SEISMIC PERFORMANCE OF IRREGULAR BUILDINGS

A DISSERTATION

SUBMITTED IN PARTIAL FULFILLMENT OF THE REQUIREMENTS
FOR THE AWARD OF THE DEGREE
OF

MASTER OF TECHNOLOGY
IN
STRUCTURAL ENGINEERING

Submitted by:

LAKSHAY GUPTA

2K17/STE/08

Under the supervision of

DR. ALOK VERMA

DEPARTMENT OF CIVIL ENGINEERING

DELHI TECHNOLOGICAL UNIVERSITY

(Formerly Delhi College of Engineering)
Bawana Road, Delhi–110042

JUNE, 2019

DELHI TECHNOLOGICAL UNIVERSITY
(Formerly Delhi College of Engineering)
Bawana Road, Delhi-110042

CANDIDATE'S DECLARATION

I, **Lakshay Gupta (2K17/STE/08)**, student of M. Tech Structural Engineering, hereby declare that the project Dissertation titled "**Seismic Performance of Irregular Buildings**" which is submitted by me to the Department of Civil Engineering, Delhi Technological University, Delhi in partial fulfilment of the requirement for the award of the degree of Master of Technology, is original and not copied from any source without proper citation. This work has not previously formed the basis for the award of any Degree, Diploma Associateship, Fellowship or other similar title or recognition.

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DEPARTMENT OF CIVIL ENGINEERING
DELHI TECHNOLOGICAL UNIVERSITY
(Formerly Delhi College of Engineering)
Bawana Road, Delhi-110042

CERTIFICATE

I hereby certify that the Project Dissertation titled "Seismic Performance of Irregular Buildings" which is submitted by Lakshay Gupta (2K17/STE/08) to the Department of Civil Engineering, Delhi Technological University, Delhi in partial fulfillment of the requirement for the award of the degree of Master of Technology, is a record of the project work carried out by the students under my supervision. To the best of my knowledge, this work has not been submitted in part or full for any Degree or Diploma to this University or elsewhere.

Place: Delhi **(DR. ALOK VERMA)**
Date: **SUPERVISOR**

ACKNOWLEDGEMENT

My project titled "Seismic Performance of Irregular Buildings" is successfully accomplished as part of my final year M. Tech project. I take this opportunity to appreciate my project guide **Dr Alok Verma,** Department of Civil Engineering, DTU, Delhi for giving me the chance to attempt major project under his guidance and uniquely for his important direction and incessant proposals fused together with extended period of his valuable time to help me over the span of this undertaking and for helping me learn and pick up information and making everything beneficial and productive all through the task.

LAKSHAY GUPTA

ABSTRACT

This paper deals with the effects of presence of irregularities in buildings on their seismic performance. The objective of the project is to carry out response spectrum analysis (RSA) of two reinforced concrete (RC) framed building models, one with a square shaped plan having symmetry in plan about the orthogonal axes and the other with an L-shaped plan which is asymmetric in plan, considering vertical mass irregularity in each floor. Mass irregularity is considered in each floor of the building models by increasing the value of live load on each floor by 50%, 100%, 150% and 200% and the effect of such increase in live load is studied. Plan area and translational stiffness of square shaped and L-shaped plan building models is taken to be same in the present study. The cross-sectional dimension of outer column (at origin in plan) in every storey is also kept same for both the building models and comparison of the analysis results is done for such columns. Various analysis results such as base shear, forces in the outer column elements considered, displacement of joints at the intersection of outer column elements considered and beam elements in every storey, etc. are obtained using SAP 2000 version 20.0.0 and the variation of these results is studied by introducing mass irregularity in each floor one by one. These results are compared for both types of building models considered. It is observed that base shear and joint displacements are more for the L-shaped plan building than that for the square shaped plan building. This led to a conclusion that the square shaped plan building performs better than the L-shaped plan building during a seismic event. It is also observed that presence of mass irregularity increases the seismic response parameters of the building.

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LIST OF ABBREVIATIONS

ABS	Absolute Sum method
ASCE	American Society of Civil Engineers
ATC	Applied Technology Council
CQC	Complete Quadratic Combination
CSM	Capacity Spectrum Method
EBF	Eccentrically Braced Frame
EC-8	Eurocode 8
EC201-2008	Egyptian Code for Loads
FEMA154	Federal Emergency Management Agency
HSC	High Strength Concrete
IBC	International Building Code
IDARC	Inelastic Damage Analysis of Reinforced Concrete structures
IDVLI	In-plane Discontinuity in Vertical Lateral force-resisting element Irregularity
IS	Indian Standard
MRF	Moment Resisting Frame
NSC	Normal Strength Concrete
NSCP	National Structural Code of the Philippines
OMRF	Ordinary Moment Resisting Frame
RC	Reinforced Concrete
RSA	Response Spectrum Analysis
SCBF	Special Concentrically Braced Frame
SELF	Static Equivalent Lateral Force method
SMRF	Special Moment Resisting Frame
SRSS	Square Root of Sum of Squares
THA	Time History Analysis
TI	Torsional Irregularity
UBC	Uniform Building Code

LIST OF SYMBOLS/NOTATIONS

ϒ	Unit weight
E	Modulus of elasticity
α	Coefficient of thermal expansion
μ	Poisson’s ratio
DL	Dead load
FF	Floor finishing load
LL	Live load
EQ_x, EQ_y	Earthquake load in x and y directions
T_a	Fundamental translational natural time period of oscillation
T, f	Natural time period and natural frequency of structure
h	Height of building
I	Importance factor
R	Response reduction factor
Z	Seismic zone factor
S_a	Design spectral acceleration
g	Acceleration due to gravity
A_h	Design horizontal seismic coefficient
W	Seismic weight of structure
V_{Bx}^*, V_{By}^*	Base shear by equivalent static method in x and y directions
V_{Bx}, V_{By}	Base shear by response spectrum method in x and y directions
C_x, C_y	Multiplying coefficients in x and y directions
I_S, I_L	Moment of inertia of column in square and L-shaped plan buildings
L	Length of column
P	Axial force
V_2, V_3	Shear force in x and y directions
T	Torsional moment
M_2, M_3	Bending moment in x and y directions
L, M, U	Lower point, mid-point and upper point of column
U1, U2	Joint displacements in x and y directions

CHAPTER 1

INTRODUCTION

1.1 INTRODUCTION

Irregularities in buildings are very common in urban infrastructure and they are unavoidable in construction of the buildings. In most of the cases, the irregularities in a building arises due to architectural and functional requirements. Such irregular buildings are more vulnerable to earthquakes than the buildings having regular configuration. Irregularity in a building may be due to non-uniform distribution of mass, strength and stiffness of building along its height. During an earthquake, failure of a structure starts at the vicinity of irregularity. In areas of high seismic zones, irregular buildings possesses a big challenge to a structural engineer. Vertical irregularities are found to be the major contributors to the failure of structures during earthquakes.

Very few studies have been carried out to examine the effect of vertical irregularity of structures on their seismic performance. The focus of present study is to assess the effects of mass irregularity and plan asymmetry in different floors of the buildings. Mass irregularity in buildings occur when one floor has much larger mass as compared to the other floors, e.g., presence of heavy machinery structures or a swimming pool on an intermediate floor of a building, people storing goods and items in bulk and making a particular floor of a building as a warehouse for business purposes, etc.

1.2 CRITERIA FOR IRREGULARITY IN BUILDINGS

There are two types of irregularities:

1. Plan irregularities
2. Vertical irregularities

Indian Standard (IS) 1893:2016 classifies plan irregularities into five types and vertical irregularities into seven types.

1.2.1 Plan irregularities

1) Torsion irregularity- A building is said to be torsionally irregular when

a) the maximum horizontal displacement of any floor in the direction of the lateral force is more than 1.5 times its minimum horizontal displacement at the far end of the same floor in that direction.

b) the natural period corresponding to the fundamental torsional mode of oscillation is more than those of first two translational modes of oscillation along each principal plan direction.

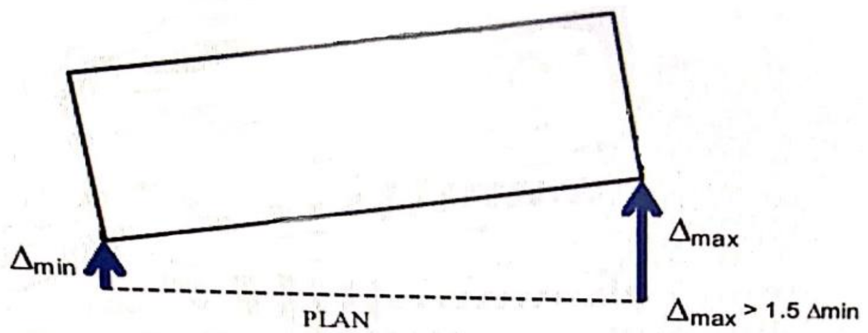

Figure 1.1 Torsional irregularity (From IS 1893:2016)

2) Re-entrant corners- A building is said to have a re-entrant corner in any plan direction, when its structural configuration in plan has a projection of size greater than 15% of its overall plan dimension in that direction.

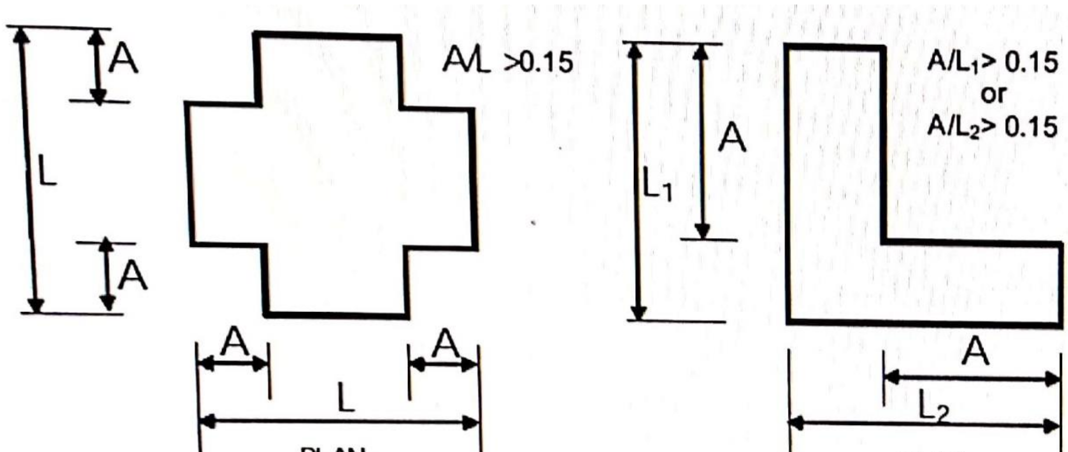

Figure 1.2 Re-entrant corners (From IS 1893:2016)

3) Floor slabs having excessive cut-outs or openings- A building is said to have discontinuity in their in-plane stiffness, when floor slabs have cut-outs or openings of area more than 50% of the full area of the floor slab.

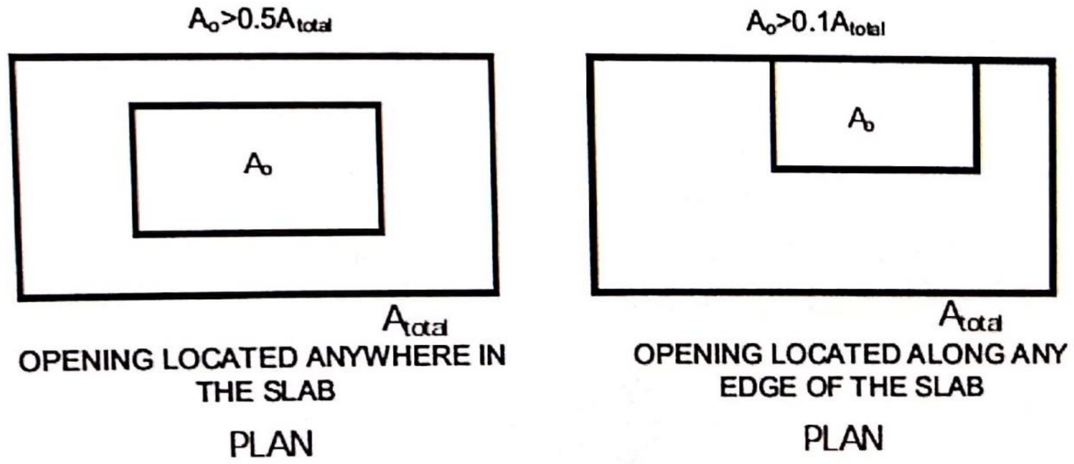

Figure 1.3 Floor slabs having excessive cut-out and openings (From IS 1893:2016)

4) Out-of-plane offsets in vertical elements- A building is said to have out-of-plane offsets in vertical elements, when structural walls or frames are moved out of plane in any storey along the height of the building.

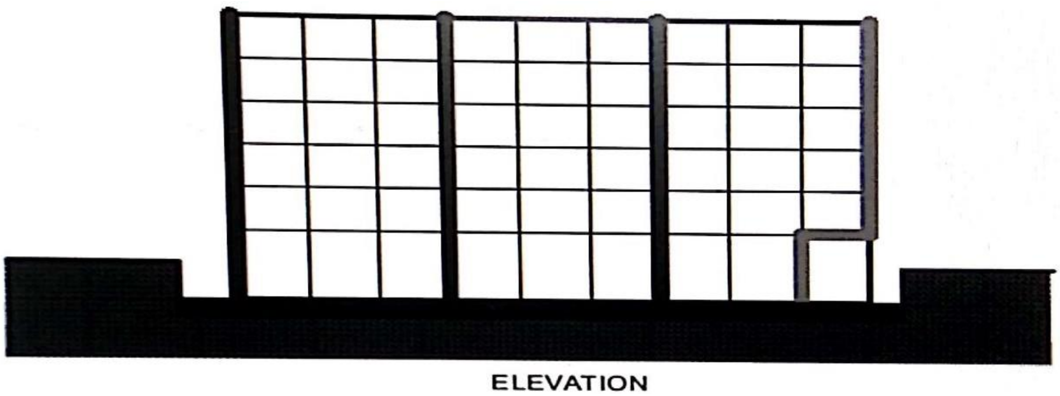

Figure 1.4 Out-of-plane offsets in vertical elements (From IS 1893:2016)

5) Non-parallel lateral force system- A building is said to have non-parallel system when the vertically oriented structural systems resisting lateral forces are not oriented along the two principal orthogonal axes in plan.

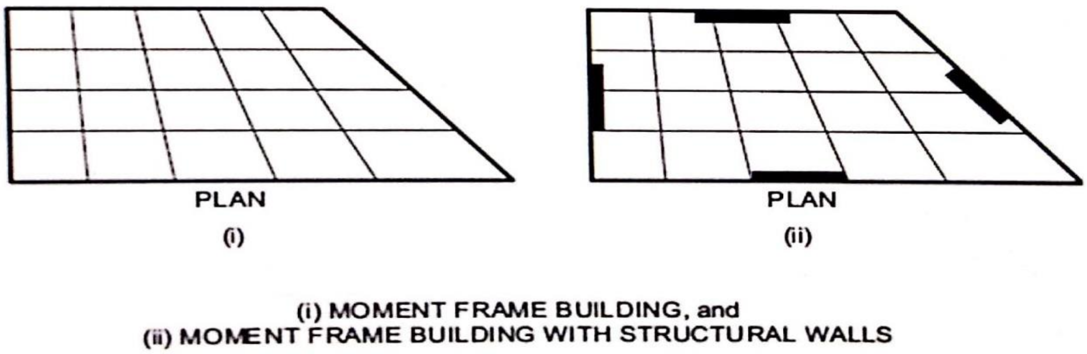

Figure 1.5 Non-parallel lateral force system (From IS 1893:2016)

1.2.2 Vertical irregularities

1) Stiffness irregularity (soft storey)- A soft storey is a storey whose lateral stiffness is less than that of the storey above.

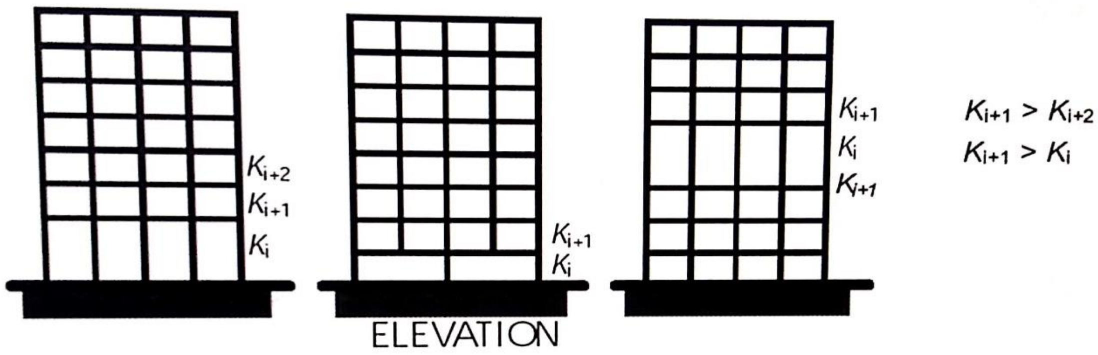

Figure 1.6 Stiffness irregularity (soft storey) (From IS 1893:2016)

2) Mass irregularity- Mass irregularity shall be considered to exist, when the seismic weight of any floor is more than 150% of that of the floors below.

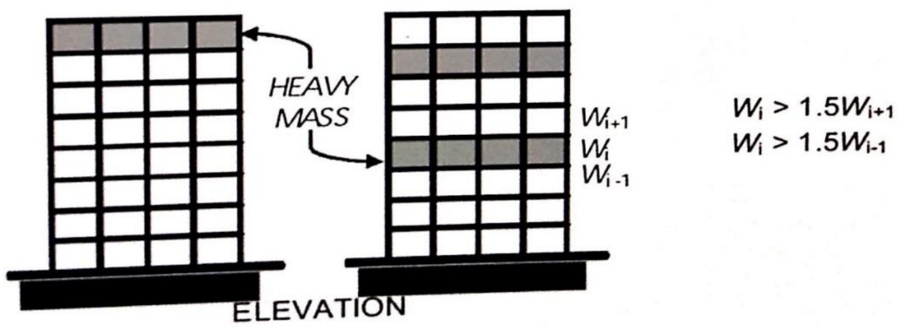

Figure 1.7 Mass irregularity (From IS 1893:2016)

3) Vertical geometric irregularity- Vertical geometric irregularity shall be considered to exist, when the horizontal dimension of the lateral force resisting system in any storey is more than 125% of the storey below.

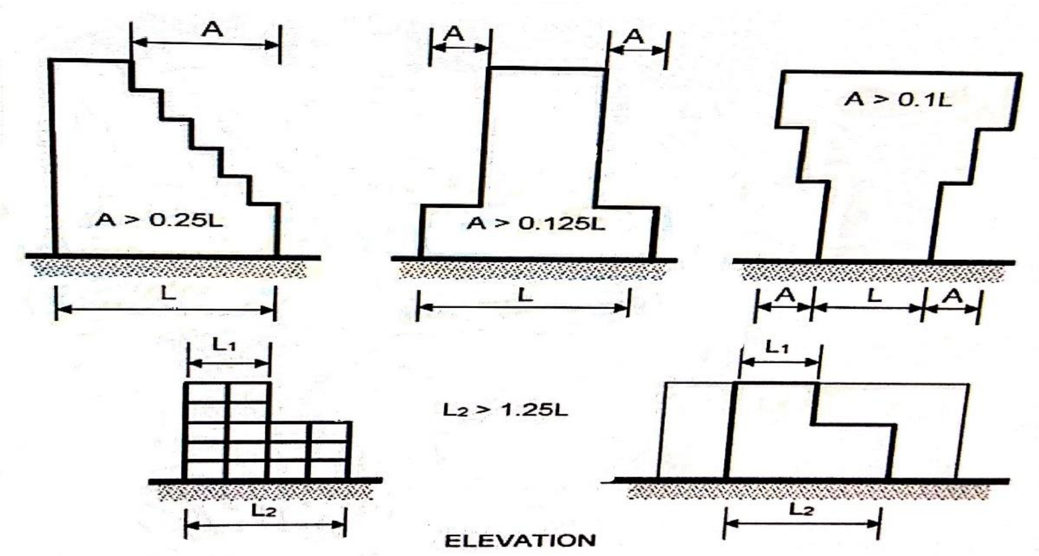

Figure 1.8 Vertical geometric irregularity (From IS 1893:2016)

4) In-plane discontinuity in vertical elements resisting lateral force- In-plane discontinuity in vertical elements which are resisting lateral force shall be considered to exist, when in-plane offset of the lateral force resisting elements is greater than 20% of the plan length of those elements.

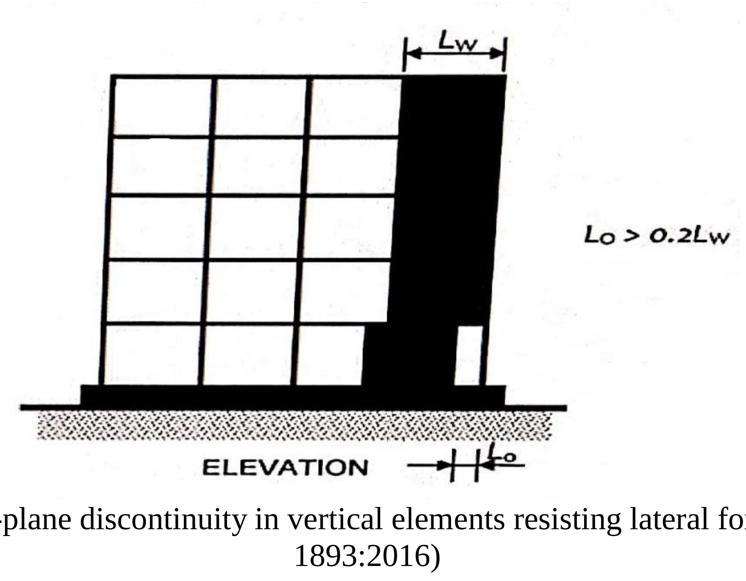

Figure 1.9 In-plane discontinuity in vertical elements resisting lateral force (From IS 1893:2016)

5) Strength irregularity (Weak storey)- A weak storey is a storey whose lateral strength is less than that of the storey above.

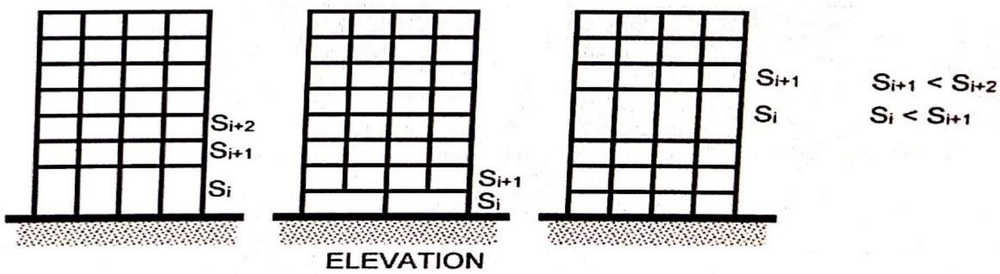

Figure 1.10 Strength irregularity (Weak storey) (From IS 1893:2016)

6) Floating or stub columns- Such columns are likely to cause concentrated damage in the structure.

7) Irregular modes of oscillation in two principal plan directions- A building is said to have lateral storey irregularity in a principal plan direction, if

a) the first three modes contribute less than 65% mass participation factor in each principal plan direction.

b) the fundamental lateral natural periods of the building in the two principal plan directions are closer to each other by 10% of the larger value.

1.3 OBJECTIVES

The objectives of the present study are as follows:

1. To study various types of building irregularities mentioned in IS 1893:2016 code.
2. To learn use SAP 2000 design software for analysis and design of building structures.
3. To carry out response spectrum analysis (RSA) of reinforced concrete (RC) framed building model having square shaped plan.
4. To convert the square shaped plan building model into an equivalent L-shaped plan building model by keeping plan area and translational stiffness same for both the models.
5. To carry out RSA of the L-shaped plan building model.

6. To obtain various analysis results in SAP 2000 software such as base shear, axial force, shear force in orthogonal directions, twisting moment, bending moment in orthogonal directions, relative displacements, etc.
7. To compare the analysis results for both the building models considered.

1.4 SCOPE OF THE STUDY

- The building is assumed to be a moment resisting 3-D frame with only beams, columns, and slabs.
- Contribution of infill walls to the stiffness is not considered and no load from the walls is considered as the walls are assumed to be of light masonry.
- No shear walls and braces are assumed in the building models.
- Earthquake load is applied in only two horizontal orthogonal directions and is neglected in the vertical direction.
- Only the effect of mass irregularity is studied on the building models.
- All columns of the building model are considered as fixed to the base.
- Eccentricity ratio for all rigid diaphragms is assumed to be 0.05. This accounts for the accidental torsion which may be due to load eccentric to the centre of mass of the diaphragms.
- Wind loads are assumed to be absent.
- Linear elastic analysis is done on the structures.
- Effect of soil-structure interaction is neglected.

1.5 SEISMIC ANALYSIS METHODS

According to IS 1893:2016, effects of design earthquake loads applied on structures can be considered in two ways:

a) Equivalent static method
b) Dynamic analysis method

Dynamic analysis can be performed in three ways:

1) Response spectrum method
2) Modal time history method
3) Time history method

1.5.1 Equivalent static method

Equivalent static method, also known as pseudo-static method, is based on an assumption that actual dynamic loading due to earthquake is equivalent to static lateral load on a structure. The effect of earthquake ground motion is defined by the seismic design response spectrum. This method involves less computational efforts because of the assumption that the building responds in its fundamental mode only. So, time periods and mode shapes of higher natural modes are not required. This method is usually conservative for low-to-medium height of buildings and may be used for analysis of regular structures with approximate natural period less than 0.4s.

1.5.2 Response spectrum method

In response spectrum analysis (RSA), also known as modal method, peak response of a structure during an earthquake is obtained directly from earthquake response spectrum or design spectrum. Multiple modes of response of the structure to the earthquake are taken into account. The response in each natural mode of vibration can be computed independently of others and the responses of different modes are combined to determine the total response of the structure using modal combination methods such as complete quadratic combination (CQC), square root of sum of squares (SRSS), absolute sum method (ABS), etc. In general, the responses need to be determined only for the first few modes because response to earthquake is primarily due to lower modes of vibration.

1.5.3 Time history method

Time history analysis (THA) overcomes all limitations of RSA as certain uncertainties are inherent in modal superposition method. THA represents the most sophisticated method of dynamic analysis for buildings. In this method, the mathematical model of the building is subjected to accelerations from earthquake records that represent the expected earthquake at the base of the structure. This method requires more computational efforts for calculating the response at discrete times. The method consists of a step-by-step direct integration over a time interval. The equations of motion are solved with the displacements, velocities, and accelerations of the previous step serving as initial functions. THA is applicable to both elastic and inelastic analyses.

1.6 ORGANIZATION OF THE DISSERTATION

The first chapter of the dissertation covers the introduction, criteria for irregularity in buildings, objectives of the project, scope of the study, and overview of seismic analysis methods. The first chapter provides a general idea about the effect of irregularities in buildings on their seismic performance. It highlights the requirement of a good structural engineer to deal with the challenges faced while designing such irregular buildings.

The second chapter provides a literature review of various studies done on irregular buildings and provides an idea about research work done by various researchers on topics related to the project. This includes the works done by various researchers from year 1968 to January 2019.

The third and the fourth chapters involves methodology, results of analysis of the project and the discussions. Firstly, response spectrum method of analysis is carried out on two RC framed building models, one with a square shaped plan and other with an L-shaped plan, considering mass irregularity in each floor. After that, various analysis results are obtained in SAP 2000 software. Finally, these results are compared for both the building models considered and discussions are made.

The fifth and the final chapter covers the conclusion in which the results have been presented in a brief manner.

CHAPTER 2

LITERATURE REVIEW

2.1 GENERAL

The present study summarizes the research works done in the past regarding structural irregularities and performance of such irregular buildings during earthquake. Criteria and acceptable limits specified for these irregularities are defined by various codes of practice (IS 1893, EC 8, UBC 97, ASCE-7.05, IBC 2003, etc). Different types of modelling approaches suggested by various researchers have also been discussed briefly.

2.2 IRREGULARITIES CONSIDERED BY VARIOUS RESEARCHERS

2.2.1 Re-entrant corners- plan irregularity

T. Mahdi and V. Bahreini evaluated the non-linear seismic behaviour of moment resisting frames (MRF's) with plan asymmetry consisting of re-entrant corners [1]. They analysed the buildings using pushover analysis with and without considering the masonry infill [1]. They considered uniform and triangular distribution of lateral loads [1]. For infills, three types of arrangements and two material types (strong and weak) have been considered [1]. They found that the presence of infill increases the stiffness and decreases the drifts, whereas absence of infill results in poor performance of beams and columns of the ground floor [1].

2.2.2 Soft storey- vertical irregularity

Adrian Fredrick C. Dya and Andres Winston C. Oretaa presented a study on seismic vulnerability assessment of soft storey irregular buildings using pushover analysis [2]. They modelled a low-rise 5-storey building as per guidelines of National Structural Code of the Philippines (NSCP), ATC 2002, and FEMA154, as low-rise buildings were mostly common in Philippines [2]. Since the number of structures is too large, it would have been time consuming to assess them in detail [2]. This demanded for non-linear static method i.e. pushover analysis for preliminary risk assessment of the existing buildings so as to determine which buildings to be prioritized for detailed assessment [2]. They simplified their analysis by assuming that the number of structural elements and their properties at each storey to be constant [2]. Thus, severity of soft first storey was varied by changing the storey height alone, and gathered data for plastic hinge formation and seismic design [2]. They found that there was localization of seismic demand at the location of soft storey [2]. They determined vulnerability index from which score modifiers were generated, which may be used for preliminary risk assessment tools [2].

2.2.3 Setback buildings- vertical irregularity

Zaid Mohammad, Abdul Baqi, and Mohammed Arif presented studies on seismic response of RC framed buildings resting on hill slopes [3]. They considered various models of setback and step back-setback buildings of varying lengths and heights, and studied the effect of seismic forces on such building models along and across the hill slope direction [3]. They found that due to varying column lengths and non-symmetry, these buildings attract large shear forces and torsional moments [3]. Response spectrum analysis was done to obtain various dynamic parameters such as fundamental time period, base shear, maximum top storey displacements, etc [3]. They concluded that step back-setback buildings perform better than step back configuration when subjected to seismic loads [3].

Cheung and Tso carried out lateral load analysis for setback buildings using the concept of compatibility analysis [4].

Shahrooz and Moehle undertook an experimental and analytical study to understand the seismic response of setback structures [5]. They found that there was concentration of damage in the members in the vicinity of setbacks [5].

Paul proposed a simplified seismic analysis of buildings resting on hill slopes by assuming only one degree of freedom per floor in either translational direction [6]. Kumar and Paul carried out a 3-D analysis of irregular buildings with rigid floor diaphragms [7]. They later performed a dynamic analysis of step-back and setback buildings [8]. Kumar presented the seismic analysis of step-back and setback buildings

[9]. Kumar and Paul also presented a simplified method for elastic seismic analysis of buildings on hill slopes [10]. They also discussed about the configuration of hill buildings from seismic point of view [11].

Birajdar and Nalawade performed seismic analysis of various step-back and setback buildings resting on sloping ground and concluded that shorter frame on the uphill side in step-back buildings attract more base-shear than the other frames [12], [13].

Singh et al. used different methods of seismic analysis to compare the dynamic properties of step-back buildings along and across hill slope direction [14].

Murty et al. studied the performance of step-back buildings along hill slopes of Himalayas during 2011 Sikkim earthquake [15]. In their studies, they examined the feasibility of plan dimensions of the buildings to be constructed on steep hill slopes [15].

2.3 METHODOLOGY USED BY VARIOUS RESEARCHERS

2.3.1 Approximate seismic analysis

In the codes of various countries, there are provisions for pseudo-static design against an equivalent lateral load for regular buildings, but not for irregular structures [16]. The codes recommend full 3D dynamic analysis for such buildings [16]. Georgoussis et al. presented an approximate seismic analysis of multi-story setback buildings with mass and stiffness irregularities subjected to strong ground motions [16]. They proposed the method for two 8-storey buildings with setback systems, one having symmetric plan, and the other having asymmetric plan [16]. Their methodology was based on Southwell's formula and the concept of equivalent single storey system [16]. Their first aim was to estimate basic dynamic data (periods and base shears) with fair amount of accuracy [16]. Their second aim was to demonstrate that a structural configuration of minimum elastic torsion during ground excitation preserves translational response in the inelastic region when the strength assignment of its resisting bents (structural walls, moment resisting frames, coupled wall systems, etc) is stiffness proportional, which is attributed to almost concurrent yielding of all these resisting bents [16].

Sarkar et al. examined the effect of vertical geometric irregularity in stepped building frames and defined 'regularity index' as a measure of vertical irregularity for stepped buildings to account for the changes in mass and stiffness along the height of the building [17]. They also proposed an empirical formula to calculate the fundamental time period of the stepped building, as a function of regularity index [17].

Karavasilis et al. studied the inelastic seismic response of plane steel MRF with setbacks [18].

Aziminejad et al [19] and Aziminejad and Moghadam [20] proposed a new methodology to study the performance of asymmetric multi-storey buildings with different element strength distributions.

2.3.2 Static equivalent lateral force (SELF) method

Yousef et al. presented a study on seismic performance of multi-storey dual system buildings irregular in elevation, and constructed from normal strength concrete (NSC) and high-strength concrete (HSC) [21]. They evaluated the applicability of Static Equivalent Lateral Force (SELF) method as per IBC-2012, EC-8 and EC201-2008 when applied to dual system buildings with different vertical irregularities viz. lateral stiffness, mass and setback irregularity [21]. They performed the seismic analysis using inelastic computer program IDARC-2D 'Version 6.1' [21]. They selected records of two real earthquakes (El Centro and Parkfield) and one artificial earthquake, with wide ranges of frequency content, as input ground motions [21]. From their studies, they concluded that maximum storey drift for NSC and HSC dual systems is conservative, except by IBC-2012 for long period dual systems [21]. They also concluded that the SELF method gives conservative results when applied to NSC and HSC dual systems with short and long periods of vibration, except by IBC-2012 with mass and setback irregularities [21]. They also found that the lateral stiffness irregularity limits of IBC-2012 and EC 201-2008 can be reduced by about 10% [21].

2.3.3 Pushover analysis

Deierlein et al. found that pushover analysis is an effective non-linear structural analysis method for seismic design of structures [22].

Freeman et al. introduced Capacity Spectrum Method (CSM) as a non-linear static method to evaluate the seismic risk of existing buildings [23].

Saiidi and Sozen performed simple non-linear dynamic analysis on RC structures [24].

Fajfar and Fischinger introduced the N2 method for non-linear seismic analysis of regular buildings [25].

Moghadam and Tso investigated on damage assessment of eccentric multi-storey buildings using 3-D pushover analysis [26]. They later extended their study to the pushover analysis of asymmetric and setback multi-storey buildings [27].

Themelis presented a study on the pushover analysis for seismic assessment and design of structures [28].

2.3.4 Super element method

Raphaël D. J. M. Steenbergen, and Johan Blaauwendraad developed a closed-form super element method for tall buildings of irregular geometry subjected to wind loads [29]. They presented results for two types of buildings, one with a symmetric plan, and other with an asymmetric plan, both with an abrupt change of the cross-sectional geometry along the height [29]. They divided the buildings into two number of super elements with their nodes only at heights where changes in properties of building occur [29]. The in-plane floor stiffness was distributed equally along the storey height i.e. half below and half above the floor [29]. From the set of differential equations, they derived load vector and stiffness matrix for each super element which describes their behaviour [29]. Using standard assembling procedure, they determined global stiffness matrix and load vector [29]. This involved lesser calculations as compared to finite element method due to smaller number of super elements [29]. After solving the set of linear equations, they determined the stress state within each super element [29]. They found that there were disturbances in the force flow along the height where floor plan of the building changes abruptly [29]. They presented the results in the form of moment and shear force distributions, and found that ratio of the characteristic length to the height of the building, and boundary conditions of the foundation also play an important role [29].

Kim and Lee carried out analysis of a shear wall with openings using super element method [30].

Lee et al. carried out an efficient seismic analysis of building including floor slabs using super element method [31].

2.4 INFLUENCE OF CONFIGURATION ON THE SEISMIC RESISTANCE OF A BUILDING

Jasmina Dražić and Nikolai Vatin discussed about the influence of configuration on the seismic resistance of a building, which may be regular or irregular [32]. Building configuration refers to the indicators of shape and dimensions of a building as a unity [32]. Architects directly have an impact on the behaviour of a structure under earthquake as they are involved in the selection of choice of structural system, coordinating the demands of an urban project and designer's style, and demands for greater freedom in interior design of building [32]. This often results in soft story, discontinuity of shear walls, variations in perimeter strength and stiffness, and irregularity building forms in the plan [32]. While regular buildings present safer and better behaviour, irregular buildings often requires unjustified simplifications during modelling and analysis, which may lead to unreliable or non-economic solutions [32]. Designing irregular configuration buildings demands the introduction of a structural designer from the initial design phases [32]. By designing buildings with a high degree of seismic architecture, the architect achieves the set aesthetic building qualities without endangering the stability of a structure [32].

Arnold and Reitherman did extensive studies on building configuration and seismic design [33].

Dražić carried out analysis of interaction of functional and structural building properties in aseismic designing [34].

2.5 STRUCTURAL PERFORMANCE OF DIAGRID SYSTEMS

Due to the structural efficiency and architectural aesthetic potential, Kyoung Sun Moon investigated the structural performance of diagrid systems employed for complex shaped tall buildings such as twisted, tilted and freeform towers [35]. To study the impacts of various geometric configurations of complex shaped tall buildings, Moon used parametric structural models for his study [35]. He presented a preliminary design methodology for diagrid structural systems based on optimal stiffness-based design concept [35]. He modelled a diagrid structure as a vertical cantilever beam on the ground, subdivided longitudinally into modules according to the repetitive diagrid pattern, and determined maximum allowable top deflection in the neighbourhood of about a five hundredth of the building height [35]. Each module was defined by a single level of diagrids that extend over multiple stories [35]. Faces of the building were classified as web planes or flange planes, depending on the direction of the loading [35]. Taller buildings behave more like bending beams and shorter buildings behave more like shear beams [35]. Moon found that for twisted diagrid towers, as rate of twisting increases, maximum top deflection increases, as building's lateral stiffness reduces [35]. However, with regard to vortex shedding, performance of twisted tower is better as compared to the straight one [35]. He also found that in case of tilted diagrid towers, lateral deformations due to dead and live loads is large due to their eccentricity [35]. Moon is still doing research regarding freeform towers [35].

Moon et al. investigated on the characteristics and methodology for preliminary design of the diagrid structural systems for tall buildings [36].

Moon later studied on the optimal grid geometry of diagrid structures for tall buildings [37].

2.6 PROGRESSIVE COLLAPSE OF IRREGULAR BUILDINGS

Yavari et al. investigated the effects of two types of irregularities, namely Torsional Irregularity (TI) and In-plane Discontinuity in Vertical Lateral force-resisting element Irregularity (IDVLI) on the progressive collapse potential of steel special moment resisting frames (SMRF's) [38]. Various buildings having different number of stories, different site locations with varying levels of seismicity, different severities of TI, and different modes of IDVLI were considered [38]. Equivalent designed buildings were considered having similar seismic masses and base shears [38]. They concluded that the resistance to progressive collapse increases with increase in seismicity level of the site and also with increase in irregularity of the building [38]. This was due to the requirement of larger sizes of beams and columns for such cases [38]. They also found that removal of external column was more critical than the internal column removal in case of buildings with IDVLI [38]. They presented results incorporating the combined effects of irregularity, seismicity level, and height of the building [38].

Hayes et al. investigated a damaged building to check if its resistance to progressive collapse can be increased by seismic retrofitting of the building [39]. They concluded that the resistance to progressive collapse can be improved by retrofitting the peripheral members of the building [39].

Kim et al. carried out an assessment of resistance to progressive collapse of steel frames [40]. They found that while linear methods give conservative results, the non-linear dynamic methods give more appropriate results in complex situations [40].

Karimiyan et al. carried out a study on seismic collapse propagation in 6-storey RC buildings of regular and irregular geometry [41]. They also evaluated the collapse distribution in 3-storey asymmetric buildings due to seismic loads [42]. From their studies, they concluded that irrespective of the magnitude of the earthquake, there is a pattern of progressive failure at the location of mass accumulation and the progressive collapse pattern can be altered by eccentricity in the plan [41], [42].

Tavakoli and Alashti investigated on the progressive collapse potential of multi-storey steel buildings under lateral loading [43]. They agreed on the fact that earthquake resistant buildings are strong enough to resist progressive collapse [43]. They also found that increasing the redundancy of the building will increase the resistance to progressive collapse [43].

Kordbagh and Mohammadi studied the influence of seismicity level and height of the building on the resistance to progressive collapse of steel frames [44]. They found that by increasing the height of the building and the seismicity level of the site, resistance to progressive collapse of the building can be increased [44].

Coffield and Adeli studied the effect of irregularities in steel frames with concentric and eccentric bracing subjected to blast loading [45]. They inferred that more the irregularity in the building, more is its progressive collapse potential [45]. They also found that steel frames with concentric bracing possess higher strength than the other systems [45].

Ebrahimi et al. conducted numerical studies on the effect of plan irregularities on the resistance to progressive collapse of four steel buildings [46]. They found that the conditions were worst for the irregular building located in site with soil class C, and demand to capacity ratio of columns in the irregular building was double that of the regular building for the buildings located in site with soil class E [46].

Kim and Hung compared the progressive collapse performance of a 30-storey irregular tower with an equivalent regular tower [47]. They found that the resistance to progressive collapse for the irregular tower was more than that of the regular tower [47].

Khandelwal et al. carried out progressive collapse analysis of Special Concentrically Braced Frames (SCBFs) and Eccentrically Braced Frames (EBFs) [48]. They found that the SCBF system is more vulnerable to progressive collapse than the EBF system [48].

2.7 DISCUSSIONS

Buildings having simple and regular geometry with uniform distribution of mass and stiffness in plan and elevation suffer much less damage than buildings with irregular configurations. Regular buildings can be easily modelled and analyzed whereas behaviour of irregular buildings during earthquake is very complex and it is very difficult to accurately determine the seismic response of a building.

Large number of research works were conducted on plan irregularities as compared to vertical irregularities. Many researchers have studied the effect of presence of single irregularity (e.g. to vary either mass, stiffness or strength). This will not result in realistic prediction of seismic response as the actual structures contain combination of various irregularities. Very few researchers have made an attempt to study the effect of combination of irregularities.

Many researchers have proposed the concept of balanced centre of mass – centre of rigidity location to generate minimum torsional response. However, previous researchers have not been able to find exact location of centre of strength, centre of rigidity and centre of mass which gives optimum values of all seismic response parameters simultaneously.

It was observed that there was variation in seismic response parameters (e.g. storey drift, storey shear, storey displacement, base shear, time period, etc) and large variation in the ductility demand at the vicinity of irregularity. Increase in seismic demand has been observed for buildings with discontinuous distributions in mass, strength and stiffness, specially at the location of soft or weak first storey. In case of vertical setback irregularity, top portion of setback was found to have greater displacement as compared to base.

Majority of researchers have used non-linear static method of analysis i.e. pushover analysis and inelastic dynamic analysis to determine the seismic response parameters of the building. Inelastic dynamic methods of seismic analysis were found to give accurate results as compared to the other methods.

CHAPTER 3

METHODOLOGY

3.1 GENERAL

Response spectrum analysis (RSA) is used for seismic evaluation of building models using SAP 2000. Two building models, one with a square shaped plan and the other with an L-shaped plan, both having same plan area and translational stiffness, are considered.

3.2 DESCRIPTION OF BUILDING MODEL

3.2.1 Structural specifications

Slab thickness = 0.125m

Width of beam = 0.3m

Depth of beam = 0.6m

Size of column = 0.6m X 0.6m, for all columns of square shaped plan building and for outer columns at origin of L-shaped plan building

= 0.588m X 0.588m, for all other columns of L-shaped plan building

Grade of concrete = M25, for beams and slabs

= M30, for columns

Number of stories = G + 6

Height of each storey = 4m

Plinth height = 1m

3.2.2 Material specifications

1. Fe 415 grade rebar

   Unit weight, ϒ = 76.9729 KN/m^3

   Modulus of elasticity, E = 2×10^8 KN/m^3

   Coefficient of thermal expansion, α = 1.17×10^{-5} /°C

   Poisson's ratio, μ = 0.3

2. M25 grade concrete

   Υ = 25 KN/m^3

   E = 25 x 10^6 KN/m^3

   α = 5.5 X 10^{-6} /°C

   μ = 0.2

3. M30 grade concrete

   Υ = 25 KN/m^3

   E = 27.386128 x 10^6 KN/m^3

   α = 5.5 X 10^{-6} /°C

   μ = 0.2

3.2.3 Loading specifications

1. DL = automatically computed by SAP 2000 software based on unit weights and sizes of the members.
2. According to IS 875 (part 1), for clay floor tiles of 12.5mm to 25.4mm thickness, FF = 0.1 to 0.2 KN/m^2, hence, FF = 0.1 KN/m^2 is taken.
3. According to IS 875 (part 2), for residential buildings, uniformly distributed LL on all rooms, kitchen, and toilet/bathrooms is 2 KN/m^2, hence, LL = 2 KN/m^2 is taken.
4. Earthquake loads are applied in x and y directions as per IS 1893:2016.
   - Importance factor, I = 1.2 (for residential building)
   - Response reduction factor, R = 5 (for special moment resisting frame)
   - Soil type = II (for medium stiff soil sites)
   - Zone factor, Z = 0.24 (for seismic zone IV)

FF and LL are applied on all the slabs of the building model except on roof slabs.

DL = Dead Load

LL = Live Load

FF = Floor Finishing load

EQ_x = Earthquake Load in x-direction

EQ_y = Earthquake Load in y-direction

3.3 CALCULATIONS

3.3.1 Estimation of design horizontal seismic coefficient

The calculations are done as per the provisions given in IS 1893:2016 code.

Approximate fundamental translational natural time period of oscillation for RC MRF building without any masonry infill is

$T_a = 0.075h^{0.75}$ (3.1)

h = height of building = 25m

$\therefore T_a = 0.075 \times (25)^{0.75} = 0.8385s$

Here, $0.55s < T_a < 4s$

∴ For medium stiff soil sites and for use in equivalent static method,

Design acceleration coefficient, $S_a/g = 1.36/T_a$ (3.2)

$= 1.36/0.8385 = 1.622$

Design horizontal seismic coefficient, $A_h = (S_a/g) * (Z/2) * (I/R)$ (3.3)

$\therefore A_h = (1.622) \times (0.24/2) \times (1.2/5) = 0.0467$

3.3.2 Square shaped plan building model

There are 25 columns, 40 beams and 16 slabs in a storey.

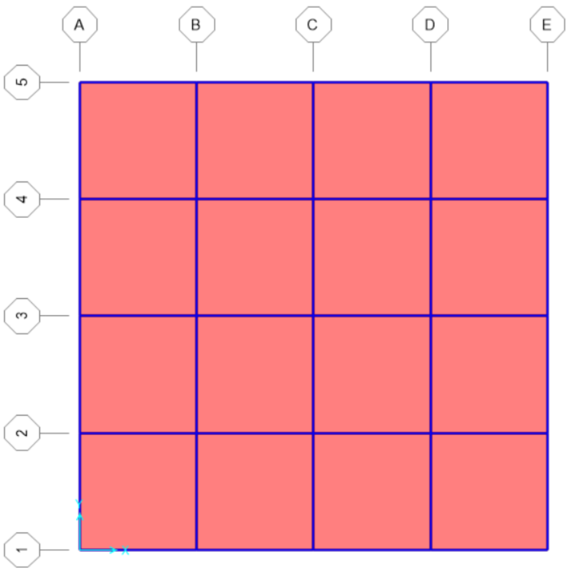

Figure 3.1 Plan: Square shaped plan model

Here, plan of the building model refers to X-Y plane @ Z = 1m. This X-Y plane is also same at Z = 5m, Z = 9m, Z = 13m, Z = 17m, Z = 21m and Z = 25m.

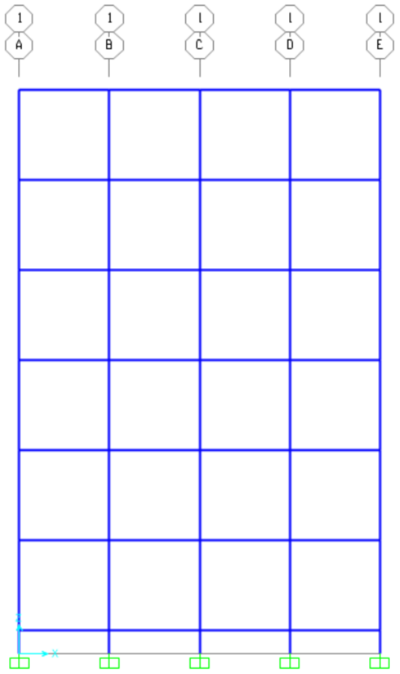

Figure 3.2 Elevation: Square shaped plan model

Here, elevation refers to X-Z plane @ Y = 0, X-Z plane @ Y = 4m, X-Z plane @ Y = 8m, X-Z plane @ Y = 12m and X-Z plane @ Y = 16m. This elevation is also same in Y-Z plane @ X = 0, Y-Z plane @ X = 4m, Y-Z plane @ X = 8m, Y-Z plane @ X = 12m and Y-Z plane @ X = 16m.

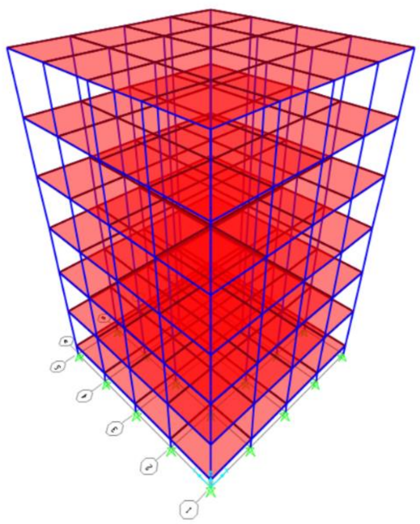

Figure 3.3 3D-view: Square shaped plan model

<u>Seismic weight calculation (W):</u>

DL = 25 x (25 x 0.6 x 0.6 x 25) + 40 x (25 x 0.3 x 0.6 x 4) x 7 + 16 x (25 x 0.125 x 4 x 4) x 7 = 5625 + 5040 + 5600 = 16265 KN

FF = (0.1 x 4 x 4) x 16 x 6 = 153.6 KN

LL = (2 x 4 x 4) x 16 x 6 = 3072 KN

Since LL = 2 KN/m^2 ≤ 3 KN/m^2, 25% of the live load will contribute to the seismic weight.

W = (DL + FF) + 0.25*LL

= (16265 + 153.6) + 0.25 x 3072

= 17186.6 KN

Base shear, $V_B^* = A_h W$ (3.4)

= 0.0467 x 17186.6 = 802.6142 KN = $V_{Bx}^* = V_{By}^*$

Multiplying coefficient in x and y directions,

$C_x = V_{Bx}^* / V_{Bx}$ (3.5)

$C_y = V_{By}^* / V_{By}$ (3.6)

V_{Bx}^*, V_{By}^* = base shear by equivalent static method in x and y directions

V_{Bx}, V_{By} = base shear by response spectrum method in x and y directions

Initially RSA was carried out by considering multiplying factors as 1 in both x and y directions.

Table 3.1 Base reactions: Square shaped plan model

OutputCase	CaseType	StepType	GlobalFX	GlobalFY	GlobalFZ	GlobalMX	GlobalMY	GlobalMZ
Text	Text	Text	KN	KN	KN	KN-m	KN-m	KN-m
DEAD	LinStatic		3.197E-14	6.04E-14	16265	130120	-130120	4.547E-13
FF	LinStatic		3.608E-16	1.665E-16	153.6	1228.8	-1228.8	-4.441E-16
LIVE	LinStatic		1.599E-14	4.885E-15	3072	24576	-24576	-4.263E-14
EQx	LinRespSpec	Max	**81.048**	3.86E-06	3.36E-06	9.11E-05	1393.5585	680.0987
EQy	LinRespSpec	Max	1.01E-05	**81.048**	2.02E-05	1393.5585	0.0001702	680.0987

From the analysis, $V_{Bx} = V_{By} = 81.048$ KN

$C_x = C_y$ = 802.6142 / 81.048 = 9.9029

Again, RSA was carried out and the final analysis results were obtained.

3.3.3 L-shaped plan building model

There are 27 columns, 42 beams and 16 slabs in a storey.

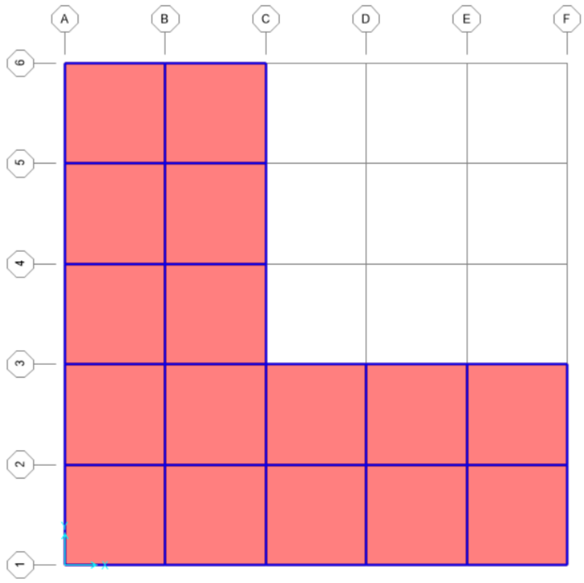

Figure 3.4 Plan: L-shaped plan model

Here, plan of the building model refers to X-Y plane @ Z = 1m. This X-Y plane is also same at Z = 5m, Z = 9m, Z = 13m, Z = 17m, Z = 21m and Z = 25m.

As number of slabs in both the models is 16, plan area in both the building models is same i.e. 4 x 4 x 16 = 256m^2.

The cross-sectional dimensions of outer column (@ X = 0 and Y = 0) in every storey for both the models is kept the same i.e. 0.6m x 0.6m. This will allow the comparison of these columns after the analysis of both the building models.

The dimensions of all columns in square shaped plan model is kept as 0.6m x 0.6m. To determine the sizes of columns (other than the outer columns at X = 0 and Y = 0) in case of L-shaped plan model, translational stiffness of both the models is equated as

$(25-1) \times 12EI_S/L^3 = (27-1) \times 12EI_L/L^3$

- ⇨ $24I_S = 26I_L$
- ⇨ $I_L = 0.923I_S$

where

I_S = moment of inertia of column in square shaped plan building = 0.6 x $(0.6)^3/12$ = 0.0108 m^4

I_L = moment of inertia of column in L-shaped plan building

E = modulus of elasticity of column material

L = length of the column

⇨ I_L = 0.923 x 0.0108 = 9.96 x 10^{-3} m^4

Based on above, the size of the columns is taken as 0.588m x 0.588m as

0.588 x $(0.588)^3/12$ = 9.96 x 10^{-3} m^4 = I_L

Thus, in L-shaped plan model, size of outer column (@ X = 0 and Y = 0) in each storey is 0.6m x 0.6m, whereas size of other columns is 0.588m x 0.588m.

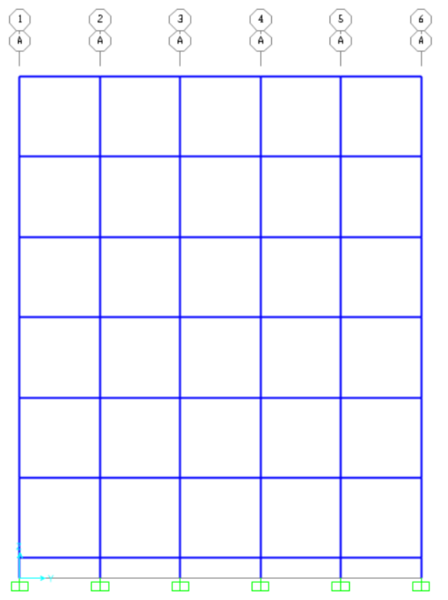

Figure 3.5 Elevation 1: L-shaped plan model

Here elevation 1 refers to X-Z plane @ Y = 0, X-Z plane @ Y = 4m and X-Z plane @ Y = 8m. This elevation is also same in Y-Z plane @ X = 0, Y-Z plane @ X = 4m and Y-Z plane @ X = 8m.

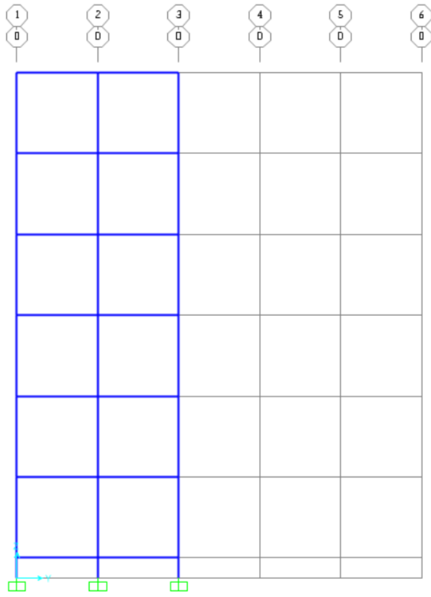

Figure 3.6 Elevation 2: L-shaped plan model

Here elevation 2 refers to X-Z plane @ Y = 12m, X-Z plane @ Y = 16m and X-Z plane @ Y = 20m. This elevation is also same in Y-Z plane @ X = 12m, Y-Z plane @ X = 16m and Y-Z plane @ X = 20m.

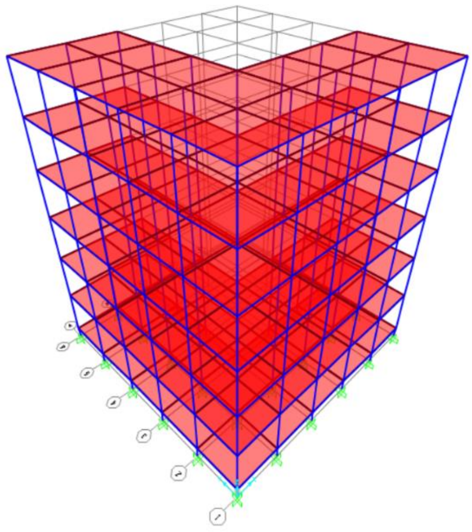

Figure 3.7 3D-view: L-shaped plan model

Seismic weight calculation (W):

DL = 26 x (25 x 0.588 x 0.588 x 25) + 1 x (25 x 0.6 x 0.6 x 25) + 42 x (25 x 0.3 x 0.6 x 4) x 7 + 16 x (25 x 0.125 x 4 x 4) x 7 = 5618.34 + 225 + 5292 + 5600 = 16735.34 KN

FF = (0.1 x 4 x 4) x 16 x 6 = 153.6 KN

LL = (2 x 4 x 4) x 16 x 6 = 3072 KN

Since LL = 2 $KN/m^2 \leq 3$ KN/m^2, 25% of the live load will contribute to the seismic weight.

W = (DL + FF) + 0.25*LL

= (16735.34 + 153.6) + 0.25 x 3072

= 17656.95 KN

Base shear, $V_B^* = A_h W$ (3.7)

$= 0.0467 \times 17656.95 = 824.5795$ KN $= V_{Bx}^* = V_{By}^*$

Multiplying coefficient in x and y directions,

$C_x = V_{Bx}^* / V_{Bx}$ (3.8)

$C_y = V_{By}^* / V_{By}$ (3.9)

V_{Bx}^*, V_{By}^* = base shear by equivalent static method in x and y directions

V_{Bx}, V_{By} = base shear by response spectrum method in x and y directions

Initially RSA was carried out by considering multiplying factors as 1 in both x and y directions.

Table 3.2 Base reactions: L-shaped plan model

OutputCase	CaseType	StepType	GlobalFX	GlobalFY	GlobalFZ	GlobalMX	GlobalMY	GlobalMZ
Text	Text	Text	KN	KN	KN	KN-m	KN-m	KN-m
DEAD	LinStatic		-4.498E-11	-1.28E-11	16735.3	131655.44	-131655.4	3.05E-10
FF	LinStatic		-5.488E-13	-1.5E-13	153.6	1190.4	-1190.4	3.8E-12
LIVE	LinStatic		-1.097E-11	-3.01E-12	3072	23808	-23808	7.58E-11
EQx	LinRespSpec	Max	**81.412**	3.404	0.025	58.874	1399.2968	726.7757
EQy	LinRespSpec	Max	3.404	**81.412**	0.025	1399.2968	58.874	726.7757

From the analysis, $V_{Bx} = V_{By} = 81.412$ KN

$C_x = C_y = 824.5795 / 81.412 = 10.1285$

Again, RSA was carried out and the final analysis results were obtained.

CHAPTER 4

ANALYSIS RESULTS AND DISCUSSION

4.1 GENERAL

The results of response spectrum analysis (RSA) carried out on the building models are presented for outer column (@ X = 0 and Y = 0) in every storey. These results are compared for both the models, one with the square shaped plan and the other with the L-shaped plan. The effect of mass irregularity in each floor is studied and the percentage change in various parameters such as base shear, column forces, joint displacements, etc. are evaluated.

The effect of mass irregularity in each storey is considered by increasing the live load on each floor. The original live load applied is 2 KN/m^2. The live load is increased by 50%, 100%, 150% and 200% in each storey one by one and the analysis is done for each case.

Table 4.1 Increase in live load

% increase in live load (%)	Intensity of live load (KN/m^2)
50	3
100	4
150	5
200	6

According to IS 1893:2016, mass irregularity exists when seismic weight of any floor is more than 150% of that of the floors below. With other factors remaining constant, seismic weight of any floor increases with increase in the intensity of live load. So, increase in live load in any storey will introduce mass irregularity in that storey.

The label number of frame elements and the joints are as follows:

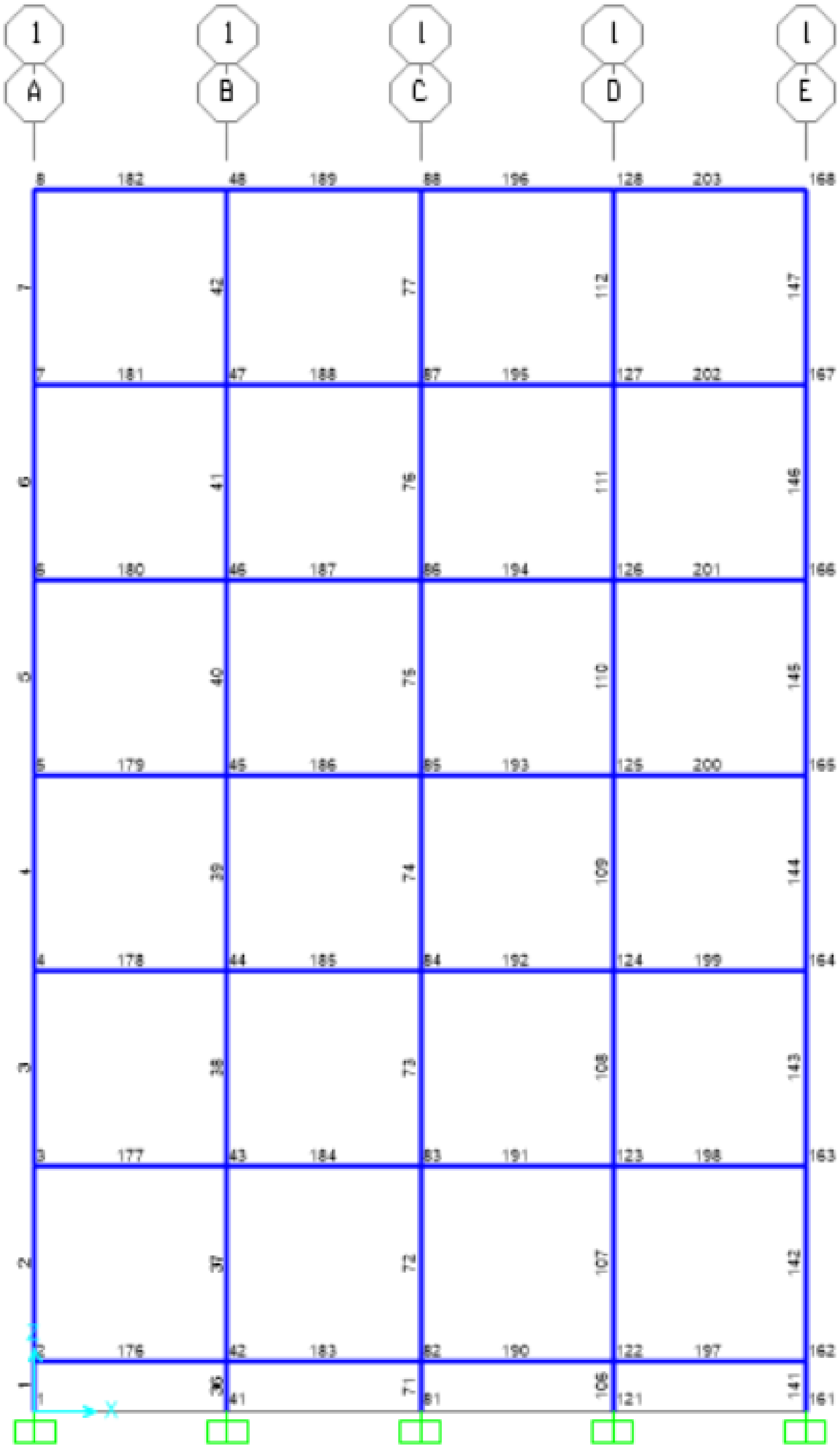

Figure 4.1 Label: Square shaped plan building

The above figure represents elevation of square shaped plan model in X-Z plane @ Y = 0 or Y-Z plane @ X = 0.

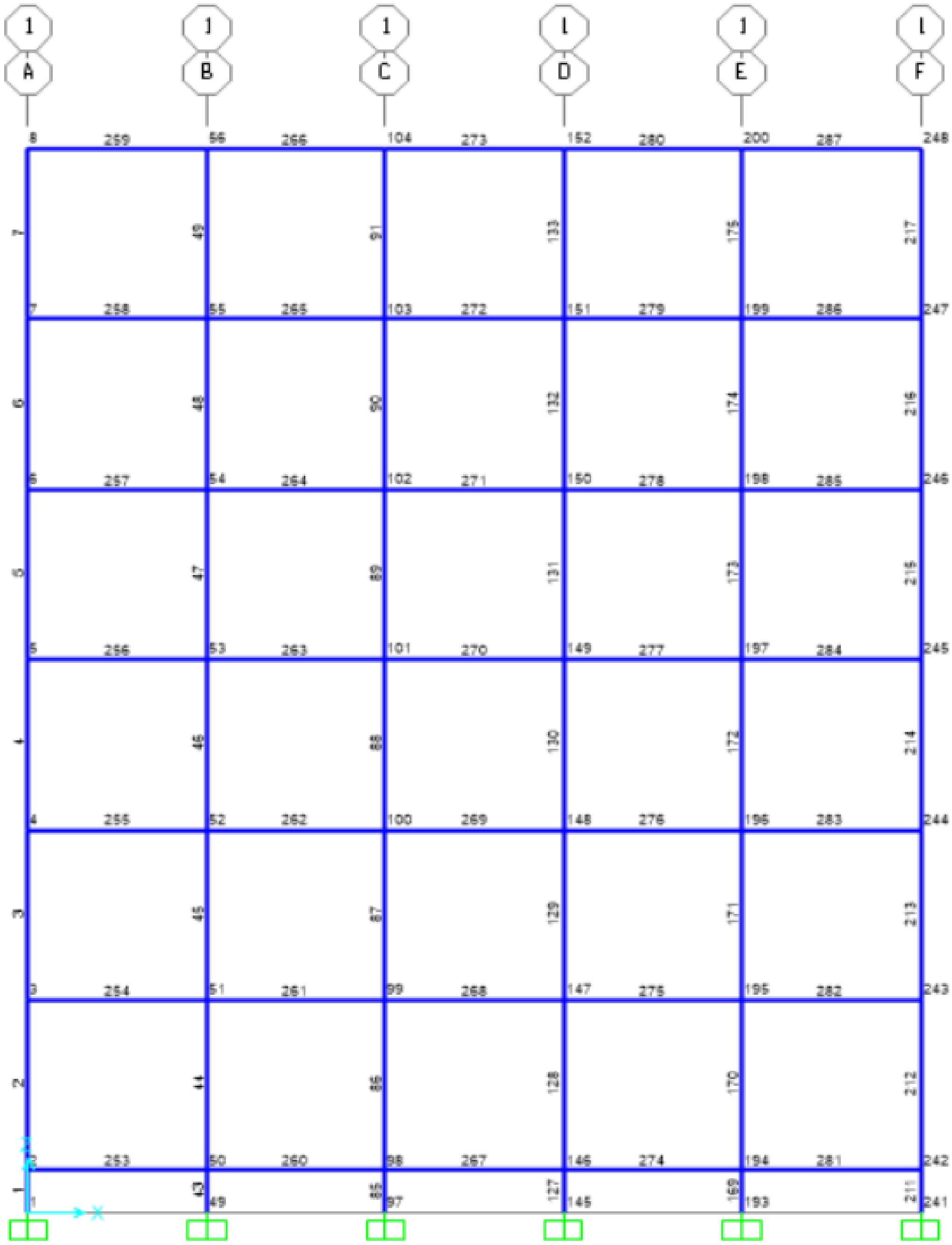

Figure 4.2 Label: L-shaped plan building

The above figure represents elevation of square shaped plan model in X-Z plane @ Y = 0 or Y-Z plane @ X = 0.

Thus, it is seen that the label number for outer column elements (@ X = 0 and Y = 0) are 1, 2, 3, 4, 5, 6 and 7 whereas label number for corresponding joints (@ X = 0 and Y = 0) are 1, 2, 3, 4, 5, 6, 7 and 8 from bottom to top for whose analysis results are to be determined.

4.2 ANALYSIS RESULTS OF SQUARE SHAPED PLAN BUILDING MODEL

The analysis results are presented for the square shaped plan building with original live load of $2KN/m^2$.

4.2.1 Mode shapes

First six modes have been considered for the modal analysis.

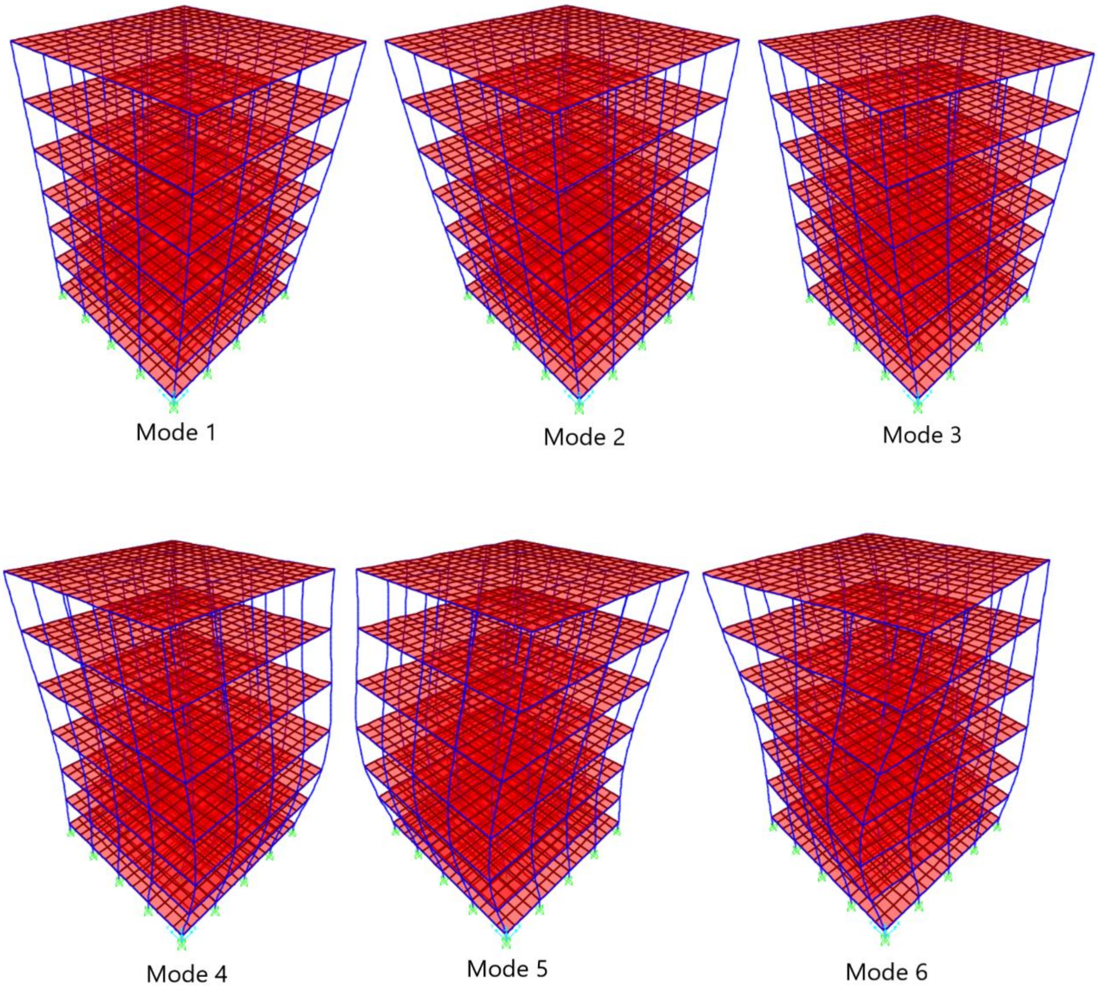

Figure 4.3 Mode shapes: Square shaped plan building

Table 4.2 Modal periods and frequencies: Square shaped plan building

Mode	Time period T (s)	Frequency f (Hz)
1	0.65493	1.52689
2	0.65493	1.52689
3	0.57532	1.73815
4	0.20882	4.78871
5	0.20882	4.78871
6	0.18447	5.42106

4.2.2 Base shear

Table 4.3 Base reactions for square shaped plan building

OutputCase	CaseType	StepType	GlobalFX	GlobalFY	GlobalFZ	GlobalMX	GlobalMY	GlobalMZ
Text	Text	Text	KN	KN	KN	KN-m	KN-m	KN-m
DEAD	LinStatic		3.197E-14	6.04E-14	16265	130120	-130120	4.547E-13
FF	LinStatic		3.608E-16	1.665E-16	153.6	1228.8	-1228.8	-4.441E-16
LIVE	LinStatic		1.599E-14	4.885E-15	3072	24576	-24576	-4.263E-14
EQx	LinRespSpec	Max	**802.606**	0.00003817	3.329E-05	0.0009024	13800.27	6734.9494
EQy	LinRespSpec	Max	0.00009974	**802.606**	0.0001997	13800.27	0.0017	6734.9494

From the above table, base shear in both the orthogonal directions is 802.606 KN.

4.2.3 Column forces

The forces of outer column elements (@ X = 0 and Y = 0) labelled 1, 2, 3, 4, 5, 6 and 7 from bottom to top are determined. These forces include P, V_2, V_3, T, M_2 and M_3. These forces are determined at lower end (L), mid-point (M) and upper end (U) of each column in consideration.

P = axial force

V_2, V_3 = shear forces in x, y directions respectively

T = torsional moment

M_2, M_3 = bending moments in x, y directions respectively

Table 4.4 Column forces for square shaped plan building

Element Label	Load Case	P (KN)			V2 (KN)			V3 (KN)			T (KN-m)			M2 (KN-m)			M3 (KN-m)		
		L	**M**	**U**	**L**	**M**	**U**	**L**	**M**	**U**	**L**	**M**	**U**	**L**	**M**	**U**	**L**	**M**	**U**
1	DEAD	-457.64	-453.14	-448.64	-8.863	-8.863	-8.863	-8.863	-8.863	-8.863	2.1E-17	2.1E-17	2.1E-17	-1.4228	3.0088	7.4404	-1.4228	3.0088	7.4404
	FF	-2.681	-2.681	-2.681	-0.157	-0.157	-0.157	-0.157	-0.157	-0.157	3.6E-19	3.6E-19	3.6E-19	-0.0251	0.0531	0.1314	-0.0251	0.0531	0.1314
	LIVE	-53.621	-53.621	-53.621	-3.13	-3.13	-3.13	-3.13	-3.13	-3.13	7.4E-18	7.4E-18	7.4E-18	-0.5025	1.0626	2.6278	-0.5025	1.0626	2.6278
	EQx	150.333	150.333	150.333	23.726	23.726	23.726	1.38	1.38	1.38	0.1171	0.1171	0.1171	2.8826	2.3689	1.9385	62.8944	51.0332	39.173
	EQy	150.333	150.333	150.333	1.38	1.38	1.38	23.726	23.726	23.726	0.1171	0.1171	0.1171	62.8944	51.0332	39.173	2.8826	2.3689	1.9385
	∑	**-213.28**	**-208.78**	**-204.28**	**12.956**	**12.956**	**12.956**	**12.956**	**12.956**	**12.956**	**0.2342**	**0.2342**	**0.2342**	**63.8266**	**57.5266**	**51.3111**	**63.8266**	**57.5266**	**51.3111**
2	DEAD	-418.7	-400.7	-382.7	-2.916	-2.916	-2.916	-2.916	-2.916	-2.916	3.6E-16	3.6E-16	3.6E-16	-5.2665	0.5656	6.3977	-5.2665	0.5656	6.3977
	FF	-2.295	-2.295	-2.295	-0.051	-0.051	-0.051	-0.051	-0.051	-0.051	3.7E-18	3.7E-18	3.7E-18	-0.0926	0.0098	0.1121	-0.0926	0.0098	0.1121
	LIVE	-45.9	-45.9	-45.9	-1.023	-1.023	-1.023	-1.023	-1.023	-1.023	8.3E-17	8.3E-17	8.3E-17	-1.8514	0.195	2.2415	-1.8514	0.195	2.2415
	EQx	135.318	135.318	135.318	26.685	26.685	26.685	1.404	1.404	1.404	0.4898	0.4898	0.4898	3.4973	0.8755	2.1195	71.8715	18.5658	34.9353
	EQy	135.318	135.318	135.318	1.404	1.404	1.404	26.685	26.685	26.685	0.4898	0.4898	0.4898	71.8715	18.5658	34.9353	3.4973	0.8755	2.1195
	∑	**-196.26**	**-178.26**	**-160.26**	**24.099**	**24.099**	**24.099**	**24.099**	**24.099**	**24.099**	**0.9796**	**0.9796**	**0.9796**	**68.1583**	**20.2117**	**45.8061**	**68.1583**	**20.2117**	**45.8061**
3	DEAD	-351.4	-333.4	-315.4	-3.802	-3.802	-3.802	-3.802	-3.802	-3.802	6.8E-16	6.8E-16	6.8E-16	-7.5412	0.0636	7.6684	-7.5412	0.0636	7.6684
	FF	-1.888	-1.888	-1.888	-0.066	-0.066	-0.066	-0.066	-0.066	-0.066	7.5E-18	7.5E-18	7.5E-18	-0.1311	0.0007	0.1325	-0.1311	0.0007	0.1325
	LIVE	-37.762	-37.762	-37.762	-1.318	-1.318	-1.318	-1.318	-1.318	-1.318	1.6E-16	1.6E-16	1.6E-16	-2.6212	0.0139	2.649	-2.6212	0.0139	2.649
	EQx	101.224	101.224	101.224	20.79	20.79	20.79	1.206	1.206	1.206	0.5753	0.5753	0.5753	2.349	0.0923	2.4739	41.3224	2.7028	42.0078
	EQy	101.224	101.224	101.224	1.206	1.206	1.206	20.79	20.79	20.79	0.5753	0.5753	0.5753	41.3224	2.7028	42.0078	2.349	0.0923	2.4739
	∑	**-188.6**	**-170.6**	**-152.6**	**16.81**	**16.81**	**16.81**	**16.81**	**16.81**	**16.81**	**1.1506**	**1.1506**	**1.1506**	**33.3779**	**2.8733**	**54.9316**	**33.3779**	**2.8733**	**54.9316**

Table 4.4 (continued)

4	DEAD	-282.47	-264.47	-246.47	-4.046	-4.046	-4.046	-4.046	-4.046	-4.046	9.5E-16	9.5E-16	9.5E-16	-7.9827	0.1094	8.2015	-7.9827	0.1094	8.2015
	FF	-1.456	-1.456	-1.456	-0.07	-0.07	-0.07	-0.07	-0.07	-0.07	1.2E-17	1.2E-17	1.2E-17	-0.1375	0.0021	0.1416	-0.1375	0.0021	0.1416
	LIVE	-29.12	-29.12	-29.12	-1.396	-1.396	-1.396	-1.396	-1.396	-1.396	2.5E-16	2.5E-16	2.5E-16	-2.7498	0.0415	2.8329	-2.7498	0.0415	2.8329
	EQx	67.78	67.78	67.78	18.134	18.134	18.134	1.026	1.026	1.026	0.5049	0.5049	0.5049	1.8418	0.2339	2.2616	32.4701	4.9935	40.326
	EQy	67.78	67.78	67.78	1.026	1.026	1.026	18.134	18.134	18.134	0.5049	0.5049	0.5049	32.4701	4.9935	40.326	1.8418	0.2339	2.2616
	∑	**-177.48**	**-159.48**	**-141.48**	**13.648**	**13.648**	**13.648**	**13.648**	**13.648**	**13.648**	**1.0098**	**1.0098**	**1.0098**	**23.4419**	**5.3804**	**53.7636**	**23.4419**	**5.3804**	**53.7636**
5	DEAD	-212.33	-194.33	-176.33	-4.431	-4.431	-4.431	-4.431	-4.431	-4.431	7.4E-16	7.4E-16	7.4E-16	-8.6977	0.1637	9.0251	-8.6977	0.1637	9.0251
	FF	-1.007	-1.007	-1.007	-0.073	-0.073	-0.073	-0.073	-0.073	-0.073	1E-17	1E-17	1E-17	-0.1454	-9E-06	0.1454	-0.1454	-9E-06	0.1454
	LIVE	-20.146	-20.146	-20.146	-1.454	-1.454	-1.454	-1.454	-1.454	-1.454	2.3E-16	2.3E-16	2.3E-16	-2.9081	-0.0002	2.9077	-2.9081	-0.0002	2.9077
	EQx	39.393	39.393	39.393	14.272	14.272	14.272	0.801	0.801	0.801	0.3928	0.3928	0.3928	1.3354	0.3049	1.8696	22.8718	6.5826	34.5388
	EQy	39.393	39.393	39.393	0.801	0.801	0.801	14.272	14.272	14.272	0.3928	0.3928	0.3928	22.8718	6.5826	34.5388	1.3354	0.3049	1.8696
	∑	**-154.7**	**-136.7**	**-118.7**	**9.115**	**9.115**	**9.115**	**9.115**	**9.115**	**9.115**	**0.7856**	**0.7856**	**0.7856**	**12.456**	**7.05101**	**48.4866**	**12.456**	**7.05101**	**48.4866**
6	DEAD	-141.39	-123.39	-105.39	-4.147	-4.147	-4.147	-4.147	-4.147	-4.147	3.7E-16	3.7E-16	3.7E-16	-8.6593	-0.365	7.9293	-8.6593	-0.365	7.9293
	FF	-0.547	-0.547	-0.547	-0.08	-0.08	-0.08	-0.08	-0.08	-0.08	4.3E-18	4.3E-18	4.3E-18	-0.1545	0.005	0.1646	-0.1545	0.005	0.1646
	LIVE	-0.547	-0.547	-0.547	-0.547	-0.547	-0.547	-0.547	-0.547	-0.547	1E-16	1E-16	1E-16	-3.0908	0.1009	3.2927	-3.0908	0.1009	3.2927
	EQx	18.125	18.125	18.125	9.877	9.877	9.877	0.536	0.536	0.536	0.2614	0.2614	0.2614	0.7814	0.3525	1.3637	12.8074	7.6773	27.0956
	EQy	18.125	18.125	18.125	0.536	0.536	0.536	9.877	9.877	9.877	0.2614	0.2614	0.2614	12.8074	7.6773	27.0956	0.7814	0.3525	1.3637
	∑	**-106.24**	**-88.238**	**-70.238**	**5.639**	**5.639**	**5.639**	**5.639**	**5.639**	**5.639**	**0.5228**	**0.5228**	**0.5228**	**1.6842**	**7.7707**	**39.8459**	**1.6842**	**7.7707**	**39.8459**
7	DEAD	-69.289	-51.289	-33.289	-6.633	-6.633	-6.633	-6.633	-6.633	-6.633	7.6E-16	7.6E-16	7.6E-16	-11.137	2.1298	15.3964	-11.137	2.1298	15.3964
	FF	-0.084	-0.084	-0.084	-0.056	-0.056	-0.056	-0.056	-0.056	-0.056	6.1E-18	6.1E-18	6.1E-18	-0.1345	-0.0216	0.0912	-0.1345	-0.0216	0.0912
	LIVE	-1.689	-1.689	-1.689	-1.128	-1.128	-1.128	-1.128	-1.128	-1.128	1.4E-16	1.4E-16	1.4E-16	-2.6893	-0.4329	1.8234	-2.6893	-0.4329	1.8234
	EQx	5.366	5.366	5.366	3.224	3.224	3.224	0.231	0.231	0.231	0.1305	0.1305	0.1305	0.3217	0.2365	0.6988	2.8333	5.7464	11.8848
	EQy	5.366	5.366	5.366	0.231	0.231	0.231	3.224	3.224	3.224	0.1305	0.1305	0.1305	2.8333	5.7464	11.8848	0.3217	0.2365	0.6988
	∑	**-60.33**	**-42.33**	**-24.33**	**-4.362**	**-4.362**	**-4.362**	**-4.362**	**-4.362**	**-4.362**	**0.261**	**0.261**	**0.261**	**-10.806**	**7.6582**	**29.8946**	**-10.806**	**7.6582**	**29.8946**

4.2.4 Joint displacements

The values of the displacements are determined for joints (@ X = 0 and Y = 0) labelled 2, 3, 4, 5, 6, 7 and 8. It is to be noted that joint labelled 1 is a fix joint and its displacement will be zero. The horizontal displacements in the two orthogonal directions U1 and U2 are determined. U1 and U2 are displacements in x and y directions respectively.

Table 4.5 Joint displacements for square shaped plan building

Joint Label	Load Case	U1 (m)	U2 (m)
2	DEAD	0	0
	FF	0	0
	LIVE	0	0
	EQx	0.0001	4.499E-06
	EQy	4.499E-06	0.0001
	∑	**0.0001045**	**0.0001045**
3	DEAD	3.874E-20	-7.664E-20
	FF	0	0
	LIVE	0	-1.838E-20
	EQx	0.001803	0.00008
	EQy	0.00008	0.001803
	∑	**0.001883**	**0.001883**
4	DEAD	1.965E-19	-2.546E-19
	FF	0	0
	LIVE	3.155E-20	-5.645E-20
	EQx	0.003884	0.000168
	EQy	0.000168	0.003884
	∑	**0.004052**	**0.004052**

Table 4.5 (continued)

5	DEAD	3.035E-19	-5.246E-19
	FF	0	0
	LIVE	4.739E-20	-1.223E-19
	EQx	0.00579	0.000246
	EQy	0.000246	0.00579
	∑	**0.006036**	**0.006036**
6	DEAD	2.795E-19	-9.372E-19
	FF	0	-1.073E-20
	LIVE	4.235E-20	-2.19E-19
	EQx	0.007342	0.000306
	EQy	0.000306	0.007342
	∑	**0.007648**	**0.007648**
7	DEAD	4.649E-19	-1.541E-18
	FF	0	-1.619E-20
	LIVE	7.556E-20	-3.315E-19
	EQx	0.008438	0.000346
	EQy	0.000346	0.008438
	∑	**0.008784**	**0.008784**
8	DEAD	9.866E-19	-1.906E-18
	FF	0	-1.904E-20
	LIVE	1.554E-19	-3.919E-19
	EQx	0.009054	0.000366
	EQy	0.000366	0.009054
	∑	**0.00942**	**0.00942**

Similarly, the above analysis results are obtained for different values of live load ($3KN/m^2$, $4KN/m^2$, $5KN/m^2$ and $6KN/m^2$) applied at each storey one by one.

4.2.5 Percentage change in base shear relative to original live load

Table 4.6 Mass irregularity in first floor: Percentage change in base shear relative to original live load for square shaped plan building

Base Shear (KN)	Original Live Load	Live load at first storey and % change relative to original live load							
		3KN/m2	% change	4KN/m2	% change	5KN/m2	% change	6KN/m2	% change
Along X	802.606	802.752	0.01819074	802.898	0.03638149	803.044	0.05457223	803.19	0.07276297
Along Y	802.606	802.752	0.01819074	802.898	0.03638149	803.044	0.05457223	803.19	0.07276297

Table 4.7 Mass irregularity in second floor: Percentage change in base shear relative to original live load for square shaped plan building

Base Shear (KN)	Original Live Load	Live load at second storey and % change relative to original live load							
		3KN/m2	% change	4KN/m2	% change	5KN/m2	% change	6KN/m2	% change
Along X	802.606	804.665	0.25653932	806.733	0.51419999	808.808	0.77273282	810.892	1.032387
Along Y	802.606	804.665	0.25653932	806.733	0.51419999	808.808	0.77273282	810.892	1.032387

Table 4.8 Mass irregularity in third floor: Percentage change in base shear relative to original live load for square shaped plan building

Base Shear (KN)	Original Live Load	Live load at third storey and % change relative to original live load							
		3KN/m2	% change	4KN/m2	% change	5KN/m2	% change	6KN/m2	% change
Along X	802.606	805.547	0.36643135	808.487	0.73273811	811.428	1.09916946	814.369	1.46560081
Along Y	802.606	805.547	0.36643135	808.487	0.73273811	811.428	1.09916946	814.369	1.46560081

Table 4.9 Mass irregularity in fourth floor: Percentage change in base shear relative to original live load for square shaped plan building

Base Shear (KN)	Original Live Load	Live load at fourth storey and % change relative to original live load							
		3KN/m2	% change	4KN/m2	% change	5KN/m2	% change	6KN/m2	% change
Along X	802.606	805.321	0.33827308	808.025	0.67517562	810.719	1.01083221	813.401	1.34499368
Along Y	802.606	805.321	0.33827308	808.025	0.67517562	810.719	1.01083221	813.401	1.34499368

Table 4.10 Mass irregularity in fifth floor: Percentage change in base shear relative to original live load for square shaped plan building

Base Shear (KN)	Original Live Load	Live load at fifth storey and % change relative to original live load							
		3KN/m2	% change	4KN/m2	% change	5KN/m2	% change	6KN/m2	% change
Along X	802.606	804.448	0.2295024	806.273	0.45688669	808.08	0.68202829	809.87	0.90505179
Along Y	802.606	804.448	0.2295024	806.273	0.45688669	808.08	0.68202829	809.87	0.90505179

Table 4.11 Mass irregularity in sixth floor: Percentage change in base shear relative to original live load for square shaped plan building

Base Shear (KN)	Original Live Load	Live load at sixth storey and % change relative to original live load							
		3KN/m2	% change	4KN/m2	% change	5KN/m2	% change	6KN/m2	% change
Along X	802.606	803.422	0.10166881	804.225	0.2017179	805.014	0.30002268	805.791	0.39683232
Along Y	802.606	803.422	0.10166881	804.225	0.2017179	805.014	0.30002268	805.791	0.39683232

4.2.6 Percentage change in column forces relative to original live load

Table 4.12 Mass irregularity in first floor: Percentage change in column forces relative to original live load for square shaped plan building

Column label	Column force	At	Original Live Load	Live load at first storey and % change relative to original live load							
				3KN/m2	% change	4KN/m2	% change	5KN/m2	% change	6KN/m2	% change
1	P (KN)	L	-213.277	-217.112	1.79813107	-220.948	3.59673101	-224.783	5.39486208	-228.618	7.19299315
		M	-208.777	-212.612	1.83688816	-216.448	3.67425531	-220.283	5.51114347	-224.118	7.34803163
		U	-204.277	-208.112	1.87735281	-211.948	3.75519515	-215.783	5.63254796	-219.618	7.50990077
	V2 (KN)	L	12.956	11.103	-14.3022538	9.252	-28.5890707	7.401	-42.8758876	5.549	-57.170423
		M	12.956	11.103	-14.3022538	9.252	-28.5890707	7.401	-42.8758876	5.549	-57.170423
		U	12.956	11.103	-14.3022538	9.252	-28.5890707	7.401	-42.8758876	5.549	-57.170423
	V3 (KN)	L	12.956	11.103	-14.3022538	9.252	-28.5890707	7.401	-42.8758876	5.549	-57.170423
		M	12.956	11.103	-14.3022538	9.252	-28.5890707	7.401	-42.8758876	5.549	-57.170423
		U	12.956	11.103	-14.3022538	9.252	-28.5890707	7.401	-42.8758876	5.549	-57.170423
	T (KN-m)	L	0.2342	0.2344	0.0853971	0.2344	0.0853971	0.2344	0.0853971	0.2346	0.17079419
		M	0.2342	0.2344	0.0853971	0.2344	0.0853971	0.2344	0.0853971	0.2346	0.17079419
		U	0.2342	0.2344	0.0853971	0.2344	0.0853971	0.2344	0.0853971	0.2346	0.17079419
	M2 (KN-m)	L	63.8266	63.5377	-0.4526326	63.249	-0.90495185	62.9602	-1.35742778	62.6713	-1.81006038
		M	57.5266	58.1636	1.10731383	58.8006	2.21462767	59.4375	3.32176767	60.0745	4.4290815
		U	51.3111	52.8739	3.04573474	54.4365	6.09107971	55.9994	9.13700934	57.562	12.1823543
	M3 (KN-m)	L	63.8266	63.5377	-0.4526326	63.249	-0.90495185	62.9602	-1.35742778	62.6713	-1.81006038
		M	57.5266	58.1636	1.10731383	58.8006	2.21462767	59.4375	3.32176767	60.0745	4.4290815
		U	51.3111	52.8739	3.04573474	54.4365	6.09107971	55.9994	9.13700934	57.562	12.1823543
2	P (KN)	L	-196.255	-196.35	0.04840641	-196.445	0.09681282	-196.541	0.14572877	-196.638	0.19515426
		M	-178.255	-178.35	0.05329444	-178.445	0.10658888	-178.541	0.16044431	-178.638	0.21486073
		U	-160.255	-160.35	0.05928052	-160.445	0.11856104	-160.541	0.17846557	-160.638	0.2389941
	V2 (KN)	L	24.099	23.923	-0.73032076	23.747	-1.46064152	23.572	-2.18681273	23.395	-2.92128304
		M	24.099	23.923	-0.73032076	23.747	-1.46064152	23.572	-2.18681273	23.395	-2.92128304
		U	24.099	23.923	-0.73032076	23.747	-1.46064152	23.572	-2.18681273	23.395	-2.92128304
	V3 (KN)	L	24.099	23.923	-0.73032076	23.747	-1.46064152	23.572	-2.18681273	23.395	-2.92128304
		M	24.099	23.923	-0.73032076	23.747	-1.46064152	23.572	-2.18681273	23.395	-2.92128304
		U	24.099	23.923	-0.73032076	23.747	-1.46064152	23.572	-2.18681273	23.395	-2.92128304
	T (KN-m)	L	0.9796	0.9798	0.0204165	0.9802	0.06124949	0.9806	0.10208248	0.9808	0.12249898
		M	0.9796	0.9798	0.0204165	0.9802	0.06124949	0.9806	0.10208248	0.9808	0.12249898
		U	0.9796	0.9798	0.0204165	0.9802	0.06124949	0.9806	0.10208248	0.9808	0.12249898
	M2 (KN-m)	L	68.1583	67.6198	-0.79007252	67.0814	-1.57999833	66.543	-2.36992413	66.0045	-3.15999665
		M	20.2117	20.0252	-0.92273287	19.8387	-1.84546575	19.6522	-2.76819862	19.4658	-3.69043673
		U	45.8061	45.9813	0.38248181	46.1566	0.76518193	46.3318	1.14766374	46.5071	1.53036386
	M3 (KN-m)	L	68.1583	67.6198	-0.79007252	67.0814	-1.57999833	66.543	-2.36992413	66.0045	-3.15999665
		M	20.2117	20.0252	-0.92273287	19.8387	-1.84546575	19.6522	-2.76819862	19.4658	-3.69043673
		U	45.8061	45.9813	0.38248181	46.1566	0.76518193	46.3318	1.14766374	46.5071	1.53036386

Table 4.12 (continued)

3	P (KN)	L	-188.597	-188.643	0.02439063	-188.69	0.04931149	-188.737	0.07423236	-188.784	0.09915322
		M	-170.597	-170.643	0.02696413	-170.69	0.05451444	-170.737	0.08206475	-170.784	0.10961506
		U	-152.597	-152.643	0.03014476	-152.69	0.06094484	-152.737	0.09174492	-152.784	0.122545
	V2 (KN)	L	16.81	16.843	0.19631172	16.877	0.39857228	16.911	0.60083284	16.945	0.8030934
		M	16.81	16.843	0.19631172	16.877	0.39857228	16.911	0.60083284	16.945	0.8030934
		U	16.81	16.843	0.19631172	16.877	0.39857228	16.911	0.60083284	16.945	0.8030934
	V3 (KN)	L	16.81	16.843	0.19631172	16.877	0.39857228	16.911	0.60083284	16.945	0.8030934
		M	16.81	16.843	0.19631172	16.877	0.39857228	16.911	0.60083284	16.945	0.8030934
		U	16.81	16.843	0.19631172	16.877	0.39857228	16.911	0.60083284	16.945	0.8030934
	T (KN-m)	L	1.1506	1.1508	0.01738224	1.1512	0.05214671	1.1516	0.08691118	1.1518	0.10429341
		M	1.1506	1.1508	0.01738224	1.1512	0.05214671	1.1516	0.08691118	1.1518	0.10429341
		U	1.1506	1.1508	0.01738224	1.1512	0.05214671	1.1516	0.08691118	1.1518	0.10429341
	M2 (KN-m)	L	33.3779	33.4836	0.3166766	33.5894	0.63365281	33.6952	0.95062901	33.8009	1.26730561
		M	2.8732959	2.9145959	1.43737371	2.9558959	2.87474743	2.9972959	4.31560147	3.0384959	5.74949486
		U	54.9316	54.9111	-0.03731914	54.8907	-0.07445623	54.8702	-0.11177537	54.8497	-0.14909451
	M3 (KN-m)	L	33.3779	33.4836	0.3166766	33.5894	0.63365281	33.6952	0.95062901	33.8009	1.26730561
		M	2.8732959	2.9145959	1.43737371	2.9558959	2.87474743	2.9972959	4.31560147	3.0384959	5.74949486
		U	54.9316	54.9111	-0.03731914	54.8907	-0.07445623	54.8702	-0.11177537	54.8497	-0.14909451

4	P (KN)	L	-177.483	-177.526	0.02422767	-177.569	0.04845535	-177.612	0.07268302	-177.654	0.09634726
		M	-159.483	-159.526	0.02696212	-159.569	0.05392424	-159.612	0.08088636	-159.654	0.10722146
		U	-141.483	-141.526	0.03039234	-141.569	0.06078469	-141.612	0.09117703	-141.654	0.12086258
	V2 (KN)	L	13.648	13.639	-0.06594373	13.629	-0.13921454	13.62	-0.20515826	13.612	-0.26377491
		M	13.648	13.639	-0.06594373	13.629	-0.13921454	13.62	-0.20515826	13.612	-0.26377491
		U	13.648	13.639	-0.06594373	13.629	-0.13921454	13.62	-0.20515826	13.612	-0.26377491
	V3 (KN)	L	13.648	13.639	-0.06594373	13.629	-0.13921454	13.62	-0.20515826	13.612	-0.26377491
		M	13.648	13.639	-0.06594373	13.629	-0.13921454	13.62	-0.20515826	13.612	-0.26377491
		U	13.648	13.639	-0.06594373	13.629	-0.13921454	13.62	-0.20515826	13.612	-0.26377491
	T (KN-m)	L	1.0098	1.01	0.0198059	1.0102	0.0396118	1.0104	0.05941771	1.0106	0.07922361
		M	1.0098	1.01	0.0198059	1.0102	0.0396118	1.0104	0.05941771	1.0106	0.07922361
		U	1.0098	1.01	0.0198059	1.0102	0.0396118	1.0104	0.05941771	1.0106	0.07922361
	M2 (KN-m)	L	23.4419	23.4149	-0.11517838	23.3881	-0.22950358	23.3611	-0.34468196	23.3343	-0.45900716
		M	5.3804	5.374	-0.11895026	5.3677	-0.23604193	5.3614	-0.3531336	5.355	-0.47208386
		U	53.7636	53.782	0.0342239	53.8004	0.0684478	53.8187	0.1024857	53.8372	0.13689559
	M3 (KN-m)	L	23.4419	23.4149	-0.11517838	23.3881	-0.22950358	23.3611	-0.34468196	23.3343	-0.45900716
		M	5.3804	5.374	-0.11895026	5.3677	-0.23604193	5.3614	-0.3531336	5.355	-0.47208386
		U	53.7636	53.782	0.0342239	53.8004	0.0684478	53.8187	0.1024857	53.8372	0.13689559

Table 4.12 (continued)

5	P (KN)	L	-154.696	-154.725	0.01874644	-154.754	0.03749289	-154.784	0.05688576	-154.813	0.07563221
		M	-136.696	-136.725	0.02121496	-136.754	0.04242992	-136.784	0.06437643	-136.813	0.08559139
		U	-118.696	-118.725	0.02443216	-118.754	0.04886433	-118.784	0.07413898	-118.813	0.09857114
	V2 (KN)	L	9.115	9.114	-0.01097093	9.114	-0.01097093	9.113	-0.02194185	9.113	-0.02194185
		M	9.115	9.114	-0.01097093	9.114	-0.01097093	9.113	-0.02194185	9.113	-0.02194185
		U	9.115	9.114	-0.01097093	9.114	-0.01097093	9.113	-0.02194185	9.113	-0.02194185
	V3 (KN)	L	9.115	9.114	-0.01097093	9.114	-0.01097093	9.113	-0.02194185	9.113	-0.02194185
		M	9.115	9.114	-0.01097093	9.114	-0.01097093	9.113	-0.02194185	9.113	-0.02194185
		U	9.115	9.114	-0.01097093	9.114	-0.01097093	9.113	-0.02194185	9.113	-0.02194185
	T (KN-m)	L	0.7856	0.7858	0.02545825	0.786	0.0509165	0.7862	0.07637475	0.7862	0.07637475
		M	0.7856	0.7858	0.02545825	0.786	0.0509165	0.7862	0.07637475	0.7862	0.07637475
		U	0.7856	0.7858	0.02545825	0.786	0.0509165	0.7862	0.07637475	0.7862	0.07637475
	M2 (KN-m)	L	12.456	12.4565	0.00401413	12.4571	0.00883109	12.4576	0.01284522	12.4581	0.01685934
		M	7.05101415	7.05399115	0.04222088	7.05689115	0.08334971	7.05979115	0.12447855	7.06259115	0.16418915
		U	48.4866	48.4962	0.01979928	48.506	0.04001105	48.5156	0.05981034	48.5252	0.07960962
	M3 (KN-m)	L	12.456	12.4565	0.00401413	12.4571	0.00883109	12.4576	0.01284522	12.4581	0.01685934
		M	7.05101415	7.05399115	0.04222088	7.05689115	0.08334971	7.05979115	0.12447855	7.06259115	0.16418915
		U	48.4866	48.4962	0.01979928	48.506	0.04001105	48.5156	0.05981034	48.5252	0.07960962

6	P (KN)	L	-106.238	-116.645	9.79592989	-116.664	9.81381427	-116.683	9.83169864	-116.702	9.84958301
		M	-88.238	-98.645	11.7942383	-98.664	11.815771	-98.683	11.8373037	-98.702	11.8588363
		U	-70.238	-80.645	14.8167659	-80.664	14.8438167	-80.683	14.8708676	-80.702	14.8979185
	V2 (KN)	L	5.639	4.587	-18.65579	4.586	-18.6735237	4.583	-18.7267246	4.582	-18.7444582
		M	5.639	4.587	-18.65579	4.586	-18.6735237	4.583	-18.7267246	4.582	-18.7444582
		U	5.639	4.587	-18.65579	4.586	-18.6735237	4.583	-18.7267246	4.582	-18.7444582
	V3 (KN)	L	5.639	4.587	-18.65579	4.586	-18.6735237	4.583	-18.7267246	4.582	-18.7444582
		M	5.639	4.587	-18.65579	4.586	-18.6735237	4.583	-18.7267246	4.582	-18.7444582
		U	5.639	4.587	-18.65579	4.586	-18.6735237	4.583	-18.7267246	4.582	-18.7444582
	T (KN-m)	L	0.5228	0.523	0.03825555	0.523	0.03825555	0.5232	0.07651109	0.5232	0.07651109
		M	0.5228	0.523	0.03825555	0.523	0.03825555	0.5232	0.07651109	0.5232	0.07651109
		U	0.5228	0.523	0.03825555	0.523	0.03825555	0.5232	0.07651109	0.5232	0.07651109
	M2 (KN-m)	L	1.6842	1.6797	-0.26718917	1.6753	-0.5284408	1.6709	-0.78969244	1.6664	-1.05688161
		M	7.7707	7.7712	0.00643443	7.7715	0.01029508	7.7718	0.01415574	7.7723	0.02059017
		U	39.8459	39.8559	0.02509668	39.8658	0.0499424	39.8757	0.07478812	39.8858	0.10013577
	M3 (KN-m)	L	1.6842	1.6797	-0.26718917	1.6753	-0.5284408	1.6709	-0.78969244	1.6664	-1.05688161
		M	7.7707	7.7712	0.00643443	7.7715	0.01029508	7.7718	0.01415574	7.7723	0.02059017
		U	39.8459	39.8559	0.02509668	39.8658	0.0499424	39.8758	0.07503909	39.8858	0.10013577

Table 4.12 (continued)

7	P (KN)	L	-60.33	-60.337	0.01160285	-60.346	0.0265208	-60.355	0.04143875	-60.364	0.0563567
		M	-42.33	-42.337	0.01653674	-42.346	0.03779825	-42.355	0.05905977	-42.364	0.08032129
		U	-24.33	-24.337	0.02877106	-24.346	0.06576243	-24.355	0.1027538	-24.364	0.13974517
	V2 (KN)	L	-4.362	-4.366	0.09170105	-4.369	0.16047685	-4.373	0.2521779	-4.375	0.29802843
		M	-4.362	-4.366	0.09170105	-4.369	0.16047685	-4.373	0.2521779	-4.375	0.29802843
		U	-4.362	-4.366	0.09170105	-4.369	0.16047685	-4.373	0.2521779	-4.375	0.29802843
	V3 (KN)	L	-4.362	-4.366	0.09170105	-4.369	0.16047685	-4.373	0.2521779	-4.375	0.29802843
		M	-4.362	-4.366	0.09170105	-4.369	0.16047685	-4.373	0.2521779	-4.375	0.29802843
		U	-4.362	-4.366	0.09170105	-4.369	0.16047685	-4.373	0.2521779	-4.375	0.29802843
	T (KN-m)	L	0.261	0.261	0	0.261	0	0.261	0	0.2612	0.07662835
		M	0.261	0.261	0	0.261	0	0.261	0	0.2612	0.07662835
		U	0.261	0.261	0	0.261	0	0.261	0	0.2612	0.07662835
	M2 (KN-m)	L	-10.8055	-10.8086	0.02868909	-10.8119	0.0592291	-10.8151	0.08884364	-10.818	0.11568183
		M	7.6582	7.6604	0.02872738	7.6626	0.05745475	7.6648	0.08618213	7.667	0.11490951
		U	29.8946	29.9087	0.04716571	29.9229	0.09466593	29.937	0.14183164	29.9511	0.18899734
	M3 (KN-m)	L	-10.8055	-10.8086	0.02868909	-10.8119	0.0592291	-10.8151	0.08884364	-10.818	0.11568183
		M	7.6582	7.6604	0.02872738	7.6626	0.05745475	7.6648	0.08618213	7.667	0.11490951
		U	29.8946	29.9087	0.04716571	29.9229	0.09466593	29.937	0.14183164	29.9511	0.18899734

Table 4.13 Mass irregularity in second floor: Percentage change in column forces relative to original live load for square shaped plan building

Column label	Column force	At	Original Live Load	Live load at second storey and % change relative to original live load							
				3KN/m2	% change	4KN/m2	% change	5KN/m2	% change	6KN/m2	% change
1	P (KN)	L	-213.277	-217.066	1.77656287	-220.858	3.55453237	-224.649	5.33203299	-228.438	7.10859586
		M	-208.777	-212.566	1.81485508	-216.358	3.63114711	-220.149	5.44696015	-223.938	7.26181524
		U	-204.277	-208.066	1.85483437	-211.858	3.71113733	-215.649	5.56695076	-219.438	7.42178513
	V2 (KN)	L	12.956	13.393	3.37295462	13.832	6.76134609	14.269	10.1343007	14.708	13.5226922
		M	12.956	13.393	3.37295462	13.832	6.76134609	14.269	10.1343007	14.708	13.5226922
		U	12.956	13.393	3.37295462	13.832	6.76134609	14.269	10.1343007	14.708	13.5226922
	V3 (KN)	L	12.956	13.393	3.37295462	13.832	6.76134609	14.269	10.1343007	14.708	13.5226922
		M	12.956	13.393	3.37295462	13.832	6.76134609	14.269	10.1343007	14.708	13.5226922
		U	12.956	13.393	3.37295462	13.832	6.76134609	14.269	10.1343007	14.708	13.5226922
	T (KN-m)	L	0.2342	0.2348	0.25619129	0.2354	0.51238258	0.236	0.76857387	0.2366	1.02476516
		M	0.2342	0.2348	0.25619129	0.2354	0.51238258	0.236	0.76857387	0.2366	1.02476516
		U	0.2342	0.2348	0.25619129	0.2354	0.51238258	0.236	0.76857387	0.2366	1.02476516
	M2 (KN-m)	L	63.8266	64.0424	0.33810355	64.2584	0.67652045	64.4748	1.01556404	64.6916	1.35523434
		M	57.5266	57.5239	-0.00469348	57.5215	-0.00886546	57.5194	-0.01251595	57.5176	-0.01564494
		U	51.3111	51.0903	-0.43031625	50.8697	-0.86024272	50.6492	-1.28997429	50.429	-1.7191212
	M3 (KN-m)	L	63.8266	64.0424	0.33810355	64.2584	0.67652045	64.4748	1.01556404	64.6916	1.35523434
		M	57.5266	57.5239	-0.00469348	57.5215	-0.00886546	57.5194	-0.01251595	57.5176	-0.01564494
		U	51.3111	51.0903	-0.43031625	50.8697	-0.86024272	50.6492	-1.28997429	50.429	-1.7191212

Table 4.13 (continued)

2	P (KN)	L	-196.255	-200.046	1.93167053	-203.839	3.86436014	-207.63	5.79603067	-211.421	7.72770121
		M	-178.255	-182.046	2.12672856	-185.839	4.25457911	-189.63	6.38130768	-193.421	8.50803624
		U	-160.255	-164.046	2.36560482	-167.839	4.73245765	-171.63	7.09806246	-175.421	9.46366728
	V2 (KN)	L	24.099	23.827	-1.12867754	23.556	-2.25320553	23.285	-3.37773352	23.015	-4.49811195
		M	24.099	23.827	-1.12867754	23.556	-2.25320553	23.285	-3.37773352	23.015	-4.49811195
		U	24.099	23.827	-1.12867754	23.556	-2.25320553	23.285	-3.37773352	23.015	-4.49811195
	V3 (KN)	L	24.099	23.827	-1.12867754	23.556	-2.25320553	23.285	-3.37773352	23.015	-4.49811195
		M	24.099	23.827	-1.12867754	23.556	-2.25320553	23.285	-3.37773352	23.015	-4.49811195
		U	24.099	23.827	-1.12867754	23.556	-2.25320553	23.285	-3.37773352	23.015	-4.49811195
	T (KN-m)	L	0.9796	0.9818	0.22458146	0.9842	0.46957942	0.9864	0.69416088	0.9886	0.91874234
		M	0.9796	0.9818	0.22458146	0.9842	0.46957942	0.9864	0.69416088	0.9886	0.91874234
		U	0.9796	0.9818	0.22458146	0.9842	0.46957942	0.9864	0.69416088	0.9886	0.91874234
	M2 (KN-m)	L	68.1583	67.946	-0.31148077	67.7339	-0.62266811	67.5223	-0.93312186	67.311	-1.24313547
		M	20.2117	20.546	1.65399249	20.8801	3.30699545	21.2143	4.96049318	21.5484	6.61349614
		U	45.8061	46.9509	2.49923045	48.0964	4.99998908	49.2425	7.50205759	50.3894	10.0058726
	M3 (KN-m)	L	68.1583	67.946	-0.31148077	67.7339	-0.62266811	67.5223	-0.93312186	67.311	-1.24313547
		M	20.2117	20.546	1.65399249	20.8801	3.30699545	21.2143	4.96049318	21.5484	6.61349614
		U	45.8061	46.9509	2.49923045	48.0964	4.99998908	49.2425	7.50205759	50.3894	10.0058726

3	P (KN)	L	-188.597	-188.805	0.11028807	-189.013	0.22057615	-189.223	0.33192469	-189.431	0.44221276
		M	-170.597	-170.805	0.12192477	-171.013	0.24384954	-171.223	0.36694666	-171.431	0.48887143
		U	-152.597	-152.805	0.13630674	-153.013	0.27261349	-153.223	0.41023087	-153.431	0.54653761
	V2 (KN)	L	16.81	16.503	-1.82629387	16.194	-3.66448543	15.887	-5.4907793	15.58	-7.31707317
		M	16.81	16.503	-1.82629387	16.194	-3.66448543	15.887	-5.4907793	15.58	-7.31707317
		U	16.81	16.503	-1.82629387	16.194	-3.66448543	15.887	-5.4907793	15.58	-7.31707317
	V3 (KN)	L	16.81	16.503	-1.82629387	16.194	-3.66448543	15.887	-5.4907793	15.58	-7.31707317
		M	16.81	16.503	-1.82629387	16.194	-3.66448543	15.887	-5.4907793	15.58	-7.31707317
		U	16.81	16.503	-1.82629387	16.194	-3.66448543	15.887	-5.4907793	15.58	-7.31707317
	T (KN-m)	L	1.1506	1.1528	0.19120459	1.1548	0.36502694	1.157	0.55623153	1.159	0.73005388
		M	1.1506	1.1528	0.19120459	1.1548	0.36502694	1.157	0.55623153	1.159	0.73005388
		U	1.1506	1.1528	0.19120459	1.1548	0.36502694	1.157	0.55623153	1.159	0.73005388
	M2 (KN-m)	L	33.3779	32.4194	-2.87166059	31.4611	-5.74272198	30.5027	-8.61408297	29.5444	-11.4851444
		M	2.8732959	2.5909959	-9.82495398	2.3089959	-19.639467	2.0271959	-29.4470194	1.7454959	-39.2510914
		U	54.9316	55.3095	0.68794646	55.6871	1.37534679	56.0647	2.06274713	56.4422	2.74996541
	M3 (KN-m)	L	33.3779	32.4194	-2.87166059	31.4611	-5.74272198	30.5027	-8.61408297	29.5444	-11.4851444
		M	2.8732959	2.5909959	-9.82495398	2.3089959	-19.639467	2.0271959	-29.4470194	1.7454959	-39.2510914
		U	54.9316	55.3095	0.68794646	55.6871	1.37534679	56.0647	2.06274713	56.4422	2.74996541

Table 4.13 (continued)

4	P (KN)	L	-177.483	-177.604	0.06817554	-177.724	0.13578765	-177.844	0.20339976	-177.964	0.27101187
		M	-159.483	-159.604	0.07587016	-159.724	0.15111328	-159.844	0.22635641	-159.964	0.30159954
		U	-141.483	-141.604	0.08552264	-141.724	0.17033849	-141.844	0.25515433	-141.964	0.33997017
	V2 (KN)	L	13.648	13.709	0.44695193	13.77	0.89390387	13.83	1.33352872	13.891	1.78048066
		M	13.648	13.709	0.44695193	13.77	0.89390387	13.83	1.33352872	13.891	1.78048066
		U	13.648	13.709	0.44695193	13.77	0.89390387	13.83	1.33352872	13.891	1.78048066
	V3 (KN)	L	13.648	13.709	0.44695193	13.77	0.89390387	13.83	1.33352872	13.891	1.78048066
		M	13.648	13.709	0.44695193	13.77	0.89390387	13.83	1.33352872	13.891	1.78048066
		U	13.648	13.709	0.44695193	13.77	0.89390387	13.83	1.33352872	13.891	1.78048066
	T (KN-m)	L	1.0098	1.0114	0.15844722	1.0128	0.29708853	1.0144	0.45553575	1.016	0.61398297
		M	1.0098	1.0114	0.15844722	1.0128	0.29708853	1.0144	0.45553575	1.016	0.61398297
		U	1.0098	1.0114	0.15844722	1.0128	0.29708853	1.0144	0.45553575	1.016	0.61398297
	M2 (KN-m)	L	23.4419	23.6272	0.79046494	23.8126	1.58135646	23.9981	2.37267457	24.1833	3.16271292
		M	5.3804	5.464	1.55378782	5.5475	3.10571705	5.631	4.65764627	5.7145	6.2095755
		U	53.7636	53.7876	0.04463987	53.8115	0.08909374	53.8354	0.1335476	53.859	0.17744347
	M3 (KN-m)	L	23.4419	23.6272	0.79046494	23.8126	1.58135646	23.9981	2.37267457	24.1833	3.16271292
		M	5.3804	5.464	1.55378782	5.5475	3.10571705	5.631	4.65764627	5.7145	6.2095755
		U	53.7636	53.7876	0.04463987	53.8115	0.08909374	53.8354	0.1335476	53.859	0.17744347

5	P (KN)	L	-154.696	-154.797	0.06528934	-154.899	0.13122511	-155.001	0.19716088	-155.102	0.26245022
		M	-136.696	-136.797	0.07388658	-136.899	0.14850471	-137.001	0.22312284	-137.102	0.29700942
		U	-118.696	-118.797	0.08509133	-118.899	0.17102514	-119.001	0.25695895	-119.102	0.34205028
	V2 (KN)	L	9.115	9.099	-0.17553483	9.083	-0.35106967	9.068	-0.51563357	9.051	-0.70213933
		M	9.115	9.099	-0.17553483	9.083	-0.35106967	9.068	-0.51563357	9.051	-0.70213933
		U	9.115	9.099	-0.17553483	9.083	-0.35106967	9.068	-0.51563357	9.051	-0.70213933
	V3 (KN)	L	9.115	9.099	-0.17553483	9.083	-0.35106967	9.068	-0.51563357	9.051	-0.70213933
		M	9.115	9.099	-0.17553483	9.083	-0.35106967	9.068	-0.51563357	9.051	-0.70213933
		U	9.115	9.099	-0.17553483	9.083	-0.35106967	9.068	-0.51563357	9.051	-0.70213933
	T (KN-m)	L	0.7856	0.7868	0.15274949	0.7878	0.28004073	0.789	0.43279022	0.7902	0.58553971
		M	0.7856	0.7868	0.15274949	0.7878	0.28004073	0.789	0.43279022	0.7902	0.58553971
		U	0.7856	0.7868	0.15274949	0.7878	0.28004073	0.789	0.43279022	0.7902	0.58553971
	M2 (KN-m)	L	12.456	12.4104	-0.36608863	12.3647	-0.73298009	12.319	-1.09987155	12.2733	-1.46676301
		M	7.05101415	7.04799115	-0.04287327	7.04499115	-0.08542034	7.04179115	-0.13080388	7.03849115	-0.17760566
		U	48.4866	48.5734	0.17901853	48.6602	0.35803707	48.7469	0.53684936	48.8335	0.7154554
	M3 (KN-m)	L	12.456	12.4104	-0.36608863	12.3647	-0.73298009	12.319	-1.09987155	12.2733	-1.46676301
		M	7.05101415	7.04799115	-0.04287327	7.04499115	-0.08542034	7.04179115	-0.13080388	7.03849115	-0.17760566
		U	48.4866	48.5734	0.17901853	48.6602	0.35803707	48.7469	0.53684936	48.8335	0.7154554

Table 4.13 (continued)

6	P (KN)	L	-106.238	-116.699	9.84675916	-116.77	9.91359024	-116.841	9.98042132	-116.912	10.0472524
		M	-88.238	-98.699	11.8554364	-98.77	11.9359006	-98.841	12.0163648	-98.912	12.096829
		U	-70.238	-80.699	14.8936473	-80.77	14.9947322	-80.841	15.0958171	-80.912	15.196902
	V2 (KN)	L	5.639	4.591	-18.5848555	4.592	-18.5671218	4.592	-18.5671218	4.594	-18.5316545
		M	5.639	4.591	-18.5848555	4.592	-18.5671218	4.592	-18.5671218	4.594	-18.5316545
		U	5.639	4.591	-18.5848555	4.592	-18.5671218	4.592	-18.5671218	4.594	-18.5316545
	V3 (KN)	L	5.639	4.591	-18.5848555	4.592	-18.5671218	4.592	-18.5671218	4.594	-18.5316545
		M	5.639	4.591	-18.5848555	4.592	-18.5671218	4.592	-18.5671218	4.594	-18.5316545
		U	5.639	4.591	-18.5848555	4.592	-18.5671218	4.592	-18.5671218	4.594	-18.5316545
	T (KN-m)	L	0.5228	0.5236	0.15302219	0.5242	0.26778883	0.525	0.42081102	0.5258	0.57383321
		M	0.5228	0.5236	0.15302219	0.5242	0.26778883	0.525	0.42081102	0.5258	0.57383321
		U	0.5228	0.5236	0.15302219	0.5242	0.26778883	0.525	0.42081102	0.5258	0.57383321
	M2 (KN-m)	L	1.6842	1.6871	0.17218858	1.6901	0.35031469	1.6928	0.51062819	1.6955	0.67094169
		M	7.7707	7.7803	0.12354099	7.7896	0.24322133	7.799	0.36418855	7.8083	0.48386889
		U	39.8459	39.9111	0.16363039	39.9765	0.32776271	40.0419	0.49189503	40.1074	0.65627831
	M3 (KN-m)	L	1.6842	1.6871	0.17218858	1.6901	0.35031469	1.6928	0.51062819	1.6955	0.67094169
		M	7.7707	7.7803	0.12354099	7.7896	0.24322133	7.799	0.36418855	7.8083	0.48386889
		U	39.8459	39.9111	0.16363039	39.9765	0.32776271	40.0419	0.49189503	40.1074	0.65627831

7	P (KN)	L	-60.33	-60.364	0.0563567	-60.401	0.11768606	-60.437	0.17735787	-60.473	0.23702967
		M	-42.33	-42.364	0.08032129	-42.401	0.16772974	-42.437	0.25277581	-42.473	0.33782188
		U	-24.33	-24.364	0.13974517	-24.401	0.2918208	-24.437	0.43978627	-24.473	0.58775175
	V2 (KN)	L	-4.362	-4.379	0.38972948	-4.396	0.77945896	-4.413	1.16918845	-4.431	1.58184319
		M	-4.362	-4.379	0.38972948	-4.396	0.77945896	-4.413	1.16918845	-4.431	1.58184319
		U	-4.362	-4.379	0.38972948	-4.396	0.77945896	-4.413	1.16918845	-4.431	1.58184319
	V3 (KN)	L	-4.362	-4.379	0.38972948	-4.396	0.77945896	-4.413	1.16918845	-4.431	1.58184319
		M	-4.362	-4.379	0.38972948	-4.396	0.77945896	-4.413	1.16918845	-4.431	1.58184319
		U	-4.362	-4.379	0.38972948	-4.396	0.77945896	-4.413	1.16918845	-4.431	1.58184319
	T (KN-m)	L	0.261	0.2614	0.1532567	0.2618	0.30651341	0.2622	0.45977011	0.2626	0.61302682
		M	0.261	0.2614	0.1532567	0.2618	0.30651341	0.2622	0.45977011	0.2626	0.61302682
		U	0.261	0.2614	0.1532567	0.2618	0.30651341	0.2622	0.45977011	0.2626	0.61302682
	M2 (KN-m)	L	-10.8055	-10.8379	0.2998473	-10.8709	0.60524733	-10.9047	0.91805099	-10.9392	1.23733284
		M	7.6582	7.6721	0.18150479	7.686	0.36300958	7.6998	0.54320859	7.7137	0.72471338
		U	29.8946	29.9762	0.272959	30.0578	0.54591799	30.1392	0.81820797	30.2205	1.09016344
	M3 (KN-m)	L	-10.8055	-10.8379	0.2998473	-10.8709	0.60524733	-10.9047	0.91805099	-10.9392	1.23733284
		M	7.6582	7.6721	0.18150479	7.686	0.36300958	7.6998	0.54320859	7.7137	0.72471338
		U	29.8946	29.9762	0.272959	30.0578	0.54591799	30.1392	0.81820797	30.2205	1.09016344

Table 4.14 Mass irregularity in third floor: Percentage change in column forces relative to original live load for square shaped plan building

Column label	Column force	At	Original Live Load	Live load at third storey and % change relative to original live load							
				3KN/m2	% change	4KN/m2	% change	5KN/m2	% change	6KN/m2	% change
1	P (KN)	L	-213.277	-217.123	1.80328868	-220.97	3.60704624	-224.818	5.41127266	-228.668	7.21643684
		M	-208.777	-212.623	1.84215694	-216.47	3.68479287	-220.318	5.52790777	-224.168	7.37198063
		U	-204.277	-208.123	1.88273766	-211.97	3.76596484	-215.818	5.64968156	-219.668	7.53437734
	V2 (KN)	L	12.956	12.958	0.01543686	12.961	0.03859216	12.965	0.06946588	12.968	0.09262118
		M	12.956	12.958	0.01543686	12.961	0.03859216	12.965	0.06946588	12.968	0.09262118
		U	12.956	12.958	0.01543686	12.961	0.03859216	12.965	0.06946588	12.968	0.09262118
	V3 (KN)	L	12.956	12.958	0.01543686	12.961	0.03859216	12.965	0.06946588	12.968	0.09262118
		M	12.956	12.958	0.01543686	12.961	0.03859216	12.965	0.06946588	12.968	0.09262118
		U	12.956	12.958	0.01543686	12.961	0.03859216	12.965	0.06946588	12.968	0.09262118
	T (KN-m)	L	0.2342	0.2344	0.0853971	0.2344	0.0853971	0.2346	0.17079419	0.2346	0.17079419
		M	0.2342	0.2344	0.0853971	0.2344	0.0853971	0.2346	0.17079419	0.2346	0.17079419
		U	0.2342	0.2344	0.0853971	0.2344	0.0853971	0.2346	0.17079419	0.2346	0.17079419
	M2 (KN-m)	L	63.8266	64.0338	0.32462954	64.2411	0.64941576	64.4483	0.9740453	64.6555	1.29867485
		M	57.5266	57.733	0.35879054	57.9393	0.71740725	58.1456	1.07602396	58.352	1.4348145
		U	51.3111	51.5168	0.40088792	51.7226	0.80197072	51.9282	1.20266375	52.134	1.60374656
	M3 (KN-m)	L	63.8266	64.0338	0.32462954	64.2411	0.64941576	64.4483	0.9740453	64.6555	1.29867485
		M	57.5266	57.733	0.35879054	57.9393	0.71740725	58.1456	1.07602396	58.352	1.4348145
		U	51.3111	51.5168	0.40088792	51.7226	0.80197072	51.9282	1.20266375	52.134	1.60374656
2	P (KN)	L	-196.255	-200.194	2.00708262	-204.136	4.01569387	-208.079	6.02481465	-212.022	8.03393544
		M	-178.255	-182.194	2.20975569	-186.136	4.42119436	-190.079	6.63319402	-194.022	8.84519368
		U	-160.255	-164.194	2.45795763	-168.136	4.91778728	-172.079	7.37824093	-176.022	9.83869458
	V2 (KN)	L	24.099	24.252	0.63488112	24.406	1.27391178	24.559	1.9087929	24.714	2.55197311
		M	24.099	24.252	0.63488112	24.406	1.27391178	24.559	1.9087929	24.714	2.55197311
		U	24.099	24.252	0.63488112	24.406	1.27391178	24.559	1.9087929	24.714	2.55197311
	V3 (KN)	L	24.099	24.252	0.63488112	24.406	1.27391178	24.559	1.9087929	24.714	2.55197311
		M	24.099	24.252	0.63488112	24.406	1.27391178	24.559	1.9087929	24.714	2.55197311
		U	24.099	24.252	0.63488112	24.406	1.27391178	24.559	1.9087929	24.714	2.55197311
	T (KN-m)	L	0.9796	0.98	0.04083299	0.9806	0.10208248	0.981	0.14291548	0.9816	0.20416497
		M	0.9796	0.98	0.04083299	0.9806	0.10208248	0.981	0.14291548	0.9816	0.20416497
		U	0.9796	0.98	0.04083299	0.9806	0.10208248	0.981	0.14291548	0.9816	0.20416497
	M2 (KN-m)	L	68.1583	68.4714	0.45937179	68.7846	0.91889029	69.0978	1.37840879	69.4109	1.83778058
		M	20.2117	20.2179	0.0306753	20.224	0.06085584	20.2302	0.09153114	20.2364	0.12220644
		U	45.8061	45.7632	-0.09365565	45.7204	-0.18709299	45.6776	-0.28053032	45.6351	-0.37331272
	M3 (KN-m)	L	68.1583	68.4714	0.45937179	68.7846	0.91889029	69.0978	1.37840879	69.4109	1.83778058
		M	20.2117	20.2179	0.0306753	20.224	0.06085584	20.2302	0.09153114	20.2364	0.12220644
		U	45.8061	45.7632	-0.09365565	45.7204	-0.18709299	45.6776	-0.28053032	45.6351	-0.37331272

Table 4.14 (continued)

3	P (KN)	L	-188.597	-192.621	2.13365006	-196.649	4.26942104	-200.676	6.40466179	-204.704	8.54043277
		M	-170.597	-174.621	2.35877536	-178.649	4.71989543	-182.676	7.08042932	-186.704	9.44154938
		U	-152.597	-156.621	2.63701121	-160.649	5.27664371	-164.676	7.91562088	-168.704	10.5552534
	V2 (KN)	L	16.81	16.557	-1.50505651	16.305	-3.00416419	16.053	-4.50327186	15.801	-6.00237954
		M	16.81	16.557	-1.50505651	16.305	-3.00416419	16.053	-4.50327186	15.801	-6.00237954
		U	16.81	16.557	-1.50505651	16.305	-3.00416419	16.053	-4.50327186	15.801	-6.00237954
	V3 (KN)	L	16.81	16.557	-1.50505651	16.305	-3.00416419	16.053	-4.50327186	15.801	-6.00237954
		M	16.81	16.557	-1.50505651	16.305	-3.00416419	16.053	-4.50327186	15.801	-6.00237954
		U	16.81	16.557	-1.50505651	16.305	-3.00416419	16.053	-4.50327186	15.801	-6.00237954
	T (KN-m)	L	1.1506	1.1514	0.06952894	1.1522	0.13905788	1.1528	0.19120459	1.1536	0.26073353
		M	1.1506	1.1514	0.06952894	1.1522	0.13905788	1.1528	0.19120459	1.1536	0.26073353
		U	1.1506	1.1514	0.06952894	1.1522	0.13905788	1.1528	0.19120459	1.1536	0.26073353
	M2 (KN-m)	L	33.3779	33.1694	-0.62466482	32.9611	-1.24873045	32.7527	-1.87309567	32.5442	-2.49776049
		M	2.8732959	3.2383959	12.7066621	3.6041959	25.4376864	3.9702959	38.1791517	4.3369959	50.9414989
		U	54.9316	56.1644	2.24424557	57.3973	4.48867319	58.6305	6.73364694	59.8637	8.97862068
	M3 (KN-m)	L	33.3779	33.1694	-0.62466482	32.9611	-1.24873045	32.7527	-1.87309567	32.5442	-2.49776049
		M	2.8732959	3.2383959	12.7066621	3.6041959	25.4376864	3.9702959	38.1791517	4.3369959	50.9414989
		U	54.9316	56.1644	2.24424557	57.3973	4.48867319	58.6305	6.73364694	59.8637	8.97862068

4	P (KN)	L	-177.483	-177.926	0.24960137	-178.369	0.49920274	-178.813	0.74936755	-179.258	1.00009578
		M	-159.483	-159.926	0.27777255	-160.369	0.55554511	-160.813	0.83394468	-161.258	1.11297129
		U	-141.483	-141.926	0.31311182	-142.369	0.62622365	-142.813	0.94004227	-143.258	1.25456769
	V2 (KN)	L	13.648	13.308	-2.4912075	12.968	-4.98241501	12.627	-7.48094959	12.285	-9.98681125
		M	13.648	13.308	-2.4912075	12.968	-4.98241501	12.627	-7.48094959	12.285	-9.98681125
		U	13.648	13.308	-2.4912075	12.968	-4.98241501	12.627	-7.48094959	12.285	-9.98681125
	V3 (KN)	L	13.648	13.308	-2.4912075	12.968	-4.98241501	12.627	-7.48094959	12.285	-9.98681125
		M	13.648	13.308	-2.4912075	12.968	-4.98241501	12.627	-7.48094959	12.285	-9.98681125
		U	13.648	13.308	-2.4912075	12.968	-4.98241501	12.627	-7.48094959	12.285	-9.98681125
	T (KN-m)	L	1.0098	1.0102	0.0396118	1.0106	0.07922361	1.0112	0.13864132	1.0116	0.17825312
		M	1.0098	1.0102	0.0396118	1.0106	0.07922361	1.0112	0.13864132	1.0116	0.17825312
		U	1.0098	1.0102	0.0396118	1.0106	0.07922361	1.0112	0.13864132	1.0116	0.17825312
	M2 (KN-m)	L	23.4419	22.3951	-4.46550834	21.3482	-8.93144327	20.3011	-13.3982314	19.2539	-17.8654461
		M	5.3804	5.1016	-5.18177087	4.8225	-10.3691175	4.5436	-15.552747	4.2646	-20.7382351
		U	53.7636	54.1684	0.75292577	54.5727	1.50492155	54.977	2.25691732	55.381	3.0083551
	M3 (KN-m)	L	23.4419	22.3951	-4.46550834	21.3482	-8.93144327	20.3011	-13.3982314	19.2539	-17.8654461
		M	5.3804	5.1016	-5.18177087	4.8225	-10.3691175	4.5436	-15.552747	4.2646	-20.7382351
		U	53.7636	54.1684	0.75292577	54.5727	1.50492155	54.977	2.25691732	55.381	3.0083551

Table 4.14 (continued)

5	P (KN)	L	-154.696	-154.994	0.19263588	-155.292	0.38527176	-155.592	0.5792005	-155.894	0.77442209
		M	-136.696	-136.994	0.21800199	-137.292	0.43600398	-137.592	0.65546907	-137.894	0.87639726
		U	-118.696	-118.994	0.25106154	-119.292	0.50212307	-119.592	0.75486958	-119.894	1.00930107
	V2 (KN)	L	9.115	9.153	0.41689523	9.192	0.84476138	9.229	1.25068568	9.267	1.66758091
		M	9.115	9.153	0.41689523	9.192	0.84476138	9.229	1.25068568	9.267	1.66758091
		U	9.115	9.153	0.41689523	9.192	0.84476138	9.229	1.25068568	9.267	1.66758091
	V3 (KN)	L	9.115	9.153	0.41689523	9.192	0.84476138	9.229	1.25068568	9.267	1.66758091
		M	9.115	9.153	0.41689523	9.192	0.84476138	9.229	1.25068568	9.267	1.66758091
		U	9.115	9.153	0.41689523	9.192	0.84476138	9.229	1.25068568	9.267	1.66758091
	T (KN-m)	L	0.7856	0.786	0.0509165	0.7864	0.10183299	0.7866	0.12729124	0.787	0.17820774
		M	0.7856	0.786	0.0509165	0.7864	0.10183299	0.7866	0.12729124	0.787	0.17820774
		U	0.7856	0.786	0.0509165	0.7864	0.10183299	0.7866	0.12729124	0.787	0.17820774
	M2 (KN-m)	L	12.456	12.5947	1.11351959	12.7329	2.22302505	12.8711	3.33253051	13.0087	4.43721901
		M	7.05101415	7.12719115	1.08036941	7.20329115	2.15964678	7.27929115	3.23750591	7.35519115	4.31394681
		U	48.4866	48.5248	0.07878465	48.5627	0.15695058	48.6005	0.23491026	48.6379	0.31204498
	M3 (KN-m)	L	12.456	12.5947	1.11351959	12.7329	2.22302505	12.8711	3.33253051	13.0087	4.43721901
		M	7.05101415	7.12719115	1.08036941	7.20329115	2.15964678	7.27929115	3.23750591	7.35519115	4.31394681
		U	48.4866	48.5248	0.07878465	48.5627	0.15695058	48.6005	0.23491026	48.6379	0.31204498

6	P (KN)	L	-106.238	-116.842	9.9813626	-117.058	10.1846797	-117.274	10.3879968	-117.49	10.5913138
		M	-88.238	-98.842	12.0174981	-99.058	12.2622906	-99.274	12.5070831	-99.49	12.7518756
		U	-70.238	-80.842	15.0972408	-81.058	15.4047667	-81.274	15.7122925	-81.49	16.0198183
	V2 (KN)	L	5.639	4.553	-19.2587338	4.516	-19.9148785	4.477	-20.6064905	4.44	-21.2626352
		M	5.639	4.553	-19.2587338	4.516	-19.9148785	4.477	-20.6064905	4.44	-21.2626352
		U	5.639	4.553	-19.2587338	4.516	-19.9148785	4.477	-20.6064905	4.44	-21.2626352
	V3 (KN)	L	5.639	4.553	-19.2587338	4.516	-19.9148785	4.477	-20.6064905	4.44	-21.2626352
		M	5.639	4.553	-19.2587338	4.516	-19.9148785	4.477	-20.6064905	4.44	-21.2626352
		U	5.639	4.553	-19.2587338	4.516	-19.9148785	4.477	-20.6064905	4.44	-21.2626352
	T (KN-m)	L	0.5228	0.523	0.03825555	0.5234	0.11476664	0.5236	0.15302219	0.5238	0.19127774
		M	0.5228	0.523	0.03825555	0.5234	0.11476664	0.5236	0.15302219	0.5238	0.19127774
		U	0.5228	0.523	0.03825555	0.5234	0.11476664	0.5236	0.15302219	0.5238	0.19127774
	M2 (KN-m)	L	1.6842	1.5833	-5.99097494	1.4819	-12.0116376	1.3804	-18.0382377	1.2786	-24.0826505
		M	7.7707	7.7591	-0.1492787	7.7473	-0.30113117	7.7356	-0.45169676	7.7238	-0.60354923
		U	39.8459	39.9383	0.23189337	40.0303	0.46278287	40.1221	0.69317044	40.2136	0.92280511
	M3 (KN-m)	L	1.6842	1.5833	-5.99097494	1.4819	-12.0116376	1.3804	-18.0382377	1.2786	-24.0826505
		M	7.7707	7.7591	-0.1492787	7.7473	-0.30113117	7.7356	-0.45169676	7.7238	-0.60354923
		U	39.8459	39.9383	0.23189337	40.0303	0.46278287	40.1221	0.69317044	40.2136	0.92280511

Table 4.14 (continued)

7	P (KN)	L	-60.33	-60.427	0.16078236	-60.524	0.32156473	-60.62	0.48068954	-60.717	0.6414719
		M	-42.33	-42.427	0.2291519	-42.524	0.4583038	-42.62	0.68509331	-42.717	0.91424522
		U	-24.33	-24.427	0.39868475	-24.524	0.7973695	-24.62	1.1919441	-24.717	1.59062885
	V2 (KN)	L	-4.362	-4.407	1.03163686	-4.451	2.04034846	-4.494	3.0261348	-4.539	4.05777166
		M	-4.362	-4.407	1.03163686	-4.451	2.04034846	-4.494	3.0261348	-4.539	4.05777166
		U	-4.362	-4.407	1.03163686	-4.451	2.04034846	-4.494	3.0261348	-4.539	4.05777166
	V3 (KN)	L	-4.362	-4.407	1.03163686	-4.451	2.04034846	-4.494	3.0261348	-4.539	4.05777166
		M	-4.362	-4.407	1.03163686	-4.451	2.04034846	-4.494	3.0261348	-4.539	4.05777166
		U	-4.362	-4.407	1.03163686	-4.451	2.04034846	-4.494	3.0261348	-4.539	4.05777166
	T (KN-m)	L	0.261	0.261	0	0.2612	0.07662835	0.2612	0.07662835	0.2614	0.1532567
		M	0.261	0.261	0	0.2612	0.07662835	0.2612	0.07662835	0.2614	0.1532567
		U	0.261	0.261	0	0.2612	0.07662835	0.2612	0.07662835	0.2614	0.1532567
	M2 (KN-m)	L	-10.8055	-10.8847	0.73296007	-10.964	1.46684559	-11.0431	2.1988802	-11.1223	2.93184027
		M	7.6582	7.6792	0.27421587	7.7001	0.54712596	7.721	0.82003604	7.7418	1.09164033
		U	29.8946	30.0038	0.36528336	30.1127	0.7295632	30.2215	1.09350853	30.33	1.45645033
	M3 (KN-m)	L	-10.8055	-10.8847	0.73296007	-10.964	1.46684559	-11.0431	2.1988802	-11.1223	2.93184027
		M	7.6582	7.6792	0.27421587	7.7001	0.54712596	7.721	0.82003604	7.7418	1.09164033
		U	29.8946	30.0038	0.36528336	30.1127	0.7295632	30.2215	1.09350853	30.33	1.45645033

Table 4.15 Mass irregularity in fourth floor: Percentage change in column forces relative to original live load for square shaped plan building

Column label	Column force	At	Original Live Load	Live load at fourth storey and % change relative to original live load							
				3KN/m2	% change	4KN/m2	% change	5KN/m2	% change	6KN/m2	% change
1	P (KN)	L	-213.277	-217.268	1.87127538	-221.262	3.74395739	-225.263	5.61992151	-229.266	7.49682338
		M	-208.777	-212.768	1.91160904	-216.762	3.82465501	-220.763	5.74105385	-224.766	7.65841065
		U	-204.277	-208.268	1.9537197	-212.262	3.908908	-216.263	5.86752302	-220.266	7.8271171
	V2 (KN)	L	12.956	13.043	0.67150355	13.13	1.3430071	13.217	2.01451065	13.302	2.67057734
		M	12.956	13.043	0.67150355	13.13	1.3430071	13.217	2.01451065	13.302	2.67057734
		U	12.956	13.043	0.67150355	13.13	1.3430071	13.217	2.01451065	13.302	2.67057734
	V3 (KN)	L	12.956	13.043	0.67150355	13.13	1.3430071	13.217	2.01451065	13.302	2.67057734
		M	12.956	13.043	0.67150355	13.13	1.3430071	13.217	2.01451065	13.302	2.67057734
		U	12.956	13.043	0.67150355	13.13	1.3430071	13.217	2.01451065	13.302	2.67057734
	T (KN-m)	L	0.2342	0.234	-0.0853971	0.234	-0.0853971	0.2338	-0.17079419	0.2336	-0.25619129
		M	0.2342	0.234	-0.0853971	0.234	-0.0853971	0.2338	-0.17079419	0.2336	-0.25619129
		U	0.2342	0.234	-0.0853971	0.234	-0.0853971	0.2338	-0.17079419	0.2336	-0.25619129
	M2 (KN-m)	L	63.8266	64.0298	0.31836256	64.2322	0.63547173	64.4339	0.95148418	64.6348	1.26624323
		M	57.5266	57.6868	0.27847987	57.8463	0.55574291	58.0052	0.83196295	58.1633	1.10679234
		U	51.3111	51.4285	0.2288004	51.5454	0.45662634	51.6618	0.68347784	51.7776	0.90916001
	M3 (KN-m)	L	63.8266	64.0298	0.31836256	64.2322	0.63547173	64.4339	0.95148418	64.6348	1.26624323
		M	57.5266	57.6868	0.27847987	57.8463	0.55574291	58.0052	0.83196295	58.1633	1.10679234
		U	51.3111	51.4285	0.2288004	51.5454	0.45662634	51.6618	0.68347784	51.7776	0.90916001

Table 4.15 (continued)

2	P (KN)	L	-196.255	-200.335	2.07892793	-204.42	4.16040356	-208.508	6.24340781	-212.601	8.32895977
		M	-178.255	-182.335	2.28885585	-186.42	4.58051668	-190.508	6.87386048	-194.601	9.17000926
		U	-160.255	-164.335	2.5459424	-168.42	5.09500484	-172.508	7.64593928	-176.601	10.1999938
	V2 (KN)	L	24.099	24.159	0.24897299	24.219	0.49794597	24.28	0.75106851	24.338	0.9917424
		M	24.099	24.159	0.24897299	24.219	0.49794597	24.28	0.75106851	24.338	0.9917424
		U	24.099	24.159	0.24897299	24.219	0.49794597	24.28	0.75106851	24.338	0.9917424
	V3 (KN)	L	24.099	24.159	0.24897299	24.219	0.49794597	24.28	0.75106851	24.338	0.9917424
		M	24.099	24.159	0.24897299	24.219	0.49794597	24.28	0.75106851	24.338	0.9917424
		U	24.099	24.159	0.24897299	24.219	0.49794597	24.28	0.75106851	24.338	0.9917424
	T (KN-m)	L	0.9796	0.9788	-0.08166599	0.9782	-0.14291548	0.9776	-0.20416497	0.977	-0.26541445
		M	0.9796	0.9788	-0.08166599	0.9782	-0.14291548	0.9776	-0.20416497	0.977	-0.26541445
		U	0.9796	0.9788	-0.08166599	0.9782	-0.14291548	0.9776	-0.20416497	0.977	-0.26541445
	M2 (KN-m)	L	68.1583	68.3616	0.29827622	68.564	0.59523198	68.7653	0.89057386	68.9657	1.18459527
		M	20.2117	20.2943	0.40867418	20.3767	0.81635884	20.4589	1.22305397	20.5407	1.62777005
		U	45.8061	45.9816	0.38313674	46.1569	0.76583686	46.3317	1.14744543	46.5063	1.52861737
	M3 (KN-m)	L	68.1583	68.3616	0.29827622	68.564	0.59523198	68.7653	0.89057386	68.9657	1.18459527
		M	20.2117	20.2943	0.40867418	20.3767	0.81635884	20.4589	1.22305397	20.5407	1.62777005
		U	45.8061	45.9816	0.38313674	46.1569	0.76583686	46.3317	1.14744543	46.5063	1.52861737

3	P (KN)	L	-188.597	-192.869	2.26514738	-197.146	4.53294591	-201.425	6.80180491	-205.706	9.07172436
		M	-170.597	-174.869	2.5041472	-179.146	5.01122529	-183.425	7.51947572	-187.706	10.0288985
		U	-152.597	-156.869	2.79953079	-161.146	5.60233818	-165.425	8.40645622	-169.706	11.2118849
	V2 (KN)	L	16.81	16.92	0.6543724	17.03	1.30874479	17.139	1.95716835	17.249	2.61154075
		M	16.81	16.92	0.6543724	17.03	1.30874479	17.139	1.95716835	17.249	2.61154075
		U	16.81	16.92	0.6543724	17.03	1.30874479	17.139	1.95716835	17.249	2.61154075
	V3 (KN)	L	16.81	16.92	0.6543724	17.03	1.30874479	17.139	1.95716835	17.249	2.61154075
		M	16.81	16.92	0.6543724	17.03	1.30874479	17.139	1.95716835	17.249	2.61154075
		U	16.81	16.92	0.6543724	17.03	1.30874479	17.139	1.95716835	17.249	2.61154075
	T (KN-m)	L	1.1506	1.1498	-0.06952894	1.1492	-0.12167565	1.1486	-0.17382235	1.1478	-0.24335129
		M	1.1506	1.1498	-0.06952894	1.1492	-0.12167565	1.1486	-0.17382235	1.1478	-0.24335129
		U	1.1506	1.1498	-0.06952894	1.1492	-0.12167565	1.1486	-0.17382235	1.1478	-0.24335129
	M2 (KN-m)	L	33.3779	33.5381	0.4799583	33.6978	0.95841859	33.8568	1.4347817	34.0151	1.9090476
		M	2.8732959	2.8021959	-2.4745102	2.7313959	-4.93857942	2.6607959	-7.395688	2.5905959	-9.83887528
		U	54.9316	54.9404	0.01601992	54.9485	0.03076553	54.9563	0.04496501	54.9633	0.05770813
	M3 (KN-m)	L	33.3779	33.5381	0.4799583	33.6978	0.95841859	33.8568	1.4347817	34.0151	1.9090476
		M	2.8732959	2.8021959	-2.4745102	2.7313959	-4.93857942	2.6607959	-7.395688	2.5905959	-9.83887528
		U	54.9316	54.9404	0.01601992	54.9485	0.03076553	54.9563	0.04496501	54.9633	0.05770813

Table 4.15 (continued)

4	P (KN)	L	-177.483	-181.806	2.43572624	-186.128	4.87088904	-190.452	7.30717872	-194.778	9.74459526
		M	-159.483	-163.806	2.71063374	-168.128	5.42064044	-172.452	8.13190121	-176.778	10.844416
		U	-141.483	-145.806	3.05549077	-150.128	6.11027473	-154.452	9.1664723	-158.778	12.2240835
	V2 (KN)	L	13.648	13.383	-1.94167644	13.116	-3.89800703	12.849	-5.85433763	12.583	-7.80334115
		M	13.648	13.383	-1.94167644	13.116	-3.89800703	12.849	-5.85433763	12.583	-7.80334115
		U	13.648	13.383	-1.94167644	13.116	-3.89800703	12.849	-5.85433763	12.583	-7.80334115
	V3 (KN)	L	13.648	13.383	-1.94167644	13.116	-3.89800703	12.849	-5.85433763	12.583	-7.80334115
		M	13.648	13.383	-1.94167644	13.116	-3.89800703	12.849	-5.85433763	12.583	-7.80334115
		U	13.648	13.383	-1.94167644	13.116	-3.89800703	12.849	-5.85433763	12.583	-7.80334115
	T (KN-m)	L	1.0098	1.0092	-0.05941771	1.0088	-0.09902951	1.0084	-0.13864132	1.0078	-0.19805902
		M	1.0098	1.0092	-0.05941771	1.0088	-0.09902951	1.0084	-0.13864132	1.0078	-0.19805902
		U	1.0098	1.0092	-0.05941771	1.0088	-0.09902951	1.0084	-0.13864132	1.0078	-0.19805902
	M2 (KN-m)	L	23.4419	23.1874	-1.08566285	22.9326	-2.17260546	22.6774	-3.26125442	22.4219	-4.35118314
		M	5.3804	5.7694	7.22994573	6.1584	14.4598915	6.5473	21.6879786	6.9363	28.9179243
		U	53.7636	55.0403	2.37465497	56.3165	4.74837994	57.5919	7.12061692	58.8666	9.49155191
	M3 (KN-m)	L	23.4419	23.1874	-1.08566285	22.9326	-2.17260546	22.6774	-3.26125442	22.4219	-4.35118314
		M	5.3804	5.7694	7.22994573	6.1584	14.4598915	6.5473	21.6879786	6.9363	28.9179243
		U	53.7636	55.0403	2.37465497	56.3165	4.74837994	57.5919	7.12061692	58.8666	9.49155191

5	P (KN)	L	-154.696	-155.34	0.41630036	-155.987	0.83454	-156.635	1.25342607	-157.284	1.67295858
		M	-136.696	-137.34	0.47111839	-137.987	0.94443144	-138.635	1.41847603	-139.284	1.89325218
		U	-118.696	-119.34	0.54256251	-119.987	1.08765249	-120.635	1.63358496	-121.284	2.18035991
	V2 (KN)	L	9.115	8.732	-4.20186506	8.347	-8.42567197	7.963	-12.638508	7.578	-16.8623149
		M	9.115	8.732	-4.20186506	8.347	-8.42567197	7.963	-12.638508	7.578	-16.8623149
		U	9.115	8.732	-4.20186506	8.347	-8.42567197	7.963	-12.638508	7.578	-16.8623149
	V3 (KN)	L	9.115	8.732	-4.20186506	8.347	-8.42567197	7.963	-12.638508	7.578	-16.8623149
		M	9.115	8.732	-4.20186506	8.347	-8.42567197	7.963	-12.638508	7.578	-16.8623149
		U	9.115	8.732	-4.20186506	8.347	-8.42567197	7.963	-12.638508	7.578	-16.8623149
	T (KN-m)	L	0.7856	0.785	-0.07637475	0.7846	-0.12729124	0.784	-0.20366599	0.7834	-0.28004073
		M	0.7856	0.785	-0.07637475	0.7846	-0.12729124	0.784	-0.20366599	0.7834	-0.28004073
		U	0.7856	0.785	-0.07637475	0.7846	-0.12729124	0.784	-0.20366599	0.7834	-0.28004073
	M2 (KN-m)	L	12.456	11.3123	-9.18192036	10.1683	-18.3662492	9.0239	-27.5537893	7.8794	-36.7421323
		M	7.05101415	6.77699115	-3.88629202	6.50269115	-7.77651255	6.22839115	-11.6667331	5.95369115	-15.5626266
		U	48.4866	48.8786	0.80847079	49.2702	1.61611662	49.6611	2.42231874	50.0517	3.22790214
	M3 (KN-m)	L	12.456	11.3123	-9.18192036	10.1683	-18.3662492	9.0239	-27.5537893	7.8794	-36.7421323
		M	7.05101415	6.77699115	-3.88629202	6.50269115	-7.77651255	6.22839115	-11.6667331	5.95369115	-15.5626266
		U	48.4866	48.8786	0.80847079	49.2702	1.61611662	49.6611	2.42231874	50.0517	3.22790214

Table 4.15 (continued)

6	P (KN)	L	-106.238	-117	10.1300853	-117.373	10.4811838	-117.748	10.8341648	-118.123	11.1871458
		M	-88.238	-99	12.1965593	-99.373	12.6192797	-99.748	13.0442666	-100.123	13.4692536
		U	-70.238	-81	15.3221903	-81.373	15.8532418	-81.748	16.3871409	-82.123	16.9210399
	V2 (KN)	L	5.639	4.597	-18.4784536	4.601	-18.4075191	4.606	-18.3188509	4.612	-18.212449
		M	5.639	4.597	-18.4784536	4.601	-18.4075191	4.606	-18.3188509	4.612	-18.212449
		U	5.639	4.597	-18.4784536	4.601	-18.4075191	4.606	-18.3188509	4.612	-18.212449
	V3 (KN)	L	5.639	4.597	-18.4784536	4.601	-18.4075191	4.606	-18.3188509	4.612	-18.212449
		M	5.639	4.597	-18.4784536	4.601	-18.4075191	4.606	-18.3188509	4.612	-18.212449
		U	5.639	4.597	-18.4784536	4.601	-18.4075191	4.606	-18.3188509	4.612	-18.212449
	T (KN-m)	L	0.5228	0.5224	-0.07651109	0.5218	-0.19127774	0.5214	-0.26778883	0.521	-0.34429992
		M	0.5228	0.5224	-0.07651109	0.5218	-0.19127774	0.5214	-0.26778883	0.521	-0.34429992
		U	0.5228	0.5224	-0.07651109	0.5218	-0.19127774	0.5214	-0.26778883	0.521	-0.34429992
	M2 (KN-m)	L	1.6842	1.7597	4.48284052	1.8349	8.94786842	1.9099	13.4010213	1.9847	17.842299
		M	7.7707	7.8378	0.86350007	7.9045	1.7218526	7.9711	2.57891824	8.0377	3.43598389
		U	39.8459	39.8539	0.02007735	39.8615	0.03915083	39.8686	0.05696947	39.8755	0.07428619
	M3 (KN-m)	L	1.6842	1.7597	4.48284052	1.8349	8.94786842	1.9099	13.4010213	1.9847	17.842299
		M	7.7707	7.8378	0.86350007	7.9045	1.7218526	7.9711	2.57891824	8.0377	3.43598389
		U	39.8459	39.8539	0.02007735	39.8615	0.03915083	39.8686	0.05696947	39.8755	0.07428619
7	P (KN)	L	-60.33	-60.496	0.27515332	-60.662	0.55030665	-60.83	0.82877507	-60.996	1.10392839
		M	-42.33	-42.496	0.39215686	-42.662	0.78431373	-42.83	1.18119537	-42.996	1.57335223
		U	-24.33	-24.496	0.68228524	-24.662	1.36457049	-24.83	2.05507604	-24.996	2.73736128
	V2 (KN)	L	-4.362	-4.445	1.90279688	-4.53	3.85144429	-4.613	5.75424117	-4.696	7.65703806
		M	-4.362	-4.445	1.90279688	-4.53	3.85144429	-4.613	5.75424117	-4.696	7.65703806
		U	-4.362	-4.445	1.90279688	-4.53	3.85144429	-4.613	5.75424117	-4.696	7.65703806
	V3 (KN)	L	-4.362	-4.445	1.90279688	-4.53	3.85144429	-4.613	5.75424117	-4.696	7.65703806
		M	-4.362	-4.445	1.90279688	-4.53	3.85144429	-4.613	5.75424117	-4.696	7.65703806
		U	-4.362	-4.445	1.90279688	-4.53	3.85144429	-4.613	5.75424117	-4.696	7.65703806
	T (KN-m)	L	0.261	0.2606	-0.1532567	0.2604	-0.22988506	0.2602	-0.30651341	0.26	-0.38314176
		M	0.261	0.2606	-0.1532567	0.2604	-0.22988506	0.2602	-0.30651341	0.26	-0.38314176
		U	0.261	0.2606	-0.1532567	0.2604	-0.22988506	0.2602	-0.30651341	0.26	-0.38314176
	M2 (KN-m)	L	-10.8055	-10.9605	1.43445468	-11.1155	2.86890935	-11.2707	4.30521494	-11.426	5.74244598
		M	7.6582	7.6568	-0.01828106	7.6553	-0.03786791	7.6538	-0.05745475	7.6522	-0.07834739
		U	29.8946	30.0387	0.48202685	30.1825	0.96305018	30.3262	1.443739	30.4695	1.92308979
	M3 (KN-m)	L	-10.8055	-10.9605	1.43445468	-11.1155	2.86890935	-11.2707	4.30521494	-11.426	5.74244598
		M	7.6582	7.6568	-0.01828106	7.6553	-0.03786791	7.6538	-0.05745475	7.6522	-0.07834739
		U	29.8946	30.0387	0.48202685	30.1825	0.96305018	30.3262	1.443739	30.4695	1.92308979

Table 4.16 Mass irregularity in fifth floor: Percentage change in column forces relative to original live load for square shaped plan building

Column label	Column force	At	Original Live Load	Live load at fifth storey and % change relative to original live load							
				3KN/m2	% change	4KN/m2	% change	5KN/m2	% change	6KN/m2	% change
1	P (KN)	L	-213.277	-217.41	1.93785546	-221.549	3.87852417	-225.693	5.82153725	-229.844	7.76783244
		M	-208.777	-212.91	1.97962419	-217.049	3.96212226	-221.193	5.94701524	-225.344	7.93526107
		U	-204.277	-208.41	2.02323316	-212.549	4.04940351	-216.693	6.07802151	-220.844	8.11006623
	V2 (KN)	L	12.956	12.996	0.30873726	13.036	0.61747453	13.076	0.92621179	13.115	1.22723063
		M	12.956	12.996	0.30873726	13.036	0.61747453	13.076	0.92621179	13.115	1.22723063
		U	12.956	12.996	0.30873726	13.036	0.61747453	13.076	0.92621179	13.115	1.22723063
	V3 (KN)	L	12.956	12.996	0.30873726	13.036	0.61747453	13.076	0.92621179	13.115	1.22723063
		M	12.956	12.996	0.30873726	13.036	0.61747453	13.076	0.92621179	13.115	1.22723063
		U	12.956	12.996	0.30873726	13.036	0.61747453	13.076	0.92621179	13.115	1.22723063
	T (KN-m)	L	0.2342	0.2338	-0.17079419	0.2334	-0.34158839	0.233	-0.51238258	0.2326	-0.68317677
		M	0.2342	0.2338	-0.17079419	0.2334	-0.34158839	0.233	-0.51238258	0.2326	-0.68317677
		U	0.2342	0.2338	-0.17079419	0.2334	-0.34158839	0.233	-0.51238258	0.2326	-0.68317677
	M2 (KN-m)	L	63.8266	63.9565	0.20352016	64.0853	0.40531691	64.2128	0.60507688	64.3389	0.80264341
		M	57.5266	57.6368	0.19156355	57.7458	0.38104112	57.8538	0.56878036	57.9606	0.7544336
		U	51.3111	51.4015	0.1761802	51.4909	0.35041151	51.5797	0.52347348	51.6675	0.69458655
	M3 (KN-m)	L	63.8266	63.9565	0.20352016	64.0853	0.40531691	64.2128	0.60507688	64.3389	0.80264341
		M	57.5266	57.6368	0.19156355	57.7458	0.38104112	57.8538	0.56878036	57.9606	0.7544336
		U	51.3111	51.4015	0.1761802	51.4909	0.35041151	51.5797	0.52347348	51.6675	0.69458655
2	P (KN)	L	-196.255	-200.445	2.13497745	-204.643	4.27403123	-208.845	6.41512318	-213.053	8.55927238
		M	-178.255	-182.445	2.3505652	-186.643	4.70561836	-190.845	7.06291549	-195.053	9.42357858
		U	-160.255	-164.445	2.61458301	-168.643	5.23415806	-172.845	7.85622913	-177.053	10.4820442
	V2 (KN)	L	24.099	24.145	0.19087929	24.191	0.38175858	24.237	0.57263787	24.282	0.75936761
		M	24.099	24.145	0.19087929	24.191	0.38175858	24.237	0.57263787	24.282	0.75936761
		U	24.099	24.145	0.19087929	24.191	0.38175858	24.237	0.57263787	24.282	0.75936761
	V3 (KN)	L	24.099	24.145	0.19087929	24.191	0.38175858	24.237	0.57263787	24.282	0.75936761
		M	24.099	24.145	0.19087929	24.191	0.38175858	24.237	0.57263787	24.282	0.75936761
		U	24.099	24.145	0.19087929	24.191	0.38175858	24.237	0.57263787	24.282	0.75936761
	T (KN-m)	L	0.9796	0.9778	-0.18374847	0.976	-0.36749694	0.9742	-0.55124541	0.9724	-0.73499388
		M	0.9796	0.9778	-0.18374847	0.976	-0.36749694	0.9742	-0.55124541	0.9724	-0.73499388
		U	0.9796	0.9778	-0.18374847	0.976	-0.36749694	0.9742	-0.55124541	0.9724	-0.73499388
	M2 (KN-m)	L	68.1583	68.3006	0.20877868	68.4411	0.41491645	68.5803	0.6191469	68.718	0.82117658
		M	20.2117	20.2608	0.2429286	20.3095	0.48387815	20.3577	0.72235388	20.4055	0.95885057
		U	45.8061	45.8868	0.17617741	45.9671	0.35148157	46.0466	0.52503924	46.1257	0.69772367
	M3 (KN-m)	L	68.1583	68.3006	0.20877868	68.4411	0.41491645	68.5803	0.6191469	68.718	0.82117658
		M	20.2117	20.2608	0.2429286	20.3095	0.48387815	20.3577	0.72235388	20.4055	0.95885057
		U	45.8061	45.8868	0.17617741	45.9671	0.35148157	46.0466	0.52503924	46.1257	0.69772367

Table 4.16 (continued)

3	P (KN)	L	-188.597	-192.899	2.28105431	-197.204	4.56369932	-201.514	6.84899548	-205.828	9.13641256
		M	-170.597	-174.899	2.5217325	-179.204	5.04522354	-183.514	7.57164546	-187.828	10.1004121
		U	-152.597	-156.899	2.81919042	-161.204	5.6403468	-165.514	8.46477978	-169.828	11.291834
	V2 (KN)	L	16.81	16.821	0.06543724	16.83	0.1189768	16.839	0.17251636	16.848	0.22605592
		M	16.81	16.821	0.06543724	16.83	0.1189768	16.839	0.17251636	16.848	0.22605592
		U	16.81	16.821	0.06543724	16.83	0.1189768	16.839	0.17251636	16.848	0.22605592
	V3 (KN)	L	16.81	16.821	0.06543724	16.83	0.1189768	16.839	0.17251636	16.848	0.22605592
		M	16.81	16.821	0.06543724	16.83	0.1189768	16.839	0.17251636	16.848	0.22605592
		U	16.81	16.821	0.06543724	16.83	0.1189768	16.839	0.17251636	16.848	0.22605592
	T (KN-m)	L	1.1506	1.1484	-0.19120459	1.1464	-0.36502694	1.1442	-0.55623153	1.142	-0.74743612
		M	1.1506	1.1484	-0.19120459	1.1464	-0.36502694	1.1442	-0.55623153	1.142	-0.74743612
		U	1.1506	1.1484	-0.19120459	1.1464	-0.36502694	1.1442	-0.55623153	1.142	-0.74743612
	M2 (KN-m)	L	33.3779	33.4313	0.1599861	33.4837	0.3169762	33.5351	0.47097031	33.5854	0.62166883
		M	2.8732959	2.8881959	0.51856824	2.9031959	1.04061681	2.9184959	1.57310634	2.9337959	2.10559588
		U	54.9316	55.1162	0.33605429	55.3002	0.67101632	55.4831	1.00397585	55.6652	1.33547903
	M3 (KN-m)	L	33.3779	33.4313	0.1599861	33.4837	0.3169762	33.5351	0.47097031	33.5854	0.62166883
		M	2.8732959	2.8881959	0.51856824	2.9031959	1.04061681	2.9184959	1.57310634	2.9337959	2.10559588
		U	54.9316	55.1162	0.33605429	55.3002	0.67101632	55.4831	1.00397585	55.6652	1.33547903
4	P (KN)	L	-177.483	-181.88	2.47742037	-186.279	4.95596761	-190.678	7.43451485	-195.081	9.91531583
		M	-159.483	-163.88	2.75703367	-168.279	5.51532138	-172.678	8.2736091	-177.081	11.0344049
		U	-141.483	-145.88	3.10779387	-150.279	6.21700134	-154.678	9.3262088	-159.081	12.4382435
	V2 (KN)	L	13.648	13.728	0.58616647	13.809	1.17966002	13.888	1.75849941	13.967	2.3373388
		M	13.648	13.728	0.58616647	13.809	1.17966002	13.888	1.75849941	13.967	2.3373388
		U	13.648	13.728	0.58616647	13.809	1.17966002	13.888	1.75849941	13.967	2.3373388
	V3 (KN)	L	13.648	13.728	0.58616647	13.809	1.17966002	13.888	1.75849941	13.967	2.3373388
		M	13.648	13.728	0.58616647	13.809	1.17966002	13.888	1.75849941	13.967	2.3373388
		U	13.648	13.728	0.58616647	13.809	1.17966002	13.888	1.75849941	13.967	2.3373388
	T (KN-m)	L	1.0098	1.0078	-0.19805902	1.006	-0.37631214	1.0042	-0.55456526	1.0024	-0.73281838
		M	1.0098	1.0078	-0.19805902	1.006	-0.37631214	1.0042	-0.55456526	1.0024	-0.73281838
		U	1.0098	1.0078	-0.19805902	1.006	-0.37631214	1.0042	-0.55456526	1.0024	-0.73281838
	M2 (KN-m)	L	23.4419	23.5432	0.43213221	23.6436	0.86042514	23.743	1.2844522	23.8417	1.70549316
		M	5.3804	5.31	-1.3084529	5.2396	-2.61690581	5.1693	-3.92350011	5.0989	-5.23195301
		U	53.7636	53.7686	0.00929997	53.7724	0.01636795	53.7754	0.02194794	53.7774	0.02566792
	M3 (KN-m)	L	23.4419	23.5432	0.43213221	23.6436	0.86042514	23.743	1.2844522	23.8417	1.70549316
		M	5.3804	5.31	-1.3084529	5.2396	-2.61690581	5.1693	-3.92350011	5.0989	-5.23195301
		U	53.7636	53.7686	0.00929997	53.7724	0.01636795	53.7754	0.02194794	53.7774	0.02566792

Table 4.16 (continued)

5	P (KN)	L	-154.696	-159.043	2.81002741	-163.393	5.6219941	-167.745	8.43525366	-172.094	11.2465739
		M	-136.696	-141.043	3.18004916	-145.393	6.36229297	-149.745	9.54599988	-154.094	12.7275121
		U	-118.696	-123.043	3.66229696	-127.393	7.32712139	-131.745	10.9936308	-136.094	14.6576127
	V2 (KN)	L	9.115	8.828	-3.14865606	8.54	-6.30828305	8.251	-9.47888097	7.962	-12.6494789
		M	9.115	8.828	-3.14865606	8.54	-6.30828305	8.251	-9.47888097	7.962	-12.6494789
		U	9.115	8.828	-3.14865606	8.54	-6.30828305	8.251	-9.47888097	7.962	-12.6494789
	V3 (KN)	L	9.115	8.828	-3.14865606	8.54	-6.30828305	8.251	-9.47888097	7.962	-12.6494789
		M	9.115	8.828	-3.14865606	8.54	-6.30828305	8.251	-9.47888097	7.962	-12.6494789
		U	9.115	8.828	-3.14865606	8.54	-6.30828305	8.251	-9.47888097	7.962	-12.6494789
	T (KN-m)	L	0.7856	0.7842	-0.17820774	0.7828	-0.35641548	0.7814	-0.53462322	0.78	-0.71283096
		M	0.7856	0.7842	-0.17820774	0.7828	-0.35641548	0.7814	-0.53462322	0.78	-0.71283096
		U	0.7856	0.7842	-0.17820774	0.7828	-0.35641548	0.7814	-0.53462322	0.78	-0.71283096
	M2 (KN-m)	L	12.456	12.1585	-2.38840719	11.8604	-4.78163134	11.5617	-7.17967245	11.2624	-9.58253051
		M	7.05101415	7.44789115	5.62865131	7.84449115	11.2533741	8.24059115	16.8710057	8.63639115	22.4843826
		U	48.4866	49.7873	2.68259684	51.0866	5.36230629	52.3843	8.03871585	53.6806	10.712238
	M3 (KN-m)	L	12.456	12.1585	-2.38840719	11.8604	-4.78163134	11.5617	-7.17967245	11.2624	-9.58253051
		M	7.05101415	7.44789115	5.62865131	7.84449115	11.2533741	8.24059115	16.8710057	8.63639115	22.4843826
		U	48.4866	49.7873	2.68259684	51.0866	5.36230629	52.3843	8.03871585	53.6806	10.712238

6	P (KN)	L	-106.238	-117.207	10.3249308	-117.786	10.8699335	-118.365	11.4149363	-118.946	11.9618216
		M	-88.238	-99.207	12.4311521	-99.786	13.087332	-100.365	13.7435119	-100.946	14.4019583
		U	-70.238	-81.207	15.6169025	-81.786	16.4412426	-82.365	17.2655827	-82.946	18.0927703
	V2 (KN)	L	5.639	4.179	-25.8911154	3.768	-33.1796418	3.358	-40.4504345	2.947	-47.7389608
		M	5.639	4.179	-25.8911154	3.768	-33.1796418	3.358	-40.4504345	2.947	-47.7389608
		U	5.639	4.179	-25.8911154	3.768	-33.1796418	3.358	-40.4504345	2.947	-47.7389608
	V3 (KN)	L	5.639	4.179	-25.8911154	3.768	-33.1796418	3.358	-40.4504345	2.947	-47.7389608
		M	5.639	4.179	-25.8911154	3.768	-33.1796418	3.358	-40.4504345	2.947	-47.7389608
		U	5.639	4.179	-25.8911154	3.768	-33.1796418	3.358	-40.4504345	2.947	-47.7389608
	T (KN-m)	L	0.5228	0.5216	-0.22953328	0.5204	-0.45906656	0.5192	-0.68859985	0.518	-0.91813313
		M	0.5228	0.5216	-0.22953328	0.5204	-0.45906656	0.5192	-0.68859985	0.518	-0.91813313
		U	0.5228	0.5216	-0.22953328	0.5204	-0.45906656	0.5192	-0.68859985	0.518	-0.91813313
	M2 (KN-m)	L	1.6842	0.4929	-70.7338796	-0.6974	-141.408384	-1.8861	-211.987887	-3.0735	-282.490203
		M	7.7707	7.485	-3.67663145	7.1987	-7.36098421	6.9121	-11.0491976	6.6252	-14.7412717
		U	39.8459	40.2012	0.89168522	40.5566	1.7836214	40.912	2.67555759	41.2673	3.5672428
	M3 (KN-m)	L	1.6842	0.4929	-70.7338796	-0.6974	-141.408384	-1.8861	-211.987887	-3.0735	-282.490203
		M	7.7707	7.485	-3.67663145	7.1987	-7.36098421	6.9121	-11.0491976	6.6252	-14.7412717
		U	39.8459	40.2012	0.89168522	40.5566	1.7836214	40.912	2.67555759	41.2673	3.5672428

Table 4.16 (continued)

7	P (KN)	L	-60.33	-60.537	0.34311288	-60.744	0.68622576	-60.95	1.02768109	-61.157	1.37079397
		M	-42.33	-42.537	0.48901488	-42.744	0.97802977	-42.95	1.46468226	-43.157	1.95369714
		U	-24.33	-24.537	0.85080148	-24.744	1.70160296	-24.95	2.54829429	-25.157	3.39909577
	V2 (KN)	L	-4.362	-4.408	1.05456213	-4.455	2.13204952	-4.502	3.20953691	-4.548	4.26409904
		M	-4.362	-4.408	1.05456213	-4.455	2.13204952	-4.502	3.20953691	-4.548	4.26409904
		U	-4.362	-4.408	1.05456213	-4.455	2.13204952	-4.502	3.20953691	-4.548	4.26409904
	V3 (KN)	L	-4.362	-4.408	1.05456213	-4.455	2.13204952	-4.502	3.20953691	-4.548	4.26409904
		M	-4.362	-4.408	1.05456213	-4.455	2.13204952	-4.502	3.20953691	-4.548	4.26409904
		U	-4.362	-4.408	1.05456213	-4.455	2.13204952	-4.502	3.20953691	-4.548	4.26409904
	T (KN-m)	L	0.261	0.2602	-0.30651341	0.2596	-0.53639847	0.259	-0.76628352	0.2584	-0.99616858
		M	0.261	0.2602	-0.30651341	0.2596	-0.53639847	0.259	-0.76628352	0.2584	-0.99616858
		U	0.261	0.2602	-0.30651341	0.2596	-0.53639847	0.259	-0.76628352	0.2584	-0.99616858
	M2 (KN-m)	L	-10.8055	-10.7708	-0.32113276	-10.7359	-0.64411642	-10.7011	-0.96617463	-10.666	-1.29100921
		M	7.6582	7.7533	1.24180617	7.8486	2.48622392	7.9438	3.72933588	8.039	4.97244783
		U	29.8946	30.0342	0.46697397	30.174	0.93461695	30.3138	1.40225994	30.4536	1.86990293
	M3 (KN-m)	L	-10.8055	-10.7708	-0.32113276	-10.7359	-0.64411642	-10.7011	-0.96617463	-10.666	-1.29100921
		M	7.6582	7.7533	1.24180617	7.8486	2.48622392	7.9438	3.72933588	8.039	4.97244783
		U	29.8946	30.0342	0.46697397	30.174	0.93461695	30.3138	1.40225994	30.4536	1.86990293

Table 4.17 Mass irregularity in sixth floor: Percentage change in column forces relative to original live load for square shaped plan building

Column label	Column force	At	Original Live Load	Live load at sixth storey and % change relative to original live load							
				3KN/m2	% change	4KN/m2	% change	5KN/m2	% change	6KN/m2	% change
1	P (KN)	L	-213.277	-217.457	1.95989253	-221.647	3.92447381	-225.847	5.89374382	-230.057	7.86770257
		M	-208.777	-212.957	2.00213625	-217.147	4.0090623	-221.347	6.02077815	-225.557	8.0372838
		U	-204.277	-208.457	2.04624113	-212.647	4.09737758	-216.847	6.15340934	-221.057	8.21433642
	V2 (KN)	L	12.956	12.968	0.09262118	12.982	0.20067922	12.993	0.28558197	13.006	0.38592158
		M	12.956	12.968	0.09262118	12.982	0.20067922	12.993	0.28558197	13.006	0.38592158
		U	12.956	12.968	0.09262118	12.982	0.20067922	12.993	0.28558197	13.006	0.38592158
	V3 (KN)	L	12.956	12.968	0.09262118	12.982	0.20067922	12.993	0.28558197	13.006	0.38592158
		M	12.956	12.968	0.09262118	12.982	0.20067922	12.993	0.28558197	13.006	0.38592158
		U	12.956	12.968	0.09262118	12.982	0.20067922	12.993	0.28558197	13.006	0.38592158
	T (KN-m)	L	0.2342	0.2336	-0.25619129	0.2328	-0.59777968	0.2322	-0.85397096	0.2316	-1.11016225
		M	0.2342	0.2336	-0.25619129	0.2328	-0.59777968	0.2322	-0.85397096	0.2316	-1.11016225
		U	0.2342	0.2336	-0.25619129	0.2328	-0.59777968	0.2322	-0.85397096	0.2316	-1.11016225
	M2 (KN-m)	L	63.8266	63.875	0.07583045	63.9226	0.15040751	63.9694	0.22373117	64.0153	0.29564476
		M	57.5266	57.5688	0.07335737	57.6103	0.14549791	57.651	0.21624779	57.691	0.28578084
		U	51.3111	51.3471	0.07016026	51.3825	0.13915118	51.4174	0.20716765	51.4517	0.27401478
	M3 (KN-m)	L	63.8266	63.875	0.07583045	63.9226	0.15040751	63.9694	0.22373117	64.0153	0.29564476
		M	57.5266	57.5688	0.07335737	57.6103	0.14549791	57.651	0.21624779	57.691	0.28578084
		U	51.3111	51.3471	0.07016026	51.3825	0.13915118	51.4174	0.20716765	51.4517	0.27401478

Table 4.17 (continued)

2	P (KN)	L	-196.255	-200.45	2.13752516	-204.653	4.27912665	-208.867	6.42633309	-213.09	8.5781254
		M	-178.255	-182.45	2.35337017	-186.653	4.7112283	-190.867	7.07525736	-195.09	9.44433536
		U	-160.255	-164.45	2.61770304	-168.653	5.24039812	-172.867	7.86995726	-177.09	10.5051324
	V2 (KN)	L	24.099	24.106	0.02904685	24.114	0.06224325	24.12	0.08714055	24.127	0.11618739
		M	24.099	24.106	0.02904685	24.114	0.06224325	24.12	0.08714055	24.127	0.11618739
		U	24.099	24.106	0.02904685	24.114	0.06224325	24.12	0.08714055	24.127	0.11618739
	V3 (KN)	L	24.099	24.106	0.02904685	24.114	0.06224325	24.12	0.08714055	24.127	0.11618739
		M	24.099	24.106	0.02904685	24.114	0.06224325	24.12	0.08714055	24.127	0.11618739
		U	24.099	24.106	0.02904685	24.114	0.06224325	24.12	0.08714055	24.127	0.11618739
	T (KN-m)	L	0.9796	0.9766	-0.30624745	0.9738	-0.5920784	0.971	-0.87790935	0.9682	-1.1637403
		M	0.9796	0.9766	-0.30624745	0.9738	-0.5920784	0.971	-0.87790935	0.9682	-1.1637403
		U	0.9796	0.9766	-0.30624745	0.9738	-0.5920784	0.971	-0.87790935	0.9682	-1.1637403
	M2 (KN-m)	L	68.1583	68.2024	0.06470232	68.2456	0.12808418	68.2876	0.18970544	68.3286	0.24985952
		M	20.2117	20.2407	0.14348125	20.2694	0.28547821	20.2977	0.42549612	20.3257	0.56402975
		U	45.8061	45.8486	0.0927824	45.8907	0.18469156	45.9325	0.27594578	45.9739	0.36632676
	M3 (KN-m)	L	68.1583	68.2024	0.06470232	68.2456	0.12808418	68.2876	0.18970544	68.3286	0.24985952
		M	20.2117	20.2407	0.14348125	20.2694	0.28547821	20.2977	0.42549612	20.3257	0.56402975
		U	45.8061	45.8486	0.0927824	45.8907	0.18469156	45.9325	0.27594578	45.9739	0.36632676
3	P (KN)	L	-188.597	-192.807	2.23227305	-197.026	4.46931818	-201.254	6.71113538	-205.49	8.95719444
		M	-170.597	-174.807	2.46780424	-179.026	4.94088407	-183.254	7.41923949	-187.49	9.90228433
		U	-152.597	-156.807	2.7589009	-161.026	5.52369968	-165.254	8.29439635	-169.49	11.0703356
	V2 (KN)	L	16.81	16.807	-0.01784652	16.805	-0.0297442	16.802	-0.04759072	16.799	-0.06543724
		M	16.81	16.807	-0.01784652	16.805	-0.0297442	16.802	-0.04759072	16.799	-0.06543724
		U	16.81	16.807	-0.01784652	16.805	-0.0297442	16.802	-0.04759072	16.799	-0.06543724
	V3 (KN)	L	16.81	16.807	-0.01784652	16.805	-0.0297442	16.802	-0.04759072	16.799	-0.06543724
		M	16.81	16.807	-0.01784652	16.805	-0.0297442	16.802	-0.04759072	16.799	-0.06543724
		U	16.81	16.807	-0.01784652	16.805	-0.0297442	16.802	-0.04759072	16.799	-0.06543724
	T (KN-m)	L	1.1506	1.147	-0.31288024	1.1436	-0.60837824	1.1402	-0.90387624	1.1368	-1.19937424
		M	1.1506	1.147	-0.31288024	1.1436	-0.60837824	1.1402	-0.90387624	1.1368	-1.19937424
		U	1.1506	1.147	-0.31288024	1.1436	-0.60837824	1.1402	-0.90387624	1.1368	-1.19937424
	M2 (KN-m)	L	33.3779	33.394	0.04823551	33.4094	0.09437382	33.4237	0.13721654	33.4373	0.17796206
		M	2.8732959	2.8791959	0.2053391	2.8851959	0.41415853	2.8912959	0.62645828	2.8973959	0.83875803
		U	54.9316	55.0039	0.13161823	55.0757	0.26232624	55.1469	0.39194198	55.2178	0.52101159
	M3 (KN-m)	L	33.3779	33.394	0.04823551	33.4094	0.09437382	33.4237	0.13721654	33.4373	0.17796206
		M	2.8732959	2.8791959	0.2053391	2.8851959	0.41415853	2.8912959	0.62645828	2.8973959	0.83875803
		U	54.9316	55.0039	0.13161823	55.0757	0.26232624	55.1469	0.39194198	55.2178	0.52101159

Table 4.17 (continued)

4	P (KN)	L	-177.483	-181.695	2.37318504	-185.911	4.74862381	-190.135	7.12857006	-194.365	9.51189691
		M	-159.483	-163.695	2.64103384	-167.911	5.28457579	-172.135	7.93313394	-176.365	10.5854542
		U	-141.483	-145.695	2.97703611	-149.911	5.95689942	-154.135	8.94241711	-158.365	11.9321756
	V2 (KN)	L	13.648	13.629	-0.13921454	13.61	-0.27842907	13.59	-0.42497069	13.571	-0.56418523
		M	13.648	13.629	-0.13921454	13.61	-0.27842907	13.59	-0.42497069	13.571	-0.56418523
		U	13.648	13.629	-0.13921454	13.61	-0.27842907	13.59	-0.42497069	13.571	-0.56418523
	V3 (KN)	L	13.648	13.629	-0.13921454	13.61	-0.27842907	13.59	-0.42497069	13.571	-0.56418523
		M	13.648	13.629	-0.13921454	13.61	-0.27842907	13.59	-0.42497069	13.571	-0.56418523
		U	13.648	13.629	-0.13921454	13.61	-0.27842907	13.59	-0.42497069	13.571	-0.56418523
	T (KN-m)	L	1.0098	1.0066	-0.31689443	1.0034	-0.63378887	1.0002	-0.9506833	0.997	-1.26757774
		M	1.0098	1.0066	-0.31689443	1.0034	-0.63378887	1.0002	-0.9506833	0.997	-1.26757774
		U	1.0098	1.0066	-0.31689443	1.0034	-0.63378887	1.0002	-0.9506833	0.997	-1.26757774
	M2 (KN-m)	L	23.4419	23.4504	0.03625986	23.4579	0.06825385	23.464	0.09427563	23.4688	0.11475179
		M	5.3804	5.3845	0.07620251	5.3889	0.15798082	5.3937	0.24719352	5.3985	0.33640622
		U	53.7636	53.9357	0.32010505	54.107	0.63872211	54.2775	0.95585117	54.4474	1.27186424
	M3 (KN-m)	L	23.4419	23.4504	0.03625986	23.4579	0.06825385	23.464	0.09427563	23.4688	0.11475179
		M	5.3804	5.3845	0.07620251	5.3889	0.15798082	5.3937	0.24719352	5.3985	0.33640622
		U	53.7636	53.9357	0.32010505	54.107	0.63872211	54.2775	0.95585117	54.4474	1.27186424

5	P (KN)	L	-154.696	-158.922	2.73180948	-163.152	5.46620469	-167.387	8.20383203	-171.625	10.9433987
		M	-136.696	-140.922	3.09153157	-145.152	6.18598935	-149.387	9.28410488	-153.625	12.3844151
		U	-118.696	-122.922	3.56035587	-127.152	7.12408169	-131.387	10.69202	-135.625	14.2624857
	V2 (KN)	L	9.115	9.18	0.71311026	9.244	1.41524959	9.309	2.12835985	9.372	2.81952825
		M	9.115	9.18	0.71311026	9.244	1.41524959	9.309	2.12835985	9.372	2.81952825
		U	9.115	9.18	0.71311026	9.244	1.41524959	9.309	2.12835985	9.372	2.81952825
	V3 (KN)	L	9.115	9.18	0.71311026	9.244	1.41524959	9.309	2.12835985	9.372	2.81952825
		M	9.115	9.18	0.71311026	9.244	1.41524959	9.309	2.12835985	9.372	2.81952825
		U	9.115	9.18	0.71311026	9.244	1.41524959	9.309	2.12835985	9.372	2.81952825
	T (KN-m)	L	0.7856	0.7832	-0.30549898	0.7808	-0.61099796	0.7784	-0.91649695	0.776	-1.22199593
		M	0.7856	0.7832	-0.30549898	0.7808	-0.61099796	0.7784	-0.91649695	0.776	-1.22199593
		U	0.7856	0.7832	-0.30549898	0.7808	-0.61099796	0.7784	-0.91649695	0.776	-1.22199593
	M2 (KN-m)	L	12.456	12.5467	0.72816313	12.6357	1.44267823	12.7232	2.14515093	12.8091	2.83477842
		M	7.05101415	6.96729115	-1.18738948	6.88369115	-2.37303452	6.80019115	-3.55726133	6.71699115	-4.73723344
		U	48.4866	48.4966	0.02062425	48.5055	0.03897984	48.5132	0.05486052	48.5195	0.0678538
	M3 (KN-m)	L	12.456	12.5467	0.72816313	12.6357	1.44267823	12.7232	2.14515093	12.8091	2.83477842
		M	7.05101415	6.96729115	-1.18738948	6.88369115	-2.37303452	6.80019115	-3.55726133	6.71699115	-4.73723344
		U	48.4866	48.4966	0.02062425	48.5055	0.03897984	48.5132	0.05486052	48.5195	0.0678538

Table 4.17 (continued)

6	P (KN)	L	-106.238	-120.78	13.6881342	-124.933	17.5972816	-129.09	21.5101941	-133.246	25.4221653
		M	-88.238	-102.78	16.4804279	-106.933	21.1870169	-111.09	25.8981391	-115.246	30.608128
		U	-70.238	-84.78	20.7038925	-88.933	26.6166463	-93.09	32.535095	-97.246	38.4521199
	V2 (KN)	L	5.639	4.303	-23.692144	4.018	-28.7462316	3.729	-33.8712538	3.44	-38.9962759
		M	5.639	4.303	-23.692144	4.018	-28.7462316	3.729	-33.8712538	3.44	-38.9962759
		U	5.639	4.303	-23.692144	4.018	-28.7462316	3.729	-33.8712538	3.44	-38.9962759
	V3 (KN)	L	5.639	4.303	-23.692144	4.018	-28.7462316	3.729	-33.8712538	3.44	-38.9962759
		M	5.639	4.303	-23.692144	4.018	-28.7462316	3.729	-33.8712538	3.44	-38.9962759
		U	5.639	4.303	-23.692144	4.018	-28.7462316	3.729	-33.8712538	3.44	-38.9962759
	T (KN-m)	L	0.5228	0.5214	-0.26778883	0.52	-0.53557766	0.5184	-0.84162204	0.517	-1.10941086
		M	0.5228	0.5214	-0.26778883	0.52	-0.53557766	0.5184	-0.84162204	0.517	-1.10941086
		U	0.5228	0.5214	-0.26778883	0.52	-0.53557766	0.5184	-0.84162204	0.517	-1.10941086
	M2 (KN-m)	L	1.6842	1.3972	-17.0407315	1.109	-34.1527135	0.8195	-51.3418834	0.5287	-68.6082413
		M	7.7707	8.162	5.03558238	8.5527	10.0634434	8.9429	15.0848701	9.3325	20.0985754
		U	39.8459	41.2069	3.41565883	42.5653	6.82479251	43.921	10.2271501	45.2741	13.6229825
	M3 (KN-m)	L	1.6842	1.3972	-17.0407315	1.109	-34.1527135	0.8195	-51.3418834	0.5287	-68.6082413
		M	7.7707	8.162	5.03558238	8.5527	10.0634434	8.9428	15.0835832	9.3325	20.0985754
		U	39.8459	41.2069	3.41565883	42.5653	6.82479251	43.921	10.2271501	45.2741	13.6229825
7	P (KN)	L	-60.33	-60.696	0.60666335	-61.062	1.2133267	-61.43	1.82330515	-61.796	2.42996851
		M	-42.33	-42.696	0.86463501	-43.062	1.72927002	-43.43	2.59862981	-43.796	3.46326482
		U	-24.33	-24.696	1.50431566	-25.062	3.00863132	-25.43	4.52116728	-25.796	6.02548294
	V2 (KN)	L	-4.362	-4.772	9.39935809	-5.181	18.7757909	-5.591	28.175149	-5.999	37.5286566
		M	-4.362	-4.772	9.39935809	-5.181	18.7757909	-5.591	28.175149	-5.999	37.5286566
		U	-4.362	-4.772	9.39935809	-5.181	18.7757909	-5.591	28.175149	-5.999	37.5286566
	V3 (KN)	L	-4.362	-4.772	9.39935809	-5.181	18.7757909	-5.591	28.175149	-5.999	37.5286566
		M	-4.362	-4.772	9.39935809	-5.181	18.7757909	-5.591	28.175149	-5.999	37.5286566
		U	-4.362	-4.772	9.39935809	-5.181	18.7757909	-5.591	28.175149	-5.999	37.5286566
	T (KN-m)	L	0.261	0.26	-0.38314176	0.2592	-0.68965517	0.2582	-1.07279693	0.2574	-1.37931034
		M	0.261	0.26	-0.38314176	0.2592	-0.68965517	0.2582	-1.07279693	0.2574	-1.37931034
		U	0.261	0.26	-0.38314176	0.2592	-0.68965517	0.2582	-1.07279693	0.2574	-1.37931034
	M2 (KN-m)	L	-10.8055	-11.8902	10.0384064	-12.9689	20.0212855	-14.0418	29.9504882	-15.1093	39.8297163
		M	7.6582	7.3645	-3.83510485	7.0702	-7.67804445	6.7753	-11.5288188	6.4798	-15.3874279
		U	29.8946	30.2759	1.27548119	30.6572	2.55096238	31.0384	3.82610906	31.4198	5.10192476
	M3 (KN-m)	L	-10.8055	-11.8902	10.0384064	-12.9689	20.0212855	-14.0418	29.9504882	-15.1093	39.8297163
		M	7.6582	7.3645	-3.83510485	7.0702	-7.67804445	6.7753	-11.5288188	6.4798	-15.3874279
		U	29.8946	30.2759	1.27548119	30.6572	2.55096238	31.0384	3.82610906	31.4198	5.10192476

4.2.7 Percentage change in joint displacements relative to original live load

Table 4.18 Mass irregularity in first floor: Percentage change in joint displacements relative to original live load for square shaped plan building

Joint label	Joint displacement	Original Live Load	Live load at first storey and % change relative to original live load							
			3KN/m2	% change	4KN/m2	% change	5KN/m2	% change	6KN/m2	% change
2	U1 (m)	0.0001045	0.0001045	0.00095695	0.0001045	0.00287084	0.0001045	0.00478473	0.00010451	0.00574168
	U2 (m)	0.0001045	0.0001045	0.00095695	0.0001045	0.00287084	0.0001045	0.00478473	0.00010451	0.00574168
3	U1 (m)	0.001883	0.001883	0	0.001884	0.05310674	0.001884	0.05310674	0.001884	0.05310674
	U2 (m)	0.001883	0.001883	0	0.001884	0.05310674	0.001884	0.05310674	0.001884	0.05310674
4	U1 (m)	0.004052	0.004052	0	0.004053	0.02467917	0.004053	0.02467917	0.004053	0.02467917
	U2 (m)	0.004052	0.004052	0	0.004053	0.02467917	0.004053	0.02467917	0.004053	0.02467917
5	U1 (m)	0.006036	0.006037	0.01656726	0.006037	0.01656726	0.006038	0.03313453	0.006038	0.03313453
	U2 (m)	0.006036	0.006037	0.01656726	0.006037	0.01656726	0.006038	0.03313453	0.006038	0.03313453
6	U1 (m)	0.007648	0.007649	0.01307531	0.007649	0.01307531	0.00765	0.02615063	0.00765	0.02615063
	U2 (m)	0.007648	0.007649	0.01307531	0.007649	0.01307531	0.00765	0.02615063	0.00765	0.02615063
7	U1 (m)	0.008784	0.008785	0.01138434	0.008786	0.02276867	0.008786	0.02276867	0.008788	0.04553734
	U2 (m)	0.008784	0.008785	0.01138434	0.008786	0.02276867	0.008786	0.02276867	0.008788	0.04553734
8	U1 (m)	0.00942	0.00942	0	0.009421	0.01061571	0.009423	0.03184713	0.009423	0.03184713
	U2 (m)	0.00942	0.00942	0	0.009421	0.01061571	0.009423	0.03184713	0.009423	0.03184713

Table 4.19 Mass irregularity in second floor: Percentage change in joint displacements relative to original live load for square shaped plan building

Joint label	Joint displacement	Original Live Load	Live load at second storey and % change relative to original live load							
			3KN/m2	% change	4KN/m2	% change	5KN/m2	% change	6KN/m2	% change
2	U1 (m)	0.0001045	0.00010451	0.01052642	0.00010452	0.02105283	0.00010553	0.98852621	0.00010554	0.99905262
	U2 (m)	0.0001045	0.00010451	0.01052642	0.00010452	0.02105283	0.00010553	0.98852621	0.00010554	0.99905262
3	U1 (m)	0.001883	0.001887	0.21242698	0.001891	0.42485396	0.001895	0.63728093	0.001898	0.79660117
	U2 (m)	0.001883	0.001887	0.21242698	0.001891	0.42485396	0.001895	0.63728093	0.001898	0.79660117
4	U1 (m)	0.004052	0.004058	0.14807502	0.004065	0.32082922	0.004071	0.46890424	0.004078	0.64165844
	U2 (m)	0.004052	0.004058	0.14807502	0.004065	0.32082922	0.004071	0.46890424	0.004078	0.64165844
5	U1 (m)	0.006036	0.006044	0.1325381	0.006053	0.28164347	0.00606	0.39761431	0.006069	0.54671968
	U2 (m)	0.006036	0.006044	0.1325381	0.006053	0.28164347	0.00606	0.39761431	0.006069	0.54671968
6	U1 (m)	0.007648	0.007658	0.13075314	0.007667	0.24843096	0.007677	0.3791841	0.007686	0.49686192
	U2 (m)	0.007648	0.007658	0.13075314	0.007667	0.24843096	0.007677	0.3791841	0.007686	0.49686192
7	U1 (m)	0.008784	0.008795	0.12522769	0.008805	0.23907104	0.008816	0.36429872	0.008826	0.47814208
	U2 (m)	0.008784	0.008795	0.12522769	0.008805	0.23907104	0.008816	0.36429872	0.008826	0.47814208
8	U1 (m)	0.00942	0.009431	0.11677282	0.009442	0.23354565	0.009453	0.35031847	0.009464	0.4670913
	U2 (m)	0.00942	0.009431	0.11677282	0.009442	0.23354565	0.009453	0.35031847	0.009464	0.4670913

Table 4.20 Mass irregularity in third floor: Percentage change in joint displacements relative to original live load for square shaped plan building

Joint label	Joint displacement	Original Live Load	Live load at third storey and % change relative to original live load							
			3KN/m2	% change	4KN/m2	% change	5KN/m2	% change	6KN/m2	% change
2	U1 (m)	0.0001045	0.0001045	0.00191389	0.0001055	0.96077474	0.00010551	0.96268864	0.00010551	0.96460253
	U2 (m)	0.0001045	0.0001045	0.00191389	0.0001055	0.96077474	0.00010551	0.96268864	0.00010551	0.96460253
3	U1 (m)	0.001883	0.001889	0.31864047	0.001896	0.69038768	0.001902	1.00902815	0.001908	1.32766861
	U2 (m)	0.001883	0.001889	0.31864047	0.001896	0.69038768	0.001902	1.00902815	0.001908	1.32766861
4	U1 (m)	0.004052	0.004065	0.32082922	0.004077	0.61697927	0.004089	0.91312932	0.004103	1.25863771
	U2 (m)	0.004052	0.004065	0.32082922	0.004077	0.61697927	0.004089	0.91312932	0.004103	1.25863771
5	U1 (m)	0.006036	0.006051	0.24850895	0.006066	0.49701789	0.006081	0.74552684	0.006095	0.97746852
	U2 (m)	0.006036	0.006051	0.24850895	0.006066	0.49701789	0.006081	0.74552684	0.006095	0.97746852
6	U1 (m)	0.007648	0.007664	0.20920502	0.00768	0.41841004	0.007696	0.62761506	0.007712	0.83682008
	U2 (m)	0.007648	0.007664	0.20920502	0.00768	0.41841004	0.007696	0.62761506	0.007712	0.83682008
7	U1 (m)	0.008784	0.008801	0.1935337	0.008818	0.3870674	0.008834	0.56921676	0.00885	0.75136612
	U2 (m)	0.008784	0.008801	0.1935337	0.008818	0.3870674	0.008834	0.56921676	0.00885	0.75136612
8	U1 (m)	0.00942	0.009436	0.16985138	0.009454	0.36093418	0.009471	0.54140127	0.009487	0.71125265
	U2 (m)	0.00942	0.009436	0.16985138	0.009454	0.36093418	0.009471	0.54140127	0.009487	0.71125265

Table 4.21 Mass irregularity in fourth floor: Percentage change in joint displacements relative to original live load for square shaped plan building

Joint label	Joint displacement	Original Live Load	Live load at fourth storey and % change relative to original live load							
			3KN/m2	% change	4KN/m2	% change	5KN/m2	% change	6KN/m2	% change
2	U1 (m)	0.0001045	0.0001045	-0.00287084	0.00010549	0.95024833	0.00010549	0.94737749	0.00010549	0.94450665
	U2 (m)	0.0001045	0.0001045	-0.00287084	0.00010549	0.95024833	0.00010549	0.94737749	0.00010549	0.94450665
3	U1 (m)	0.001883	0.001889	0.31864047	0.001895	0.63728093	0.001901	0.9559214	0.001907	1.27456187
	U2 (m)	0.001883	0.001889	0.31864047	0.001895	0.63728093	0.001901	0.9559214	0.001907	1.27456187
4	U1 (m)	0.004052	0.004065	0.32082922	0.004078	0.64165844	0.004091	0.96248766	0.004104	1.28331688
	U2 (m)	0.004052	0.004065	0.32082922	0.004078	0.64165844	0.004091	0.96248766	0.004104	1.28331688
5	U1 (m)	0.006036	0.006055	0.314778	0.006073	0.61298873	0.006092	0.92776673	0.006111	1.24254473
	U2 (m)	0.006036	0.006055	0.314778	0.006073	0.61298873	0.006092	0.92776673	0.006111	1.24254473
6	U1 (m)	0.007648	0.007668	0.26150628	0.007687	0.50993724	0.007707	0.77144351	0.007725	1.00679916
	U2 (m)	0.007648	0.007668	0.26150628	0.007687	0.50993724	0.007707	0.77144351	0.007725	1.00679916
7	U1 (m)	0.008784	0.008803	0.21630237	0.008822	0.43260474	0.008841	0.6489071	0.008858	0.8424408
	U2 (m)	0.008784	0.008803	0.21630237	0.008822	0.43260474	0.008841	0.6489071	0.008858	0.8424408
8	U1 (m)	0.00942	0.009438	0.1910828	0.009456	0.38216561	0.009475	0.58386412	0.009492	0.76433121
	U2 (m)	0.00942	0.009438	0.1910828	0.009456	0.38216561	0.009475	0.58386412	0.009492	0.76433121

Table 4.22 Mass irregularity in fifth floor: Percentage change in joint displacements relative to original live load for square shaped plan building

Joint label	Joint displacement	Original Live Load	Live load at fifth storey and % change relative to original live load							
			3KN/m2	% change	4KN/m2	% change	5KN/m2	% change	6KN/m2	% change
2	U1 (m)	0.0001045	0.00010449	-0.00861252	0.00010448	-0.0162681	0.00010547	0.93302328	0.00010547	0.92536771
	U2 (m)	0.0001045	0.00010449	-0.00861252	0.00010448	-0.0162681	0.00010547	0.93302328	0.00010547	0.92536771
3	U1 (m)	0.001883	0.001887	0.21242698	0.00189	0.37174721	0.001894	0.58417419	0.001898	0.79660117
	U2 (m)	0.001883	0.001887	0.21242698	0.00189	0.37174721	0.001894	0.58417419	0.001898	0.79660117
4	U1 (m)	0.004052	0.004062	0.24679171	0.004071	0.46890424	0.004079	0.66633761	0.004088	0.88845015
	U2 (m)	0.004052	0.004062	0.24679171	0.004071	0.46890424	0.004079	0.66633761	0.004088	0.88845015
5	U1 (m)	0.006036	0.006051	0.24850895	0.006066	0.49701789	0.006081	0.74552684	0.006096	0.99403579
	U2 (m)	0.006036	0.006051	0.24850895	0.006066	0.49701789	0.006081	0.74552684	0.006096	0.99403579
6	U1 (m)	0.007648	0.007669	0.27458159	0.007688	0.52301255	0.007707	0.77144351	0.007727	1.03294979
	U2 (m)	0.007648	0.007669	0.27458159	0.007688	0.52301255	0.007707	0.77144351	0.007727	1.03294979
7	U1 (m)	0.008784	0.008804	0.2276867	0.008823	0.44398907	0.008842	0.66029144	0.008861	0.87659381
	U2 (m)	0.008784	0.008804	0.2276867	0.008823	0.44398907	0.008842	0.66029144	0.008861	0.87659381
8	U1 (m)	0.00942	0.009438	0.1910828	0.009456	0.38216561	0.009474	0.57324841	0.009491	0.7537155
	U2 (m)	0.00942	0.009438	0.1910828	0.009456	0.38216561	0.009474	0.57324841	0.009491	0.7537155

Table 4.23 Mass irregularity in sixth floor: Percentage change in joint displacements relative to original live load for square shaped plan building

Joint label	Joint displacement	Original Live Load	Live load at sixth storey and % change relative to original live load							
			3KN/m2	% change	4KN/m2	% change	5KN/m2	% change	6KN/m2	% change
2	U1 (m)	0.0001045	0.00010449	-0.01339726	0.00010447	-0.02583757	0.00010446	-0.03827788	0.00010445	-0.04976124
	U2 (m)	0.0001045	0.00010449	-0.01339726	0.00010447	-0.02583757	0.00010446	-0.03827788	0.00010445	-0.04976124
3	U1 (m)	0.001883	0.001885	0.10621349	0.001886	0.15932023	0.001888	0.26553372	0.001889	0.31864047
	U2 (m)	0.001883	0.001885	0.10621349	0.001886	0.15932023	0.001888	0.26553372	0.001889	0.31864047
4	U1 (m)	0.004052	0.004057	0.12339585	0.00406	0.19743337	0.004065	0.32082922	0.004069	0.4195459
	U2 (m)	0.004052	0.004057	0.12339585	0.00406	0.19743337	0.004065	0.32082922	0.004069	0.4195459
5	U1 (m)	0.006036	0.006044	0.1325381	0.006052	0.26507621	0.00606	0.39761431	0.006069	0.54671968
	U2 (m)	0.006036	0.006044	0.1325381	0.006052	0.26507621	0.00606	0.39761431	0.006069	0.54671968
6	U1 (m)	0.007648	0.007662	0.18305439	0.007676	0.36610879	0.00769	0.54916318	0.007703	0.71914226
	U2 (m)	0.007648	0.007662	0.18305439	0.007676	0.36610879	0.00769	0.54916318	0.007703	0.71914226
7	U1 (m)	0.008784	0.008804	0.2276867	0.008824	0.45537341	0.008844	0.68306011	0.008864	0.91074681
	U2 (m)	0.008784	0.008804	0.2276867	0.008824	0.45537341	0.008844	0.68306011	0.008864	0.91074681
8	U1 (m)	0.00942	0.00944	0.21231423	0.009461	0.43524416	0.009482	0.6581741	0.009502	0.87048832
	U2 (m)	0.00942	0.00944	0.21231423	0.009461	0.43524416	0.009482	0.6581741	0.009502	0.87048832

4.3 ANALYSIS RESULTS OF L-SHAPED PLAN BUILDING MODEL

The analysis results are presented for the L-shaped plan building with original live load of 2KN/m^2.

4.3.1 Mode shapes

First six modes have been considered for the modal analysis.

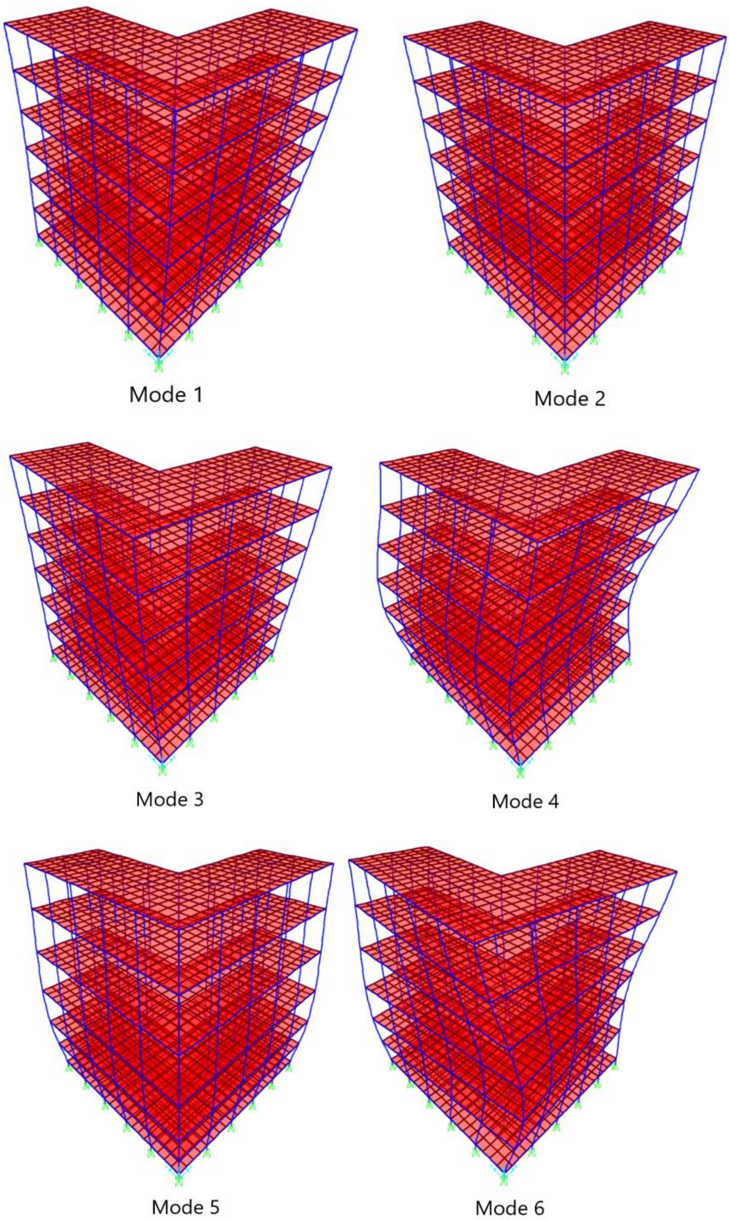

Figure 4.4 Mode shapes: L-shaped plan building

Table 4.24 Modal periods and frequencies: L-shaped plan building

Mode	Time period T (s)	Frequency f (Hz)
1	0.66124	1.51232
2	0.65775	1.52034
3	0.60299	1.65841
4	0.21054	4.74975
5	0.20985	4.7653
6	0.19308	5.17916

4.3.2 Base shear

Table 4.25 Base reactions for L-shaped plan building

OutputCase	CaseType	StepType	GlobalFX	GlobalFY	GlobalFZ	GlobalMX	GlobalMY	GlobalMZ
Text	Text	Text	KN	KN	KN	KN-m	KN-m	KN-m
DEAD	LinStatic		-4.498E-11	-1.28E-11	16735.3	131655.44	-131655.4	3.05E-10
FF	LinStatic		-5.488E-13	-1.5E-13	153.6	1190.4	-1190.4	3.8E-12
LIVE	LinStatic		-1.097E-11	-3.01E-12	3072	23808	-23808	7.58E-11
EQx	LinRespSpec	Max	**824.584**	34.473	0.249	596.3049	14172.778	7361.147
EQy	LinRespSpec	Max	34.473	**824.584**	0.249	14172.778	596.3049	7361.148

From the above table, base shear in both the orthogonal directions is 824.584 KN.

4.3.3 Column forces

The forces of outer column elements (@ X = 0 and Y = 0) labelled 1, 2, 3, 4, 5, 6 and 7 from bottom to top are determined. These forces include P, V_2, V_3, T, M_2 and M_3. These forces are determined at lower point (L), mid-point (M) and upper point (U) of each column in consideration.

P = axial force

V_2, V_3 = shear forces in x, y directions respectively

T = torsional moment

M_2, M_3 = bending moments in x, y directions respectively

Table 4.26 Column forces for L-shaped plan building

Element Label	**Load Case**	**P (KN)**			**V2 (KN)**			**V3 (KN)**			**T (KN-m)**			**M2 (KN-m)**			**M3 (KN-m)**		
		L	**M**	**U**	**L**	**M**	**U**	**L**	**M**	**U**	**L**	**M**	**U**	**L**	**M**	**U**	**L**	**M**	**U**
1	DEAD	-460.91	-456.41	-451.91	-8.882	-8.882	-8.882	-8.882	-8.882	-8.882	-1.714E-14	-1.714E-14	-1.714E-14	-1.4454	2.9956	7.4367	-1.4454	2.9956	7.4367
	FF	-2.722	-2.722	-2.722	-0.157	-0.157	-0.157	-0.157	-0.157	-0.157	-2.201E-16	-2.201E-16	-2.201E-16	-0.0251	0.0532	0.1315	-0.0251	0.0532	0.1315
	LIVE	-54.432	-54.432	-54.432	-3.131	-3.131	-3.131	-3.131	-3.131	-3.131	-4.399E-15	-4.399E-15	-4.399E-15	-0.5014	1.064	2.6294	-0.5014	1.064	2.6294
	EQx	153.081	153.081	153.081	21.454	21.454	21.454	5.54	5.54	5.54	0.5289	0.5289	0.5289	13.9963	11.2391	8.4904	59.0875	48.3623	37.6381
	EQy	153.081	153.081	153.081	5.54	5.54	5.54	21.454	21.454	21.454	0.5289	0.5289	0.5289	59.0875	48.3623	37.6381	13.9963	11.2391	8.4904
	∑	**-211.91**	**-207.41**	**-202.91**	**14.824**	**14.824**	**14.824**	**14.824**	**14.824**	**14.824**	**1.0578**	**1.0578**	**1.0578**	**71.1119**	**63.7142**	**56.3261**	**71.1119**	**63.7142**	**56.3261**
2	DEAD	-421.9	-403.9	-385.9	-2.954	-2.954	-2.954	-2.954	-2.954	-2.954	-7.318E-14	-7.318E-14	-7.318E-14	-5.3477	0.5604	6.4684	-5.3477	0.5604	6.4684
	FF	-2.335	-2.335	-2.335	-0.052	-0.052	-0.052	-0.052	-0.052	-0.052	-9.405E-16	-9.405E-16	-9.405E-16	-0.0935	0.0097	0.113	-0.0935	0.0097	0.113
	LIVE	-46.695	-46.695	-46.695	-1.032	-1.032	-1.032	-1.032	-1.032	-1.032	-1.88E-14	-1.88E-14	-1.88E-14	-1.8699	0.1946	2.2591	-1.8699	0.1946	2.2591
	EQx	137.8	137.8	137.8	25.514	25.514	25.514	5.989	5.989	5.989	2.2392	2.2392	2.2392	16.0246	4.0506	7.9374	68.4788	17.5142	33.6443
	EQy	137.8	137.8	137.8	5.989	5.989	5.989	25.514	25.514	25.514	2.2392	2.2392	2.2392	68.4788	17.5142	33.6443	16.0246	4.0506	7.9374
	∑	**-195.33**	**-177.33**	**-159.33**	**27.465**	**27.465**	**27.465**	**27.465**	**27.465**	**27.465**	**4.4784**	**4.4784**	**4.4784**	**77.1923**	**22.3295**	**50.4222**	**77.1923**	**22.3295**	**50.4222**
3	DEAD	-354.35	-336.35	-318.35	-3.898	-3.898	-3.898	-3.898	-3.898	-3.898	-1.004E-13	-1.004E-13	-1.004E-13	-7.748	0.0479	7.8438	-7.748	0.0479	7.8438
	FF	-1.925	-1.925	-1.925	-0.067	-0.067	-0.067	-0.067	-0.067	-0.067	-1.291E-15	-1.291E-15	-1.291E-15	-0.1338	0.00045	0.1347	-0.1338	0.00045	0.1347
	LIVE	-38.495	-38.495	-38.495	-1.343	-1.343	-1.343	-1.343	-1.343	-1.343	-2.581E-14	-2.581E-14	-2.581E-14	-2.676	0.009	2.6941	-2.676	0.009	2.6941
	EQx	103.279	103.279	103.279	19.167	19.167	19.167	4.886	4.886	4.886	2.7829	2.7829	2.7829	9.7528	0.4978	9.8129	37.7811	2.6687	39.0623
	EQy	103.279	103.279	103.279	4.886	4.886	4.886	19.167	19.167	19.167	2.7829	2.7829	2.7829	37.7811	2.6687	39.0623	9.7528	0.4978	9.8129
	∑	**-188.21**	**-170.21**	**-152.21**	**18.745**	**18.745**	**18.745**	**18.745**	**18.745**	**18.745**	**5.5658**	**5.5658**	**5.5658**	**36.9761**	**3.22385**	**59.5478**	**36.9761**	**3.22385**	**59.5478**

<u>Table 4.26 (continued)</u>

4	DEAD	-285	-267	-249	-4.182	-4.182	-4.182	-4.182	-4.182	-4.182	-1.073E-13	-1.073E-13	-1.073E-13	-8.268	0.0963	8.4607	-8.268	0.0963	8.4607
	FF	-1.487	-1.487	-1.487	-0.072	-0.072	-0.072	-0.072	-0.072	-0.072	-1.385E-15	-1.385E-15	-1.385E-15	-0.1413	0.0019	0.145	-0.1413	0.0019	0.145
	LIVE	-29.746	-29.746	-29.746	-1.432	-1.432	-1.432	-1.432	-1.432	-1.432	-2.77E-14	-2.77E-14	-2.77E-14	-2.8258	0.0373	2.9003	-2.8258	0.0373	2.9003
	EQx	69.418	69.418	69.418	16.755	16.755	16.755	4.296	4.296	4.296	2.5724	2.5724	2.5724	7.7318	1.0257	9.483	29.913	4.7432	37.3605
	EQy	69.418	69.418	69.418	4.296	4.296	4.296	16.755	16.755	16.755	2.5724	2.5724	2.5724	29.913	4.7432	37.3605	7.7318	1.0257	9.483
	∑	**-177.39**	**-159.39**	**-141.39**	**15.365**	**15.365**	**15.365**	**15.365**	**15.365**	**15.365**	**5.1448**	**5.1448**	**5.1448**	**26.4097**	**5.9044**	**58.3495**	**26.4097**	**5.9044**	**58.3495**
5	DEAD	-214.3	-196.3	-178.3	-4.6	-4.6	-4.6	-4.6	-4.6	-4.6	-1.123E-13	-1.123E-13	-1.123E-13	-9.0449	0.1559	9.3568	-9.0449	0.1559	9.3568
	FF	-1.031	-1.031	-1.031	-0.075	-0.075	-0.075	-0.075	-0.075	-0.075	-1.444E-15	-1.444E-15	-1.444E-15	-0.15	-0.0001	0.1497	-0.15	-0.0001	0.1497
	LIVE	-20.628	-20.628	-20.628	-1.498	-1.498	-1.498	-1.498	-1.498	-1.498	-2.894E-14	-2.894E-14	-2.894E-14	-2.9992	-0.0025	2.9941	-2.9992	-0.0025	2.9941
	EQx	40.577	40.577	40.577	13.138	13.138	13.138	3.445	3.445	3.445	2.1145	2.1145	2.1145	5.6078	1.4104	8.2122	20.9742	6.1909	31.8973
	EQy	40.577	40.577	40.577	3.445	3.445	3.445	13.138	13.138	13.138	2.1145	2.1145	2.1145	20.9742	6.1909	31.8973	5.6078	1.4104	8.2122
	∑	**-154.8**	**-136.8**	**-118.8**	**10.41**	**10.41**	**10.41**	**10.41**	**10.41**	**10.41**	**4.229**	**4.229**	**4.229**	**14.3879**	**7.75457**	**52.6101**	**14.3879**	**7.75457**	**52.6101**
6	DEAD	-142.7	-124.7	-106.7	-4.328	-4.328	-4.328	-4.328	-4.328	-4.328	-1.035E-13	-1.035E-13	-1.035E-13	-9.0379	-0.3817	8.2745	-9.0379	-0.3817	8.2745
	FF	-0.563	-0.563	-0.563	-0.082	-0.082	-0.082	-0.082	-0.082	-0.082	-1.336E-15	-1.336E-15	-1.336E-15	-0.1593	0.0048	0.1688	-0.1593	0.0048	0.1688
	LIVE	-11.254	-11.254	-11.254	-1.64	-1.64	-1.64	-1.64	-1.64	-1.64	-2.671E-14	-2.671E-14	-2.671E-14	-3.185	0.0953	3.3756	-3.185	0.0953	3.3756
	EQx	18.834	18.834	18.834	9.1	9.1	9.1	2.41	2.41	2.41	1.5187	1.5187	1.5187	3.2953	1.6451	6.4021	11.7	7.2362	25.1056
	EQy	18.834	18.834	18.834	2.41	2.41	2.41	9.1	9.1	9.1	1.5187	1.5187	1.5187	11.7	7.2362	25.1056	3.2953	1.6451	6.4021
	∑	**-116.85**	**-98.851**	**-80.851**	**5.46**	**5.46**	**5.46**	**5.46**	**5.46**	**5.46**	**3.0374**	**3.0374**	**3.0374**	**2.6131**	**8.5997**	**43.3266**	**2.6131**	**8.5997**	**43.3266**
7	DEAD	-69.853	-51.853	-33.853	-6.903	-6.903	-6.903	-6.903	-6.903	-6.903	-8.389E-14	-8.389E-14	-8.389E-14	-11.592	2.2141	16.0207	-11.592	2.2141	16.0207
	FF	-0.091	-0.091	-0.091	-0.06	-0.06	-0.06	-0.06	-0.06	-0.06	-1.087E-15	-1.087E-15	-1.087E-15	-0.1406	-0.021	0.0986	-0.1406	-0.021	0.0986
	LIVE	-1.822	-1.822	-1.822	-1.196	-1.196	-1.196	-1.196	-1.196	-1.196	-2.176E-14	-2.176E-14	-2.176E-14	-2.8114	-0.4194	1.9727	-2.8114	-0.4194	1.9727
	EQx	5.621	5.621	5.621	2.795	2.795	2.795	1.128	1.128	1.128	0.8939	0.8939	0.8939	1.2371	1.3223	3.4921	2.7293	5.3425	10.5827
	EQy	5.621	5.621	5.621	1.128	1.128	1.128	2.795	2.795	2.795	0.8939	0.8939	0.8939	2.7293	5.3425	10.5827	1.2371	1.3223	3.4921
	∑	**-60.524**	**-42.524**	**-24.524**	**-4.236**	**-4.236**	**-4.236**	**-4.236**	**-4.236**	**-4.236**	**1.7878**	**1.7878**	**1.7878**	**-10.578**	**8.4385**	**32.1668**	**-10.578**	**8.4385**	**32.1668**

4.3.4 Joint displacements

The values of the displacements are determined for joints (@ X = 0 and Y = 0) labelled 2, 3, 4, 5, 6, 7 and 8. It is to be noted that joint labelled 1 is a fix joint and its displacement will be zero. The horizontal displacements in the two orthogonal directions U1 and U2 are determined. U1 and U2 are displacements in x and y directions respectively.

Table 4.27 Joint displacements for L-shaped plan building

Joint Label	Load Case	U1 (m)	U2 (m)
2	DEAD	-3.308E-08	-3.308E-08
	FF	9.896E-11	9.896E-11
	LIVE	1.979E-09	1.979E-09
	EQx	0.000094	0.000022
	EQy	0.000022	0.000094
	∑	**0.00011597**	**0.00011597**
3	DEAD	-1.082E-06	-1.082E-06
	FF	-8.236E-09	-8.236E-09
	LIVE	-1.647E-07	-1.647E-07
	EQx	0.00171	0.000399
	EQy	0.000399	0.00171
	∑	**0.00210775**	**0.00210775**
4	DEAD	-3.802E-06	-3.802E-06
	FF	-3.904E-08	-3.904E-08
	LIVE	-7.808E-07	-7.808E-07
	EQx	0.003659	0.000861
	EQy	0.000861	0.003659
	∑	**0.00451538**	**0.00451538**

Table 4.27 (continued)

5	DEAD	-8.078E-06	-8.078E-06
	FF	-9.265E-08	-9.265E-08
	LIVE	-1.853E-06	-1.853E-06
	EQx	0.005435	0.001286
	EQy	0.001286	0.005435
	∑	**0.00671098**	**0.00671098**
6	DEAD	-0.000014	-0.000014
	FF	-1.635E-07	-1.635E-07
	LIVE	-3.269E-06	-3.269E-06
	EQx	0.006877	0.001632
	EQy	0.001632	0.006877
	∑	**0.00849157**	**0.00849157**
7	DEAD	-0.00002	-0.00002
	FF	-2.45E-07	-2.45E-07
	LIVE	-0.0000049	-0.0000049
	EQx	0.007893	0.001878
	EQy	0.001878	0.007893
	∑	**0.00974586**	**0.00974586**
8	DEAD	-0.000026	-0.000026
	FF	-3.385E-07	-3.385E-07
	LIVE	-6.771E-06	-6.771E-06
	EQx	0.008457	0.002019
	EQy	0.002019	0.008457
	∑	**0.01044289**	**0.01044289**

Similarly, the above analysis results are obtained for different values of live load ($3KN/m^2$, $4KN/m^2$, $5KN/m^2$ and $6KN/m^2$) applied at each storey one by one.

4.3.5 Percentage change in base shear relative to original live load

Table 4.28 Mass irregularity in first floor: Percentage change in base shear relative to original live load for L-shaped plan building

Base Shear (KN)	Original Live Load	Live load at first storey and % change relative to original live load							
		3KN/m2	% change	4KN/m2	% change	5KN/m2	% change	6KN/m2	% change
Along X	824.584	824.73	0.0177059	824.876	0.0354118	825.022	0.05311769	825.168	0.07082359
Along Y	824.584	824.73	0.0177059	824.876	0.0354118	825.022	0.05311769	825.168	0.07082359

Table 4.29 Mass irregularity in second floor: Percentage change in base shear relative to original live load for L-shaped plan building

Base Shear (KN)	Original Live Load	Live load at second storey and % change relative to original live load							
		3KN/m2	% change	4KN/m2	% change	5KN/m2	% change	6KN/m2	% change
Along X	824.584	826.665	0.25236968	828.754	0.50570955	830.852	0.76014087	832.958	1.01554238
Along Y	824.584	826.665	0.25236968	828.754	0.50570955	830.852	0.76014087	832.958	1.01554238

Table 4.30 Mass irregularity in third floor: Percentage change in base shear relative to original live load for L-shaped plan building

Base Shear (KN)	Original Live Load	Live load at third storey and % change relative to original live load							
		3KN/m2	% change	4KN/m2	% change	5KN/m2	% change	6KN/m2	% change
Along X	824.584	827.568	0.36187944	830.552	0.72375889	833.537	1.08575961	836.522	1.44776033
Along Y	824.584	827.568	0.36187944	830.552	0.72375889	833.537	1.08575961	836.522	1.44776033

Table 4.31 Mass irregularity in fourth floor: Percentage change in base shear relative to original live load for L-shaped plan building

Base Shear (KN)	Original Live Load	Live load at fourth storey and % change relative to original live load							
		3KN/m2	% change	4KN/m2	% change	5KN/m2	% change	6KN/m2	% change
Along X	824.584	827.372	0.33810988	830.149	0.67488576	832.915	1.01032763	835.671	1.34455677
Along Y	824.584	827.372	0.33810988	830.149	0.67488576	832.915	1.01032763	835.671	1.34455677

Table 4.32 Mass irregularity in fifth floor: Percentage change in base shear relative to original live load for L-shaped plan building

Base Shear (KN)	Original Live Load	Live load at fifth storey and % change relative to original live load							
		3KN/m2	% change	4KN/m2	% change	5KN/m2	% change	6KN/m2	% change
Along X	824.584	826.522	0.2350276	828.442	0.46787228	830.344	0.69853405	832.228	0.92701289
Along Y	824.584	826.522	0.2350276	828.442	0.46787228	830.344	0.69853405	832.228	0.92701289

Table 4.33 Mass irregularity in sixth floor: Percentage change in base shear relative to original live load for L-shaped plan building

Base Shear (KN)	Original Live Load	Live load at sixth storey and % change relative to original live load							
		3KN/m2	% change	4KN/m2	% change	5KN/m2	% change	6KN/m2	% change
Along X	824.584	825.498	0.11084377	826.397	0.21986844	827.282	0.32719529	828.152	0.43270304
Along Y	824.584	825.498	0.11084377	826.397	0.21986844	827.282	0.32719529	828.152	0.43270304

4.3.6 Percentage change in column forces relative to original live load

Table 4.34 Mass irregularity in first floor: Percentage change in column forces relative to original live load for L-shaped plan building

Column label	Column force	At	Original Live Load	Live load at first storey and % change relative to original live load							
				3KN/m2	% change	4KN/m2	% change	5KN/m2	% change	6KN/m2	% change
1	P (KN)	L	-211.906	-215.752	1.81495569	-219.595	3.62849565	-223.439	5.44250753	-227.284	7.25699131
		M	-207.406	-211.252	1.85433401	-215.095	3.70722158	-218.939	5.5605913	-222.784	7.41444317
		U	-202.906	-206.752	1.89545898	-210.595	3.78943944	-214.439	5.68391275	-218.284	7.57887889
	V2 (KN)	L	14.824	12.979	-12.4460335	11.133	-24.8988127	9.287	-37.351592	7.442	-49.7976255
		M	14.824	12.979	-12.4460335	11.133	-24.8988127	9.287	-37.351592	7.442	-49.7976255
		U	14.824	12.979	-12.4460335	11.133	-24.8988127	9.287	-37.351592	7.442	-49.7976255
	V3 (KN)	L	14.824	12.979	-12.4460335	11.133	-24.8988127	9.287	-37.351592	7.442	-49.7976255
		M	14.824	12.979	-12.4460335	11.133	-24.8988127	9.287	-37.351592	7.442	-49.7976255
		U	14.824	12.979	-12.4460335	11.133	-24.8988127	9.287	-37.351592	7.442	-49.7976255
	T (KN-m)	L	1.0578	1.058	0.01890717	1.0582	0.03781433	1.0584	0.0567215	1.0586	0.07562866
		M	1.0578	1.058	0.01890717	1.0582	0.03781433	1.0584	0.0567215	1.0586	0.07562866
		U	1.0578	1.058	0.01890717	1.0582	0.03781433	1.0584	0.0567215	1.0586	0.07562866
	M2 (KN-m)	L	71.1119	70.8306	-0.39557374	70.5493	-0.79114747	70.2681	-1.18658059	69.9868	-1.58215432
		M	63.7142	64.3558	1.00699687	64.9972	2.01367984	65.6388	3.02067671	66.2804	4.02767358
		U	56.3261	57.8904	2.77722051	59.4549	5.55479609	61.0193	8.33219413	62.5837	11.1095922
	M3 (KN-m)	L	71.1119	70.8306	-0.39557374	70.5493	-0.79114747	70.2681	-1.18658059	69.9868	-1.58215432
		M	63.7142	64.3558	1.00699687	64.9972	2.01367984	65.6388	3.02067671	66.2804	4.02767358
		U	56.3261	57.8904	2.77722051	59.4549	5.55479609	61.0193	8.33219413	62.5837	11.1095922
2	P (KN)	L	-195.331	-195.434	0.05273101	-195.538	0.10597396	-195.643	0.15972887	-195.746	0.21245988
		M	-177.331	-177.434	0.05808347	-177.538	0.11673086	-177.643	0.17594216	-177.746	0.23402564
		U	-159.331	-159.434	0.0646453	-159.538	0.12991822	-159.643	0.19581877	-159.746	0.26046407
	V2 (KN)	L	27.465	27.29	-0.63717459	27.114	-1.27799017	26.939	-1.91516476	26.764	-2.55233934
		M	27.465	27.29	-0.63717459	27.114	-1.27799017	26.939	-1.91516476	26.764	-2.55233934
		U	27.465	27.29	-0.63717459	27.114	-1.27799017	26.939	-1.91516476	26.764	-2.55233934
	V3 (KN)	L	27.465	27.29	-0.63717459	27.114	-1.27799017	26.939	-1.91516476	26.764	-2.55233934
		M	27.465	27.29	-0.63717459	27.114	-1.27799017	26.939	-1.91516476	26.764	-2.55233934
		U	27.465	27.29	-0.63717459	27.114	-1.27799017	26.939	-1.91516476	26.764	-2.55233934
	T (KN-m)	L	4.4784	4.479	0.01339764	4.4796	0.02679528	4.4802	0.04019293	4.4808	0.05359057
		M	4.4784	4.479	0.01339764	4.4796	0.02679528	4.4802	0.04019293	4.4808	0.05359057
		U	4.4784	4.479	0.01339764	4.4796	0.02679528	4.4802	0.04019293	4.4808	0.05359057
	M2 (KN-m)	L	77.1923	76.6536	-0.69786753	76.1149	-1.39573507	75.5762	-2.0936026	75.0374	-2.79159968
		M	22.3295	22.1421	-0.83924853	21.9547	-1.67849706	21.7674	-2.51729775	21.58	-3.35654627
		U	50.4222	50.5965	0.34568107	50.7709	0.69156046	50.9453	1.03743986	51.1197	1.38331925
	M3 (KN-m)	L	77.1923	76.6536	-0.69786753	76.1149	-1.39573507	75.5762	-2.0936026	75.0374	-2.79159968
		M	22.3295	22.1421	-0.83924853	21.9547	-1.67849706	21.7674	-2.51729775	21.58	-3.35654627
		U	50.4222	50.5965	0.34568107	50.7709	0.69156046	50.9453	1.03743986	51.1197	1.38331925

Table 4.34 (continued)

3	P (KN)	L	-188.21	-188.264	0.02869136	-188.318	0.05738271	-188.373	0.08660539	-188.427	0.11529674
		M	-170.21	-170.264	0.03172552	-170.318	0.06345103	-170.373	0.09576406	-170.427	0.12748957
		U	-152.21	-152.264	0.0354773	-152.318	0.0709546	-152.373	0.10708889	-152.427	0.14256619
	V2 (KN)	L	18.745	18.778	0.17604695	18.811	0.35209389	18.844	0.52814084	18.878	0.70952254
		M	18.745	18.778	0.17604695	18.811	0.35209389	18.844	0.52814084	18.878	0.70952254
		U	18.745	18.778	0.17604695	18.811	0.35209389	18.844	0.52814084	18.878	0.70952254
	V3 (KN)	L	18.745	18.778	0.17604695	18.811	0.35209389	18.844	0.52814084	18.878	0.70952254
		M	18.745	18.778	0.17604695	18.811	0.35209389	18.844	0.52814084	18.878	0.70952254
		U	18.745	18.778	0.17604695	18.811	0.35209389	18.844	0.52814084	18.878	0.70952254
	T (KN-m)	L	5.5658	5.5664	0.01078012	5.567	0.02156024	5.5676	0.03234036	5.5684	0.04671386
		M	5.5658	5.5664	0.01078012	5.567	0.02156024	5.5676	0.03234036	5.5684	0.04671386
		U	5.5658	5.5664	0.01078012	5.567	0.02156024	5.5676	0.03234036	5.5684	0.04671386
	M2 (KN-m)	L	36.9761	37.0803	0.28180365	37.1846	0.56387775	37.2887	0.84541095	37.3929	1.12721461
		M	3.2238522	3.2651522	1.2810761	3.3062522	2.55594844	3.3474522	3.83392266	3.3885522	5.108795
		U	59.5478	59.5288	-0.03190714	59.51	-0.06347842	59.491	-0.09538556	59.4722	-0.12695683
	M3 (KN-m)	L	36.9761	37.0803	0.28180365	37.1846	0.56387775	37.2887	0.84541095	37.3929	1.12721461
		M	3.2238522	3.2651522	1.2810761	3.3062522	2.55594844	3.3474522	3.83392266	3.3885522	5.108795
		U	59.5478	59.5288	-0.03190714	59.51	-0.06347842	59.491	-0.09538556	59.4722	-0.12695683

4	P (KN)	L	-177.393	-177.439	0.02593112	-177.487	0.05298969	-177.535	0.08004825	-177.583	0.10710682
		M	-159.393	-159.439	0.02885949	-159.487	0.05897373	-159.535	0.08908798	-159.583	0.11920222
		U	-141.393	-141.439	0.03253344	-141.487	0.06648137	-141.535	0.1004293	-141.583	0.13437723
	V2 (KN)	L	15.365	15.355	-0.06508298	15.346	-0.12365766	15.336	-0.18874064	15.327	-0.24731533
		M	15.365	15.355	-0.06508298	15.346	-0.12365766	15.336	-0.18874064	15.327	-0.24731533
		U	15.365	15.355	-0.06508298	15.346	-0.12365766	15.336	-0.18874064	15.327	-0.24731533
	V3 (KN)	L	15.365	15.355	-0.06508298	15.346	-0.12365766	15.336	-0.18874064	15.327	-0.24731533
		M	15.365	15.355	-0.06508298	15.346	-0.12365766	15.336	-0.18874064	15.327	-0.24731533
		U	15.365	15.355	-0.06508298	15.346	-0.12365766	15.336	-0.18874064	15.327	-0.24731533
	T (KN-m)	L	5.1448	5.1452	0.00777484	5.1458	0.0194371	5.1464	0.03109936	5.1468	0.0388742
		M	5.1448	5.1452	0.00777484	5.1458	0.0194371	5.1464	0.03109936	5.1468	0.0388742
		U	5.1448	5.1452	0.00777484	5.1458	0.0194371	5.1464	0.03109936	5.1468	0.0388742
	M2 (KN-m)	L	26.4097	26.3824	-0.10337111	26.3553	-0.20598492	26.328	-0.30935603	26.3008	-0.41234849
		M	5.9044	5.8982	-0.10500644	5.8919	-0.21170652	5.8857	-0.31671296	5.8796	-0.42002574
		U	58.3495	58.3688	0.03307655	58.388	0.06598171	58.4073	0.09905826	58.4267	0.13230619
	M3 (KN-m)	L	26.4097	26.3824	-0.10337111	26.3553	-0.20598492	26.328	-0.30935603	26.3008	-0.41234849
		M	5.9044	5.8982	-0.10500644	5.8919	-0.21170652	5.8857	-0.31671296	5.8796	-0.42002574
		U	58.3495	58.3688	0.03307655	58.388	0.06598171	58.4267	0.13230619

Table 4.34 (continued)

5	P (KN)	L	-154.802	-154.837	0.02260953	-154.87	0.04392708	-154.905	0.06653661	-154.938	0.08785416
		M	-136.802	-136.837	0.02558442	-136.87	0.04970688	-136.905	0.0752913	-136.938	0.09941375
		U	-118.802	-118.837	0.02946078	-118.87	0.05723809	-118.905	0.08669888	-118.938	0.11447619
	V2 (KN)	L	10.41	10.408	-0.0192123	10.407	-0.02881844	10.407	-0.02881844	10.405	-0.04803074
		M	10.41	10.408	-0.0192123	10.407	-0.02881844	10.407	-0.02881844	10.405	-0.04803074
		U	10.41	10.408	-0.0192123	10.407	-0.02881844	10.407	-0.02881844	10.405	-0.04803074
	V3 (KN)	L	10.41	10.408	-0.0192123	10.407	-0.02881844	10.407	-0.02881844	10.405	-0.04803074
		M	10.41	10.408	-0.0192123	10.407	-0.02881844	10.407	-0.02881844	10.405	-0.04803074
		U	10.41	10.408	-0.0192123	10.407	-0.02881844	10.407	-0.02881844	10.405	-0.04803074
	T (KN-m)	L	4.229	4.2294	0.0094585	4.2298	0.018917	4.2302	0.0283755	4.2306	0.037834
		M	4.229	4.2294	0.0094585	4.2298	0.018917	4.2302	0.0283755	4.2306	0.037834
		U	4.229	4.2294	0.0094585	4.2298	0.018917	4.2302	0.0283755	4.2306	0.037834
	M2 (KN-m)	L	14.3879	14.3877	-0.00139006	14.3875	-0.00278011	14.3873	-0.00417017	14.3872	-0.0048652
		M	7.7545727	7.7574499	0.03710327	7.7603737	0.07480747	7.7632727	0.11219187	7.7661727	0.14958916
		U	52.6101	52.6209	0.02052838	52.6316	0.04086668	52.6423	0.06120498	52.6531	0.08173336
	M3 (KN-m)	L	14.3879	14.3877	-0.00139006	14.3875	-0.00278011	14.3873	-0.00417017	14.3872	-0.0048652
		M	7.7545727	7.7574499	0.03710327	7.7603737	0.07480747	7.7632727	0.11219187	7.7661727	0.14958916
		U	52.6101	52.6209	0.02052838	52.6316	0.04086668	52.6423	0.06120498	52.6531	0.08173336

6	P (KN)	L	-116.851	-116.873	0.0188274	-116.896	0.03851058	-116.918	0.05733798	-116.94	0.07616537
		M	-98.851	-98.873	0.02225572	-98.896	0.04552306	-98.918	0.06777878	-98.94	0.0900345
		U	-80.851	-80.873	0.02721055	-80.896	0.05565794	-80.918	0.08286849	-80.94	0.11007903
	V2 (KN)	L	5.46	5.458	-0.03663004	5.456	-0.07326007	5.453	-0.12820513	5.451	-0.16483516
		M	5.46	5.458	-0.03663004	5.456	-0.07326007	5.453	-0.12820513	5.451	-0.16483516
		U	5.46	5.458	-0.03663004	5.456	-0.07326007	5.453	-0.12820513	5.451	-0.16483516
	V3 (KN)	L	5.46	5.458	-0.03663004	5.456	-0.07326007	5.453	-0.12820513	5.451	-0.16483516
		M	5.46	5.458	-0.03663004	5.456	-0.07326007	5.453	-0.12820513	5.451	-0.16483516
		U	5.46	5.458	-0.03663004	5.456	-0.07326007	5.453	-0.12820513	5.451	-0.16483516
	T (KN-m)	L	3.0374	3.0378	0.01316916	3.038	0.01975374	3.0384	0.03292289	3.0388	0.04609205
		M	3.0374	3.0378	0.01316916	3.038	0.01975374	3.0384	0.03292289	3.0388	0.04609205
		U	3.0374	3.0378	0.01316916	3.038	0.01975374	3.0384	0.03292289	3.0388	0.04609205
	M2 (KN-m)	L	2.6131	2.6081	-0.19134361	2.6032	-0.37886036	2.5982	-0.57020397	2.5931	-0.76537446
		M	8.5997	8.6001	0.00465133	8.6006	0.01046548	8.6009	0.01395398	8.6013	0.0186053
		U	43.3266	43.3376	0.02538856	43.3484	0.05031551	43.3593	0.07547327	43.3703	0.10086183
	M3 (KN-m)	L	2.6131	2.6081	-0.19134361	2.6032	-0.37886036	2.5982	-0.57020397	2.5931	-0.76537446
		M	8.5997	8.6001	0.00465133	8.6006	0.01046548	8.6009	0.01395398	8.6013	0.0186053
		U	43.3266	43.3376	0.02538856	43.3484	0.05031551	43.3593	0.07547327	43.3703	0.10086183

Table 4.34 (continued)

7	P (KN)	L	-60.524	-60.534	0.01652237	-60.542	0.02974027	-60.552	0.04626264	-60.562	0.06278501
		M	-42.524	-42.534	0.02351613	-42.542	0.04232904	-42.552	0.06584517	-42.562	0.0893613
		U	-24.524	-24.534	0.04077638	-24.542	0.07339749	-24.552	0.11417387	-24.562	0.15495025
	V2 (KN)	L	-4.236	-4.24	0.09442871	-4.243	0.16525024	-4.247	0.25967894	-4.251	0.35410765
		M	-4.236	-4.24	0.09442871	-4.243	0.16525024	-4.247	0.25967894	-4.251	0.35410765
		U	-4.236	-4.24	0.09442871	-4.243	0.16525024	-4.247	0.25967894	-4.251	0.35410765
	V3 (KN)	L	-4.236	-4.24	0.09442871	-4.243	0.16525024	-4.247	0.25967894	-4.251	0.35410765
		M	-4.236	-4.24	0.09442871	-4.243	0.16525024	-4.247	0.25967894	-4.251	0.35410765
		U	-4.236	-4.24	0.09442871	-4.243	0.16525024	-4.247	0.25967894	-4.251	0.35410765
	T (KN-m)	L	1.7878	1.788	0.01118693	1.7882	0.02237387	1.7886	0.04474773	1.7888	0.05593467
		M	1.7878	1.788	0.01118693	1.7882	0.02237387	1.7886	0.04474773	1.7888	0.05593467
		U	1.7878	1.788	0.01118693	1.7882	0.02237387	1.7886	0.04474773	1.7888	0.05593467
	M2 (KN-m)	L	-10.578	-10.5823	0.04065041	-10.5864	0.0794101	-10.5907	0.1200605	-10.5948	0.15882019
		M	8.4385	8.4408	0.02725603	8.4432	0.0556971	8.4456	0.08413818	8.448	0.11257925
		U	32.1668	32.1823	0.04818633	32.1977	0.09606178	32.2132	0.14424811	32.2286	0.19212356
	M3 (KN-m)	L	-10.578	-10.5823	0.04065041	-10.5864	0.0794101	-10.5907	0.1200605	-10.5948	0.15882019
		M	8.4385	8.4408	0.02725603	8.4432	0.0556971	8.4456	0.08413818	8.448	0.11257925
		U	32.1668	32.1823	0.04818633	32.1977	0.09606178	32.2132	0.14424811	32.2286	0.19212356

Table 4.35 Mass irregularity in second floor: Percentage change in column forces relative to original live load for L-shaped plan building

Column label	Column force	At	Original Live Load	Live load at second storey and % change relative to original live load							
				3KN/m2	% change	4KN/m2	% change	5KN/m2	% change	6KN/m2	% change
1	P (KN)	L	-211.906	-215.738	1.80834898	-219.567	3.61528225	-223.397	5.42268742	-227.228	7.2305645
		M	-207.406	-211.238	1.84758397	-215.067	3.69372149	-218.897	5.54034117	-222.728	7.38744299
		U	-202.906	-206.738	1.88855923	-210.567	3.77563995	-214.397	5.66321351	-218.228	7.5512799
	V2 (KN)	L	14.824	15.259	2.93443065	15.695	5.87560712	16.129	8.80329196	16.564	11.7377226
		M	14.824	15.259	2.93443065	15.695	5.87560712	16.129	8.80329196	16.564	11.7377226
		U	14.824	15.259	2.93443065	15.695	5.87560712	16.129	8.80329196	16.564	11.7377226
	V3 (KN)	L	14.824	15.259	2.93443065	15.695	5.87560712	16.129	8.80329196	16.564	11.7377226
		M	14.824	15.259	2.93443065	15.695	5.87560712	16.129	8.80329196	16.564	11.7377226
		U	14.824	15.259	2.93443065	15.695	5.87560712	16.129	8.80329196	16.564	11.7377226
	T (KN-m)	L	1.0578	1.0598	0.18907166	1.0616	0.35923615	1.0636	0.54830781	1.0654	0.7184723
		M	1.0578	1.0598	0.18907166	1.0616	0.35923615	1.0636	0.54830781	1.0654	0.7184723
		U	1.0578	1.0598	0.18907166	1.0616	0.35923615	1.0636	0.54830781	1.0654	0.7184723
	M2 (KN-m)	L	71.1119	71.3365	0.31584025	71.5616	0.63238361	71.7868	0.9490676	72.0126	1.26659532
		M	63.7142	63.7214	0.01130046	63.7291	0.02338568	63.737	0.0357848	63.7451	0.04849782
		U	56.3261	56.1162	-0.3726514	55.9065	-0.74494772	55.6969	-1.11706651	55.4875	-1.48883022
	M3 (KN-m)	L	71.1119	71.3365	0.31584025	71.5616	0.63238361	71.7868	0.9490676	72.0126	1.26659532
		M	63.7142	63.7214	0.01130046	63.7291	0.02338568	63.737	0.0357848	63.7451	0.04849782
		U	56.3261	56.1162	-0.3726514	55.9065	-0.74494772	55.6969	-1.11706651	55.4875	-1.48883022

Table 4.35 (continued)

2	P (KN)	L	-195.331	-199.16	1.96026232	-202.991	3.92154855	-206.822	5.88283478	-210.651	7.8430971
		M	-177.331	-181.16	2.15923894	-184.991	4.31960571	-188.822	6.47997248	-192.651	8.63921142
		U	-159.331	-163.16	2.40317327	-166.991	4.80760178	-170.822	7.2120303	-174.651	9.61520357
	V2 (KN)	L	27.465	27.2	-0.96486437	26.936	-1.92608775	26.672	-2.88731112	26.408	-3.8485345
		M	27.465	27.2	-0.96486437	26.936	-1.92608775	26.672	-2.88731112	26.408	-3.8485345
		U	27.465	27.2	-0.96486437	26.936	-1.92608775	26.672	-2.88731112	26.408	-3.8485345
	V3 (KN)	L	27.465	27.2	-0.96486437	26.936	-1.92608775	26.672	-2.88731112	26.408	-3.8485345
		M	27.465	27.2	-0.96486437	26.936	-1.92608775	26.672	-2.88731112	26.408	-3.8485345
		U	27.465	27.2	-0.96486437	26.936	-1.92608775	26.672	-2.88731112	26.408	-3.8485345
	T (KN-m)	L	4.4784	4.4856	0.1607717	4.4928	0.32154341	4.5	0.48231511	4.5072	0.64308682
		M	4.4784	4.4856	0.1607717	4.4928	0.32154341	4.5	0.48231511	4.5072	0.64308682
		U	4.4784	4.4856	0.1607717	4.4928	0.32154341	4.5	0.48231511	4.5072	0.64308682
	M2 (KN-m)	L	77.1923	76.997	-0.25300451	76.8021	-0.50549083	76.6074	-0.75771806	76.4132	-1.00929756
		M	22.3295	22.6672	1.51234913	23.0049	3.02469827	23.3426	4.5370474	23.6803	6.04939654
		U	50.4222	51.5803	2.29680577	52.7392	4.59519815	53.8987	6.89478047	55.0589	9.19575108
	M3 (KN-m)	L	77.1923	76.997	-0.25300451	76.8021	-0.50549083	76.6074	-0.75771806	76.4132	-1.00929756
		M	22.3295	22.6672	1.51234913	23.0049	3.02469827	23.3426	4.5370474	23.6803	6.04939654
		U	50.4222	51.5803	2.29680577	52.7392	4.59519815	53.8987	6.89478047	55.0589	9.19575108

3	P (KN)	L	-188.21	-188.452	0.12857978	-188.695	0.25769088	-188.937	0.38627066	-189.18	0.51538175
		M	-170.21	-170.452	0.14217731	-170.695	0.28494213	-170.937	0.42711944	-171.18	0.56988426
		U	-152.21	-152.452	0.15899087	-152.695	0.31863872	-152.937	0.47762959	-153.18	0.63727745
	V2 (KN)	L	18.745	18.437	-1.64310483	18.127	-3.29687917	17.818	-4.94531875	17.511	-6.58308882
		M	18.745	18.437	-1.64310483	18.127	-3.29687917	17.818	-4.94531875	17.511	-6.58308882
		U	18.745	18.437	-1.64310483	18.127	-3.29687917	17.818	-4.94531875	17.511	-6.58308882
	V3 (KN)	L	18.745	18.437	-1.64310483	18.127	-3.29687917	17.818	-4.94531875	17.511	-6.58308882
		M	18.745	18.437	-1.64310483	18.127	-3.29687917	17.818	-4.94531875	17.511	-6.58308882
		U	18.745	18.437	-1.64310483	18.127	-3.29687917	17.818	-4.94531875	17.511	-6.58308882
	T (KN-m)	L	5.5658	5.5714	0.10061447	5.577	0.20122893	5.5826	0.3018434	5.5882	0.40245787
		M	5.5658	5.5714	0.10061447	5.577	0.20122893	5.5826	0.3018434	5.5882	0.40245787
		U	5.5658	5.5714	0.10061447	5.577	0.20122893	5.5826	0.3018434	5.5882	0.40245787
	M2 (KN-m)	L	36.9761	36.0105	-2.61141656	35.0448	-5.22310357	34.0793	-7.83424969	33.1136	-10.4459367
		M	3.2238522	2.9425522	-8.72558612	2.6611522	-17.4542741	2.3799522	-26.1767584	2.0988522	-34.8961407
		U	59.5478	59.9261	0.63528795	60.3044	1.27057591	60.6828	1.90603179	61.0607	2.54064802
	M3 (KN-m)	L	36.9761	36.0105	-2.61141656	35.0448	-5.22310357	34.0793	-7.83424969	33.1136	-10.4459367
		M	3.2238522	2.9425522	-8.72558612	2.6611522	-17.4542741	2.3799522	-26.1767584	2.0988522	-34.8961407
		U	59.5478	59.9261	0.63528795	60.3044	1.27057591	60.6828	1.90603179	61.0607	2.54064802

Table 4.35 (continued)

4	P (KN)	L	-177.393	-177.54	0.08286685	-177.687	0.16573371	-177.835	0.24916428	-177.982	0.33203114
		M	-159.393	-159.54	0.09222488	-159.687	0.18444976	-159.835	0.27730201	-159.982	0.36952689
		U	-141.393	-141.54	0.10396554	-141.687	0.20793109	-141.835	0.31260388	-141.982	0.41656942
	V2 (KN)	L	15.365	15.423	0.37748129	15.482	0.76147088	15.541	1.14546046	15.599	1.52294175
		M	15.365	15.423	0.37748129	15.482	0.76147088	15.541	1.14546046	15.599	1.52294175
		U	15.365	15.423	0.37748129	15.482	0.76147088	15.541	1.14546046	15.599	1.52294175
	V3 (KN)	L	15.365	15.423	0.37748129	15.482	0.76147088	15.541	1.14546046	15.599	1.52294175
		M	15.365	15.423	0.37748129	15.482	0.76147088	15.541	1.14546046	15.599	1.52294175
		U	15.365	15.423	0.37748129	15.482	0.76147088	15.541	1.14546046	15.599	1.52294175
	T (KN-m)	L	5.1448	5.149	0.08163583	5.153	0.15938423	5.1572	0.24102006	5.1614	0.32265589
		M	5.1448	5.149	0.08163583	5.153	0.15938423	5.1572	0.24102006	5.1614	0.32265589
		U	5.1448	5.149	0.08163583	5.153	0.15938423	5.1572	0.24102006	5.1614	0.32265589
	M2 (KN-m)	L	26.4097	26.5903	0.68383965	26.7707	1.366922	26.9512	2.050383	27.1316	2.73346536
		M	5.9044	5.9876	1.40911862	6.0708	2.81823725	6.154	4.22735587	6.2369	5.63139354
		U	58.3495	58.3796	0.0515857	58.4095	0.10282864	58.4394	0.15407159	58.4692	0.20514315
	M3 (KN-m)	L	26.4097	26.5903	0.68383965	26.7707	1.366922	26.9512	2.050383	27.1316	2.73346536
		M	5.9044	5.9876	1.40911862	6.0708	2.81823725	6.154	4.22735587	6.2369	5.63139354
		U	58.3495	58.3796	0.0515857	58.4095	0.10282864	58.4394	0.15407159	58.4692	0.20514315

5	P (KN)	L	-154.802	-154.925	0.07945634	-155.047	0.15826669	-155.168	0.23643105	-155.289	0.31459542
		M	-136.802	-136.925	0.08991097	-137.047	0.17909095	-137.168	0.26753995	-137.289	0.35598895
		U	-118.802	-118.925	0.10353361	-119.047	0.20622548	-119.168	0.30807562	-119.289	0.40992576
	V2 (KN)	L	10.41	10.392	-0.17291066	10.375	-0.33621518	10.358	-0.49951969	10.341	-0.66282421
		M	10.41	10.392	-0.17291066	10.375	-0.33621518	10.358	-0.49951969	10.341	-0.66282421
		U	10.41	10.392	-0.17291066	10.375	-0.33621518	10.358	-0.49951969	10.341	-0.66282421
	V3 (KN)	L	10.41	10.392	-0.17291066	10.375	-0.33621518	10.358	-0.49951969	10.341	-0.66282421
		M	10.41	10.392	-0.17291066	10.375	-0.33621518	10.358	-0.49951969	10.341	-0.66282421
		U	10.41	10.392	-0.17291066	10.375	-0.33621518	10.358	-0.49951969	10.341	-0.66282421
	T (KN-m)	L	4.229	4.2322	0.07566801	4.2356	0.15606526	4.239	0.23646252	4.2422	0.31213053
		M	4.229	4.2322	0.07566801	4.2356	0.15606526	4.239	0.23646252	4.2422	0.31213053
		U	4.229	4.2322	0.07566801	4.2356	0.15606526	4.239	0.23646252	4.2422	0.31213053
	M2 (KN-m)	L	14.3879	14.3397	-0.33500372	14.2915	-0.67000744	14.2433	-1.00501116	14.1952	-1.33931985
		M	7.7545727	7.7518727	-0.03481817	7.7490727	-0.07092589	7.7461727	-0.10832318	7.7432727	-0.14572047
		U	52.6101	52.7018	0.17430113	52.7935	0.34860226	52.885	0.52252324	52.9765	0.69644422
	M3 (KN-m)	L	14.3879	14.3397	-0.33500372	14.2915	-0.67000744	14.2433	-1.00501116	14.1952	-1.33931985
		M	7.7545727	7.7518727	-0.03481817	7.7490727	-0.07092589	7.7461727	-0.10832318	7.7432727	-0.14572047
		U	52.6101	52.7018	0.17430113	52.7935	0.34860226	52.885	0.52252324	52.9765	0.69644422

Table 4.35 (continued)

6	P (KN)	L	-116.851	-116.937	0.073598	-117.02	0.14462863	-117.104	0.21651505	-117.188	0.28840147
		M	-98.851	-98.937	0.08699963	-99.02	0.17096438	-99.104	0.25594076	-99.188	0.34091714
		U	-80.851	-80.937	0.10636851	-81.02	0.20902648	-81.104	0.3129213	-81.188	0.41681612
	V2 (KN)	L	5.46	5.459	-0.01831502	5.459	-0.01831502	5.458	-0.03663004	5.458	-0.03663004
		M	5.46	5.459	-0.01831502	5.459	-0.01831502	5.458	-0.03663004	5.458	-0.03663004
		U	5.46	5.459	-0.01831502	5.459	-0.01831502	5.458	-0.03663004	5.458	-0.03663004
	V3 (KN)	L	5.46	5.459	-0.01831502	5.459	-0.01831502	5.458	-0.03663004	5.458	-0.03663004
		M	5.46	5.459	-0.01831502	5.459	-0.01831502	5.458	-0.03663004	5.458	-0.03663004
		U	5.46	5.459	-0.01831502	5.459	-0.01831502	5.458	-0.03663004	5.458	-0.03663004
	T (KN-m)	L	3.0374	3.04	0.08559953	3.0426	0.17119905	3.045	0.250214	3.0476	0.33581352
		M	3.0374	3.04	0.08559953	3.0426	0.17119905	3.045	0.250214	3.0476	0.33581352
		U	3.0374	3.04	0.08559953	3.0426	0.17119905	3.045	0.250214	3.0476	0.33581352
	M2 (KN-m)	L	2.6131	2.6132	0.00382687	2.6134	0.01148062	2.6134	0.01148062	2.6133	0.00765374
		M	8.5997	8.6093	0.1116318	8.6188	0.22210077	8.6284	0.33373257	8.6378	0.44303871
		U	43.3266	43.3969	0.16225598	43.4671	0.32428116	43.5374	0.48653714	43.6077	0.64879312
	M3 (KN-m)	L	2.6131	2.6132	0.00382687	2.6134	0.01148062	2.6134	0.01148062	2.6133	0.00765374
		M	8.5997	8.6093	0.1116318	8.6188	0.22210077	8.6284	0.33373257	8.6378	0.44303871
		U	43.3266	43.3969	0.16225598	43.4671	0.32428116	43.5374	0.48653714	43.6077	0.64879312

7	P (KN)	L	-60.524	-60.566	0.06939396	-60.605	0.13383121	-60.646	0.20157293	-60.688	0.27096689
		M	-42.524	-42.566	0.09876775	-42.605	0.19048067	-42.646	0.28689681	-42.688	0.38566457
		U	-24.524	-24.566	0.17126081	-24.605	0.3302887	-24.646	0.49747186	-24.688	0.66873267
	V2 (KN)	L	-4.236	-4.254	0.42492918	-4.274	0.89707271	-4.294	1.36921624	-4.314	1.84135977
		M	-4.236	-4.254	0.42492918	-4.274	0.89707271	-4.294	1.36921624	-4.314	1.84135977
		U	-4.236	-4.254	0.42492918	-4.274	0.89707271	-4.294	1.36921624	-4.314	1.84135977
	V3 (KN)	L	-4.236	-4.254	0.42492918	-4.274	0.89707271	-4.294	1.36921624	-4.314	1.84135977
		M	-4.236	-4.254	0.42492918	-4.274	0.89707271	-4.294	1.36921624	-4.314	1.84135977
		U	-4.236	-4.254	0.42492918	-4.274	0.89707271	-4.294	1.36921624	-4.314	1.84135977
	T (KN-m)	L	1.7878	1.7896	0.1006824	1.7912	0.19017787	1.7928	0.27967334	1.7946	0.38035574
		M	1.7878	1.7896	0.1006824	1.7912	0.19017787	1.7928	0.27967334	1.7946	0.38035574
		U	1.7878	1.7896	0.1006824	1.7912	0.19017787	1.7928	0.27967334	1.7946	0.38035574
	M2 (KN-m)	L	-10.578	-10.6151	0.35072793	-10.653	0.70901872	-10.6915	1.07298166	-10.7307	1.44356211
		M	8.4385	8.4534	0.17657167	8.4684	0.35432838	8.4833	0.53090004	8.4982	0.70747171
		U	32.1668	32.2551	0.27450663	32.3433	0.54870239	32.4313	0.82227638	32.5193	1.09585038
	M3 (KN-m)	L	-10.578	-10.6151	0.35072793	-10.653	0.70901872	-10.6915	1.07298166	-10.7307	1.44356211
		M	8.4385	8.4534	0.17657167	8.4684	0.35432838	8.4833	0.53090004	8.4982	0.70747171
		U	32.1668	32.2551	0.27450663	32.3433	0.54870239	32.4313	0.82227638	32.5193	1.09585038

Table 4.36 Mass irregularity in third floor: Percentage change in column forces relative to original live load for L-shaped plan building

Column label	Column force	At	Original Live Load	Live load at third storey and % change relative to original live load							
				3KN/m2	% change	4KN/m2	% change	5KN/m2	% change	6KN/m2	% change
1	P (KN)	L	-211.906	-215.824	1.84893302	-219.742	3.69786603	-223.662	5.54774287	-227.582	7.3976197
		M	-207.406	-211.324	1.88904853	-215.242	3.77809707	-219.162	5.66810989	-223.082	7.55812272
		U	-202.906	-206.824	1.93094339	-210.742	3.86188679	-214.662	5.79381586	-218.582	7.72574493
	V2 (KN)	L	14.824	14.827	0.02023745	14.832	0.05396654	14.836	0.08094981	14.839	0.10118726
		M	14.824	14.827	0.02023745	14.832	0.05396654	14.836	0.08094981	14.839	0.10118726
		U	14.824	14.827	0.02023745	14.832	0.05396654	14.836	0.08094981	14.839	0.10118726
	V3 (KN)	L	14.824	14.827	0.02023745	14.832	0.05396654	14.836	0.08094981	14.839	0.10118726
		M	14.824	14.827	0.02023745	14.832	0.05396654	14.836	0.08094981	14.839	0.10118726
		U	14.824	14.827	0.02023745	14.832	0.05396654	14.836	0.08094981	14.839	0.10118726
	T (KN-m)	L	1.0578	1.0596	0.17016449	1.0612	0.32142182	1.0628	0.47267915	1.0644	0.62393647
		M	1.0578	1.0596	0.17016449	1.0612	0.32142182	1.0628	0.47267915	1.0644	0.62393647
		U	1.0578	1.0596	0.17016449	1.0612	0.32142182	1.0628	0.47267915	1.0644	0.62393647
	M2 (KN-m)	L	71.1119	71.3261	0.30121541	71.5402	0.60229019	71.7544	0.9035056	71.9684	1.20443976
		M	63.7142	63.9265	0.33320673	64.1389	0.6665704	64.3512	0.99977713	64.5634	1.33282691
		U	56.3261	56.5367	0.37389416	56.7472	0.74761079	56.9578	1.12150495	57.1682	1.49504404
	M3 (KN-m)	L	71.1119	71.3261	0.30121541	71.5402	0.60229019	71.7544	0.9035056	71.9684	1.20443976
		M	63.7142	63.9265	0.33320673	64.1389	0.6665704	64.3512	0.99977713	64.5634	1.33282691
		U	56.3261	56.5367	0.37389416	56.7472	0.74761079	56.9578	1.12150495	57.1682	1.49504404
2	P (KN)	L	-195.331	-199.338	2.05138969	-203.347	4.10380329	-207.356	6.15621688	-211.367	8.20965438
		M	-177.331	-181.338	2.2596162	-185.347	4.52036023	-189.356	6.78110426	-193.367	9.04297613
		U	-159.331	-163.338	2.51489039	-167.347	5.03103602	-171.356	7.54718165	-175.367	10.0645825
	V2 (KN)	L	27.465	27.621	0.56799563	27.777	1.13599126	27.933	1.70398689	28.089	2.27198252
		M	27.465	27.621	0.56799563	27.777	1.13599126	27.933	1.70398689	28.089	2.27198252
		U	27.465	27.621	0.56799563	27.777	1.13599126	27.933	1.70398689	28.089	2.27198252
	V3 (KN)	L	27.465	27.621	0.56799563	27.777	1.13599126	27.933	1.70398689	28.089	2.27198252
		M	27.465	27.621	0.56799563	27.777	1.13599126	27.933	1.70398689	28.089	2.27198252
		U	27.465	27.621	0.56799563	27.777	1.13599126	27.933	1.70398689	28.089	2.27198252
	T (KN-m)	L	4.4784	4.4854	0.15630582	4.4922	0.30814577	4.4992	0.46445159	4.506	0.61629153
		M	4.4784	4.4854	0.15630582	4.4922	0.30814577	4.4992	0.46445159	4.506	0.61629153
		U	4.4784	4.4854	0.15630582	4.4922	0.30814577	4.4992	0.46445159	4.506	0.61629153
	M2 (KN-m)	L	77.1923	77.5133	0.41584459	77.8341	0.83143008	78.1548	1.24688602	78.4755	1.66234197
		M	22.3295	22.3381	0.03851407	22.3467	0.07702815	22.3552	0.11509438	22.3639	0.15405629
		U	50.4222	50.3884	-0.06703397	50.3546	-0.13406793	50.3211	-0.20050692	50.2875	-0.26714423
	M3 (KN-m)	L	77.1923	77.5133	0.41584459	77.8341	0.83143008	78.1548	1.24688602	78.4755	1.66234197
		M	22.3295	22.3381	0.03851407	22.3467	0.07702815	22.3552	0.11509438	22.3639	0.15405629
		U	50.4222	50.3884	-0.06703397	50.3546	-0.13406793	50.3211	-0.20050692	50.2875	-0.26714423

Table 4.36 (continued)

3	P (KN)	L	-188.21	-192.294	2.16991658	-196.378	4.33983317	-200.465	6.51134371	-204.553	8.68338558
		M	-170.21	-174.294	2.39938899	-178.378	4.79877798	-182.465	7.1999295	-186.553	9.60166853
		U	-152.21	-156.294	2.68313514	-160.378	5.36627028	-164.465	8.05137639	-168.553	10.7371395
	V2 (KN)	L	18.745	18.495	-1.33368898	18.245	-2.66737797	17.994	-4.00640171	17.743	-5.34542545
		M	18.745	18.495	-1.33368898	18.245	-2.66737797	17.994	-4.00640171	17.743	-5.34542545
		U	18.745	18.495	-1.33368898	18.245	-2.66737797	17.994	-4.00640171	17.743	-5.34542545
	V3 (KN)	L	18.745	18.495	-1.33368898	18.245	-2.66737797	17.994	-4.00640171	17.743	-5.34542545
		M	18.745	18.495	-1.33368898	18.245	-2.66737797	17.994	-4.00640171	17.743	-5.34542545
		U	18.745	18.495	-1.33368898	18.245	-2.66737797	17.994	-4.00640171	17.743	-5.34542545
	T (KN-m)	L	5.5658	5.5732	0.13295483	5.5806	0.26590966	5.588	0.39886449	5.5952	0.52822595
		M	5.5658	5.5732	0.13295483	5.5806	0.26590966	5.588	0.39886449	5.5952	0.52822595
		U	5.5658	5.5732	0.13295483	5.5806	0.26590966	5.588	0.39886449	5.5952	0.52822595
	M2 (KN-m)	L	36.9761	36.7686	-0.5611733	36.5609	-1.12288749	36.3533	-1.68433123	36.1456	-2.24604542
		M	3.2238522	3.5951522	11.5172774	3.9669522	23.0500641	4.3392522	34.5983603	4.7119522	46.159064
		U	59.5478	60.7973	2.0983143	62.0471	4.19713239	63.297	6.29611841	64.5469	8.39510444
	M3 (KN-m)	L	36.9761	36.7686	-0.5611733	36.5609	-1.12288749	36.3533	-1.68433123	36.1456	-2.24604542
		M	3.2238522	3.5951522	11.5172774	3.9669522	23.0500641	4.3392522	34.5983603	4.7119522	46.159064
		U	59.5478	60.7973	2.0983143	62.0471	4.19713239	63.297	6.29611841	64.5469	8.39510444

4	P (KN)	L	-177.393	-177.88	0.27453169	-178.369	0.55019082	-178.858	0.82584995	-179.35	1.10320024
		M	-159.393	-159.88	0.30553412	-160.369	0.612323	-160.858	0.91911188	-161.35	1.2277829
		U	-141.393	-141.88	0.34443006	-142.369	0.69027462	-142.858	1.03611919	-143.35	1.38408549
	V2 (KN)	L	15.365	15.018	-2.25837943	14.671	-4.51675887	14.325	-6.76863	13.976	-9.04002603
		M	15.365	15.018	-2.25837943	14.671	-4.51675887	14.325	-6.76863	13.976	-9.04002603
		U	15.365	15.018	-2.25837943	14.671	-4.51675887	14.325	-6.76863	13.976	-9.04002603
	V3 (KN)	L	15.365	15.018	-2.25837943	14.671	-4.51675887	14.325	-6.76863	13.976	-9.04002603
		M	15.365	15.018	-2.25837943	14.671	-4.51675887	14.325	-6.76863	13.976	-9.04002603
		U	15.365	15.018	-2.25837943	14.671	-4.51675887	14.325	-6.76863	13.976	-9.04002603
	T (KN-m)	L	5.1448	5.1462	0.02721194	5.1476	0.05442388	5.149	0.08163583	5.1504	0.10884777
		M	5.1448	5.1462	0.02721194	5.1476	0.05442388	5.149	0.08163583	5.1504	0.10884777
		U	5.1448	5.1462	0.02721194	5.1476	0.05442388	5.149	0.08163583	5.1504	0.10884777
	M2 (KN-m)	L	26.4097	25.3448	-4.03223058	24.2797	-8.06521846	23.2145	-12.098585	22.1492	-16.1323302
		M	5.9044	5.6258	-4.71851501	5.3472	-9.43703001	5.0685	-14.1572387	4.7897	-18.879141
		U	58.3495	58.7518	0.68946606	59.1537	1.3782466	59.5553	2.06651299	59.9566	2.75426525
	M3 (KN-m)	L	26.4097	25.3448	-4.03223058	24.2797	-8.06521846	23.2145	-12.098585	22.1492	-16.1323302
		M	5.9044	5.6258	-4.71851501	5.3472	-9.43703001	5.0685	-14.1572387	4.7897	-18.879141
		U	58.3495	58.7518	0.68946606	59.1537	1.3782466	59.5553	2.06651299	59.9566	2.75426525

Table 4.36 (continued)

5	P (KN)	L	-154.802	-155.136	0.21575949	-155.47	0.43151897	-155.804	0.64727846	-156.14	0.86432992
		M	-136.802	-137.136	0.24414848	-137.47	0.48829695	-137.804	0.73244543	-138.14	0.97805588
		U	-118.802	-119.136	0.28114005	-119.47	0.5622801	-119.804	0.84342014	-120.14	1.12624367
	V2 (KN)	L	10.41	10.442	0.30739673	10.473	0.60518732	10.505	0.91258405	10.536	1.21037464
		M	10.41	10.442	0.30739673	10.473	0.60518732	10.505	0.91258405	10.536	1.21037464
		U	10.41	10.442	0.30739673	10.473	0.60518732	10.505	0.91258405	10.536	1.21037464
	V3 (KN)	L	10.41	10.442	0.30739673	10.473	0.60518732	10.505	0.91258405	10.536	1.21037464
		M	10.41	10.442	0.30739673	10.473	0.60518732	10.505	0.91258405	10.536	1.21037464
		U	10.41	10.442	0.30739673	10.473	0.60518732	10.505	0.91258405	10.536	1.21037464
	T (KN-m)	L	4.229	4.2286	-0.0094585	4.2282	-0.018917	4.2278	-0.0283755	4.2274	-0.037834
		M	4.229	4.2286	-0.0094585	4.2282	-0.018917	4.2278	-0.0283755	4.2274	-0.037834
		U	4.229	4.2286	-0.0094585	4.2282	-0.018917	4.2278	-0.0283755	4.2274	-0.037834
	M2 (KN-m)	L	14.3879	14.5138	0.87504083	14.6393	1.74730155	14.7647	2.61886724	14.8896	3.48695779
		M	7.7545727	7.8288727	0.95814435	7.9031727	1.9162887	7.9774727	2.87443304	8.0515727	3.82999827
		U	52.6101	52.6518	0.07926235	52.6934	0.15833462	52.7348	0.23702673	52.7758	0.31495853
	M3 (KN-m)	L	14.3879	14.5138	0.87504083	14.6393	1.74730155	14.7647	2.61886724	14.8896	3.48695779
		M	7.7545727	7.8288727	0.95814435	7.9031727	1.9162887	7.9774727	2.87443304	8.0515727	3.82999827
		U	52.6101	52.6518	0.07926235	52.6934	0.15833462	52.7348	0.23702673	52.7758	0.31495853
6	P (KN)	L	-116.851	-117.087	0.20196661	-117.326	0.40650059	-117.563	0.60932298	-117.801	0.81300117
		M	-98.851	-99.087	0.23874316	-99.326	0.48052119	-99.563	0.72027597	-99.801	0.96104238
		U	-80.851	-81.087	0.29189497	-81.326	0.58750046	-81.563	0.88063227	-81.801	1.17500093
	V2 (KN)	L	5.46	5.418	-0.76923077	5.376	-1.53846154	5.334	-2.30769231	5.291	-3.0952381
		M	5.46	5.418	-0.76923077	5.376	-1.53846154	5.334	-2.30769231	5.291	-3.0952381
		U	5.46	5.418	-0.76923077	5.376	-1.53846154	5.334	-2.30769231	5.291	-3.0952381
	V3 (KN)	L	5.46	5.418	-0.76923077	5.376	-1.53846154	5.334	-2.30769231	5.291	-3.0952381
		M	5.46	5.418	-0.76923077	5.376	-1.53846154	5.334	-2.30769231	5.291	-3.0952381
		U	5.46	5.418	-0.76923077	5.376	-1.53846154	5.334	-2.30769231	5.291	-3.0952381
	T (KN-m)	L	3.0374	3.037	-0.01316916	3.0364	-0.03292289	3.036	-0.04609205	3.0354	-0.06584579
		M	3.0374	3.037	-0.01316916	3.0364	-0.03292289	3.036	-0.04609205	3.0354	-0.06584579
		U	3.0374	3.037	-0.01316916	3.0364	-0.03292289	3.036	-0.04609205	3.0354	-0.06584579
	M2 (KN-m)	L	2.6131	2.5031	-4.20955953	2.3928	-8.43059967	2.2821	-12.6669473	2.1712	-16.9109487
		M	8.5997	8.587	-0.14767957	8.574	-0.29884763	8.561	-0.4500157	8.5481	-0.60002093
		U	43.3266	43.4213	0.21857242	43.5157	0.43645243	43.6097	0.65340922	43.7035	0.8699044
	M3 (KN-m)	L	2.6131	2.5031	-4.20955953	2.3928	-8.43059967	2.2821	-12.6669473	2.1712	-16.9109487
		M	8.5997	8.587	-0.14767957	8.574	-0.29884763	8.561	-0.4500157	8.5481	-0.60002093
		U	43.3266	43.4213	0.21857242	43.5157	0.43645243	43.6097	0.65340922	43.7035	0.8699044

Table 4.36 (continued)

7	P (KN)	L	-60.524	-60.628	0.17183266	-60.735	0.34862203	-60.841	0.52375917	-60.947	0.69889631
		M	-42.524	-42.628	0.24456777	-42.735	0.49619039	-42.841	0.74546139	-42.947	0.99473239
		U	-24.524	-24.628	0.42407438	-24.735	0.86038167	-24.841	1.29261132	-24.947	1.72484097
	V2 (KN)	L	-4.236	-4.285	1.15675165	-4.335	2.33711048	-4.384	3.49386213	-4.433	4.65061379
		M	-4.236	-4.285	1.15675165	-4.335	2.33711048	-4.384	3.49386213	-4.433	4.65061379
		U	-4.236	-4.285	1.15675165	-4.335	2.33711048	-4.384	3.49386213	-4.433	4.65061379
	V3 (KN)	L	-4.236	-4.285	1.15675165	-4.335	2.33711048	-4.384	3.49386213	-4.433	4.65061379
		M	-4.236	-4.285	1.15675165	-4.335	2.33711048	-4.384	3.49386213	-4.433	4.65061379
		U	-4.236	-4.285	1.15675165	-4.335	2.33711048	-4.384	3.49386213	-4.433	4.65061379
	T (KN-m)	L	1.7878	1.7876	-0.01118693	1.7874	-0.02237387	1.7872	-0.0335608	1.787	-0.04474773
		M	1.7878	1.7876	-0.01118693	1.7874	-0.02237387	1.7872	-0.0335608	1.787	-0.04474773
		U	1.7878	1.7876	-0.01118693	1.7874	-0.02237387	1.7872	-0.0335608	1.787	-0.04474773
	M2 (KN-m)	L	-10.578	-10.6634	0.80733598	-10.7488	1.61467196	-10.8343	2.4229533	-10.9196	3.22934392
		M	8.4385	8.4599	0.25359957	8.4812	0.5060141	8.5026	0.75961368	8.5238	1.01084316
		U	32.1668	32.2849	0.36714874	32.4029	0.73398659	32.5207	1.10020269	32.6383	1.46579703
	M3 (KN-m)	L	-10.578	-10.6634	0.80733598	-10.7488	1.61467196	-10.8343	2.4229533	-10.9196	3.22934392
		M	8.4385	8.4599	0.25359957	8.4812	0.5060141	8.5026	0.75961368	8.5238	1.01084316
		U	32.1668	32.2849	0.36714874	32.4029	0.73398659	32.5207	1.10020269	32.6383	1.46579703

Table 4.37 Mass irregularity in fourth floor: Percentage change in column forces relative to original live load for L-shaped plan building

Column label	Column force	At	Original Live Load	Live load at fourth storey and % change relative to original live load							
				3KN/m2	% change	4KN/m2	% change	5KN/m2	% change	6KN/m2	% change
1	P (KN)	L	-211.906	-215.993	1.92868536	-220.083	3.85878644	-224.176	5.79030325	-228.274	7.72417959
		M	-207.406	-211.493	1.97053123	-215.583	3.9425089	-219.676	5.915933	-223.774	7.89176784
		U	-202.906	-206.993	2.01423319	-211.083	4.0299449	-215.176	6.04713513	-219.274	8.06678955
	V2 (KN)	L	14.824	14.907	0.55990286	14.989	1.1130599	15.069	1.65272531	15.152	2.21262817
		M	14.824	14.907	0.55990286	14.989	1.1130599	15.069	1.65272531	15.152	2.21262817
		U	14.824	14.907	0.55990286	14.989	1.1130599	15.069	1.65272531	15.152	2.21262817
	V3 (KN)	L	14.824	14.907	0.55990286	14.989	1.1130599	15.069	1.65272531	15.152	2.21262817
		M	14.824	14.907	0.55990286	14.989	1.1130599	15.069	1.65272531	15.152	2.21262817
		U	14.824	14.907	0.55990286	14.989	1.1130599	15.069	1.65272531	15.152	2.21262817
	T (KN-m)	L	1.0578	1.0584	0.0567215	1.0588	0.09453583	1.0592	0.13235016	1.0596	0.17016449
		M	1.0578	1.0584	0.0567215	1.0588	0.09453583	1.0592	0.13235016	1.0596	0.17016449
		U	1.0578	1.0584	0.0567215	1.0588	0.09453583	1.0592	0.13235016	1.0596	0.17016449
	M2 (KN-m)	L	71.1119	71.3091	0.27730942	71.5057	0.55377511	71.7014	0.82897518	71.8962	1.10290964
		M	63.7142	63.8705	0.24531423	64.026	0.48937286	64.1809	0.73248977	64.3351	0.97450804
		U	56.3261	56.4413	0.2045233	56.556	0.40815892	56.6702	0.61090684	56.7838	0.81258955
	M3 (KN-m)	L	71.1119	71.3091	0.27730942	71.5057	0.55377511	71.7014	0.82897518	71.8962	1.10290964
		M	63.7142	63.8705	0.24531423	64.026	0.48937286	64.1809	0.73248977	64.3351	0.97450804
		U	56.3261	56.4413	0.2045233	56.556	0.40815892	56.6702	0.61090684	56.7838	0.81258955

Table 4.37 (continued)

2	P (KN)	L	-195.331	-199.503	2.13586169	-203.679	4.27377119	-207.859	6.41372849	-212.043	8.5557336
		M	-177.331	-181.503	2.35266254	-185.679	4.70758074	-189.859	7.06475461	-194.043	9.42418415
		U	-159.331	-163.503	2.61844839	-167.679	5.23940727	-171.859	7.86287665	-176.043	10.4888565
	V2 (KN)	L	27.465	27.524	0.21481886	27.582	0.42599672	27.639	0.63353359	27.695	0.83742946
		M	27.465	27.524	0.21481886	27.582	0.42599672	27.639	0.63353359	27.695	0.83742946
		U	27.465	27.524	0.21481886	27.582	0.42599672	27.639	0.63353359	27.695	0.83742946
	V3 (KN)	L	27.465	27.524	0.21481886	27.582	0.42599672	27.639	0.63353359	27.695	0.83742946
		M	27.465	27.524	0.21481886	27.582	0.42599672	27.639	0.63353359	27.695	0.83742946
		U	27.465	27.524	0.21481886	27.582	0.42599672	27.639	0.63353359	27.695	0.83742946
	T (KN-m)	L	4.4784	4.4804	0.04465881	4.4824	0.08931761	4.4844	0.13397642	4.4862	0.17416935
		M	4.4784	4.4804	0.04465881	4.4824	0.08931761	4.4844	0.13397642	4.4862	0.17416935
		U	4.4784	4.4804	0.04465881	4.4824	0.08931761	4.4844	0.13397642	4.4862	0.17416935
	M2 (KN-m)	L	77.1923	77.3903	0.25650227	77.5873	0.51170907	77.7833	0.76562041	77.9782	1.01810673
		M	22.3295	22.4105	0.36274883	22.4911	0.72370631	22.5715	1.08376811	22.6516	1.4424864
		U	50.4222	50.5967	0.34607772	50.7711	0.69195711	50.9449	1.03664656	51.1185	1.38093935
	M3 (KN-m)	L	77.1923	77.3903	0.25650227	77.5873	0.51170907	77.7833	0.76562041	77.9782	1.01810673
		M	22.3295	22.4105	0.36274883	22.4911	0.72370631	22.5715	1.08376811	22.6516	1.4424864
		U	50.4222	50.5967	0.34607772	50.7711	0.69195711	50.9449	1.03664656	51.1185	1.38093935

3	P (KN)	L	-188.21	-192.562	2.31231072	-196.919	4.62727804	-201.275	6.94171404	-205.636	9.25880665
		M	-170.21	-174.562	2.55684155	-178.919	5.11662065	-183.275	7.67581223	-187.636	10.2379414
		U	-152.21	-156.562	2.85920767	-160.919	5.72170028	-165.275	8.5835359	-169.636	11.4486565
	V2 (KN)	L	18.745	18.849	0.55481462	18.955	1.12029875	19.058	1.66977861	19.161	2.21925847
		M	18.745	18.849	0.55481462	18.955	1.12029875	19.058	1.66977861	19.161	2.21925847
		U	18.745	18.849	0.55481462	18.955	1.12029875	19.058	1.66977861	19.161	2.21925847
	V3 (KN)	L	18.745	18.849	0.55481462	18.955	1.12029875	19.058	1.66977861	19.161	2.21925847
		M	18.745	18.849	0.55481462	18.955	1.12029875	19.058	1.66977861	19.161	2.21925847
		U	18.745	18.849	0.55481462	18.955	1.12029875	19.058	1.66977861	19.161	2.21925847
	T (KN-m)	L	5.5658	5.5694	0.06468073	5.5728	0.12576808	5.5762	0.18685544	5.5794	0.24434942
		M	5.5658	5.5694	0.06468073	5.5728	0.12576808	5.5762	0.18685544	5.5794	0.24434942
		U	5.5658	5.5694	0.06468073	5.5728	0.12576808	5.5762	0.18685544	5.5794	0.24434942
	M2 (KN-m)	L	36.9761	37.1253	0.40350388	37.2736	0.80457377	37.4212	1.20375053	37.5683	1.60157507
		M	3.2238522	3.1517522	-2.23645488	3.0797522	-4.46980789	3.0081522	-6.69075338	2.9368522	-8.90239323
		U	59.5478	59.5586	0.01813669	59.5688	0.03526579	59.5785	0.05155522	59.5875	0.06666913
	M3 (KN-m)	L	36.9761	37.1253	0.40350388	37.2736	0.80457377	37.4212	1.20375053	37.5683	1.60157507
		M	3.2238522	3.1517522	-2.23645488	3.0797522	-4.46980789	3.0081522	-6.69075338	2.9368522	-8.90239323
		U	59.5478	59.5586	0.01813669	59.5688	0.03526579	59.5785	0.05155522	59.5875	0.06666913

Table 4.37 (continued)

4	P (KN)	L	-177.393	-181.776	2.47078521	-186.163	4.94382529	-190.552	7.41799282	-194.942	9.89272406
		M	-159.393	-163.776	2.74980708	-168.163	5.50212368	-172.552	8.25569504	-176.942	11.0098938
		U	-141.393	-145.776	3.09987057	-150.163	6.20257014	-154.552	9.30668421	-158.942	12.4115055
	V2 (KN)	L	15.365	15.097	-1.74422389	14.829	-3.48844777	14.56	-5.23917995	14.293	-6.97689554
		M	15.365	15.097	-1.74422389	14.829	-3.48844777	14.56	-5.23917995	14.293	-6.97689554
		U	15.365	15.097	-1.74422389	14.829	-3.48844777	14.56	-5.23917995	14.293	-6.97689554
	V3 (KN)	L	15.365	15.097	-1.74422389	14.829	-3.48844777	14.56	-5.23917995	14.293	-6.97689554
		M	15.365	15.097	-1.74422389	14.829	-3.48844777	14.56	-5.23917995	14.293	-6.97689554
		U	15.365	15.097	-1.74422389	14.829	-3.48844777	14.56	-5.23917995	14.293	-6.97689554
	T (KN-m)	L	5.1448	5.1468	0.0388742	5.149	0.08163583	5.151	0.12051003	5.153	0.15938423
		M	5.1448	5.1468	0.0388742	5.149	0.08163583	5.151	0.12051003	5.153	0.15938423
		U	5.1448	5.1468	0.0388742	5.149	0.08163583	5.151	0.12051003	5.153	0.15938423
	M2 (KN-m)	L	26.4097	26.1494	-0.98562271	25.8886	-1.97313866	25.6276	-2.96141191	25.3661	-3.9515784
		M	5.9044	6.2986	6.67637694	6.6927	13.3510602	7.0867	20.0240499	7.4807	26.6970395
		U	58.3495	59.6423	2.21561453	60.9342	4.42968663	62.2253	6.64238768	63.5158	8.85406045
	M3 (KN-m)	L	26.4097	26.1494	-0.98562271	25.8886	-1.97313866	25.6276	-2.96141191	25.3661	-3.9515784
		M	5.9044	6.2986	6.67637694	6.6927	13.3510602	7.0867	20.0240499	7.4807	26.6970395
		U	58.3495	59.6423	2.21561453	60.9342	4.42968663	62.2253	6.64238768	63.5158	8.85406045

5	P (KN)	L	-154.802	-155.494	0.44702265	-156.188	0.89533727	-156.882	1.34365189	-157.578	1.79325849
		M	-136.802	-137.494	0.50584056	-138.188	1.01314308	-138.882	1.52044561	-139.578	2.0292101
		U	-118.802	-119.494	0.58248178	-120.188	1.16664703	-120.882	1.75081228	-121.578	2.336661
	V2 (KN)	L	10.41	10.014	-3.80403458	9.617	-7.61767531	9.221	-11.4217099	8.824	-15.2353506
		M	10.41	10.014	-3.80403458	9.617	-7.61767531	9.221	-11.4217099	8.824	-15.2353506
		U	10.41	10.014	-3.80403458	9.617	-7.61767531	9.221	-11.4217099	8.824	-15.2353506
	V3 (KN)	L	10.41	10.014	-3.80403458	9.617	-7.61767531	9.221	-11.4217099	8.824	-15.2353506
		M	10.41	10.014	-3.80403458	9.617	-7.61767531	9.221	-11.4217099	8.824	-15.2353506
		U	10.41	10.014	-3.80403458	9.617	-7.61767531	9.221	-11.4217099	8.824	-15.2353506
	T (KN-m)	L	4.229	4.2238	-0.12296051	4.2186	-0.24592102	4.2134	-0.36888153	4.2082	-0.49184204
		M	4.229	4.2238	-0.12296051	4.2186	-0.24592102	4.2134	-0.36888153	4.2082	-0.49184204
		U	4.229	4.2238	-0.12296051	4.2186	-0.24592102	4.2134	-0.36888153	4.2082	-0.49184204
	M2 (KN-m)	L	14.3879	13.2157	-8.14712362	12.0433	-16.2956373	10.8708	-24.444846	9.6983	-32.5940547
		M	7.7545727	7.4806727	-3.53210951	7.2066727	-7.06550859	6.9324727	-10.6014868	6.6579727	-14.1413337
		U	52.6101	52.9942	0.73008795	53.378	1.45960567	53.7611	2.18779284	54.1437	2.91502962
	M3 (KN-m)	L	14.3879	13.2157	-8.14712362	12.0434	-16.2949423	10.8708	-24.444846	9.6983	-32.5940547
		M	7.7545727	7.4806727	-3.53210951	7.2066727	-7.06550859	6.9324727	-10.6014868	6.6579727	-14.1413337
		U	52.6101	52.9942	0.73008795	53.378	1.45960567	53.7611	2.18779284	54.1437	2.91502962

Table 4.37 (continued)

6	P (KN)	L	-116.851	-117.255	0.34573945	-117.661	0.69319047	-118.065	1.03892992	-118.471	1.38638095
		M	-98.851	-99.255	0.40869592	-99.661	0.81941508	-100.065	1.228111	-100.471	1.63883016
		U	-80.851	-81.255	0.49968461	-81.661	1.0018429	-82.065	1.5015275	-82.471	2.00368579
	V2 (KN)	L	5.46	5.457	-0.05494505	5.453	-0.12820513	5.448	-0.21978022	5.443	-0.31135531
		M	5.46	5.457	-0.05494505	5.453	-0.12820513	5.448	-0.21978022	5.443	-0.31135531
		U	5.46	5.457	-0.05494505	5.453	-0.12820513	5.448	-0.21978022	5.443	-0.31135531
	V3 (KN)	L	5.46	5.457	-0.05494505	5.453	-0.12820513	5.448	-0.21978022	5.443	-0.31135531
		M	5.46	5.457	-0.05494505	5.453	-0.12820513	5.448	-0.21978022	5.443	-0.31135531
		U	5.46	5.457	-0.05494505	5.453	-0.12820513	5.448	-0.21978022	5.443	-0.31135531
	T (KN-m)	L	3.0374	3.0318	-0.18436821	3.0264	-0.36215184	3.0208	-0.54652005	3.0152	-0.73088826
		M	3.0374	3.0318	-0.18436821	3.0264	-0.36215184	3.0208	-0.54652005	3.0152	-0.73088826
		U	3.0374	3.0318	-0.18436821	3.0264	-0.36215184	3.0208	-0.54652005	3.0152	-0.73088826
	M2 (KN-m)	L	2.6131	2.6718	2.24637404	2.7302	4.48126746	2.7886	6.71616088	2.8466	8.93574681
		M	8.5997	8.6626	0.73142086	8.7251	1.4581904	8.7877	2.18612277	8.8501	2.91172948
		U	43.3266	43.3336	0.01615636	43.3404	0.0318511	43.3466	0.04616102	43.3525	0.05977852
	M3 (KN-m)	L	2.6131	2.6718	2.24637404	2.7302	4.48126746	2.7886	6.71616088	2.8466	8.93574681
		M	8.5997	8.6626	0.73142086	8.7251	1.4581904	8.7877	2.18612277	8.8501	2.91172948
		U	43.3266	43.3336	0.01615636	43.3404	0.0318511	43.3466	0.04616102	43.3525	0.05977852

7	P (KN)	L	-60.524	-60.702	0.29409821	-60.881	0.58984866	-61.06	0.8855991	-61.24	1.18300178
		M	-42.524	-42.702	0.41858715	-42.881	0.83952591	-43.06	1.26046468	-43.24	1.68375506
		U	-24.524	-24.702	0.72581961	-24.881	1.45571685	-25.06	2.18561409	-25.24	2.91958897
	V2 (KN)	L	-4.236	-4.327	2.14825307	-4.418	4.29650614	-4.508	6.42115203	-4.599	8.5694051
		M	-4.236	-4.327	2.14825307	-4.418	4.29650614	-4.508	6.42115203	-4.599	8.5694051
		U	-4.236	-4.327	2.14825307	-4.418	4.29650614	-4.508	6.42115203	-4.599	8.5694051
	V3 (KN)	L	-4.236	-4.327	2.14825307	-4.418	4.29650614	-4.508	6.42115203	-4.599	8.5694051
		M	-4.236	-4.327	2.14825307	-4.418	4.29650614	-4.508	6.42115203	-4.599	8.5694051
		U	-4.236	-4.327	2.14825307	-4.418	4.29650614	-4.508	6.42115203	-4.599	8.5694051
	T (KN-m)	L	1.7878	1.7848	-0.167804	1.7818	-0.33560801	1.7788	-0.50341201	1.7758	-0.67121602
		M	1.7878	1.7848	-0.167804	1.7818	-0.33560801	1.7788	-0.50341201	1.7758	-0.67121602
		U	1.7878	1.7848	-0.167804	1.7818	-0.33560801	1.7788	-0.50341201	1.7758	-0.67121602
	M2 (KN-m)	L	-10.578	-10.7423	1.55322367	-10.9068	3.10833806	-11.0714	4.66439781	-11.2361	6.22140291
		M	8.4385	8.4366	-0.02251585	8.4348	-0.04384666	8.4327	-0.06873259	8.4306	-0.09361853
		U	32.1668	32.3221	0.48279593	32.4772	0.96497009	32.6322	1.44683338	32.7869	1.92776403
	M3 (KN-m)	L	-10.578	-10.7423	1.55322367	-10.9068	3.10833806	-11.0714	4.66439781	-11.2361	6.22140291
		M	8.4385	8.4366	-0.02251585	8.4348	-0.04384666	8.4327	-0.06873259	8.4306	-0.09361853
		U	32.1668	32.3221	0.48279593	32.4772	0.96497009	32.6322	1.44683338	32.7869	1.92776403

Table 4.38 Mass irregularity in fifth floor: Percentage change in column forces relative to original live load for L-shaped plan building

Column label	Column force	At	Original Live Load	Live load at fifth storey and % change relative to original live load							
				3KN/m2	% change	4KN/m2	% change	5KN/m2	% change	6KN/m2	% change
1	P (KN)	L	-211.906	-216.152	2.00371863	-220.404	4.0102687	-224.662	6.01965022	-228.925	8.03139128
		M	-207.406	-211.652	2.04719246	-215.904	4.0972778	-220.162	6.15025602	-224.425	8.20564497
		U	-202.906	-207.152	2.0925946	-211.404	4.18814624	-215.662	6.2866549	-219.925	8.38762777
	V2 (KN)	L	14.824	14.856	0.21586616	14.887	0.42498651	14.917	0.62736104	14.948	0.83648138
		M	14.824	14.856	0.21586616	14.887	0.42498651	14.917	0.62736104	14.948	0.83648138
		U	14.824	14.856	0.21586616	14.887	0.42498651	14.917	0.62736104	14.948	0.83648138
	V3 (KN)	L	14.824	14.856	0.21586616	14.887	0.42498651	14.917	0.62736104	14.948	0.83648138
		M	14.824	14.856	0.21586616	14.887	0.42498651	14.917	0.62736104	14.948	0.83648138
		U	14.824	14.856	0.21586616	14.887	0.42498651	14.917	0.62736104	14.948	0.83648138
	T (KN-m)	L	1.0578	1.0566	-0.11344299	1.0554	-0.22688599	1.0544	-0.32142182	1.0532	-0.43486481
		M	1.0578	1.0566	-0.11344299	1.0554	-0.22688599	1.0544	-0.32142182	1.0532	-0.43486481
		U	1.0578	1.0566	-0.11344299	1.0554	-0.22688599	1.0544	-0.32142182	1.0532	-0.43486481
	M2 (KN-m)	L	71.1119	71.221	0.15342017	71.3291	0.30543411	71.4362	0.45604182	71.5422	0.60510266
		M	63.7142	63.8077	0.14674908	63.9004	0.29224255	63.9921	0.43616651	64.0829	0.57867791
		U	56.3261	56.4039	0.13812424	56.4811	0.27518326	56.5576	0.41099952	56.6334	0.54557301
	M3 (KN-m)	L	71.1119	71.221	0.15342017	71.3291	0.30543411	71.4362	0.45604182	71.5422	0.60510266
		M	63.7142	63.8077	0.14674908	63.9004	0.29224255	63.9921	0.43616651	64.0829	0.57867791
		U	56.3261	56.4039	0.13812424	56.4811	0.27518326	56.5576	0.41099952	56.6334	0.54557301
2	P (KN)	L	-195.331	-199.63	2.20087953	-203.938	4.40636663	-208.249	6.61338958	-212.566	8.82348424
		M	-177.331	-181.63	2.42428002	-185.938	4.85363529	-190.249	7.28468232	-194.566	9.71911285
		U	-159.331	-163.63	2.69815667	-167.938	5.40196195	-172.249	8.10765011	-176.566	10.817104
	V2 (KN)	L	27.465	27.502	0.13471691	27.539	0.26943382	27.577	0.40779173	27.612	0.53522665
		M	27.465	27.502	0.13471691	27.539	0.26943382	27.577	0.40779173	27.612	0.53522665
		U	27.465	27.502	0.13471691	27.539	0.26943382	27.577	0.40779173	27.612	0.53522665
	V3 (KN)	L	27.465	27.502	0.13471691	27.539	0.26943382	27.577	0.40779173	27.612	0.53522665
		M	27.465	27.502	0.13471691	27.539	0.26943382	27.577	0.40779173	27.612	0.53522665
		U	27.465	27.502	0.13471691	27.539	0.26943382	27.577	0.40779173	27.612	0.53522665
	T (KN-m)	L	4.4784	4.4736	-0.10718114	4.4688	-0.21436227	4.464	-0.32154341	4.459	-0.43319043
		M	4.4784	4.4736	-0.10718114	4.4688	-0.21436227	4.464	-0.32154341	4.459	-0.43319043
		U	4.4784	4.4736	-0.10718114	4.4688	-0.21436227	4.464	-0.32154341	4.459	-0.43319043
	M2 (KN-m)	L	77.1923	77.3107	0.15338317	77.4279	0.30521179	77.5437	0.45522675	77.6583	0.60368716
		M	22.3295	22.3728	0.19391388	22.4156	0.38558857	22.4581	0.57591975	22.5003	0.76490741
		U	50.4222	50.4935	0.14140597	50.5642	0.28162198	50.6344	0.42084637	50.7042	0.55927746
	M3 (KN-m)	L	77.1923	77.3107	0.15338317	77.4279	0.30521179	77.5437	0.45522675	77.6583	0.60368716
		M	22.3295	22.3728	0.19391388	22.4156	0.38558857	22.4581	0.57591975	22.5003	0.76490741
		U	50.4222	50.4935	0.14140597	50.5642	0.28162198	50.6344	0.42084637	50.7042	0.55927746

Table 4.38 (continued)

3	P (KN)	L	-188.21	-192.61	2.33781414	-197.015	4.67828489	-201.423	7.02034961	-205.835	9.36453961
		M	-170.21	-174.61	2.58504201	-179.015	5.17302156	-183.423	7.76276364	-187.835	10.3548558
		U	-152.21	-156.61	2.89074305	-161.015	5.78477104	-165.423	8.68076999	-169.835	11.5793969
	V2 (KN)	L	18.745	18.747	0.01066951	18.748	0.01600427	18.747	0.01066951	18.748	0.01600427
		M	18.745	18.747	0.01066951	18.748	0.01600427	18.747	0.01066951	18.748	0.01600427
		U	18.745	18.747	0.01066951	18.748	0.01600427	18.747	0.01066951	18.748	0.01600427
	V3 (KN)	L	18.745	18.747	0.01066951	18.748	0.01600427	18.747	0.01066951	18.748	0.01600427
		M	18.745	18.747	0.01066951	18.748	0.01600427	18.747	0.01066951	18.748	0.01600427
		U	18.745	18.747	0.01066951	18.748	0.01600427	18.747	0.01066951	18.748	0.01600427
	T (KN-m)	L	5.5658	5.5616	-0.07546085	5.5572	-0.15451507	5.5528	-0.2335693	5.5486	-0.30903015
		M	5.5658	5.5616	-0.07546085	5.5572	-0.15451507	5.5528	-0.2335693	5.5486	-0.30903015
		U	5.5658	5.5616	-0.07546085	5.5572	-0.15451507	5.5528	-0.2335693	5.5486	-0.30903015
	M2 (KN-m)	L	36.9761	37.0119	0.0968193	37.0467	0.19093414	37.0806	0.28261499	37.1136	0.37186182
		M	3.2238522	3.2369522	0.40634617	3.2501522	0.81579422	3.2636522	1.23454791	3.2770522	1.65019972
		U	59.5478	59.7226	0.29354569	59.8968	0.58608378	60.0701	0.87711049	60.2429	1.16729753
	M3 (KN-m)	L	36.9761	37.0119	0.0968193	37.0467	0.19093414	37.0806	0.28261499	37.1136	0.37186182
		M	3.2238522	3.2369522	0.40634617	3.2501522	0.81579422	3.2636522	1.23454791	3.2770522	1.65019972
		U	59.5478	59.7226	0.29354569	59.8968	0.58608378	60.0701	0.87711049	60.2429	1.16729753

4	P (KN)	L	-177.393	-181.868	2.52264746	-186.348	5.04811351	-190.829	7.57414329	-195.313	10.1018642
		M	-159.393	-163.868	2.80752605	-168.348	5.618189	-172.829	8.42947934	-177.313	11.2426518
		U	-141.393	-145.868	3.16493744	-150.348	6.33341113	-154.829	9.50259207	-159.313	12.6738947
	V2 (KN)	L	15.365	15.435	0.45558087	15.506	0.91767003	15.575	1.3667426	15.645	1.82232346
		M	15.365	15.435	0.45558087	15.506	0.91767003	15.575	1.3667426	15.645	1.82232346
		U	15.365	15.435	0.45558087	15.506	0.91767003	15.575	1.3667426	15.645	1.82232346
	V3 (KN)	L	15.365	15.435	0.45558087	15.506	0.91767003	15.575	1.3667426	15.645	1.82232346
		M	15.365	15.435	0.45558087	15.506	0.91767003	15.575	1.3667426	15.645	1.82232346
		U	15.365	15.435	0.45558087	15.506	0.91767003	15.575	1.3667426	15.645	1.82232346
	T (KN-m)	L	5.1448	5.143	-0.03498678	5.141	-0.07386099	5.1392	-0.10884777	5.1372	-0.14772197
		M	5.1448	5.143	-0.03498678	5.141	-0.07386099	5.1392	-0.10884777	5.1372	-0.14772197
		U	5.1448	5.143	-0.03498678	5.141	-0.07386099	5.1392	-0.10884777	5.1372	-0.14772197
	M2 (KN-m)	L	26.4097	26.4949	0.32260874	26.579	0.64105234	26.6624	0.9568454	26.7448	1.26885197
		M	5.9044	5.8311	-1.24144706	5.7579	-2.48120046	5.6847	-3.72095386	5.6114	-4.96240092
		U	58.3495	58.3518	0.00394176	58.3531	0.00616972	58.3536	0.00702662	58.3533	0.00651248
	M3 (KN-m)	L	26.4097	26.4949	0.32260874	26.579	0.64105234	26.6624	0.9568454	26.7448	1.26885197
		M	5.9044	5.8311	-1.24144706	5.7579	-2.48120046	5.6847	-3.72095386	5.6114	-4.96240092
		U	58.3495	58.3518	0.00394176	58.3531	0.00616972	58.3536	0.00702662	58.3533	0.00651248

Table 4.38 (continued)

5	P (KN)	L	-154.802	-159.212	2.8488004	-163.622	5.69760081	-168.034	8.54769318	-172.446	11.3977856
		M	-136.802	-141.212	3.22363708	-145.622	6.44727416	-150.034	9.67237321	-154.446	12.8974723
		U	-118.802	-123.212	3.71205872	-127.622	7.42411744	-132.034	11.1378596	-136.446	14.8516018
	V2 (KN)	L	10.41	10.118	-2.8049952	9.826	-5.60999039	9.534	-8.41498559	9.241	-11.2295869
		M	10.41	10.118	-2.8049952	9.826	-5.60999039	9.534	-8.41498559	9.241	-11.2295869
		U	10.41	10.118	-2.8049952	9.826	-5.60999039	9.534	-8.41498559	9.241	-11.2295869
	V3 (KN)	L	10.41	10.118	-2.8049952	9.826	-5.60999039	9.534	-8.41498559	9.241	-11.2295869
		M	10.41	10.118	-2.8049952	9.826	-5.60999039	9.534	-8.41498559	9.241	-11.2295869
		U	10.41	10.118	-2.8049952	9.826	-5.60999039	9.534	-8.41498559	9.241	-11.2295869
	T (KN-m)	L	4.229	4.2278	-0.0283755	4.2264	-0.06148026	4.2252	-0.08985576	4.2238	-0.12296051
		M	4.229	4.2278	-0.0283755	4.2264	-0.06148026	4.2252	-0.08985576	4.2238	-0.12296051
		U	4.229	4.2278	-0.0283755	4.2264	-0.06148026	4.2252	-0.08985576	4.2238	-0.12296051
	M2 (KN-m)	L	14.3879	14.0823	-2.12400698	13.7763	-4.25079407	13.4695	-6.38314139	13.1621	-8.51965888
		M	7.7545727	8.1555727	5.17114244	8.5562727	10.3384162	8.9566727	15.5018213	9.3565727	20.6587785
		U	52.6101	53.9277	2.50446207	55.2435	5.00550275	56.5578	7.50369226	57.8706	9.9990306
	M3 (KN-m)	L	14.3879	14.0823	-2.12400698	13.7763	-4.25079407	13.4695	-6.38314139	13.1621	-8.51965888
		M	7.7545727	8.1555727	5.17114244	8.5562727	10.3384162	8.9566727	15.5018213	9.3565727	20.6587785
		U	52.6101	53.9277	2.50446207	55.2435	5.00550275	56.5578	7.50369226	57.8706	9.9990306

6	P (KN)	L	-116.851	-117.471	0.53059024	-118.089	1.0594689	-118.707	1.58834755	-119.326	2.118082
		M	-98.851	-99.471	0.6272066	-100.089	1.25238996	-100.707	1.87757332	-101.326	2.5037683
		U	-80.851	-81.471	0.76684271	-82.089	1.53121174	-82.707	2.29558076	-83.326	3.06118663
	V2 (KN)	L	5.46	5.034	-7.8021978	4.61	-15.5677656	4.186	-23.3333333	3.761	-31.1172161
		M	5.46	5.034	-7.8021978	4.61	-15.5677656	4.186	-23.3333333	3.761	-31.1172161
		U	5.46	5.034	-7.8021978	4.61	-15.5677656	4.186	-23.3333333	3.761	-31.1172161
	V3 (KN)	L	5.46	5.034	-7.8021978	4.61	-15.5677656	4.186	-23.3333333	3.761	-31.1172161
		M	5.46	5.034	-7.8021978	4.61	-15.5677656	4.186	-23.3333333	3.761	-31.1172161
		U	5.46	5.034	-7.8021978	4.61	-15.5677656	4.186	-23.3333333	3.761	-31.1172161
	T (KN-m)	L	3.0374	3.0302	-0.23704484	3.023	-0.47408968	3.0158	-0.71113452	3.0086	-0.94817936
		M	3.0374	3.0302	-0.23704484	3.023	-0.47408968	3.0158	-0.71113452	3.0086	-0.94817936
		U	3.0374	3.0302	-0.23704484	3.023	-0.47408968	3.0158	-0.71113452	3.0086	-0.94817936
	M2 (KN-m)	L	2.6131	1.3928	-46.6993226	0.1743	-93.3297616	-1.0426	-139.898971	-2.2579	-186.40695
		M	8.5997	8.3119	-3.34662837	8.0237	-6.69790807	7.7352	-10.0526763	7.4462	-13.4132586
		U	43.3266	43.6719	0.79696999	44.0176	1.5948632	44.3632	2.39252561	44.7093	3.19134204
	M3 (KN-m)	L	2.6131	1.3928	-46.6993226	0.1743	-93.3297616	-1.0426	-139.898971	-2.2579	-186.40695
		M	8.5997	8.3119	-3.34662837	8.0237	-6.69790807	7.7352	-10.0526763	7.4462	-13.4132586
		U	43.3266	43.6719	0.79696999	44.0176	1.5948632	44.3632	2.39252561	44.7093	3.19134204

Table 4.38 (continued)

7	P (KN)	L	-60.524	-60.747	0.36844888	-60.973	0.74185447	-61.196	1.11030335	-61.421	1.4820567
		M	-42.524	-42.747	0.52440975	-42.973	1.05587433	-43.196	1.58028407	-43.421	2.10939705
		U	-24.524	-24.747	0.90931333	-24.973	1.83085957	-25.196	2.74017289	-25.421	3.65764149
	V2 (KN)	L	-4.236	-4.292	1.32200189	-4.348	2.64400378	-4.406	4.01322002	-4.462	5.33522191
		M	-4.236	-4.292	1.32200189	-4.348	2.64400378	-4.406	4.01322002	-4.462	5.33522191
		U	-4.236	-4.292	1.32200189	-4.348	2.64400378	-4.406	4.01322002	-4.462	5.33522191
	V3 (KN)	L	-4.236	-4.292	1.32200189	-4.348	2.64400378	-4.406	4.01322002	-4.462	5.33522191
		M	-4.236	-4.292	1.32200189	-4.348	2.64400378	-4.406	4.01322002	-4.462	5.33522191
		U	-4.236	-4.292	1.32200189	-4.348	2.64400378	-4.406	4.01322002	-4.462	5.33522191
	T (KN-m)	L	1.7878	1.7828	-0.27967334	1.7778	-0.55934668	1.773	-0.82783309	1.768	-1.10750643
		M	1.7878	1.7828	-0.27967334	1.7778	-0.55934668	1.773	-0.82783309	1.768	-1.10750643
		U	1.7878	1.7828	-0.27967334	1.7778	-0.55934668	1.773	-0.82783309	1.768	-1.10750643
	M2 (KN-m)	L	-10.578	-10.5584	-0.18529022	-10.5386	-0.37247117	-10.519	-0.55776139	-10.4991	-0.74588769
		M	8.4385	8.5316	1.10327665	8.6246	2.20536825	8.7178	3.30982995	8.811	4.41429164
		U	32.1668	32.3212	0.47999801	32.4759	0.96092866	32.6308	1.44248107	32.7859	1.92465523
	M3 (KN-m)	L	-10.578	-10.5584	-0.18529022	-10.5386	-0.37247117	-10.519	-0.55776139	-10.4992	-0.74494233
		M	8.4385	8.5316	1.10327665	8.6246	2.20536825	8.7178	3.30982995	8.811	4.41429164
		U	32.1668	32.3212	0.47999801	32.4759	0.96092866	32.6308	1.44248107	32.7859	1.92465523

Table 4.39 Mass irregularity in sixth floor: Percentage change in column forces relative to original live load for L-shaped plan building

Column label	Column force	At	Original Live Load	Live load at sixth storey and % change relative to original live load							
				3KN/m2	% change	4KN/m2	% change	5KN/m2	% change	6KN/m2	% change
1	P (KN)	L	-211.906	-216.213	2.03250498	-220.53	4.06972903	-224.855	6.11072834	-229.192	8.15739054
		M	-207.406	-211.713	2.07660338	-216.03	4.15802822	-220.355	6.24331022	-224.692	8.33437798
		U	-202.906	-207.213	2.12265778	-211.53	4.25024396	-215.855	6.38177284	-220.192	8.51921579
	V2 (KN)	L	14.824	14.825	0.00674582	14.826	0.01349164	14.826	0.01349164	14.826	0.01349164
		M	14.824	14.825	0.00674582	14.826	0.01349164	14.826	0.01349164	14.826	0.01349164
		U	14.824	14.825	0.00674582	14.826	0.01349164	14.826	0.01349164	14.826	0.01349164
	V3 (KN)	L	14.824	14.825	0.00674582	14.826	0.01349164	14.826	0.01349164	14.826	0.01349164
		M	14.824	14.825	0.00674582	14.826	0.01349164	14.826	0.01349164	14.826	0.01349164
		U	14.824	14.825	0.00674582	14.826	0.01349164	14.826	0.01349164	14.826	0.01349164
	T (KN-m)	L	1.0578	1.0552	-0.24579316	1.0528	-0.47267915	1.0502	-0.7184723	1.0478	-0.94535829
		M	1.0578	1.0552	-0.24579316	1.0528	-0.47267915	1.0502	-0.7184723	1.0478	-0.94535829
		U	1.0578	1.0552	-0.24579316	1.0528	-0.47267915	1.0502	-0.7184723	1.0478	-0.94535829
	M2 (KN-m)	L	71.1119	71.1282	0.02292162	71.1443	0.04556199	71.16	0.06763987	71.1754	0.08929588
		M	63.7142	63.7304	0.02542604	63.7461	0.05006733	63.7618	0.07470862	63.777	0.09856516
		U	56.3261	56.3421	0.02840601	56.3577	0.05610188	56.3732	0.0836202	56.3884	0.11060592
	M3 (KN-m)	L	71.1119	71.1282	0.02292162	71.1443	0.04556199	71.16	0.06763987	71.1754	0.08929588
		M	63.7142	63.7304	0.02542604	63.7461	0.05006733	63.7618	0.07470862	63.777	0.09856516
		U	56.3261	56.3421	0.02840601	56.3577	0.05610188	56.3732	0.0836202	56.3884	0.11060592

Table 4.39 (continued)

2	P (KN)	L	-195.331	-199.65	2.21111856	-203.976	4.42582079	-208.313	6.64615448	-212.66	8.87160768
		M	-177.331	-181.65	2.43555836	-185.976	4.87506415	-190.313	7.32077302	-194.66	9.77212106
		U	-159.331	-163.65	2.71070915	-167.976	5.42581168	-172.313	8.14781806	-176.66	10.8761007
	V2 (KN)	L	27.465	27.458	-0.02548698	27.452	-0.04733297	27.445	-0.07281995	27.439	-0.09466594
		M	27.465	27.458	-0.02548698	27.452	-0.04733297	27.445	-0.07281995	27.439	-0.09466594
		U	27.465	27.458	-0.02548698	27.452	-0.04733297	27.445	-0.07281995	27.439	-0.09466594
	V3 (KN)	L	27.465	27.458	-0.02548698	27.452	-0.04733297	27.445	-0.07281995	27.439	-0.09466594
		M	27.465	27.458	-0.02548698	27.452	-0.04733297	27.445	-0.07281995	27.439	-0.09466594
		U	27.465	27.458	-0.02548698	27.452	-0.04733297	27.445	-0.07281995	27.439	-0.09466594
	T (KN-m)	L	4.4784	4.4678	-0.23669168	4.4572	-0.47338335	4.4468	-0.70560915	4.4366	-0.93336906
		M	4.4784	4.4678	-0.23669168	4.4572	-0.47338335	4.4468	-0.70560915	4.4366	-0.93336906
		U	4.4784	4.4678	-0.23669168	4.4572	-0.47338335	4.4468	-0.70560915	4.4366	-0.93336906
	M2 (KN-m)	L	77.1923	77.199	0.00867962	77.2052	0.01671151	77.211	0.02422521	77.2165	0.03135028
		M	22.3295	22.3494	0.08911977	22.3692	0.17779171	22.3888	0.26556797	22.4081	0.35200072
		U	50.4222	50.4477	0.05057296	50.4732	0.10114592	50.4988	0.15191721	50.5243	0.20249017
	M3 (KN-m)	L	77.1923	77.199	0.00867962	77.2052	0.01671151	77.211	0.02422521	77.2165	0.03135028
		M	22.3295	22.3494	0.08911977	22.3692	0.17779171	22.3888	0.26556797	22.4081	0.35200072
		U	50.4222	50.4477	0.05057296	50.4732	0.10114592	50.4988	0.15191721	50.5243	0.20249017

3	P (KN)	L	-188.21	-192.536	2.29849636	-196.868	4.60018065	-201.208	6.90611551	-205.558	9.21736358
		M	-170.21	-174.536	2.5415663	-178.868	5.08665766	-183.208	7.63644909	-187.558	10.1921156
		U	-152.21	-156.536	2.84212601	-160.868	5.68819394	-165.208	8.53951777	-169.558	11.3974115
	V2 (KN)	L	18.745	18.732	-0.06935183	18.717	-0.14937317	18.701	-0.23472926	18.686	-0.3147506
		M	18.745	18.732	-0.06935183	18.717	-0.14937317	18.701	-0.23472926	18.686	-0.3147506
		U	18.745	18.732	-0.06935183	18.717	-0.14937317	18.701	-0.23472926	18.686	-0.3147506
	V3 (KN)	L	18.745	18.732	-0.06935183	18.717	-0.14937317	18.701	-0.23472926	18.686	-0.3147506
		M	18.745	18.732	-0.06935183	18.717	-0.14937317	18.701	-0.23472926	18.686	-0.3147506
		U	18.745	18.732	-0.06935183	18.717	-0.14937317	18.701	-0.23472926	18.686	-0.3147506
	T (KN-m)	L	5.5658	5.5548	-0.19763556	5.5438	-0.39527112	5.533	-0.58931331	5.5222	-0.78335549
		M	5.5658	5.5548	-0.19763556	5.5438	-0.39527112	5.533	-0.58931331	5.5222	-0.78335549
		U	5.5658	5.5548	-0.19763556	5.5438	-0.39527112	5.533	-0.58931331	5.5222	-0.78335549
	M2 (KN-m)	L	36.9761	36.969	-0.01920159	36.9612	-0.0402963	36.9528	-0.06301368	36.9438	-0.08735372
		M	3.2238522	3.2274522	0.11166765	3.2309522	0.22023342	3.2346522	0.33500295	3.2384522	0.45287436
		U	59.5478	59.6035	0.0935383	59.6591	0.18690867	59.7147	0.28027904	59.77	0.37314561
	M3 (KN-m)	L	36.9761	36.969	-0.01920159	36.9612	-0.0402963	36.9528	-0.06301368	36.9438	-0.08735372
		M	3.2238522	3.2274522	0.11166765	3.2309522	0.22023342	3.2346522	0.33500295	3.2384522	0.45287436
		U	59.5478	59.6035	0.0935383	59.6591	0.18690867	59.7147	0.28027904	59.77	0.37314561

Table 4.39 (continued)

4	P (KN)	L	-177.393	-181.7	2.42794248	-186.013	4.85926728	-190.334	7.29510184	-194.662	9.73488244
		M	-159.393	-163.7	2.70212619	-168.013	5.40801666	-172.334	8.11892618	-176.662	10.8342274
		U	-141.393	-145.7	3.04611968	-150.013	6.09648285	-154.334	9.15250401	-158.662	12.2134759
	V2 (KN)	L	15.365	15.336	-0.18874064	15.305	-0.39049788	15.275	-0.58574683	15.243	-0.79401237
		M	15.365	15.336	-0.18874064	15.305	-0.39049788	15.275	-0.58574683	15.243	-0.79401237
		U	15.365	15.336	-0.18874064	15.305	-0.39049788	15.275	-0.58574683	15.243	-0.79401237
	V3 (KN)	L	15.365	15.336	-0.18874064	15.305	-0.39049788	15.275	-0.58574683	15.243	-0.79401237
		M	15.365	15.336	-0.18874064	15.305	-0.39049788	15.275	-0.58574683	15.243	-0.79401237
		U	15.365	15.336	-0.18874064	15.305	-0.39049788	15.275	-0.58574683	15.243	-0.79401237
	T (KN-m)	L	5.1448	5.138	-0.13217229	5.1312	-0.26434458	5.1246	-0.39262945	5.1178	-0.52480174
		M	5.1448	5.138	-0.13217229	5.1312	-0.26434458	5.1246	-0.39262945	5.1178	-0.52480174
		U	5.1448	5.138	-0.13217229	5.1312	-0.26434458	5.1246	-0.39262945	5.1178	-0.52480174
	M2 (KN-m)	L	26.4097	26.4002	-0.03597163	26.3894	-0.0768657	26.3776	-0.12154625	26.3647	-0.17039194
		M	5.9044	5.9035	-0.01524287	5.9031	-0.02201748	5.9028	-0.02709844	5.9031	-0.02201748
		U	58.3495	58.51	0.27506662	58.6701	0.54944772	58.8299	0.82331468	58.9891	1.09615335
	M3 (KN-m)	L	26.4097	26.4002	-0.03597163	26.3894	-0.0768657	26.3776	-0.12154625	26.3647	-0.17039194
		M	5.9044	5.9035	-0.01524287	5.9031	-0.02201748	5.9028	-0.02709844	5.9031	-0.02201748
		U	58.3495	58.51	0.27506662	58.6701	0.54944772	58.8299	0.82331468	58.9891	1.09615335

5	P (KN)	L	-154.802	-159.103	2.77838788	-163.407	5.55871371	-167.715	8.34162349	-172.028	11.1277632
		M	-136.802	-141.103	3.14395988	-145.407	6.29011272	-149.715	9.43918949	-154.028	12.5919212
		U	-118.802	-123.103	3.62030942	-127.407	7.24314405	-131.715	10.8693456	-136.028	14.4997559
	V2 (KN)	L	10.41	10.465	0.52833814	10.518	1.03746398	10.573	1.56580211	10.625	2.06532181
		M	10.41	10.465	0.52833814	10.518	1.03746398	10.573	1.56580211	10.625	2.06532181
		U	10.41	10.465	0.52833814	10.518	1.03746398	10.573	1.56580211	10.625	2.06532181
	V3 (KN)	L	10.41	10.465	0.52833814	10.518	1.03746398	10.573	1.56580211	10.625	2.06532181
		M	10.41	10.465	0.52833814	10.518	1.03746398	10.573	1.56580211	10.625	2.06532181
		U	10.41	10.465	0.52833814	10.518	1.03746398	10.573	1.56580211	10.625	2.06532181
	T (KN-m)	L	4.229	4.2282	-0.018917	4.2276	-0.03310475	4.2268	-0.05202175	4.226	-0.07093876
		M	4.229	4.2282	-0.018917	4.2276	-0.03310475	4.2268	-0.05202175	4.226	-0.07093876
		U	4.229	4.2282	-0.018917	4.2276	-0.03310475	4.2268	-0.05202175	4.226	-0.07093876
	M2 (KN-m)	L	14.3879	14.4644	0.53169677	14.5394	1.05296812	14.6128	1.56311901	14.6846	2.06214945
		M	7.7545727	7.6647727	-1.15802641	7.5753727	-2.31089458	7.4863727	-3.4586045	7.3975727	-4.60373529
		U	52.6101	52.6205	0.01976807	52.6298	0.03744528	52.6382	0.0534118	52.6455	0.06728746
	M3 (KN-m)	L	14.3879	14.4644	0.53169677	14.5394	1.05296812	14.6128	1.56311901	14.6846	2.06214945
		M	7.7545727	7.6647727	-1.15802641	7.5753727	-2.31089458	7.4863727	-3.4586045	7.3975727	-4.60373529
		U	52.6101	52.6205	0.01976807	52.6298	0.03744528	52.6382	0.0534118	52.6455	0.06728746

Table 4.39 (continued)

6	P (KN)	L	-116.851	-121.053	3.59603255	-125.254	7.19120932	-129.459	10.7898092	-133.663	14.3875534
		M	-98.851	-103.053	4.25084218	-107.254	8.50067273	-111.459	12.7545498	-115.663	17.0074152
		U	-80.851	-85.053	5.19721463	-89.254	10.3931924	-93.459	15.5941176	-97.663	20.7938059
	V2 (KN)	L	5.46	5.172	-5.27472527	4.884	-10.5494505	4.594	-15.8608059	4.302	-21.2087912
		M	5.46	5.172	-5.27472527	4.884	-10.5494505	4.594	-15.8608059	4.302	-21.2087912
		U	5.46	5.172	-5.27472527	4.884	-10.5494505	4.594	-15.8608059	4.302	-21.2087912
	V3 (KN)	L	5.46	5.172	-5.27472527	4.884	-10.5494505	4.594	-15.8608059	4.302	-21.2087912
		M	5.46	5.172	-5.27472527	4.884	-10.5494505	4.594	-15.8608059	4.302	-21.2087912
		U	5.46	5.172	-5.27472527	4.884	-10.5494505	4.594	-15.8608059	4.302	-21.2087912
	T (KN-m)	L	3.0374	3.0406	0.10535326	3.0436	0.20412195	3.0464	0.29630605	3.0492	0.38849016
		M	3.0374	3.0406	0.10535326	3.0436	0.20412195	3.0464	0.29630605	3.0492	0.38849016
		U	3.0374	3.0406	0.10535326	3.0436	0.20412195	3.0464	0.29630605	3.0492	0.38849016
	M2 (KN-m)	L	2.6131	2.3223	-11.1285446	2.0303	-22.3030117	1.7368	-33.5348819	1.4421	-44.8126746
		M	8.5997	8.9929	4.57225252	9.3855	9.13752805	9.7776	13.6969894	10.1692	18.2506367
		U	43.3266	44.7103	3.19365009	46.0911	6.38060683	47.4692	9.56133184	48.8444	12.7353635
	M3 (KN-m)	L	2.6131	2.3223	-11.1285446	2.0303	-22.3030117	1.7368	-33.5348819	1.4421	-44.8126746
		M	8.5997	8.9929	4.57225252	9.3855	9.13752805	9.7776	13.6969894	10.1692	18.2506367
		U	43.3266	44.7103	3.19365009	46.0911	6.38060683	47.4692	9.56133184	48.8444	12.7353635

7	P (KN)	L	-60.524	-60.909	0.63611129	-61.295	1.27387483	-61.68	1.90998612	-62.065	2.54609742
		M	-42.524	-42.909	0.90537108	-43.295	1.81309378	-43.68	2.71846487	-44.065	3.62383595
		U	-24.524	-24.909	1.56989072	-25.295	3.14385908	-25.68	4.7137498	-26.065	6.28364052
	V2 (KN)	L	-4.236	-4.659	9.98583569	-5.081	19.9480642	-5.503	29.9102927	-5.924	39.8489141
		M	-4.236	-4.659	9.98583569	-5.081	19.9480642	-5.503	29.9102927	-5.924	39.8489141
		U	-4.236	-4.659	9.98583569	-5.081	19.9480642	-5.503	29.9102927	-5.924	39.8489141
	V3 (KN)	L	-4.236	-4.659	9.98583569	-5.081	19.9480642	-5.503	29.9102927	-5.924	39.8489141
		M	-4.236	-4.659	9.98583569	-5.081	19.9480642	-5.503	29.9102927	-5.924	39.8489141
		U	-4.236	-4.659	9.98583569	-5.081	19.9480642	-5.503	29.9102927	-5.924	39.8489141
	T (KN-m)	L	1.7878	1.7858	-0.11186934	1.7836	-0.23492561	1.7816	-0.34679494	1.7794	-0.46985121
		M	1.7878	1.7858	-0.11186934	1.7836	-0.23492561	1.7816	-0.34679494	1.7794	-0.46985121
		U	1.7878	1.7858	-0.11186934	1.7836	-0.23492561	1.7816	-0.34679494	1.7794	-0.46985121
	M2 (KN-m)	L	-10.578	-11.6625	10.2524107	-12.7415	20.4528266	-13.8155	30.6059747	-14.8848	40.7146909
		M	8.4385	8.1483	-3.43899982	7.8575	-6.88510991	7.5661	-10.3383303	7.274	-13.7998459
		U	32.1668	32.563	1.23170474	32.9595	2.46434212	33.3559	3.69666861	33.7528	4.93054951
	M3 (KN-m)	L	-10.578	-11.6625	10.2524107	-12.7415	20.4528266	-13.8155	30.6059747	-14.8848	40.7146909
		M	8.4385	8.1483	-3.43899982	7.8575	-6.88510991	7.5661	-10.3383303	7.274	-13.7998459
		U	32.1668	32.563	1.23170474	32.9595	2.46434212	33.356	3.69697949	33.7528	4.93054951

4.3.7 Percentage change in joint displacements relative to original live load

Table 4.40 Mass irregularity in first floor: Percentage change in joint displacements relative to original live load for L-shaped plan building

Joint label	Joint displacement	Original Live Load	Live load at first storey and % change relative to original live load							
			3KN/m2	% change	4KN/m2	% change	5KN/m2	% change	6KN/m2	% change
2	U1 (m)	0.00011597	0.00011598	0.00882219	0.00011599	0.01764351	0.000116	0.02646483	0.00011601	0.03528615
	U2 (m)	0.00011597	0.00011598	0.00882219	0.00011599	0.01764351	0.000116	0.02646483	0.00011601	0.03528615
3	U1 (m)	0.00210775	0.00210879	0.04940825	0.00210883	0.05137149	0.00210887	0.05333567	0.00210891	0.05529946
	U2 (m)	0.00210775	0.00210879	0.04940825	0.00210883	0.05137149	0.00210887	0.05333567	0.00210891	0.05529946
4	U1 (m)	0.00451538	0.0045154	0.00049165	0.00451542	0.00098331	0.00451644	0.02361928	0.00451647	0.02411094
	U2 (m)	0.00451538	0.0045154	0.00049165	0.00451542	0.00098331	0.00451644	0.02361928	0.00451647	0.02411094
5	U1 (m)	0.00671098	0.00671098	0.00010431	0.00671199	0.01510957	0.006712	0.01521388	0.006713	0.03021915
	U2 (m)	0.00671098	0.00671098	0.00010431	0.00671199	0.01510957	0.006712	0.01521388	0.006713	0.03021915
6	U1 (m)	0.00849157	0.00849256	0.01165862	0.00849355	0.02331725	0.00849454	0.03497587	0.00849453	0.03485811
	U2 (m)	0.00849157	0.00849256	0.01165862	0.00849355	0.02331725	0.00849454	0.03497587	0.00849453	0.03485811
7	U1 (m)	0.00974586	0.00974583	-0.0002873	0.0097468	0.00969643	0.00974877	0.02994093	0.00974875	0.02965363
	U2 (m)	0.00974586	0.00974583	-0.0002873	0.0097468	0.00969643	0.00974877	0.02994093	0.00974875	0.02965363
8	U1 (m)	0.01044289	0.01044285	-0.00042134	0.0104438	0.00873321	0.01044476	0.01788777	0.01044471	0.01746643
	U2 (m)	0.01044289	0.01044285	-0.00042134	0.0104438	0.00873321	0.01044476	0.01788777	0.01044471	0.01746643

Table 4.41 Mass irregularity in second floor: Percentage change in joint displacements relative to original live load for L-shaped plan building

Joint label	Joint displacement	Original Live Load	Live load at second storey and % change relative to original live load							
			3KN/m2	% change	4KN/m2	% change	5KN/m2	% change	6KN/m2	% change
2	U1 (m)	0.00011597	0.00011597	-0.0007571	0.00011697	0.86078497	0.00011697	0.86002769	0.00011697	0.85927016
	U2 (m)	0.00011597	0.00011597	-0.0007571	0.00011697	0.86078497	0.00011697	0.86002769	0.00011697	0.85927016
3	U1 (m)	0.00210775	0.00211183	0.19366953	0.00211691	0.43478351	0.00212099	0.62845361	0.00212507	0.82212504
	U2 (m)	0.00210775	0.00211183	0.19366953	0.00211691	0.43478351	0.00212099	0.62845361	0.00212507	0.82212504
4	U1 (m)	0.00451538	0.00452251	0.15784282	0.00452863	0.29353909	0.00453576	0.45138191	0.00454289	0.60922472
	U2 (m)	0.00451538	0.00452251	0.15784282	0.00452863	0.29353909	0.00453576	0.45138191	0.00454289	0.60922472
5	U1 (m)	0.00671098	0.00671902	0.11992294	0.00672807	0.25474684	0.00673712	0.38957074	0.00674517	0.50949367
	U2 (m)	0.00671098	0.00671902	0.11992294	0.00672807	0.25474684	0.00673712	0.38957074	0.00674517	0.50949367
6	U1 (m)	0.00849157	0.00850254	0.12917521	0.00851151	0.23479764	0.00852147	0.35219646	0.00853244	0.48137167
	U2 (m)	0.00849157	0.00850254	0.12917521	0.00851151	0.23479764	0.00852147	0.35219646	0.00853244	0.48137167
7	U1 (m)	0.00974586	0.00975674	0.11167825	0.00976662	0.21309572	0.00977851	0.335045	0.00978939	0.44672325
	U2 (m)	0.00974586	0.00975674	0.11167825	0.00976662	0.21309572	0.00977851	0.335045	0.00978939	0.44672325
8	U1 (m)	0.01044289	0.01045269	0.09387248	0.0104645	0.20690632	0.0104763	0.31993058	0.0104881	0.43295484
	U2 (m)	0.01044289	0.01045269	0.09387248	0.0104645	0.20690632	0.0104763	0.31993058	0.0104881	0.43295484

Table 4.42 Mass irregularity in third floor: Percentage change in joint displacements relative to original live load for L-shaped plan building

Joint label	Joint displacement	Original Live Load	Live load at third storey and % change relative to original live load							
			3KN/m2	% change	4KN/m2	% change	5KN/m2	% change	6KN/m2	% change
2	U1 (m)	0.00011597	0.00011597	-0.00153213	0.00011697	0.85923481	0.00011696	0.8577025	0.00011696	0.8561702
	U2 (m)	0.00011597	0.00011597	-0.00153213	0.00011697	0.85923481	0.00011696	0.8577025	0.00011696	0.8561702
3	U1 (m)	0.00210775	0.00211369	0.2822495	0.00212064	0.61193833	0.00212659	0.89418784	0.00213354	1.22388141
	U2 (m)	0.00210775	0.00211369	0.2822495	0.00212064	0.61193833	0.00212659	0.89418784	0.00213354	1.22388141
4	U1 (m)	0.00451538	0.00452834	0.28705237	0.0045413	0.57410474	0.00455426	0.86115489	0.00456722	1.14820726
	U2 (m)	0.00451538	0.00452834	0.28705237	0.0045413	0.57410474	0.00455426	0.86115489	0.00456722	1.14820726
5	U1 (m)	0.00671098	0.00672592	0.22262036	0.00674086	0.44524073	0.0067558	0.66786109	0.00677174	0.90538242
	U2 (m)	0.00671098	0.00672592	0.22262036	0.00674086	0.44524073	0.0067558	0.66786109	0.00677174	0.90538242
6	U1 (m)	0.00849157	0.00850736	0.18598451	0.00852315	0.37195724	0.00853895	0.55794175	0.00855474	0.74392625
	U2 (m)	0.00849157	0.00850736	0.18598451	0.00852315	0.37195724	0.00853895	0.55794175	0.00855474	0.74392625
7	U1 (m)	0.00974586	0.0097615	0.16052978	0.00977815	0.33132034	0.00979379	0.49185013	0.00981044	0.66264068
	U2 (m)	0.00974586	0.0097615	0.16052978	0.00977815	0.33132034	0.00979379	0.49185013	0.00981044	0.66264068
8	U1 (m)	0.01044289	0.01045939	0.15800223	0.01047389	0.29685268	0.01049039	0.45484533	0.01050689	0.61284756
	U2 (m)	0.01044289	0.01045939	0.15800223	0.01047389	0.29685268	0.01049039	0.45484533	0.01050689	0.61284756

Table 4.43 Mass irregularity in fourth floor: Percentage change in joint displacements relative to original live load for L-shaped plan building

Joint label	Joint displacement	Original Live Load	Live load at fourth storey and % change relative to original live load							
			3KN/m2	% change	4KN/m2	% change	5KN/m2	% change	6KN/m2	% change
2	U1 (m)	0.00011597	0.00011597	-0.00184049	0.00011696	0.85861827	0.00011696	0.85677726	0.00011696	0.85493711
	U2 (m)	0.00011597	0.00011597	-0.00184049	0.00011696	0.85861827	0.00011696	0.85677726	0.00011696	0.85493711
3	U1 (m)	0.00210775	0.0021137	0.28239658	0.00211965	0.56478842	0.0021246	0.79974093	0.00213055	1.08213751
	U2 (m)	0.00210775	0.0021137	0.28239658	0.00211965	0.56478842	0.0021246	0.79974093	0.00213055	1.08213751
4	U1 (m)	0.00451538	0.00452722	0.26219509	0.00454106	0.56867441	0.00455289	0.83086729	0.00456573	1.11522885
	U2 (m)	0.00451538	0.00452722	0.26219509	0.00454106	0.56867441	0.00455289	0.83086729	0.00456573	1.11522885
5	U1 (m)	0.00671098	0.00672876	0.2649838	0.00674754	0.54488346	0.00676533	0.80986726	0.00678311	1.07486595
	U2 (m)	0.00671098	0.00672876	0.2649838	0.00674754	0.54488346	0.00676533	0.80986726	0.00678311	1.07486595
6	U1 (m)	0.00849157	0.00851026	0.22013603	0.00852895	0.44028385	0.00854665	0.64865527	0.00856534	0.8687913
	U2 (m)	0.00849157	0.00851026	0.22013603	0.00852895	0.44028385	0.00854665	0.64865527	0.00856534	0.8687913
7	U1 (m)	0.00974586	0.00976233	0.16906675	0.00977981	0.34840453	0.00979629	0.51748153	0.00981277	0.68655854
	U2 (m)	0.00974586	0.00976233	0.16906675	0.00977981	0.34840453	0.00979629	0.51748153	0.00981277	0.68655854
8	U1 (m)	0.01044289	0.01045816	0.14625261	0.01047444	0.30207154	0.01049071	0.45790004	0.01050498	0.59456718
	U2 (m)	0.01044289	0.01045816	0.14625261	0.01047444	0.30207154	0.01049071	0.45790004	0.01050498	0.59456718

Table 4.44 Mass irregularity in fifth floor: Percentage change in joint displacements relative to original live load for L-shaped plan building

Joint label	Joint displacement	Original Live Load	Live load at fifth storey and % change relative to original live load							
			3KN/m2	% change	4KN/m2	% change	5KN/m2	% change	6KN/m2	% change
2	U1 (m)	0.00011597	0.00011597	-0.00189637	0.00011596	-0.00379326	0.00011696	0.85660997	0.00011696	0.85471377
	U2 (m)	0.00011597	0.00011597	-0.00189637	0.00011596	-0.00379326	0.00011696	0.85660997	0.00011696	0.85471377
3	U1 (m)	0.00210775	0.00211069	0.13981292	0.00211464	0.32706992	0.00211759	0.46688284	0.00212053	0.60670051
	U2 (m)	0.00210775	0.00211069	0.13981292	0.00211464	0.32706992	0.00211759	0.46688284	0.00212053	0.60670051
4	U1 (m)	0.00451538	0.00452321	0.17348492	0.00453104	0.3469654	0.00453888	0.52046139	0.00454671	0.69393523
	U2 (m)	0.00451538	0.00452321	0.17348492	0.00453104	0.3469654	0.00453888	0.52046139	0.00454671	0.69393523
5	U1 (m)	0.00671098	0.00672463	0.20342793	0.00673628	0.37705393	0.00674993	0.58046695	0.00676358	0.78389488
	U2 (m)	0.00671098	0.00672463	0.20342793	0.00673628	0.37705393	0.00674993	0.58046695	0.00676358	0.78389488
6	U1 (m)	0.00849157	0.0085101	0.21819293	0.00852662	0.41283308	0.00854515	0.63102601	0.00856268	0.83744256
	U2 (m)	0.00849157	0.0085101	0.21819293	0.00852662	0.41283308	0.00854515	0.63102601	0.00856268	0.83744256
7	U1 (m)	0.00974586	0.00976223	0.16796884	0.0097786	0.33594795	0.00979497	0.50392705	0.00981034	0.66164539
	U2 (m)	0.00974586	0.00976223	0.16796884	0.0097786	0.33594795	0.00979497	0.50392705	0.00981034	0.66164539
8	U1 (m)	0.01044289	0.010457	0.1350967	0.01047111	0.27019339	0.01048621	0.4148564	0.01050066	0.5532089
	U2 (m)	0.01044289	0.010457	0.1350967	0.01047111	0.27019339	0.01048621	0.4148564	0.01050066	0.5532089

Table 4.45 Mass irregularity in sixth floor: Percentage change in joint displacements relative to original live load for L-shaped plan building

Joint label	Joint displacement	Original Live Load	Live load at sixth storey and % change relative to original live load							
			3KN/m2	% change	4KN/m2	% change	5KN/m2	% change	6KN/m2	% change
2	U1 (m)	0.00011597	0.00011597	-0.00194138	0.00011596	-0.00388293	0.00011596	-0.00582397	0.00011596	-0.00776587
	U2 (m)	0.00011597	0.00011597	-0.00194138	0.00011596	-0.00388293	0.00011596	-0.00582397	0.00011596	-0.00776587
3	U1 (m)	0.00210775	0.00210869	0.04488209	0.00210964	0.08976418	0.00211058	0.13464626	0.00210953	0.08464022
	U2 (m)	0.00210775	0.00210869	0.04488209	0.00210964	0.08976418	0.00211058	0.13464626	0.00210953	0.08464022
4	U1 (m)	0.00451538	0.0045172	0.04044622	0.00452003	0.10304342	0.00452186	0.143483	0.00452468	0.20606912
	U2 (m)	0.00451538	0.0045172	0.04044622	0.00452003	0.10304342	0.00452186	0.143483	0.00452468	0.20606912
5	U1 (m)	0.00671098	0.00671662	0.08408613	0.00672126	0.15327129	0.00672691	0.23735742	0.00673255	0.32144354
	U2 (m)	0.00671098	0.00671662	0.08408613	0.00672126	0.15327129	0.00672691	0.23735742	0.00673255	0.32144354
6	U1 (m)	0.00849157	0.00850196	0.12236846	0.00851335	0.25652508	0.00852374	0.37890531	0.00853413	0.50127376
	U2 (m)	0.00849157	0.00850196	0.12236846	0.00851335	0.25652508	0.00852374	0.37890531	0.00853413	0.50127376
7	U1 (m)	0.00974586	0.00976205	0.16620399	0.00977925	0.34267902	0.00979445	0.49862223	0.00981065	0.66483649
	U2 (m)	0.00974586	0.00976205	0.16620399	0.00977925	0.34267902	0.00979445	0.49862223	0.00981065	0.66483649
8	U1 (m)	0.01044289	0.01045887	0.15297489	0.01047484	0.30595935	0.01049182	0.46851013	0.01050766	0.62024015
	U2 (m)	0.01044289	0.01045887	0.15297489	0.01047484	0.30595935	0.01049182	0.46851013	0.01050766	0.62024015

4.4 COMPARISON OF BASE SHEAR FOR BOTH THE BUILDING MODELS CONSIDERED

Table 4.46 Base shear comparison

Mass irregularity at storey	Base shear for square shaped plan building (KN)	Base shear for L-shaped plan building (KN)
0	802.606	824.584
1	803.19	825.168
2	810.892	832.958
3	814.369	836.522
4	813.401	835.671
5	809.87	832.228
6	805.791	828.152

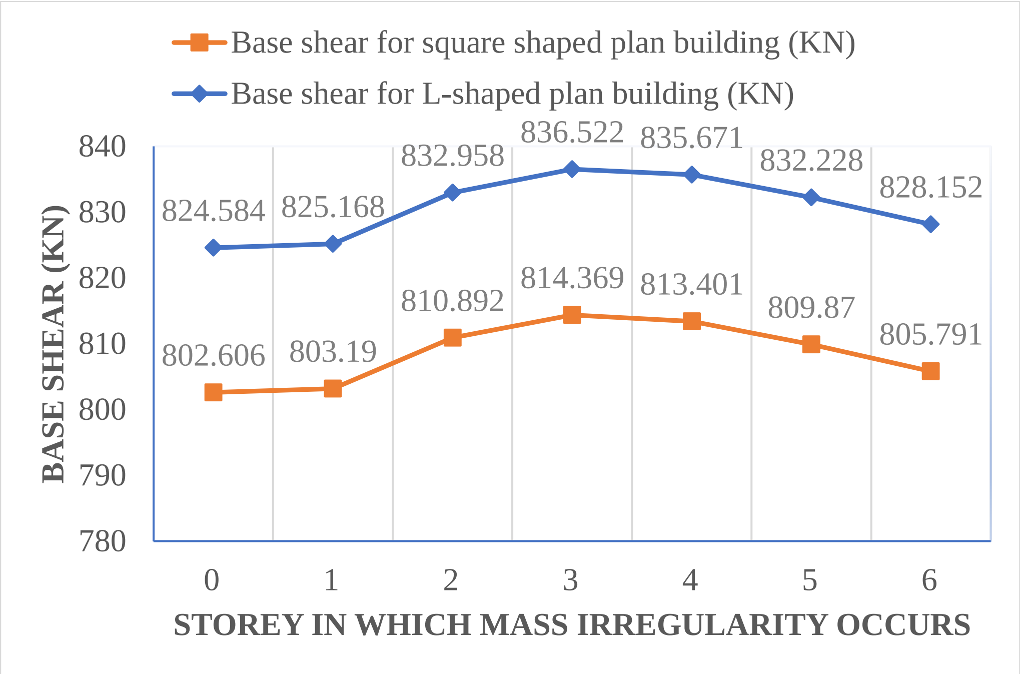

Figure 4.5 Base shear comparison

Base shear for L-shaped plan building is found to be more than that for the square shaped plan building.

4.5 COMPARISON OF JOINT DISPLACEMENTS FOR BOTH THE BUILDING MODELS CONSIDERED

Table 4.47 Joint displacement comparison when no mass irregularity occurs

Joint label	Joint displacement for square shaped plan building (m)	Joint displacement for L-shaped plan building (m)
2	0.000104499	0.000115969
3	0.001883	0.002107745
4	0.004052	0.004515378
5	0.006036	0.006710976
6	0.007648	0.008491568
7	0.008784	0.009745855
8	0.00942	0.010442891

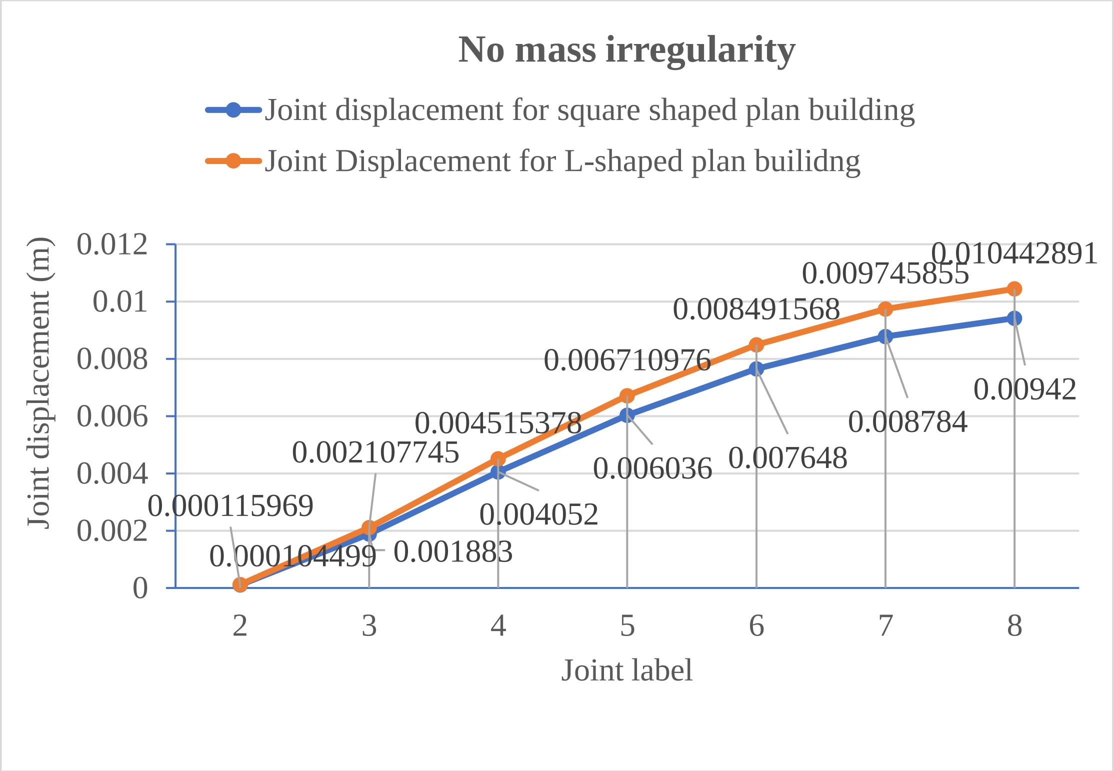

Figure 4.6 Joint displacement comparison when no mass irregularity occurs

Table 4.48 Joint displacement comparison when mass irregularity occurs in first floor

Joint label	Joint displacement for square shaped plan building (m)	Joint displacement for L-shaped plan building (m)
2	0.000104505	0.00011601
3	0.001884	0.002108911
4	0.004053	0.004516467
5	0.006038	0.006713004
6	0.00765	0.008494528
7	0.008788	0.009748745
8	0.009423	0.010444715

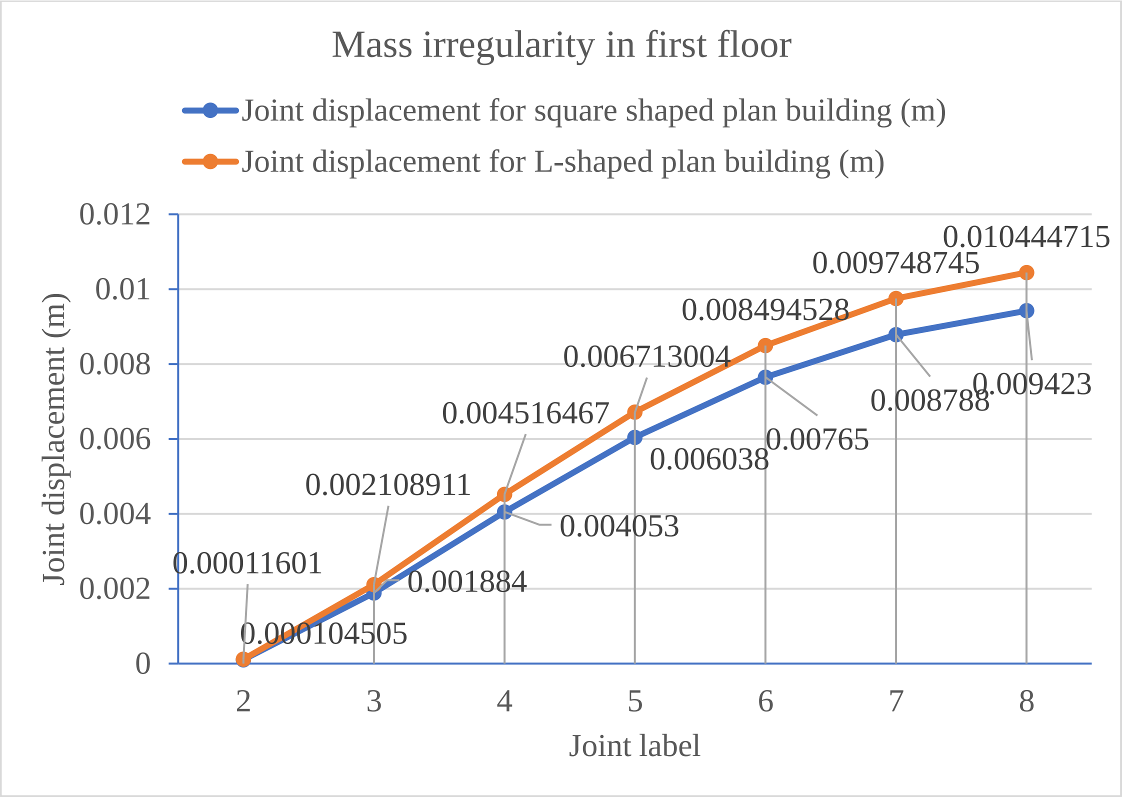

Figure 4.7 Joint displacement comparison when mass irregularity occurs in first floor

Table 4.49 Joint displacement comparison when mass irregularity occurs in second floor

Joint label	Joint displacement for square shaped plan building (m)	Joint displacement for L-shaped plan building (m)
2	0.000105543	0.000116965
3	0.001898	0.002125073
4	0.004078	0.004542887
5	0.006069	0.006745168
6	0.007686	0.008532444
7	0.008826	0.009789392
8	0.009464	0.010488104

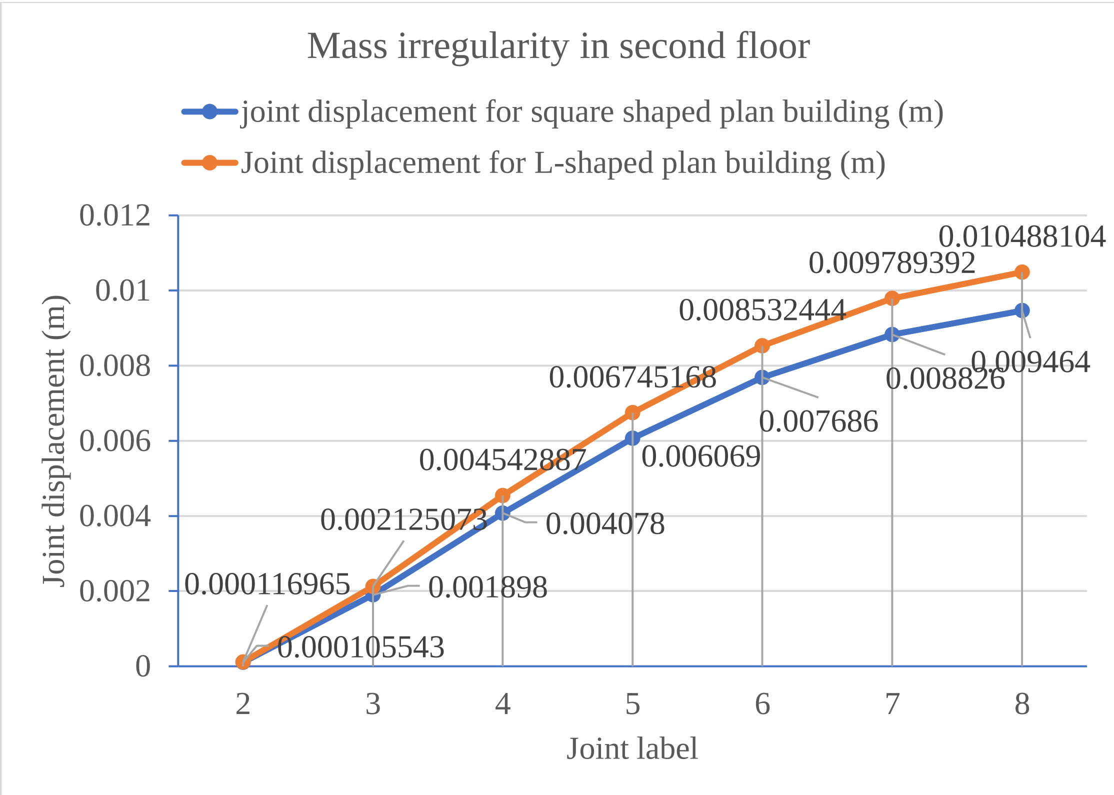

Figure 4.8 Joint displacement comparison when mass irregularity occurs in second floor

Table 4.50 Joint displacement comparison when mass irregularity occurs in third floor

Joint label	Joint displacement for square shaped plan building (m)	Joint displacement for L-shaped plan building (m)
2	0.000105507	0.000116962
3	0.001908	0.002133541
4	0.004103	0.004567224
5	0.006095	0.006771736
6	0.007712	0.008554739
7	0.00885	0.009810435
8	0.009487	0.01050689

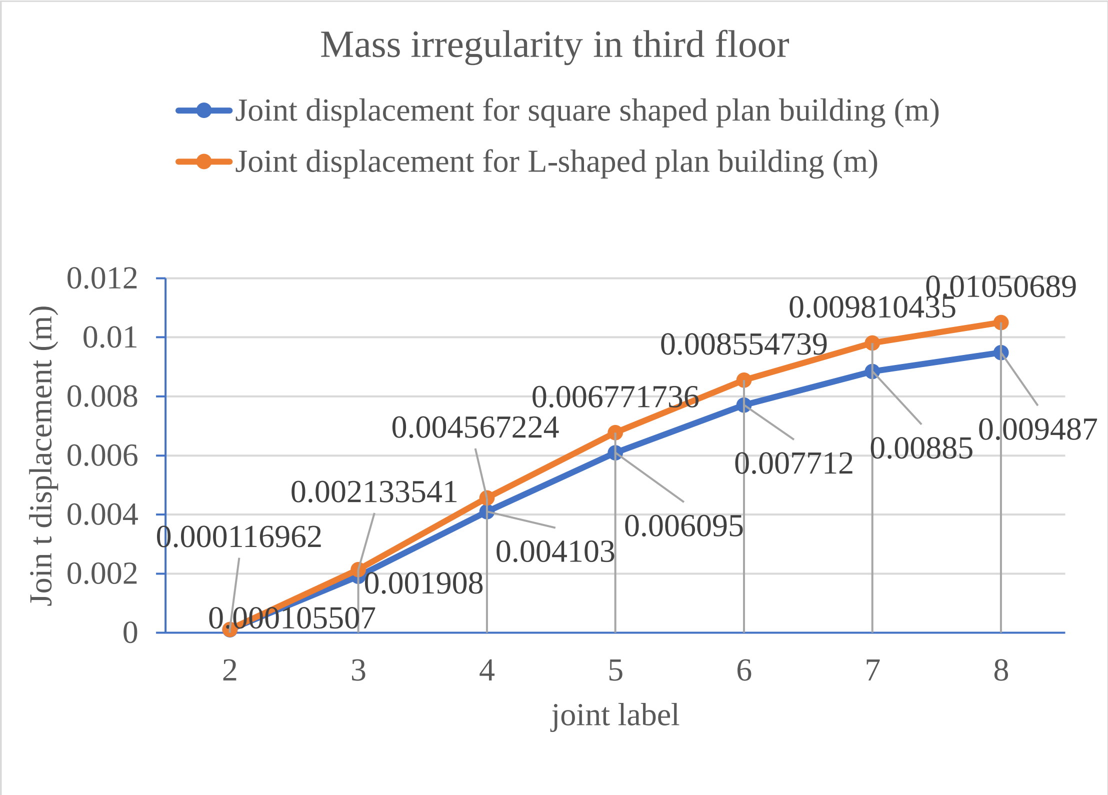

Figure 4.9 Joint displacement comparison when mass irregularity occurs in third floor

Table 4.51 Joint displacement comparison when mass irregularity occurs in fourth floor

Joint label	Joint displacement for square shaped plan building (m)	Joint displacement for L-shaped plan building (m)
2	0.000105486	0.00011696
3	0.001907	0.002130554
4	0.004104	0.004565735
5	0.006111	0.00678311
6	0.007725	0.008565342
7	0.008858	0.009812766
8	0.009492	0.010504981

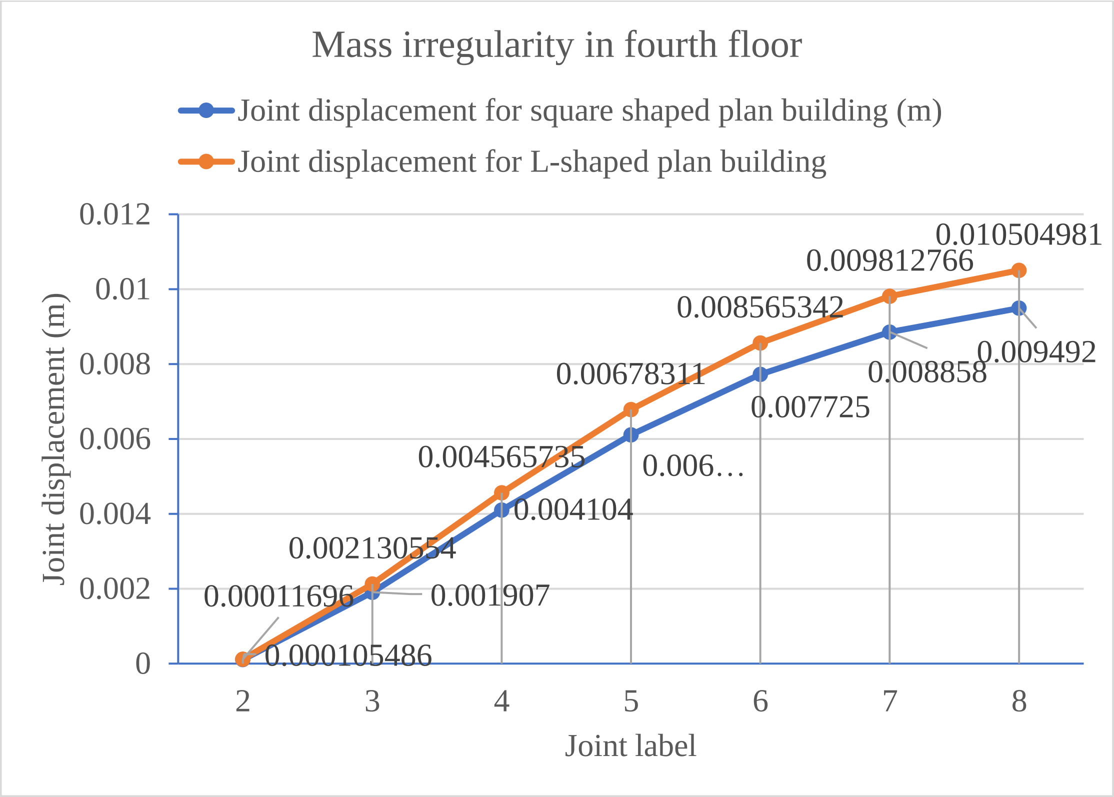

Figure 4.10 Joint displacement comparison when mass irregularity occurs in fourth floor

Table 4.52 Joint displacement comparison when mass irregularity occurs in fifth floor

Joint label	Joint displacement for square shaped plan building (m)	Joint displacement for L-shaped plan building (m)
2	0.000105466	0.00011696
3	0.001898	0.002120533
4	0.004088	0.004546712
5	0.006096	0.006763583
6	0.007727	0.00856268
7	0.008861	0.009810338
8	0.009491	0.010500662

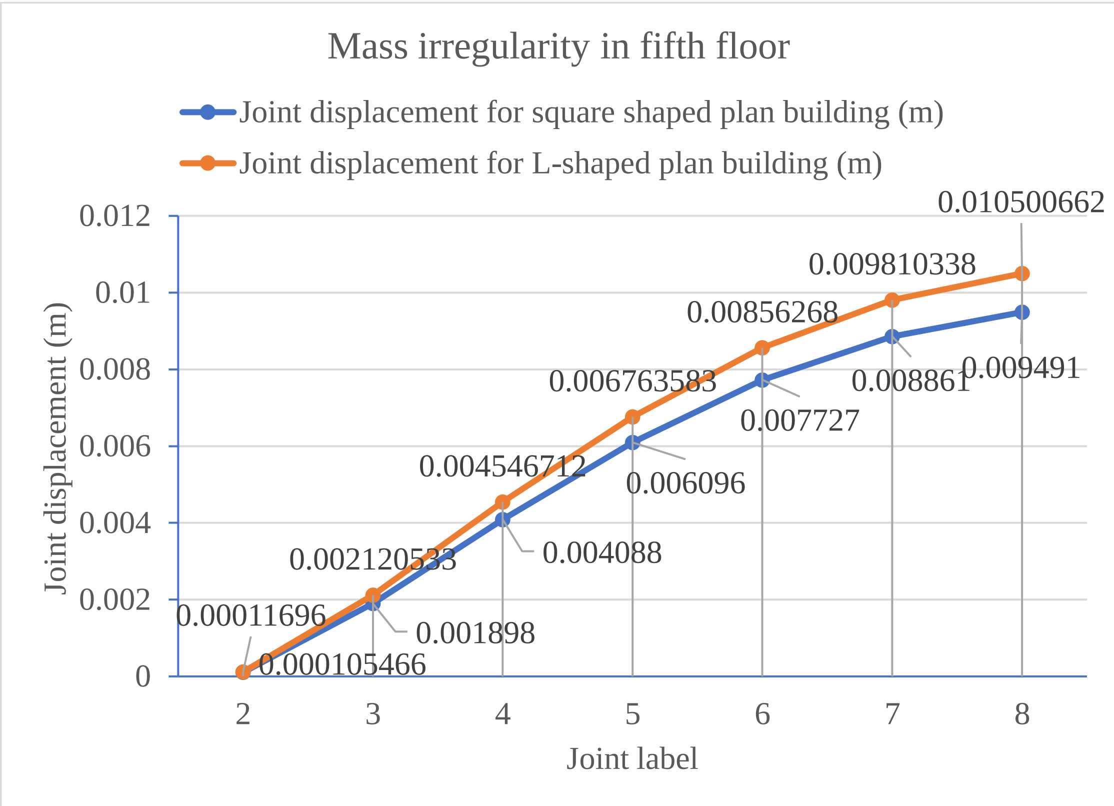

Figure 4.11 Joint displacement comparison when mass irregularity occurs in fifth floor

Table 4.53 Joint displacement comparison when mass irregularity occurs in sixth floor

Joint label	**Joint displacement for square shaped plan building (m)**	**Joint displacement for L-shaped plan building (m)**
2	0.000104447	0.00011596
3	0.001889	0.002109529
4	0.004069	0.004524683
5	0.006069	0.006732548
6	0.007703	0.008534134
7	0.008864	0.009810649
8	0.009502	0.010507662

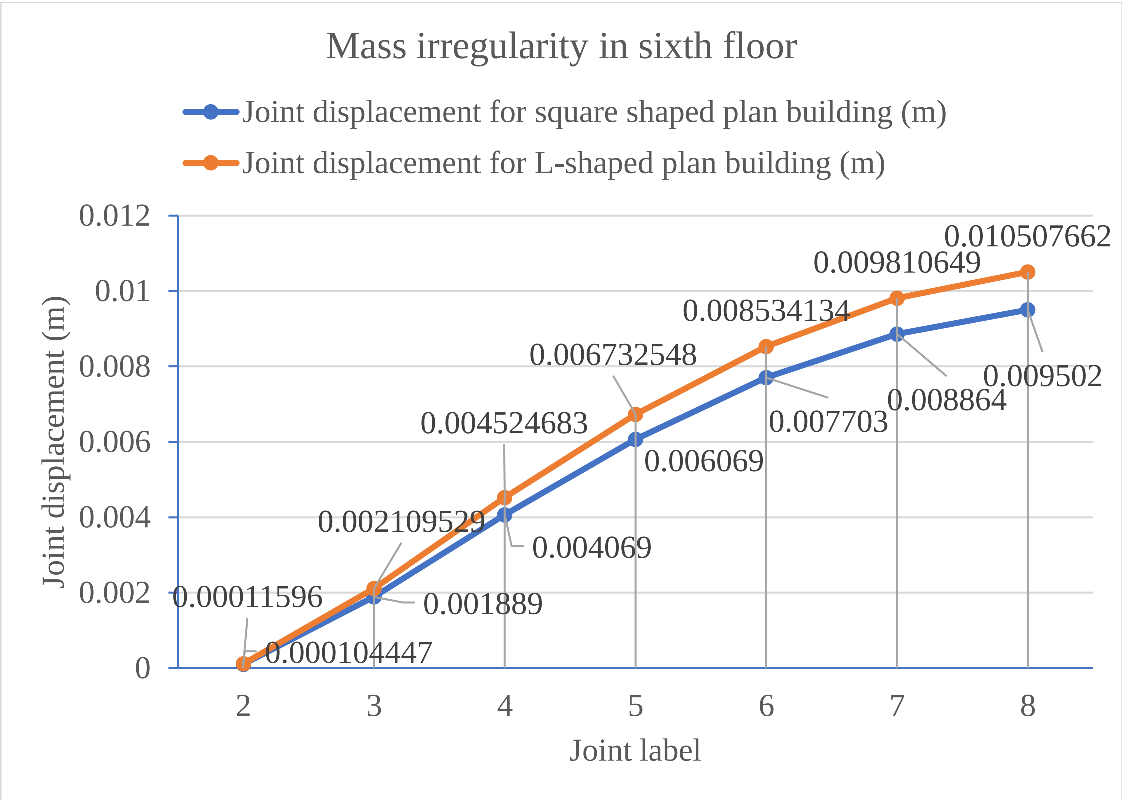

Figure 4.12 Joint displacement comparison when mass irregularity occurs in sixth floor

The joint displacements for L-shaped plan building are found to be more than that for the square shaped plan building in each case.

4.6 DISCUSSIONS

Wherever '*percent change*' of any parameter is mentioned, it means magnitude of percent increase or percent decrease of that parameter relative to the original live load of 2 KN/m^2. Similarly, wherever '*percent increase*' of any parameter is mentioned, it means percent increase of that parameter relative to the original live load of 2 KN/m^2. As according to IS 1893:2016, mass irregularity exists when seismic weight of any floor is more than 150% of that of the floors below, the mass irregularity is considered corresponding to 200% increase in live load and its analysis results are compared for both the building models.

From the analysis results obtained, following observations are made:

- The magnitude of forces in the considered columns for mass regular L-shaped plan building are more than that for the mass regular square shaped plan building, except axial force in columns 1, 2, 3 and 4, shear force about the orthogonal axes for columns 6 and 7, and bending moment about the orthogonal axes in column 7 for mass regular L-shaped plan building are less than the corresponding parameters for mass regular square shaped plan building.
- The magnitude of forces in the considered columns for mass irregular L-shaped plan building are more than that for the mass irregular square shaped plan building, except
    - Axial force in columns 1, 2, 3 and 4, shear force about the orthogonal axes in column 7, and bending moment about the orthogonal axes at lower point of column 7 for mass irregular L-shaped plan building are less than the corresponding parameters for mass irregular square shaped plan building when mass irregularity occurs in first floor.
    - When mass irregularity occurs in any one of second, third or fourth floor, axial force in columns 1, 2 and 3, shear force about the orthogonal axes in column 7, and bending moment about the orthogonal axes at lower point of column 7 for mass irregular L-shaped plan building are less than the corresponding parameters for mass irregular square shaped plan building.
    - When mass irregularity occurs in fifth floor, axial force in columns 1 and 2, shear force about the orthogonal axes in column 7, and bending

moment about the orthogonal axes at lower point of columns 6 and 7 for mass irregular L-shaped plan building are less than the corresponding parameters for mass irregular square shaped plan building.

  - When mass irregularity occurs in sixth floor, axial force in columns 1 and 2, shear force about the orthogonal axes in column 7, and bending moment about the orthogonal axes at lower point of column 7 for mass irregular L-shaped plan building are less than the corresponding parameters for mass irregular square shaped plan building.

- Percent increase in axial force in all columns for L-shaped plan building is more than that of square shaped plan building except for column 6. This is true irrespective of the storey in which mass irregularity occurs.
- In column 1, percent change in shear force about the orthogonal axes for L-shaped plan building is less than that for the square shaped plan building except when there is mass irregularity in third floor. In the same column, percent change in bending moment about the orthogonal axes for L-shaped plan building is less than that for the square shaped plan building except at mid-point of the column when there is mass irregularity in second floor.
- In column 2, percent change in shear force about the orthogonal axes for L-shaped plan building is less than that for the square shaped plan building. This is true irrespective of the storey in which mass irregularity occurs. In the same column, percent change in bending moment about the orthogonal axes for L-shaped plan building is less than that for the square shaped plan building except at mid-point of the column when there is mass irregularity in third floor.
- In column 3, percent change in shear force about the orthogonal axes for L-shaped plan building is less than that for the square shaped plan building except when there is mass irregularity in sixth floor. In the same column, percent change in bending moment about the orthogonal axes for L-shaped plan building is less than that for the square shaped plan building except at upper end of the column when there is mass irregularity in fourth floor.
- In column 4, percent change in shear force about the orthogonal axes for L-shaped plan building is less than that for the square shaped plan building except when there is mass irregularity in sixth floor. In the same column, percent change in bending moment about the orthogonal axes for L-shaped plan building

is less than that for the square shaped plan building except at upper end of the column when there is mass irregularity in second floor, and at lower end of the column when there is mass irregularity in sixth floor.

- In column 5, percent change in shear force about the orthogonal axes for L-shaped plan building is less than that for the square shaped plan building except when there is mass irregularity in first floor. In the same column, percent change in bending moment about the orthogonal axes for L-shaped plan building is less than that for the square shaped plan building except at upper end of the column when there is mass irregularity in either first or third floor.
- In column 6, percent change in shear force about the orthogonal axes for L-shaped plan building is much less than that for the square shaped plan building. This is true irrespective of the storey in which mass irregularity occurs. In the same column, percent change in bending moment about the orthogonal axes for L-shaped plan building is less than that for the square shaped plan building except at upper end of the column when there is mass irregularity in first floor.
- In column 7, percent change in shear force about the orthogonal axes for L-shaped plan building is more than that for the square shaped plan building. This is true irrespective of the storey in which mass irregularity occurs. In the same column, percent change in bending moment about the orthogonal axes for L-shaped plan building is more than that for the square shaped plan building except at mid-point of the column when there is mass irregularity in any of first three floors, at mid-point and lower end of the column when there is mass irregularity in fifth floor, and at mid-point and upper end of the column when there is mass irregularity in sixth floor.
- The percent increase in joint displacements for L-shaped plan building is less than that for the square shaped plan building except at joints 2,3 and 6 when mass irregularity occurs in first floor, and at joint 3 when mass irregularity occurs in second floor.

CHAPTER 5

CONCLUSION

5.1 GENERAL

Two types of RC framed buildings are considered, one with a square shaped plan which is symmetric in plan about the orthogonal axes, and the other with an L-shaped plan which is asymmetric in plan. Plan area and translational stiffness of both the models are kept same. The cross-sectional dimension of outer column (@ X = 0 and Y = 0) in every storey is also kept same for both the building models i.e. 0.6m x 0.6m so that comparison of the analysis results can be done for such columns. Response spectrum analysis (RSA) is carried out to determine the base shear, forces in the outer column (@ X = 0 and Y = 0) and the joint displacements. Vertical mass irregularity is considered in each floor of the building models by increasing the value of live load on each floor by 50%, 100%, 150% and 200% and the effect of such increase in live load is studied.

5.2 CONCLUSIONS

The conclusion of the study is divided into three parts. In the first part, effect of mass irregularity on base shear is explained. In the second part, comparison is done on the forces in outer column (@ X = 0 and Y = 0) for both square shaped and L-shaped plan buildings having mass irregularity. In the last part, the effect of mass irregularity on joint displacements is mentioned.

5.2.1 Effect on base shear

- Base shear for L-shaped plan building is found to be more than that for the square shaped plan building.
- Percent increase in base shear is found to be more for square shaped plan building when there is mass irregularity in any one of the first four storeys whereas the percent increase in base shear is found to be more for L-shaped plan building when the mass irregularity is present in any one of the upper two storeys.

- Presence of mass irregularity in first floor is observed to have the least effect on percent increase in base shear whereas the percent increase in base shear is found to be maximum when mass irregularity exists in the third floor. This is observed for both square shaped and L-shaped plan buildings.

5.2.2 Effect on column forces

The analysis results are determined for outer column (@ X = 0 and Y = 0) labelled 1, 2, 3, 4, 5, 6 and 7 from lower to upper storey respectively. Following conclusions can be made in general ignoring few exceptions mentioned earlier under sub-heading 4.6:

- The magnitude of forces in the considered columns for L-shaped plan building are found to be more than that for the square shaped plan building.
- Percent increase in axial force in all columns for L-shaped plan building is observed to be more than that of square shaped plan building for most of the columns.
- Percent change in shear force and bending moment about the orthogonal axes for L-shaped plan building is found to be less than that for the square shaped plan building. This holds true for all columns except for the column in uppermost storey.
- In column 7, percent change in shear force and bending moment about the orthogonal axes for L-shaped plan building is found to be more than that for the square shaped plan building.

5.2.3 Effect on joint displacements

The analysis results are determined for joints (@ X = 0 and Y = 0) labelled 1, 2, 3, 4, 5, 6, 7 and 8 from lower to upper storey respectively in which joint 1 is the fix joint. Following conclusions can be made in general ignoring few exceptions mentioned earlier under sub-heading 4.6:

- The displacements at the considered joints for L-shaped plan building are found to be more than that for the square shaped plan building.
- The percent increase in joint displacements at most of the joints for L-shaped plan building are found to be less than that for the square shaped plan building.
- For square shaped plan building, presence of mass irregularity in first floor is found to have the least effect on percent increase in joint displacements. The

percent increase in joint displacements for square shaped plan building is observed to be maximum at joint 2 when mass irregularity exists in second floor, at joint 3 when mass irregularity exists in third floor, at joints 4 and 5 when mass irregularity exists in fourth floor, at joint 6 when mass irregularity exists in fifth floor, and at joints 7 and 8 when mass irregularity exists in sixth floor.

- For L-shaped plan building, presence of mass irregularity in first floor is found to have the least effect on percent increase in joint displacements for joints 3, 4, 5, 6, 7 and 8, whereas the presence of mass irregularity in sixth floor is found to have the least effect on percent increase in joint displacement for joint 2. The percent increase in joint displacements for L-shaped plan building is observed to be maximum at joint 2 when mass irregularity exists in second floor, at joints 3, 4 and 8 when mass irregularity exists in third floor, and at joints 5, 6 and 7 when mass irregularity exists in fourth floor.

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