DEVELOPMENT OF IOS APPLICATION FOR DESIGN OF FLAT SLABS

Shreelakshmi m j[1], Ritesh L[2], Spandana B[3], Manjunatha L[4]
[1,2] PG Student , [3,4] Assistant Professor, S J B Institute of Technology, Bengaluru

Abstract
Flat slab structural building provides a benefit over conventional slab structures because of their architectural, functional and economical aspects. Because of the absence of deep beams, flat slab structural system is significantly more flexible for lateral loads. A traditional common practice in construction is to support slab by beam and beam supported by column this may be called as beam slab load transfer construction technique. As due to this old traditional construction net height of room is reduced. Hence to improve aesthetical and structural aspect of multi-storey, shopping mall ,offices, warehouses ,public community hall etc. are constructed in such a way were slab are directly on columns. This types of slab directly supported on column termed as flat slab.
The present work is done by developing IOS application because in present days use of application is increasing day to day. So keeping in that the development of IOS application is done and the results are compared with the application developed.
Index Terms: Flat Slabs, Storey Shear, Storey Displacement, IOS Application, Swift Programming Language.

I. INTRODUCTION

Flat slab called beamless slab is a slab supported directly by columns without beams. A part of slab bounded on each of the four sides by centre line of column is called a panel. Panel may be divided into column strip and middle strip. The flat slab is often thickened closed to supporting columns to provide adequate strength in shear and to reduce the amount of negative reinforcement in the support regions. The thickened portion i.e., the projection below the slab is called drop or drop panel. Flat slab systems are popular for use in office and residential buildings, hospitals, schools and hotels. They are quick and easy to formwork and build. Absence of beams allows lower storey heights and as a result cost saving in vertical cladding, partition walls, mechanical systems, plumbing and a large number of other items of construction especially for medium and high rise buildings.

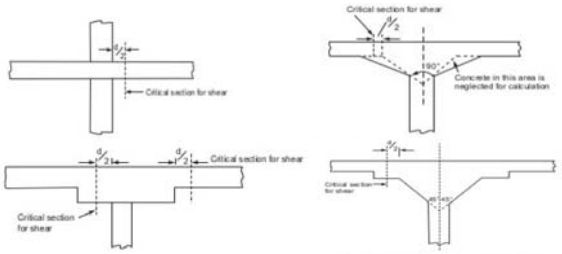


Fig. i: Types of Flat Slabs

A. Conventional Slab

Conventional slab is a slab system in which the loads are directly transferred from slabs to beam and beam to column. These slabs are used in the small buildings, Where there is very less spacing provided in inside the building. These are limited in its length and its thickness. Here the clear spacing between the floor and the slab is less because of the thickness of the beam. While in the construction of this slab more form work is needed and this form work is complicated and costly too. To install the sprinkler, piping and other utilities are quite difficult as beams are present. The reinforcement are usually provided

in single layer and it is more resistant to earthquake as it is flexible than flat slab system.

B. One way slab

A concrete slab in which the reinforcing steel runs perpendicular to the supporting beams. When a slab is supported only on two parallel apposite edges, it spans only in the direction perpendicular to two supporting edges. Such a slab is called one-way slab. Also, if the slab is supported on all four edges and the ratio of longer span(ly) to shorter span (lx) i.e. ly/lx>2, practically the slab spans across the shorter span. Such a slab is also designed as one-way slabs. In this case, the main reinforcement is provided along the spanning direction to resist one way bending.

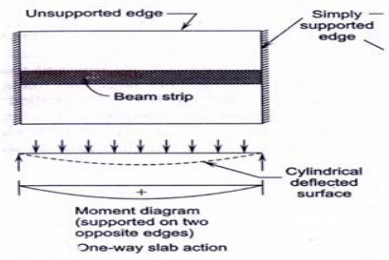


Fig ii: Behavior of One-way slab

C. Two way Slab

Two-way slabs subjected mostly to uniformly distributed loads resist them primarily by bending about both the axis. However, as in the one-way slab, the depth of the two-way slabs should also be checked for the shear stresses to avoid any reinforcement for shear. Moreover, these slabs should have sufficient depth for the control deflection. Thus, strength and deflection are the requirements of design of two-way slabs. A rectangular slab supported on four edge supports, which bends in two orthogonal directions and deflects in the form of dish or a saucer is called two-way slabs. For a two-way slab the ratio of ly/lx shall be≤2.0.

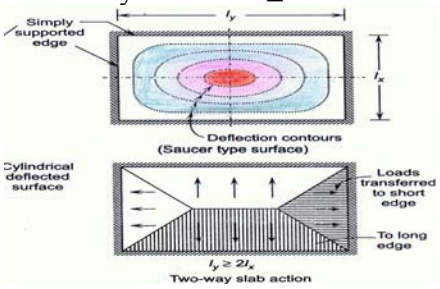


Fig iii: Behavior of Two-way slab

D. Significance of Application Development in day by day life

Over the years mobile phones have changed from a simple communication device to an operative tool that has become the focal point of many businesses due to its amazing new features. Increasing advances in mobile technology, high speed data access and the interactive interfaces have turned mobile computing into a whole new experience for users. One of the biggest reasons for this is the development of mobile apps. The mobile app development company has seen one of the biggest growths in the last decade by developing apps for androids as well as iPhone. Now these mobile apps have become an integral part of our lives and we rely on them in more than one way.

II. PROCEDURE FOR DEVELOPMENT OF IOS APPLICATION

A. Information about IOS

IOS is the working framework that keeps running on iPad, iPhone, and iPod touch gadgets. The working framework deals with the gadget equipment and gives the advances required to actualize local applications. The working framework likewise dispatches with different framework applications, for example, Phone, Mail, and Safari, that give standard framework administrations to the client. The IOS Software Development Kit (SDK) contains the instruments and interfaces expected to create, introduce, run, and test local applications that show up on an IOS gadget's Home screen. Local applications are assembled utilizing the IOS framework systems and Objective-C dialect and run straightforwardly on IOS.

B. X-code and Swift Programming Language

Xcode is an incorporated improvement condition for macOS containing a suite of programming advancement instruments created by Apple for creating programming for macOS, iOS, watchOS and tvOS. To begin with discharged in 2003, the most recent stable discharge is rendition 2008 and is accessible by means of the Mac App Store for nothing out of pocket for macOS Sierra users. Swift is a universally useful, multi-worldview, gathered programming dialect created by Apple Inc. for iOS, macOS, watchOS, tvOS, and Linux. Swift is intended to

work with Apple's Cocoa and Cocoa Touch structures and the expansive assortment of surviving Objective-C (ObjC) code composed for Apple items.

C. BUILDING OF APPLICATION IN X-CODE

X-code is the IOS application developer tool used in the Mac system for building of the application and act as a platform for the design and development of apps. X-code consists of swift programming language where program is done for the development of the app.

i. The steps in developing the application is Creating new project in the X-code.
ii. Selecting particular story boards like launch screen, navigation controller and view controller for the particular gadget.
iii. Designing the view controller screen by using the assistant tools like outlets, table views, images and buttons etc.
iv. Writing program in the coca touch classes for the app and assigning to the particular view controllers.

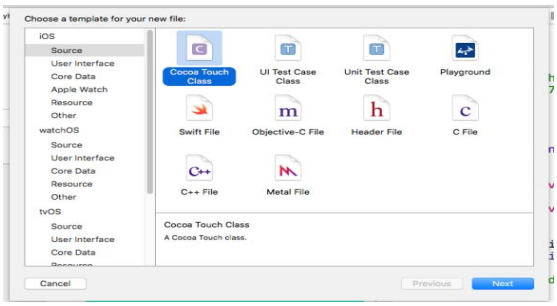
D. Procedure

i. Initially the screen of the application is designed for the app and that can be done using view controllers of particular size and that screen should be disabled for auto layouts. Multi screens can be done using multiple view controllers and these screens can be attached by using the push segues.

ii. The design of the view controller is done by using the assistant tools in the X-code, suppose if we need to input the data the outlets is used and for the naming text field is used similarly the image view can be used for the image update. After inputting the outlets the action can be done and this can be achieve by using the buttons.

iii. After designing the view controller using assistant tools, the screen should be attached to the swift programming class called the coca touch class where the programming for the current screen can be done. Swift programming language consists of many data types, functions, variables, arrays, strings, and conditionals. By using these data types the programming can be done for the required application.

iv. After all the design procedure the app is tested by one of the tool in the X-code called simulator and this simulator shows the application same as in the iPhone and preview of the application can be seen.




```
//
//  ViewController.swift
//  abc
//
//  Created by Ritesh on 6/14/17.
//  Copyright © 2017 Ritesh. All rights reserved.
//

import UIKit

class ViewController: UIViewController {

    override func viewDidLoad() {
        super.viewDidLoad()

        // Do any additional setup after loading the view.
    }

    override func didReceiveMemoryWarning() {
        super.didReceiveMemoryWarning()
        // Dispose of any resources that can be recreated.
    }


    /*
    // MARK: - Navigation

    // In a storyboard-based application, you will often want to do a little preparation before navigation
    override func prepare(segue: UIStoryboardSegue, sender: AnyObject?) {
        // Get the new view controller using segue.destinationViewController.
        // Pass the selected object to the new view controller.
    }
    */

}
```

Fig IV: Coca touch class in X-code

III. DEVELOPMENT OF APPLICATION FOR FLAT SLABS

A.Graphical User Interface

The GUI is the basic thing required for the development of application, by creating this GUI user can understand the working of app. The GUI acts as the blue print for development of the application. The GUI can be done by knowing the step by step procedure for the design and that can be achieved by writing the flowchart and algorithm.To develop any program the flow chart is very important and it is step by step procdure to do the programming.

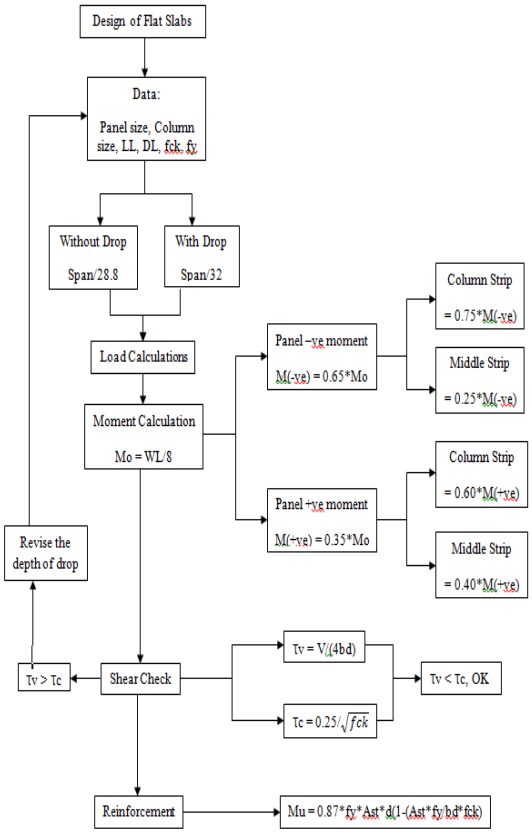
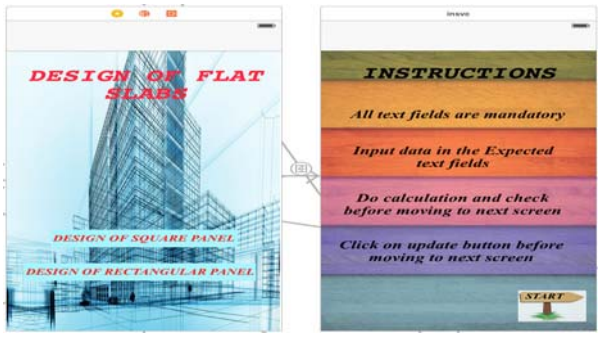
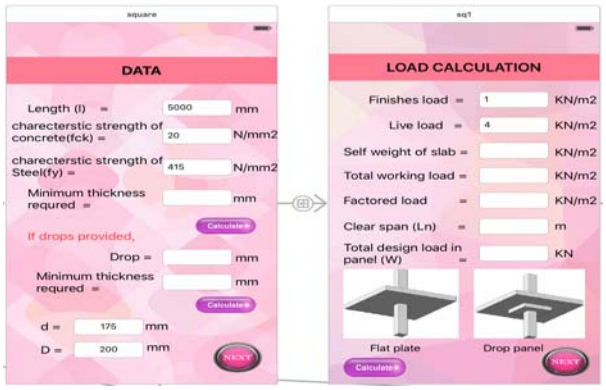


Fig IV: Flow chart of design of flat slabs

B. Square Panel Flat Slab



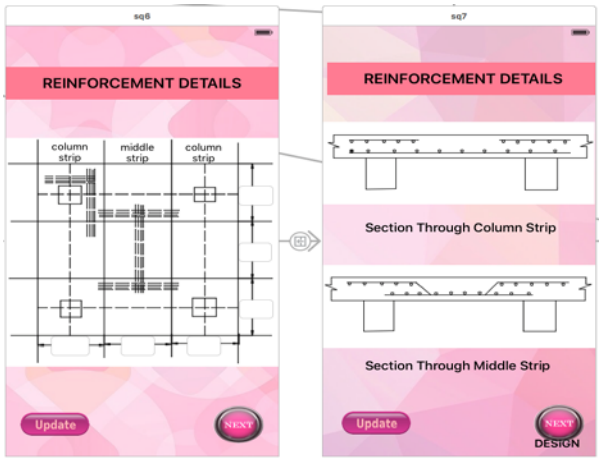
Screen-1 Screen-2



Screen-3 Screen-4

Screen-5 Screen-6

Screen-7 Screen-8



Screen-9 Screen-10

Fig V: GUI of Square panel

i. Designs of square panel in flat slabs application have been developed in eight screens.
ii. The GUI of the app is as shown in the fig. In the first screen all the data required are made to enter in the text fields.
iii. In the second screen LL and DL required is made to enter and the self-weight of the slab, total working load, factored load

and design load are calculated by writing the code in the assistant editor area.

iv. In the third screen, to calculate the panel moments, moments in column strip and middle strip is designed.

v. In the fourth screen shear check is calculated.

vi. In the fifth and sixth screen reinforcement for the required moments and spacing required for the bars are calculated.

vii. Lastly in the seventh and eighth screen reinforcement detailing of the top view, section through column strip and section through middle strips are shown.

C. Rectangular Panel Flat Slab

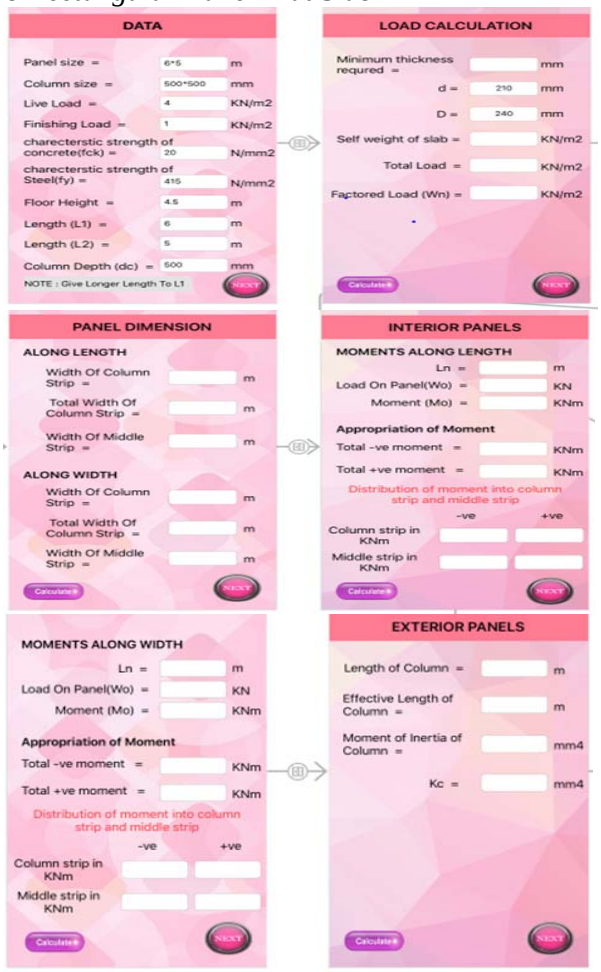


Fig VI: GUI of Rectangular panel

i. Designs of the rectangular panel in flat slabs have been designed in fifteen screens, and the GUI developed for this is shown in the fig.

ii. In the first screen the screen is designed to input the data required in the text fields.

iii. In the second screen it is designed to calculate the loads.

iv. In the third screen, panel moment along length and along width is designed to calculate.
v. In the fourth and fifth screen moments along length and width are designed for the interior panel.
vi. In the sixth screen, data required for the exterior panel is calculated and from seventh to tenth screen the moments value in longer span direction and in shorter span direction are designed to calculate.
vii. In the eleventh screen, shear check is calculated and in the rest four screens the reinforcement and spacing required along longer span and along shorter span is designed.

IV. RESULTS AND DISCUSSIONS

The interior panel has a flat slab of size 5m*5m, Size of column 500m*500m, imposed load on panel is 4 KN/m^2, floor finish load is 1kN/m^2, use M_{20} concrete and Fe415 steel.

a) calculation of loads
Minimum thickness of the slab = Span / 28.8 = 5000 / 28.8 = 173.6 mm
Let d = 175 mm and D = 200 mm
L_n = 5-0.5 = 4.5m
Self weight of slab = 0.20*25 = 5 KN/m^2
Finish load = 1 kN/m^2
Imposed load = 4 kN/m^2
Total working load = 10 kN/m^2

Factored load = 1.5*10 = 15 kN/m^2
Total design load in a panel W = 15*L_2*L_n = 15*5*4.5 = 337.5 kN

b) Moment calculation
Panel moment, M_o = (W*L_n)/8 = (337.5*4.5)/8 = 189.84 kNm
Panel +ve moment = 0.65*189.84 = 123.40 kNm
Panel –ve moment = 0.35*189.84 = 66.44 kNm
Distribution of moment into column strip and middle strip:

	Column strip in kNm	Middle strip in kNm
-ve moment	0.75*123.40 = 92.55	0.25*123.40 = 30.85
+ve moment	0.60*66.44 = 39.86	0.40*66.44 = 26.58

c) Check for shear
The critical section for shear is at a distance d/2 from the column face. Hence periphery of critical section around a column is square of a size = 500+d = 500+175 = 675mm.
Shear to be resisted by the critical section,
V = 15*5*5 – 15*0.675*0.675 = 368.166 kN
τ_v = (368.166*1000)/(4*675*175) = 0.779 N/mm^2
$\tau_c = 0.25*\sqrt{fck} = 0.25*\sqrt{20}$ = 1.118 N/mm^2
Safe in shear since $\tau_v < \tau_c$

d) check for Reinforcement
For –ve moment in column strip:
M_u = 92.55kNm
$92.55*10^6 = 0.87*f_y*A_{st}*d\ (1-A_{st}*f_y / bd*f_{ck})$
A_{st} = 1583.74 mm^2
Using 12mm bars, spacing required is given by,
S = (π/4*12^2) / 1583.74 * 2500 = 178mm
Provide 12mm bars at 175mm c/c.
For +ve moment in column strip:
M_u = 39.86kNm
$39.86*10^6 = 0.87*f_y*A_{st}*d\ (1-A_{st}*f_y / bd*f_{ck})$
A_{st} = 651 mm^2
Using 10mm bars, spacing required is given by,
S = (π/4*10^2) / 651 * 2500 = 301mm
Provide 10mm bars at 300mm c/c.
Provide 10mm diameter bars at 300mm c/c in the middle strip to take up –ve and +ve moments. Since span is same in both directions.
The developed screens showing the same results in the example:

Screen-1

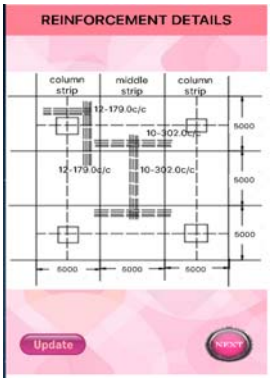
Screen-2

Screen-3

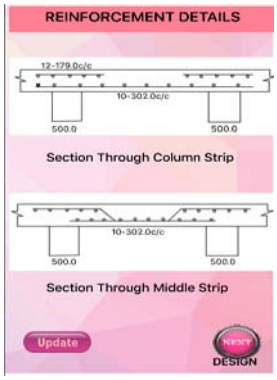
Screen-4

Screen-5

Screen-6



Screen-7



Screen-8

V. CONCLUSIONS

i. With the use of IOS application the time taken for the design calculation for Flat Slabs is reduced.

ii. With the use of IOS application the complexity involved in design of Flat Slabs is reduced, since it is not required to know all the equations for the design process.

iii. The IOS application is developed for both the square panel and rectangular panel structure.

iv. The result obtained from the application has been compared with the standard problem given in the S.S.Bhavikati text book.

REFERENCES

[1] H.S Kim, et.al "Efficient analysis of flat slab structures subjected to lateral loads" Received 14 October 2003; received in revised form 7 October 2004; accepted 8 October 2004

[2] M.G Sahab, et.al "Cost optimization of reinforced concrete flat slab buildings (2004), engineering structures" 27 (2005) 313-322

[3] Sandesh D. Bothara, International Journal of Engineering Research and Applications (IJERA) Vol. 2, Issue 4, July-August 2012, pp.275-280

[4] Prof. K S Sable, International Journal of Computer Technology and Electronics Engineering (IJCTEE) Volume 2, Issue 3, June 2012

[5] Rajib Kumar Biswas, Comparative Analysis of a 15 Story Flat Plate Building with and Without Shear Wall and Diagonal Bracing Under Wind and Seismic Loads IOSR Journal of Mechanical and Civil Engineering (IOSR-JMCE) e-ISSN: 2278-1684,p-ISSN: 2320-334X, Volume 9, Issue 2 (Sep. - Oct. 2013), PP 97-101

[6] P.M.B. Raj Kiran Nanduri, Critical comparison of flat plate multi-storeyed frames with and without R.C in filled walls under wind and earthquake loads IRACST – Engineering Science and Technology: An International Journal (ESTIJ), ISSN: 2250-3498,Vol.3, No.2, April 2013

[7] Sumit Pawah, International Journal of Emerging Technology and Advanced Engineering, Volume 4, Issue 7, July 2014

[8] Navyashree K, "Use of flat slabs in multi storey commercial building situated in high seismic zone" Volume: 03 Issue: 08 | Aug-2014.

[9] Abhay Guleria, "Structural Analysis of a Multi-Storeyed Building using ETABS for different Plan Configurations", International Journal of Engineering Research & Technology(IJERT) ISSN: 2278-0181 IJERTV3IS051552 Vol. 3 Issue 5, May – 2014

[10] Amit A. Sathawane, "Analysis And Design Of Flat Slab And Grid Slab And Their Cost Comparison, International Journal of Engineering Research and Applications (IJERA) ISSN: 2248-9622 Vol. 1, Issue 3, pp.837-848