Adaptive Reuse of Building Materials for Restaurant Interiors: An Approach to Sustainable Architecture

Srinivas Daketi

Abstract**—**Construction and demolition of buildings is a continuous process, which was happening from age old days, still going on in the present era and has a tremendous future. The construction industry today experiences a lot of waste produced on many job sites whether they be new projects, renovations, or complete demolition. Most of the materials, which are part of demolition, were dumped in to landfills, taking large amount of space since ages. This paper aims at designing interiors for restaurant by adaptive reuse of materials to attain sustainability in architecture. It also aims at the usage of these materials in various architectural and interior projects, rather than leaving them unused and dumping in to landfills. The paper explains about the steps and process involved in various stages for adaptive reuse of materials in case of identified project.

Keywords**—** Building materials, Interiors, Reuse, Sustainable architecture

I. Introduction

CONSTRUCTION is a continuous process, which was happening from age old days, still going on in the present era and has a tremendous future.

Every building gets older, some stand still for years, some decades and few centuries. Space is a major criterion for any building or construction activity. Buildings get erased, demolished, renovated, revitalized, reused etc. During this process, lot of construction or building materials are dumped or moved or used for filling. The need of the hour is sustainability and saving environment in all aspects. Architects can play major role by using waste, demolished construction material, building materials for contemporary or modern buildings and evolve a new trend or style, which can set an example to the next generation.

Building materials could be reused in three ways.

1. Conventional reuse of materials
2. Adaptive reuse of materials
3. Recycled content reuse of materials

The conventional reuse of building materials involves building or remodeling with materials salvaged from older structures.

Adaptive reuse involves salvaging a material that was used for one purpose in its original structure and reusing it for a different purpose within a new or remodeled structure.

The third category of building material reuse is recycled building material content, which involves taking previously used material and, through some type of manufacturing process, turning it into new building material.

Most of the building /construction materials, which are part of demolition, were dumped in to landfills, taking large amount of spaces since ages. This is a global environmental concern. Most of these materials have long life span, and they have great acceptability for reuse, for different purposes, either in construction or non-construction activities.

'*In recent years, designers have changed the focus from simply emulating the looks and style of the past; they are going to the source by getting recycled building materials, furniture, and hardware from building material reuse centers and using them to either renovate or remodel – in some cases completely repurposing the elements – to create the styles of today'*. [1]

"I think it's very much a trend, and sustainability has taken it to the next level as a lifestyle," says Marjorie Marcellus, Interior Design instructor from The Art Institute of Portland, about the explosion of reused design elements in the home design and interior design industries. [2]

Recycling and sustainability need to be carefully considered. The World Commission on Environment and Development in 1987 defined Sustainable Development as "Development which meets the needs of the present without compromising the ability of future generations to meet their own needs". It has been stated that the earth's resources are being used up at such a rate that we need three planets the size of the earth to sustain the present rate of growth. Michael Dickson (the recent President of The Institute of Structural Engineers) has highlighted the four Rs of sustainability as Reduce, Re-use, Refurbish and Recycle. [3]

This paper aims at designing interiors for restaurant by adaptive reuse of materials to attain sustainability in architecture. The industry today experiences a lot of waste produced on many job sites whether they be new projects, renovations, or complete demolitions. While it is understood that material will be replaced or eliminated during such

Srinivas Daketi, Assistant Professor of Architecture is with School of Planning and Architecture: Vijayawada, Andhra Pradesh, India. Established 2008 by Ministry of Human Resource Development, Govt. of India. (phone: +91 984 9885555; e-mail: daketi@gmail.com, srinivas.d@spav.ac.in)

processes, it is difficult to accept the fact that a large percentage of these materials are simply being thrown away rather than recycled and reused.

II. METHODOLOGY

The following methodology was adopted:

1. Identifying a live site for proposals (Interiors for restaurant)
2. Framing the requirements
3. Finalizing the requirements
4. Conceptual design proposal
5. Abstract estimation or deriving the project cost based on usage of convention materials and techniques.
6. Identifying the required material for the project.
7. Identifying the availability of required material.
8. Selection of materials, suitable for adaptive reuse in restaurant interiors.
9. Design process
10. Abstract estimation or deriving the project cost based on adaptive reuse of materials.
11. Comparative cost analysis
12. Conclusion

III. IDENTIFYING LIVE SITE

A live site, which has a proposal for a restaurant was identified. The site is located in the heart of Vijayawada city, Andhra Pradesh, India. The area of the site is 323.5 sq meters, with 153 sq meters per each floor. The building is in commercial zone with parking in the stilt floor and three floors of commercial space for restaurant and banquet hall.

IV. FRAMING AND FINALIZING THE REQUIREMENTS

Framing and finalizing of requirements based on the need, concept, availability of space, demand and various business modules. Attaining the maximum number of seating becomes the first criteria for any business model or challenge to the designer. The list requirements other than seating, is the kitchen, pantry and wash rooms.

V. CONCEPTUAL DESIGN PROPOSAL

Based on the factors like availability of space, location and other constraints, a proposal has been finalized. Various options have been worked out, to attain maximum seating capacity. The seating capacity of 102 seats, wash rooms and kitchen was attained. The requirements are divided in to two floors, as per the space constraint. The conceptual plan in Fig.1&2 is the output after six alternative design models, with alternative seating models, space division at floor level and also space floor division from floor to floor etc.

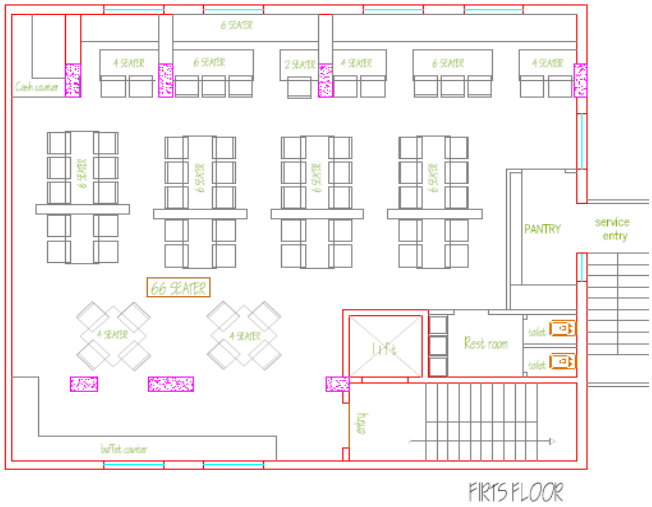

Fig. 1 Conceptual first floor plan

Fig. 2 Conceptual second floor plan

VI. ABSTRACT ESTIMATE OR DERIVING THE PROJECT COST BASED ON USAGE OF CONVENTIONAL MATERIALS

Abstract estimate is prepared based on the conventional design and materials. Some components are not taken into consideration, where there is no choice of reuse of materials but have to go ahead with new materials. The total project cost includes various other components like air conditioning, plumbing, water supply, sanitary, electrical, painting etc. The rates are based on market values as shown in the table-I. The total is Rs.18, 08,082/- (Eighteen lakhs eight thousand and eighty two rupees only) which is exclusive of few components as mentioned above.

TABLE I

S.No	Description	Quantity	Rate in Rupees	Amount in Rupees
1	***Flooring*** Vitrified tiles of 600mm x 600mm in size. The rate is inclusive of material, laying, transport and base material required for the flooring.	263 sq mts	810.00	2,13,030.00
2	***False ceiling*** Gypsum board ceiling completed with Birla putti and painted with plastic emulsion.	290 sq mts	720.00	2,08,800.00
3	***Main Door*** Main door designed with 20mm flush door, 4mm teak veneer on both sides, polished with melamine, and finished with necessary hardware. The rate is inclusive of labour, transport and others.	2 no.s	35,000.00	70,000.00
4	***Tables*** Double seater table: Stainless Steel base and table top made of 19mm ply and finished with lacquer, to the complete finish.	01 no.s	4,000.00	4,000.00
	Four seater table : Stainless Steel base and table top made of 19mm ply and finished with lacquer, to the complete finish.	11 no.s	8,500.00	93,500.00
	Six seater table: Stainless Steel base and table top made of 19mm ply and finished with lacquer, to the complete finish.	12 no.s	12,000.00	1,44,000.00
5	***Chairs:*** Chairs made of combination of teak wood and plywood, with wall nut polish and cushioned with selected fabric.	97 no.s	7,500.00	7,27,500.00
6	***Sofa:*** Providing and fixing of sofa made of medium teak wood, and cushioned with selected fabric.	25 seats	2850.00	71,250.00
7	***Partition:*** Providing and fixing of partition with 18mm, 12mm ply, finished with teak veneer of 4mm in thickness, with 8mm designed glass and finished with polish. The size of each partition is 4.2 sq mts @ Rs 7000/- per sq mt = Rs. 29,400/-	4 no.s	29,400.00	1,17,600.00
8	***Wall mural:*** One side of wall is treated with mural of selected concept, with fibre which is embossed and finished as per design.	10 sq mts	12,000.00	1,20,000.00
9	***Storage Unit:*** The storage unit shall be made of 18mm, 12mm ply with 8m laminate fixed at the internal surface and 4mm thick veneer, polished at the outer surface. The unit is finished with necessary hardware and fixtures.	2.8 sq mts	13,715.00	38,402.00
	Total: Eighteen lakhs eight thousand and eighty two rupees only			***18,08,082.00***

Note :-

1. The rates are derived based on the market study and local market rates.
2. All the items in the interiors are not included in above estimate. Few items are taken into consideration for comparative analysis.

Abstract estimate is prepared based on the conventional design and materials. Some components are not taken into consideration, where there is no choice of reuse of materials but have to go ahead with new materials. The total project cost includes various other components like air conditioning, plumbing, water supply, sanitary, electrical, painting etc. The rates are based on market values as shown in the table-I. The total is Rs.18, 08,082/- (Eighteen lakhs eight thousand and eighty two rupees only) which is exclusive of few components as mentioned above.

VII. Available Material, Quantities and Sizes

The first step in identifying the materials is to evolve a design concept. A traditional restaurant with local materials and technology is the need of the hour in urban context. The client wants the design to be traditional and vernacular, which gives a feel of village/rural settlement in urban context. Based on this concept, a survey has been conducted to identify the availability of building materials from demolished buildings. Traditional building materials are available from either vernacular traditional settlements or villas or bungalows. There are various construction materials available in these locations. The usage is limited materials which can be used for restaurant interiors. A check list along with finalized conceptual drawing with detailed measurements needs to be part of the survey team, for better clarity and choice. A detailed list of the available or suitable materials is made to work on the interiors. The list includes materials available in more than one location, number of items or pieces available, and the sizes of the same. The quality of available material and approximate estimate or budget necessary to convert the material in to usable form in the interior project has to be checked. Generally the cost should not increase, when compared to the conventional materials or technology. The analysis of the available materials has led to selection of the required material for adaptive reuse for restaurant interiors.

TABLE II

TABLE SHOWING THE SELECTED MATERIALS FOR REUSE, SIZES AND AVAILABILITY

S.No	DESRIPTION OF ITEM & NO.S	Related Photographs
1	Description :Wall hanging for display of antique/ pottery /sculptures Approx. Size available: 6'-0" to 8'-0" in length Required no.s : 6 pcs	
2	Description : Elements used for partitions Approx. Size available: 1'6" x 2'-0" Required no.s : 8 pcs	
3	Description : Mirrors in toilets Approx. Size available: 30" x 25" Required no.s : 2 pcs (available 2 pcs) Can add 2 more no.s if available	
4	Description : Mirrors in toilets Required no.s : 1 pcs (available 1 pcs) Can add 1 more no.s if available	
5	Description : Columns Approx. Size available: Ht 80.5" + 6" Required no.s : 2 pcs (available 2 pcs)	
6	Description : Round table Approx. Size available: 5'-0" dia Required no.s : 1 pcs (available 1 pcs)	
7	Description : Round table – chamfered (octagonal) Approx. Size available: 3'-3" in dia Required no.s : 2 pcs (available 2 pcs)	
8	Description : Table marble top Approx. Size available: 4'-0" x 2'-0" Required no.s :1 pcs (available1 pcs)	
9	Description : Chair for banquet Approx. Size available: ---- Required no.s :1 pcs (available1 pcs)	
10	Description : Brackets Approx. Size available: 8" x 14" Required no.s :12 pcs	
11	Description : old telephones Approx. Size available: -- Required no.s : 2 pcs	
12	Description : old wall clocks Approx. Size available: -- Required no.s : 2 pcs	
13	Description : old lanterns Approx. Size available: -- Required no.s : 6 pcs	
14	Description : Crockery unit Approx. Size available: 3'-4.5" x 16" x4'-1" Required no.s : 1 pcs (available-1pc)	
15	Description : cradle Approx. Size available: 3'-10" x 12" to 24" Required no.s : 1 pcs (available in combination of 4 pieces)	

16	Description :Trunk box Approx. Size available: Large and small sizes 3'-10" x 2'-3" Required no.s :2 pcs	
17	Description :Pianno (can be used in banquet hall) Approx. Size available: Required no.s :1 pcs	
18	Description :Hanging lights Approx. Size available: ------ Required no.s :8 pcs	
19	Description :Pandiri Bed (Can be used for buffey or bed room in terrace, guest bed room) Approx. Size available: 6'-11" x 46" Required no.s :1 pcs	
20	Description :Designed wooden piece Approx. Size available: Required no.s :2 pcs or as per availability	
21	Description :DOOR Approx. Size available: Required no.s :1 pcs or as per availability	
22	Description :DOOR Approx. Size available: Required no.s :1 pcs or as per availability	

VIII. Design process

The final design was evolved based on the available materials. The selected materials, their sizes, requirement on site and available quantities are shown Table-II.The details have been worked with necessary architectural drawings for execution of the project. There was no possibility of selection of reused materials for the complete project. Locally available materials were selected along with adaptive reuse of materials to attain sustainability.

Various materials like columns, brackets, rafters, jails, railing posts, windows, doors, cupboards, sofas, tables, beds, storage units, crockery units, writing tables, wall clocks, lanterns, cradle, hanging lights etc which were bought from different locations, where houses are demolished and proposed for the interiors. Packing wood (Pine wood) was identified, which was originally used for packing of machines. These machines are imported from various countries.

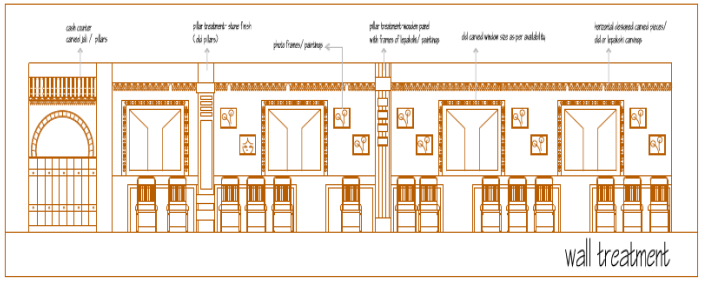

Fig. 3 Section

The selected doors are proposed for the main entry, as the selection of the same is based on the available opening size. The windows of selected size are proposed for wall treatment as shown in Fig-3.

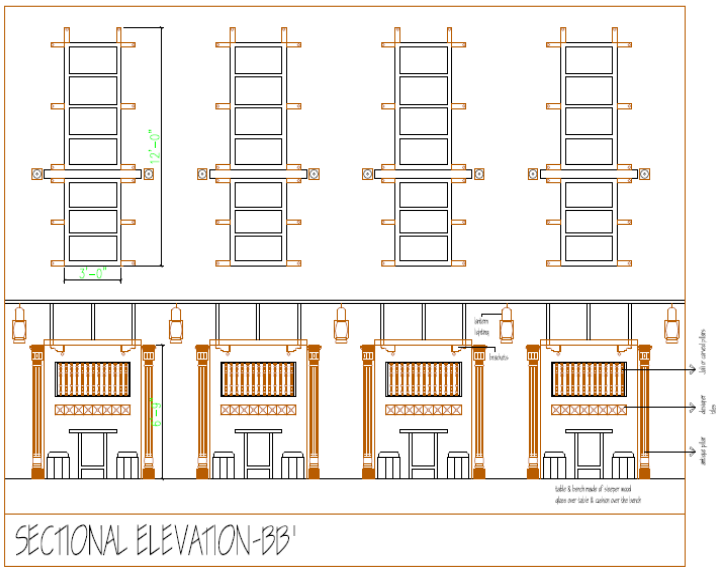

Fig. 4 Sectional elevation

The columns, brackets, railing posts and jali's are designed for partitions with combination of conventional materials, like ply wood and reuse of materials like packing wood as shown in Fig-4. The furniture (chairs and tables) is made of packing wood and railway sleeper wood. The complete furniture in the restaurant is designed with reused of wood and few tables and sofas were selected, which could be directly used as part of seating in the restaurant. The division of spaces was also made on the type of furniture, which could be used.

The choice of flooring is based on the locally available material. Tandoor stone is locally available and is at lower pricing when compared to vitrified/ceramic tiles.

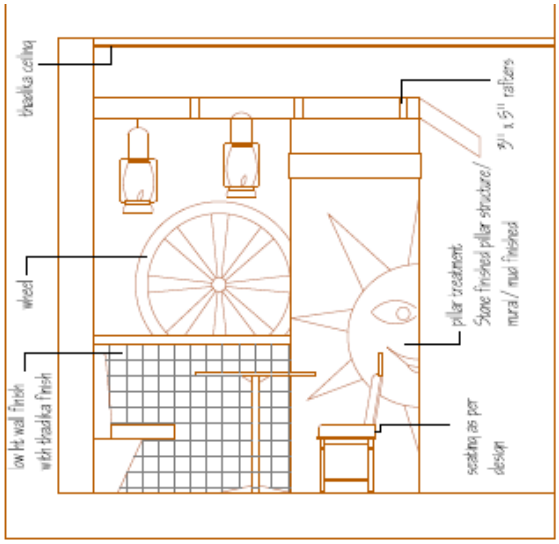

Fig. 5 Partition Section

The lanterns, wall clocks, hanging lights have become part of interiors. The details were worked out beforehand, as shown in partition section i.e. Fig-5. An old carved bed which is made of first class teak wood is redesigned for buffet counter. The heights and widths of the bed are altered, to attain the required sizes for the counter but still retaining the intricate carving designs. Old cupboards and crockery units can be directly used for display units and crockery with minor alterations and polishing.

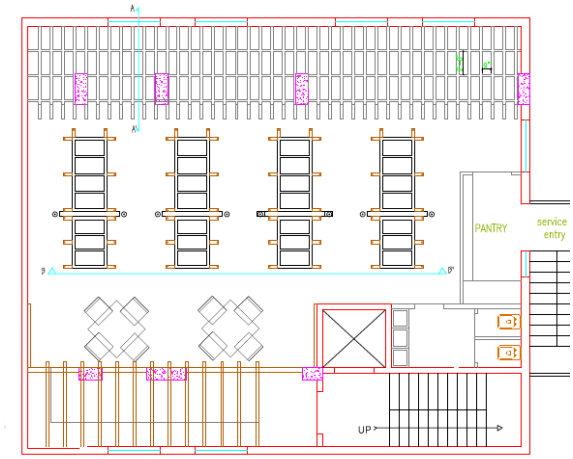

Fig. 6 Reflective ceiling plan

The false ceiling is proposed with rafters, packing wood which can reused and local traditional bamboo sheets (new material – locally available) as shown in Fig-5. Conventional methods of false ceiling with Plaster of paris (POP) or Gypsum board ceiling or Armstrong tile ceiling is avoided to reduce the cost and attain sustainable solutions with adaptive reuse of materials.

Fig. 7 View showing false ceiling, partitions and wall treatment

Fig. 8 View showing flooring and wall treatment

Fig. 9 View showing partitions and furniture

IX. ABSTRACT ESTIMATION OR DERIVING THE PROJECT COST BASED ON ADAPTIVE REUSE OF MATERIALS

Abstract estimate based on the design and available materials for reuse is prepared as shown in table-III.

TABLE III

S.No	Description	Quantity	Rate in Rupees	Amount in Rupees
1	**Flooring** Locally available tandoor stones of size 600 mm x 600mm in size. The rate is inclusive of material, laying, transport and base material required for the flooring.	263 sq mts	485.00	1,27,555.00
2	**False ceiling** Providing and fixing of false ceiling with packing wood, sleeper wood and other wooden sections available during demolition of buildings. The wood is made in to sections of required sizes and fixed as false ceiling. The sections are polished to necessary finish.	290 sq mts	620.00	1,79,800.00
3	**Main Door** Main door is selected based on the available opening and proposed fix the same with minor alterations and finished with polish.	2 no.s	40,000.00	80,000.00
4	**Tables** Double seater table: Tables are made of packing wood or sleeper wood base and the top is made of the sections cut to required sizes.	01 no.s	3,500.00	3,500.00
	Four seater table : Tables are made of packing wood or sleeper wood base and the top is made of the sections cut to required sizes.	11 no.s	6,000.00	66,000.00
	Six seater table: Tables are made of packing wood or sleeper wood base and the top is made of the sections cut to required sizes.	12 no.s	10,000.00	1,20,000.00
5	**Chairs:** Chairs made of sections of packing wood and sleeper wood and finished with cushion and selected fabric.	97 no.s	4,500.00	4,36,500.00
6	**Sofa:** Providing and fixing of sofa made of packing wood sections, and cushioned with selected fabric.	25 seats	2000.00	50,000.00
7	**Partition:** Providing and fixing of partition with columns, rafters, brackets, railway posts as per design and finished with necessary polish	4 no.s	29,000.00	1,16,000.00
8	**Wall mural:** The wall is treated with the old windows and fixed to the wall as per design.	10 sq mts	8,000.00	80,000.00
9	**Storage Unit:** The available storage unit as per required size is proposed for storage unit.	2 no.s	10,000.00	20,000.00
	Additional costing (carpentry, labour, polishing etc) for converting the old material into usable stage.			1,00,000.00
	Total: Thirteen lakhs seventy nine thousand three hundred and fifty five only			**13,79,355.00**

Note :-

1. The rates are derived based on the market study and local market rates.
2. All the items in the interiors are not included in above estimate. Few items are taken into consideration for comparative analysis.

X. COMPARATIVE COST ANALYSIS

As per the comparative analysis the approximate cost of the project excluding few components with new materials and conventional way of executing the project is Rs.18,08,082/- (Eighteen lakhs eight thousand and eighty two rupees only) whereas the cost of the project with reuse of materials and usage of locally available materials is Rs.13,79,355/- (Thirteen lakhs seventy nine thousand three hundred and fifty five only) A difference of Rs.4,28,727/- (Four lakhs twenty eight thousand seven hundred and twenty seven rupees only) All the projects which use reused materials need not necessarily be cheaper. Sometimes they are more expensive when compared to the projects where new materials are used.

XI. CONCLUSION

Reuse helps us to save time, money, energy, and resources. Reuse offers quality products to people and organizations with limited means, while generating jobs and business activity that contribute to the economy. It also reduces the consumption of new resources and minimizes landfill waste and pollution. Reusable products reduce disposal needs and they are often cheaper. Some products have intricate carvings, which needs lot of time and skill to make in modern days. The value of these products has great appreciation. Most of the building materials can be reused or recycled.

Careful sustainable design can limit the amount of new products necessary for goals at hand. So long as existing material is reparable, has remaining life, and can be useful part of any building, it is unlikely that a new material will be environmentally preferable. [4]

Reusing materials for any project needs inventory of available materials, their usage, cost factor etc. This should be done at the very beginning of the project to save time and make the project move in the same phase as the conventional project.

There were few circumstances where the usage of old materials would be expensive when compared to conventional. But people console by saying that they are saving environment rather than purchasing new materials and giving life or re-birth to the material which had to be buried.

The entire project plays with tension between the past and the present, between old and new materials, the usage of locally available materials, to achieve sustainability and create ambience with touch of traditional or vernacular character to the restaurant.

REFERENCES

[1] http://insite.artinstitutes.edu/recycled-building-materials-on-display-in-interior-design-54094.aspx, *Accessed on 26/12/2012*

[2] http://insite.artinstitutes.edu/recycled-building-materials-on-display-in-interior-design-54094.aspx, *Accessed on 26/12/2012*)

[3] David Doran, James Douglas, Richard Pratley, *Refurbishment and Repair in Construction.* Whittles Publishing, 2009, pp 4-5.

[4] Lisa Gelfand, Chris Duncan, *Sustainable Renovation, Strategies for commercial building systems and envelope*, John Wiley & Sons, 2012, pp 146-148

[5] Shashi Jain, *Creative Interiors- Design of enclosed space*, Management Publishing Co.,1994