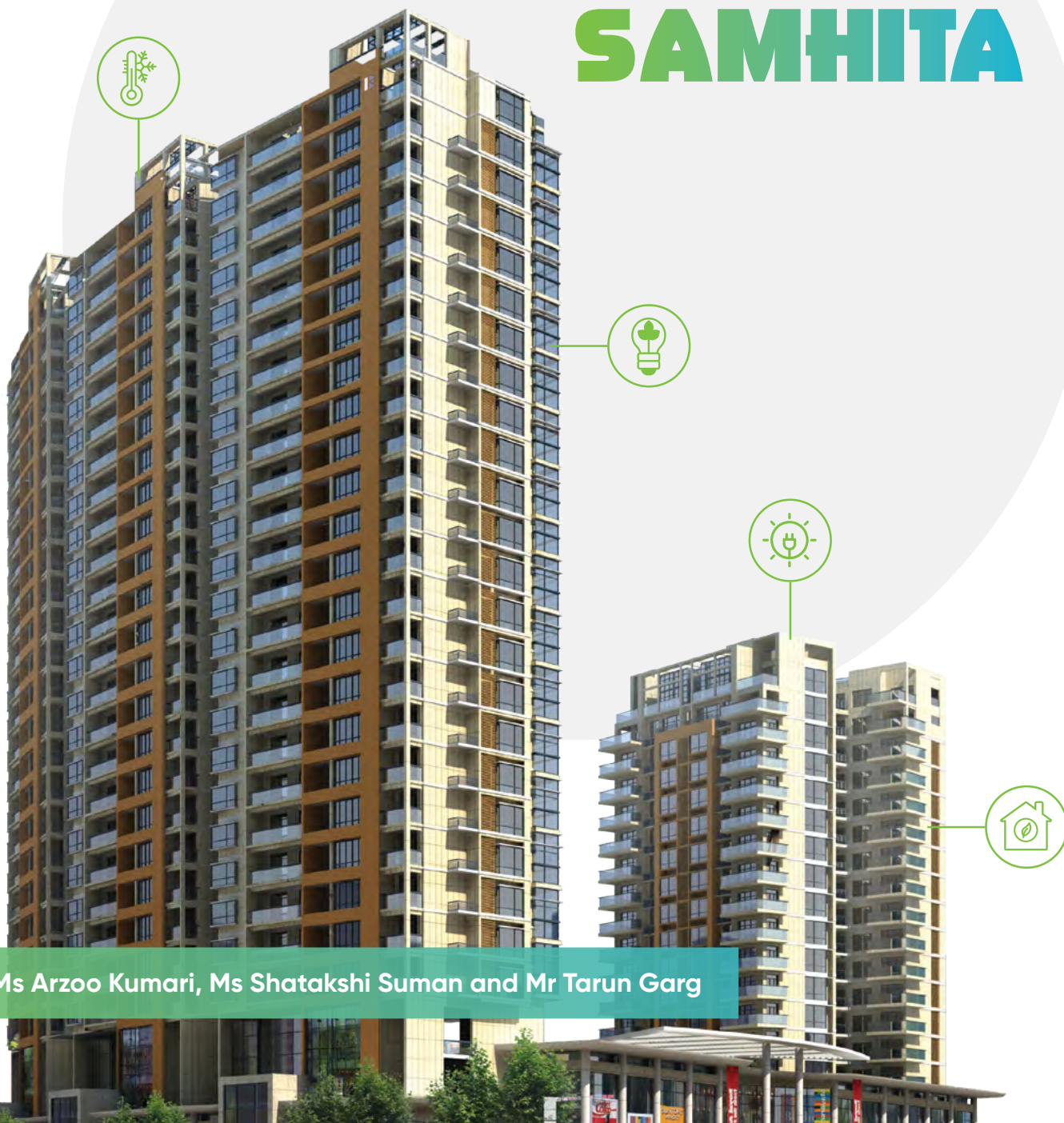# SUBSTANTIATING THE SCOPE OF CODE ECO-NIWAS SAMHITA

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NOVEMBER 2021

SUBSTANTIATING THE
SCOPE OF CODE

ECO-NIWAS SAMHITA

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List of Acronyms

AHJ	Authority Having Jurisdiction
AHP	Affordable Housing in Partnership
ARHCs	Affordable Rental Housing Complexes
BEE	Bureau of Energy Efficiency
BIS	Bureau of Indian Standards
BLC	Beneficiary-led Construction
CLSS	Credit Linked Subsidy Scheme
ENS	Eco-Niwas Samhita
ISSR	In-Situ Slum Redevelopment
MoHUA	Ministry of Housing and Urban Affairs
PMAY	Pradhan Mantri Awas Yojana
PMAY-U	Pradhan Mantri Awas Yojana - Urban
ULB	Urban Local Bodie

Glossary
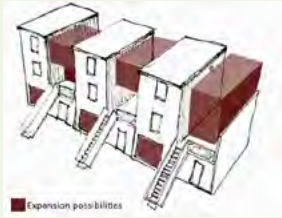
Corporation zones: Zones means the area determined by the ULB to plan for facilities and governance.

Floor Area Ratio (FAR)/ Floor Space Index (FSI): FAR or FSI is the ratio of a building's cumulative floor area to the area of the land upon which it is constructed.

Gentrification of plots: Amalgamation of two or more plots to make it one.

Land Parcels: The land parcel is a plot boundary constructed from legal descriptions on survey maps and shown on tax maps.

Housing Typologies:

Typology	Visual Representation	Description
Cluster Court Housing[1]		Separate tenements use the building, each consisting of a single room or two with joint sanitary arrangements.
Group Housing[2]		A building where more than two dwelling units have common service facilities and joint ownership of land
Incremental housing[3]		The residential building where the owner gradually appends the construction area according to the availability of materials, funding, time, and others.
Plotted Housing[4]		A row of housing with a common wall and only front or rear open space.
Row Housing[5]		Detached housing with two or more sides having open spaces.

1.   Collective Research Initiatives Trust. (2007). Housing Typologies in Mumbai. Mumbai: CRIT.
2.   Administrator of U.T. Chandigarh. (2021). Chandigarh Master Plan- 2031. Retrieved from Chandigarh Administration: http://chandigarh.gov.in/cmp2031/housing.pdf.
3.   https://www.researchgate.net/figure/The-incremental-housing-methodology-in-the-Quinta-Monroy-project-by-architect-Alejandro_fig4_351594155
4.   Administrator of U.T. Chandigarh. (2021). Chandigarh Master Plan- 2031. Retrieved from Chandigarh Administration: http://chandigarh.gov.in/cmp2031/housing.pdf.
5.   Administrator of U.T. Chandigarh. (2021). Chandigarh Master Plan- 2031. Retrieved from Chandigarh Administration: http://chandigarh.gov.in/cmp2031/housing.pdf.

With an urbanisation rate of 31.41%, India's present urban population is 377 million, projected to reach 590 million by 2030.

As per a study conducted by AEEE, the Indian residential sector floor space will potentially grow from **15.3 billion m^2 in 2017-18 to 21.9 billion m^2 by 2027.**

01

Introduction

With an urbanisation rate of 31.41%, India's present urban population is 377 million, projected to reach 590 million by 2030[6]. This projected growth in the urban population set for an embryonic surge in affordable housing market demand. As per a study conducted by AEEE, the Indian residential sector floor space will potentially grow from 15.3 billion m2 in 2017-18 to 21.9 billion m2 by 2027[7]. The urban housing shortage in India was identified by a technical group formulated by the Ministry of Housing and poverty alleviation, which estimated a deficit of 18.78 million housing in urban India in 2012[8].

6. MoHUA, 2019. Handbook of Urban Statistics, New Delhi: Government of India Press: http://mohua.gov.in/pdf/5c80e2225a124Handbook 20of 20Urban 20Statistics 20 2019.pdf
7. Kachhawa, S., Kumar, S., & Singh, M. (2019). Decoding India's residential building stock characteristics to enable effective energy efficiency policies and programs. eceee
8. Ministry of Housing & Urban Poverty Alleviation, Government of India. (2012-17). Report of the Technical Group on Urban Housing Shortage (TG-12) (2012-17). Retrieved from Smartnet: https:// smartnet.niua.org/content/e4cad814-ff8d-497b-a5cc-74db29abe318

Addressing this large quantum of housing deficit, the government of India launched Pradhan Mantri Awas Yojana- Urban (PMAY-U) scheme in 2015. Up till now, 5.02 million houses have been constructed and delivered to beneficiaries under the PMAY-U scheme[9].

The upcoming building stock provides us with an opportunity to ensure sustainable and comfortable living conditions, incorporate strategies and interventions to optimise building design and efficient resource consumption over the lifecycle of a building which is estimated to be a minimum of 40-60 years. Recognising a massive potential for energy savings in the new construction of residential buildings, the Bureau of Energy Efficiency launched the Residential Energy Conservation Building Code in 2018, Eco Niwas Samhita (ENS), to enhance thermal performance and reduce energy consumption.

The Residential Energy Conservation Building code, or Eco Niwas Samhita (ENS), has been developed by BEE to set standards to limit heat gain and loss and ensure adequate natural ventilation and daylighting potential. ENS launched in two parts where ENS 2018 (Part 1) sets minimum standards for building envelope designs for energy-efficient residential buildings. Part 2 of the code launched by the Bureau as Eco Niwas Samhita 2021 (ENS 2021) focuses on the building's code compliance and electromechanical systems. ENS applies to "Residential buildings" with plot area ≥ 500m2 and "Residential part of Mixed-land use building projects with plot area ≥ 500m2. The Bureau has specified the code's applicability. However, it's at the state's discretion to amend these criteria as per the state's requirements.

The ENS code has been developed considering its adoption by the Urban Local Bodies (ULBs) into building byelaws[10]. This report deliberates to understand the applicability of ENS in upcoming residential building stock and its impact on different categories of residential buildings and floor space.

The study was conducted by assessing the hypothetical applicability of ENS on the sample existing residential built stock, assuming that the same construction trend will follow in upcoming residential built stock where ENS will be a mandate.

This report deliberates to understand the applicability of ENS in upcoming residential building stock and its impact on different categories of residential buildings and floor space.

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9. PMAY status as updated on its website in September
10. Bureau of Energy efficiency, (2020). ECBC Residential. Retrieved from Bureau of Energy Efficiency: https://beeindia.gov.in/content/ecbc-residential

This report analyses the existing residential building stock and the applicability criteria of ENS. The basis of ENS applicability as defined by the Bureau of Energy Efficiency is the plot size.

The study highlights:

01 | The predominant building typology of the identified sample plots.

02 | The area shares of each housing typology of the identified plots.

03 | The percentage share of residential plots that are in the scope of ENS.

04 | Spans of ENS applicability (existing sampling of residential building stock)

02

Research Methodology

This study was conducted for city jurisdiction area, in the top million-plus cities across India covering the four climatic zones (Hot & Dry, Composite, Warm & Humid and Temperate) and one city from the cold climate (not a million Plus city) to gauge the housing trend dominating in the urban landscape. We conducted the study for ten cities, 9 of which are the top million-plus cities, barring Shillong, to access a fair sample of residential buildings.

The sampling strategy, methodology for data collection is described in the section. We describe the and limitations of the study.

2.1. Sampling Strategy

The report assesses the residential plot area of 10 Indian cities representing the six geographical divisions and five different climate zones. This study was limited to ten cities based on their demography, geographical location and climatic zone. Nine out of ten cities were from the top million-plus cities in the four climatic zones. With less than a million population per the census of 2011, Shillong was included as the 10th city to assess the cold climate and capture the housing trend in the North-Eastern region of India (see Table 1).

Cities	Population as per 2011 census (in millions)	Geographical location (region)	Climatic Zone
Ahmedabad	5.57	Western Zone	Hot and Dry
Bangalore	8.44	Southern Zone	Temperate
Chennai	7.09	Southern Zone	Warm and Humid
Delhi	16.78	Northern Zone	Composite
Hyderabad	6.81	Southern Zone	Composite
Jaipur	3.05	Northern Zone	Composite
Kolkata	4.49	Eastern Zone	Warm and Humid
Mumbai	12.44	Western Zone	Warm and Humid
Shillong	0.14	North Eastern Zone	Cold
Surat	6.18	Western Zone	Hot and Dry

Table 1: Selected cities with their population, geographical location and climatic zones.

Ten localities were selected from the prime residential settlement areas and recent expansion of the city to capture comprehensive data points for the analysis. Factors like spatial distribution and density variation also influenced the selection of these localities. This study limited its assessment to ten random samples from each identified locality to represent each cardinal direction (as shown in the figure below), making it a cumulative 1000 samples across the ten cities.

The report assesses the residential plot area of 10 Indian cities representing the six geographical divisions and five different climate zones. This study was limited to ten cities based on their demography, geographical location and climatic zone.

Figure 1: Selected cities and localities for case study
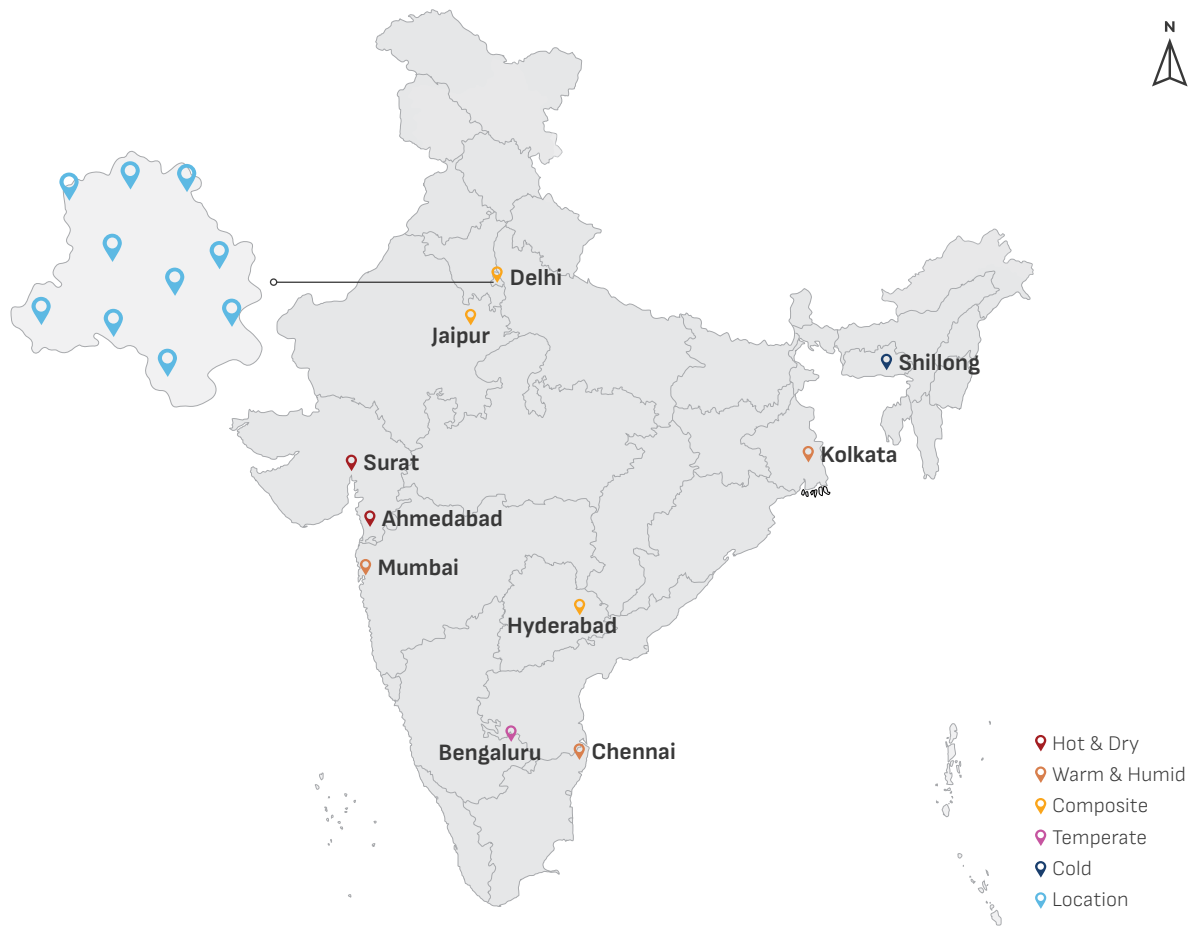
2.2. Data Collection process

Land, a state subject, does not have a national level repository or a common platform for record maintenance and information. It is only available at the state or municipal level. Some sources that give details of the land parcel, category of the residential building, and its land use is:

- Municipal online land registration records
- Bhu-Naksha
- Satellite Imagery

Municipal Online Land registration records

As part of reform under good governance, land registration is digitised and available online, with information like property type, area, address etc. However, this method lacks information on unauthorised localities not identified by the local body. This good governance reform, however, is not adopted by all municipal corporations.

As part of reform under good governance, land registration is digitised and available online, with information like property type, area, address etc.

The steps involved to get data for this study using the records are:

1. Login on to the Inline Registration Information System of the city

2. Go to search information about the property, enter its location in terms of zones, localities etc.

3. Collect the displayed information regarding the size and land use as shown in Figures 2 and 3.

4. Analyse the property address to identify the housing typology

   Example: Group housing has the floor wise property registration; hence the address will include information about the floor (shown in figure 2). The address will have a simple house number is plotted or row housing, as shown in figure 3.

5. Cross verify the housing typology from satellite imagery.

Figure 2: Property level information from online registration (group housing)

Property Address	Area	Deed Type	Property Type
House No. RZF-86/11 MAHAVIR ENCLAVE ND, Road No. F FLOOR,Mahavir Enclave	83.61 Sq. Meter	SALE,SALE WITHIN MC AREA	Residential
House No. G-43 MAHAVIR ENCLAVE ND, Road No. 2ND FLOOR,Mahavir Enclave	33.444 Sq. Meter	SALE,SALE WITHIN MC AREA	Residential
House No. RZD-1/303 MAHAVIR ENCLAVE ND, Road No. F FLOOR,Mahavir Enclave	56.4368 Sq. Meter	SALE,SALE WITHIN MC AREA	Residential
House No. D-1/115 MAHAVIR ENCLAVE ND, Road No. 3RD FLOOR,Mahavir Enclave	37.6245 Sq. Meter	SALE,SALE WITHIN MC AREA	Residential
House No. I-53 MAHAVIR ENCLAVE ND, Road No. F FLOOR,Mahavir Enclave	70 Sq. Yard	SALE,SALE WITHIN MC AREA	Residential
House No. RZF-2/230 MAHAVIR ENCLAVE ND, Road No. 2ND FLOOR,Mahavir Enclave	91.971 Sq. Meter	SALE,SALE WITHIN MC AREA	Residential
House No. I-39 MAHAVIR ENCLAVE ND, Road No. 3RD FLOOR,Mahavir Enclave	60 Sq. Yard	MORTGAGE,MORTGAGE WITHOUT POSSESSION	Residential
House No. H NO F1/62-B, Road No. THIRD FLOOR,Mahavir Enclave	45.9855 Sq. Meter	SALE,SALE WITHIN MC AREA	Residential
House No. FNO 154 MAHAVIR ENCLAVE ND, Road No. 2ND FLOOR,Mahavir Enclave	41.81 Sq. Meter	SALE,SALE WITHIN MC AREA	Residential
House No. H-3/6, Road No. THIRD FLOOR, Khasra 79/16,Mahavir Enclave	96.1515 Sq. Meter	SALE,SALE WITHIN MC AREA	Residential
House No. RZ-H-12, Road No. THIRD FLOOR, Khasra 15/5,Mahavir Enclave	45.9855 Sq. Meter	SALE,SALE WITHIN MC AREA	Residential
House No. D-1/362 PLOT NO B-3 MAHAVIR ENCLAVE ND, Road No. 2ND FLOOR,Mahavir Enclave	41.805 Sq. Meter	SALE,SALE WITHIN MC AREA	Residential
House No. RZ-D-75/3, Khasra 75,Mahavir Enclave	75.249 Sq. Meter	RECTIFICATION DEED,RECTIFICATION DEED	Residential

e-Search	Search By Name	Search By Property Address	Complete Search	Specific Search	DDA Deed Search	Integrated search	Find SR Office	Reports		Login
				GROUND FLOOR, Khasra 52,Najafgarh	Meter					
43	27-01-2020	SHRI RAM CHARAN	IIFL HOME FINANCE LTD. THROUGH ITS AUTH. REPRESENTATIVE OF MR. RAM SANEHI	House No. 686,Najafgarh	50.19 Sq. Meter	MORTGAGE,MORTGAGE WITHOUT POSSESSION				Residential
46	27-01-2020	SHRI MOHIT RAMDEO	SATISH CHANDER GUPTA	House No. 116A, Khasra 33/6,Najafgarh	120 Sq. Yard	SALE,SALE WITHIN MC AREA				Residential
52	05-02-2020	MEENA GUPTA	SHRIRAM CITY UNION FINANCE LTD. THROUGH AUTH. SIGN. MR. BINOY VARGHESE	House No. 387, Khasra 52,Najafgarh	50 Sq. Yard	MORTGAGE,MORTGAGE WITHOUT POSSESSION				Residential

Bhu–Naksha

National Land Records Modernisation Programme (NLRMP) is a centrally–sponsored scheme to digitise land records primarily to maintain title transfer and resolve land disputes. Bhu–Naksha, the cadastral mapping software developed by National Information Centre (NIC), gives the plot level ownership data and information.

National Land Records Modernisation Programme (NLRMP) is a centrally-sponsored scheme to digitise land records primarily to maintain title transfer and resolve land disputes. Bhu-Naksha, the cadastral mapping software developed by National Information Centre (NIC), gives the plot level ownership data and information. As the platform is still in the implementation phase, not all places have digitised information. The figure below shows the type of land-related information that is provided on the platform. This, however, does not verify the land use type. Hence for our analysis, we identified the land use through satellite imagery of the sample plot, as shown in the images below.

Bhu-Naksha displays information on a plain map (shown in figure 4) or overlays the cadastral map on the satellite imagery (Figure 5).

1. Log in to the Bhu-Naksha portal of the state
2. Select rural/ urban in the category drop-down
3. Select district, taluka and locality in the drop-down menu
4. Press enter to display the map.
5. Select the desired plot to get the associated information (as shown in figure 4)
6. Chose satellite image as base map (as shown in figure 5)
7. Verify housing typology from the satellite imagery.

Figure 4: Cadastral map by Bhu-Naksha with information about its size and ownership
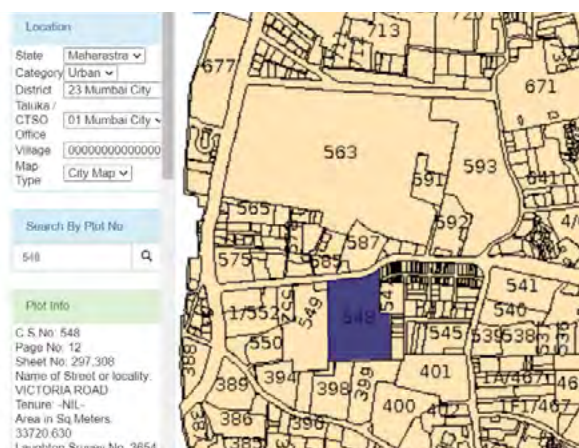
Figure 5: Cadastral Map by Bhu-Naksha with satellite imagery as a base map

Satellite Imagery

There are several satellites with different characteristics that acquire multispectral images of the earth surface. These satellites are particularly useful for land cover and environmental monitoring. This method can calculate the plot area by approximation and can be used to have a rough estimate. Any satellite imagery can be used for the purpose, for example, Landsat series and Cartosat series. The significant advantage it has is that the imagery is available for all cities. However, this approach can only be used for approximation as the data required is not for the area of building footprint but the plot area hence the gentrification or subdivision can become a significant barrier if wholly relied on this approach.

1. Open the satellite imagery repository for the desired location
2. Zoom till the points plot level details are visible.
3. Identify residential buildings and note down their housing typology.
4. Trace out the visible plot boundary.
5. Calculate the area of the enclosed polygon and convert it to on-ground size by using the reference scale of the map.

The figure below shows the calculation methods that have been done on the google search engine. To calculate size/ area, one needs to select the coordinate points that enclose the plot, and the search engine provides the facility to measure the distance and area of the traced line.

Figure 6: Approximation of plot area by satellite imagery

Hybrid Data Source

All the mentioned data sources have their attribute (as shown in the table below). Going with one data source wouldn't have provided the required information for the analysis. Hence, an amalgamation of information from these sources was used, based on the availability of information for each city. The land records were fetched from the Municipal online land registration records or Bhu-Naksha, and the land use was cross verified from satellite imagery wherever required.

Source	Advantages	Limitations
Municipal online Land registration records	Gives information about the exact area and type of land use along with the address	Information is only available for the individual property type. In group housing, information is only for the individual apartments, not the whole plot area. Since it is a database in the making, information is not available for all areas of the city
Bhu-Naksha	Gives information about the exact area along with the address	Does not give information about the land use of buildings. Since it is a database in the making, information is not available for all cities and states
Satellite Imagery	Gives information about building typology, landuse, approximate area, and location	It does not give an exact plot area and can be confusing in case of amalgamation, gentrification, or subdivision of plots

Table 2: Advantages and limitations of sources available for sample collection for plot area assessment

2.3. Limitations

Due to the unavailability of consolidated data about land parcels, this analysis has few limitations, as mentioned below:

- Statistically small sample size: The ratio of sample to the city's population is negligible; hence the data inferred can only partially represent the overall scenario.

- Lack of vacant plots in million-plus cities: The analysis was conducted in million-plus cities, where new development scope is limited compared to smaller cities.

- Analysis of existing residential buildings: The existing buildings can only show the construction trend of the past.

- The study is restricted to the plot's total area and does not consider the number of dwelling units constructed or the floor space.

The plots applicable for ENS compliance primarily consisted of 70% group housing, followed by 30% plotted housing.

Even though it was found that in terms of number, the scope of ENS applied to 21% of the total plots, it was astonishing to observe that these plots cover **92% (1.58 million m^2) of the total cumulative area (1.72 million m^2) of the 1,000 sample plots.**

03

Findings of the Study

One thousand plot samples collected from the ten cities of India were analysed to assess the applicability of ENS, i.e. plot area of 500 m^2 and above.

The samples were analysed to understand the number of plots that would fall under the scope of ENS and the cumulative area that the code would have impacted.

The 1000 sample plots were classified and analysed based on the residential building categories (group, row and plotted); 240 samples belong to group housing, 380 to row housing and the remaining 380 to plotted housings (Figure 7).

The graph below shows the percentage share of cumulative area of different residential building categories in the ten cities. The cumulative area of plots under group housing was found to be maximum for Delhi (97.7%), followed by Mumbai (96.8%) and the least for Shillong (11.7%). In contrast, the area under plotted housing dominated the cityscape of Shillong (84%), followed by Kolkata (46%). The percentage share of row housing was humbling low in all the other cities.

Figure 7: Percentage of Housing Typology
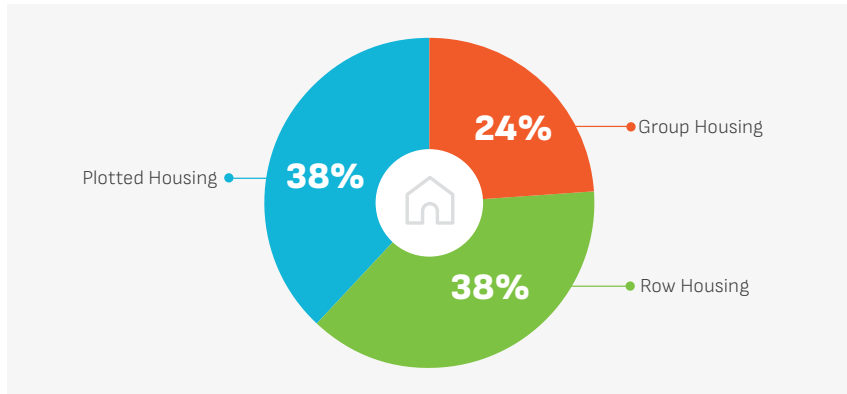
Figure 8: Residential plot area Assessment
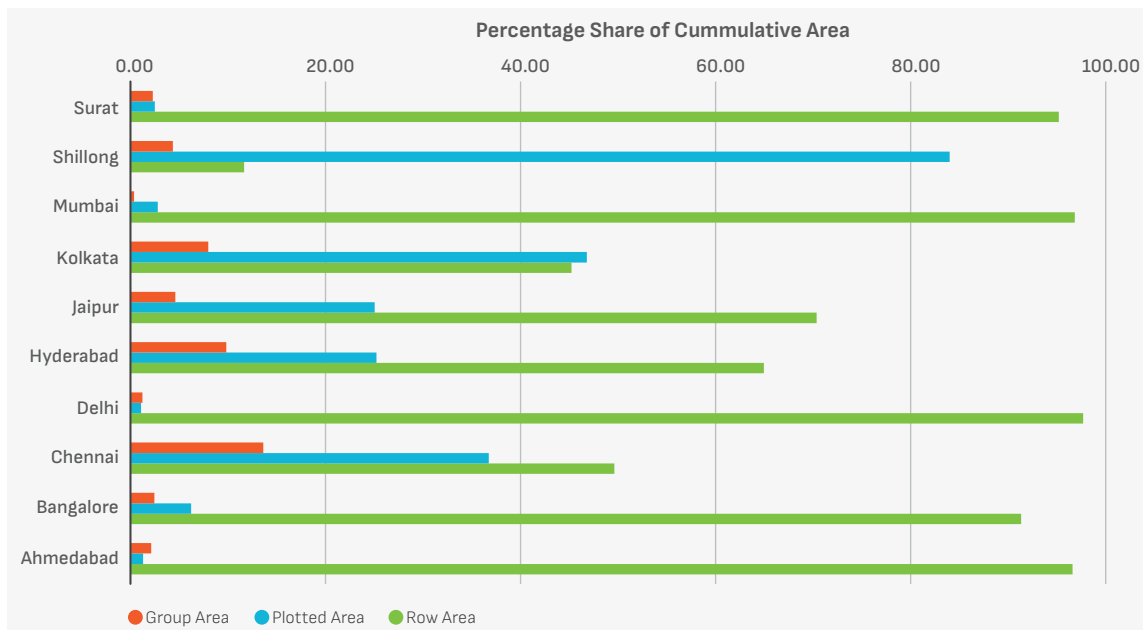
Analysing the 1,000 samples, we also observed that only 210 samples were more than 500 m² (falling under the scope of ENS). The plots applicable for ENS compliance primarily consisted of 70% group housing, followed by 30% plotted housing. Even though it was found that in terms of number, the scope of ENS applied to 21% of the total plots, it was astonishing to observe that these plots cover 92% (1.58 million m2) of the total cumulative area (1.72 million m²) of the 1,000 sample plots. It was also interesting to note that with respect to area, approximately 98.1% of these ENS applicable plots are group housing, and merely 1.9% are plotted.

Figure 9: Analysis of samples

81%
More than 5000 sq. m

8%
1000–5000 sq. m

3%
500–1000 sq. m

7%
100–500 sq. m

1%
Less than 100 sq. m
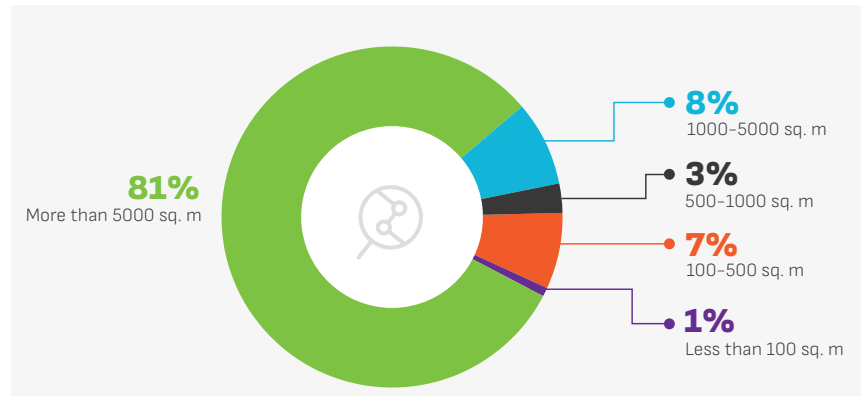
The scope of ENS seemed justified with 500 m² plot area criteria considered for the code's applicability. However, the scope can be revised based on the state's administrative preference. The scope can be expanded once a streamlined administrative framework for code compliance and verification is in place, along with the capacity to verify a more significant quantum of compliance checks.

Figure 10: Summary of Findings

Total no. Plots: 1000
Total Area: 1.72 million m²

91.3%
6.9%
1.8%

ENS EXEMPTED
(8% of 1.72 million m²)

Total no. Plots: 790
Total Area: 0.14 million m²

16.7%   **25%**   **58.3%**

ENS APPLICABLE
(92% of 1.72 million m²)

Total no. Plots: 210
Total Area: 1.58 million m²

98.1%
1.9%

● Group Housing   ● Plotted Housing   ● Row Housing
*The Boxes Depict Proportionate Area Covered
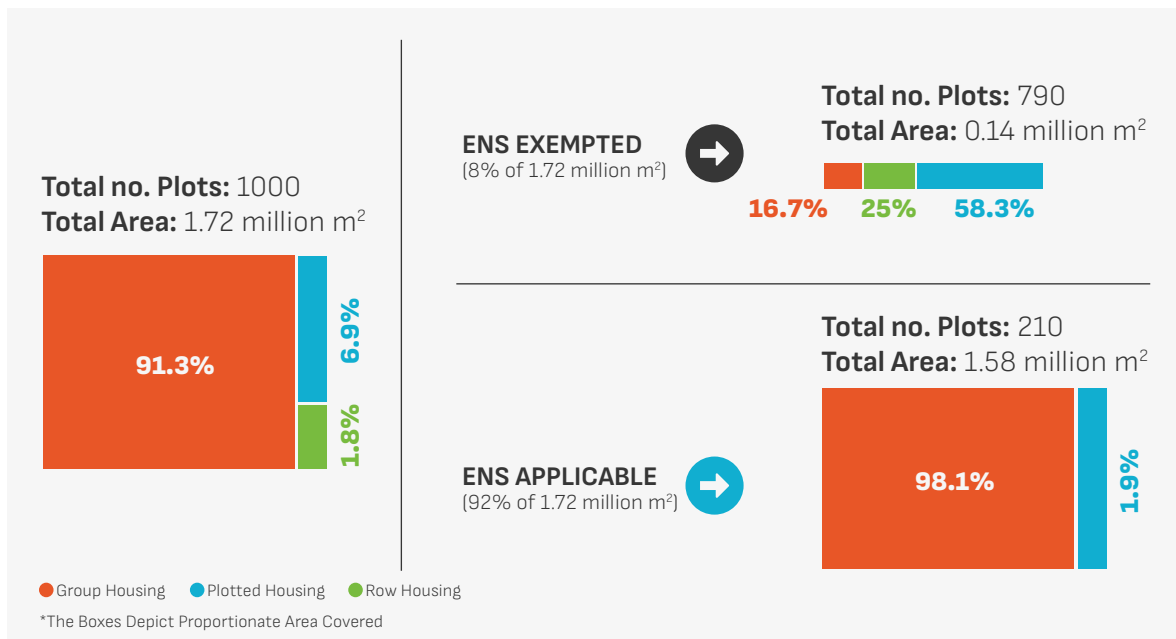
■ **Key findings from the analysis of the 1000 sample plots identified were**

A. The cumulative area of the 1000 plots was 1.72 million m².

B. Of these 1,000 plots, 380 plotted, and 380 row housing. The remaining 240 plots belonged to the group housing category.

C. Group housing covered a maximum area of 1.57 million m², approximately 91.3% of the total area. Plotted housing covered 0.12 million m² (6.9%), and row housing covered 0.03 million m2 (1.8%)

■ **Plots falling under the scope of ENS (Plot size ≥500m²)**

A. ENS applies to 210 sample plots covering 92% (1.58 million m²) of the cumulative area of the 1,000 samples.

B. Out of the 210 ENS applicable plots, 175 were group housing covering an area of 1.55 million m² (98.1% of total ENS applicable area)

C. Thirty-five plots categorised as plotted housing covered a cumulative area of 0.03 million m² (1.9% of total ENS applicable area).

■ **Plots exempted from the scope of ENS (Plot size ≤ 500m²)**

A. Based on the plot size, 790 plots were exempted from the applicability criteria of ENS out of the 1,000 sample plots.

B. These 790 plots, however, covered only 8% (0.14 million m²) of the cumulative area of a total of 1,000 samples.

C. Out of the 790 ENS exempted plots, 65 belonged to group housings, 345 plotted housings, and 380 row housings.

To better understand the relationship between the plots and the residential floor space, we took a hypothetical assumption of Floor Area Ratio/ Floor Space Index to be one. With this assumption, the impact of ENS will be the most on Group housing in terms of code-compliant floor space. With the present scope of ENS, even though a large quantum of residential housed may be exempted, they however attribute to a minuscule fraction of the total effective area that the present scope of the code can impact.

With the present scope of ENS, even though a large quantum of residential housed may be exempted, they however attribute to a minuscule fraction of the total effective area that the present scope of the code can impact.

04

Propositions on ENS Adoption Based on the Study

The report examined the proportion of existing residential plots that would hypothetically fall under the scope of ENS to understand the extent of the code's applicability based on the present scope of the code.

Based on the set of findings, the following were construed:

■ For effective code implementation, it is ideal that the state considers the local factors while defining enforcement strategies for code compliance. Understanding the development trend in the housing sector will help define the roadmap for code compliance in the cities. The cities may consider a phase-wise code adoption mechanism by primarily targeting housing typologies (Group housing in this case), which will have a more considerable impact with minimum burden on administrative set-up.

■ From the analysis, we observed that, though applicable to a small number of plots, the present scope of ENS captures almost 90% of the total area under the residential housing segment. Additionally, most ENS applicable plots fall under the category of group housing in the urbanscape.

■ It is recommended to target group housing for mandatory code compliance comprising compliance checks and verification. The other residential building typologies may have a self-declaration model in the initial phase of code compliance. The code compliance verification may go through rigorous scrutiny once is the administrative capacity to accommodate for it. This strategy will ensure that the small-scale developments are kept aside from the administrative process of code compliance and reduce the burden of the allied department for compliance checks and verification.

■ Irrespective of group housing size, AHJ can look at mandating ENS for all group housings in the initial ENS implementation phase and verify compliance.

■ The code, at present, applies to new constructions. The code may look at the existing residential built stock and incremental housing to benefit from code compliance. This step will achieve the overarching benefit of "Thermal comfort for All", especially in housing where space cooling is a distant reach. Additionally, code compliance will benefit energy conservation, better ventilated and daylit spaces, and promote occupants' well-being and health, one of the Sustainable Development Goals (SDG-3). Code compliance in incremental housing can also reduce and delay the dependency on space cooling.

■ AHJ can develop a user-centric strategy for incremental housing. From our analysis, we inferred that incremental housing is beyond the present scope. Though the code mandates compliance for applicable residential plots, the concerned authority/ministry can create awareness among the end-users for voluntary adoption and market demand, not limited to the defined scope of the code.
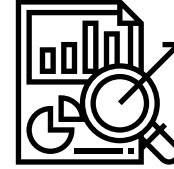
From the analysis, we observed that, though applicable to a small number of plots, the present scope of **ENS captures almost 90%** of the total area under the residential housing segment.

Way Forward

Eco Niwas Samhita applies to residential buildings and residential parts of mixed-use buildings with plot area 500 m² and above. However, states have the autonomy to redefine the applicability criteria for mandatory code compliance considering the locale requirements.

Following a similar study methodology, the local or state government can identify the housing trend of the state and base the rationale for amendments in the code's applicability on it.

An authority can collect the housing development data from the buildings approved or additions in the property tax data in the past decade. The data points can be assessed to define a trendline for different categories of housing. Revision on the scope of code can be made based on the identified housing trend and the administrative capacity of the jurisdiction. The states can prepare an action plan for ENS implementation in detail based on the rationale for code's applicability criteria, forecast for housing development, present and future capacity building requirement, administrative capacity for compliance verification. Code compliance can be planned phase-wise and indicative quantifiable targets for each phase as a parameter of success.

Moreover, the authority responsible for code adoption may define enforcement mechanisms based on local factors and allied constraints. There is a need for a well-defined framework for the ENS implementation, which may act as a guiding document for the states and implementing authority. AEEE's subsequent report will highlight various feasible compliance mechanisms models that can help streamline the implementation process.