Building Regulations for North Eastern Region of India

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Abstract

The age of urbanization has ushered in better connectivity and accessibility, opening up the North-Eastern Region to the rest of the world like never before. Consequently, the region has experienced unprecedented population growth, urban development and an increase in tourist influx. This rapid urbanization has also brought with it several issues like poor living conditions, increased vulnerability to hazards and environmental degradation, which highlights the poor state of building regulations in these regions. Building regulations, while enforced to regulate the ever-increasing demand for development in hill towns, are yet to achieve any substantial impact on elevating the issues faced in the North Eastern cities, which calls into question the appropriateness of these regulations given the current context. This paper attempts to study the type of development occurring in the North Eastern Region and the issues faced to accommodate the growing population. It also presents an in-depth study of the state of existing building regulations in major hill towns of the region, and briefly discusses the possible strategies to revise the existing building regulations for achieving contextually appropriate development.

Keywords – *Building Regulations, North-East India, Hilly Region, Contextual Regulations, Urban Environment, Urban Development*

Introduction

The North-Eastern States of India, covering a territory of 2, 55,000 sq. km, constitutes 8.06% of land and 3.73% of the total population of India. It is connected with the rest of the country by a narrow corridor, also known as the 'Siliguri Chicken-neck'. About two-thirds of the north-eastern region comprises of hilly terrain while the rest is level or gently undulating land. Geographically, this region may be broadly divided into the Eastern Himalayan Range in the north (Arunachal Pradesh), merging with the Arkansas Yoma Range in the East, Brahmaputra and Imphal Valleys, Barak River Valley System and Meghalaya Plateau (**Mibang, 2005**).

While this region provides a lucrative avenue for development with its vast reserves of resources, recreational potential and beautiful scenery, there are also various issues and challenges associated with its unique setting. As majority of the settlements in the north-eastern states are on hilly regions, development in this region faces constraints arising from its difficult terrain, vulnerability to disasters, ecological sensitivity and steep gradients. Most of the hill cities in North East such as Kohima, Shillong and Gangtok are also popular tourist destinations due to their scenic beauty, rich culture and heritage. This, coupled with a growing population on an already ecologically sensitive region, has placed tremendous pressure on development with most cities well exceeding their carrying capacity. The cities here are characterized by low-rise, high-density settlements, scattered holdings due to shortage of buildable land, natural and man-made hazards like earthquakes and landslides, heavy traffic congestion especially during peak tourist months and non-adherence to building regulations.

Currently, the common type of development pattern that can be seen in Indian hill towns are linear or ribbon development along major routes, clustered settlements around administrative or tourist centers in hill capitals or tourist towns and scattered development in small hill towns, where small clusters are dispersed over a large area. These development patterns have been influenced by the amount of developable land available all together or scattered within the planning area of a hill town. The hill towns usually begin development from the highest point of developable land (usually the ridge areas), and start moving downwards as the town boundaries expand, or start growing along the major road passing through it in the form of a spine. The hill towns have experienced a shift in its development trends in the last few decades as evidenced by the expansion of town sizes, densification of development, etc. There has been a shift from low-rise, high-density development to mid-rise, high-density development. Being centers of various type of employment generating factors due to their tourism potential, the hill towns have faced a surge in the number of in-migrations and seen unprecedented population growth in the last few decades. Not only have these conditions created a poor quality of life

in these cities but also caused environmental degradation and a gradually diminishing natural ecosystem.

Issues of development in North-Eastern Cities

The issues faced by the cities due to an uncontrolled and unregulated development are listed as follows:

1. **Unmonitored population growth**: Population in the major hill cities are increasing at an alarming rate with no regard for the carrying capacity of hills. There is no proper assignment of densities according to factors like slope gradient, ecological sensitivity and hazard sensitivity of a zone. Such an issue consequently creates a chain reaction of other issues such as scarcity of buildable land which then leads to increase in land price, encroachment on ecologically sensitive areas, etc.; deficiency in infrastructure and basic services as the population exceeds the design capacity, and so on.

2. **Traffic issues:** With increasing population, the number of vehicles is increasing as well. Due to space constraints, the roads in these cities remain narrow and there is no scope for road widening. Thus, the roads cannot accommodate a large intake of vehicles and traffic congestion is a very common menace here, especially along main roads and roads abutting educational institutions and administrative offices. The issue is aggravated by roadside parking of vehicles as there is no parking provision in most residential buildings and insufficient parking provision in commercial areas. Traffic jams in sloping intersections are also a common site of car accidents. Since public transport is not very efficient here due to the narrow roads, the number of private vehicles is only increasing and the traffic issues continue to persist.

3. **Encroachment of roads:** Encroachment of roads by buildings is a side-effect of unregulated development. No setback of buildings is maintained as building construction occurs unchecked, especially in residential colonies. Entrance to buildings starts directly from the edge of roads, which leads to interference with ongoing traffic. Lack

of a buffer area between the road and the buildings lead to accidents, especially in busy commercial streets and also leaves no room for pedestrian footpaths.

4. **Unsustainable tourism practices:** The economy of most of the north-eastern cities are based on its tourism sector. Cities like Shillong and Gangtok have a very high inflow of tourists during peak tourist months which worsens the already prevailing problems of overcrowding. There is also no proper management of tourist flow according to the city's design capacity which leads to a shortage of tourist infrastructure and resources.

5. **High vulnerability to disasters:** There is no clearly defined zoning-related regulations in these cities and even where they are present, zoning is generally based only on land use and other factors like slope gradient, ecological sensitivity and hazard vulnerability are not considered. Due to this, construction occurs in landslide prone areas and destruction of buildings during landslides in monsoon months is a very common issue here. The North-Eastern cities are also located in high seismic activity zones so earthquakes are a very common occurrence here. In cities like Kohima, where inspection of building construction is not carried out properly, most residential buildings are constructed without the prescribed safety measures and buildings get damaged frequently during tremors.

6. **Ecological issues:** The North-Eastern region contains a diverse range of ecosystems and has a large number of biodiversity hotspots. Due to prevailing pressures of development, the urban scape of the cities is slowly encroaching on the surrounding natural scape in their peripheries. Even in the cases of reserved forests, though the forests themselves are protected, the adjacent areas or transition zones are left unregulated and encroachment of these areas lead to ecological imbalance, which negatively affect the ecosystem in these areas.

7. **Decreased quality of life:** Poor living conditions like lack of sunlight inside buildings, water shortage, cramped dwellings due to high land price, delay in commuting due to traffic congestion, etc. are some prevalent issues arising as a consequence of the current unregulated pattern of development.

8. **Disappearing character of cities:** The cities in this region used to have articulate vernacular character due to their distinct traditional architectural styles as well as the unique conditions under which they were built. However, over the years, the new buildings that have come up have no coherence with the vernacular character of the city.

9. **Unpleasant aesthetic appearance:** The urban scape of Hill towns and cities are unique in the way that they are viewed collectively due to their topography. So, when the buildings are not in harmony with each other due to outlandish designs or non-uniform scale, it sticks out more as compared to plain areas. Due to the absence or poor enforcement of development regulations, adjacent buildings have no co-relation to each other in terms of design or scale, even in the main commercial streets. The potential for a memorable streetscape, as often seen in tourist destinations, is not properly utilized.

Fig. 1 *High density development occurring in North-Eastern hill cities with no regard for the carrying capacity of hills*

10. **Environment degradation**: Most cities here don't have large industries or major industrial areas which, in turn, acts as a positive point for cleaner environment of the area. But increasing vehicular growth and traffic problems such as congestion and slow movement of vehicles is leading to degrading air quality in the main town area.

Fig. 2 *Buildings being constructed with non-adherence to ground coverage or setback regulations*.

The issues discussed in this section clearly indicates a lacuna in the existing framework of development control, arising from a non-contextual approach towards and poor enforcement of building regulations. Hence, there is a need to review the existing building regulations applicable in these cities and analyze the impact they have on the city's urban environment.

Overview of building regulations in north-eastern hill cities/towns

The issues discussed in this section clearly indicates a lacuna in existing framework of development control, arising from a non-contextual approach towards and poor enforcement of building regulations. Hence, there is a need to review the existing building regulations applicable in these cities and analysis the impact they have on the city's urban environment.

Overview of building regulations in north-eastern hill cities/towns

Building regulations are a set of rules enforced in human settlements aimed to protect public health, safety, general welfare, and environment. These are the means by which government/development authority can control use of available land resources, buildings, infrastructure facilities to ensure proper spatial organization and environmental protection in the city (**Kumar, 2014**). While states can form their own building bye-laws, Model Building Bye-Laws - 2016 acts as a standard for construction and a direction for states to devise their own rules for construction. The existing building regulations in different towns and cities of India have also been influenced by the National Building Code and Delhi Master Plan(s).

Major issues faced are rigidity and uniformity of building regulations, cumbersome administrative framework, unclear jurisdictions of enforcement agencies and insufficiently responsible professionals for ensuring compliance (**Indo-USAID 2005, ASCI, 2011**). As a result, problems related to contextual inappropriateness of existing building regulations and resultant development, are most prevalent in various Indian cities/towns. This scenario of contextually inappropriate building regulations and resulting unsuitable development is heightened in case of ecologically sensitive and seismically vulnerable regions of India such as the North-Eastern cities.

Post-independence, the North-Eastern region consisted of only Assam and the princely states of Manipur and Tripura. Nagaland, Meghalaya, Arunachal, Mizoram were part of the larger territory of Assam and only attained statehood in 1972. Ever since, development in these regions have been slow as compared to the rest of the country. Formulation of Building regulations in most of the north-eastern states came into force as late as 2012. Though never out of the planning currents as part of the composite State of Assam, the newly founded states of North-East were late comers in the planning mainstream and they were set on following the planning patterns of Major states in the country despite having completely different contexts.

Not only do the North-Eastern cities follow a very generalized and rigid set of building regulations but also cities like Kohima, Gangtok

and Aizawl are yet to update their building regulations (**Table 1**) as per the Model Building Bye-Laws - 2016, necessary for staying up-to-date with emerging issues of climate change, sustainability and inclusiveness.

Table 1 *Year of Formulation and Amendment of Building Bye-laws*

City	**Agartala**	**Aizawl**	**Gangtok**	**Guwahati**	**Imphal**	**Itanagar**	**Kohima**	**Shillong**
State	Tripura	Mizoram	Sikkim	Assam	Manipur	Arunachal Pradesh	Nagaland	Meghalaya
Year of formulation of Building Bye-laws	2004	2012	1991	2006	2012	2009	2012	2011
Year of Amendment	2017	-	2001	2020	2019	2019	-	2021

This paper is an attempt to critically review the existing building regulations in the North-Eastern cities of India with the aim of understanding its impact on the urban environment of the cities.

The objectives of this research are:

a) To critically review the impact of existing building-bye laws and regulations on the urban environment of cities.
b) To find out the lacunas in existing building-bye laws and regulations.
c) To suggest possible changes in the existing bye-laws and regulations for a more efficient approach to urban development.

After studying the aforementioned points in the objectives, this paper attempts to put forward possible suggestions for a more efficient approach towards urban development in the North-Eastern States of India.

Study of existing building regulations enforced in hill towns

In this paper, we study the existing building regulations in major North-Eastern cities/towns of India to identify different issues pertaining to their formulation and enforcement. Building regulations considered for this review are taken from the latest development plans and building bye-laws available with local governing authorities/bodies. Different documents/master plan/development plan/building regulations used for this study of existing building regulations of North-Eastern cities as follows:

a) The Sikkim Building Construction Regulations, 1991 (As amended by the Sikkim Building Construction (Amendment) Regulations, 2001) (**UDHD, 2001**)
b) Meghalaya Building-Bye Laws 2011 (**MUDA, 2011**)
c) Arunachal Pradesh Building Bye-Laws, 2019 (**APTP, 2019**)
d) Tripura Building Rules, 2017 (Along with 1st Amendment Rules, 2019 & 2nd Amendment Rules, 2020) (**TUDA, 2020**)
e) The Imphal Municipal Building Bye-Laws, 2012 (**IMC, 2012**)
f) The Aizawl Municipal Council Building Regulations, 2012 (**AMC, 2012**)
g) Guwahati Building Construction (Regulation) Bye-Laws, 2014 (**GMDA, 2014**)

A general profile of the cities selected for this study are shown in **Table 2**.

Table 2 *General profile of cities in North-Eastern Region*.

Sl. No.	Town / City	Urban Area (sq. km)	Urban Population	Population Density (pph)	Year of Enforcement of Building Bye-laws
1	Agartala	76.504	4,00,004 (2011)	52	2004
2	Aizawl	176	3,14,754 (2011)	17	2012
3	Gangtok	19.2	100,290 (2011)	53	1991
4	Guwahati	216	9,57,352 (2011)	44	2006
5	Imphal	110.03	2,68,243 (2011)	24	2012
6	Itanagar	200	59,490 (2011)	29	2009
7	Kohima	10.98	99,039 (2011)	90	2012
8	Shillong	64.36	143,007 (2011)	23	2011

Building regulations for residential buildings in hill towns

For the purpose of this study, we will be focusing on the building regulations related to residential buildings as these comprise the majority of buildings in the cities and also because such regulations are the most commonly specified regulations in the building regulations/bye-laws of North-Eastern cities. We will consider factors like plot size, Floor Area Ratio (FAR), ground coverage, building height, permissible number of storeys and various setbacks to review the existing regulations in place.

Nowhere has the slope gradient been used as a factor even though it's one of the major factors determining the stability of site in landslide-prone hilly regions. Recharging ground water in hilly regions is more difficult than in plain areas due to high surface runoff resulting from its topography. However, maximum ground coverage is as high as 70% in Agartala for detached buildings on plot sizes of 100-400 sq. m. (**Table 2**). Compared to Guwahati, which has more or less plain terrain (50-680 elevation) as compared to Gangtok,

which is at a higher elevation (1650 m), maximum ground coverage for plot sizes below 600 sq. m. is given as 55% in the former case and 70% in the later (**Table 2**). It is also observed that in cities like Kohima, where no maximum allowable ground coverage or F.A.R is even mentioned, people build on almost 80-85% of their land to compensate for high land prices. Such practices leave very little open space for rainwater percolation into the ground and only add to the water crisis going on in these cities. Additionally, on studying **Table 2**, we can observe that there is a general trend of small area plots having higher permissible ground coverage than large area plots, which leads to bigger building foot prints and higher built-to-open space ratio. Buildings with higher footprints require more cutting of slopes and trees, which in turn disturbs the natural drainage pattern (**Kumar, 2014**).

Floor area ratio (FAR) is the ratio of a building's total floor area (gross floor area) to the size of the plot of land upon which it is built (**Caves, R. W., 2004**). It is a regulatory tool used in zoning to limit urban density. Not only does it regulate building density but it also, indirectly, regulates the number of people that a building can hold and hence can be used as an important tool for regulating zoning densities. However, on studying the existing building bye-laws of the north-eastern cities, it is observed that other than Guwahati city, no other cities have mentioned F.A.R. based on different density zones and F.A.R. remains the same for both high density and low-density zones. Also, in the case of Aizawl, F.A.R. has been kept the same range for all plot sizes (**Table 2**). Such a case would result in very dense built-up in the smaller plots.

The permissible building height should ideally be determined taking into consideration factors like width of abutting road and seismic sensitivity of the zone. However, other than Arunachal Pradesh, Tripura and Guwahati, other cities in the study don’t have building height restrictions based on the road width. In Kohima city, only the front setback has been determined according to road width. This results in cases where buildings abutting narrow roads have very high storeys

that do not allow sunlight inside the buildings and creates dark alleyways. All the cities in this region lies in Seismic Zone V with the exclusion of Gangtok, which lies in Seismic Zone IV. Despite being located in the highest risk seismic zone, along with having a topography that is not as stable as plain areas, the cities have permissible heights as high as 24.6 m (**Table 2**). Disregard for influence of seismic vulnerability on permissible building height is further highlighted by the fact that a city like Aizawl, which lies on Seismic Zone V has a higher maximum permissible height (**Table 2**) as compared to Gangtok, which lies on a relatively lower risk zone.

Setback regulations define the area around buildings which needs to be kept open to ensure proper daylight and ventilation in buildings, and this open area around buildings can be used for landscaping purposes (Kumar, 2014). As observed in **Table 2**, minimum setbacks allotted are insufficient, especially in cities like Itanagar, Aizawl and Kohima, where buildable land is quite limited due to their topography. Cities like Guwahati and Imphal which are more or less plain in comparison to the other cities have a much higher setback restriction. One anomaly is the case of Agartala – despite being located in a relatively plain area, the setback provision is very less (1.5 m). An overall trend is observed wherein smaller plots with permissible building height as high as 19 m, has very less setback provision, which results in poor living conditions and an increased risk of road blockage in case of building collapse during disasters.

The study of the existing building regulations mentioned above shows the various lacunas in the method of formulation of said regulations and points at the need for reconsidering the factors that should influence these regulations that determine the quality of development and ultimately, shape the fabric of the city as a whole.

Table 2 *Existing regulations of residential buildings*

City	Building type	Plot area (sq. m)	Coverage (%)	Setbacks (in metres)			No. of storeys	F.A.R	Building height (m)
				Front	Side	Rear			
Itanagar	Row housing	*	75	2.0	-	1.0	3	*	11.40
Kohima		Below 125	*	2.0	-	1.8	*	*	*
		125-500	*	2.0	-	2.0	*	*	*
		501-1000	*	3.0	-	3.0	*	*	*
		Above 1000	*	3.0	-	5.0	*	*	*
Agartala	Semi-detached buildings	100-400	70	1.5	1.5	1.5	3	2.5	11.50
		400-1200	60	1.5	1.5	1.5	4	2.75	13.50
		Above 1200	50	1.5	1.5	1.5	4	2.75	13.50
Gangtok		250-500	70	3.0	1.5	1.5	4	*	12.00
		500-1000	50	3.0	1.5	1.5	4	*	12.00
		Above 1000	40	3.0	1.5	1.5	4	*	12.00
Itanagar		48-60	75	2.0	1.0	1.0	2	1.5	8.40
		60-100	65	2.0	1.0	1.0	4	1.8	14.40
		100-250	65	3.0	1.2	1.2	4	1.8	14.40
		250-500	60	5.0	3.0	3.0	5	2.0	17.40
		500-1500	50	5.0	3.0	3.0	5	2.5	17.40
		1500-3000	45	5.0	3.0	3.0	5	2.25	17.40
Shillong		Up to 200	50	3.0	1.0	1.0	4	2.0	19.00

Agartala	**Detached buildings**	100-400	70	1.5	1.5	1.5	3	2.5	11.50
		400-1200	60	1.5	1.5	1.5	4	2.75	13.50
		Above 1200	50	1.5	1.5	1.5	4	2.75	13.50
Aizawl		46.45-93	71	1.2	0.6	0.6	4	2.0-3.0	12.85
		93-130	68	1.5	0.9	0.9	5	2.0-3.0	16.00
		Above 130	68-50	2.0	1.2	1.2	6	2.0-3.0	19.00
Gangtok		250-500	70	3.0	1.5	1.5	4	*	12.00
		500-1000	50	3.0	1.5	1.5	4	*	12.00
		Above 1000	40	3.0	1.5	2.0	4	*	12.00
Guwahati		Below 670	55	4.5	3.6	3.6	5	1.5	15.60
		670-1338	50	6.0	4.2	4.2	6	1.6	18.60
		1338-6690	45	6.0	5.5	5.5	8	1.75	24.60
		Above 6690	40	6.0	5.5	5.5	8	1.75	24.60
Imphal		90 - 150	*	1.5	0.9	0.9	3	1.8	11.00
		150 - 300	*	2.0	1.2	1.2	3	1.8	11.00
		300 - 500	*	3.0	1.8	2.0	4	1.8	13.00
		500 - 750	*	4.0	2.4	3.0	4	2.0	13.00
		750 - 1000	*	5.0	4.2	4.5	5	2.0	16.00
		1000-1500	*	6.0	4.5	4.5	6	2.5	19.00
		1500 - 2000	*	7.0	4.5	4.5	7	2.5	22.00

		2000 - 2500	*	8.0	4.5	4.5	8	2.5	25.00
Itanagar		48-60	75	2.0	1.0	1.0	2	1.5	8.40
		60-100	65	2.0	1.0	1.0	4	1.8	14.40
		100-250	65	3.0	1.2	1.2	4	1.8	14.40
		250-500	60	5.0	3.0	3.0	5	2.0	17.40
		500-1500	50	5.0	3.0	3.0	5	2.5	17.40
		1500-3000	45	5.0	3.0	3.0	5	2.25	17.40
Shillong		201–300	50	3.0	1.2	1.8	4	2.0	19.00
		300–400	50	3.0	1.8	2.5	4	2.0	19.00
		400–500	50	3.0	1.8	3.0	4	2.0	19.00

**Not specified*

Other regulations enforced on development in North-Eastern cities

A city is a shared space between both the manmade and the natural environment, and both are interdependent on each other. Since the type of development occurring in a city also plays a major role in determining the quality of the natural ecosystem within and around the city, it is also important to study the building regulations that impact the environment.

On studying **Table 3**, we observe that 50% of the cities have no provision for solar passive design. While it is still understandable for cold climate cities like Kohima and Gangtok, cities like Agartala and Guwahati which receive ample amount and duration of sunlight during their hot summer months should have mandatory regulations for solar passive design. More than 50% of the cities don't have regulations for cutting of slopes and only Guwahati has provisions to regulate slope stability, despite most cities being located in a hilly terrain where slope stability plays a large role in determining safety of buildings. Almost all the cities, with the exception of Imphal and Itanagar, have no provision

for tree preservation, which further highlights the fact that these regulations are based purely on human interest whereas an overall consideration of both the environment and the people should have been adopted.

Table 3 *Comparison between environmental regulations*

Indicators	Agartala	Guwahati	Shillong	Kohima	Imphal	Aizawl	Itanagar	Gangtok
Solar passive design	No	No	Yes	No	Yes	Yes	Yes	No
Rain water harvesting	Yes	No	Yes	Yes	Yes	Yes	Yes	No
Cutting of slopes	No	Yes	Yes	No	No	No	Yes	No
Tree preservation	No	No	No	No	Yes	No	Yes	No
Drainage of site	No	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Maintenance of drainage pattern	Yes	Yes	Yes	Yes	Yes	No	Yes	No
Slope stability	No	No	No	No	No	No	No	Yes
Preservation of natural features	No	Yes	No	No	No	No	Yes	No
Material regulations	Yes	Yes	Yes	Yes	No	Yes	Yes	Yes

As the cities in the North-Eastern region have a very high vulnerability to disasters due to their location and topography, another important aspect to consider is the building regulations pertaining to hazard safety. As observed in **Table 4**, only Guwahati city has regulations for slope stability even though most of the cities are located on topographical settings with steep slopes. This, combined with the fact that zoning is not done on the basis of hazard vulnerability, results in buildings being constructed on high hazard risk zones with no

regulations for slope stability, leading to loss of life and property during disasters. An example of such a case is in Kohima city, where the practice of constructing buildings on areas with high landslide risk has led to many instances of disasters.

Fig. 3 *Construction with no regard for slope stability*

Table 4 *Comparison between hazard safety regulations*

Indicators	Agartala	Guwahati	Shillong	Kohima	Imphal	Aizawl	Itanagar	Gangtok
Earthquake	Yes	Yes	Yes	Yes	Yes	Yes	Yes	No
Slope stability	No	Yes	No	No	No	No	No	No
Fire safety	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Construction safety	No	Yes	No	Yes	Yes	No	No	No
Quality of Materials	Yes	No	Yes	Yes	No	Yes	Yes	Yes
Cyclones	Yes	Yes	Yes	Yes	Yes	Yes	Yes	No
Any other hazard /s	Landslide	Flood	Flood	Landslide, Flood	Landslide	Landslide	Landslide	-

Impact of building regulations on the urban environment of north-eastern cities of India

The fabric of a city and its urban environment is shaped by the collective influence of its guiding planning principles, development

control regulations, building regulations and planning policies. Building regulations, in particular, are the controlling and regulatory mechanism to ensure the efficient implementation of various polices and plan proposals, and to achieve a specific character in the context (**Kumar, 2015**).

As seen in the previous study, building regulations play a major role in influencing the type and quality of development that will occur in the city. This influence is manifested as the impact it has on various aspects of the city's urban environment and can be categorised as follows:

a) Impact on natural environment

There is no provision for cutting of slopes in more than 50% of the cities (**Table 3**), which leads to indiscriminate cutting of slope for construction without any consideration for slope gradient and soil stability. Even in cities with regulations for slope cutting, it is not enforced properly due to large building footprint resulting from provision of ground coverage as high as 70% (**Table 2)** and FAR **as** high as 3.0 (**Table 2).** Larger building footprint leads to larger cutting of slopes and removal of vegetation cover on these slopes results in decreased stability of slope.

Fig. 4 *Larger building footprint leads to larger cutting of slopes in Kohima*

Fig. 5 *Built-up on slopes in Aizawl, Mizoram*

b) Impact on development pattern

There has been a shift from low-rise to midrise development especially in core areas of the city to accommodate growing population and scarcity of buildable land within the city. Earthquake safety provisions for previously low-rise buildings are not sufficient for the mid-rise development coming up in recent years. High density areas in most of the cities fall under disaster-vulnerable areas, such as in Kohima city, where more than 50% of severe and high-risk landslide-vulnerable zones fall under high-density areas (100-200pph). Due to space constraints, availability of topographically suitable land takes priority over hazard vulnerability.

Fig. 6 *New mid-rise development next to previous low-rise development in Shillong, Meghalay*

Fig. 7 *Narrow, mid-rise building in Kohima, Nagaland*

c) Impact on existing buildings

Lack of proper enforcement of building regulations like building height in the city has led to buildings of inappropriate scale coming up within the city, especially in case of tourist infrastructure. There is no relation between proportion of adjacent buildings and no aesthetic control, which creates incoherence in the overall image of the city.

Fig. 8 *Buildings of non-uniform Scale along the main street in Kohima*

Fig. 9 *Buildings of inappropriate scale in Aizawl*

d) Impact on transportation network and system

Narrow roads that have no scope for widening are unable to accommodate such a large intake of vehicles and traffic congestion is a very common problem here, especially along main roads and roads abutting educational institutions and administrative offices. The issue is also aggravated by roadside parking of vehicles as there is no parking provision in most residential buildings and insufficient parking provision in commercial areas. Since public transport is not very efficient here due to the narrow roads, the number of private vehicles is only increasing and the traffic issues continue to persist.

Fig.10 *Residences built on slopes without road access*

Fig. 11 Roadside parking in residential areas

e) Impact on open spaces and social infrastructure

Open space available is taken up for illegal parking or encroachment of commercial areas or used as illegal dumping sites due to lack of space within the city as well as lack of proper enforcement of development regulation.

Fig. 12 Open dumping of garbage in building setbacks

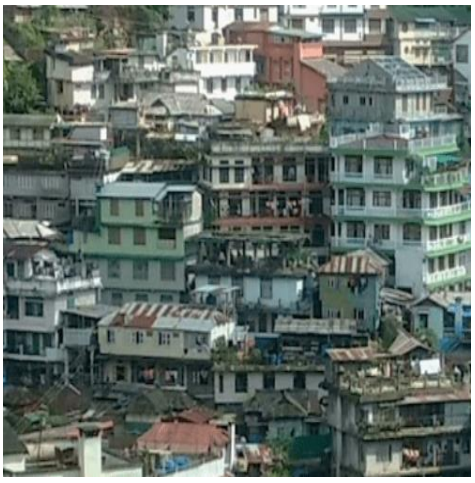

Fig. 13 No open space left within the city due to large built up and high ground coverage

f) Impact on townscape

The townscape of these cities is unique in the way that they are viewed collectively due to their topography. Due to the absence or poor enforcement of development regulations in the North-Eastern cities, adjacent buildings have no co-relation to each other in terms of design or scale, even in the main commercial streets. The potential for a memorable streetscape, as often seen in tourist destinations, is not properly utilized. Overall, the cities are becoming more and more unpleasant to look at.

Fig. 14 *Unesthetic townscape due poor enforcement of development regulations in Kohima*

Suggestions for Change in Existing Building Regulations of North-Eastern Cities

The study paints a clear picture of the lacunas prevalent in the existing building regulations being exercised in the cities of the North-Eastern region. The main causes behind these issues are:

- A very generalized approach that has been largely influenced by the National Building Code, which results in non-contextual regulations insufficient to address the issues of the North-Eastern cities. Factors that take priority for development in plain areas might not necessarily be the same for that in hilly areas where majority of the North-Eastern cities are based.

- An approach to building regulations that is largely human-centric with no concerns for the environment and ecology.
- No coherence between the site and the regulations being formulated for the buildings that will be constructed on that site. Since the cities may have micro-environments due to the wide range of biodiversity and ecosystem seen in hilly regions, it is necessary to detail out zone-based regulations instead of prescribing an overall set of regulations for the entire city.

Some suggestions have been put forward as follows to be included in the existing building regulations for a more well-rounded development:

1. First and foremost, zoning should be according to both land use and ecological sensitivity. The maximum allowable density should be allocated according to slope, i.e., slope conditions should be used as the decisive factor in the development capability of the city's hillside lands. Once the maximum densities are determined, the actual densities can be further refined based on other factors like land use etc.
2. Building regulations should be detailed out according to the characteristics of the zone in which they are located instead of being prescribed a set of regulations for the overall city as practiced currently.

Conclusion

In conclusion, the cities of the North-Eastern region are experiencing an unprecedented increase in population due to increased accessibility. Because these cities have been developing in an unregulated manner during the past years, urban issues like traffic congestion, poor living conditions and infrastructure deficiencies have reached to the point of being called a serious crisis. This is only made worse by non-contextual building regulations that fail to fully grasp the issues faced by the cities.

The planning of cities in hilly regions is a challenging task and building regulations have to be formulated in a sensitive way. Prevailing conditions and vulnerabilities of hilly regions have to be studied and

understood properly for the regulation of development in such a type of topography. There is a need to understand the peculiar context of hill settlements for suitable modification of existing building regulations to make them appropriate for a well-rounded development in hill settlements.

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