Spatial Distribution of Building Materials in Rural House Construction in Haryana

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Abstract

Housing is one of the most fundamental indicators of human well-being, and the materials used to build a house reveal, more clearly than almost any other single variable, the interplay of environment, economy, and culture in a region. This paper examines the spatial distribution of building materials used for the floor, wall, and roof of rural houses in Haryana, drawing on Census of India (2011) House Listing and Housing Census data for twenty-one districts and a primary field survey of 600 sample households in Nuh and Panchkula districts. Percentage analysis and a composite Z-score index were used to measure inter-district variation and disparity in material use. The results show that traditional materials such as mud, unburnt brick, and thatch remained concentrated in the semi-arid western and southern districts of Hisar, Bhiwani, Sirsa, Mahendragarh, and Nuh, while the northern and north-eastern districts of Karnal, Kurukshetra, Panipat, and Ambala, and the National Capital Region-adjoining districts of Gurugram and Faridabad, showed markedly higher use of burnt brick, cement, and reinforced cement concrete (RCC). Burnt brick emerged as the near-universal wall material across the state (87.8 per cent), whereas floor and roof materials displayed much sharper spatial contrasts, with composite disparity indices ranging from 0.61 in Mahendragarh to -0.40 in Fatehabad for floor materials, and from 1.03 in Sonipat to -0.52 in Hisar for wall materials. The field survey corroborated these census-based patterns, showing systematically better housing quality, larger house size, and more durable materials in Panchkula than in Nuh. Both hypotheses of the study, that houses and building materials are unevenly distributed across rural Haryana, were accepted. The paper concludes with policy suggestions for district- and village-specific housing interventions, promotion of low-cost and climate-adapted local materials, and closer convergence between rural housing schemes and basic amenities.

Keywords: Rural housing, Building materials, Haryana, Spatial disparity, Composite index, Census of India, Geography of housing.

1. Introduction

A house is far more than a physical shelter; it is a socio-spatial expression of the environment, economy, and culture of the people who build and inhabit it. The choice of building material for the floor, wall, and roof of a house is shaped simultaneously by the physical setting, such as climate, soil, and the local availability of stone, timber, or clay, and by socio-economic conditions, such as household income, occupation, education, and access to markets. In a geographically and economically diverse state like Haryana, these influences combine to produce marked regional variation in the type of houses and the materials used to build them.

Rural housing in India has traditionally relied on materials that are locally available, inexpensive, and adapted to local climatic conditions, such as mud, thatch, bamboo, and unburnt brick. Over the past few decades, rising rural incomes, the spread of brick kilns and cement industries, improved road connectivity, and government housing schemes such as the Indira Awaas Yojana and the Pradhan Mantri Awaas Yojana-Gramin (PMAY-G) have encouraged a gradual shift toward pucca construction using burnt brick, cement, and reinforced cement concrete (RCC). This transition, however, has not proceeded uniformly across space. Agriculturally prosperous and industrially connected districts have modernised their housing stock faster than drought-prone or economically weaker districts, producing a distinct geography of building materials within the state.

Haryana, formed in 1966 out of the erstwhile Punjab, is administratively divided into districts spread across four broad physiographic tracts, the Shivalik foothills and piedmont plains in the north, the fertile alluvial plains of the centre and east that are part of the Indo-Gangetic system, the semi-arid tracts of the south and south-west bordering Rajasthan, and the sandy plains of the west bordering the Thar margins. This physiographic diversity, combined with sharp inter-district differences in irrigation, industrialisation, and proximity to the National Capital Region, provides an ideal setting for a geographical study of building materials. Despite a fairly large body of research on rural housing in India, comparatively few studies have examined the spatial distribution of construction materials at the district level within a single state using a systematic, map-based, quantitative approach. This paper attempts to fill that gap for Haryana by combining secondary Census data with a primary field survey, and by using a composite index to measure the degree of inter-district disparity in the use of floor, wall, and roof materials.

2. Review of Literature

Research on housing conditions in India has evolved from a largely welfare-oriented concern with the rural poor toward a more geographically and statistically grounded analysis of spatial disparity. Hirway (1987) observed that early village housing programmes under the Five-Year Plans were never accompanied by a comprehensive assessment of housing need, and argued for subsidised construction using local labour and locally available material. Nair et al. (1997), studying rural Kerala, linked persistent slum-like conditions in villages to poverty, weak institutions, and an unfavourable financial framework, while Nayar (1997) demonstrated a positive statistical association between improved housing and better health outcomes, challenging the assumption that medical services alone determine population health.

A second strand of literature examined regional and inter-state disparities using formal indices. Shah and Jaiswal (2002) documented pronounced rural-urban and inter-district inequality in Rajasthan's housing amenities and linked it to slow industrial and agricultural growth. Aderamo and Aina (2011) applied a Z-score technique to social-amenity data in Nigeria, a method later adapted by several Indian housing studies, including the present one, to measure disparity in building materials. Khan et al. (2012) used a comparable composite approach to show that central and eastern Indian states lagged behind northern and western states in housing amenities, while Khan and Hassan (2013) found a declining gradient in housing quality from the coast toward the interior of Odisha.

Studies specific to Haryana and the neighbouring Punjab plains are comparatively limited but instructive. Chandna (2013) assessed housing quality in the Punjab-Haryana region and attributed differences in roof and floor material largely to income, proximity to Delhi and Chandigarh, and socio-cultural background. Wankhede (2012) mapped wall, roof, and floor materials for rural and urban Maharashtra using 2001 Census data, demonstrating that material choice reflects underlying economic and social structure. More recent work has turned to the sustainability and affordability dimensions of building materials: UNDP (2018, 2021) argued that affordable rural housing depends on strengthening the supply chain for local materials and combining traditional knowledge with disaster-resilient technology, while UNESCO (2020) stressed that vernacular practices using local, climate-adapted material are often more sustainable than industrial alternatives. Bansal (2024) and Viñolas (2025) provided technical evidence that stabilised earth and low-carbon wall systems can match the durability of fired brick at a fraction of the embodied energy and cost, and Barbhuiya (2025) showed that simple lime-based retrofitting can substantially extend the life of earthen walls.

Studies focused specifically on Haryana's rural housing and government schemes include NABARD (2022), which identified rising material costs as a major constraint on pucca construction, Rani and Chamar (2024), who documented caste-linked disparities in wall material and sanitation access among Balmiki households, and the Government of Haryana (2024) Statistical Abstract, which recorded sharp district-wise variation in the proportion of pucca houses. Taken together, this body of literature establishes three points that motivate the present study: first, that building material choice is jointly determined by environment, economy, and culture; second, that composite or Z-score indices offer a robust way of summarising multi-variable spatial disparity; and third, that very few studies have applied this approach specifically to the spatial pattern of floor, wall, and roof materials within rural Haryana at the district level. This study addresses that gap.

3. Objectives of the Study

The study is guided by the following objectives:

(1) To examine the spatial distribution of houses in rural areas of Haryana.

(2) To examine the spatial distribution of building materials used in house construction in rural areas of Haryana.

(3) To analyse the reasons for variation in the distribution of houses and building materials in rural areas of Haryana.

(4) To suggest policy measures for improving the quality of rural houses in Haryana.

4. Hypotheses

On the basis of the objectives stated above, the study tests the following hypotheses:

H1: There exists a significant disparity in the spatial distribution of houses in rural areas of Haryana.

H2: There exists a significant disparity in the spatial distribution of building materials used in house construction in rural areas of Haryana.

5. Research Methodology

The study is based on both secondary and primary data. Secondary data on the type of building material used for the floor, wall, and roof of census houses in rural Haryana were obtained from the House Listing and Housing Census, Primary Census Abstract, Census of India (2011a, 2011b), for all twenty-one districts of the state that existed at the time of that Census. Supplementary demographic and socio-economic information, including population, literacy, and levels of urbanisation, was drawn from the same Census, and from successive issues of the Economic Review of Haryana, the Statistical Abstract of Haryana, and government reports on rural housing schemes.

Primary data were collected through a structured household survey covering a purposive sample of 600 households, 300 each from Nuh district, identified from the composite disparity analysis as the district with the least developed housing conditions, and Panchkula district, identified as the district with the most developed housing conditions in terms of concrete roofing and pucca construction. Three large villages were selected from each district (Singar, Sakras, and Ghasera in Nuh; Suketri, Rampur Seori, and Bataur in Panchkula), and information was collected on house size, year of construction, house type, condition, materials used in floor, wall, and roof, and access to basic amenities such as drinking water, kitchen, bathroom, toilet, sewerage, and cattle-shed facilities.

District-wise absolute and percentage figures were tabulated for each category of floor, wall, and roof material. To measure the degree of inter-district disparity, a composite Z-score index was constructed for each material category following the method used by Aderamo and Aina (2011) and Khan et al. (2012). For each material, the district-wise percentage was standardised as $Z = (X_i - \bar{X}) / \sigma$, where X_i is the percentage value for district i, $\bar{X}$ is the mean percentage for the state, and σ is the standard deviation across districts. The composite index for a district was obtained by averaging the standardised Z-scores of all material categories within a group (floor, wall, or roof); positive values indicate above-average reliance on modern or durable materials and negative values indicate above-average reliance on traditional materials, relative to the state mean. Bar diagrams, pie charts, and choropleth maps were prepared using Microsoft Excel and ArcGIS to visualise spatial patterns; the maps reproduced in this paper were originally prepared by the author using Survey of India base maps and Census of India district boundaries.

6. Results and Discussion

6.1 Spatial Distribution of Floor Materials

At the state level, mud remained the single most widely used floor material in rural Haryana in 2011, accounting for 40.6 per cent of census houses, followed by cement (36.2 per cent), burnt brick (15.9 per cent), stone (4.5 per cent), mosaic or floor tiles (2.5 per cent), and wood or bamboo (0.1 per cent). Table 1 presents the full district-wise distribution.

Table 1: Distribution of Materials of Floor in Rural Areas of Haryana, 2011 (Per cent)

District	Mud	Wood/ Bamboo	Burnt Brick	Stone	Cement	Mosaic/ Tiles	Other
Ambala	45.76	0.11	7.19	5.62	39.01	2.12	0.19
Bhiwani	38.54	0.12	7.76	2.84	47.05	3.47	0.22
Faridabad	30.29	0.10	5.51	5.23	56.08	2.46	0.32
Fatehabad	54.36	0.08	17.97	4.81	21.42	1.29	0.07
Gurugram	25.86	0.09	2.98	6.74	58.28	5.62	0.44
Hisar	43.91	0.13	22.82	2.17	29.60	1.30	0.06
Jhajjar	29.04	0.14	19.42	7.00	38.09	6.03	0.29
Jind	32.82	0.14	34.11	3.73	27.67	1.43	0.10
Kaithal	39.98	0.09	24.41	8.50	25.73	1.20	0.09
Karnal	42.64	0.13	17.46	6.65	31.29	1.68	0.15
Kurukshetra	45.70	0.11	12.45	7.03	32.82	1.65	0.24
Mahendragarh	32.57	0.24	0.99	2.44	58.84	4.59	0.32
Nuh	60.03	0.14	3.12	1.51	34.51	0.60	0.10
Palwal	49.12	0.15	5.25	3.12	40.77	1.45	0.15
Panchkula	35.52	0.05	3.45	3.24	55.58	1.89	0.26
Panipat	30.11	0.14	29.07	5.97	33.04	1.55	0.12
Rewari	34.23	0.10	1.94	3.89	52.52	6.98	0.35
Rohtak	27.50	0.12	28.77	4.89	35.20	3.27	0.24
Sirsa	60.51	0.14	19.68	2.24	16.48	0.88	0.06
Sonipat	23.75	0.14	33.56	5.05	35.00	2.29	0.21
Yamunanagar	57.17	0.10	6.36	3.66	31.01	1.56	0.14
Haryana	40.64	0.13	15.91	4.49	36.21	2.45	0.18

Source: Computed from Census of India, House Listing and Housing Census, 2011.

The spatial pattern of mud flooring was strongly associated with semi-arid, less urbanised districts: the highest shares were recorded in Sirsa (60.5 per cent) and Nuh (60.0 per cent), and the lowest in Sonipat (23.8 per cent) and Gurugram (25.9 per cent), a difference of nearly thirty-seven percentage points. Cement flooring showed the opposite pattern, peaking in Mahendragarh (58.8 per cent) and Gurugram (58.3 per cent), districts benefiting respectively from stone-quarrying income and proximity to Delhi, and falling to its lowest level in Sirsa (16.5 per cent). Burnt-brick flooring, an intermediate option in cost terms, was most common in Jind (34.1 per cent) and least common in Mahendragarh (0.99 per cent), reflecting the latter district's early shift directly to cement. Figure 2 maps the spatial pattern of mud flooring across the state, showing a clear west-to-east gradient from higher to lower reliance on this traditional material.

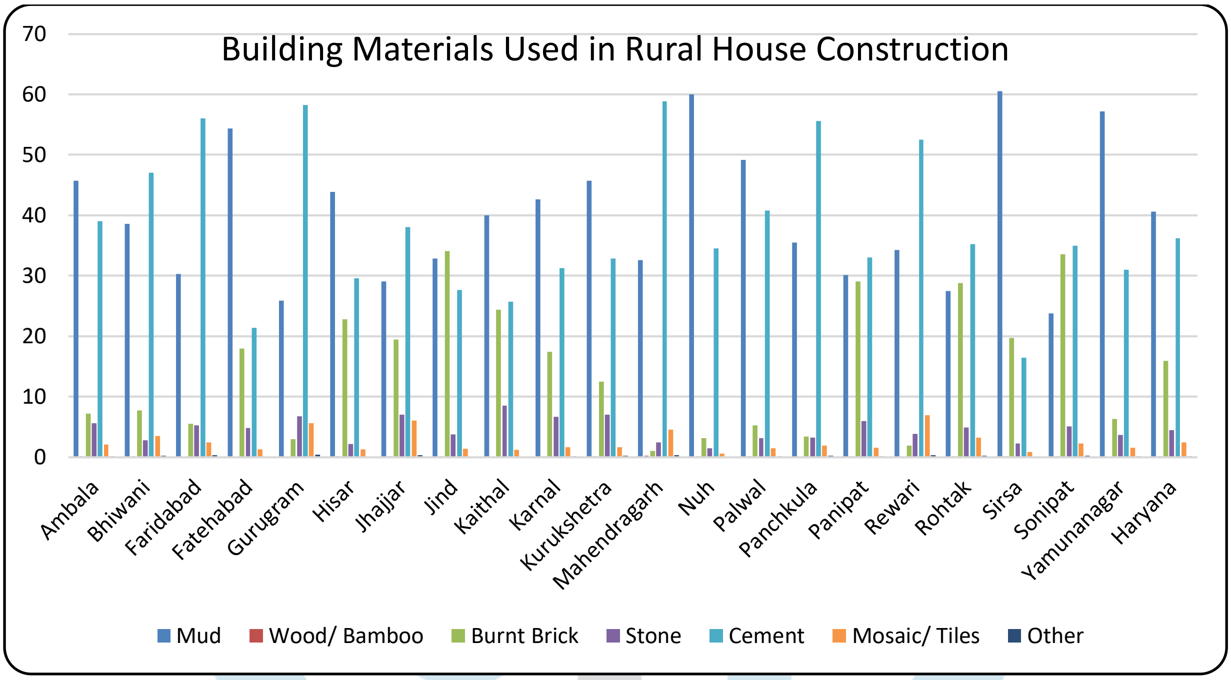

Figure 2: Spatial Pattern of Mud as Material of Floor in Rural Areas of Haryana, 2011

Source: Prepared by the author, based on Census of India, 2011.

6.2 Spatial Distribution of Wall Materials

Burnt brick was overwhelmingly the dominant wall material across rural Haryana, used in 87.8 per cent of census houses at the state level, followed by stone packed with mortar (3.9 per cent), mud or unburnt brick (4.7 per cent), stone not packed with mortar (1.3 per cent), and concrete (1.1 per cent), with all other categories together accounting for less than two per cent. Table 2 gives the complete district-wise picture.

Table 2: Distribution of Materials of Wall in Rural Areas of Haryana, 2011 (Per cent)

District	Grass/ Thatch	Mud/ Unburnt Brick	Stone (no mortar)	Stone (mortar)	Burnt Brick	Concrete	Other
Ambala	1.15	4.27	1.15	2.03	88.01	2.89	0.24
Bhiwani	0.56	4.07	1.06	3.65	89.66	0.57	0.13
Faridabad	0.77	5.58	2.52	5.12	84.69	0.66	0.29
Fatehabad	0.95	5.82	0.57	0.73	90.65	0.96	0.14
Gurugram	0.34	2.92	1.32	4.98	88.67	1.27	0.31
Hisar	0.43	3.73	0.66	0.60	93.32	1.04	0.10
Jhajjar	0.42	2.57	1.55	3.12	90.89	1.14	0.14
Jind	0.81	2.32	0.80	0.72	94.29	0.82	0.11
Kaithal	0.79	5.26	1.28	2.09	88.68	1.57	0.14
Karnal	0.70	3.97	0.97	1.89	90.43	1.65	0.13
Kurukshetra	0.66	3.64	1.17	1.41	90.44	2.34	0.16
Mahendragarh	0.30	2.74	2.75	19.83	73.47	0.27	0.35

Nuh	1.81	12.67	3.74	14.77	66.17	0.20	0.26
Palwal	0.91	5.54	1.50	4.36	86.87	0.26	0.28
Panchkula	0.46	3.49	0.89	1.38	92.52	0.98	0.16
Panipat	0.29	2.24	2.27	11.51	82.55	0.42	0.52
Rewari	0.34	2.68	1.20	2.13	92.67	0.71	0.13
Rohtak	1.45	12.45	0.61	0.41	84.23	0.48	0.15
Sirsa	0.34	2.41	1.05	1.97	93.28	0.64	0.15
Sonipat	1.84	3.00	1.95	7.88	82.41	2.00	0.44
Yamunanagar	2.40	6.15	0.72	0.78	87.59	1.96	0.18
Haryana	0.81	4.66	1.31	3.93	87.83	1.05	0.20

Source: Computed from Census of India, House Listing and Housing Census, 2011.

Even though burnt brick dominated everywhere, its share fell markedly below the state average in Nuh (66.2 per cent) and Mahendragarh (73.5 per cent), where households relied instead on mud or unburnt brick and on stone packed with mortar, materials associated with lower cost and, in Mahendragarh, ready local availability of stone. Stone-packed-with-mortar walls were, in fact, almost exclusively confined to the Aravalli fringe districts of Mahendragarh (19.8 per cent) and Nuh (14.8 per cent), underscoring the influence of local geology on material choice. Figure 3 maps the district-wise pattern of burnt-brick walls, showing that the districts of the north-east and centre, together with most of the National Capital Region periphery, recorded near-universal use of this material, while the Aravalli-fringe south recorded a comparatively lower, though still majority, share.

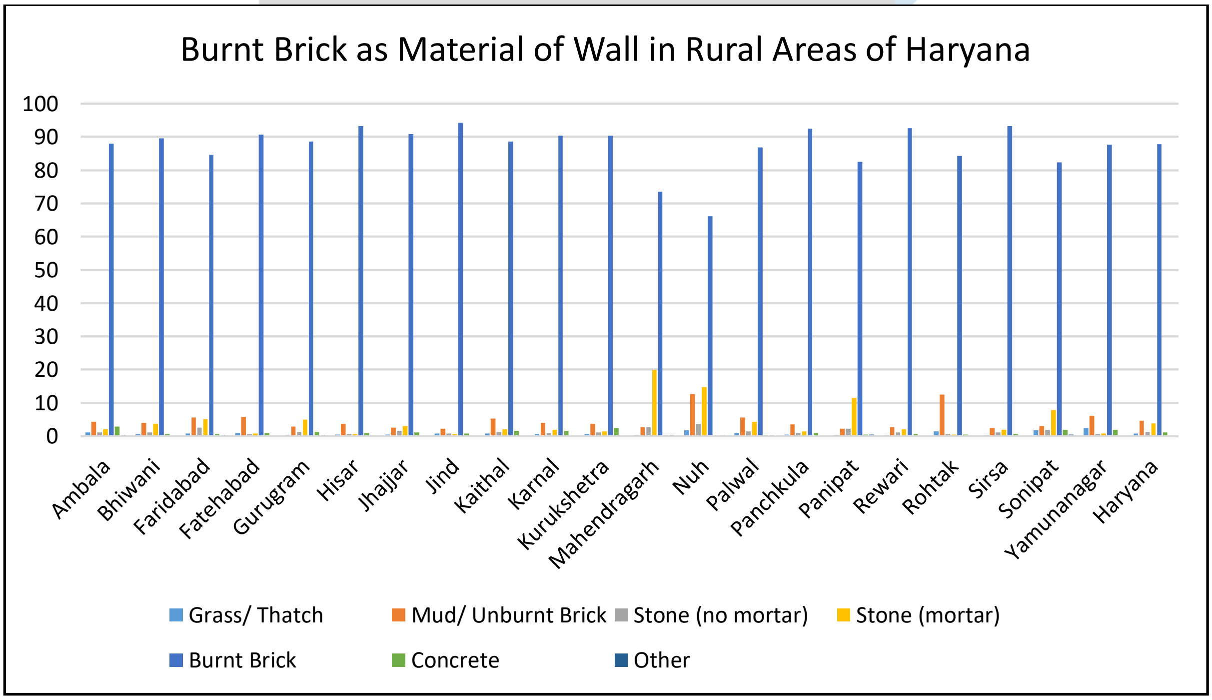

Figure 3: Spatial Pattern of Burnt Brick as Material of Wall in Rural Areas of Haryana, 2011

Source: Prepared by the author using ArcGIS, based on Census of India, 2011.

6.3 Spatial Distribution of Roof Materials

Roof material displayed the greatest degree of spatial variation among the three components of house construction. At the state level, traditional materials, grass, thatch, bamboo, wood, and mud combined, still covered 28.1 per cent of rural census houses, followed closely by concrete (17.6 per cent) and burnt brick (17.6 per cent), with stone or slate roofing accounting for 25.3 per cent, largely on account of its concentration in a small number of districts. Table 3 presents the complete pattern.

Table 3: Distribution of Materials of Roof in Rural Areas of Haryana, 2011 (Per cent)

District	Grass/ Thatch/Mud	Hand-made Tiles	Burnt Brick	Stone/ Slate	G.I./Metal/ Asbestos	Concrete	Other
Ambala	28.33	13.75	8.49	1.25	1.30	42.49	4.02
Bhiwani	24.88	0.68	14.67	45.21	2.95	9.79	1.97
Faridabad	3.92	0.76	7.87	71.39	6.71	8.07	1.00
Fatehabad	34.83	3.57	41.21	2.50	1.35	15.09	1.24
Gurugram	2.35	0.46	6.57	61.00	12.00	16.49	1.15
Hisar	50.11	1.37	24.87	10.44	0.90	11.14	1.33
Jhajjar	12.57	1.28	20.60	55.79	3.53	4.76	1.48
Jind	64.27	3.49	15.29	2.45	0.55	12.50	1.43
Kaithal	58.00	7.38	10.90	1.24	0.58	19.89	2.03
Karnal	29.44	18.68	18.61	1.31	1.15	27.58	3.22
Kurukshetra	30.31	19.78	9.91	1.11	1.08	35.14	2.66
Mahendragarh	4.22	0.23	6.22	65.11	8.17	15.03	1.01
Nuh	18.86	0.42	8.44	59.92	6.49	4.98	0.87
Palwal	6.62	0.41	10.14	71.66	7.83	2.37	0.96
Panchkula	21.59	0.59	4.39	1.29	4.22	66.66	1.26
Panipat	27.81	26.01	21.35	3.87	1.36	15.54	4.06
Rewari	3.75	0.25	5.36	65.39	10.32	13.93	0.99
Rohtak	37.42	3.91	24.94	28.05	0.97	3.14	1.56
Sirsa	23.89	8.66	46.45	1.40	1.31	16.74	1.54
Sonipat	26.80	8.44	29.38	26.34	1.49	5.57	1.98
Yamunanagar	27.46	7.43	4.58	0.98	2.74	55.33	1.48
Haryana	28.14	6.34	17.58	25.34	3.18	17.59	1.83

Source: Computed from Census of India, House Listing and Housing Census, 2011. 'Other' includes plastic/polythene and any other material.

Concrete roofing, the most durable and costly option, was concentrated in Panchkula (66.7 per cent) and Ambala (42.5 per cent), both located in the sub-Shivalik north, whereas it fell below three per cent in Rohtak and Palwal. Stone or slate roofing, drawn from Aravalli quarries, dominated in Palwal (71.7 per cent), Faridabad (71.4 per cent), and Mahendragarh (65.1 per cent). Traditional roofing (grass, thatch, and mud) remained most prevalent in Jind (64.3 per cent) and Kaithal (58.0 per cent), districts with a strong agrarian base but comparatively limited urban and industrial influence. Figure 4 shows the spatial pattern of concrete roofing, highlighting a pronounced concentration in the sub-mountainous northern belt around Panchkula and Ambala.

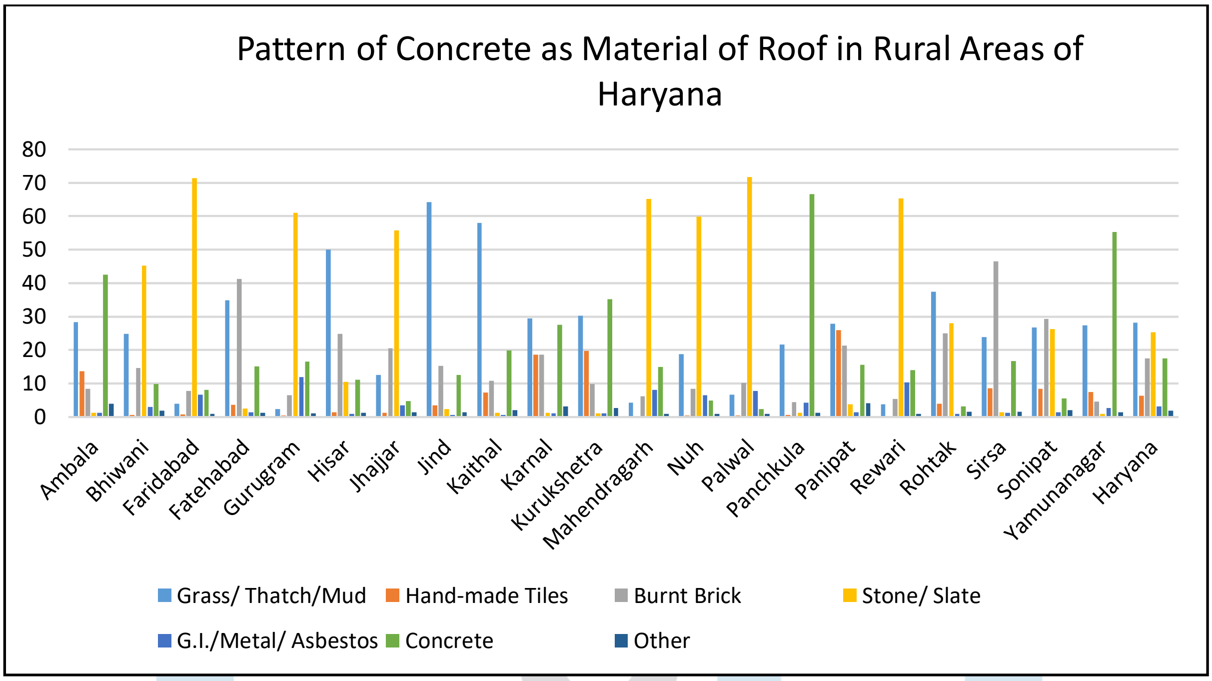

Figure 4: Spatial Pattern of Concrete as Material of Roof in Rural Areas of Haryana

Source: Prepared by the author using ArcGIS, based on Census of India, 2011.

6.4 Inter-District Differentials in Building Materials

The gap between the highest- and lowest-ranked district for each material category provides a straightforward measure of the intensity of spatial disparity. As Table 4 shows, the largest differentials were recorded for materials associated with the traditional-modern transition, cement flooring (a gap of 42.4 percentage points between Mahendragarh and Sirsa), burnt-brick flooring (33.1 points between Jind and Mahendragarh), stone-or-slate roofing (70.7 points between Palwal and Yamunanagar), and concrete roofing (64.3 points between Panchkula and Palwal). By contrast, materials used only marginally anywhere in the state, such as wood or bamboo flooring and plastic or polythene walling, showed differentials of less than one percentage point, since their overall incidence was too low to generate large absolute gaps.

Table 4: Inter-District Differentials in Major Building Materials, 2011

Material	Component	Highest (%)	Lowest (%)	Gap (points)
Floor	Mud	Sirsa (60.51)	Sonipat (23.75)	36.76
Floor	Burnt Brick	Jind (34.11)	Mahendragarh (0.99)	33.12
Floor	Cement	Mahendragarh (58.84)	Sirsa (16.48)	42.36
Wall	Mud/Unburnt Brick	Nuh (12.67)	Panipat (2.24)	10.43
Wall	Stone (mortar)	Mahendragarh (19.83)	Rohtak (0.41)	19.42
Wall	Burnt Brick	Jind (94.29)	Nuh (66.17)	28.11
Roof	Grass/Thatch/Mud	Jind (64.27)	Gurugram (2.35)	61.92
Roof	Stone/Slate	Palwal (71.66)	Yamunanagar (0.98)	70.68
Roof	Concrete	Panchkula (66.66)	Palwal (2.37)	64.29

Source: Computed from Census of India, House Listing and Housing Census, 2011.

6.5 Composite Disparity Index of Building Materials

To summarise the multi-material pattern into a single comparable measure, a composite Z-score index was computed separately for floor, wall, and roof materials for each district (see Research Methodology). Table 5 presents the resulting composite indices. A positive value indicates a district's above-average reliance on modern or durable materials relative to the state mean, while a negative value indicates above-average reliance on traditional materials.

Table 5: Composite Disparity Index of Floor, Wall and Roof Materials by District, 2011

District	Floor Index	Wall Index	Roof Index
Ambala	-0.02	0.30	0.56
Bhiwani	-0.01	-0.19	0.05
Faridabad	0.10	0.39	-0.15
Fatehabad	-0.40	-0.27	-0.08
Gurugram	0.52	-0.03	-0.09
Hisar	-0.38	-0.52	-0.20
Jhajjar	0.58	-0.29	-0.07
Jind	-0.18	-0.46	-0.08
Kaithal	-0.10	-0.14	0.05
Karnal	0.04	-0.10	0.38
Kurukshetra	0.12	-0.09	0.26
Mahendragarh	0.61	0.31	-0.17
Nuh	-0.38	0.85	-0.24
Palwal	-0.12	0.10	-0.18
Panchkula	-0.33	-0.43	0.20
Panipat	0.01	0.28	0.39
Rewari	0.36	-0.44	-0.11
Rohtak	0.14	0.00	-0.21
Sirsa	-0.33	-0.44	-0.03
Sonipat	0.11	1.03	-0.09
Yamunanagar	-0.30	0.23	-0.18
Haryana	-0.01	-0.07	0.00

Source: Computed by the author, based on Tables 1–3 (Census of India, 2011).

For floor materials, the highest positive disparities were recorded in Mahendragarh (0.61) and Jhajjar (0.58), on account of the widespread use of cement and mosaic tiles, while Fatehabad (-0.40) and Hisar (-0.38) recorded the lowest values, reflecting continued dependence on mud flooring. For wall materials, Sonipat (1.03) and Nuh (0.85) recorded the highest indices, though for different reasons, Sonipat through a relatively higher, though still modest, use of concrete and G.I./metal-sheet walling, and Nuh through a comparatively high share of stone-packed-with-mortar and mud construction relative to other districts; Hisar (-0.52) and Jind (-0.46) recorded the lowest values because of their overwhelming, almost uniform, dependence on burnt brick alone. For roof materials, Ambala (0.56), Panipat (0.39), and Karnal (0.38) recorded the highest indices due to greater use of concrete and machine-made tiles, while Rohtak (-0.21) and Nuh (-0.24) recorded the lowest, reflecting continued dependence on traditional and stone roofing.

Table 6: Summary of Disparity in Building Materials Used in Rural Haryana, 2011

Material	Highest disparity districts	Lowest disparity districts	State average
Floor	Mahendragarh (0.61), Jhajjar (0.58)	Fatehabad (-0.40), Hisar (-0.38)	-0.01
Wall	Sonipat (1.03), Nuh (0.85)	Hisar (-0.52), Jind (-0.46)	-0.07
Roof	Ambala (0.56), Panipat (0.39), Karnal (0.38)	Rohtak (-0.21), Nuh (-0.24)	0.00

Source: Prepared by the author, based on Table 5.

Although the state-level averages appear small (floor -0.01, wall -0.07, roof 0.00), this is a statistical artefact of the index construction rather than evidence of spatial uniformity: the district-level extremes reported in Tables 5 and 6 confirm that considerable disparity exists locally, even though it partly cancels out when averaged across the state. This finding provides clear statistical support for Hypothesis.

6.6 Field Survey Findings: Nuh and Panchkula

The primary field survey of 600 households in Nuh and Panchkula corroborated the Census-based composite index results. The average area of the sampled houses was 163.2 square yards in Nuh compared with 239.0 square yards in Panchkula, and the proportion of houses with a lawn or open area was substantially higher in Panchkula (265 of 300 households) than in Nuh (177 of 300 households), as shown in Table 7.

Table 7: Average Area of House and Lawn/Open Area in Sample Villages, 2025

District	Average House Area (sq. yd.)	Houses with Lawn/Open Area	Average Lawn Area (sq. yd., if available)
Nuh	163.21	177	72.04
Panchkula	238.97	265	104.66
Combined	200.50	442	91.59

Source: Primary field survey conducted *by the author, 2025.*

Table 8 summarises the materials actually reported by sampled households for the floor, wall, and roof of their houses. Cement and mosaic/tiled flooring together accounted for 73.3 per cent of sampled houses, considerably higher than the corresponding Census-based state average, which reflects both a decade and a half of housing improvement since 2011 and the deliberate oversampling of a more developed district (Panchkula). Burnt brick again dominated wall material in both districts, though its share was distinctly higher in Panchkula (90.7 per cent) than in Nuh (69.3 per cent), where stone-packed-with-mortar and mud/unburnt-brick walls retained a combined share of over twenty per cent. Roof material showed the sharpest contrast of all: stone/slate roofing remained dominant in Nuh (60.7 per cent) while concrete roofing dominated in Panchkula (42.7 per cent), reproducing at the household level exactly the pattern already identified through the composite index at the district level.

Table 8: Materials Used in Floor, Wall and Roof of Sampled Houses, 2025 (Per cent)

Component	Material	Nuh (%)	Panchkula (%)	Combined (%)
Floor	Mud	17.33	11.00	14.17
Floor	Burnt Brick	6.67	8.33	7.50
Floor	Stone	3.67	6.00	4.83
Floor	Cement	37.33	24.33	30.83
Floor	Mosaic/Tiles	34.67	50.34	42.50
Wall	Mud/Unburnt Brick	10.67	5.33	8.00
Wall	Stone (mortar)	13.67	1.00	7.33
Wall	Burnt Brick	69.33	90.66	80.00
Wall	Concrete	0.67	0.00	0.33
Roof	Grass/Thatch/Mud	11.67	1.00	6.33
Roof	Burnt Brick	11.33	8.67	10.00
Roof	Stone/Slate	60.67	45.33	53.00
Roof	Concrete	7.33	42.66	25.00

Source: Primary field survey conducted by the author, 2025.

7. Conclusion

This paper set out to examine the spatial distribution of building materials used in rural house construction in Haryana and to identify the extent and nature of inter-district disparity. Both objectives were met, and both hypotheses were accepted. Census-based percentage analysis and a composite Z-score index show that floor, wall, and roof materials each display a distinct and interpretable spatial pattern: mud flooring, mud or unburnt brick walling, and traditional or stone roofing remain concentrated in the semi-arid south and south-west, including Sirsa, Mahendragarh, and Nuh, while cement flooring, burnt-brick and concrete walling, and concrete roofing are concentrated in the sub-Shivalik north and the National Capital Region periphery, including Panchkula, Ambala, and Gurugram. Burnt brick has become the almost universal wall material across the state, which somewhat masks the persistence of substantial disparity in floor and, especially, roof materials, where the gap between the best- and worst-performing districts exceeded sixty percentage points.

The primary field survey of Nuh and Panchkula reinforced these Census-based conclusions at the household level, showing that houses in the lagging district were, on average, smaller, less likely to have open or lawn space, and considerably more dependent on stone and mud materials than houses in the leading district. The disparities identified in this study are not simply a function of aggregate district wealth; they also reflect the local availability of raw material (notably Aravalli stone in Mahendragarh, Nuh, and Rewari), physiographic setting, proximity to brick kilns and cement markets, and the differential reach of government housing schemes. The study thus confirms that the geography of building materials in rural Haryana is best understood as the outcome of an interaction between physical environment, resource endowment, and socio-economic development, rather than any single factor acting alone.

8. Policy Implications

On the basis of the above findings, the following policy measures are suggested for improving the quality of rural housing in Haryana:

1. District- and village-specific targeting: Because disparity is concentrated at the district and even village level rather than being evenly spread, housing schemes such as PMAY-G should prioritise micro-level (block or village) diagnostics in identified lagging districts such as Nuh, Fatehabad, Hisar, and Mahendragarh, rather than relying solely on state- or district-wide averages that can mask local deprivation.

2. Promotion of low-cost, climate-adapted local materials: Where traditional materials such as mud and stabilised earth remain in use for genuine reasons of cost, climate suitability, and resource availability, policy should support their qualitative improvement, for example through lime-based stabilisation and simple retrofitting, rather than treating their replacement by cement or brick as the only marker of housing progress.

3. Strengthening the local building-material supply chain: Given the strong association between proximity to brick kilns, cement markets, and quarries and the modernisation of building materials, investment in rural material hubs, transport connectivity, and skill training for masons in materially disadvantaged districts would help narrow the observed disparities.

4. Convergence of housing schemes with basic amenities: The field survey found those Nuh households lagging not only in construction material but also in drinking-water access, sewerage, and bathroom facilities; housing schemes should therefore be more closely converged with water-supply, sanitation, and electrification programmes rather than treated as a stand-alone intervention.

5. Support for cleaner brick-kiln technology: Since burnt brick remains the dominant wall material practically everywhere in the state, transitioning kilns to cleaner and more fuel-efficient technologies would simultaneously reduce environmental and health costs while sustaining the supply of the state's most-used building material.

6. Periodic, geography-aware monitoring: Housing indicators should be periodically re-mapped at the district level, using the type of composite index approach applied in this study, to track whether disparities are narrowing over time and to redirect scheme resources toward districts and villages that continue to lag behind.

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