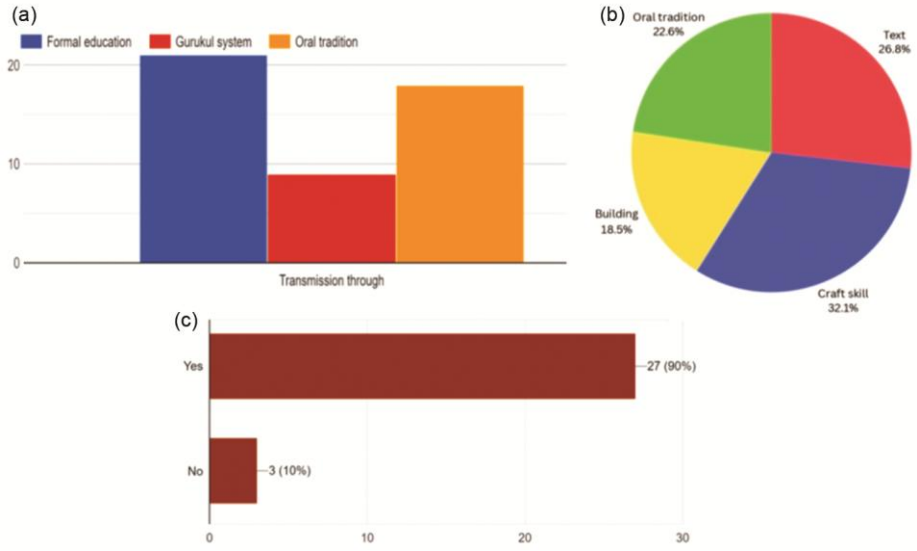

Fig. 5 — (a) Transmission of traditional knowledge, (b) Prioritization provided by experts on sources of TAKS, (c) Context responsiveness of TAKS

One question in the survey ranked the guiding principles of TAKS according to their importance (high, medium, and low). The percentages of respondents' feedback are presented in Table 3. Over 50% of experts rated climate, geography, geology, material resources, and cultural aspects as 'highly important', with none assigning low importance to these aspects. More than 50% of experts rated economic factors, user demands, and aesthetics as having 'medium importance.' Compared to other principles, 60% of experts rated social systems as 'less important. 'Experts suggest that geology and geography are interconnected, with geology focusing on the Earth's structure and geography on its surface. This connection led to their consideration as a single guiding principle for understanding Earth. The social system categorises people into four varnas (Chaturvarna), determined by qualities (guna) and actions (karma), and not birth. Social hierarchies were relevant in ancient times but have little significance today. Consequently, social systems were removed from the list and geology was combined with geography, resulting in seven guiding principles.

The components of TAKS identified from the extensive literature review are listed in Table 1b. The task was to determine whether any component needed to be added or removed. According to the comments, all of the suggested components are valid and should remain. Some experts have suggested adding Jīrṇoddhār- maintenance, repairs, and renovation of buildings, which will be included. One question was to define TAKS by analysing the aforementioned concepts using experts' expertise. The proposed definitions of the experts were thoroughly analysed. Keywords from each definition were selected and similar keywords were arranged in rows, resulting in a tabular format with different subsets. This is illustrated in Table 4.

Table 3 — Guiding principles and order of importance from phase-1 of expert opinion survey

Knowledge of	Guiding principle	Order of importance (in percentage %)		
		High	Medium	Low
	1. Climate	86.66	13.33	0
	2. Geography	83.33	16.66	0
	3. Geology	70	30	0
	4. Material resources	63.33	36.66	0
	5. Cultural aspects	56.66	43.33	0
	6. User needs	40	56.66	3.33
	7. Social system	16	24	60
	8. Economic aspects	40	53.33	6.66
	9. Aesthetic sensibility	40	56.66	3.33

Table 4 — Occurrence of keywords from definitions

Category of Key words	Keywords from the definition of TAKS proposed by experts																								
Science/ Knowledge	shastra (science)	science	science	Indian knowledge system	collection of knowledge	knowledge development	knowledge	knowledge or craft	Inevitable system	Holistic concept	Collective knowledge	knowledge													
Engineering & practice	Building construction	architecture	architecture	architecture	Construction systems	Building construction	Building construction	practice	maintenance & restoration	practices	Engineering & technology	Design, construction methodology	engineering	Building bylaws											
Craftsmanship	skill	physical	physical	technique	skill	material	materials	technological	craftsmanship	technological	tools & techniques														
Transfer of Knowledge	Generation to generation	Transferred from generation	Generational knowledge	generation	hereditary	generation																			
Textual & oral traditions	ancient treatises	texts	ancient scientific texts	oral	oral traditions	texts	textual traditions																		
Time	time	muhurta	time	astronomy	time or muhurta	time	astronomy																		
Environmental context	nature	space	Climate	environment	environment	region	context	land	ecology	energy	energy systems	context specific	nature	eco-friendly											
Society	society	people	life	component of life	people	community	human activities	culture	client specific	comfort	users' needs	society													
Beliefs	panjabhoota	spiritual	Spiritual pursuits	Panjabootakalpana	spiritual dimensions	religious beliefs	astrology	beliefs	Inner balance or antaranga shanti	Shakti pramana tradition															
Evolving and adapting	time tested design	past	vernacular traditions	history	adapting	heritage	evolving	historic	identity																
Sustainability	sustainability	Sustainable solutions	sustainable																						

The frequency of keywords from the TAKS definition provided by experts in the survey was analysed multiple times. The next stage was to generate a TAKS definition by incorporating relevant primary keywords from experts' suggestions. The coined definition was sent again to the same experts for review in phase-2 of the expert opinion survey. Some mentioned it should be shortened due to length. Hence, it was refined by incorporating expert feedback and judgment, resulting in the final definition of TAKS.

The Traditional Architectural Knowledge Systems refers to the collective knowledge, practices, and beliefs in architecture which is available in ancient texts, historical buildings, traditional craftsmanship and oral tradition of a particular region, evolved over a period based on the context within which it exists.

Although there is no precise definition for this term, the definition proposed in this study can be applied in future research worldwide. The final question asked for suggestions and remarks on the study area. Most experts expressed concerns about the younger generation's lack of knowledge and ignorance of TAKS in formal education. They also noted that misinterpretation and reckless actions by some TAKS practitioners were misleading societies and harming ancient wisdom. According to them, Shastras (science) guides architects in practice, yet changes must be made when necessary. Expert interactions clarified many facts regarding the study area. The outcomes of the expert opinion survey and interview-phase-1 are given below,

- Using a methodical approach and experts' recommendations, TAKS was defined.
- The sources were confined to text (written knowledge), craft skills (construction methods and techniques), buildings, and oral traditions.
- Among the nine guiding principles put forward, experts suggested that geology can be combined with geography, and social systems were important in the past, although they are not very relevant in modern society. Thus, geology was combined with geography and social systems were eliminated from the list, leaving a list of seven guiding principles.
- The ranking of the guiding principles clarified their order of importance in design and construction.
- The identified 11 components in the TAKS concerning residential architecture were approved by experts, and Jīrṇoddhār (maintenance, repairs, and renovation of buildings) was included in the list of components.
- 90% of experts strongly agreed that TAKS is a context-responsive solution.

The outcomes from the phase-2 of the Expert Opinion Survey and interview are,

- Final definition of the Traditional Architectural Knowledge System (TAKS).
- Final list of TAKS components concerning residential architecture.
- The final list of guiding principles aids in the design and construction of built environments.
- The relation between identified components and guiding principles of the TAKS.

Relationship between components and guiding principles of TAKS

The relationship between the TAKS components and guiding principles was analysed. Table 5 presents the correlation between the guiding principles and the

Table 5 — Relation between guiding principles and components

Component	Guiding principles Knowledge of 1. Climate	2. Geography & geology	3. Material resources	4. Socio Cultural aspects	5. User's needs	6. Economic aspects	7. Aesthetic sensibility
1. *Bhūparikṣā parigrahī*	80	100	50	50	30	60	20
2. *Kṣetravinyāsaḥ*	10	100	20	40	50	30	20
3. *Diknirṇāya*	90	80	00	70	70	20	50
4. *Vāstuvinyāsavidhiḥ*	80	90	20	70	70	40	70
5. *Vṛkṣavinyāsaḥ*	90	90	10	70	40	30	60
6. *Maṇḍalavinyāsaḥ*	60	70	50	50	70	60	60
7. *Mānabhedayonyadinirṇāya*	30	10	60	70	60	80	90
8. *Sālavidhānam*	80	40	60	90	80	70	50
9. *Gṛhāvayavavidhāya*	60	30	80	50	40	80	80
10. *Kavātabāhyāgehakūpādividhāya:*	60	80	60	70	70	80	60
11. *Dravyā njanā*	50	30	100	20	20	70	60
12. *Jīrṇoddhār*	70	60	90	70	50	80	70

components which are listed in columns and rows. Experts ticked boxes for correlated principles and components, leaving the others empty. Multiple selections were allowed. The data were reviewed and analysed, and expert responses are presented as percentages (%) in Table 5.

Different TAKS components demonstrate varying strengths across the guiding principles. *Bhūparikṣā* parigrahī and *Kṣetravinyāsaḥ* show strong environmental and geographical understanding but lack in material resources and aesthetic sensibility. *Diknirṇāya* excels in climate and geological knowledge while integrating cultural and economic user needs, despite poor material resource use. *Vāstuvinyāsavidhiḥ* and *Vṛkṣavinyāsaḥ* perform exceptionally in geography, geology, and climate, yet are weak in material aspects. *Maṇḍalavinyāsaḥ* maintains moderate performance with attention to geography and user needs, while *Mānabhedayonyadinirṇāya* emphasizes aesthetic sensibility. *Śālavidhānam* stands out for sociocultural, climatic, and user-centric performance. *Gṛhāvayavavidhāya* is not ably influenced by material, economic, and aesthetic factors, while *Kavātabāhyāgehakūpādividhāya* provides sound geological, geographical, and economic insights. *Dravyānjanā* prioritises material knowledge and cost efficiency, and *Jīrṇoddhār* emphasises balanced performance in material, climate, sociocultural, economic, and aesthetic dimensions. Overall, each component contributes uniquely, reflecting a composite understanding of traditional architectural wisdom.

Application of TAKS in the contemporary scenario

The guiding principles and components of TAKS can be practically adopted in contemporary residential design by integrating their core ideas into modern architectural practices through contextual adaptation. For instance, *Bhūparikṣāparigrahī* can guide site selection based on environmental suitability, while *Diknirṇāya* and *Vāstuvinyāsavidhiḥ* can help optimise orientation and zoning for climate responsiveness and energy efficiency. Incorporating *Vṛkṣavinyāsaḥ* fosters biodiversity and thermal comfort through strategic landscaping. Human-centric proportions (manuṣyapramāṇaḥ) can be reintroduced through customised spatial planning to enhance user comfort. Principles related to materials (*Dravyānjanā*) and construction methods promote the use of locally available sustainable resources. Integrating *śālavidhānam* and *Gṛhāvayavavidhāya* supports modular, flexible design layouts suited to evolving family needs. Ancillary elements, such as wells and courtyards (*Kavātabāhyāgehakūpādividhāya*), can be reimagined as community spaces or water management systems. Furthermore, grounding designs in ecological, socio-cultural contexts, and aesthetics enrich the spatial experience, ensuring sustainability and relevance in today's world.

Conclusions

This research paper aims to define Traditional Architectural Knowledge Systems (TAKS) through a systematic approach involving an extensive literature review, expert opinion surveys, and interviews. This study focuses on the TAKS within the context of residential architecture in India. By conducting this research, it was identified the guiding principles and components of TAKS, shedding light on its relevance in contemporary architectural discourse. Through the expert opinion survey and interview process, a comprehensive understanding of TAKS emerged. The definition of TAKS was established, which included all pertinent concepts from respondents' definitions. This definition is universally applicable. The identified guiding principles and components of the TAKS provide valuable insights into the factors influencing traditional architectural practices, emphasising the regional aspects of the TAKS. This study also highlights the importance of TAKS as a context-responsive approach tailored to specific environmental, cultural, and historical contexts. Moreover, it underscored the need to preserve and promote TAKS in the face of modernisation and homogenisation, which often overlooks traditional and cultural values.

The definition, guiding principles, components of the TAKS, core theories from the ancient texts established in this study can serve as valuable references for future studies and practices in the field of architecture. By recognising and integrating TAKS into contemporary architectural discourse, architects and researchers can foster a deeper appreciation of traditional knowledge systems and contribute to sustainable and culturally sensitive architectural practices. The goal of future research is to test the recommended guiding principles and components using case studies and field surveys.

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Conflict of Interest

Author declares that there is no conflict of interest.

Author Contributions

A S B designed and executed the research, analysed the findings, and drafted the manuscript. A P K provided guidance throughout the project, whereas C K oversaw the work and reviewed the manuscript. All authors reviewed and approved the final version of the manuscript.

Ethical Approval

This study followed ethical guidelines to ensure the participants' rights, dignity, and privacy. Informed consent was obtained from each participant, who was informed of the study's purpose and procedures. Personal data were anonymised and stored securely.

Data Availability

The authors state that all data supporting the findings of the study are included within the article itself and may be made available by corresponding author upon reasonable request.

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