Journal of Civil Engineering and Environmental Technology
Print ISSN: 2349-8404; Online ISSN: 2349-879X; Volume 1, Number 4; August, 2014 pp. 53 – 58

http://www.krishisanskriti.org/jceet.html

Study of Traditional Houses in Assam

Navanita Das, Shulanki Pal, Spondan Sapon Bora, Onenjungla Walling
Royal Group of Institutions
Guwahati, Assam
Bachelor of Engineering
Royal Group of Institutions
Guwahati, Assam

Abstract **: The North-Eastern region of India, being prone to many types of natural calamities, uses building construction techniques which prove to be resilient to disasters. One of the most common types of traditional housing practices found in this part of the country is the Assam-type housing, predominantly witnessed in the state of Assam. This type of construction uses lightweight materials such as bamboo, ikra (a locally available reed), wood etc which prove to be extremely effective against earthquake events. Unfortunately these houses are becoming extinct with the advancement in technology, and hence the growing popularity of RCC multi-storied buildings and steel framed structures. This project work studies the salient features of some of the existing traditional houses in Assam. A detailed estimate shows the cost comparison of an Assam type house and a RCC house. The study proves that if the ancient wisdom can be incorporated into modern building practices, it would lead to a far better earthquake resistant design, and would be cost effective as well.**

1. INTRODUCTION

Traditional houses and their construction were based on several factors ranging from socio-cultural, economic to physical factors, whereas today, housing forms are based on a different set of ideas/factors such as world view, rationalization and fashion. In past, people were more concerned about holistic orientations, were highly responsive to site, climate, topography for physical comfort and peaceful microclimate within the house. The old/traditional house represents certain values which tell something about the life style of the people, which explain their acceptance and success. Also, the fact that these houses, without the use of technology, remain unchanged in their design, points out towards their credibility.

1.1. Introduction of region - Assam

Assam is located in the north eastern part of the country, surrounded by six of the other seven sister states: Arunachal Pradesh, Nagaland, Manipur, Mizoram, Tripura and Meghalaya. It is a land of plains, hills and river valleys. It spreads over an area of 78, 523 sq. kilometres and its most important landmass are the plains of Barak Hills and the Brahmaputra Valley The great majority of Assam's people live in rural areas. Its geographical features especially the presence of river Brahmaputra has made it a very fertile area which has led to its prosperity in agriculture.

1.2. Climate

Assam experiences a tropical monsoon rain forest type of climate which is characterised by heavy rainfall and high humidity during most time of the year. The hilly areas experience sub- alpine climate whereas the plains experience sultry climate.

1.3. Disasters

Across Assam, families regularly face uncertainty on account of natural disasters as the state has a long list of disasters in the past. Along with flooding and landslides, the state is vulnerable to cyclones and earthquakes. Assam lies in a region which is one of the six most seismically active in the world and has recorded two of the largest earthquakes in India's recent history i.e. 1897 Great Assam Earthquake (M 8.7)and the 1950 Assam Earthquake (M 8.4) . In the past Assam has also witnessed high intensity flood towards the upper part of the state like in the districts of Lakhimpur, Dhemaji and Majuli.

2. TYPES OF TRADITIONAL HOUSES IN ASSAM

2.1. Ikra house

Ikra house, commonly referred to as the "Assam type house" is common throughout the Northeast India. Majority of such houses are used for residential purposes. Typically these houses are built with light weight locally available materials like bamboos, wooden planks, thatch etc. Such houses have a proper system of bamboo/wooden beam-column and fulfil the earthquake safety requirements of rectangularity and simplicity. Ikra houses are single-storey structures consisting of brick or stone masonry walls up to about 1 m above the plinth. This masonry supports the walls consisting of bamboo woven together with a wooden frame, and plastered with cement or mud plaster. The roof generally consists of GI sheets supported on wood/bamboo trusses, which laterally connect the parallel walls. Bamboo superstructure is connected to the masonry foundation walls using steel angles, and flats with bolts and nails. There were no reports of any significant damages to Ikra structures during past earthquakes.

Fig 1. Front view of an Assam type house

2.2. Mud house

Mud is a mixture of water and some combination of soil, silt and clay. The typical plan dimensions of these buildings are: lengths between 5 and 10 meters, and widths between 3 and 5meters. The building has 1 to 2 storey(s). The typical span of the roofing/flooring system is 3-4 meters. Roughly, the ratio of the length and width of the house can be expressed as 3:2 or 2:1 The typical storey height in such buildings is 1.6-2.5 meters.

2.3. Chang house

This house on raised stilts is an age old structure originating in the Himalayan ranges. In North Eastern India the tribes living on houses on stilts mainly live in hills amongst thick vegetation, forest and by the banks of rivers. Traditionally people of the Mishing community of Assam live in houses on stilts; these houses and the flight of 5-7 stairs leading to these houses have religious and social beliefs and practices attached to it. The house on stilts is a big hall with a central kitchen for a large joint family.

Fig 2. Chang house at Sadiya, Assam

2.4. Bamboo house

In bamboo housing system, for main structural member bamboo is used. The brick wall is used for modelling. And it is rigidly connected with plinth as well as with bamboo. In this system the wall is made of bamboo strips and it is plastered with mud. The houses are detailed out to combat the heavy monsoons. The roof of the house is built local grass and can last up to 10 years before it is replaced again. The stilted part of the house is for protection against gentle floods.

3. SEISMIC VULNERABILITY OF TRADITIONAL HOUSES IN ASSAM

3.1. History of past earthquakes

1897 Earthquake This was one of the most powerful earthquakes in the Indian sub-continent and probably one of the largest known anywhere. The quake created havoc across southwest of the present states of Assam, Meghalaya and Bangladesh. About 1542 people were killed and hundreds more injured. It had a magnitude of M 8.7.

1950 Earthquake The 1950 Assam-Tibet earthquake also known as the Assam earthquake occurred on August 15, 1950, and had a magnitude of M 8.4. The epicentre was actually located near Rima, Tibet. The earthquake was destructive in both Assam and Tibet, and 1,526 people were killed. It was the 10th largest earthquake of the 20th century. It was caused by two plates converging i.e. Eurasian Plate and Indian Plate.

3.2. Performance of traditional houses

Performance of traditional houses has been extremely good in several past earthquakes in the region. In the recent 18 September 2011 earthquake (M 6.9), severe damage was observed in reinforced concrete construction. On the other hand, the only damage observed in Ikra houses due to earthquake shaking alone (not due to landslides) was to additional class rooms of Ikra type constructed on third storey of Govt. Secondary School building. Therefore, such houses may not be suitable for construction on higher stories due to possible amplification of ground motion along of the height. No injury has been reported due to falling light weight debris of Ikra walls. On the other hand, damage sustained by the reinforced concrete part of the school building was severe. These traditional constructions are more flexible and hence, do not break under pressure due to rigidity.

4. ECONOMIC ASPECT

A detailed cost estimation of an Assam type house and a RCC house, both single roomed and of dimensions 3m x 3m was made using the current rates as provided by the S.R. of A.P.W.D. for the year 2010-2011. The estimates are as shown below-

4.1. Detailed estimate of traditional Assam type house (single room)

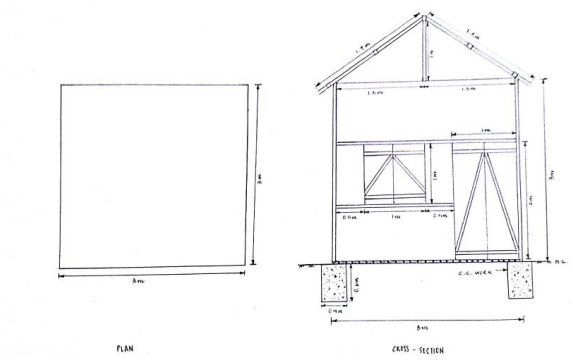

Fig 3. Traditional Assam Type House (Single Room)

Table1. Cost estimation of Assam type house (Single room)

Item No.	Particulars of item of work	Measurement No	L	B	D	Quantity	Unit	Rate (as per S.R of P.W.D for 2010-2011) Rs. P.	Amount Rs. P.
1.	Earthwork in excavation in foundation trenches etc.	4	0.04	0.04	0.60	0.384	cu m	64.67	24.83
2.	Plain cement concrete work 1:3:6 etc.	4	0.04	0.04	0.60	0.384	cu m	3733.63	1433.71
3.	Earthwork in filling in plinth etc.	1	3.00	3.00	0.25	2.25	cu m	137.00 (as per W.R. dept. for 2010-2011)	308.25
4.	Supplying fitting and fixing 750 mm long F.L. double straps at the bottom of timber post etc	4	–	–	–	4	sets	335.07	1340.28
5.	Providing dressed wood work in roof truss etc. With hollock timber (Battens)	1 3 4	2.00 3.00 3.00	0.075 0.075 0.075	0.05 0.05 0.05	0.008 0.034 0.045 0.087	cu m	29212.44	2541.48
6.	Providing dressed wood work in roof truss etc. With hollock timber (a) Truss	2	0.075	0.075	1.80 + 1.00 + 1.80	0.05	cu m		
	(b) Purlin	5	3.50	0.075	0.05	0.07 0.12	cu m cu m	27356.92	3282.83
7.	Providing wood work in frame (Chowkaths) of doors and windows etc. With 1st class (hollock) (a) Door	1 2	1.00 2.00	0.075 0.075	0.075 0.075	0.006 0.023 0.029	cu m cu m cu m		
	(b) Window	2 2	1.00 1.00	0.075 0.075	0.075 0.075	0.011 0.011 0.022	cu m cu m cu m		
						0.051	cu m	46853.38	2389.52
8.	Providing fitting and fixing local wood (hollock) Battened door and window etc. (a) Door (b) Window	1 1	1.00 1.00	2.00 1.00	– –	2.00 1.00 3.00	sq m sq m sq m	1034.14	3102.42
9.	Brickwork in cement mortar 1:1:9 etc. (cement, lime, sand)	4	3.00	3.00	–	36.00	sq m		
	Deduct – (a) Door (b) Window	1 1	2.00 1.00	1.00 1.00	– –	2.00 1.00	sq m sq m		
	Quantity including wall thickness	–	–	–	0.075	33.00 2.48	sq m cu m		
	Wall at both sides of truss members	2x2	1/2x1.5x1.00		0.075	0.225 2.705	cu m cu m	4249.20	11494.09
10.	15mm thick lime plaster etc.	4	3.00	3.00	–	36.00	sq m		
	Deduct- (a) Door (b) Window	1 1	2.00 1.00	1.00 1.00	– –	2.00 1.00	sq m sq m		
						33.00	sq m	110.77	3655.41
11.	Providing corrugated galvanized iron sheet roofing etc. 0.45 mm thick	2	1.90	3.10	–	11.78	sq m	335.27	3949.48
12.	Providing galvanized iron ridging etc. 0.45mm thick; 150mm lapping	1	3.20	–	–	3.20	R m	108.62	347.58

Grand total=36,569.88

4.2. Detailed estimate of present day RCC house (Single room)

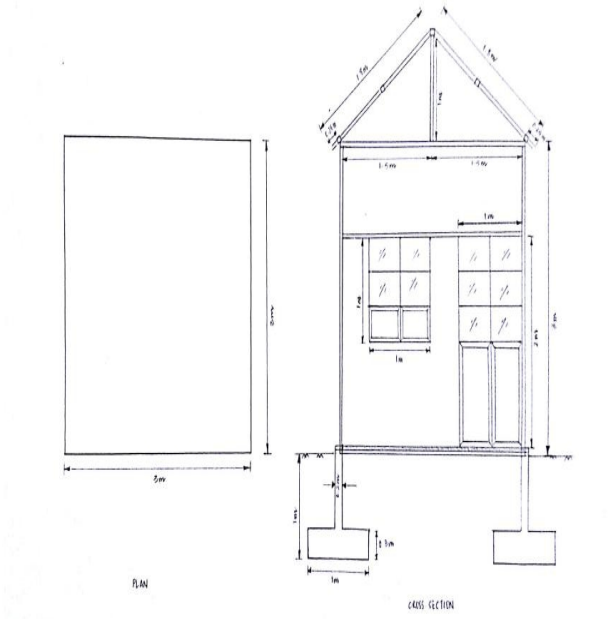

Fig 4. Present day RCC house (Single room)

Table 2. Cost estimation of RCC house (Single room)

Item No.	Particulars of item of work	Measurement No	L	B	D	Quantity	Unit	Rate(as per S.R. of P.W.D for 2010-2011) Rs. P.	Amount Rs. P
1.	Earthwork in excavation in foundation trenches etc.	4	1.00	1.00	1.00	4.00	cu m	64.67	258.68
2.	Providing and laying reinforced cement concrete 1:2:4 excluding cost of centering and shuttering in-								
	(a) Column base	4	1.00	1.00	0.30	1.20	cu m		
	(b) Column	4	0.20	0.20	1.00	0.16	cu m		
	(c) Piller	4	0.10	0.10	3.00	0.12	cu m		
	(d) Lintel –	4	3.00	0.10	0.075	0.09	cu m		
	(i)On G.L								
	(ii)Above doors and windows	4	3.00	0.075	0.05	0.045	cu m		
	(iii)Below truss	4	3.00	0.075	0.05	0.045	cu m		
						1.66	cu m	4734.15	7858.69
3.	Supplying fitting and fixing reinforcement etc								
	(a)10mm dia bars for:								
	(i)Base-net	4x2 x6	1.00	_	_	48.00	m		
	(ii)Column	4x4	4.40	_	_	70.40	m		
	(iii)Lintel	4x3	3.00	_	_	36.00	m		
						154.40	m		
						=1.0036	qtl.		
	(b)6mm dia stirrups:								
	(i)Column	4	4.00	_	_	16.00	m		
	(ii)Lintel	4x3	3.00	_	_	36.00	m		
						52.00	m		
	Total stirrups	52/.15	0.50	_	_	173.50	m		
						=0.47	qtl.		
						1.4736	qtl.	5793.80	8537.74
4.	Providing brick soling under floor etc Brick on flat soling	1	3.00	3.00	_	9.00	sq m	286.37	2577.33
5.	25mm thick cement concrete topping 1:2:4 etc	1	3.00	3.00	_	9.00	sq m	194.54	1750.86
6.	Brick work in cement mortar 1:3 etc.	4	3.00	3.00	_	36.00	sq m		
							sq m		
	Deduct:								
	(a) Door	1	2.00	1.00	_	2.00	sq m		
	(b) Window	1	1.00	1.00	_	1.00			
						33.00	cu m		
	Quantity including wall thickness	_	_	_	0.13	4.29	cu m		
							cu m		
	Deduct: Lintels:								
	(i)G.L	4	3.00	0.10	0.075	0.09	cu m		
	(ii)Above doors and windows	4	3.00	0.075	0.05	0.045	cu m		
	(iii)Below truss	4	3.200	0.075	0.05	0.045	cu m		
						0.180	cu m		
	Wall at both sides of roof truss members	2x2	1/2x1.5x1.00		0.075	0.225	cu m		
						4.335	cu m	4752.45	20601.87
7.	10 mm thick cement plaster 1:3 etc	4	3.00	3.00	_	36.00	sq m		
	Deduct:								
	(a) Door	1	2.00	1.00	-	2.00	sq m		
	(b) Window	1	1.00	1.00	-	1.00	sq m		
	Wall at both sides of roof truss members	2x2	1/2x1.5x1.00		-	33.00x2 =66.00	sq m		
						3.00x2 =6.00	sq m		
						72.00	sq m	99.76	7182.72
8.	Providing undressed wood work in roof truss etc.								
	With sal wood								
	(a) Truss	2	0.075	0.075	4.60	0.05	cu m		
	(b) Purlin	5	3.50	0.075	0.05	0.07	cu m		
						0.12	cu m	39903.10	4788.37
9.	Providing wood work in frame(chowkaths) of doors and windows etc.								
	With 1st class (hollock)								
	(a) Door	1	1.00	0.075	0.075	0.006			
		2	2.00	0.075	0.075	0.023			
						0.029	cu m		
	(b) Window	2	1.00	0.075	0.075	0.011			
		2	1.00	0.075	0.075	0.011			
						0.022	cu m		
10.	Providing fitting and fixing 1/3 panelled and 2/3 glazed door and window etc								
	With teak wood								
	(a) Door	1	2.00	1.00	-	2.00	sq m		
	(b) Window	1	1.00	1.00	-	1.00	sq m		
						3.00	sq m	2819.38	8458.14
11.	Providing corrugated galvanized iron sheet roofing etc. 0.63mm thick	2	1.90	3.50	-	13.30	sq m	425.09	5653.69
12.	Providing galvanized iron ridging etc. 0.63mm thick 150mm lapping	1	3.50	-	-	3.50	R m	108.62	380.17
13.	Colour washing with lime on wall etc.	4	3.00	3.00	-	36.00	sq m		
	Deduct:								
	(a) Door	1	2.001	1.001	-	2.00	sq m		
	(b) Window	1	1.00	1.00	-	1.00	sq m		
						33.00x2 =66.00	sq m		
	Walls at both sides of roof truss members	2x2	1/2x1.5x1.00		-	3x2 =6.00	sq m		
						72.00	sq m	21.40	1540.80
14.	Painting two coats on new G.C.I sheets etc. 0.63mm thick	2	1.90	3.50	-	13.30	sq m	50.35	669.66

GrandTotal=72,648.24

Hence, we observe that the cost of construction of houses of similar size in present day and using RCC is approximately, double of those constructed in the past, i.e. traditional houses.

5. SITE OBSERVATIONS

For practical analysis, a process of rapid visual screening was carried out in a few sites (6 no.s) spreading across Assam in the districts of Kamrup-metro, Dibrugarh, Sadiya and Silchar. The data sheet format used to obtain various information for some of the sites is shown below:

Table 3. Data collected from site visit for some traditional houses in Assam

Sl no.	1	3	3	4
Name	Assam Engineering Institute (Electrical laboratory)	Cotton College (Zoology laboratory)	Chang house	Bamboo house
Location	Chandmari, Guwahati	Dighalipukhuri, Guwahati	Mishing village, Sadiya	Udarband, Silchar
Architectural aspect→				
a. Building sitting	Flat terrain	Flat terrain	Slightly sloping terrain	Flat terrain
b. Building shape	Rectangular	L-shaped	Rectangular	Rectangular
c. Building size	33.35m x 4.35m	8.05m x 29.5m x 12.17m	9.9m x 5.49m	5.36m x 4.32m
d.Verandah orientation	along its length	along its length	along its length	along its length
e. Door size	2.1m x 1.25 m	2.15m x 1.26m	2.05m x1.1m	1.8m x1.15m
f.Window size	1.25m x 0.95m	1.78m x 1.32m	1.6m x1.2m	0.95m x 0.75m
g.Material of frames and panels	Sal wood	Sal wood	Sal wood	Gamari
Functional planning→				
a.Nature of use	Institutional	Institutional	Residential	Residential
b.Number of storeys	1	2	1	1
c.Elevators anf fire exits	No	No	No	No
Structural system→	Masonry for floor and walls, steel for roof and timber for truss, column, door and window. Shallow foundation	Steel roof, timber truss, floor and staircase, shallow foundation	Masonry pillars, rest bamboo, foundation on stilts	Steel roofing, timber wallls and columns, shallow foundation
Socio-economic aspect→				
b.Number of housing units	1	1	1	1
c.Economic level of inhabitants			low	low
d.Source of financing	Govt. owned housing	Govt. owned housing	Personal saving	Owner financed
Seismic features→				
a.F oundation posts	No settlement, sliding or tilting	No settlement	No settlement, sliding or tilting	No settlement, sliding or tilting
b.Frames	Light and flexible, no tilting and dislodging	Lightweight, flexible, no tilting and dislodging seen	light, flexible coonections, no tilting	light, flexible
c. Walls	No damage	No damage	No damage	No damage
d. Roofing	No dislodging of roof purlins and rafters	No dislodging	C.I sheets with hay supported on timber	Bamboo and timber planks
e.Joinery between various elements	Bolting	Bolting	Coconut ropes and aluminium wires	Steel clamps
f.Truss	In good condition	Hollock wood, in good condition	Timber	Bamboo, lightweight
Final remarks	Good performance over a long time	Ground floor made of brick, first floor made of ikra	Preferred in flood prone and hilly areas, cheap and common among tribals	Common in rural areas

By analysing the data collected through the RVS process, the following important conclusions could be made:

- As the materials are available in abundance in the surrounding locality, the cost of construction is less for the traditional houses.
- Another advantage is that the materials used are of light weight and give flexible connections. Hence, their performance is high during earthquake.
- The use of ikra and mud in the walls, lead to maintaining a cool temperature during summer and a moderate warm temperature during winter.
- These houses do not require skilled labours to build.
- These houses did not require reinforcement or deep foundation. So, this reduced the cost of construction.
- The Chang house performs very well during mild floods.
- However, the walls have insignificant strength and hence, are vulnerable to high pressure during heavy flood flow.
- In mud houses, there is no monolithic joint between wall and roof, hence, are also vulnerable to seismic forces.
- These houses are vulnerable to fire because of untreated- wood based materials.
- When built on hill slopes, unequal length of vertical posts leads to unsymmetrical shaking that may damage the house.
- Traditional houses are devoid of elevators or fire-protected exits. Hence, they are prone to accidental calamities.

6. CONCLUSION

Traditional houses have been in the North-eastern region for a long time and after their analysis, it can be concluded that they have been constructed to withstand the frequent disasters, i.e. earthquake, flood, landslide etc. The materials used are relatively cheap and locally available in abundance. Added advantage of the materials showed that they are of light weight and hence, more flexible and performed well during disasters. Assam is a high earthquake prone area and hence, if the benefits of traditional housing

practices can be introduced in the modern day construction, it would lead to a better earthquake resistive design and hence, a safer environment.

REFERENCES

[1] Khan, A.A., Ghosh, C., "Traditional Earthquake Safe Housing Practices of North East India", *Training Program, NIDM*, Ministry of Home Affairs, Govt. Of India, New Delhi, 2010

[2] Das, P., Korde, C., Sudhakar, P., and Satya, S., "Traditional bamboo houses of North-Eastern Region: A field study of Assam & Mizoram", *Trans Tech Publications, Switzerland*, 2012

[3] Kakkad, M.D., Capt., Sanghvi, C.S., "Comparative Study of Bamboo (Ikra) Housing system with Modern Construction Practices", *National Conference on Recent Trends in Engineering & Technology*,13-14, May, 2011, pp. 1-3.

[4] Nath , R., Dr. Pathak, J., Dr. Sharma, R., Dr. Hazarika, P. J., " Assam type house- the traditional earthquake resistant construction practice in Assam", *IIT-R, Disaster mitigation in housing in India - An agenda for future*, March 19-20 , 2010

[5] *Key Engineering Materials Vol. 517*, 2012, pp. 197-202

[6] Kaushik, H.B., Dasgupta, K., Sahoo, D.R., and Kharel, G., "Reconnaissance report, Sikkim Earthquake of 14 February 2006"