IJESRT
INTERNATIONAL JOURNAL OF ENGINEERING SCIENCES & RESEARCH TECHNOLOGY

INFLUENCES OF BRACING SYSTEM IN RC STRUCTURE ON SLOPING GROUND UNDER WIND LOADS

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ABSTRACT

In this work effect of wind velocity on building with and without bracing resting on a sloping ground has been studied, bracing with a frame structure resist a lateral load generate from wind and earthquake loads , The present study to determining the behavior of with and without bracing building structure on a sloping ground during effect of wind loads. 60 models of a three different height and different sloping ground such as 1) building without brace 2) building with diagonal brace 3) building with x-brace 4) building with chevron brace(inverted v brace) ,resting on a different angle sloping ground is consider for analysis, Stadd-Pro V8i software is used for analysis. to study the parameter such as displacement, storey drift, bending moment, shear force, axial forces, by using static method. From analysis conclude that increasing in sloping ground and height of building displacement and storey drift increases, A lateral displacement and storey drift is reduced by using inverted v bracing (chevron brace) compare to diagonal brace and x-brace, axial force in column not changed by providing any type of bracing and increases in ground slope axial force increases minutely, in case of column shear force is reduced by x- brace and chevron brace (inverted v brace) of different height of a structure, bending moment in column reduced by inverted v brace. In case of beam shear force reduced by x-brace and bending moment reduced by providing x type of bracing.

KEYWORDS: diagonal bracing, x bracing , v bracing, sloping ground, wind load

INTRODUCTION

Wind loads are the necessary design load for engineering structures, for high rise buildings ,long span bridges, and high towers. wind load could also be taken as a vital loading, and complex dynamic wind load effects management the structural style of the structures. Thus data of the dynamic characteristics of a vital structure below wind loading becomes a demand in engineering style and in tutorial study. Within the current research on tall buildings, the study of wind induced demands is classified as: along wind and across wind response. These demands square measure caused by completely different mechanism. moving on the wind induced is because of the consequences of turbulence impact whereas the perpendicular part is expounded to the consequences of wind storm. On the opposite hand the impact of wind load on tall structures not solely distributed over the broader surface however additionally it\'s higher intensity. Moreover, in high risk unstable zone the unstable performance of structures square measure thought of because the primary importance that influence different hand in unstable zones, could also be the impact of impact forces ensuing from earth movement bigger than the forces caused by wind masses and consequently, unstable loading determines type and final style of the structure (with this assumption that with relevancy the all international codes and standards, wind and earthquake masses never the same time apply on the structure).

Calculation of ground slope is key to several ancient geographical info systems (GIS) application. Slope is a vital part in scientific, military and civilian analyses. Varied strategies exist for conniving slope. Manual slope generation, based mostly upon contour line info, may be a long established and customarily acceptable methodology. Multi-storied buildings frames on sloping ground are going to be developing in sizable amount in future times. During this regard realistic analysis and style of those building frames on sloping ground square measure of preponderant importance

It is watching from the what went before earthquake reimbursement of buildings is more in hilly area compared to plain ground, construction buildings in hilly area are increase, because of increase in population and economy and unavailable of land, earlier than in hilly area construction of building by brick bats and stone masonry. But in recent days

ISSN: 2277-9655
(I2OR), Publication Impact Factor: 3.785

concrete frame structure are more constructed, hilly area having a different slope, so that construction of building not symmetric because of a sloping ground, due to earthquake in hilly area more effected compare to a plane ground because of a structural irregularity, for structural irregularity distribution of loads irregular during earthquake so possible of structural failure is more so that without failure is reduced by using bracings compared to step back building

The purpose of structural system used to all kind of gravity loads transfer to ground effectively with failure of a structural system, most common gravity loads are dead load, live load and snow load, these are all upright load except these load some other lateral loads caused by wind and earthquake and blasting, lateral load develops high forces to produce sway movement or vibration so that it is very necessity to have sufficient strength against vertical loads with lateral forces many methods is there to protect structure from a lateral forces such as by providing shear wall and bracing it can reducing a lateral forces

Shear wall provides to a structure it contribute large strength and stiffness to frame structure in the way of their orientation, and also it decline lateral sway of building and damage of a structure, so that large earthquake horizontal forces carry by shear wall, overturning effects on them are large

Steel bracing most efficient and economical methodology to resisting horizontal forces in a frame structure. Bracing can be used for all world tallest buildings and also for rehabilitation of a structure .bracing is efficient because the diagonals work in axial pressure and consequently call for minimize member dimension in provision stiffness and strength against horizontal shear. A bracing technique improves the seismic presentation of the frame by its lateral stiffness and capacity by providing steel bracing self weight of a building can be reduced compared to shear wall, steel bracing can be act as rehabilitation because after construction of a structure we can provide but shear wall we can't provide so steel bracing is a type of retrofitting

1.2 STRENGTHENING OF RC STRUCTURE BY USING STEEL BRACING

steel bracing is a kind of method to capable of resisting a horizontal forces generated by wind load, earthquake load and blast load on a building structure , at the moment bracing is used in whole world for tall structure to resisting a lateral loads and also it is used as a retrofit technique. Bracings is transferred a load in axial mechanism so that it increasing rigidity and strength of a structure against horizontal forces and shear. Now a days many techniques is used for increasing rigidity and ductility of a existing building such as by using infill walls, by providing walls to present column, encasing columns and adding steel bracings. By providing bracings to a building structure it resist lateral forces and improves a seismic performance and exceeding a stiffness and strength of a structure. by addition of a bracing to a structure the load transferred out of the frame and into the brace and by passing to weak columns by increasing a strength of a column

There are two types bracings 1) concentric bracing system and 2) eccentric bracing system. steel brace generally provided in vertical aligned. For this increase in stiffness and minimum added dead weight to structure it is very helpful to deficient a lateral stiffness

Concentric bracing decline the lateral drift and enlarging the lateral stiffness of the frame and also increasing a natural frequency , large inertia force generated by earthquake force attract a increasing stiffness by providing bracing. Further by providing bracing decline the bending moments and shear forces in columns, by connecting bracing to a column increasing in axial compression in a column

Eccentric bracing decline the horizontal stiffness of the structure and improve the energy dissipation capacity. Eccentric connection to beams of brace the stiffness depends on the flexural stiffness of the beams and columns, therefore decline the lateral stiffness of the structure. the bracing forces of a vertical component generated by earthquake load causes lateral load on the beams at the point of connection of the eccentric bracings

MATERIALS AND METHODS

3.1 BUILDING DESCRIPTION

Table3.1 parameter consider for study

No of storeys	10, 15, 20
Dimension of building	15m×15m
Bay width	3m
Storey height	3m
Geometric properties	
Column size	600mm×600mm

ISSN: 2277-9655
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Beam size	200mm×500mm
Slab thickness	125mm
Bracing angle	2 ISA130×130×10
Material properties	
Grade of concrete	M25
Unit weight of concrete	25 KN/M^2
Modulus of elasticity	2×10^5 N/MM^2
Loadings	
Live load on floor	2 KN/M^2
Floor finish	1 KN/M^2

Wind load parameters according to IS-875(Part-3) 1987

Wind speed Vb=44 m/sec

Class of a building k1= B and C

Terrain category k3= 3

K2= is depend upon a height of a building and type of terrain category

Design wind speed Vz=k1*k2*k3*Vb…..(i)

Wind pressure Pz=0.6(Vz)^2……(ii)

3.2 BUILDING MODEL

For modeling G+10,G+15,G+20 building is consider for analysis, different types of bracing used with RC structure, they are diagonal bracing, x-bracing, inverted v bracing, and different angle of sloping ground such as 0^0 , 5^0 , 10^0 ,$15^{0,}$ 30^0 considered for a analysis of a study, static load method is used for analysis

1) TYPE A,

a) Building (G+10,G+15,G+20) without brace of a 0^0 inclined footing level
b) Building (G+10,G+15,G+20)with diagonal of a 0^0 inclined footing level
c) Building (G+10,G+15,G+20)with x-bracing of a 0^0 inclined footing level
d) Building (G+10,G+15,G+20) with inverted v-bracing of a 0^0 inclined footing level

2) TYPE B

a) Building(G+10,G+15,G+20) without brace of a 5^0 inclined footing level
b) Building (G+10,G+15,G+20) with diagonal of a 5^0 inclined footing level

c) Building (G+10,G+15,G+20) with x-bracing of a 5^0 inclined footing level

d) Building (G+10,G+15,G+20) with inverted v-bracing of a 5^0 inclined footing level

TYPE C

a) Building (G+10,G+15,G+20) without brace of a 10^0 inclined footing level

b) Building (G+10,G+15,G+20) with diagonal of a 10^0 inclined footing level

c) Building (G+10,G+15,G+20) with x-bracing of a 10^0 inclined footing level

d) Building (G+10,G+15,G+20) with inverted v-bracing of a 10^0 inclined footing level

TYPE D

a) Building (G+10,G+15,G+20) without brace of a 15^0 inclined footing level

b) Building (G+10,G+15,G+20) diagonal of a 15^0 inclined footing level

c) Building (G+10,G+15,G+20) x-bracing of a 15^0 inclined footing level

d) Building (G+10,G+15,G+20) with inverted v-bracing of a 15^0 inclined footing level

TYPE E

a) Building(G+10,G+15,G+20) without brace of a 30^0 inclined footing level

b) Building(G+10,G+15,G+20) with diagonal of a 30^0 inclined footing level

c) Building(G+10,G+15,G+20) with x-bracing of a 30^0 inclined footing level

d) Building(G+10,G+15,G+20) with inverted v-bracing of a 30^0 inclined footing level

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(I2OR), Publication Impact Factor: 3.785

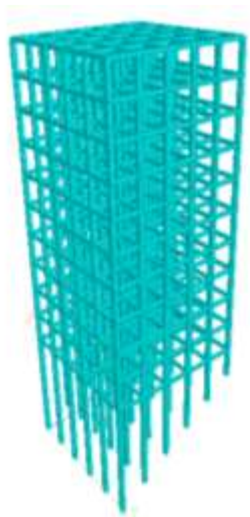


Fig 1.1building witout brcace

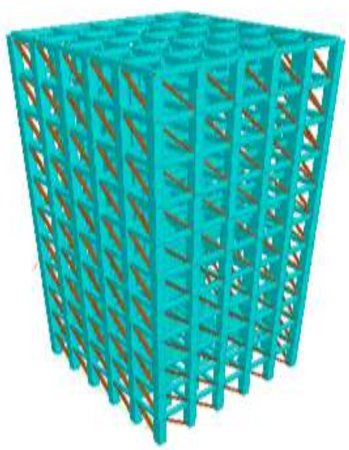


Fig1.2 building with diagonal brace

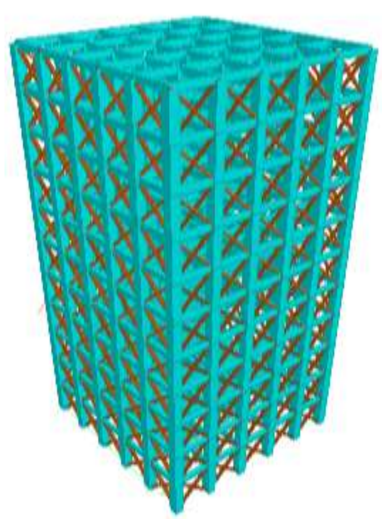
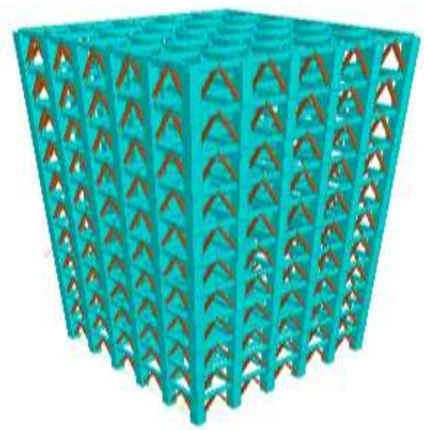


Fig1.3 building with x-brace



1.4 Building with inverted v brace

RESULTS AND DISCUSSION

From Fig(1,2,3) shows plot variation of displacement with sloping ground, displacement increase with increase in sloping ground and height of building, max displacement reducing by providing chevron brace compared to diagonal brace and x-brace for different heights of a building, from Fig (4,5,6) shows plot variation of storey drift with sloping ground, storey drift increase with increase in sloping ground and height of building, max storey drift reducing by providing chevron brace compared to diagonal brace and x-brace for different heights of a building,, from Fig (7,8,9) shows variation between sloping ground with axial force of column axial force is not effected by increase in sloping ground and also axial force is not reduced by providing any type of bracing from Fig (10,11,12) shows plot variation of shear force in column with sloping ground, shear force in column increase with increase in sloping ground and height of building, max shear force reducing by providing chevron brace and x-brace compared to diagonal brace for different heights of a building, Fig (13,14,15) shows plot variation of bending moment with sloping ground, bending moment increase with increase in sloping ground and height of building, max bending moment reducing by providing chevron brace compared to diagonal brace and x-brace for different heights of a building,Fig (16, 17, 18,) shows variation shear force in beam with sloping grounds max shear force reduced by providing x-brace type compared to other bracing systems Fig(19,20,21) shows variation bending moment in beam with sloping ground, max bending moment reduced by providing x-brace type compared to other bracing systems,and also increasing sloping ground bending moment varied minutely

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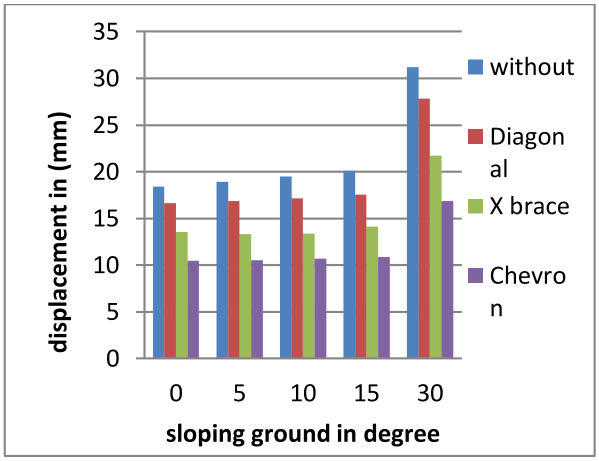

Fig1shows Displacement with sloping ground of g+10 building

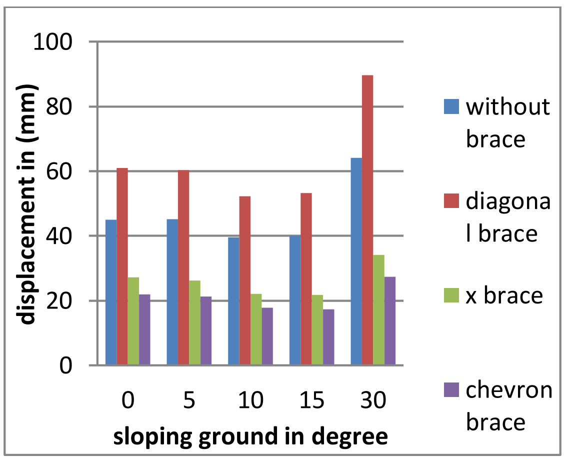

Fig2 shows Displacement with sloping ground of g+15 building

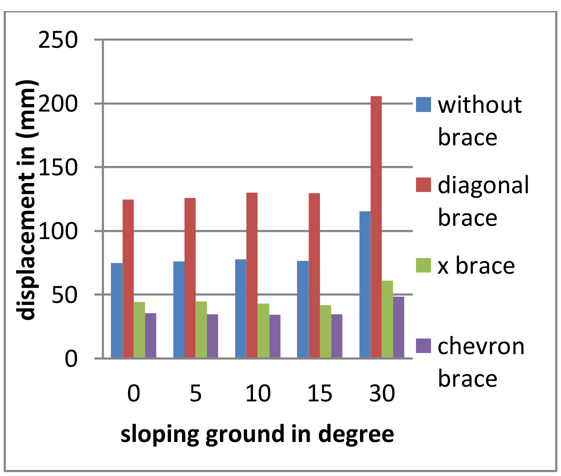

Fig3 shows displacement with sloping ground of g+20 building

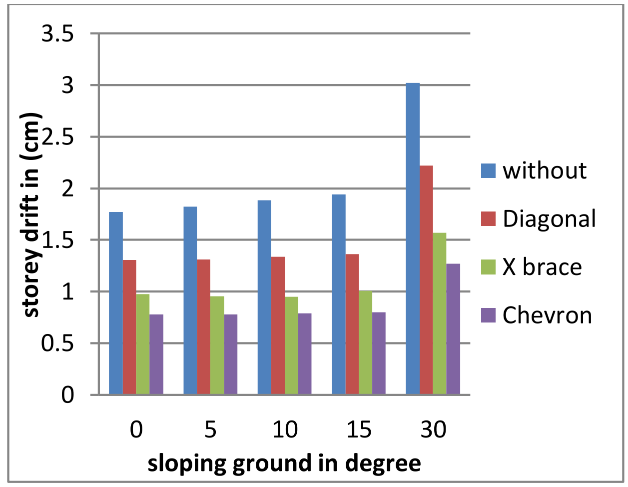

Fig4 shows Storey drift with sloping ground of g+10 building

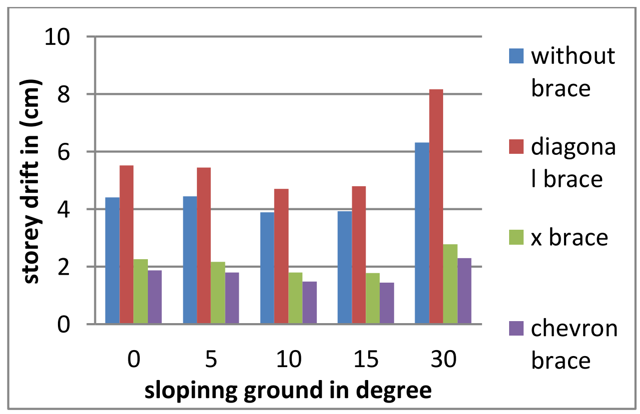

Fig5 shows Storey drift with sloping ground of g+15 building

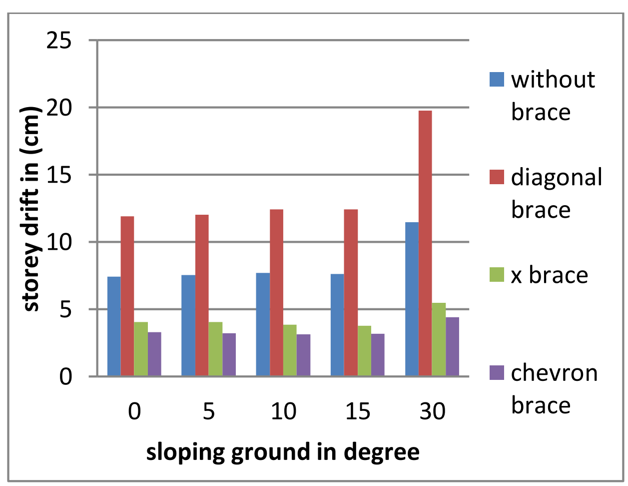

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Fig6 shows Storey drift with sloping ground of g+20

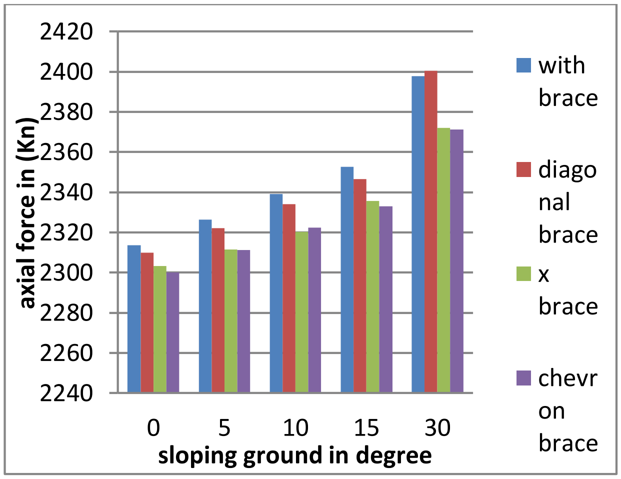


Fig7 shows Axial force with sloping ground in column g+10 building

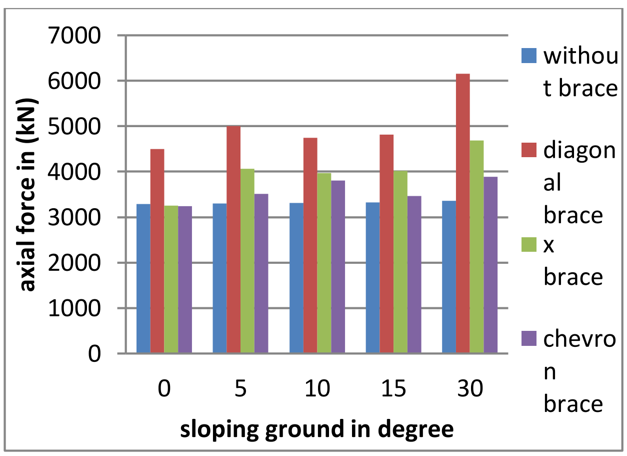
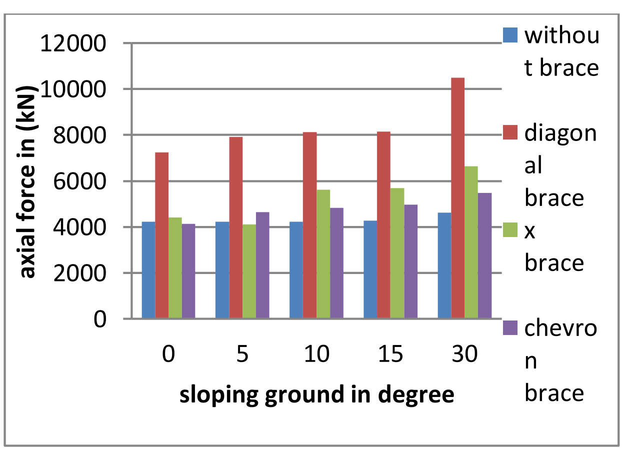


Fig8 shows Axial force with sloping ground in column g+15 building



building

Fig9 shows Axial force with sloping ground in column g+20 building

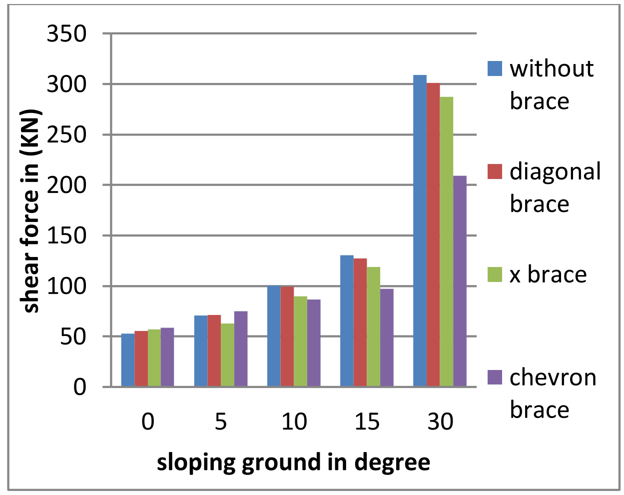


Fig10 shows Shear force with sloping ground in column g+10 building

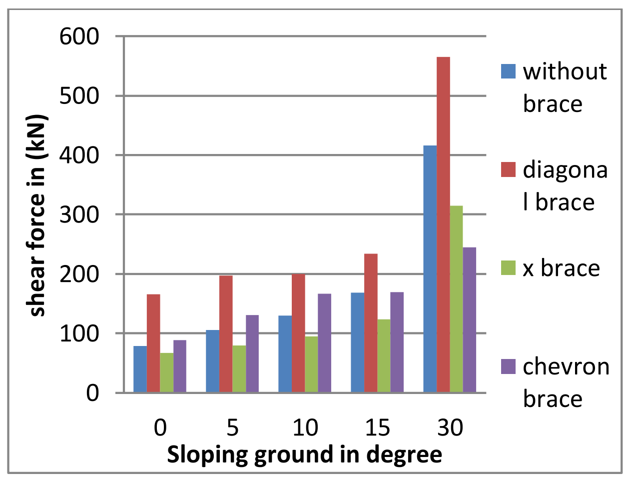


Fig11 shows Shear force with sloping ground in column g+15 building

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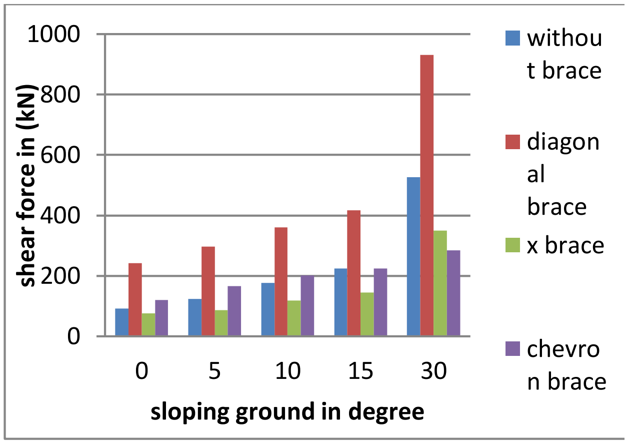


Fig12 shows Shear force with sloping ground in column g+20 building

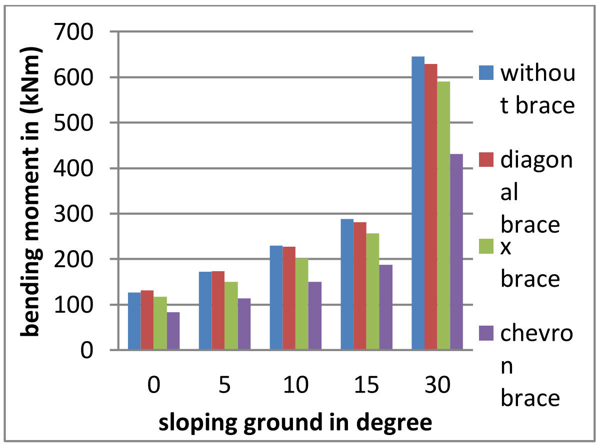


Fig13 shows Bending moment with sloping ground in column g+10 building

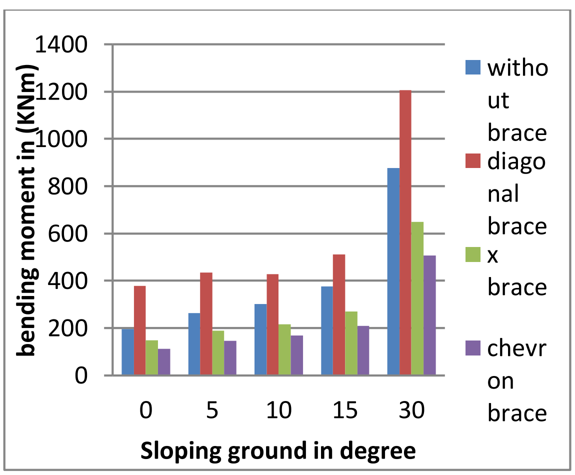


Fig14 shows Bending moment with sloping ground in column g+15 building

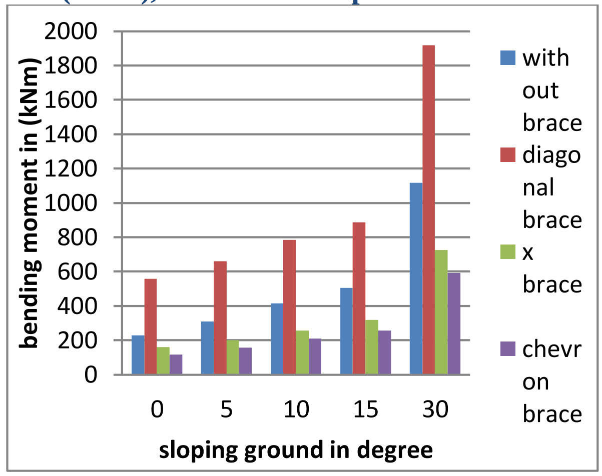


Fig15 shows Bending moment with sloping ground in column g+20 building

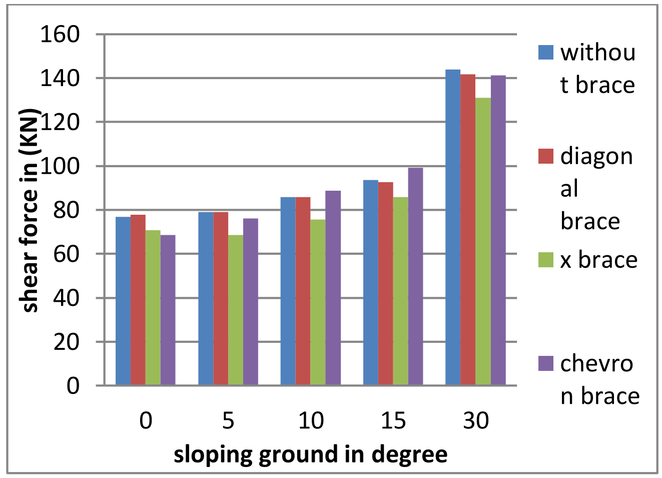


Fig16 shows shear force with sloping ground in beam g+10 building

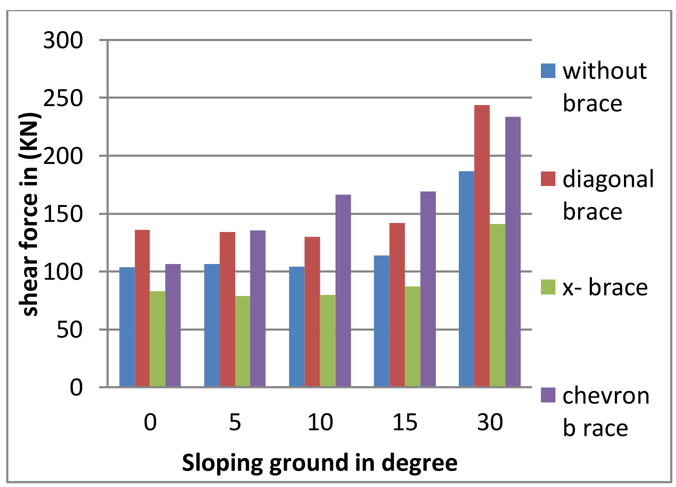
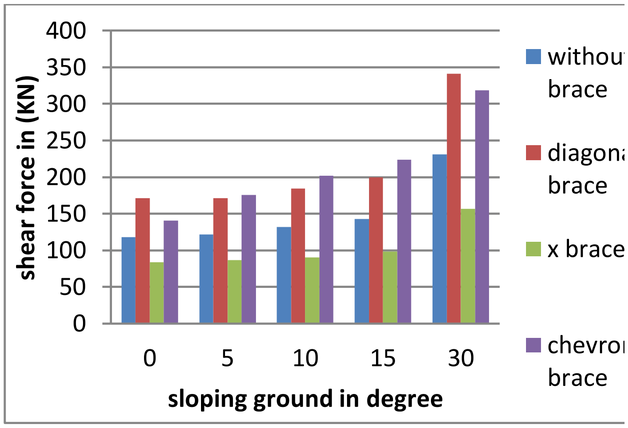


Fig17 shows shear force with sloping ground in beam g+15 building



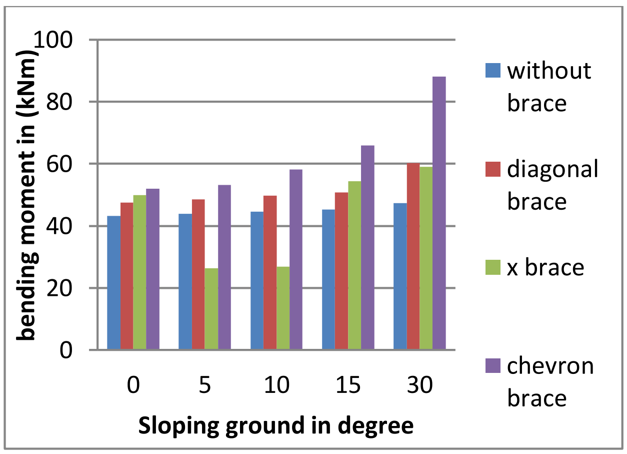


Fig19 shows Bending moment with sloping ground in beam g+10 building

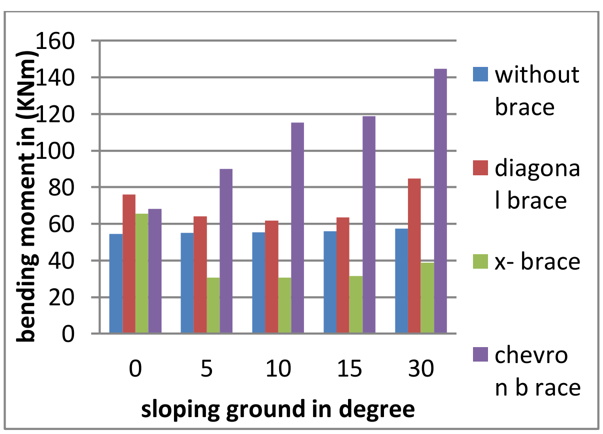


Fig20 shows Bending moment with sloping ground in beam g+15 building

Fig18 shows shear force with sloping ground in beam g+20 building

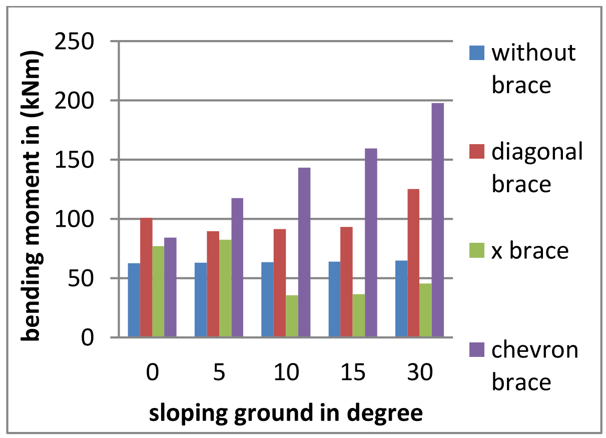


Fig21 shows Bending moment with sloping ground in beam g+20 building

CONCLUSION

1) Displacement increases with respect to increase in sloping ground and height of a building , by using bracing it can be reduced, chevron brace reduces maximum displacement compared to a diagonal brace and x brace
2) Storey drift increases with increase in sloping ground and height of a building , by using bracing it can be reduced, chevron brace reduces maximum story drift compared to a diagonal brace and x brace

3) Axial force in column affected minutely by increase in ground slope, increase in height of a building increases in axial force, and by providing bracing also it cannot be reduced
4) Shear force in column increases with increase in sloping ground and height of a building , chevron brace reduced shear force in column some extent compare to diagonal brace and x- brace in G+10 building, and in G+15,G+20, x- brace reduced a shear force upto 0 to 15 degree. For above 15 degree slope chevron brace perform better
5) Bending moment in column increase with respect increasing in ground slope and height of a building, by providing bracing it can be reduced, chevron brace reduces maximum bending moment compared to diagonal brace and x- brace
6) Shear force in beam increases with respect to increase in sloping ground and height . Shear force can be reduced by using x- brace compared to a diagonal brace and chevron brace
7) Bending moment in a beam is not affected by increase in sloping ground and by providing bracing it can be reduced, using x-brace bending moment is reduced in 10^0 to 30^0 of G+15 and G+20 structure and 5^0 to 10^0 of G+10 compared to diagonal brace and chevron brace

REFERENCES

1. Umakant Arya, Aslam Hussain and Waseem Khan “wind analysis of a building frames on sloping ground” *international journal of scientific and research publications*,volume 4, issue 5, may 2014,pp 1-7
2. G Suresh and Dr.E Arunakanthi, “Seismic analysis of buildings resting on sloping ground and considering bracing system” *IJERT*,vol. 3 issue 9, september- 2014,pp 1107-1113
3. M.D. Kevadkar and P.B. Kodag, “Lateral load analysis of r.c.c. building” *international journal of modern engineering research (IJMER),* vol.3, issue.3, may-june. 2013 pp-1428-1434
4. Viswanath K.G , Prakash K.B. and Anant Desai “Seismic analysis of steel braced reinforced concrete frames” *international journal of civil and structural engineering*, volume 1, no 1, 2010,pp 114-122
5. Suresh P, Panduranga Rao B and Kalyana Rama J.S, “Influence of diagonal braces in rcc multi-storied frames under wind loads: a case study” *international journal of civil and structural engineering,* volume 3, issue 1, august 2012,pp 214-226
6. Shivanand.B and H.S.Vidyadhara, “Design of 3d rc frame on sloping ground, *ijret: international journal of research in engineering and technology”* volume: 03 issue: 08, aug-2014,pp 307-317
7. Jawad Ahmed and H S Vidyadhar, “Wind analysis and design of multi bay multi storey 3d rc frame” *IJERT* ,vol. 2 issue 9, september – 2013,pp 2567-2570
8. Dr. B.Dean Kumar and Dr. B.L.P Swami, “Wind effects on tall building frames-influence of dynamic parameters” *international journal of advanced technology in civil engineering,* vol. 3 no. 5 , may 2010, pp 583-587

9. Alfa Rasikan and M G Rajendran , " Wind behavior of buildings with and without shear wall" *international journal of engineering research and applications (ijera)*, vol. 3, issue 2, march -april 2013, pp.480-485
10. Ranjitha K. P, Khalid Nayaz Khan, Dr. N.S.Kumarand and Syed Ahamed Raza, "Effect of wind pressure on r.c tall buildings using gust factor method" *IJERT*,vol. 3 issue 7, july – 2014,pp1045-1053
11. Vikram.M.B, Chandradhara G. P and Keerthi Gowda B.S, "A study on effect of wind on the static and dynamic analysis" *international journal of emerging trends in engineering and development* , vol.3 issue 4, (may 2014),pp 885-890
12. Salem Mohammad Aji and Y K Bind, "Performance of lateral systems in tall buildings for varying zones types" *international journal of research in engineering technology and management (IJRETM)*, volume 02 issue 05 , sep-2014,pp 1-7
13. Sujit Kumar, Dr. Vivek Garg and Dr. Abhay Sharma, "Effect of sloping ground on structural performance of rcc building under seismic load" *international journal of science, engineering and technology (IJSET)*, volume 2 issue 6 ,august 2014 (ver ii),pp 1310-1321
14. Ajay Kumar Sreerama and Pradeep Kumar Ramancharla, "Earthquake behavior of reinforced concrete framed buildings on hill slopes" *international symposium on new technologies for urban safety of mega cities in asia*(usmca 2013), iiit/tr/2013/-1
15. Rishi Mishra, Dr. Abhay Sharma and Dr.Vivek Garg, "Analysis of rc building frames for seismic forces using different types of bracing systems" *IJERT* ,vol. 3 issue 7, july – 2014,pp 1135-1140
16. Krishnaraj R. Chavan and H.S.Jadhav, " Seismic response of r c building with different arrangement of steel bracing system" *int. Journal of engineering research and applications(IJERA)*, vol. 4, issue 7(version 3), july 2014, pp.218-222
17. Massumin and M.Absalan, "Interaction between bracing system and moment resisting frame in braced rc frames" *archives of civil and mechanical engineering* ,volume13, (2013),pp 260 – 268
18. IS: 875(Part-3):1987, "Code of Practice for Design Loads (Other Than Earthquake) for Buildings and Structures", Part 3 Wind Loads, Second Revision, Bureau of Indian Standards, New Delhi, 1989.