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Analyse and Design of Waste Transfer Station Plant Using PEB Roofing Concept for SWM for Coimbatore Corporation

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ABSTRACT—

Solid waste management is one of the most important areas where the problem arises from time to time. Municipal bodies are unable to provide a 100% efficient system for solid waste management. Solid waste management frequently suffers more than other services. The real problems are mainly of organization, management & planning. By solving this problem, we collected the solid waste management details, reserved land details of Coimbatore Corporation and selected the site for waste transfer station plant. We also suggested the idea of implementing Pre-engineering building concept for constructing waste transfer plant. Pre-engineered buildings (PEBs) are predesigned, prefabricated and site erected metal building systems used in economically viable and light weight industrial structures. A typical frame of the structure has been analyzed by the concept of pre- engineering buildings. Detailed two dimensional drawings were done using AutoCAD 2009 software. Analysis and design of the whole structure was carried out in STAAD.Pro-V8I software. The results of analysis have been investigated and discussed in the report.

Keywords—Pre Engineered Building, PEB, Solid Waste management, SWM

INTRODUCTION

Coimbatore popularly known as “Manchester of South India” is situated in the western part of Tamil Nadu. Coimbatore is well known for its textile industries, because of its proximity to the hills of the Western Ghats, Coimbatore enjoys an excellent climate throughout the year. Coimbatore city was constituted as a municipality in 1866, with a population of 24,000 covering an extent of 105.56 Sq.km. Coimbatore city has been elevated as a municipal corporation from 1981. The study area has bounded between 10° 58’ N to 11° 30’ N and 76° 55’E to 77° 30’ E. At present the population of the city is approximately 16.13 Lakhs, including a floating population of around 1.5 lakhs with an area of 257.36 Sq.km. The city has been divided into five zones namely, North, South, East, West and Central. Each Zone consists of 20 wards, total of 100 wards.

It is fundamental for every organization to manage waste applying the best environmental option, in an ordered process: prevention, preparation for re-use, recycling, recovery and disposal. With the aim of complying with recycling and recovery target quantities set by environmental clearance, each Member State is working on different organizational models, based however on the same simple principle: each player operating in the waste sector must actively participate in managing the whole waste value chain. The sustainability model addresses economic growth; social cohesion and environmental protection must go hand in hand as an inseparable whole.

Pre-engineered buildings (herein after referred as PEB) are metal building systems used in many lighter industrial applications. It utilizes non-prismatic rigid frame building structures using with members with slender elements. Steel was very expensive item in USA. The concept of PEB originated from there. The idea was that section should be provided as per the bending moment diagram. This directed to saving in steel and the development of PEB concept. PEB systems are now extensively used in industrial and many other non- residential constructions worldwide but in India it is relatively a new concept, introduced in late 1990’s. With respect to design of the structure and aesthetic appearance, India is way behind. As compared to other countries Indian codes for building design are stringent but safer. In India, American codes are also followed for the construction of PEB.

Analyse and design of waste transfer station plant using PEB roofing concept for SWM for coimbatore corporation is made in this project.

REVIEW OF LITERATURES

Aurobindo Ogro (2003) has done logistics and spatial management for solid waste management system using GIS for Dehradun city. The objective was to increase the revenue base of the local bodies and deliver the services in an efficient way by taking appropriate planning and management. He has created a phased action plan, one element of which is creation of an efficient GIS system. He collected the ward maps of the city, ward wise population distribution existing lifting cycle pattern of the waste bins of city etc., The software used for the project was Arc view GIS. After implementing all the

process, the expected end results were the proper logistics and management and spatial planning using GIS analysis for implementing and managing the system at field level (Aurobindo Ogro)

Christos Chalkias and Katia Lasaridi (2009) have done a research on the basis of ARCGIS model for the optimization of municipal solid waste collection and transport system in Nikea, Greece. They have implemented two scenarios of collecting vehicle routing optimization and reallocation of bins respectively and compared it with current empirical collection scheme. In this case study they were replaces the existing large number of small (501 bins) bins with a reduced number of larger bins (162 bins of 1100L capacity) and establishes an optimal route with the help of Arc GIS. An alteration of the classic Dijkstra's algorithm of network analysis was used for finding the optimal path. As a result of their analysis, effectively reduces the collection time, travel distance and also the savings in fuel consumptions (Christos Chalkias, Katia Lasaridi)

This paper describes a method to compare raster maps of categorical data. The method applies fuzzy set theory and involves both fuzziness of location and fuzziness of category. The fuzzy comparison yields a map. The comparison method presented here, was primarily developed to be of use in the calibration and validation process of cellular models for land-use dynamics. The method is based on fuzzy set theory. In this paper three types of membership vectors will be distinguished the Crisp Vector (Vcrisp) the Fuzzy Category Vector (Vcat) and the Fuzzy Neighborhood Vector (Vnbh). The two maps were created for the map comparison and for the calibration purpose; the particular model is a constrained cellular automaton and applied for the study of the urban development of Dublin,

STRUCTURAL ASPECTS

A structure is subjected to various types of loadings such as permanent, semi permanent, movable, moving and occasional. The permanent loads are due to self weight of structure, semi permanent ones are due to fixtures, which are rarely removed, movable loads are due to machines, stationary, etc. and moving loads are mostly moving on the structure. The occasional loads are due to wind, earthquake or floods. For design purpose the analysis if carried out for loads described, designed for and checked for occasional loads by permitting increase in permissible stresses and strains.

The most critical load on industrial building is wind load. The structure is analyzed for wind as per IS: 875 (Part3) - 1987. Procedure for wind load computation is dealt in detail towards the end of this chapter and the exact analysis is presented.

GEOTECHNICAL INVESTIGATION

The work of sub-soil exploration for the proposed project of Waste transfer station, Coimbatore. The soil investigation and laboratory studies were carried out in July 2012 as per the report. The object of investigation was to ascertain the nature and characteristics of sub-soil below the ground level at the proposed site. The study is carried out for the identification of suitable foundation systems for the proposed structure and assessment of safe bearing capacity.

The geotechnical investigation includes mobilization of boring rings with all necessary equipments and personnel, boring of five boreholes of 150 *mm* diameter with rotary drilling equipments through sand, silt, clay and gravel to a maximum depth of 18.5 *m*, conduction of standard penetration testing the disturbed in bore holes and collecting the disturbed samples including packing and transportation to laboratory and conduction of various laboratory tests.

Recommendations according to the geotechnical investigation suggest that at a depth of 3 *m*, a size of 2 *m*_×_2 *m* footing can be proposed. Safe bearing capacity of 20 *T/m2* can be used in lateritic gravelly silty sand.

SOLID WASTE MANAGEMENT

Solid wastes are all waste arising from human and animal activities that are normally solid and that are discarded as useless or unwanted. It encompasses the heterogeneous mass of throwaways from the urban community as well as the more homogeneous accumulations of agricultural, industrial and mineral wastes. Solid waste management may be defined as that discipline associated with the control of generation, storage, collection, transfer, transport, processing and disposal of solid wastes in a manner that is in accord with the best principles of public health, economics, engineering, conservation, aesthetics and other environmental considerations that is responsible to public attitudes.

Garbage Generation per day (MT)	850
Garbage collected per day (MT)	810
Garbage handled by Corporation (Primary Collections)	100%
Generation per person (gm / day)	600
Collection Efficiency	95%

PRIMARY WASTE COLLECTION

Primary waste collection comprises street sweeping, door to door collection, collection from bins and open dumping, collection of drain silt. Detailed below are the salient features of Coimbatore Corporation operations in waste collection.

STREET SWEEPING

Corporation carries out street sweeping on regular basis with frequency varying from daily to weekly. Street sweeping is carried out both with traditional and modern methods. Road sweeping and mopping is also carried out with 12 nos. of road sweeping flipper machines to clean the roads. There are about 100 containers of 2 MT capacities, which are places at important locations in the city. 2,137 sanitary workers are involved in the conservancy works, which works out to be about 275 m of road length per conservancy worker, which is low according to the norms. Zone wise of street sweeping.

AMOUNT OF GARBAGE REMOVED

Zones	No. of wards	Garbage removed
East zone	20	142
West zone	20	180
North zone	20	174
South zone	20	187
Central zone	20	167
Total- 5 zones	100	850

Roof slope	Access	Live load
≤10°	Provided	1.5 *kN/m2*of plan area
	Not provided	0.75 *kN/m2* of plan area
≥10°		Less 0.02 *kN/m2* for every degree increase in slope over 10 but not less than 400 *N/m2*

SNOW LOAD

Recommendations for snow loads are provided in IS : 875 (Part 4) – 1987. If the structure is situated in an area where the roof is subjected to snow, the load considered for design should be the maximum of live load or snow load. The load due to snow depends upon the pitch of the roof, shape of the roof and roofing material. Snow load may be assumed to be 2.5 *N/m2* per *mm* depth of snow. When the roof slope is greater than 50°, the snow load may be neglected.

DYNAMIC IMPOSED LOADS

Dynamic imposed loads which act on structures include repeated loads as well as impact and blast loads. Dynamic forces including vibration, shock, acceleration, retardation and impact, etc. are of importance in the design of overhead travelling cranes, lifts, etc. found in industrial buildings. Impact due to vertical crane loads is converted empirically into equivalent static loads through an impact factor, which is normally a percentage of the crane loads. The impact factors are suggested in the IS : 875 (Part 2) – 1987 for the cranes and lifts.

BUILDING HEIGHT

Eave height	:	12.00 *m*
Ridge height	:	16.00 *m*
Number of spans	:	4 *Nos*
Single span width	:	30.00 *m*
Total span width	:	120.00 *m*
Number of bays	:	16 *Nos*
Single bay length	:	12.00 *m*
Total bay length	:	192.00 *m*
Roof angle	:	15º

LOAD CALCULATION

Weight of purlins, *w1 = 10 N/m*
Weight of GI sheets, *w2 = 15 N/m2*
Weight of bracing, *w3* = 12 *N/m2*
Self weight of truss by empirical formula, *w4* = 100 *N/m2*
Total weight per m^2, *w5* = 262 *N/m*
Total load on intermediate panel points, *g*
= *w5*× *lb*× *lp* + *w1*× *lb*
= 262×12×1.5+100×12
= 4716+1200
= 5916 N
= 6 KN
Total load on the end panel points, g1 = 6/2 = 3 KN
Uniformly distributed load dead load, *wg*
= *w5* × *lb* + *w1* × *lb* ÷ *l*
= 262 × 12 + 100 × 12 ÷ 15
= 3224 *N/m*
= 3.2 *KN/m*

TABLE OF RESULT

Maximum axial force	= 1.63 *KN*
Maximum shear force	= 46.5 *KN*
Maximum bending moment	= 36.1 *KN*
Support reaction	= 60.0 *KN*

RESULTS AND DISCUSSION

From the investigation of analysis report, the member forces required for the design of the members are obtained and are as shown in the Figure 9.5. As the loading and combinations are symmetrical, the values can be mirrored to obtain the forces for the whole structure.

CONCLUSION

Solid waste disposal in bigger cities are the challenging task for corporation administrations. The site which is being used for dumping the solid wastes for Coimbatore Corporation creates more problems. By solving this problem, we collected the solid waste management details, reserved land details of Coimbatore Corporation and selected the site for waste transfer station plant. Waste transfer station plant is used for dumping the solid wastes and it secure from pollution. We also suggest the idea of implementing Pre-engineering building concept for constructing waste transfer plant

Pre-engineered buildings (PEBs) are predesigned, prefabricated and site erected metal building systems used in economically viable and light weight industrial structures. Pre-engineering building concept is extensively used worldwide. A typical frame of the structure has been analyzed by the concept of pre- engineering buildings. Detailed two dimensional drawings were done using AutoCAD 2009 software. Analysis and design of the whole structure was carried out in STAAD.Pro-V8I software. The results of analysis have been investigated and discussed in the report.

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