STABILITY COEFFICIENT OF MOMENT RESISTING FRAME STRUCTURE FOR DIFFERENT BUILDING PARAMETERS

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Stability Coefficient of Moment Resisting Frame Structure for Different Building Parameters

Submitted by

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DECLARATION

It is thereby declared that except for the contents where specific references have been made to the work of others, the study contained in this project is the result of investigations carried out by the author under the supervision of Dr. Raquib Ahsan, Professor, Department of Civil Engineering, Bangladesh University of Engineering and Technology.

No part of this project has been submitted to any other university or educational establishment for a degree, diploma or other qualification.

Md. Subbir Bin Harun

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ABSTRACT

High Rise Moment Resisting Frame structures are exposed to both static and dynamic loads. The process of designing high-rise buildings depends on many parameters. Stability Coefficient is one of them. It indicates whether a Moment Resisting frame Structure needs a second order analysis or not.

P-delta effect is secondary effect on a structure. It is also known as "Geometric non-linearity effect". As number of stories increases P-delta effect becomes more important. If the change in bending moment and displacement due to lateral load is more than 10% of primary moment and displacement P-delta effect should be considered in design, that is, second order analysis is required.

There are many important factors which take part in determination of stability coefficient. Load, base shear, earthquake load characteristics, story drift etc. play vital role in this factor. This study covers stability coefficient determination of ninety (90) moment resisting frame buildings for different building parameters to determine when it is necessary to perform the second order analysis.

Moment resisting frames are considered as frames which resist 100% of seismic force and are not enclosed or adjoined by components that are more rigid and will prevent the frames from deflecting under seismic forces. In this study, three different aspect ratios of structure are compared individually in same seismic zone namely Seismic Zone II of Bangladesh. As a case study a commercial building located at Dhaka city of Bangladesh with a floor area around 1000 square meter per floor has been considered in this study. Each structure was analyzed, and designed separately for comparison. Comparisons were made for height of structure varying from two storied to thirty storied building. Comparisons were made for both symmetric and asymmetric buildings. The comparisons were made in terms of their stability coefficient obtained from Finite Element analysis. Finally, it is concluded that for up to 24 storied RCC building at Dhaka city in both the cases of symmetric and asymmetric commercial buildings considered in the case study one does not need to consider P-delta effect in the analysis.

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NOTATION

Symbols		Description
C	-	Numeric co-efficient/horizontal force factor
Cd	-	Deflection amplification factor
C_t	-	Structural type co-efficient
d	-	Día of bar
Ec	-	Young's modulus of concrete
Eh	-	Horizontal earthquake loading
Ev	-	Vertical earthquake loading
f'c	-	Compressive strength of concrete
F_i	-	Lateral force applied at story level –i
F_t	-	Concentrated lateral force at the top
fy		Tensile strength of steel
F_y	-	Yield strength of Reinforcement
h_n	-	Total height of the structure above the base
I	-	Structural Importance co-efficient
M	-	Mass of the building
M_c	-	Columns Moment
M_g	-	Girders Moment
P	-	Total Design Load
R	-	Response Modification co-efficient
S	-	Site co-efficient of soil
T	-	Time period of the structural
V	-	Base Shear
Vw	-	Basic wind speed
W	-	Seismic Dead load
Wx	-	Horizontal Wind loading
Wy	-	Vertical Wind loading
Z	-	Seismic zone Co-efficient
Δ	-	Design Story Drift
θ	-	Stability Coefficient
Ω	-	System over strength factor

LIST OF ABBREVIATIONS

Abbreviation		Explanation
ASCE	-	American Society of Civil Engineers
BFL	-	Bare Frame Linear
BFP	-	Bare Frame Push
BNBC	-	Bangladesh National Building Code
DL	-	Dead Load
EQ	-	Earth Quack
ESFM	-	Equivalent Static Force Method
FF	-	Floor Finish
IBC	-	International Building Code
IMRF	-	Intermediate Moment Resisting Frame
LL	-	Live Load
LTHA	-	Linear Time History Analysis
MF	-	Magnification Factor
MI	-	Masonry Infill
MRFS	-	Moment Resisting Frame Structure
NTHA	-	Non-Linear Time History Analysis
OMRF	-	Ordinary Moment Resisting Frame
PW	-	Partition Wall
RCC	-	Reinforce Cement Concrete
RSA	-	Response Spectrum Analysis
SC	-	Stability Coefficient
SMRF	-	Special Moment Resisting Frame
SSFL	-	Soft Story Frame Linear
SSFP	-	Soft Story Frame Push
SW	-	Self-Weight
UBC	-	Uniform Building Code
WL	-	Wind Load

CHAPTER - 1

INTRODUCTION

1.1 General

High Rise Moment Resisting Frame structures are exposed to both static and dynamic loads. The process of designing high-rise buildings depends on many parameters. Stability Coefficient is one of them. It indicates whether a Moment Resisting frame Structure needs a second order analysis or not.

P-delta effect is a secondary effect on a structure. It is also known as "Geometric non-linearity effect". As number of stories increases P-delta effect becomes more important (Kumar et. al. 2019). If the change in bending moment and displacement is more than 10% of primary moment and displacement, P-delta effect should be considered in design, that is, second order analysis is required (BNBC 2020). P-delta is a second-order effect on a structure which is loaded laterally. One first-order effect is the initial deflection of the structure in reaction to the lateral load. The magnitude of the P-delta effect depends on the magnitude of this initial deflection. P-delta is a moment found by multiplying the force due to the weight of the structure and applied axial load, P, by the first-order deflection, Δ (Lindeburg & Baradar 2001; Comino 2016).

For easy understanding, when a structure is loaded, it will deflect or deform to relieve the stress. This deflection is said to be the first-order effect. Without any additional loading, if any stresses or adverse effects induced in a structure due to the first-order deflection, it is called a second-order effect. P-delta analysis is called a second-order analysis because it depends on the initial deflection of the structure. If the initial first-order deflection is more, then obviously the P-delta effect will be more in the structure. There are many important factors which take part in determination of stability coefficient. Load, base shear, earthquake load characteristics, story drift etc. play vital role in this factor (Kadid & Boumrkik 2008). For different building parameters it also varies.

Civil engineers all around the world are in general, trained for linear analysis. Consequently, seismic evaluation or design process, which essentially involves a nonlinear behavior, is linearized. As relatively new development, seismic evaluation and design methods offered a great opportunity to engineers such that they are now able to directly calculate the nonlinear seismic demand and evaluate its consequences for the structure, which might be considered as break through, is earthquake engineering. The correct analysis will depend upon the proper modeling of the behavior of materials, elements connection and structure.

An earthquake is a phenomenon during which strong vibrations occur in the ground due to release of enormous energy within a short period of time causing sudden disturbance in the earth's crust on the upper mantle (Verney 1979). In other words, it be defined as a sudden transient motion or series of motions of the ground originating in a limited region and spreading there in all direction during an earthquake, the ground motions cause structures to vibrate and induce inertial forces on them. Hence, structures in such locations need to be suitably designed and detailed to ensure stability, strength and serviceability with acceptable levels of safety under seismic effects (Deierlein et al. 2010). Systematic recording and analysis of data collected from previous earthquake and scientificinvestigations carried all over the world over the last few decades have resulted in the establishment of regulations and guidelines for earthquake and wind load resistant design of buildings and structures.

Bangladesh is typically a storm prone area where consideration to the thrust due to storm must be given in the analysis and design of building and structures. Wind load due to storm is typically modeled as lateral thrust force (Ghosh et al. 1992). causing sway or overturning of the building. Detailed specifications on wind loading on buildings are outlined in BNBC (2020).

1.2 Background And Present Status of Problem

Urban development has been rapidly progressing in Bangladesh and now a days we are constructing many high-rise building structures. Bangladesh is recognized as an earthquake pronecountry. All buildings must be earthquake and wind resistant with proper planning and structural design. New housing in Bangladesh seems to be constructed to meet the social demand, but the effect of earthquake and wind is not properly considered in many cases.

Based on the severity of the probable intensity of the seismic ground motion and damages, Bangladesh has been divided into four Seismic zones i.e., zone-I, zone-2, zone-3, zone-4 with zone-4 being the most severe (BNBC 2020).

Structural framing system and components shall be designed with adequate stiffness to have deflections or any other deformations within the serviceability limit. There are different types of structural-systems. Structural systems have gradually evolved for residential and office buildings, reflecting their differing functional requirements.

Several studies had been carried out on seismic and wind action in various aspects by different researches. But very few studies have been carried out on structural design system requirement due to seismic and wind load in Bangladesh. The current study is under taken using a software for structural analysis and determination of the design criteria needed for different heights with changing building regularity and aspect ratio. It will help the structural engineers to get ideas about the required design process.

1.3 Objectives With Specific Aims

Objectives of the study are as follows:

a) To decide if it is necessary or not to include P-delta effect in analysis for a building up to a certain height.
b) To determine the change of requirement of second order analysis due to change of various parameters of moment resisting frame buildings.

1.4 Outline of the Methodology

Modeling the structural system of the building for structural analysis has been performed. A basic structural analysis model of the building has been prepared with the dimensions and details obtained from preliminary design strategies. The analytical model of the building is a 3-dimensional one for studying dynamic behavior including all possible stiffness and masses of the building as seismic and wind load design codes require all buildings to be analyzed with torsional effects with at least a minimum eccentricity between mass and stiffness at each floor level of the building. It is required that cracked moment of inertia properties be used in modeling moment frame members.

Following procedures will be followed during the analysis.

Creating finite element structural models using ETABS software as per architectural drawing

⇓

Application of loads on slabs

⇓

Include earthquake load and wind load.

⇓

Analyze the building

⇓

Check design.

⇓

Take total vertical design load, story shear force & story drift

⇓

Determine **stability coefficient**

⇓

Increase building height & repeat steps 1 to 7

⇓

Repeat Step 1 to 8 for different building parameters

⇓

Presenting comparisons in graphs

1.5 Scopes of the Study

There are some limitations of the present study where the stability coefficients of buildings of different aspect ratios have been determined. They are given below.

a) We have considered only RCC structure in this study. Structures of other building materials were not considered in this study.

b) In this study, a simple layout plan was selected. No parametric study related to different layout plans was conducted.

c) In the study, only square and rectangular columns were selected in all the buildings.

d) All the structures were selected at earthquake zone-2 according to BNBC-2020.

e) All the structure were selected as moment resisting frame structures only.

f) In this study, only three aspects ratios for both symmetric and asymmetric buildings were selected.

g) Same study could be done by changing many structural criteria such as Site class (S), Importance factor (I), Response modification factor (R), System Over strength factor(Ω_o), Deflection Amplification Factor(C_d) etc.

h) By changing materials properties same study could be done and comparison could be made with these results.

i) Many structural criteria such as soft story effect, vertical irregularity, non-linearity etc. has not been considered in this study which might be considered.

j) Vertical Irregularity has not been considered in this study.

1.6 Layout of Project Report

The Report is organized into five chapters. The general background, objective of the study and methodology of the work are presented in Chapter 1 to give basic idea of the project work done under the study. Chapter 2 reviews existing literature on the subject which includes few previous studies, earthquake as dynamic load and its causes, including seismic zoning map of Bangladesh. Pattern of wind load and its effect on structure is also discussed. This chapter also discusses about various structural systems and response modification coefficient, seismic effect and force on structure, different types of analysis methods and their prerequisite. In Chapter 3 a discussion on analysis parameters, model and software used in this study is reported. Chapter 4 is composed of results and discussion of the research work. Chapter 5 draws conclusions by summarizing the outcome of the research work and proposes new directions for further research and developments.

CHAPTER - 2

LITERATURE REVIEW

2.1 General

From the age of industrialization, the process of urbanization has started which is still in progress in many parts of the world. In Bangladesh this process began in the nineteenth century. People migrated from rural to urban areas, thereby forcing an increase in the density of cities. A lot of high-rise buildings are being constructed. The building must cope with the vertical forces of gravity and the horizontal forces of wind above ground and the seismic forces below ground. Since the foundation is the point of contact between the building and the earth, seismic force acts on the building by shaking the foundation back and forth (Kumar 2012).

The response of a building during earthquake is a complicated issue. Till now, no mathematical tool is available to predict the behavior of a structure during earthquake (Powell 2010). Basically, this is because of the unpredictable nature of earthquake excitation that might occur at a specific time and site and then resulting complicated response of a building itself.

The design of the structural members in a building is to be based on the internal forces resulting from a linear elastic analysis using the code-prescribed seismic forces (Beavers 2002). In general, these forces are determined considering the buildings location relative to the seismic source zone or fault, occupancy, site characteristics, structural system, height and configuration. The magnitude of earthquake loading is a result of the dynamic response of the building to the shaking of the ground.

The seismic design forces are a fraction of the actual forces that a structure may experience during an earthquake. For design purpose, the seismic forces are reduced since it is impractical as well as uneconomical to design a structure for the maximum probable forces. Accurate design of a structure is very much related to find out the actual design category and process of that structure. For actual stability of a structure proper design method and consideration is absolutely necessary.

2.2 Previous Study

Different studies had been carried out on seismic action in various aspects by several researches. It is found that a very few studies are carried out in this particular aspect. Earthquakes cause immense economic losses. Reducing disaster risk is a top priority for all concerns. It is also very much helpful for an engineer to know the accurate design procedure and consideration which is needed for a structure in different seismic zones and for different building height especially different aspect ratio such as length and width ratio. So, the behavior of building under the influence of seismic load has been a major point of interest for the engineers from a long period of time.

When a slender structure is exposed to lateral loads i.e., wind or seismic loads it experiences sway or lateral displacement. Whenever this lateral displacement is increased to peak then gravity loads start to act with an eccentricity. This is equal to the magnitude of elastic deflection causing an additional overturning moment. Due to which, a second order deflection is developed in the structure.

A study titled "P-delta Effect in High- Rise Buildings with and without Shear Wall" was conducted by Kumar (2019).

P-delta analysis and linear static analysis by providing shear wall in 6 models was done. The result of analysis of those models shows the effect of P-delta will be considerable when lateral loads on building are considered. P-delta is negligible when only the gravity loads were considered. In all models the differences are observed very clearly. Story displacement for both P-delta and without P-delta was found the same trend of increasing with building height and aspect ratio (Length by width).

The displacements of conventional building models (without P-delta) found less when compared to building with P- delta. The story drifts in building models with P-delta effect are more when comparing with models analyzed using equivalent static analysis method (without P-delta effect). Shear wall placed at center of frame shows more effectiveness when comparing with shear wall placed at corner and without shear wall of the structure.

The results show the bending moment (BM) in shear wall increases 18% due to P-delta effect (Kumar et. al. 2019). The results of analysis were checked with P-Δ effect and without P-delta effect (P-Δ) in the building models. In elastic or inelastic dynamic analyses, increase in eccentricity causes change in P-delta effect. The change is very important in elastic analysis and is somewhat less important in inelastic analysis. However, the variation does not have a constant increasing or decreasing trend. One of the facts that the increase in eccentricity the mass moment of inertia is not increased in all cases (Kumar et. al. 2019).

2.3 Moment Resisting Frame System

There are various types of structural systems in building construction. In this study moment resisting frame structure has been considered. Moment Resisting Frame System is a structural system with an essentially complete space frame providing support for gravity loads. Moment-resisting frames provide resistance to lateral loads primarily by flexural action of members (Schueller 1977). Moment resisting frame system may be classified as one of the following types:

i. Special moment resisting frame (SMRF)
ii. Intermediate moment resisting Frames (IMRF)
iii. Ordinary moment resisting Frames (OMRF)

2.3.1. Special moment resisting frame (SMRF)

It is a moment- resisting frame specially detailed to provide ductile behavior and to comply with the requirements given in BNBC 2020 Sections 8.3.3 to 8.3.8. Design base shear is low. Response reduction factor, R = 8. Low design base shear. It is safe to design a structure with ductile detailing. In seismic zones 2, 3 and 4, reinforced concrete frames resisting forces induced by earthquake motions must be special moment-resisting frames (SMRF) for seismic design category D.

2.3.2. Intermediate moment resisting frames (IMRF)

It is expected to withstand limited inelastic deformations in their members and connections when subjected to the forces resulting from the ground motion of the design earthquake. In seismic zone 2 and 3, reinforced concrete frames resisting forces in-deuced by earthquake motions must be, at a minimum, intermediate moment-resisting frames (IMRF) for seismic design category C.

2.3.3. Ordinary moment resisting Frames (OMRF)

It is a moment- resisting frame system not meeting special detailing requirement for ductile behavior. It is used for low earthquakes. Design base shear is high. Response reduction factor, R = 3. High base shear design. It is not safe to design a structure without ductile detailing. In seismic zone 1, the moment-resisting frames can be ordinary moment-resisting frames (OMRF).

The framing system, IMRF and SMRF shall have special detailing to provide ductile behavior for concrete structure (BNBC 2020). OMRF need conform to the ductility requirements.

2.4 Seismic Effect and Force on Structure

The seismic effect on structure during earthquakes depends critically on its overall shape, size, location of epicenter and geometry, in addition to how the earthquake forces are carried to the ground. It is observed from the past earthquakes that all structural elements do not respond equally. It mainly depends on their location in that structure. When the structures are twisting during earthquake, inertia forces are developed and it flows in different structural member. It is found that due to seismic effect on structure, seismic loads are developed on it. These loads are depended on various factors of structure and surrounding (weight, height, structural system, soil condition). Effects of inertia forces and calculation of forces in various stories level are given in following section. The Blue Book and the UBC seismic provisions have been recognized throughout the world as leading references for the design of earthquake resistant buildings (Diebold & Moore 2009).

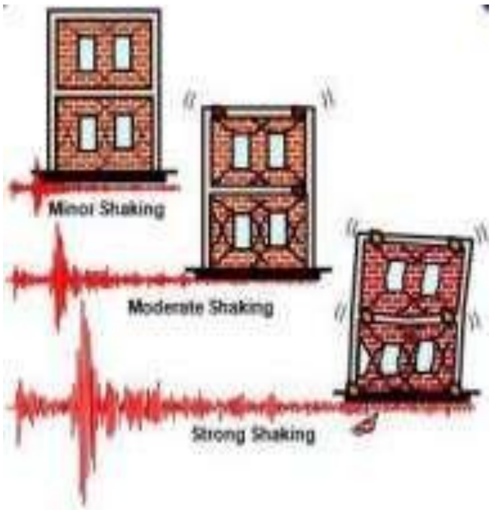


Figure 2.1: Effect on buildings due to ground shaking

Source: “Seismic Safety of Nuclear Power Plants A Monograph” by Vijay Muthekar

2.4.1. Inertia forces in structures

Earthquake causes shaking of the ground. So, a building resting on it will experience motion at its base. From Newton’s First Law of Motion, even though the base of the building moves with the ground, the roof has a tendency to stay in its original position. But since the walls and columns are connected to it, they drag the roof along with them. This tendency to continue to remain in the previous position is known as inertia. In the building, since the walls or columns are flexible, the motion of the roof is different from that of the ground. Let us a building whose roof is supported on columns. Similarly, when the ground moves, even the building is thrown backwards, and the roof experiences a force,called inertia force. If the roof has a mass M and experiences an acceleration *a*, then from Newton's Second Law of Motion, the inertia force FI is mass M times acceleration *a*, and its direction is opposite to that of the acceleration. Clearly, more mass means higher inertia force. Therefore, lighter buildings sustain the earthquake shaking better.

2.4.2. Effect of deformations in structures

The inertia force experienced by the roof is transferred to the ground via the columns, causing forces in columns. These forces generated in the columns can also be understood in another way. During earthquake shaking, the columns undergo relative movement between their ends. In Figure 2.2, this movement is shown as quantity *u* between the roof and the ground. But, given a free option, columns would like to come back the straight vertical position, i.e., columns resist deformations.

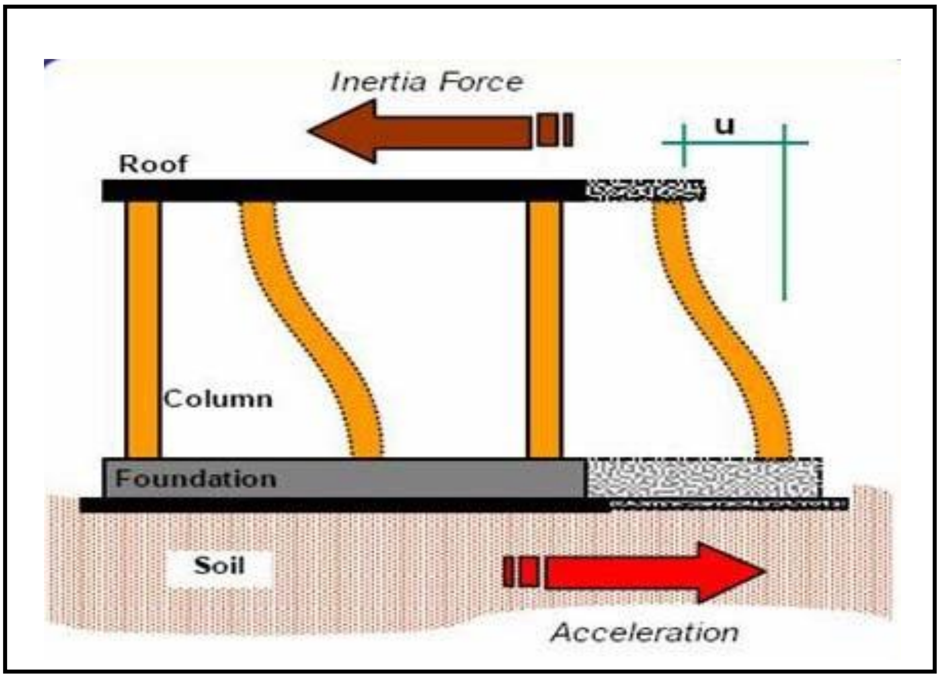


Figure 2.2: Inertia force and relative motion within a building.
Source: "Earthquake Resistant Buildings Design" by Haseeb Jamal (2017)

In the straight vertical position, the columns carry no horizontal earthquake force through them. But, when forced to bend, they develop internal forces. The larger is the relative horizontal displacement *u* between the top and bottom of the column, the larger this internal force in columns. Also, the stiffer the columns are (bigger is the column size), larger is this force. For this reason, these internal forces in the columns are called stiffness forces. In fact, the stiffness force in a column is the column stiffness times the relative displacement between its ends (Applied Technology Council 1978).

2.4.3. Horizontal and vertical shaking

Earthquake causes shaking of the ground in all three directions – along the two horizontal directions (X and Y, say), and the vertical direction (Z, say*)* Figure 2.3. Also, during the earthquake, the ground shakes randomly back and forth (- and +) along each of these X, Y and Z directions. All structures are primarily designed to carry the gravity loads, i.e., they are designed for a force equal to the mass M (this includes mass due to own weight and imposed loads) times the acceleration due to gravity *g* acting in the vertical downward direction (-Z). The downward force Mg is called the gravity load. The vertical acceleration during ground shaking either adds to or subtracts from the acceleration due to gravity. Since factors of safety are used inthe design of structures to resist the gravity loads, usually most structures tend to be adequate against vertical shaking.

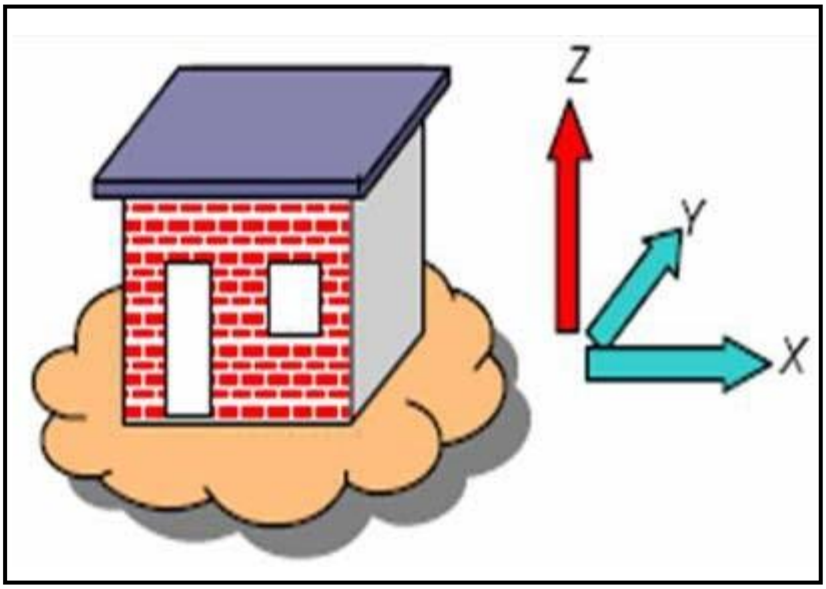


Figure 2.3: Principal direction of force in a building.

Source: "Earthquake Resistant Buildings Design" by Haseeb Jamal (2017)

However, horizontal shaking along X and Y directions (both + and – directions of each) remains a concern. Structures designed for gravity loads, in general, may not be able to safely sustain the effects of horizontal earthquake shaking. Hence, it is necessary to ensure adequacy of the structures against horizontal earthquake effects.

2.4.4. Flow of inertia forces to foundations

Under horizontal shaking of the ground, horizontal inertia forces are generated at level of the mass of the structure (usually situated at the floor levels). These lateral inertia forces are transferred by the floor slab to the walls or columns, to the foundations, and finally to the soil system underneath. So, each of these structural elements (floor slabs, walls, columns, and foundations) and the connections between them must be designed to safely transfer these inertia forces through them. Walls or columns are the most critical elements in transferring the inertia forces (Nilson et al. 2003).

2.4.5. Response of tall buildings

In general, tall buildings respond to seismic motion somewhat differently than low- rise buildings. The magnitude of inertia forces induced in an earthquake depends on the building mass, ground acceleration in Figure 2.4, the nature of foundation andthe dynamic characteristics of the structure. If a building and its foundation were infinitely rigid, it would have the same acceleration as the ground (Moghadam & Aziminejad 2004). The inertia force F for a given ground acceleration *a* given by Newton's Law F =Ma, where M is the building mass. For a structure that deforms only slightly, thereby-absorbing some energy, the force F tends to be less than the product of mass and ground acceleration. Tall buildings are invariably more flexible than low-rise buildings, and in general experience accelerations much less than low-rise buildings (Schueller 1977).

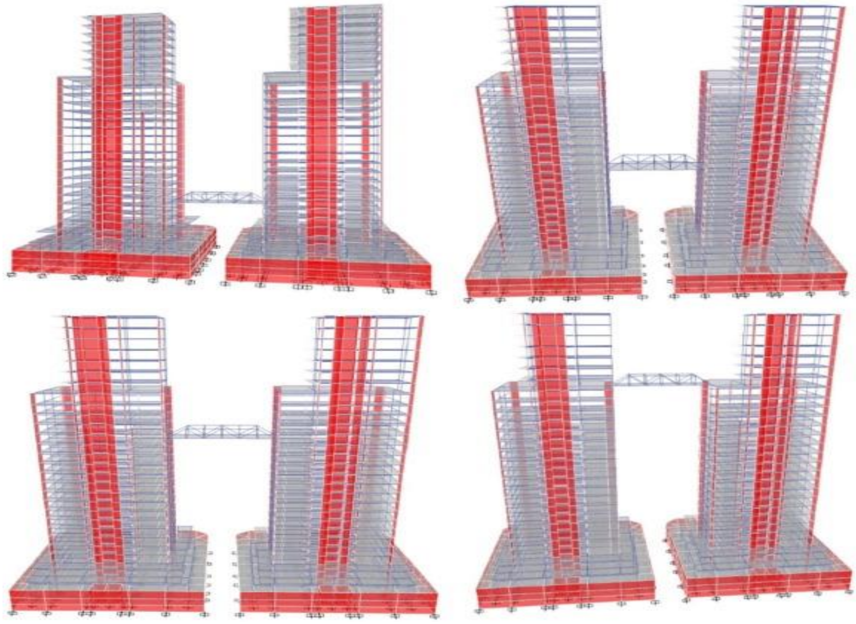


Figure 2.4: Response of tall building during earthquake

Source: “Ain Shams Engineering Journal”, Volume 10 (2019)

When the ground shakes, the base of building moves with the ground, and the building swings back-and-forth. If the building were rigid, then every point in it would move by the same amount as the ground. But most buildings are flexible, and different parts move back-and-forth by different amounts. The building will oscillate back-and-forth horizontally and after some time comes back to the original position, these oscillations are periodic. The time is taken (in seconds) for each complete cycle of oscillation is the same and is called Fundamental Natural Period T of the building. Value of T depends on the building flexibility and mass; more the flexibility, the longer is the T, and more the mass, the longer is the T. In general, taller buildings are more flexible and have larger mass, and therefore have a longer T. On the contrary, low- to medium-rise buildings generally have shorter T (Smith & Coull 1991).

2.5 Wind Load Effect and Force on Structure

Wind Load effect on structure depends critically on its overall shape, size, location etc. It is observed from the past all structural elements do not respond equally. It mainly depends on their location in that structure. When the structures are twisting due to wind load, inertia forces are developed and it flows in different structural member. It is found that these loads are depended on various factors of structure and its surrounding (weight, height, structural system, wind velocity, action angle etc.).

2.6 Structural Analysis

There are various methods for Structural analysis for seismic resistant structures (Bulent 2021)which is below

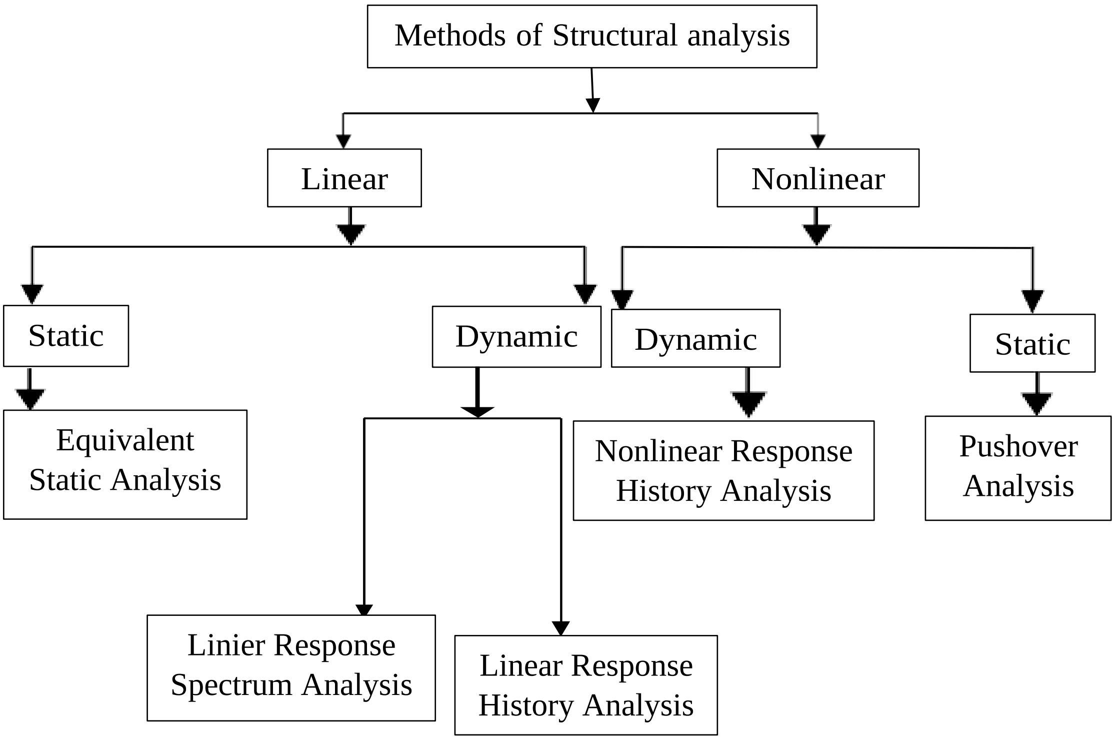


Figure 2.5: Methods of seismic analysis

2.6.1. Static analysis procedure

Although analysis of buildings subjected to dynamic earthquake loads should theoretically require dynamic analysis procedures, for certain type of building structures subjected to earthquake shaking, simplified static analysis procedures may also provide reasonably good results. The equivalent static force method is such a procedure for determining the seismic lateral forces acting on the structure. This type of analysis may be applied to buildings whose seismic response is not significantly affected by contributions from modes higher than the fundamental mode in each direction. This requirement is deemed to be satisfied in buildings which fulfill the following two conditions:

(a) The building period in the two main horizontal directions is smaller than both $4T_C$ (T_C Structure Period) and 2 seconds.

(b) The building does not possess irregularity in elevation.

2.6.2. Linear equivalent static analysis

The evaluation of the seismic loads starts with the calculation of the design base shear which is derived from the design response spectrum presented. This Section presents different computations relevant to the equivalent static analysis procedure.

Design base shear

The seismic design base shear force in a given direction shall be determined from the following relation:

$V = S_a W$ Where,

S_a = Lateral seismic force coefficient. It is the design spectral acceleration (in units of g) corresponding to the building period T.

W = Total seismic weight of the building.

Vertical distribution of lateral forces

In the absence of a more rigorous procedure, the total seismic lateral force at the base level, in other words the base shear V, shall be considered as the sum of lateral forces F_x induced at different floor levels, these forces may be calculated as

$F_x = V \frac{w_x {h_x}^k}{\sum_{i=1}^{n} w_i {h_i}^k}$ Where,

F_x = Part of base shear force induced at level x

w_i and w_x = Part of the total effective seismic weight of the structure (W) assigned to level i or x.

h_i and h_x = the height from the base to level i or x

$k = 1$ For structure period ≤ 0.5s

= 2 for structure period ≥ 2.5s

= linear interpolation between 1 and 2 for other periods.

n = number of stories

Story shear and its horizontal distribution

The design story shear V_x, at any storey x is the sum of the forces F_x in that storey and all other stories above it, given by Equation

$V_x = \sum_{i=x}^{n} F_i$

Where, $F_i =$ Portion of base shear induced at level i, as determined by previous equation.

Deflection and story drift

The deflections (δ_x) of level x at the center of the mass shall be determined in accordance with the following equation:

$\delta_x = \frac{C_d \delta_{xe}}{I}$ Where,

C_d = Deflection amplification factor.

δ_{xe} = Deflection determined by an elastic analysis

I = Importance factor.

The design story drift at story x shall be computed as the difference of the deflections at the centers of mass at the top and bottom of the story under consideration:

$\Delta_x = \delta_x - \delta_{x-1}$

Overturning effects

The structure shall be designed to resist overturning effects caused by the seismic forces [6]. At any story, the increment of overturning moment in the story under consideration shall be distributed to the various vertical force resisting elements in the same proportion as the distribution of the horizontal shears to those elements. The overturning moments at level$x$, M_x shall be determined as follows:

$M_x = \sum_{i=x}^{n} F_i (h_i - h_x)$ Where,

F_i = Portion of the seismic base shear, V induced at level i

h_i, h_x = Height from the base to level i or x.

The foundations of structures, except inverted pendulum-type structures, shall be permitted to be designed for three-fourths of the foundation overturning design moment, M_o determined using above equation.

P-delta effects

To illustrate the effect, we have to consider a case in statics, a perfectly rigid body anchored on the ground subject to small lateral forces. For example, a concentrated vertical load applied to the top of the structure and the weight of the structure itself are used to compute the ground reaction force and moment (Bulent 2021). Real structures are flexible and will bend to the side. The amount of bending is found through a strength of materials analysis. During this side displacement, the top has changed position and the structure is experiencing an additional moment, P×Δ. This moment is not accounted for in a basic first-order analysis. By superposition, the structure responds to this moment by additional bending and displacement at the top.

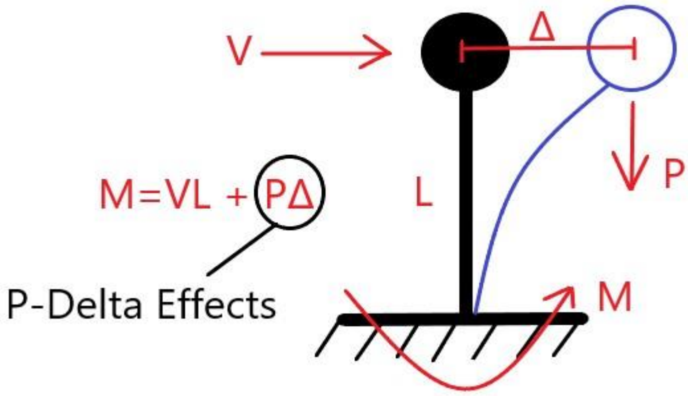


Figure 2.6: P-delta effect on a member

In some sense, the P-delta effect is similar to the buckling load of an elastic, small-scale solid column given the boundary conditions of a free end on top and a completely restrained end at the bottom, with the exception that there may exist an invariant vertical load at the top of the column. A rod planted firmly into the ground, given a constant cross-section, can only extend so far up before it buckles under its own weight; in this case the lateral displacement for the solid is an infinitesimal quantity governed by Euler buckling. If the lateral displacement and/or the vertical axial loads through the structure are significant then a P-delta analysis should be performed to account for the non-linearities (Lindeburg & Baradar 2001; (Comino 2016).

P-delta effect one type of geometric nonlinearity, involves the equilibrium compatibility relationships of a structural system loaded about its deflected configuration.

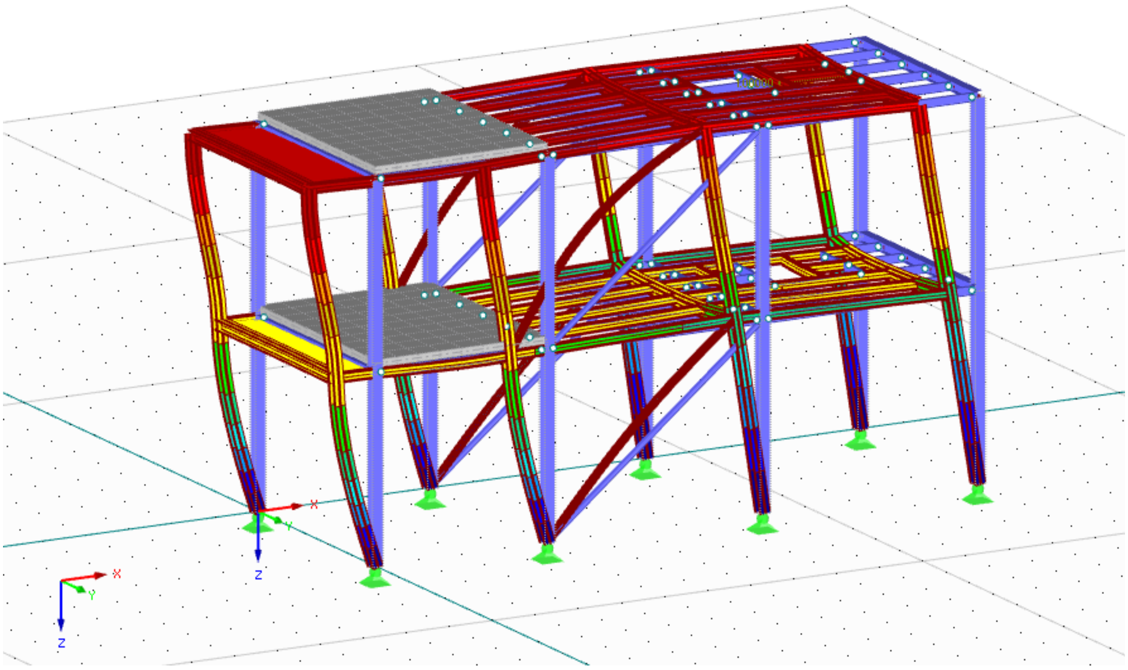


Figure 2.7: P-delta effect on a Structure

Source: Consideration of P-Delta Effects (Second-Order Analysis) in the Response Spectrum Analysis According to ASCE 7-16

P-δ effect, or P-"small-delta", is associated with local deformation relative to the element chord between end nodes. Small P-delta effects can affect overall structural behavior by slightly reducing the buckling load, and can change the moment within the member. Typically, P-δ only becomes significant at larger displacement values or in especially slender columns (Powell 2010). Small P-delta effect is important for local buckling and for design algorithms that expect member buckling to be accounted for by analysis. This includes the AISC direct-analysis method.

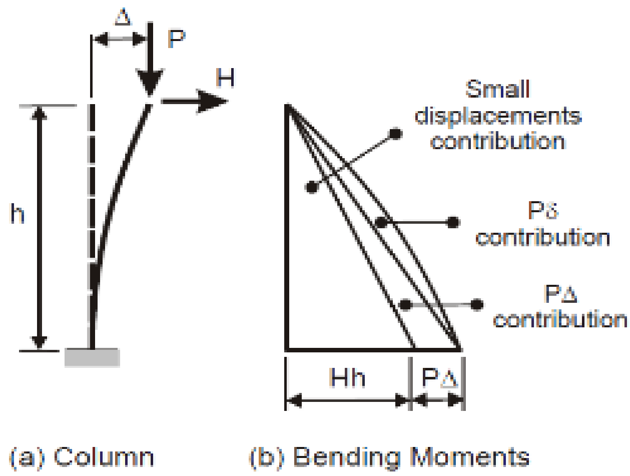


Figure 2.8: P-δ and P-Δ & effect on a Structure

Source: “P-Delta effect” by Mike Abell (2019)

Small P-delta is automatically included in frame elements to the extent that the deflected shape can be well represented by a cubic curve. The frame small P-delta effect is very accurate for a single element with effective-length factor of 2 (cantilever), and it is moderately accurate for an effective-length factor of 1 (pinned or sway condition). When accurate small P-delta effects are important for analysis or design of a member, it is generally recommended to auto-mesh frame objects into 2 or more elements, especially for axial loads close to buckling. For most other purposes, small P-delta effects as they impact the overall structure are adequately considered with a single frame object between connections.

P-Δ effect, or P-"big-delta", is associated with displacements of the member ends. Large P-delta effect is important for overall structure behavior under significant axial load. As indicated intuitively by Figure, gravity loading will influence structural response under significant lateral displacement.

P-Δ may contribute to loss of lateral resistance, ratcheting of residual deformations, and dynamic instability (Deierlein et al. 2010). As shown in Figure, effective lateral stiffness decreases, reducing strength capacity in all phases of the force-deformation relationship (PEER/ATC 2010) To consider P-Δ effect directly, gravity load should be present during nonlinear analysis. Application will cause minimal increase to computational time and will remain accurate for drift levels up to 10%.

Large P-delta is included in all elements – frame, shell, solid, link.

The P-delta effects on story shears and moments, the resulting member forces and moments, and the story drifts induced by these effects are not required to be considered if the stability coefficient (*θ*) determined by the following equation is not more than 0.10

$\theta = \frac{P_x \Delta}{V_x h_{sx} C_d}$ Where,

P_x = Total vertical design load at and above levelx; where computing P_x, no individual load factor need exceed 1.0

$\Delta =$ Design story drift occurring simultaneously with V_x

V_x = Storey shear force acting between levels x and $x - 1$

h_{sx} = Storey height below level x

C_d = Deflection amplification factor given in Table 6.2.19

The stability coefficient θ shall not exceed θ_{max} determined as follows:

$\theta \frac{0.5}{\beta C_d}_{max}$

Where, β is the ratio of shear demand to shear capacity for the story between levels x and$x - 1$. This ratio is permitted to be conservatively taken as 1.0.

Where, the stability coefficient θ is greater than 0.10 but less than or equal to θ_{max}, the incremental factor related to P-delta effects on displacements and member forces shall be determined by rational analysis. Alternatively, it is permitted to multiply displacements and member forces by $\frac{1}{(1-\theta)}$.

Where, θ is greater than θ_{max}, the structure is potentially unstable and shall be redesigned.

Where, the P-delta effect is included in an automated analysis, shall still be satisfied, however, the value of θ computed from this equation using the results of the P-delta analysis is permitted to be divided by $(1 + \theta)$ before checking the later equation.

2.6.3. Three-dimensional analysis: Where three-dimensional analysis is performed, ground motions shall consist of pairs of appropriate horizontal ground motion acceleration time histories (in two orthogonal horizontal directions) that shall be selected and scaled from individual recorded events. Appropriate ground motions shall be selected from events having magnitudes, fault distance, and source mechanisms that are consistent with those that control the maximum considered earthquake. Where the required number of recorded ground motion pairs are not available, appropriate simulated ground motion pairs shall be used to make up the total number required. For each pair of horizontal ground motion components, an SRSS spectrum shall be constructed by taking the square root of the sum of the squares of the five-percent-damped response spectra for the components (where an identical scale factor is applied to both components of a pair). Each pair of motions shall be scaled such that for each period between $0.2T$ and $1.5T$ (where T is the natural period of the fundamental mode of the structure) the average of the SRSS spectra from all horizontal component pairs is not less than 1.3 times the corresponding ordinate of the real design acceleration response spectrum.

2.7 Loads And Load Combinations

2.7.1. Loads

There are many kinds of loads act on a structure. According to building criteria and location different kinds of loads varies.

i. Dead load

Dead load is the vertical load due to the weight of permanent structural and nonstructural components of a building such as walls, floors, ceilings, permanent partitions and fixed service equipment etc.

ii. Live load

Live load is the load superimposed by the use or occupancy of the building not including the environmental loads such as wind load, rain load, earthquake load or dead load. The minimum floor live loads shall be the greatest actual imposed loads resulting from the intended use or occupancy of the floor.

iii. Earthquake load

Load effects of earthquake, or related internal moments and forces, Earthquake load is applied and analyzed in two methods. Equivalent static force method is used for static analysis and response spectrum method for dynamic analysis.

iv. Wind Load

Load effects of wind is not negligible. Proper structural design of any building structure must include loads due to wind also. Although there has been no major incident of wind hazard in the recent past of Bangladesh, wind pressure is not uncommon in this area.

2.7.2. Load combinations

i. Combinations of load effects for allowable stress/strength design

Provisions of this Section shall apply to all construction materials permitting their use in proportioning structural members by allowable stress/strength design method. When this method is used in designing structural members, all loads listed herein shall be considered to act in the following combinations. The combination that produces the most unfavorable effect shall be used in design.

1. D + F
2. D + H + F + L + T
3. D + H + F + (Lr or R)
4. D + H + F + 0.75(L + T) + 0.75(Lr or R)
5. D + H + F + (W or 0.7E)
6. D + H + F + 0.75(W or 0.7E) + 0.75L + 0.75(Lr or R)
7. 0.6D + W + H
8. 0.6D + 0.7E + H

When a structure is located in a flood zone or in tidal surge zone, the following load combinations shall be considered:

1. In Coastal Zones vulnerable to tidal surges, $1.5F_a$ shall be added to other loads in combinations (5), (6); E shall be set equal to zero in (5) and (6).
2. In non-coastal Zones, $0.75F_a$ shall be added to combinations (5), (6) and (7); E shall be set equal to zero in (5) and (6).

ii. Combinations of load effects for strength design method

When strength design method is used, structural members and foundations shall be designed to have strength not less than that required to resist the most unfavorable effect of the combinations of factored loads listed in the following Sections

1. 1.4(D + F)
2. 1.2(D + F + T) + 1.6(L + H) + 0.5(L_r or R)

3. $1.2D + 1.6(L_r \text{ or } R) + (L \text{ or } 0.8W)$
4. $1.2D + 1.6W + L + 0.5(L_r \text{ or } R)$
5. $1.2D + 1.0E + 1.0L$
6. $0.9D + 1.6W + 1.6H$
7. $0.9D + 1.0E + 1.6H$

Each relevant strength limit state shall be investigated. Effects of one or more loads not acting shall be investigated. The most unfavorable effect from both wind and earthquake loads shall be investigated, where appropriate, but they need not be considered to act simultaneously.

Exceptions:

1. The load factor on live load L in combinations (3), (4), and (5) is permitted to be reduced to 0.5 for all occupancies in which minimum specified uniformly distributed live load is less than or equal to 5.0 kN/m^2, with the exception of garages or areas occupied as places of public assembly.
2. The load factor on H shall be set equal to zero in combinations (6) and (7) if the structural action due to H counteracts that due to W or E. Where lateral earth pressure provides resistance to structural actions from other forces, it shall not be included in H but shall be included in the design resistance.
3. For structures designed in accordance with the provisions of Chapter 6, Part 6 of this Code (reinforced concrete structures), where wind load W has not been reduced by a directionality factor, it shall be permitted to use 1.3W in place of 1.6W in (4) and (6) above.

When a structure is located in a flood zone or in tidal surge zone, the following load combinations shall be considered:

1. In Coastal Zones vulnerable to tidal surges, 1.6W shall be replaced by 1.6W+2.0Fa in combinations (4) and (6).
2. In Non-coastal Zones, 1.6W shall be replaced by 0.8W+1.0Fa in combinations (4) and (6).

2.8 Earthquake Load

The seismic load effect, E, shall be determined in accordance with the following:

1. For use in load combination 5 in allowable Stress/Strength Design Method or load combination 5 and 6 in Strength Design Method, E shall be determined in accordance with the following equation,

$E = E_h + E_v$

2. For use in load combination 7 in Strength Design Method or load combination 8 in allowable Stress/Strength Design Method, E shall be determined in accordance with following equation,

$E = E_h - E_v$ Where,

E = total seismic load effect

E_h = effect of horizontal seismic forces.

E_v = effect of vertical seismic forces.

2.8.1 Horizontal earthquake loading, E_h

The horizontal seismic load effect, E_h, shall be taken as the horizontal load effects of seismic base shear V or component forces F_c.

The directions of application of horizontal seismic forces for design shall be those which will produce the most critical load effects. Earthquake forces act in both principal directions of the building simultaneously. In order to account for that,

(a) For structures of Seismic Design Category B, the design horizontal seismic forces are permitted to be applied independently in each of two orthogonal directions and orthogonal interaction effects are permitted to be neglected

(b) Structures of Seismic Design Category C and D shall, as a minimum, conform to the requirements of (a) for Seismic Design Category B and in addition the requirements of this Section. The structure of Seismic Design Category C with plan irregularity type V and Seismic Design Category D shall be designed for 100% of the horizontal seismic forces in one principal direction combined with 30% of the horizontal seismic forces in the orthogonal direction. Possible combinations are:

"±100% in x-direction ±30% in y-direction" or

"±30% in x-direction ±100% in y-direction"

The combination which produces most unfavorable effect for the particular action effect shall be considered. This approach may be applied to equivalent static analysis, response spectrum analysis and linear time history analysis procedure.

(c) Where three-dimensional analysis of a spatial structure model is performed as in 3D time history analysis, simultaneous application of accelerations in two directions shall be considered where the ground motions shall satisfy the conditions.

2.8.2 Vertical earthquake loading, E_v

The maximum vertical ground acceleration shall be taken as 50 percent of the expected horizontal peak ground acceleration (PGA). The vertical seismic load effect E_v may be determined as:

$E_v = 0.50(a_h)D$ Where,

a_h = expected horizontal peak ground acceleration (in g) for design $= (2/3)ZS$

D = effect of dead load, S = site dependent soil factor.

2.9 Combination of Earthquake Loading with Other Loadings

When earthquake effect is included in the analysis and design of a building or structure, the provisions set forth shall be followed to combine earthquake load effects, both horizontal and vertical, with other loading effects to obtain design forces etc.

Seismic Load Effect Including Over Strength Factor

Where specifically required, conditions requiring over strength factor, Ω_o, applications shall be determined in accordance with the following,

1. For use in load combination 5 in Strength Design Method or load combinations 5 and 6 in allowable Stress/Strength Design Method, E shall be taken equal to E_m as determined in accordance with the following equation,

   $E_m = E_{mh} + E_v$

2. For use in load combination 7 in Strength Design Method or load combination 8 in allowable Stress/Strength Design Method, E shall be taken equal to E_m as determined in accordance with the following equation,

   $E_m = E_{mh} - E_v$ where

E_m = total seismic load effect including over strength factor

E_{mh} = effect of horizontal seismic forces including structural over strength.

E_v = effect of vertical seismic forces.

The horizontal seismic load effect with over strength factor, E_{mh}, shall be determined in accordance with the following equation:

$E_{mh} = \Omega_o E_h$

Where, Ω_o is the system over strength factor. Like E_h, directional combinations (b) is also applicable for calculating E_{mh}. The value of E_{mh} need not exceed the maximum force that can develop in the structure or element as determined by a rational, plastic mechanism analysis or nonlinear response analysis (static or dynamic) utilizing realistic expected values of material strengths.

Allowable Stress Increase for Load Combinations with over strength Where allowable stress design methodologies are used with the seismic load effect applied in load combinations 5, 6, or 8 of allowable Stress/Strength Design Method, allowable stresses are permitted to be determined using an allowable stress increase of 1.2. This increase shall not be combined with increases in allowable stresses or load combination reductions otherwise permitted elsewhere by this standard.

Minimum Upward Force for Horizontal Cantilevers for Seismic Design Categories D through E

In structures assigned to Seismic Design Category D, or E, horizontal cantilever structural components shall be designed for a minimum net upward force of 0.2 times the dead load in addition to the applicable load combinations allowable Stress/Strength Design Method and Strength Design Method.

2.10 Drift And Deformation

2.10.1. Story drift limit

The design story drift (Δ) of each story, as determined in Sections shall not exceed the allowable story drift (Δa) for any story.

For structures with significant torsional deflections, the maximum drift shall include torsional effects. For structures assigned to Seismic Design Category C or D having torsional irregularity, the design story drift, shall be computed as the largest difference of the deflections along any of the edges of the structure at the top and bottom of the story under consideration. For seismic force–resisting systems comprised solely of moment frames in Seismic Design Categories D, the allowable story drift for such linear elastic analysis procedures shall not exceed Δ_a/ρ where ρ is termed as a structural redundancy factor. The value of redundancy factor ρ may be considered as 1.0 with exception of structures of very low level of redundancy where ρ may be considered as 1.3.

For nonlinear time history analysis (NTHA), the story drift shall not exceed 1.25 times the story drift limit specified above for linear elastic analysis procedures.

2.10.2. Diaphragm deflection

The deflection in the plane of the diaphragm, as determined by engineering analysis, shall not exceed the permissible deflection of the attached elements. Permissible deflection shall be that deflection that will permit the attached element to maintain its structural integrity under the individual loading and continue to support the prescribed loads (BNBC 2020).

2.11 Seismic Zoning of Bangladesh

Seismic zones express the proneness of a region to earthquake occurrence in the historical past including the expectations in future. A region experiencing more frequent and large earthquakes has a higher seismicity compared to one with less frequent and small earthquakes. Both the temporal and spatial distributions of all earthquakes, small and big, have to be systematically accounted for by determining their past behavior to determine the future trend (Islam 2004).

The seismicity of various regions in a country is often described by a seismic zoning map. Preparation of such a map is an important but difficult step, using data about past earthquakes and taking into consideration the probability and frequency of damaging earthquakes. It is common practice to carry out detailed seismic tectonic studies of seismically active regions for the earthquake resistant design of buildings and other structures. For proper guidance in the design of structures, it is essential to have the full possible understanding of the seismicity and tectonics of the country. The seismicity at a site is assessed partly by its distance from any fault and partly from the frequency and size of shocks that have occurred in the past. The zoning of a country depends primarily on the known seismic history of the region and its tectonic features (Applied Technology Council 1978).

It is also the site of the major Dauki fault system along with numerous subsurface active faults and a flexure zone to be called as Hinge zone. Bangladesh experienced several historical great earthquakes during last the 100 years and has been affected by small earthquakes occasionally.

The seismicity of Bangladesh is deeply related with tectonic behavior in and around Bangladesh which is caused by the sub-dictions of the Indian plate below the Tibet sub plate in the north. The northern and eastern parts of Bangladesh lie in the seismically active zone. The region is also surrounded by most active seismic zones which influence the seismicity of Bangladesh. The large earthquake events in India adjoining Bangladesh caused damage in the region and hence seismicity of Bangladesh should be considered regionally. On the basis of morph tectonic behavior and seismicity a seismic zoning map of Bangladesh has been prepared and Bangladesh has been divided into four generalized seismic zones.

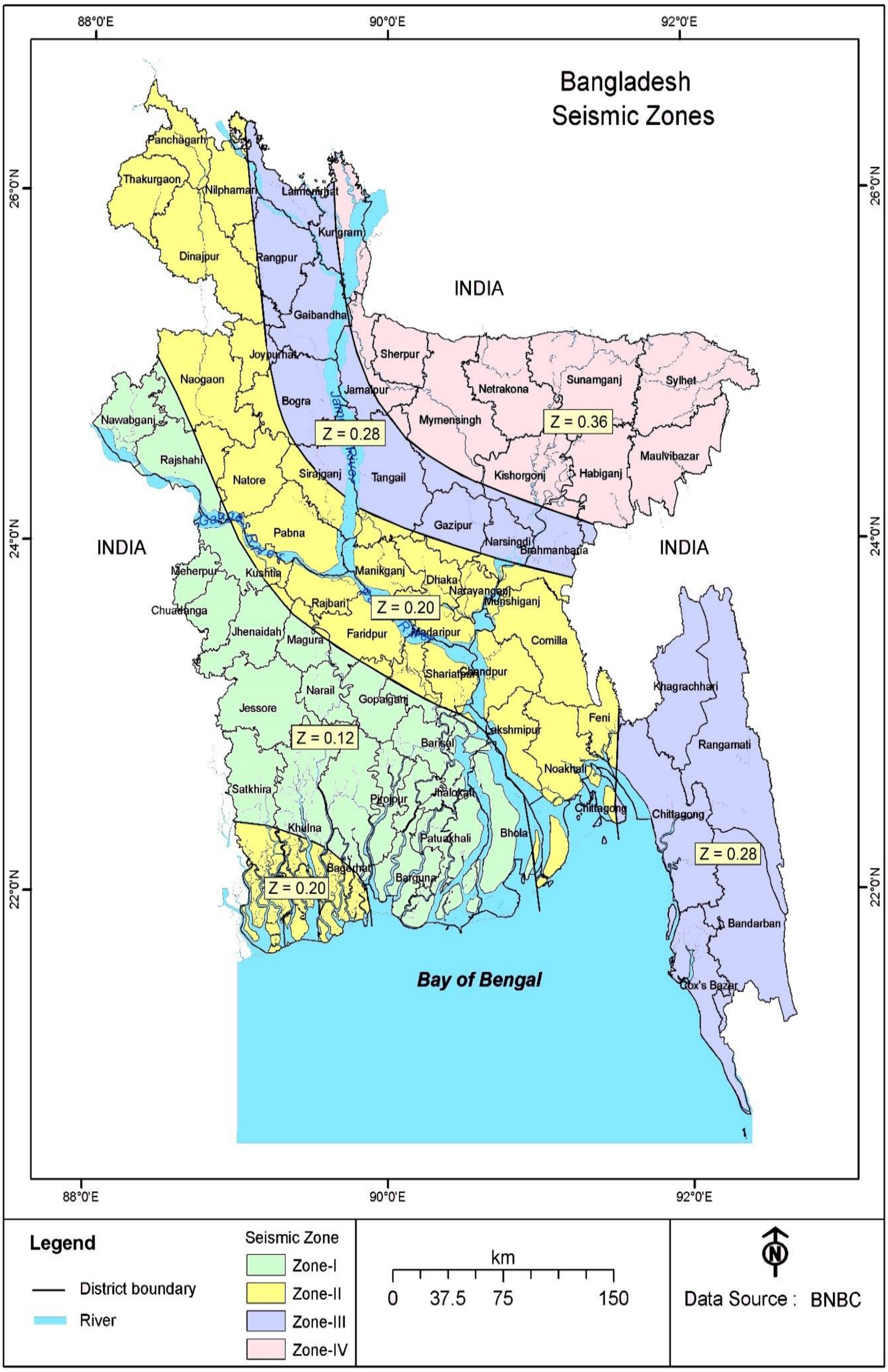


Figure 2.9: Seismic zoning map of Bangladesh (BNBC 2020)

2.12 Wind Load

Buildings and other structures, including the Main Wind-Force Resisting System and all components and generally designed and constructed to resist wind loads as some specific procedure. The design wind loads for buildings and other structures, including the Main Wind-Force Resisting System and component and cladding elements thereof, shall be determined using one of the following procedures (BNBC 2020).

Method 1: Simplified Procedure for buildings and structures meeting the requirements.

Method 2: Analytical Procedure for buildings and structures meeting the requirements.

Method 3: Wind Tunnel Procedure.

Wind pressure acts on opposite faces of each building surface. In the calculation of design wind loads for Main Wind-Force Resisting System and for components and cladding for buildings, the algebraic sum of the pressures acting on opposite faces of each building surface shall be taken into account (Ghosh et al. 1992).

2.12.1. Basic Wind Speed

The basic wind speed, V used in the determination of design wind loads on buildings and other structures. The wind shall be assumed to come from any horizontal direction. We can take the value of basic wind speed from given data at BNBC-2020. The map showing different considerable wind speed at different places of Bangladesh has given below.

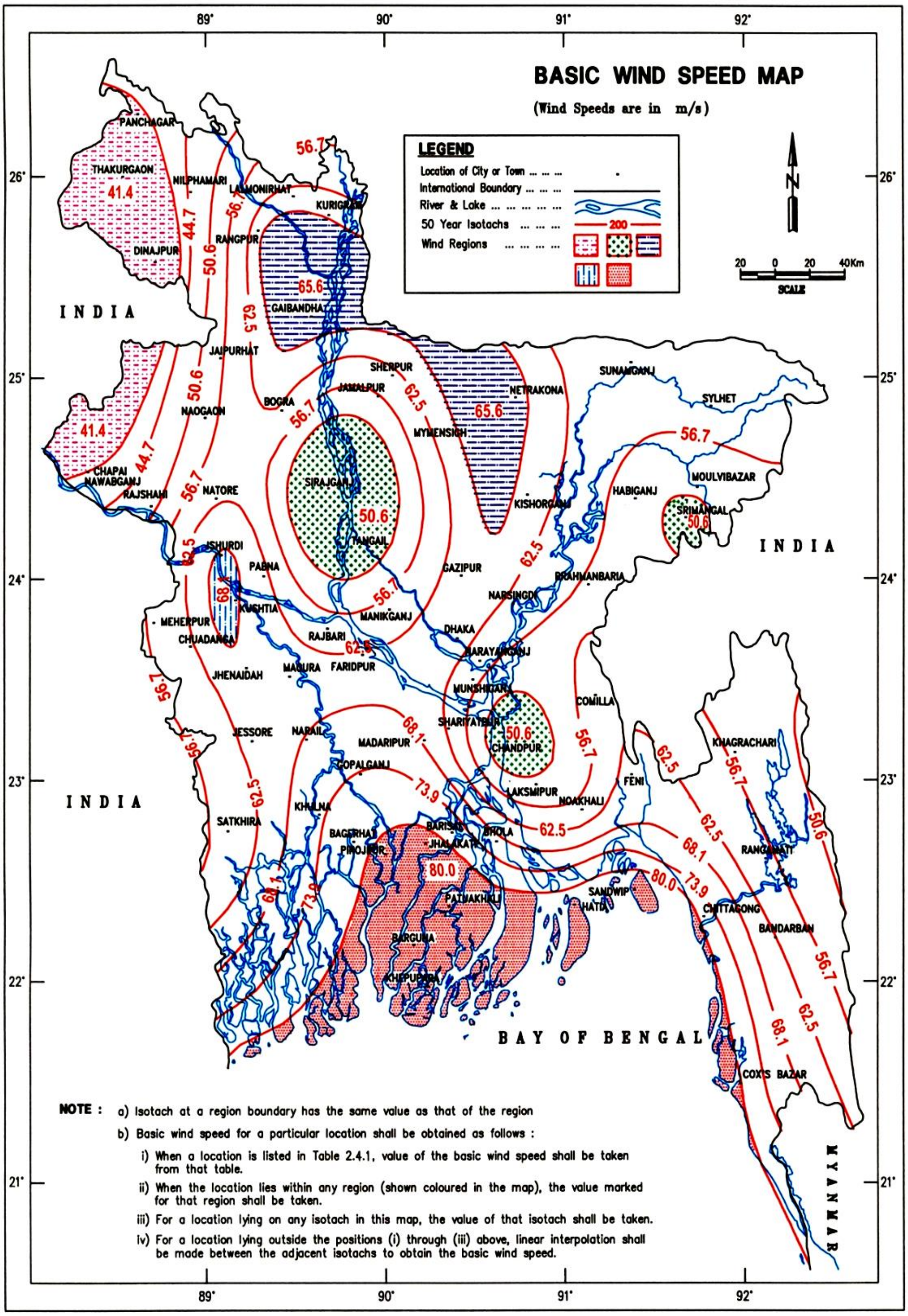


Figure 2.10: Basic wind speed map of Bangladesh (BNBC 2020)

2.12.2. Importance Factor

An importance factor, *I* for the building or other structure shall be determined from Table given at BNBC-2020 based on building and structure categories listed in BNBC (2020). We are considering Important factor I= 1 for Residential and commercial buildings in Dhaka city at Bangladesh according to BNBC (2020).

2.12.3. Exposure Categories

There are three Exposure categories in Bangladesh according to BNBC-2020. All of them are described below.

Exposure A: Exposure A shall apply where the ground surface roughness condition, as defined by Surface Roughness A at BNBC-2020, prevails in the upwind direction for a distance of at least 792 m or 20 times the height of the building, whichever is greater.

Exception: For buildings whose mean roof height is less than or equal to 9.1 m, the upwind distance may be reduced to 457 m.

Exposure B: Exposure B shall apply for all cases where Exposures A or C do not apply.

Exposure C: Exposure C shall apply where the ground surface roughness, as defined by Surface Roughness C at BNBC-2020, prevails in the upwind direction for a distance greater than 1,524 m or 20 times the building height, whichever is greater. Exposure C shall extend into downwind areas of Surface Roughness A or B for a distance of 200 m or 20 times the height of the building, whichever is greater.

For a site located in the transition zone between exposure categories, the category resulting in the largest wind forces shall be used.

Exception: An intermediate exposure between the preceding categories is permitted in a transition zone provided that it is determined by a rational analysis method defined in the recognized literature.

CHAPTER - 3

STRUCTURAL ANALYSIS

3.1 General

The main objective of this study is to find out the stability coefficient of moment resisting frame structure for different aspect ratio for both symmetric and asymmetric buildings. Floor area of all the buildings is considered to be around 1000 square meter. All buildings were considered as commercial buildings. Structures of many different heights have been considered for this study. The analysis was started from two storied building and increased building height with two floors each time. Each height of structure has been analyzed for determination of stability coefficient at same aspect ratio. To get the outcome of this study, each structure has been analyzed at same seismic zone and considering many related values same. This chapter will discuss about assumptions for analysis, design, structural stability, models and software that have been consideredfor the analysis and design of these selected structures. Analysis and design of these structures have been carried out by using software. Comparisons have been done based on analysis result for each height of structure and for both symmetric and asymmetric buildings separately. Various results have been discussed in chapter four.

3.2 Design Criteria

To analysis and design of any structure using software, it is very much important to input few important parameters such as, sizes of structural elements, material properties and various loads. Self-weight of a structure is automatically calculated by the software according to size and material property, but other loads (live, floor finish,partition wall, seismic and wind) are required to input before analysis. It is to be mentioned here that total design load P, Story shear V, Story drift occurring simultaneously and story height H are the variables for this study. Other variables are depending on structural system and location. Factors related with design criteria are given in following sections.

3.2.1 Loads

All structures have been designed to resist gravity and lateral forces. Gravity load of a structure depends on the sizes of structural elements. Lateral forces depend on the size and shape of the structure as well as on its geographic location. In the present investigation wind and earthquake loads have been chosen as lateral loads. All the structures are considered located at zone -2 (BNBC 2020) of Bangladesh. Seismic force of a structure depends on weight, location, structural system of that structure which is described in chapter two. Seismic zone coefficient (Z) and Response modification factor (R) are fixed for seismic load in this study. Seismic zone coefficients are given as per BNBC (2020) for analysis of these structures. Other loads have been considered as per BNBC (2020) for analysis. It is to be mentioned here that all loads are needed to combine before analysis. Loads combinations are also done as per BNBC, 2020. Load combination as per BNBC (2020) presented in Table 3.1.

Table 3.1: Load Combinations (BNBC 2020)

Serial No	Load Combinations
1.	1.4(D + F)
2.	1.2(D + F + T) + 1.6(L + H) + 0.5(L_r or R)
3.	1.2D + 1.6(Lr or R) + (L or 0.8W)
4.	1.2D + 1.6W + L + 0.5(Lr or R)
5.	1.2D + 1.0E + 1.0L
6.	0.9D + 1.6W + 1.6H
7.	0.9D + 1.0E + 1.6H

3.2.2 Materials property

Any material which has got application in engineering constructions is termed as engineering material. Every engineering structure must be sufficiently strong and durable to resist the action of external forces and internal stresses due to various types of loads. In order to achieve maximum economy, the engineer must know the strength and characteristics of the materials. In this study, compressive strength of concrete and tensile strength of steel are considered f'c = 27.5 MPa for columns and f'c = 24 MPa for beam and slab and fy = 420 MPa respectively. Young's modulus of concrete, Ec = 4734 x sqrt(fc').

3.2.3 Structural system

Before starting analysis, a structure must be considered under a structural system. Structural systems and configuration of a structure have been described in chapter two. In this study one types of structural systems are considered i.e., Intermediate moment resisting frame structure system. Three different aspect ratios of structure for both symmetric and asymmetric building have been taken in consideration for this study. In each case building height has considered from two storied to thirty storied. In each and every case frame system is considered as moment resisting frame system. To fulfill the requirement of this study, each height of structure has been considered in seismic zone-2 under same structural system for different aspect ratio (Length by Width) and seismic design category C.

3.2.4 Response modification factor, R

The Response Modification Factor (R) is a measure of the ability of the structure to withstand earthquake motions without collapse. It represents the ratio of forces in an entirely linear elastic system to the forces anticipated in a system with significant yielding. Its magnitude depends on the type and material of the structure, the possibility of failure of the vertical load system, the degree of redundancy of the system that would allow some localized failures without overall failure and the ability of secondary system. The Response Modification Factor R for different frame system are given in appendix D. In the case of this study, for Intermediate reinforced concrete moment resisting frame system, the values of R, has been considered 5 for this study when only columns are used and 5.5 when shear wall used along with columns.

3.2.5 Zone coefficient, Z

This is the coefficient that represents the earthquake severity of the regions. Bangladesh is divided into four zones of different earthquake severity. These are defined in Figure given in chapter two in a seismic zoning map in the Code. The zoning coefficients of the different zones are given in BNBC (2020). The values of this coefficient are considered to represent the effective peak ground acceleration (associated with an earthquake that has a 10% probability of being exceeded in 40 years) expressed as a fraction of the acceleration due to gravity. In the case of this study, for the location of building at Dhaka City which is located at Zone-2 of seismic zoning map of Bangladesh the values of Z, has been considered 0.2 for this study.

3.2.6 Importance factor, I

Buildings are classified in four occupancy categories. Depending on the consequences of collapse for human life, on their importance for public safety and civil protection in the immediate post-earthquake period, and on the social and economic consequences of collapse. Depending on occupancy category, buildings may be designed for higher seismic forces using importance factor greater than one. Different occupancy categories and corresponding importance factors are given in BNBC (2020). In the case of this study, for building occupancy category-2, the values of Importance factor I, has been considered 1 for this study.

3.2.7 System over strength factor, $\boldsymbol{\Omega_o}$

For different Structural system, System over strength Factor varies. The System over strength Factor, Ω_o for different frame system are given in BNBC (2020). In the case of this study, for Intermediate reinforced concrete moment resisting frame system, the values of System over strength Factor, Ω_o has been considered 3 for this study.

3.2.8 Deflection amplification factor, $\boldsymbol{C_d}$

For different Structural system, Deflection Amplification Factor, $\boldsymbol{C_d}$ varies. Deflection Amplification Factor, $\boldsymbol{C_d}$ for different frame system are given in BNBC (2020). In the case of this study, for Intermediate reinforced concrete moment resisting frame system, the values of Deflection Amplification Factor, $\boldsymbol{C_d}$ has been considered 4.5 for this study.

3.2.9 Site classification, S

Site Classification is determined based on the soil properties of upper 30 meters of the site profile. Average soil properties are determined. The site profile up to a depth of 30 m is divided into n number of distinct soil or rock layers. Where some of the layers are cohesive, k is the number of cohesive layers. Hence $\sum_{i=1}^{n} d_i$ = 30 m, while $\sum_{i=1}^{k} d_{ci}$ < 30 m if $k < n$ in other words if there are both cohesionless and cohesive layers. The standard penetration value directly measured in the field without correction will be used. The site classification should be done using average shear wave velocity if this can be estimated, otherwise the value of standard penetration may be used. The site class S for different soil condition is given in appendix. In the case of this study, for Intermediate reinforced in the case of this study, as the soil condition of Dhaka city indicates Deep deposits of dense or medium dense sand, gravel or stiff clay with thickness from several tens to many hundreds of meters, the values of Site Class has been considered Sc for this study.

3.3 Structural Stability

After analysis of a structure, few important parameters have been checked to see the stability of a structure. In this study drift, overturning, base shear, and displacement are checked for these different heights of structure in seismic zone-2. Comparisons are carried out on the analysis result for different heights of structure which is given in chapter four.

3.3.1 Drift

Story drift is the displacement of one level relative to the level above or below due to the design lateral forces. The provision of adequate stiffness, particularly lateral stiffness, is a major consideration in the design of building for several important reasons. In terms of serviceability limit state, deflections must be maintained at a sufficiently low level to allow proper functioning of nonstructural components and to prevent excessive cracking and consequent loss of stiffness. One simple parameter that afford and estimates the lateral stiffness of a building is the drift index, definedas the ratio of the maximum deflection at the top of the building to the total height. Design drifts index limits have been considered in this study as per BNBC, 2020.

3.3.2 Overturning

Every building has been designed to resist overturning caused by wind or earthquake, which ever governs. Moments can be calculated from the triangular load distribution formula. However, the loading is based on an envelope of maximum shears and may be less at any moment in time. Overturning moment due to lateral load is checked at the base of a structure. In this study overturning moment due to lateral load in x and y direction are checked from ETABS analysis result.

3.4 Loads For Analysis

Prior to structural analysis it is essential that the loads that may act upon a building during its lifetime be duly considered and incorporated in the analysis. The loads that may act upon the factory building are considered as follows:

3.4.1 Dead loads (D)

Dead loads (D) are those gravity load which remain acting on the structure permanently without any change during the structures normal service life. These are basically the loads coming from the weight of the different components of the structure. For the sake of convenience in the analysis, sometimes this kind of loadsare divided into two types, namely a) self-weight of the structure (SW) and b) the weight coming from the non-structural permanent components of the building (SDEAD). In concrete building the weight of slabs, beams and columns etc. which form the main structural system is considered the self-weight (SW). The weights of floor finish, water proofing layer, partition walls and other non-structural permanent components generally constitute the rest of the total dead load, i.e., SDEAD. For the analysis and design checking of the building, following are the values of dead loads,

- Unit weight of reinforced concrete = 150 pcf
- Unit weight of brickwork = 120 pcf
- Floor Finish = 25psf
- Partition wall load = 50psf

3.4.2 Live load (L)

Live load is the gravity load due to non-permanent objects like machines, furniture, and human. Analysis has been carried out based on load recommended by BNBC (2020). Live load for light work room without storage is taken 50 Psf.

Earthquake load (E)

Although there has been no major incident of earthquake hazard in the recent past of Bangladesh, earth quake is not uncommon in this area. Scientific geological study of the earth crust below Bangladesh shows that Bangladesh does fall in moderate to high seismic risk zone. Statistical evidence from past major and minor earthquake incidents shows that a major earthquake is overdue in the recent times of geological scale. Therefore, it is necessary to prepare against any possible earthquake hazard. Regarding the earthquake resistant structural design, it essential that the specific design code is followed. For the analysis and design checking of these structures' main considerations for calculation of earthquakeload are given below.

- Zone co-efficient, Z = 0.2 (zone 2, As Per BNBC 2020)
- Structure importance co-efficient, I = 1.00 (Standard Occupancy, Table 6.2.17, BNBC 2020)
- Response modification co-efficient, R = 5.0 (IMRF, Table 6.2.19, BNBC 2020)
- Site co-efficient, S=1.15 (Table 6.2.16, BNBC 2020)

3.4.3 Wind Load (W)

Proper structural design of any building structure must include loads due to wind also. For the analysis and design checking of these structures' main considerations for calculation of wind load are given below. Bangladesh is typically a storm prone area where consideration to the thrust due to storm must be given in the analysis and design of building and structures. Wind load due to storm is typically modeled as lateral thrust force causingsway or overturning of the building. Detailed specifications on wind loading on buildings are outlined in BNBC (2020). The structure is located in Dhaka for which the following basic parameters are used in wind load calculation,

- Basic wind speed, Vw = 62.5 m/s (Dhaka City, As per BNBC 2020)
- Structure importance co-efficient, I = 1.00 (Standard Occupancy, Table 6.2.17, BNBC 2020)
- External Pressure Co-efficient, Windward, Cp = 0.8 (Figure 6.2.6, BNBC 2020)
- External Pressure Co-efficient, Leeward, Cp =0.2 & 0.3 (Figure 6.2.6, BNBC 2020)
- Exposure Type = A (BNBC 2020)

3.4.4 Loading and load combination

The basic sources of loads are described in earlier section. These loads are applied on the model in seven basic categories. These are as followed:

Load Case 1: Self-weight of structure (SW).

Load Case 2: Floor finish (FF)

Load Case 3: Partition wall (PW).

Load Case 4: Live load on roof (LL)

Load Case 5: Earthquake load on East-West Direction. (Ex)

Load Case 6: Earthquake load on North-South Direction. (Ey)

Load Case 7: Wind load on East-West Direction. (Wx)

Load Case 8: Wind load on North-South Direction. (Wy)

These eight basic load cases are analyzed by ETABS-V9.7.1. When these eight basic load cases are combined accordingly considering the direction of lateral loads, we obtain, after simplification, the following combination cases:

Combination Case 1: 1.4 D

Combination Case 2: 1.2 D + 1.6 L + L

Combination Case 3: 1.2 D + 1.6 L +0.5Lr

Combination Case 4: 1.2 D + 1.6 L + 0.8Wx

Combination Case 5: 1.2 D + 1.6 L - 0.8 Wx

Combination Case 6: 1.2 D + 1.6 L + 0.8 Wy

Combination Case 7: 1.2 D + 1.6 L – 0.8 Wy

Combination Case 8: 1.2 D + L+ 0.5Lr + 1.6 Wx

Combination Case 9: 1.2 D +L + 0.5Lr - 1.6 Wx

Combination Case 10: 1.2 D + L+ 0.5Lr + 1.6 Wy

Combination Case 11: 1.2 D +L + 0.5Lr - 1.6 Wy

Combination Case 12: 0.9 D + 1.6 Wx

Combination Case 13: 0.9 D - 1.6 Wx

Combination Case 14: 0.9 D + 1.6 Wy

Combination Case 15: 0.9 D - 1.6 Wy

Combination Case 16: 1.2 D + L + Ex

Combination Case 17: 1.2 D + L - Ex

Combination Case 18: 1.2 D + L + Ey

Combination Case 19: 1.2 D + L - Ey

Combination Case 20: 0.9 D + Ex

Combination Case 21: 0.9 D - Ex

Combination Case 22: 0.9 D + Ey

Combination Case 23: 0.9 D – Ey

3.4.5 Application of load and analysis

A static analysis is performed using the loadings and combinations of loads (mentioned earlier) for this building.

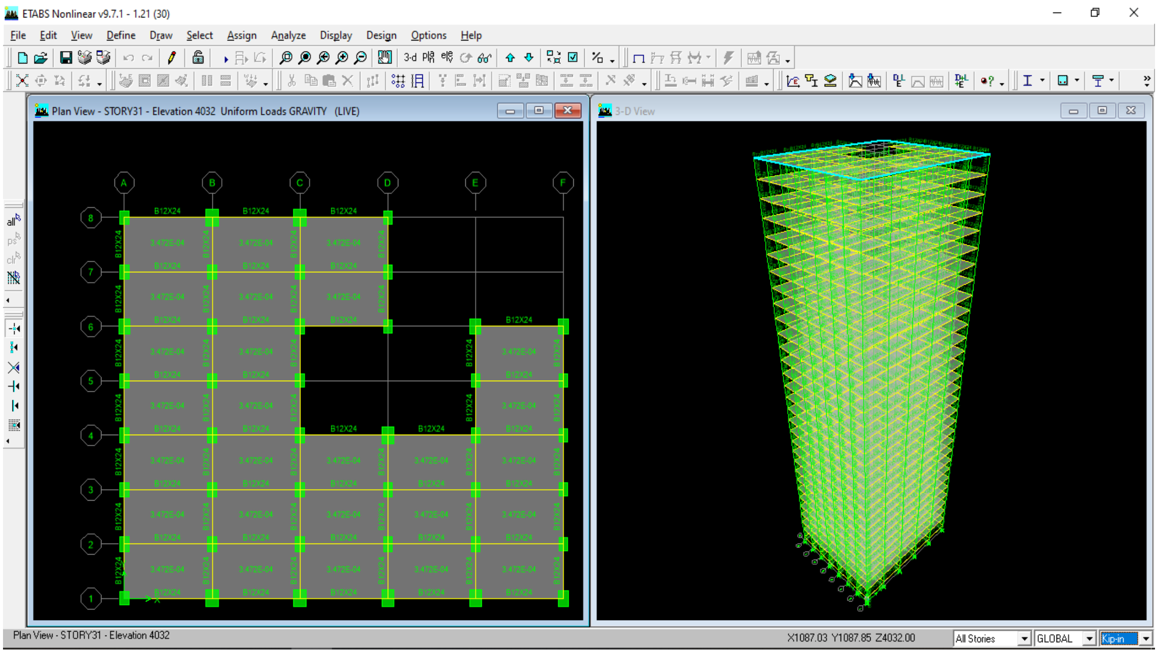


Figure 3.1: Applied Live load on floor

3.5 Software

Software is used to save time for analysis and design of any structure. One analysis software has been used for this study. Extended Three-Dimensional Analysis of Building System (ETABS) Nonlinear Version 9.7.1 has been used for analysis and design of these

Selected structures.

For nearly 30 years, ETABS has been recognized as the industry standard for building analysis and design software. Today, continuing in the same tradition, ETABS has evolved into a completely integrated building analysis and design environment. ETABS is the solution, whether it can design a simple 2D in frame or perform a dynamic analysis of a complex high-rise that utilizes non-linear dampers for inter- story drift control. In this study, ETABS software has been used for analysis and design of beams and columns for these symmetric and asymmetric moment resisting frame structures. This software has been formulated based on finite element method. It is described in Appendix B.

3.6 Models

Three different aspect ratios (Length/Width) for both symmetric and asymmetric structures have been considered for this study. The heights are started from 2 storied building and in each and every cases it has been gradually increased up to 30 storied building. Data was taken after every 2 story. So, for symmetric building it has considered 45 models and for asymmetric building it has been consider another 45 models. In a whole about 90 models have been analyzed. Each and every model have been checked at zone-2 according to BNBC-2020. Some coefficients were taken constant in every model which will be discussed at chapter-4. Buildings (both symmetric and asymmetric) with aspect ratio 1.21 have been considered with only Column (With out shear wall) but Buildings, with aspect ratio 3.33 and 5.95 have been considered shear walls from 20 storied to 30.

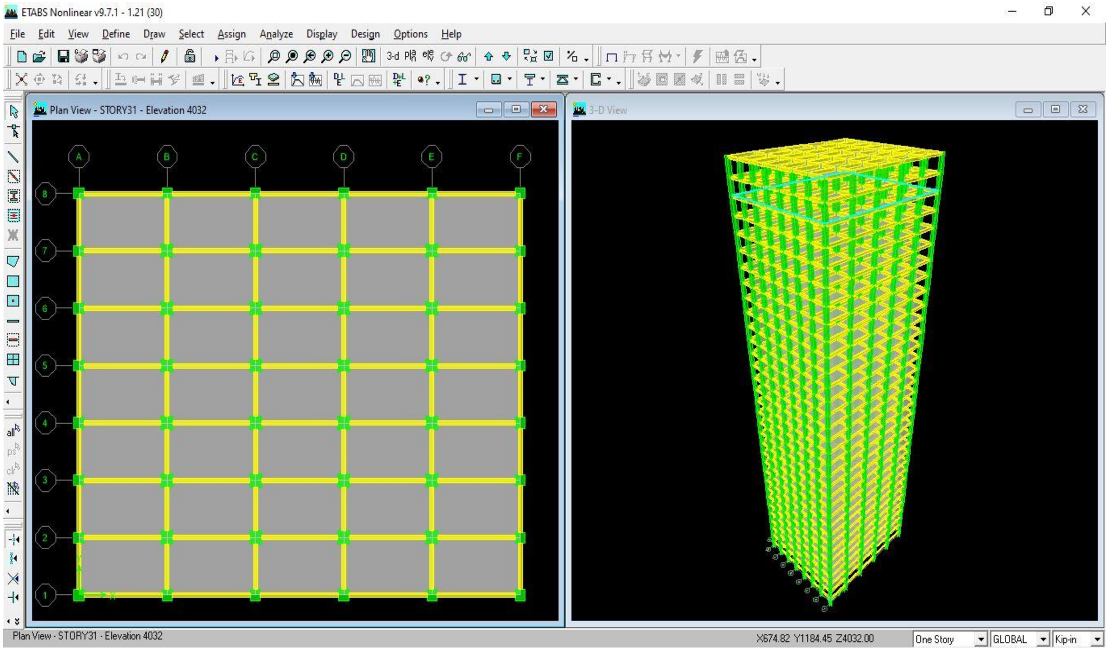


Figure 3.2: Plan and 3D view of 30 storied symmetric building of aspect ratio 1.21

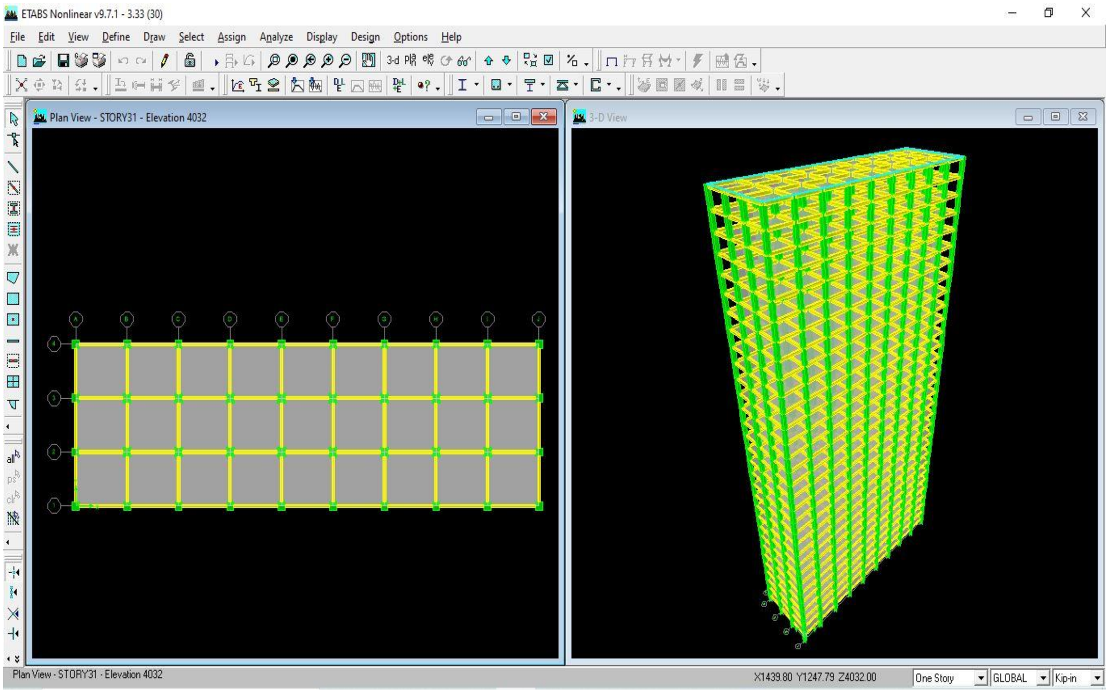


Figure 3.3: Plan and 3D view of 30 storied symmetric building of aspect ratio 3.33

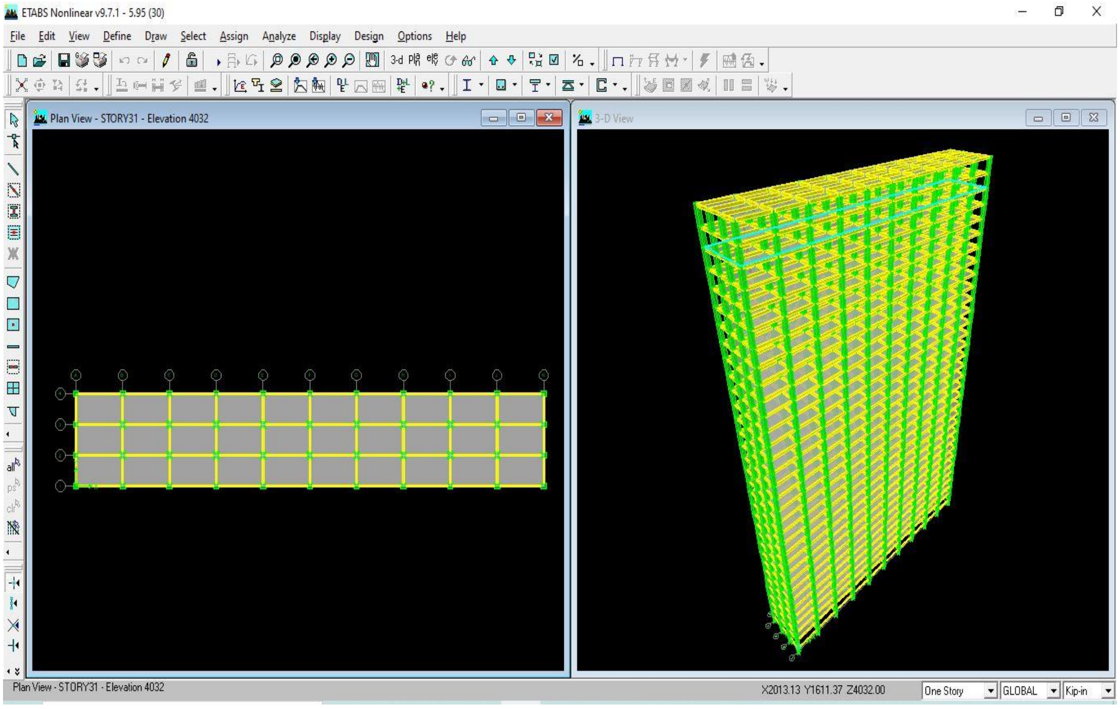


Figure 3.4: Plan and 3D view of 30 storied symmetric building of aspect ratio 5.95

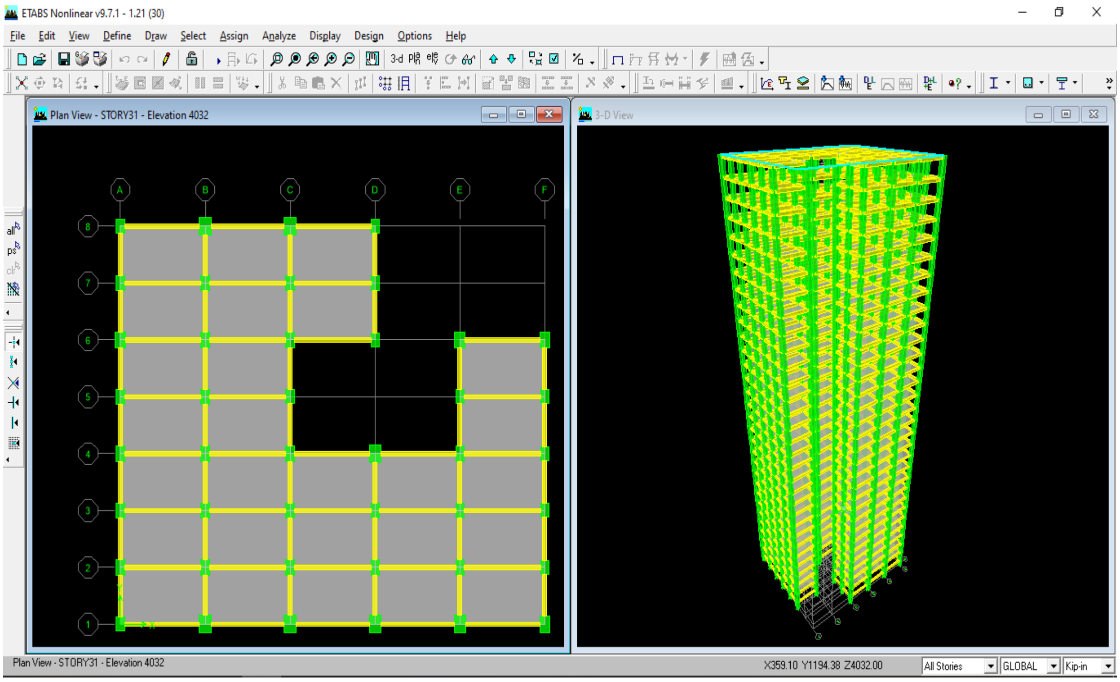


Figure 3.5: Plan and 3D view of 30 storied asymmetric building of aspect ratio 1.21

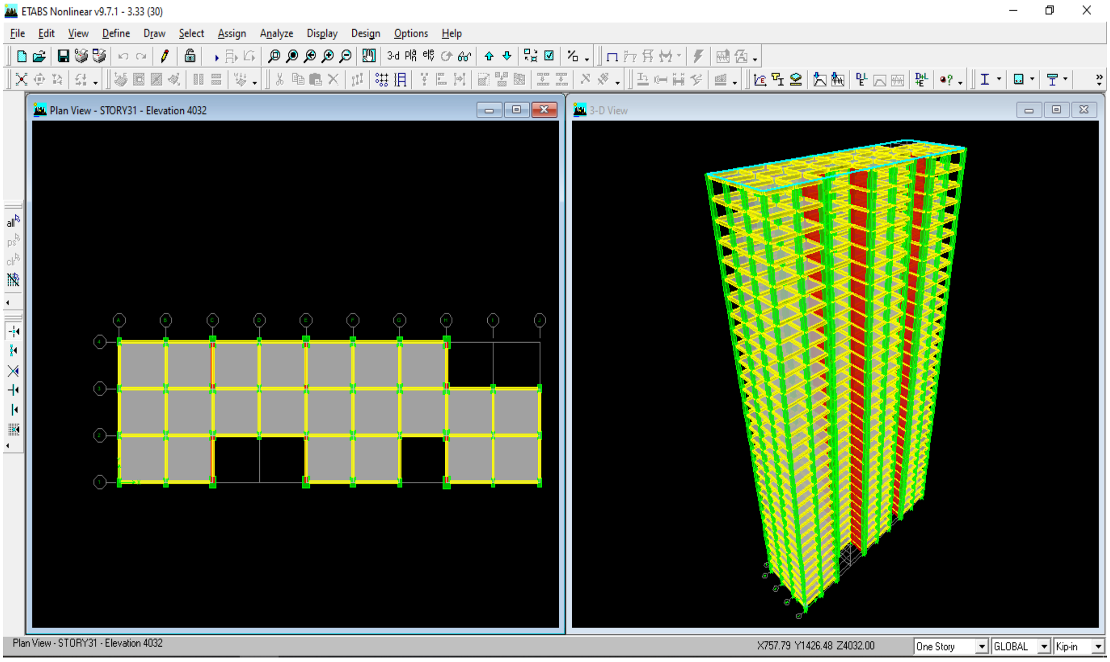


Figure 3.6: Plan and 3D view of 30 storied asymmetric building of aspect ratio 3.33

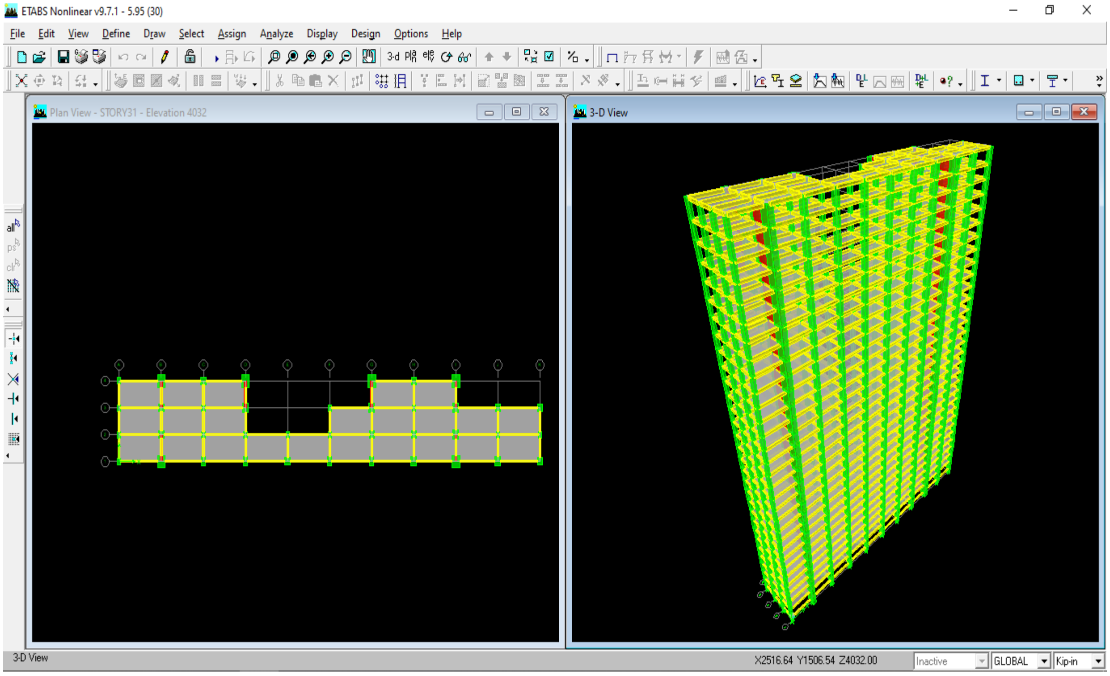


Figure 3.7: Plan and 3D view of 30 storied asymmetric building of aspect ratio 5.95

3.7 Analysis Procedure

We can describe the analysis procedure by these steps.

a) Creating models on E-Tabs as per architectural drawing.

b) Load distribution on slab.

c) Include earthquake load and wind load.

d) Analysis the building.

e) Check design.

f) Take total vertical design load, story shear force & story drift.

g) Determine **stability coefficient**.

h) Increase building height & repeat steps (a) to (g).

i) Repeat (a) to (h) for different building parameters.

j) Presenting comparisons in graphs.

To determine Stability Coefficient, we have considered three symmetric building of different aspect ratio and three asymmetric building at same different aspect ratios. All the necessary data for different analysis criteria have taken from relevant tables described in BNBC-2020. The Zone coefficient considered z=0.2, Response modification factor has considered R=5, we get deflection Amplification Factor C_d= 4.5. System Overstrength Factor considered Ὠ= 3. The Coefficient Ct= 0.0466 and m=0.9 both have considered accordingly. Site Class has Considered SC. For site class SC The value of Tb and Td has considered 0.2 Sec and 2 Sec Accordingly. Important factor of building has considered I=1. All other loads and parameters which we have considered in this building including these has taken from BNBC-2020. Loads and loads combination has also followed according to BNBC-2020. Now after fixing all these values at first, we did the model of a two storied building by ETABS and then we applied loads and load combinations on it including Earthquake load. Then we made the analysis by ETABS and checked the design whether it is OK or not. When we found it Ok then we took total vertical design load (P), story shear force (Vx) & story drift (Δ). We have considered typical floor height 11’-0”. Now by putting these values in the equation mentioned below we can determine the value of stability coefficient (Θ).

$$\theta = \frac{P_x \Delta}{V_x h_{sx} C_d}$$

Where,

$P_x =$ Total vertical design load at and above level x; where computing P_x, no individual load factor need exceed 1.0

$\Delta =$ Design story drift occurring simultaneously with V_x

$V_x =$ Story shear force acting between levels x and $x - 1$

$h_{sx} =$ Story height below level x

$C_d =$ Deflection amplification factor

Then we increased the story height from two storied to four storied and have done the same work again with same procedure and we obtained the value of stability coefficient (Θ) for four storied building. Now repeating the same work again and again just increasing the story height by two storied each time we have obtained the value of stability coefficient (Θ) for after every two storied building up to thirty storied. Now we have all the values of stability coefficient (Θ) up to thirty story of a symmetric building with a fixed aspect ratio (Length / Width). Then we have created a new model with different aspect ratio and all other parameters were unchanged. Following the same work procedure, we have gathered all the values of stability coefficient (Θ) up to thirty story for this building also. By doing same procedure again we have determined same things for another different aspect ratio. So, in total we have collected values of stability coefficient (Θ) for three symmetric buildings of different aspect ratios. After doing this we have done the same work for three asymmetric buildings of different aspect ratios. Over all we have determined the values of stability coefficient (Θ) for six building each starting from two story and ended at thirty story. Total 90 model analysis work has done for this study.

CHAPTER 04

RESULTS AND DISCUSSION

4.1 General

To carry out this subject study, some moment resisting frame structures have considered in seismic zones-2 according to BNBC-2020. It is Consider moment resisting frames as frames which resist 100% of seismic force and are not enclosed or adjoined by components that are more rigid and will prevent the frames from deflecting under seismic forces. In this way, three different aspect ratios of structure are compared individually in same seismic zone. It has considered as a commercial building located at Dhaka city of Bangladesh with a floor area around 10000 square feet per floor. Each structure is analyzed, and designed separately for comparison. Important features which are very much related with analysis and design of this structure have been described in chapter three. Comparisons are carried out on various aspects. These comparisons are done for height of structure from two storied to thirty storied building. The same comparison has done for both in case of symmetric and asymmetric buildings. Finally, the comparison between symmetric and asymmetric building has done. The main comparison has done for their stability coefficient which were determined from various data found from their ETABS analysis. Some graphical representation has done comparing the result found from analysis. Finally, there are some recommendations regarding the required analysis method of moment resisting frame structure for different height at Dhaka city in both case of symmetric and asymmetric buildings.

4.2 Stability Coefficient of a Building

Stability coefficient of a building mainly depends on vertical load, Story shear and story drift at different floor. Generally, in a high-rise structure it starts to increase from ground floor and at 3rd, 4th or 5th floor it become highest and after the highest value it start to decrease. For example, we have considered a 30-story asymmetric building of aspect ratio 5.95 and determined story drift at different floor.

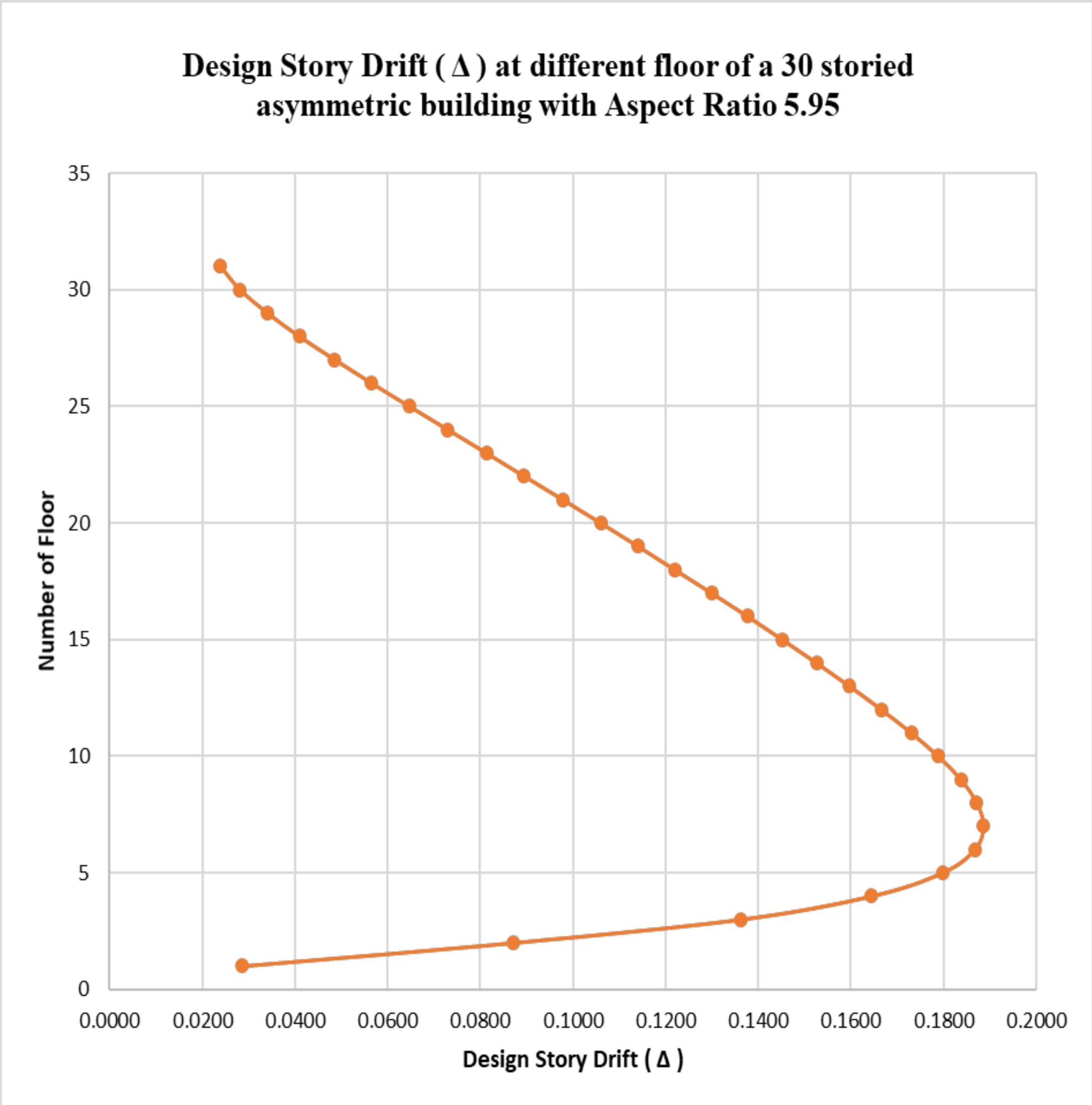


Figure 4.1: Story drift at different floor of 30 storied asymmetric building.

As we can see here the change of story drift at different floor, we can see the change of stability coefficient at different floor of a building as well. To observe that we have considered the same building and we have found the change of stability coefficient at same pattern.

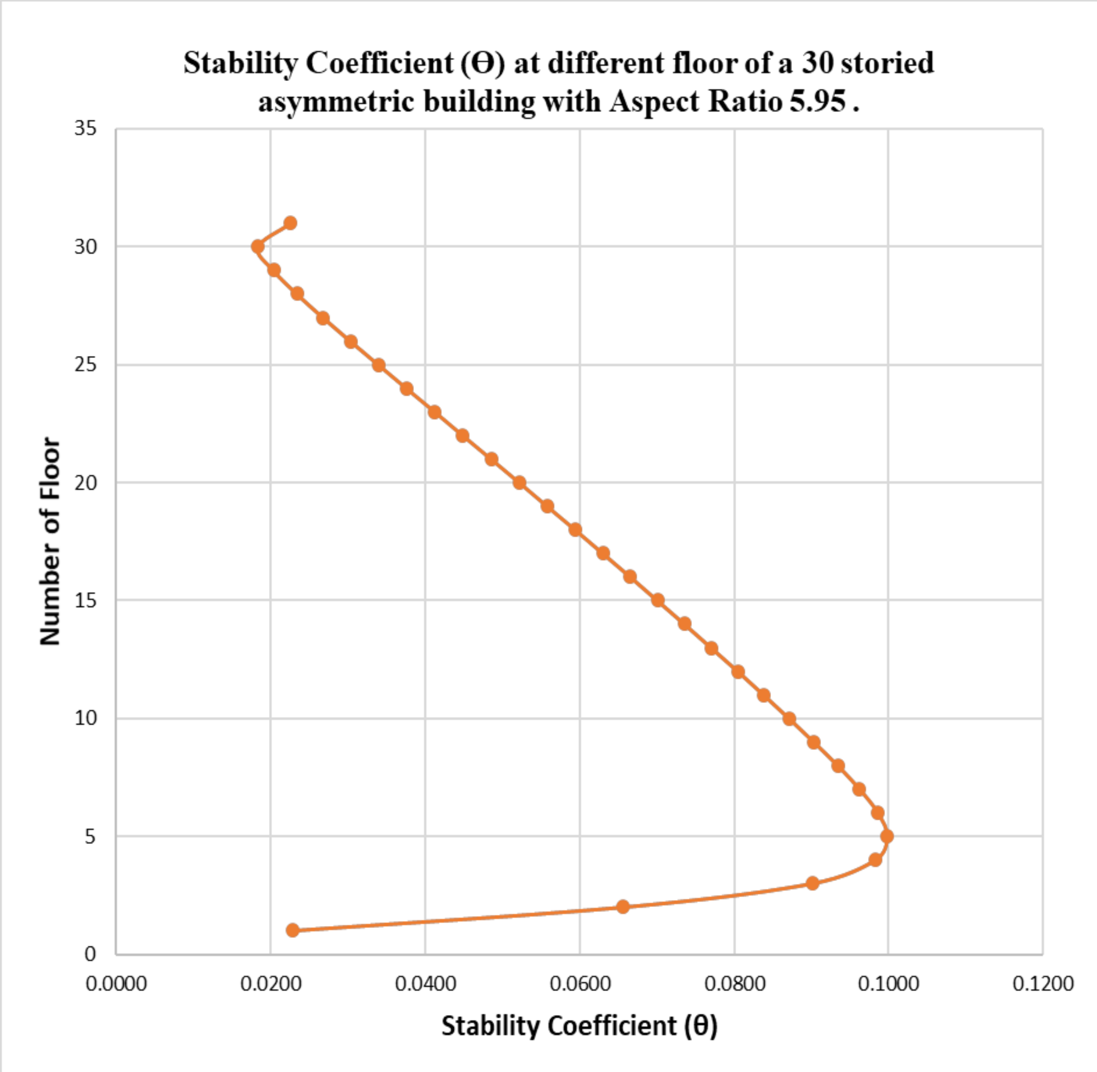


Figure 4.2: Stability Coefficient at different floor of 30 storied asymmetric building.

4.3 Stability Coefficient for Different Load Combination

We have different type of load combination according to BNBC 2020. Generally, two type of lateral load govern the stability coefficient of a building. One of them is earthquake load and the other is wind load. We have considered an asymmetric building of aspect ratio 5.95 and analysis the building for two different categories of load combination and found that at low rise building Earthquake load is major responsible for the increase of value of stability coefficient but after a certain height it actually occurs due to wind load. For example, here we can see the result of a 30 storied asymmetric buildings stability coefficient at different floor due to earthquake related load combinations and wind load related load combinations. Here we can observe that the maximum value of stability coefficient comes from wind load related load combinations.

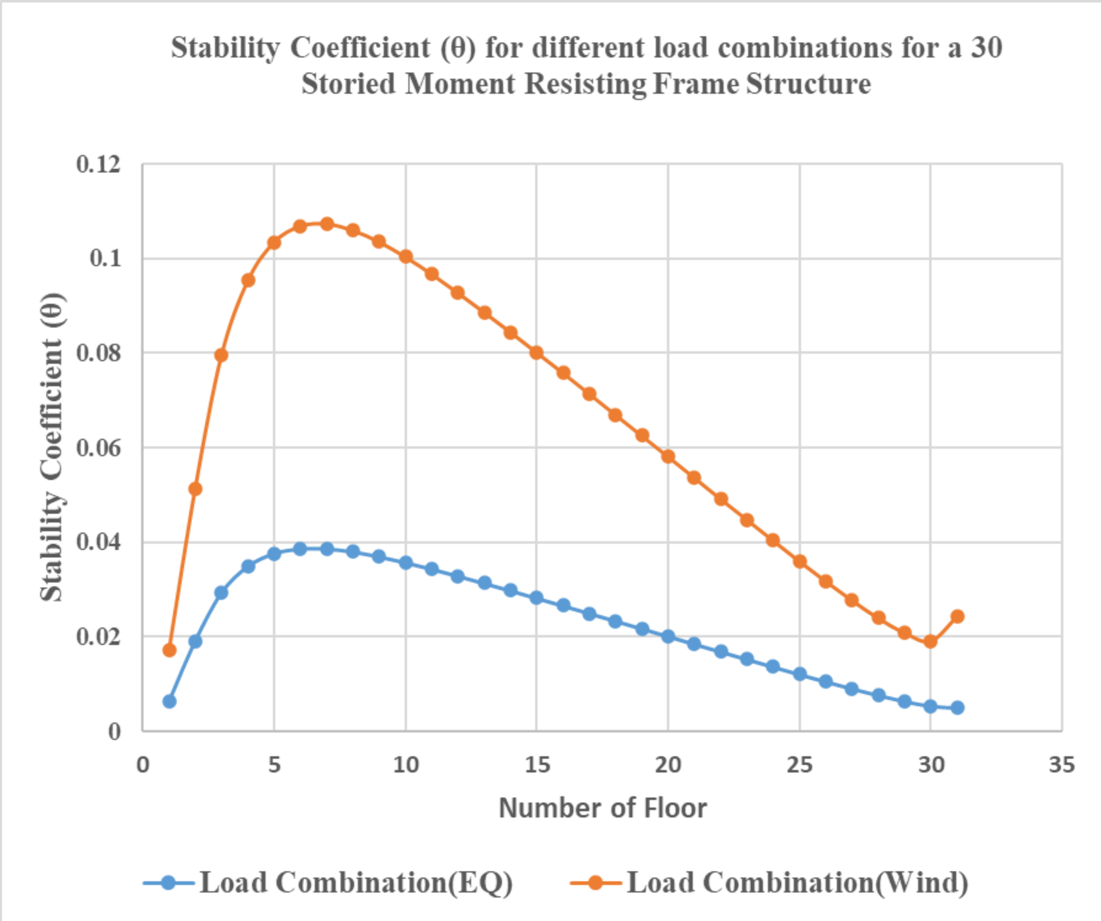


Figure 4.3: Stability Coefficient at different floor for different load combination.

4.4 Symmetric Building

To determine stability coefficient of moment resisting frame structure at first, we have considered some symmetric buildings. Per floor area of all of the buildings are around ten thousand square feet. We have considered buildings of three different aspect ratios (Length/ Width) which are 1.21, 3.33 and 5.95. Maximum analysis criteria are remaining unchanged and we made the analysis with ETABS 9.7.1 version which has described in Appendix-A the result we obtained from each aspect ratios for symmetric buildings are described hare.

4.4.1 Stability coefficient (ϴ) for aspect ratio 1.21

To determine Stability Coefficient, we have considered a building which has per floor length 110’-0” and per floor width 91’-0” So the aspect ratio (Length/ Width) of this building is 1.21. All the necessary data for different analysis criteria have taken from relevant tables described in BNBC-2020. The Zone coefficient, Response modification factor, deflection Amplification Factor, System Over strength Factor, Site class, important factor etc. have described at chapter 3. All other loads and parameters which we have considered in this building including these has given at Appendix J. Loads and loads combination has also followed according to BNBC-2020. Now after analyzing the model of this building, we have determined stability coefficient (ϴ) for every two floors. All the relevant data we received from ETABS analysis has described chart wise at Appendix D. Now finally we have got the values of stability coefficient (ϴ) for the symmetric building with aspect ratio 1.21 as given below.

Table 4.1: Stability Coefficient (ϴ) for aspect ratio 1.21

Sl. No.	Number of Story	Floor	Aspect Ratio (L/W)	Aspect Ratio (H/W)	Exterior Column Size	Interior Column Size	Vertical Design Load (P)	Story Shear (Vx)	Absolute Value (Vx)	DriftX	Design Story Drift Δ (Inch)	Floor Height (hsx)	Deflection Amplification Factor (Cd)	Stability Coefficient (θ)
1	2	STORY2	1.21	0.12	12X12	12X12	6421.81	80.76	80.76	0.00031	0.04052	132	1	0.0244
2	4	STORY2	1.21	0.12	12X12	14X14	12912.25	215.73	215.73	0.00063	0.08329	132	1	0.0378
3	6	STORY2	1.21	0.12	12X14	12X20	19503.01	371.08	371.08	0.0011	0.14454	132	1	0.0576
4	8	STORY2	1.21	0.12	12X18	14X22	26310.23	541.68	541.68	0.0012	0.1551	132	1	0.0571
5	10	STORY2	1.21	0.12	14X18	14X26	33191.36	750.28	750.28	0.0014	0.1799	132	1	0.0603
6	12	STORY2	1.21	0.12	14X22	16X28	40384	961.57	961.57	0.0014	0.1868	132	1	0.0594
7	14	STORY3	1.21	0.24	14X28	16X34	44521.49	1128.66	1128.66	0.0016	0.2142	132	1	0.0640
8	16	STORY3	1.21	0.24	16X28	16X38	51964.91	1368.34	1368.34	0.0018	0.2373	132	1	0.0683
9	18	STORY3	1.21	0.24	20X30	18X38	60082.81	1621.41	1621.41	0.0018	0.2381	132	1	0.0668
10	20	STORY3	1.21	0.24	22X30	22X38	68580.84	1907.52	1907.52	0.0018	0.2435	132	1	0.0663
11	22	STORY4	1.21	0.36	24X32	26X38	73906.25	2102.99	2102.99	0.0020	0.2598	132	1	0.0692
12	24	STORY4	1.21	0.36	26X34	26X42	82893.97	2394.79	2394.79	0.0022	0.2866	132	1	0.0751
13	26	STORY4	1.21	0.36	28X36	28X42	92077.04	2698.86	2698.86	0.0023	0.3098	132	1	0.0801
14	28	STORY5	1.21	0.48	30X40	30X42	97860.46	2918.98	2918.98	0.0026	0.3381	132	1	0.0859
15	30	STORY5	1.21	0.48	30X42	32X44	108338.4	3245.12	3245.12	0.0028	0.3654	132	1	0.0924

Here we can see that for 30 storied symmetric building of aspect ratio 1.21 stability coefficient (ϴ) is 0.0924 which is less than 0.1. So, in this case there is no necessary to include P-delta effect in analysis i.e., second order analysis is not needed here.

4.4.2 Stability coefficient (ϴ) for aspect ratio 3.33

To determine Stability Coefficient, we have considered a building which has per floor length 180’-0” and per floor width 54’-0” So the aspect ratio (Length/ Width) of this building is 3.33. All the necessary data for different analysis criteria have taken from relevant tables described in BNBC-2020. The Zone coefficient, Response modification factor, deflection Amplification Factor, System Over strength Factor, Site class, important factor etc. have described at chapter 3. All other loads and parameters which we have considered in this building including these has given at Appendix D. Loads and loads combination has also followed according to BNBC-2020. Now after analyzing the model of this building, we have determined stability coefficient (ϴ) for every two floors. All the relevant data we received from ETABS analysis has described chart wise at Appendix D. Now finally we have got the values of stability coefficient (ϴ) for the symmetric building with aspect ratio 3.33 as given below.

Table 4.2: Stability Coefficient (ϴ) for aspect ratio 3.33

Sl. No.	Number of Story	Floor	Aspect Ratio (L/W)	Aspect Ratio (H/W)	Exterior Column Size	Interior Column Size	Vertical Design Load (P)	Story Shear (Vx)	Absolute Value (Vx)	DriftX	Design Story Drift Δ (Inch)	Floor Height (hsx)	Deflection Amplification Factor (Cd)	Stability Coefficient (θ)
1	2	STORY2	3.33	0.2	12X12	12X12	6119.82	47.93	47.93	0.00021	0.02798	132	1	0.0271
2	4	STORY2	3.33	0.2	12X14	12X18	12376.91	128.01	128.01	0.00042	0.05597	132	1	0.0410
3	6	STORY2	3.33	0.2	12X16	14X22	18824.07	220.2	220.2	0.00047	0.06217	132	1	0.0403
4	8	STORY2	3.33	0.2	12X18	14X26	25633.77	321.43	321.43	0.00048	0.06283	132	1	0.0380
5	10	STORY2	3.33	0.2	14X20	16X28	32086.2	430.05	430.05	0.00062	0.08197	132	1	0.0463
6	12	STORY3	3.33	0.41	14X24	16X32	35672.32	511.99	511.99	0.00076	0.10085	132	1	0.0532
7	14	STORY3	3.33	0.41	16X26	18X34	42844.55	647.67	647.67	0.00081	0.10745	132	1	0.0538
8	16	STORY3	3.33	0.41	16X30	20X36	50254.37	785.5	785.5	0.00088	0.11603	132	1	0.0562
9	18	STORY3	3.33	0.41	16X32	20X40	60754.55	910.43	910.43	0.00088	0.11669	132	1	0.0590
10	20	STORY3	3.33	0.41	14X24,18X34	20X40,22X42	68117.4	1048.53	1048.53	0.00115	0.1522	132	1	0.0749
11	22	STORY4	3.33	0.61	16X26,20X36	22X42,26X44	73048.84	1156.93	1156.93	0.00121	0.16012	132	1	0.0766
12	24	STORY4	3.33	0.61	18X26,22X36	24X42,30X46	81495.89	1303.88	1303.88	0.00129	0.16962	132	1	0.0803
13	26	STORY4	3.33	0.61	18X28,24X36	28X44,34X50	90551.86	1470.79	1470.79	0.00138	0.1815	132	1	0.0847
14	28	STORY5	3.33	0.81	18X30,24X38	30X46,36X54	95573.28	1592.17	1592.17	0.00152	0.20024	132	1	0.0911
15	30	STORY5	3.33	0.81	18X34,26X42	34X50,38X58	105404.9	1771.62	1771.62	0.00164	0.21661	132	1	0.0976

Here we can see that for 30 storied symmetric building of aspect ratio 3.33 stability coefficient (ϴ) is 0.0976 which is very near to 0.1. So, in this case there is no necessary to include P-delta effect in analysis i.e., second order analysis is not needed here. But we can say that for symmetric building with aspect ratio 3.33 if a building is more than 30 storied height, it is needed to consider P-delta effect in analysis.

4.4.3 Stability coefficient (ϴ) for aspect ratio 5.95

To determine Stability Coefficient, we have considered a building which has per floor length 250'-0" and per floor width 42'-0" So the aspect ratio (Length/ Width) of this building is 5.95. All the necessary data for different analysis criteria have taken from relevant tables described in BNBC-2020. The Zone coefficient, Response modification factor, deflection Amplification Factor, System Overstrength Factor, Site class, important factor etc. have described at chapter 3. All other loads and parameters which we have considered in this building including these has been from BNBC (2020). Loads and loads combination has also followed according to BNBC-2020. Now after analyzing the model of this building, we have determined stability coefficient (ϴ) for every two floors. All the relevant data we received from ETABS analysis has described chart wise at Appendix D. Now finally we have got the values of stability coefficient (ϴ) for the symmetric building with aspect ratio 5.95 as given below.

Table 4.3: Stability Coefficient (Θ) for aspect ratio 5.95

Sl. No.	Number of Story	Floor	Aspect Ratio (L/W)	Aspect Ratio (H/W)	Exterior Column Size	Interior Column Size	Vertical Design Load (P)	Story Shear (Vx)	Absolute Value (Vx)	DriftX	Design Story Drift Δ (Inch)	Floor Height (hsx)	Deflection Amplification Factor (Cd)	Stability Coefficient (θ)
1	2	STORY2	5.95	0.26	12x12	12x12	6686.68	37.28	37.28	0.00015	0.02033	132	1	0.0276
2	4	STORY2	5.95	0.26	12X14	12X20	13478.95	99.57	99.57	0.00034	0.04501	132	1	0.0462
3	6	STORY2	5.95	0.26	12X22	14X22	20655.32	171.27	171.27	0.00034	0.04488	132	1	0.0410
4	8	STORY2	5.95	0.26	14X24	14X26	27731.38	250	250	0.00046	0.06125	132	1	0.0515
5	10	STORY2	5.95	0.26	14X26	16X30	35338.48	334.48	334.48	0.00047	0.06164	132	1	0.0493
6	12	STORY3	5.95	0.52	14X28	16X32	39080.44	393.58	393.58	0.00059	0.07828	132	1	0.0589
7	14	STORY3	5.95	0.52	14X30	18X36	47186.91	492.3	492.3	0.00063	0.08276	132	1	0.0601
8	16	STORY3	5.95	0.52	16X34, 20X40	20X38	55532.06	597.22	597.22	0.00068	0.09029	132	1	0.0636
9	18	STORY3	5.95	0.52	20X36, 24X42	20X42	64555.65	708.11	708.11	0.00073	0.09649	132	1	0.0666
10	20	STORY4	5.95	0.79	20X36,30X46	18X34,24X36	70342.81	770.82	770.82	0.00089	0.11801	132	1	0.0816
11	22	STORY4	5.95	0.79	22X38,34X50	20X36,26X38	79841.57	879.62	879.62	0.00094	0.12434	132	1	0.0855
12	24	STORY4	5.95	0.79	24X40,38X54	22X38,28X42	89764.03	1002.73	1002.73	0.00101	0.13292	132	1	0.0901
13	26	STORY5	5.95	1.05	28X42,42X60	24X40,32X46	96857.25	1079.54	1079.54	0.00106	0.14005	132	1	0.0952
14	28	STORY5	5.95	1.05	30X44,44X66	36X52, 28X42	108359.9	1211.14	1211.14	0.00113	0.14929	132	1	0.1012
15	30	STORY6	5.95	1.31	44X74,32X46	38X56,30X44	115976.9	1291.34	1291.34	0.00121	0.16025	132	1	0.1090

Here we can see that for 30 storied symmetric building of aspect ratio 5.95 stability coefficient (Θ) is 0.109 which is greater than 0.1. We can also see that for 28 storied symmetric building of aspect ratio 5.95 stability coefficient (Θ) is 0.101 which is greater than 0.1. So, in this case Building which is higher than 26 storied it is necessary to include P-delta effect in analysis i.e., second order analysis is needed.

4.4.4 Relation of (Θ) with aspect ratio and building height

For different aspect Ratio we can see at same height stability coefficient (Θ) is not same. Again, at same aspect ratio stability coefficient (Θ) changes with building height. Now we can observe the change characteristics of stability coefficient (Θ) of same aspect ratio with building height and with same building height for different aspect ratio.

I. (Θ) for different building height at aspect ratio 1.21

Here we have the data of highest value of Stability Coefficient (Θ) and in which floor the highest value is occurring for a symmetric building with aspect ratio (L/W) 1.21. A graphical representation has placed here to understand the changes with building height. We have determined the coefficient for increasing every two story and have done the work up to 30 story.

II. (Θ) for different building height at aspect ratio 3.33

Here we have the data of highest value of Stability Coefficient (Θ) and in which floor the highest value is occurring for a symmetric building with aspect ratio (L/W) 1.21. A graphical representation has placed here to understand the changes with building height. We have determined the coefficient for increasing every two story and have done the work up to 30 story.

III. (Θ) for different building height at aspect ratio 5.95

Here we have the data of highest value of Stability Coefficient (Θ) and in which floor the highest value is occurring for a symmetric building with aspect ratio (L/W) 1.21. A graphical representation has placed here to understand the changes with building height. We have determined the coefficient for increasing every two story and have done the work up to 30 story.

IV. Comparison of different aspect ratio

After getting all the values of stability coefficient (Θ) for different building heights for three different symmetric building with different aspect ratio (length/width) now we can compare them as we can see the value of stability coefficient of same height building which are different in length by width aspect ratio.

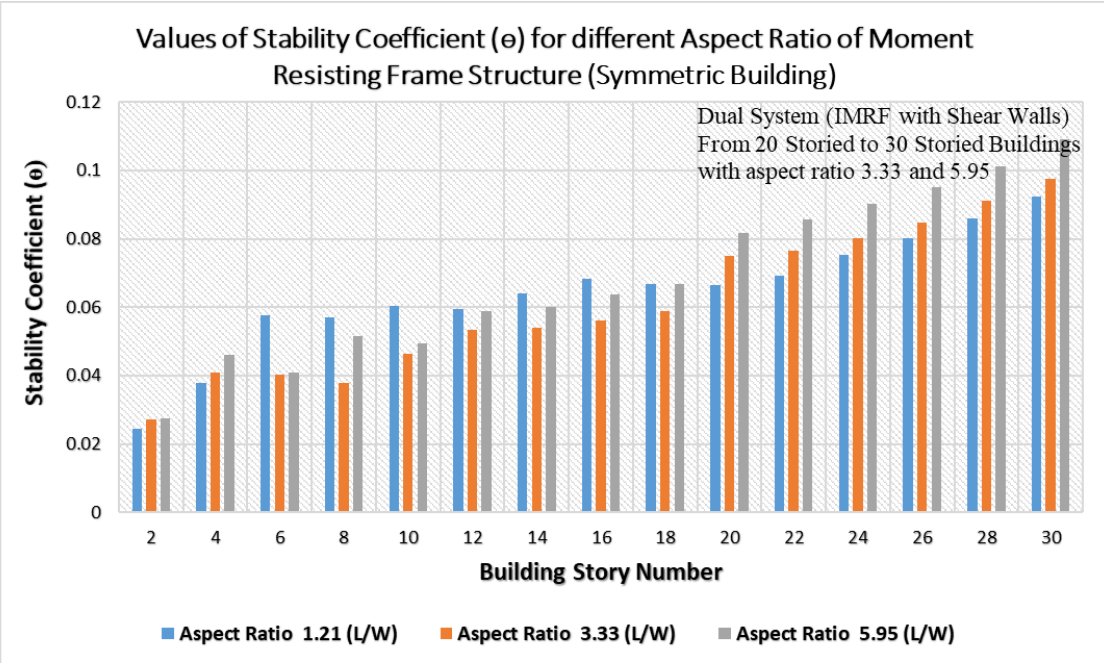


Figure 4.4: Comparison of stability Coefficient (Θ) for different aspect ratio

4.4.5 Location of maximum value of stability coefficient (Θ)

When we determine stability coefficient (Θ) for a building then we get different values at different floor of the building. We take the highest value of them and this is the value of stability coefficient (Θ) for that building. Now when we increase the building height the location of maximum value of stability coefficient (Θ) changes. Now we can see the change of location of maximum value of stability coefficient (Θ) for different aspect ratio.

I. (Ɵ) for different building height at aspect ratio 1.21

We started with a two storied building where we found the highest value of stability coefficient at 2nd story but with increase of building height the location where highest value occurs become changed. Here is the actual scenario of the location where highest value creates with increase of building height for a symmetric building with aspect ratio 1.21.

II. (Ɵ) for different building height at aspect ratio 3.33

We started with a two storied building where we found the highest value of stability coefficient at 2nd story but with increase of building height the location where highest value occurs become changed. Here is the actual scenario of the location where highest value creates with increase of building height for a symmetric building with aspect ratio 3.33.

III. (Ɵ) for different building height at aspect ratio 5.95

We started with a two storied building where we found the highest value of stability coefficient at 2nd story but with increase of building height the location where highest value occurs become changed. Here is the actual scenario of the location where highest value creates with increase of building height for a symmetric building with aspect ratio 5.95.

IV. Comparison of different aspect ratio

To understand the change of location where the highest value of stability coefficient occurs with increasing building height for different type of symmetric building with different aspect ratio, we can make this comparison and can see with the graphical representation.

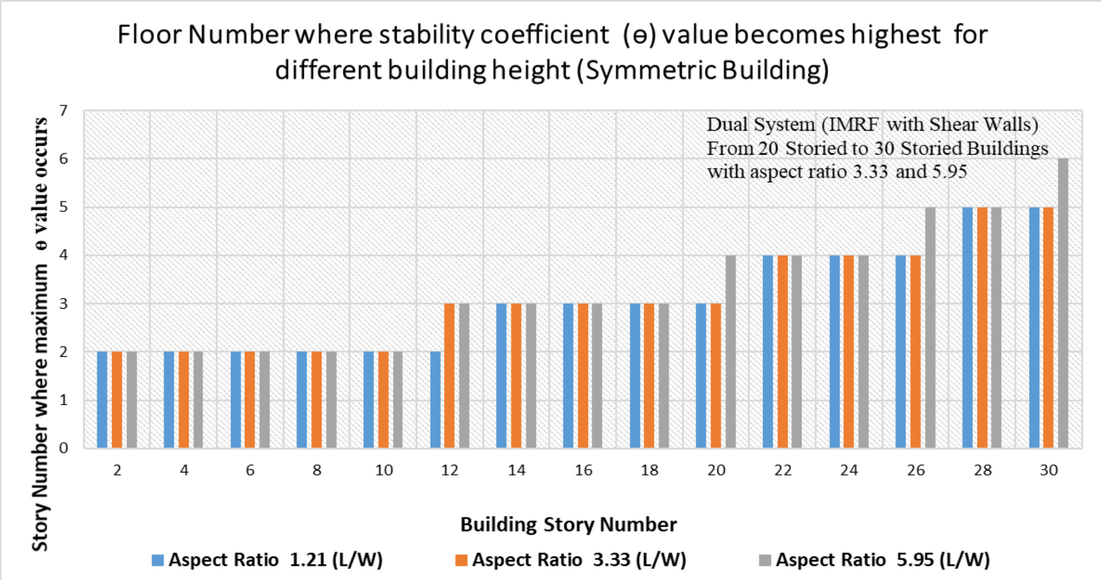


Figure 4.5: Comparison of location of highest value of (Θ) for different aspect ratio.

4.5 Asymmetric Building

To determine stability coefficient of moment resisting frame structure at first, we have considered some asymmetric buildings. Per floor area of all of the buildings are around ten thousand square feet. We have considered buildings of three different aspect ratios (Length/ Width) which are 1.21, 3.33 and 5.95. Maximum analysis criteria are remaining unchanged and we made the analysis with ETABS 9.7.1 version which has described in Appendix-A the result we obtained from each aspect ratios for symmetric buildings are described hare.

4.5.1 Stability coefficient (Θ) for aspect ratio 1.21

To determine Stability Coefficient, we have considered a building which has per floor length 110’-0” and per floor width 91’-0” So the aspect ratio (Length/ Width) of this building is 1.21. All the necessary data for different analysis criteria have taken from relevant tables described in BNBC-2020. The Zone coefficient, Response modification factor, deflection Amplification Factor, System Over strength Factor, Site class, important factor etc. have described at chapter 3. All other loads and parameters which we have considered in this building including these has given at Appendix J. Loads and loads combination has also followed according to BNBC-2020. Now after analyzing the model of this building, we have determined stability coefficient (Θ) for every two floors. All the relevant data we received from ETABS analysis has described chart wise at Appendix D. Now finally we have got the values of stability coefficient (Θ) for the asymmetric building with aspect ratio 1.21 as given below.

Table 4.4: Stability Coefficient (Θ) for aspect ratio 1.21

Sl. No.	Number of Story	Floor	Aspect Ratio (L/W)	Aspect Ratio (H/W)	Exterior Column Size	Interior Column Size	Vertical Design Load (P)	Story Shear (Vx)	Absolute Value (Vx)	DriftX	Design Story Drift Δ (Inch)	Floor Height (hsx)	Deflection Amplification Factor (Cd)	Stability Coefficient (θ)
1	2	STORY2	1.21	0.12	12X12	12X12	5045.25	80.76	80.76	0.00038	0.05016	132	1	0.024
2	4	STORY2	1.21	0.12	12X12	12X14	10107.7	215.73	215.73	0.001	0.132264	132	1	0.047
3	6	STORY2	1.21	0.12	12X14, 12X18	12X20	15310	371.08	371.08	0.00141	0.186648	132	1	0.058
4	8	STORY2	1.21	0.12	12X18,12X22	14X24	20709	541.68	541.68	0.00155	0.2046	132	1	0.059
5	10	STORY2	1.21	0.12	14X20, 14X24	16X26	26296.5	750.28	750.28	0.00156	0.20592	132	1	0.055
6	12	STORY2	1.21	0.12	14X22, 14X28	16X28	31795.3	961.57	961.57	0.00188	0.248556	132	1	0.062
7	14	STORY3	1.21	0.24	16X26	18X30	35207.1	1128.7	1128.66	0.00195	0.257136	132	1	0.061
8	16	STORY3	1.21	0.24	18X26,18X28	20X30,22X30	41457.6	1368.3	1368.34	0.002	0.264132	132	1	0.061
9	18	STORY3	1.21	0.24	18X28,18X30	22X30,24X30	47521	1621.4	1621.41	0.00224	0.295152	132	1	0.066
10	20	STORY3	1.21	0.24	18X30,20X30	24X30,24X32	53800.3	1907.5	1907.52	0.00251	0.331716	132	1	0.071
11	22	STORY4	1.21	0.36	20X30,22X32	24X32,24X34	57628.4	2103	2102.99	0.00278	0.366696	132	1	0.076
12	24	STORY4	1.21	0.36	22X32,24X32	24X36,24X38	64349.5	2394.8	2394.79	0.00308	0.406032	132	1	0.083
13	26	STORY4	1.21	0.36	24X34,24X36	24X38,30X40	71630.2	2698.9	2698.86	0.00334	0.441408	132	1	0.089
14	28	STORY5	1.21	0.48	26X40,26X38	28X42,34X44	77128.2	2919	2918.98	0.00356	0.470316	132	1	0.094
15	30	STORY5	1.21	0.48	26X42,26X38	32X44,36X48	84979.3	3245.1	3245.12	0.00389	0.513084	132	1	0.102

Here we can see that for 30 storied asymmetric building of aspect ratio 1.21 stability coefficient (Θ) is 0.102 which is greater than 0.1. and we can also see that for 28 storied asymmetric building of aspect ratio 1.21 stability coefficient (Θ) is 0.094 which is less than 0.1. So, in this case there is no necessary to include P-delta effect in analysis i.e., second order analysis is not needed here. Over all we can say that In Dhaka city Asymmetric building with aspect ratio 1.21 which is higher than 28 storied it is necessary to include P-delta effect in analysis i.e., second order analysis is needed.

4.5.2 Stability coefficient (Θ) for aspect ratio 3.33

To determine Stability Coefficient, we have considered a building which has per floor length 180’-0” and per floor width 54’-0” So the aspect ratio (Length/ Width) of this building is 3.33. All the necessary data for different analysis criteria have taken from relevant tables described in BNBC-2020. The Zone coefficient, Response modification factor, deflection Amplification Factor, System Over strength Factor, Site class, important factor etc. have described at chapter 3. All other loads and parameters which we have considered in this building including these has given at Appendix J. Loads and loads combination has also followed according to BNBC-2020. Now after analyzing the model of this building, we have determined stability coefficient (Θ) for every two floors. All the relevant data we received from ETABS analysis has described chart wise at Appendix D. Now finally we have got the values of stability coefficient (Θ) for the asymmetric building with aspect ratio 3.33 as given below.

Table 4.5: Stability Coefficient (ϴ) for aspect ratio 3.33

Sl. No.	Number of Story	Floor	Aspect Ratio (L/W)	Aspect Ratio (H/W)	Exterior Column Size	Interior Column Size	Vertical Design Load (P)	Story Shear (Vx)	Absolute Value (Vx)	DriftX	Design Story Drift Δ (Inch)	Floor Height (hsx)	Deflection Amplification Factor (Cd)	Stability Coefficient (θ)
1	2	STORY2	3.33	0.2	12X12	12X12	5061.09	47.93	47.93	0.00023	0.030888	132	1	0.025
2	4	STORY2	3.33	0.2	12X12	12X16	10196.1	128.01	128.01	0.00052	0.068904	132	1	0.042
3	6	STORY2	3.33	0.2	12X14	12X20,14X22	15495.8	220.2	220.2	0.00064	0.084216	132	1	0.045
4	8	STORY2	3.33	0.2	12X16	14X24,16X26	21006.4	321.43	321.43	0.00065	0.085536	132	1	0.042
5	10	STORY3	3.33	0.41	12X18	16X26,18X28	23950	392.12	392.12	0.00071	0.093456	132	1	0.043
6	12	STORY3	3.33	0.41	14X22	18X28, 18X32	29725.3	511.99	511.99	0.00081	0.106392	132	1	0.047
7	14	STORY3	3.33	0.41	16X28	18X32, 20X34	35808.4	647.67	647.67	0.0009	0.119196	132	1	0.050
8	16	STORY3	3.33	0.41	16X30	20X34, 22X36	42386.5	785.5	785.5	0.00095	0.125928	132	1	0.051
9	18	STORY4	3.33	0.61	18X34	24X38,24X40	46753	865.05	865.05	0.001	0.131604	132	1	0.054
10	20	STORY3	3.33	0.41	18X28	18X30,18X32	56525.5	1048.5	1048.53	0.00142	0.18678	132	1	0.076
11	22	STORY3	3.33	0.41	18X30	20X34,20X38	63476.9	1204.2	1204.21	0.00152	0.201168	132	1	0.080
12	24	STORY4	3.33	0.61	18X34	24X38,26X42	68358	1303.9	1303.88	0.0016	0.211068	132	1	0.084
13	26	STORY4	3.33	0.61	20X36	26X42,32X48	76910	1470.8	1470.79	0.00166	0.219252	132	1	0.087
14	28	STORY5	3.33	0.81	20X38,26X44	30X46,36X56	82022.9	1592.2	1592.17	0.00181	0.239448	132	1	0.093
15	30	STORY5	3.33	0.81	36X60,36X56	28X46,32X52	89674.7	1771.6	1771.62	0.00197	0.260172	132	1	0.100

Here we can see that for 30 storied asymmetric building of aspect ratio 3.33 stability coefficient (ϴ) is 0.100 which is equal to 0.1. and we can also see that for 28 storied asymmetric building of aspect ratio 1.21 stability coefficient (ϴ) is 0.093 which is less than 0.1. So, in this case there is no necessary to include P-delta effect in analysis i.e., second order analysis is not needed here. Over all we can say that In Dhaka city Asymmetric building with aspect ratio 3.33 which is higher than 28 storied it is necessary to include P-delta effect in analysis i.e., second order analysis is needed.

4.5.3 Stability coefficient (ϴ) for aspect ratio 5.95

To determine Stability Coefficient, we have considered a building which has per floor length 250’-0” and per floor width 42’-0” So the aspect ratio (Length/ Width) of this building is 5.95. All the necessary data for different analysis criteria have taken from relevant tables described in BNBC-2020. The Zone coefficient, Response modification factor, deflection Amplification Factor, System Over strength Factor, Site class, important factor etc. have described at chapter 3. All other loads and parameters which we have considered in this building including these has given at Appendix J. Loads and loads combination has also followed according to BNBC-2020. Now after analyzing the model of this building, we have determined stability coefficient (ϴ) for every two floors. All the relevant data we received from ETABS analysis has described chart wise at Appendix D. Now finally we have got the values of stability coefficient (ϴ) for the symmetric building with aspect ratio 5.95 as given below.

Table 4.6: Stability Coefficient (Θ) for aspect ratio 5.95

Sl. No.	Number of Story	Floor	Aspect Ratio (L/W)	Aspect Ratio (H/W)	Exterior Column Size	Interior Column Size	Vertical Design Load (P)	Story Shear (Vx)	Absolute Value (Vx)	DriftX	Design Story Drift Δ (Inch)	Floor Height (hsx)	Deflection Amplification Factor (Cd)	Stability Coefficient (θ)
1	2	STORY2	5.95	0.26	12X12	12X12	5216.52	37.28	37.28	0.00018	0.023628	132	1	0.025
2	4	STORY2	5.95	0.26	12X16	12X18	10542.6	99.57	99.57	0.00039	0.050952	132	1	0.041
3	6	STORY2	5.95	0.26	12X18	12X22,14X24	16007.9	171.27	171.27	0.00053	0.070092	132	1	0.050
4	8	STORY2	5.95	0.26	12X22	14X24,14X26	21602.2	250	250	0.0006	0.078804	132	1	0.052
5	10	STORY2	5.95	0.26	14X24	14X28,14X30	27343.1	334.48	334.48	0.00069	0.091608	132	1	0.057
6	12	STORY3	5.95	0.52	14X28	16X32,16X34	30776.8	393.58	393.58	0.00071	0.09372	132	1	0.056
7	14	STORY3	5.95	0.52	14X30	18X36,20X38	37597.3	492.3	492.3	0.00072	0.094908	132	1	0.055
8	16	STORY3	5.95	0.52	16X32	20X40,22X42	44589.2	597.22	597.22	0.00078	0.103224	132	1	0.058
9	18	STORY4	5.95	0.79	18X34,24X42	28X44,30X46	49890.1	672.82	672.82	0.00081	0.107448	132	1	0.060
10	20	STORY4	5.95	0.79	16X30,26X24	18X36,20X38	55596.8	770.82	770.82	0.00117	0.15378	132	1	0.084
11	22	STORY4	5.95	0.79	16X32,20X40	24X44,30X52	63771.7	879.62	879.62	0.00123	0.1617	132	1	0.089
12	24	STORY4	5.95	0.79	18X34,28X44	28X48,34X56	72649.8	1002.7	1002.73	0.00126	0.165792	132	1	0.091
13	26	STORY5	5.95	1.05	20X36,28X44	32X52,40X66	79216.8	1079.5	1079.54	0.00131	0.17226	132	1	0.096
14	28	STORY6	5.95	1.31	22X38,32X46	46X72,36X56	86532.3	1169.9	1169.89	0.00137	0.180312	132	1	0.101
15	30	STORY7	5.95	1.57	24X40,36X46	52X78,40X58	93735.9	1248.5	1248.51	0.00143	0.188628	132	1	0.107

Here we can see that for 30 storied asymmetric building of aspect ratio 5.95 stability coefficient (Θ) is 0.107 which is greater than 0.1. and we can also see that for 24 storied asymmetric building of aspect ratio 1.21 stability coefficient (Θ) is 0.091 which is less than 0.1. So, in this case there is no necessary to include P-delta effect in analysis i.e., second order analysis is not needed here. Over all we can say that In Dhaka city Asymmetric building with aspect ratio 5.95 which is higher than 24 storied it is necessary to include P-delta effect in analysis i.e., second order analysis is needed.

4.5.4 Relation of (Θ) with aspect ratio and building height

For different aspect Ratio we can see at same height stability coefficient (Θ) is not same. Again, at same aspect ratio stability coefficient (Θ) changes with building height. Now we can observe the change characteristics of stability coefficient (Θ) of same aspect ratio of with building height and with same building height for different aspect ratio.

I. (Θ) for different building height at aspect ratio 1.21

Here we have the data of highest value of Stability Coefficient (Θ) and in which floor the highest value is occurring for an asymmetric building with aspect ratio (L/W) 1.21. A graphical representation has placed here to understand the changes with building height. We have determined the coefficient for increasing every two story and have done the work up to 30 story.

II. (Θ) for different building height at aspect ratio 3.33

Here we have the data of highest value of Stability Coefficient (Θ) and in which floor the highest value is occurring for an asymmetric building with aspect ratio (L/W) 1.21.

A graphical representation has placed here to understand the changes with building height. We have determined the coefficient for increasing every two story and have done the work up to 30 story.

III. (Θ) for different building height at aspect ratio 5.95

Here we have the data of highest value of Stability Coefficient (Θ) and in which floor the highest value is occurring for an asymmetric building with aspect ratio (L/W) 1.21. A graphical representation has placed here to understand the changes with building height. We have determined the coefficient for increasing every two story and have done the work up to 30 story.

IV. Comparison for different aspect ratio

After getting all the values of stability coefficient (Θ) for different building heights for three different asymmetric building with different aspect ratio (length/width) now we can compare them as we can see the value of stability coefficient of same height building which are different in length by width aspect ratio.

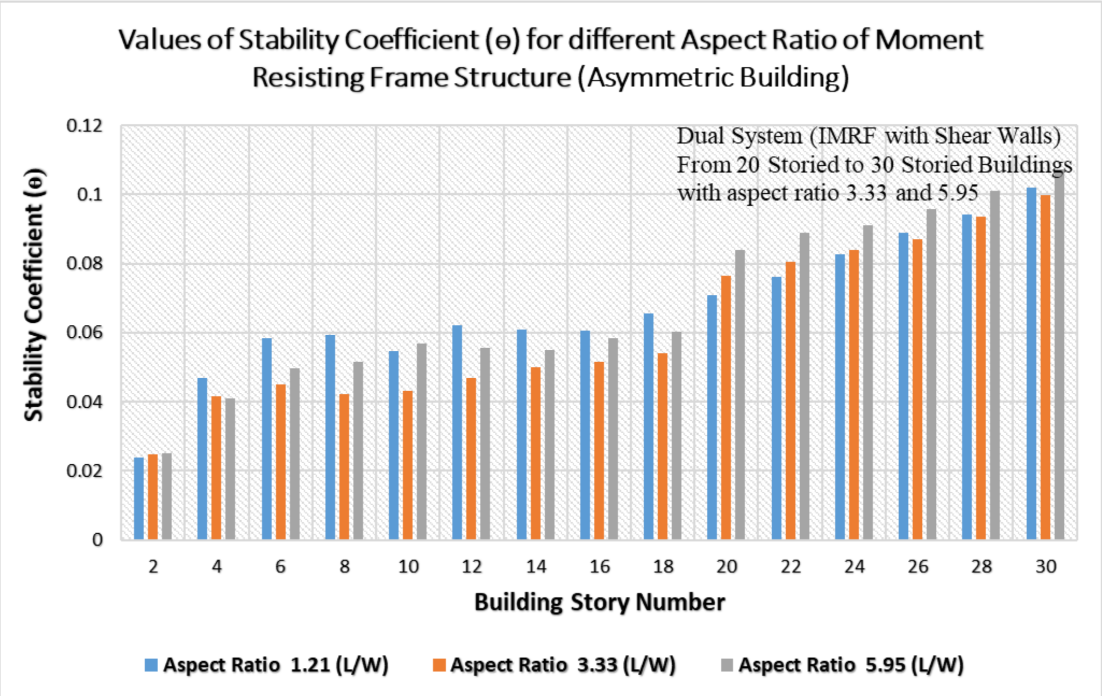


Figure 4.6: Comparison of stability Coefficient (Θ) for different aspect ratio

4.5.5 Location of maximum value of stability coefficient (Θ)

When we determine stability coefficient (Θ) for a building then we get different values at different floor of the building. We take the highest value of them and this is the value of stability coefficient (Θ) for that building. Now when we increase the building height the location of maximum value of stability coefficient (ϴ) changes. Now we can see the change of location of maximum value of stability coefficient (ϴ) for different aspect ratio.

I. (ϴ) for different building height at aspect ratio 1.21

We started with a two storied building where we found the highest value of stability coefficient at 2nd story but with increase of building height the location where highest value occurs become changed. Here is the actual scenario of the location where highest value creates with increase of building height for an asymmetric building with aspect ratio 1.21.

II. (ϴ) for different building height at aspect ratio 3.33

We started with a two storied building where we found the highest value of stability coefficient at 2nd story but with increase of building height the location where highest value occurs become changed. Here is the actual scenario of the location where highest value creates with increase of building height for a symmetric building with aspect ratio 3.33.

III. (ϴ) for different building height at aspect ratio 5.95

We started with a two storied building where we found the highest value of stability coefficient at 2nd story but with increase of building height the location where highest value occurs become changed. Here is the actual scenario of the location where highest value creates with increase of building height for an asymmetric building with aspect ratio 5.95.

IV. Comparison for different aspect ratio

To understand the change of location where the highest value of stability coefficient occurs with increasing building height for different type of asymmetric building with different aspect ratio, we can make this comparison and can see with the graphical representation.

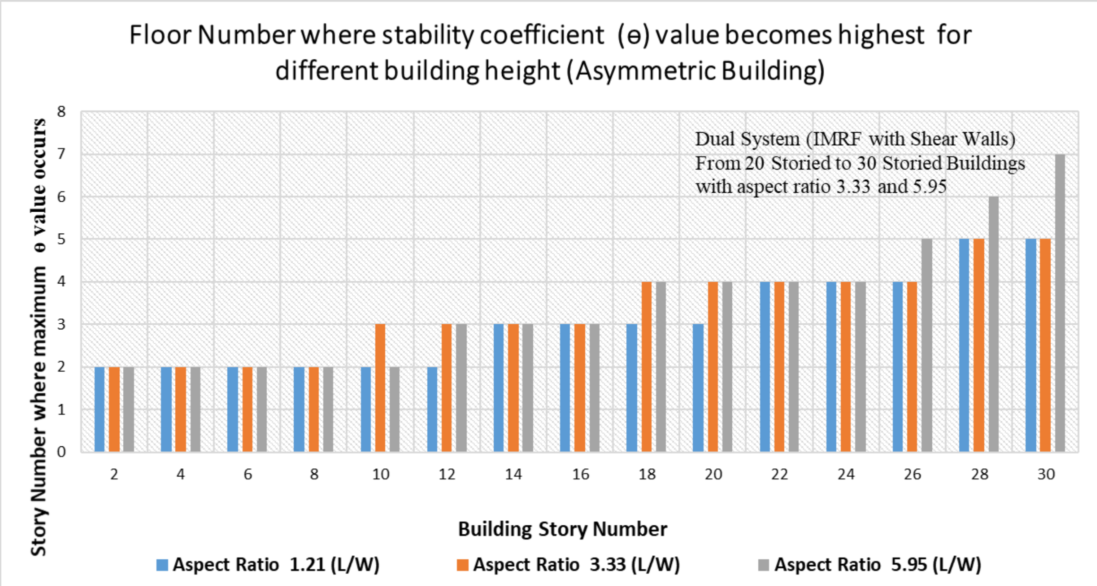


Figure 4.7: Comparison of location of highest value of (ϴ) for different aspect ratio.

4.6 Comparison of Symmetric and Asymmetric Building

Now after analyzing three symmetric building with different aspect ratio and three asymmetric building with different aspect ratio we have got values of stability coefficient for different building height. Now we are going to compare the results of symmetric and asymmetric building at same aspect ratio.

4.6.1 (ϴ) for aspect ratio 1.21 for symmetric and asymmetric building

At first, we will see the comparison between a symmetric and an asymmetric building with aspect ratio (length by width) 1.21. In both cases we will compare from two storied to thirty storied building. A graphical representation is also added to get the comparison clearly.

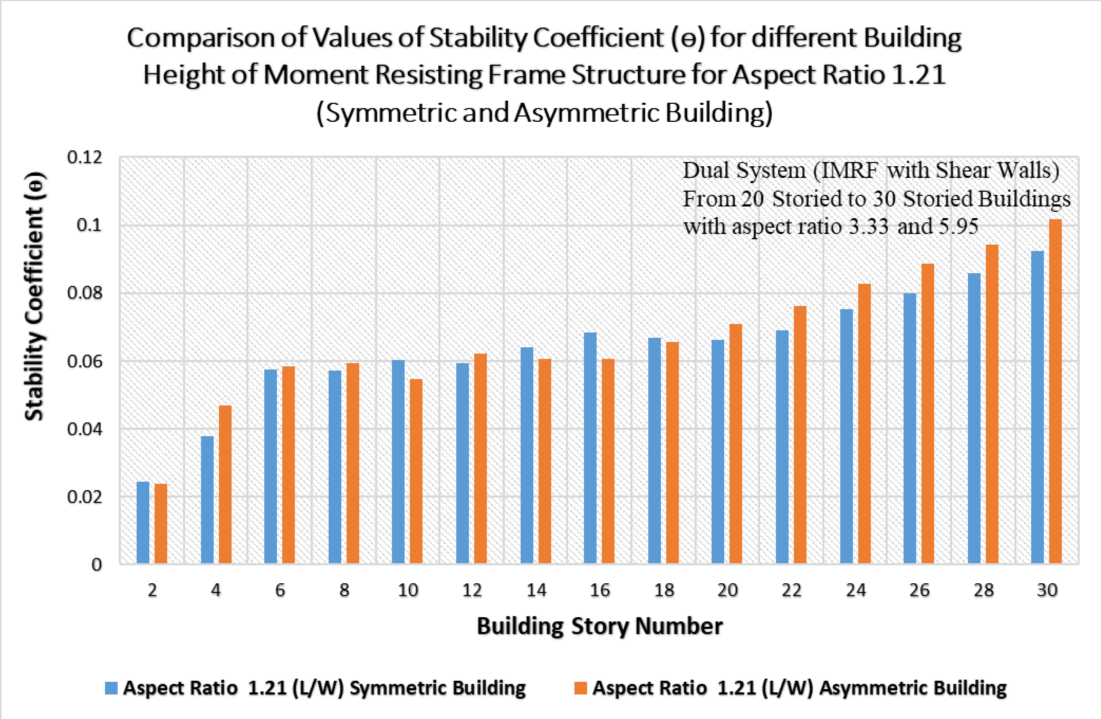


Figure 4.8: Comparison of Stability Coefficient (Θ) for aspect ratio 1.21

4.6.2 (Θ) for aspect ratio 3.33 for symmetric and asymmetric building

Now we will see the comparison between a symmetric and an asymmetric building with aspect ratio (length by width) 3.33. In both cases we will compare from two storied to thirty storied building. A graphical representation is also added to get the comparison clearly.

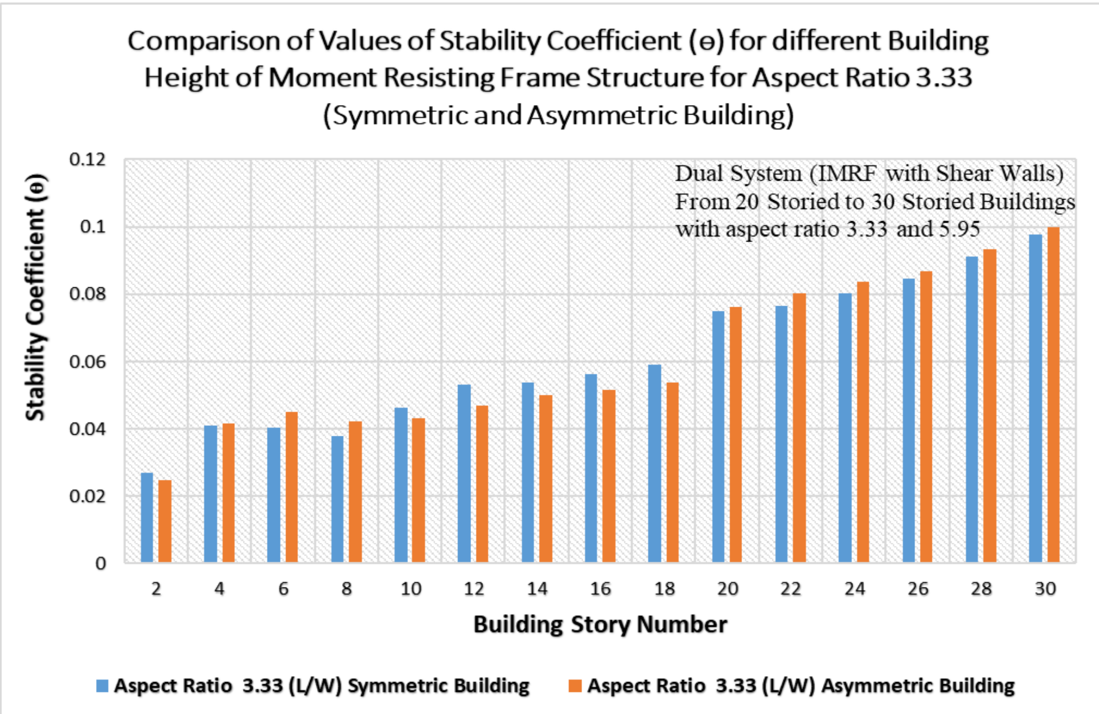


Figure 4.9: Comparison of Stability Coefficient (Θ) for aspect ratio 3.33

4.6.3 (ϴ) for aspect ratio 5.95 for symmetric and asymmetric building

Now we will see the comparison between a symmetric and an asymmetric building with aspect ratio (length by width) 5.95. In both cases we will compare from two storied to thirty storied building. A graphical representation is also added to get the comparison clearly.

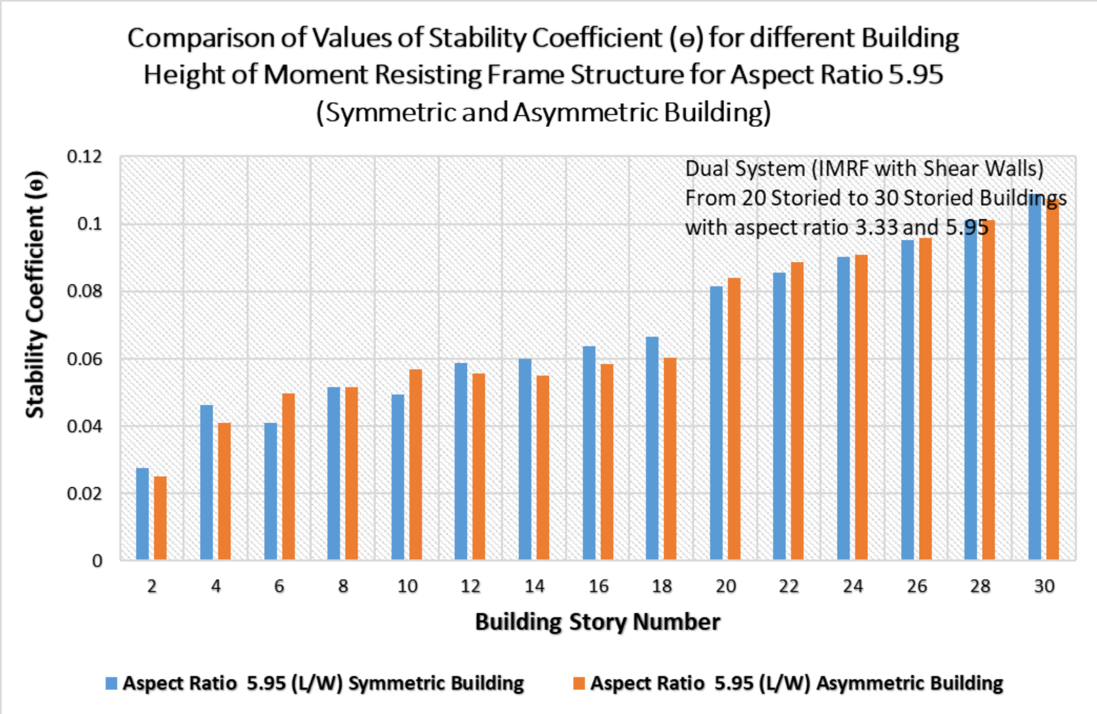


Figure 4.10: Comparison of Stability Coefficient (ϴ) for aspect ratio 5.95

CHAPTER – 5

CONCLUSIONS

5.1 General

Different kinds of symmetric and asymmetric moment resisting frame structures are being constructed in Bangladesh and the structural properties of these structures vary a lot from one to another. The main objective of the present study is to evaluate either the analysis procedure of a high-rise building structure will be static or dynamic. It can be determined for many other cases and for many different aspect ratios by following this study. Ultimately this study will give an overall idea that will help all structural designer of Bangladesh whether they will design a structure considering static analysis or dynamic analysis.

5.2 Conclusions of the Study

Findings of the study as presented in the previous chapters are summarized bellows:

a) Stability coefficient (Ө) for both symmetric and asymmetric building increases with the increase of building height at a fixed aspect ratio when other structural criteria are unchanged.

b) Generally, Stability coefficient (Ө) for both symmetric and asymmetric building increases with the increase of aspect ratio at a fixed building height when other structural criteria are unchanged.

c) It has been observed that in both cases of symmetric and asymmetric building stability coefficient for aspect ratio 3.33 (length by width) is less then both aspect ratio 1.21 (length by width) and 5.95 (length by width) at same building height for low rise building which indirectly indicates that building with aspect ratio 3.33 (length by width) is more stable than aspect ratio 1.21 and 5.95 for low rise building. But in case if high rise building aspect ratio 1.21 is more stable than aspect ratio 3.33 and 5.95.

d) It is clear from comparison graphs that stability coefficient of asymmetric building is higher than stability coefficient of symmetric building for same aspect ratio at same building height for high rise building. which ultimately indicates that symmetric building is more stable than asymmetric building at same building height.

e) The location of highest value of Stability coefficient (Ө) for both symmetric and asymmetric building increases with building height at a fixed aspect ratio when other structural criteria are unchanged.

f) The location of highest value of Stability coefficient (ϴ) for both symmetric and asymmetric building increases with the increase of aspect ratio at a fixed building height when other structural criteria are unchanged.

g) In case of asymmetric building Increase of Stability coefficient (ϴ) with building height is more rapid than symmetric building at a fixed aspect ratio when other structural criteria are unchanged.

h) Stability coefficient increases with building height by width aspect ratio but the value of stability coefficient is higher at building with higher length by width aspect ratio at same height by width aspect ratio.

i) In cases of symmetric building with aspect ratio 1.21 there is no necessary to include P-Delta effect in analysis for building up to 30 storied. But for aspect ratio 3.33 it is needed to consider P-Delta effect in analysis for building which are more than 28 storied and when the aspect ratio is 5.95 then it should be considered for building which are more than 26 storied.

j) In cases of Asymmetric building with aspect ratio both 1.21 and 3.33 it is needed to consider P-Delta effect in analysis for building which are more than 28 storied and when the aspect ratio is 5.95 then it should be considered for building which are more than 24 storied.

k) As the values of Stability coefficient (ϴ) we have determined for three different aspect ratios in case of both symmetric and asymmetric buildings up to 24 storied is lower than the boundary limit (i.e., 0.1) So we can say that in Dhaka city we can make any moment resisting frame structure at any aspect ratio up to 24 storied heights with 1st order analysis. No second order analysis is needed for building less then 25 storied.

5.3 Recommendations For Future Studies

Due to certain limitations this study is not conclusive. This is only the beginning. Here is an attempt to give direction to future studies.

a) In this study, simple layout plan for various height structures were selected. Different layout plan can also be selected.

b) In the study, only RCC Columns and shear wall were considered. Extra shear wall in layout plan can be considered.

c) Only square and rectangular columns were selected in every structure. Spiral column can be selected and then it is possible to evaluate effect of column shape.

d) All the structure were selected at earthquake zone-2 according to BNBC-2020. Same study can be done at different earthquake zone of Bangladesh and outside of Bangladesh.

e) All the structure were selected as moment resisting frame structure. Same study can be done for different kind of frame structure.

f) In this study, only three aspects ratios for both symmetric and asymmetric building were selected. Same study can be done for more different aspect ratios.

g) Same study like this can be done by changing many structural criteria such as Site class (S), Importance factor (I), Response modification factor (R), System Over strength Factor (Ω_o), Deflection Amplification Factor (C_d) etc.

h) By changing materials properties same study can be done and comparison can be made with these results.

i) By changing loads and load combinations same study can be repeated and the result can be compared with these results.

j) Different software can be used to do same modeling and analysis and more accurate result can be obtained which can be compared with these results.

k) Same study can be done for Steel structures and a comparison can be made between RCC structure and steel structure at same height and same aspect ratio considering all other structural criteria unchanged.

l) Vertical irregularity and tortional effect have not considered for asymmetric buildings in this study which can be included for better result.

References

Applied Technology Council. (1978). Tentative provisions for the development of seismic regulations for buildings: A cooperative effort with the design professions, building code interests, and the research community. National Science Foundation.

Beavers, J. E. (2002). A review of seismic hazard description in US design codes and procedures. Progress in Structural Engineering and Materials, 1, 46–63.

BNBC (2020). Bangladesh National Building Code, Housing and Building Research Institute, Ministry of Housing and Public Works, Government of Bangladesh.

Comino, P. (2016). What is P-Delta Analysis? Sky Civ Engineering. Sydney, Australia.

Deierlein, G. G., Reinhorn, A. M., and Willford, M. R. (2010). Nonlinear Structural Analysis For Seismic Design, NEHRP Seismic Design Technical Brief No. 4., NIST GCR 10-917-5. Gaithersburg, MD: National Institute of Standards and Technology.

Diebold, J., & Moore, K. (2009). SEAOC Blue Book. SEAOC Seismology Committee.

Ghosh, S. K., Domel, A. W., & Fanella, D. A. (1992). Design of Concrete Buildings for Earthquake and Wind Forces. International Conference of Building Officials.

Islam, S. (2004). Banglapedia: National Encyclopedia of Bangladesh. Asiatic Society of Bangladesh.

Kadid, A., & Boumrkik, A. (2008). "pushover analysis of reinforced concrete frame structures", asian journal of civil engineering (building and housing), Vol. 9(1), 75–83.

Kumar, N. D. B. (2012). "Seismic performance evaluation of r c-framed buildings - an approach to torsionally asymmetric buildings", IOSR Journal of Engineering, 02(07), 01–12.

Kumar, P. V., et al. "Behavior of P-Delta Effect in High- Rise Buildings with and without Shear Wall." International Journal of Recent Technology and Engineering, no. 2, Blue Eyes Intelligence Engineering and Sciences Engineering and Sciences Publication-BEIESP July 2019, pp 2060-68 cross ref doi:10.35940/ijrte.b2282.078219

Lindeburg, M.R., & Baradar, M. (2001). Seismic Design of Building Structures: A Professional's Introduction to Earthquake Forces and Design Details (8th ed.). Professional Publications, Inc. Belmont, CA.

Bulent's Blog - Bentley Colleague Blogs - Bentley Communities. (n.d.). Retrieved September 11, 2021. Modification to current p-delta implementation for rigid diaphragms (RAM Frame, Release 14.02).

Moghadam, A. S., & Aziminejad, A. (2004). Interaction of torsion and p-delta effects in tall buildings, 13th World Conference on Earthquake Engineering, Vancouver, Canada.

Nilson, A. H., Darwin, D., & Dolan, C. W. (2003). Design of Concrete Structures (13th ed.). McGraw-Hill Companies.

Ozhendekci, N., & Z., Polat (2008). Torsional irregularity of buildings. The 14th World Conference on Earthquake Engineering, Beijing, China.

PEER/ATC (2010). Modeling and acceptance criteria for seismic design and analysis of tall buildings, PEER/ATC 72-1 Report. Redwood City, CA: Applied Technology Council.

Powell, G. H. (2010). Modeling for Structural Analysis: Behavior and Basics (1st ed.).

Schueller, W. (1977). High-rise Building Structures, John Wiley & Sons.

Smith, B. S., & Coull, A. (1991). Tall Building Structures. Wiley-Interscience.

Verney, P. (1979). The Earthquake Handbook (1st ed.). Paddington Press.

APPENDIX A

ETABS MODELING OF BUILDING

Step 1:

1) Open ETABS 9.7.1 application

2) Click the File menu and choose to create a New Model option from there.

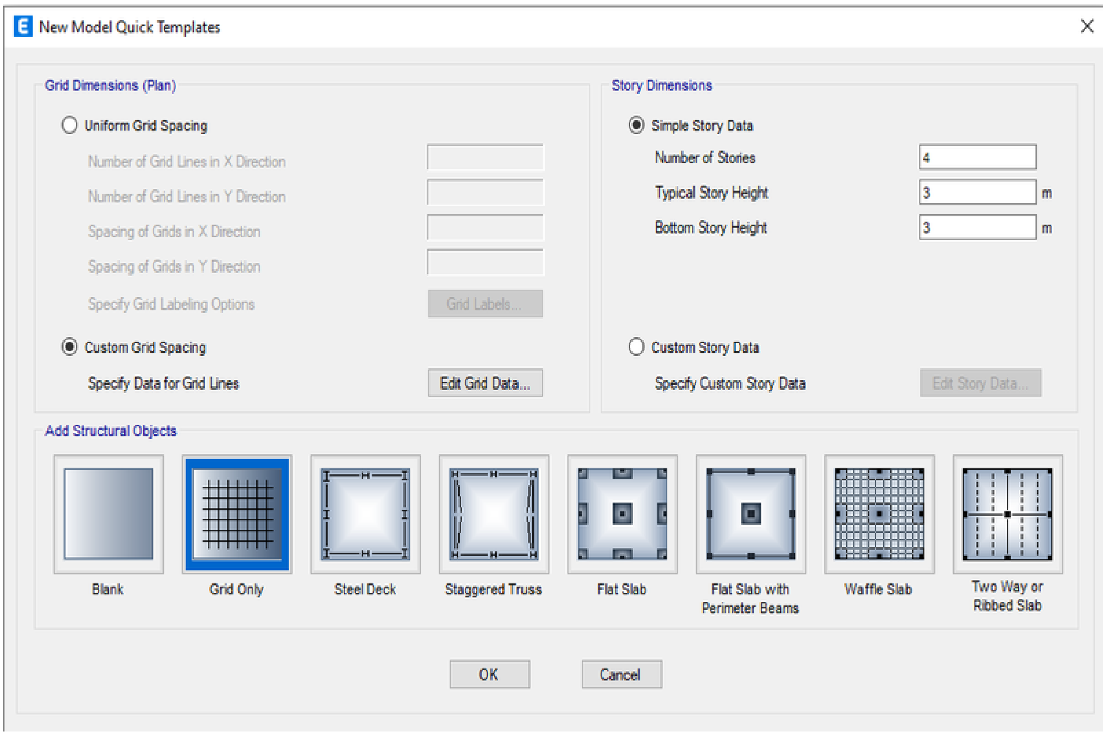
3) After choosing a new model a dialogue box will appear which is known as Model Initialization.

4) Choose the Built-in settings option and select the display units and codes.

Step 2:

1) After the model initialization needs to select Grid and Story inputs from the new model quick templates dialogue box.

2) In this dialogue box choose custom grid spacing and custom story data which is used to provide the inputs whatever we want.

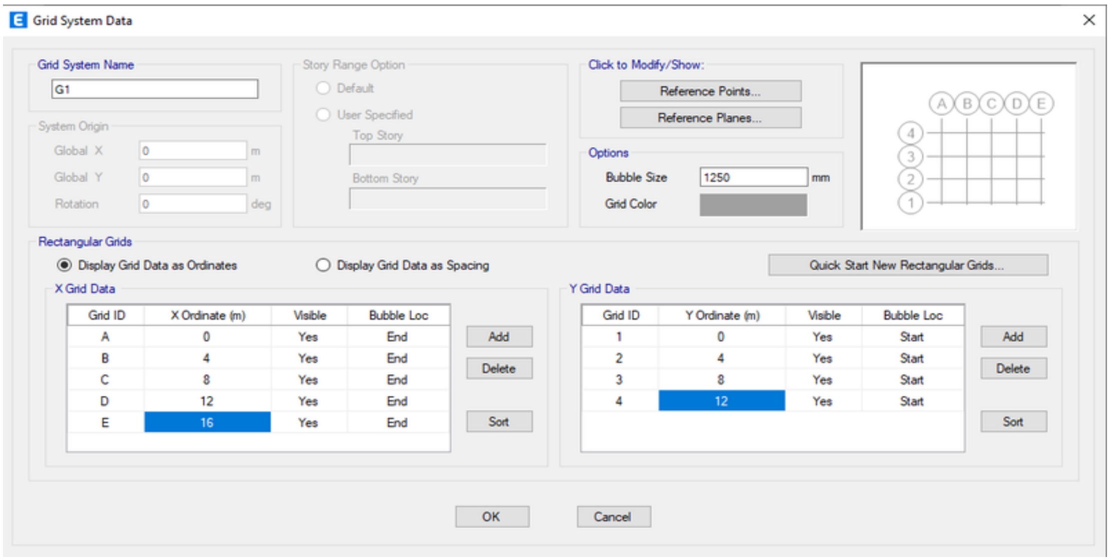


Step 3:

1) In the Grid system data dialogue box, set x grid data as needed.

2) And also set Y grid data as the drawing needed.

3) Click OK



Step 4:

1) In a story data dialogue box, need to input all the relevant details about the story which we want to model.

2) Click add a story and add more desired story.

3) Put story height for all the story except plinth

4) Make 1st story as Master story

5) Choose all other stories as similar to 1st story

6) Click OK.

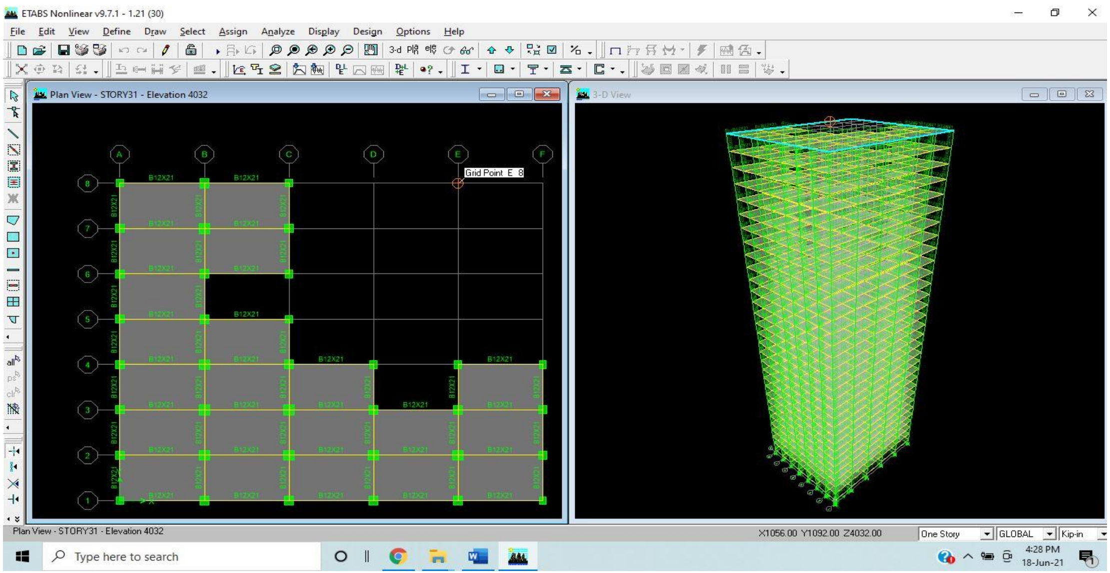
Step 5:

1) On the top right corner click the drop-down arrow

2) Choose New window option

3) Now the screen splits into two.

4) Here, we can see the plan and elevation of each story simultaneously.



Step 6:

Applying Properties to Materials

1) Click Define tab

2) Choose Material properties

Step 7:

1) After selecting Material Properties from the define tab, a dialogue box will appear. In this dialogue box Select required specifications.

2) Similarly choose all other inputs like Material type, standard, grade accordingly.

Step 8:

1) After applying the properties of Beams and columns we need to apply the property of Slab

2) Click Define menu and choose Section properties

3) Select Slab Sections

4) Click to select Add New Property

Step 9:

1) Rename the Property name

2) Select the material.

3) Choose modeling type as Membrane from the drop-down list

Step 10:

Drawing of Columns and Beams:

1) To drawing the columns and beams in Etabs just click the Quickdraw columns tool in the model tree

2) After clicking the tool, the property tab will appear on that tab all the relevant detail about the particular objects will show.

Step 11:

1) Draw the Columns in accordance with the grids

2) Click the Select object tool to discard the drawing.

Step 12:

Applying Loads:

1) Click Define tab

2) Choose Load Patterns.

Step 13:

1) Add new load as Brick wall, EQX with both positive and negative eccentricity as per IBC2006

2) Similarly add EQY with positive and negative eccentricity

3) Similarly add wind load Wx and Wy .

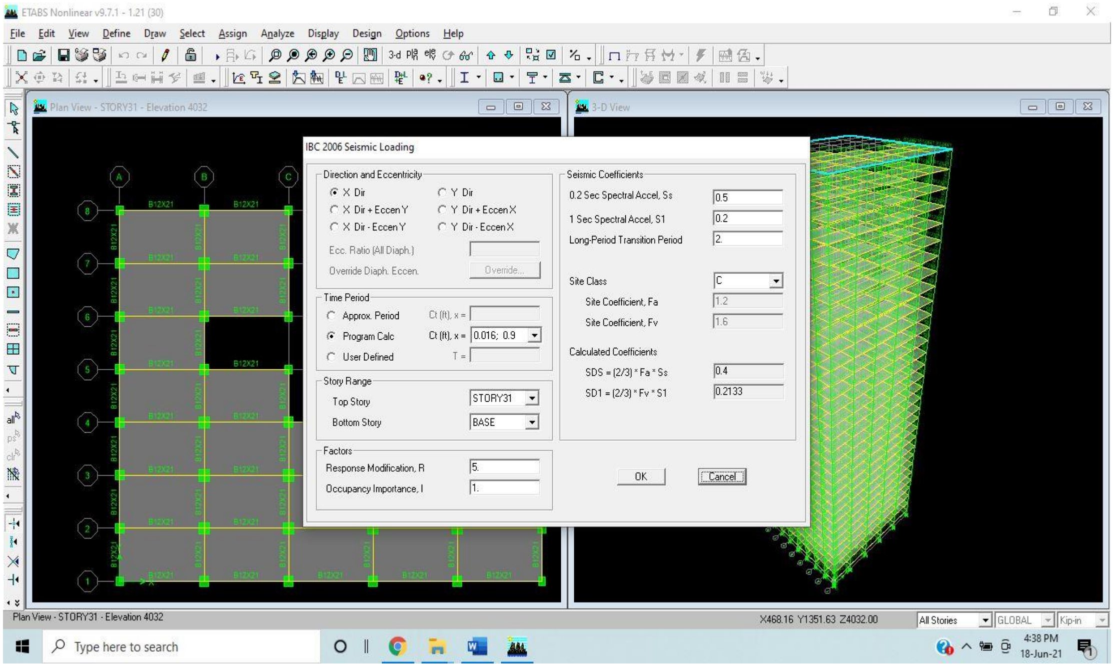
Step 14:

1) After providing the names and codes of load

2) Click Modify Lateral load option

3) Set story rage as a base to top.

4) Assume others values according to BNBC 2020.



Step 15:

1) After providing the load inputs need to assign the shell loads of each story

2) Change tab as Similar story

3) Select the entire grids

4) Click the Assign tab and choose Shell loads

5) Select Uniform load.

6) Choose the load pattern name as already set in the previous step.

7) Click ok

8) Similarly, we need to assign the live loads for all the beams and slab.

9) Click the Select tab

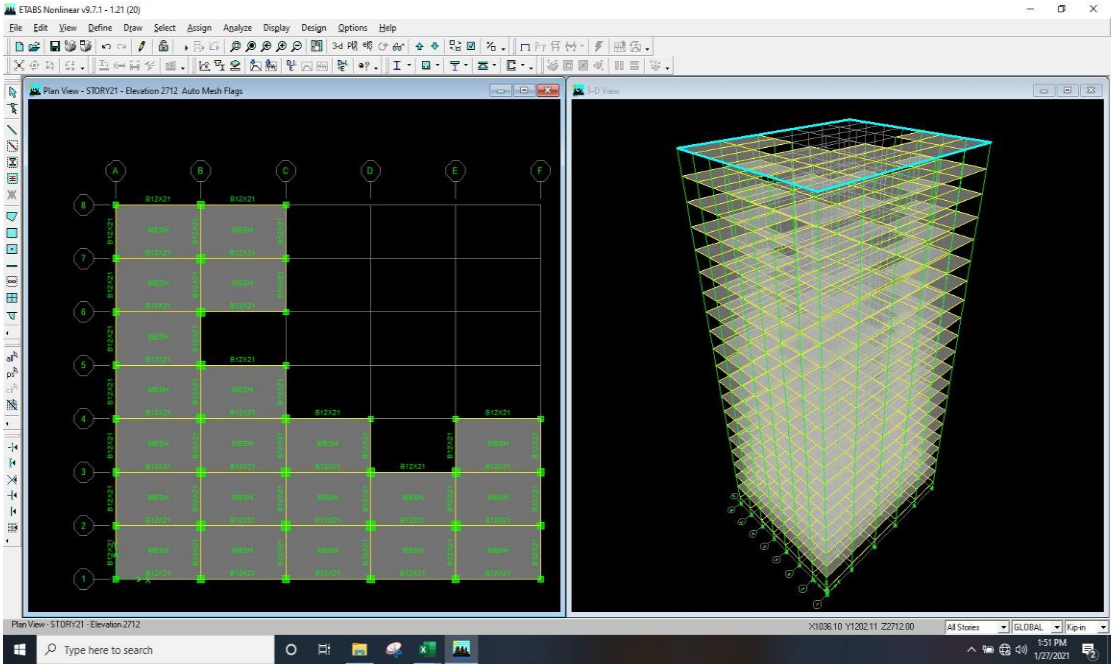
10) Choose object type and select Beam

11) Choose the load pattern name from the drop-down list

12) Set load

13) Click Ok

14) Now we can see the loads applied.



Step 16:

1) Before running the analysis we have to set one more step i.e., Mass Source

2) Go to the Define tab

3) Select the Mass Source option.

4) Tick marks the specified load patterns

5) Add the load patterns which we want to assign the model

6) Click Ok

Step 17:

1) One of the important steps for modeling is to set load combination

2) Click the Define tab

3) Select Load Combinations

Step 18:

1) Choose the load combination

2) Select Concrete frame design

3) Click Ok

Step 19:

1) Immediately ETABS will give you various load combinations as per the code which we are set previously.

2) Click Ok

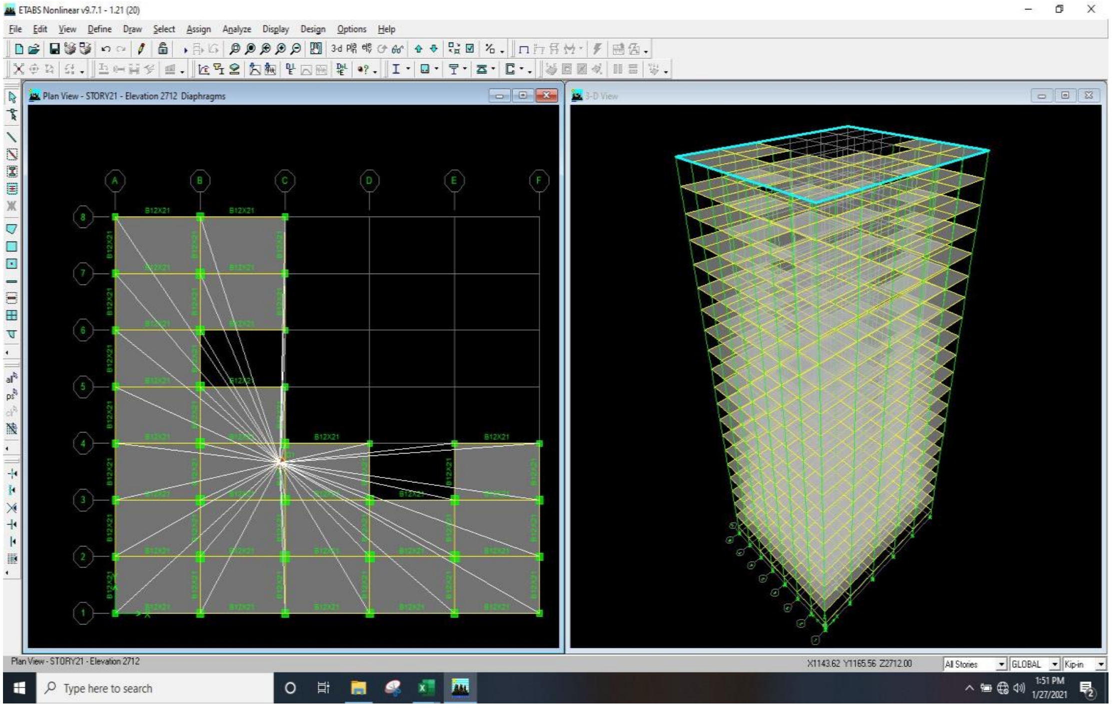
Step 20:

1) Final step of analysis is to set Diaphragm

2) Click the Assign tab

3) Choose shell and select Diaphragm.

4) Choose an all-story option from the bottom of the screen



Step 21:

1) Click the check tab

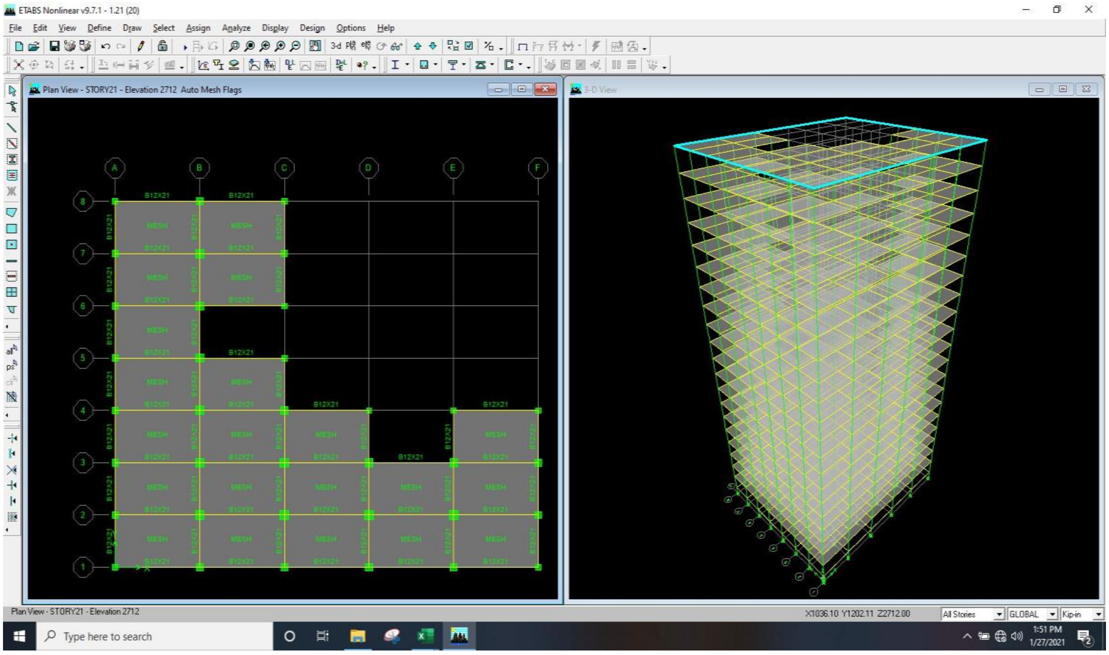
2) And check the model is there any mistakes. If not go ahead the analysis.

Step 22:

1) Select all slabs.

2) Assign Area object mesh option.

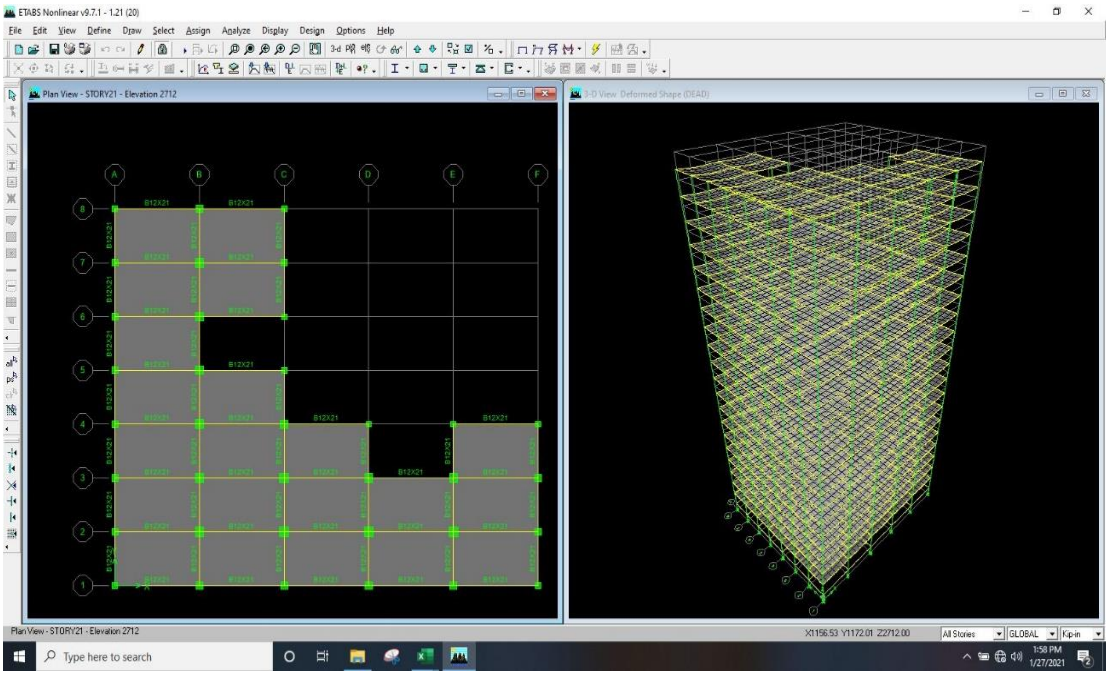
3) Complete auto meshing.



Step 23:

1) Select Analyze.

2) Click Run Analysis.

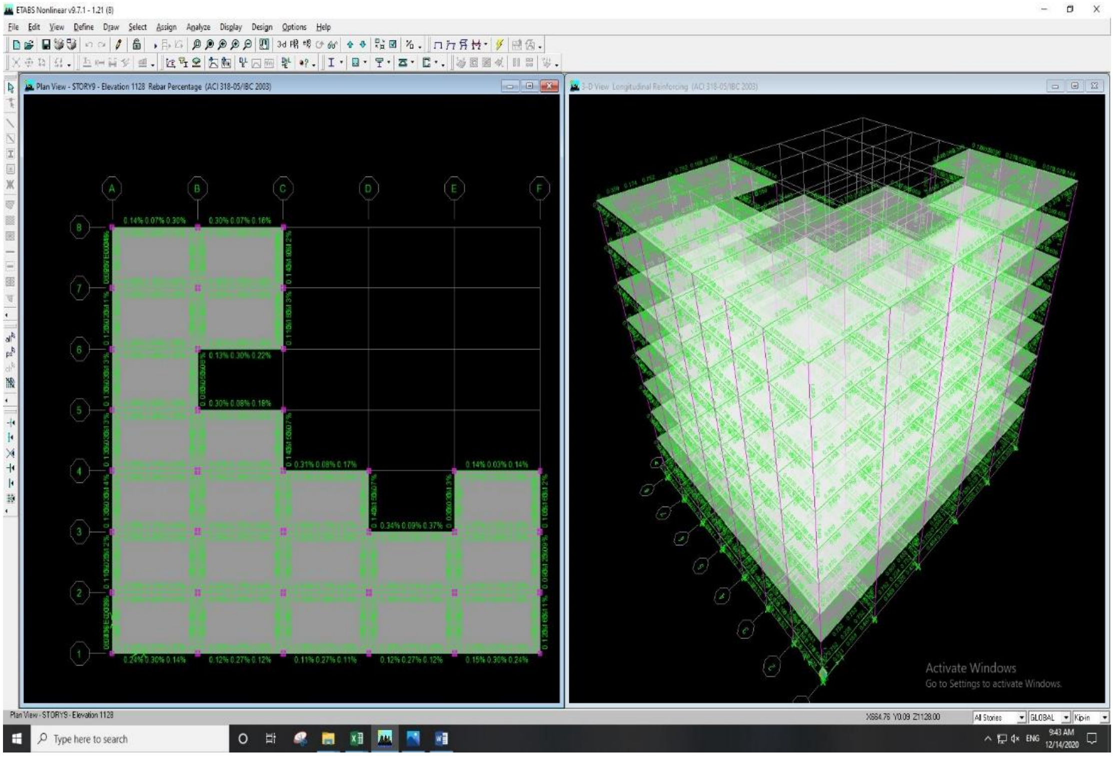


Step 24:

1) Select Design.

2) Select Concrete frame design.

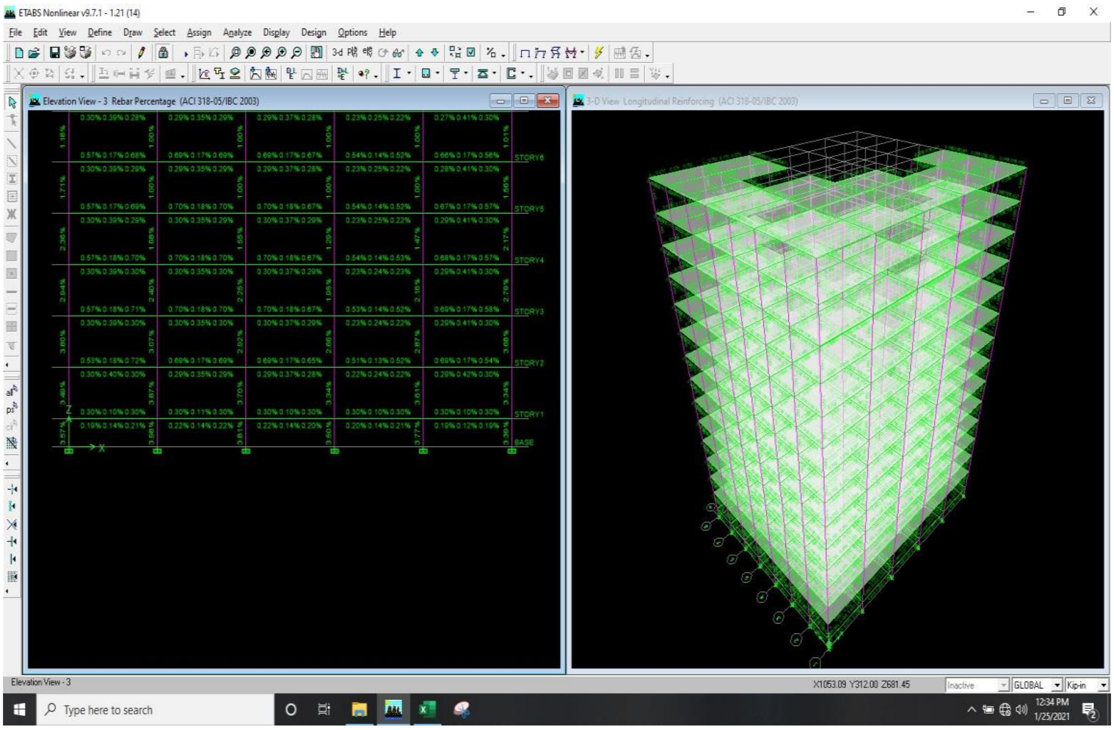
3) Click Start Design.



Step 25:

1) Check if the design is perfect or not.

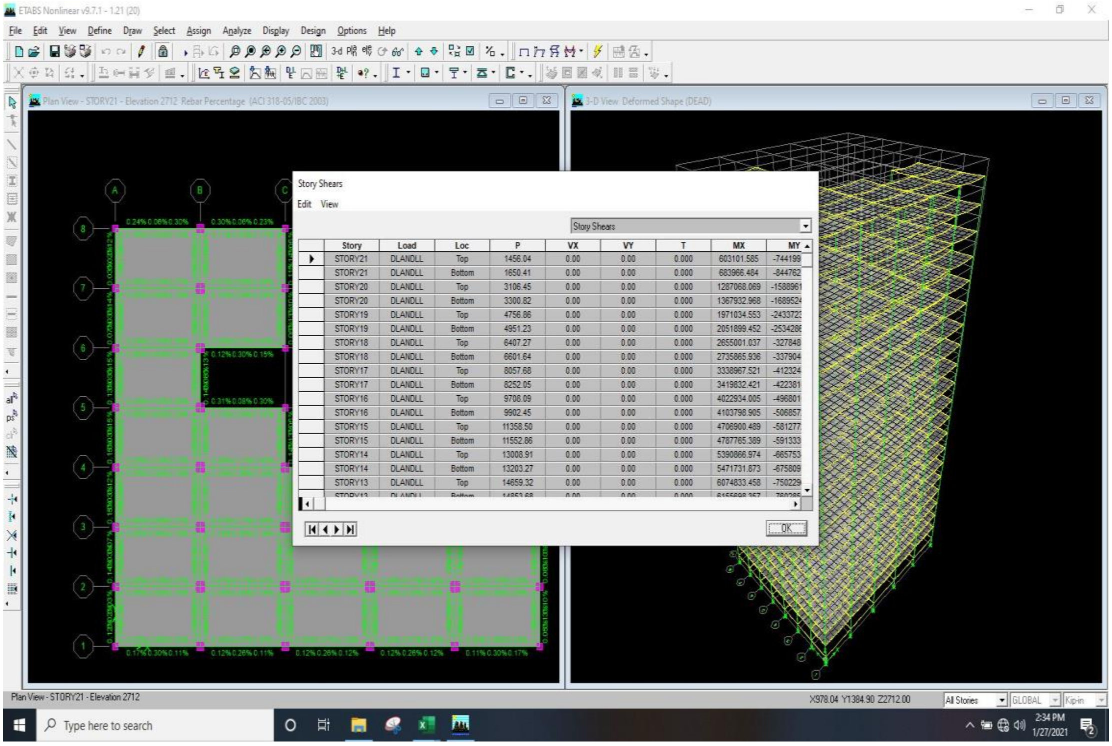
2) Check rebar percentage of all columns which should be less than 6%.



Step 26:

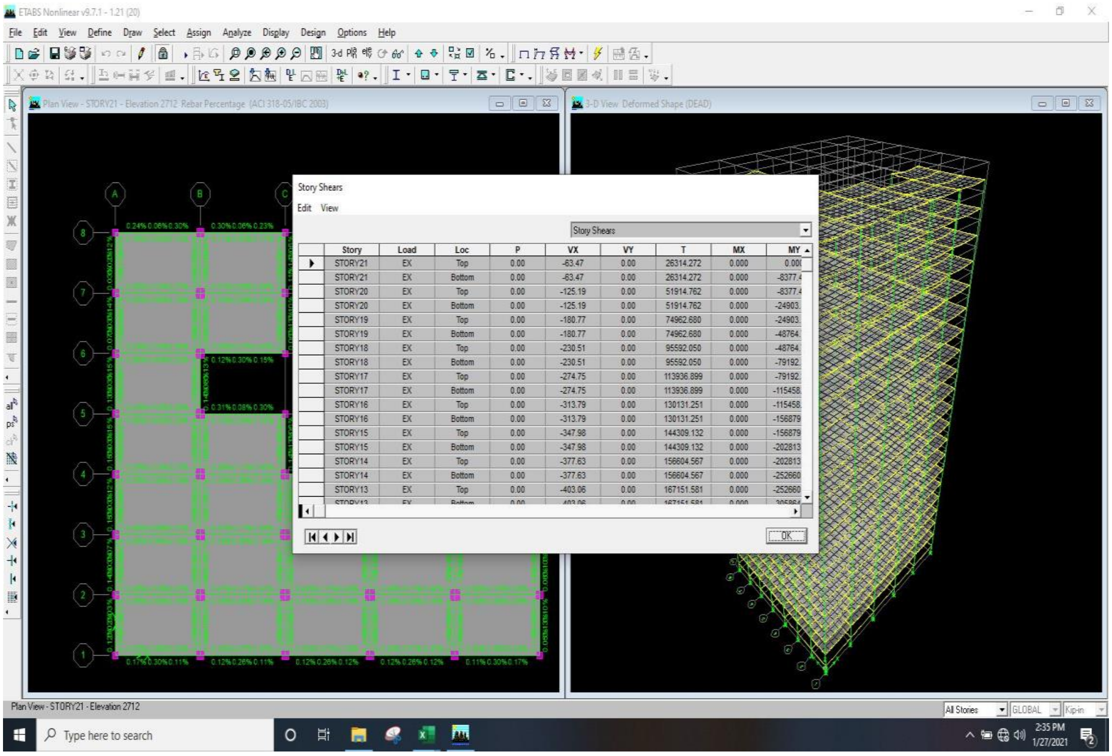
1) Go to display and click show table.

2) Select tables for story share and story drift and copy them.



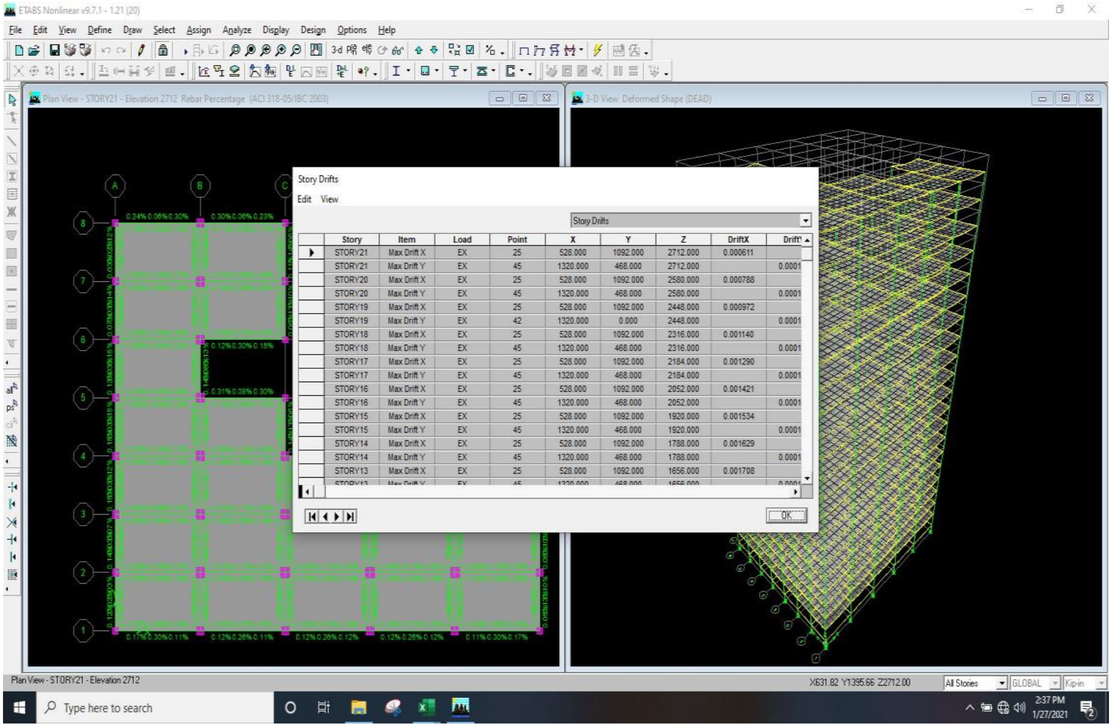
Story Shears

	Story	Load	Loc	P	VX	VY	T	MX	MY
▶	STORY21	DLANDLL	Top	1456.04	0.00	0.00	0.000	603101.585	-744199
	STORY21	DLANDLL	Bottom	1650.41	0.00	0.00	0.000	683966.484	-844762
	STORY20	DLANDLL	Top	3106.45	0.00	0.00	0.000	1287068.069	-1588961
	STORY20	DLANDLL	Bottom	3300.82	0.00	0.00	0.000	1367932.968	-1689524
	STORY19	DLANDLL	Top	4756.86	0.00	0.00	0.000	1971034.553	-2433723
	STORY19	DLANDLL	Bottom	4951.23	0.00	0.00	0.000	2051899.452	-2534286
	STORY18	DLANDLL	Top	6407.27	0.00	0.00	0.000	2655001.037	-327848
	STORY18	DLANDLL	Bottom	6601.64	0.00	0.00	0.000	2735865.936	-337904
	STORY17	DLANDLL	Top	8057.68	0.00	0.00	0.000	3338967.521	-412324
	STORY17	DLANDLL	Bottom	8252.05	0.00	0.00	0.000	3419832.421	-422381
	STORY16	DLANDLL	Top	9708.09	0.00	0.00	0.000	4022934.005	-496801
	STORY16	DLANDLL	Bottom	9902.45	0.00	0.00	0.000	4103798.905	-506857
	STORY15	DLANDLL	Top	11358.50	0.00	0.00	0.000	4706900.489	-581277
	STORY15	DLANDLL	Bottom	11552.86	0.00	0.00	0.000	4787765.389	-591333
	STORY14	DLANDLL	Top	13008.91	0.00	0.00	0.000	5390866.974	-665753
	STORY14	DLANDLL	Bottom	13203.27	0.00	0.00	0.000	5471731.873	-675809
	STORY13	DLANDLL	Top	14659.32	0.00	0.00	0.000	6074833.458	-750229



Story Shears

	Story	Load	Loc	P	VX	VY	T	MX	MY
▶	STORY21	EX	Top	0.00	-63.47	0.00	26314.272	0.000	0.000
	STORY21	EX	Bottom	0.00	-63.47	0.00	26314.272	0.000	-8377.4
	STORY20	EX	Top	0.00	-125.19	0.00	51914.762	0.000	-8377.4
	STORY20	EX	Bottom	0.00	-125.19	0.00	51914.762	0.000	-24903.
	STORY19	EX	Top	0.00	-180.77	0.00	74962.680	0.000	-24903.
	STORY19	EX	Bottom	0.00	-180.77	0.00	74962.680	0.000	-48764.
	STORY18	EX	Top	0.00	-230.51	0.00	95592.050	0.000	-48764.
	STORY18	EX	Bottom	0.00	-230.51	0.00	95592.050	0.000	-79192.
	STORY17	EX	Top	0.00	-274.75	0.00	113936.899	0.000	-79192.
	STORY17	EX	Bottom	0.00	-274.75	0.00	113936.899	0.000	-115458.
	STORY16	EX	Top	0.00	-313.79	0.00	130131.251	0.000	-115458.
	STORY16	EX	Bottom	0.00	-313.79	0.00	130131.251	0.000	-156879
	STORY15	EX	Top	0.00	-347.98	0.00	144309.132	0.000	-156879
	STORY15	EX	Bottom	0.00	-347.98	0.00	144309.132	0.000	-202813
	STORY14	EX	Top	0.00	-377.63	0.00	156604.567	0.000	-202813
	STORY14	EX	Bottom	0.00	-377.63	0.00	156604.567	0.000	-252660
	STORY13	EX	Top	0.00	-403.06	0.00	167151.581	0.000	-252660


ETABS Nonlinear v9.7.1 - 1.21 (20)
File Edit View Define Draw Select Assign Analyze Display Design Options Help
Plan View - STORY21 - Elevation 2712 Rebar Percentage (ACI 318-05/IBC 2003)
3-D View Deformed Shape (DEAD)
Story Drifts
Edit View
Story Drifts
Story Item Load Point X Y Z DriftX DriftY
STORY21 Max Drift X EX 25 528.000 1092.000 2712.000 0.000611
STORY21 Max Drift Y EX 45 1320.000 468.000 2712.000 0.0001
STORY20 Max Drift X EX 25 528.000 1092.000 2580.000 0.000788
STORY20 Max Drift Y EX 45 1320.000 468.000 2580.000 0.0001
STORY19 Max Drift X EX 25 528.000 1092.000 2448.000 0.000972
STORY19 Max Drift Y EX 42 1320.000 0.000 2448.000 0.0001
STORY18 Max Drift X EX 25 528.000 1092.000 2316.000 0.001140
STORY18 Max Drift Y EX 45 1320.000 468.000 2316.000 0.0001
STORY17 Max Drift X EX 25 528.000 1092.000 2184.000 0.001290
STORY17 Max Drift Y EX 45 1320.000 468.000 2184.000 0.0001
STORY16 Max Drift X EX 25 528.000 1092.000 2052.000 0.001421
STORY16 Max Drift Y EX 45 1320.000 468.000 2052.000 0.0001
STORY15 Max Drift X EX 25 528.000 1092.000 1920.000 0.001534
STORY15 Max Drift Y EX 45 1320.000 468.000 1920.000 0.0001
STORY14 Max Drift X EX 25 528.000 1092.000 1788.000 0.001629
STORY14 Max Drift Y EX 45 1320.000 468.000 1788.000 0.0001
STORY13 Max Drift X EX 25 528.000 1092.000 1656.000 0.001708
OK
Plan View - STORY21 - Elevation 2712
X631.82 Y1395.66 Z2712.00
All Stories
GLOBAL
Kip-in
Type here to search
2:37 PM
1/27/2021

APPENDIX B

Modeling with Frame and Shell Element Using ETABS

The physical structural members in a structural model are represented by objects. The geometry of an object is assigning properties and loads to the object to completely define the model of the physical member. For analysis purpose ETABS converts each object into one or more elements. The term element will be used more often than object, since what is described herein is the Etabs analysis portion of the program that operates on the element-based analysis model. However, it should be clear that the properties described here for elements are actually assigned in the interface to the objects and the conversion to analysis elements is automatic.

The Frame element is a very powerful element that can be used to model beams, columns, braces, and trusses in planar and three-dimensional structures. It includes the effects of biaxial bending, torsion, axial deformation, and bi axial shear deformations. The Shell element is a type of area object that is used to model membrane, plate, and shell behavior in planar and three-dimensional structures. The Shell element is a three or four node formulation that combines membrane and plate bending behavior.

Frame Element

The Frame element is used to model beam-column and truss behavior in planar and three-dimensional structures. The Frame element can also be used to model cable behavior when nonlinear properties are added (e.g., tension only, large deflections). This element will often be referred to simply as the frame element, although it can always be used for cable analysis. The Frame element uses a general, three-dimensional, beam-column formulation which includes the effects of biaxial bending, torsion, axial deformation, and biaxial shear deformations (Wilson, 1976).

A Frame element is modeled as a straight line connecting two points. In the graphical user interface, you can divide curved objects into multiple straight objects, subject to your specification. Each element has its own local coordinate system (Figure E.1) for defining section properties and loads, and for interpreting output.

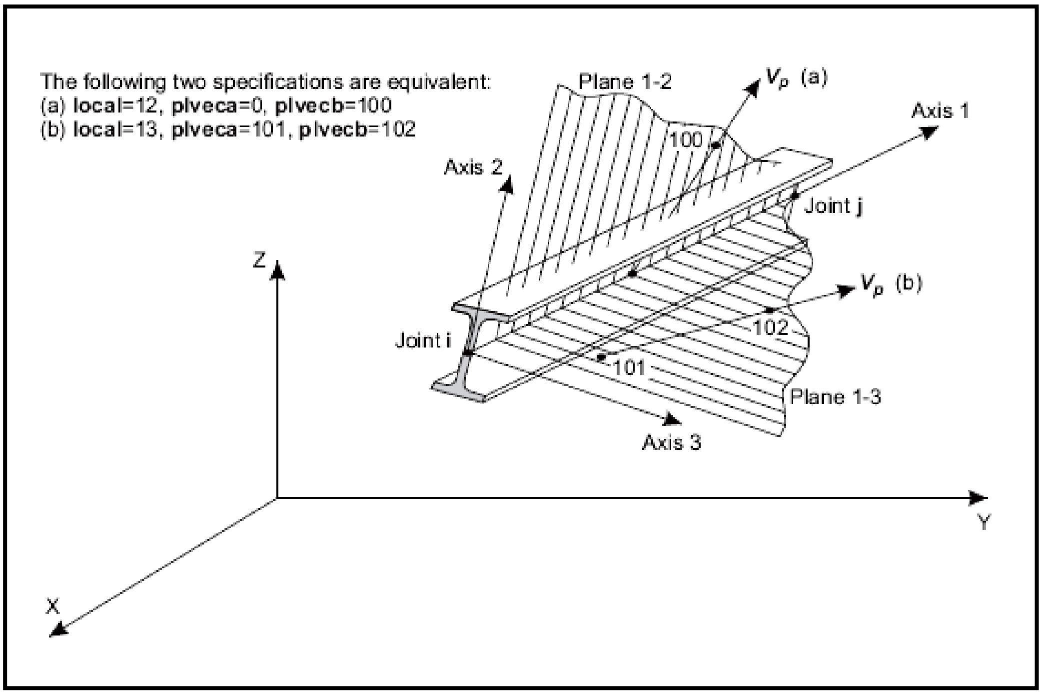


Figure E.1: Frame element in local coordinate system

The element may be prismatic or non-prismatic. The non-prismatic formulation lows the element length to be divided into any number of segments over which properties may vary. The variation of the bending stiffness may be linear, parabolic, or cubic over each segment of length. The axial, shear, tensional, mass, and weight properties all vary linearly over each segment.

Insertion points and end offsets are available to account for the finite size of beam and column intersections. The end of sets may be made partially or fully rigid to model the stiffening effect that can occur when the ends of an element are embedded inbeam and column intersections. End releases are also available to model different fixity conditions at the ends of the element. Each Frame element may be loaded by gravity (in any direction), multiple concentrated loads, multiple distributed loads, strain loads, and loads due to temperature change (Figure E.2).

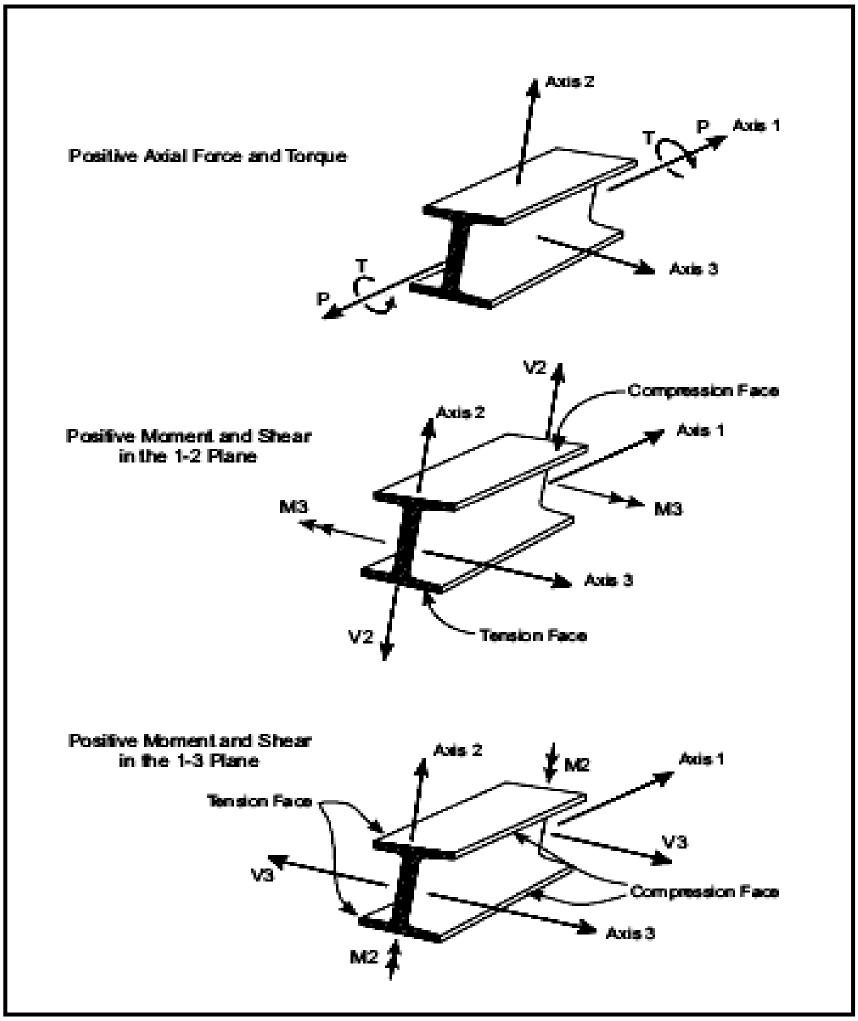


Figure E.2: Frame elements with internal force

Element internal forces are produced at the ends of each element and at a user specified number of equally spaced output stations along the length of the element. Cable behavior is modeled using the frame element and adding the appropriate features.

The Shell Element

The Shell element is used to model shell, membrane, and plate behavior in planar and three-dimensional structures. The shell element is one type of area object. Depending on the type of section properties, the object could also be used to model plane stress/strain and asymmetric solid behavior. The Shell element is a three - or four - node formulation that combines separate membrane and plate- bending behavior. A shell element with three nodes is given below (Figure E.3).

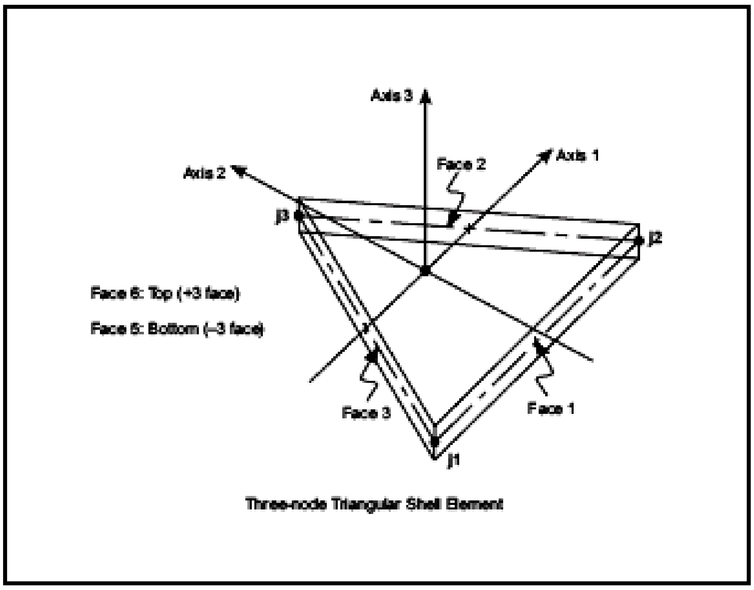


Figure E.3: Shell elements with three nodes

The four- joint element does not have to be planar (Figure E.4). The membrane behavior uses an isoperimetric formulation that includes translational in-plane stiffness components and a rotational stiffness component in the neither direction normal to the plane of the element (Taylor 1985, and Ibrahim 1991).

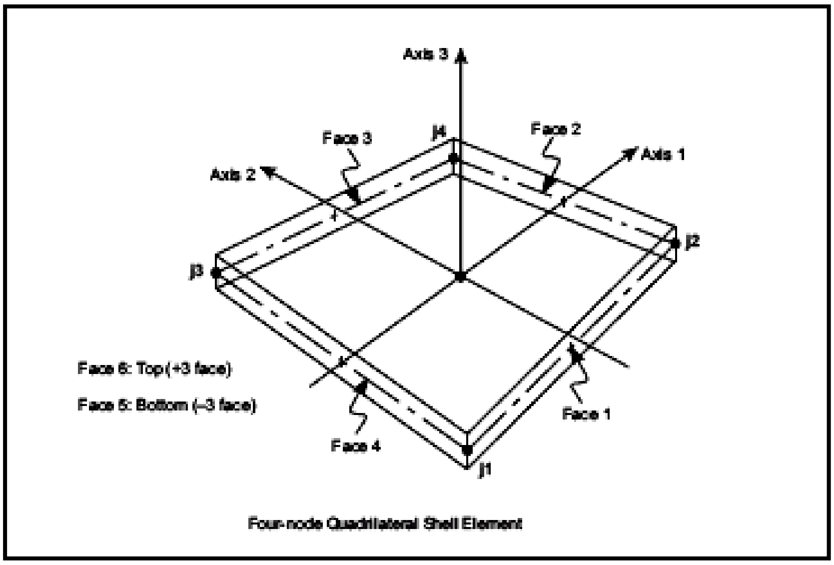


Figure E.4: Shell elements with four nodes

The plate bending behavior includes two-way, out-of-plane, plate rotational stiffness components and a translational stiffness component in the direction normal to the plane of the element. By default, a thin-plate (Kirchhoff) formulation is used that neglects transverse shearing deformation. Optionally, may choose a thick-plate formulation which includes the effects of transverse shearing deformation. Structures that can be modeled with this element include:

a) Three- dimensional shells, such as tanks and domes
b) Plate structures, such as floor slabs
c) Membrane structures, such as shear walls

For each Shell element in the structure, choose to model pure membrane, pure plate,or full shell behavior. It is generally recommended that use the full shell behavior unless the entire structure is planar and is adequately restrained.

Each Shell element has its own local coordinate system for defining material properties and loads (Figure E.5) and for interpreting output. Temperature- dependent,orthotropic material properties are allowed. Each element may be loaded by gravity and uniform loads in any direction; surface pressure on the top, bottom and side faces;and loads due to temperature change.

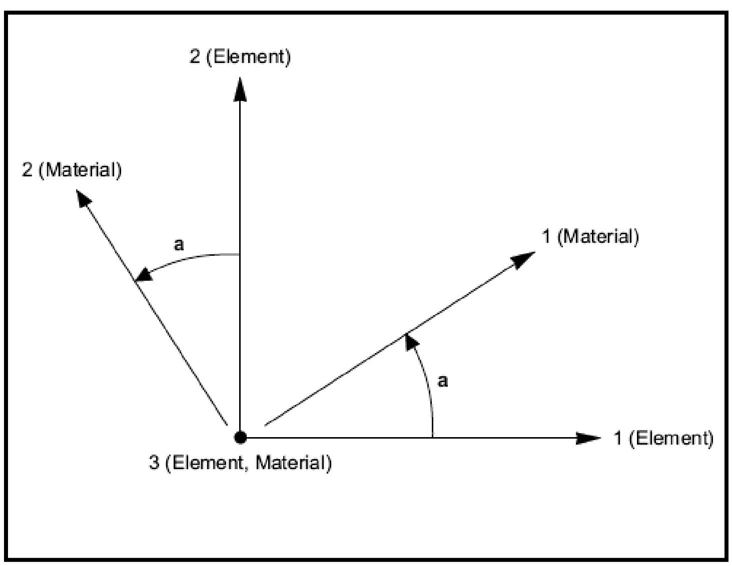


Figure E.5: Shell elements local coordinate with materials

A variable, four-to-eight-point numerical integration formulation is used for the Shell stiffness. Stresses and internal forces and moments, in the element local coordinate system, are evaluated at the 2- by-2 Gauss integration points and extrapolated to the joints of the element. An approximate error in the element stresses or internal forces can be estimated from the difference in values calculated from different elements attached to a common joint. This will give an indication of the accuracy of a given finite- element approximation and can then be used as the basis for the selection of a new and more accurate finite element mesh (Figure E.6).

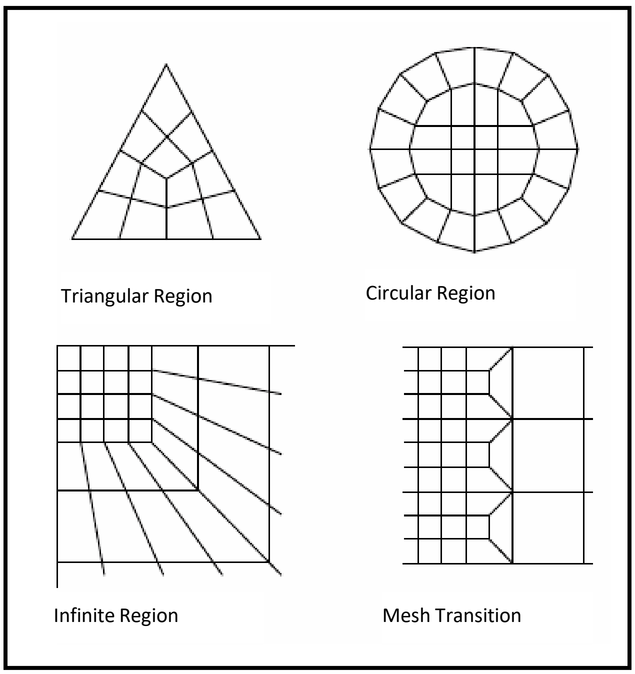


Figure E.6: Shell elements with mesh

The Plane Element

The Plane element is used to model plane-stress and plane-strain behavior in two-dimensional solids. The Plane element is one type of area object. Depending on the type of section properties assign to an area, the object could also be used to model shell and ax symmetric solid behavior.

The Plane element is a three- or four-node element for modeling two-dimensional solids of uniform thickness. It is based upon an isoperimetric formulation that includes four optional in compatible bending modes. The element should be planar; if it is not, it is formulated for the projection of the element upon an average plane calculated for the element. The incompatible bending modes significantly improve the bending behavior of the element if the element geometry is of a rectangular form. Improved behavior is exhibited even with non-rectangular geometry. Structures that can be modeled with this element include:

a) Thin, planar structures in a state of plane stress
b) Long, prismatic structures in a state of plane strain

The stresses and strains are assumed not to vary in the thickness direction. For plane- stress, the element has no out-of-plane stiffness. For plane-strain, the element can support loads with anti-plane shear stiffness. Each Plane element has its own local coordinate system for defining material properties and loads, and for interpreting output. Temperature dependent, orthotropic material properties are allowed. Each element may be loaded by gravity (in any direction); surface pressure on the side faces; pore pressure within the element; and loads due to temperature change.

APPENDIX C

Sl. No.	Description	Value
1	Building Length	110'-0"
2	Building Width	91'-0"
3	Building Area	10010 Sft
4	Aspect Ratio (L/W)	1.21
5	Grid in X-Direction	6
6	Grid in Y-Direction	8
7	X-Direction Grid Spacing	22'-0"
8	Y-Direction Grid Spacing	13'-0"
9	Base Height	6'-0"
10	Typical Floor Height	11'
11	No. of Column	48
12	Beam Section	12"X24"
13	Slab Thickness	6"
14	Column Concrete Strength	4000 Psi
15	Beam Concrete Strength	4000 Psi
16	Slab Concrete Strength	3500 Psi
17	Rebar Size	#5 to #8
18	Clear Cover from Rebar Center	2.2"
19	Rebar Yield Strength, Fy	60 Ksi
20	Maximum Rebar (%) Allowed	6%
21	FF Load	25 lb-ft
22	PW Load	50 lb-ft
23	LIVE Load	50 lb-ft
24	Ct	0.016
25	Response Modiffication Factor, R	5
26	Occupancy Importance, I	1
27	0.2 Sec Spectral Accel, Ss	0.5
28	1 Sec Spectral Accel, S1	0.2
29	Transition Period, T	2 Sec
30	Tb	0.2 Sec
31	Td	2.0 Sec
32	Site Class	SC
33	Deflection Amplification Factor, Cd	4.5
34	System Overstrength Factor, Ὼ	3
35	Building Category	C
36	External Pressure Co-efficient, Windward, Cp	0.8
37	External Pressure Co-efficient, Leeward, Cp	0.5
38	For Wind Load, Exposure type	B
39	Wind Speed, V	147 mile/hour
40	Number of load combination used	23

General Information of Symmetric Building with aspect ratio (L/W) 1.21

Sl. No.	Description	Value
1	Building Length	180'-0"
2	Building Width	54'-0"
3	Building Area	9720 Sft
4	Aspect Ratio (L/W)	3.33
5	Grid in X-Direction	10
6	Grid in Y-Direction	4
7	X-Direction Grid Spacing	20'-0"
8	Y-Direction Grid Spacing	18'-0"
9	Base Height	6'-0"
10	Typical Floor Height	11'
11	No. of Column	40
12	Beam Section	12"X24"
13	Slab Thickness	6"
14	Column Concrete Strength	4000 Psi
15	Beam Concrete Strength	4000 Psi
16	Slab Concrete Strength	3500 Psi
17	Rebar Size	#5 to #8
18	Clear Cover from Rebar Center	2.2"
19	Rebar Yield Strength, Fy	60 Ksi
20	Maximum Rebar (%) Allowed	6%
21	FF Load	25 lb-ft
22	PW Load	50 lb-ft
23	LIVE Load	50 lb-ft
24	Ct	0.016
25	Response Modification Factor, R	5.5
26	Occupancy Importance, I	1
27	0.2 Sec Spectral Accel, Ss	0.5
28	1 Sec Spectral Accel, S1	0.2
29	Transition Period, T	2 Sec
30	Tb	0.2 Sec
31	Td	2.0 Sec
32	Site Class	SC
33	Deflection Amplification Factor, Cd	4.5
34	System Overstrength Factor, Ὠ	3
35	Building Category	C
36	External Pressure Co-efficient, Windward, Cp	0.8
37	External Pressure Co-efficient, Leeward, Cp	0.3
38	For Wind Load, Exposure type	B
39	Wind Speed, V	147 mile/hour
40	Number of load combination used	23

General Information of Symmetric Building with aspect ratio (L/W) 3.33

Sl. No.	Description	Value
1	Building Length	250'-0"
2	Building Width	42'-0"
3	Building Area	10500 Sft
4	Aspect Ratio (L/W)	5.95
5	Grid in X-Direction	11
6	Grid in Y-Direction	4
7	X-Direction Grid Spacing	25'-0"
8	Y-Direction Grid Spacing	14'-0"
9	Base Height	6'-0"
10	Typical Floor Height	11'
11	No. of Column	44
12	Beam Section	12"X24"
13	Slab Thickness	6"
14	Column Concrete Strength	4000 Psi
15	Beam Concrete Strength	4000 Psi
16	Slab Concrete Strength	3500 Psi
17	Rebar Size	5# to 8#
18	Clear Cover from Rebar Center	2.2"
19	Rebar Yield Strength, Fy	60 Ksi
20	Maximum Rebar (%) Allowed	6%
21	FF Load	25 lb-ft
22	PW Load	50 lb-ft
23	LIVE Load	50 lb-ft
24	Ct	0.016
25	Response Modification Factor, R	5.5
26	Occupancy Importance, I	1
27	0.2 Sec Spectral Accel, Ss	0.5
28	1 Sec Spectral Accel, S1	0.2
29	Transition Period, T	2 Sec
30	Tb	0.2 Sec
31	Td	2.0 Sec
32	Site Class	SC
33	Deflection Amplification Factor, Cd	4.5
34	System Overstrength Factor, ٰΩ	3
35	Building Category	C
36	External Pressure Co-efficient, Windward, Cp	0.8
37	External Pressure Co-efficient, Leeward, Cp	0.2
38	For Wind Load, Exposure type	B
39	Wind Speed, V	147 mile/hour
40	Number of load combination used	23

General Information of Symmetric Building with aspect ratio (L/W) 5.95

Sl. No.	Description	Value
1	Building Length	110'-0"
2	Building Width	91'-0"
3	Building Area	10010 Sft
4	Aspect Ratio (L/W)	1.21
5	Grid in X-Direction	6
6	Grid in Y-Direction	8
7	X-Direction Grid Spacing	22'-0"
8	Y-Direction Grid Spacing	13'-0"
9	Base Height	6'-0"
10	Typical Floor Height	11'
11	No. of Column	36
12	Beam Section	12"X24"
13	Slab Thickness	6"
14	Column Concrete Strength	4000 Psi
15	Beam Concrete Strength	4000 Psi
16	Slab Concrete Strength	3500 Psi
17	Rebar Size	#5 to #8
18	Clear Cover from Rebar Center	2.2"
19	Rebar Yield Strength, Fy	60 Ksi
20	Average Rebar (%) Allowed	6.00%
21	FF Load	25 lb-ft
22	PW Load	50 lb-ft
23	LIVE Load	50 lb-ft
24	Ct	0.016
25	Response Modification Factor, R	5
26	Occupancy Importance, I	1
27	0.2 Sec Spectral Accel, Ss	0.5
28	1 Sec Spectral Accel, S1	0.2
29	Transition Period, T	2 Sec
30	Tb	0.2 Sec
31	Td	2.0 Sec
32	Site Class	SC
33	Deflection Amplification Factor, Cd	4.5
34	System Overstrength Factor, Ω	3
35	Building Category	C
36	External Pressure Co-efficient, Windward, Cp	0.8
37	External Pressure Co-efficient, Leeward, Cp	0.5
38	For Wind Load, Exposure type	B
39	Wind Speed, V	147 mile/hour
40	Number of load combination used	23

General Information of Asymmetric Building with aspect ratio (L/W) 1.21

Sl. No.	Description	Value
1	Building Length	180'-0"
2	Building Width	54'-0"
3	Building Area	9720 Sft
4	Aspect Ratio (L/W)	3.33
5	Grid in X-Direction	10
6	Grid in Y-Direction	4
7	X-Direction Grid Spacing	20'-0"
8	Y-Direction Grid Spacing	18'-0"
9	Base Height	6'-0"
10	Typical Floor Height	11'
11	No. of Column	33
12	Beam Section	12"X24"
13	Slab Thickness	6"
14	Column Concrete Strength	4000 Psi
15	Beam Concrete Strength	4000 Psi
16	Slab Concrete Strength	3500 Psi
17	Rebar Size	#5 to #8
18	Clear Cover from Rebar Center	2.2"
19	Rebar Yield Strength, Fy	60 Ksi
20	Maximum Rebar (%) Allowed	6%
21	FF Load	25 lb-ft
22	PW Load	50 lb-ft
23	LIVE Load	50 lb-ft
24	Ct	0.016
25	Response Modification Factor, R	5.5
26	Occupancy Importance, I	1
27	0.2 Sec Spectral Accel, Ss	0.5
28	1 Sec Spectral Accel, S1	0.2
29	Transition Period, T	2 Sec
30	Tb	0.2 Sec
31	Td	2.0 Sec
32	Site Class	SC
33	Deflection Amplification Factor, Cd	4.5
34	System Overstrength Factor, Ὠ	3
35	Building Category	C
36	External Pressure Co-efficient, Windward, Cp	0.8
37	External Pressure Co-efficient, Leeward, Cp	0.3
38	For Wind Load, Exposure type	B
39	Wind Speed, V	147 mile/hour
40	Number of load combination used	23

General Information of Asymmetric Building with aspect ratio (L/W) 3.33

Sl. No.	Description	Value
1	Building Length	250'-0"
2	Building Width	42'-0"
3	Building Area	10500 Sft
4	Aspect Ratio (L/W)	5.95
5	Grid in X-Direction	11
6	Grid in Y-Direction	4
7	X-Direction Grid Spacing	25'-0"
8	Y-Direction Grid Spacing	14'-0"
9	Base Height	6'-0"
10	Typical Floor Height	11'
11	No. of Column	36
12	Beam Section	12"X24"
13	Slab Thickness	6"
14	Column Concrete Strength	4000 Psi
15	Beam Concrete Strength	4000 Psi
16	Slab Concrete Strength	3500 Psi
17	Rebar Size	#5 to #8
18	Clear Cover from Rebar Center	2.2"
19	Rebar Yield Strength, Fy	60 Ksi
20	Maximum Rebar (%) Allowed	6%
21	FF Load	25 lb-ft
22	PW Load	50 lb-ft
23	LIVE Load	50 lb-ft
24	Ct	0.016
25	Response Modification Factor, R	5.5
26	Occupancy Importance, I	1
27	0.2 Sec Spectral Accel, Ss	0.5
28	1 Sec Spectral Accel, S1	0.2
29	Transition Period, T	2 Sec
30	Tb	0.2 Sec
31	Td	2.0 Sec
32	Site Class	SC
33	Deflection Amplification Factor, Cd	4.5
34	System Overstrength Factor, Ὠ	3
35	Building Category	C
36	External Pressure Co-efficient, Windward, Cp	0.8
37	External Pressure Co-efficient, Leeward, Cp	0.2
38	For Wind Load, Exposure type	B
39	Wind Speed, V	147 mile/hour
40	Number of load combination used	23

General Information of Asymmetric Building with aspect ratio (L/W) 5.95

APPENDIX D

Floor	Aspect Ratio (L/W)	Aspect Ratio (H/W)	Number of Story	Exterior Column Size	Interior Column Size	Vertical Design Load (P)	Story Shear (Vx)	Absolute Value (Vx)	DriftX	Design Story Drift Δ (Inch)	Floor Height (hsx)	Deflection Amplification Factor (Cd)	Stability Coefficient (θ)
STORY3	1.21	0.24	2	12X12	12X12	3210.9	27.87	27.87	0.000119	0.015708	132	1	0.013709978
STORY2	1.21	0.12	2	12X12	12X12	6421.81	80.76	80.76	0.000307	0.040524	132	1	0.024411784
STORY1	1.21	0	2	12X12	12X12	6986.97	80.76	80.76	0.00011	0.01452	132	1	0.009516675

Determination of stability coefficient (ϴ) of a 2 storied symmetric building with aspect ratio 1.21

Floor	Aspect Ratio (L/W)	Aspect Ratio (H/W)	Number of Story	Exterior Column Size	Interior Column Size	Vertical Design Load (P)	Story Shear (Vx)	Absolute Value (Vx)	DriftX	Design Story Drift Δ (Inch)	Floor Height (hsx)	Deflection Amplification Factor (Cd)	Stability Coefficient (θ)
STORY5	1.21	0.48	4	12X12	14X14	3228.06	33.28	33.28	0.000112	0.014784	132	1	0.010863663
STORY4	1.21	0.36	4	12X12	14X14	6456.12	97.84	97.84	0.000299	0.039468	132	1	0.019729966
STORY3	1.21	0.24	4	12X12	14X14	9684.19	158.87	158.87	0.000483	0.063756	132	1	0.029442083
STORY2	1.21	0.12	4	12X12	14X14	12912.25	215.73	215.73	0.000631	0.083292	132	1	0.037767718
STORY1	1.21	0	4	12X12	14X14	13486.77	215.73	215.73	0.000228	0.030096	132	1	0.014253852

Determination of stability coefficient (ϴ) of a 4 storied symmetric building with aspect ratio 1.21

Floor	Aspect Ratio (L/W)	Aspect Ratio (H/W)	Number of Story	Exterior Column Size	Interior Column Size	Vertical Design Load (P)	Story Shear (Vx)	Absolute Value (Vx)	DriftX	Design Story Drift Δ (Inch)	Floor Height (hsx)	Deflection Amplification Factor (Cd)	Stability Coefficient (θ)
STORY7	1.21	0.73	6	12X14	12X20	3250.5	37.09	37.09	0.000132	0.017424	132	1	0.011568239
STORY6	1.21	0.6	6	12X14	12X20	6501	109.8	109.8	0.000344	0.045408	132	1	0.020367432
STORY5	1.21	0.48	6	12X14	12X20	9751.5	180.08	180.08	0.000557	0.073524	132	1	0.03016207
STORY4	1.21	0.36	6	12X14	12X20	13002	247.49	247.49	0.000761	0.100452	132	1	0.039979482
STORY3	1.21	0.24	6	12X14	12X20	16252.5	311.37	311.37	0.000952	0.125664	132	1	0.0496913
STORY2	1.21	0.12	6	12X14	12X20	19503.01	371.08	371.08	0.001095	0.14454	132	1	0.057550383
STORY1	1.21	0	6	12X14	12X20	20089.77	371.08	371.08	0.000389	0.051348	132	1	0.021059935

Determination of stability coefficient (ϴ) of a 6 storied symmetric building with aspect ratio 1.21

Floor	Aspect Ratio (L/W)	Aspect Ratio (H/W)	Number of Story	Exterior Column Size	Interior Column Size	Vertical Design Load (P)	Story Shear (Vx)	Absolute Value (Vx)	DriftX	Design Story Drift Δ (Inch)	Floor Height (hsx)	Deflection Amplification Factor (Cd)	Stability Coefficient (θ)
STORY9	1.21	0.97	8	12X18	14X22	3288.78	40.11	40.11	0.000117	0.015444	132	1	0.0095933
STORY8	1.21	0.85	8	12X18	14X22	6577.56	119.16	119.16	0.000285	0.03762	132	1	0.015731828
STORY7	1.21	0.73	8	12X18	14X22	9866.34	196.29	196.29	0.000458	0.060456	132	1	0.023020957
STORY6	1.21	0.6	8	12X18	14X22	13155.11	271.28	271.28	0.000627	0.082764	132	1	0.030404947
STORY5	1.21	0.48	8	12X18	14X22	16443.89	343.84	343.84	0.000789	0.104148	132	1	0.037733333
STORY4	1.21	0.36	8	12X18	14X22	19732.67	413.53	413.53	0.000944	0.124608	132	1	0.045045439
STORY3	1.21	0.24	8	12X18	14X22	23021.45	479.69	479.69	0.001088	0.143616	132	1	0.052215676
STORY2	1.21	0.12	8	12X18	14X22	26310.23	541.68	541.68	0.001175	0.1551	132	1	0.057071556
STORY1	1.21	0	8	12X18	14X22	26917.87	541.68	541.68	0.000432	0.057024	132	1	0.021467508

Determination of stability coefficient (ϴ) of an 8 storied symmetric building with aspect ratio 1.21

Floor	Aspect Ratio (L/W)	Aspect Ratio (H/W)	Number of Story	Exterior Column Size	Interior Column Size	Vertical Design Load (P)	Story Shear (Vx)	Absolute Value (Vx)	DriftX	Design Story Drift Δ (Inch)	Floor Height (hsx)	Deflection Amplification Factor (Cd)	Stability Coefficient (θ)
STORY11	1.21	1.21	10	14X18	14X26	3319.14	44.16	44.16	0.000127	0.016764	132	1	0.009545534
STORY10	1.21	1.09	10	14X18	14X26	6638.27	131.45	131.45	0.000282	0.037224	132	1	0.014241097
STORY9	1.21	0.97	10	14X18	14X26	9957.41	217.07	217.07	0.000445	0.05874	132	1	0.020412989
STORY8	1.21	0.85	10	14X18	14X26	13276.55	300.9	300.9	0.000605	0.07986	132	1	0.026694293
STORY7	1.21	0.73	10	14X18	14X26	16595.68	382.75	382.75	0.00076	0.10032	132	1	0.032952885
STORY6	1.21	0.6	10	14X18	14X26	19914.82	462.38	462.38	0.000911	0.120252	132	1	0.039236993
STORY5	1.21	0.48	10	14X18	14X26	23233.96	539.49	539.49	0.001056	0.139392	132	1	0.045478251
STORY4	1.21	0.36	10	14X18	14X26	26553.09	613.63	613.63	0.001193	0.157476	132	1	0.051623676
STORY3	1.21	0.24	10	14X18	14X26	29872.23	684.12	684.12	0.001319	0.174108	132	1	0.057594386
STORY2	1.21	0.12	10	14X18	14X26	33191.36	750.28	750.28	0.001363	0.179916	132	1	0.060297254
STORY1	1.21	0	10	14X18	14X26	33815.56	750.28	750.28	0.00051	0.06732	132	1	0.022985999

Determination of stability coefficient (ϴ) of a10 storied symmetric building with aspect ratio 1.21

Floor	Aspect Ratio (L/W)	Aspect Ratio (H/W)	Number of Story	Exterior Column Size	Interior Column Size	Vertical Design Load (P)	Story Shear (Vx)	Absolute Value (Vx)	DriftX	Design Story Drift Δ (Inch)	Floor Height (hsx)	Deflection Amplification Factor (Cd)	Stability Coefficient (θ)
STORY13	1.21	1.45	12	14X22	16X28	3365.33	46.98	46.98	0.000128	0.016896	132	1	0.009169056
STORY12	1.21	1.33	12	14X22	16X28	6730.67	140.02	140.02	0.000262	0.034584	132	1	0.012594169
STORY11	1.21	1.21	12	14X22	16X28	10096	231.6	231.6	0.000405	0.05346	132	1	0.017654922
STORY10	1.21	1.09	12	14X22	16X28	13461.33	321.64	321.64	0.000547	0.072204	132	1	0.022893134
STORY9	1.21	0.97	12	14X22	16X28	16826.67	410	410	0.000686	0.090552	132	1	0.028153892
STORY8	1.21	0.85	12	14X22	16X28	20192	496.53	496.53	0.000821	0.108372	132	1	0.03338697
STORY7	1.21	0.73	12	14X22	16X28	23557.33	581.07	581.07	0.000953	0.125796	132	1	0.038635854
STORY6	1.21	0.6	12	14X22	16X28	26922.67	663.36	663.36	0.00108	0.14256	132	1	0.043832133
STORY5	1.21	0.48	12	14X22	16X28	30288	743.1	743.1	0.001202	0.158664	132	1	0.048992297
STORY4	1.21	0.36	12	14X22	16X28	33653.34	819.85	819.85	0.001317	0.173844	132	1	0.054060436
STORY3	1.21	0.24	12	14X22	16X28	37018.67	892.89	892.89	0.001417	0.187044	132	1	0.058747948
STORY2	1.21	0.12	12	14X22	16X28	40384	961.57	961.57	0.001415	0.18678	132	1	0.059427145
STORY1	1.21	0	12	14X22	16X28	41033.4	961.57	961.57	0.000541	0.071412	132	1	0.023086275

Determination of stability coefficient (Θ) of a 12 storied symmetric building with aspect ratio 1.21

Floor	Aspect Ratio (L/W)	Aspect Ratio (H/W)	Number of Story	Exterior Column Size	Interior Column Size	Vertical Design Load (P)	Story Shear (Vx)	Absolute Value (Vx)	DriftX	Design Story Drift Δ (Inch)	Floor Height (hsx)	Deflection Amplification Factor (Cd)	Stability Coefficient (θ)
STORY15	1.21	1.69	14	14X28	16X34	3424.73	50.14	50.14	0.000139	0.018348	132	1	0.009494166
STORY14	1.21	1.57	14	14X28	16X34	6849.46	149.58	149.58	0.000267	0.035244	132	1	0.012226272
STORY13	1.21	1.45	14	14X28	16X34	10274.19	247.71	247.71	0.000407	0.053724	132	1	0.016881011
STORY12	1.21	1.33	14	14X28	16X34	13698.92	344.44	344.44	0.000545	0.07194	132	1	0.021675506
STORY11	1.21	1.21	14	14X28	16X34	17123.65	439.69	439.69	0.000681	0.089892	132	1	0.026521426
STORY10	1.21	1.09	14	14X28	16X34	20548.38	533.35	533.35	0.000815	0.10758	132	1	0.031399512
STORY9	1.21	0.97	14	14X28	16X34	23973.11	625.29	625.29	0.000945	0.12474	132	1	0.036230531
STORY8	1.21	0.85	14	14X28	16X34	27397.84	715.38	715.38	0.001072	0.141504	132	1	0.041055781
STORY7	1.21	0.73	14	14X28	16X34	30822.57	803.41	803.41	0.001195	0.15774	132	1	0.045845796
STORY6	1.21	0.6	14	14X28	16X34	34247.3	889.16	889.16	0.001314	0.173448	132	1	0.050610635
STORY5	1.21	0.48	14	14X28	16X34	37672.03	972.3	972.3	0.001428	0.188496	132	1	0.055328251
STORY4	1.21	0.36	14	14X28	16X34	41096.76	1052.37	1052.37	0.001535	0.20262	132	1	0.059944246
STORY3	1.21	0.24	14	14X28	16X34	44521.49	1128.66	1128.66	0.001623	0.214236	132	1	0.064021387
STORY2	1.21	0.12	14	14X28	16X34	47946.22	1200.48	1200.48	0.001579	0.208428	132	1	0.063064009
STORY1	1.21	0	14	14X28	16X34	48628.01	1200.48	1200.48	0.000606	0.079992	132	1	0.024547326

Determination of stability coefficient (Θ) of a 14 storied symmetric building with aspect ratio 1.21

Floor	Aspect Ratio (L/W)	Aspect Ratio (H/W)	Number of Story	Exterior Column Size	Interior Column Size	Vertical Design Load (P)	Story Shear (Vx)	Absolute Value (Vx)	DriftX	Design Story Drift Δ (Inch)	Floor Height (hsx)	Deflection Amplification Factor (Cd)	Stability Coefficient (θ)
STORY17	1.21	1.93	16	16X28	16X38	3464.33	52.62	52.62	0.000157	0.020724	132	1	0.01033637
STORY16	1.21	1.81	16	16X28	16X38	6928.65	157.09	157.09	0.000279	0.036828	132	1	0.012305642
STORY15	1.21	1.69	16	16X28	16X38	10392.98	260.35	260.35	0.000413	0.054516	132	1	0.016486655
STORY14	1.21	1.57	16	16X28	16X38	13857.31	362.36	362.36	0.000546	0.072072	132	1	0.02088004
STORY13	1.21	1.45	16	16X28	16X38	17321.64	463.03	463.03	0.000678	0.089496	132	1	0.025363523
STORY12	1.21	1.33	16	16X28	16X38	20785.96	562.29	562.29	0.000808	0.106656	132	1	0.029869028
STORY11	1.21	1.21	16	16X28	16X38	24250.29	660.05	660.05	0.000935	0.12342	132	1	0.034351975
STORY10	1.21	1.09	16	16X28	16X38	27714.62	756.21	756.21	0.001059	0.139788	132	1	0.038811683
STORY9	1.21	0.97	16	16X28	16X38	31178.94	850.63	850.63	0.001181	0.155892	132	1	0.043288302
STORY8	1.21	0.85	16	16X28	16X38	34643.27	943.18	943.18	0.001299	0.171468	132	1	0.04771264
STORY7	1.21	0.73	16	16X28	16X38	38107.6	1033.65	1033.65	0.001413	0.186516	132	1	0.052093106
STORY6	1.21	0.6	16	16X28	16X38	41571.93	1121.8	1121.8	0.001523	0.201036	132	1	0.056439695
STORY5	1.21	0.48	16	16X28	16X38	45036.25	1207.32	1207.32	0.001628	0.214896	132	1	0.060728734
STORY4	1.21	0.36	16	16X28	16X38	48500.58	1289.74	1289.74	0.001726	0.227832	132	1	0.064906106
STORY3	1.21	0.24	16	16X28	16X38	51964.91	1368.34	1368.34	0.001798	0.237336	132	1	0.068281939
STORY2	1.21	0.12	16	16X28	16X38	55429.23	1442.42	1442.42	0.0017	0.2244	132	1	0.065327499
STORY1	1.21	0	16	16X28	16X38	56132.63	1442.42	1442.42	0.000655	0.08646	132	1	0.025489714

Determination of stability coefficient (Θ) of a 16 storied symmetric building with aspect ratio 1.21

Floor	Aspect Ratio (L/W)	Aspect Ratio (H/W)	Number of Story	Exterior Column Size	Interior Column Size	Vertical Design Load (P)	Story Shear (Vx)	Absolute Value (Vx)	DriftX	Design Story Drift Δ (Inch)	Floor Height (hsx)	Deflection Amplification Factor (Cd)	Stability Coefficient (θ)
STORY19	1.21	2.18	18	20X30	18X38	3534.28	54.98	54.98	0.000165	0.02178	132	1	0.010606697
STORY18	1.21	2.05	18	20X30	18X38	7068.57	164.21	164.21	0.000269	0.035508	132	1	0.011579352
STORY17	1.21	1.93	18	20X30	18X38	10602.85	272.34	272.34	0.000388	0.051216	132	1	0.015105771
STORY16	1.21	1.81	18	20X30	18X38	14137.13	379.3	379.3	0.000508	0.067056	132	1	0.018933989
STORY15	1.21	1.69	18	20X30	18X38	17671.41	485.05	485.05	0.000628	0.082896	132	1	0.022879385
STORY14	1.21	1.57	18	20X30	18X38	21205.7	589.52	589.52	0.000745	0.09834	132	1	0.026798491
STORY13	1.21	1.45	18	20X30	18X38	24739.98	692.65	692.65	0.000861	0.113652	132	1	0.030753083
STORY12	1.21	1.33	18	20X30	18X38	28274.26	794.35	794.35	0.000974	0.128568	132	1	0.03466876
STORY11	1.21	1.21	18	20X30	18X38	31808.54	894.53	894.53	0.001085	0.14322	132	1	0.038581452
STORY10	1.21	1.09	18	20X30	18X38	35342.83	993.1	993.1	0.001194	0.157608	132	1	0.042492538
STORY9	1.21	0.97	18	20X30	18X38	38877.11	1089.91	1089.91	0.0013	0.1716	132	1	0.046371024
STORY8	1.21	0.85	18	20X30	18X38	42411.39	1184.82	1184.82	0.001403	0.185196	132	1	0.050221283
STORY7	1.21	0.73	18	20X30	18X38	45945.68	1277.64	1277.64	0.001502	0.198264	132	1	0.054013972
STORY6	1.21	0.6	18	20X30	18X38	49479.96	1368.11	1368.11	0.001598	0.210936	132	1	0.057794312
STORY5	1.21	0.48	18	20X30	18X38	53014.24	1455.92	1455.92	0.001688	0.222816	132	1	0.061464941
STORY4	1.21	0.36	18	20X30	18X38	56548.52	1540.6	1540.6	0.001767	0.233244	132	1	0.064858649
STORY3	1.21	0.24	18	20X30	18X38	60082.81	1621.41	1621.41	0.001804	0.238128	132	1	0.066848847
STORY2	1.21	0.12	18	20X30	18X38	63617.09	1697.65	1697.65	0.001613	0.212916	132	1	0.060444948
STORY1	1.21	0	18	20X30	18X38	64358.64	1697.65	1697.65	0.000621	0.081972	132	1	0.023542376

Determination of stability coefficient (ϴ) of an 18 storied symmetric building with aspect ratio 1.21

Floor	Aspect Ratio (L/W)	Aspect Ratio (H/W)	Number of Story	Exterior Column Size	Interior Column Size	Vertical Design Load (P)	Story Shear (Vx)	Absolute Value (Vx)	DriftX	Design Story Drift Δ (Inch)	Floor Height (hsx)	Deflection Amplification Factor (Cd)	Stability Coefficient (θ)
STORY21	1.21	2.42	20	22X30	22X38	3609.52	57.84	57.84	0.000183	0.024156	132	1	0.011420162
STORY20	1.21	2.3	20	22X30	22X38	7219.04	172.85	172.85	0.000276	0.036432	132	1	0.011527076
STORY19	1.21	2.18	20	22X30	22X38	10828.55	286.82	286.82	0.000386	0.050952	132	1	0.014572974
STORY18	1.21	2.05	20	22X30	22X38	14438.07	399.69	399.69	0.000498	0.065736	132	1	0.017989339
STORY17	1.21	1.93	20	22X30	22X38	18047.59	511.42	511.42	0.000611	0.080652	132	1	0.021561686
STORY16	1.21	1.81	20	22X30	22X38	21657.11	621.97	621.97	0.000722	0.095304	132	1	0.025140173
STORY15	1.21	1.69	20	22X30	22X38	25266.63	731.28	731.28	0.000831	0.109692	132	1	0.02871208
STORY14	1.21	1.57	20	22X30	22X38	28876.14	839.29	839.29	0.000939	0.123948	132	1	0.032306706
STORY13	1.21	1.45	20	22X30	22X38	32485.66	945.92	945.92	0.001045	0.13794	132	1	0.035888357
STORY12	1.21	1.33	20	22X30	22X38	36095.18	1051.1	1051.1	0.001148	0.151536	132	1	0.039422763
STORY11	1.21	1.21	20	22X30	22X38	39704.7	1154.72	1154.72	0.00125	0.165	132	1	0.042980874
STORY10	1.21	1.09	20	22X30	22X38	43314.21	1256.69	1256.69	0.001349	0.178068	132	1	0.04649585
STORY9	1.21	0.97	20	22X30	22X38	46923.73	1356.88	1356.88	0.001445	0.19074	132	1	0.049971103
STORY8	1.21	0.85	20	22X30	22X38	50533.25	1455.11	1455.11	0.001539	0.203148	132	1	0.053446593
STORY7	1.21	0.73	20	22X30	22X38	54142.77	1551.21	1551.21	0.001629	0.215028	132	1	0.056857919
STORY6	1.21	0.6	20	22X30	22X38	57752.29	1644.92	1644.92	0.001715	0.22638	132	1	0.060212763
STORY5	1.21	0.48	20	22X30	22X38	61361.8	1735.9	1735.9	0.001794	0.236808	132	1	0.063415559
STORY4	1.21	0.36	20	22X30	22X38	64971.32	1823.69	1823.69	0.001853	0.244596	132	1	0.066015527
STORY3	1.21	0.24	20	22X30	22X38	68580.84	1907.52	1907.52	0.001845	0.24354	132	1	0.066333066
STORY2	1.21	0.12	20	22X30	22X38	72190.36	1986.7	1986.7	0.001562	0.206184	132	1	0.056758113
STORY1	1.21	0	20	22X30	22X38	72972.95	1986.7	1986.7	0.000594	0.078408	132	1	0.021818056

Determination of stability coefficient (ϴ) of a 20 storied symmetric building with aspect ratio 1.21

Floor	Aspect Ratio (L/W)	Aspect Ratio (H/W)	Number of Story	Exterior Column Size	Interior Column Size	Vertical Design Load (P)	Story Shear (Vx)	Absolute Value (Vx)	DriftX	Design Story Drift Δ (Inch)	Floor Height (hsx)	Deflection Amplification Factor (Cd)	Stability Coefficient (θ)
STORY23	1.21	2.66	22	24X32	26X38	3695.31	60.04	60.04	0.000204	0.026928	132	1	0.012555684
STORY22	1.21	2.54	22	24X32	26X38	7390.62	179.48	179.48	0.000289	0.038148	132	1	0.01190043
STORY21	1.21	2.42	22	24X32	26X38	11085.94	297.94	297.94	0.000393	0.051876	132	1	0.014622993
STORY20	1.21	2.3	22	24X32	26X38	14781.25	415.37	415.37	0.000501	0.066132	132	1	0.017828457
STORY19	1.21	2.18	22	24X32	26X38	18476.56	531.75	531.75	0.00061	0.08052	132	1	0.02119549
STORY18	1.21	2.05	22	24X32	26X38	22171.87	647.02	647.02	0.000718	0.094776	132	1	0.024604189
STORY17	1.21	1.93	22	24X32	26X38	25867.19	761.14	761.14	0.000825	0.1089	132	1	0.028037459
STORY16	1.21	1.81	22	24X32	26X38	29562.5	874.07	874.07	0.000931	0.122892	132	1	0.031487967
STORY15	1.21	1.69	22	24X32	26X38	33257.81	985.74	985.74	0.001035	0.13662	132	1	0.03491979
STORY14	1.21	1.57	22	24X32	26X38	36953.12	1096.1	1096.1	0.001137	0.150084	132	1	0.038331993
STORY13	1.21	1.45	22	24X32	26X38	40648.44	1205.07	1205.07	0.001237	0.163284	132	1	0.041725477
STORY12	1.21	1.33	22	24X32	26X38	44343.75	1312.56	1312.56	0.001335	0.17622	132	1	0.045101867
STORY11	1.21	1.21	22	24X32	26X38	48039.06	1418.49	1418.49	0.001431	0.188892	132	1	0.048462728
STORY10	1.21	1.09	22	24X32	26X38	51734.37	1522.75	1522.75	0.001525	0.2013	132	1	0.051810812
STORY9	1.21	0.97	22	24X32	26X38	55429.69	1625.2	1625.2	0.001616	0.213312	132	1	0.055115911
STORY8	1.21	0.85	22	24X32	26X38	59125	1725.68	1725.68	0.001704	0.224928	132	1	0.058382203
STORY7	1.21	0.73	22	24X32	26X38	62820.31	1824	1824	0.001788	0.236016	132	1	0.061580435
STORY6	1.21	0.6	22	24X32	26X38	66515.62	1919.91	1919.91	0.001866	0.246312	132	1	0.064647899
STORY5	1.21	0.48	22	24X32	26X38	70210.94	2013.07	2013.07	0.001933	0.255156	132	1	0.067418295
STORY4	1.21	0.36	22	24X32	26X38	73906.25	2102.99	2102.99	0.001968	0.259776	132	1	0.06916224
STORY3	1.21	0.24	22	24X32	26X38	77601.56	2188.92	2188.92	0.001905	0.25146	132	1	0.067536032
STORY2	1.21	0.12	22	24X32	26X38	81296.87	2270.14	2270.14	0.001527	0.201564	132	1	0.054683993
STORY1	1.21	0	22	24X32	26X38	82126.26	2270.14	2270.14	0.000567	0.074844	132	1	0.02051221

Determination of stability coefficient (ϴ) of a 22 storied symmetric building with aspect ratio 1.21

Floor	Aspect Ratio (L/W)	Aspect Ratio (H/W)	Number of Story	Exterior Column Size	Interior Column Size	Vertical Design Load (P)	Story Shear (Vx)	Absolute Value (Vx)	DriftX	Design Story Drift Δ (Inch)	Floor Height (hsx)	Deflection Amplification Factor (Cd)	Stability Coefficient (θ)
STORY25	1.21	2.9	24	26X34	26X42	3767.91	62.17	62.17	0.000228	0.030096	132	1	0.013818296
STORY24	1.21	2.78	24	26X34	26X42	7535.82	185.91	185.91	0.000312	0.041184	132	1	0.01264685
STORY23	1.21	2.66	24	26X34	26X42	11303.72	308.71	308.71	0.000416	0.054912	132	1	0.015232249
STORY22	1.21	2.54	24	26X34	26X42	15071.63	430.54	430.54	0.000525	0.0693	132	1	0.018378329
STORY21	1.21	2.42	24	26X34	26X42	18839.54	551.38	551.38	0.000635	0.08382	132	1	0.021696666
STORY20	1.21	2.3	24	26X34	26X42	22607.45	671.19	671.19	0.000745	0.09834	132	1	0.025093566
STORY19	1.21	2.18	24	26X34	26X42	26375.35	789.92	789.92	0.000854	0.112728	132	1	0.028514975
STORY18	1.21	2.05	24	26X34	26X42	30143.26	907.55	907.55	0.000962	0.126984	132	1	0.031951756
STORY17	1.21	1.93	24	26X34	26X42	33911.17	1024.01	1024.01	0.001068	0.140976	132	1	0.035367945
STORY16	1.21	1.81	24	26X34	26X42	37679.08	1139.27	1139.27	0.001173	0.154836	132	1	0.038794632
STORY15	1.21	1.69	24	26X34	26X42	41446.99	1253.25	1253.25	0.001276	0.168432	132	1	0.042199369
STORY14	1.21	1.57	24	26X34	26X42	45214.89	1365.91	1365.91	0.001377	0.181764	132	1	0.045581996
STORY13	1.21	1.45	24	26X34	26X42	48982.8	1477.16	1477.16	0.001476	0.194832	132	1	0.048944334
STORY12	1.21	1.33	24	26X34	26X42	52750.71	1586.93	1586.93	0.001573	0.207636	132	1	0.052287667
STORY11	1.21	1.21	24	26X34	26X42	56518.62	1695.11	1695.11	0.001668	0.220176	132	1	0.055614714
STORY10	1.21	1.09	24	26X34	26X42	60286.52	1801.6	1801.6	0.001761	0.232452	132	1	0.058927932
STORY9	1.21	0.97	24	26X34	26X42	64054.43	1906.27	1906.27	0.001851	0.244332	132	1	0.062197249
STORY8	1.21	0.85	24	26X34	26X42	67822.34	2008.95	2008.95	0.001937	0.255684	132	1	0.065393301
STORY7	1.21	0.73	24	26X34	26X42	71590.25	2109.45	2109.45	0.00202	0.26664	132	1	0.068554507
STORY6	1.21	0.6	24	26X34	26X42	75358.16	2207.5	2207.5	0.002095	0.27654	132	1	0.07151771
STORY5	1.21	0.48	24	26X34	26X42	79126.06	2302.78	2302.78	0.002153	0.284196	132	1	0.073979454
STORY4	1.21	0.36	24	26X34	26X42	82893.97	2394.79	2394.79	0.002171	0.286572	132	1	0.075147637
STORY3	1.21	0.24	24	26X34	26X42	86661.88	2482.76	2482.76	0.002069	0.273108	132	1	0.072219397
STORY2	1.21	0.12	24	26X34	26X42	90429.79	2565.98	2565.98	0.001617	0.213444	132	1	0.056986013
STORY1	1.21	0	24	26X34	26X42	91298.77	2565.98	2565.98	0.000591	0.078012	132	1	0.021028057

Determination of stability coefficient (ϴ) of a 24 storied symmetric building with aspect ratio 1.21

Floor	Aspect Ratio (L/W)	Aspect Ratio (H/W)	Number of Story	Exterior Column Size	Interior Column Size	Vertical Design Load (P)	Story Shear (Vx)	Absolute Value (Vx)	DriftX	Design Story Drift Δ (Inch)	Floor Height (hsx)	Deflection Amplification Factor (Cd)	Stability Coefficient (θ)
STORY27	1.21	3.14	26	28X36	28X42	3836.54	64.25	64.25	0.000256	0.033792	132	1	0.015286447
STORY26	1.21	3.02	26	28X36	28X42	7673.09	192.16	192.16	0.000336	0.044352	132	1	0.013416727
STORY25	1.21	2.9	26	28X36	28X42	11509.63	319.18	319.18	0.000438	0.057816	132	1	0.015794279
STORY24	1.21	2.78	26	28X36	28X42	15346.17	445.29	445.29	0.000547	0.072204	132	1	0.018851434
STORY23	1.21	2.66	26	28X36	28X42	19182.72	570.45	570.45	0.000658	0.086856	132	1	0.022126794
STORY22	1.21	2.54	26	28X36	28X42	23019.26	694.64	694.64	0.000769	0.101508	132	1	0.025483432
STORY21	1.21	2.42	26	28X36	28X42	26855.8	817.82	817.82	0.00088	0.11616	132	1	0.028897684
STORY20	1.21	2.3	26	28X36	28X42	30692.35	939.96	939.96	0.000989	0.130548	132	1	0.032293645
STORY19	1.21	2.18	26	28X36	28X42	34528.89	1061.01	1061.01	0.001097	0.144804	132	1	0.035700128
STORY18	1.21	2.05	26	28X36	28X42	38365.43	1180.94	1180.94	0.001203	0.158796	132	1	0.039082098
STORY17	1.21	1.93	26	28X36	28X42	42201.98	1299.71	1299.71	0.001308	0.172656	132	1	0.042471159
STORY16	1.21	1.81	26	28X36	28X42	46038.52	1417.24	1417.24	0.001412	0.186384	132	1	0.045868301
STORY15	1.21	1.69	26	28X36	28X42	49875.06	1533.5	1533.5	0.001514	0.199848	132	1	0.049240848
STORY14	1.21	1.57	26	28X36	28X42	53711.61	1648.41	1648.41	0.001613	0.212916	132	1	0.052557814
STORY13	1.21	1.45	26	28X36	28X42	57548.15	1761.91	1761.91	0.001711	0.225852	132	1	0.055885309
STORY12	1.21	1.33	26	28X36	28X42	61384.69	1873.9	1873.9	0.001807	0.238524	132	1	0.059193199
STORY11	1.21	1.21	26	28X36	28X42	65221.24	1984.3	1984.3	0.001901	0.250932	132	1	0.062483282
STORY10	1.21	1.09	26	28X36	28X42	69057.78	2092.98	2092.98	0.001992	0.262944	132	1	0.065725949
STORY9	1.21	0.97	26	28X36	28X42	72894.32	2199.83	2199.83	0.00208	0.27456	132	1	0.068923592
STORY8	1.21	0.85	26	28X36	28X42	76730.87	2304.66	2304.66	0.002164	0.285648	132	1	0.072047765
STORY7	1.21	0.73	26	28X36	28X42	80567.41	2407.29	2407.29	0.002243	0.296076	132	1	0.075068937
STORY6	1.21	0.6	26	28X36	28X42	84403.95	2507.46	2507.46	0.002311	0.305052	132	1	0.077790883
STORY5	1.21	0.48	26	28X36	28X42	88240.5	2604.81	2604.81	0.002357	0.311124	132	1	0.079845693
STORY4	1.21	0.36	26	28X36	28X42	92077.04	2698.86	2698.86	0.002347	0.309804	132	1	0.080072628
STORY3	1.21	0.24	26	28X36	28X42	95913.58	2788.84	2788.84	0.002193	0.289476	132	1	0.075421495
STORY2	1.21	0.12	26	28X36	28X42	99750.13	2874.01	2874.01	0.001658	0.218856	132	1	0.057545282
STORY1	1.21	0	26	28X36	28X42	100656.6	2874.01	2874.01	0.000595	0.07854	132	1	0.020838705

Determination of stability coefficient (Θ) of a 26 storied symmetric building with aspect ratio 1.21

Floor	Aspect Ratio (L/W)	Aspect Ratio (H/W)	Number of Story	Exterior Column Size	Interior Column Size	Vertical Design Load (P)	Story Shear (Vx)	Absolute Value (Vx)	DriftX	Design Story Drift Δ (Inch)	Floor Height (hsx)	Deflection Amplification Factor (Cd)	Stability Coefficient (θ)
STORY29	1.21	3.38	28	30X40	30X42	3914.42	66.27	66.27	0.000285	0.03762	132	1	0.01683431
STORY28	1.21	3.26	28	30X40	30X42	7828.84	198.26	198.26	0.000364	0.048048	132	1	0.014373539
STORY27	1.21	3.14	28	30X40	30X42	11743.26	329.4	329.4	0.000464	0.061248	132	1	0.016541811
STORY26	1.21	3.02	28	30X40	30X42	15657.67	459.67	459.67	0.000573	0.075636	132	1	0.019518013
STORY25	1.21	2.9	28	30X40	30X42	19572.09	589.04	589.04	0.000684	0.090288	132	1	0.022727335
STORY24	1.21	2.78	28	30X40	30X42	23486.51	717.48	717.48	0.000796	0.105072	132	1	0.026056841
STORY23	1.21	2.66	28	30X40	30X42	27400.93	844.97	844.97	0.000908	0.119856	132	1	0.029444885
STORY22	1.21	2.54	28	30X40	30X42	31315.35	971.47	971.47	0.001019	0.134508	132	1	0.03284748
STORY21	1.21	2.42	28	30X40	30X42	35229.77	1096.96	1096.96	0.001129	0.149028	132	1	0.036258761
STORY20	1.21	2.3	28	30X40	30X42	39144.18	1221.39	1221.39	0.001238	0.163416	132	1	0.039676512
STORY19	1.21	2.18	28	30X40	30X42	43058.6	1344.73	1344.73	0.001345	0.17754	132	1	0.043067245
STORY18	1.21	2.05	28	30X40	30X42	46973.02	1466.94	1466.94	0.001451	0.191532	132	1	0.046462604
STORY17	1.21	1.93	28	30X40	30X42	50887.44	1587.96	1587.96	0.001555	0.20526	132	1	0.049831211
STORY16	1.21	1.81	28	30X40	30X42	54801.86	1707.75	1707.75	0.001658	0.218856	132	1	0.053205378
STORY15	1.21	1.69	28	30X40	30X42	58716.28	1826.24	1826.24	0.001759	0.232188	132	1	0.056554416
STORY14	1.21	1.57	28	30X40	30X42	62630.69	1943.38	1943.38	0.001858	0.245256	132	1	0.059879088
STORY13	1.21	1.45	28	30X40	30X42	66545.11	2059.08	2059.08	0.001955	0.25806	132	1	0.063181465
STORY12	1.21	1.33	28	30X40	30X42	70459.53	2173.26	2173.26	0.002049	0.270468	132	1	0.066430881
STORY11	1.21	1.21	28	30X40	30X42	74373.95	2285.84	2285.84	0.002142	0.282744	132	1	0.069693855
STORY10	1.21	1.09	28	30X40	30X42	78288.37	2396.68	2396.68	0.002232	0.294624	132	1	0.072909042
STORY9	1.21	0.97	28	30X40	30X42	82202.79	2505.66	2505.66	0.002318	0.305976	132	1	0.076046258
STORY8	1.21	0.85	28	30X40	30X42	86117.2	2612.62	2612.62	0.0024	0.3168	132	1	0.079108818
STORY7	1.21	0.73	28	30X40	30X42	90031.62	2717.34	2717.34	0.002474	0.326568	132	1	0.081969215
STORY6	1.21	0.6	28	30X40	30X42	93946.04	2819.58	2819.58	0.002533	0.334356	132	1	0.084397435
STORY5	1.21	0.48	28	30X40	30X42	97860.46	2918.98	2918.98	0.002561	0.338052	132	1	0.085858977
STORY4	1.21	0.36	28	30X40	30X42	101774.9	3015.04	3015.04	0.002518	0.332376	132	1	0.084996931
STORY3	1.21	0.24	28	30X40	30X42	105689.3	3106.98	3106.98	0.002306	0.304392	132	1	0.07844258
STORY2	1.21	0.12	28	30X40	30X42	109603.7	3194.07	3194.07	0.001691	0.223212	132	1	0.05802624
STORY1	1.21	0	28	30X40	30X42	110552.6	3194.07	3194.07	0.000596	0.078672	132	1	0.020628651

Determination of stability coefficient (Θ) of a 28 storied symmetric building with aspect ratio 1.21

Floor	Aspect Ratio (L/W)	Aspect Ratio (H/W)	Number of Story	Exterior Column Size	Interior Column Size	Vertical Design Load (P)	Story Shear (Vx)	Absolute Value (Vx)	DriftX	Design Story Drift Δ (Inch)	Floor Height (hsx)	Deflection Amplification Factor (Cd)	Stability Coefficient (θ)
STORY31	1.21	3.63	30	30X42	32X44	4012.53	68.26	68.26	0.000318	0.041976	132	1	0.018693005
STORY30	1.21	3.51	30	30X42	32X44	8025.06	204.24	204.24	0.000394	0.052008	132	1	0.015481167
STORY29	1.21	3.38	30	30X42	32X44	12037.6	339.41	339.41	0.000493	0.065076	132	1	0.017484861
STORY28	1.21	3.26	30	30X42	32X44	16050.13	473.74	473.74	0.000602	0.079464	132	1	0.02039553
STORY27	1.21	3.14	30	30X42	32X44	20062.66	607.22	607.22	0.000714	0.094248	132	1	0.023590691
STORY26	1.21	3.02	30	30X42	32X44	24075.19	739.81	739.81	0.000828	0.109296	132	1	0.026945104
STORY25	1.21	2.9	30	30X42	32X44	28087.72	871.49	871.49	0.000941	0.124212	132	1	0.030327995
STORY24	1.21	2.78	30	30X42	32X44	32100.26	1002.24	1002.24	0.001054	0.139128	132	1	0.033758056
STORY23	1.21	2.66	30	30X42	32X44	36112.79	1132.02	1132.02	0.001166	0.153912	132	1	0.037196793
STORY22	1.21	2.54	30	30X42	32X44	40125.32	1260.81	1260.81	0.001277	0.168564	132	1	0.040640567
STORY21	1.21	2.42	30	30X42	32X44	44137.85	1388.57	1388.57	0.001387	0.183084	132	1	0.044087945
STORY20	1.21	2.3	30	30X42	32X44	48150.39	1515.27	1515.27	0.001495	0.19734	132	1	0.047506275
STORY19	1.21	2.18	30	30X42	32X44	52162.92	1640.87	1640.87	0.001602	0.211464	132	1	0.050927251
STORY18	1.21	2.05	30	30X42	32X44	56175.45	1765.32	1765.32	0.001707	0.225324	132	1	0.05431961
STORY17	1.21	1.93	30	30X42	32X44	60187.98	1888.57	1888.57	0.001811	0.239052	132	1	0.057715855
STORY16	1.21	1.81	30	30X42	32X44	64200.51	2010.57	2010.57	0.001913	0.252516	132	1	0.061084954
STORY15	1.21	1.69	30	30X42	32X44	68213.05	2131.27	2131.27	0.002013	0.265716	132	1	0.064427721
STORY14	1.21	1.57	30	30X42	32X44	72225.58	2250.6	2250.6	0.002111	0.278652	132	1	0.067745579
STORY13	1.21	1.45	30	30X42	32X44	76238.11	2368.48	2368.48	0.002208	0.291456	132	1	0.07107248
STORY12	1.21	1.33	30	30X42	32X44	80250.64	2484.82	2484.82	0.002302	0.303864	132	1	0.07434622
STORY11	1.21	1.21	30	30X42	32X44	84263.17	2599.54	2599.54	0.002393	0.315876	132	1	0.077568249
STORY10	1.21	1.09	30	30X42	32X44	88275.71	2712.51	2712.51	0.002482	0.327624	132	1	0.080774011
STORY9	1.21	0.97	30	30X42	32X44	92288.24	2823.6	2823.6	0.002566	0.338712	132	1	0.083868687
STORY8	1.21	0.85	30	30X42	32X44	96300.77	2932.65	2932.65	0.002644	0.349008	132	1	0.086822238
STORY7	1.21	0.73	30	30X42	32X44	100313.3	3039.44	3039.44	0.002712	0.357984	132	1	0.089506511
STORY6	1.21	0.6	30	30X42	32X44	104325.8	3143.71	3143.71	0.002761	0.364452	132	1	0.091625378
STORY5	1.21	0.48	30	30X42	32X44	108338.4	3245.12	3245.12	0.002768	0.365376	132	1	0.092409713
STORY4	1.21	0.36	30	30X42	32X44	112350.9	3343.16	3343.16	0.002689	0.354948	132	1	0.090367069
STORY3	1.21	0.24	30	30X42	32X44	116363.4	3437.05	3437.05	0.002419	0.319308	132	1	0.081896725
STORY2	1.21	0.12	30	30X42	32X44	120376	3526.02	3526.02	0.001729	0.228228	132	1	0.059026901
STORY1	1.21	0	30	30X42	32X44	121378.4	3526.02	3526.02	0.000598	0.078936	132	1	0.020585326

Determination of stability coefficient (ϴ) of a 30 storied symmetric building with aspect ratio 1.21

Floor	Aspect Ratio (L/W)	Aspect Ratio (H/W)	Number of Story	Exterior Column Size	Interior Column Size	Vertical Design Load (P)	Story Shear (Vx)	Absolute Value (Vx)	DriftX	Design Story Drift Δ (Inch)	Floor Height (hsx)	Deflection Amplification Factor (Cd)	Stability Coefficient (θ)
STORY3	3.33	0.41	2	12X12	12X12	3059.91	16.54	16.54	0.00008	0.01056	132	1	0.014800048
STORY2	3.33	0.2	2	12X12	12X12	6119.82	47.93	47.93	0.000212	0.027984	132	1	0.02706868
STORY1	3.33	0	2	12X12	12X12	9143.73	71.51	71.51	0.000103	0.013596	132	1	0.013170245

Determination of stability coefficient (ϴ) of a 2 storied symmetric building with aspect ratio 3.33

Floor	Aspect Ratio (L/W)	Aspect Ratio (H/W)	Number of Story	Exterior Column Size	Interior Column Size	Vertical Design Load (P)	Story Shear (Vx)	Absolute Value (Vx)	DriftX	Design Story Drift Δ (Inch)	Floor Height (hsx)	Deflection Amplification Factor (Cd)	Stability Coefficient (θ)
STORY5	3.33	0.81	4	12X14	12X18	3094.23	19.75	19.75	0.000074	0.009768	132	1	0.011593571
STORY4	3.33	0.61	4	12X14	12X18	6188.46	58.06	58.06	0.000202	0.026664	132	1	0.021530639
STORY3	3.33	0.41	4	12X14	12X18	9282.68	94.27	94.27	0.000326	0.043032	132	1	0.032100919
STORY2	3.33	0.2	4	12X14	12X18	12376.91	128.01	128.01	0.000424	0.055968	132	1	0.040995312
STORY1	3.33	0	4	12X14	12X18	15419.54	153.41	153.41	0.000168	0.022176	132	1	0.01688601

Determination of stability coefficient (ϴ) of a 4 storied symmetric building with aspect ratio 3.33

Floor	Aspect Ratio (L/W)	Aspect Ratio (H/W)	Number of Story	Exterior Column Size	Interior Column Size	Vertical Design Load (P)	Story Shear (Vx)	Absolute Value (Vx)	DriftX	Design Story Drift Δ (Inch)	Floor Height (hsx)	Deflection Amplification Factor (Cd)	Stability Coefficient (θ)
STORY7	3.33	1.22	6	12X16	14X22	3137.34	22.01	22.01	0.000058	0.007656	132	1	0.008267411
STORY6	3.33	1.02	6	12X16	14X22	6274.69	65.16	65.16	0.000151	0.019932	132	1	0.014540795
STORY5	3.33	0.81	6	12X16	14X22	9412.03	106.86	106.86	0.000246	0.032472	132	1	0.021667222
STORY4	3.33	0.61	6	12X16	14X22	12549.38	146.86	146.86	0.000337	0.044484	132	1	0.028797093
STORY3	3.33	0.41	6	12X16	14X22	15686.72	184.77	184.77	0.000421	0.055572	132	1	0.035742324
STORY2	3.33	0.2	6	12X16	14X22	18824.07	220.2	220.2	0.000471	0.062172	132	1	0.040264019
STORY1	3.33	0	6	12X16	14X22	21890.22	246.9	246.9	0.000183	0.024156	132	1	0.016224829

Determination of stability coefficient (Ө) of a 6 storied symmetric building with aspect ratio 3.33

Floor	Aspect Ratio (L/W)	Aspect Ratio (H/W)	Number of Story	Exterior Column Size	Interior Column Size	Vertical Design Load (P)	Story Shear (Vx)	Absolute Value (Vx)	DriftX	Design Story Drift Δ (Inch)	Floor Height (hsx)	Deflection Amplification Factor (Cd)	Stability Coefficient (θ)
STORY9	3.33	1.63	8	12X18	14X26	3204.22	23.8	23.8	0.00005	0.0066	132	1	0.006731555
STORY8	3.33	1.43	8	12X18	14X26	6408.44	70.71	70.71	0.000121	0.015972	132	1	0.010966218
STORY7	3.33	1.22	8	12X18	14X26	9612.66	116.48	116.48	0.000195	0.02574	132	1	0.016092623
STORY6	3.33	1.02	8	12X18	14X26	12816.88	160.98	160.98	0.000268	0.035376	132	1	0.021337581
STORY5	3.33	0.81	8	12X18	14X26	16021.1	204.04	204.04	0.000338	0.044616	132	1	0.02653956
STORY4	3.33	0.61	8	12X18	14X26	19225.32	245.39	245.39	0.000405	0.05346	132	1	0.031730122
STORY3	3.33	0.41	8	12X18	14X26	22429.54	284.65	284.65	0.000464	0.061248	132	1	0.036561766
STORY2	3.33	0.2	8	12X18	14X26	25633.77	321.43	321.43	0.000476	0.062832	132	1	0.037960596
STORY1	3.33	0	8	12X18	14X26	28736.39	349.18	349.18	0.000185	0.02442	132	1	0.015224904

Determination of stability coefficient (Ө) of an 8 storied symmetric building with aspect ratio 3.33

Floor	Aspect Ratio (L/W)	Aspect Ratio (H/W)	Number of Story	Exterior Column Size	Interior Column Size	Vertical Design Load (P)	Story Shear (Vx)	Absolute Value (Vx)	DriftX	Design Story Drift Δ (Inch)	Floor Height (hsx)	Deflection Amplification Factor (Cd)	Stability Coefficient (θ)
STORY11	3.33	2.04	10	14X20	16X28	3208.62	25.31	25.31	0.000057	0.007524	132	1	0.007226051
STORY10	3.33	1.83	10	14X20	16X28	6417.24	75.34	75.34	0.00013	0.01716	132	1	0.011073018
STORY9	3.33	1.63	10	14X20	16X28	9625.86	124.42	124.42	0.000208	0.027456	132	1	0.016092098
STORY8	3.33	1.43	10	14X20	16X28	12834.48	172.47	172.47	0.000284	0.037488	132	1	0.021134066
STORY7	3.33	1.22	10	14X20	16X28	16043.1	219.38	219.38	0.000359	0.047388	132	1	0.026253409
STORY6	3.33	1.02	10	14X20	16X28	19251.72	265.02	265.02	0.000431	0.056892	132	1	0.031308925
STORY5	3.33	0.81	10	14X20	16X28	22460.34	309.22	309.22	0.0005	0.066	132	1	0.036317735
STORY4	3.33	0.61	10	14X20	16X28	25668.96	351.72	351.72	0.000567	0.074844	132	1	0.04138036
STORY3	3.33	0.41	10	14X20	16X28	28877.58	392.12	392.12	0.000624	0.082368	132	1	0.045954325
STORY2	3.33	0.2	10	14X20	16X28	32086.2	430.05	430.05	0.000621	0.081972	132	1	0.046333055
STORY1	3.33	0	10	14X20	16X28	35191.23	458.68	458.68	0.000239	0.031548	132	1	0.018336758

Determination of stability coefficient (Ө) of a 10 storied symmetric building with aspect ratio 3.33

Floor	Aspect Ratio (L/W)	Aspect Ratio (H/W)	Number of Story	Exterior Column Size	Interior Column Size	Vertical Design Load (P)	Story Shear (Vx)	Absolute Value (Vx)	DriftX	Design Story Drift Δ (Inch)	Floor Height (hsx)	Deflection Amplification Factor (Cd)	Stability Coefficient (θ)
STORY13	3.33	2.44	12	14X24	16X32	3242.94	26.94	26.94	0.000062	0.008184	132	1	0.007463336
STORY12	3.33	2.24	12	14X24	16X32	6485.88	80.29	80.29	0.000135	0.01782	132	1	0.01090539
STORY11	3.33	2.04	12	14X24	16X32	9728.81	132.8	132.8	0.000213	0.028116	132	1	0.015604191
STORY10	3.33	1.83	12	14X24	16X32	12971.75	184.43	184.43	0.00029	0.03828	132	1	0.020396939
STORY9	3.33	1.63	12	14X24	16X32	16214.69	235.09	235.09	0.000365	0.04818	132	1	0.025174877
STORY8	3.33	1.43	12	14X24	16X32	19457.63	284.71	284.71	0.000439	0.057948	132	1	0.030002106
STORY7	3.33	1.22	12	14X24	16X32	22700.57	333.19	333.19	0.000511	0.067452	132	1	0.034814944
STORY6	3.33	1.02	12	14X24	16X32	25943.51	380.37	380.37	0.00058	0.07656	132	1	0.039559471
STORY5	3.33	0.81	12	14X24	16X32	29186.44	426.1	426.1	0.000647	0.085404	132	1	0.044317359
STORY4	3.33	0.61	12	14X24	16X32	32429.38	470.1	470.1	0.000711	0.093852	132	1	0.049047626
STORY3	3.33	0.41	12	14X24	16X32	35672.32	511.99	511.99	0.000764	0.100848	132	1	0.05323083
STORY2	3.33	0.2	12	14X24	16X32	38915.26	551.37	551.37	0.00074	0.09768	132	1	0.052228617
STORY1	3.33	0	12	14X24	16X32	42039	581.11	581.11	0.000283	0.037356	132	1	0.020472952

Determination of stability coefficient (Ө) of a 12 storied symmetric building with aspect ratio 3.33

Floor	Aspect Ratio (L/W)	Aspect Ratio (H/W)	Number of Story	Exterior Column Size	Interior Column Size	Vertical Design Load (P)	Story Shear (Vx)	Absolute Value (Vx)	DriftX	Design Story Drift Δ (Inch)	Floor Height (hsx)	Deflection Amplification Factor (Cd)	Stability Coefficient (θ)
STORY15	3.33	2.85	14	16X26	18X34	3295.73	28.77	28.77	0.000065	0.00858	132	1	0.007446036
STORY14	3.33	2.65	14	16X26	18X34	6591.47	85.84	85.84	0.000129	0.017028	132	1	0.009905634
STORY13	3.33	2.44	14	16X26	18X34	9887.2	142.15	142.15	0.000199	0.026268	132	1	0.013841384
STORY12	3.33	2.24	14	16X26	18X34	13182.94	197.65	197.65	0.00027	0.03564	132	1	0.01800857
STORY11	3.33	2.04	14	16X26	18X34	16478.67	252.31	252.31	0.000339	0.044748	132	1	0.022140498
STORY10	3.33	1.83	14	16X26	18X34	19774.41	306.06	306.06	0.000407	0.053724	132	1	0.026296102
STORY9	3.33	1.63	14	16X26	18X34	23070.14	358.82	358.82	0.000474	0.062568	132	1	0.030475577
STORY8	3.33	1.43	14	16X26	18X34	26365.88	410.52	410.52	0.000538	0.071016	132	1	0.034553355
STORY7	3.33	1.22	14	16X26	18X34	29661.61	461.03	461.03	0.000601	0.079332	132	1	0.038666958
STORY6	3.33	1.02	14	16X26	18X34	32957.35	510.24	510.24	0.000663	0.087516	132	1	0.042824402
STORY5	3.33	0.81	14	16X26	18X34	36253.08	557.95	557.95	0.000721	0.095172	132	1	0.046847335
STORY4	3.33	0.61	14	16X26	18X34	39548.82	603.9	603.9	0.000775	0.1023	132	1	0.050753992
STORY3	3.33	0.41	14	16X26	18X34	42844.55	647.67	647.67	0.000814	0.107448	132	1	0.053847582
STORY2	3.33	0.2	14	16X26	18X34	46140.29	688.89	688.89	0.000754	0.099528	132	1	0.05050121
STORY1	3.33	0	14	16X26	18X34	49292.83	720.04	720.04	0.000289	0.038148	132	1	0.019784495

Determination of stability coefficient (Ө) of a 14 storied symmetric building with aspect ratio 3.33

Floor	Aspect Ratio (L/W)	Aspect Ratio (H/W)	Number of Story	Exterior Column Size	Interior Column Size	Vertical Design Load (P)	Story Shear (Vx)	Absolute Value (Vx)	DriftX	Design Story Drift Δ (Inch)	Floor Height (hsx)	Deflection Amplification Factor (Cd)	Stability Coefficient (θ)
STORY17	3.33	3.26	16	16X30	20X36	3350.29	30.21	30.21	0.00007	0.00924	132	1	0.007763002
STORY16	3.33	3.06	16	16X30	20X36	6700.58	90.18	90.18	0.000128	0.016896	132	1	0.009510692
STORY15	3.33	2.85	16	16X30	20X36	10050.87	149.46	149.46	0.000195	0.02574	132	1	0.013113339
STORY14	3.33	2.65	16	16X30	20X36	13401.17	208.01	208.01	0.000261	0.034452	132	1	0.016815083
STORY13	3.33	2.44	16	16X30	20X36	16751.46	265.8	265.8	0.000327	0.043164	132	1	0.020608455
STORY12	3.33	2.24	16	16X30	20X36	20101.75	322.79	322.79	0.000392	0.051744	132	1	0.024411803
STORY11	3.33	2.04	16	16X30	20X36	23452.04	378.91	378.91	0.000456	0.060192	132	1	0.028223405
STORY10	3.33	1.83	16	16X30	20X36	26802.33	434.11	434.11	0.000519	0.068508	132	1	0.032043513
STORY9	3.33	1.63	16	16X30	20X36	30152.62	488.31	488.31	0.00058	0.07656	132	1	0.035814379
STORY8	3.33	1.43	16	16X30	20X36	33502.91	541.44	541.44	0.000639	0.084348	132	1	0.039539671
STORY7	3.33	1.22	16	16X30	20X36	36853.2	593.37	593.37	0.000697	0.092004	132	1	0.043289483
STORY6	3.33	1.02	16	16X30	20X36	40203.5	643.98	643.98	0.000753	0.099396	132	1	0.04700959
STORY5	3.33	0.81	16	16X30	20X36	43553.79	693.07	693.07	0.000807	0.106524	132	1	0.05071336
STORY4	3.33	0.61	16	16X30	20X36	46904.08	740.39	740.39	0.000854	0.112728	132	1	0.054101331
STORY3	3.33	0.41	16	16X30	20X36	50254.37	785.5	785.5	0.000879	0.116028	132	1	0.056236271
STORY2	3.33	0.2	16	16X30	20X36	53604.66	828.03	828.03	0.000782	0.103224	132	1	0.050624789
STORY1	3.33	0	16	16X30	20X36	56786.96	860.18	860.18	0.000299	0.039468	132	1	0.019739242

Determination of stability coefficient (Ө) of a 16 storied symmetric building with aspect ratio 3.33

Floor	Aspect Ratio (L/W)	Aspect Ratio (H/W)	Number of Story	Exterior Column Size	Interior Column Size	Vertical Design Load (P)	Story Shear (Vx)	Absolute Value (Vx)	DriftX	Design Story Drift Δ (Inch)	Floor Height (hsx)	Deflection Amplification Factor (Cd)	Stability Coefficient (θ)
STORY19	3.33	3.67	18	16X32	20X40	3573.8	30.87	30.87	0.000074	0.009768	132	1	0.008566932
STORY18	3.33	3.46	18	16X32	20X40	7147.59	92.21	92.21	0.000124	0.016368	132	1	0.009611768
STORY17	3.33	3.26	18	16X32	20X40	10721.39	152.92	152.92	0.000184	0.024288	132	1	0.012900443
STORY16	3.33	3.06	18	16X32	20X40	14295.19	212.98	212.98	0.000244	0.032208	132	1	0.016377248
STORY15	3.33	2.85	18	16X32	20X40	17868.99	272.36	272.36	0.000305	0.04026	132	1	0.020010435
STORY14	3.33	2.65	18	16X32	20X40	21442.78	331.02	331.02	0.000364	0.048048	132	1	0.023579155
STORY13	3.33	2.44	18	16X32	20X40	25016.58	388.92	388.92	0.000423	0.055836	132	1	0.027208715
STORY12	3.33	2.24	18	16X32	20X40	28590.38	446.03	446.03	0.000481	0.063492	132	1	0.030831946
STORY11	3.33	2.04	18	16X32	20X40	32164.17	502.28	502.28	0.000538	0.071016	132	1	0.034451548
STORY10	3.33	1.83	18	16X32	20X40	35737.97	557.63	557.63	0.000593	0.078276	132	1	0.038004799
STORY9	3.33	1.63	18	16X32	20X40	39311.77	611.99	611.99	0.000647	0.085404	132	1	0.041560671
STORY8	3.33	1.43	18	16X32	20X40	42885.56	665.28	665.28	0.0007	0.0924	132	1	0.045123695
STORY7	3.33	1.22	18	16X32	20X40	46459.36	717.4	717.4	0.000751	0.099132	132	1	0.048635321
STORY6	3.33	1.02	18	16X32	20X40	50033.16	768.2	768.2	0.0008	0.1056	132	1	0.052104306
STORY5	3.33	0.81	18	16X32	20X40	53606.96	817.5	817.5	0.000846	0.111672	132	1	0.055475826
STORY4	3.33	0.61	18	16X32	20X40	57180.75	865.05	865.05	0.000882	0.116424	132	1	0.058301164
STORY3	3.33	0.41	18	16X32	20X40	60754.55	910.43	910.43	0.000884	0.116688	132	1	0.058990831
STORY2	3.33	0.2	18	16X32	20X40	64328.35	953.24	953.24	0.000742	0.097944	132	1	0.050073052
STORY1	3.33	0	18	16X32	20X40	67632.56	985.62	985.62	0.000278	0.036696	132	1	0.019076167

Determination of stability coefficient (Ө) of an 18 storied symmetric building with aspect ratio 3.33

Floor	Aspect Ratio (L/W)	Aspect Ratio (H/W)	Number of Story	Exterior Column Size	Interior Column Size	Vertical Design Load (P)	Story Shear (Vx)	Absolute Value (Vx)	DriftX	Design Story Drift Δ (Inch)	Floor Height (hsx)	Deflection Amplification Factor (Cd)	Stability Coefficient (θ)
STORY21	3.33	4.07	20	14X24,18X34	20X40,22X42	3585.13	31.8	31.8	0.000106	0.013992	132	1	0.011950433
STORY20	3.33	3.87	20	14X24,18X34	20X40,22X42	7170.25	95.02	95.02	0.000164	0.021648	132	1	0.01237551
STORY19	3.33	3.67	20	14X24,18X34	20X40,22X42	10755.38	157.66	157.66	0.000233	0.030756	132	1	0.015894986
STORY18	3.33	3.46	20	14X24,18X34	20X40,22X42	14340.51	219.7	219.7	0.000303	0.039996	132	1	0.019777763
STORY17	3.33	3.26	20	14X24,18X34	20X40,22X42	17925.63	281.12	281.12	0.000373	0.049236	132	1	0.023784363
STORY16	3.33	3.06	20	14X24,18X34	20X40,22X42	21510.76	341.89	341.89	0.000443	0.058476	132	1	0.027872318
STORY15	3.33	2.85	20	14X24,18X34	20X40,22X42	25095.88	401.97	401.97	0.000511	0.067452	132	1	0.031902865
STORY14	3.33	2.65	20	14X24,18X34	20X40,22X42	28681.01	461.34	461.34	0.000578	0.076296	132	1	0.035933636
STORY13	3.33	2.44	20	14X24,18X34	20X40,22X42	32266.14	519.96	519.96	0.000644	0.085008	132	1	0.039963447
STORY12	3.33	2.24	20	14X24,18X34	20X40,22X42	35851.26	577.77	577.77	0.000709	0.093588	132	1	0.043994225
STORY11	3.33	2.04	20	14X24,18X34	20X40,22X42	39436.39	634.73	634.73	0.000772	0.101904	132	1	0.047965108
STORY10	3.33	1.83	20	14X24,18X34	20X40,22X42	43021.52	690.78	690.78	0.000834	0.110088	132	1	0.051941208
STORY9	3.33	1.63	20	14X24,18X34	20X40,22X42	46606.64	745.85	745.85	0.000894	0.118008	132	1	0.05586423
STORY8	3.33	1.43	20	14X24,18X34	20X40,22X42	50191.77	799.85	799.85	0.000952	0.125664	132	1	0.059739407
STORY7	3.33	1.22	20	14X24,18X34	20X40,22X42	53776.89	852.67	852.67	0.001009	0.133188	132	1	0.063636438
STORY6	3.33	1.02	20	14X24,18X34	20X40,22X42	57362.02	904.18	904.18	0.001063	0.140316	132	1	0.067437708
STORY5	3.33	0.81	20	14X24,18X34	20X40,22X42	60947.15	954.2	954.2	0.001112	0.146784	132	1	0.071026232
STORY4	3.33	0.61	20	14X24,18X34	20X40,22X42	64532.27	1002.45	1002.45	0.001152	0.152064	132	1	0.074159484
STORY3	3.33	0.41	20	14X24,18X34	20X40,22X42	68117.4	1048.53	1048.53	0.001153	0.152196	132	1	0.074904259
STORY2	3.33	0.2	20	14X24,18X34	20X40,22X42	71702.53	1092.05	1092.05	0.000974	0.128568	132	1	0.063951526
STORY1	3.33	0	20	14X24,18X34	20X40,22X42	75012.92	1124.98	1124.98	0.00036	0.04752	132	1	0.024004561

Determination of stability coefficient (ϴ) of a 20 storied symmetric building with aspect ratio 3.33

Floor	Aspect Ratio (L/W)	Aspect Ratio (H/W)	Number of Story	Exterior Column Size	Interior Column Size	Vertical Design Load (P)	Story Shear (Vx)	Absolute Value (Vx)	DriftX	Design Story Drift Δ (Inch)	Floor Height (hsx)	Deflection Amplification Factor (Cd)	Stability Coefficient (θ)
STORY23	3.33	4.48	22	16X26,20X36	22X42,26X44	3652.44	33.03	33.03	0.000113	0.014916	132	1	0.01249548
STORY22	3.33	4.28	22	16X26,20X36	22X42,26X44	7304.88	98.74	98.74	0.000167	0.022044	132	1	0.01235482
STORY21	3.33	4.07	22	16X26,20X36	22X42,26X44	10957.33	163.91	163.91	0.000232	0.030624	132	1	0.015509124
STORY20	3.33	3.87	22	16X26,20X36	22X42,26X44	14609.77	228.51	228.51	0.000299	0.039468	132	1	0.019116543
STORY19	3.33	3.67	22	16X26,20X36	22X42,26X44	18262.21	292.53	292.53	0.000366	0.048312	132	1	0.022848832
STORY18	3.33	3.46	22	16X26,20X36	22X42,26X44	21914.65	355.95	355.95	0.000432	0.057024	132	1	0.026596794
STORY17	3.33	3.26	22	16X26,20X36	22X42,26X44	25567.09	418.73	418.73	0.000498	0.065736	132	1	0.030407209
STORY16	3.33	3.06	22	16X26,20X36	22X42,26X44	29219.54	480.86	480.86	0.000563	0.074316	132	1	0.034210791
STORY15	3.33	2.85	22	16X26,20X36	22X42,26X44	32871.98	542.29	542.29	0.000626	0.082632	132	1	0.037946227
STORY14	3.33	2.65	22	16X26,20X36	22X42,26X44	36524.42	603.01	603.01	0.000689	0.090948	132	1	0.041732849
STORY13	3.33	2.44	22	16X26,20X36	22X42,26X44	40176.86	662.95	662.95	0.000751	0.099132	132	1	0.045512968
STORY12	3.33	2.24	22	16X26,20X36	22X42,26X44	43829.3	722.09	722.09	0.000811	0.107052	132	1	0.049225945
STORY11	3.33	2.04	22	16X26,20X36	22X42,26X44	47481.75	780.37	780.37	0.00087	0.11484	132	1	0.052935303
STORY10	3.33	1.83	22	16X26,20X36	22X42,26X44	51134.19	837.72	837.72	0.000928	0.122496	132	1	0.056644855
STORY9	3.33	1.63	22	16X26,20X36	22X42,26X44	54786.63	894.08	894.08	0.000983	0.129756	132	1	0.06023539
STORY8	3.33	1.43	22	16X26,20X36	22X42,26X44	58439.07	949.36	949.36	0.001038	0.137016	132	1	0.063895419
STORY7	3.33	1.22	22	16X26,20X36	22X42,26X44	62091.51	1003.45	1003.45	0.00109	0.14388	132	1	0.067447054
STORY6	3.33	1.02	22	16X26,20X36	22X42,26X44	65743.96	1056.22	1056.22	0.001139	0.150348	132	1	0.070896566
STORY5	3.33	0.81	22	16X26,20X36	22X42,26X44	69396.4	1107.46	1107.46	0.001183	0.156156	132	1	0.074129938
STORY4	3.33	0.61	22	16X26,20X36	22X42,26X44	73048.84	1156.93	1156.93	0.001213	0.160116	132	1	0.076589113
STORY3	3.33	0.41	22	16X26,20X36	22X42,26X44	76701.28	1204.21	1204.21	0.001192	0.157344	132	1	0.075923573
STORY2	3.33	0.2	22	16X26,20X36	22X42,26X44	80353.72	1248.89	1248.89	0.000973	0.128436	132	1	0.062602927
STORY1	3.33	0	22	16X26,20X36	22X42,26X44	83700.84	1282.71	1282.71	0.000357	0.047124	132	1	0.023295367

Determination of stability coefficient (ϴ) of a 22 storied symmetric building with aspect ratio 3.33

Floor	Aspect Ratio (L/W)	Aspect Ratio (H/W)	Number of Story	Exterior Column Size	Interior Column Size	Vertical Design Load (P)	Story Shear (Vx)	Absolute Value (Vx)	DriftX	Design Story Drift Δ (Inch)	Floor Height (hsx)	Deflection Amplification Factor (Cd)	Stability Coefficient (θ)
STORY25	3.33	4.89	24	18X26,22X36	24X42,30X46	3704.36	33.85	33.85	0.000125	0.0165	132	1	0.013679321
STORY24	3.33	4.69	24	18X26,22X36	24X42,30X46	7408.72	101.22	101.22	0.000176	0.023232	132	1	0.012882185
STORY23	3.33	4.48	24	18X26,22X36	24X42,30X46	11113.08	168.08	168.08	0.000238	0.031416	132	1	0.015736037
STORY22	3.33	4.28	24	18X26,22X36	24X42,30X46	14817.43	234.42	234.42	0.000302	0.039864	132	1	0.019089087
STORY21	3.33	4.07	24	18X26,22X36	24X42,30X46	18521.79	300.21	300.21	0.000368	0.048576	132	1	0.022704169
STORY20	3.33	3.87	24	18X26,22X36	24X42,30X46	22226.15	365.44	365.44	0.000432	0.057024	132	1	0.026274345
STORY19	3.33	3.67	24	18X26,22X36	24X42,30X46	25930.51	430.09	430.09	0.000497	0.065604	132	1	0.029964574
STORY18	3.33	3.46	24	18X26,22X36	24X42,30X46	29634.87	494.13	494.13	0.00056	0.07392	132	1	0.033585346
STORY17	3.33	3.26	24	18X26,22X36	24X42,30X46	33339.23	557.54	557.54	0.000623	0.082236	132	1	0.037253543
STORY16	3.33	3.06	24	18X26,22X36	24X42,30X46	37043.59	620.29	620.29	0.000685	0.09042	132	1	0.040908058
STORY15	3.33	2.85	24	18X26,22X36	24X42,30X46	40747.95	682.35	682.35	0.000745	0.09834	132	1	0.044489225
STORY14	3.33	2.65	24	18X26,22X36	24X42,30X46	44452.3	743.69	743.69	0.000805	0.10626	132	1	0.048116959
STORY13	3.33	2.44	24	18X26,22X36	24X42,30X46	48156.66	804.26	804.26	0.000864	0.114048	132	1	0.051733711
STORY12	3.33	2.24	24	18X26,22X36	24X42,30X46	51861.02	864.03	864.03	0.000921	0.121572	132	1	0.055280487
STORY11	3.33	2.04	24	18X26,22X36	24X42,30X46	55565.38	922.93	922.93	0.000977	0.128964	132	1	0.058820687
STORY10	3.33	1.83	24	18X26,22X36	24X42,30X46	59269.74	980.91	980.91	0.001032	0.136224	132	1	0.062356762
STORY9	3.33	1.63	24	18X26,22X36	24X42,30X46	62974.1	1037.9	1037.9	0.001085	0.14322	132	1	0.065831871
STORY8	3.33	1.43	24	18X26,22X36	24X42,30X46	66678.46	1093.8	1093.8	0.001136	0.149952	132	1	0.069250988
STORY7	3.33	1.22	24	18X26,22X36	24X42,30X46	70382.81	1148.52	1148.52	0.001185	0.15642	132	1	0.072618352
STORY6	3.33	1.02	24	18X26,22X36	24X42,30X46	74087.17	1201.91	1201.91	0.00123	0.16236	132	1	0.075818671
STORY5	3.33	0.81	24	18X26,22X36	24X42,30X46	77791.53	1253.78	1253.78	0.001268	0.167376	132	1	0.078673818
STORY4	3.33	0.61	24	18X26,22X36	24X42,30X46	81495.89	1303.88	1303.88	0.001285	0.16962	132	1	0.080315841
STORY3	3.33	0.41	24	18X26,22X36	24X42,30X46	85200.25	1351.78	1351.78	0.00124	0.16368	132	1	0.078154959
STORY2	3.33	0.2	24	18X26,22X36	24X42,30X46	88904.61	1397.09	1397.09	0.000979	0.129228	132	1	0.062299217
STORY1	3.33	0	24	18X26,22X36	24X42,30X46	92280.04	1431.39	1431.39	0.000355	0.04686	132	1	0.022886435

Determination of stability coefficient (Ɵ) of a 24 storied symmetric building with aspect ratio 3.33

Floor	Aspect Ratio (L/W)	Aspect Ratio (H/W)	Number of Story	Exterior Column Size	Interior Column Size	Vertical Design Load (P)	Story Shear (Vx)	Absolute Value (Vx)	DriftX	Design Story Drift Δ (Inch)	Floor Height (hsx)	Deflection Amplification Factor (Cd)	Stability Coefficient (θ)
STORY27	3.33	5.3	26	18X28,24X36	28X44,34X50	3772.99	35.01	35.01	0.00014	0.01848	132	1	0.015087649
STORY26	3.33	5.09	26	18X28,24X36	28X44,34X50	7545.99	104.72	104.72	0.000188	0.024816	132	1	0.013547041
STORY25	3.33	4.89	26	18X28,24X36	28X44,34X50	11318.98	173.94	173.94	0.000249	0.032868	132	1	0.016203438
STORY24	3.33	4.69	26	18X28,24X36	28X44,34X50	15091.98	242.67	242.67	0.000313	0.041316	132	1	0.019465899
STORY23	3.33	4.48	26	18X28,24X36	28X44,34X50	18864.97	310.87	310.87	0.000377	0.049764	132	1	0.022878032
STORY22	3.33	4.28	26	18X28,24X36	28X44,34X50	22637.97	378.55	378.55	0.000442	0.058344	132	1	0.026432394
STORY21	3.33	4.07	26	18X28,24X36	28X44,34X50	26410.96	445.68	445.68	0.000507	0.066924	132	1	0.030044778
STORY20	3.33	3.87	26	18X28,24X36	28X44,34X50	30183.95	512.24	512.24	0.00057	0.07524	132	1	0.033587481
STORY19	3.33	3.67	26	18X28,24X36	28X44,34X50	33956.95	578.21	578.21	0.000633	0.083556	132	1	0.037174641
STORY18	3.33	3.46	26	18X28,24X36	28X44,34X50	37729.94	643.57	643.57	0.000696	0.091872	132	1	0.040803702
STORY17	3.33	3.26	26	18X28,24X36	28X44,34X50	41502.94	708.29	708.29	0.000757	0.099924	132	1	0.04435715
STORY16	3.33	3.06	26	18X28,24X36	28X44,34X50	45275.93	772.35	772.35	0.000818	0.107976	132	1	0.047951979
STORY15	3.33	2.85	26	18X28,24X36	28X44,34X50	49048.93	835.71	835.71	0.000877	0.115764	132	1	0.051472295
STORY14	3.33	2.65	26	18X28,24X36	28X44,34X50	52821.92	898.33	898.33	0.000935	0.12342	132	1	0.054978121
STORY13	3.33	2.44	26	18X28,24X36	28X44,34X50	56594.91	960.18	960.18	0.000993	0.131076	132	1	0.058529386
STORY12	3.33	2.24	26	18X28,24X36	28X44,34X50	60367.91	1021.21	1021.21	0.001049	0.138468	132	1	0.062010691
STORY11	3.33	2.04	26	18X28,24X36	28X44,34X50	64140.9	1081.37	1081.37	0.001103	0.145596	132	1	0.065423872
STORY10	3.33	1.83	26	18X28,24X36	28X44,34X50	67913.9	1140.6	1140.6	0.001156	0.152592	132	1	0.068830851
STORY9	3.33	1.63	26	18X28,24X36	28X44,34X50	71686.89	1198.83	1198.83	0.001208	0.159456	132	1	0.072235232
STORY8	3.33	1.43	26	18X28,24X36	28X44,34X50	75459.89	1255.96	1255.96	0.001257	0.165924	132	1	0.075522375
STORY7	3.33	1.22	26	18X28,24X36	28X44,34X50	79232.88	1311.89	1311.89	0.001303	0.171996	132	1	0.07869596
STORY6	3.33	1.02	26	18X28,24X36	28X44,34X50	83005.87	1366.48	1366.48	0.001345	0.17754	132	1	0.081701082
STORY5	3.33	0.81	26	18X28,24X36	28X44,34X50	86778.87	1419.53	1419.53	0.001374	0.181368	132	1	0.083995525
STORY4	3.33	0.61	26	18X28,24X36	28X44,34X50	90551.86	1470.79	1470.79	0.001375	0.1815	132	1	0.084654375
STORY3	3.33	0.41	26	18X28,24X36	28X44,34X50	94324.86	1519.82	1519.82	0.001295	0.17094	132	1	0.080371816
STORY2	3.33	0.2	26	18X28,24X36	28X44,34X50	98097.85	1566.24	1566.24	0.000984	0.129888	132	1	0.061630583
STORY1	3.33	0	26	18X28,24X36	28X44,34X50	101510.7	1601.39	1601.39	0.00035	0.0462	132	1	0.022186196

Determination of stability coefficient (Ɵ) of a 26 storied symmetric building with aspect ratio 3.33

Floor	Aspect Ratio (L/W)	Aspect Ratio (H/W)	Number of Story	Exterior Column Size	Interior Column Size	Vertical Design Load (P)	Story Shear (Vx)	Absolute Value (Vx)	DriftX	Design Story Drift Δ (Inch)	Floor Height (hsx)	Deflection Amplification Factor (Cd)	Stability Coefficient (θ)
STORY29	3.33	5.7	28	18X30,24X38	30X46,36X54	3822.93	36.15	36.15	0.000158	0.020856	132	1	0.016708795
STORY28	3.33	5.5	28	18X30,24X38	30X46,36X54	7645.86	108.14	108.14	0.000206	0.027192	132	1	0.01456489
STORY27	3.33	5.3	28	18X30,24X38	30X46,36X54	11468.79	179.67	179.67	0.000267	0.035244	132	1	0.017043285
STORY26	3.33	5.09	28	18X30,24X38	30X46,36X54	15291.72	250.73	250.73	0.000332	0.043824	132	1	0.020248279
STORY25	3.33	4.89	28	18X30,24X38	30X46,36X54	19114.66	321.29	321.29	0.000398	0.052536	132	1	0.023678405
STORY24	3.33	4.69	28	18X30,24X38	30X46,36X54	22937.59	391.35	391.35	0.000464	0.061248	132	1	0.027195712
STORY23	3.33	4.48	28	18X30,24X38	30X46,36X54	26760.52	460.89	460.89	0.00053	0.06996	132	1	0.030773234
STORY22	3.33	4.28	28	18X30,24X38	30X46,36X54	30583.45	529.89	529.89	0.000596	0.078672	132	1	0.034399095
STORY21	3.33	4.07	28	18X30,24X38	30X46,36X54	34406.38	598.34	598.34	0.00066	0.08712	132	1	0.037952019
STORY20	3.33	3.87	28	18X30,24X38	30X46,36X54	38229.31	666.21	666.21	0.000725	0.0957	132	1	0.041602873
STORY19	3.33	3.67	28	18X30,24X38	30X46,36X54	42052.24	733.49	733.49	0.000788	0.104016	132	1	0.045177392
STORY18	3.33	3.46	28	18X30,24X38	30X46,36X54	45875.17	800.15	800.15	0.00085	0.1122	132	1	0.048733231
STORY17	3.33	3.26	28	18X30,24X38	30X46,36X54	49698.1	866.16	866.16	0.000912	0.120384	132	1	0.052328285
STORY16	3.33	3.06	28	18X30,24X38	30X46,36X54	53521.04	931.5	931.5	0.000973	0.128436	132	1	0.055905499
STORY15	3.33	2.85	28	18X30,24X38	30X46,36X54	57343.97	996.13	996.13	0.001032	0.136224	132	1	0.059408889
STORY14	3.33	2.65	28	18X30,24X38	30X46,36X54	61166.9	1060.02	1060.02	0.001091	0.144012	132	1	0.062954555
STORY13	3.33	2.44	28	18X30,24X38	30X46,36X54	64989.83	1123.13	1123.13	0.001148	0.151536	132	1	0.066428931
STORY12	3.33	2.24	28	18X30,24X38	30X46,36X54	68812.76	1185.42	1185.42	0.001204	0.158928	132	1	0.069891315
STORY11	3.33	2.04	28	18X30,24X38	30X46,36X54	72635.69	1246.82	1246.82	0.001258	0.166056	132	1	0.073287001
STORY10	3.33	1.83	28	18X30,24X38	30X46,36X54	76458.62	1307.28	1307.28	0.001311	0.173052	132	1	0.076676191
STORY9	3.33	1.63	28	18X30,24X38	30X46,36X54	80281.55	1366.72	1366.72	0.001362	0.179784	132	1	0.080004296
STORY8	3.33	1.43	28	18X30,24X38	30X46,36X54	84104.48	1425.06	1425.06	0.00141	0.18612	132	1	0.083215666
STORY7	3.33	1.22	28	18X30,24X38	30X46,36X54	87927.41	1482.19	1482.19	0.001455	0.19206	132	1	0.086314428
STORY6	3.33	1.02	28	18X30,24X38	30X46,36X54	91750.35	1537.95	1537.95	0.001494	0.197208	132	1	0.0891284
STORY5	3.33	0.81	28	18X30,24X38	30X46,36X54	95573.28	1592.17	1592.17	0.001517	0.200244	132	1	0.091061046
STORY4	3.33	0.61	28	18X30,24X38	30X46,36X54	99396.21	1644.57	1644.57	0.001504	0.198528	132	1	0.090900296
STORY3	3.33	0.41	28	18X30,24X38	30X46,36X54	103219.1	1694.72	1694.72	0.001398	0.184536	132	1	0.08514702
STORY2	3.33	0.2	28	18X30,24X38	30X46,36X54	107042.1	1742.22	1742.22	0.001041	0.137412	132	1	0.063959084
STORY1	3.33	0	28	18X30,24X38	30X46,36X54	110482.2	1778.2	1778.2	0.000366	0.048312	132	1	0.022740118

Determination of stability coefficient (Ɵ) of a 28 storied symmetric building with aspect ratio 3.33

Floor	Aspect Ratio (L/W)	Aspect Ratio (H/W)	Number of Story	Exterior Column Size	Interior Column Size	Vertical Design Load (P)	Story Shear (Vx)	Absolute Value (Vx)	DriftX	Design Story Drift Δ (Inch)	Floor Height (hsx)	Deflection Amplification Factor (Cd)	Stability Coefficient (θ)
STORY31	3.33	6.11	30	18X34,26X42	34X50,38X58	3903.89	37.27	37.27	0.000176	0.023232	132	1	0.018435327
STORY30	3.33	5.91	30	18X34,26X42	34X50,38X58	7807.77	111.5	111.5	0.000222	0.029304	132	1	0.015545515
STORY29	3.33	5.7	30	18X34,26X42	34X50,38X58	11711.66	185.3	185.3	0.000282	0.037224	132	1	0.017823465
STORY28	3.33	5.5	30	18X34,26X42	34X50,38X58	15615.54	258.63	258.63	0.000346	0.045672	132	1	0.020890758
STORY27	3.33	5.3	30	18X34,26X42	34X50,38X58	19519.43	331.5	331.5	0.000413	0.054516	132	1	0.024318325
STORY26	3.33	5.09	30	18X34,26X42	34X50,38X58	23423.32	403.89	403.89	0.00048	0.06336	132	1	0.027837267
STORY25	3.33	4.89	30	18X34,26X42	34X50,38X58	27327.2	475.78	475.78	0.000547	0.072204	132	1	0.031417837
STORY24	3.33	4.69	30	18X34,26X42	34X50,38X58	31231.09	547.15	547.15	0.000614	0.081048	132	1	0.03504686
STORY23	3.33	4.48	30	18X34,26X42	34X50,38X58	35134.97	618.01	618.01	0.00068	0.08976	132	1	0.038659212
STORY22	3.33	4.28	30	18X34,26X42	34X50,38X58	39038.86	688.32	688.32	0.000745	0.09834	132	1	0.042253531
STORY21	3.33	4.07	30	18X34,26X42	34X50,38X58	42942.74	758.07	758.07	0.00081	0.10692	132	1	0.045884443
STORY20	3.33	3.87	30	18X34,26X42	34X50,38X58	46846.63	827.24	827.24	0.000874	0.115368	132	1	0.04949465
STORY19	3.33	3.67	30	18X34,26X42	34X50,38X58	50750.52	895.81	895.81	0.000937	0.123684	132	1	0.053084066
STORY18	3.33	3.46	30	18X34,26X42	34X50,38X58	54654.4	963.75	963.75	0.000999	0.131868	132	1	0.056653433
STORY17	3.33	3.26	30	18X34,26X42	34X50,38X58	58558.29	1031.03	1031.03	0.001061	0.140052	132	1	0.060260464
STORY16	3.33	3.06	30	18X34,26X42	34X50,38X58	62462.17	1097.64	1097.64	0.001121	0.147972	132	1	0.063791491
STORY15	3.33	2.85	30	18X34,26X42	34X50,38X58	66366.06	1163.53	1163.53	0.00118	0.15576	132	1	0.067305485
STORY14	3.33	2.65	30	18X34,26X42	34X50,38X58	70269.95	1228.68	1228.68	0.001238	0.163416	132	1	0.070802974
STORY13	3.33	2.44	30	18X34,26X42	34X50,38X58	74173.83	1293.03	1293.03	0.001295	0.17094	132	1	0.074286838
STORY12	3.33	2.24	30	18X34,26X42	34X50,38X58	78077.72	1356.55	1356.55	0.00135	0.1782	132	1	0.077700728
STORY11	3.33	2.04	30	18X34,26X42	34X50,38X58	81981.6	1419.18	1419.18	0.001404	0.185328	132	1	0.081104699
STORY10	3.33	1.83	30	18X34,26X42	34X50,38X58	85885.49	1480.85	1480.85	0.001456	0.192192	132	1	0.084444254
STORY9	3.33	1.63	30	18X34,26X42	34X50,38X58	89789.38	1541.5	1541.5	0.001506	0.198792	132	1	0.087721574
STORY8	3.33	1.43	30	18X34,26X42	34X50,38X58	93693.26	1601.03	1601.03	0.001553	0.204996	132	1	0.090882515
STORY7	3.33	1.22	30	18X34,26X42	34X50,38X58	97597.15	1659.33	1659.33	0.001596	0.210672	132	1	0.093872257
STORY6	3.33	1.02	30	18X34,26X42	34X50,38X58	101501	1716.26	1716.26	0.001628	0.214896	132	1	0.096281261
STORY5	3.33	0.81	30	18X34,26X42	34X50,38X58	105404.9	1771.62	1771.62	0.001641	0.216612	132	1	0.097633507
STORY4	3.33	0.61	30	18X34,26X42	34X50,38X58	109308.8	1825.15	1825.15	0.001608	0.212256	132	1	0.096303628
STORY3	3.33	0.41	30	18X34,26X42	34X50,38X58	113212.7	1876.4	1876.4	0.001466	0.193512	132	1	0.088451185
STORY2	3.33	0.2	30	18X34,26X42	34X50,38X58	117116.6	1924.97	1924.97	0.001062	0.140184	132	1	0.064612855
STORY1	3.33	0	30	18X34,26X42	34X50,38X58	120600.8	1961.78	1961.78	0.000368	0.048576	132	1	0.022622878

Determination of stability coefficient (Ɵ) of a 30 storied symmetric building with aspect ratio 3.33

Floor	Aspect Ratio (L/W)	Aspect Ratio (H/W)	Number of Story	Exterior Column Size	Interior Column Size	Vertical Design Load (P)	Story Shear (Vx)	Absolute Value (Vx)	DriftX	Design Story Drift Δ (Inch)	Floor Height (hsx)	Deflection Amplification Factor (Cd)	Stability Coefficient (θ)
STORY3	5.95	0.52	2	12x12	12x12	3343.34	12.86	12.86	0.00006	0.00792	132	1	0.015598787
STORY2	5.95	0.26	2	12x12	12x12	6686.68	37.28	37.28	0.000154	0.020328	132	1	0.027622015
STORY1	5.95	0	2	12x12	12x12	7260.48	37.28	37.28	0.000055	0.00726	132	1	0.010711545

Determination of stability coefficient (Ө) of a 2 storied symmetric building with aspect ratio 5.95

Floor	Aspect Ratio (L/W)	Aspect Ratio (H/W)	Number of Story	Exterior Column Size	Interior Column Size	Vertical Design Load (P)	Story Shear (Vx)	Absolute Value (Vx)	DriftX	Design Story Drift Δ (Inch)	Floor Height (hsx)	Deflection Amplification Factor (Cd)	Stability Coefficient (θ)
STORY5	5.95	1.05	4	12X14	12X20	3369.74	15.36	15.36	0.00006	0.00792	132	1	0.013163047
STORY4	5.95	0.79	4	12X14	12X20	6739.48	45.16	45.16	0.000162	0.021384	132	1	0.024176168
STORY3	5.95	0.52	4	12X14	12X20	10109.22	73.32	73.32	0.000262	0.034584	132	1	0.036124054
STORY2	5.95	0.26	4	12X14	12X20	13478.95	99.57	99.57	0.000341	0.045012	132	1	0.046161715
STORY1	5.95	0	4	12X14	12X20	14067.16	99.57	99.57	0.000122	0.016104	132	1	0.01723605

Determination of stability coefficient (Ө) of a 4 storied symmetric building with aspect ratio 5.95

Floor	Aspect Ratio (L/W)	Aspect Ratio (H/W)	Number of Story	Exterior Column Size	Interior Column Size	Vertical Design Load (P)	Story Shear (Vx)	Absolute Value (Vx)	DriftX	Design Story Drift Δ (Inch)	Floor Height (hsx)	Deflection Amplification Factor (Cd)	Stability Coefficient (θ)
STORY7	5.95	1.57	6	12X22	14X22	3442.55	17.12	17.12	0.000043	0.005676	132	1	0.008646592
STORY6	5.95	1.31	6	12X22	14X22	6885.11	50.68	50.68	0.00011	0.01452	132	1	0.014944004
STORY5	5.95	1.05	6	12X22	14X22	10327.66	83.11	83.11	0.000179	0.023628	132	1	0.022243426
STORY4	5.95	0.79	6	12X22	14X22	13770.22	114.23	114.23	0.000245	0.03234	132	1	0.029534307
STORY3	5.95	0.52	6	12X22	14X22	17212.77	143.71	143.71	0.000307	0.040524	132	1	0.036770722
STORY2	5.95	0.26	6	12X22	14X22	20655.32	171.27	171.27	0.00034	0.04488	132	1	0.041004314
STORY1	5.95	0	6	12X22	14X22	21283.24	171.27	171.27	0.000129	0.017028	132	1	0.016030466

Determination of stability coefficient (Ө) of a 6 storied symmetric building with aspect ratio 5.95

Floor	Aspect Ratio (L/W)	Aspect Ratio (H/W)	Number of Story	Exterior Column Size	Interior Column Size	Vertical Design Load (P)	Story Shear (Vx)	Absolute Value (Vx)	DriftX	Design Story Drift Δ (Inch)	Floor Height (hsx)	Deflection Amplification Factor (Cd)	Stability Coefficient (θ)
STORY9	5.95	2.1	8	14X24	14X26	3466.42	18.51	18.51	0.000045	0.00594	132	1	0.008427277
STORY8	5.95	1.83	8	14X24	14X26	6932.84	55	55	0.000113	0.014916	132	1	0.014243835
STORY7	5.95	1.57	8	14X24	14X26	10399.27	90.6	90.6	0.000183	0.024156	132	1	0.021005148
STORY6	5.95	1.31	8	14X24	14X26	13865.69	125.21	125.21	0.000252	0.033264	132	1	0.027906348
STORY5	5.95	1.05	8	14X24	14X26	17332.11	158.7	158.7	0.000319	0.042108	132	1	0.034838961
STORY4	5.95	0.79	8	14X24	14X26	20798.53	190.86	190.86	0.000383	0.050556	132	1	0.041736545
STORY3	5.95	0.52	8	14X24	14X26	24264.96	221.4	221.4	0.000441	0.058212	132	1	0.048332644
STORY2	5.95	0.26	8	14X24	14X26	27731.38	250	250	0.000464	0.061248	132	1	0.051469441
STORY1	5.95	0	8	14X24	14X26	28372.32	250	250	0.000176	0.023232	132	1	0.019974113

Determination of stability coefficient (Ө) of an 8 storied symmetric building with aspect ratio 5.95

Floor	Aspect Ratio (L/W)	Aspect Ratio (H/W)	Number of Story	Exterior Column Size	Interior Column Size	Vertical Design Load (P)	Story Shear (Vx)	Absolute Value (Vx)	DriftX	Design Story Drift Δ (Inch)	Floor Height (hsx)	Deflection Amplification Factor (Cd)	Stability Coefficient (θ)
STORY11	5.95	2.62	10	14X26	16X30	3533.85	19.69	19.69	0.000041	0.005412	132	1	0.007358448
STORY10	5.95	2.36	10	14X26	16X30	7067.7	58.6	58.6	0.000095	0.01254	132	1	0.011457875
STORY9	5.95	2.1	10	14X26	16X30	10601.54	96.77	96.77	0.000154	0.020328	132	1	0.016871315
STORY8	5.95	1.83	10	14X26	16X30	14135.39	134.14	134.14	0.000213	0.028116	132	1	0.02244549
STORY7	5.95	1.57	10	14X26	16X30	17669.24	170.63	170.63	0.000269	0.035508	132	1	0.027855744
STORY6	5.95	1.31	10	14X26	16X30	21203.09	206.13	206.13	0.000325	0.0429	132	1	0.03343038
STORY5	5.95	1.05	10	14X26	16X30	24736.94	240.51	240.51	0.000378	0.049896	132	1	0.038878065
STORY4	5.95	0.79	10	14X26	16X30	28270.78	273.56	273.56	0.000429	0.056628	132	1	0.044334569
STORY3	5.95	0.52	10	14X26	16X30	31804.63	304.98	304.98	0.000472	0.062304	132	1	0.049222196
STORY2	5.95	0.26	10	14X26	16X30	35338.48	334.48	334.48	0.000467	0.061644	132	1	0.049339483
STORY1	5.95	0	10	14X26	16X30	36016.2	334.48	334.48	0.000181	0.023892	132	1	0.019489752

Determination of stability coefficient (Ө) of a 10 storied symmetric building with aspect ratio 5.95

Floor	Aspect Ratio (L/W)	Aspect Ratio (H/W)	Number of Story	Exterior Column Size	Interior Column Size	Vertical Design Load (P)	Story Shear (Vx)	Absolute Value (Vx)	DriftX	Design Story Drift Δ (Inch)	Floor Height (hsx)	Deflection Amplification Factor (Cd)	Stability Coefficient (θ)
STORY13	5.95	3.14	12	14X28	16X32	3552.77	20.71	20.71	0.000044	0.005808	132	1	0.007548135
STORY12	5.95	2.88	12	14X28	16X32	7105.53	61.72	61.72	0.0001	0.0132	132	1	0.011512524
STORY11	5.95	2.62	12	14X28	16X32	10658.3	102.09	102.09	0.000161	0.021252	132	1	0.016808564
STORY10	5.95	2.36	12	14X28	16X32	14211.07	141.78	141.78	0.000221	0.029172	132	1	0.022151548
STORY9	5.95	2.1	12	14X28	16X32	17763.83	180.72	180.72	0.00028	0.03696	132	1	0.027522534
STORY8	5.95	1.83	12	14X28	16X32	21316.6	218.87	218.87	0.000338	0.044616	132	1	0.032919134
STORY7	5.95	1.57	12	14X28	16X32	24869.37	256.13	256.13	0.000394	0.052008	132	1	0.038256088
STORY6	5.95	1.31	12	14X28	16X32	28422.13	292.41	292.41	0.000449	0.059268	132	1	0.043642613
STORY5	5.95	1.05	12	14X28	16X32	31974.9	327.56	327.56	0.000502	0.066264	132	1	0.04900293
STORY4	5.95	0.79	12	14X28	16X32	35527.67	361.39	361.39	0.000552	0.072864	132	1	0.054266233
STORY3	5.95	0.52	12	14X28	16X32	39080.44	393.58	393.58	0.000593	0.078276	132	1	0.058881805
STORY2	5.95	0.26	12	14X28	16X32	42633.2	423.85	423.85	0.000575	0.0759	132	1	0.057836711
STORY1	5.95	0	12	14X28	16X32	43321.24	423.85	423.85	0.000223	0.029436	132	1	0.022792584

Determination of stability coefficient (Ө) of a 12 storied symmetric building with aspect ratio 5.95

Floor	Aspect Ratio (L/W)	Aspect Ratio (H/W)	Number of Story	Exterior Column Size	Interior Column Size	Vertical Design Load (P)	Story Shear (Vx)	Absolute Value (Vx)	DriftX	Design Story Drift Δ (Inch)	Floor Height (hsx)	Deflection Amplification Factor (Cd)	Stability Coefficient (θ)
STORY15	5.95	3.67	14	14X30	18X36	3629.76	21.87	21.87	0.000045	0.00594	132	1	0.007468642
STORY14	5.95	3.4	14	14X30	18X36	7259.52	65.25	65.25	0.000093	0.012276	132	1	0.010346902
STORY13	5.95	3.14	14	14X30	18X36	10889.29	108.05	108.05	0.000148	0.019536	132	1	0.014915455
STORY12	5.95	2.88	14	14X30	18X36	14519.05	150.24	150.24	0.000203	0.026796	132	1	0.019617726
STORY11	5.95	2.62	14	14X30	18X36	18148.81	191.78	191.78	0.000257	0.033924	132	1	0.024320806
STORY10	5.95	2.36	14	14X30	18X36	21778.57	232.63	232.63	0.00031	0.04092	132	1	0.029021866
STORY9	5.95	2.1	14	14X30	18X36	25408.33	272.74	272.74	0.000362	0.047784	132	1	0.03372375
STORY8	5.95	1.83	14	14X30	18X36	29038.1	312.03	312.03	0.000413	0.054516	132	1	0.038434559
STORY7	5.95	1.57	14	14X30	18X36	32667.86	350.43	350.43	0.000463	0.061116	132	1	0.043161884
STORY6	5.95	1.31	14	14X30	18X36	36297.62	387.83	387.83	0.000511	0.067452	132	1	0.047825294
STORY5	5.95	1.05	14	14X30	18X36	39927.38	424.1	424.1	0.000557	0.073524	132	1	0.052439403
STORY4	5.95	0.79	14	14X30	18X36	43557.14	459.02	459.02	0.000599	0.079068	132	1	0.056840065
STORY3	5.95	0.52	14	14X30	18X36	47186.91	492.3	492.3	0.000627	0.082764	132	1	0.060097893
STORY2	5.95	0.26	14	14X30	18X36	50816.67	523.62	523.62	0.000577	0.076164	132	1	0.055997133
STORY1	5.95	0	14	14X30	18X36	51546.7	523.62	523.62	0.000224	0.029568	132	1	0.022051222

Determination of stability coefficient (Ө) of a 14 storied symmetric building with aspect ratio 5.95

Floor	Aspect Ratio (L/W)	Aspect Ratio (H/W)	Number of Story	Exterior Column Size	Interior Column Size	Vertical Design Load (P)	Story Shear (Vx)	Absolute Value (Vx)	DriftX	Design Story Drift Δ (Inch)	Floor Height (hsx)	Deflection Amplification Factor (Cd)	Stability Coefficient (θ)
STORY17	5.95	4.19	16	16X34, 20X40	20X38	3702.14	22.97	22.97	0.000048	0.006336	132	1	0.007736296
STORY16	5.95	3.93	16	16X34, 20X40	20X38	7404.27	68.56	68.56	0.000093	0.012276	132	1	0.010043715
STORY15	5.95	3.67	16	16X34, 20X40	20X38	11106.41	113.63	113.63	0.000145	0.01914	132	1	0.014172573
STORY14	5.95	3.4	16	16X34, 20X40	20X38	14808.55	158.15	158.15	0.000197	0.026004	132	1	0.018446313
STORY13	5.95	3.14	16	16X34, 20X40	20X38	18510.69	202.09	202.09	0.00025	0.033	132	1	0.022899067
STORY12	5.95	2.88	16	16X34, 20X40	20X38	22212.82	245.41	245.41	0.000301	0.039732	132	1	0.027244443
STORY11	5.95	2.62	16	16X34, 20X40	20X38	25914.96	288.08	288.08	0.000352	0.046464	132	1	0.031665044
STORY10	5.95	2.36	16	16X34, 20X40	20X38	29617.1	330.05	330.05	0.000402	0.053064	132	1	0.036073547
STORY9	5.95	2.1	16	16X34, 20X40	20X38	33319.24	371.26	371.26	0.00045	0.0594	132	1	0.04038587
STORY8	5.95	1.83	16	16X34, 20X40	20X38	37021.37	411.65	411.65	0.000498	0.065736	132	1	0.044787179
STORY7	5.95	1.57	16	16X34, 20X40	20X38	40723.51	451.14	451.14	0.000544	0.071808	132	1	0.049105797
STORY6	5.95	1.31	16	16X34, 20X40	20X38	44425.65	489.62	489.62	0.000589	0.077748	132	1	0.05344289
STORY5	5.95	1.05	16	16X34, 20X40	20X38	48127.78	526.94	526.94	0.000632	0.083424	132	1	0.057723378
STORY4	5.95	0.79	16	16X34, 20X40	20X38	51829.92	562.91	562.91	0.000669	0.088308	132	1	0.061598153
STORY3	5.95	0.52	16	16X34, 20X40	20X38	55532.06	597.22	597.22	0.000684	0.090288	132	1	0.063601234
STORY2	5.95	0.26	16	16X34, 20X40	20X38	59234.2	629.55	629.55	0.0006	0.0792	132	1	0.056453848
STORY1	5.95	0	16	16X34, 20X40	20X38	60003.71	629.55	629.55	0.000231	0.030492	132	1	0.022017087

Determination of stability coefficient (Ө) of a 16 storied symmetric building with aspect ratio 5.95

Floor	Aspect Ratio (L/W)	Aspect Ratio (H/W)	Number of Story	Exterior Column Size	Interior Column Size	Vertical Design Load (P)	Story Shear (Vx)	Absolute Value (Vx)	DriftX	Design Story Drift Δ (Inch)	Floor Height (hsx)	Deflection Amplification Factor (Cd)	Stability Coefficient (θ)
STORY19	5.95	4.71	18	20X36, 24X42	20X42	3797.39	24.01	24.01	0.000053	0.006996	132	1	0.00838241
STORY18	5.95	4.45	18	20X36, 24X42	20X42	7594.78	71.72	71.72	0.000094	0.012408	132	1	0.009954118
STORY17	5.95	4.19	18	20X36, 24X42	20X42	11392.17	118.94	118.94	0.000144	0.019008	132	1	0.013792437
STORY16	5.95	3.93	18	20X36, 24X42	20X42	15189.56	165.65	165.65	0.000195	0.02574	132	1	0.017880858
STORY15	5.95	3.67	18	20X36, 24X42	20X42	18986.96	211.83	211.83	0.000246	0.032472	132	1	0.02204972
STORY14	5.95	3.4	18	20X36, 24X42	20X42	22784.35	257.46	257.46	0.000297	0.039204	132	1	0.026283508
STORY13	5.95	3.14	18	20X36, 24X42	20X42	26581.74	302.5	302.5	0.000347	0.045804	132	1	0.030492112
STORY12	5.95	2.88	18	20X36, 24X42	20X42	30379.13	346.91	346.91	0.000396	0.052272	132	1	0.034677973
STORY11	5.95	2.62	18	20X36, 24X42	20X42	34176.52	390.67	390.67	0.000444	0.058608	132	1	0.038841925
STORY10	5.95	2.36	18	20X36, 24X42	20X42	37973.91	433.71	433.71	0.000492	0.064944	132	1	0.043077549
STORY9	5.95	2.1	18	20X36, 24X42	20X42	41771.3	475.99	475.99	0.000538	0.071016	132	1	0.047213091
STORY8	5.95	1.83	18	20X36, 24X42	20X42	45568.69	517.44	517.44	0.000584	0.077088	132	1	0.05143034
STORY7	5.95	1.57	18	20X36, 24X42	20X42	49366.09	557.97	557.97	0.000628	0.082896	132	1	0.055561956
STORY6	5.95	1.31	18	20X36, 24X42	20X42	53163.48	597.49	597.49	0.00067	0.08844	132	1	0.059615277
STORY5	5.95	1.05	18	20X36, 24X42	20X42	56960.87	635.84	635.84	0.000708	0.093456	132	1	0.063425226
STORY4	5.95	0.79	18	20X36, 24X42	20X42	60758.26	672.82	672.82	0.000736	0.097152	132	1	0.066463659
STORY3	5.95	0.52	18	20X36, 24X42	20X42	64555.65	708.11	708.11	0.000731	0.096492	132	1	0.066642443
STORY2	5.95	0.26	18	20X36, 24X42	20X42	68353.04	741.41	741.41	0.000604	0.079728	132	1	0.055684758
STORY1	5.95	0	18	20X36, 24X42	20X42	69174.51	741.41	741.41	0.000227	0.029964	132	1	0.021179393

Determination of stability coefficient (Θ) of an 18 storied symmetric building with aspect ratio 5.95

Floor	Aspect Ratio (L/W)	Aspect Ratio (H/W)	Number of Story	Exterior Column Size	Interior Column Size	Vertical Design Load (P)	Story Shear (Vx)	Absolute Value (Vx)	DriftX	Design Story Drift Δ (Inch)	Floor Height (hsx)	Deflection Amplification Factor (Cd)	Stability Coefficient (θ)
STORY21	5.95	5.24	20	20X36,30X46	18X34,24X36	3907.93	24.45	24.45	0.00007	0.00924	132	1	0.011188348
STORY20	5.95	4.98	20	20X36,30X46	18X34,24X36	7815.87	73.06	73.06	0.000113	0.014916	132	1	0.012088603
STORY19	5.95	4.71	20	20X36,30X46	18X34,24X36	11723.8	121.23	121.23	0.000166	0.021912	132	1	0.016053376
STORY18	5.95	4.45	20	20X36,30X46	18X34,24X36	15631.74	168.94	168.94	0.000221	0.029172	132	1	0.020448766
STORY17	5.95	4.19	20	20X36,30X46	18X34,24X36	19539.67	216.16	216.16	0.000277	0.036564	132	1	0.02503927
STORY16	5.95	3.93	20	20X36,30X46	18X34,24X36	23447.6	262.89	262.89	0.000331	0.043692	132	1	0.029522445
STORY15	5.95	3.67	20	20X36,30X46	18X34,24X36	27355.54	309.09	309.09	0.000386	0.050952	132	1	0.034162342
STORY14	5.95	3.4	20	20X36,30X46	18X34,24X36	31263.47	354.74	354.74	0.000439	0.057948	132	1	0.038689359
STORY13	5.95	3.14	20	20X36,30X46	18X34,24X36	35171.41	399.81	399.81	0.000492	0.064944	132	1	0.043281393
STORY12	5.95	2.88	20	20X36,30X46	18X34,24X36	39079.34	444.27	444.27	0.000544	0.071808	132	1	0.047851894
STORY11	5.95	2.62	20	20X36,30X46	18X34,24X36	42987.28	488.07	488.07	0.000595	0.07854	132	1	0.052405253
STORY10	5.95	2.36	20	20X36,30X46	18X34,24X36	46895.21	531.17	531.17	0.000645	0.08514	132	1	0.056944877
STORY9	5.95	2.1	20	20X36,30X46	18X34,24X36	50803.14	573.51	573.51	0.000694	0.091608	132	1	0.061476485
STORY8	5.95	1.83	20	20X36,30X46	18X34,24X36	54711.08	615.04	615.04	0.000741	0.097812	132	1	0.065915892
STORY7	5.95	1.57	20	20X36,30X46	18X34,24X36	58619.01	655.65	655.65	0.000787	0.103884	132	1	0.070362481
STORY6	5.95	1.31	20	20X36,30X46	18X34,24X36	62526.95	695.26	695.26	0.000831	0.109692	132	1	0.074734481
STORY5	5.95	1.05	20	20X36,30X46	18X34,24X36	66434.88	733.72	733.72	0.00087	0.11484	132	1	0.07877439
STORY4	5.95	0.79	20	20X36,30X46	18X34,24X36	70342.81	770.82	770.82	0.000894	0.118008	132	1	0.081583862
STORY3	5.95	0.52	20	20X36,30X46	18X34,24X36	74250.75	806.26	806.26	0.000876	0.115632	132	1	0.080673303
STORY2	5.95	0.26	20	20X36,30X46	18X34,24X36	78158.68	839.72	839.72	0.000708	0.093456	132	1	0.065898568
STORY1	5.95	0	20	20X36,30X46	18X34,24X36	79040.45	839.72	839.72	0.000263	0.034716	132	1	0.02475544

Determination of stability coefficient (Θ) of a 20 storied symmetric building with aspect ratio 5.95

Floor	Aspect Ratio (L/W)	Aspect Ratio (H/W)	Number of Story	Exterior Column Size	Interior Column Size	Vertical Design Load (P)	Story Shear (Vx)	Absolute Value (Vx)	DriftX	Design Story Drift Δ (Inch)	Floor Height (hsx)	Deflection Amplification Factor (Cd)	Stability Coefficient (θ)
STORY23	5.95	5.76	22	22X38,34X50	20X36,26X38	3992.08	25.11	25.11	0.000075	0.0099	132	1	0.011923775
STORY22	5.95	5.5	22	22X38,34X50	20X36,26X38	7984.16	75.07	75.07	0.000114	0.015048	132	1	0.012124607
STORY21	5.95	5.24	22	22X38,34X50	20X36,26X38	11976.24	124.62	124.62	0.000164	0.021648	132	1	0.01576074
STORY20	5.95	4.98	22	22X38,34X50	20X36,26X38	15968.31	173.74	173.74	0.000217	0.028644	132	1	0.019944303
STORY19	5.95	4.71	22	22X38,34X50	20X36,26X38	19960.39	222.41	222.41	0.00027	0.03564	132	1	0.024231398
STORY18	5.95	4.45	22	22X38,34X50	20X36,26X38	23952.47	270.63	270.63	0.000323	0.042636	132	1	0.028587547
STORY17	5.95	4.19	22	22X38,34X50	20X36,26X38	27944.55	318.36	318.36	0.000376	0.049632	132	1	0.033003992
STORY16	5.95	3.93	22	22X38,34X50	20X36,26X38	31936.63	365.6	365.6	0.000428	0.056496	132	1	0.037387521
STORY15	5.95	3.67	22	22X38,34X50	20X36,26X38	35928.71	412.31	412.31	0.000479	0.063228	132	1	0.041740079
STORY14	5.95	3.4	22	22X38,34X50	20X36,26X38	39920.79	458.46	458.46	0.00053	0.06996	132	1	0.046150196
STORY13	5.95	3.14	22	22X38,34X50	20X36,26X38	43912.87	504.04	504.04	0.00058	0.07656	132	1	0.050530642
STORY12	5.95	2.88	22	22X38,34X50	20X36,26X38	47904.94	549	549	0.000629	0.083028	132	1	0.054885623
STORY11	5.95	2.62	22	22X38,34X50	20X36,26X38	51897.02	593.31	593.31	0.000678	0.089496	132	1	0.059304882
STORY10	5.95	2.36	22	22X38,34X50	20X36,26X38	55889.1	636.92	636.92	0.000725	0.0957	132	1	0.063618033
STORY9	5.95	2.1	22	22X38,34X50	20X36,26X38	59881.18	679.77	679.77	0.000771	0.101772	132	1	0.067917663
STORY8	5.95	1.83	22	22X38,34X50	20X36,26X38	63873.26	721.8	721.8	0.000816	0.107712	132	1	0.072209172
STORY7	5.95	1.57	22	22X38,34X50	20X36,26X38	67865.34	762.92	762.92	0.000858	0.113256	132	1	0.076323155
STORY6	5.95	1.31	22	22X38,34X50	20X36,26X38	71857.42	803.04	803.04	0.000898	0.118536	132	1	0.080354606
STORY5	5.95	1.05	22	22X38,34X50	20X36,26X38	75849.5	842	842	0.00093	0.12276	132	1	0.083776764
STORY4	5.95	0.79	22	22X38,34X50	20X36,26X38	79841.57	879.62	879.62	0.000942	0.124344	132	1	0.085503694
STORY3	5.95	0.52	22	22X38,34X50	20X36,26X38	83833.65	915.56	915.56	0.000899	0.118668	132	1	0.082317326
STORY2	5.95	0.26	22	22X38,34X50	20X36,26X38	87825.73	949.53	949.53	0.000698	0.092136	132	1	0.06456074
STORY1	5.95	0	22	22X38,34X50	20X36,26X38	88753.39	949.53	949.53	0.000255	0.03366	132	1	0.02383507

Determination of stability coefficient (Ɵ) of a 22 storied symmetric building with aspect ratio 5.95

Floor	Aspect Ratio (L/W)	Aspect Ratio (H/W)	Number of Story	Exterior Column Size	Interior Column Size	Vertical Design Load (P)	Story Shear (Vx)	Absolute Value (Vx)	DriftX	Design Story Drift Δ (Inch)	Floor Height (hsx)	Deflection Amplification Factor (Cd)	Stability Coefficient (θ)
STORY25	5.95	6.29	24	24X40,38X54	22X38,28X42	4080.18	26.03	26.03	0.000084	0.011088	132	1	0.013166927
STORY24	5.95	6.02	24	24X40,38X54	22X38,28X42	8160.37	77.84	77.84	0.000121	0.015972	132	1	0.012685056
STORY23	5.95	5.76	24	24X40,38X54	22X38,28X42	12240.55	129.26	129.26	0.000169	0.022308	132	1	0.016003814
STORY22	5.95	5.5	24	24X40,38X54	22X38,28X42	16320.73	180.27	180.27	0.000221	0.029172	132	1	0.020008217
STORY21	5.95	5.24	24	24X40,38X54	22X38,28X42	20400.92	230.87	230.87	0.000274	0.036168	132	1	0.02421212
STORY20	5.95	4.98	24	24X40,38X54	22X38,28X42	24481.1	281.04	281.04	0.000327	0.043164	132	1	0.028484627
STORY19	5.95	4.71	24	24X40,38X54	22X38,28X42	28561.28	330.75	330.75	0.000379	0.050028	132	1	0.032727816
STORY18	5.95	4.45	24	24X40,38X54	22X38,28X42	32641.46	380	380	0.000432	0.057024	132	1	0.037108186
STORY17	5.95	4.19	24	24X40,38X54	22X38,28X42	36721.65	428.77	428.77	0.000483	0.063756	132	1	0.041366133
STORY16	5.95	3.93	24	24X40,38X54	22X38,28X42	40801.83	477.03	477.03	0.000534	0.070488	132	1	0.045674648
STORY15	5.95	3.67	24	24X40,38X54	22X38,28X42	44882.01	524.76	524.76	0.000585	0.07722	132	1	0.050034255
STORY14	5.95	3.4	24	24X40,38X54	22X38,28X42	48962.2	571.93	571.93	0.000634	0.083688	132	1	0.054275934
STORY13	5.95	3.14	24	24X40,38X54	22X38,28X42	53042.38	618.51	618.51	0.000683	0.090156	132	1	0.058572934
STORY12	5.95	2.88	24	24X40,38X54	22X38,28X42	57122.56	664.47	664.47	0.000731	0.096492	132	1	0.062841951
STORY11	5.95	2.62	24	24X40,38X54	22X38,28X42	61202.75	709.77	709.77	0.000778	0.102696	132	1	0.067086154
STORY10	5.95	2.36	24	24X40,38X54	22X38,28X42	65282.93	754.36	754.36	0.000824	0.108768	132	1	0.071309632
STORY9	5.95	2.1	24	24X40,38X54	22X38,28X42	69363.11	798.18	798.18	0.000869	0.114708	132	1	0.075517481
STORY8	5.95	1.83	24	24X40,38X54	22X38,28X42	73443.3	841.18	841.18	0.000912	0.120384	132	1	0.079626584
STORY7	5.95	1.57	24	24X40,38X54	22X38,28X42	77523.48	883.26	883.26	0.000953	0.125796	132	1	0.08364454
STORY6	5.95	1.31	24	24X40,38X54	22X38,28X42	81603.66	924.32	924.32	0.000988	0.130416	132	1	0.087225654
STORY5	5.95	1.05	24	24X40,38X54	22X38,28X42	85683.85	964.21	964.21	0.001011	0.133452	132	1	0.089841811
STORY4	5.95	0.79	24	24X40,38X54	22X38,28X42	89764.03	1002.73	1002.73	0.001007	0.132924	132	1	0.090146279
STORY3	5.95	0.52	24	24X40,38X54	22X38,28X42	93844.21	1039.57	1039.57	0.000937	0.123684	132	1	0.084584996
STORY2	5.95	0.26	24	24X40,38X54	22X38,28X42	97924.39	1074.41	1074.41	0.000699	0.092268	132	1	0.063708592
STORY1	5.95	0	24	24X40,38X54	22X38,28X42	98900.11	1074.41	1074.41	0.000251	0.033132	132	1	0.023104706

Determination of stability coefficient (Ɵ) of a 24 storied symmetric building with aspect ratio 5.95

Floor	Aspect Ratio (L/W)	Aspect Ratio (H/W)	Number of Story	Exterior Column Size	Interior Column Size	Vertical Design Load (P)	Story Shear (Vx)	Absolute Value (Vx)	DriftX	Design Story Drift Δ (Inch)	Floor Height (hsx)	Deflection Amplification Factor (Cd)	Stability Coefficient (θ)
STORY27	5.95	6.81	26	28X42,42X60	24X40,32X46	4211.18	26.63	26.63	0.000094	0.012408	132	1	0.014864849
STORY26	5.95	6.55	26	28X42,42X60	24X40,32X46	8422.37	79.64	79.64	0.000128	0.016896	132	1	0.013536707
STORY25	5.95	6.29	26	28X42,42X60	24X40,32X46	12633.55	132.28	132.28	0.000172	0.022704	132	1	0.016427053
STORY24	5.95	6.02	26	28X42,42X60	24X40,32X46	16844.74	184.55	184.55	0.000222	0.029304	132	1	0.020262976
STORY23	5.95	5.76	26	28X42,42X60	24X40,32X46	21055.92	236.42	236.42	0.000273	0.036036	132	1	0.02431379
STORY22	5.95	5.5	26	28X42,42X60	24X40,32X46	25267.11	287.89	287.89	0.000324	0.042768	132	1	0.02843636
STORY21	5.95	5.24	26	28X42,42X60	24X40,32X46	29478.29	338.94	338.94	0.000376	0.049632	132	1	0.032701472
STORY20	5.95	4.98	26	28X42,42X60	24X40,32X46	33689.48	389.56	389.56	0.000427	0.056364	132	1	0.036927323
STORY19	5.95	4.71	26	28X42,42X60	24X40,32X46	37900.66	439.73	439.73	0.000478	0.063096	132	1	0.04119918
STORY18	5.95	4.45	26	28X42,42X60	24X40,32X46	42111.85	489.43	489.43	0.000529	0.069828	132	1	0.045516557
STORY17	5.95	4.19	26	28X42,42X60	24X40,32X46	46323.03	538.65	538.65	0.000579	0.076428	132	1	0.049793065
STORY16	5.95	3.93	26	28X42,42X60	24X40,32X46	50534.22	587.37	587.37	0.000628	0.082896	132	1	0.054029811
STORY15	5.95	3.67	26	28X42,42X60	24X40,32X46	54745.4	635.55	635.55	0.000677	0.089364	132	1	0.058315846
STORY14	5.95	3.4	26	28X42,42X60	24X40,32X46	58956.59	683.17	683.17	0.000725	0.0957	132	1	0.062566459
STORY13	5.95	3.14	26	28X42,42X60	24X40,32X46	63167.77	730.21	730.21	0.000772	0.101904	132	1	0.066782869
STORY12	5.95	2.88	26	28X42,42X60	24X40,32X46	67378.96	776.63	776.63	0.000818	0.107976	132	1	0.070968143
STORY11	5.95	2.62	26	28X42,42X60	24X40,32X46	71590.14	822.38	822.38	0.000863	0.113916	132	1	0.075126208
STORY10	5.95	2.36	26	28X42,42X60	24X40,32X46	75801.32	867.42	867.42	0.000907	0.119724	132	1	0.079260101
STORY9	5.95	2.1	26	28X42,42X60	24X40,32X46	80012.51	911.7	911.7	0.00095	0.1254	132	1	0.08337379
STORY8	5.95	1.83	26	28X42,42X60	24X40,32X46	84223.69	955.15	955.15	0.000989	0.130548	132	1	0.087208532
STORY7	5.95	1.57	26	28X42,42X60	24X40,32X46	88434.88	997.68	997.68	0.001025	0.1353	132	1	0.090856539
STORY6	5.95	1.31	26	28X42,42X60	24X40,32X46	92646.06	1039.2	1039.2	0.001051	0.138732	132	1	0.093698046
STORY5	5.95	1.05	26	28X42,42X60	24X40,32X46	96857.25	1079.54	1079.54	0.001061	0.140052	132	1	0.095193825
STORY4	5.95	0.79	26	28X42,42X60	24X40,32X46	101068.4	1118.52	1118.52	0.001034	0.136488	132	1	0.093431281
STORY3	5.95	0.52	26	28X42,42X60	24X40,32X46	105279.6	1155.81	1155.81	0.000931	0.122892	132	1	0.084802283
STORY2	5.95	0.26	26	28X42,42X60	24X40,32X46	109490.8	1191.11	1191.11	0.000663	0.087516	132	1	0.060945169
STORY1	5.95	0	26	28X42,42X60	24X40,32X46	110538	1191.11	1191.11	0.000231	0.030492	132	1	0.021437376

Determination of stability coefficient (Θ) of a 26 storied symmetric building with aspect ratio 5.95

Floor	Aspect Ratio (L/W)	Aspect Ratio (H/W)	Number of Story	Exterior Column Size	Interior Column Size	Vertical Design Load (P)	Story Shear (Vx)	Absolute Value (Vx)	DriftX	Design Story Drift Δ (Inch)	Floor Height (hsx)	Deflection Amplification Factor (Cd)	Stability Coefficient (θ)
STORY29	5.95	7.33	28	30X44,44X66	36X52, 28X42	4348.02	27.5	27.5	0.000104	0.013728	132	1	0.016443421
STORY28	5.95	7.07	28	30X44,44X66	36X52, 28X42	8681.84	82.26	82.26	0.000136	0.017952	132	1	0.014353638
STORY27	5.95	6.81	28	30X44,44X66	36X52, 28X42	13015.67	136.68	136.68	0.000179	0.023628	132	1	0.01704569
STORY26	5.95	6.55	28	30X44,44X66	36X52, 28X42	17349.5	190.72	190.72	0.000227	0.029964	132	1	0.020649835
STORY25	5.95	6.29	28	30X44,44X66	36X52, 28X42	21683.32	244.4	244.4	0.000277	0.036564	132	1	0.024575612
STORY24	5.95	6.02	28	30X44,44X66	36X52, 28X42	26017.15	297.69	297.69	0.000329	0.043428	132	1	0.028753543
STORY23	5.95	5.76	28	30X44,44X66	36X52, 28X42	30350.98	350.59	350.59	0.000381	0.050292	132	1	0.032983609
STORY22	5.95	5.5	28	30X44,44X66	36X52, 28X42	34684.8	403.08	403.08	0.000432	0.057024	132	1	0.037173349
STORY21	5.95	5.24	28	30X44,44X66	36X52, 28X42	39018.63	455.15	455.15	0.000484	0.063888	132	1	0.041491853
STORY20	5.95	4.98	28	30X44,44X66	36X52, 28X42	43352.46	506.78	506.78	0.000535	0.07062	132	1	0.045766538
STORY19	5.95	4.71	28	30X44,44X66	36X52, 28X42	47686.28	557.95	557.95	0.000585	0.07722	132	1	0.049998161
STORY18	5.95	4.45	28	30X44,44X66	36X52, 28X42	52020.11	608.66	608.66	0.000635	0.08382	132	1	0.054271301
STORY17	5.95	4.19	28	30X44,44X66	36X52, 28X42	56353.94	658.87	658.87	0.000685	0.09042	132	1	0.05858887
STORY16	5.95	3.93	28	30X44,44X66	36X52, 28X42	60687.77	708.58	708.58	0.000733	0.096756	132	1	0.06277927
STORY15	5.95	3.67	28	30X44,44X66	36X52, 28X42	65021.59	757.74	757.74	0.000781	0.103092	132	1	0.067017528
STORY14	5.95	3.4	28	30X44,44X66	36X52, 28X42	69355.42	806.34	806.34	0.000829	0.109428	132	1	0.071304466
STORY13	5.95	3.14	28	30X44,44X66	36X52, 28X42	73689.25	854.35	854.35	0.000875	0.1155	132	1	0.07547035
STORY12	5.95	2.88	28	30X44,44X66	36X52, 28X42	78023.07	901.73	901.73	0.000921	0.121572	132	1	0.079690426
STORY11	5.95	2.62	28	30X44,44X66	36X52, 28X42	82356.9	948.44	948.44	0.000965	0.12738	132	1	0.083794872
STORY10	5.95	2.36	28	30X44,44X66	36X52, 28X42	86690.73	994.43	994.43	0.001008	0.133056	132	1	0.087873712
STORY9	5.95	2.1	28	30X44,44X66	36X52, 28X42	91024.55	1039.64	1039.64	0.001048	0.138336	132	1	0.091756501
STORY8	5.95	1.83	28	30X44,44X66	36X52, 28X42	95358.38	1084.02	1084.02	0.001085	0.14322	132	1	0.095444588
STORY7	5.95	1.57	28	30X44,44X66	36X52, 28X42	99692.21	1127.48	1127.48	0.001115	0.14718	132	1	0.098588724
STORY6	5.95	1.31	28	30X44,44X66	36X52, 28X42	104026	1169.89	1169.89	0.001134	0.149688	132	1	0.100834709
STORY5	5.95	1.05	28	30X44,44X66	36X52, 28X42	108359.9	1211.14	1211.14	0.001131	0.149292	132	1	0.10118979
STORY4	5.95	0.79	28	30X44,44X66	36X52, 28X42	112693.7	1250.99	1250.99	0.001085	0.14322	132	1	0.097740712
STORY3	5.95	0.52	28	30X44,44X66	36X52, 28X42	117027.5	1289.14	1289.14	0.000955	0.12606	132	1	0.086694441
STORY2	5.95	0.26	28	30X44,44X66	36X52, 28X42	121361.3	1325.28	1325.28	0.00066	0.08712	132	1	0.060438914
STORY1	5.95	0	28	30X44,44X66	36X52, 28X42	122475.4	1325.28	1325.28	0.000225	0.0297	132	1	0.020793317

Determination of stability coefficient (Θ) of a 28 storied symmetric building with aspect ratio 5.95

Floor	Aspect Ratio (L/W)	Aspect Ratio (H/W)	Number of Story	Exterior Column Size	Interior Column Size	Vertical Design Load (P)	Story Shear (Vx)	Absolute Value (Vx)	DriftX	Design Story Drift Δ (Inch)	Floor Height (hsx)	Deflection Amplification Factor (Cd)	Stability Coefficient (θ)
STORY31	5.95	7.86	30	44X74,32X46	38X56,30X44	4460.65	28.04	28.04	0.000114	0.015048	132	1	0.01813531
STORY30	5.95	7.6	30	44X74,32X46	38X56,30X44	8921.3	83.9	83.9	0.000145	0.01914	132	1	0.015418218
STORY29	5.95	7.33	30	44X74,32X46	38X56,30X44	13381.95	139.42	139.42	0.000186	0.024552	132	1	0.017852838
STORY28	5.95	7.07	30	44X74,32X46	38X56,30X44	17842.59	194.6	194.6	0.000233	0.030756	132	1	0.02136343
STORY27	5.95	6.81	30	44X74,32X46	38X56,30X44	22303.24	249.43	249.43	0.000283	0.037356	132	1	0.025304963
STORY26	5.95	6.55	30	44X74,32X46	38X56,30X44	26763.89	303.89	303.89	0.000334	0.044088	132	1	0.029415707
STORY25	5.95	6.29	30	44X74,32X46	38X56,30X44	31224.54	357.98	357.98	0.000386	0.050952	132	1	0.033668564
STORY24	5.95	6.02	30	44X74,32X46	38X56,30X44	35685.19	411.69	411.69	0.000438	0.057816	132	1	0.037965734
STORY23	5.95	5.76	30	44X74,32X46	38X56,30X44	40145.84	465	465	0.00049	0.06468	132	1	0.042304218
STORY22	5.95	5.5	30	44X74,32X46	38X56,30X44	44606.49	517.9	517.9	0.000541	0.071412	132	1	0.046596082
STORY21	5.95	5.24	30	44X74,32X46	38X56,30X44	49067.14	570.38	570.38	0.000592	0.078144	132	1	0.050927008
STORY20	5.95	4.98	30	44X74,32X46	38X56,30X44	53527.78	622.43	622.43	0.000643	0.084876	132	1	0.05529676
STORY19	5.95	4.71	30	44X74,32X46	38X56,30X44	57988.43	674.02	674.02	0.000693	0.091476	132	1	0.05962135
STORY18	5.95	4.45	30	44X74,32X46	38X56,30X44	62449.08	725.14	725.14	0.000742	0.097944	132	1	0.063901064
STORY17	5.95	4.19	30	44X74,32X46	38X56,30X44	66909.73	775.77	775.77	0.000791	0.104412	132	1	0.068223309
STORY16	5.95	3.93	30	44X74,32X46	38X56,30X44	71370.38	825.88	825.88	0.000839	0.110748	132	1	0.072504176
STORY15	5.95	3.67	30	44X74,32X46	38X56,30X44	75831.03	875.46	875.46	0.000887	0.117084	132	1	0.076830607
STORY14	5.95	3.4	30	44X74,32X46	38X56,30X44	80291.68	924.48	924.48	0.000933	0.123156	132	1	0.081031647
STORY13	5.95	3.14	30	44X74,32X46	38X56,30X44	84752.33	972.9	972.9	0.000979	0.129228	132	1	0.08528372
STORY12	5.95	2.88	30	44X74,32X46	38X56,30X44	89212.97	1020.69	1020.69	0.001024	0.135168	132	1	0.089502279
STORY11	5.95	2.62	30	44X74,32X46	38X56,30X44	93673.62	1067.81	1067.81	0.001067	0.140844	132	1	0.093602563
STORY10	5.95	2.36	30	44X74,32X46	38X56,30X44	98134.27	1114.22	1114.22	0.001108	0.146256	132	1	0.097586447
STORY9	5.95	2.1	30	44X74,32X46	38X56,30X44	102594.9	1159.85	1159.85	0.001146	0.151272	132	1	0.101369814
STORY8	5.95	1.83	30	44X74,32X46	38X56,30X44	107055.6	1204.64	1204.64	0.00118	0.15576	132	1	0.104865829
STORY7	5.95	1.57	30	44X74,32X46	38X56,30X44	111516.2	1248.51	1248.51	0.001204	0.158928	132	1	0.107540612
STORY6	5.95	1.31	30	44X74,32X46	38X56,30X44	115976.9	1291.34	1291.34	0.001214	0.160248	132	1	0.109030867
STORY5	5.95	1.05	30	44X74,32X46	38X56,30X44	120437.5	1333	1333	0.001198	0.158136	132	1	0.108240172
STORY4	5.95	0.79	30	44X74,32X46	38X56,30X44	124898.2	1373.27	1373.27	0.001133	0.149556	132	1	0.103045734
STORY3	5.95	0.52	30	44X74,32X46	38X56,30X44	129358.8	1411.83	1411.83	0.000978	0.129096	132	1	0.089609171
STORY2	5.95	0.26	30	44X74,32X46	38X56,30X44	133819.5	1448.38	1448.38	0.00066	0.08712	132	1	0.060979055
STORY1	5.95	0	30	44X74,32X46	38X56,30X44	135002.7	1448.38	1448.38	0.000221	0.029172	132	1	0.020599289

Determination of stability coefficient (ϴ) of a 30 storied symmetric building with aspect ratio 5.95

Floor	Aspect Ratio (L/W)	Aspect Ratio (H/W)	Number of Story	Exterior Column Size	Interior Column Size	Vertical Design Load (P)	Story Shear (Vx)	Absolute Value (Vx)	DriftX	Design Story Drift Δ (Inch)	Floor Height (hsx)	Deflection Amplification Factor (Cd)	Stability Coefficient (θ)
STORY3	1.21	0.24	2	12X12	12X12	2522.62	27.87	27.87	0.00015	0.0198	132	1	0.013577072
STORY2	1.21	0.12	2	12X12	12X12	5045.25	80.76	80.76	0.00038	0.05016	132	1	0.023739413
STORY1	1.21	0	2	12X12	12X12	5521.49	80.76	80.76	0.000137	0.018084	132	1	0.009366569

Determination of stability coefficient (ϴ) of a 2 storied asymmetric building with aspect ratio 1.21

Floor	Aspect Ratio (L/W)	Aspect Ratio (H/W)	Number of Story	Exterior Column Size	Interior Column Size	Vertical Design Load (P)	Story Shear (Vx)	Absolute Value (Vx)	DriftX	Design Story Drift Δ (Inch)	Floor Height (hsx)	Deflection Amplification Factor (Cd)	Stability Coefficient (θ)
STORY5	1.21	0.48	4	12X12	12X14	2526.91	33.28	33.28	0.000181	0.023892	132	1	0.01374311
STORY4	1.21	0.36	4	12X12	12X14	5053.82	97.84	97.84	0.000479	0.063228	132	1	0.02474223
STORY3	1.21	0.24	4	12X12	12X14	7580.74	158.87	158.87	0.00077	0.10164	132	1	0.0367418
STORY2	1.21	0.12	4	12X12	12X14	10107.65	215.73	215.73	0.001002	0.132264	132	1	0.046946949
STORY1	1.21	0	4	12X12	12X14	10586.24	215.73	215.73	0.000352	0.046464	132	1	0.017273242

Determination of stability coefficient (ϴ) of a 4 storied asymmetric building with aspect ratio 1.21

Floor	Aspect Ratio (L/W)	Aspect Ratio (H/W)	Number of Story	Exterior Column Size	Interior Column Size	Vertical Design Load (P)	Story Shear (Vx)	Absolute Value (Vx)	DriftX	Design Story Drift Δ (Inch)	Floor Height (hsx)	Deflection Amplification Factor (Cd)	Stability Coefficient (θ)
STORY7	1.21	0.73	6	12X14, 12X18	12X20	2551.66	37.09	37.09	0.000183	0.024156	132	1	0.012589749
STORY6	1.21	0.6	6	12X14, 12X18	12X20	5103.32	109.8	109.8	0.000456	0.060192	132	1	0.021194116
STORY5	1.21	0.48	6	12X14, 12X18	12X20	7654.98	180.08	180.08	0.000731	0.096492	132	1	0.031073914
STORY4	1.21	0.36	6	12X14, 12X18	12X20	10206.64	247.49	247.49	0.000993	0.131076	132	1	0.040951931
STORY3	1.21	0.24	6	12X14, 12X18	12X20	12758.3	311.37	311.37	0.001238	0.163416	132	1	0.050726709
STORY2	1.21	0.12	6	12X14, 12X18	12X20	15309.96	371.08	371.08	0.001414	0.186648	132	1	0.058338589
STORY1	1.21	0	6	12X14, 12X18	12X20	15802.05	371.08	371.08	0.000498	0.065736	132	1	0.021206804

Determination of stability coefficient (ϴ) of a 6 storied asymmetric building with aspect ratio 1.21

Floor	Aspect Ratio (L/W)	Aspect Ratio (H/W)	Number of Story	Exterior Column Size	Interior Column Size	Vertical Design Load (P)	Story Shear (Vx)	Absolute Value (Vx)	DriftX	Design Story Drift Δ (Inch)	Floor Height (hsx)	Deflection Amplification Factor (Cd)	Stability Coefficient (θ)
STORY9	1.21	0.97	8	12X18,12X22	14X24	2588.62	40.11	40.11	0.000174	0.022968	132	1	0.011229616
STORY8	1.21	0.85	8	12X18,12X22	14X24	5177.24	119.16	119.16	0.000396	0.052272	132	1	0.017205329
STORY7	1.21	0.73	8	12X18,12X22	14X24	7765.86	196.29	196.29	0.000624	0.082368	132	1	0.024687435
STORY6	1.21	0.6	8	12X18,12X22	14X24	10354.47	271.28	271.28	0.000846	0.111672	132	1	0.032290923
STORY5	1.21	0.48	8	12X18,12X22	14X24	12943.09	343.84	343.84	0.001058	0.139656	132	1	0.039826051
STORY4	1.21	0.36	8	12X18,12X22	14X24	15531.71	413.53	413.53	0.00126	0.16632	132	1	0.047324147
STORY3	1.21	0.24	8	12X18,12X22	14X24	18120.33	479.69	479.69	0.001446	0.190872	132	1	0.054622771
STORY2	1.21	0.12	8	12X18,12X22	14X24	20708.95	541.68	541.68	0.00155	0.2046	132	1	0.059257998
STORY1	1.21	0	8	12X18,12X22	14X24	21221.19	541.68	541.68	0.000559	0.073788	132	1	0.021899729

Determination of stability coefficient (ϴ) of an 8 storied asymmetric building with aspect ratio 1.21

Floor	Aspect Ratio (L/W)	Aspect Ratio (H/W)	Number of Story	Exterior Column Size	Interior Column Size	Vertical Design Load (P)	Story Shear (Vx)	Absolute Value (Vx)	DriftX	Design Story Drift Δ (Inch)	Floor Height (hsx)	Deflection Amplification Factor (Cd)	Stability Coefficient (θ)
STORY11	1.21	1.21	10	14X20, 14X24	16X26	2629.65	44.16	44.16	0.000178	0.023496	132	1	0.010599586
STORY10	1.21	1.09	10	14X20, 14X24	16X26	5259.29	131.45	131.45	0.000356	0.046992	132	1	0.014243494
STORY9	1.21	0.97	10	14X20, 14X24	16X26	7888.94	217.07	217.07	0.000544	0.071808	132	1	0.019770504
STORY8	1.21	0.85	10	14X20, 14X24	16X26	10518.58	300.9	300.9	0.000729	0.096228	132	1	0.025483698
STORY7	1.21	0.73	10	14X20, 14X24	16X26	13148.23	382.75	382.75	0.000908	0.119856	132	1	0.031191621
STORY6	1.21	0.6	10	14X20, 14X24	16X26	15777.87	462.38	462.38	0.001081	0.142692	132	1	0.036887144
STORY5	1.21	0.48	10	14X20, 14X24	16X26	18407.52	539.49	539.49	0.001246	0.164472	132	1	0.0425138
STORY4	1.21	0.36	10	14X20, 14X24	16X26	21037.17	613.63	613.63	0.001402	0.185064	132	1	0.048064978
STORY3	1.21	0.24	10	14X20, 14X24	16X26	23666.81	684.12	684.12	0.001539	0.203148	132	1	0.053240982
STORY2	1.21	0.12	10	14X20, 14X24	16X26	26296.46	750.28	750.28	0.00156	0.20592	132	1	0.054676224
STORY1	1.21	0	10	14X20, 14X24	16X26	26831.08	750.28	750.28	0.000582	0.076824	132	1	0.020813148

Determination of stability coefficient (ϴ) of a 10 storied asymmetric building with aspect ratio 1.21

Floor	Aspect Ratio (L/W)	Aspect Ratio (H/W)	Number of Story	Exterior Column Size	Interior Column Size	Vertical Design Load (P)	Story Shear (Vx)	Absolute Value (Vx)	DriftX	Design Story Drift Δ (Inch)	Floor Height (hsx)	Deflection Amplification Factor (Cd)	Stability Coefficient (θ)
STORY13	1.21	1.45	12	14X22, 14X28	16X28	2649.61	46.98	46.98	0.000216	0.028512	132	1	0.012182115
STORY12	1.21	1.33	12	14X22, 14X28	16X28	5299.22	140.02	140.02	0.000394	0.052008	132	1	0.014911389
STORY11	1.21	1.21	12	14X22, 14X28	16X28	7948.83	231.6	231.6	0.000584	0.077088	132	1	0.020043682
STORY10	1.21	1.09	12	14X22, 14X28	16X28	10598.44	321.64	321.64	0.000772	0.101904	132	1	0.025438365
STORY9	1.21	0.97	12	14X22, 14X28	16X28	13248.05	410	410	0.000956	0.126192	132	1	0.030890575
STORY8	1.21	0.85	12	14X22, 14X28	16X28	15897.66	496.53	496.53	0.001134	0.149688	132	1	0.036307869
STORY7	1.21	0.73	12	14X22, 14X28	16X28	18547.27	581.07	581.07	0.001306	0.172392	132	1	0.041686431
STORY6	1.21	0.6	12	14X22, 14X28	16X28	21196.88	663.36	663.36	0.001472	0.194304	132	1	0.04703601
STORY5	1.21	0.48	12	14X22, 14X28	16X28	23846.48	743.1	743.1	0.001629	0.215028	132	1	0.052275489
STORY4	1.21	0.36	12	14X22, 14X28	16X28	26496.09	819.85	819.85	0.001777	0.234564	132	1	0.057429471
STORY3	1.21	0.24	12	14X22, 14X28	16X28	29145.7	892.89	892.89	0.001902	0.251064	132	1	0.062085051
STORY2	1.21	0.12	12	14X22, 14X28	16X28	31795.31	961.57	961.57	0.001883	0.248556	132	1	0.062263349
STORY1	1.21	0	12	14X22, 14X28	16X28	32340.83	961.57	961.57	0.000704	0.092928	132	1	0.023677885

Determination of stability coefficient (ϴ) of a 12 storied asymmetric building with aspect ratio 1.21

Floor	Aspect Ratio (L/W)	Aspect Ratio (H/W)	Number of Story	Exterior Column Size	Interior Column Size	Vertical Design Load (P)	Story Shear (Vx)	Absolute Value (Vx)	DriftX	Design Story Drift Δ (Inch)	Floor Height (hsx)	Deflection Amplification Factor (Cd)	Stability Coefficient (θ)
STORY15	1.21	1.69	14	16X26	18X30	2708.24	50.14	50.14	0.000228	0.030096	132	1	0.012315092
STORY14	1.21	1.57	14	16X26	18X30	5416.47	149.58	149.58	0.000378	0.049896	132	1	0.01368783
STORY13	1.21	1.45	14	16X26	18X30	8124.71	247.71	247.71	0.000543	0.071676	132	1	0.01781001
STORY12	1.21	1.33	14	16X26	18X30	10832.94	344.44	344.44	0.000708	0.093456	132	1	0.022267221
STORY11	1.21	1.21	14	16X26	18X30	13541.18	439.69	439.69	0.00087	0.11484	132	1	0.026793483
STORY10	1.21	1.09	14	16X26	18X30	16249.41	533.35	533.35	0.001028	0.135696	132	1	0.031319759
STORY9	1.21	0.97	14	16X26	18X30	18957.65	625.29	625.29	0.001182	0.156024	132	1	0.03583608
STORY8	1.21	0.85	14	16X26	18X30	21665.89	715.38	715.38	0.001331	0.175692	132	1	0.040310464
STORY7	1.21	0.73	14	16X26	18X30	24374.12	803.41	803.41	0.001474	0.194568	132	1	0.044718703
STORY6	1.21	0.6	14	16X26	18X30	27082.36	889.16	889.16	0.001612	0.212784	132	1	0.049098885
STORY5	1.21	0.48	14	16X26	18X30	29790.59	972.3	972.3	0.001742	0.229944	132	1	0.053373658
STORY4	1.21	0.36	14	16X26	18X30	32498.83	1052.37	1052.37	0.001861	0.245652	132	1	0.057470588
STORY3	1.21	0.24	14	16X26	18X30	35207.06	1128.66	1128.66	0.001948	0.257136	132	1	0.060765291
STORY2	1.21	0.12	14	16X26	18X30	37915.3	1200.48	1200.48	0.001834	0.242088	132	1	0.057924047
STORY1	1.21	0	14	16X26	18X30	38492.79	1200.48	1200.48	0.000697	0.092004	132	1	0.022348956

Determination of stability coefficient (Θ) of a 14 storied asymmetric building with aspect ratio 1.21

Floor	Aspect Ratio (L/W)	Aspect Ratio (H/W)	Number of Story	Exterior Column Size	Interior Column Size	Vertical Design Load (P)	Story Shear (Vx)	Absolute Value (Vx)	DriftX	Design Story Drift Δ (Inch)	Floor Height (hsx)	Deflection Amplification Factor (Cd)	Stability Coefficient (θ)
STORY17	1.21	1.93	16	18X26,18X28	20X30,22X30	2763.84	52.62	52.62	0.000255	0.03366	132	1	0.013393751
STORY16	1.21	1.81	16	18X26,18X28	20X30,22X30	5527.67	157.09	157.09	0.000385	0.05082	132	1	0.013547348
STORY15	1.21	1.69	16	18X26,18X28	20X30,22X30	8291.51	260.35	260.35	0.000533	0.070356	132	1	0.016974745
STORY14	1.21	1.57	16	18X26,18X28	20X30,22X30	11055.35	362.36	362.36	0.000682	0.090024	132	1	0.020807343
STORY13	1.21	1.45	16	18X26,18X28	20X30,22X30	13819.19	463.03	463.03	0.000829	0.109428	132	1	0.024741612
STORY12	1.21	1.33	16	18X26,18X28	20X30,22X30	16583.02	562.29	562.29	0.000974	0.128568	132	1	0.028725144
STORY11	1.21	1.21	16	18X26,18X28	20X30,22X30	19346.86	660.05	660.05	0.001115	0.14718	132	1	0.032681992
STORY10	1.21	1.09	16	18X26,18X28	20X30,22X30	22110.7	756.21	756.21	0.001252	0.165264	132	1	0.036607022
STORY9	1.21	0.97	16	18X26,18X28	20X30,22X30	24874.53	850.63	850.63	0.001385	0.18282	132	1	0.040500834
STORY8	1.21	0.85	16	18X26,18X28	20X30,22X30	27638.37	943.18	943.18	0.001514	0.199848	132	1	0.04436533
STORY7	1.21	0.73	16	18X26,18X28	20X30,22X30	30402.21	1033.65	1033.65	0.001637	0.216084	132	1	0.04814823
STORY6	1.21	0.6	16	18X26,18X28	20X30,22X30	33166.05	1121.8	1121.8	0.001755	0.23166	132	1	0.051886627
STORY5	1.21	0.48	16	18X26,18X28	20X30,22X30	35929.88	1207.32	1207.32	0.001865	0.24618	132	1	0.055502457
STORY4	1.21	0.36	16	18X26,18X28	20X30,22X30	38693.72	1289.74	1289.74	0.001959	0.258588	132	1	0.058772309
STORY3	1.21	0.24	16	18X26,18X28	20X30,22X30	41457.56	1368.34	1368.34	0.002001	0.264132	132	1	0.060625705
STORY2	1.21	0.12	16	18X26,18X28	20X30,22X30	44221.39	1442.42	1442.42	0.001785	0.23562	132	1	0.054724131
STORY1	1.21	0	16	18X26,18X28	20X30,22X30	44829.22	1442.42	1442.42	0.000678	0.089496	132	1	0.021071679

Determination of stability coefficient (Θ) of a 16 storied asymmetric building with aspect ratio 1.21

Floor	Aspect Ratio (L/W)	Aspect Ratio (H/W)	Number of Story	Exterior Column Size	Interior Column Size	Vertical Design Load (P)	Story Shear (Vx)	Absolute Value (Vx)	DriftX	Design Story Drift Δ (Inch)	Floor Height (hsx)	Deflection Amplification Factor (Cd)	Stability Coefficient (θ)
STORY19	1.21	2.18	18	18X28,18X30	22X30,24X30	2795.35	54.98	54.98	0.000306	0.040392	132	1	0.015557968
STORY18	1.21	2.05	18	18X28,18X30	22X30,24X30	5590.7	164.21	164.21	0.000433	0.057156	132	1	0.014741935
STORY17	1.21	1.93	18	18X28,18X30	22X30,24X30	8386.05	272.34	272.34	0.000579	0.076428	132	1	0.017828901
STORY16	1.21	1.81	18	18X28,18X30	22X30,24X30	11181.4	379.3	379.3	0.000727	0.095964	132	1	0.021431262
STORY15	1.21	1.69	18	18X28,18X30	22X30,24X30	13976.75	485.05	485.05	0.000874	0.115368	132	1	0.025184372
STORY14	1.21	1.57	18	18X28,18X30	22X30,24X30	16772.1	589.52	589.52	0.001019	0.134508	132	1	0.028990993
STORY13	1.21	1.45	18	18X28,18X30	22X30,24X30	19567.45	692.65	692.65	0.001161	0.153252	132	1	0.032798397
STORY12	1.21	1.33	18	18X28,18X30	22X30,24X30	22362.8	794.35	794.35	0.0013	0.1716	132	1	0.036598024
STORY11	1.21	1.21	18	18X28,18X30	22X30,24X30	25158.15	894.53	894.53	0.001435	0.18942	132	1	0.040358563
STORY10	1.21	1.09	18	18X28,18X30	22X30,24X30	27953.5	993.1	993.1	0.001566	0.206712	132	1	0.044079328
STORY9	1.21	0.97	18	18X28,18X30	22X30,24X30	30748.85	1089.91	1089.91	0.001692	0.223344	132	1	0.047735184
STORY8	1.21	0.85	18	18X28,18X30	22X30,24X30	33544.2	1184.82	1184.82	0.001814	0.239448	132	1	0.051357319
STORY7	1.21	0.73	18	18X28,18X30	22X30,24X30	36339.55	1277.64	1277.64	0.001931	0.254892	132	1	0.054922882
STORY6	1.21	0.6	18	18X28,18X30	22X30,24X30	39134.9	1368.11	1368.11	0.002041	0.269412	132	1	0.058382974
STORY5	1.21	0.48	18	18X28,18X30	22X30,24X30	41930.25	1455.92	1455.92	0.002142	0.282744	132	1	0.061689238
STORY4	1.21	0.36	18	18X28,18X30	22X30,24X30	44725.6	1540.6	1540.6	0.002224	0.293568	132	1	0.064565581
STORY3	1.21	0.24	18	18X28,18X30	22X30,24X30	47520.95	1621.41	1621.41	0.002236	0.295152	132	1	0.065533606
STORY2	1.21	0.12	18	18X28,18X30	22X30,24X30	50316.3	1697.65	1697.65	0.00194	0.25608	132	1	0.057499262
STORY1	1.21	0	18	18X28,18X30	22X30,24X30	50941.31	1697.65	1697.65	0.000736	0.097152	132	1	0.02208512

Determination of stability coefficient (Θ) of an 18 storied asymmetric building with aspect ratio 1.21

Floor	Aspect Ratio (L/W)	Aspect Ratio (H/W)	Number of Story	Exterior Column Size	Interior Column Size	Vertical Design Load (P)	Story Shear (Vx)	Absolute Value (Vx)	DriftX	Design Story Drift Δ (Inch)	Floor Height (hsx)	Deflection Amplification Factor (Cd)	Stability Coefficient (θ)
STORY21	1.21	2.42	20	18X30,20X30	24X30,24X32	2831.59	57.84	57.84	0.000365	0.04818	132	1	0.017868782
STORY20	1.21	2.3	20	18X30,20X30	24X30,24X32	5663.19	172.85	172.85	0.000491	0.064812	132	1	0.016086933
STORY19	1.21	2.18	20	18X30,20X30	24X30,24X32	8494.78	286.82	286.82	0.000638	0.084216	132	1	0.018895717
STORY18	1.21	2.05	20	18X30,20X30	24X30,24X32	11326.37	399.69	399.69	0.000789	0.104148	132	1	0.022358593
STORY17	1.21	1.93	20	18X30,20X30	24X30,24X32	14157.96	511.42	511.42	0.000939	0.123948	132	1	0.025994925
STORY16	1.21	1.81	20	18X30,20X30	24X30,24X32	16989.56	621.97	621.97	0.001087	0.143484	132	1	0.02969219
STORY15	1.21	1.69	20	18X30,20X30	24X30,24X32	19821.15	731.28	731.28	0.001233	0.162756	132	1	0.033420137
STORY14	1.21	1.57	20	18X30,20X30	24X30,24X32	22652.74	839.29	839.29	0.001375	0.1815	132	1	0.037111746
STORY13	1.21	1.45	20	18X30,20X30	24X30,24X32	25484.34	945.92	945.92	0.001515	0.19998	132	1	0.04081611
STORY12	1.21	1.33	20	18X30,20X30	24X30,24X32	28315.93	1051.1	1051.1	0.00165	0.2178	132	1	0.044449895
STORY11	1.21	1.21	20	18X30,20X30	24X30,24X32	31147.52	1154.72	1154.72	0.001782	0.235224	132	1	0.048067827
STORY10	1.21	1.09	20	18X30,20X30	24X30,24X32	33979.11	1256.69	1256.69	0.00191	0.25212	132	1	0.051643683
STORY9	1.21	0.97	20	18X30,20X30	24X30,24X32	36810.71	1356.88	1356.88	0.002033	0.268356	132	1	0.055153126
STORY8	1.21	0.85	20	18X30,20X30	24X30,24X32	39642.3	1455.11	1455.11	0.002152	0.284064	132	1	0.058628028
STORY7	1.21	0.73	20	18X30,20X30	24X30,24X32	42473.89	1551.21	1551.21	0.002264	0.298848	132	1	0.061990889
STORY6	1.21	0.6	20	18X30,20X30	24X30,24X32	45305.48	1644.92	1644.92	0.00237	0.31284	132	1	0.065276115
STORY5	1.21	0.48	20	18X30,20X30	24X30,24X32	48137.08	1735.9	1735.9	0.002465	0.32538	132	1	0.068355264
STORY4	1.21	0.36	20	18X30,20X30	24X30,24X32	50968.67	1823.69	1823.69	0.002534	0.334488	132	1	0.070820485
STORY3	1.21	0.24	20	18X30,20X30	24X30,24X32	53800.26	1907.52	1907.52	0.002513	0.331716	132	1	0.070877398
STORY2	1.21	0.12	20	18X30,20X30	24X30,24X32	56631.86	1986.7	1986.7	0.002128	0.280896	132	1	0.060659686
STORY1	1.21	0	20	18X30,20X30	24X30,24X32	57276.63	1986.7	1986.7	0.000801	0.105732	132	1	0.023092858

Determination of stability coefficient (ϴ) of a 20 storied asymmetric building with aspect ratio 1.21

Floor	Aspect Ratio (L/W)	Aspect Ratio (H/W)	Number of Story	Exterior Column Size	Interior Column Size	Vertical Design Load (P)	Story Shear (Vx)	Absolute Value (Vx)	DriftX	Design Story Drift Δ (Inch)	Floor Height (hsx)	Deflection Amplification Factor (Cd)	Stability Coefficient (θ)
STORY23	1.21	2.66	22	20X30,22X32	24X32,24X34	2881.42	60.04	60.04	0.000415	0.05478	132	1	0.019916544
STORY22	1.21	2.54	22	20X30,22X32	24X32,24X34	5762.84	179.48	179.48	0.000536	0.070752	132	1	0.017210175
STORY21	1.21	2.42	22	20X30,22X32	24X32,24X34	8644.26	297.94	297.94	0.000681	0.089892	132	1	0.019758143
STORY20	1.21	2.3	22	20X30,22X32	24X32,24X34	11525.68	415.37	415.37	0.000831	0.109692	132	1	0.023058574
STORY19	1.21	2.18	22	20X30,22X32	24X32,24X34	14407.1	531.75	531.75	0.00098	0.12936	132	1	0.026551872
STORY18	1.21	2.05	22	20X30,22X32	24X32,24X34	17288.52	647.02	647.02	0.001128	0.148896	132	1	0.030140414
STORY17	1.21	1.93	22	20X30,22X32	24X32,24X34	20169.94	761.14	761.14	0.001274	0.168168	132	1	0.033760548
STORY16	1.21	1.81	22	20X30,22X32	24X32,24X34	23051.36	874.07	874.07	0.001418	0.187176	132	1	0.037396122
STORY15	1.21	1.69	22	20X30,22X32	24X32,24X34	25932.78	985.74	985.74	0.001558	0.205656	132	1	0.040987757
STORY14	1.21	1.57	22	20X30,22X32	24X32,24X34	28814.2	1096.1	1096.1	0.001696	0.223872	132	1	0.044584329
STORY13	1.21	1.45	22	20X30,22X32	24X32,24X34	31695.62	1205.07	1205.07	0.00183	0.24156	132	1	0.048132461
STORY12	1.21	1.33	22	20X30,22X32	24X32,24X34	34577.04	1312.56	1312.56	0.00196	0.25872	132	1	0.051632686
STORY11	1.21	1.21	22	20X30,22X32	24X32,24X34	37458.45	1418.49	1418.49	0.002087	0.275484	132	1	0.055111975
STORY10	1.21	1.09	22	20X30,22X32	24X32,24X34	40339.87	1522.75	1522.75	0.002209	0.291588	132	1	0.058519634
STORY9	1.21	0.97	22	20X30,22X32	24X32,24X34	43221.29	1625.2	1625.2	0.002327	0.307164	132	1	0.061885271
STORY8	1.21	0.85	22	20X30,22X32	24X32,24X34	46102.71	1725.68	1725.68	0.002439	0.321948	132	1	0.065159537
STORY7	1.21	0.73	22	20X30,22X32	24X32,24X34	48984.13	1824	1824	0.002546	0.336072	132	1	0.068373681
STORY6	1.21	0.6	22	20X30,22X32	24X32,24X34	51865.55	1919.91	1919.91	0.002645	0.34914	132	1	0.071453547
STORY5	1.21	0.48	22	20X30,22X32	24X32,24X34	54746.97	2013.07	2013.07	0.002729	0.360228	132	1	0.074217231
STORY4	1.21	0.36	22	20X30,22X32	24X32,24X34	57628.39	2102.99	2102.99	0.002778	0.366696	132	1	0.076125739
STORY3	1.21	0.24	22	20X30,22X32	24X32,24X34	60509.81	2188.92	2188.92	0.002711	0.357852	132	1	0.074942024
STORY2	1.21	0.12	22	20X30,22X32	24X32,24X34	63391.23	2270.14	2270.14	0.002222	0.293304	132	1	0.062046972
STORY1	1.21	0	22	20X30,22X32	24X32,24X34	64063.19	2270.14	2270.14	0.000828	0.109296	132	1	0.023366101

Determination of stability coefficient (ϴ) of a 22 storied asymmetric building with aspect ratio 1.21

Floor	Aspect Ratio (L/W)	Aspect Ratio (H/W)	Number of Story	Exterior Column Size	Interior Column Size	Vertical Design Load (P)	Story Shear (Vx)	Absolute Value (Vx)	DriftX	Design Story Drift Δ (Inch)	Floor Height (hsx)	Deflection Amplification Factor (Cd)	Stability Coefficient (θ)
STORY25	1.21	2.9	24	22X32,24X32	24X36,24X38	2924.98	62.17	62.17	0.000475	0.0627	132	1	0.022347845
STORY24	1.21	2.78	24	22X32,24X32	24X36,24X38	5849.95	185.91	185.91	0.000594	0.078408	132	1	0.018691142
STORY23	1.21	2.66	24	22X32,24X32	24X36,24X38	8774.93	308.71	308.71	0.000739	0.097548	132	1	0.021005712
STORY22	1.21	2.54	24	22X32,24X32	24X36,24X38	11699.91	430.54	430.54	0.000891	0.117612	132	1	0.024212895
STORY21	1.21	2.42	24	22X32,24X32	24X36,24X38	14624.88	551.38	551.38	0.001043	0.137676	132	1	0.027664677
STORY20	1.21	2.3	24	22X32,24X32	24X36,24X38	17549.86	671.19	671.19	0.001194	0.157608	132	1	0.031219972
STORY19	1.21	2.18	24	22X32,24X32	24X36,24X38	20474.84	789.92	789.92	0.001343	0.177276	132	1	0.034810753
STORY18	1.21	2.05	24	22X32,24X32	24X36,24X38	23399.81	907.55	907.55	0.001489	0.196548	132	1	0.038391623
STORY17	1.21	1.93	24	22X32,24X32	24X36,24X38	26324.79	1024.01	1024.01	0.001633	0.215556	132	1	0.041980432
STORY16	1.21	1.81	24	22X32,24X32	24X36,24X38	29249.77	1139.27	1139.27	0.001775	0.2343	132	1	0.045571587
STORY15	1.21	1.69	24	22X32,24X32	24X36,24X38	32174.74	1253.25	1253.25	0.001913	0.252516	132	1	0.04911253
STORY14	1.21	1.57	24	22X32,24X32	24X36,24X38	35099.72	1365.91	1365.91	0.002049	0.270468	132	1	0.052653049
STORY13	1.21	1.45	24	22X32,24X32	24X36,24X38	38024.7	1477.16	1477.16	0.00218	0.28776	132	1	0.056117039
STORY12	1.21	1.33	24	22X32,24X32	24X36,24X38	40949.68	1586.93	1586.93	0.002308	0.304656	132	1	0.059556415
STORY11	1.21	1.21	24	22X32,24X32	24X36,24X38	43874.65	1695.11	1695.11	0.002432	0.321024	132	1	0.062947625
STORY10	1.21	1.09	24	22X32,24X32	24X36,24X38	46799.63	1801.6	1801.6	0.002552	0.336864	132	1	0.066292549
STORY9	1.21	0.97	24	22X32,24X32	24X36,24X38	49724.61	1906.27	1906.27	0.002666	0.351912	132	1	0.069541991
STORY8	1.21	0.85	24	22X32,24X32	24X36,24X38	52649.58	2008.95	2008.95	0.002776	0.366432	132	1	0.072752052
STORY7	1.21	0.73	24	22X32,24X32	24X36,24X38	55574.56	2109.45	2109.45	0.002879	0.380028	132	1	0.075848756
STORY6	1.21	0.6	24	22X32,24X32	24X36,24X38	58499.54	2207.5	2207.5	0.002972	0.392304	132	1	0.078759064
STORY5	1.21	0.48	24	22X32,24X32	24X36,24X38	61424.51	2302.78	2302.78	0.003048	0.402336	132	1	0.081302559
STORY4	1.21	0.36	24	22X32,24X32	24X36,24X38	64349.49	2394.79	2394.79	0.003076	0.406032	132	1	0.082654024
STORY3	1.21	0.24	24	22X32,24X32	24X36,24X38	67274.47	2482.76	2482.76	0.002961	0.390852	132	1	0.08023317
STORY2	1.21	0.12	24	22X32,24X32	24X36,24X38	70199.44	2565.98	2565.98	0.002368	0.312576	132	1	0.064783153
STORY1	1.21	0	24	22X32,24X32	24X36,24X38	70895.16	2565.98	2565.98	0.000871	0.114972	132	1	0.024064757

Determination of stability coefficient (Θ) of a 24 storied asymmetric building with aspect ratio 1.21

Floor	Aspect Ratio (L/W)	Aspect Ratio (H/W)	Number of Story	Exterior Column Size	Interior Column Size	Vertical Design Load (P)	Story Shear (Vx)	Absolute Value (Vx)	DriftX	Design Story Drift Δ (Inch)	Floor Height (hsx)	Deflection Amplification Factor (Cd)	Stability Coefficient (θ)
STORY27	1.21	3.14	26	24X34,24X36	24X38,30X40	2984.59	64.25	64.25	0.000538	0.071016	132	1	0.024991586
STORY26	1.21	3.02	26	24X34,24X36	24X38,30X40	5969.19	192.16	192.16	0.000654	0.086328	132	1	0.020315624
STORY25	1.21	2.9	26	24X34,24X36	24X38,30X40	8953.78	319.18	319.18	0.000797	0.105204	132	1	0.0223578
STORY24	1.21	2.78	26	24X34,24X36	24X38,30X40	11938.37	445.29	445.29	0.000949	0.125268	132	1	0.025442999
STORY23	1.21	2.66	26	24X34,24X36	24X38,30X40	14922.96	570.45	570.45	0.001102	0.145464	132	1	0.028828297
STORY22	1.21	2.54	26	24X34,24X36	24X38,30X40	17907.56	694.64	694.64	0.001255	0.16566	132	1	0.032353432
STORY21	1.21	2.42	26	24X34,24X36	24X38,30X40	20892.15	817.82	817.82	0.001406	0.185592	132	1	0.035917883
STORY20	1.21	2.3	26	24X34,24X36	24X38,30X40	23876.74	939.96	939.96	0.001555	0.20526	132	1	0.039499905
STORY19	1.21	2.18	26	24X34,24X36	24X38,30X40	26861.34	1061.01	1061.01	0.001702	0.224664	132	1	0.043089133
STORY18	1.21	2.05	26	24X34,24X36	24X38,30X40	29845.93	1180.94	1180.94	0.001846	0.243672	132	1	0.04665401
STORY17	1.21	1.93	26	24X34,24X36	24X38,30X40	32830.52	1299.71	1299.71	0.001988	0.262416	132	1	0.050216644
STORY16	1.21	1.81	26	24X34,24X36	24X38,30X40	35815.12	1417.24	1417.24	0.002127	0.280764	132	1	0.053751489
STORY15	1.21	1.69	26	24X34,24X36	24X38,30X40	38799.71	1533.5	1533.5	0.002262	0.298584	132	1	0.057231786
STORY14	1.21	1.57	26	24X34,24X36	24X38,30X40	41784.3	1648.41	1648.41	0.002395	0.31614	132	1	0.060709046
STORY13	1.21	1.45	26	24X34,24X36	24X38,30X40	44768.89	1761.91	1761.91	0.002523	0.333036	132	1	0.06410765
STORY12	1.21	1.33	26	24X34,24X36	24X38,30X40	47753.49	1873.9	1873.9	0.002648	0.349536	132	1	0.067480251
STORY11	1.21	1.21	26	24X34,24X36	24X38,30X40	50738.08	1984.3	1984.3	0.002769	0.365508	132	1	0.070802673
STORY10	1.21	1.09	26	24X34,24X36	24X38,30X40	53722.67	2092.98	2092.98	0.002885	0.38082	132	1	0.074052262
STORY9	1.21	0.97	26	24X34,24X36	24X38,30X40	56707.27	2199.83	2199.83	0.002996	0.395472	132	1	0.077230959
STORY8	1.21	0.85	26	24X34,24X36	24X38,30X40	59691.86	2304.66	2304.66	0.003101	0.409332	132	1	0.080317469
STORY7	1.21	0.73	26	24X34,24X36	24X38,30X40	62676.45	2407.29	2407.29	0.003199	0.422268	132	1	0.083289493
STORY6	1.21	0.6	26	24X34,24X36	24X38,30X40	65661.05	2507.46	2507.46	0.003285	0.43362	132	1	0.08602193
STORY5	1.21	0.48	26	24X34,24X36	24X38,30X40	68645.64	2604.81	2604.81	0.003346	0.441672	132	1	0.088178528
STORY4	1.21	0.36	26	24X34,24X36	24X38,30X40	71630.23	2698.86	2698.86	0.003344	0.441408	132	1	0.08875284
STORY3	1.21	0.24	26	24X34,24X36	24X38,30X40	74614.82	2788.84	2788.84	0.003163	0.417516	132	1	0.084625391
STORY2	1.21	0.12	26	24X34,24X36	24X38,30X40	77599.42	2874.01	2874.01	0.002453	0.323796	132	1	0.066231982
STORY1	1.21	0	26	24X34,24X36	24X38,30X40	78327.65	2874.01	2874.01	0.000886	0.116952	132	1	0.024146853

Determination of stability coefficient (Θ) of a 26 storied asymmetric building with aspect ratio 1.21

Floor	Aspect Ratio (L/W)	Aspect Ratio (H/W)	Number of Story	Exterior Column Size	Interior Column Size	Vertical Design Load (P)	Story Shear (Vx)	Absolute Value (Vx)	DriftX	Design Story Drift Δ (Inch)	Floor Height (hsx)	Deflection Amplification Factor (Cd)	Stability Coefficient (θ)
STORY29	1.21	3.38	28	26X40,26X38	28X42,34X44	3085.13	66.27	66.27	0.000584	0.077088	132	1	0.027187504
STORY28	1.21	3.26	28	26X40,26X38	28X42,34X44	6170.25	198.26	198.26	0.000691	0.091212	132	1	0.02150531
STORY27	1.21	3.14	28	26X40,26X38	28X42,34X44	9255.38	329.4	329.4	0.000829	0.109428	132	1	0.023292987
STORY26	1.21	3.02	28	26X40,26X38	28X42,34X44	12340.51	459.67	459.67	0.000977	0.128964	132	1	0.026228987
STORY25	1.21	2.9	28	26X40,26X38	28X42,34X44	15425.63	589.04	589.04	0.001129	0.149028	132	1	0.029565965
STORY24	1.21	2.78	28	26X40,26X38	28X42,34X44	18510.76	717.48	717.48	0.001281	0.169092	132	1	0.0330494
STORY23	1.21	2.66	28	26X40,26X38	28X42,34X44	21595.89	844.97	844.97	0.001432	0.189024	132	1	0.036599305
STORY22	1.21	2.54	28	26X40,26X38	28X42,34X44	24681.01	971.47	971.47	0.001581	0.208692	132	1	0.040166631
STORY21	1.21	2.42	28	26X40,26X38	28X42,34X44	27766.14	1096.96	1096.96	0.001728	0.228096	132	1	0.04373896
STORY20	1.21	2.3	28	26X40,26X38	28X42,34X44	30851.27	1221.39	1221.39	0.001874	0.247368	132	1	0.047335642
STORY19	1.21	2.18	28	26X40,26X38	28X42,34X44	33936.39	1344.73	1344.73	0.002017	0.266244	132	1	0.050902188
STORY18	1.21	2.05	28	26X40,26X38	28X42,34X44	37021.52	1466.94	1466.94	0.002157	0.284724	132	1	0.054436731
STORY17	1.21	1.93	28	26X40,26X38	28X42,34X44	40106.65	1587.96	1587.96	0.002295	0.30294	132	1	0.057964156
STORY16	1.21	1.81	28	26X40,26X38	28X42,34X44	43191.77	1707.75	1707.75	0.00243	0.32076	132	1	0.061458645
STORY15	1.21	1.69	28	26X40,26X38	28X42,34X44	46276.9	1826.24	1826.24	0.002561	0.338052	132	1	0.06489571
STORY14	1.21	1.57	28	26X40,26X38	28X42,34X44	49362.02	1943.38	1943.38	0.002689	0.354948	132	1	0.068300832
STORY13	1.21	1.45	28	26X40,26X38	28X42,34X44	52447.15	2059.08	2059.08	0.002814	0.371448	132	1	0.071675836
STORY12	1.21	1.33	28	26X40,26X38	28X42,34X44	55532.28	2173.26	2173.26	0.002935	0.38742	132	1	0.07499666
STORY11	1.21	1.21	28	26X40,26X38	28X42,34X44	58617.4	2285.84	2285.84	0.003052	0.402864	132	1	0.078264579
STORY10	1.21	1.09	28	26X40,26X38	28X42,34X44	61702.53	2396.68	2396.68	0.003164	0.417648	132	1	0.081457184
STORY9	1.21	0.97	28	26X40,26X38	28X42,34X44	64787.66	2505.66	2505.66	0.00327	0.43164	132	1	0.084550836
STORY8	1.21	0.85	28	26X40,26X38	28X42,34X44	67872.78	2612.62	2612.62	0.00337	0.44484	132	1	0.087548617
STORY7	1.21	0.73	28	26X40,26X38	28X42,34X44	70957.91	2717.34	2717.34	0.00346	0.45672	132	1	0.090350993
STORY6	1.21	0.6	28	26X40,26X38	28X42,34X44	74043.04	2819.58	2819.58	0.003531	0.466092	132	1	0.092725149
STORY5	1.21	0.48	28	26X40,26X38	28X42,34X44	77128.16	2918.98	2918.98	0.003563	0.470316	132	1	0.09414509
STORY4	1.21	0.36	28	26X40,26X38	28X42,34X44	80213.29	3015.04	3015.04	0.003504	0.462528	132	1	0.093221771
STORY3	1.21	0.24	28	26X40,26X38	28X42,34X44	83298.42	3106.98	3106.98	0.003224	0.425568	132	1	0.086435737
STORY2	1.21	0.12	28	26X40,26X38	28X42,34X44	86383.54	3194.07	3194.07	0.002387	0.315084	132	1	0.064556353
STORY1	1.21	0	28	26X40,26X38	28X42,34X44	87166.61	3194.07	3194.07	0.000837	0.110484	132	1	0.022841845

Determination of stability coefficient (Θ) of a 28 storied asymmetric building with aspect ratio 1.21

Floor	Aspect Ratio (L/W)	Aspect Ratio (H/W)	Number of Story	Exterior Column Size	Interior Column Size	Vertical Design Load (P)	Story Shear (Vx)	Absolute Value (Vx)	DriftX	Design Story Drift Δ (Inch)	Floor Height (hsx)	Deflection Amplification Factor (Cd)	Stability Coefficient (θ)
STORY31	1.21	3.63	30	26X42,26X38	32X44,36X48	3147.38	68.26	68.26	0.000658	0.086856	132	1	0.030339526
STORY30	1.21	3.51	30	26X42,26X38	32X44,36X48	6294.77	204.24	204.24	0.000764	0.100848	132	1	0.023546829
STORY29	1.21	3.38	30	26X42,26X38	32X44,36X48	9442.15	339.41	339.41	0.000901	0.118932	132	1	0.025065193
STORY28	1.21	3.26	30	26X42,26X38	32X44,36X48	12589.53	473.74	473.74	0.00105	0.1386	132	1	0.027903505
STORY27	1.21	3.14	30	26X42,26X38	32X44,36X48	15736.91	607.22	607.22	0.001204	0.158928	132	1	0.031203254
STORY26	1.21	3.02	30	26X42,26X38	32X44,36X48	18884.3	739.81	739.81	0.001359	0.179388	132	1	0.034689669
STORY25	1.21	2.9	30	26X42,26X38	32X44,36X48	22031.68	871.49	871.49	0.001514	0.199848	132	1	0.038274637
STORY24	1.21	2.78	30	26X42,26X38	32X44,36X48	25179.06	1002.24	1002.24	0.001667	0.220044	132	1	0.041879683
STORY23	1.21	2.66	30	26X42,26X38	32X44,36X48	28326.44	1132.02	1132.02	0.001818	0.239976	132	1	0.045491659
STORY22	1.21	2.54	30	26X42,26X38	32X44,36X48	31473.83	1260.81	1260.81	0.001968	0.259776	132	1	0.049127543
STORY21	1.21	2.42	30	26X42,26X38	32X44,36X48	34621.21	1388.57	1388.57	0.002115	0.27918	132	1	0.052733286
STORY20	1.21	2.3	30	26X42,26X38	32X44,36X48	37768.59	1515.27	1515.27	0.00226	0.29832	132	1	0.056331224
STORY19	1.21	2.18	30	26X42,26X38	32X44,36X48	40915.97	1640.87	1640.87	0.002402	0.317064	132	1	0.059895153
STORY18	1.21	2.05	30	26X42,26X38	32X44,36X48	44063.36	1765.32	1765.32	0.002542	0.335544	132	1	0.063449721
STORY17	1.21	1.93	30	26X42,26X38	32X44,36X48	47210.74	1888.57	1888.57	0.002679	0.353628	132	1	0.066970021
STORY16	1.21	1.81	30	26X42,26X38	32X44,36X48	50358.12	2010.57	2010.57	0.002813	0.371316	132	1	0.070456334
STORY15	1.21	1.69	30	26X42,26X38	32X44,36X48	53505.5	2131.27	2131.27	0.002943	0.388476	132	1	0.073883969
STORY14	1.21	1.57	30	26X42,26X38	32X44,36X48	56652.89	2250.6	2250.6	0.00307	0.40524	132	1	0.077279113
STORY13	1.21	1.45	30	26X42,26X38	32X44,36X48	59800.27	2368.48	2368.48	0.003194	0.421608	132	1	0.080643308
STORY12	1.21	1.33	30	26X42,26X38	32X44,36X48	62947.65	2484.82	2484.82	0.003313	0.437316	132	1	0.083927836
STORY11	1.21	1.21	30	26X42,26X38	32X44,36X48	66095.03	2599.54	2599.54	0.003428	0.452496	132	1	0.087159175
STORY10	1.21	1.09	30	26X42,26X38	32X44,36X48	69242.42	2712.51	2712.51	0.003538	0.467016	132	1	0.090314757
STORY9	1.21	0.97	30	26X42,26X38	32X44,36X48	72389.8	2823.6	2823.6	0.003642	0.480744	132	1	0.093371459
STORY8	1.21	0.85	30	26X42,26X38	32X44,36X48	75537.18	2932.65	2932.65	0.003738	0.493416	132	1	0.096280831
STORY7	1.21	0.73	30	26X42,26X38	32X44,36X48	78684.56	3039.44	3039.44	0.00382	0.50424	132	1	0.098891578
STORY6	1.21	0.6	30	26X42,26X38	32X44,36X48	81831.95	3143.71	3143.71	0.003879	0.512028	132	1	0.100971824
STORY5	1.21	0.48	30	26X42,26X38	32X44,36X48	84979.33	3245.12	3245.12	0.003887	0.513084	132	1	0.101788117
STORY4	1.21	0.36	30	26X42,26X38	32X44,36X48	88126.71	3343.16	3343.16	0.003786	0.499752	132	1	0.099800107
STORY3	1.21	0.24	30	26X42,26X38	32X44,36X48	91274.09	3437.05	3437.05	0.003431	0.452892	132	1	0.091113427
STORY2	1.21	0.12	30	26X42,26X38	32X44,36X48	94421.48	3526.02	3526.02	0.002483	0.327756	132	1	0.066490983
STORY1	1.21	0	30	26X42,26X38	32X44,36X48	95238.5	3526.02	3526.02	0.000858	0.113256	132	1	0.02317475

Determination of stability coefficient (ϴ) of a 30 storied asymmetric building with aspect ratio 1.21

Floor	Aspect Ratio (L/W)	Aspect Ratio (H/W)	Number of Story	Exterior Column Size	Interior Column Size	Vertical Design Load (P)	Story Shear (Vx)	Absolute Value (Vx)	DriftX	Design Story Drift Δ (Inch)	Floor Height (hsx)	Deflection Amplification Factor (Cd)	Stability Coefficient (θ)
STORY3	3.33	0.41	2	12X12	12X12	2530.54	16.54	16.54	0.00009	0.01188	132	1	0.013769565
STORY2	3.33	0.2	2	12X12	12X12	5061.09	47.93	47.93	0.000234	0.030888	132	1	0.024708847
STORY1	3.33	0	2	12X12	12X12	7558.33	71.51	71.51	0.000113	0.014916	132	1	0.011943662

Determination of stability coefficient (ϴ) of a 2 storied asymmetric building with aspect ratio 3.33

Floor	Aspect Ratio (L/W)	Aspect Ratio (H/W)	Number of Story	Exterior Column Size	Interior Column Size	Vertical Design Load (P)	Story Shear (Vx)	Absolute Value (Vx)	DriftX	Design Story Drift Δ (Inch)	Floor Height (hsx)	Deflection Amplification Factor (Cd)	Stability Coefficient (θ)
STORY5	3.33	0.81	4	12X12	12X16	2549.02	19.75	19.75	0.000093	0.012276	132	1	0.01200298
STORY4	3.33	0.61	4	12X12	12X16	5098.05	58.06	58.06	0.000249	0.032868	132	1	0.021863838
STORY3	3.33	0.41	4	12X12	12X16	7647.07	94.27	94.27	0.000402	0.053064	132	1	0.032609761
STORY2	3.33	0.2	4	12X12	12X16	10196.09	128.01	128.01	0.000522	0.068904	132	1	0.041577681
STORY1	3.33	0	4	12X12	12X16	12703.42	153.41	153.41	0.000207	0.027324	132	1	0.017141046

Determination of stability coefficient (ϴ) of a 4 storied asymmetric building with aspect ratio 3.33

Floor	Aspect Ratio (L/W)	Aspect Ratio (H/W)	Number of Story	Exterior Column Size	Interior Column Size	Vertical Design Load (P)	Story Shear (Vx)	Absolute Value (Vx)	DriftX	Design Story Drift Δ (Inch)	Floor Height (hsx)	Deflection Amplification Factor (Cd)	Stability Coefficient (θ)
STORY7	3.33	1.22	6	12X14	12X20,14X22	2582.63	22.01	22.01	0.000081	0.010692	132	1	0.009504454
STORY6	3.33	1.02	6	12X14	12X20,14X22	5165.25	65.16	65.16	0.000206	0.027192	132	1	0.016329673
STORY5	3.33	0.81	6	12X14	12X20,14X22	7747.88	106.86	106.86	0.000333	0.043956	132	1	0.024144152
STORY4	3.33	0.61	6	12X14	12X20,14X22	10330.5	146.86	146.86	0.000454	0.059928	132	1	0.031935496
STORY3	3.33	0.41	6	12X14	12X20,14X22	12913.13	184.77	184.77	0.000568	0.074976	132	1	0.039696151
STORY2	3.33	0.2	6	12X14	12X20,14X22	15495.76	220.2	220.2	0.000638	0.084216	132	1	0.044896889
STORY1	3.33	0	6	12X14	12X20,14X22	18021.41	246.9	246.9	0.000245	0.03234	132	1	0.017882728

Determination of stability coefficient (Θ) of a 6 storied asymmetric building with aspect ratio 3.33

Floor	Aspect Ratio (L/W)	Aspect Ratio (H/W)	Number of Story	Exterior Column Size	Interior Column Size	Vertical Design Load (P)	Story Shear (Vx)	Absolute Value (Vx)	DriftX	Design Story Drift Δ (Inch)	Floor Height (hsx)	Deflection Amplification Factor (Cd)	Stability Coefficient (θ)
STORY9	3.33	1.63	8	12X16	14X24,16X26	2625.8	23.8	23.8	0.000072	0.009504	132	1	0.007943597
STORY8	3.33	1.43	8	12X16	14X24,16X26	5251.6	70.71	70.71	0.000167	0.022044	132	1	0.012403015
STORY7	3.33	1.22	8	12X16	14X24,16X26	7877.39	116.48	116.48	0.000267	0.035244	132	1	0.018056861
STORY6	3.33	1.02	8	12X16	14X24,16X26	10503.19	160.98	160.98	0.000364	0.048048	132	1	0.023749293
STORY5	3.33	0.81	8	12X16	14X24,16X26	13128.99	204.04	204.04	0.000457	0.060324	132	1	0.029405746
STORY4	3.33	0.61	8	12X16	14X24,16X26	15754.79	245.39	245.39	0.000545	0.07194	132	1	0.03499067
STORY3	3.33	0.41	8	12X16	14X24,16X26	18380.59	284.65	284.65	0.000626	0.082632	132	1	0.040422446
STORY2	3.33	0.2	8	12X16	14X24,16X26	21006.38	321.43	321.43	0.000648	0.085536	132	1	0.042348674
STORY1	3.33	0	8	12X16	14X24,16X26	23555.59	349.18	349.18	0.00025	0.033	132	1	0.016864934

Determination of stability coefficient (Θ) of an 8 storied asymmetric building with aspect ratio 3.33

Floor	Aspect Ratio (L/W)	Aspect Ratio (H/W)	Number of Story	Exterior Column Size	Interior Column Size	Vertical Design Load (P)	Story Shear (Vx)	Absolute Value (Vx)	DriftX	Design Story Drift Δ (Inch)	Floor Height (hsx)	Deflection Amplification Factor (Cd)	Stability Coefficient (θ)
STORY11	3.33	2.04	10	12X18	16X26,18X28	2661.11	25.31	25.31	0.000075	0.0099	132	1	0.007885549
STORY10	3.33	1.83	10	12X18	16X26,18X28	5322.21	75.34	75.34	0.000156	0.020592	132	1	0.011020238
STORY9	3.33	1.63	10	12X18	16X26,18X28	7983.32	124.42	124.42	0.000244	0.032208	132	1	0.015656085
STORY8	3.33	1.43	10	12X18	16X26,18X28	10644.42	172.47	172.47	0.00033	0.04356	132	1	0.02036678
STORY7	3.33	1.22	10	12X18	16X26,18X28	13305.53	219.38	219.38	0.000414	0.054648	132	1	0.025109351
STORY6	3.33	1.02	10	12X18	16X26,18X28	15966.64	265.02	265.02	0.000495	0.06534	132	1	0.029822228
STORY5	3.33	0.81	10	12X18	16X26,18X28	18627.74	309.22	309.22	0.000572	0.075504	132	1	0.034457885
STORY4	3.33	0.61	10	12X18	16X26,18X28	21288.85	351.72	351.72	0.000646	0.085272	132	1	0.039100981
STORY3	3.33	0.41	10	12X18	16X26,18X28	23949.95	392.12	392.12	0.000708	0.093456	132	1	0.043243305
STORY2	3.33	0.2	10	12X18	16X26,18X28	26611.06	430.05	430.05	0.000692	0.091344	132	1	0.042820262
STORY1	3.33	0	10	12X18	16X26,18X28	29179.52	458.68	458.68	0.000268	0.035376	132	1	0.017049166

Determination of stability coefficient (Θ) of a 10 storied asymmetric building with aspect ratio 3.33

Floor	Aspect Ratio (L/W)	Aspect Ratio (H/W)	Number of Story	Exterior Column Size	Interior Column Size	Vertical Design Load (P)	Story Shear (Vx)	Absolute Value (Vx)	DriftX	Design Story Drift Δ (Inch)	Floor Height (hsx)	Deflection Amplification Factor (Cd)	Stability Coefficient (θ)
STORY13	3.33	2.44	12	14X22	18X28, 18X32	2702.3	26.94	26.94	0.000082	0.010824	132	1	0.008225264
STORY12	3.33	2.24	12	14X22	18X28, 18X32	5404.6	80.29	80.29	0.000157	0.020724	132	1	0.010568218
STORY11	3.33	2.04	12	14X22	18X28, 18X32	8106.89	132.8	132.8	0.000239	0.031548	132	1	0.01458996
STORY10	3.33	1.83	12	14X22	18X28, 18X32	10809.19	184.43	184.43	0.00032	0.04224	132	1	0.018754762
STORY9	3.33	1.63	12	14X22	18X28, 18X32	13511.49	235.09	235.09	0.000399	0.052668	132	1	0.022932003
STORY8	3.33	1.43	12	14X22	18X28, 18X32	16213.79	284.71	284.71	0.000476	0.062832	132	1	0.027107457
STORY7	3.33	1.22	12	14X22	18X28, 18X32	18916.09	333.19	333.19	0.000551	0.072732	132	1	0.031281748
STORY6	3.33	1.02	12	14X22	18X28, 18X32	21618.39	380.37	380.37	0.000623	0.082236	132	1	0.035408305
STORY5	3.33	0.81	12	14X22	18X28, 18X32	24320.68	426.1	426.1	0.000692	0.091344	132	1	0.039497561
STORY4	3.33	0.61	12	14X22	18X28, 18X32	27022.98	470.1	470.1	0.000757	0.099924	132	1	0.043514988
STORY3	3.33	0.41	12	14X22	18X28, 18X32	29725.28	511.99	511.99	0.000806	0.106392	132	1	0.046795007
STORY2	3.33	0.2	12	14X22	18X28, 18X32	32427.58	551.37	551.37	0.00076	0.10032	132	1	0.044697682
STORY1	3.33	0	12	14X22	18X28, 18X32	35018.51	581.11	581.11	0.000293	0.038676	132	1	0.017656594

Determination of stability coefficient (Θ) of a 12 storied asymmetric building with aspect ratio 3.33

Floor	Aspect Ratio (L/W)	Aspect Ratio (H/W)	Number of Story	Exterior Column Size	Interior Column Size	Vertical Design Load (P)	Story Shear (Vx)	Absolute Value (Vx)	DriftX	Design Story Drift Δ (Inch)	Floor Height (hsx)	Deflection Amplification Factor (Cd)	Stability Coefficient (θ)
STORY15	3.33	2.85	14	16X28	18X32, 20X34	2754.49	28.77	28.77	0.000089	0.011748	132	1	0.008521015
STORY14	3.33	2.65	14	16X28	18X32, 20X34	5508.98	85.84	85.84	0.000159	0.020988	132	1	0.010204192
STORY13	3.33	2.44	14	16X28	18X32, 20X34	8263.47	142.15	142.15	0.000237	0.031284	132	1	0.013777294
STORY12	3.33	2.24	14	16X28	18X32, 20X34	11017.96	197.65	197.65	0.000315	0.04158	132	1	0.017559612
STORY11	3.33	2.04	14	16X28	18X32, 20X34	13772.45	252.31	252.31	0.000391	0.051612	132	1	0.021342903
STORY10	3.33	1.83	14	16X28	18X32, 20X34	16526.94	306.06	306.06	0.000467	0.061644	132	1	0.025217542
STORY9	3.33	1.63	14	16X28	18X32, 20X34	19281.43	358.82	358.82	0.00054	0.07128	132	1	0.029017257
STORY8	3.33	1.43	14	16X28	18X32, 20X34	22035.92	410.52	410.52	0.000611	0.080652	132	1	0.032797299
STORY7	3.33	1.22	14	16X28	18X32, 20X34	24790.41	461.03	461.03	0.00068	0.08976	132	1	0.03656482
STORY6	3.33	1.02	14	16X28	18X32, 20X34	27544.9	510.24	510.24	0.000747	0.098604	132	1	0.0403262
STORY5	3.33	0.81	14	16X28	18X32, 20X34	30299.39	557.95	557.95	0.00081	0.10692	132	1	0.043986927
STORY4	3.33	0.61	14	16X28	18X32, 20X34	33053.88	603.9	603.9	0.000867	0.114444	132	1	0.047454403
STORY3	3.33	0.41	14	16X28	18X32, 20X34	35808.37	647.67	647.67	0.000903	0.119196	132	1	0.049925052
STORY2	3.33	0.2	14	16X28	18X32, 20X34	38562.86	688.89	688.89	0.000819	0.108108	132	1	0.045846191
STORY1	3.33	0	14	16X28	18X32, 20X34	41182.26	720.04	720.04	0.000314	0.041448	132	1	0.017959043

Determination of stability coefficient (Θ) of a 14 storied asymmetric building with aspect ratio 3.33

Floor	Aspect Ratio (L/W)	Aspect Ratio (H/W)	Number of Story	Exterior Column Size	Interior Column Size	Vertical Design Load (P)	Story Shear (Vx)	Absolute Value (Vx)	DriftX	Design Story Drift Δ (Inch)	Floor Height (hsx)	Deflection Amplification Factor (Cd)	Stability Coefficient (θ)
STORY17	3.33	3.26	16	16X30	20X34, 22X36	2825.77	30.21	30.21	0.000098	0.012936	132	1	0.009166682
STORY16	3.33	3.06	16	16X30	20X34, 22X36	5651.53	90.18	90.18	0.00016	0.02112	132	1	0.01002711
STORY15	3.33	2.85	16	16X30	20X34, 22X36	8477.3	149.46	149.46	0.000232	0.030624	132	1	0.013158929
STORY14	3.33	2.65	16	16X30	20X34, 22X36	11303.06	208.01	208.01	0.000305	0.04026	132	1	0.016573402
STORY13	3.33	2.44	16	16X30	20X34, 22X36	14128.83	265.8	265.8	0.000377	0.049764	132	1	0.020039763
STORY12	3.33	2.24	16	16X30	20X34, 22X36	16954.59	322.79	322.79	0.000448	0.059136	132	1	0.023531263
STORY11	3.33	2.04	16	16X30	20X34, 22X36	19780.36	378.91	378.91	0.000518	0.068376	132	1	0.02704132
STORY10	3.33	1.83	16	16X30	20X34, 22X36	22606.12	434.11	434.11	0.000586	0.077352	132	1	0.030515736
STORY9	3.33	1.63	16	16X30	20X34, 22X36	25431.89	488.31	488.31	0.000652	0.086064	132	1	0.033957102
STORY8	3.33	1.43	16	16X30	20X34, 22X36	28257.65	541.44	541.44	0.000717	0.094644	132	1	0.037420093
STORY7	3.33	1.22	16	16X30	20X34, 22X36	31083.42	593.37	593.37	0.000779	0.102828	132	1	0.040807564
STORY6	3.33	1.02	16	16X30	20X34, 22X36	33909.18	643.98	643.98	0.000839	0.110748	132	1	0.044178083
STORY5	3.33	0.81	16	16X30	20X34, 22X36	36734.95	693.07	693.07	0.000894	0.118008	132	1	0.047384889
STORY4	3.33	0.61	16	16X30	20X34, 22X36	39560.71	740.39	740.39	0.000941	0.124212	132	1	0.050279755
STORY3	3.33	0.41	16	16X30	20X34, 22X36	42386.48	785.5	785.5	0.000954	0.125928	132	1	0.051478933
STORY2	3.33	0.2	16	16X30	20X34, 22X36	45212.25	828.03	828.03	0.000819	0.108108	132	1	0.044719192
STORY1	3.33	0	16	16X30	20X34, 22X36	47870.52	860.18	860.18	0.00031	0.04092	132	1	0.017252042

Determination of stability coefficient (Θ) of a 16 storied asymmetric building with aspect ratio 3.33

Floor	Aspect Ratio (L/W)	Aspect Ratio (H/W)	Number of Story	Exterior Column Size	Interior Column Size	Vertical Design Load (P)	Story Shear (Vx)	Absolute Value (Vx)	DriftX	Design Story Drift Δ (Inch)	Floor Height (hsx)	Deflection Amplification Factor (Cd)	Stability Coefficient (θ)
STORY19	3.33	3.67	18	18X34	24X38,24X40	2922.06	30.87	30.87	0.000106	0.013992	132	1	0.010033637
STORY18	3.33	3.46	18	18X34	24X38,24X40	5844.13	92.21	92.21	0.000161	0.021252	132	1	0.010203936
STORY17	3.33	3.26	18	18X34	24X38,24X40	8766.19	152.92	152.92	0.000227	0.029964	132	1	0.013012851
STORY16	3.33	3.06	18	18X34	24X38,24X40	11688.26	212.98	212.98	0.000295	0.03894	132	1	0.016189486
STORY15	3.33	2.85	18	18X34	24X38,24X40	14610.32	272.36	272.36	0.000363	0.047916	132	1	0.019472559
STORY14	3.33	2.65	18	18X34	24X38,24X40	17532.38	331.02	331.02	0.00043	0.05676	132	1	0.022774828
STORY13	3.33	2.44	18	18X34	24X38,24X40	20454.45	388.92	388.92	0.000497	0.065604	132	1	0.026138696
STORY12	3.33	2.24	18	18X34	24X38,24X40	23376.51	446.03	446.03	0.000562	0.074184	132	1	0.029454518
STORY11	3.33	2.04	18	18X34	24X38,24X40	26298.58	502.28	502.28	0.000626	0.082632	132	1	0.032776362
STORY10	3.33	1.83	18	18X34	24X38,24X40	29220.64	557.63	557.63	0.000688	0.090816	132	1	0.036052222
STORY9	3.33	1.63	18	18X34	24X38,24X40	32142.71	611.99	611.99	0.000748	0.098736	132	1	0.039286176
STORY8	3.33	1.43	18	18X34	24X38,24X40	35064.77	665.28	665.28	0.000807	0.106524	132	1	0.042534376
STORY7	3.33	1.22	18	18X34	24X38,24X40	37986.83	717.4	717.4	0.000864	0.114048	132	1	0.045749402
STORY6	3.33	1.02	18	18X34	24X38,24X40	40908.9	768.2	768.2	0.000917	0.121044	132	1	0.048832936
STORY5	3.33	0.81	18	18X34	24X38,24X40	43830.96	817.5	817.5	0.000965	0.12738	132	1	0.051739298
STORY4	3.33	0.61	18	18X34	24X38,24X40	46753.03	865.05	865.05	0.000997	0.131604	132	1	0.053884482
STORY3	3.33	0.41	18	18X34	24X38,24X40	49675.09	910.43	910.43	0.00098	0.12936	132	1	0.053470984
STORY2	3.33	0.2	18	18X34	24X38,24X40	52597.15	953.24	953.24	0.000794	0.104808	132	1	0.043810727
STORY1	3.33	0	18	18X34	24X38,24X40	55307.96	985.62	985.62	0.000294	0.038808	132	1	0.016497778

Determination of stability coefficient (Θ) of an 18 storied asymmetric building with aspect ratio 3.33

Floor	Aspect Ratio (L/W)	Aspect Ratio (H/W)	Number of Story	Exterior Column Size	Interior Column Size	Vertical Design Load (P)	Story Shear (Vx)	Absolute Value (Vx)	DriftX	Design Story Drift Δ (Inch)	Floor Height (hsx)	Deflection Amplification Factor (Cd)	Stability Coefficient (θ)
STORY21	3.33	4.07	20	18X28	18X30,18X32	2975.03	31.8	31.8	0.000141	0.018612	132	1	0.013191171
STORY20	3.33	3.87	20	18X28	18X30,18X32	5950.05	95.02	95.02	0.000213	0.028116	132	1	0.01333783
STORY19	3.33	3.67	20	18X28	18X30,18X32	8925.08	157.66	157.66	0.000297	0.039204	132	1	0.016813071
STORY18	3.33	3.46	20	18X28	18X30,18X32	11900.1	219.7	219.7	0.000383	0.050556	132	1	0.020745281
STORY17	3.33	3.26	20	18X28	18X30,18X32	14875.13	281.12	281.12	0.000468	0.061776	132	1	0.024763663
STORY16	3.33	3.06	20	18X28	18X30,18X32	17850.15	341.89	341.89	0.000552	0.072864	132	1	0.028820038
STORY15	3.33	2.85	20	18X28	18X30,18X32	20825.18	401.97	401.97	0.000635	0.08382	132	1	0.032897951
STORY14	3.33	2.65	20	18X28	18X30,18X32	23800.21	461.34	461.34	0.000716	0.094512	132	1	0.036937942
STORY13	3.33	2.44	20	18X28	18X30,18X32	26775.23	519.96	519.96	0.000796	0.105072	132	1	0.040989851
STORY12	3.33	2.24	20	18X28	18X30,18X32	29750.26	577.77	577.77	0.000875	0.1155	132	1	0.045055087
STORY11	3.33	2.04	20	18X28	18X30,18X32	32725.28	634.73	634.73	0.000951	0.125532	132	1	0.049031464
STORY10	3.33	1.83	20	18X28	18X30,18X32	35700.31	690.78	690.78	0.001026	0.135432	132	1	0.053024868
STORY9	3.33	1.63	20	18X28	18X30,18X32	38675.33	745.85	745.85	0.001099	0.145068	132	1	0.056987582
STORY8	3.33	1.43	20	18X28	18X30,18X32	41650.36	799.85	799.85	0.001169	0.154308	132	1	0.060873002
STORY7	3.33	1.22	20	18X28	18X30,18X32	44625.39	852.67	852.67	0.001236	0.163152	132	1	0.064687373
STORY6	3.33	1.02	20	18X28	18X30,18X32	47600.41	904.18	904.18	0.001301	0.171732	132	1	0.068490935
STORY5	3.33	0.81	20	18X28	18X30,18X32	50575.44	954.2	954.2	0.00136	0.17952	132	1	0.072084048
STORY4	3.33	0.61	20	18X28	18X30,18X32	53550.46	1002.45	1002.45	0.001408	0.185856	132	1	0.075214771
STORY3	3.33	0.41	20	18X28	18X30,18X32	56525.49	1048.53	1048.53	0.001415	0.18678	132	1	0.076281621
STORY2	3.33	0.2	20	18X28	18X30,18X32	59500.52	1092.05	1092.05	0.001208	0.159456	132	1	0.065818074
STORY1	3.33	0	20	18X28	18X30,18X32	62240.21	1124.98	1124.98	0.000447	0.059004	132	1	0.02473055

Determination of stability coefficient (Θ) of a 20 storied asymmetric building with aspect ratio 3.33

Floor	Aspect Ratio (L/W)	Aspect Ratio (H/W)	Number of Story	Exterior Column Size	Interior Column Size	Vertical Design Load (P)	Story Shear (Vx)	Absolute Value (Vx)	DriftX	Design Story Drift Δ (Inch)	Floor Height (hsx)	Deflection Amplification Factor (Cd)	Stability Coefficient (θ)
STORY23	3.33	4.48	22	18X30	20X34,20X38	3022.71	33.03	33.03	0.000159	0.020988	132	1	0.014550738
STORY22	3.33	4.28	22	18X30	20X34,20X38	6045.42	98.74	98.74	0.00023	0.03036	132	1	0.014081898
STORY21	3.33	4.07	22	18X30	20X34,20X38	9068.12	163.91	163.91	0.000312	0.041184	132	1	0.017261018
STORY20	3.33	3.87	22	18X30	20X34,20X38	12090.83	228.51	228.51	0.000396	0.052272	132	1	0.020952994
STORY19	3.33	3.67	22	18X30	20X34,20X38	15113.54	292.53	292.53	0.00048	0.06336	132	1	0.024799163
STORY18	3.33	3.46	22	18X30	20X34,20X38	18136.25	355.95	355.95	0.000563	0.074316	132	1	0.028685795
STORY17	3.33	3.26	22	18X30	20X34,20X38	21158.95	418.73	418.73	0.000645	0.08514	132	1	0.032592656
STORY16	3.33	3.06	22	18X30	20X34,20X38	24181.66	480.86	480.86	0.000726	0.095832	132	1	0.036509348
STORY15	3.33	2.85	22	18X30	20X34,20X38	27204.37	542.29	542.29	0.000806	0.106392	132	1	0.040433573
STORY14	3.33	2.65	22	18X30	20X34,20X38	30227.08	603.01	603.01	0.000884	0.116688	132	1	0.044312265
STORY13	3.33	2.44	22	18X30	20X34,20X38	33249.78	662.95	662.95	0.000961	0.126852	132	1	0.048198263
STORY12	3.33	2.24	22	18X30	20X34,20X38	36272.49	722.09	722.09	0.001036	0.136752	132	1	0.052041019
STORY11	3.33	2.04	22	18X30	20X34,20X38	39295.2	780.37	780.37	0.001109	0.146388	132	1	0.055843224
STORY10	3.33	1.83	22	18X30	20X34,20X38	42317.91	837.72	837.72	0.001181	0.155892	132	1	0.059658898
STORY9	3.33	1.63	22	18X30	20X34,20X38	45340.62	894.08	894.08	0.00125	0.165	132	1	0.063390049
STORY8	3.33	1.43	22	18X30	20X34,20X38	48363.32	949.36	949.36	0.001316	0.173712	132	1	0.06704109
STORY7	3.33	1.22	22	18X30	20X34,20X38	51386.03	1003.45	1003.45	0.00138	0.18216	132	1	0.070668914
STORY6	3.33	1.02	22	18X30	20X34,20X38	54408.74	1056.22	1056.22	0.001441	0.190212	132	1	0.074229795
STORY5	3.33	0.81	22	18X30	20X34,20X38	57431.45	1107.46	1107.46	0.001495	0.19734	132	1	0.077528776
STORY4	3.33	0.61	22	18X30	20X34,20X38	60454.15	1156.93	1156.93	0.001536	0.202752	132	1	0.080262051
STORY3	3.33	0.41	22	18X30	20X34,20X38	63476.86	1204.21	1204.21	0.001524	0.201168	132	1	0.080333775
STORY2	3.33	0.2	22	18X30	20X34,20X38	66499.57	1248.89	1248.89	0.001274	0.168168	132	1	0.067836601
STORY1	3.33	0	22	18X30	20X34,20X38	69265.27	1282.71	1282.71	0.000469	0.061908	132	1	0.025325609

Determination of stability coefficient (Θ) of a 22 storied asymmetric building with aspect ratio 3.33

Floor	Aspect Ratio (L/W)	Aspect Ratio (H/W)	Number of Story	Exterior Column Size	Interior Column Size	Vertical Design Load (P)	Story Shear (Vx)	Absolute Value (Vx)	DriftX	Design Story Drift Δ (Inch)	Floor Height (hsx)	Deflection Amplification Factor (Cd)	Stability Coefficient (θ)
STORY25	3.33	4.89	24	18X34	24X38,26X42	3107.18	33.85	33.85	0.000176	0.023232	132	1	0.0161555
STORY24	3.33	4.69	24	18X34	24X38,26X42	6214.36	101.22	101.22	0.00024	0.03168	132	1	0.014734701
STORY23	3.33	4.48	24	18X34	24X38,26X42	9321.55	168.08	168.08	0.000317	0.041844	132	1	0.017580505
STORY22	3.33	4.28	24	18X34	24X38,26X42	12428.73	234.42	234.42	0.000397	0.052404	132	1	0.02104857
STORY21	3.33	4.07	24	18X34	24X38,26X42	15535.91	300.21	300.21	0.000478	0.063096	132	1	0.024736568
STORY20	3.33	3.87	24	18X34	24X38,26X42	18643.09	365.44	365.44	0.000558	0.073656	132	1	0.028466627
STORY19	3.33	3.67	24	18X34	24X38,26X42	21750.28	430.09	430.09	0.000637	0.084084	132	1	0.032214021
STORY18	3.33	3.46	24	18X34	24X38,26X42	24857.46	494.13	494.13	0.000715	0.09438	132	1	0.035968437
STORY17	3.33	3.26	24	18X34	24X38,26X42	27964.64	557.54	557.54	0.000792	0.104544	132	1	0.039724495
STORY16	3.33	3.06	24	18X34	24X38,26X42	31071.82	620.29	620.29	0.000868	0.114576	132	1	0.04348021
STORY15	3.33	2.85	24	18X34	24X38,26X42	34179.01	682.35	682.35	0.000942	0.124344	132	1	0.047184916
STORY14	3.33	2.65	24	18X34	24X38,26X42	37286.19	743.69	743.69	0.001016	0.134112	132	1	0.050938925
STORY13	3.33	2.44	24	18X34	24X38,26X42	40393.37	804.26	804.26	0.001087	0.143484	132	1	0.05459378
STORY12	3.33	2.24	24	18X34	24X38,26X42	43500.55	864.03	864.03	0.001157	0.152724	132	1	0.05825045
STORY11	3.33	2.04	24	18X34	24X38,26X42	46607.73	922.93	922.93	0.001225	0.1617	132	1	0.061862188
STORY10	3.33	1.83	24	18X34	24X38,26X42	49714.92	980.91	980.91	0.001292	0.170544	132	1	0.065481723
STORY9	3.33	1.63	24	18X34	24X38,26X42	52822.1	1037.9	1037.9	0.001356	0.178992	132	1	0.069011242
STORY8	3.33	1.43	24	18X34	24X38,26X42	55929.28	1093.8	1093.8	0.001417	0.187044	132	1	0.072455467
STORY7	3.33	1.22	24	18X34	24X38,26X42	59036.46	1148.52	1148.52	0.001476	0.194832	132	1	0.075869654
STORY6	3.33	1.02	24	18X34	24X38,26X42	62143.65	1201.91	1201.91	0.00153	0.20196	132	1	0.079107241
STORY5	3.33	0.81	24	18X34	24X38,26X42	65250.83	1253.78	1253.78	0.001576	0.208032	132	1	0.082020217
STORY4	3.33	0.61	24	18X34	24X38,26X42	68358.01	1303.88	1303.88	0.001599	0.211068	132	1	0.083830152
STORY3	3.33	0.41	24	18X34	24X38,26X42	71465.19	1351.78	1351.78	0.001549	0.204468	132	1	0.081891713
STORY2	3.33	0.2	24	18X34	24X38,26X42	74572.38	1397.09	1397.09	0.001234	0.162888	132	1	0.065867136
STORY1	3.33	0	24	18X34	24X38,26X42	77384.15	1431.39	1431.39	0.000447	0.059004	132	1	0.024165821

Determination of stability coefficient (Θ) of a 24 storied asymmetric building with aspect ratio 3.33

Floor	Aspect Ratio (L/W)	Aspect Ratio (H/W)	Number of Story	Exterior Column Size	Interior Column Size	Vertical Design Load (P)	Story Shear (Vx)	Absolute Value (Vx)	DriftX	Design Story Drift Δ (Inch)	Floor Height (hsx)	Deflection Amplification Factor (Cd)	Stability Coefficient (θ)
STORY27	3.33	5.3	26	20X36	26X42,32X48	3204.58	35.01	35.01	0.000195	0.02574	132	1	0.017848989
STORY26	3.33	5.09	26	20X36	26X42,32X48	6409.16	104.72	104.72	0.000253	0.033396	132	1	0.015484315
STORY25	3.33	4.89	26	20X36	26X42,32X48	9613.74	173.94	173.94	0.000325	0.0429	132	1	0.017962892
STORY24	3.33	4.69	26	20X36	26X42,32X48	12818.32	242.67	242.67	0.000402	0.053064	132	1	0.021234453
STORY23	3.33	4.48	26	20X36	26X42,32X48	16022.91	310.87	310.87	0.00048	0.06336	132	1	0.024740235
STORY22	3.33	4.28	26	20X36	26X42,32X48	19227.49	378.55	378.55	0.000558	0.073656	132	1	0.028342199
STORY21	3.33	4.07	26	20X36	26X42,32X48	22432.07	445.68	445.68	0.000635	0.08382	132	1	0.031960969
STORY20	3.33	3.87	26	20X36	26X42,32X48	25636.65	512.24	512.24	0.000711	0.093852	132	1	0.035584215
STORY19	3.33	3.67	26	20X36	26X42,32X48	28841.23	578.21	578.21	0.000787	0.103884	132	1	0.039255717
STORY18	3.33	3.46	26	20X36	26X42,32X48	32045.81	643.57	643.57	0.000861	0.113652	132	1	0.042872481
STORY17	3.33	3.26	26	20X36	26X42,32X48	35250.39	708.29	708.29	0.000935	0.12342	132	1	0.046533362
STORY16	3.33	3.06	26	20X36	26X42,32X48	38454.97	772.35	772.35	0.001007	0.132924	132	1	0.050138091
STORY15	3.33	2.85	26	20X36	26X42,32X48	41659.55	835.71	835.71	0.001078	0.142296	132	1	0.053737534
STORY14	3.33	2.65	26	20X36	26X42,32X48	44864.13	898.33	898.33	0.001147	0.151404	132	1	0.057283133
STORY13	3.33	2.44	26	20X36	26X42,32X48	48068.72	960.18	960.18	0.001215	0.16038	132	1	0.060825569
STORY12	3.33	2.24	26	20X36	26X42,32X48	51273.3	1021.21	1021.21	0.001282	0.169224	132	1	0.064367143
STORY11	3.33	2.04	26	20X36	26X42,32X48	54477.88	1081.37	1081.37	0.001346	0.177672	132	1	0.067809562
STORY10	3.33	1.83	26	20X36	26X42,32X48	57682.46	1140.6	1140.6	0.001409	0.185988	132	1	0.071255993
STORY9	3.33	1.63	26	20X36	26X42,32X48	60887.04	1198.83	1198.83	0.001469	0.193908	132	1	0.074608628
STORY8	3.33	1.43	26	20X36	26X42,32X48	64091.62	1255.96	1255.96	0.001526	0.201432	132	1	0.077871757
STORY7	3.33	1.22	26	20X36	26X42,32X48	67296.2	1311.89	1311.89	0.00158	0.20856	132	1	0.081049475
STORY6	3.33	1.02	26	20X36	26X42,32X48	70500.78	1366.48	1366.48	0.001628	0.214896	132	1	0.083993377
STORY5	3.33	0.81	26	20X36	26X42,32X48	73705.36	1419.53	1419.53	0.001662	0.219384	132	1	0.086294977
STORY4	3.33	0.61	26	20X36	26X42,32X48	76909.95	1470.79	1470.79	0.001661	0.219252	132	1	0.086856334
STORY3	3.33	0.41	26	20X36	26X42,32X48	80114.53	1519.82	1519.82	0.001563	0.206316	132	1	0.082390685
STORY2	3.33	0.2	26	20X36	26X42,32X48	83319.11	1566.24	1566.24	0.001187	0.156684	132	1	0.063144718
STORY1	3.33	0	26	20X36	26X42,32X48	86184.01	1601.39	1601.39	0.00042	0.05544	132	1	0.022603666

Determination of stability coefficient (Θ) of a 26 storied asymmetric building with aspect ratio 3.33

Floor	Aspect Ratio (L/W)	Aspect Ratio (H/W)	Number of Story	Exterior Column Size	Interior Column Size	Vertical Design Load (P)	Story Shear (Vx)	Absolute Value (Vx)	DriftX	Design Story Drift Δ (Inch)	Floor Height (hsx)	Deflection Amplification Factor (Cd)	Stability Coefficient (θ)
STORY29	3.33	5.7	28	20X38,26X44	30X46,36X56	3280.92	36.15	36.15	0.000225	0.0297	132	1	0.020420664
STORY28	3.33	5.5	28	20X38,26X44	30X46,36X56	6561.83	108.14	108.14	0.00028	0.03696	132	1	0.016990128
STORY27	3.33	5.3	28	20X38,26X44	30X46,36X56	9842.75	179.67	179.67	0.000351	0.046332	132	1	0.019228615
STORY26	3.33	5.09	28	20X38,26X44	30X46,36X56	13123.66	250.73	250.73	0.000428	0.056496	132	1	0.022402291
STORY25	3.33	4.89	28	20X38,26X44	30X46,36X56	16404.58	321.29	321.29	0.000507	0.066924	132	1	0.025886651
STORY24	3.33	4.69	28	20X38,26X44	30X46,36X56	19685.5	391.35	391.35	0.000586	0.077352	132	1	0.029476691
STORY23	3.33	4.48	28	20X38,26X44	30X46,36X56	22966.41	460.89	460.89	0.000664	0.087648	132	1	0.033087496
STORY22	3.33	4.28	28	20X38,26X44	30X46,36X56	26247.33	529.89	529.89	0.000742	0.097944	132	1	0.03675389
STORY21	3.33	4.07	28	20X38,26X44	30X46,36X56	29528.25	598.34	598.34	0.00082	0.10824	132	1	0.040467234
STORY20	3.33	3.87	28	20X38,26X44	30X46,36X56	32809.16	666.21	666.21	0.000896	0.118272	132	1	0.044125737
STORY19	3.33	3.67	28	20X38,26X44	30X46,36X56	36090.08	733.49	733.49	0.000971	0.128172	132	1	0.04777634
STORY18	3.33	3.46	28	20X38,26X44	30X46,36X56	39370.99	800.15	800.15	0.001045	0.13794	132	1	0.051418715
STORY17	3.33	3.26	28	20X38,26X44	30X46,36X56	42651.91	866.16	866.16	0.001118	0.147576	132	1	0.055053149
STORY16	3.33	3.06	28	20X38,26X44	30X46,36X56	45932.83	931.5	931.5	0.00119	0.15708	132	1	0.058679622
STORY15	3.33	2.85	28	20X38,26X44	30X46,36X56	49213.74	996.13	996.13	0.001261	0.166452	132	1	0.062299626
STORY14	3.33	2.65	28	20X38,26X44	30X46,36X56	52494.66	1060.02	1060.02	0.001329	0.175428	132	1	0.065815176
STORY13	3.33	2.44	28	20X38,26X44	30X46,36X56	55775.58	1123.13	1123.13	0.001397	0.184404	132	1	0.069376194
STORY12	3.33	2.24	28	20X38,26X44	30X46,36X56	59056.49	1185.42	1185.42	0.001462	0.192984	132	1	0.072835441
STORY11	3.33	2.04	28	20X38,26X44	30X46,36X56	62337.41	1246.82	1246.82	0.001526	0.201432	132	1	0.076295606
STORY10	3.33	1.83	28	20X38,26X44	30X46,36X56	65618.32	1307.28	1307.28	0.001588	0.209616	132	1	0.079708932
STORY9	3.33	1.63	28	20X38,26X44	30X46,36X56	68899.24	1366.72	1366.72	0.001647	0.217404	132	1	0.083028746
STORY8	3.33	1.43	28	20X38,26X44	30X46,36X56	72180.16	1425.06	1425.06	0.001702	0.224664	132	1	0.08620734
STORY7	3.33	1.22	28	20X38,26X44	30X46,36X56	75461.07	1482.19	1482.19	0.001753	0.231396	132	1	0.089248515
STORY6	3.33	1.02	28	20X38,26X44	30X46,36X56	78741.99	1537.95	1537.95	0.001793	0.236676	132	1	0.091800376
STORY5	3.33	0.81	28	20X38,26X44	30X46,36X56	82022.9	1592.17	1592.17	0.001814	0.239448	132	1	0.093450788
STORY4	3.33	0.61	28	20X38,26X44	30X46,36X56	85303.82	1644.57	1644.57	0.001786	0.235752	132	1	0.092639792
STORY3	3.33	0.41	28	20X38,26X44	30X46,36X56	88584.74	1694.72	1694.72	0.001641	0.216612	132	1	0.085776741
STORY2	3.33	0.2	28	20X38,26X44	30X46,36X56	91865.65	1742.22	1742.22	0.001201	0.158532	132	1	0.06332762
STORY1	3.33	0	28	20X38,26X44	30X46,36X56	94772.19	1778.2	1778.2	0.000417	0.055044	132	1	0.022224723

Determination of stability coefficient (ϴ) of a 28 storied asymmetric building with aspect ratio 3.33

Floor	Aspect Ratio (L/W)	Aspect Ratio (H/W)	Number of Story	Exterior Column Size	Interior Column Size	Vertical Design Load (P)	Story Shear (Vx)	Absolute Value (Vx)	DriftX	Design Story Drift Δ (Inch)	Floor Height (hsx)	Deflection Amplification Factor (Cd)	Stability Coefficient (θ)
STORY31	3.33	6.11	30	36X60,36X56	28X46,32X52	3321.28	37.27	37.27	0.000254	0.033528	132	1	0.022634964
STORY30	3.33	5.91	30	36X60,36X56	28X46,32X52	6642.57	111.5	111.5	0.000309	0.040788	132	1	0.018408557
STORY29	3.33	5.7	30	36X60,36X56	28X46,32X52	9963.85	185.3	185.3	0.00038	0.05016	132	1	0.020433152
STORY28	3.33	5.5	30	36X60,36X56	28X46,32X52	13285.13	258.63	258.63	0.000457	0.060324	132	1	0.023474865
STORY27	3.33	5.3	30	36X60,36X56	28X46,32X52	16606.42	331.5	331.5	0.000536	0.070752	132	1	0.026850803
STORY26	3.33	5.09	30	36X60,36X56	28X46,32X52	19927.7	403.89	403.89	0.000616	0.081312	132	1	0.030393085
STORY25	3.33	4.89	30	36X60,36X56	28X46,32X52	23248.99	475.78	475.78	0.000696	0.091872	132	1	0.03401004
STORY24	3.33	4.69	30	36X60,36X56	28X46,32X52	26570.27	547.15	547.15	0.000775	0.1023	132	1	0.037634943
STORY23	3.33	4.48	30	36X60,36X56	28X46,32X52	29891.55	618.01	618.01	0.000854	0.112728	132	1	0.041305778
STORY22	3.33	4.28	30	36X60,36X56	28X46,32X52	33212.84	688.32	688.32	0.000931	0.122892	132	1	0.044922644
STORY21	3.33	4.07	30	36X60,36X56	28X46,32X52	36534.12	758.07	758.07	0.001008	0.133056	132	1	0.048579146
STORY20	3.33	3.87	30	36X60,36X56	28X46,32X52	39855.4	827.24	827.24	0.001084	0.143088	132	1	0.052225779
STORY19	3.33	3.67	30	36X60,36X56	28X46,32X52	43176.69	895.81	895.81	0.001158	0.152856	132	1	0.055813852
STORY18	3.33	3.46	30	36X60,36X56	28X46,32X52	46497.97	963.75	963.75	0.001232	0.162624	132	1	0.059440207
STORY17	3.33	3.26	30	36X60,36X56	28X46,32X52	49819.25	1031.03	1031.03	0.001304	0.172128	132	1	0.063009129
STORY16	3.33	3.06	30	36X60,36X56	28X46,32X52	53140.54	1097.64	1097.64	0.001375	0.1815	132	1	0.066568495
STORY15	3.33	2.85	30	36X60,36X56	28X46,32X52	56461.82	1163.53	1163.53	0.001444	0.190608	132	1	0.070071995
STORY14	3.33	2.65	30	36X60,36X56	28X46,32X52	59783.1	1228.68	1228.68	0.001512	0.199584	132	1	0.073568421
STORY13	3.33	2.44	30	36X60,36X56	28X46,32X52	63104.39	1293.03	1293.03	0.001578	0.208296	132	1	0.077011923
STORY12	3.33	2.24	30	36X60,36X56	28X46,32X52	66425.67	1356.55	1356.55	0.001643	0.216876	132	1	0.080452159
STORY11	3.33	2.04	30	36X60,36X56	28X46,32X52	69746.96	1419.18	1419.18	0.001705	0.22506	132	1	0.083793858
STORY10	3.33	1.83	30	36X60,36X56	28X46,32X52	73068.24	1480.85	1480.85	0.001765	0.23298	132	1	0.087088796
STORY9	3.33	1.63	30	36X60,36X56	28X46,32X52	76389.52	1541.5	1541.5	0.001822	0.240504	132	1	0.090289786
STORY8	3.33	1.43	30	36X60,36X56	28X46,32X52	79710.81	1601.03	1601.03	0.001876	0.247632	132	1	0.093400798
STORY7	3.33	1.22	30	36X60,36X56	28X46,32X52	83032.09	1659.33	1659.33	0.001923	0.253836	132	1	0.096226012
STORY6	3.33	1.02	30	36X60,36X56	28X46,32X52	86353.37	1716.26	1716.26	0.001959	0.258588	132	1	0.098566797
STORY5	3.33	0.81	30	36X60,36X56	28X46,32X52	89674.66	1771.62	1771.62	0.001971	0.260172	132	1	0.099766742
STORY4	3.33	0.61	30	36X60,36X56	28X46,32X52	92995.94	1825.15	1825.15	0.001928	0.254496	132	1	0.098236404
STORY3	3.33	0.41	30	36X60,36X56	28X46,32X52	96317.22	1876.4	1876.4	0.001755	0.23166	132	1	0.090085654
STORY2	3.33	0.2	30	36X60,36X56	28X46,32X52	99638.51	1924.97	1924.97	0.001269	0.167508	132	1	0.0656848
STORY1	3.33	0	30	36X60,36X56	28X46,32X52	102567.1	1961.78	1961.78	0.000438	0.057816	132	1	0.022899804

Determination of stability coefficient (ϴ) of a 30 storied asymmetric building with aspect ratio 3.33

Floor	Aspect Ratio (L/W)	Aspect Ratio (H/W)	Number of Story	Exterior Column Size	Interior Column Size	Vertical Design Load (P)	Story Shear (Vx)	Absolute Value (Vx)	DriftX	Design Story Drift Δ (Inch)	Floor Height (hsx)	Deflection Amplification Factor (Cd)	Stability Coefficient (θ)
STORY3	5.95	0.52	2	12X12	12X12	2608.26	12.86	12.86	0.00007	0.00924	132	1	0.014197372
STORY2	5.95	0.26	2	12X12	12X12	5216.52	37.28	37.28	0.000179	0.023628	132	1	0.025047132
STORY1	5.95	0	2	12X12	12X12	5696.73	37.28	37.28	0.000066	0.008712	132	1	0.010085413

Determination of stability coefficient (ϴ) of a 2 storied asymmetric building with aspect ratio 5.95

Floor	Aspect Ratio (L/W)	Aspect Ratio (H/W)	Number of Story	Exterior Column Size	Interior Column Size	Vertical Design Load (P)	Story Shear (Vx)	Absolute Value (Vx)	DriftX	Design Story Drift Δ (Inch)	Floor Height (hsx)	Deflection Amplification Factor (Cd)	Stability Coefficient (θ)
STORY5	5.95	1.05	4	12X16	12X18	2635.65	15.36	15.36	0.000069	0.009108	132	1	0.011839834
STORY4	5.95	0.79	4	12X16	12X18	5271.3	45.16	45.16	0.000185	0.02442	132	1	0.021594121
STORY3	5.95	0.52	4	12X16	12X18	7906.95	73.32	73.32	0.000299	0.039468	132	1	0.032244654
STORY2	5.95	0.26	4	12X16	12X18	10542.6	99.57	99.57	0.000386	0.050952	132	1	0.040870178
STORY1	5.95	0	4	12X16	12X18	11037.74	99.57	99.57	0.00014	0.01848	132	1	0.01551957

Determination of stability coefficient (ϴ) of a 4 storied asymmetric building with aspect ratio 5.95

Floor	Aspect Ratio (L/W)	Aspect Ratio (H/W)	Number of Story	Exterior Column Size	Interior Column Size	Vertical Design Load (P)	Story Shear (Vx)	Absolute Value (Vx)	DriftX	Design Story Drift Δ (Inch)	Floor Height (hsx)	Deflection Amplification Factor (Cd)	Stability Coefficient (θ)
STORY7	5.95	1.57	6	12X18	12X22,14X24	2667.99	17.12	17.12	0.000065	0.00858	132	1	0.010129635
STORY6	5.95	1.31	6	12X18	12X22,14X24	5335.97	50.68	50.68	0.000169	0.022308	132	1	0.017793586
STORY5	5.95	1.05	6	12X18	12X22,14X24	8003.96	83.11	83.11	0.000274	0.036168	132	1	0.02638774
STORY4	5.95	0.79	6	12X18	12X22,14X24	10671.95	114.23	114.23	0.000375	0.0495	132	1	0.035034415
STORY3	5.95	0.52	6	12X18	12X22,14X24	13339.93	143.71	143.71	0.00047	0.06204	132	1	0.043627911
STORY2	5.95	0.26	6	12X18	12X22,14X24	16007.92	171.27	171.27	0.000531	0.070092	132	1	0.04963044
STORY1	5.95	0	6	12X18	12X22,14X24	16520.71	171.27	171.27	0.000196	0.025872	132	1	0.018906167

Determination of stability coefficient (ϴ) of a 6 storied asymmetric building with aspect ratio 5.95

Floor	Aspect Ratio (L/W)	Aspect Ratio (H/W)	Number of Story	Exterior Column Size	Interior Column Size	Vertical Design Load (P)	Story Shear (Vx)	Absolute Value (Vx)	DriftX	Design Story Drift Δ (Inch)	Floor Height (hsx)	Deflection Amplification Factor (Cd)	Stability Coefficient (θ)
STORY9	5.95	2.1	8	12X22	14X24,14X26	2700.27	18.51	18.51	0.000059	0.007788	132	1	0.008607019
STORY8	5.95	1.83	8	12X22	14X24,14X26	5400.54	55	55	0.000146	0.019272	132	1	0.014335979
STORY7	5.95	1.57	8	12X22	14X24,14X26	8100.81	90.6	90.6	0.000237	0.031284	132	1	0.021190861
STORY6	5.95	1.31	8	12X22	14X24,14X26	10801.08	125.21	125.21	0.000325	0.0429	132	1	0.028035708
STORY5	5.95	1.05	8	12X22	14X24,14X26	13501.35	158.7	158.7	0.00041	0.05412	132	1	0.034880614
STORY4	5.95	0.79	8	12X22	14X24,14X26	16201.62	190.86	190.86	0.000491	0.064812	132	1	0.041679741
STORY3	5.95	0.52	8	12X22	14X24,14X26	18901.89	221.4	221.4	0.000566	0.074712	132	1	0.048321905
STORY2	5.95	0.26	8	12X22	14X24,14X26	21602.16	250	250	0.000597	0.078804	132	1	0.051585958
STORY1	5.95	0	8	12X22	14X24,14X26	22132.55	250	250	0.000223	0.029436	132	1	0.019742235

Determination of stability coefficient (ϴ) of an 8 storied asymmetric building with aspect ratio 5.95

Floor	Aspect Ratio (L/W)	Aspect Ratio (H/W)	Number of Story	Exterior Column Size	Interior Column Size	Vertical Design Load (P)	Story Shear (Vx)	Absolute Value (Vx)	DriftX	Design Story Drift Δ (Inch)	Floor Height (hsx)	Deflection Amplification Factor (Cd)	Stability Coefficient (θ)
STORY11	5.95	2.62	10	14X24	14X28,14X30	2734.31	19.69	19.69	0.000061	0.008052	132	1	0.008470945
STORY10	5.95	2.36	10	14X24	14X28,14X30	5468.63	58.6	58.6	0.000142	0.018744	132	1	0.013251629
STORY9	5.95	2.1	10	14X24	14X28,14X30	8202.94	96.77	96.77	0.000227	0.029964	132	1	0.019242197
STORY8	5.95	1.83	10	14X24	14X28,14X30	10937.25	134.14	134.14	0.000312	0.041184	132	1	0.025439257
STORY7	5.95	1.57	10	14X24	14X28,14X30	13671.56	170.63	170.63	0.000394	0.052008	132	1	0.03156886
STORY6	5.95	1.31	10	14X24	14X28,14X30	16405.88	206.13	206.13	0.000473	0.062436	132	1	0.037646055
STORY5	5.95	1.05	10	14X24	14X28,14X30	19140.19	240.51	240.51	0.00055	0.0726	132	1	0.043769924
STORY4	5.95	0.79	10	14X24	14X28,14X30	21874.5	273.56	273.56	0.000623	0.082236	132	1	0.049816543
STORY3	5.95	0.52	10	14X24	14X28,14X30	24608.81	304.98	304.98	0.000688	0.090816	132	1	0.055514661
STORY2	5.95	0.26	10	14X24	14X28,14X30	27343.13	334.48	334.48	0.000694	0.091608	132	1	0.056733234
STORY1	5.95	0	10	14X24	14X28,14X30	27892.09	334.48	334.48	0.000264	0.034848	132	1	0.022014804

Determination of stability coefficient (ϴ) of a 10 storied asymmetric building with aspect ratio 5.95

Floor	Aspect Ratio (L/W)	Aspect Ratio (H/W)	Number of Story	Exterior Column Size	Interior Column Size	Vertical Design Load (P)	Story Shear (Vx)	Absolute Value (Vx)	DriftX	Design Story Drift Δ (Inch)	Floor Height (hsx)	Deflection Amplification Factor (Cd)	Stability Coefficient (θ)
STORY13	5.95	3.14	12	14X28	16X32,16X34	2797.89	20.71	20.71	0.000058	0.007656	132	1	0.007835713
STORY12	5.95	2.88	12	14X28	16X32,16X34	5595.78	61.72	61.72	0.000124	0.016368	132	1	0.011242332
STORY11	5.95	2.62	12	14X28	16X32,16X34	8393.67	102.09	102.09	0.000197	0.026004	132	1	0.016197012
STORY10	5.95	2.36	12	14X28	16X32,16X34	11191.55	141.78	141.78	0.000269	0.035508	132	1	0.021233791
STORY9	5.95	2.1	12	14X28	16X32,16X34	13989.44	180.72	180.72	0.00034	0.04488	132	1	0.026319221
STORY8	5.95	1.83	12	14X28	16X32,16X34	16787.33	218.87	218.87	0.000409	0.053988	132	1	0.031370302
STORY7	5.95	1.57	12	14X28	16X32,16X34	19585.22	256.13	256.13	0.000476	0.062832	132	1	0.036397785
STORY6	5.95	1.31	12	14X28	16X32,16X34	22383.11	292.41	292.41	0.000542	0.071544	132	1	0.041488477
STORY5	5.95	1.05	12	14X28	16X32,16X34	25181	327.56	327.56	0.000604	0.079728	132	1	0.046432177
STORY4	5.95	0.79	12	14X28	16X32,16X34	27978.89	361.39	361.39	0.000663	0.087516	132	1	0.0513296
STORY3	5.95	0.52	12	14X28	16X32,16X34	30776.77	393.58	393.58	0.00071	0.09372	132	1	0.055519861
STORY2	5.95	0.26	12	14X28	16X32,16X34	33574.66	423.85	423.85	0.000679	0.089628	132	1	0.053785995
STORY1	5.95	0	12	14X28	16X32,16X34	34158.3	423.85	423.85	0.000261	0.034452	132	1	0.021034131

Determination of stability coefficient (Θ) of a 12 storied asymmetric building with aspect ratio 5.95

Floor	Aspect Ratio (L/W)	Aspect Ratio (H/W)	Number of Story	Exterior Column Size	Interior Column Size	Vertical Design Load (P)	Story Shear (Vx)	Absolute Value (Vx)	DriftX	Design Story Drift Δ (Inch)	Floor Height (hsx)	Deflection Amplification Factor (Cd)	Stability Coefficient (θ)
STORY15	5.95	3.67	14	14X30	18X36,20X38	2892.1	21.87	21.87	0.00006	0.00792	132	1	0.007934431
STORY14	5.95	3.4	14	14X30	18X36,20X38	5784.19	65.25	65.25	0.000114	0.015048	132	1	0.010105711
STORY13	5.95	3.14	14	14X30	18X36,20X38	8676.29	108.05	108.05	0.000177	0.023364	132	1	0.014212895
STORY12	5.95	2.88	14	14X30	18X36,20X38	11568.39	150.24	150.24	0.00024	0.03168	132	1	0.018479856
STORY11	5.95	2.62	14	14X30	18X36,20X38	14460.49	191.78	191.78	0.000303	0.039996	132	1	0.022846639
STORY10	5.95	2.36	14	14X30	18X36,20X38	17352.58	232.63	232.63	0.000364	0.048048	132	1	0.027151868
STORY9	5.95	2.1	14	14X30	18X36,20X38	20244.68	272.74	272.74	0.000425	0.0561	132	1	0.031546487
STORY8	5.95	1.83	14	14X30	18X36,20X38	23136.78	312.03	312.03	0.000484	0.063888	132	1	0.035888221
STORY7	5.95	1.57	14	14X30	18X36,20X38	26028.88	350.43	350.43	0.000541	0.071412	132	1	0.040183843
STORY6	5.95	1.31	14	14X30	18X36,20X38	28920.97	387.83	387.83	0.000596	0.078672	132	1	0.044444468
STORY5	5.95	1.05	14	14X30	18X36,20X38	31813.07	424.1	424.1	0.000649	0.085668	132	1	0.048683524
STORY4	5.95	0.79	14	14X30	18X36,20X38	34705.17	459.02	459.02	0.000695	0.09174	132	1	0.052546933
STORY3	5.95	0.52	14	14X30	18X36,20X38	37597.27	492.3	492.3	0.000719	0.094908	132	1	0.054910496
STORY2	5.95	0.26	14	14X30	18X36,20X38	40489.36	523.62	523.62	0.000637	0.084084	132	1	0.049256565
STORY1	5.95	0	14	14X30	18X36,20X38	41124.39	523.62	523.62	0.000243	0.032076	132	1	0.019084884

Determination of stability coefficient (Θ) of a 14 storied asymmetric building with aspect ratio 5.95

Floor	Aspect Ratio (L/W)	Aspect Ratio (H/W)	Number of Story	Exterior Column Size	Interior Column Size	Vertical Design Load (P)	Story Shear (Vx)	Absolute Value (Vx)	DriftX	Design Story Drift Δ (Inch)	Floor Height (hsx)	Deflection Amplification Factor (Cd)	Stability Coefficient (θ)
STORY17	5.95	4.19	16	16X32	20X40,22X42	2972.61	22.97	22.97	0.000066	0.008712	132	1	0.008541239
STORY16	5.95	3.93	16	16X32	20X40,22X42	5945.22	68.56	68.56	0.000116	0.015312	132	1	0.010059007
STORY15	5.95	3.67	16	16X32	20X40,22X42	8917.84	113.63	113.63	0.000176	0.023232	132	1	0.013812724
STORY14	5.95	3.4	16	16X32	20X40,22X42	11890.45	158.15	158.15	0.000237	0.031284	132	1	0.017818758
STORY13	5.95	3.14	16	16X32	20X40,22X42	14863.06	202.09	202.09	0.000298	0.039336	132	1	0.021916928
STORY12	5.95	2.88	16	16X32	20X40,22X42	17835.67	245.41	245.41	0.000358	0.047256	132	1	0.026018377
STORY11	5.95	2.62	16	16X32	20X40,22X42	20808.29	288.08	288.08	0.000417	0.055044	132	1	0.030120303
STORY10	5.95	2.36	16	16X32	20X40,22X42	23780.9	330.05	330.05	0.000475	0.0627	132	1	0.034224898
STORY9	5.95	2.1	16	16X32	20X40,22X42	26753.51	371.26	371.26	0.000532	0.070224	132	1	0.038336657
STORY8	5.95	1.83	16	16X32	20X40,22X42	29726.12	411.65	411.65	0.000587	0.077484	132	1	0.042388516
STORY7	5.95	1.57	16	16X32	20X40,22X42	32698.74	451.14	451.14	0.000641	0.084612	132	1	0.04645984
STORY6	5.95	1.31	16	16X32	20X40,22X42	35671.35	489.62	489.62	0.000693	0.091476	132	1	0.050488635
STORY5	5.95	1.05	16	16X32	20X40,22X42	38643.96	526.94	526.94	0.00074	0.09768	132	1	0.054269045
STORY4	5.95	0.79	16	16X32	20X40,22X42	41616.57	562.91	562.91	0.000778	0.102696	132	1	0.057518416
STORY3	5.95	0.52	16	16X32	20X40,22X42	44589.18	597.22	597.22	0.000782	0.103224	132	1	0.058385082
STORY2	5.95	0.26	16	16X32	20X40,22X42	47561.8	629.55	629.55	0.000658	0.086856	132	1	0.049711166
STORY1	5.95	0	16	16X32	20X40,22X42	48240.74	629.55	629.55	0.000248	0.032736	132	1	0.01900358

Determination of stability coefficient (Θ) of a 16 storied asymmetric building with aspect ratio 5.95

Floor	Aspect Ratio (L/W)	Aspect Ratio (H/W)	Number of Story	Exterior Column Size	Interior Column Size	Vertical Design Load (P)	Story Shear (Vx)	Absolute Value (Vx)	DriftX	Design Story Drift Δ (Inch)	Floor Height (hsx)	Deflection Amplification Factor (Cd)	Stability Coefficient (θ)
STORY19	5.95	4.71	18	18X34,24X42	28X44,30X46	3118.13	24.01	24.01	0.000078	0.010296	132	1	0.010129702
STORY18	5.95	4.45	18	18X34,24X42	28X44,30X46	6236.27	71.72	71.72	0.000121	0.015972	132	1	0.010521314
STORY17	5.95	4.19	18	18X34,24X42	28X44,30X46	9354.4	118.94	118.94	0.000174	0.022968	132	1	0.013684762
STORY16	5.95	3.93	18	18X34,24X42	28X44,30X46	12472.53	165.65	165.65	0.000231	0.030492	132	1	0.017393024
STORY15	5.95	3.67	18	18X34,24X42	28X44,30X46	15590.67	211.83	211.83	0.000289	0.038148	132	1	0.021270375
STORY14	5.95	3.4	18	18X34,24X42	28X44,30X46	18708.8	257.46	257.46	0.000347	0.045804	132	1	0.025215387
STORY13	5.95	3.14	18	18X34,24X42	28X44,30X46	21826.93	302.5	302.5	0.000404	0.053328	132	1	0.029150677
STORY12	5.95	2.88	18	18X34,24X42	28X44,30X46	24945.06	346.91	346.91	0.00046	0.06072	132	1	0.033076958
STORY11	5.95	2.62	18	18X34,24X42	28X44,30X46	28063.2	390.67	390.67	0.000515	0.06798	132	1	0.036994261
STORY10	5.95	2.36	18	18X34,24X42	28X44,30X46	31181.33	433.71	433.71	0.000569	0.075108	132	1	0.040907926
STORY9	5.95	2.1	18	18X34,24X42	28X44,30X46	34299.46	475.99	475.99	0.000622	0.082104	132	1	0.044820824
STORY8	5.95	1.83	18	18X34,24X42	28X44,30X46	37417.6	517.44	517.44	0.000673	0.088836	132	1	0.048666599
STORY7	5.95	1.57	18	18X34,24X42	28X44,30X46	40535.73	557.97	557.97	0.000722	0.095304	132	1	0.052452277
STORY6	5.95	1.31	18	18X34,24X42	28X44,30X46	43653.86	597.49	597.49	0.000766	0.101112	132	1	0.05596555
STORY5	5.95	1.05	18	18X34,24X42	28X44,30X46	46772	635.84	635.84	0.000801	0.105732	132	1	0.058921068
STORY4	5.95	0.79	18	18X34,24X42	28X44,30X46	49890.13	672.82	672.82	0.000814	0.107448	132	1	0.060358738
STORY3	5.95	0.52	18	18X34,24X42	28X44,30X46	53008.26	708.11	708.11	0.000773	0.102036	132	1	0.057865847
STORY2	5.95	0.26	18	18X34,24X42	28X44,30X46	56126.39	741.41	741.41	0.000589	0.077748	132	1	0.044588613
STORY1	5.95	0	18	18X34,24X42	28X44,30X46	56884.72	741.41	741.41	0.000212	0.027984	132	1	0.016265711

Determination of stability coefficient (Ɵ) of an 18 storied asymmetric building with aspect ratio 5.95

Floor	Aspect Ratio (L/W)	Aspect Ratio (H/W)	Number of Story	Exterior Column Size	Interior Column Size	Vertical Design Load (P)	Story Shear (Vx)	Absolute Value (Vx)	DriftX	Design Story Drift Δ (Inch)	Floor Height (hsx)	Deflection Amplification Factor (Cd)	Stability Coefficient (θ)
STORY21	5.95	5.24	20	16X30,26X24	18X36,20X38	3088.71	24.45	24.45	0.000095	0.01254	132	1	0.012001123
STORY20	5.95	4.98	20	16X30,26X24	18X36,20X38	6177.42	73.06	73.06	0.000152	0.020064	132	1	0.01285201
STORY19	5.95	4.71	20	16X30,26X24	18X36,20X38	9266.13	121.23	121.23	0.000221	0.029172	132	1	0.01689198
STORY18	5.95	4.45	20	16X30,26X24	18X36,20X38	12354.84	168.94	168.94	0.000293	0.038676	132	1	0.021427537
STORY17	5.95	4.19	20	16X30,26X24	18X36,20X38	15443.55	216.16	216.16	0.000364	0.048048	132	1	0.026005978
STORY16	5.95	3.93	20	16X30,26X24	18X36,20X38	18532.26	262.89	262.89	0.000435	0.05742	132	1	0.030665043
STORY15	5.95	3.67	20	16X30,26X24	18X36,20X38	21620.97	309.09	309.09	0.000506	0.066792	132	1	0.035394904
STORY14	5.95	3.4	20	16X30,26X24	18X36,20X38	24709.68	354.74	354.74	0.000575	0.0759	132	1	0.040052055
STORY13	5.95	3.14	20	16X30,26X24	18X36,20X38	27798.39	399.81	399.81	0.000643	0.084876	132	1	0.044707148
STORY12	5.95	2.88	20	16X30,26X24	18X36,20X38	30887.1	444.27	444.27	0.00071	0.09372	132	1	0.049361517
STORY11	5.95	2.62	20	16X30,26X24	18X36,20X38	33975.81	488.07	488.07	0.000776	0.102432	132	1	0.054019359
STORY10	5.95	2.36	20	16X30,26X24	18X36,20X38	37064.52	531.17	531.17	0.00084	0.11088	132	1	0.058614374
STORY9	5.95	2.1	20	16X30,26X24	18X36,20X38	40153.23	573.51	573.51	0.000903	0.119196	132	1	0.063221856
STORY8	5.95	1.83	20	16X30,26X24	18X36,20X38	43241.94	615.04	615.04	0.000964	0.127248	132	1	0.067776454
STORY7	5.95	1.57	20	16X30,26X24	18X36,20X38	46330.65	655.65	655.65	0.001023	0.135036	132	1	0.072288957
STORY6	5.95	1.31	20	16X30,26X24	18X36,20X38	49419.36	695.26	695.26	0.001079	0.142428	132	1	0.076695753
STORY5	5.95	1.05	20	16X30,26X24	18X36,20X38	52508.07	733.72	733.72	0.00113	0.14916	132	1	0.080867523
STORY4	5.95	0.79	20	16X30,26X24	18X36,20X38	55596.78	770.82	770.82	0.001165	0.15378	132	1	0.084027722
STORY3	5.95	0.52	20	16X30,26X24	18X36,20X38	58685.49	806.26	806.26	0.00115	0.1518	132	1	0.083705397
STORY2	5.95	0.26	20	16X30,26X24	18X36,20X38	61774.2	839.72	839.72	0.000943	0.124476	132	1	0.069372018
STORY1	5.95	0	20	16X30,26X24	18X36,20X38	62516.47	839.72	839.72	0.00035	0.0462	132	1	0.026057215

Determination of stability coefficient (Ɵ) of a 20 storied asymmetric building with aspect ratio 5.95

Floor	Aspect Ratio (L/W)	Aspect Ratio (H/W)	Number of Story	Exterior Column Size	Interior Column Size	Vertical Design Load (P)	Story Shear (Vx)	Absolute Value (Vx)	DriftX	Design Story Drift Δ (Inch)	Floor Height (hsx)	Deflection Amplification Factor (Cd)	Stability Coefficient (θ)
STORY23	5.95	5.76	22	16X32,20X40	24X44,30X52	3188.58	25.11	25.11	0.000106	0.013992	132	1	0.013460354
STORY22	5.95	5.5	22	16X32,20X40	24X44,30X52	6377.17	75.07	75.07	0.000157	0.020724	132	1	0.013337095
STORY21	5.95	5.24	22	16X32,20X40	24X44,30X52	9565.75	124.62	124.62	0.000221	0.029172	132	1	0.016963816
STORY20	5.95	4.98	22	16X32,20X40	24X44,30X52	12754.33	173.74	173.74	0.00029	0.03828	132	1	0.021289028
STORY19	5.95	4.71	22	16X32,20X40	24X44,30X52	15942.92	222.41	222.41	0.000359	0.047388	132	1	0.025734042
STORY18	5.95	4.45	22	16X32,20X40	24X44,30X52	19131.5	270.63	270.63	0.000428	0.056496	132	1	0.030256372
STORY17	5.95	4.19	22	16X32,20X40	24X44,30X52	22320.08	318.36	318.36	0.000496	0.065472	132	1	0.034774343
STORY16	5.95	3.93	22	16X32,20X40	24X44,30X52	25508.67	365.6	365.6	0.000563	0.074316	132	1	0.039281677
STORY15	5.95	3.67	22	16X32,20X40	24X44,30X52	28697.25	412.31	412.31	0.00063	0.08316	132	1	0.043848724
STORY14	5.95	3.4	22	16X32,20X40	24X44,30X52	31885.84	458.46	458.46	0.000695	0.09174	132	1	0.04833717
STORY13	5.95	3.14	22	16X32,20X40	24X44,30X52	35074.42	504.04	504.04	0.00076	0.10032	132	1	0.052885801
STORY12	5.95	2.88	22	16X32,20X40	24X44,30X52	38263	549	549	0.000823	0.108636	132	1	0.057359652
STORY11	5.95	2.62	22	16X32,20X40	24X44,30X52	41451.59	593.31	593.31	0.000885	0.11682	132	1	0.061830505
STORY10	5.95	2.36	22	16X32,20X40	24X44,30X52	44640.17	636.92	636.92	0.000946	0.124872	132	1	0.066302834
STORY9	5.95	2.1	22	16X32,20X40	24X44,30X52	47828.75	679.77	679.77	0.001005	0.13266	132	1	0.070711996
STORY8	5.95	1.83	22	16X32,20X40	24X44,30X52	51017.34	721.8	721.8	0.001062	0.140184	132	1	0.075062919
STORY7	5.95	1.57	22	16X32,20X40	24X44,30X52	54205.92	762.92	762.92	0.001117	0.147444	132	1	0.079363515
STORY6	5.95	1.31	22	16X32,20X40	24X44,30X52	57394.5	803.04	803.04	0.001168	0.154176	132	1	0.083478751
STORY5	5.95	1.05	22	16X32,20X40	24X44,30X52	60583.09	842	842	0.001209	0.159588	132	1	0.086989259
STORY4	5.95	0.79	22	16X32,20X40	24X44,30X52	63771.67	879.62	879.62	0.001225	0.1617	132	1	0.088811414
STORY3	5.95	0.52	22	16X32,20X40	24X44,30X52	66960.25	915.56	915.56	0.001171	0.154572	132	1	0.085642069
STORY2	5.95	0.26	22	16X32,20X40	24X44,30X52	70148.84	949.53	949.53	0.000911	0.120252	132	1	0.067302342
STORY1	5.95	0	22	16X32,20X40	24X44,30X52	70945.59	949.53	949.53	0.000331	0.043692	132	1	0.024731173

Determination of stability coefficient (Θ) of a 22 storied asymmetric building with aspect ratio 5.95

Floor	Aspect Ratio (L/W)	Aspect Ratio (H/W)	Number of Story	Exterior Column Size	Interior Column Size	Vertical Design Load (P)	Story Shear (Vx)	Absolute Value (Vx)	DriftX	Design Story Drift Δ (Inch)	Floor Height (hsx)	Deflection Amplification Factor (Cd)	Stability Coefficient (θ)
STORY25	5.95	6.29	24	18X34,28X44	28X48,34X58	3302.26	26.03	26.03	0.000116	0.015312	132	1	0.01471618
STORY24	5.95	6.02	24	18X34,28X44	28X48,34X56	6604.52	77.84	77.84	0.000162	0.021384	132	1	0.013745275
STORY23	5.95	5.76	24	18X34,28X44	28X48,34X56	9906.78	129.26	129.26	0.000221	0.029172	132	1	0.016937942
STORY22	5.95	5.5	24	18X34,28X44	28X48,34X56	13209.04	180.27	180.27	0.000285	0.03762	132	1	0.020882989
STORY21	5.95	5.24	24	18X34,28X44	28X48,34X56	16511.31	230.87	230.87	0.000351	0.046332	132	1	0.025102741
STORY20	5.95	4.98	24	18X34,28X44	28X48,34X56	19813.57	281.04	281.04	0.000418	0.055176	132	1	0.029469372
STORY19	5.95	4.71	24	18X34,28X44	28X48,34X56	23115.83	330.75	330.75	0.000484	0.063888	132	1	0.033826339
STORY18	5.95	4.45	24	18X34,28X44	28X48,34X56	26418.09	380	380	0.000549	0.072468	132	1	0.038167188
STORY17	5.95	4.19	24	18X34,28X44	28X48,34X56	29720.35	428.77	428.77	0.000613	0.080916	132	1	0.04249032
STORY16	5.95	3.93	24	18X34,28X44	28X48,34X56	33022.61	477.03	477.03	0.000677	0.089364	132	1	0.046865621
STORY15	5.95	3.67	24	18X34,28X44	28X48,34X56	36324.87	524.76	524.76	0.00074	0.09768	132	1	0.051224186
STORY14	5.95	3.4	24	18X34,28X44	28X48,34X56	39627.13	571.93	571.93	0.000802	0.105864	132	1	0.055567916
STORY13	5.95	3.14	24	18X34,28X44	28X48,34X56	42929.4	618.51	618.51	0.000863	0.113916	132	1	0.059898906
STORY12	5.95	2.88	24	18X34,28X44	28X48,34X56	46231.66	664.47	664.47	0.000923	0.121836	132	1	0.064219336
STORY11	5.95	2.62	24	18X34,28X44	28X48,34X56	49533.92	709.77	709.77	0.000981	0.129492	132	1	0.068462707
STORY10	5.95	2.36	24	18X34,28X44	28X48,34X56	52836.18	754.36	754.36	0.001039	0.137148	132	1	0.07277267
STORY9	5.95	2.1	24	18X34,28X44	28X48,34X56	56138.44	798.18	798.18	0.001094	0.144408	132	1	0.076944365
STORY8	5.95	1.83	24	18X34,28X44	28X48,34X56	59440.7	841.18	841.18	0.001147	0.151404	132	1	0.081051003
STORY7	5.95	1.57	24	18X34,28X44	28X48,34X56	62742.96	883.26	883.26	0.001196	0.157872	132	1	0.084958653
STORY6	5.95	1.31	24	18X34,28X44	28X48,34X56	66045.22	924.32	924.32	0.001238	0.163416	132	1	0.088458523
STORY5	5.95	1.05	24	18X34,28X44	28X48,34X56	69347.49	964.21	964.21	0.001265	0.16698	132	1	0.090980777
STORY4	5.95	0.79	24	18X34,28X44	28X48,34X56	72649.75	1002.73	1002.73	0.001256	0.165792	132	1	0.090999657
STORY3	5.95	0.52	24	18X34,28X44	28X48,34X56	75952.01	1039.57	1039.57	0.001161	0.153252	132	1	0.084823806
STORY2	5.95	0.26	24	18X34,28X44	28X48,34X56	79254.27	1074.41	1074.41	0.000858	0.113256	132	1	0.063290702
STORY1	5.95	0	24	18X34,28X44	28X48,34X56	80113.02	1074.41	1074.41	0.000306	0.040392	132	1	0.022816787

Determination of stability coefficient (Θ) of a 24 storied asymmetric building with aspect ratio 5.95

Floor	Aspect Ratio (L/W)	Aspect Ratio (H/W)	Number of Story	Exterior Column Size	Interior Column Size	Vertical Design Load (P)	Story Shear (Vx)	Absolute Value (Vx)	DriftX	Design Story Drift Δ (Inch)	Floor Height (hsx)	Deflection Amplification Factor (Cd)	Stability Coefficient (θ)
STORY27	5.95	6.81	26	20X36,28X44	32X52,40X66	3444.21	26.63	26.63	0.000132	0.017424	132	1	0.017072314
STORY26	5.95	6.55	26	20X36,28X44	32X52,40X66	6888.41	79.64	79.64	0.000172	0.022704	132	1	0.014877028
STORY25	5.95	6.29	26	20X36,28X44	32X52,40X66	10332.62	132.28	132.28	0.000226	0.029832	132	1	0.017653252
STORY24	5.95	6.02	26	20X36,28X44	32X52,40X66	13776.83	184.55	184.55	0.000286	0.037752	132	1	0.021350167
STORY23	5.95	5.76	26	20X36,28X44	32X52,40X66	17221.04	236.42	236.42	0.000349	0.046068	132	1	0.025421466
STORY22	5.95	5.5	26	20X36,28X44	32X52,40X66	20665.24	287.89	287.89	0.000413	0.054516	132	1	0.029645851
STORY21	5.95	5.24	26	20X36,28X44	32X52,40X66	24109.45	338.94	338.94	0.000477	0.062964	132	1	0.033929922
STORY20	5.95	4.98	26	20X36,28X44	32X52,40X66	27553.66	389.56	389.56	0.000541	0.071412	132	1	0.038265043
STORY19	5.95	4.71	26	20X36,28X44	32X52,40X66	30997.86	439.73	439.73	0.000604	0.079728	132	1	0.042577735
STORY18	5.95	4.45	26	20X36,28X44	32X52,40X66	34442.07	489.43	489.43	0.000667	0.088044	132	1	0.04693799
STORY17	5.95	4.19	26	20X36,28X44	32X52,40X66	37886.28	538.65	538.65	0.000729	0.096228	132	1	0.051274665
STORY16	5.95	3.93	26	20X36,28X44	32X52,40X66	41330.49	587.37	587.37	0.00079	0.10428	132	1	0.055588619
STORY15	5.95	3.67	26	20X36,28X44	32X52,40X66	44774.69	635.55	635.55	0.00085	0.1122	132	1	0.059882757
STORY14	5.95	3.4	26	20X36,28X44	32X52,40X66	48218.9	683.17	683.17	0.00091	0.12012	132	1	0.064228814
STORY13	5.95	3.14	26	20X36,28X44	32X52,40X66	51663.11	730.21	730.21	0.000968	0.127776	132	1	0.068486998
STORY12	5.95	2.88	26	20X36,28X44	32X52,40X66	55107.31	776.63	776.63	0.001025	0.1353	132	1	0.072730892
STORY11	5.95	2.62	26	20X36,28X44	32X52,40X66	58551.52	822.38	822.38	0.001081	0.142692	132	1	0.076964655
STORY10	5.95	2.36	26	20X36,28X44	32X52,40X66	61995.73	867.42	867.42	0.001134	0.149688	132	1	0.081048578
STORY9	5.95	2.1	26	20X36,28X44	32X52,40X66	65439.94	911.7	911.7	0.001186	0.156552	132	1	0.085128627
STORY8	5.95	1.83	26	20X36,28X44	32X52,40X66	68884.14	955.15	955.15	0.001233	0.162756	132	1	0.08892231
STORY7	5.95	1.57	26	20X36,28X44	32X52,40X66	72328.35	997.68	997.68	0.001273	0.168036	132	1	0.092288098
STORY6	5.95	1.31	26	20X36,28X44	32X52,40X66	75772.56	1039.2	1039.2	0.001302	0.171864	132	1	0.094934443
STORY5	5.95	1.05	26	20X36,28X44	32X52,40X66	79216.76	1079.54	1079.54	0.001305	0.17226	132	1	0.095761039
STORY4	5.95	0.79	26	20X36,28X44	32X52,40X66	82660.97	1118.52	1118.52	0.001261	0.166452	132	1	0.09319054
STORY3	5.95	0.52	26	20X36,28X44	32X52,40X66	86105.18	1155.81	1155.81	0.00112	0.14784	132	1	0.083437418
STORY2	5.95	0.26	26	20X36,28X44	32X52,40X66	89549.39	1191.11	1191.11	0.000783	0.103356	132	1	0.058867084
STORY1	5.95	0	26	20X36,28X44	32X52,40X66	90485.57	1191.11	1191.11	0.000272	0.035904	132	1	0.020663142

Determination of stability coefficient (Θ) of a 26 storied asymmetric building with aspect ratio 5.95

Floor	Aspect Ratio (L/W)	Aspect Ratio (H/W)	Number of Story	Exterior Column Size	Interior Column Size	Vertical Design Load (P)	Story Shear (Vx)	Absolute Value (Vx)	DriftX	Design Story Drift Δ (Inch)	Floor Height (hsx)	Deflection Amplification Factor (Cd)	Stability Coefficient (θ)
STORY29	5.95	7.33	28	22X38,32X46	46X72,36X56	3605.51	27.5	27.5	0.000157	0.020724	132	1	0.020584184
STORY28	5.95	7.07	28	22X38,32X46	46X72,36X56	7211.02	82.26	82.26	0.000192	0.025344	132	1	0.016830973
STORY27	5.95	6.81	28	22X38,32X46	46X72,36X56	10816.54	136.68	136.68	0.000241	0.031812	132	1	0.019072184
STORY26	5.95	6.55	28	22X38,32X46	46X72,36X56	14422.05	190.72	190.72	0.000297	0.039204	132	1	0.022458834
STORY25	5.95	6.29	28	22X38,32X46	46X72,36X56	18027.56	244.4	244.4	0.000358	0.047256	132	1	0.026406982
STORY24	5.95	6.02	28	22X38,32X46	46X72,36X56	21633.07	297.69	297.69	0.00042	0.05544	132	1	0.030521312
STORY23	5.95	5.76	28	22X38,32X46	46X72,36X56	25238.58	350.59	350.59	0.000483	0.063756	132	1	0.034770627
STORY22	5.95	5.5	28	22X38,32X46	46X72,36X56	28844.09	403.08	403.08	0.000547	0.072204	132	1	0.039142893
STORY21	5.95	5.24	28	22X38,32X46	46X72,36X56	32449.61	455.15	455.15	0.00061	0.08052	132	1	0.043489536
STORY20	5.95	4.98	28	22X38,32X46	46X72,36X56	36055.12	506.78	506.78	0.000673	0.088836	132	1	0.047880926
STORY19	5.95	4.71	28	22X38,32X46	46X72,36X56	39660.63	557.95	557.95	0.000735	0.09702	132	1	0.052245834
STORY18	5.95	4.45	28	22X38,32X46	46X72,36X56	43266.14	608.66	608.66	0.000797	0.105204	132	1	0.056654148
STORY17	5.95	4.19	28	22X38,32X46	46X72,36X56	46871.65	658.87	658.87	0.000858	0.113256	132	1	0.061037649
STORY16	5.95	3.93	28	22X38,32X46	46X72,36X56	50477.17	708.58	708.58	0.000918	0.121176	132	1	0.065395639
STORY15	5.95	3.67	28	22X38,32X46	46X72,36X56	54082.68	757.74	757.74	0.000977	0.128964	132	1	0.06973207
STORY14	5.95	3.4	28	22X38,32X46	46X72,36X56	57688.19	806.34	806.34	0.001035	0.13662	132	1	0.074047271
STORY13	5.95	3.14	28	22X38,32X46	46X72,36X56	61293.7	854.35	854.35	0.001092	0.144144	132	1	0.078343443
STORY12	5.95	2.88	28	22X38,32X46	46X72,36X56	64899.21	901.73	901.73	0.001147	0.151404	132	1	0.082551755
STORY11	5.95	2.62	28	22X38,32X46	46X72,36X56	68504.72	948.44	948.44	0.0012	0.1584	132	1	0.086674607
STORY10	5.95	2.36	28	22X38,32X46	46X72,36X56	72110.24	994.43	994.43	0.001249	0.164868	132	1	0.090570166
STORY9	5.95	2.1	28	22X38,32X46	46X72,36X56	75715.75	1039.64	1039.64	0.001295	0.17094	132	1	0.094313316
STORY8	5.95	1.83	28	22X38,32X46	46X72,36X56	79321.26	1084.02	1084.02	0.001333	0.175956	132	1	0.097539934
STORY7	5.95	1.57	28	22X38,32X46	46X72,36X56	82926.77	1127.48	1127.48	0.001359	0.179388	132	1	0.099955192
STORY6	5.95	1.31	28	22X38,32X46	46X72,36X56	86532.28	1169.89	1169.89	0.001366	0.180312	132	1	0.101037785
STORY5	5.95	1.05	28	22X38,32X46	46X72,36X56	90137.8	1211.14	1211.14	0.00134	0.17688	132	1	0.099728068
STORY4	5.95	0.79	28	22X38,32X46	46X72,36X56	93743.31	1250.99	1250.99	0.001256	0.165792	132	1	0.094118736
STORY3	5.95	0.52	28	22X38,32X46	46X72,36X56	97348.82	1289.14	1289.14	0.001071	0.141372	132	1	0.080876077
STORY2	5.95	0.26	28	22X38,32X46	46X72,36X56	100954.3	1325.28	1325.28	0.00071	0.09372	132	1	0.054084853
STORY1	5.95	0	28	22X38,32X46	46X72,36X56	101978.5	1325.28	1325.28	0.000239	0.031548	132	1	0.018390726

Determination of stability coefficient (Θ) of a 28 storied asymmetric building with aspect ratio 5.95

Floor	Aspect Ratio (L/W)	Aspect Ratio (H/W)	Number of Story	Exterior Column Size	Interior Column Size	Vertical Design Load (P)	Story Shear (Vx)	Absolute Value (Vx)	DriftX	Design Story Drift Δ (Inch)	Floor Height (hsx)	Deflection Amplification Factor (Cd)	Stability Coefficient (θ)
STORY31	5.95	7.86	30	24X40,36X46	52X78,40X58	3749.44	28.04	28.04	0.000181	0.023892	132	1	0.024202876
STORY30	5.95	7.6	30	24X40,36X46	52X78,40X58	7498.88	83.9	83.9	0.000213	0.028116	132	1	0.019037681
STORY29	5.95	7.33	30	24X40,36X46	52X78,40X58	11248.31	139.42	139.42	0.000258	0.034056	132	1	0.020815263
STORY28	5.95	7.07	30	24X40,36X46	52X78,40X58	14997.75	194.6	194.6	0.00031	0.04092	132	1	0.023891585
STORY27	5.95	6.81	30	24X40,36X46	52X78,40X58	18747.19	249.43	249.43	0.000368	0.048576	132	1	0.027658926
STORY26	5.95	6.55	30	24X40,36X46	52X78,40X58	22496.63	303.89	303.89	0.000428	0.056496	132	1	0.031684352
STORY25	5.95	6.29	30	24X40,36X46	52X78,40X58	26246.06	357.98	357.98	0.00049	0.06468	132	1	0.035925385
STORY24	5.95	6.02	30	24X40,36X46	52X78,40X58	29995.5	411.69	411.69	0.000553	0.072996	132	1	0.040291266
STORY23	5.95	5.76	30	24X40,36X46	52X78,40X58	33744.94	465	465	0.000616	0.081312	132	1	0.044702974
STORY22	5.95	5.5	30	24X40,36X46	52X78,40X58	37494.38	517.9	517.9	0.000678	0.089496	132	1	0.049085132
STORY21	5.95	5.24	30	24X40,36X46	52X78,40X58	41243.81	570.38	570.38	0.000741	0.097812	132	1	0.053581232
STORY20	5.95	4.98	30	24X40,36X46	52X78,40X58	44993.25	622.43	622.43	0.000803	0.105996	132	1	0.058046013
STORY19	5.95	4.71	30	24X40,36X46	52X78,40X58	48742.69	674.02	674.02	0.000864	0.114048	132	1	0.062481357
STORY18	5.95	4.45	30	24X40,36X46	52X78,40X58	52492.13	725.14	725.14	0.000924	0.121968	132	1	0.066887398
STORY17	5.95	4.19	30	24X40,36X46	52X78,40X58	56241.56	775.77	775.77	0.000984	0.129888	132	1	0.071337761
STORY16	5.95	3.93	30	24X40,36X46	52X78,40X58	59991	825.88	825.88	0.001043	0.137676	132	1	0.075762354
STORY15	5.95	3.67	30	24X40,36X46	52X78,40X58	63740.44	875.46	875.46	0.0011	0.1452	132	1	0.080088735
STORY14	5.95	3.4	30	24X40,36X46	52X78,40X58	67489.88	924.48	924.48	0.001156	0.152592	132	1	0.084391551
STORY13	5.95	3.14	30	24X40,36X46	52X78,40X58	71239.31	972.9	972.9	0.00121	0.15972	132	1	0.088600643
STORY12	5.95	2.88	30	24X40,36X46	52X78,40X58	74988.75	1020.69	1020.69	0.001262	0.166584	132	1	0.092717478
STORY11	5.95	2.62	30	24X40,36X46	52X78,40X58	78738.19	1067.81	1067.81	0.001311	0.173052	132	1	0.096670538
STORY10	5.95	2.36	30	24X40,36X46	52X78,40X58	82487.63	1114.22	1114.22	0.001355	0.17886	132	1	0.100312989
STORY9	5.95	2.1	30	24X40,36X46	52X78,40X58	86237.07	1159.85	1159.85	0.001392	0.183744	132	1	0.103497867
STORY8	5.95	1.83	30	24X40,36X46	52X78,40X58	89986.5	1204.64	1204.64	0.001418	0.187176	132	1	0.105924473
STORY7	5.95	1.57	30	24X40,36X46	52X78,40X58	93735.94	1248.51	1248.51	0.001429	0.188628	132	1	0.107286812
STORY6	5.95	1.31	30	24X40,36X46	52X78,40X58	97485.38	1291.34	1291.34	0.001415	0.18678	132	1	0.106820677
STORY5	5.95	1.05	30	24X40,36X46	52X78,40X58	101234.8	1333	1333	0.001362	0.179784	132	1	0.103437228
STORY4	5.95	0.79	30	24X40,36X46	52X78,40X58	104984.3	1373.27	1373.27	0.001246	0.164472	132	1	0.095254666
STORY3	5.95	0.52	30	24X40,36X46	52X78,40X58	108733.7	1411.83	1411.83	0.001032	0.136224	132	1	0.079480651
STORY2	5.95	0.26	30	24X40,36X46	52X78,40X58	112483.1	1448.38	1448.38	0.000661	0.087252	132	1	0.051334145
STORY1	5.95	0	30	24X40,36X46	52X78,40X58	113585.8	1448.38	1448.38	0.000217	0.028644	132	1	0.017017715

Determination of stability coefficient (Θ) of a 30 storied asymmetric building with aspect ratio 5.95