

VACANT BUILDINGS IN INFRASTRUCTURE PROJECTS: STRATEGIES FOR REUSE

Vaishali Anagal*, Dharati Sote and Shamishtha Ruikar

Dr. B. N. College of Architecture, Pune, India

ABSTRACT

Vacant Buildings in infrastructure projects has become a serious environmental and economic issue in Indian planning scenario. Several instances of newly constructed unoccupied buildings indicate wastage of financial and environmental resources such as virgin building materials and most importantly land resource. Vacant vegetable markets constructed as a part of public infrastructure projects by municipal authorities in many cities particularly in the city of Nasik is a glaring example of such redundant investments in Maharashtra state of India. Large scale presence of abandoned, vacant and unoccupied buildings is resulting into an ineffective use of resources and increasing risk to first responders and the community. Vacant and abandoned properties, whether residential or commercial, are a drain on city budgets in addition to detracting from the quality of life, as well as the economic opportunities, of those living around them. They are an impediment to individual neighbourhood redevelopment and, ultimately, to achievement of city wide economic development goals. Minimizing the harm done by vacant and abandoned properties and restoring these properties to productive use are priorities for city planners across the globe.

This research attempts to quantify the amount of resources in terms of embodied energy invested into such projects using a case study method. It further evaluates the reuse potential of such built spaces to prompt the meaningful use of resources by investigating its structural capacity and architectural configuration. A spatial analysis with respect to adjacent land uses will also be done to identify the best suitable reuse of the case-study building. Finally, this research draws conclusions to suggest planning strategies to prevent building vacancy in public sector buildings and also reuse strategies for existing unoccupied buildings to evade wastage of environmental resources.

Keywords: Building Reuse; Infrastructure Projects; Reuse strategies; Vacant Buildings.

1. INTRODUCTION: VACANT BUILDINGS AND ASSOCIATED RISKS

Worldwide, building vacancy has been considered as a major socio-economic issue for local governments to tackle with. A vacant building poses a financial burden on local government in terms of its maintenance, fire safety and well-being of the neighbourhood in general. It is thus reflected in the definition of vacant building derived by various agencies.

The National Vacant Properties Campaign in Washington (NVPC, 2005) defines vacant properties as residential, commercial, and industrial buildings where a site poses a threat to public safety (meeting the definition of a public nuisance), or the owners or managers neglect the fundamental duties of property ownership (e.g., they fail to pay taxes or utility bills, default on mortgages, or carry liens against the property.) Here, vacant properties can include abandoned, boarded-up buildings; unused lots that attract trash and debris; vacant or under-performing commercial properties known as grey fields. On the other hand, some of the authorities and insurance companies define the vacant building based on the occupancy percentage and period of vacancy. For instance, in Building and Personal Property Form CP 00 10, the Insurance Services Office (ISO), 2009, Zurich, North America, a building is considered vacant unless at least 31% of its total square footage is rented to a lessee or sub-lessee to conduct its customary operations and/or used by the property owner to conduct customary operations. A report on Vacant & Abandoned

* Corresponding Author: E-mail - ymanagal@rediffmail.com

buildings in Oklahoma City views a building vacant if has had 30 percent or greater vacancy as identified in the U.S. Postal Service database or had its water, gas or electricity shut off for six months or more. Similarly, an ordinance issued by the city of Evanston on vacant buildings defines vacant buildings, especially those which remain boarded for more than six (6) months, are unsightly and diminish neighbouring property values and neighbours' sense of well-being, and are a public nuisance.

It is important to note that the term 'abandoned' and 'vacant' are interchangeably used, however, there is elusive difference between these terms (Abandoned Building Project, 2006; Botts, 2010). The dictionary meaning of 'vacant' is empty or unoccupied, whereas the dictionary meaning of 'abandoned' is surrendered or deserted. This difference is sometimes denoted with the status of ownership and sometimes with the status of the building. For example, a building that is unoccupied and has a viable owner who is interested in the property and can be easily contacted is considered vacant. On the other hand, a building that does not have a viable owner is generally considered abandoned (Abandoned Building Project, 2006). Coleman (2004), defines unoccupied building that is one with contents, but no humans inside at the time of fire, whereas, vacant building is one that is with no (or only a few worthless) contents inside. These definitions are developed to understand the life risks and conservation potential in the building for fire department in the Toledo, Ohio State, U.S. Abandoned buildings are considered to be in the state of grave disrepair, perhaps boarded up, strewn with trash, and scrawled with graffiti (Shane, 2011).

Vacant buildings are considered as shelters of criminal activities, hazard for public safety and often victims of vandalism, theft and fire casualties. They create nuisance in surrounding neighbourhood through their unsightly appearance. (An Ordinance, the city of Evanston; A report on vacant Properties, US, 2011; Halvey, 2009). Vacant buildings are a huge burden on local authorities for maintenance, fire brigades and police departments to encounter the theft and other illegal acts. (An Ordinance, the city of Evanston; Vacant Properties-The True Costs to Communities, 2005) A vacant building does not only depreciate its own value, but also devaluates the properties and lead to blight in the surrounding neighbourhood. (How Can Municipalities Confront the Vacant Property Challenge? ,2010)

The vegetable markets that are studied in this research are 'unoccupied' since its inception, have a viable owner (Local Municipal Authority), are structurally in sound condition and therefore are considered as 'vacant buildings'.

2. ENVIRONMENTAL IMPACT OF VACANT BUILDINGS

Researchers in construction industry have always been inquisitive about assessing the environmental impact of built forms. Life Cycle Analysis has been regarded as a tool to evaluate the environmental impact of buildings over its life cycle i.e. from raw materials to final disposal of the product. The environmental impact of a product is assessed in terms of atmospheric emissions, waterborne waste and solid waste (Williams, 2009). In case of vacant buildings, since its full life cycle is not being realized, it is difficult to carry out its life cycle analysis. In addition, it is highly challenging to calculate the atmospheric emissions that a building releases during its vacancy. However, there is a common agreement on the building's negative impact on the environment throughout its life cycle.

In designing a life cycle analysis, the inputs and outputs of a process or product are clearly defined where inputs include energy and raw materials and outputs include various types of products and wastes. (See figure no.1).The concern with regards to vacant buildings is resource investments in terms of energy and materials till the construction completion stage. Since the building is not in operation, operational energy is almost negligible for these vacant buildings. However, there are investments incurred in terms of energy and finance for maintenance purpose. In this research, embodied energy in the building till construction completion stage is considered as one of the parameters of this resource consumption. The energy calculations for case-study building indicated that 26251445 MJ i.e. 7010 MJ/Sq. M. embodied energy is consumed by the case-study building (See Annexure). Looking at the average 20% rate of vacancy in vegetable markets in urban area of Maharashtra State, the overall resource wastage that occurs due to the building vacancy of these markets can be anticipated.

It should be noted that the land as an important resource has not been discussed yet. In urban areas, where land scarcity is a roaring issue, wastage of land through vacancy cannot be tolerated. If vacancy of

existing built stock continues, there would be additional resource consumption in the construction of buildings for same purposes which will have its own economic and environmental repercussions. This research emphasizes on meaningful utilization of these resources.

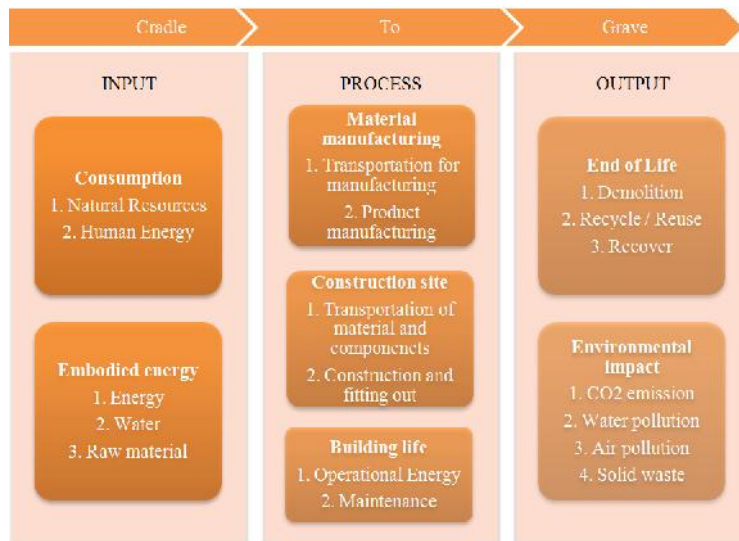


Figure 1: Life Cycle Analysis of Building Block
Source: Adapted from Williams (2009)

3. VACANCY IN INFRASTRUCTURE PROJECT IN MAHARASHTRA

In Maharashtra state of India, 20% of existing markets built by local municipal authorities are laying vacant waiting for vendors to occupy their stalls (See figure no.2). Municipal corporations have already invested land as the most precious resource and also the administrative and financial resources in these properties. In addition, their administrative and financial resources are being further exhausted by legal battles with vendors who have simply denied occupying these buildings. In the absence of any regulations to address the issue of safety, maintenance and reuse of vacant buildings, managing these buildings has become financially a daunting task for municipal corporations. Thus, these public buildings have turned out to be 'No man's Land' and havens of illegal activities at the same time.

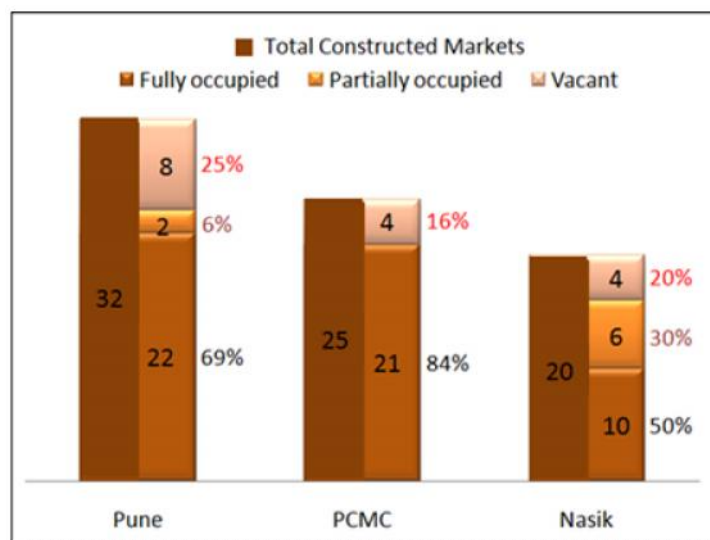


Figure 2: Vacancy in Vegetable Market in 3 Major Cities in Maharashtra
Source: Adapted from Mandai Market Department, PMC, PCMC, NMC (Dept- of Taxes,), and Site survey.

This research aims on identifying the reuse potential of these markets to bring life to the redundant building and to negate its socio-economic and environmental impact. It also interrogates the deficient planning process that is devoid of participatory approach and long term sustainability goals.

4. METHODOLOGY

This research adopts a case study method to study the factors responsible for vacant vegetable markets. Case study is selected from the city of Nasik where financial and resource investments were quite high. Structured interviews were conducted with vendors, customers and officials in Nasik Municipal Corporation to study the reasons of unoccupied vegetable markets. The intentions of these interviews included to gauge the possibility of continuing the use of the building for intended purpose and also to obtain the insight into guidelines for future planning that focuses on preventing building redundancy. Further, socio-economic and environmental impact of vacant buildings is studied with respect to case-study building. To analyse the environmental impact of vacancy in a typical vegetable market, embodied energy of the building has been considered as an indicator. It is highly essential to evaluate reuse potential of these vacant markets so that resources invested in these built structures can be efficiently recovered. To identify the reuse potential of the case study building certain filters are being used. Initially, a spatial analysis was done to understand the existing land-use. A spatial analysis was complimented with a study of development plan (1996-2016) provisions and population studies. This triggered various options of building uses that can be employed based on the needs of the population. However, building cannot sustain all of these uses structurally for which it is not designed. Therefore, it was essential to carry out a structural analysis of the building to examine what type of function will be supported by the existing building. This process facilitated further filtration of proposed reuses and finally, architectural configuration was studied to assess what type of reuses are most suitable so that building can be well adapted to new uses with minimum destruction and additions to conform Development Control Rules. Thus, the methodology adopted in this research for the assessment of reuse potential of existing vegetable market offered insight into defining strategies for adaptive reuse of existing vacant markets and can be widely applied to public infrastructure projects. The higher rate of vacancy in these types of public projects poses a question on the existing planning process. Therefore, at the end, this research also suggests recommendations on shifting the planning approach in infrastructure projects.

5. CASE STUDY

5.1. INTRODUCTION

Nasik, a third largest city after Mumbai and Pune is important city in Maharashtra State with its socio-cultural and economic context. A city with more than 1.4 million populations has been earmarked as a part of The Delhi Mumbai Industrial Corridor (DMIC) project. Nasik, also recognized as Vine Capital of India plays a significant role as an exporter of vegetable produce.

Nasik Municipal Corporation (NMC) is a local governing body in the city which is responsible for planning, development and maintenance of public infrastructure as per Maharashtra Regional and Town Planning Act (1966). Out of 26 existing markets, the city corporation has developed 20 built vegetable markets in the city as a part of public infrastructure projects. Out of these built markets only 50% markets are successfully operating with its full occupancy. (See figure 3). In 30% of the markets, only few of the vendors have occupied their stalls and these markets are partly used. Some of the markets are provided with platforms for vendors with storage space underneath and roof (steel truss with sheet roofing) above, whereas some of the markets are enclosures with Reinforced Concrete framed structures with staircase and toilets. A selected case-study of Ganghat market falls under later category with a footprint of 3745.06 Sq.M.

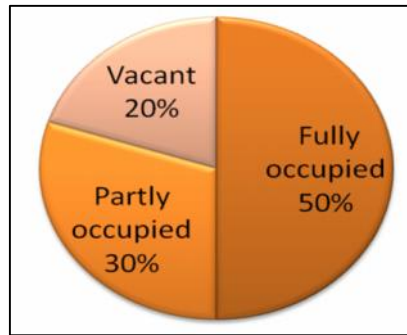


Figure 3: Vegetable Markets in Nasik
Source: Adopted from NMC (Dept- of.Taxes,), Site survey

5.2. BACKGROUND

The traditional vegetable market is located on the bank of river Godavari which was established during Peshwa regime in 1818. The existence of this market can be revealed in the gazette of the British Government. Since the vegetable market has its existence for more than 200 years, it is ancestral occupation of many of the vendors. It was the only vegetable market in the city until last 25 years and used to serve the entire city. Although, there are number of markets developed by Nasik Municipal Corporation in various parts of the city, few customers from distant locations regularly visit this market. Almost 600 vendors run their business at this location under temporary shelter and cater mainly to the population in down town area. (Old Nasik) (See Figures 4 and 5).

A new vegetable market was constructed since there is a dearth of infrastructure including potable water, toilets, solid waste disposal at the existing market. In addition, the existing market adds to the pollution of the river due to waste water and solid waste disposal (See Figure 6). The paucity of parking space for vendors and customers lead to traffic problems and air pollution.



Figure 4: Aerial View



Figure 5: Temporary Shade Devoid of Infrastructure

Photo Courtesy: Ruikar Sharmishtha

In 2009, a new market was built at 200m distance on south-eastern side of existing market with an aim to reduce the nuisances of existing market and to provide better infrastructure to both the vendors and customers, to shift the vegetable market permanently from the river bank (See Figure 7)



Figure 6: Pollution in River :
Water Waste and Solid Waste Disposal



Figure 7: Location of Two Markets

Photo Courtesy: Ruikar Sharmishtha

Located on 12 meter wide Mahatma Phule road and accessible from all three sides of city namely, Ganeshwadi (Panchavati area), Gadgemaharaj Bridge (New city area) and Gangaghat (Malegaon stand), Gagaghat vegetable market is RCC framed single story structure with provision of vertical expansion of additional 3 floors. The market facilitates built platforms with storage facility for vendors, separate washing areas for vegetables, finished flooring with floor drains for maintaining hygiene and a toilet block separated from the main structure and parking facility for vendors and customers (See Figures 8 and 9). The architectural planning offers the view of all the vendors at a glance from the entry point. Despite the fact that a new facility provides much better infrastructure as compared to the existing one, vendors were highly rigid to shift. They moved the court against the NMC and the court had given its verdict in favor of vendors in 2012.



Figure 8: Platforms for Vendors in New Market



Figure 9: Toilet Block in New Market

Photo Courtesy: Ruikar Sharmishtha

5.3. FACTORS THAT ARE RESPONSIBLE FOR BUILDING VACANCY

The structured interviews with vendors revealed that there was a lack of participatory approach in planning. The vendors were not taken into confidence by local municipal authority in planning and designing stage of new vegetable market. There was neither any participation in terms of deliberations nor in terms of any financial involvement of the vendors in the entire process. Vendors also raised an issue of inaccessibility of new market for aged and differently able customers since the new market has a high plinth (40 steps) from temple side without any provision of ramps. (See figure 10). The new location is being perceived as a high risk of losing business by the vendors, as against the existing market which is located next to the temple where people buy vegetables on their way to home. The proposed use of the land where existing market is located is not revealed by the municipal authority and hence, there is apparent risk in the minds of vendors that this land will be encroached by new vegetable vendors and the

business in the new market will be at loss. This uncertainty of business is leading to the apprehension regarding the new market for the vendors.



Figure 10: New Market with Entrance Steps
Photo Courtesy: Ruikar Sharmishtha

In the planning process when the reservations for public amenities are proposed, the vacant lands under the ownership of municipal authorities are given priorities for new proposals in the development plans to avoid the heavy compensation liabilities and also the lengthy bureaucratic and legal processes against the land acquisitions of private lands. In urban areas where the paucity of land is a major issue, available lands in the hands of public sector are reserved for public amenities. In such a constrained situation, other factors of planning such as convenience of people are overlooked which results into vacancy in infrastructure projects.

Vegetable market has been viewed as a convenient shopping in Indian scenario. Therefore, ‘Convenience’ of customers is the ‘key word’ and plays a significant role in planning and design of vegetable markets. Historical evidences reveal that vegetable markets have always been an open air and road side activity where senior citizens, housewives and working people buy the vegetables on the way to their home after finishing their routine works. The study of vacant markets in 3 major cities in Maharashtra state demonstrates that the justification of vacancy is associated with the inconvenience of customers which affect the business of vendors on account of flawed planning processes.

5.4. SOCIO-ECONOMIC IMPACT

As discussed in the literature review, vandalism, fire and thefts are common issues in vacant sites. The vegetable markets constructed by corporations are public buildings and semi-open structures that cannot be locked and hence, are accessible to everyone. Thus, these buildings become ‘home’ of ‘homeless’ people. Easy access for the vandals in vacant buildings leads to annoyance of litter, damage, illegal and criminal activities and threat to the public safety. (See Figures 11 and 12).



Figure 11: ‘Home’ of ‘Homeless



Figure 12: Deterioration of Paving and Compound Wall
Photo courtesy: Ruikar Sharmishtha

5.5. IDENTIFYING REUSE POTENTIAL OF NEW MARKET

With a view to reduce the socio-economic and environmental burden of vacant buildings, it is imperative to evaluate existing built stock for its reuse potential and reclaim these buildings for new purpose. In some instances, a partial reuse of vacant markets has been observed in Maharashtra state. Ganeshwadi vegetable market is being partially used as a local library (See Figure 13) However, a scientific approach in identifying a new function is lacking since the reuse is focused more on economic considerations that is the financial returns from the reallocated function.



Figure 13: Ganeshwadi Market.
Photo courtesy: Ruikar Sharmishtha

5.6. SPATIAL ANALYSIS

A scientific approach to recoup these redundant markets necessitates a comprehensive study of its spatial setting to understand its accessibility and proximity, existing land use zoning to recognize compatibility of proposed functions, population studies to identify their needs, and provisions in developments plans that have not yet been realized and development control regulations so that additional requirements of proposed uses to adhere to these rules can be identified.

The reuse of vacant lots and abandoned buildings could provide cities with excellent opportunities of mixed-use neighbourhoods that are walk-able and pedestrian friendly (Schilling J.M.). City and neighbourhood plans can provide a framework through which to evaluate commercial property reuse alternatives. While determining property reuse alternatives, the long-term vision and policy goals for the area and the preferences of neighbourhood population, present and future market demand for various uses, public sector costs for uses and availability of resources, and developer interest in specific uses for the property needs to be considered (Eppig *et.al.*, 2014).

The interviews with customers of existing market indicated that this market serves the population of around 100 thousands which is located in the radius of around 1.5 km. Existing public amenities in this radius were also located by studying existing land use to identify the gaps. Majority of land-use is dominated by residential zone with amenities such as schools, public library, theatre, cinema hall, community halls, grocery shops (wholesalers), Health Care facilities, post office and banks etc. (See Figure 14).

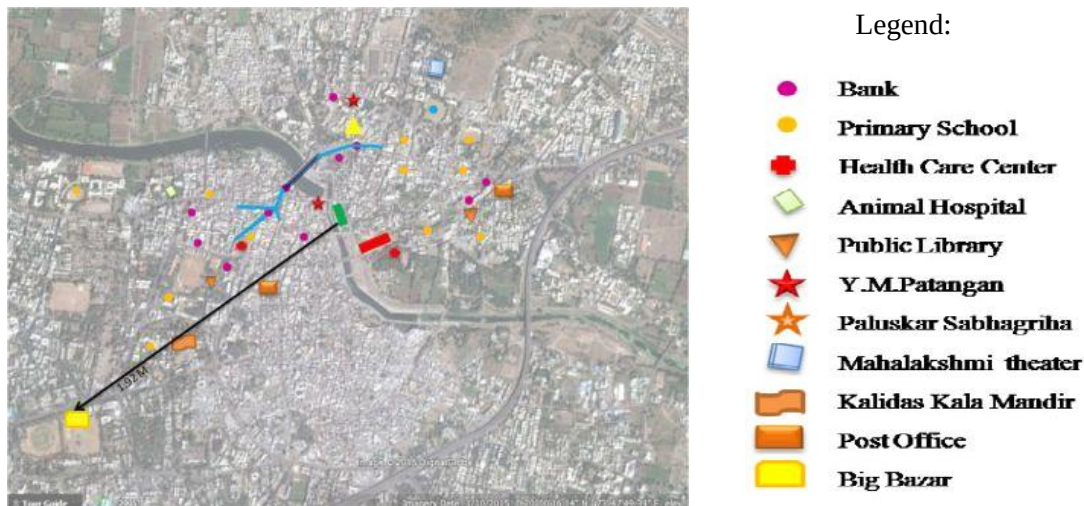


Figure 14: Spatial Analysis in the Surrounding Neighbourhood

This prompted few reuse alternatives that can be assigned to the vacant buildings:

Table 1: Proposed Uses and Their Rationale

Sr. No.	Proposed Reuse	Rationale	Social Benefits
1	Small Scale Industry for Women	The site has a slum in the proximity. A small scale industry will provide employment opportunity for women from economically weaker section of the society.	Social upliftment and Women Empowerment
2	Vedic School (School of Traditional Hindu Rituals Learning)	Nasik has its great historical and cultural values. Located on the bank of river Godavari, site has advantage of natural setting and is best suitable location for Vedic School.	Historical and cultural context of Nasik sets a great advantage for running Vedic School to boost his traditional culture.
3	Yoga Center	This facilitates a complimentary role to Vedic School that Boosts Indian Traditional Physical Education.	Fitness and good Health for all age groups
4	Gymnasium	A well-equipped Gymnasium is not available for sportsmen and young generation in the vicinity	Fitness and good Health for all age groups
5	Music School	In the radius of 1.5km there is no Music school where Indian Traditional or other forms of Music are taught.	Propagating Indian Music and other forms of music to new generation.
6	Agriculture Information Center and Sales	Nasik is one of major exporters of agricultural produce.	Agricultural Information Center and Sales will cater to the farmers in Nasik Region.
7	Retail Shopping Centre	The area is served by wholesalers' shops. Retail Shopping facility under one roof is not available.	Population can get better shopping experience along with eatery places.
8	Industrial Training Institute	Residential area is by middle and low income group. This facility can serve to the population in Nasik Region.	It can provide skill set to the young generation for job opportunities and self-employment.
9	Banks	Although there are few banks in this area, co-operative/ nationalized banks have opportunity to establish their extension counters.	Financial empowerment of local residents.
10	Offices	The surrounding area does not have buildings exclusively designed as office buildings. Growing city like Nasik requires commercial buildings.	Support to the local businesses.

5.7. STRUCTURAL ANALYSIS

The alternative reuses that is outcome of above-mentioned study needs to be supplemented by the structural analysis of the said building to examine whether it supports a particular function. To assess the structural potential of the case study building interviews with practicing structural engineers were conducted. Experts were provided with architectural and structural drawings of the building. Experts suggested that structure can be reclaimed by any commercial activity where loading conditions are upto 400kg/Sq. M. Industrial Training Institute requires heavy machineries in the training workshops, hence cannot be supported at upper floors. Also, if this use is considered at ground floor, it will require machine foundations at ground level and thus, requires significant intervention. The bank can be allotted without a vault at any floor. Gymnasium which necessitates accommodating heavy equipment can be accommodated at ground floor. Structural analysis ameliorated the filtration process of the proposed reuses.

5.8. ARCHITECTURAL CONFIGURATION

A vegetable market with RCC Framed structure having 10 bays with column grid of 5.7 X 5.7m and 7.6m centre to centre distance between columns of adjacent bays (See figure no. 15) and a clear floor height of 4.3m can complement above mentioned proposed reuses. 7 numbers of staircases planned on the periphery of the structures provides a separate access for each bays on upper floors. This can easily facilitate mixed use development within a same structure. Although a structure lacks provision of toilet blocks to conform to Development Control (DC) rules for the proposed reuses, the side margins in the site offers opportunity of addition of toilet blocks as per DC Rules. The existing building is semi-open building which does not have façade on any of its sides. Any commercial reuse would require a well-designed façade that can attract businesses. Thus, a building entails few additions such as services in terms of elevators, sanitary facilities, electric services and data cabling to support offices and a façade. It also necessitates removal of existing platforms designed for vegetable sales.

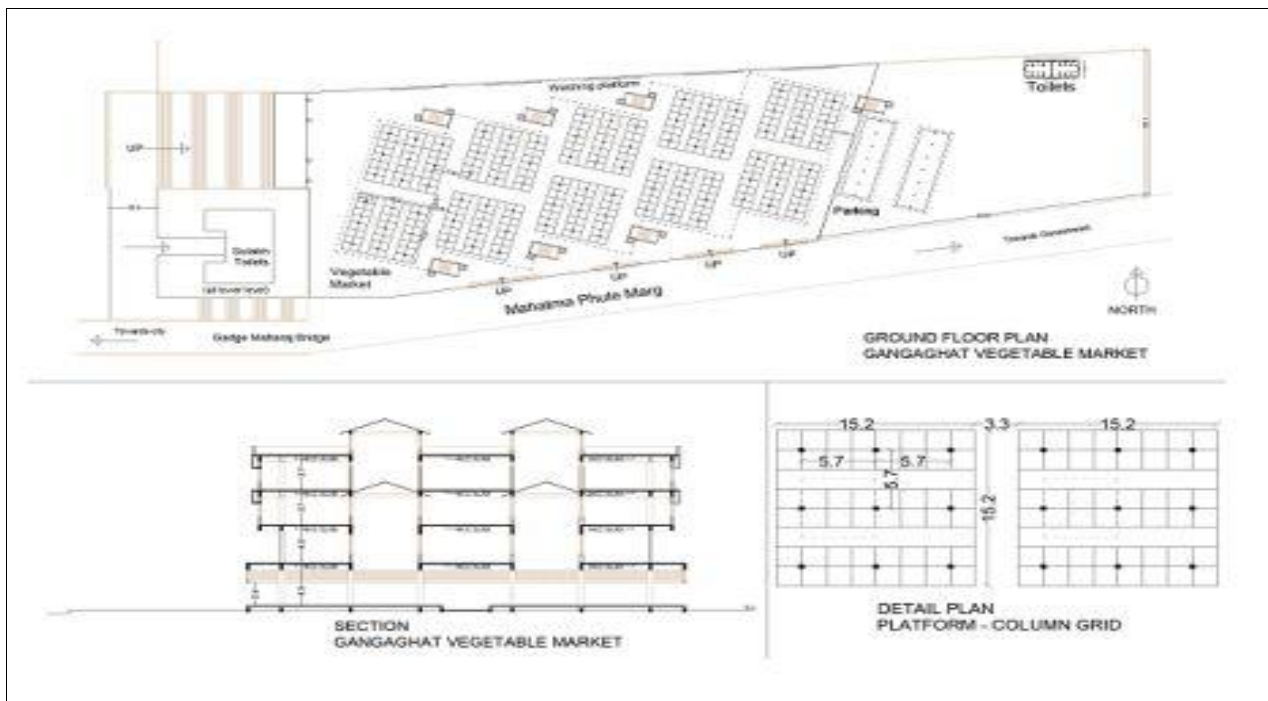


Figure 15: Plan and section of vegetable market.
Source: Architects Sanjay Dhumne Associates, Nasik, Maharashtra

5.9. COMPATIBILITY STUDY AND RESULTS

A simple grid planning offers an opportunity to reconfigure the existing market to adapt to the proposed reuses. From the structural analysis and study of architectural configuration, it can be deduced that Industrial Training Centre cannot be provided in this building, whereas Gymnasium can be provided at ground floor level. The proposed reuses suggested in Table 1 are not exclusive. The larger floor plate allows mixed use development depending on their compatibility. This further prompts to a compatibility study of different functions which can be conceded together on one floor as follows:

Table 2: Floor wise Proposed Uses

Sr. No.	Floor	Proposed Reuses	Alternative Reuse
1	Ground Floor	Retail Shopping centre, Small scale industry for women and their sales counter	Vedic School, Yoga Centre, Gymnasium, Music School
2	First Floor	Offices, Extension counters of Bank, Post Office	
3	Second Floor	Agriculture Information Centre and sales	
4	Third Floor	Few Departments of Nasik Municipal Corporation, Post office	

With the involvement of prospective users, these reuses can be finalised based on common consensus and financial benefits to the municipal corporation. With the aim to reduce the financial burden on Municipal Corporation to develop and maintain these properties and to reduce risks of building obsolescence, appropriate decisions on reuse of existing vacant buildings can be taken.

6. DISCUSSION

Although a simple grid planning can support above mentioned reuses; certain additions and demolitions that are essential for future reuses demands investments in terms of new material and financial resources. In Indian Scenario, local governments are always in the deficit of financial resources. These new requirements will certainly pose additional burden on their machineries. Therefore, there is great requirement of mechanisms that can augment financial resources on one hand and revitalize cities by creating vibrant commercial spaces through reclamation of vacant buildings on the other hand.

There is every possibility these proposed reuses may fail in the absence of participatory processes. Public- Private Partnerships and community organizations can play a significant role in these rejuvenation projects if involved throughout the stages of initial planning, funding and execution. Private partners who could be potential users of the proposed mixed use developments can be involved while conceiving the ideas of new proposals to understand their preferences, concerns and ensure the occupancy for the new functions. Public participation through community organizations is also equally important to give them a sense of inclusion and understand their felt needs and aspirations. It has been observed through a case study that although, MRTTP act envisage public participation in planning process, participatory process of all stakeholders is lacking due to negligence of both the parties - government and stakeholders resulting into redundancy of infrastructure projects. The case studies of vacant markets in these 3 cities also indicated that since there was no financial involvement of vendors in the project, there was no consciousness about the utilization of the infrastructure. Participation of potential users (Entrepreneurs, Vendors) in planning limited to conceptualization of project will give them a sense of inclusion, whereas monetary contribution in the project will give them a sense of belonging and accountability.

7. REDEFINING PLANNING APPROACH TO PREVENT BUILDING VACANCY

The significant percentage of building vacancy in vegetable markets in Maharashtra State and case-studies suggest that there is need to redefine planning approach towards infrastructure projects. The planning clues conceived from historical and cultural context are essential in any planning projects. Public infrastructure is intended for public use and therefore, stakeholders' involvement in planning process would ensure the success of such projects. Stakeholders' contribution should not be confined to

idea board; rather it should be extended to financial involvement. In other words, there should be shift in governments' role from provider to catalyst. Public infrastructure is developed through public funds and resources, therefore it is crucial to design it with the perspective of long term use and hence, mixed use developments and adaptive reuse should form design priorities so that optimum utilization of resources can be realized throughout its life cycle.

8. REUSE STRATEGIES FOR EXISTING VACANT BUILDINGS

With the prospect to retrieve the resources consumed in existing vacant building following strategies are recommended for their reuse as an outcome of this research based on case-studies and literature:

1. Formulation of regulation for vacant buildings to address the issues of security, fire safety, maintenance and possession of vacant properties
2. Development of inventory of existing vacant built stock with their documentation of physical status through photographs, architectural and structural drawings, age, building footprint, access to the building, availability and status of provision of parking, vertical access and services such as water supply, electrification, drainage and sanitation, etc.
3. Preparation of a report of each of the building including land use zoning in surrounding areas, amenities in proximity of the building and population studies etc.
4. Evaluating vacant buildings for its reuse potential using spatial analysis to study market demands, structural analysis to study its technical potential to sustain a particular function and studying architectural configuration to assess spatial flexibility for intended reuse.
5. Defining best suitable reuse of the building based on socio-economic and environmental considerations.
6. Encouraging receivership to allow private sector participation and other stakeholders involvement in reuse project to lessen the financial liabilities of local government.
7. Sharing economic benefits of reclaimed projects through public private partnerships.

9. CONCLUSION

The shift in planning approach recommended in this research will certainly reduce the rate of building vacancy. There is also a need to change the design approach from designing buildings for too specific purpose to designing building for generic purpose in the public sector by adopting design strategies for adaptive reuse. A vacant properties bank can be developed using above mentioned strategies which can aid in combating land scarcity in urban areas and serve as a land management tool. Vacant properties also offer an opportunity for local government to employ these building to Development Plan provisions which have not yet been realized and thus, reduce the financial burden of acquisition of land and construction of other public amenities. Commercial properties can be effectively rejuvenated and brought back to vibrant social life through private and community participation. The financial benefits can be pocketed by all the stakeholders and thus, can create a win-win situation for all. Strategic reuse of buildings can convert unsightly and hazardous vacant buildings which are considered to be financial, administrative and social nuisance into fostering economic opportunities for both the society and local government.

It should be noted that, there is a scope for further research on a development of tool that can assist in weighing proposed reuses based on socio-economic and environmental considerations.

10. REFERENCES

An Ordinance, Adding a New Chapter 20 to Title 4 of the City Code, "Vacant Buildings" [online], 2004. Available from: http://www.cityofevanston.org/pdf/vacant_buildings_ordinance.pdf [Accessed 29 March 2015].

- Atlanta Regional Commission Staff, 2011. *City of Alpharetta Strategies for Vacant Commercial Property Re-Use* [online]. Available from: <http://www.google.co.in/atlantaregional.com/Library/Services/community/choices/alpharetta.pdf/> [Accessed 1 April 2015].
- BJA, n.d. *Addressing Foreclosed and Abandoned Properties* [online]. Available from: www.courtinnovation.org [Accessed 4 April 2015].
- Botts S. M., 2010. *Analyzing the Problem of Abandoned, Vacant and Unoccupied Buildings in Middletown, Ohio* [online]. Available from: <https://www.usfa.fema.gov/pdf/efop/efo44528.pdf> [Accessed 12 April 2015].
- Cleveland City Planning Commission, n.d. *Ideas for Vacant Land Re-Use in Cleveland* [online]. Available from: [http://www.google.co.in/Ideas for vacant land re-use in Cleveland.pdf](http://www.google.co.in/Ideas%20for%20vacant%20land%20re-use%20in%20Cleveland.pdf) [Accessed 25 March 2015].
- Coleman, J., 2004. *Fighting Fires in Vacant Occupancies* [online]. Available from: <http://www.fireengineering.com/articles/print/volume-157/issue-4/departments/roundtable/fighting-fires-in-vacant-occupancies.html> [Accessed 12 April 2015].
- Communities and Local Government, 2012. *New Opportunities for Sustainable Development and Growth through the Reuse of Existing Buildings, Consultation* [online]. Available from: https://www.gov.uk/government/uploads/system/uploads/attachment_data/file/8351/2171937.pdf [Accessed 2 April 2015].
- Community Safety Initiative_LISC_CSI, n.d. *Combating Crime Problems Stemming from Foreclosed and Vacant Properties* [online]. Available from: http://www.google.co.in/_safety_topics_asset_upload_file.pdf [Accessed 28 March 2015].
- Enconsult Corporation, Penn institute for urban research, 2010. *Vacant Land Management in Philadelphia, Final Report, The Cost of the Current System and the Benefits of Reform, Prepared for Redevelopment Association of Community Development Corporations* [online]. Available from: http://planphilly.com/uploads/media_items/http-planphilly-com-sites-planphilly-com-files-econsult_vacant_land_full_report-pdf.original.pdf [Accessed 20 March 2015].
- Energy Analysis and Saving Technologies: Life Cycle Energy Analysis (LCEA) of Building Construction [online], n.d. Available from: <http://www.emsd.gov.hk/emsd/eng/pee/lceabc.shtml> [Accessed 7th April 2015].
- Marianne, E. and Brachman, L., 2014, *Redeveloping Commercial Vacant Properties in Legacy Cities, A Guidebook to Linking Property Reuse and Economic Revitalization* [online]. The German Marshall Fund of the United States and Greater Ohio Policy Center. Available from: https://www.mml.org/resources/sample_docs/ordinances/blight/toolkits-and-reports/redeveloping%20commercial%20vacant%20prop-may14.pdf [Accessed 28 March 2015].
- GSBS Richman Consulting, 2013. *Final Draft, Addressing Vacant and Abandoned Buildings in Oklahoma City, Prevalence, Costs + Program Proposal* [online]. Available from: <http://www.okc.gov/documents/vacant%20and%20abandoned%20home%20study.pdf> [Accessed 29 March 2015].
- Mike, H., 2009. *Protecting your Vacant Building: How to Reduce the Risks and Become More Aware of Coverage Pitfalls* [online]. 2009 Zurich Services Corporation, Real Estate Practice Leader, Zurich in North America. Available from: <http://www.zurichna.com/internet/zna/SiteCollectionDocuments/en/media/whitepapers/RECold2AvacantpropertyWhitepaper.pdf> [Accessed 26 March 2015].
- How Can Municipalities Confront the Vacant Property Challenge?, 2010. *Report by Business and Professional People for the Public Interest, Chicago Metropolitan Agency for Planning, Metropolitan Mayors Caucus* [online]. Available from: <https://www.google.co.in/How+Can+Municipalities+Confront+the+Vacant+Property+Challenge.pdf> [Accessed 6 April 2015].
- IAAI/USFA Abandoned Building Project, 2006. *Managing Vacant and Abandoned Properties in Your Community* [online]. Available from: <https://www.firearson.com/uploads/Background-Paper.pdf> [Accessed 3 April 2015].
- National Vacant Properties Campaign, Creating Opportunity from Abandonment, 2015. *Vacant properties, the True Costs to Communities* [online]. Available from: <http://www.smartgrowthamerica.org/documents/true-costs.pdf> [Accessed 25 March 2015].
- Orange County Planning, n.d. *Adaptive Reuse of Vacant Properties, Smart Growth Principles at Work* [online]. Available from: http://www.cityofnewburgh-ny.gov/sites/newburghny/files/u98/orange_county_planning_department.pdf [Accessed 1 April 2015].

- Planning Property and Development Department, n.d. *Vacant Buildings* [online]. Bylaw No. 79/2010. Available from: http://www.winnipeg.ca/ppd/pdf_files/bylaw79-2010.pdf [Accessed 3 April 2015].
- Preservation Green Lab and Urban Land Institute, Philadelphia, 2014. *Retrofitting Philadelphia: The Partnership for Building Reuse* [online]. Available from: <http://www.preservationnation.org/information-center/sustainable-communities/green-lab/partnership-building-reuse/04614-NTHP-Philadelphia-WEB-FINAL.pdf> [Accessed 3 April 2015].
- Schilling, J. M., n.d. *The Revitalization of Vacant Properties - Where Broken Windows Meet Smart Growth* [online]. International City/Country, ICMA Management Association. Available from: http://www.usmayors.org/brownfields/library/Revitalization_of_Vacant_Properties.pdf [Accessed 30 March 2015].
- Shane, J.M., n.d. Abandoned Buildings and Lots, Guide No. 64, The Problem of Abandoned Buildings and Lots, Available from: http://www.popcenter.org/problems/abandoned_buildings_and_lots/http://www.popcenter.org/problems/abandoned_buildings_and_lots/ [Accessed 12 April 2015].
- Shane J.M., 2011. Abandoned Buildings and Lots. *22nd Annual Problem-Oriented Policing Conference Miami*, Florida October 10-11, 2011.
- The United States Conference of Mayors, 2006. *Combating Problems of Vacant and Abandoned Properties Best Practices in 27 Cities*.
- The United States Conference of Mayors, 2008. *Vacant and Abandoned Properties, Survey and Best Practices* [online]. Available from: www.usmayors.org [Accessed 12 April 2015].
- United States Government Accountability Office, GAO, 2011. *Vacant Properties, Growing Number Increases Communities' Costs and Challenges, Report to the Ranking Member, Subcommittee on Regulatory Affairs, Stimulus Oversight, and Government Spending, Committee on Oversight and Government Reform, House of Representatives* [online]. Available from: <http://www.gao.gov/assets/590/586089.pdf> [Accessed 4 April 2015].
- Way, K., McCarthy, M. and Scott, J., 2007. *Building Hope: Tools for Transforming Abandoned and Blighted Properties into Community Assets, a Report on Dallas, Texas*. Prepared for: Builders of Hope
- Luke, W., 2011. Vacant Property: Strategies for Redevelopment in the Contemporary City, Georgia Institute of Technology, MCRP.
- Williams, A, 2009. *Life Cycle Analysis: A Step by Step Approach* [online]. University of Illinois at Urbana Champaign. Available from: http://www.istc.illinois.edu/info/library_docs/TR/TR040.pdf [Accessed 24 March 2015].
- Willis, 2010. *Strategic Outcomes Practice, Technical Advisory Bulletin* [online]. Available from: www.willis.com [Accessed 6 April 2015].

ANNEXURE 1: EMBODIED ENERGY CALCULATION

	Material	Location	Specification	Unit	Quantity	Embodied Energy of material		Total Embodied energy	
1	Steel		Recycled						
	a	Reinforcement in structural members in Ground Floor and First Floor	Galvanised from ore	MT	398.80	MJ/Kg	25	MJ	997000.00
	b	Entrance gate, Skylights	Galvanised from ore	MT	28.00	MJ/Kg	25	MJ	70000.00
	c	Shutters, Grill, Railing	Galvanised from ore	MT	420.00	MJ/Kg	25	MJ	1050000.00
2	a	Concrete with Portland cement	Pile and Pile cap	CuM	421.94	MJ/Kg	1.5	MJ	1518984.00
	b	Upto Plinth	Structure, reinforced	CuM	1363.35	MJ/Kg	1.5	MJ	4908060.00

	c		Upto First Slab	Structure, reinforced	CuM	1213.72	MJ/Kg	1.5	MJ	4369392.00
	d		Upto Second Slab (Toilet block)	Structure, reinforced	CuM	6.54	MJ/Kg	1.5	MJ	23544.00
	e		Parking floor	Structure, reinforced	SqM	2663.00	MJ/Kg	1.5	MJ	1438020.00
	f		Percast chamber covers	Structure, reinforced	CuM	62.10	MJ/Kg	1.5	MJ	223560.00
3	a	Mortar and plaster	Plaster Internal and External		SqM	15543.20	MJ/Kg	1.0	MJ	442981.20
	b		Terrace Waterproofing		SqM	3807.98	MJ/Kg	1.0	MJ	578812.96
	c		Toilet waterproofing		SqM	51.98	MJ/Kg	1.0	MJ	9876.20
	d		Dry mortar below Kota flooring for platforms		SqM	350.00	MJ/Kg	1.0	MJ	16625.00
	e		Dry mortar below flooring in toilet block		SqM	75.35	MJ/Kg	1.0	MJ	9305.73
	f		Mortar in Brick work		Cu m	24.57	MJ/Kg	1.0	MJ	46683.00
4	a	Masonry	Masonry for Platforms and toilet	Fired clay (well fired bricks massive) 150 x 150 x 76	CuM	351.04	MJ/Kg	3.0	MJ	2000928.00
	b		Koba filling for waterproofing on terrace	Fired clay (well fired bricks massive) 150 x 150 x 77	SqM	3756.00	MJ/Kg	3.0	MJ	1605690.00
	c		Koba filling for waterproofing in toilet	Fired clay (well fired bricks massive) 150 x 150 x 78	SqM	51.98	MJ/Kg	3.0	MJ	29628.60
5	a	Flooring	Kota for Platform flooring		SqM	350.00	MJ/Kg	0.5	MJ	15120.00
	b		Kota for Washing areas		SqM	90.00	MJ/Kg	0.5	MJ	3037.50
	c		Tiles in Toilet block	Ceramic tiles 300x300	SqM	75.35	MJ/Kg	8	MJ	6028.00
	d		Wall tiles in Toilet (Inside & outside)	Ceramic tiles 300x150	SqM	305.16	MJ/Kg	8	MJ	14647.68
6		Electrical conduit		Polyvinyl Chloride Pipe (dia 40 to 63 mm, wt 0.33 to 0.56 kg/m)	RM	487.40	MJ/Kg	85	MJ	17400.18
7	a	Plumbing	PVC - Drainage	Polyvinyl Chloride Pipe (dia 40 to 110 mm, wt 0.33 to 1.64 kg/m)	RM	132.30	MJ/Kg	85	MJ	8771.49
	b		From septic tank to Main	Soil pipe (Cast Iron) dia	RM	35.00	MJ/Kg	13	MJ	3822.00

		drainage line	110mm, wt 8.40 kg/m							
	c	PVC - Water supply	Polyvinyl Chloride Pipe (dia 40 to 110 mm, wt 0.33 to 1.64 kg/m)	RM	180.20	MJ/Kg	85	MJ	6433.14	
8		Glass in skylights	Wired glass 12 mm thk	SqM	706.48	MJ/Kg	12	MJ	244159.49	
9		Paint	cement paint (Double coat)	SqM	15543.20	MJ/Kg	59	MJ	22926.22	
10	a	Plinth filling	Substrate made of gravel and crushed rocks of thickness = 1000 mm	Stone structural	Cu M	4188.86	MJ/Kg	0.5	MJ	5654961.00
	b		Blinding course mureom of thickness 150 mm	Earth compressed structural	Cu m	907.01	MJ/Kg	0.5	MJ	907010.00
11		Doors	Concrete frame	R m	74.4	MJ/Kg	1.5	MJ	1607.04	
			PVC Panel	No	14	MJ/Kg	85	MJ	5950.00	
12		Toilet	Cement jali in toilet window	Sq M	5.04	MJ/Kg	1.0	MJ	478.80	
Total								MJ	26251445	
Building footprint								Sq. M.	3745.06	
Embodied energy per Sq. M.								MJ/ Sq. M.	7010	