

# A Voided Slab and Conventional Flat Slab; A Comparative Study

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## Abstract

The Bubble Deck slab is a newly designed bi-axial concrete floor slab system. High density polythene (HDPE) hollow spheres are placed in the center of slab by replacing the ineffective concrete to decrease its dead weight so increase the efficiency of floor. This abstract deal with work carried out to compare the bubble deck voided slab system and conventional flat slab system by finite element analysis using SAP 2000 as well as manual calculation by Direct design method using IS-456:2000 to study the behavior of bending moments, shear force, deflections and reactions due to change in span for various load conditions. The present study is carried out to study the seismic behavior of structure due to reduction in dead weight of structure by modelling and analysis of G+12 storey structure for 6m x 7m, 7m x 8m, 8m x 9m grid systems.

**Keywords:** Bubble Deck Voided Slab, SAP2000, Shear Force, Bending Moment

## I. INTRODUCTION

The flat plate floor systems are commonly used in multi-storey buildings, because flat plate floor system present advantages from technical and functional point of view. The self-weight of slab can reduce by replacing the middle height of the cross section of slab with void former. Actually, the concept of removing non-working concrete from slab cross section is quite old. The voided slab used in construction field more than 50 years. By introducing void former into the slab, self-weight of the slab can be reduce and this lead to reduction in overall cost of the slab. The overall weight of slab is decreasing as much as 35% compared to solid slab of same capacity. The main idea behind voided flat plate slab is to removing the unused concrete from the middle of the slab. The spherical balls, which are inserted in the middle of the flat plate slabs, are manufactured from recycled plastic, which do not react chemically with concrete or steel.

## II. LITERATURE REVIEW

Reshma Mathew and Bina.P (2006) studied the punching shear behavior of bubble deck slab compared to solid slab. The punching shear capacity of bubble deck slab is small in comparison with solid slab. Hence, the GFRP strips with various orientations are used as a strengthening system for bubble deck slab. Finite element analysis was carried out using ANSYS software. Strengthened slabs have higher punching capacity compared with control bubble deck slab. There is increment in load carrying capacity up to 20% due to strengthened bubble deck slab. By introducing HDPE balls of 180 mm diameter in to a flat slab of thickness 230mm can save the weight up to 23.62% around one ball.

M.Surendar and M.Ranjitham (2016) studied the analysis of bubble deck slab numerically as well as experimentally. For numerical study, the bubble deck slab and conventional slab is analyzed by using ANSYS software with appropriate support conditions and providing uniformly distributed loading. Also, for experimental investigation the test specimens were designed for two types of slabs, one for conventional one way RC slab and other were for one way bubble deck slab. The stress and deformation results were evaluated and compared the bubble deck slab with conventional slab were observed using finite element analysis. By numerical and experimental studies it is shows that the bubble deck slab can withstand 80% of stress when compared with conventional slab. Slight variation occurs in the deformation when compared with conventional slab. At last the comparison has been made for Bubble Deck Slab with the Conventional slab over its self-weight. From the evaluation of these results, Bubble Deck Slab gives better performance than that of the conventional slab.

P. Prabhu Teja et al (2012) discussed the various properties of Bubble deck slab based on the various studies done abroad. Moment, deflection and stress distributions are verified using Finite Element Method (FEM) in SAP2000. The finite element models of the office slabs created for this study in SAP2000 verify the prior analysis and experiments. It gives the bending stresses in the bubble deck slab are found to be 6.43% lesser than of a solid slab. Also, deflection of bubble deck is 5.88% more than the solid slab as the stiffness is reduced due to hollow portion. Further, the shear resistance of bubble deck slab is 0.6 times the shear resistance of the solid slab of same thickness. However required resistance can be achieved by providing vertical reinforcement.

Saifee Bhagat and Dr. K. B. Parikh (2014) studied the parameters of voided slab in terms of moment of inertia, shear capacity, stiffness reduction factor, weight reduction factor and compared with the flat plate slab. The voided flat plate slab and solid flat plate slab are considered with interior span ranging from 6m x 6m to 14m x 14m having thickness from 280mm to 600mm having

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**Padhraic Smyth**



## **A Voided Slab And Conventional Flat Slab A Comparative Study:**

**Proceedings of the International Conference on Industrial and Manufacturing Systems (CIMS-2020)** Ravi Pratap Singh, Dr Mohit Tyagi, Dilbagh Panchal, J. Paulo Davim, 2021-07-24 In order to deal with the societal challenges novel technology plays an important role For the advancement of technology Department of Industrial and Production Engineering under the aegis of NIT Jalandhar is organizing an International Conference on Industrial and Manufacturing Systems CIMS 2020 from 26th 28th June 2020 The present conference aims at providing a leading forum for sharing original research contributions and real world developments in the field of Industrial and Manufacturing Systems so as to contribute its share for technological advancements This volume encloses various manuscripts having its roots in the core of industrial and production engineering Globalization provides all around development and this development is impossible without technological contributions CIMS 2020 gathered the spirits of various academicians researchers scientists and practitioners answering the vivid issues related to optimisation in the various problems of industrial and manufacturing systems

**Recent Developments in Structural Engineering, Volume 4** Manmohan Dass Goel, Arvind Y. Vyavahare, Ashish P. Khatri, 2024-10-25 The book presents the select proceedings of 13th Structural Engineering Convention It covers the latest research in multidisciplinary areas within structural engineering Various topics covered include structural dynamics structural mechanics finite element methods structural vibration control advanced cementitious and composite materials bridge engineering soil structure interaction blast impact fire material and many more The book will be a useful reference material for structural engineering researchers and practicing engineers

**Recent Developments in Waste Management** Ajay S. Kalamdhad, 2020-01-03 This volume presents select papers presented during the Second International Conference on Waste Management held at IIT Guwahati The book comprises of eight sections and deals with various technologies associated with curbing of different environmental issues as well as management and legislative policies associated with them This book will be of interest to various researchers students policy makers and people who pursue keen interest in the waste management techniques and policies

**Lift Slab** United States Lift Slab Corporation, 1955  
**Engineering Manual** United States Lift Slab Corporation, 1955  
**Building Science Abstracts**, 1967  
**Applied Mechanics Reviews**, 1989  
*The Athenaeum*, 1914  
**Athenaeum and Literary Chronicle** James Silk Buckingham, John Sterling, Frederick Denison Maurice, Henry Stebbing, Charles Wentworth Dilke, Thomas Kibble Hervey, William Hepworth Dixon, Norman Maccoll, Vernon Horace Rendall, John Middleton Murry, 1914  
**Flat Plate Voided Slabs** Hunter Wheeler, 2018 In structural engineering it can be challenging to incorporate a sustainable design without sacrificing structural integrity However flat plate voided slabs are an interesting alternative to standard flat plate concrete slab systems due to the reduction in concrete and the recycled plastic void formers that are located inside the slab This research is necessary because an increased use of voided slabs in concrete structures would help fight climate change by reducing the

CO<sub>2</sub> emissions caused from cement production This report will discuss the advantages and disadvantages of implementing plastic void formers into solid flat plate slabs and examine a parametric study comparing voided flat plate slabs to solid flat plate slabs The design of the voided slabs follows the CRSI Design Guide for Voided Concrete Slabs while also referencing the ACI 318 14 Building Code Requirements for Structural Concrete Three different slabs for typical square bay sizes of 25 feet 30 feet and 35 feet are designed to compare the effectiveness of voided slabs to traditional solid slabs

*Finite Element Bibliography* Gerard De Vries,1976-12 This bibliography had its inception in 1967 when the compilers first attempted a comprehensive coverage of the finite element literature using both manual and computer based retrieval Initially the data base was stored on a card index but this was subsequently transferred to punched cards and magnetic tape Computer processing was adopted at an early stage to derive the three index formats from the data base Over the subsequent years several versions of the bibliography were produced with two of these being made available in a report form to other researchers From the widespread interest in these documents it became evident that there was a need for a commercially available comprehensive bibliography in this area A major effort was undertaken to revise update and extend the data base resulting in this present volume The bibliography covers the period 1956 1975 primarily although some earlier publications of historical interest are included The citations are not restricted to the English language and documents are listed in many languages and from diverse places of origin All publication formats were accepted so that references will be found to books monographs journal papers and articles theses dissertations reports surveys and the like

**Plastic Voided Slab Systems** Corey J. Midkiff,2013 Reinforced concrete slabs are one of the most common components in modern building construction Reinforced concrete slabs with plastic voids slabs are a new and innovative type of structural concrete slab system developed to allow for lighter self weight of the structure while maintaining similar load carrying capacity of a solid slab Plastic voided slabs are capable of reducing the amount of concrete necessary to construct a building by 30 percent or more This reduction can be beneficial in terms of financial savings as well as building performance This report examines a two way reinforced concrete slab with plastic voids construction in comparison to traditional flat plate reinforced concrete slab construction The design process for plastic voided slabs is directly compared with traditional two way flat plate reinforced concrete slabs through a design comparison of typical bays of 20 by 20 6m by 6m 25 by 25 7.6m by 7.6m 30 by 30 9m by 9m and 35 by 35 10.7m by 10.7m The traditional slab design process follows the ACI 318 11 Building Code Requirements for Structural Concrete chapter 13 Direct Design Method while the plastic voided slab design process is modified from the BubbleDeck Design Guide for compliance with BCA using AS3600 and EC2 Sizes of traditional slab bays are compared to sizes of plastic voided slab bays Results of the comparison study are presented

**A Comparison of the Methods Used in the Design of Flat Slab Construction** I. Mandelbaum,1921 *A Comparative Test of Two Full Sized Reinforced Concrete Flat Slab Panels ...* Henry Turner Eddy,1913 *Assessment of R. C. Flat Slab Building* Mohd Rizwan Bhina,D. K. Paul,2013-09

Doctoral Thesis Dissertation from the year 2013 in the subject Engineering Civil Engineering grade B course Master of technology Structural Dynamics language English abstract Flat Slab building is very popular from the aesthetic and architectural point of view From functional aspect a flat slab building is more efficient than a R C frame building So construction of Flat Slab building is increasing also in high seismic zone Sometimes international building codes remain silent about the seismic response of flat slab buildings In this paper the response of Flat Slab building and a normal symmetric R C frame building of same dimension have been studied for varying seismic intensities Static Response Spectrum Pushover and Time history analysis have been performed to assess the performance of the two buildings The costs of construction for these two buildings have also been compared An extensive study on lumped plasticity model as per FEMA 356 with varying position of plastic hinge and its effect on pushover curve has also discussed in the paper The paper also comments on the plastic hinge pattern

**A Study of Tests on a Flat Plate and a Flat Slab** David Sheldon Hatcher, Mete Avni Sozen, Chester Paul Siess, 1961

A Study of Tests on a Flat Plate and a Flat Slab D. S. Hatcher, C. P. Siess, M. A. Sozen, 1961

**Flat Slab Design (comparison Between Empirical and Continuous Frame Methods ; in Accordance with CP 110, Part 1, 1972)** Nader G. Mirzai, 1984

**Comparative Performance Studies on Bonded Post-Tensioned and RC Flat Slab** Ajay Nagaraj, 2020

In a developing country like India the benefits of Post Tensioning system are yet to be recognized The post tensioning method is now a day s being adopted widely due to its applications By using post tensioning method one can achieve the most economical and safe design for commercial as well as residential buildings The present study focuses on Post Tensioned flat slab systems with respect to strength service and cost estimation The designs were analysed using ADAPT Builder software with different panel sizes The results indicate that PT slabs have better moment carrying capacity also the costs are better than the RC flat slab systems

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