

# Use of Industrial Waste in the Field of Construction

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**Abstract**— The basic elements of our environment are air, water, trees, buildings, vehicles, people, animals, birds & the most important WASTE.....

The waste play an important role in our daily lives as it is spread anywhere & everywhere without considering its uselessness in our activities. So to give the justice to this waste, it should be reused in every possible ways.

The study focuses on the types, ingredients and various sources of the waste. The main types are residential, commercial, food, bio medical, educational, hospitality, construction, maintenance, & industrial; further divided into biodegradable & non-biodegradable, so ingredients change accordingly.

There are some of the treatments & processes which make this waste reusable in various other forms. The most harmful and dangerous are the Industrial waste.

The achievable aim & objective of this study would be to understand, in what ways the industrial wastes can be reutilized in construction. The study would focus on the literature to understand the importance of waste management, causes of industrial waste, and effects of industrial pollution, theory & reasons behind the issue. From the survey & research one of the industry i.e. Packaging Industry is been finalized to work out for development of new material for construction field.

Book & live Case studies help to identify the major problems in current scenario, and current materials that are used in packaging. Enlisted materials which are prominently used in the packaging industry are paper, glass, metal, cartons, plastic, bubble sheet, thermacol.

After the studies & research the achievable task is to develop a material or a technique which can easily be utilized in the field of construction with low initial investment.

**Key words:** industrial waste, packaging material, treatments & processes

## INTRODUCTION

Waste is any substance which is discarded after primary use, or it is worthless, defective and of no use.

Examples include municipal solid waste (household trash/refuse), hazardous waste, wastewater (such as sewage, which contains bodily wastes (feces and urine) and surface runoff), radioactive waste, and others.

Industrial waste is the waste produced by industrial activity which includes any material that is rendered useless during a manufacturing process such as that of factories, industries, mills, and mining operations.

It has existed since the start of the Industrial Revolution.

We have millions of factories, mills, industries, mining plants, etc. around the world. These industries use raw materials to produce finished goods for consumers.

But in the manufacturing process, there are materials which are rendered useless. They constitute the industrial waste.

Some examples of industrial wastes are metals, paints, sand paper, slag, ash, radioactive wastes, etc.

Industrial waste can be categorised into biodegradable and non-biodegradable.

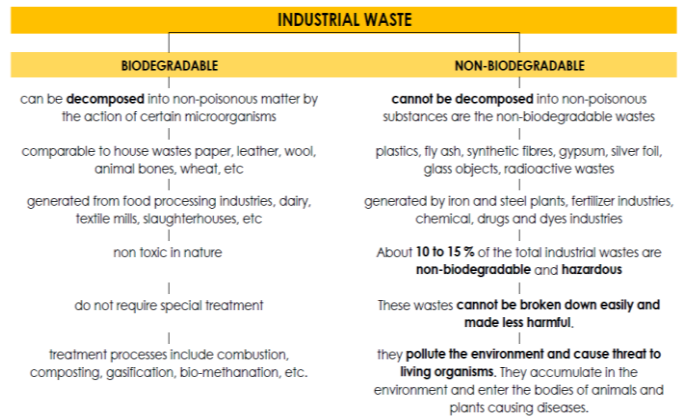


Figure 1 Segregation of waste

About 10 to 15 % of the total industrial wastes are non-biodegradable and hazardous, and the rate of increase in this category of waste is only increasing every year.

These wastes cannot be broken down easily and made less harmful.

Hence, they pollute the environment and cause threat to living organisms.

They accumulate in the environment and enter the bodies of animals and plants causing diseases.

However, with the advancement in technology, several disposal and reuse methods have been developed.

Wastes from one industry is being treated and utilised in another industry.

For example, the cement industry uses the slag and fly ash generated as waste by steel industries.

Landfill and incineration are other methods which are being resorted to, for the treated of hazardous wastes.

## NEED OF THE STUDY

Industrial waste is simply a catchall term for the undesired by-products of industrial activities such as mining and manufacturing.

Basic need of this study would be,

- IMPROVE THE QUALITY OF ENVIRONMENT
- PROTECTING HUMAN HEALTH

**c) LEGAL LIABILITY**

Inefficient Waste Disposal: Water pollution and soil pollution are often caused directly due to inefficiency in disposal of waste. Long term exposure to polluted air and water causes chronic health problems, making the issue of industrial pollution into a severe one.

**CURRENT SCENARIO**

Industrial waste dumped on road  
 Oct 4, 2017, 06:25 IST ([www.timesofindia.indiatimes.com](http://www.timesofindia.indiatimes.com))



Figure 1: Bali silan hospital, Sundarbans, India. Photo: Samrpan Foundation  
 Figure 2 Current Scenario of solid waste

Throwing of industrial waste is a serious concern in our area. In spite of several complaints through this app no work has been done. Authorities pass the ball to one another. Small industries from Sultanpuri area

dump these on the road during early morning hours. Experts say damage done to wetlands is beyond repair

Written by Garima Mishra | Pune October5,2017 8:57 am  
 October5,2017 8:57 am (<http://indianexpress.com>)

In 1840, a study on the fish of Mula-Mutha found 120 species; the figure dipped to 62 in a survey conducted between 1997 and 2002.



Figure 4 solid waste dump



Figure 3 solid waste collection in bags



Figure 5 solid waste dump

**AIM & OBJECTIVE**

The achievable aim & objective of this study would be to understand, in what ways the industrial wastes can be reutilized in construction.

The thesis is focused on;

- Use of industrial waste in the field of construction.

- The scope is limited with the use of the air bubble sheet as a construction material
- Use of the air bubble sheet in construction practice as fillers, insulating materials etc.

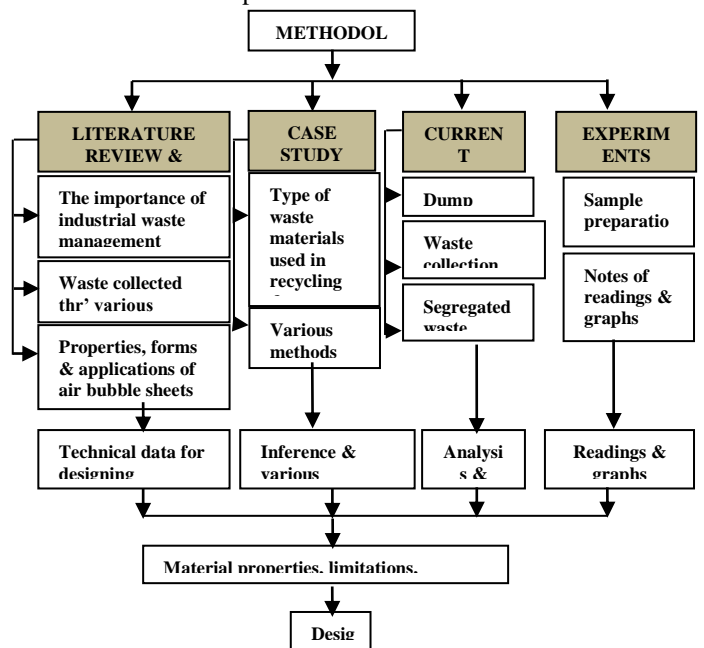
**METHODOLOGY**

Identified issue is dangerous to the society, it has to control. But the technique to be developed which is not harmful to the society as well as environment.

The methods to be used to reuse or recycle the waste material is without burning it or incinerate it.

To start with, the research & in depth literature survey was carried out to understand the theory & reasons behind the issue and framed the critical analysis of the same.

Case studies & experiments played the major role in finding out to identify the major problems in current scenario & the solution to the said problem.



**A. LITERATURE STUDY**

**1. THE IMPORTANCE OF INDUSTRIAL WASTE MANAGEMENT**

Industrial waste is simply a catchall term for the undesired by-products of industrial activities such as mining and manufacturing.

Basic need of this study would be,

**a) Improve The Quality Of Environment**

Poor industrial waste management can lead to those wastes getting into the local environment and then causing possibly irreparable damage.

For example, chemical pollutants from manufacturing and similar industrial processes can enter the water and get into the bodies of everything living in that water.

Certain chemicals can build up if ingested, meaning that higher and higher concentrations build up in the bodies of animals higher on the food chain, including potentially humans.

Proper industrial waste management will help deter such outcomes while also ensuring that less hazardous industrial wastes are recycled, which is something that comes with its own benefits.

**b) Protecting Human Health**

Improper handling and disposal of industrial waste can contribute to increased incidents of serious medical conditions among the human residents of the local region. For example, if the run-off from a cattle ranch enters the local river, residents living down-river from that ranch can find themselves falling ill with diseases such as e-coli infections. Effective industrial waste management will not only do a better job of ensuring that such outcomes never happen, but also reducing the amount of industrial waste that is produced in the first place.

**2. LEGAL LIABILITY**

Businesses have the obligation to effectively manage and dispose of their industrial waste. If they fail to do so, they will become liable for the damages caused through their negligence.

**CAUSES OF INDUSTRIAL POLLUTION**

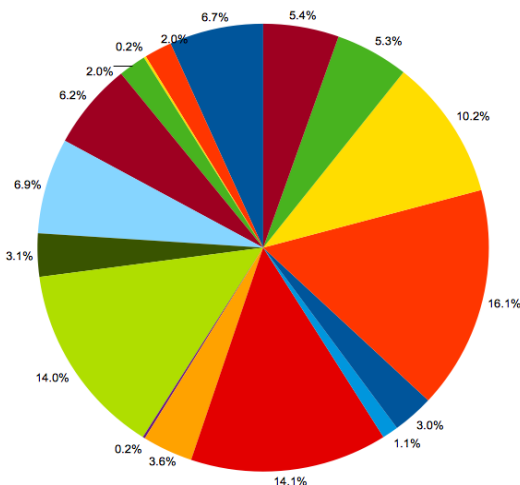
1. Lack of Policies to Control Pollution:
2. Unplanned Industrial Growth:
3. Use of Outdated Technologies:
4. Presence of Large Number of Small Scale Industries:
5. Inefficient Waste Disposal:
6. Leaching of Resources From Our Natural World:

**EFFECTS OF INDUSTRIAL POLLUTION**

1. Water Pollution:
2. Soil Pollution:
3. Air Pollution:
4. Wildlife Extinction:
5. Global Warming:

**WASTE COLLECTED THR' VARIOUS INDUSTRIES**

Figure 7 Pie Chart showing waste collected thr' various industries



- Accommodation and Food Services
- Administrative, Support, Waste Management, Remediation Services
- Agriculture, Forestry, Fishing and Hunting
- Arts, Sports, Entertainment, and Recreation
- Banking, Finance, and Insurance
- Construction
- Education
- Healthcare and Social Services
- Holding Companies and Managing Offices
- Manufacturing
- Retail
- Transportation and Warehousing
- Wholesalers
- Other Services – Repair, Personal Care, Laundry, Religious, etc.
- Professional, Scientific, and Technical Services
- Public Administration, Information, Utility Services
- Real Estate and Rentals

**AIR BUBBLE SHEET FORMS:**

- Air Bubble Sheet / Film
- Reflective Bubble Insulation
- Air Bubble Pouch
- Air Bubble Film Rolls / Bags

**A. PROPERTIES OF AIR BUBBLE SHEETS**

Air bubble LDPE film has following properties.

1. Excellent water resistance
2. Atmospheric resistance
3. High dielectric properties.
4. Resistance to termite and white ant.
5. Easy and economical packaging process.
6. Very high shock absorption property.
7. Resistant to most acid and alkalis for moderate duration.
8. Light in weight, attractive look, printable, washable and heat sealable.

**B. CASE STUDY**

This study is conducted thr' books, net & live case study. Interview method & observations in case of live case study. Case study has been selected by having certain parameters such as use of waste materials in any form or methods in construction, the application of the same, any techniques which can be incorporated for the same purpose. Materials used such as bottle, can, cardboards,

**ANALYSIS WITH VARIOUS BUILDING ELEMENTS**

List of all building elements to analyze, various possible alternative solutions using Air Bubble Wrap.

Table 7: analysis of various building elements for possible alternative solution using air bubble sheet.

NO	ELEMENT	ALTERNATIVE SOLUTION	FOR
1	Plinth	-	
2	Flooring	below the tiling material	water proofing the surface
3	Columns	-	
4	beam	-	
5	Walls	creating cavity within the reinforced wall - air	thermal insulation

		bubble pouch	
6	plaster	-	
7	Window	-	
8	Sill	beneath the plaster or on the plaster beneath sill	water proofing
9	Lintel	covering stone material	
10	Chhajja	covering on concrete surface	water proofing
11	shutters	sandwich between double glass	protection against harsh UV rays
12	frame	-	
13	partition	preparing partition sandwiched with A B Wrap sheets	light weight easy transportation
15	slab	on slab below flooring tiles / flooring material	water proofing
16	waterproofing	-	
17	tiles	-	
18	cladding	-	
19	roof	on terrace slab below flooring tiles / flooring material	protection against harsh UV rays waterproofing
20	electrification	-	
21	plumbing	-	
22	sanitation	-	
23	drainage	-	

EXPERIMENTS

A. *Stitched with cloth or sandwich paneled in frame – for insulation*

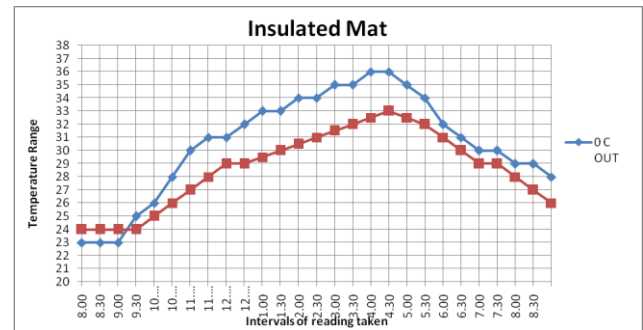
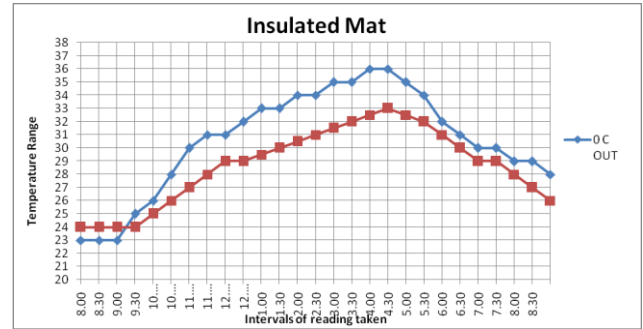


Figure 6 created with sandwiched air bubble sheet in cotton cloth.

Thermal test:

The air bubble sheet is stitched sandwiched in cloth. This improves the insulating property of the cloth.

- The place where there is tremendous cold & cannot be protected by a simple tent, this kind of insulating tent material can be helpful for the same. This increases the cavity or air gap in two cloths.
- If this kind of a panel is used as flooring material also, it will help in trapping the heat & reduce the heat loss.



Graph 1: temperature graph on 25 February 2018

Graph 2: temperature graph on 26 February 2018

Sound Test:

This mat was hanged in the door of a room and checked on sound meter for the sound penetration through it.

The sound created outside the room was 60 – 62 DB & inside the room was 40 – 45 DB.

B. *Sandwich with glass for window*

When a bubble sheet is sandwiched in two glass panels, it creates cavity n traps the heat inside reduces the loss of heat which is there inside the room.

Need to observe the same experiment in summer season too.



Figure 8 single glass with a backing of air bubble sheet



Figure 7 sandwich glass with air bubble sheet



Figure 12 sandwich glass on box for the whole day

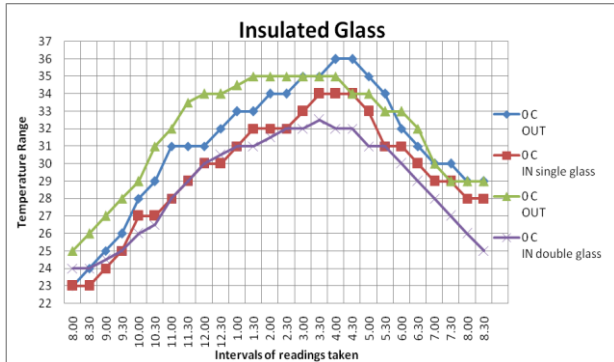
When A Bubble Sheet Is Sandwiched In Two Glass Panels, It Creates Cavity N Traps The Heat Inside Reduces The Loss Of Heat Which Is There Inside The Room.

Need to observe the same experiment in summer season too.

The panel of air bubble sheet sandwiched in two glasses.  
 Size: 15'' x 15'' stucked together.  
 The panel kept covering the box for two days sequentially  
 single glass & double glass.

**Thermal Test:**

The temperature records taken on thermometer continuously for these days give the graph showing the temperature decrease inside the box.



Graph 3: temperature graph for 22 & 23 February 2018 for glass panel single & double.

**Sound Test:**

This insulated glass was kept on the box and checked on sound meter for the sound penetration through it.  
 The sound created outside the room was 45 – 47 DB & inside the box was 37 - 38 DB.

**C. Sandwich with cardboard**



Figure 9 air wavy strips sandwiched in card board

When a spiral wavy thick air bubble sheet is sandwiched with cardboard can be utilized as insulating panels, as there is an air gap created This air gap makes it light in weight and can be applicable for light weight



Figure 9: comparison between two covering panels, glass & cardboard sequentially.

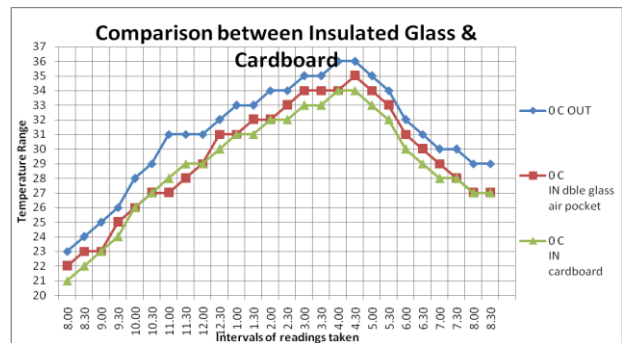
The panel of air bubble sheet sandwiched in cardboard.  
 Size: 15'' x 15'' stucked together.

To compare two different materials in the same situation, this cardboard sandwich mat is kept with the glass panel on another box.

But this time, the box covering with glass has the air circulation pockets on its sides.

**Thermal Test:**

The temperature records taken on thermometer continuously for these days give the graph showing the temperature decrease inside the box.



Graph 4 temperature graph for 24 Feb, 2018 for glass sandwich & cardboard panel

**Sound Test:**

This cardboard was kept on the box and checked on sound meter for the sound penetration through it.  
 The sound created outside the room was 45 – 47 DB & inside the box was 40 - 42 DB.

**D. Sandwich in concrete block**



Figure 10 concrete block with insulating air bubble pouches inside

The cube of concrete with air bubble pouches is prepared and tested NDT, Non Destructive Test, with Rebound Hammer.

The rebound hammer, tests the compressive strength of the concrete block without breaking it down.

Compressive strength: 125 Kg/cm<sup>2</sup>.

Weight: 15 kg.

ANALYSIS OVERALL TEMPERATURE RATING & GRAPH

Graph 5: graph representing the temperature readings taken for a period of a week.

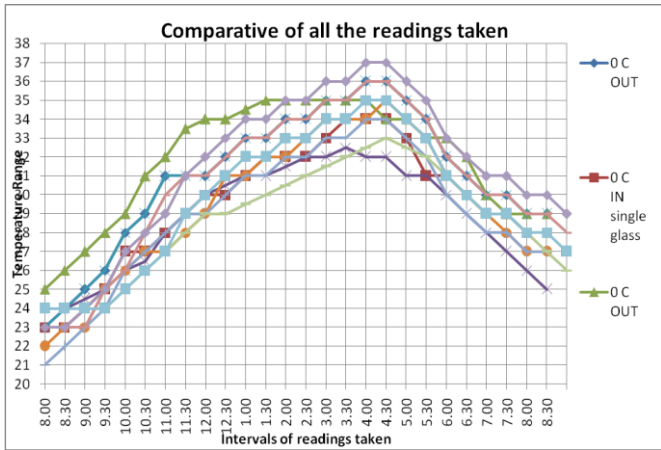


TABLE 9: OVERALL TEMPERATURE READING TAKEN

TIME	22/02/18		23/02/28		24/02/18		25/02/18		26/02/18		°C IN Another room	
	OPEN BOX	SINGLE GLASS	OUT	DOUBLE GLASS	OUT	DOUBLE GLASS WITH AIR POCKET ON SIDE	CARDBOARD SANDWICH	OUT	CLOTH	OUT		CLOTH
8.00	23	23	25	24	23	22	21	23	24	23	24	23
8.30	24	23	26	24	24	23	22	23	24	23	24	23
9.00	25	24	27	24.5	25	23	23	23	24	24	24	23.5
9.30	26	25	28	25	26	25	24	25	24	25	24	24.5
10.00	28	27	29	26	28	26	26	26	25	27	25	26.5
10.30	29	27	31	26.5	29	27	27	28	26	28	26	27
11.00	31	28	32	28	31	27	28	30	27	29	27	28
11.30	31	29	33.5	29	31	28	29	31	28	31	29	31
12.00	31	30	34	30	31	29	29	31	29	32	30	31
12.30	32	30	34	30.5	32	31	30	32	29	33	31	31.5
1.00	33	31	34.5	31	33	31	31	33	29.5	34	32	32
1.30	33	32	35	31	33	32	31	33	30	34	32	33
2.00	34	32	35	31.5	34	32	32	34	30.5	35	33	33.5
2.30	34	32	35	32	34	33	32	34	31	35	33	34
3.00	35	33	35	32	35	34	33	35	31.5	36	34	34.5
3.30	35	34	35	32.5	35	34	33	35	32	36	34	35
4.00	36	34	35	32	36	34	34	36	32.5	37	35	35.5
4.30	36	34	34	32	36	35	34	36	33	37	35	36
5.00	35	33	34	31	35	34	33	35	32.5	36	34	35.5
5.30	34	31	33	31	34	33	32	34	32	35	33	34.5
6.00	32	31	33	30	32	31	30	32	31	33	31	34
6.30	31	30	32	29	31	30	29	31	30	32	30	32
7.00	30	29	30	28	30	29	28	30	29	31	29	31.5
7.30	30	29	29	27	30	28	28	30	29	31	29	30
8.00	29	28	29	26	29	27	27	29	28	30	28	29.5
8.30	29	28	29	25	29	27	27	29	27	30	28	29.5
								28	26	29	27	29

FINDINGS

Table 10: comparison of all combinations

	Experiment	Temp. difference	positive point	Negative point
cloth as a mat	covered the window for the period of a week in mid of winter & summer season, in February 2018	the temperature of the room remains unchanged & warm because the cool breezes outside can not enter the room, due to these insulating panels.	1. light weight 2. Thermal insulation good in winter season as well as sound insulator 3. easy to carry 4. easy to install as a tent 5. cost effective	1. not appropriate in case of rain and summer (need to test more) 2.
6mm thk glass	this sanwiched glass panel kept on the box which has pockets on its side for air circulation.	the air is circulated from given air pockets, the temperature is trapped in side the box, it remains unchanged even if the box is kept in sun.	1. thermal insulation 2. reduces UV rays to enter inside 3. traps heat inside the room 4. good in winter as well as summer season 5. sound insulating material	Need to test in summer
cardboard	the spiral wavy air strip is insulated in card board	as compared to anything else, the cardboard structure is more thermally insulated & helpful in summer season	1. light weight 2. good to use in prefabricated walls 3. thermally insulated panel 4. easy to install 5. cost effective	construction details
concrete block	the NDT: non destructive test		Comparatively light in weight Reduced thickness	Need to test on heat factor

CONCLUSION

In this thesis, the problem of waste generated from industries and not treated it properly to reduce the pollution in surrounding is addressed.

One of the most contributions of this work is to avoid various treatments on the waste generated & try to use it as it is available, and to propose the methods to solve the problem by hybridization.

The experiments & readings helped to establish the graph stating the efficiency of the material if clubbed in best possible ways with other materials.

To conclude on the note of application of these materials,

Mat is light in weight, thermally insulated, easy to carry, easy to install as a tent, & cost effective; but not appropriate in case of rain.

With Glass it is thermally insulated, reduces UV rays to enter inside, and traps heat inside the room, good in winter as well as summer season.

In combination with Cardboard is light weight, good to use in prefabricated walls, thermally insulated panel, easy to install & cost effective, only construction details are to be worked out critically.

### RECOMMENDATION

Sandwiched in	applicable for	applicable in
cloth as a mat	1. Tents 2. Mats 3. Thermal partitions 4. Thermal Paneling 5. light weight traveling blanket or sleeping bag 6. sound proof panels	Extreme climatic conditions; Rajasthan, in deserts. Where in winters the outside temperature is extremely cold and same as inside the tent. Which unable to live inside.  Insulate your dog's outdoor house with bubble cushioning to keep him warm when the temperature begins to drop in the fall.
6mm thk glass	1. Window glass 2. panels	Windows can help retain heat indoors and help keep homes cool during summer, with the trapped air in the bubbles having a thermal retention effect.
cardboard	1. Partitions 2. light weight constructed walls- alternative for pre fabricated walls	
concrete block	reinforced constructions light weight non structural members	

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