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3.3.1

Number of Research paper published per teacher in the Journals notified on UGC care list during the last five years

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Number of Research paper published per teacher in the Journals notified on UGC care list during the last five years

2020-2021

Sr.No.	Name of the author/s	Department of the teacher	Name of journal	Year of publication	ISBN Number	Link to the recognition in UGC enlistment of the journal/ digital object identifier number	
						Link to website of the journal	Link to arcticle/paper/abstract of the arcticle
1	Ar. Swati Rode	B.Arch.	Indian Journal of STEAM Vol.01 Issue-03 April. 2021	2021	Processing		

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2022-2023

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1	Ar. A. Sonpitale	B.Arch.	Wardha blocks: A Revolutionary Material for Composite Regions	2023	Proceeding		Conference2023@sbpatilarchitecture.com

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1	Ar. A. Sonpitale	B.Arch.	"Study of traditional occupation of Vadar community with new Transform"	2022	978-93-92774-00-3		

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2018-2019

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1	Ar. A. Bhagat	B.Arch.	Study Of Laterite Stone as Building Material in warm and Humid climate of Konkan	2019	978-93-87793-80-4		

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PREAMBLE

The built environment around us is fast changing and becoming a multidisciplinary effort. Architects must work collaboratively with other allied professions, such as engineers, environmental professionals, conservationists, IT professionals, procurement specialists, landscape designers, etc.

In addition, the future of the built environment is moving towards smart cities, which is changing the scope of the architecture profession.

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Call for Abstracts

Extended Last Date – 26th MARCH 2023

Call for PAPERS / POSTER presentation: Submissions of abstract are invited on any of the given themes and related areas. The **abstract should not exceed 250 words.** The **Font name:** Times new roman; **Font size:** 12; **Line spacing:** 1.5; **Margin:** 1" on all sides on A4 paper. **Keywords:** 3-5 should be given below the abstract in italic. The abstract should be sent in MS word format to the following email id: **conference2023@sbpatilarchitecture.com**

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Study of multisensory aspect through Practical Approach

on the streets of Pune

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Abstract

Architecture plays an important role in shaping the human life. Architecture cannot be experience without human involvement. A person's experience is evoked when 5 senses are involved. Thus while designing understanding of these 5 senses (sight, smell, taste, touch and hearing) is a must. But now a day's architecture is appreciated though sight only. Thus other senses are overlooked, giving architecture an incomplete meaning. Experiencing a space which involve senses gives an unforgettable memory about the place and situation. Hence this philosophy must be inculcated at the early stage of architecture that is 1st year students. They are naïve and enthusiastic. They have urge for learning. If this philosophy is harbored in them they could use these ideas in their design process for long run. In student's life open spaces plays an important role especially streets. Streets are used with as socio cultural aspect, for communications, gathering and casual meetings. Hence study of street with senses involved will benefit them to understand the human senses and street environment with an eye of architecture.

The aim of the study is to introduce the understanding of multisensory aspect to the first year architecture students through practical approach. This research is an applied experimental research. The study will take place on the streets of Pune. This approach will help students to understand the multisensory aspects in shaping their design and social aspects.

Key Words- Multisensory Aspect, human senses, Philosophy, Practical approach.

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PRE-ENGINEERING STRUCTURES FOR HEALTHCARE COVID 19

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Abstract: The whole world is facing disaster named Covid 19. The numbers of affected people are increasing and also the death rate due to corona virus. The people with positive symptoms need to be medically quarantined. Along with the quarantined facility a testing lab as well as the consulting lab is also needed. But the medical infrastructure is not enough to meet the increasing number of people. Now is the high time to build new infrastructure to fight against the virus. Basic consideration of healthcare infrastructure in this pandemic situation is cost effectiveness, modular construction, easy and rapid construction and mobility. Conventional way of building will be time consuming. Pre-engineered buildings are the answer to meet the demand. This reduces the time period and cost of the construction. Pre-engineered building could be built in less than half of the time as that of conventional technologies. PEB is the offsite building technology where process of planning, designing, fabricating, assembling building elements is done at the level factory. Then they are transported on the site producing high quality and custom made buildings.

Key word: *Modular construction,ConstructionTechnology, CostEffective, Rapid construction, Pre-Engineered Building, Off-site manufacturing, mobility.*

Introduction

The whole world is facing disaster named Covid 19.Our health facilities and workforce are currently inundated by a plethora of activities related to controlling the pandemic.Our country's healthcare facilities are disproportionate to the size of the population, The primary challenge is the gap between the supply and demand.

In India, the main challenges of healthcare development are the costs involved in the building and upgrade of healthcare infrastructure, now more than ever, in this pandemic situation it is imperative to explore newer alternatives to bridge the critical gaps in infrastructure, especially with respect to the availability of healthcare centres. The best way to deliver rapid treatment to covid patient is an alternative of construction like off-site building technology that ensures a fast and reliable solution.

Need of the study

There are 1,45,894 Sub Centers, 23,391 Primary Health Centers and 4,510 Community Health Centers in India as on March 2009

These figures are insufficient keeping in mind the model of 2005 National Commission on Macroeconomics and Health.

Fig 2.Source- Graph CSSEGISandData/COVID-19

Objectives

i) To identify various components of PEB construction technology.

ii) To execute required healthcare center in optimum period using PEB considering stability and serviceability.

iii) To dismantle existing PEB structure after attaining desired goal and reuse.

Pre Engineered building structures

Pre- engineered construction is the process of planning, designing, fabricating, transporting and assembling building elements at a factory rather than at the construction site. It cuts the delivery time by 50 per cent and reduces cost up to 30 per cent while producing high quality and custom built buildings.

Off-site building includes the integration of automation,

Study of multisensory aspect through Practical Approach on the streets of Pune

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Wardha blocks: A Revolutionary Material for Composite Regions

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Human have been evolving since decades. Many changes have been adopted with many priority changes. But the priority that did not change over decades are food, shelter and clothes. Shelter has been evolved from caves to high-rise structures. But this evolution has a cost to pay in terms of temperature rise and climate change. As per the Forbes report of 5 April 2022, nearly 40% emission comes from real estate. The rise in temperature is an alarming risk. This scenario is no different in rural areas. Hence to lower the temperature in houses 'Mud House technology" which has been used from ages has to be adopted. But mud house technology is not enough to meet new challenges. Therefore, Centre of Science for Villages, Wardha had developed special technique of mud wall and clay tiles roofing system to meet the modern issues. This paper aims to study the impact of Wardha block construction to control the temperature. It also investigates the temperature difference in the convention housing (concrete homes) and Mud House. The methodology adopted was the comparative analysis of both type of houses. Through this research, author intend to suggest the technology to control the rising temperature in houses. The study undergoes experimental research.

Key Word-Rising Temperature, carbon footprint, Mud houses, Appropriate technology. Rural areas.

Study of Traditional Occupation of Vadar community with new Transform

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Abstract: Vadar community is one of the oldest nomadic communities, known for their stone carving and stone work. Stone working is one of the earliest and important occupation in India. Vadars are prominent in conserving this traditional occupation. Components of house construction like door frames,Varandah seating,tulsi vrundavan,jata & pata(grinding stone), stone flooring, decorative cornices,columns are some of the products of the skillful work of this communities for so many years. But, due to urbanization and technological uplift, the stone products are losing their values and getting mere wages. The Vadar communities are migrators. But in the most recent years the people are migrating for jobs other than the stone carving and stone products. One group of this community migrated to Wardha and settled there. Some of the people try to keep this traditional work alive by making the stone carving and stone products and selling them on mere wages. Due to the awareness of historical buildings and attachment of people to history this profession got new platform to grow. Being migrators the most challenging part is to get the dwelling place, since the urban area cost so high, such people have to live in slums. They work in their dwelling place and sell the products on roads. The purpose of the study is to understand spatial requirement for conserving this traditional occupation of stone carving in the dwelling space of Vadar community.

Key words - Vadar community, traditional occupation, spatial, stone carving, conservation.

Introduction

Vadar also called as Bhovi,mati vadar,jati wadar etc. had traces originally from Orissa, their they are believed to be migrated to various parts of India. They are majorly located in Kranataka, Maharashtra and Telangana. The main occupation of this community is the traditional work which includes stone cutting, mine work, stone engraver, digging, construction etc. From ancient times they are engaged in the construction work and are known for their work in building forts and historical buildings. Since they are engaged with earth and earth excavation the name is given as 'Bhavi'. Originally the word Bhovi derived from Bhavi which means earth diggers in Kannada. The Vadar community is known for their hard work. Male and female contribute equally in social and economic activities.

The traditional work they perform demands migration hence this tribe has to migrate from one place to another as per the job requirements One of the group migrated to Wardha in search of work and got settled at Arvi Naka.High rates of real estate made them live in slums. The earning by the head of the house is inadequate hence almost all the members in the family are working. The head male of the house is doing the traditional work while the female works on daily wages. But the decline in the stone product products due to technologies and low income from it shifts the attention of the new generation towards the daily wages work.

The study shows that the people are skilled in stone work but the low product selling lead to insecurity of the earning The stone products are losing their values due to urbanization and technological uplift and getting mere wages. The migration and mere wages contribute to low standard of living. The livelihood is highly

compromised. The purpose of the study is to understand spatial requirement for conserving this traditional occupation of stone carving in the dwelling space of Vadar community. The study will try to find out the future of this traditional occupation.

Aim- To identify and enhance the sense of place, culture and occupation of Vadar Community.

Objectives –

a) To study about Vadar community
b) To study their occupation and livelihood.
c) Identification of issues for livelihood.
d) To study the spatial requirement for their occupation.
f) To study the availability of market for products and skills.

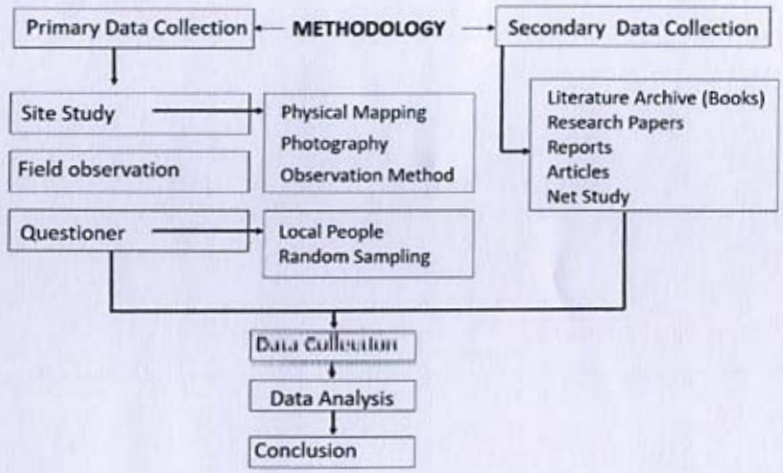
Methodology

The present study was conducted in the slum of Arvi Naka,Dist-Wardha of Maharashtra state. The study is purely based on primary data collection; the data collection has made from Vadar communities of Wardha.The slum has 20 houses of vadar. The researcher has selected 5 houses from the slum to conduct the study.The secondary data is also used to strengthen the study. The collection of secondary data is from books,articles,research papers and data available on internet.

Primary data collection

1) Interview
   The interview was scheduled in local language i.e Marathi. The family head male and female were interviewed. This interview gave the information about the personal information, traditional work, source of raw material and other occupation adopted over a period of time for survival.
2) Group discussion-
   The discussion with the Vadar community provided with vital information relevant to study.

Methodology Flow Chart



Literature Study

Vadar community is recognized by their typical profession. Stone cutting stone engraving and earth digging work. But in this 21st century the traditional profession of Vadar community is appearing to be vanished. Modern machinery and technology has replaced the role of Vadar in the society. So Vadar community has lost their work. Therefore, now days it is seen that Vadar people accept any work that is available, instead of their traditional skilled jobs. This tribe is known as Nomadic tribe but now settled at one or other places.

The study suggests that out of 500 people of vadar community 67% not doing family business only 33% are doing their traditional jobs. The income of these people vary from 1000- 15000 Monthly Income. Due to their acute poverty and nomadic way of life, the Wadars have a low social and economic status in society.The problem faced at workplace is the availability of raw material, storage and display of the finished product to sell. The set up for traditional occupation workplace is easy as most of work takes place at home in verandah or angan. Since the wages are low for stone products the vadar people opt for supportive business. Living condition is of low standard due to low income of major group in community and lack of education.Awareness about the Government opportunities is low

The Vadar community are called as **keeper for craft**. The Vadar community has contributed in construction of. From ancient period they are known for the traditional work. They have built wells to drink water, lakes and also canals. They built houses and palaces to live. They built places live temples, statues, caves, etc. to pray. They built roads, railways, pools over the rivers and lakes for communication.to make life easy of women's they built *jata, pata, khalbatta* etc. The historic places we see today is built by them. The list is never ending. Though they have such glorious history their hard work is lesser known. Restoration of historic building are taking place,vadar community skills are being used by the Archaeological Survey of India (ASI) and at UNESCO World Heritage Site as well.

Data collection - Study of Vadar slum in Wardha at Arvi Naka

Introduction to the Wardha city

India is a developing country and many regions in the country are developing rapidly in the context of industries, education, trade and agriculture. Thus giving rise to new infrastructures. In present scenario, Wardha city is powerfully emerging as an education and industrial hub in the region. From being rural vicinity decades ago it has now become the busiest emerging city in the Vidharbha region. With the development the city is also inviting the migrants in search of employment. Giving birth to slum.

Figure 1.map showing Wardha city

Figure 2.map showing location of Arvi Naka and slum

Figure 3 Slum at Arvi Naka

Location of Vadar community(slum):

- Slum is situated in prime square of city the square is known as Arvi Naka.
- It is 4 kilometer form Wardha Railway Station.
- Total area of Slum is 50,000sq.ft.
- Total population of slum is 350 and near about 100 Vadar resides in the slum

History of the slum:

- The land acquired by wadar community was once acquired by Shikh's
- In 1984, the Indira Gandhi was killed by a Sikh.
- On that background, the people around the land made them to vacant the place.
- The vacant was then acquired by Wadar, in today's date it makes more than 50 years.

Study of Individual Houses from Slum

1. House no. 1- Name: Uttam Jadhav(55) (no. of people in house- 8)

Figure 4 Location House no.1 **Figure 5** Working space outside the house in Angan and Finished product storage inside house.

Table 1. Details of traditional and other occupation of house no. 1

Origin	Traditional occupation	Other Occupation		Working of traditional occupation			
		Members	Occupation	Alone	Community	At home	Some other place
Uddir, washim Maharashtra	Stone work	Man Wife Son (1) Wife Son (2) Wife Daughter Son-in-law	Stone work garbage collection daily wages house wife daily wages house wife not working	✓		✓	
				Source of material	**Transportation**		**Medium of transport**
				Pipri (15 km from wardha)	Alone ✓		Truck Rs-2500/trip
					Community		

Table 2. Details of Space required and product selling

Space required (for stone work)		Product Selling	Market Value of the occupation
Working	3.2 X 3 = 10 m sq.	Door to door By cycle	•They are in great demand during 'yatra'
Raw Material	in working space		
Finished product	1 x 2 = 2 m sq inside the house		

Area statement of the house

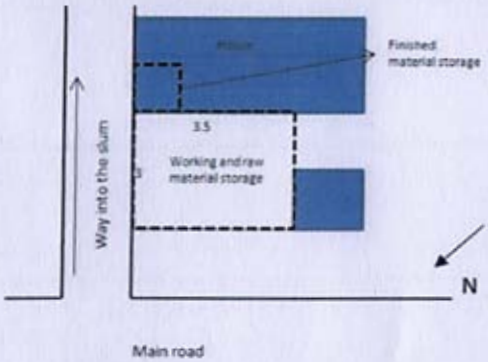


Figure 6 Area Distribution of house no.1

Table 3. Details of Earning and Remark

Earning		Remark
Stone Work	**Other Occupation**	• the new generation is not taking interest the traditional occupation due to low value of the Product • the head of the family is not leaving the stone work job because he thinks its his identity.
5-6 product a month Rs- 250-300/product 2,000 /month	a) Wife – 150/ day b) son (1)- 200/day c) son (2)- 200/day	
Total - 2000/month	Total - 16,500/month	
Family income - 18,500/month		

Source- Site analysis by Researcher

2. House no. 2- Name: Fakirdas Jadhav (no. of people in house- 7)

Figure 7 Location House no.3

Figure 8 Working space in the Verandah with finished product storage

Table 4. Details of traditional and other occupation of house no. 2

Origin	Traditional occupation	Other Occupation		Working of traditional occupation			
		Members	Occupation	Alone	Community	At home	Some other place
Parbhani Maharashtra	Stone work	Man Wife Son (1) Wife Son (2) Wife Son (3)	Stone work house wife stone work house wife stone work and daily wages house wife stone work	✓		✓	
				Source of material		**Transportation**	**Medium of transport**
				•Pipri (15 km from wardha) •Amravati		Alone ✓	Truck Rs-2500/trip If outside wardha Rs-3500/trip
						Community	

(Source : site visit)

Table 5. Details of Space required and product selling of house no. 2

Space required (for stone work)		Product Selling	Market Value of the occupation
Working Raw Material Finished product	3.2 X 2= 7m sq. in veranda no space near house some other space 1 x 2 = 2 m sq veranda	•They sell products in yatra •Door to door by cycle	•They are in great demand during 'yatra' • door to door selling gives variables

(Source : site visit)

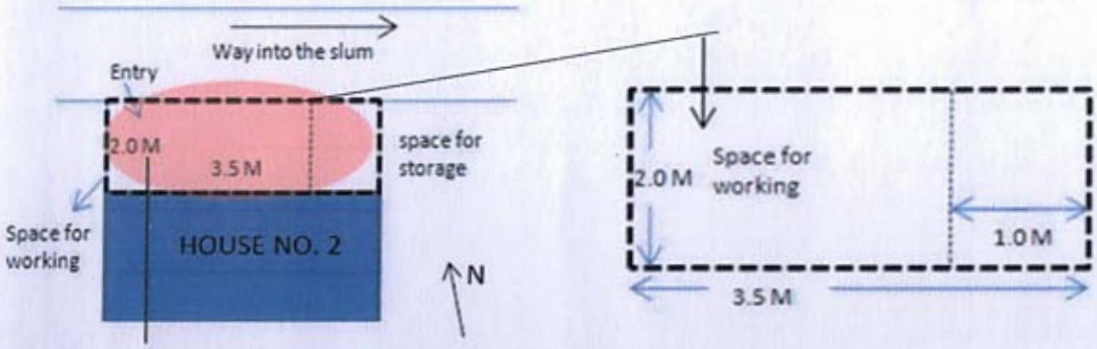


Figure 9 Area Distribution of house no.2

Figure 9 Exploded plan showing working space

Table 6. Details of Earning and Remark

Earning		Remark
Stone Work	Other Occupation	• due to the involvement of more people in the occupation from same house maximum products are sold . • during 'yatra' all male members work to get max. finished products • rest of the time, other work can be opted for livelihood
10-15product a month Rs- 250-300/product 4,500 /month	a) son (2)- 200/day	
Total 1500/month	Total - 6000/month	
Family income - 10,500/month		

(Source : site visit)

House no. 3- Name- Jiram Jadhav (noof people in house- 3)

3.

Name- Jiram Jadhav (no. of people in house- 3)

Figure 10 Location of house no. 3

Figure 11 Showing raw material storage, owner of the house and the storage of finished products inside house.

Table 7. Details of traditional and other occupation of house no. 3

Origin	Traditional occupation	Other Occupation		Working of traditional occupation			
		Members	Occupation	Alone	Community	At home	Some other place
They don't know	Stone work	Man (dead) Wife Son (1) Son (2)	Stone work daily wages daily wages not working	✓		✓	
				Source of material		**Transportation**	**Medium of transport**
				•Pipri,wardha •Amravati • Nagpur		Alone ✓	Truck Rs-2500/trip If outside wardha Rs-3500/trip
						Community	

(Source : site visit)

Table 8 Details of space required and product selling of house no. 3

Space required (for stone work)		Product Selling	Market Value of the occupation
Working	2 X 2= 4m sq. in veranda	•Door to door by cycle	• door to door selling gives variables • satisfactory market value .
Raw Material	in working space		
Finished product	1 x 2 = 2 m sq inside home		

(Source : site visit)

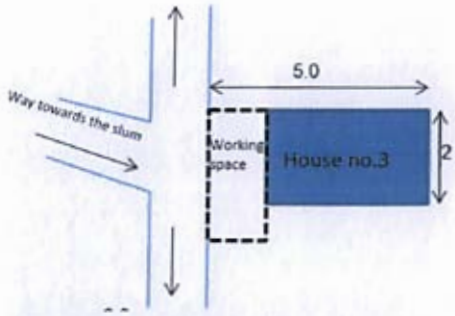


Figure 12 Area distribution of house no. 3

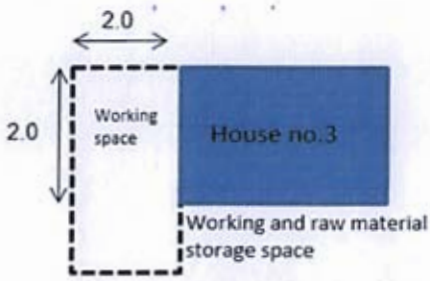


Figure 13 Exploded view showing working and storage area in plan

Table 9. Details of Earning and Remark

Earning		Remark
Stone Work	**Other Occupation**	
5-6 product a month Rs- 250-300/product 1,800 /month	Wife – 150/day son (2)- 200/day	• no involvement of the new generation in the stone work business • wife and son opted for another job for the income consistency.
Total - 1800/month	Total -10,000/month	
Family income - 12,300/month		

(Source : site visit)

4. House no. 4- Name: Ram Prasad Mule (no. of people in house- 9)

Figure 14 Location of house no. 4

Figure 15 Showing raw material storage, owner of the House working on stone and the storage of finished products

Table 10. Details of traditional and other occupation of house no. 4

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Study of Laterite Stone as Building Material in Warm and Humid Climate of Konkan

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Abstract:

Due to their inherent properties, completely different building materials respond otherwise to climate. The thermal properties of building materials determine the energy consumption patterns and comfort conditions in an enclosed space. Various building materials, such as locally available stones, used for construction work which we can study to understand the properties associated with materials. To know how properties will impact performance to consider the long-term effects of using a material on the environment Building material (construction material).

Keywords: Laterite stone, AAC blocks, Thermal Comfort, Konkan Region.

1. Introduction

Over the years, the use of common construction materials is widely practiced by the humans. The use of waste and recycled materials did not become common among Engineers. Also, the use of common construction materials does not provide satisfactory and desired properties in short period of time. Laterite can be a residual ferruginous rock, usually found in tropical regions and has shut genetic association with bauxite.

The term 'laterite' was originally used for very ferruginous deposits first determined in Malabar Region of coastal Kerala and different elements of state. it's an extremely worn material, made in secondary oxides of iron, aluminium or both. It is either onerous or capable of hardening on exposure to wetness and drying. Aluminous laterites and ferruginous laterite are quite common. Laterite is found in various parts of India, where it is extensively used as building material in regions of Kerala, Goa, Karnataka and Andhra Pradesh.

2.Characteristics of laterite

Laterite occurs principally as a cap over the summits of Basaltic hills and plateaus and is the characteristic feature of tropical monsoon regions. It is best developed in the Western Ghats and its foothills. Laterite stone was used as building material in Konkan for centuries. Type of weathered material which was indurated clay,
full of cavities and pores, containing large quantity of iron in the form of red and yellow ochre. It was soft when fresh and could be cut easily and when exposed, it became hard and resisted air and water much better than bricks.

it comply with Base case ECBC And it is also complies with the Super ECBC.

For North, East and West wall construction:
Option-01: 500mm thick composite walls
(300mm stone +50mm insulation +150mm cement concrete hollow block)

Table 6. U-Value calculation Option-01 (north, East and west)

No.	Skin Components	K Value W/m degC	Thickness (mm)	R Value for Given Thickness
1	Air film-internal			0.123
2	Cement concrete hollow	0.52	150	0.288
4	Glasswool insulation	0.034	50	1.471
6	Stone	2.92	300	0.103
7	Air film external			0.076
	Total 'R' value		500	2.06

"U" Value	0.485 w/sqmk

The wall assembly does not comply With Basecase ECBC

Option-02: 600mm thick composite walls.
(350mm stone +100mm insulation +150mm cement concrete hollow block)

Table 7. U-Value calculation Option-02 (north, East and west)

No.	Skin Components	K Value W/m degC	Thickness (mm)	R Value for Given Thickness
1	Air film-internal			0.123
2	Cement concrete hollow	0.52	150	0.288
4	Glasswool insulation	0.034	100	2.941
6	Stone	2.92	350	0.120
7	Air film external			0.076
	Total 'R' value		600	3.55

"U" Value	0.282 w/sqmk

By increasing the insulation by 50mm, assembly is comply with Base case ECBC

Sunspace:
Double glazing is used with 20mm space and the U-Value is 2.50 W/m2 degc.
And it does not comply With Base case ECBC.

6. RECOMENDATIONS

•Longer axis of the building should be East-west to maximum solar exposure
• External wall can be painted Black.
• To prevent heat loss cork-based weather-strips can be used to seal tight all the openings.
• Roof space collector can be used to pass the heated air inside the building.
•Avoid Window openings on the North side of the Building.
•South wall should be treated with Trombe wall construction.
•For External south wall 25mm thick glazing then 150mm Cavity and 300mm thick Stone wall can be used.This wall assembly comply with the super ECBC.
•For External three side walls (North, East and West) composite wall of 600mm can be used with 100mm thick insulation , 350mm stone and 150mm cement concrete hollow block. This wall composition complies with the Base case ECBC.
•Air lock should be provided at the entrance of the house to prevent heat loss.

CONCLUSION

The concept of passive solar heating is simple but application to the building requires attention to the details.
Attention towards construction methods and techniques. Assuming moderate level of sun tempering or Passive solar heating reduces the use of energy required for heating to the building by 5 % to 25 %.

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3.7 Air Lock at the entrance.

An airlock is a transitional space. The air lock is a small chamber consist of the two airtight doors. It has two doors in series to separate a controlled environment from a corridor. The two doors are interlocked to avoid being opened at the same time. This system can prevent contamination as well.
The recessed entry or the air locks should be provided as it helps to reduce the heat losses.

3.8 Glazed Atrium:

Atrium works effectively around the year in cold climate, and proves their efficiency so that it can be called as cool climate variant of open courtyard. Roof glazing provides thermal comfort and at the same time protection from rain and wind and a moderate resistance to heat flow. It adds aesthetics, environmental and economic benefits to the building. Mainly located centrally within the building. It has glazing mainly to its roof and less exposed to outside. The thermal buffering effect of atrium can be more substantial. Large glazing admits large amounts of solar radiation, at the same time low thermal properties of glass may lead to very low temperatures at night. Heat storage within this space is essential and should be provided to modulate the fluctuations in temperature. Design considerations are important in the sense of form, dimensions and materials in contact with main building as they provide solar control and heat dissipation. These particular phases helps to benefit the environmental performance of a glazed atrium over the year:

1. The Thermal Buffer Phase: In the regions with low winter sunshine, the most frequent condition is the atrium temperature is higher than that of outdoors, but lower than those in adjoining indoor spaces.

2.Sun Space Phase: Within the comfort range, heat can flow naturally to adjoining rooms by opening doors or windows, displacing conventional heating and saving energy but, atrium temperature is higher than that in adjoining spaces.

3. Over Heated Phase: The atrium temperature tends to rise above the comfort range and may also cause thermal discomfort in adjacent spaces. The glazed envelope and provisions for heat dissipation can prevent the rise in temperature much above the outdoor and provides effective shading as well. Heat storage can further allow heat attenuation of the peak temperature.

4. EXTERNAL WALL ASSEMBLIES

Below are the different effective combinations of material used for external wall assembly in cold and dry climate.
Different case studies are analyzed and types of wall assemblies are proposed for cold and dry climate to achieve better human comfort.

South wall:

South wall should be treated with Trombe wall

Option-01: 25mm thick Glazing + 100mm Cavity +230mm thick Brick wall plastered on both side.

Option-02: 25mm thick Glazing + 100mm Cavity +300mm thick Stone wall.

North, East and West wall

Option-01: 500mm thick composite walls (300mmstone +50mm insulation +150mm cement concrete hollow block)

Option-02: 600mm thick rammed earth wall.

5. U- VALUE CALCULATION OF EXTERNAL WALL ASSEMBLIES

As per Basecase

For ECBC compliant building: 0.34

For ECBC + : 0.22

Super ECBC compliant building: 0.22

For South Wall construction, Considering

Option -01: 25mm thick Glazing + 100mm Cavity +230mm thick Brick wall plastered on both side

Table 3. U-Value calculation Option-01

"U" value of Opaque Skin				
No.	Skin Components	K Value W/m degC	Thickness (mm)	R Value for Given Thickness
1	Air film-internal			0.123
2	Glass	0.96	25	0.026
4	cavity	0.026	100	3.846
6	12mm plaster	0.201	12	0.060
5	Brickwork dense	1.47	230	0.156
6	12mm plaster	0.201	12	0.060
7	Air film external			0.076
	Total 'R' value		379	4.35
	"U" Value	0.230 w/sqmk		

To comply With ECBC U-value needed id 0.34
The U value of above assembly is 0.23w/sqmK and it comply with Base case ECBC

Option-02: 25mm thick Glazing + 100mm Cavity +300mm thick Stone wall.

Table 4. U-Value calculation Option-02

No.	Skin Components	K Value W/m degC	Thickness (mm)	R Value for Given Thickness
1	Air film-internal			0.123
2	Glass	0.96	25	0.026
4	cavity	0.026	100	3.846
6	Stone	2.92	300	0.103
7	Air film external			0.076
	Total 'R' value		425	4.17
	"U" Value	0.240 w/sqmk		

To comply With ECBC U-value needed id 0.34.
The U value of above assembly is 0.240 w/sqmK and it comply with Base case ECBC

Option-03: 25mm thick Glazing + 150mm Cavity +300mm thick Stone wall.

Table 5. U-Value calculation Option-03

No.	Skin Components	K Value W/m degC	Thickness (mm)	R Value for Given Thickness
1	Air film-internal			0.123
2	Glass	0.96	25	0.026
4	cavity	0.026	150	5.769
6	Stone	2.92	300	0.103
7	Air film external			0.076
	Total 'R' value		475	6.10
	"U" Value	0.164 w/sqmk		

Advantages of Roof space collector over Trombe wall.

•Roof space collector has better exposure to sun than Trombe wall.

•Roof space collector does not interfere with building elevation.

•Roof space collector has low maintenance and has low capital cost as compare to Trombe wall.

•Roof space collector better suited for day time occupation.

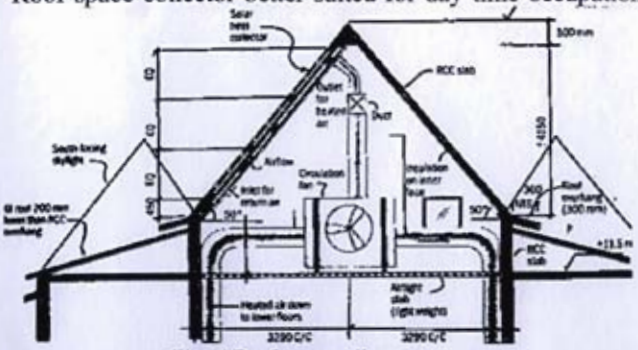

Fig.*10* Roof space collector

3.4 Transitional Spaces

Transition spaces are the fully surrounded space located at the center or circumference of a building. Which are rarely in use for constant occupation and are not heated by conventional means, the glass house as a form of extended house should include a wide range of forms and sizes. Conservatory or a glass house is different from glazed walls (Trombe) and roof. It is an architectural design which is more commonly practiced as space that is veranda, essentially in a cool climate. Conservatory should be design in a way to attain and maintain temperatures suitable for occupation in maximum time in a year. Moreover, In addition to providing pleasant space and habitability, good design also implies on the parent building meaningful thermal buffering effect, without creating more exposure to unneedful excess heat in warm period.

The exposed Sunspaces are used to collect the sun's heat, store it centrally and distribute it to different rooms. Sunspace heats the wind before it enters into the building. A sunspace different than direct gain and Trombe wall systems adds a room to the buildings.

Winter season section: A wall divides sunspace and a wall, two openings are provided on this wall. Air available in sunspace rises up when heated by sun radiation and endowed into the room. At the same time the cool air in the room at the lower level get into the sunspace. Which forms a cycle of passive heating air and flow, which goes on and on.

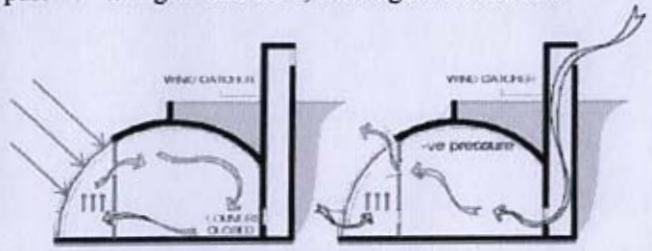

Fig.*11* section for Winter season (left)
section for Summer season (Right)

catcher placed with opened mouth to the prevailing wind direction forces the air to move inside and at the same time the warm air inside the room created due to negative pressure drawn out of the room. Sunspace can be ventilated to the outside direction to avoid excess heating if required. A properly vented sunspace can function as same as screened in porch, which make it open to the elements regardless of the time of year.

•To take advantage of the prevailing summer wind, operable windows and vent openings should be located for effective and required cross ventilation.

•With Sunspace we can combine earth berm and rock bed. Combination of sunspace with earth berm or rock bed can give optimum result.

3.5 Rock Bed

Rock bed can be used to enlarge the thermal mass of the building and thereby it also increases the ability of building to store energy. In rock beds air is drawn from the sunspace and through the bed of rocks. Heat is given in the direction to the rocks and air is circulated in repetitive manner to a location in the hot space to collect more and more heat. At night time when the heated air is needed, Available air from the stored space is released to rooms direction coming through the rock bed, where it pickups heat and distributed back to occupied space.

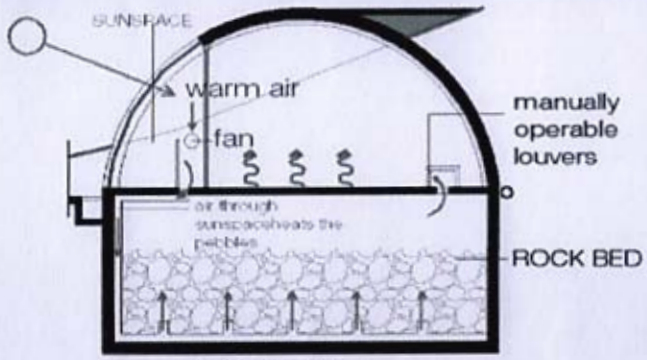

Fig.*12* Rock Bed

3.6 Earth Berms

Earth berm is the sheltering under earth. Here for external thermal mass earth is used. It reduces heat loss, and by this indoor air temperature is maintained.

Earth Berms restricts the heat loss in two ways:

By increasing the resistance to heat flow of the walls, roof, and floor and by reducing the temperature difference between inside and outside.

Daily temperature fluctuations are negligible at a depth greater than (0.6m) below the earth's surface.

3. PASSIVE DESIGN STRATEGIES

3.1Orientation of the building

Building orientation plays a vital role in this climate. To have maximum solar exposure longer axis of the building should be oriented East-West and it is more efficient for both winter heating and summer cooling. South sun is useful for daylighting in the building we can reduce radiation coming from the south sun by introducing proper shading devices. Long façade of the building is available to collect solar radiation i.e this orientation allows for maximum solar glazing (windows) to the south for solar capture for heating.

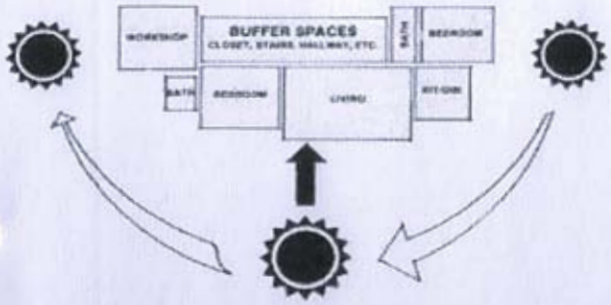

Fig.8 Orientation of the building

3.2 Building Materials and Construction Techniques

• Walls plays a major role in receiving the amount of solar radiation. Building material used for the construction should be with low embodied energy and the choice of building material is important in reducing the energy content of the building and it also maximizes thermal comfort of the occupant.

• The strain on conventional energy can be reduced by using low-energy materials, efficient building technologies. i.e we should use locally available material.

• Heat loss control can be achieved by compact building form, high level of thermal insulation, air tightness, and earth sheltering and earth air heat exchangers.

•When Building needs Mechanical heating or cooling then building should be provided with good thermal insulation

•An airtight construction with controllable means of ventilation to minimize infiltration and heat recovery from outgoing indoor air to reduce heat loss, are the options.

• Windows should be orientated in south direction, East & West direction.

•Careful consideration to joint and frame materials to minimize thermal bridges and cold air infiltration and warm air exfiltration.

• Windows should be orientated in south direction, East & West direction.

•Penetration and absorption of solar radiation into the building will depend on the colour of the external surface. Below shows the % of absorption radiation of incident solar radiation

Table 1. External Wall surface with solar absorption capacity

External Wall Surfaces	% Radiation absorbed
White washed external wall surfaces	15 %
Medium dark paint shades like dark grey, green, red etc if used for the external façade.	60to 70 %
Black external wall surfaces	80to 90 %

•The air and surface temperatures of the buildings depends on the type of shading present in the building and the composition of glass is used in the windows.

Table 2. Type of shading with Entry of % of radiation

Type of Shading	% of radiation enter into the building
With external shading	10 %
Internal shades	40 to 50 %
Without shading	90 %

• The indoor temperature of the building also depends on the material used for the external surfaces, materials used for the construction etc. It is possible to increase 10 degree Celcius than outdoor temperature when the external wall is thin, low resistance and capacity walls, painted externally dark and have large unshaded windows and if the ventilation is absent, the indoor temperature above outdoor maximum may rise above 20 degree Celcius.

3.3 Trombe wall construction

Glazed outer side of external wall helps trapping solar radiation. Glazed wall also prevents convective and radiative losses, which results in higher wall surface temperatures. Eventually, It maintains air cavity between glazing and wall, above outside temperature. The warmed air tends to rise up, the warmed up air can be endowed from cavity to adjoining room through the opening at the top of the wall and a controllable loop to withdraw air from the room can be established via openings at the bottom part. Through this process by conduction additional solar radiation is absorbed by the external wall.

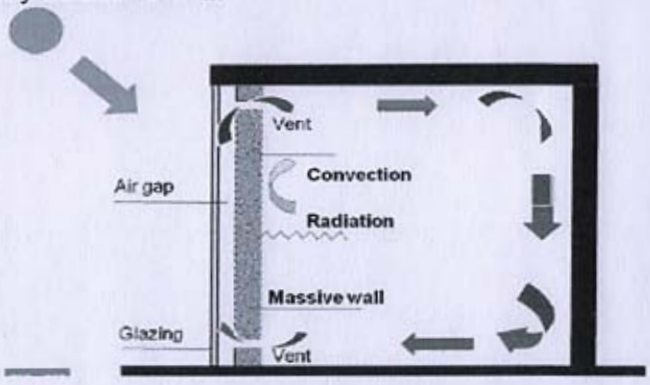

Fig.9 Trombe wall section

3.3 Roof Space Collectors

Roof space collectors replaces the roof cover on a south facing slopes, which we glazed to trap solar radiation. This solar radiation is then collected and absorbed inside the loft to heat air, heated air then passes to the rooms with the help of ducting

•South wall is painted black to provide better heating as black surfaces absorbs 80-90% of solar radiation.
•Heat loss happens through the door and windows of the building therefore to prevent heat loss cork-based weather-strips are used to seal tight all the openings
•Air lock at the entrance is designed.
•Hostel is properly lighted with natural light in the day.
•Future provision of Photovoltaic cells is planned to provide most of the night lighting.
Below is the plan of the LEDeG (fig.1) and section showing the use of renewable source of energy in the building and Air lock, trombe wall and solarism.

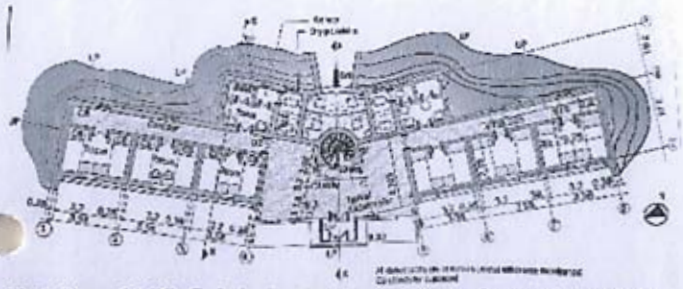

Fig.1 Plan of LEDeG, Leh showing arrangement of rooms around the central courtyard.

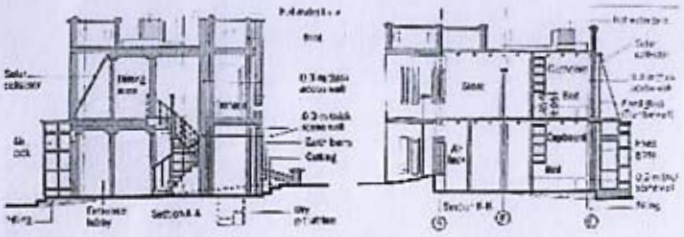

Fig.2 Sections of LEDeG ,Leh

2.2 Sarai for Tabo Gompa ,Spiti

The sarai is an institutional building for Topo Gompa and is located in spiti district. Due to the site drawbacks the building is oriented in such a way that it had to face the east and West.It has rooms surrounded by courtyards.
It has two intermittent courtyards, it acts as sunspace because it is covered by glass. It provides heat and light for the north side of the building.
Below are the external wall assembly used and passive design Features used in this building.

External wall construction

•600mm thick rammed earth wall.
•Trombe wall is on South façade.

Passive Design Features

•Minimum opening and sizes is on the South, East and West.
•Thermally massive construction.
•Centrally located courtyards covered by glass for heating of inner rooms and daylighting.

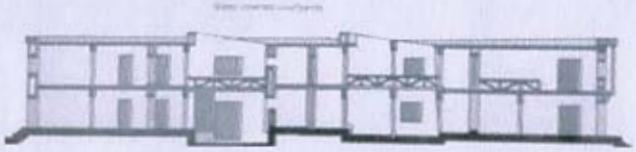

Fig.4 South Façade trombe wall

Fig.5 Plan

2.3 Airport and Staff Housing colony, kargil

Kargil is located in cold and dry region and Airport is designed is for maximum solar penetration in all the areas and it is heated by the solar energy whether the gain is direct or indirect. Airport Staff housing consist of residential units ,2 numbers of three bedroom units, 4 two-bedroom units and 8 one-bedroom units. It designed in a cluster like form and it is planned in such as a way it will have maximum solar penetration inside the building.
Below are the external wall assembly used and passive design Features used in this building

External wall construction

•500mm thick composite walls.
(300mm stone +50mm insulation +150mm cement concrete hollow block)

Passive Design Features

• Large double glazed surfaces on south face
• Earth berming on the east face acts as insulation.
•Clerestory maximizes solar heat gain and daylight to all inner spaces.
•Clustered around central open spaces with maximum southern exposure.
•Terraces and glazing on the longer side have southern orientation for direct solar gain.
• Minimum opening on north prevent heat loss.
• North-side entrances provided with double air lock.

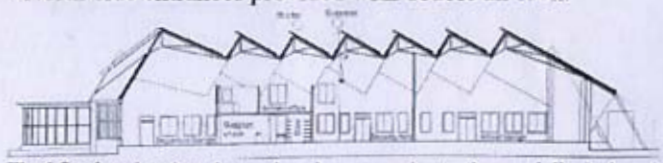

Fig.6 *Section* showing change in solar access due to the specially designed roof opening

PASSIVE DESIGN STRATEGIES FOR RESIDENTIAL BUILDINGS IN COLD AND DRY CLIMATES

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Abstract: As the study shows that, buildings emits 6% of the greenhouse gases and consumes more energy. And many of the researches shows that there will be energy crises in future and for the energy crises the contribution of residential sector is more than any other sector .Buildings in cold climates consumes more energy and more amount of gas emission takes place because of heating required in winter season. So, improvising the thermal comfort of the residents and no use or reducing the use of fossil fuel based system in the building is a challenge. Because of the rapid development and urbanization the use of heating and cooling system is increased in the individual buildings. Hence studying the passive design strategies and its impact on the building's energy consumption is important .Cold and dry climate is considered for the study purpose. The results shows that different types of passive design strategies which can be applied to the buildings in cold and dry climates and the use of building materials for the external wall assembly which can be recommended and integrated in the residential buildings at the time of designing itself in the similar type of climatic conditions.

Key Words: **Passive strategies, energy consumption, human body comfort, heating systems, construction techniques**

1. INTRODUCTION

India's domestic energy consumption has increased tremendously. In 2012 the energy consumption is increased from 80 TWh to 186 TWh, and it adds upto 22% of total current electrical consumption. Buildings total floor area is expected to rise 400 percent and till 2030 it is estimated to be around by 20 billion meter square.By2050, it is predicted that energy consumption will increase more than eight times. So to develop India, energy efficient strategies or the passive design strategies should be studied and should apply to the buildings to reduce the current energy demand.

Passive design is design that takes advantage of the Natural Energy Sources available, climate to maintain a comfortable temperature range in the house.

Characteristics of Cold and Dry climate

The area which has cold and dry climate is in the mountainous region and has less vegetation. Solar radiation is extreme with low percentage of diffused radiation. Relative humidity is consistently low at 10-50 percent. Precipitation is also very low and it is generally less than 200mm per year. Wind is occasionally extreme. Sky is clear throughout the year, cloud cover is less than 50 percent and the temperature varies from 25 degree to -25 degree Celsius.

The main objectives of the Building Design in this climate

a. Resist Heat Loss from the building

b. Promote heat gain in the building.

a) **To resist heat loss, below following steps can be taken**

•.Using appropriate material which can gain heat faster and release very slowly or it can store heat for longer duration and release heat when it is needed.

b) To Promote Heat gain below following steps can be taken

•By avoiding shading devices or excessive shading.

•By trapping the heat which is coming from the sun.

2. CASE STUDIES

2.1 LEDeG (Ladakh Ecological development Group) ,Leh

The climate of the Leh is cold and dry. Here in this climate harnessing solar energy is very important to have better human comfort inside the building.

LEDeG is a hostel having accommodation for 24 people with toilets, laundry area and study facilities all the facilities are integrated into the building.

Here traditional techniques have been modified and adapted.

Below are the external wall assembly used in the hostel and solar passive design features is used to have good human comfort.

External wall construction

• Ground floor wall assembly is made up of Rubble masonry with mud mortar.

• Thick mass of earth on the wall and it is framed with timber.

• Thick mass of earth is also on the roof which provides insulation.

Passive Design Features

•Orientation: Longer face of the building is facing [illegible] and