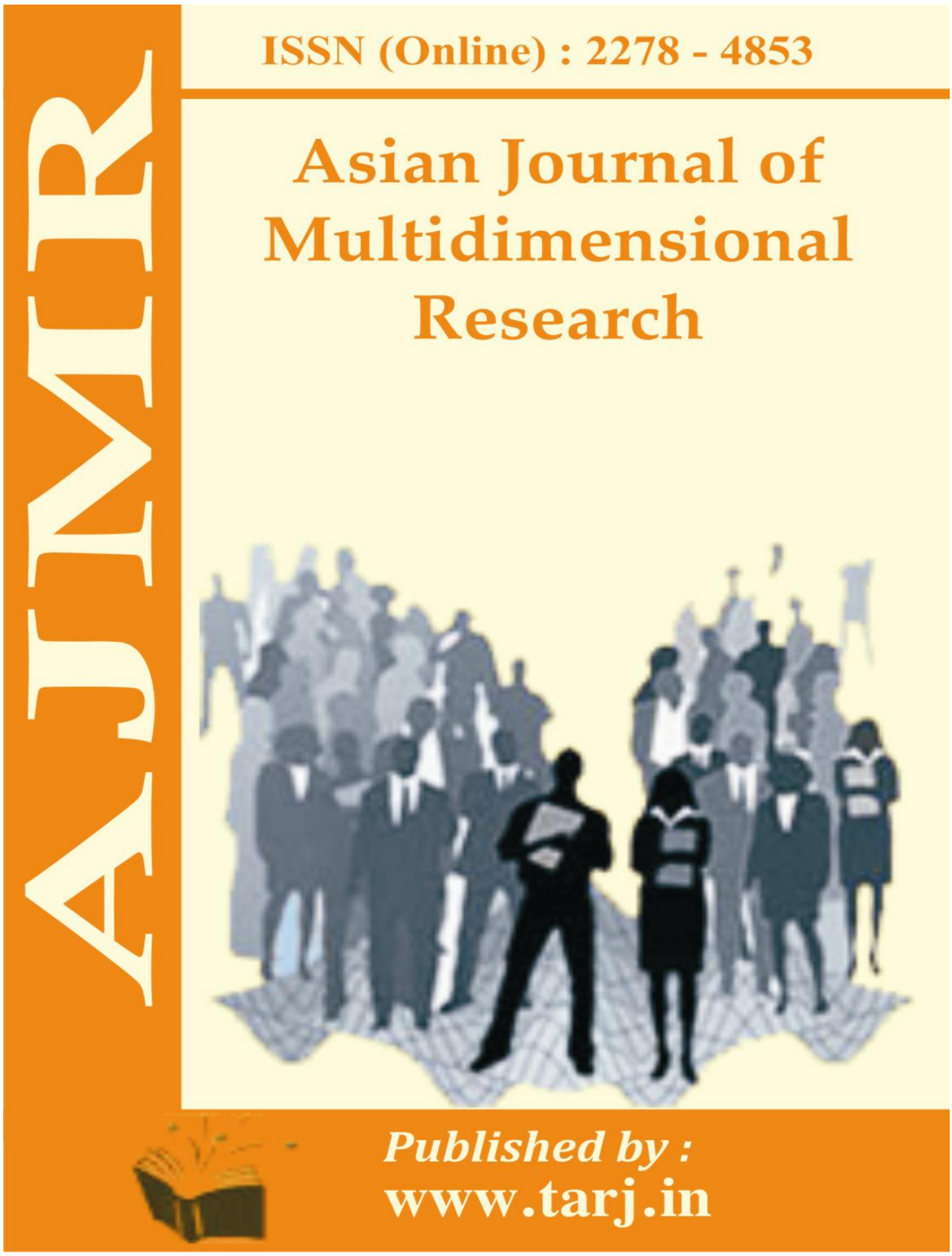
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STUDYING THE EXPERIENCE OF FORMING A ROTATING MOVEMENT ON LEFT AND RIGHT SIDES OF YOUNG VOLLEYBALL PLAYERS

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ABSTRACT

Young volleyball players focus on the use of physical exercises and efficiency in shaping right-hand and left-hand movement speed and ball-bearing accuracy.

KEYWORDS: *Volleyball Training, Right and Left Movement, Ball Motion, Kinematic And Physiologic Al Laws, Training, Effectiveness.*

INTRODUCTION

One of the key features of the volleyball game is that all motions that can be played by the opponent are transferred parallel or diagonally to the ball input. Players who pass those balls to a specific "position" based on the plan and tactics are always required to move quickly and rapidly to the left and to the right. Observing and watching video games shows that young volleyball players, as well as professional volleyball players, should have a great deal of mobility, quick access and delivering the ball to a specific “position” by along sides. Moreover, it was established that this problem was not studied in special research as a topical scientific and practical issue.

Many experts in the field of volleyball theory and methodology, according to the opinion of scientists, believe that the issue of volleyball-oriented mobility and top-of-the-line definition is the reason for early training it would be unlikely that the ability to master this skill would be so great [1,86]. The steps to open the essence of the chosen subject, solving the research objective, and proving the scientific hypothesis are based on the following objectives:

1. Experience in the training of young volleyball players on the right and left hand movement and ball rolling accuracy.

2. Develop an exercise complex that is capable of forming the right and left side movement speed and ball motion accuracy, and test its effectiveness on the example of young volleyball players.

Volleyball in these types of sports is characterized by its specific features. In particular, in this sport, balls (ball, groove, transfer), which are directed by the opponent area, are parallel or diagonally arranged on side treads. Hence, the movement of the ball, its timely reception and the accuracy of delivering it to the position depend on the speed of movement [2, 78].

The trainings at the volleyball clubs in the schools and the circles, it was revealed that at all stages of the training and improvement process, the problem of forming is not subject to serious

consideration. In order to study this "problem" and officially determine its original condition, we interviewed 18 young members of sport regularly engaged in volleyball [3, 96].

As it is known, it does not require proof of the importance of using the principle of consciousness and activity as well as a number of pedagogical principles in the process of teaching sports, developing and improving physical qualities. Everyone involved in sports clubs should have the necessary and sufficient insight into the technical tactical skills or physical quality that is being taught. He can then absorb the ability or quality to comprehend their anatomical, biomechanical, kinematic and physiological laws [4, 46]. Only the conscious, sufficiently theoretical knowledge based on the quality of the skills or abilities that the child develops in a creative way, the child can then invent a new generation of these techniques or movements. At the very least, these actions will provide the basis for the most effective and convenient ways to use less energy. Unfortunately, as noted above, the children involved in the survey did not have theoretical knowledge of technical skills or physical attributes. The absence of theoretical knowledge about the physical attitudes in the lessons is also confirmed by the responses of members: 18 respondents - only 5 respondents - "Yes" and 13 "No". Thus, it is clear that the annual plan of the training process does not utilize the specialized training hours allocated for theoretical training.

According to the opinions and conclusions of many specialists-scientists working in the field of theory and methodology of physical training and sports, the strategy of physical qualities development at all stages of many-year sports training is the continuation of the chosen sport [5, 56].

The pedagogical experience of raising the speed of the right and left hand movement of volleyball players from January 2018 to July of this year is based on the boys' 8-9 grade boys in secondary school volleyball was held. Each of the 18 students has been trained in the experimental and supervisory teams.

The children included in the control group during the six months were engaged in regular usual trainings.

In the experimental group exercises were performed with the following case-focused exercises designed to improve the speed of riding and ball rolling:

1. The group's members are divided into 6 teams and placed in the background as a volleyball player.

When the signal is given, they run in the opposite direction to the right-hand side of the field and run to the left and return to the next partner's hand. His partner continues the rehearsal and the exercise continues until the last participant is running.

The relay-race exercise is repeated 3 times. The score can be 2-0 or 2: 1.

2. This relay-race exercise is only thrown into the basketball basket by the players who are placed just outside the back of the pitch. Each player who scored the ball in the basket is given 2 points. The first team to win the relay will be given 5 points. The game is repeated 3 times. The team that has collected many points is considered to be the winner.

3. Each two teams will be positioned opposite each other in 3-meter cannon with 3 people. The first two players standing on the drawers are awarded a ball (1 kg). An alert balloon will be placed side by side with the ball to the participants who are standing in the opposite columns.

The ball bounces off the ball to the players who are in the opposite pitch, and they will be replaced by the ball. The game continues in this way and repeats five times. A player who does not explicitly extend the ball or missed the ball is expelled from the game. The game will continue until 2 players remain.

Specific test standards have been developed to increase the speed of the volleyball right and left navigation, and its effectiveness has been tested on the example of young volleyball players.

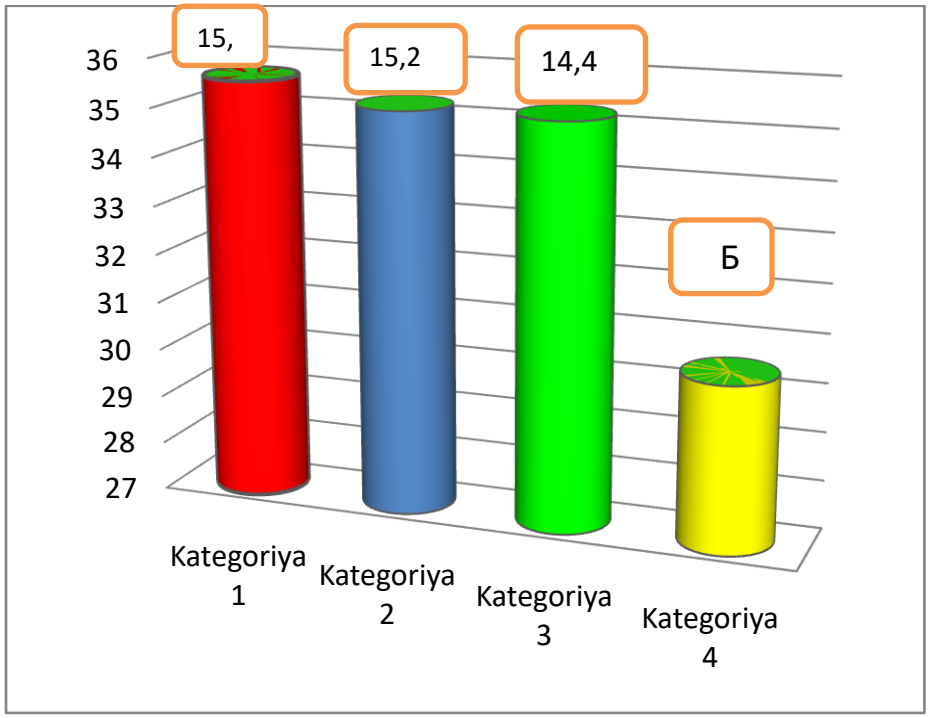
At corner angles, the handles must be hand-swapped at the corners.

"9-3-6-3-9" meters running track and forward.

The "9-3-6-3-9" meters shuttle running was accepted in the traditional order, the running was carried out in the perpendicular direction to the marked tiles. However, although running this test is not officially used in volleyball practice, we have decided to use this test to determine the fast moving speeds that are of critical importance in volleyball.

Running "Archasimon".

The “Archasimon” was tested in the traditional practice of volleyball practice. But it is crucial to run that test in the right direction. Doing this test in such a way does not apply to volleyball practice. The emphasis in modern volleyball is that movement is focused primarily on mobility.



Note: □ - before the experiment; □ - after the experiment;

A - Control group; B - experimental group.

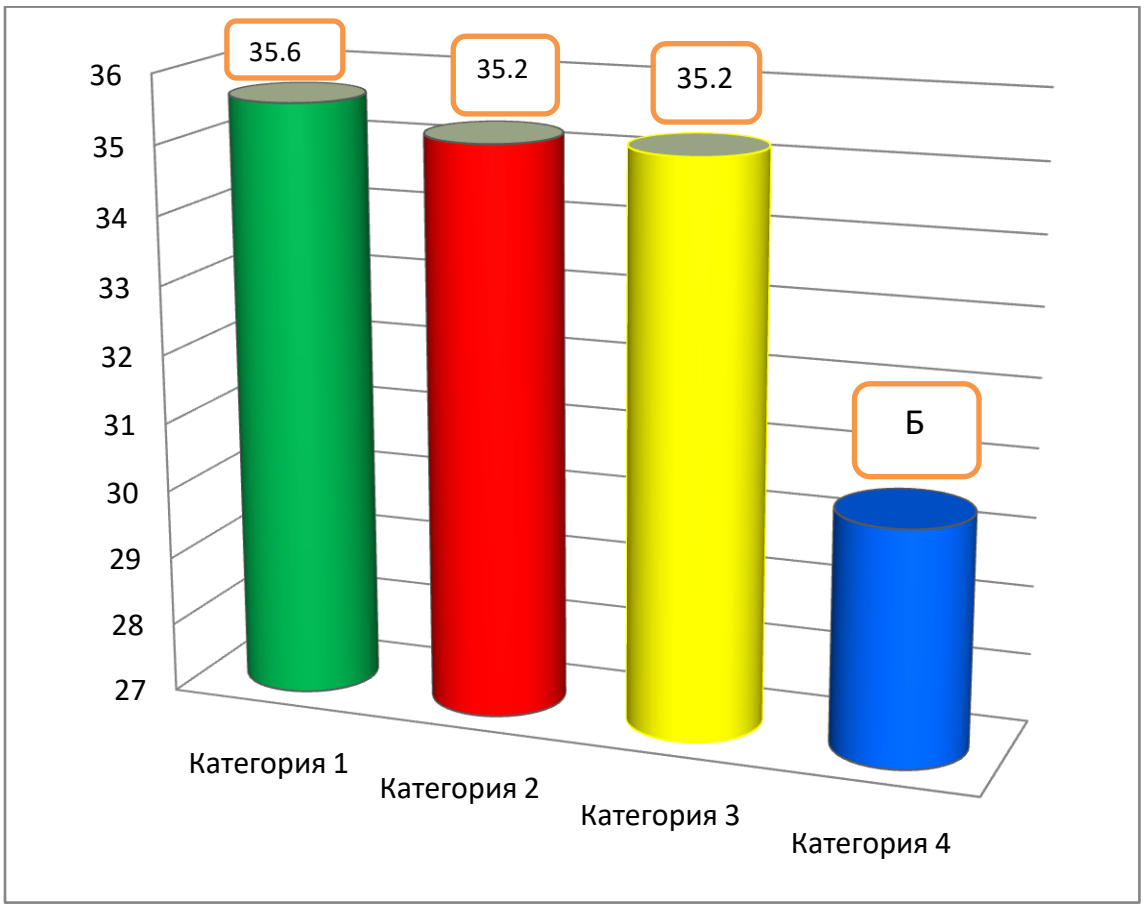
Picture 1. Dynamics of experimental mobility of young women volleyball players in speeds of 9-3-6-3-9 meter shuttle running.

In the experimental group, these indicators were as follows:

- Before the experiment - 35.2 sec;

- After the experiment - 30.4 sec;

- Increase in speed of operation - 5.2 sec.



Note: □ - before the experiment; - er the experiment;

A - Control group; B - experimental group.

Picture 2. Dynamics of changes in the speed of experiment on the Archasimon running by young women volleyball players.

In the "Archasimon" running, the minimum indicator of the speed of the student's was 26,0 sec. .

Of course, it would be wrong to compare this figure taken from sport members aged 14-15 to the volleyball players. At any rate, it may be assumed that the images obtained in young volleyball players are not enough for members of the same age. The important thing is that, both in the control group and the experimental group, the points obtained before the experiment were expressed in different ways after the traditional and experimental exercises used during the experiment.

In other words, the experimental group found that experimental smooth-running exercises have the potential to effectively increase the mobility of the field. Thus, it is possible to conclude that regular exercises that demonstrate their effectiveness in the pedagogical experience in the training of young volleyball players in order to increase the mobility of the field are an opportunity to achieve a good result.

One of the most important conditions for the training of qualified volleyball players is to prioritize the speed and accuracy of ball rolling in deciding the fate of attacking tactics during long-term volleyball exercises.

It's important to note, however, that the ability to build these capacities from the initial stage of preparation can result in extremely high results. It is not doubtful if the exercises are routinely used in a specific game exercise that has been tested and tested in practice, and the expected outcome is greater.

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FEATURES OF THE NARRATIVEOF THE MODERN INTELLECTUAL DETECTIVE (BASED ON D. BROWN'S NOVELS)

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ABSTRACT

This Article Discusses The Features Of The Narrative In The Modern Intellectual Detective. An Analysis Is Made Based On D.Brown's Novels.

KEYWORDS: *Embedded Narratives, Actantial Model, Sequential Communal Voice, Female Marginalization, Patriarchal Domination.*

INTRODUCTION

Dan Brown's multilayered fiction starts from deconstructing the traditional interpretation of Leonardo's artistic works, develops by self-reconstructing the symbolic system of the artistic and religious world, and terminates with an indefinite, thought-provoking ending. The novel purports to expose an ancient conspiracy of Vatican and the Priory of Sion, which according to Dan Brown conceals the marriage and offspring of Jesus Christ and Mary Magdalene. In the critical circle of *The Da Vinci Code*, most of scholars tend to label *The Da Vinci Code*a feminist text in post-modernistic literary context, regardless of various perspectives and theories adopted by them. Under such academic circumstances, the author applies the feminist narratology to analyze the narrative characteristics of *The Da Vinci Code*, to justify that female character in the text is dominated by male narrators, and is suppressed to be speech-absent and consignedtoan objective, marginal status in the narration. This thesis attempts to interpret the narrative structure and voice of the novel from feminist perspective on three levels: "story", "narrative discourse" and "narrating". The feminist interpretation of the novel is not to reduce its literary value to political value but to be of great help to further studies on this novel.

MATERIALS AND METHODS

For some twenty years in history, feminism and narratology have entailed separate inquiries of antithetical tendency: the one general, mimetic and political, the other specific, semiotic and technical. Robyn Warhol illustrates some compelling reasons in *Feminisms*: *an Anthology of Literary Theory and Criticism* as accountable for their incompatibility. At first, the technical vocabulary (neology) of narrative poetics has alienated feminist critics who maintain special politicalconcerns. Secondly, feminists are distrustful to theconceptual universe which is organized into the neat paradigms of binary logic in the traditional theory.

American scholar Susan S. Lancer is regarded as the initiator of feminist narratology on account of her research on the issue, and her *The Narrative Act*: *Point of View in Prose Fiction* published in Princet on University Press in 1981

was the first toassociate the narrative forms with feminist criticism, which inaugurated the practiceof feminist narratology although the term was not formally adopted in this book then. As a formalist scholar, Lancer is deeply influenced by feminism, Marxism and speech act theory and she is the first to propose the theoretical framework of feminist narratology, besides some practical analyses. Her studies were succeeded by some academic papers on feminist narratology by Brewer, Warhol and MiekeBal, whose concerted efforts helped to bring feminist narratology in to bloom in 1980s.

RESULTS AND DISCUSSION

The Da Vinci Code follows the traditional principles of thriller fiction by startingwith a ruthless murder and developing with suspense through the detective process. The narrative modeof classical detective fiction provides *The Da Vinci Code* with sophisticated clues and breath taking suspense emerging in the process of deciphering the mysterious, symbolic codes in the paintings of Leonardo and in the anagrams of Sauniere.The renown edcurator Jacques Sauniere is interrogated by an albinomonk for the where abouts of something mysterious his brethren possess. Sauniereliestothealbinoaboutthehidingplaceoftheobject that his brethren guard, only to be shot on thechest and informed of the death of the other guardians of his brotherhood. Deceived by Sauniere, the albi nomonkis set on his quest of the object that Sauniere's brethrentry to protect, as he confirms the where abouts given by the four guardians refers to the identical place. In the fifteen minutes before his drawn-out death, Sauniere tries to pass on the secret to finish the mission with which his brethren have been entrusted for centuries. He spends the last minutes of his life arranging his own body instrange fashion: stripping off every shred of clothing, arms and legs sprawling outward like Da Vinci's TheVitruvian Man surrounded by a largecircle, drawing with his own blood a five-pointed star, the pentaclecenteredonhisnavel,and writinga bizarre message with series of numbers andthree lines of words.The last lineof the message goes like this: "P.S. Find Robert Langdon" (Brown,2003: p. 74). It is the last sentenceon the parquet floor of the Louvre's Grand Gallery that involves Sophie Neveu and Robert Langdon into the inquiry of the symbolic world and the Holy Grail quest.

If the underlying structure of the novel is generalized in a sentence, it shouldbe "Jacques Sauniere wants Sophie Neveu to reveal the secret". Somecriticsrecommend that the generalization of the first-degree narrative be "Jacques Sauniere hands down a secret to Sophie Neveu". The former designates that the secret is still left to be interpreted and revealed by Sophie, while the latter means the secret is crystal clear to her. If the primary structure of the story is generalized with the second sentence, it is needless for Dan Brown to continue the story any longer concerning the purported theme of *The Da Vinci Code*.

The act antial grammar with its discussion on these mantics of event and role relationships in sentence and the examination of textual unfolding of action as a pattern of practical reasoning provides a suitable spring board from which to launch an analytical overview of the narrative structure. "Algirdas J. Greimas points out that actants and predicates are two big classes tomake up the 'semanticsyntax', and they combine with each other to form the semantic kernel ornucleus of a textual micro-universe".

"Voice" has been a heated topic in the feminist narratology but it has been ignored in conventional narrative poetics. As a narratological term, "voice" attends to the specific forms of textual practice and avoids thees sentializing tendency of its more casual feministus age. As apolitical term, "voice" rescues textual study from formalist is olation that of ten

treats literary events as if they were in consequential to human history. The concept of "voice" infeminist narratology is adopted from classic narratology for its technical categorization of narrative voices. This concept is applied in feminist narratology to reveal its social andpolitical indication by combining the technical studies of classic narratology with the political and ideological concerns of feminism. Feminist narratology is committed to discovering the historical and contextual reasons for the author's choice of specific narrative voice in literature. Infeminist narratology, voice focuses on examining the intertwined relation between social status and textualstructure, and serves as thechief technique toexpress ideological orientation. Structuralists consider the relation among narrator, narratee, and narrativeobject only structural, but "Lanser regards it as the siteof crisis, contradiction, orchallenge that is manifested in and sometimes resolved through ideologically charged technical practice" (Lanser, 1992:p.7). For feminists, the choice of an appropriate narrator, who takes control of the right of "voicing", has become the signifier of achievement of women's social status and power in the hierarchical power system. Lanserargues, "Despite compelling interrogations of 'voice'asahumanist fiction, for thecollectively and personally silenced the term has becomea tropeof identity and power: as Luce Irigaray suggests, to find a voice (voix) is to find away (voie)" (Lanser,1992:p.3).

To differentiate the authority of the narrators and narrating characters, Lanser's distinction is to be applied in the successive parts. Dan Brown relates *The Da Vinci Code* from omniscient points of view and headoptsa " public voice" that suggests the narration directed toward a narratee outside the fiction. The omniscient narrator is not present as acharacter in the story, and even outside the fiction; thus the narrator of *The DaVinci Code* is an extradiegetic narrator. In the first-degree narrative of the novel, readers cannot discover the textual distinction between the author and a public, heterodiegetic narrator; so it is safe for readers to equate the narrator with the author, because "Lanser argues if the distinctionbetween the (implied) author and a public, heterodiegetic narrator is not textually marked, readers are invited toequate the narrator with theauthor and thenarratee with themselves (or their historical equivalences)" (Lanser, 1992: p. 16).Theomniscient narrator, theauthor Dan Brown claims the "authorial voice" inthe first-degree narrative. The second-degree narrative is also unfolded from omniscient points of view, but the voice is shared among diverse narrating characters. The omniscient narrator attends to the synchronic and diachronic development of the whole story, while the narrating characters focus on the diachronic development of the Holy Grailquest. "Moreover, since authorial narrator sexist outside narrative time (indeed, outside fiction) and are not 'humanized' by events, they conventionally carry an authority superior to that conferred on characters, even on narrating characters" (Lanser, 1992: p. 16). As a result, the male author, Dan Brown as an omniscient narrator in superior to those narrating characters in the novel. The salient narrative feature of the parallel narratives in the embedded narratives is the alternation of the role of narrator and narratee among protagonists in the process of searching for the truth of the Holy Grail. Harvard symbologist Robert Langdon serves as the initial narrating character forhe is the first among the protagonists toemergeon the sceneof the murder.Langdon is a heterodiegetic narrator in that he is not present as acharacter in the story he narrates. Langdon takes a private voice and directs his narration

toward the narratees who are fictional characters.The first narratee of Langdon as a heterodiegetic narrator is Captain Bezu Fache, to whom Langdon explains the symbolic implication of Pentacle in the pagan religion, the harmony between male and female indicated by The Vitruvi an Man exhibited by Sauniere. Langdon's symbolic interpretation becomes more and more complicated as the narrative develops, so that Sophie as a more adequate narrateee merges in the narrative. Although Sophie is a cryptologist, she is much less sophisticated compared with Langdon interms of the interpretation of religious symbols. From Lang don's narration, Sophie acquires the knowledge about the "sacred feminine", AMON L'ISA symbolizing union between male and female, Vatican's conspiracyin early Christianity, Holy Grail as Sangreal, Knight Templar, and the Priory ofSion. Robert Langdon's narration actualizes the indoctrination to Sophie with the worship of the "sacred feminine" and on the symbolism of the Holy Grail, but his narrating declines after heand Sophie manage toextricate the "cryptex" from the Depository Bank of Zurich.

CONCLUSION

*The Da Vinci Code*is a story of the Holy Grail quest, or according to Dan Brown, a story to rediscover the "sacred feminine" to revive the "GoddessWorship" and to subvert the traditional Christian culture. On account of the acclaimed the me of the story, some critics take it fo rgranted that the novel is a feminist text that strives to rediscover the identity of the female.To erase the ambiguity concerning the story that purports to do justice to women, theauthor of this thesis applies feminist narratology to examining the structure of the narrativeand the voiceof female character in the novel. The novel is interpreted not only on its political orientations but alsoon the narrative structure in which the political concernsareen coded.To the disappointment of those credulouscritics, the female marginalization and patriarchal domination are pervasively embodied in the structure of the story designed by the male author. The patriarchal domination deprives female character of the rights of "voicing" in the narrative, thus woman in the novel is speech-absent and obscure. The male characters occupy the subjective position and the female characteris forced to take an objective position. Feminist literary critics regard literary discourse as the site of power struggle; therefore woman in *The DaVinci Code* loses the fight against the oppression of the patriarchy because her voice is suppressed by the male characters in the process of narrating. Outside the fiction the male author claims the authorial voice, and inside it the male narrating characters constitute a sequential communal voice. The female voice is suppressed under the pervasive male's hegemony over the narrative voice. So phieis taught, in the process of being in doctrinated, to internalize the reigning patriarchal ideology and so she is conditioned to derogateher owns exand to cooperate in her owns ubordination.

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FEMALE HISTORIANS AND THE HISTORICAL SOCIETY OF NIGERIA: 1955 - 2017

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ABSTRACT

When the Historical Society of Nigeria (HSN) was founded in 1955, only one expatriate female historian, Jean Margaret Bradshaw, was among the seven signatories to the Memorandum of Association. The first indigenous professional female historian in Nigeria, Professor Bolanle Alake Awe, emerged in 1960. Since then, various Departments of History have been established across Nigerian universities and other tertiary institutions, with female historians and students teaching and studying History. Although there is a relative paucity of female historians in comparison to male historians, majority of the few female historians, as shall be analyzed in this paper, have not been consistently active in the HSN. This accounts for why in sixty-two years of its founding and existence, only a few female historians, prominent amongst who are Professor Egodi Uchendu, Dr Winifred Akoda and Dr Mfon Ekpootu, have served in the Council of the HSN. The paper, using the example of active female historians in the HSN, illustrates how greater participation by female historians in its affairs will contribute to building a more vibrant Historical Society of Nigeria.

KEYWORDS: *Female, Historians, Nigeria, 1955-2017.*

INTRODUCTION

The expatriate female historian, Jean Margaret Bradshaw, was the only woman among the seven signatories to the Memorandum and Articles of Association upon which the HSN was founded on 14 October 1955. An English historian, she was, at the time, a lecturer in the Department of History of the University College, Ibadan, where she taught from 1952 to 1956. This underscores the significant role Bradshaw played despite her relative minority status as the only female historian,[1] and in view of the absence of indigenous professional female historians in Nigeria at the time. The fact that there were no indigenous professional female historians at that time (in the 1950s and earlier) is significant but understandable. Girl-child western (European) education, especially at the tertiary level, was not a priority to most Nigerian peoples and families from the era of the establishment of the first tertiary institutions in Nigeria, at Calabar in the late nineteenth century, and at Yaba and Ibadan respectively, in the twentieth century.[2] Besides, the few girls that were sent to tertiary schools in the early twentieth century, and afterwards, mostly

opted for courses such as medicine, nursing and teaching that were thought to be very professional and congruent with the feminine gender.

The restricted access of girls to western education especially at the higher levels at the time, is adequately buttressed by the first principal of the premier Nigerian University College of Ibadan, Dr Kenneth Mellanby. In his words: 'Our first 104 students, which included three girls, could academically be divided into four groups. Seventeen were reading Arts, taking three subjects selected from English, Latin, History, Geography, and Mathematics. Thirty-eight were studying science…'[3]

One of the pioneer female students of the University College, Dr (Mrs.) Grace Olufumilayo Nzegwu (then Miss Grace OlufumilayoYoloye), who studied medicine, reiterates the foregoing observation made by Dr Mellanby, herself being indeed one of the three girls he had referred to in his account. In her own words:

It seems like yesterday, but it was 32 long years ago (as at January 1980) when we three hopeful young girls stepped into one of the log cabins just vacated by the Army in Eleyele, Ibadan, to be part of the nucleus of the University College, Ibadan (UCI). There were one hundred or so others who were male and we all started off in the Higher College, Yaba, which was then an exclusive male club. It was unimaginable that mere girls could dare into the exclusive club of men! Impossible!! Unbelievable!!! Insufferable and didn't our male counterparts make us know and feel it!!!! One would have thought we were from Outer Space. By the grace of God, by the time we arrived at UCI, we had been accepted either because these Lords decided that we had qualified to become 'Lords' or they discovered 'Ladies' can be just as good as Lords in many ways, but believe me, it was by dint of work and determination.[4]

The foregoing notwithstanding, even a cursory survey reveals that certain professions like teaching and nursing have overtime evolved in such a manner in Nigeria that women mostly outnumber their male colleagues. But with regards to History however, a recent comparative survey in the universities in the six Nigerian geopolitical zones reveal that there are more Nigerian professional male historians than females nationwide. Albeit, there are, as we shall subsequently observe, over one hundred female historians in Nigeria at present, most of whom, as evidence show, do not participate actively in the HSN.

Thus, this paper examines the extent of the participation of female historians in the activities of the HSN. It also explores the values that female historians could add to the operations of the Historical Society, and in the promotion of the discipline of History, for which their increased active participation is advocated. Furthermore, the paper highlights the factors inhibiting the active participation of the relatively few Nigerian female historians in the affairs of the Society. In conclusion, the paper proposes the strategies that could be employed to improve the number of female historians in the HSN, and to ensure that ultimately, female historians become much more active and consistent in the affairs of the Society, which is the main vehicle for the sustenance and promotion of the discipline and practice of History in Nigeria. The main thrust of the paper being that the participation of female historians, though largely lukewarm, the example of those who are active, as presented in the paper, illustrates that increased participation by female historians will be positively beneficial to the HSN and the discipline of history in Nigeria.

Available statistics from the six geopolitical zones of Nigeria reveal that as at 2017, the North-Central and North-East zones have 209 history lecturers of which 184 are males and 25 are females. The North-West zone has 96 history lecturers out of which 9 are females. The South-

South zone has a population of 30 female lecturers of the 90 history lecturers. The South-East zone has a data of 15 female history lecturers of the 75 historians teaching in various institutions of learning within the zone. The South-West zone has a statistic of 71 history lecturers of which 59 are males and 12 are females.

Statistics from some select Departments of History in Nigerian universities, which are amongst others, already part of the foregoing statistics of History lecturers from the respective geopolitical zones, reveal in specific details, the number of female historians vis-à-vis their male counterparts. The Department of History at the University of Ibadan has 1 female lecturer and 10 male lecturers. The History Department at the Ahmadu Bello University, Zaria, has 18 lecturers composed of 2 females and 16 males. At the University of Ilorin, the history department has 3 female lecturers out of 13 history lecturers. For the University of Lagos, there are 21 history lecturers of which 3 are females. The Obafemi Awolowo University, Ile-Ife, has 17 history lecturers composed of 3 females and 14 males. The University of Port Harcourt has 22 history lecturers of which 2 are females. The Benue State University, Makurdi, has 2 female history lecturers and 16 males. The Bayelsa State-owned Niger Delta University has 11 lecturers in the Department of History, of which 3 are females. The Universities of Uyo and Benin rank higher than others in the population of female history lecturers, with 6 female lecturers out of 23 lecturers; and 5 female lecturers out of 13 lecturers respectively.[5]

Here, we can safely infer, judging from the comprehensive statistics from the geopolitical zones, and from the select statistics of the Departments of History of some Nigerian universities cited above, that although female historians are fewer, they still constitute an average of about 20% of the total number of known professional historians in Nigeria. This amounts to an estimated numerical strength of over 100 professional female historians in Nigeria.[6]Therefore, the central question in this paper is, how much has the relatively few, but above 100 professional female historians in Nigeria been participating in the activities of the HSN, and in its main objective of promoting historical consciousness and learning in Nigeria? This study reveals that only between five to nine percent of the relatively few female historians have been consistently and actively involved in the affairs of the HSN.

Participation of Female Historians in the Affairs of the HSN

From its inception, the HSN has had its Council, composed of some elected members, as its main policy-making organ. The Council, in performing its leadership functions, is accountable to the General Congress, comprising all registered members. Furthermore, the HSN has had as its main activities, the annual congresses, which it has held virtually every year since its founding. It has also sustained the publication of two journals being the *Journal of the Historical Society of Nigeria* (JHSN), and *Tarikh*. Besides the Society's journals, its members have also been engaged in various research interests in the last sixty years of its existence.

In what follows then, an attempt is made to examine the extent to which female historians have or have not participated and contributed to the progress of the HSN. Generally, the activities of the HSN include effective membership of the Council; active participation in the annual congresses of the Society, where 'active' implies consistent commitment in sufficiently attending and engaging in Congress activities; and being amply published in the various editions of the Society's publications over the years.

With regards to their active and consistent participation in the HSN Council, female historians, it is evident, have not been sufficiently involved. This position is predicated upon the fact that,

despite the findings that male historians outnumber female historians in essentially all parts of Nigeria, only a minimal average of about 1% of the relatively few female historians have served in the respective Councils of the Historical Society of Nigeria since its founding sixty-two years ago in 1955. Besides, only two female historians, Professor Egodi Uchendu and Dr MfonEkpootu, serve in the current (2017-19) Council of the Historical Society of Nigeria and only Professor Uchendu has risen to the Vice Presidency of the Society since the creation of the zonal vice presidency over ten years ago. She was elected Vice President (South-East Nigeria), in 2012,[7] when the Society was fifty-seven years old. Professor Egodi is also the first female editor of the *Journal of the Historical Society of Nigeria*, which is almost as old as the Historical Society itself. Thus, without any ambiguity, the foregoing precedent reveals the paucity of participation of female historians in the Historical Society of Nigeria.

Apart from their participation at the Council level of the Historical Society of Nigeria, it is a fact that only between five to nine percent of the over one hundred known professional female historians in Nigeria have consistently attended the annual congresses of the Historical Society of Nigeria since 2005. Here, the argument that they are relatively few in comparison to their male counterparts does not hold any gain. This is so because though comparatively few, only less than 10% of the few but over 100 of female historians, as stated earlier, have been attending the annual congresses consistently in the last ten years. For instance, of the 101 participants, only 9 female historians attended the 57th Congress of the Historical Society of Nigeria at the Ibrahim Babangida University, Lapai, Niger State, in 2012. Virtually the same statistics was recorded in previous congresses and at the 58th/59th congress at the University of Nigeria, Nsukka, in 2014, with only minimal, less than 10% improvements at the 60th, 61st and 62nd congresses of the Society at Abuja, Port Harcourt and Sokoto, in 2015, 2016 and 2017 respectively.[8]

There is also poor participation of female historians in the publications of the Historical Society of Nigeria. The fewness of female historians in comparison to their male counterparts still does not present any strong justification for their lack of participation in the Historical Society's publication activities. While we recognise the fact that not a few female historians have been visible in publishing seminal articles in learned journals within and outside Nigeria, it is pertinent to note however that with regards to the flagship *Journal of the Historical Society of Nigeria* (*JHSN*), the number of articles written and published by female historians since 2009, for instance, have been infinitesimal compared to the population of over one hundred practicing female historians in Nigeria at present. Indeed, a recent check by this writer reveals that only a minimal number of female historians seem to have been keen about having their articles published in the *Journal of the Historical Society of Nigeria*. This certainly accounts for the poor visibility of female writers in what is clearly the most seminal publication of the Historical Society of Nigeria.

The 18th Volume of the *Journal of the Historical Society of Nigeria* (JHSN), published in 2009, had only one female contribution by Shade Ifamose, out of 8 contributors; Volume 19 of 2010, had no female contributor out of 10 contributors; Volume 20 of 2011 had only one female contributor, Jacinta C. Nwaka, out of 13 published submissions. Volume 21 of 2012 had no female contributor out of thirteen contributions. Volume 23 of 2014 had only one female entry by Professor Egodi Uchendu.[9] The same statistic applies to Volume 24 of 2015, while the 25th Volume of 2016 did not fare better.

Certainly, the low visibility of female historians revealed by the above statistics with regards to the *Journal of the Historical Society of Nigeria* can also not be justified by the so-called fewness

of female historians vis-à-vis their male counterparts. This is so because, as stated earlier there are above one hundred female historians in Nigeria, and besides, some female historians have, before they became withdrawn in this regard, been active in the publishing activities of the Historical Society in the recent past. For instance, the 17th Volume of the *Journal of the Historical Society of Nigeria* issued as the 2007/2008 edition, laudably had contributions from 2 female historians namely, Naomi Bot and Winifred E. Akoda.[10]

Besides the *Journal of the Historical Society of Nigeria*, Nigerian female historians have not fared any better in publishing articles in the *Tarikh* – which is the journal published mainly for mentoring younger generations of historians. Although the *Tarikh* itself has been slow in being issued by the Historical Society of Nigeria in the last decade and more, female participation in the few editions that have been published in the last ten years, has been abysmal. In the New Series Issues Volume 1 No.1, and Volume 1 No. 2, of 2005 and 2009 respectively, for instance, there were no female entries at all.[11]

Indeed, the foregoing trend no doubt leaves much more to be desired. Here, we shall turn to the pioneer Nigerian professional female historian – Professor Bolanle Awe – as a role model. Although she became the first indigenous female lecturer in Nigeria in 1960, when it was still virtually prohibitive for a woman to seek western tertiary education, not to speak of becoming a lecturer in the University, or even aspiring to a position of authority in society, she stood tall amongst her male colleagues, and became a champion of documenting the history of Nigerian women and other histories. She was in fact the only Nigerian female historian that contributed to the seminal book – *A Thousand Years of West African History* (1969), written by several members of the Historical Society of Nigeria under the editorship of its President at the time, Professor J.F. Ade-Ajayi. She rose to become the first Nigerian female Professor of History in 1976, and Fellow of the Historical Society of Nigeria in 1992. Her edited book – *Nigerian Women in Historical Perspective*, and her chapter in that book entitled 'Saviors of their Societies,' has been described by a female historian in North-West Nigeria, Aisha BalarabeBawa, as having done great justice to the role of Nigerian women in society.[12]

Apart from Professor Bolanle Awe, we also remember amongst others Professor Elizabeth Isichei – Nigerian female historian by marriage and specialization. Her cerebral book – *A History of the Igbo People* (1976), became one of the indisputable pacesetters and reference publication even for the entirely male-dominated arguably yet-to-be-rivaled book of the Historical Society of Nigeria – *Groundwork of Nigerian History* (1980), edited by Professor ObaroIkime, in which she was acknowledged.[13]

Clearly, the present recession in female participation in contributing articles to the journals of the Historical Society of Nigeria, which, it is hoped should improve with future editions; and the lack of sufficient participation in the membership of the Council and in the conferences of the Historical Society of Nigeria discussed earlier, presents a glaring reflection of several factors. Amongst such factors are the laid-back attitude on the part of many of the relatively few female historians in Nigeria towards the Historical Society; sheer ignorance about the Society and its activities; as well as the insufficient awareness or sensitivity about the reclusive attitudes of female historians in Nigeria on the part of their male counterparts. But why is female participation in the activities of the Historical Society of Nigeria important? The answer lies below.

The Significance of Female Participation in the HSN

Scholars, Ebiegberi J. Alagoa, Chabuovie M. Sorgwe, Atei M. Okorobia, Amakivie O.I. Gabriel and other keen observers of cultural trends through the years, with or without any gender sentiments, agree that there are roles that women play better than men in society,[14] as in particular organizations as the Historical Society of Nigeria. But without any intention to instigate the well-known debates of the sexes, we approach this subject with the objectivity that it deserves by rather advocating the complementarity of the sexes. That was what Sharon Alakija, Director of the United Nations Development Fund for Women did when she spoke in advocating that women should be as recognized as men. She opined that: 'no nation, no matter how rich in physical resources can afford to sideline half of its human population'.[15]

Overtime, women have shown peculiar abilities by their outstanding performances in various spheres of life, in this instance, in the affairs of the Historical Society of Nigeria and in promoting historical consciousness. Certainly, the importance and ability of women must be what an historian, Dr Emma Onwuzirike, meant to buttress when, in writing about the significance of women in the traditional African society, he stated that 'the traditional society understood the indispensability of the women-folk, hence both sexes lived on complementary rather than on competitive lines.'A local priest, he further notes, once remarked that his skepticism about heaven arose from the fact that, he was told, there were no women in heaven, and that all the inhabitants of heaven are either Angelic males or sexless Angels. The local priests' answer to converts, Onwuzirike further narrates, was that a society without women would be hell rather than heaven.[16] And it is therefore plausible to add, that a society or an organization, (the Historical Society of Nigeria inclusive), without a strong female inclusion, activity and participation, would rather be dismal, uncreative, unattractive and retrogressive. Indeed, there has always been the need for that profound negotiating influence and finesse in virtually every affair that only the feminine gender is, for the most part, endowed with by nature to possess and confer. Hence, the popular saying 'a woman's job; a woman's touch," which is buttressed by the lines of the eminent British writer, John Fowles, who wrote, "The power of women! I've never felt so full of mysterious power."[17]

Besides the influence, creativity and finesse that women bring with them to organizations, the advocacy for increased participation of the female-folk in the affairs of the HSN is necessary for the purpose of historical justice. For in the implied words of the development historian, Atei Mark Okorobia, if historians must tell their own history, which they should of course document, they must strive towards ensuring what would clearly be termed objectivity in relation to the participation and documentation of the activities of both male and females alike. In Okorobia's words:…and if we must have a clear picture of the past challenges, opportunities, struggles, triumphs and failures of an individual, group or society, (the Historical Society of Nigeria inclusive), attempts have to be made to ensure that historical justice is done without regard to sex and other subjective criteria. Attempts have to be made to pay equal or adequate attention to both the male and female experiences within the society.[18]

Okorobia's treatise proffers one of the vital answers to the question about why increased female-historian participation in the HSN should be advocated at all. It is advocated for the purpose of 'historical justice,' which implies the practice of giving equal attention to the participation of women, as to the participation of men, in the promotion and progress of the HSN and by that, historical consciousness in Nigeria. By 'historical justice' Okorobia simply means that female historians in Nigeria should be given as much attention as their male counterparts. 'Historical justice' as applied here is however not to suggest that the HSN discriminates against women.

Rather, it is intended to emphasize the need to motivate the Society to do more in encouraging increased participation of professional female historians in all its affairs, such as towards the promotion of historical awareness in Nigeria, as well as in the documentation of history, including the history of the HSN itself.

Apart from the 'historical justice' stated above, increased female participation is advocated herein for the value they bring in mentoring the younger generation, and in this case, younger historians to the level of professionalism. Certainly, while the following instances may be viewed as a few amongst several examples, the cases of how Nigerian Professors J.F. Ade-Ajayi and E.J. Alagoa became lifelong historians validate the impact of mothers or women in the choice and consolidation of their individual careers. It also poses an example for professional female historians. That is, to be more involved in the activities of the Historical Society of Nigeria as mentors, especially to prospective and practicing female and male historians alike, by bringing with them the unique mentoring ability that is peculiar to women.

When Professor J.F. Ade-Ajayi's mother asked him what he was going to the United Kingdom to study, he replied 'Itan', the Yoruba word for 'story'.[19] According to Professor Ade-Ajayi, his mother was surprised and wondered why he was leaving the shores of Nigeria just to study 'story', as she was herself an effective raconteur – a folklorist and informal native historian. Notwithstanding, he recalls, she gave him her support and encouragement, obviously because of her interest in the native folklore, rich in history and tradition. Indeed, the positive disposition, co-operation and encouragement of Professor Ade-Ajayi's mother, served to motivate him towards becoming the historian of significance and president of the Historical Society of Nigeria that he became. The emphasis here underscores the significance and role of women as mentors and motivators worthy of emulation.

Professor E.J. Alagoa's experience on the mentoring ability of females is even more profound, dating back to his childhood days. His maternal grandmother, Tuamain, was a native healer, midwife and renowned folklorist.[20] It was she, he reminisces, who first introduced him to effective narrative skills, which became his earliest history lesson, and would eventually prove vital to his calling as a professional historian. The feats of the mother and grandmother of Professors Ade-Ajayi and Alagoa respectively, are only a few but very reliable examples of how much women, even as the female members of the HSN, could, among other efforts, encourage and inspire the younger generations of History students and graduates to take up professional careers as historians who would promote historical consciousness mainly through the agency of the Historical Society. Here we have a worthy example in Professor Egodi Uchendu who, in 2009, initiated a prize for the best graduating female history student at the University of Nigeria, Nsukka.[21] Clearly, this motivational and mentoring gesture, many would agree, has the propensity of enhancing female participation in the HSN.

In addition to all the reasons that have been adduced for which increased participation of women in the HSN is advocated, women have been described to have, for the most part, been generally more empathic, emotionally attached, morally stable, disciplined and committed to their vocations or endeavors than most men. This certainly could be attributed to the peculiar composition of women, and the high regards and expectations that society, in Nigeria as elsewhere, naturally bestows on, and demands of them. And it is an established fact in most societies, that certain behavioral traits as indolence or lack of sufficient commitment to a worthy cause that could be excused if manifested by men cannot be condoned when exhibited by women even in similar circumstances. Women in most African societies are expected to be bastions of

morality and the very personification of beauty, character and industry. The woman, writes Mojekwu-Chikezie, is usually and enterprisingly, the burden bearer; mother, wife, resource manager, motivator, mobiliser and catalyst.[22]Thus, it evidently follows that when they are sufficiently active and visible in any organization, they enhance its growth and effectiveness by bringing the foregoing qualities and virtues to bear on that organization.

This position is buttressed by certain female historians who have been evidently committed, if not more committed than their male counterparts in certain instances. These female historians have, as we had summarily observed elsewhere in this paper, been very active in the Historical Society of Nigeria, and have enhanced the discipline, practice, and consciousness of history through their numerous seminal developmental and mentoring scholarly efforts. They are: Professors Bolanle Awe, Elizabeth Isichei, Gloria Emeagwali, and in more contemporary times, Professors Egodi Uchendu, Stella Effah-Atoe, Winifred Akoda, Sade Ifamose, HannatuAlahira, Husaina Ibrahim, Aisha BalarabeBawa, Drs MfonEkpootu, Zara E. Kwaghe, Nike Ajayi and a few others.

Indeed, the commitments of the female historians mentioned above to the growth of the Historical Society, and by that, to the advancement of historical consciousness in Nigeria, has been adjudged remarkable and worth emulating. They have, by their fervent involvement in the affairs and activities of the HSN; as well as by their respective research interests, publications and teachings, inspired younger generations of female and of course male historians alike, to be more committed to the discipline and practice of History, to ensure the corporate sustenance of the Historical Society of Nigeria. The following details their respective efforts at promoting the Historical Society of Nigeria by every known index through robust historical scholarship in Nigeria and beyond.

Professor Bolanle Awe is, as stated earlier, the first indigenous professional female historian in Nigeria. She became a lecturer at the premier University of Ibadan in 1960, and Professor of Oral History in 1978. She also taught at the University of Lagos from 1966 to 1969.[23] Her works on African, Nigerian, Yoruba, Oral and Feminine history, speak for her as a legendary historical icon that have contributed to the growth of the History discipline and of Nigeria. A Fellow of the Historical Society of Nigeria, she has visibly been an epitome of who a professional female historian should be. Her contributions to the growth of the Institute of African Studies at the University of Ibadan, where she was Director; and her chairmanship of the Women Research and Development Center of the University of Ibadan were also phenomenal. Professor Bolanle Awe's rare ability to combine public service, academic career and family life, with equal dedication, especially during her tenures following her appointments as Commissioner for Education, and then for Trade, Industries and Co-operatives, is clearly admirable and exemplary of a worthy female historian.

With regards to Elizabeth Isichei,[24] she became a Nigerian by marriage but took upon herself the rare vocation clearly worthy of emulation, to know Nigerian history and to make it known for national development. An active member of the Historical Society of Nigeria in her years in Nigeria, she contributed immensely to an understanding of African, Nigerian and Igbo history. That she did by her numerous classical publications which focused, not just on the elites and rulers, but on the less privileged social groups such as peasant farmers, craftsmen and workers, all from an African perspective. Together with Professors Kenneth Dike, Henry Charles Smith, Ade-Ajayi, Bolanle Awe and others, she proved herself as a true Africanist scholar and historian. A Social Historian, she studied in two New Zealand universities, graduating with a first class

honours degree. She taught at the University of Canterbury, New Zealand, before winning a scholarship to Oxford where she studied and obtained her doctorate degree from Nuffield College, Oxford University. From 1969, Elizabeth began to teach in African Universities. She taught at the University of Nigeria, Nsukka, and at the University of Jos, Nigeria. Prominent amongst her numerous outstanding publications are: *A History of Nigeria* (1983); *The Igbo People and the Europeans* (1973); *A History of the Igbo People* (I976), etc.

Gloria Emeagwali is another professional female historian who has contributed enormously to the promotion of historical consciousness in Nigeria. A Fellow of the Historical Society of Nigeria, and a recipient of the National Scholar Award of the Society,[25] she was the Kenneth Dike memorial lecturer at the 57th Annual Congress of the Historical Society of Nigeria held at Ibrahim Badamasi Babangida University, Lapai, Niger State, Nigeria. A Nigerian by marriage, she taught history at the Ahmadu Bello University, Zaria, from 1979 to 1986. She also taught history at the University of Ilorin, Kwara State, Nigeria, where she was an Associate Professor, and at the Nigerian Defense Academy, Kaduna, Nigeria, where she was Visiting Associate Professor from 1986 to 1989. A leading scholar on a vast spectrum of research interests ranging from gender studies to indigenous African technology, and to methodology of history, she has contributed to the promotion of historical knowledge and consciousness in Nigeria, Africa, her native Caribbeans and the world at-large. This, she has achieved through her numerous publications and through her website visited by thousands of students and other personalities daily. Currently, a Professor of History at the Central Connecticut State University, New Britain, USA, she has also been a Visiting Professor and Guest Lecturer and Assessor in various institutions around the world. Professor Gloria Emeagwali is the author of several books and articles. Her books include: *Africa and the Academy*. New Jersey: Africa World Press, 2006; *The African Experience.* New York: Whittier, 2006 (co-edited with Walton Brown-Foster); *Women Pay The Price: Structural Adjustment in Africa and the Caribbean.* New Jersey: Africa World Press, 1995 etc.

Professor Egodi Uchendu's contributions to the growth of the discipline of history and by that to national development, and to the advancement of the Historical Society of Nigeria, of which she became a fellow in 2014, has been clearly noteworthy. She has been a major source of inspiration, many would agree, to female historians in contemporary Nigeria. That is especially by her active involvement in the Historical Society of Nigeria, and by the obviously widespread and incisive worth of her scholarship. Professor Egodi Uchendu is the first woman and professional female historian to be elected to the Vice Presidency of the Historical Society of Nigeria in 2012, in which she evidently served creditably and was thus re-elected to serve another two-year tenure in 2014. Prior to her being elected Vice President, she had served as a member of the Council of the Historical Society of Nigeria representing the South-East zone from 2010 to 2012.[26] significantly also; she is the first female historian to the appointed editor of the *Journal of the Historical Society of Nigeria*.

Professor Uchendu joined the Department of History of the University of Nigeria, Nsukka, in 1997. She rose through the ranks and was promoted Professor in 2012. In her own right, and as head of the History and International Studies Department of the University of Nigeria from 2012 to 2013, she has been actively committed to inspiring the younger generations to be involved in the sustaining historical scholarship and by that, strengthening their chances of eventually becoming members of the Historical Society of Nigeria. Professor Egodi has clearly been a leader in mentoring younger generations of historians, and especially female history students and

graduates who certainly look up to her as a role model for women in the History profession. As we had observed earlier in this paper, in 2009, she initiated a prize for the best-graduating female student of the Department of History and International Studies, University of Nigeria. Four female students of the Department have since received the award as at 2015.[27]

Professor Uchendu is vastly published and serves as review editor to several international journals. She is member of several significant global Associations as the African Studies Association (since 2002), and had also lectured at the Nigerian Defence Academy as part of her several contributions to national development. Her publications include: *Women and Conflict in the Nigerian Civil War*(New Jersey, 2007); *Masculinities in Contemporary Africa* (Dakar, 2008); *Dawn for Islam in Eastern Nigeria: A History of the Arrival of Islam in Igboland* (Berlin, 2011; with a special Nigerian edition published 2012); *New Face of Islam in Eastern Nigeria and the Lake Chad Basin: Essays in Honour of Simon Ottenberg* (Makurdi, 2012).

Factors Inhibiting the Participation of Female Historians in the HSN

Although the foregoing reasons and examples explain why the HSN should see more of its available female historians participating sufficiently in its affairs and activities, there is no gainsaying the fact that there have been other factors inhibiting their adequate participation in at least the last ten years and earlier. What then are those factors?

First, there is the issue of the glaringly laidback and unenthusiastic attitudes of most female historians towards the affairs of the HSN. The point has already been made elsewhere in this paper, that although professional male historians outnumber their female counterparts with a ratio of about three males to one female, there are above one hundred professional indigenous female historians in Nigeria, out of whom only less than ten percent participate sufficiently in the affairs of the HSN. This certainly leaves much to be desired with regards to increased female participation in the affairs of the Society.

Second, there is the prevalence of widespread ignorance amongst majority of historians about the nature, programmes and projects of the HSN, even in this era of the internet. Here again, the female historians who are by their number fewer, are evidently more culpable. Clearly, this fact was revealed in a recent encounter of this writer with a female professor and head of a History Department in a Southern Nigerian university. The encounter, which some would argue, was more an exception than the rule, was albeit expository of the fact that there are some professional historians in Nigeria that cannot properly pronounce even the name of the 'Historical Society of Nigeria'. Undoubtedly, such historians lack adequate knowledge of what the HSN is all about; when it was founded; who founded it; what its present programmes are; and what its challenges and triumphs have been. This certainly is again a plausible factor that accounts for why the greater percentages of female historians have not been committed members of the HSN.

Third, the identified lack of sufficient participation of professional female historians in the HSN has been attributed to certain social and religious factors. This is the position of the avid historian, lecturer and member of the HSN, Dr Emmanuel Osewe Akubor, who has been in virtually all the conferences of the Historical Society of Nigeria over the last decade.[28] According to him, as women, professional female historians face quite a number of domestic and religious challenges that hinder them from participating maximally in the affairs of the HSN, especially as it relates to attending conferences regularly, and serving on the council of the Society. He posits that not every husband, (especially of married female historians who hail from families with strict extremist religious codes that subsumes the woman entirely to the will of her

husband), would permit his wife to travel away from the home for three or four days to attend an academic conference or to serve in the Historical Society Council amidst other men, and at the expense of the welfare of the home.

Fourth, the organisation of the HSN itself has some fundamental operational flaws that allow what could be regarded as indifference in relation to the affairs of the Society. There have never been membership enforcement and compliance rules and procedures since its inception in 1955.[29] Hence, many professional historians, females and males alike, could leisurely stay away from the Society's meetings without sanction.

Fifth, up to the present, there is no comprehensive data bank of all members of the HSN. As such, the Society does not yet have direct contact with all her members. This situation certainly hampers adequate information dissemination and responses, which are of course indispensable to effective participation of all female historians. The statistics of over one hundred female lecturers in Nigeria that has been stated above, was, for instance, derived from a reasonably reliable projection based on available data.

Sixth, the Emeritus Professor of History, and two-time president of the HSN, E.J. Alagoa,[30] acknowledged the fact that female historians have been much less visible and participatory in the membership and leadership of the HSN over the years. According to him, the leadership of the Historical Society has not been sufficiently gender sensitive.[31] This is with regards to the enhanced participation of all its female members, even when the number of professional female historians has improved tremendously at least since the last ten years, beginning from the golden jubilee year of 2005, which was clearly a watershed in the history of the HSN.

Enhancing the Participation of Professional Female Historians in the HSN

In the previous segment of this study, we had identified and examined the inhibiting factors that have hindered professional female historians over the years, from participating actively and sufficiently in the affairs and activities of the HSN, especially in its cardinal objective of promoting the practice of history in Nigeria. In this segment therefore, we shall proffer some measures that could be employed to improve their participation in the affairs of the HSN.

Three major suggestions are proposed here as possible solutions to the problem. As a first line charge, it is imperative for the professional Nigerian female historians in Nigeria and in diaspora to enhance their participation by ensuring a systematically organized contact and follow-up system geared towards reaching out to female historians who hardly know about up and coming HSN activities. For this, a comprehensive and regularly updated data bank is indispensable, especially for disseminating information towards enhancing the participation of female historians in the HSN. While this is certainly not an advocacy for the emergence of a movement or association of female historians in Nigeria, there is equally no gainsaying the fact that professional female historians nationwide, need to consciously initiate well-thought-out strategies for motivating and mentoring female history graduates especially after their national youth service year, to take up career as historians and to be active in the HSN.

With regards to the above position, the best female history undergraduate student reward initiative of Professor Egodi Uchendu, cited previously, serves the prime and only known example. Mentoring younger female historians in a sort of 'catch them early' bid, which is definitely complementary to the efforts of the Students' Historical Society of Nigeria, (SHSN), is certainly a step in the right direction. That is, when we consider its potential effect in enhancing

female-historians' participation in the HSN. Mentoring in this sense increases continuity and progressive growth of the number of active female historians. It is also significant because at least two prominent institutions of higher learning in Nigeria are already showing signs that the population of female historians could increase with more motivation at the university undergraduate level. In the 2012/2013 and 2013/2014 academic sessions for instance, the history departments of the Universities of Benin and Lagos graduated more female students than males. At Benin, the department graduated 33 females and 14 males; and 44 females and 26 males in the two sessions respectively. The University of Lagos graduated 45 females above 44 males in the 2012/2013 session.[32]

While we take the suggested solutions above into cognizance, it is significant to note that in the course of the last decade and onwards, during the HSN presidencies of Professors Yakubu Ochefu, OlayemiAkinwumi and C.B.N.Ogbogbo, there has been some reforms geared towards reviving the Society. Such reforms include the creation and sustenance of the HSN website, its data bank of members, ensuring the regular publication of the JHSN, and very significantly, commencing the process of re-introducing the teaching of history in Nigerian schools in collaboration with the relevant government agencies and institutions, amongst several other initiatives.

While we welcome the stated reforms of the last decade and more, the impact of the reforms is yet to be seen in form of a notable increase in the number of active participating female historians in the HSN. It is therefore incumbent upon the Historical Society to ensure that more professional female historians are motivated and involved in its affairs. This should also be, especially with regards to the negotiation processes of reintroducing history in all strata of the Nigerian educational system, amongst other engagements, where women are known to have possessed and exhibited comparative advantage by their negotiating abilities, with the expected positive outcomes. Thus, perhaps this significance of women was what the American author and humorist, Mark Twain, observed when he wrote: "What would men be without women?" Scarce Sir… mighty scarce."[33]

CONCLUSION

This study has been an exposition of the paucity of professional Nigerian female-historian participation in the affairs and activities of the HSN, towards the promotion of historical consciousness and learning in Nigeria. The essay highlighted the significance of women and their participation in the HSN as an association, for which their increased involvement in its affairs is advocated. Besides, it identified six reasons why there is the paucity of professional female-historian participation in the Historical Society. It proposes measures to ameliorate and possibly eliminate the factors inhibiting the commitment of professional female historians' participation in the affairs of the HSN.

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England. Hence, only Jean Margaret Bradshaw who taught until 1956 was available and active enough to be the only female signatory to the original Memorandum and Articles of Association of the Historical Society of Nigeria.

2. G.O. Nzegwu, 'Reminiscences of an Ibadan Alumna,' in T.N. Tamuno (ed.), *Ibadan Voices: Ibadan University in Transition* (Ibadan: Ibadan University Press, 1981), 30.

3. *Ibid*., 30.

4. *Ibid*.

5. Information was derived from data of historians gathered by the author of this paper from Heads of History Departments of various higher institutions of learning across Nigeria, from respective Vice Presidents of the Historical Society of Nigeria, and from the Secretariat of the Historical Society of Nigeria, from June, 2015 to March 2017.

6. *Ibid*.

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32. Information derived from statistics supplied by Dr NkemOnyekpe of the Department of History, University of Lagos.

33. A quotation by American Writer and Humorist, Samuel Langhorne Clemens (1835 – 1610), who used the pseudonym Mark Twain as the author of his writings.

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THE STRUCTURALIST INTERPRETATION OF NUMBER THEORY: AN APPRAISAL

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ABSTRACT

The paper is concerned with the study of the structuralist interpretation of number theory. The purpose of the study is to appraise Hellman's modal structuralist interpretation of Peano Arithmetic so as to ascertain whether such an interpretation is categorical. The method adopted for the appraisal is content analysis. It has been shown in the essay that modal structuralism is a formal system at par with Peano Arithmetic and therefore needs the same type of interpretation as the latter. Hence, the paper concludes that it will amount to the problem of circularity to assume that a system that is identical to another in elliptical spaces and structure is an adequate interpretation of that other.

KEYWORDS: *Modal, Structuralism, Categoricity, Peano Arithmetic, And Number.*

INTRODUCTION

The structuralist interpretation of number theory is an interpretation of Peano Arithmetic. The reason is that Peano Arithmetic has shown itself to be an adequate, comprehensive, and fruitful formalism of general arithmetic that is devoid of analytic paradoxes. To be sure, it is recognised by mathematicians as a mini-form of general arithmetic. It is currently studied in many departments of mathematics as a continuous part of mainstream mathematics. Hence, its interpretation is the interpretation of all general arithmetic.

The structuralist interpretation that will be considered in the paper is due to Geoffrey Hellman. Hellman refers to his structuralist interpretation of Peano Arithmetic as a "modal structural interpretation" because of his intention to avoid the Platonist implications of the theory arising from the use of bound variables in the original system. Without specifying the domain of their reference, bound variables must make existential claims. Most epistemologist have sought to resolve the existential quandary of bound variables by resorting to some form of putative ontological assumptions. Such, solutions lead to the fallacy of ontological convenience. The fallacy of ontological convenience is the epistemic practice of asserting the existence of some queer putative ontology as the domain of reference for concepts. A typical example of ontological convenience is Platonism.

Geoffrey Hellman has no intention of committing ontological convenience. But he does not want to fall victim to the opposite tendency, which is nominalism or denial of existential reference. He instead proposes a kind of modal structuralism, in which existence is acknowledged but the specific nature of that existence is treated as hypothetical. The paper seeks to appraise Geoffrey

Hellman's claim to adequately interpret Peano Arithmetic in a modal structuralist formal system. The assessment of Hellman's works is based on the essay's thesis, which states that every adequate interpretation of a formal system must make some definite ontological commitment before it can be assumed to have attained categoricity. To achieve this objective, the paper adopts the method of content analysis.

The concept of structuralism in the foundations of mathematics

Geoffery Hellman begins the discussion of structuralism with the following statement: "With the rise of multiple geometries in the nineteen-nineties and the rise of abstract algebra in the twentieth century, the axiomatic method, the set-theoretic foundation... a certain view called "structuralism" have become commonplace" (Hellman, 2005, p. 536). A careful look at the pre-conditions according to which structuralism has become commonplace above shows that the structuralist orientation is consistent with the tradition of formalisation of mathematical knowledge. The traditions referred to above by Hellman are those that are amenable to formalization.

The basic objective of a formal system is the establishment of the basic structure of any body of knowledge with reference to the most basic notions, functions, and logic. There are certain established variables that must be present for a system of truth to be called a formal system. Some of these variables are presented by Hamilton (1978) in the following outline:

(1) An alphabet of symbols.

(2) A set of finite strings of these symbols, called a "well-formed formula." These are to be thought of as the words and sentences in our formal language.

(3) A set of well-formed formulas, called axioms

(4) A finite set of "rules of deduction," i.e., rules that enable one to deduce a well-formed formula *A*, say, as a 'direct consequence' of a finite set of well-formed formulas $A_1,...A_k$, say (Pp. 27–28).

Both the symbols and the well-formed formulas are, most of the time, undefined notions. They are referred to as the "primitive notions" of the formal system. This approach is one that places emphasis on structure because, in most cases, the so-called "primitive notions" are left undefined. For instance, Richard Dedekind's set theory could be understood as a definite structure for arithmetic (Joyce, 2005). Dedekind himself recognised this when he argued that numbers could be dispensed with in the system.

Care must be taken to avoid the temptation to assume that a structuralist theory must be defined in structuralist ontology. An assumption like that would be erroneous because a structure is an axiomatized version of a real theory. A structuralist is therefore one who refuses to commit to any definite ontology as the realisation of an axiom system. Hence, structuralism in ontology is identified with a variable ontological commitment. An axiom system for which one person gives a structuralist interpretation could be legitimately interpreted in realist terms by another.

According to Geoffrey Hellman, structuralism is a theory that views mathematics as "systems of objects fulfilling certain structured relations among themselves and in relation to other systems, without regard to the particular nature of the objects themselves" (Hellman, 2005,p. 536). So, mathematics is the study of the structure of relations among objects within systems, without

placing emphasis on the nature of any specific object. Hellman (2005) believes that mathematics is concerned with the investigation of "abstract structures" (p. 536).

The implication of the structuralist interpretation of the mathematical project is that the entities named in mathematical systems do not have definite referents. They are only space markers or variables (Hellman, 2005). But it could still be argued that Hellman could not avoid existential problems because of his inability to deny the existence of structural objects. But he could respond that the resultant structures do not possess esoteric existence because they are products of first-order logic. To avoid this problem of existence, some structuralists have made efforts to interpret arithmetic without the use of bound variables.

Peano Arithmetic as Structuralism

Peano arithmetic used the very same five primitive notions as Dedekind's formalised arithmetic. Now, considering that Peano's system consists of *1, a* number, a successor, and the axioms as representative of arithmetic, it becomes even clearer why Peano is an ontological structuralist in the foundations of mathematics. As Donald Gillies (1993) argues, "Peano can best be considered as a forerunner of the formalist philosophy of mathematics" (p.69). The word "formalist" is used here to refer to commitment to the axiomatic method and not formalism as a school in the philosophy of mathematics. Unlike philosophical formalism, Peano acknowledged that mathematics refers, but that the domain of reference was indefinable.

The formalistic approach of Peano is an adequate basis to classify his system as structuralist. As a result, the entities named in the system are merely placeholders awaiting actual interpretation.So,Peano arithmetic makes some kind of ontological commitment.

So, to the question of whether Peano arithmetic makes any existential commitment or not, the answer should be in the affirmative. The theory's logical components make existential commitment; thus, the theory makes existential commitment. Tomasz Bigaj (1998), in his work titled "Analyticity and Existence in Mathematics," observes that Peano arithmetic makes a commitment to the existence of two types of objects, namely, number and successor. He traces this commitment to one of the axioms as follows:"$\exists x \forall y \sim xSy$(*there is x, for each y, such that: it is not the case that x is the successor of y*)"(Tomasz, 1998, p. 107, parenthesis mine). An existential commitment to *x,* and the successor of *y* is made in the context by the bound variable. The axiom just stated above is Peano arithmetic's axiom that states that: *1* is not the successor of any number. Tomasz argues that if the successor were made to represent any binary function whatever, Peano arithmetic will still make ontological commitment. "Let the successor function *S* be substitute by we have the following:$\alpha \exists x \forall y \sim (x \alpha y)$: (*there are α and x for each y such that, it is not the case that x stands in relation α to y.*)"(Tomasz, 1998, p. 107, parenthesis mine). Tomasz (1998) argues that in this instance, a commitment is made to *α* and at least one of *x* and *y*. But to what form of entity are these commitments actually made? One could answer to the ontology of numbers. But given what is called in Volker Halbach (2004) "proof-theoretic reductions" (p. 316), theories are said to commit to the ontology of theories within which they are consistently interpreted. According to Halbach (2004), "proof-theoretic reductions of various kinds are often seen as ontological reductions" (p. 316). There have been arguments that the concept of number in Peano arithmetic is the same as set in classical set theory. The successful "interpretation... (and also reducible in another sense to)" (Halbach, 2004, p. 316) of Peano arithmetic in Zermelo-Frankel set theory established this notion.The ontology of Zermelo-Frankael set theory is, therefore, the ontology of Peano arithmetic. Halbach later supports his

argument with the assertion that "ontological commitments to numbers, sets, and other abstract objects are made by accepting theories about those objects" (2004, p. 316). Peano had at one time also recognised the similarity of Dedekind's set-theory to his work. Geoffrey Hellman has also demonstrated this similarity in his structuralism.

Halbach (2004) and Hellman (1989) are misrepresenting Peano Arithmetic. Peano's recognition of the similarity between Dedekind's system and his was a recognition of structural similarity, not the similarity of ontological commitment. Otherwise, his arithmetic would have been unwarranted. Besides, the interpretation of Peano Arithmetic in Zermelo-Frankael is not a proof that the ontology of Peano Arithmetic is the same as the ontology of set theory, which is sets. The well-ordering of sets to form series could satisfy Peano Arithmetic. However, because sets are not ordinals by definition, the ontology of sets cannot satisfy Peano Arithmetic without the well-ordering.What satisfies Peano Arithmetic in the Zermelo-Frankael interpretation is the ontology of the structure of well-ordered sets, which is ordinal, not the sets themselves.

Another error that is used to support the assumption that Peano Arithmetic shares the same ontology as Zermelo-Frankael is the principle that every categorical axiom system has its semantic contents automatically determined (Ludusan, 2015). Hence, some scholars move from here to the assumption that, since the categoricity of Peano arithmetic is established in set-theories, thenPeano arithmetic is committed to the ontology of set theories.

The nature of mathematical propositions represented in Peano's formal system could be understood as analytic. This analyticity confers necessity and apriority on such propositions. Truth in Peano arithmetic is purely coherent. This structure of truth is the same in all ontological systems that are used in its interpretation. In such interpretations, the bound variables are given unique constants and contents. It follows that only ontological systems, in which entities are necessarily serial by nature and not by some defined well-ordering, are the systems to which Peano Arithmetic is necessarily committed.

Without reference to any unique ontological commitment, Geoffrey Hellman (1989) has carried out an extensive structuralist interpretation of Peano Arithmetic. In the same vein, most mathematical models of Peano Arithmetic have all shown their submissions to be structuralist, because they assume that Peano Arithmetic is satisfied by any linearly ordered structure of any identical set of entities. These structuralists are not interested in the unique ontological features of the entities involved. Hellman's structural approach to the interpretation of Peano Arithmetic, christened "modal structuralism," shall be the preoccupation of the next section.

Modal Structural Interpretation of Number

The modal-structuralist interpretation of natural numbers is an interpretation of Peano's Arithmetic, which is therefore due to Geoffrey Hellman, with a claim that it has roots in the writings of Richard Dedekind. According to Hellman, it is a widely, if not universally, accepted view that, in the theory of arithmetic, what matters are the structural relations among the items of an arbitrary progression, not the individual identities of those items (Hellman, 1989). Consequently, the natural numbers are not essential to the structuralist interpretation of number theory. They can be dispensed with. Hellman (1989) argues that: "any ω-sequence will do" (p. 11).

In a far deeper analysis, the -sequence is again dispensed with and a simple two-pplace relation is used (Hellman, 1989, p. 23**).** Such a two-place relation is a certain form of bijection between

the object and its predecessors when considered from the viewpoint of a first-order object system. Hellman contends that, while the structuralist position is similar to the modern set theoretic approach, it differs in that the latter refers to some objects, resulting in paradoxes and difficulties, whereas structuralism makes no unique ontological commitment.

The only system that is closer to model structuralism, Hellman argues, is that developed by Richard Dedekind in his classic *Essays on the Theory of Numbers* (1991). Dedekind used the notion of a "simply infinite system" to represent the -sequence and also the notion of a successor function in his interpretation of natural number series. Consequently, Hellman identifies Peano arithmetic in Dedekind's analysis.

Dedekind's remarks are as follows:

If, in the consideration of a simply infinite system *N* set in order by a transformation *Φ* we entirely neglect the special character of the elements, simply retaining their distinctness and taking into account only the relations to one another in which they are placed by the order-setting transformation *Φ*, then these elements are called natural numbers, ordinal numbers, or simply numbers, and the base-element *1* is called the base-number of the number series (1991, p. 113).

Mathematical realism of the 19th century made Dedekind to conceive that his system actually freed arithmetic of contents. He assumed some level of achievements for his system of the infinite elements. He writes as thus:

With reference to ... freeing the elements from every other content (abstraction), we are justified in calling numbers a free creation of the human mind. The relations or laws which are derived entirely from the conditions *Φ, α, β, γ, δ...* are always the same in ordered simply infinite system, whatever names may happen to be given to the individual elements for the first object of the science of numbers or arithmetic (Dedekind, 1991, p. 113).

The starting point of mathematical thinking in the present system is sheer consideration of any kind of element and its infinite possibility. The primary issues are the preservation of the c relation, which organises the elements. As a result, the validity of arithmetic laws is determined by the operation of the constant c rather than the specific types of elements. We can avoid specificity, according to Dedekind, as long as the relation that orders entities retains its meaning and its operations and arithmetic remain valid. As a result, discussing class or number is unnecessary for that validity. Hence, Dedekind (1991) writes:

... It is clear that every theorem regarding numbers, i.e. regarding the elements *n* of the simply infinite system *N* set in order by the transformation *φ* and indeed every theorem in which we leave entirely out of the consideration the special character of the elements *n* and discuss only such notions as arise from the arrangement *φ*, possess perfectly general validity for every other simply infinite system *Ω* set in order by the transformation *ψ* (p. 113).

The transformation *φ* and *ψ* become the Peano's successor function. The ordering is called succession, or whatever, he prefers to call it. But some fundamental issues mentioned here must be noted for future understanding. The concept of the set *N* restricts the notion of elements to properties of a set. Thus, the infinite system is expected to be a set. This notion is unacceptable to Hellman, who prepares to dispense with set theory completely in his modal structuralist interpretation of numbers. He prefers to retain a relation, such as the transformation function, without the need for the ordered elements. Hellman, however, recognises in Dedekind's analysis an emerging system that resembles Peano's system of postulates. It is on the basis of this latter

system that he bases his interpretation of numbers. Using Peano's first-order axioms, Hellman argues that it is important to construe a (pure) number's theoretic statement as elliptical or as a statement as to what would be the case in any structure of appropriate type (Hellman, 1989). Given the context of Peano Arithmetic, the appropriate types are either a progression or a sequence. To establish the expected conditional in the system, Hellman writes:

If *X* were any -sequence and held in *x*----------*(1)*. *S* is supposed to be satisfied by some statement in *x*. Hellman opines that equation *(1)* above is universal. For a modal structuralist interpretation, hereinafter known as (*msi)*, there is no place foruniversal quantification so as to avoid the realism of possible world ontologies.

Consequently, equation *(1)* is translated into an existential statement, still fulfilling a modal property. The modal operators, □ and ◊ would be used to represent necessity and possibility, respectively. As a result, Equation (2) is as follows:

$\Diamond\exists X$ *(x is an ω - sequence)* ---------- *(2)*

In this translation, Hellman (1989) claims to have achieved one of the *msi* objectives. The equation reads: "If there were some *x* (*x* would be an*ω* - sequence)"(p. 16). The hypothetical character is meant to frustrate Platonism.

Taking equation *(2)* and a higher order Peano Arithmetic called PA^2, meaning second-order Peano Arithmetic, all possible *x* are as follows:

$\Box\forall X\ (X\vDash \wedge\ PA^2 \supset X \vDash S)$ ---------- *(3)*

This would read: Each *X* is necessarily such that if *X* is a sequence of second-order Peano Arithmetic then *S* holds in *X*sequence.

Hellman defines Peano's principle of mathematical induction in the same second order language as follows: $\forall X[\{\forall x(\forall y\ (x\neq s(y))\supset P(x)\ \&\forall n\ (P(n)\supset P(s(n)))\}\supset \forall nP(n)]$

This would be read: For all *x*, each *x* and *y* is such that *x* is not equal to the successor of *y* implies *x* is *P* and for all *n*, *n* is *P* implies the successor of *n* is *P*, implying therefore all *n* is *P*. This states the fifth axiom of Peano's mathematics. What it implies for equation *(3)* is that if *S* holds in $X\vDash$ then statements of *S*-type would also hold in $X\vDash$ (where $X\vDash$ means any *x* sequence). But *X* is an*ω*-sequence. So the next problem, which is that of justification, is concerned with the establishment of the *ω*-sequence.

The next equation which is equation *(4)* addresses the classical problem of truth. The equation is *ω*-sequence are possible ---------- *(4)* Hellman argues that the acceptance of equation *(4)* would promote possible world discussion. Consequently, he establishes another equation that would make the same assertion, while avoiding the *ω* −sequence. Hence he writes:

$\Box(\wedge PA^2 \supset S)$ ---------- *(5)*

This reads: "necessarily *S* holds in second-order Peano Arithmetic". Equation *(6)* adds the universal quantifier but eliminates the successor function of the first-order Peano Arithmetic, substituting a two-place relation variable for it (Hellman, 1989, p. 23). It is of the form:

$\Box\forall f(\wedge PA^2 \supset A)(^{s}_{f})$ ----------*(6)*

It reads: *For each f, A necessarily holds in* $\wedge PA^2$*, even when s is substituted for f*. It is important to note that all references to *A* involve reference to *PA*. So, to take the system higher to PA^2, all

references to *PA* must be removed. To achieve that goal, Hellman establishes another equation, which shows a link in the entire system of equations. Equation *(7)* is as follows:

$\Box\forall X\forall f[\wedge PA^2 \supset A]^x(f^S)$ ----------*(7)*.

This reads: *for all X, each f is such that if A is implied in* $\wedge PA^2$ *then f is a substitute for s in X*. A presupposition made here is the view that the knowledge of the elevation of *PA* to PA^2 and the satisfaction of *A* in *PA* given *s* is taken for granted. So, the first-order system is relativized in the second- order.

The relativisation of the first-order system in the second-order is extended to major operations definable on *PA*. Hence, the addition and multiplication operations are transferred from $\sum$ and $\prod$ to *g* and *h*, respectively. The resultant equation *(8)* for the new second-order variable is as follows:

$\Box\forall X\forall f\forall g\forall h(\wedge PA^2 \supset A)^x(f^{s,}{}_{g,}{}^{\sum}{}_{h,}{}^{\prod})$ ---------- *(8).*

Hellman seeks to reduce the range of *msi* of theory to a non-possibilia, by establishing a comprehension axiom, defining limits for *A* such, that only some *X* and some *f* could be referred to, and *A* would be subsumed in $\wedge PA^2$as just a possible model and not as a fundamental model for $\wedge PA^2$, though it may be fundamental model in *PA*. The comprehension scheme is as follows:

$\Box\exists R\forall X_1 \ldots \forall X_k[R(X_1 \ldots X_k) \equiv A]$, meaning:*there is necessarily a relation R for each of* X_1 *to* X_k*, such that* X_1 *to* X_k*is R is equivalent to A.* The possession of *R* is identical with being an argument in *X*. All possible arguments of *X* loose content when *S*is substituted by *f*. Hence, there would be no need to indicate such an argument, because *X* would suddenly become a structure like $\wedge PA^2$, the moment it takes the relation variable *f*. Thus, the ninth equation is as follows:

$\Diamond\exists X\exists f(\wedge PA^2)^{x}(f^{s})$ ---------- *(9)*

Reading: *If there were X and f for* $\wedge PA^2$*, f would substitute s in X.*

The system is an *msi*. Its hypothetical nature does not allow for commitment to any content.

Evaluation and Conclusion

Hellman believes that, by virtue of his modal structural interpretation of Peano Arithmetic, he has solved the problem of platonism in the foundations of mathematics. Numbers are completely dispensed with. But it is difficult to imagine how such a feat is achieved because the idea of appropriate type, which *X* represents as an -*sequence* in Hellman's system, makes reference to numbers. Establishing a hypothetical reference over a controlled domain of existential quantification does not eliminate existential consequences. How does Hellman deny existence in the face of the use of bound variables?

The traditional model theory of modular logic is itself suspect. Such models seek to interpret modal logic in first or second-order logic while still pretending that the principles are modal. But the pretence cannot translate into the conferment of modal logic with the title it so desires because the first-order logic within which it is interpreted makes an existential and not just a hypothetical commitment. So, it could be argued that Hellman's achievement in relation to Peano mathematics is simply meta-linguistic. His system as well as Dedekind's cannot be used as an interpretation of general arithmetic because they are on par with the latter. In a nutshell,

they are simply summaries of either Peano Arithmetic or general arithmetic.They are not any form of interpretation.

Contrary to Hellman's view that Dedekind and his system are adequate interpretations of Peano Arithmetic, or even general arithmetic, the two systems are not in any way different from Peano's mathematics or general arithmetic. They only possess metalinguistic advantages. As a result, they are better understood as Peano Arithmetic isomorphic systems rather than their interpretation.

If a theoretical system is at best isomorphic to another, which is the original theory, the former cannot be said to be an interpretation of the latter. Isomorphic models are similar models of the same theory, with different contents in system constants and variables. So, Hellman's interpretation of Peano Arithmetic is not a system of entities different from Peano Arithmetic but an isomorphic model of the same system.

Hence, it could be concluded that modal structuralism or structuralism of any sort, which purports itself to be an adequate interpretation of Peano Arithmetic, is not an interpretation of the theory at all but its isomorphic model, or what Bridge (1977) calls an elementary equivalence of Peano Arithmetic. It will amount to the problem of circularity to assume that an axiom system that is identical to another in structure and elliptical spaces is an adequate interpretation of that other.

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SEMANTIC ANALYSIS OF OLD ENGLISH PHRASEOLOGICAL UNITS

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ABSTRACT

This article deals with the characteristics and semantic analysis of phraseological units in fiction and Old English.

KEYWORDS: *Phraseological Units, Classification, Phraseological Combinations, Old English.*

INTRODUCTION

Phraseology – (from the Greek “phrasis” and “logos”) is a science that studies stable combinations of words – phraseological units. The term “phraseology” was introduced by Swiss scientist Sh. Bally, where he understood this science as that which is studying connected combinations. Despite the fact that different authors name these units differently, each definition emphasizes the essence of phraseologism – their semantic unity, stability of meaning. Stability, as arle, is characterized by the reproduction of the existing combination in the finished form. A. Kunin identifies five types of resistance of phraseological units: sustainability, structural-semantic stability, and semantic stability, lexical and syntactic stability [9]. Phraseological units are word-groups that cannot be made in the process of speech; they exist in the language as ready-made units. They are compiled in special dictionaries. Like words, phraseologocal units express a single notion and are used in a sentence as one part of it. American and British lexicographers call such units idioms. Phraseological units can be classified according to the ways they are formed, according to the degree of motivation of their meaning, according to their structure and according to their part-of-speech meaning.

Speaking about phraseological units, one cannot fail to mention their classifications. There are several classifications of phraseological units in English, such as the classification of A.V. Kunin, A.I. Smirnitsky, V.V. Vinogradov [10, 15]. Based on the consideration of the meanings of phraseological units, we have compiled a thematic classification of phraseological units with a color designation component

1. Phraseological units associated with various spheres of human life (38%). Such phraseological units describe the psychological state of a person, his mood, emotions, for example: be in the pink, black-affronted, be green with envy; characterize the appearance of a person, for example: be red as a beetroot, black as a raven; denote a group of people, for example: men in blue or character traits: white feather, yellow-livered.

2. Phraseological units call actions, deeds (14%): to paint town red, to sing the black psalm;

3. Phraseological units call an abstract concept (12%). For example: a white lie, red alert;

4. Phraseological units denote a sign by action (7.3%). For example: till all is blue, yellow-bellied;

5. Phraseological units name dishes and food (5.7%): brown sugar, blue plate;

6. Phraseological units design a place (5%). For example: a green-belt area, a black hole, white Africa, blue earth;

7. Phraseological units denote an intense color feature of an object (4.8%): as red as a cherry, white as the driven snow, as black as night;

8. Phraseological units associated with time (4%). For example: the blackest day of the life, a red letter day;

9. Phraseological units denote concepts related to profit (3%). For example: green stuff, black money, gray market;

10. Phraseological units name a specific subject (2.2%): a black flag, a green glass, a white elephant, black diamond;

11. Other (4%). For example: white magic, a blue, a purple heart, black Maria.

Phraseological combinations are phraseologies whose meaning is understood from the phraseological meaning of whole phraseological units. The transfer of meaning based on metaphor is clear and unambiguous. The lexical components of phraseological combinations are the most stable. Phraseologisms such as “to look a gift horse in the mouth” (to examine a present too critically, to find fault with something one gained without effort), “to ride a high horse” (to behave a superior, haughtly, overbearing way), “a big bug” (a person to importance), “a fish out of water” (a person situated uncomfortably outside his usual and proper environment) are examples of phraseological combinations. There is a lot of phraseology. Some of them are easy to translate and some are even international. For example, to know the way the wind blows – to know where the wind blows. Phraseological units are words that have a specific valence. One component of such phraseological units is used in its literal sense, and the rest is used in a metaphorical sense. Phraseological units are to some extent semantically indivisible. Phraseological units are partially altered combinations of words. The meaning of these phraseological units is easily understood from the meaning of the words that make them up. To be at one’s wits end, to be a goodhand at something, to come off a poor second, to coma to a sticky end, to stick at nothing, gospel truth, bosom friend are examples of phraseological units. In conclusion, the semantic aspects of occupational phraseological units show that in both languages they are related to human physical labor, which express concepts directly related to human labor activity.

As a lexical unit, they are in many ways close to words, and many of the characteristics of words are also characteristic of phraseology. There are different hypotheses in defining the object of phraseology. The object of phraseology consists only of stable combinations. Phraseology is defined as the study of the spiritual and structural properties of phraseological units, their appearance in the language system, and the properties of their use at a point. Although the term "phraseology" is derived from the Greek word “frama” (phraseos), it is used to mean different things. For this reason, the term phraseology is used in linguistics in two senses: in the general

sense of the existing phraseological units in the language, and in the sense of the field that studies such units. So phraseology is the science of expressions. Like other branches of linguistics, phraseology has its stages of formation and development. Although phraseology is very ancient in origin, the science of phraseology spans nearly two hundred years. The founder of the science of phraseology is the Swiss scientist Charles Bally. In his work French Stylistics (1909), he included special chapters on the study of word combinations. Ferdinand de Saussure, on the other hand, expressed his views on syntagma and its features. He said that there are ready-made units in a language whose linguistic nature is due to their meaning and syntactic properties, such combinations are used ready-made, traditionally. Phraseology is one of the fastest growing fields in the further development of linguistics. While phraseology has been studied in Russian and English linguistics for a long time, it has been studied systematically in Uzbek linguistics since the 1940s and 1950s. During this period Sh.Rakhmatullayev (1969), G.A. Bayramov (1970), G.H. Akhunzyakov (1974), V.G. Uraksin (1975), L.K. Bayramova (1983), M.F. Chernov (1986) are devoted doctoral dissertations to the study of phraseology. The sources of the origin of phraseological combinations in English are very different. It is expedient to study the origin of phraseological combinations in English into three main groups.

1. Old phraseological combinations in English
2. Phraseological combinations learned from other languages
3. Phraseological combinations derived from the American version of English

The authors of most of the phraseological combinations in English are still unknown to science. This problem is especially evident in articles that are considered to be a type of stable combination. Phraseological combinations in all languages, especially in English, are also folk art that reflects the wisdom and linguistic taste of the nation. Many phraseological units reflect the traditions, customs and beliefs of the English people, historical truths and facts of English history that we know and do not know. The roots of many phraseological units go back to professional communication. The main source of phraseological combinations is the change of their meanings of interconnected words. Many English phraseologies are derived from works of art and various literary sources. According to the number of phraseological combinations in English, after the literary sources, the first place is occupied by the Bible, and the second place is occupied by phraseology from Shakespeare’s works. The works of writers, children’s poetry, fairy tales, and caricatures are also the source of phraseology. V.V. Vinogradov classifies phraseology into three classes: phraseological fusions, phraseological units, phraseological collocations or combinations. Phraseological fusioncomponents are phraseologies that are not related to the meaning of the whole unit. Phraseological units are made up of words that have a specific valence. One component of such phraseological units is used in its literal sense, the rest in a metaphorical sense. Phraseological units are, to a certain extent, semantically indivisible. For example: heavy father – the main role in the play; to kick the bucket – to die. Phraseologisms such as the bureaucratic method are idioms that have the same meaning as a whole.

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SOURCES CATEGORY FOR STUDYING LETTER OF MUSHAF RASMI KHAT

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ABSTRACT

Rasmi khat of the Holy Qur'an is unique in its spelling style. The subject of learning this spelling has become an independent science with its own sources and foundations. Therefore, this science is taught as a separate subject in prestigious universities and institutes in the world.

Mushaf rasmi is studied based on the following sources:

1. The oldest manuscript mushafs. The main and most respected of them are the Mushafs attributed to Hazrat Usman;

2. Early works on formal letters. The importance of grouping these works is that their authors read Uthman's Mushafs themselves, saw the writing of the words with their own eyes, and told them to their students and recorded them in their works.

3. Collecting works. This type of works is so named because it covers all the necessary arguments on the subject, unlike those of the previous stage.

4. Clauses. In order to make it easier to remember the information about the picture letter, the scribes put the information in verse and wrote poems.

The following lines show the most important of these sources.

KEYWORDS: *Holy Qur'an, Ancient Mushafs, Mushafs Uthmani, Rasmi Khat, Verses.*

INTRODUCTION

In recent years, special attention has been paid to studying the rich scientific heritage of our ancestors and conducting scientific research in this regard. A number of decisions taken by the President of Uzbekistan Shavkat Mirziyoyev are a clear proof of our words.

The Holy Qur'an has been the basis of the spirituality of our people for thousands of years. Studying it in all aspects and centralizing scientific conclusions in this regard have always been important for scientists. Now that a manuscript is being published in Uzbekistan, it is natural that the interest and need for sources related to the picture letter and spelling style of this manuscript will increase. This article is about the resources you will need to study this very topic – Mashaf picture letter.

The Holy Qur'an has been studied in every way by scientists since ancient times. In particular, the researches about his writing processes and letter style have not stopped for centuries and are

still going on intensively today. Mushaf writing was first studied and analyzed by Muslim scholars, and later Western researchers also carried out a number of scientific efforts in this regard. Thus, scientific works on the study of mushaf picture letters have been created.

Although the main approaches to the mushaf picture letter have come to a standstill, research on it is still important today. There is a great need for this knowledge especially when studying ancient manuscripts and publishing manuscripts. With this in mind, this article provides information about the necessary resources for studying the cover letter.

Mushaf rasmi khat is studied based on the following sources:

I. The oldest manuscript manuscripts. The main and most respected of them are the Mushafs attributed to Hazrat Usman;

II. Early works on formal letters. The importance of grouping these works is that their authors read Uthman's Mushafs themselves, saw the writing of the words with their own eyes, and told them to their students and recorded them in their works.[1]

The following books are the most popular resources at this stage:

1. "Ikhtilafu masohifish-Sham wal-Iraq wal-Hijaz" and "Maqtu'ul-Qur'an wa masuluh" belong to the pen of Abdullah bin Amir Yahsubi (d. 118 H), the imam of recitation in Sham.

2. "Maqtu'ul-Qur'an wa mawsuluh", a treatise by Hamza ibn Habib Zayyat, may Allah bless him and grant him peace, the elder of Kufa (d. 156 H). The importance of this book can be understood from the words of the author: "I was afraid that I would lose my eyesight because I depended on Mushaf a lot."

3. A lot of information has been narrated from Nafi' ibn Abd al-Rahman Madani, one of the imams of recitation, about the letter of the Mushaf painting, and some scholars say that he has completed a work on this topic. However, there is no information about the title or other description of this book. Only the narrations from Nafi are famous, and it is possible that he wrote a work collecting them. It is said that the Mushafi of Madinah was given to him, and it was imprinted in his mind after he read it a lot.

4. "Ikhtilāfu masohif ahlil-Madīna wa ahlil-Kūfa wa ahlil-Basra" and "Maqtū'ul-Qur'an wa mavsūluh" belong to the pen of Ali ibn Hamza Kisai (d. 189 h), a student of Imam Hamza, one of the ten recitation imams.

The books at this stage recorded a certain type of information about mushaf painting and did not cover the subject completely. At the same time, these works themselves disappeared, but the information contained in them was preserved in the works of the next stage.

III. Collecting works. This type of works is so named because it covers all the necessary arguments on the subject, unlike those of the previous stage. Works at this stage can be divided into two:

a) Works that have disappeared. For example, the work "Hijāus-sunna" by Ghazi ibn Qays Andalusi (d. 199 h), "Hijāul-masohif" by Muhammad ibn Isa Asfahani (d. 253 h), "Ikhtilāful-masohif" by Abu Hatim Sahl ibn Muhammad Sijistani and others works belong to this category of resources;

b) preserved works. There are many such works, the main ones are:

1. "Al-Masohif". Author: Abu Bakr Abdullah ibn Sulayman Sijistani (d. 316 H), better known as Ibn Abu Dawud, son of the great Muhaddith Imam Abu Dawud. It was effectively used in this scientific work.

2. "Iyzohul-Waqfi Wal-Ibtidā". Author: Abu Bakr Muhammad ibn Qasim Anbari (d. 327).

3. "Hijāu masāhifil-amsār". Author: Abu Abbas Ahmad ibn Ammar Mahdavi (d. 440 H).

4. "Al-Badi' fi ma'rifati ma rusima fi mushafi Usman". Author: Muhammad ibn Yusuf ibn Mu'az Andalusi (died 442 H).

5. "Al-Muqni' fī ma'rifati marsūmi masohifi ahlil-amsor". Author: Abu Amr Usman ibn Sa'id Daniy (died 444 H). This work is also very popular and is considered one of the main sources of scientific work.

There are a lot of works on this subject, and if we list them here, our words will be too long. It can be said that at least one work has been written on this topic in almost every Hijri century and continues to this day.

III. Sentences. In order to make it easier to remember the information about the picture letter, the scribes put the information in verse and wrote poems. The most famous of them are:

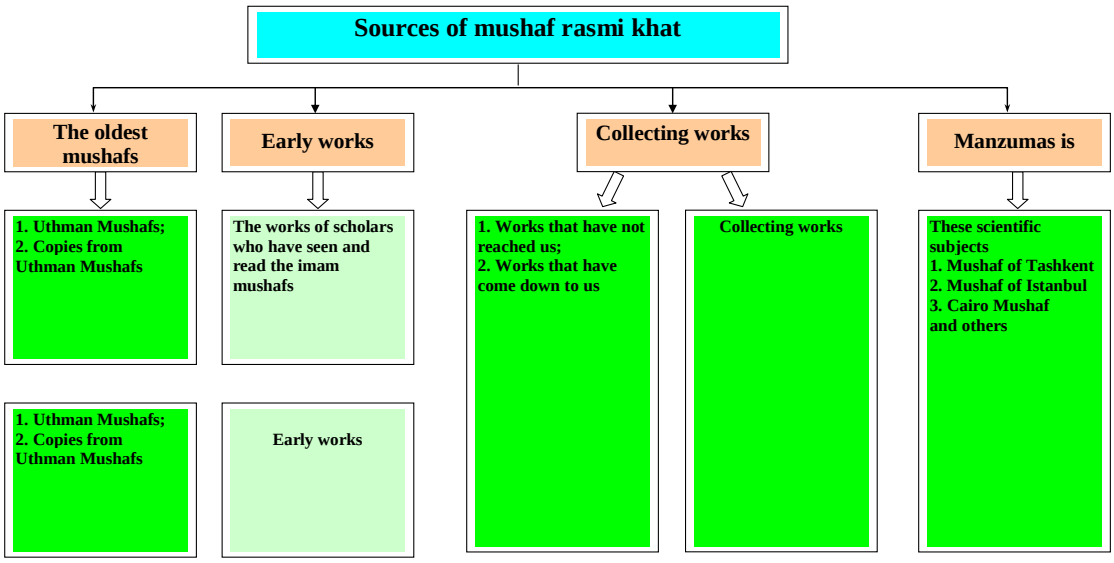
1. "Al-Munsif". Moderator: Abu Hasan Ali ibn Muhammad Muradi al-Andalusi (died 563 H).

2. "Aqilatu atrōbil-qasōid fī asnal-maqōsid". Nazim: "Abu Qasim Muhammad ibn Firrukh ibn Khalaf Shatibi (died 590 H). This manzuma is the most widespread and unique work on its subject, and belongs to the famous Imam Shatibi, one of the geniuses of the science of recitation. Currently, this work is remembered in many places.

3. "Mavriduz-zom'an fī rosmil-Qur'an". Moderator: Abu Abdullah Muhammad ibn Muhammad Kharroz (d. 718 H).

These manzumas are very important not only for mushaf scribes, but also for talibi ilms who memorize the Qur'an.

Summing up from the above lines, the Mushaf picture letter is studied through the following sources:



It is fair to say that there are very few works written by Western researchers on the study of mushaf picture letters. They mainly focused on this topic in their works on Quranic sciences and ancient manuscripts. Even then, without going into details, they spoke in a general way. In general, almost all sources on this topic are in Arabic. Because the topic being studied requires it.

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OPTIMIZATION OF STEEL TRUSS BRIDGE

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ABSTRACT

This thesis aims to optimize the weight for double lane steel truss bridge with RCC composite deck of 100m span. The optimization here is targeted to achieve minimum weight of the steel and relationship between weight of steel and truss height, weight of truss and height to span ratio, wind force and truss height to span ratio. The analysis and design is based on IRC codes and guidelines using MS-excel sheets and SAP2000 computer software. The study outcome shows that total weight of stringer and cross girder found minimum for maximum spacing of stringer possible for minimum thickness of deck. The total wind force acting on the truss bridge girder is increases with increases in height of girder approximately linearly and it decreases with increases in panel spacing up to certain limit then increases with increases in panel spacing.

KEYWORDS: *K-truss Bridge, optimization, panel spacing, height to span ratio, wind force.*

1. INTRODUCTION

Nepal is the mountainous country with a lot of river and rivulets, so we need many bridges to ease the extension of road network. Truss bridge has advantage in Nepalese topography since the construction does not demand construction of pier in narrow deep gorge, work can be carried out in all seasons and flood has less effect on the bridge. Truss is like a deep beam of different truss configurations. Due to strong load- bearing capacity, effective use of materials, affordable to construct, versatile and adaptable design, steel truss bridge design needs to be considered. The greatest benefit of optimization would be the saving of material and speed up the construction process, thus saving time. The saving of material and time ultimately reduces the final cost of the project. In 2019, A. Khadka & B. Mandal [1] has performed the Parametric Study for Economic Steel K -Truss Bridge. They concluded that the total weight of stringer and cross girder goes on decreasing as the panel spacing goes on decreasing. V. Khatri & P. Singh et al [2], 2012, performed the Comparative Study for Different Girder Spacing of Short Span Steel-Concrete Composite Bridge with MS and HPS and found that the 4-girders system is more economical than 5-girders system. Moreover the theory is comparable to a paper published by A. Naibaho and T. Rochman[3], 2022, the effectiveness of the using a K- truss type on the Patikraja bridge, K-Truss type show a good results in internal forces and maximum deflection. In 2014, C. Maraveas et al [4], optimal design

of through-truss steel bridges were performed the optimum height-to-span ratio for through-truss steel bridges of medium span falls within the range of 1/7 and 1/10 for two traffic lanes and between 1/8 and 1/12 for a single lane, irrespective of deck type. In 2007, J. L. Waling [5] has performed mathematical investigation for the determination of least weight proportions of bridge trusses. The results of those calculations show that weight savings can be accomplished by designing these trusses somewhat deeper than is normally done by present-day designers. In 2015, A. Jamadar& H. Jadhav [6] has conducted optimization of double track railway bridge superstructure using FEM, showed that the weight minimization can be done by designing the bridge somewhat deeper than they are normally built. The optimum height to span ratio of 50m bridge was found to be at 1/6.73 and for 60m at 1/6.91. And also in 2016, V. Gandhe & P. Chowdhary [7] conducted parametric study of truss bridges for economic consideration, concluded that as the span of truss and height of truss increases, the modified trusses are economical with respect to conventional truss bridge. In 2017, S. Gupta et al [8] provided the comparative analysis of different truss type railway steel bridge considering railway loadings. They have considered four vehicle load cases along with dead load & rail load for the Steel Bridge of 50m span for analysis and observed that out of all four cases howe type truss bridge shows least values construction material i.e. 697.683 Newton. The relationship between steel weight, wind force and truss height to span ratio on long span truss bridge has incorporated. Therefore, this study is helpful to find the relationship among steel weight, wind force, truss height to span ratio to optimization of steel truss bridge. It will provide economy in truss bridge design and construction with relatively longer span.

2. Need of the Study

About 250 to 300 road bridges are built annually across Nepal *(DoR, GoN, 2021)*. According to official data, 3000 bridges has been built until now and in coming 10 years 2500 bridges planned to be built by DoR*(Economic survey report, MoF, GoN, 2078/2079).* In terai, the eroding behaviour of rivers and higher cost of pile foundations, require longer span lengths, while in the hills, such bridges are the only options in large rivers like Koshi, Karnali, Gandaki, etc. To move ahead with such a big construction there must be cost effective solutions for most of the long span bridges can be truss bridges. Previous studies have been carried out on medium span truss bridges by working stress methods. The design of two-lane truss bridges up to length 60 m has already been standardized by the DoR, GoN. The depth and shape of truss are chosen by rule of thumbs mentioned in books and optimization is not carried out for each design. For long span truss bridges, the effect of different parameters such as height to span ratio, relationship between wind force and truss height to span ratio need to be incorporate for economy. The findings can be used by engineers in Nepal in order to achieve lighter and more economic truss design in the future.

3. Research Objectives

The overall objective of the study is to find the relationship among weight of truss, truss height to span ratio, wind force to optimization of steel truss bridge. To achieve the goal following specific objectives are targeted.

a) To evaluate the relationship between weight of truss and truss height to span ratio.

b) To evaluate the relationship between wind force and truss height to span ratio.

4. Theoretical Concept

The depth of the deck slab depends upon spacing of stringer given. As spacing of the stringer increases the slab increases and depth of the deck slab also increases and vice versa. The optimum depth of the RCC deck slab is obtained by given different trial spacing of stringer. Note that the minimum thickness of the deck slab should be 200mm. The spacing between the cross girder decreases the span of stringer also decreases so that the weight of the stringer decreases but increases the number of cross girder causes increase in weight of steel. The minimum weight of truss bridge is obtained by combination of certain number of stringer and cross girder. Number of nodes where weight of cross girder and stringer becomes minimum give the minimum weight of truss and ultimately minimum total weight of truss bridge or for the truss configuration for which minimum weight of truss is obtained can give the total weight of the truss bridge minimum. The parameters panel span, cross section of member and height influence the optimization of truss bridge. The load on chord member decreases and remains same in web member as height of truss increases. The weight of the truss decreases due to decrease in loads i.e. X-section on chord member while web member becomes slender due to increase in length. So the additional weight adds to the web member to make stiffer that avoid the buckling. The weight of truss decreases due to reduced weight of chord member as the height increases. Beyond certain value of height of truss due to heavy web member the total weight of truss increases. The span to depth ratio of a truss girder bridge which makes the minimum weight of chord members nearly equal to the minimum weight of web members of truss that gives the economy. The member sections will be varied so as to achieve the demand-capacity ratio members in a certain range for which the truss will be considered safe.

Wind force on a truss depends on several factors including location, height above ground, exposed area, shape of members, etc. For a given location, basic wind velocity is constant. For a 100m span truss, generally built-up sections are used as members. Thus, the coefficient of drag can be assumed constant. With variation in height of the truss for given span of 100m, small variation may occur in design wind pressure that depends on height. The major cause of variation in wind force may be due to the exposure area. When height increases, the exposed envelope area of the truss increases, the length of the internal members will increase, so their exposed area will increase and but the forces in the chord members decreases, thus smaller sections can be used in chord members, so exposed area of chord members will decrease. Since some factors increase while others decrease when height to span ratio of truss is varied, its relationship needs to be studied, while optimizing the height to span ratio of the truss. Similarly, the geometry of top chord of the truss will be parabolic and diagonal member shall be K-truss girder which gives the minimum weight of steel. The least weight of truss, stringer and cross girder for given panel spacing and height and total weight of truss bridge by calculating the least weight of RCC deck for given stringer spacing and try to obtain minima with overall truss with best diagonal angle and cross girder span.

5. Research Framework

For conducting this study the methods will be undertaken on K-truss Bridge which gives the least weight of truss bridge. A truss bridge has floor system, truss panel and height & width of truss. As the spacing of cross girder reduces, size of stringer and cross girder reduces, but numbers of panel increases. As the numbers of panel increases, numbers of vertical, diagonal members increase that leads to increase weight of truss. On the opposite if spacing of cross girder increases, it reduces weight of diagonal and vertical members but increases size of cross

girder, stringer and depth of deck slab. That again increases dead load of bridge and finally weight of truss. With the variation of panel spacing and height of truss, the steel weight of the truss will be noted and it will be plotted against the parameter that is being varied on a graph. On the other side, generally standard steel sections were used in bridge construction. Its optimum use is great importance in economic design of a truss bridge. To overcome the way forward to these questions literature review is back bone of this study. Therefore in first hand almost all research papers related to these topics would be studied. Based on the current research, a conceptual frame work would be defined for the targeted objective. As per the conceptual frame work, analysis proceeded to achieve the goal i.e. to find the relationship among weight of truss, truss height/span ratio, wind force to optimization of steel truss bridge.

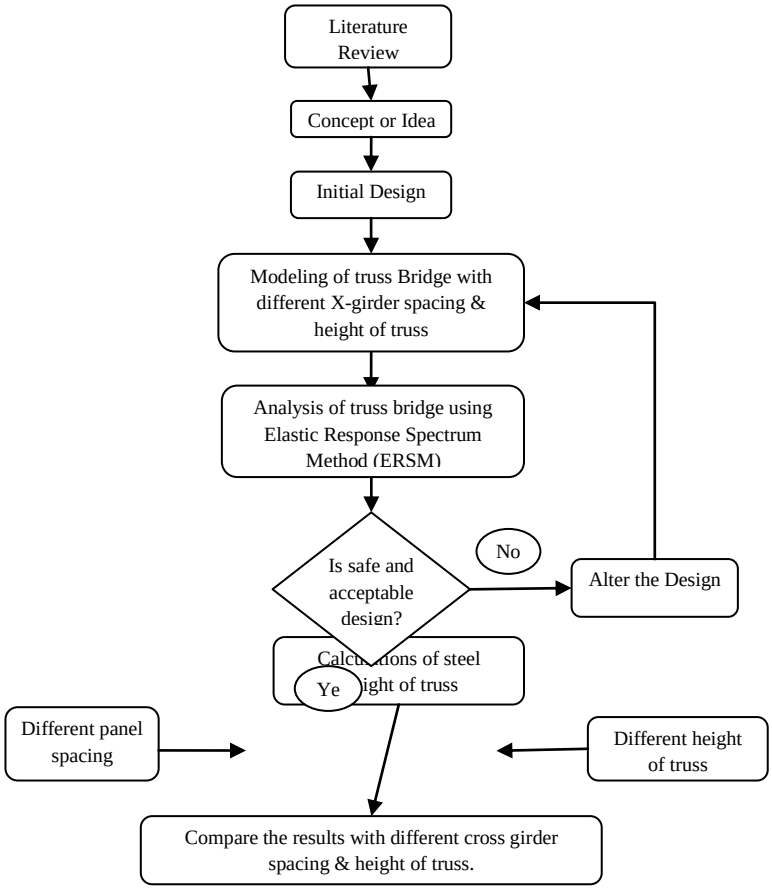

Figure 1: Methodological Framework

6. Analysis and Design

SAP2000 software is suitable for finite element analysis of the truss and design code is selected as IS 800-2007, since it is closest to the recommended IRC: 24-2010 code for steel bridge design. Deck is analyzed as a one way slab, using effective width method and designed in bending manually recommended in IRC: 112-2011. Stringers are designed by manual calculations for superimposed dead loads and live loads as steel I-beams. Cross beam is designed from manual analysis as a steel beam. Dead loads and live loads are assigned as per loads transferred from stringers. Design of truss members is carried out by using section designer in SAP2000. The section sizes of the members are tuned so as to achieve maximum demand capacity ratio indicating optimum design of the member.

6.1 Deck, Stringer and Cross-Girder

The unit weight of RCC deck considered is 25kN/m3 while wearing coat is 22kN/m3. The thickness of the wearing coat is taken as 0.075m while the thickness of the slab is fixed as 0.22m for 3-stringer and 0.20m for 4 and 5-stringer case. For the analysis and design 3nos stringer (3.3m spacing), 4no stringer (2.475m spacing) and 5nos stringer (1.98m spacing) system was selected while the number of cross-girders depends on the panel length (7.14m, 6.25m, 5.55m, 5m and 4.54m).

6.2 Truss

K-truss configurations with inclined chords are selected as these are the most common types of trusses used. According to IRC24:2010, depth or height of the truss taken should be equal to or more than 10m for 100m span so, the height of truss above 14m was selected. The overall width of the bridge is taken as 10.5m of which 1m footpath and 7.5m is the total carriageway width. Three cases of number of stringers are taken, viz. 3-stringer, 4-stringer and 5-stringer and five cases of cross girder spacing are taken, viz. 4.54, 5, 5.55, 6.25, and 7.14m. Five depth of truss girder viz. 16m, 18m, 20m, 22m, and 24m at the mid are considered for the study.

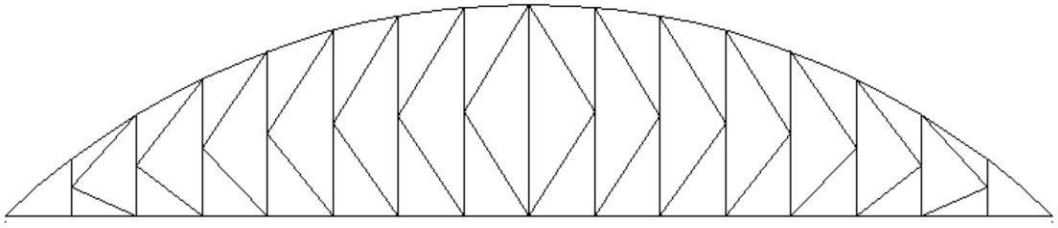

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Figure 2: K-truss gird

6.3 Modeling:

The Finite Element modeling of K-truss Bridge with a height of 20m and having span 100m modeled using SAP2000. The materials used are M25 grade concrete and Fe350steel.3D geometry of truss is created as a center-line model, i.e. all members meeting each other at their respective centroids. Thus, some eccentricity in the connections of members mostly cross members like crossbeams, braces and stringers is ignored. Members of the steel truss shall be composed of either Indian Standard sections or steel plates and shall be single or built-up and are modeled in Section Designer of SAP2000 without considering lacing/battens. The bridge roadway deck has been modeled with diaphragm constraints. Steel bridge elements top and bottom chords, cross girders, diagonals and stringers are modeled with frame elements. End releases are not applied in the software, in order to evaluate actual moments at the joints. Bearing is modeled as one pin and other transverse-free at one side of the truss, and as one longitudinal-free and other free in both directions at other side of truss.

6.4 Load and load combinations

Superimposed loads are calculated manually in excel. Thickness of deck slab is assumed as 220 mm for 3-stringer and 200mm for 4 and 5-stringer case, plus a wearing course of 75 mm thickness. IRC Class A and 70R vehicle loads are assigned in the model. Moving load analysis option provided in the software is used based on the concept of influence lines. Wind load is

applied as point load at joints of the truss as per convention at a height of 20m above normal water level. Uniformly distributed load along the member length would be a more realistic model. Braking forces and effect of wind on live loads are applied on the cross girder at the junction with stringers. Lift due to wind is applied as pressure on the deck slab. Uniform temperature load is applied on all frame members. For a simply supported span of 100m, seismic analysis shall be done using Elastic Response Spectrum Method (ERSM) as per IRC SP114-2018. Load combination is done as per IRC 6-2017 Annex B based on limit state design.

7. Results

The results of calculations are shows the weight of 100m span two lane traffic through type K-truss bridge, M25 grade concrete deck composite with several different panel spacing and height. IS 800 code-based design is also carried out in SAP2000. The results of calculations are summarized and also calculated data are plotted on the graphs below.

7.1 Variation in weight of deck with change in number of stringer

The weight of slab for 3-stringers spacing is highest among the weight of slab for 4-stringer and 5-stringer. As the number of stringer increase the span of slab and thickness decreases. This again is due to the increase in span of the slab resulting in higher depth. The slab depth has reduced by 0.02m when 4-stringer and 5-stringers is used as below.

TABLE 1: WEIGHT OF SLAB FOR DIFFERENT NO OF STRINGER

No of Stringer	Thickness of deck slab (mm)	Weight of deck slab (KN)
3	220	4125
4	200	3750
5	200	3750

7.2 Variation in weight of stringer with number of panel point

The overall weight of the stringer is in decreasing order with the increase in panel number. This is attributed due to the decrease in design responses. If we take a closer look and make comparison of weight between three different arrangements of stringers; 3, 4 and 5 by varying number of panels, we can deduce that the least weight is obtained for combination of 3-stringer and 18 panels. It can also be observed that with the increase in number of stringer the weight is also seen to be increasing. Despite having almost same section requirement, the cause in increase in total weight is primarily due to increase in number of stringers.

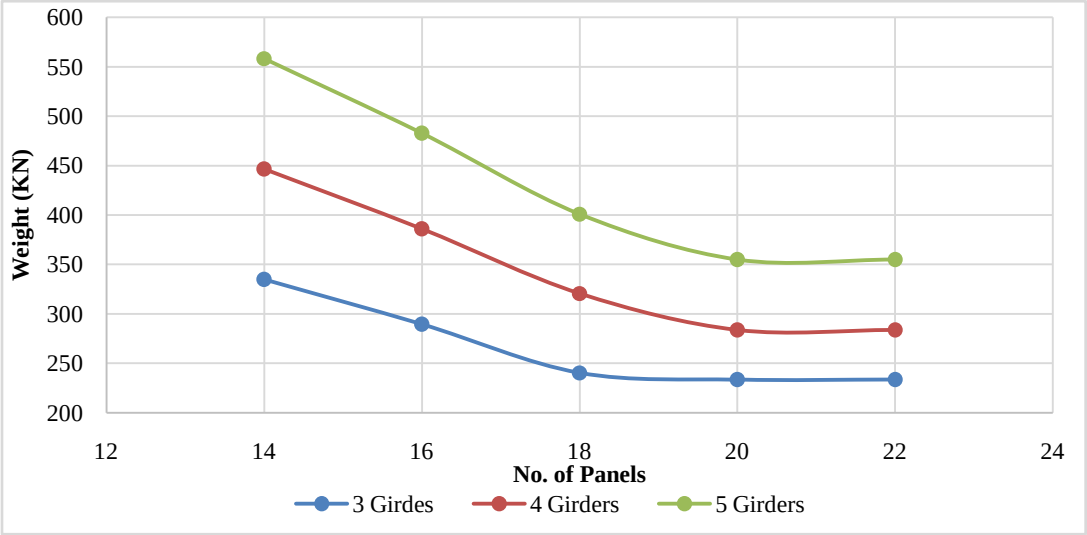

Figure 3: Weight of stringer VS no of panel point

7.3Variation in weight of stringer and cross girder with number of panel point

The nature of the graph has almost taken a parabolic shape. For all the number of stringer the lowest total weight is achieved when the panel number is 18. And the overall lowest weight is for the combination of 3 stringers and 18 panels. The explanation behind achieving this nature of graph is for the increase in panel number there is increase in weight of cross girder and for stringer. This is because of the variation in length of stringer. Since one parameter under observation is in increasing in weight and other is decreasing, combination of both the gives lowest value at one point, which in our case is 18, for 3 numbers of stringers.

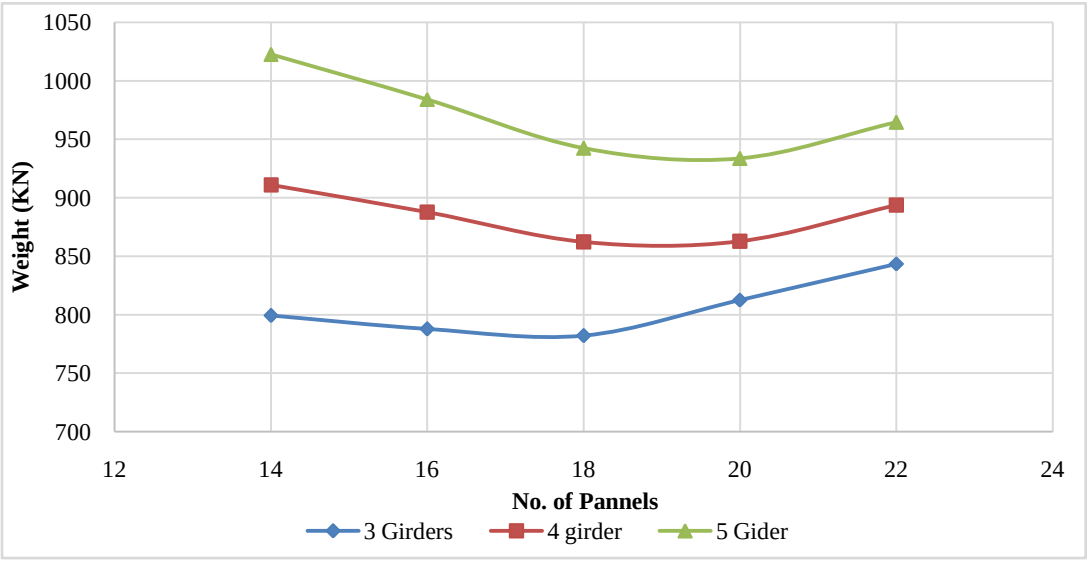

Figure 4: Total Weight of stringer & X-girder VS no of panel point

7.4 Variation in weight of cross girder, stringer with number of panel point for 3-stringer

There is slight variation in total weight when the numbers of panels are varied. The weight of stringer has been decreasing as the panel number increases but the weight of cross girder increases. This is because as the number cross girder is increased the load on the stringer is

reduced and hence weight of stringer is reduced. The total weight of stringer and cross girder is found to be minimum with 3-stringer for 100m span bridge when the no of panel point is18, i.e. spacing of cross girder at 5.55m.

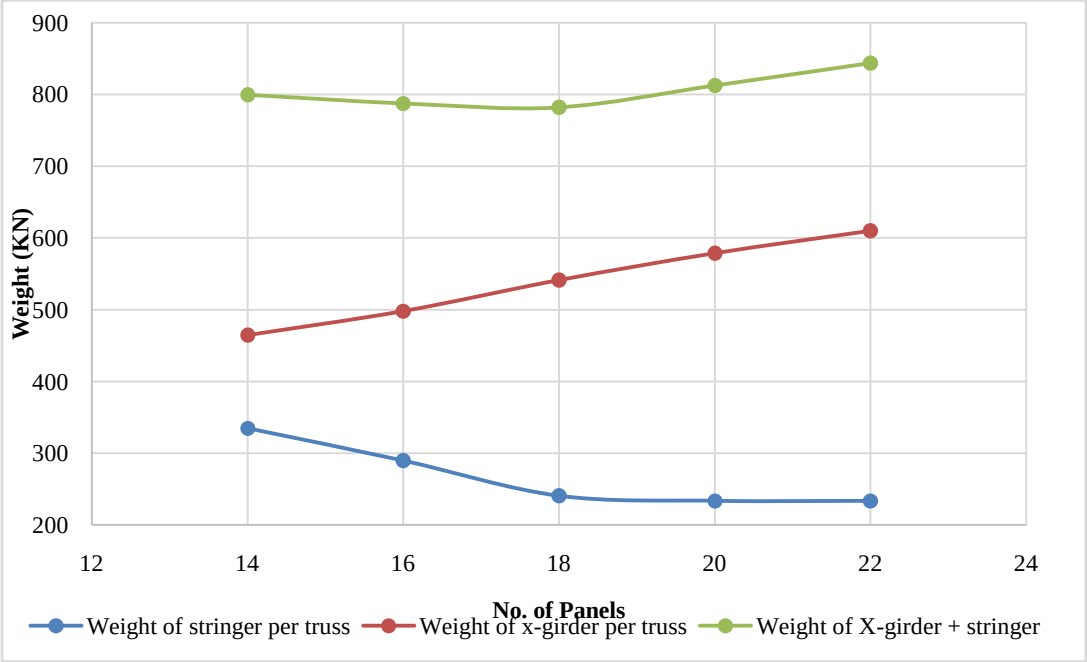

Figure 5: Weight of cross girder, stringer vs. number of panel point for 3-stringer

7.5 Variation in Weight of Component of Truss with Height of Truss for 6.25m Panel Spacing

The height of bridge increases the slender member achieved which liable to buckling due to which the member section increases which adds weight of member. On the other hand, by increasing the height of bridge force on the top and bottom member becomes lower due to which small section is used which make the bridge light. In table 5.5 as the height of the truss is increased the weight of bracings is slightly increased, weight of cross girder and stringer remains constant, but the weight of bottom chord member goes on decreasing and top member becomes zigzag and the weight web member goes increasing.

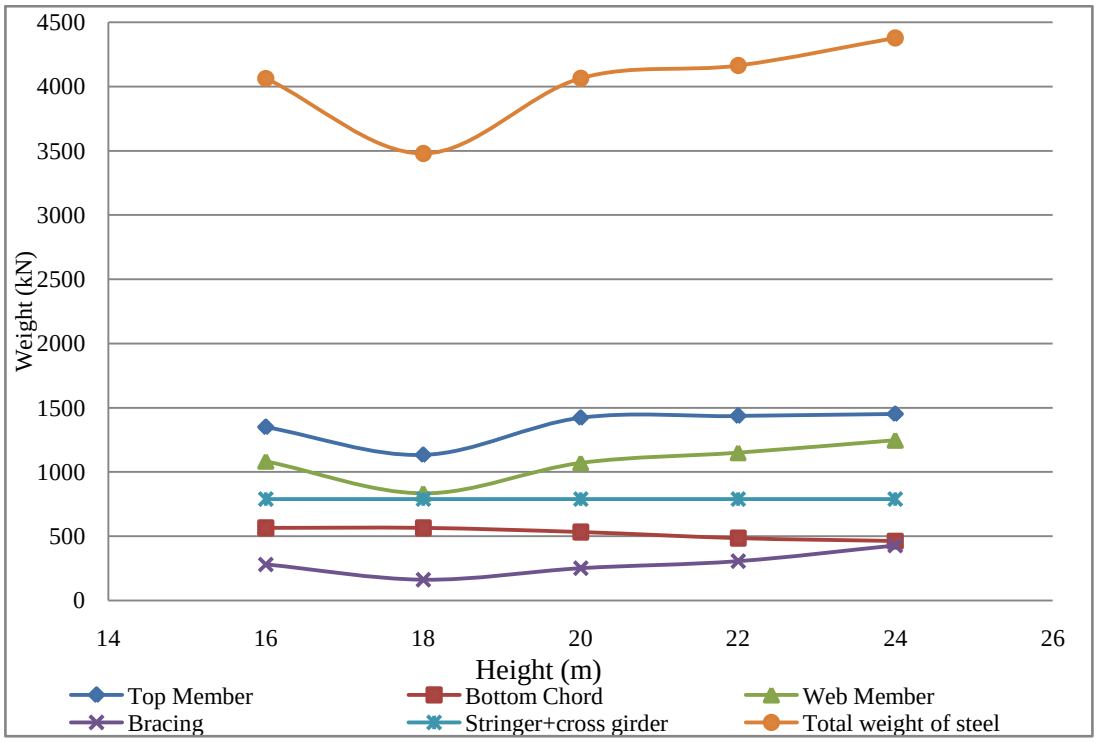

Figure 6: Weight of component of truss with height of truss for 6.25m panel spacing.

7.6 Variation in Total Steel Weight with Height for Each Panel Length

At panel length of 6.25m and truss height of 18m gives the minimum weight. The minimum weight is obtained at 18m height (height to span ratio 1/5.55) for panel length of 6.25m and 5.55m and at 16m height (height to span ratio 1/6.25) for panel length of 7.14m, 5m and 4.54m respectively. The weight of steel goes on decreasing with increase in height but after certain height weight goes on increasing for each panel length.

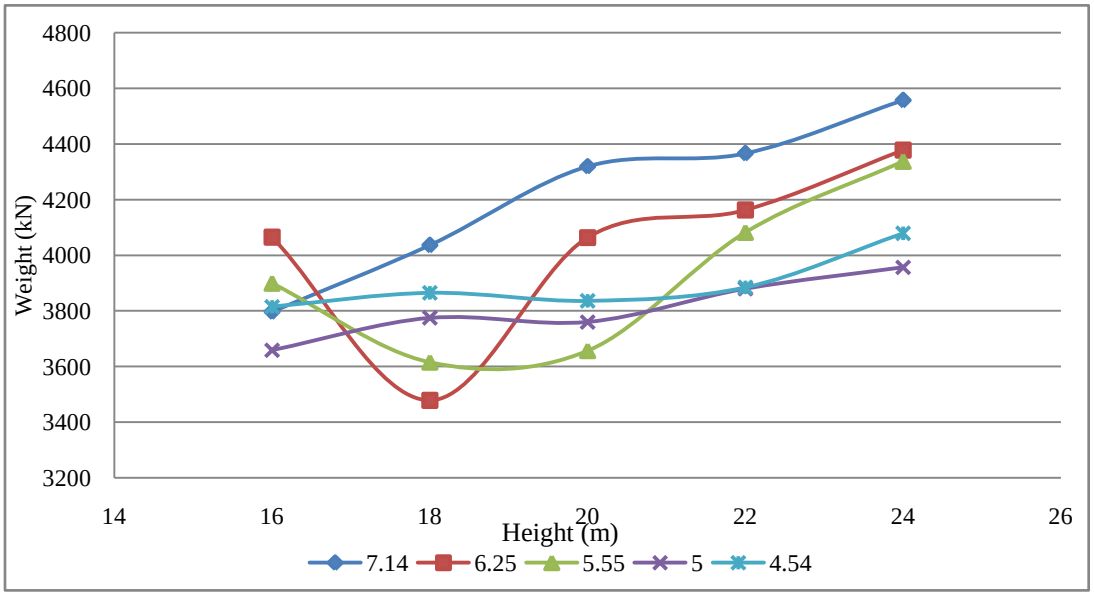

Figure 7: Total steel weight vs. height for each panel length.

7.7 Variation in Total Steel Weight with Different Panel Spacing and Height

Figure 8 and 9 shows the minimum weight of steel for different panel spacing and height respectively. Up to height to span ratio 1/5.55 the weight of truss girder has decreased and then increased. The ratio is not less than 1/10 and slightly equal to 1/6-1/8 as indicated by Indian code and other writers respectively. At 6.26m panel length and girder height of 18m the minimum weight is obtained.

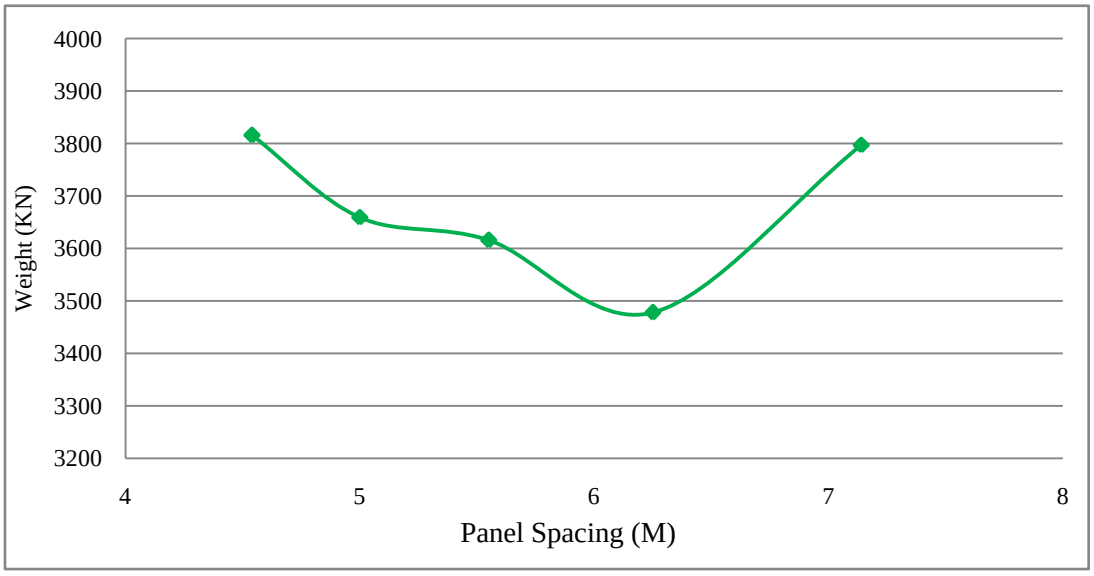

Figure 8: Minimum weight vs. panel length

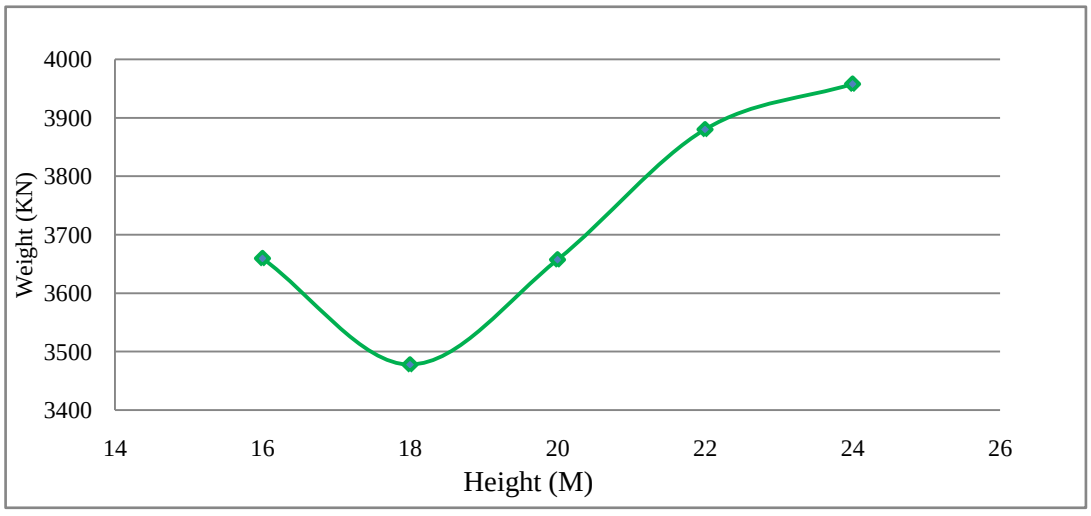

Figure 9: Minimum weight vs. height of truss girder

7.8 Comparison between total Weight Stringer and Cross Girder, Minimum Weight of Truss and Total Weight of Steel

Table 2 shows the comparison between minimum weight of truss, total weight of stringer and cross girder and total weight of steel for the given panel spacing. The minimum weight of cross girder and stringer is found to be at panel spacing 5.55m. Whereas the minimum weight of the truss only is obtained at 6.25m spacing. The total minimum weight of steel is found at 6.25m panel spacing. Hence by providing the combination of uneconomical weight of stringer and cross girder and economical truss weight, the minimum weight of the steel has been achieved.

TABLE 2: TOTAL WEIGHT, STRINGER AND CROSS GIRDER AND MINIMUM WEIGHT OF TRUSS

Panel spacing (m)	Minimum weight of truss (kN)	Weight of stringer +cross girder (kN)	Total weight of steel (kN)
7.14	2997.870	799.361	3797.235
6.25	**2690.370**	787.728	**3478.094**
5.55	2833.820	**782.012**	3615.827
5	2846.938	812.549	3659.487
4.54	2972.233	843.507	3815.740

7.9 Variation in Wind Forces with Panel Spacing

Figure 10, 11, 12 and 13 shows that the variation of wind forces with panel spacing of truss girder. It shows that wind force decreases with increases in panel spacing up to certain limit then it increases with increases in panel spacing. The minimum wind force obtained at panel spacing of 5.555m in both transverse and longitudinal directions with respective height of truss girder. It is because at this panel spacing the perimeter and the area of truss member has minimum.

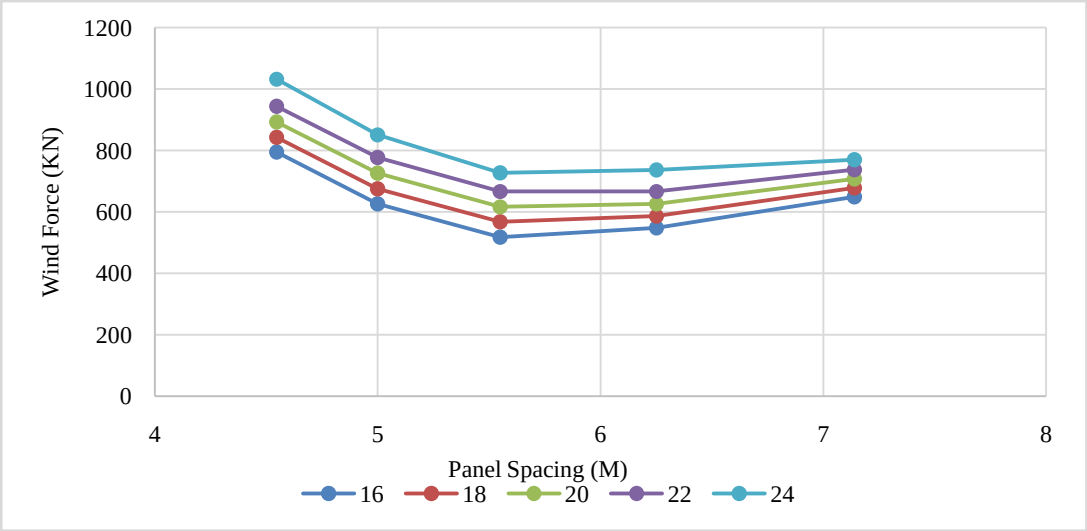

Figure 10: Windward Force vs. Panel spacing in Transverse direction

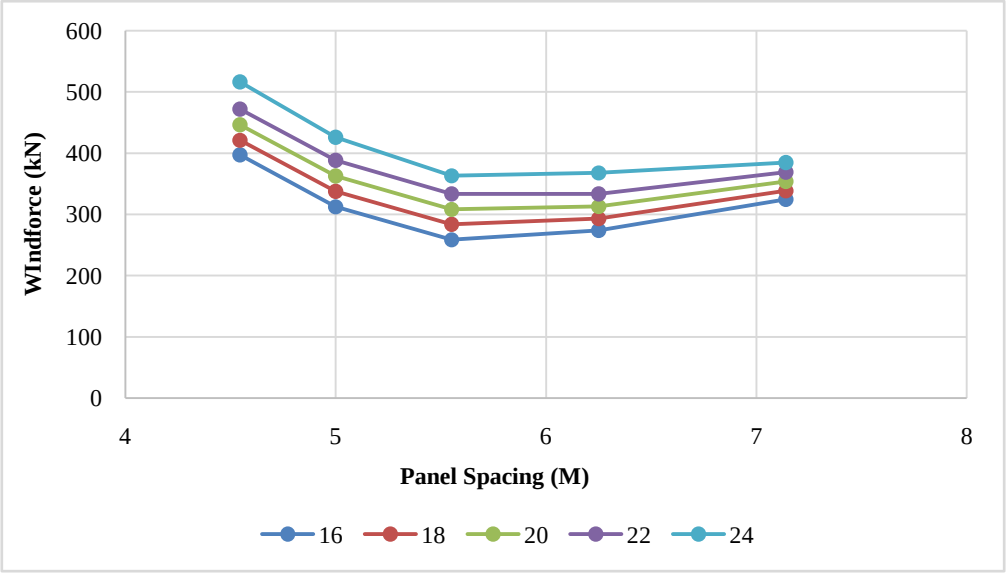

Figure 11: Windward Force vs. Panel spacing in longitudinal direction

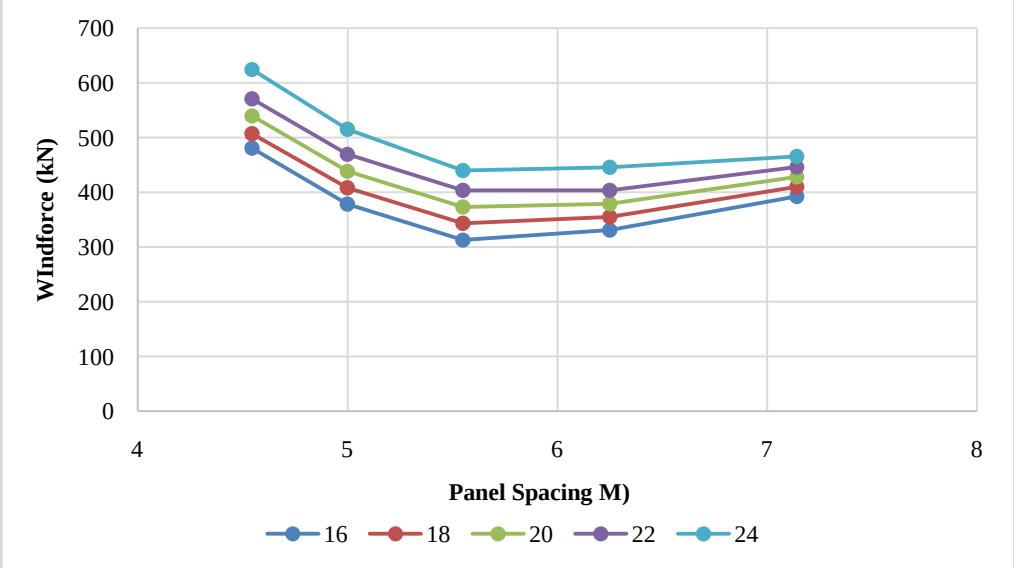

Figure 12: Leeward Force vs. Panel spacing in transverse direction

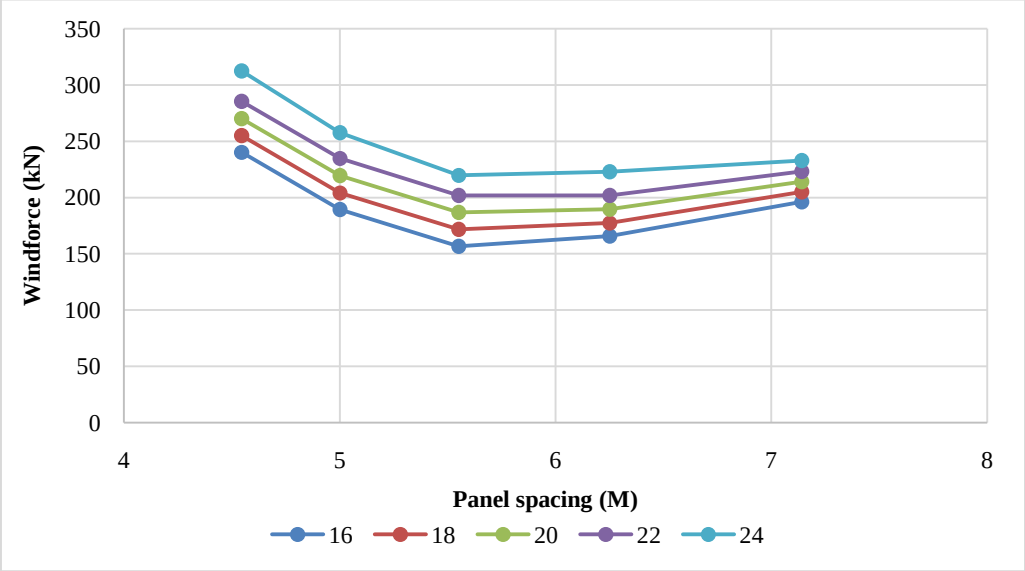

Figure 13: Leeward Force vs. Panel spacing in longitudinal direction

7.10 Variation in wind forces with truss height

Figure 14, 15, 16 and 17 shows that the variation of wind forces with height of truss girder. It shows that wind force increases with increases in height approximately linearly. It is because as height increases, the perimeter and the area of truss member increase in both transverse and longitudinal directions with respective panel spacing of truss girder.

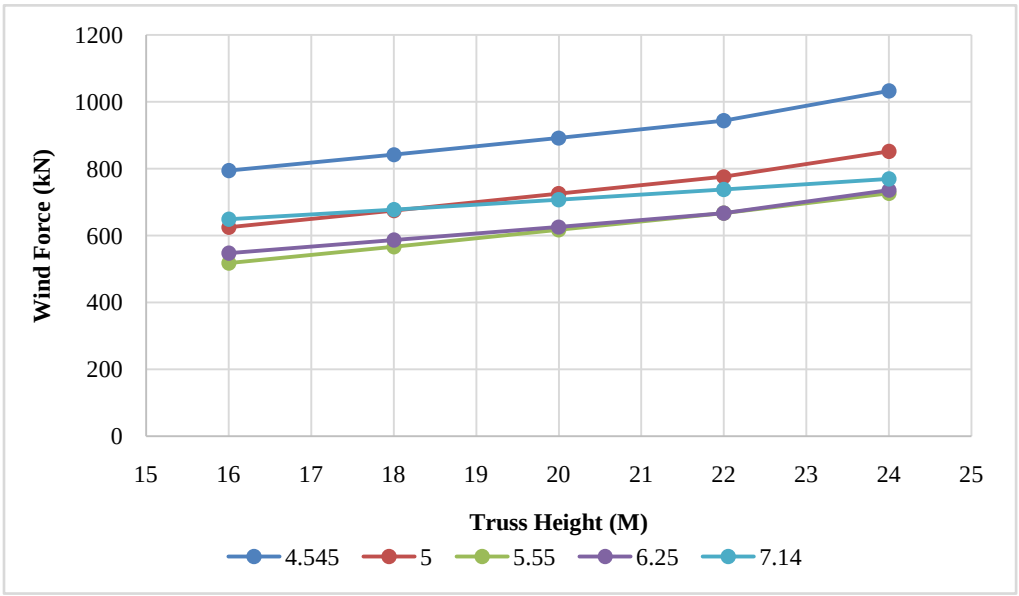

Figure 14: Windward Force vs. truss height in transverse direction

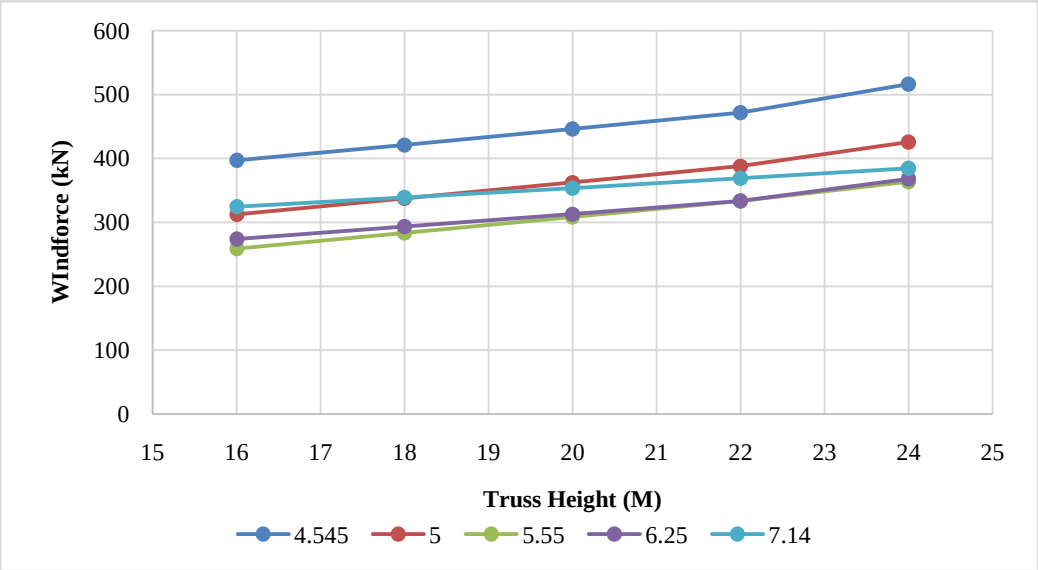

Figure 15: Windward Force vs. truss height in longitudinal direction

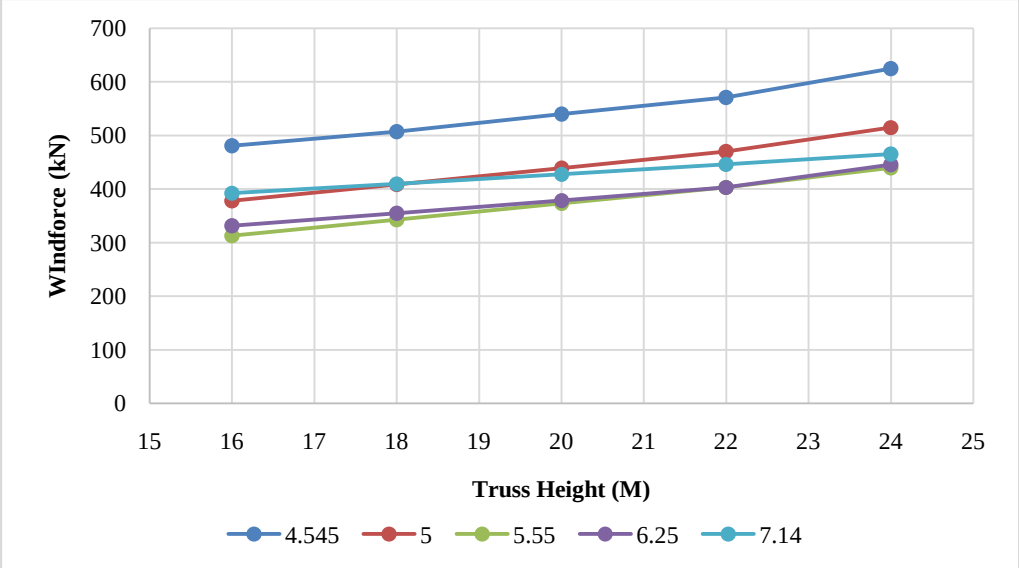

Figure 16: Leeward Force vs. truss height in transverse direction

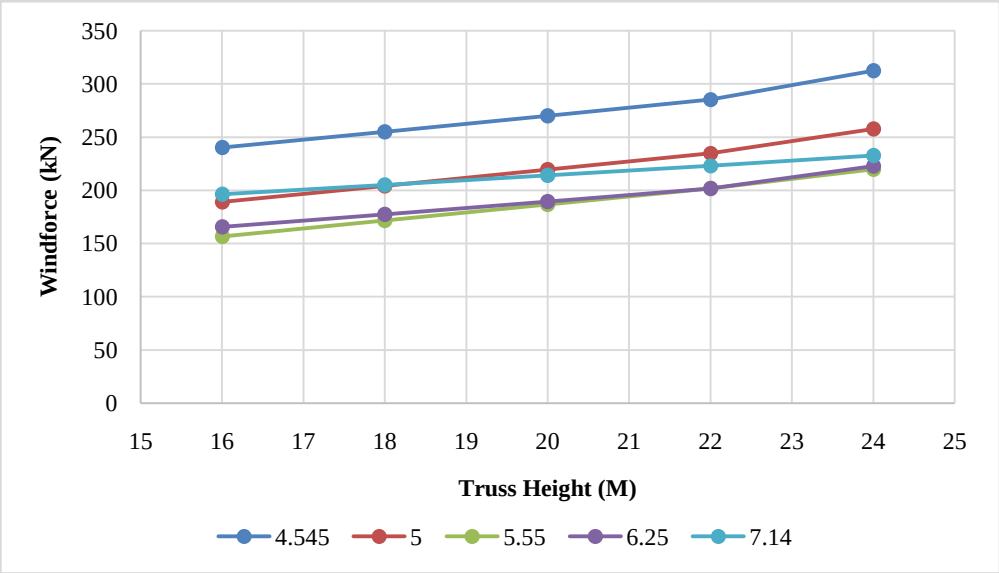

Figure 17: Leeward Force vs. truss height in longitudinal direction

8. CONCLUSIONS

In the present work, three dimensional model of common steel100m span steel K-truss Bridge have been analyzed for IRC loading using SAP2000 commercial software. The major conclusions that were drawn from this thesis work are;

- Total weight of stringer and cross girder minimum for maximum spacing of stringer possible for minimum thickness of deck i.e. 19 number of cross girder. The weight of truss and total weight of steel is found minimum at 6.25m panel spacing and 1/5.555 height to span ratio for k-truss steel bridge.
- The total wind force acting on the truss bridge girder is increases with increases in height of girder approximately linearly and it decreases with increases in panel spacing up to certain limit then increases with increases in panel spacing. The minimum wind force is found at panel spacing of 5.55m in both transverse and longitudinal directions with respective height of truss girder.

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"COMPARATIVE STUDY AND ANALYSIS OF BOX BRIDGE"

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ABSTRACT

This study deals with the computational analysis of Box Bridge. It introduces a conventional concept of multispan bridge where the multispan span deck is supported by Pier/shearwall and mat beaneath along the whole longitudinal section of span. It includes comparative studies among two types of box bridges. To observe structural response parameter at different location of bridge intersecting deck, slab, pier and optimum & more efficient type of bridge between two types of Box Bridge. The geometries bridges are same besides of some necessary structural components. For the comparison of analysis of these bridge models structural symmetries are considered. The structural elements are required to be designed to withstand maximum bending moment and shear force, static and vehicle loads as per IRC are taken into consideration for the analysis of these bridges. Analysis has been performed with the help of SAP2000v14 software. Deflection pattern of deck slab, pier and shearwall are taken as study parameter of this research.

KEYWORDS: *Pier, Shear Wall, Box Bridge, SAP2000v14.*

INTRODUCTION

This Study carried out at the analysis of Box Bridge with the objective of gaining knowledge about the technical practices in a structural analysis, design of the Bridge. A bridge is a structure that connects the stream, river, gorge, and valley. It is used for the Railroad track, roadway, waterway etc. as box culverts serves with multi span. The traffic that uses the bridge is Pedestrian or cycle traffic, Vehicle or rail traffic.RCC box minor bridge comprising of top slab, base slab and stem are cast monolithically to carry live load, embankment load, water pressure and lateral earth pressure in a better way. The top of the box may be at road level or it may at a depth below the road level if the road is in embankment. The required height and number of boxes depends on hydraulic and other requirements at the site such as road level, nalla bed level, scour depth etc. The barrel of the box culvert should be of sufficient length to accommodate the carriageway and the kerbs [1].Box bridge consisting of two horizontal and two or more vertical slabs built monolithically are economical due to their rigidity and monolithic action and separate foundations are not required since the bottom slab resting directly on the soil, serves as raft slab[2]. This types of bridge have non-linear structural behavior but they have their own structural limits, efficiencies, deficiencies and different ranges of limit of serviceability and

durability for a particular geometry, loading and natural conditions. Bridges are classified as Nepal Bridge Standard 2067 as per the criteria given below:

- Culvert – length upto 6m
- Minor Bridge– When length ≤ 50m (with span ≤ 25 m)
- Major Bridge– Major Bridge : When span >25 m or length >50 m(with smaller spans)
- Special Bridge– Bridges that require special design considerations, whose construction features (e.g. concrete girder bridges with >50m span, steel trusses > 100m span, arch bridges, suspension bridges, cable-stayed bridges and other nonstandard bridges).

RESEARCH METHODOLOGY

This would enable bridge engineers to better understand the behaviour of Box Bridge outlining a different approach towards analysis and design. The structural elements were designed to withstand maximum bending moment and shear force. The purpose of this study is to determine the most economical and preferable design among both frame bridges and Shear wall box bridges.Some detail of Box Bridge:

Framed Structure Box Bridge

It's a box bridge model where the analysis is performed using frame structure for individual pier. There after the beaneath piers is analysed manually and using software. The main criteria punching Shear on the both deck slab and mat are consider.

Framed Structure Box Bridge

It's a box bridge model where the analysis is performed using Shear wall structure for individual shearwall. There after the mat beaneath shearwall is analysed manually and using software. The main criteria punching Shear and bending moment are on the both deck slab and mat are consider.

The geomatric section of the box bridge for the study is taken as follow:

TABLE II DIMENSION OF BRIDGE

S.N.	***Description***	***Dimension***
1	Deck Slab thickness	500 mm
2	Bottom Slab thickness	500 mm
3	End wall thickness	500 mm
4	No. of end wall	2 nos
5	Side wall thickness	0.5 m
6	No. of side wall	3 nos
7	No. of boxes	4 nos
8	Size of box	
i	Clear length	6 m
ii	Clear height	5 m

9	Total length of bridge	26.5 m
10	Effective Span	6.5 m
11	Effective height	5.75 m
12	Carriageway	5 m
13	No. of footpath	0 nos
14	Width of bridge	5 m

The following procedure used to study of the Bridge:

i. Collect experience from inspection and literal review of box bridge.

ii. Selection type of box bridge and its span, selection of material, component of bridge and its cross section.

iii. Modeling of different box bridge is done in Finite element method software SAP2000v14.

iv. Computational analyze maximum deflection and stresses in deck slab, piers and maximum force in component of box bridge.

Finite Element Method (FEM)

It is necessary for the intermediate and final stages of the design to obtain a reasonably accurate estimate of the structure deflections and member forces. With the wide availability of structural analysis programs and powerful computers, it is now possible to solve very large and complex structural models. Computer software SAP2000 v14 was used for finite element modeling of those bridges. After a three-dimensional finite-element model is constructed, and modal analysis is performed.

i. The bridge co-ordinate data was defined to facilitate the geometry of the bridge and then the sectional and material properties are defined in SAP2000v14.

ii. All the structural components are placed in the grid data system.

iii. Various loads and load combinations are defined as per codal specifications.

ANALYSIS AND INTERPRETATION OF DATA

The overall goal in completing this study of bridge analysis is to come up with a framework or model of a bridge that is structured in order to meet the objective of the study and analysis of the bridge is done Member Force Comparison.

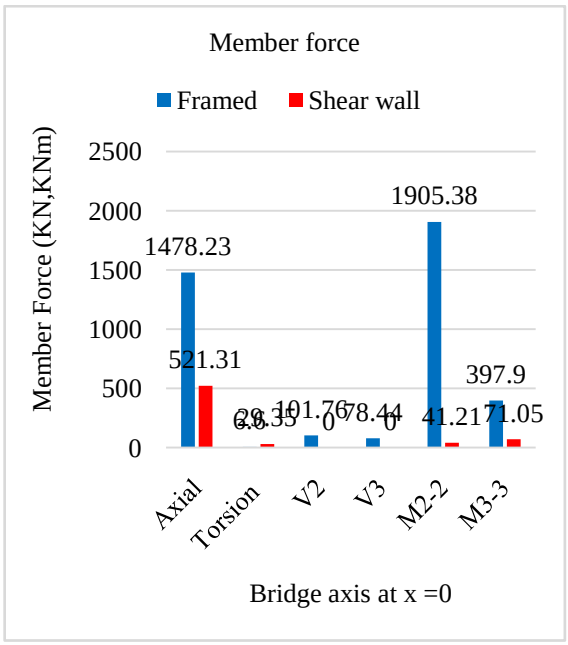

Fig 1. Member force of bridge at bridge axis x=0.

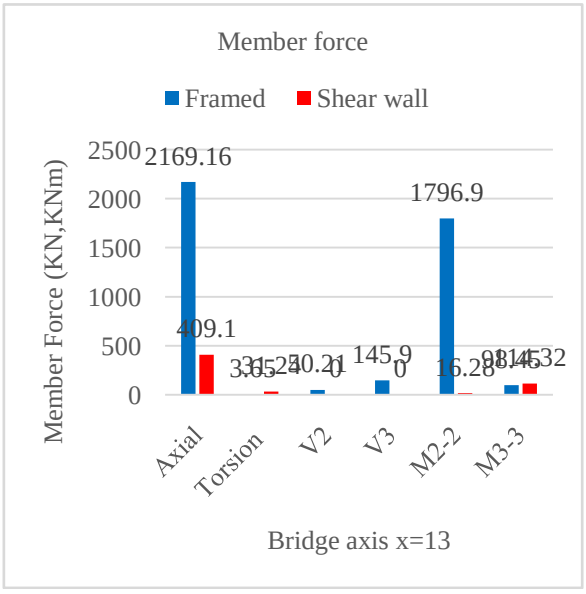

Fig 2. Member force of bridge at bridge axis x=13.

The value of all member force Axil, Shear and Moment force value is higher in case of frame structure then the shear wall structure bridge.

Pier Displacement Comparison

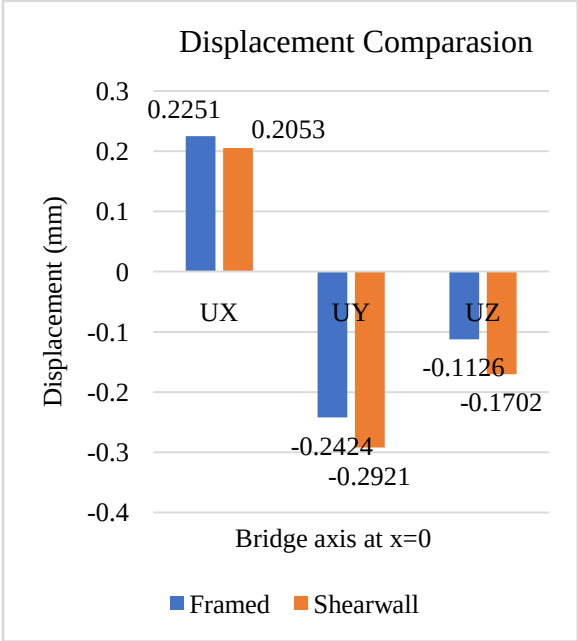

Fig 3. Pier displacement bridge at bridge axis x=0.

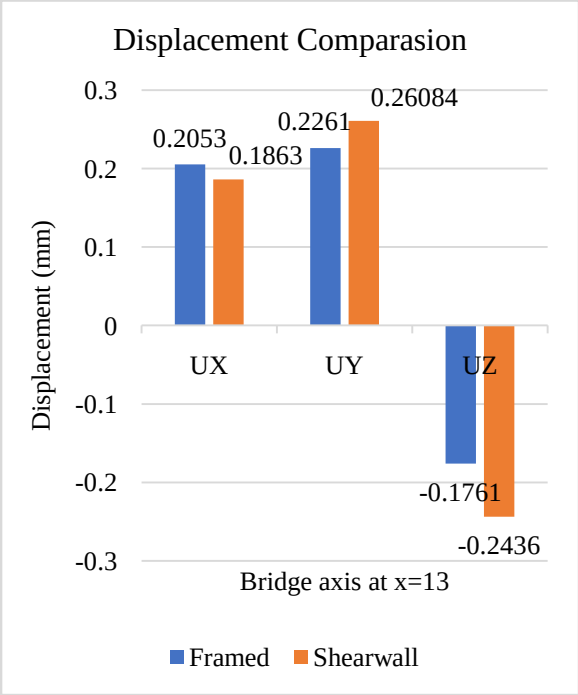

Fig 4. Pier displacement bridge at bridge axis x=13.

The observation that influence of structural displacement in x-axis or along the vehicle movement direction is more in frame Structure Bridge then Shearwall Bridge but in y-axis and z-axis are less displacement in the framed structure Box Bridge then shearwall Structure Bridge in all location of bridge axis.

CONCLUSION AND RECOMMNEDATION

After analysis and compare the result displacement in deck slab, pier, axial force, moment and shear force in different structural component, as well joint reaction and all influence of structural parameter of box bridge conclusion are summarized below.

i. From displacement analysis there is seen pier in frame structure have more displacement along vehicle movement axis ie x-axis while less deflection in other two direction then shear wall structure in all location of bridge.

ii. The maximum member forces axial, Shear and Moment are observed highly deflected using method of analysis so the analysis of monolithic shear wall structure should be implemented as the box bridge is seemed less acting then monolithic pier connecting top deck slab and bottom mat slab.

iii. From analysis of Moment, shear and axial force in deck slab all parameter have the higher value in frame structure then the monolithic shear wall structure in all supported location of bridge.

Different analysis result of conventional box bridge we should follow different ways of analysis to get optimum solution of structural parameters among this the shear wall structure bridge is preferable for box bridge design.

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EFFECT OF MINERAL ADMIXTURE (GGBS) AND POLYPROPYLENE FIBER ON SELF COMPACTING CONCRETE

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ABSTRACT

This paper focuses on effect of mineral admixture ground granulated blast furnace slag (GGBFS) and polypropylene fiber on self-compacting concrete. The properties of self-compacting concrete are filling ability, passing ability, viscosity etc, which is measured by slump flow test, L box test, and V funnel test. A by-product of iron industries is a hot molten iron slag which is obtained from rapid cooled from a blast furnace in water or steam, to produce a glassy, granular product that is then dried and ground into a fine powder which is later known as ground granulated blast furnace slag which have similar properties to cement and can be used to replace cement by some proportion in concrete. Use of GGBS reduces the industrial waste which is also important for environmental aspects. Also use of CGBS, reduction in the temperature rise and to help in avoiding early age thermal cracking, improved workability, as well as light weight replacement of cement in large structures as bridges and retaining walls, GGBS can be very perfect replacement to the cement.

This study focuses on the effect of GGBS and polypropylene fiber on the properties of self-compacting concrete. In this research work, a series of experiments have been done in a row to detect the optimum percentage of replacement of cement by GGBS. The grade of concrete taken was M40 and grade of cement was 43 OPC. The experimental works carried out to find the feasible percentage replacements of constituent materials by supplementary materials. Specially, the replacements percentage in the castings of samples was varied only for the GGBS and 1% of polypropylene fiber is constant, where the replacement percentages for the GGBS by 5%, 10% 15%, and 20% respectively. In conventional concrete there is some limitation like self-compaction, surface finishes, maintains strength at congested area. Due to these limitations here we are trying to make self-compacting concrete with the use of mineral admixture and fiber. This paper mainly focus on the mix proportions by replacement of cement by GGBS and fiber to critically check the fresh, mechanical and durability properties of self-compacting concrete.

KEYWORDS: *Scc Strength, Durability, Ggbs, Fiber.*

1. INTRODUCTION

In today's world, the increase of sustainability in construction practices has been given a significant emphasis. Because of Increasing in the uses of industrial materials as partial replacement for supplementary cementitious material (SCM) in cement, a primary material used in the construction industry is one way to achieve sustainability. In recent the partial substitute of binder with the SCMs like ground granulated blast furnace slag, silica fume etc. The positive aspects of self-compacting concrete are reduction in labour, safety due to decrease in human risk, less construction time, refined filling capacity, better interfacial transitional zone, decreased permeability, improved durability, more freedom in designing, superior quality production and good structural implementation etc. One of the major drawbacks of SCC was its cost due to the utilization of high amounts of cement, mineral admixtures and chemical admixtures. The uses of mineral admixture materials improve the rheological and durability property of concrete which in turn reduces the usage of cement. This will result into strong structures which requires fewer repair during its life span.As we compared the ordinary concrete with SCC has a lower viscosity therefore, a more significant flow rate when pumped. To achieve a high workability, there is limitation on the nominal maximum size, amount and grading of the aggregate. So to maintain consistency of fresh mixture of SCC, and to reduce settlement effects, the practice was to utilize high range water reducing admixture, to restrict the maximum size of coarse aggregate and fine content, and to utilize low water powder proportions or polycarboxylic ether to modify the flow properties and rheology of SCC. The properties of fresh SCC are influenced by water to content or some mineral admixtures, or by polycarboxylic ether.

There are various ways to making a self-compacting concrete by using different types of mineral and chemical admixture and using different types of fiber. Incorporating fibers into concrete mixes is recognized as an efficient way to resolve the brittle texture and dramatically improve the material properties of concrete.

The composition of self-compacting concrete is analogous to that of traditional concrete. The notable distinction between SCC and ancient concrete is that the SCC incorporates a heap of fineness content of water agent high range(super plasticizer) and viscosity modifying agent that is cement, fine mixture ,water mineral and chemical admixture. SSC mixture develop higher shrinkage deformation and gift larger cracking tendency significantly at early stage(called motor vehicle genius and plastics Ardra Mohan And K.M.Mini[2018] studied the effect of silica fume and ultrafine ground granulated blast furnace slag on self-compacting concrete. He performed the series of experiment by using 5%, 10%, 15% of silica fume and ultra-fine GGBFS as the replacement of cement and he concluded that 5% of silica fume and 10% of ultra-fine GGBFS gives the high workability.

Lhami et al.(2108)studied the effect of shrinkage reducing admixture on self-compacting concrete. The results showed that there is an improvement in a fresh properties of self-compacting concrete by using the different percentage of shrinkage reducing admixtures. The workability of fresh properties as compared to 0%, 0.8, 1% and 1.2% of admixtures, among these the best workability result is obtained by the 1% of shrinkage reducing admixture.

2. LITERATURE REVIEW

Xi Liu et al.(2019) studied the effect on self compacting lightweight concrete by incorporating steel and polypropylene fibers. They concluded that the workability properties is slightly influenced by using fiber. The result showed that by using 0.5% of steel fiber and 1% of polypropylene fiber slump values is decreased by 5% and also increases in flow time as compared to without fiber.

Mucteba et al.(2011)have studied the effect of different mineral admixture on self compacting concrete. Cement was replaced with different percentage of fly ash, granulated blast furnace slag, limestone powder, basalt powder (BP) and marble powder. They concluded that all these admixture showed the good workability(like slump flow in the range of 690-750mm) but among these admixture fly ash and GGBS shows the best performance as compared to other mineral admixture.

Dinakar et al.[2018] studied the design of self-compacting concrete with ground granulated blast furnace slag. The results show that from the proper experimental investigation and the self-compacting slag concretes were evaluated for their self-compact ability and strength characteristics. The results indicate that the using of GGBS as a partial replacement of cement can be capable of producing high quality self-compacting concrete.

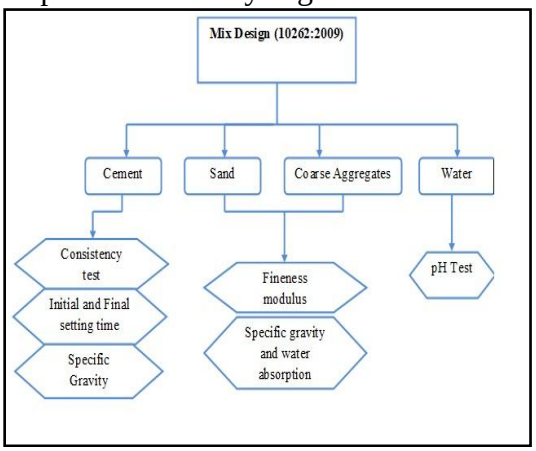
Syamak et al.(2018) studied the effect of GGBS on the frost resistance of self-compactingconcrete. The result showes that with increasing the percentage of replacement of cement with ggbs there is also increase in workability. The slump flow of 0%, 30%,50%,65%,80% of ggbs is 680, 720,810,690,760 respectively.

shrinkage) compared to plain concrete mixture.

Gidion et al.(2015)have studied the behavior of self compacting concrete under the different curing temperature. The results showed that the compressive strength of self-compacting concrete greatly affected by curing temperature as compared to conventional or normal concrete. They concluded that the strength development of concrete specimens cured at higher temperature is faster than the specimens cured at the lower temperature. In low temperature, the strength of concrete specimens have higher strength at later.

3. METHODOLOGY

The methodology which is adopted in this study is given the flow chart below.



- Mix proportion has been performed as per IS 10262:2019. The test performed on the fresh concrete are
- Slump Flow.
- V Funnel
- L box
- U box
- Stability
- Test on fresh properties
- The test performed on the hardened concrete are
- Compressive strength test
- Split strength test
- Flexural strength test

TESTING OF MATERIALS

Test on coarse aggregate

Sieve analysis of coarse aggregate is done to know the particle size distribution of the sample as per IS 2386(part 1)-1963.

The specific gravity test, water absorption test, impact value test, impact value test, crushing test, flakiness index, elongation index was conducted for the coarse aggregate and the test results obtained are given in table below:

S.N	Properties	Result
1	Types Of Aggregate	Crushed
2	Specific Gravity	2.76
3	Water Absorption	0.5%
4	Impact Value Test	29.5%
5	Crushing Test	21.28%
6	Flakiness Index	8.7%
7	Elongation Index	22.07%

Test on fine aggregates

The test result of the fine aggregates are listed on the table blow.

Test on cement

The fineness test, consistency test, initial setting time, final setting time, soundness test, and specific gravity test were conducted and the test values obtained are given below.

S.N	**Properties**	**Result**	**Standard Values**

1	Consistency	28%	-
2	Initial Setting Time	41 minutes	<30 minutes
3	Final Setting Time	484.6 minutes	> 600 minutes
4	Fineness	8%	>10%
5	Specific Gravity	3	2.9-3.15

Test on fresh concrete

Test on fresh concrete

15%, 20% and 1% of polypropylene fiber:3 samples for every 7 days were tested. All the required equipment for casting and testing were available in the lab.

- **Compressive strength**

The compressive strength test is results are listed in the table below.

Replacement of cement with GGBS	Polypropylene Fiber	7 days strength (N/mm2)	28 days strength (N/mm2)
5%	1%	30.1	46.3
10%	1%	28.8	46.5
15%	1%	26.4	46.7
20%	1%	23.33	47.01

- **Flexural Strength Test**

The flexural strength test results are listed on the table below

Replacement of cement with GGBS	Polypropylene Fiber	7 days strength (N/mm2)	28 days strength (N/mm2)
5%	1%	4.56	6.94
10%	1%	4.14	6.97
15%	1%	3.6	7.01

20%	1%	2.89	6.71

Filling ability (Flow ability)

The ability of freshly mixed concrete to flow and fill all the spaces within formwork under its own weight is called filling ability of SCC. This test is one of the important test of self-compacting concrete. This test is performed to know the flow ability of freshly mixed concrete. This test is also known as slump flow test. The obtained slump flow test describes the flow ability of a freshly mix concrete in unconfined condition. There are different classes of slump flow which are given below:

- Slump flow class 1 (SF1):In this class the slump flow range lies in between 500mm - 650mm.This class of SSC is appropriate for unreinforced or lightly reinforced.

Fiber Content (Constant)	**% of Replacement of cement**	**Slump (mm)**	**L- box**
1%	0%	580	0.72
1%	5%	635	0.8
1%	10%	675	0.85
1%	15%	720	0.88
1%	20%	765	0.93

- Concrete structures, for examples tunnel lining and the section that are small enough to prevent long horizontal flow like piles and deep foundation.

- Slump flow class 2 (SF2):In this class slump flow range lies between 660-750mm. This class of concrete is appropriate for normal application like walls, columns etc.

- Slump flow class 3(SF3):In this class slump flow rang lies between 760mm-850mm.This class of self-compacting concrete is appropriate for heavily reinforced structure in vertical application likes complex structure. This class concrete gives better surface finishes as compared to SF1 and SF2 for normal vertical applications but segregation resistance is more difficult to control in congested areas.

4. CASTING AND TESTING ON HARDENEND PRPOERTIES

After the fixing of proportion of replacement of cement by polypropylene fiber and GGBS, I prepared for the casting of all the samples required to check the hardend properties of concrete i.e compressive strength, flexural strength, split strength. Total of 84 samples comprising 36 cubes, 24 beams and 24 cylinder were casted. The size of cubes is l*b*h=150*150*150 mm, cylinder is d=150 mm and h=300 mm, beam is l*b*h=500*100*100 mm. These samples were tested on the basis of 7 days of curing. For the each replacement of GGBS i.e. 5%, 10%, 15%,

20% and 1% of polypropylene fiber:3 samples for every 7 days were tested. All the required equipment for casting and testing were available in the lab.

5. CONCLUSION

In conclusion, self-compacting concrete (SCC) is greatly influenced by using the different types of fiber, mineral and chemical admixture. The following observations have been made from the study by using GGBS and Polypropylene fiber:

- For 20% replacement of cement with GGBS and polypropylene fiber , the fresh properties observed were better as compared to 5%,10%, 15% replacement. Hence, the result shows that if we increase the GGBS replacement, we can have a better workable concrete.
- Increasing the GGBFS content in concrete mix leads to increase the flow characteristic of self compacting concrete.
- The hardened properties like compressive strength, flexural strength of SCC increases with increasing the GGBS upto 20%.

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AN ANALYTICAL ASSESSMENT OF THE ECONOMIC AND FINANCIAL INCLUSION STATUS OF UTTAR PRADESH.

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ABSTRACT

As per the census 2011, Uttar Pradesh accounts for 16.5 percent of the nation's population, equivalent to the seventh-largest country in the world. Geographically, Uttar Pradesh is the fourth largest state after Rajasthan, Madhya Pradesh, and Maharashtra and covers 7.4 percent of the country's total geographical area. Due to the highest population and large land area, the State's economics and development have an indispensable impact on the nation's overall development. It is the fastest developing State with a growth rate of 7.4 percent in 2017-2018 against the nation's growth rate of 8 percent. State provides various opportunities to investors to invest in the State, therefore, hold 17th place in the investment environment among the State of India. According to the Ph.D. Chamber report, Uttar Pradesh stands 9th in agriculture, 14th in infrastructure,16th in the consumer market, and 19th in primary education on macroeconomic parameters. Despite development in many areas, the State is suffering from the issue of chronic poverty. States 593.19 lakh population, including both rural and urban, are lives below the poverty line. They are suffering from various socio and economic problems, though state government carrying out numerous efforts to improve the situation of the poor but failed to attain desired results. In this background, present study will analyze the progress of the state's economy on various indicators with the progress of the banking sector in rural Uttar Pradesh.

KEYWORDS: *Economic Status, Financial Inclusion, Poverty, Rural India, Unemployment.*

INTRODUCTION

1. AN OVERVIEW OF UTTAR PRADESH

Uttar Pradesh is considered the most dominated State of India due to its large population and vast geographical area convergence. It is located centrally in the Indo-Gangetic Plain, It is the most critical area for the State's economy, and it furnishes with the commending condition for agricultural and industrial development. It stretches across the entire State from east to west and the southeast of New Delhi. The State comprises four economic regions, nine Agro-Climatic Zones, and 75 districts, 340 Tehsils, 821 development blocks, and 97,814 villages. (State Focus Paper 2018-19, NABARD). In 2011 Chief Minister of Uttar Pradesh has proposed the idea of dividing U.P into four economic regions from a development perspective. The assembly passed the resolution, and Uttar Pradesh was divided into four economic regions as Eastern U.P (Poorvanchal), WesternU.P (Paschim Pradesh), Bundelkhand, and Central U.P (Awadh

Pradesh). Moreover, in the same line of development and providing hassle-free services to their citizens, the Chief Minister has added three new districts besides 72 existing districts: Prabudh Nagar, Panchsheel Nagar, Bhim Nagar. Table 4.1 illustrates the distribution of the district in the economic region of Uttar Pradesh, and figure 1.1 depicts the State's geographical distribution.According to the census of India 2011, the total population of the State is 19,98,12,34, which incorporated 77.7 percent rural population and 22.3 percent urban population. It is also among India's most densely populated state, with 829 persons against 382 persons at all India levels inhabiting every square kilometer.

TABLE 1.1: DISTRIBUTION OF DISTRICT IN ECONOMIC REGIONS OF UTTAR PRADESH

Regions	Districts	Total Number of Districts
Western Region	Agra, Firozabad, Mainpuri, Mathura, Aligarh, Etah, Hathras, Kasganj, Badaun, Bareilly, Pilibhit, Shahjahanpur, Auraiya, Etawah, Farrukhabad, Kannauj, Baghpat, Bulandshahr, Gautam Buddha Nagar (GBN), Ghaziabad, Meerut, Hapur, Bijnor, Amroha, Muradabad, Rampur, Sambhal, Muzaffarnagar, Saharanpur, Shamli.	30
Central Region	Barabanki, Hardoi, Kanpur Nagar, Kanpur Dehat, Lakhimpur Khiri, Lucknow, Fatehpur, Raibareilly, Sitapur, Unnao,	10
Eastern Region	Allahabad, Bhadohi, Kaushambi, Pratapgarh, Azamgarh, Ballia, Mau, Basti, Sant Kabir Nagar, Siddharthnagar, Bahraich, Balrampur, Gonda, Shravasti, Deoria, Gorakhpur, Kushinagar, Maharajganj, Mirzapur, Sonbhadra, Chandauli, Ghazipur, Jaunpur, Varanasi, Sultanpur, Ambedkarnagar, Faizabad, Amethi	28
Bundelkhand Region	Jhansi, Jalaun, Hamirpur, Mahoba, Banda, Chitrakoot, Lalitpur.	7

The Eastern region of the State is the most populated region with 39.98 percent of the total population, followed by the western region 38.23 percent, and the least populated region is the Bundelkhand region with 5.24 percent of the total population. The most populated district of Uttar Pradesh in Allahabad, Moradabad, and Gazipur, while the least populated districts are Mohoba. The literacy rate of the State is 67.7 percent against the nation's literacy rate of 74.04 percent.

Uttar Pradesh is also known as a Hindu concentrated state with its 79.93percent of Hindu population. There is only 19.08 percent population belongs to the Muslim community and concentrated in Moradabad, Bijnor, and Mujjafarnagar district. Its 20.7 percent population belongs to scheduled caste from which 23.1 percent lives in a rural area, and 12 percent lives in an urban area.

The rural workforce of Uttar Pradesh is majorly engaged in agriculture activities, whereas the urban workforce is in industries. The total number of workers in Uttar Pradesh is 65,814,715 people, and they work as a main worker and marginal worker and engaged in cultivation and agriculture activities. Therefore, the work participation rate of U.P is 32.9 percent, including

both men and women, against India's work participation rate (WPR) of 39.79 percent. The WPR in rural Uttar Pradesh is 33.4 percent while 31.2 percent in urban.

TABLE 1.2: AN OVERVIEW ON UTTAR PRADESH

Population (2011)	19,98,12,34	
Density	829 person per sq/km	
Highly Populated Region	Eastern Region	
Least Populated Region	Bundelkhand Region	
Highly Populated District	Allahabaad, Moradabaad, Gazipur	
Least Populated District	Mahoba	
Hindu Population	79.9 percent	
SC Population	20.7 Percent	
	23.1 percent (Rural)	12 percent (Urban)
Work Participation Rate	32.9 percent	
	33.4 percent (Rural)	31.2 (Urban)
Literacy Rate	67.7	
	65.5 Percent (Rural)	75.1 (Urban)

Source: Census of India 2011

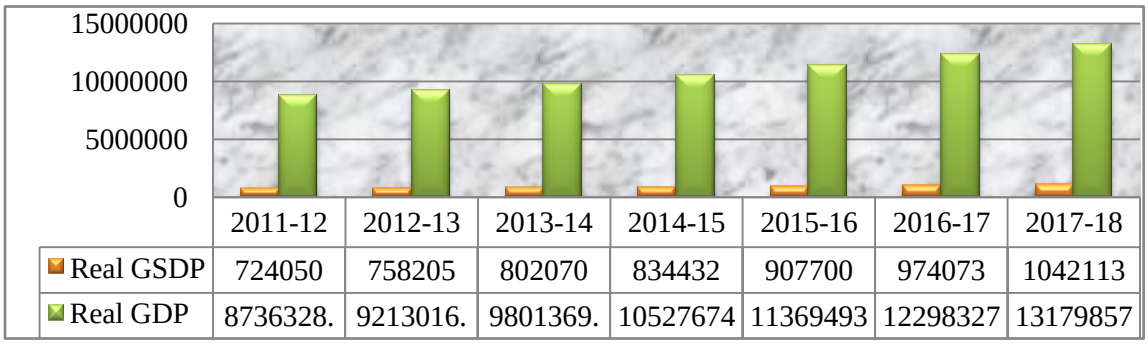
2. ECONOMIC STATUS OF UTTAR PRADESH

Uttar Pradesh has been rising as a speedily growing economy over recent years. Being geographically benefitted and overpopulated, most of the population depends on the agriculture sector for their livelihood. The State has adopted various development strategies to advance its industrial sector and provide new empowerment opportunities to their citizen. With these strategies, the State is also trying to reduce poverty and pace up the progress of the banking industry, information technology, agro-based, and food processes industry, etc. Despite this, the State has been achieving a sluggish but steady growth rate against the nation's growth rate.

2.1 Growth Experience

The State's real Gross State Domestic Product is continuously increasing from 724050 crores in 2011-2012 to 1042113 crores in 2017-2018 with the compound annual growth rate of 6 percent; however, this rate is meagre than the Nation's CAGR of 27%. The State's western region contributes a higher proportion in GSDP due to its strong agricultural and industrial base. Noida and Ghaziabad districts located in this region are evolving as the industrial hub of the State. In 2016-17 western regions contributed 55 percent in total GSDP, and a minuscule contribution by the Bundelkhand region that is 5.9 percent, has been reported.

Graph1.1 Real Gross Domestic Product of U.P and Gross Domestic Product of India (Amt. in Crore)



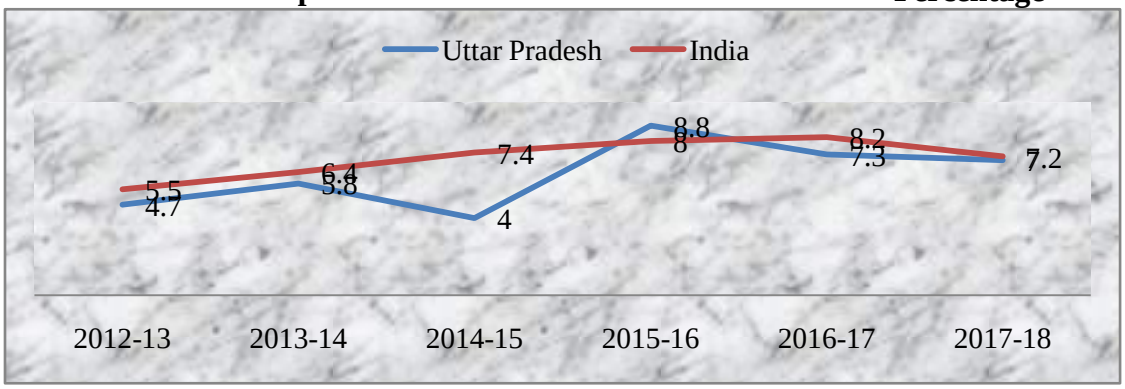
	2011-12	2012-13	2013-14	2014-15	2015-16	2016-17	2017-18
Real GSDP	724050	758205	802070	834432	907700	974073	1042113
Real GDP	8736328.	9213016.	9801369.	10527674	11369493	12298327	13179857

Source: Ministry of Statistics and Programme Implementation (GoI)

Graph 1.2 illustrates the growth rate of real GSDP compared to the nation's real GDP growth rate. It shows that due to lack of public investment and the inefficiency to stimulate investment from outside, the growth rate of U.P was at its lowest as 4 percent in 2014-2015; however, after 2015, the growth rate increased to 8 percent due to the adoption of various initiatives taken by the state government to strengthen its industrial base and to attract investor. Implementing a public-private partnership policy and one district one product policy has a substantial impact on the State.

The share of the primary, secondary and tertiary sectors in real GSDP is illustrated in Graph 1.3. The tertiary sector contributes more than other sectors in the gross state domestic product. The Share of this sector has increased from 42.8 percent in 2011-12 to 46.4 percent in 2014-15 and then started to decrease till 2017-18.

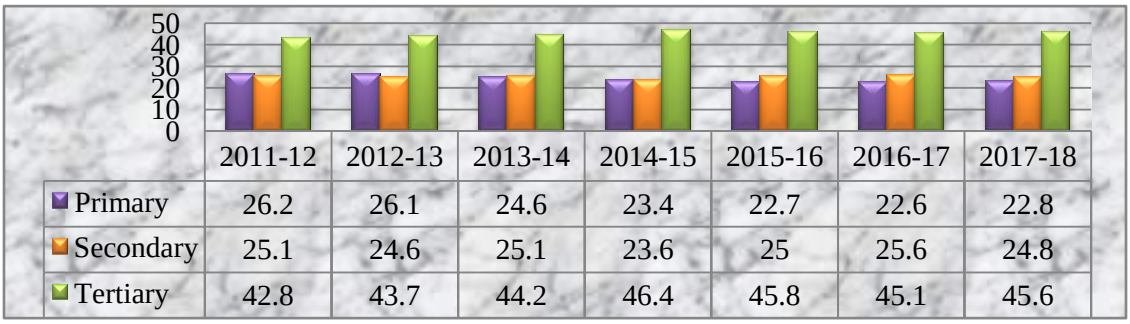
Graph1.2 Real GSDP and GDP Growth Rate inPercentage



Source: Ministry of Statistics and Programme Implementation (GoI)

Despite an agriculture-based economy, the contribution of the primary sector is meager in total GSDP of the State due to the dependence on monsoon for agriculture productivity, fragmented and small size of landholdings, debility in public investment in agriculture, lack of commercialization of the agricultural sector. The share of the primary sector interruptedly declined from 26.2 percent in 2011-12 to 22.8 percent in 2017-18.with the up and down vicissitude the secondary sector contributes lower than other sectors during 2011-2013 than it geared up its contribution in total GSDP.

Graph1.3 Economic Activity vise Percentage Share in GSDP (at constant price 2011-2021)



	2011-12	2012-13	2013-14	2014-15	2015-16	2016-17	2017-18
Primary	26.2	26.1	24.6	23.4	22.7	22.6	22.8
Secondary	25.1	24.6	25.1	23.6	25	25.6	24.8
Tertiary	42.8	43.7	44.2	46.4	45.8	45.1	45.6

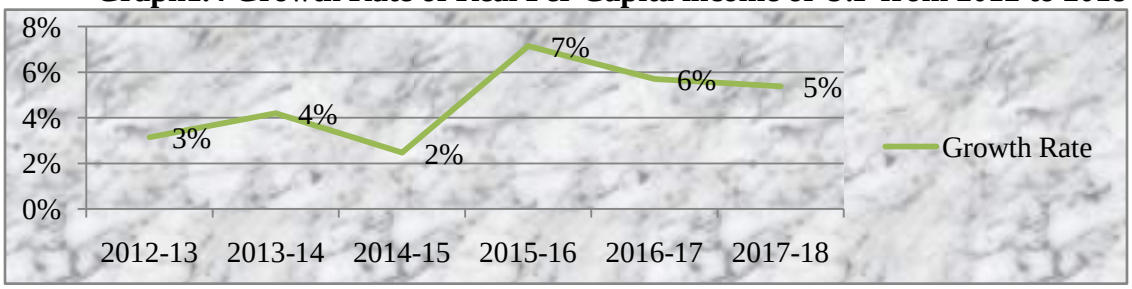
Source: Ministry of Statistics and Programme Implementation (GoI)

2.2 Per Capita Income

Per capita income is the crucial determinant of the nation's inhabitants' economic well-being and social development. The per capita income of Uttar Pradesh is the lowest among the State of India, along with Bihar, Orissa, and Madhya Pradesh. The high population pressure in the State and the low growth rate of State Domestic products may affect the per capita income growth rate. Graph 1.4 shows the growth rate of the real PCI of Uttar Pradesh and shows the same behavior as the GSDP of the State (Graph 4.2). It is highest in 2015-2016, with a 7 percent growth rate.

However, Graph 1.5 shows that the State's real per capita income continuously increases from 2011 -12 to 2017-2018. It was 35916.83rs. in 2011-2012 which increased to 47189.5 rs in 2017-2018 against the nation's real PCI of 87623 rs.

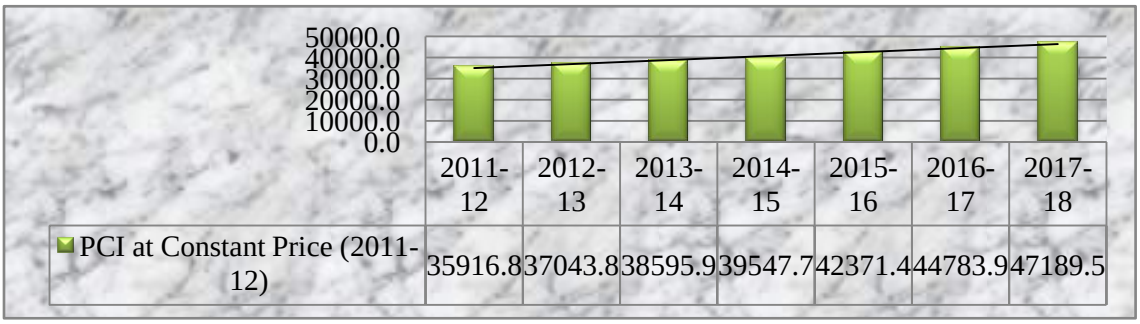
Graph1.4 Growth Rate of Real Per Capita income of U.P from 2012 to 2018



Source:

Ministry of Statistics and Programme Implementation (GoI)

Graph1.5 Real Per Capita Income of Uttar Pradesh at Constant Price (2011-2018) (Amt. in Rs)



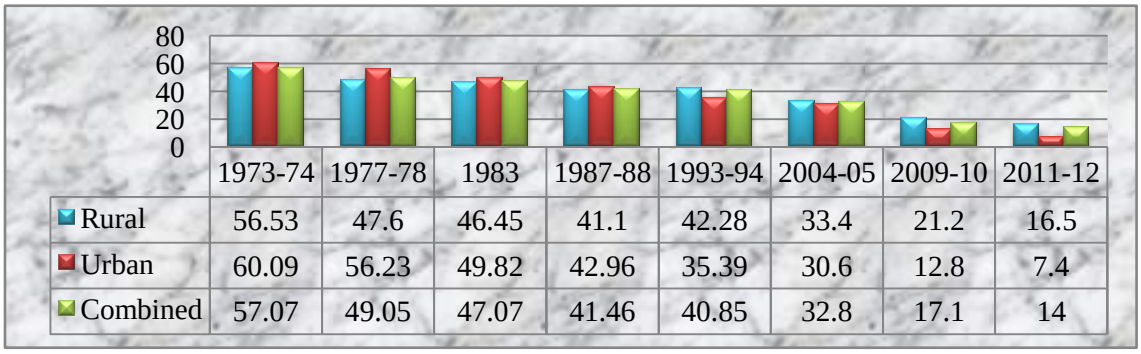
	2011-12	2012-13	2013-14	2014-15	2015-16	2016-17	2017-18
PCI at Constant Price (2011-12)	35916.8	37043.8	38595.9	39547.7	42371.4	44783.9	47189.5

Source: Ministry of Statistics and Programme Implementation (GoI)

2.3 Poverty

A large number of poor live in Uttar Pradesh than in the other states of the Nation. Total 29.9 percent of the State's population lives below the poverty line against India's average of 21.92 percent. However, the poverty level is dropped over time. It fell from 57.7 percent in 1973-74 to 17 percent in 2011-12. It is also evident from Graph 4.6 that poverty incidence is higher in the Urban

Graph1.6 Percentage of Population Below Poverty Line in Uttar Pradesh



	1973-74	1977-78	1983	1987-88	1993-94	2004-05	2009-10	2011-12
Rural	56.53	47.6	46.45	41.1	42.28	33.4	21.2	16.5
Urban	60.09	56.23	49.82	42.96	35.39	30.6	12.8	7.4
Combined	57.07	49.05	47.07	41.46	40.85	32.8	17.1	14

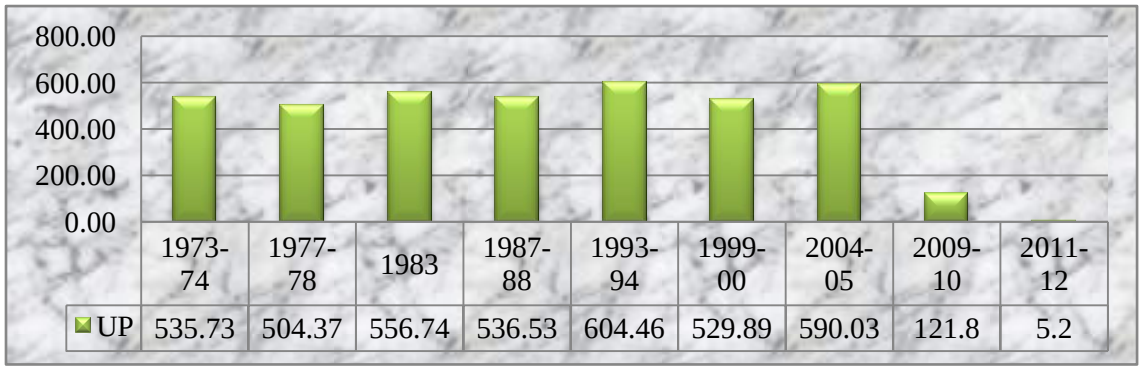
Source: NITI Ayog (GOI), 2011

Note: Poverty estimates for the year 1973-74 to 2004-05 are as per the calculation of Lakdawala Committee and Estimates for the Year 2009-2010 to 2011-2012 as per the Tendulkar Committee area than in rural areas from 1973-74 to 1987-88. After 1988, urban poverty eventually declined than rural poverty and reached 7.4 percent in 2011-12 than poverty in rural areas of 16.5 percent.

Even with a significant fall in poverty ratio, the absolute number of poor has remained high till 2004-05. Due to the effective implementation of poverty alleviation schemes in the states, number declined from 590.03 lakh to 5.2 lakh in 2011-2012. (Graph 1.7)

Due to the State's high regional disparities, the bundelkhand region is the home of the highest number of poor, followed by the eastern region. Kaushambi, Hardoi, and Bahraich having the highest number of poor in the states. In contrast, Bhagpat, Gaziabaad, and Meerut have the lowest poor (BPL Survey,2002).

Graph1.7 Number of Poor in Uttar Pradesh (In Lakh.)



	1973-74	1977-78	1983	1987-88	1993-94	1999-00	2004-05	2009-10	2011-12
UP	535.73	504.37	556.74	536.53	604.46	529.89	590.03	121.8	5.2

Source: NITI Ayog (GOI), 2011

Note: Poverty estimates for the year 1973-74 to 2004-05 are as per the calculation of Lakdawala Committee and Estimates for the Year 2009-2010 to 2011-2012 as per the Tendulkar Committee

The major reason for high poverty incidence in Uttar Pradesh is the slow economic growth rate, the excessive burden on the agriculture sector, high-income inequality, asset, extensive landlessness, low level of investment, social deprivation, etc. and illiteracy. According to NAFIS Report 2016-17, 63% of the total households in the State are agriculture households. There are 2.33 crore farmers, of which 2.16 crore farmers are Small & Marginal Farmers (SF/MF), accounting for about 92% of the total farmers. 65% of the farmland is held by the SF/MF, whereas other farmers hold 35% farmland. The average size of the land is 0.80 hectares compared to all India's average size of 1.15 hectares. Correspondingly, the average monthly income of agriculture households is Rs.6668, about 34% lower than the national average monthly income of Rs.8931. Of this, the average monthly income for agriculture households having SF/MF is Rs.6769. As per the Socio-Economic and Caste Census 2011, 55.22% of the rural households are landholders, whereas only 40.24% of the total rural households are cultivators. About 72% of the total rural households had income less than Rs.5000.

3. PROGRESS AND STATUS OF FINANCIAL INCLUSION IN UTTAR PRADESH

According to the Census of India 2011, 72 percent of households avail themselves with banking facilities, including 73.5 and 66.1 percent in the rural and urban area of Uttar Pradesh as against the 58.6 percent of India. According to the Reserve Bank of India, 17,068 branches of scheduled commercial banks, including regional rural banks, are functioning in Uttar Pradesh as of March 2018, which is 11.4 percent of total bank branches in India. Out of which 7,66,4 branches are situated in 106,774 villages of the State and serve 155,317,278 rural populations. Therefore the population per branch in a rural area is 20,656 as against India's average of 16,371.population per branch (Table 1.3)

TABLE 1.3: NUMBER OF VILLAGES AND AVERAGE RURAL POPULATION PER BANK BRANCH IN UTTAR PRADESH (BY MARCH 2018).

Number of Villages as per Census of Uttar Pradesh 2011	106,774
Total Rural Population as Per Census of Uttar Pradesh 2011	155,317,278
Total Number of Bank Branches in Rural Area by March 2018	7,66,4
**Number of Population Per Branch	20,656

Source: Census of India, 2011, Office of the Registrar General & Census Commissioner, India Bank Branch Statistics, Database on Indian Economy Reserve Bank of India

** Calculated by Researcher

As of March 2018, the bank network in Uttar Pradesh includes 31 Commercial Banks (21 Public Sector Commercial Banks and 10 Private Sector Commercial Banks), 7 Regional Rural Banks, Uttar Pradesh Cooperative Bank (U.PCB) with 50 affiliated District Cooperative Banks (DCBs) having 1340 branches (7251 PACS) and Uttar Pradesh Sahakari Gram Vikas Bank Ltd (U.PSGVB) with 323 branches in Uttar Pradesh. To supervise and investigate the working of all banks, the Bank of Baroda was appointed as a convener bank of the State Level Bankers' Committee of Uttar Pradesh. Altogether 9 PSB act as a role of the lead bank in the group of districts of the State. Etah district Bank of Aryvrat and Prathama Bank in Jyotiba Phule Nagar plays a significant role in availing of banking services.

3.1 Branch Expansion of Scheduled Commercial Banks in Uttar Pradesh

A network delivers banking services in the State of 17,068 branches, of which 11,422 branches (about 70%) are rural/semi-urban. Table 1.4 indicates the population group-wise bank branch expansion in Uttar Pradesh with yearly percentage change and compound annual growth rate. It reveals that the rural branches have increased from 4,929 in 2010 to 7,664 in 2018, with a compound annual growth rate of 5 percent. At the same time, semi-urban branches have increased from 1,926 in 2010 to 3,752 in 2018, with a compound annual growth rate of 7 percent. On the other side, urban and metropolitan bank branches have jointly increased from 3,617 in 2010 to 5,652 in 2018, with a compound annual growth rate of 4 percent in urban and 5 percent in metropolitan areas. Altogether the total branch expansion in Uttar Pradesh is increased from 10,472 in 2010 to 17068 in 2018 with a CAGR of 5 percent over the nation's CAGR of 2.95 percent. The fluctuation in percentage change in all population groups is due to the applicability of new banking policies.

TABLE 1.4: BRANCH EXPANSION OF SCHEDULED COMMERCIAL BANKS IN UTTAR PRADESH (MARCH 2010- MARCH 2018)

Year	Rural	% Change	Semi Urban	% Change	Urban	% Change	Metro-politan	% Change	Total
2010	4,929		1,926		1,936		1,681		10,472
2011	5,083	3%	2,143	11%	2,057	6%	1,757	5%	11,040
2012	5,783	14%	2,459	15%	2,259	10%	1,895	8%	12,396
2013	5,973	3%	2,696	10%	2,410	7%	2,011	6%	13,090
2014	6,993	17%	2,964	10%	2,594	8%	2,143	7%	14,694
2015	7,511	7%	3,186	7%	2,764	7%	2,312	8%	15,773
2016	7,742	3%	3,357	5%	2,829	2%	2,336	1%	16,264
2017	7,526	-3%	3,686	10%	3,252	15%	2,408	3%	16,872
2018	7,664	2%	3,752	2%	2,874	-12%	2,778	15%	17,068
CAGR**	**5%**		**7%**		**4%**		**5%**		5%

Source: Basic Statistical Returns of Scheduled Commercial Banks, RBI
*CAGR stands for Compound Annual Growth Rate. Calculated by researcher
% Change calculated by researcher

3.2 Growth of Scheduled Commercial Banks in Rural Uttar Pradesh

Financial inclusion is specially meant for financial deepening in remote areas so all segments of the nation can enjoy the benefit of Banking policies; therefore, Table 1.5 indicates the growth of SCBs in rural Uttar Pradesh concerning the number of offices deposits, credit outstanding, and CD ratio. It is clear from table 4.5 that the number of offices is hiked from 4,929 in 2010 to 7,664 in 2018. However, percent of the Bank branches declined from 47 in 2010 to 44.9 in 2018, and percent of deposits in rural bank branches also declined from 20.3 in 2010 to 19.5 in 2018. In addition, the percent of the credit to lend hiked up from 22.1 in 2010 to 22.9 in 2018. Henceforth, the CD ratio of the rural branches also improved from 46.9 percent in 2010 to 48.1 percent in 2018. The CD ratio is high in rural branches from 2010 to 2018 than the CD ratio of overall Bank branches in a state.

TABLE 1.5: GROWTH OF SCHEDULED COMMERCIAL BANKS IN RURAL UTTAR PRADESH (MARCH 2010-MARCH 2018)

Year	Number Of Bank Offices		Deposit (In Lakh)		Credit Outstanding (In Lakh)		Credit Deposit Ratio	
	Rural	**POT	Rural	**POT	Rural	**POT	Rural	U.P
2010	4,929	47.1	63623,11	20.3	29864,22	22.1	46.9	43.3
2011	5,083	46.0	7,49,919.22	20.1	3,48,184.93	21.3	46.4	43.9
2012	5,783	46.7	8,73,744.10	20.2	4,30,567.70	22.6	49.5	44
2013	5,973	45.6	10,04,691.23	19.6	4,97,297.34	22.1	49.5	44
2014	6,993	47.6	11,79,113.69	19.7	5,95,623.96	22.3	50.5	44.6
2015	7,511	47.6	13,40,586.76	19.9	7,05,894.71	23.4	52.6	45.4
2016	7,742	47.6	14,92,308.87	20.9	8,18,350.44	24.1	54.8	44.5
2017	7,526	44.6	16,95,395.05	19.5	8,39,045.51	23.7	49.8	39.9
2018	7,664	44.9	18,67,406.64	19.5	8,99,222.71	22.9	48.1	41.2

Source: Basic Statistical Returns of Scheduled Commercial Banks, RBI
** Percentage of Total calculated by researcher

3.3 Status of Small Borrower Accounts in Rural Uttar Pradesh

Uttar Pradesh is one of the poorest states of India. With this perspective, it is essential to look towards the contribution of any policy on the part of small borrowers. Table 1.6 illustrates the status of small borrower account in Uttar Pradesh and reveals that the number of the account in rural areas has been increased by 18.9 percent from March 2010 to March 2018 as against the states increment in these accounts 32.3 percent. It can also be noticed from the table that a total number of small borrows account in the rural area accounts for 54.2 percent of the total small borrower account in Uttar Pradesh in 2018. Moreover, the amount outstanding of these accounts has increased by 90 percent from 2010 to 2018 in a rural area over the 84 percent increment in the State. Amount outstanding in the rural area accounts for 56.9 percent of the total amount outstanding in Uttar Pradesh.

TABLE 1.6 STATUS OF SMALL BORROWERS ACCOUNT IN UTTAR PRADESH

	No. of A/C			Amt. Outstanding		
Year	**2010**	**2018**	**% Increase***	**2010**	**2018**	**% Increase***
Rural	5,267.00	6,220.18	18.09	19,91,991	37,95,680	90
U.P	8,706.00	11518.67	32.3	36,23,577	66,65,470.33	84

Source: Basic Statistical Returns of Scheduled Commercial Banks, RBI

*Calculated by researcher

3.4 Regional Disparities in Rural Uttar Pradesh in Respect to Usage and Availability of Banking Services

Due to the high concentration of population and large geographical area, the consistent execution of any policy is problematic in Uttar Pradesh. This generates regional disparities among the region/district of Uttar Pradesh. Therefore, regional disparities affect the development of financial institutions' expansion and the State's developmental scenario. Table 1.7 illustrates the discrepancies in the availability and usage of banking services among the region and the states' district as of March 2018. The table indicates the number of bank branches, Deposit amount, amount outstanding, Credit Deposit Ratio, and Banking facility among the four regions of the

State. Data reveals that the eastern region has the highest bank branches, 3372, followed by 2227 in the western region, 1370 in the central region, and 390 in the Bundelkhand region. The district having the highest bank branches are Jaunpur (230), Allahabad (216), And Azamgamgarh (216) in Eastern Region, whereas Raibareily (189), Sitapur (170), and barabanki (153) are in the central region. The district having the highest bank branches in Western Region are Moradabad (139), Bareily (135), and Shahjahanpur (121), followed by Banda (70), Jalaun(59), and Hamirpur (45) in Bundelkhand Region. The table also discloses that the State's western region contributes 58 percent deposit in total deposits of rural bank branches followed by eastern region 23 percent, central region 16 percent, and Bundelkhand region 3 percent. In addition, 42 percent of total credit is allocated through rural branches of the western region, followed by 34 percent of the eastern region, 17 percent of the central region, and 8 percent of the Bundelkhand region of the State. This deposit and credit amount indicate the credit deposit ratio of the State, and the Table shows that the western region has a good CD ratio of 89 percent, but still, some districts indicate that rural branches are highly dependent on their deposit to fulfill the requirement of credit. These districts are Kashganj, Rampur, Sharanpur, Badaun, Etah, Hathras, Jyotiba Phule Nagar, Mathura, Pilibhit, Shahjahanpur, Aligarh, Agra, Firozabaad, Farrukhabaad, Bulandsehar. These all-districts possess a CD ratio above 90 percent. At the same time, districts with a low CD ratio are Ghaziabad, Gautam Budha Nagar, Etawa, Auraiya. These all districts have a CD ratio of less than or near to 40 percent. In the same way, the eastern region has a 45 percent CD ratio. Except for Bahraichand Sravasti districts, the rest have less than a 45 percent CD ratio. The central region has a 51 percent CD ratio, and the Bundelkhand region has a 101.1 percent. Overall, Twenty-seven districts of the states have a CD ratio lower than 40 percent. Table 1.7 also shows the statistics regarding the household using banking facilities in a rural area. 45 percent of the rural household out of the total households using banking facilities are in the eastern region, followed by 30.75 percent in the western region, 19 percent in the central region, and 5 percent in the Bundelkhand region. Though the share of Central and Bundelkhand regions is lower than the eastern and western regions, districts of these regions significantly use banking facilities with low discrepancies.

3.5 Status of Financial Inclusion Initiatives in the Uttar Pradesh

1. The number of households per branch has improved from 1799 as of 31 March 2017 to 1700 as of 31 March 2018.
2. Lead Banks have set U.P FLCCs and R-SETI in all 75 districts. In addition, 224
3. Financial Literacy Centres (FLCs), viz. Sixty-four by RRB at the district level and 160 by District Central Cooperative Banks (DCCBs) at the block level have been established with NABARD assistance.
4. Under the 'Going Digital' initiative, 6328 Financial Literacy camps have been sanctioned to 6 RRBs and 14 DCCBs in 2018-19. Financial support has been sanctioned for capital expenditure to 69 RSETIs.

Table No 4.7 Regional Disparities in Rural Uttar Pradesh in Respect to Usage and Availability of Banking Services

Western	No.of Bank Branches	Deposit Amount(In Lakh.)	Amount Oustanding(in Lakh.)	CD ratio	Banking Facility	Eastern	No.of Bank Branches	Deposit Amount(In Lakh.)	Amount Oustanding(in Lakh.)	CD ratio	Banking Facility	Central Region	No.of Bank Branches	Deposit Amount(In Lakh.)	Amount Oustanding(in Lakh.)	CD ratio	Banking Facility
Agra	514	338364.775	212252.17	63%	65%	**Allahabad**	543	397541.3	94511.56	24%	73%	**Barabanki**	281	88281.569	39095.129	44%	76%
Aligarh	295	170962.269	84600.409	49%	64%	**Ambedkar Nagar**	168	57492.4	17188.58	30%	76%	**Fatehpur**	189	67182.611	24095.807	36%	68%
Auraiya	51	22728.437	5746.618	25%	65%	**Azamgarh**	311	162109.5	28054.1	17%	81%	**Hardoi**	240	76187.916	35370.145	46%	68%
Badaun	164	48512.255	32402.191	67%	47%	**Bahraich**	195	57077.6	29397.77	52%	65%	**Kanpur Dehat**	161	44146.687	16126.233	37%	67%
Bareily	562	176563.138	78190.258	44%	66%	**Ballia**	213	100275.9	18093.74	18%	77%	**Kanpur Nagar**	86	25123.973	15121.666	60%	57%
Bhagpat	129	42819.989	19754.945	46%	71%	**Balrampur**	143	40224.57	15102.95	38%	82%	**Lakhimpur Khiri**	254	70559.098	49538.54	70%	80%
Bijnor	278	107035.807	67389.621	63%	74%	**Basti**	161	66347.81	18146.6	27%	88%	**Lucknow**	976	1373462.606	402925.208	29%	75%
Bulandsehar	235	111766.876	59952.462	54%	63%	**Chandauli**	159	55132.03	16945.29	31%	77%	**Raibareili**	296	87253.298	37106.655	43%	78%
Etah	121	40447.246	24864.04	61%	63%	**Deorio**	211	97065.47	21505.69	22%	82%	**Sitapur**	284	78269.463	33703.859	43%	79%
Etawa	117	62538.372	17336.161	28%	62%	**Faizabad**	185	93307.66	25437.04	27%	82%	**Unnao**	207	88948.681	24077.702	27%	68%
Farrukhabaad	129	50249.474	21483.419	43%	63%	**Ghazipur**	267	133601.8	27005.13	20%	77%	**Total**	2974	1999415.902	677160.944	34%	
Firozabaad	152	67842.492	36913.702	54%	51%	**Gonda**	224	77301.4	31596.25	41%	80%	**Bundelkhand Region**	**No.of Bank Branches**	**Deposit Amount(In Lakh.)**	**Amount Oustanding(in Lakh.)**	**CD ratio**	**Banking Facility**
Gautam Budha Nagar	479	770948.51	390515.25	51%	75%	**Gorakhpur**	403	259491.4	82129.19	32%	79%	Banda	138	48056.998	23992.175	50%	64%
Ghaziabaad	459	481847.45	213109.4	44%	69%	**Jaunpur**	329	144515.4	32221.38	22%	82%	Chitrkoot	78	21575.117	11557.278	54%	68%
Hathras	133	42714.796	29235.032	68%	65%	**Kaushambi**	120	30401.59	8366.922	28%	67%	Hamirpur	100	28260.558	15735.505	56%	73%
Jyotiba Phule Nagae	194	47435.967	30523.91	64%	73%	**Kushi Nagar**	189	69050.12	21535.35	31%	85%	Jalaun	130	46766.446	24614.981	53%	74%
Kannauj	122	37879.288	19729.149	52%	67%	**Maharajganj**	147	42981.49	16401.26	38%	82%	Jhansi	203	127993.253	52263.387	41%	71%
Kashganj	86	25123.973	15121.666	60%	57%	**Mau**	158	82465.89	14561.5	18%	74%	Lalitpur	87	28698.494	21496.609	75%	68%
Mainpuri	110	44764.215	21171.047	47%	67%	**Mirzapur**	184	73131.13	24296.89	33%	75%	Mahoba	61	23945.457	15608.463	65%	73%
Mathura	271	125948.387	69211.283	55%	71%	**Pratapgarh**	243	89337.12	18923.67	21%	83%	Total	797	325296.323	165268.398	51%	
Meerut	447	286451.62	138330.85	48%	68%	**Sant Kabir Nagar**	119	36836.17	10547.52	29%	81%						
Muradabad	331	156633.518	92665.912	59%	66%	**Sant Ravidas Nagar**	124	47411.33	17114.42	36%	74%						
Muzzafarnagar	263	107448.425	80525.242	75%	65%	**Sharvasti**	71	15569.22	8088.151	52%	72%						
Pilibhit	146	40231.447	29857.517	74%	72%	**Sidharth nagar**	138	42595.87	11607.78	27%	78%						
Rampur	198	49270.606	32325.285	66%	66%	**Sonbhadra**	152	72676.73	22790.7	31%	82%						
Shahjahanpur	274	117096.335	77736.127	66%	63%	**Sultanpur**	171	75737.52	18845.26	25%	79%						
Sharanpur	224	68728.904	43596.95	63%	67%	**Varanasi**	491	384188.3	139371.1	36%	75%						
Total	6484	3642354.57	1944540.6	53.38691		**Total**	5819	2803867	789785.8	28%							

Source:Source: Source: Basic Statistical Returns of Scheduled Commercial Banks, RBI
Census of India 2011

5. RBI has started the pilot project in 80 blocks of 9 states to inquire about the advanced and participatory financial literacy methods, including Uttar Pradesh. In the State, this project operates NGOs in cooperation with the sponsor banks to instruct the households to prepare a budget, maintain a booklet for financial transactions, motivate them to save in.Saving accounts, inspire them to borrow from formal financial institutions, etc. NABARD has prolonged support for establishing two Financial Literacy Centres at Lakhimpur Kheri by Allahabad bank and at Faizabad by Bank of Baroda in Uttar Pradesh.

6. NABARD is implementing a pilot project viz. Comprehensive Financial Inclusion in 3 different villages of Fatehpur district in collaboration with Baroda U.P Gramin Bank to intensify and deepen technology-based financial inclusion in the Sub Service Area.
7. The State of Uttar Pradesh has been divided into 37424 SSA and allocated to the Banks for coverage under PMJDY. As of 01st August 2018, a total of 4.90 crore a/c have been opened with deposits to the tune of Rs.13754.71 crore.
8. RU.Pay Debit cards have been issued to 3.87 crore accounts (79%), whereas 3.65 crore accounts have been Aadhaar seeded (74%). However, the number of zero balance accounts in the State declined to 14% of the total a/c compared to 22% in 2017-18.

4. INDEX OF FINANCIAL INCLUSION

Index of financial Inclusion is important to track the progress of financial inclusion in the country. *If you cannot measure it, you cannot manage it*. Sharma (2008) has proposed the methodology to calculate the IFI for any country. The methodology is the same as used by UNDP for the calculation of some renowned development indexes such as the HDI, the HPI, and the GDI. The index she made has incorporated the information of the dimension of financial inclusion. She has introduced the three dimensions as 1) Banking penetration with the indicator of total deposit accounts per lakhs of the 2) Availability of banking services with the indicator of a number of bank branches per 1000 populations, and 3) Usage of banking services with an indicator of the ratio of credit and deposit to the GDP. However, these dimensions can also be increased according to their importance. The IFI calculated in the present study is used to compare levels of financial inclusion throughout UttarPradesh districts at a particular time.

4.1 The Present Index

In the present IFI, the researcher has taken four basic dimensions of an inclusive financial system: ***Banking Penetration*** (BP), Availability ***of the Banking Services*** (BS), ***Usage of Banking Services 1*** **(BU 1),** and ***Usage of Financial Services 2*** **(BU 2)**. The indicators that have been used are 1.) Total deposit accounts per lakhs population. 2.) Number of bank branches per 1000 population 3.) Deposit to the ratio of GDP and 4. Credit to the Ratio of GDP, respectively.

Hence the IFI formula for computing the present index is

$$IFI = 1 - \frac{\sqrt{(1-d1)^2 + (1-d2)^2 + (1-d3)^2 + (1-d4)^2}}{\sqrt{4}}$$

4.2 Results and Discussion

IFI values were computed using data of all four dimensions for all the 71 districts of Uttar Pradesh and the State's rural area for the year 2017-2018. Initially, all the districts were classified/grouped in four categories: up to 0.30, more than 0.30 and U.P to 0.50, more than .55, and up to .66 and more than 0.66 according to their IFI values. However, one district falls in the

HFI group regarding rural Uttar Pradesh and none in Uttar Pradesh. Therefore, depending on the value of IFI, all the seventy-one districts are characterized into categories, viz.:

- $0.66 < IFI \leq 1.00$ – Very High Financial Inclusion (VHFI)
- $0.50 \leq IFI < 0.66$ – High Financial Inclusion (HFI)
- $0.30 \leq IFI < 0.50$ – Medium Financial Inclusion (MFI)
- $0 \leq IFI < 0.30$ – Low Financial Inclusion (LFI)

4.3 INDEX OF FINANCIAL INCLUSION FOR UTTAR PRADESH

The calculated values of the 4-dimensional Index of Financial Inclusion (4d-IFI) across all the 71 districts of Uttar Pradesh are presented in Table 1.8. It is evident from the table that Gautam Budh Nagar has a 1 index value for penetration dimension index followed by Kanpur Nagar (.41), Varanasi (.41), Agra (.31), Gorakhpur (.31), Jhansi (.31), and Ballia (.30) and so on. This implies that these districts have a sufficient number of offices of SCB's s to give service to the people who reside in the districts. The penetration index value of Gautam Budh Nagar (1) is higher than the State's penetration index value of (.25). Similarly, the availability dimension index shows that again Gautam Budha Nagar has a very high index value (1), followed by Lucknow (.71), Kanpur Nagar (.41), Varanasi (.41), Bareily (.38), Agra (.35), and Jyotibaphule Nagar (.31). The overall availability dimension index value for Uttar Pradesh is .21, which shows the low availability of banking services in the State.

It is clear from table 1.8; the district leading in penetration dimension index is legged in the availability dimension index. Hence we can say that the districts significantly penetrated with banks are not capable of providing services in the area.

In addition, an Index value of usage dimensions 1 and 2 reveals that, Except for Jaunpur (.97) and Faizabad (.79), no other district of Uttar Pradesh falls in either medium or medium the U.Pper range of the index. The overall usage dimension index value 1 and is .11 and .17, respectively. This implies that the amount deposited and credit lending amount is higher than the SGDP of the state.

Furthermore, based on the four dimension indices, an index of Financial Inclusion has been calculated. The results suggest, Jaunpur (.59), followed by GautamBudh Nagar (.54), fall in the range of high financial inclusion, whereas Lucknow (.36), Kanpur Nagar (.32), and Varanasi (.32) fall in the range of medium financial inclusion and remaining districts fall in the low range of financial inclusion. Hence, the IFI value for Uttar Pradesh is .17, which indicates the low level of financial inclusion in the state.

TABLE 1.8 INDEX OF FINANCIAL INCLUSION FOR UTTAR PRADESH

Districts	Penetration Dimension	Availability Dimension	Usage Dimension 1	Usage Dimension 2	IFI
	Value	Value	Value	Value	Value
Agra	0.33	0.35	0.20	0.06	0.25
Aligarh	0.24	0.21	0.13	0.05	0.17
Allahabad	0.30	0.25	0.07	0.08	0.18
Ambedkar Nagar	0.25	0.17	0.06	0.05	0.14

Districts	Penetration Dimension	Availability Dimension	Usage Dimension 1	Usage Dimension 2	IFI
Auraiya	0.05	0.05	0.00	0.01	0.03
Azamgarh	0.26	0.16	0.04	0.08	0.14
Baghpat	0.20	0.28	0.06	0.02	0.16
Bahraich	0.17	0.12	0.08	0.03	0.11
Ballia	0.30	0.16	0.04	0.07	0.15
Balrampur	0.16	0.16	0.07	0.04	0.11
Banda	0.22	0.20	0.12	0.05	0.15
Bara Banki	0.25	0.23	0.07	0.03	0.16
Bareilly	0.43	0.38	0.06	0.03	0.25
Basti	0.25	0.15	0.04	0.04	0.13
Bijnor	0.23	0.20	0.10	0.02	0.15
Budaun	0.12	0.08	0.05	0.01	0.07
Bulandshahr	0.22	0.16	0.07	0.02	0.13
Chandauli	0.27	0.21	0.07	0.06	0.16
Chitrakoot	0.07	0.07	0.11	0.04	0.08
Deoria	0.29	0.16	0.06	0.07	0.16
Etah	0.22	0.17	0.06	0.01	0.13
Etawah	0.25	0.19	0.04	0.04	0.14
Faizabad	0.24	0.19	0.97	0.79	0.55
Farrukhabad	0.22	0.17	0.06	0.03	0.13
Fatehpur	0.20	0.18	0.05	0.03	0.12
Firozabad	0.21	0.14	0.09	0.03	0.12
Gautam Buddha Nagar	1.00	1.00	0.17	0.07	0.54
Ghaziabad	0.25	0.28	0.28	0.14	0.24
Ghazipur	0.28	0.19	0.06	0.08	0.16
Gonda	0.22	0.15	0.07	0.04	0.13
Gorakhpur	0.31	0.25	0.14	0.10	0.21
Hamirpur	0.26	0.25	0.07	0.02	0.17
Hardoi	0.20	0.13	0.07	0.03	0.11
Hathras	0.24	0.23	0.10	0.02	0.16
Jalaun	0.25	0.20	0.07	0.02	0.15
Jaunpur	0.29	0.18	1.00	1.00	0.59
Jhansi	0.31	0.29	0.11	0.06	0.20
Jyotiba Phule Nagar	0.26	0.31	0.05	0.01	0.17
Kanauj	0.23	0.19	0.04	0.01	0.13
Kanpur Dehat	0.26	0.25	0.04	0.02	0.16
Kanpur Nagar	0.41	0.44	0.26	0.14	0.32
Kanshiram Nagar	0.00	0.00	0.02	0.00	0.01
Kaushambi	0.19	0.19	0.02	0.03	0.12
Kheri	0.21	0.15	0.07	0.01	0.12
Kushi Nagar	0.22	0.11	0.04	0.03	0.11
Lalitpur	0.23	0.18	0.09	0.01	0.14

Districts	Penetration Dimension	Availability Dimension	Usage Dimension 1	Usage Dimension 2	IFI
Lucknow	0.59	0.71	0.00	0.01	0.36
Maharajganj	0.19	0.11	0.04	0.02	0.10
Mahoba	0.27	0.17	0.05	0.01	0.14
Mainpuri	0.22	0.13	0.07	0.03	0.12
Mathura	0.26	0.31	0.15	0.05	0.20
Mau	0.29	0.18	0.03	0.07	0.15
Meerut	0.37	0.40	0.13	0.05	0.25
Mirzapur	0.26	0.19	0.06	0.04	0.15
Moradabad	0.15	0.17	0.18	0.06	0.15
Muzaffarnagar	0.12	0.15	0.15	0.03	0.12
Pilibhit	0.20	0.18	0.07	0.01	0.12
Pratapgarh	0.25	0.19	0.05	0.07	0.15
Rai Bareli	0.18	0.24	0.10	0.05	0.15
Rampur	0.20	0.23	0.05	0.01	0.13
Saharanpur	0.26	0.21	0.12	0.03	0.16
Sant Kabir Nagar	0.25	0.17	0.06	0.05	0.14
Sant Ravidas Nagar	0.26	0.20	0.09	0.06	0.16
Shahjahanpur	0.21	0.19	0.08	0.02	0.13
Shravasti	0.22	0.15	0.07	0.02	0.13
Siddharthanagar	0.17	0.11	0.03	0.03	0.09
Sitapur	0.18	0.15	0.04	0.02	0.11
Sonbhadra	0.26	0.22	0.05	0.04	0.16
Sultanpur	0.11	0.08	0.04	0.05	0.07
Unnao	0.23	0.16	0.03	0.04	0.13
Varanasi	0.41	0.41	0.27	0.16	0.32
U.P	**0.25**	**0.21**	**0.11**	**0.07**	**0.17**

Source: Calculated by the Researcher

4.4 Index of Financial Inclusion for Rural Uttar Pradesh

A similar methodology has been used to calculate the IFI for rural Uttar Pradesh. Table 1.10 presents the results which shows that Kanpur Nagar (1) followed by Mirzapur (.65), Faizabad (.64), Sultanpur (.63), Sant Ravidasnagar (.63), Shahjahanpur (.62), and Ballia (.62) fall in the rage of VHFI in penetration dimension index. The overall penetration dimension index value is .48 shows the medium level of penetration in rural Uttar Pradesh. Similarly, The availability dimension index values indicate that Ghaziabad (.60), Jyotibaphule Nagar (.58), Meerut (.54), Moradabad (.55), Rai Bareily (.63), and Rampur (.58) fall in the range of HFI. In addition, Allahabad (.24), Ambedkar Nagar (.14), Auraiya (.15), Azamgarh (.11),Bahraich (.13), Ballia (.18), BaraBanki (.27), Shahranpur (.21), Sant Ravidas Nagar (.27), Shrawasti (.09), Sidharthnagar (.08) , Sonbhadra (.06) Unnao (.14), and Varanasi (.27) fall in the range of LFI.The availability dimension index value for rural U.P is .30. Furthermore, index values for Usage dimensions 1 and 2 indicate that all 75 districts of Rural Uttar Pradesh fall in the range of

LFI, and the sum up value for Rural Uttar Pradesh for Usage dimension index is .09 and .05, respectively. The overall IFI value for rural U.P is .34, showing the MFI in the rural area.

The penetration dimension index value is higher than the availability and usage dimensions index value, which indicates that due to the government efforts, the banking services reach the rural area significantly, but banks are failing to provide the banking services to the beneficiaries; therefore, the level of usage is also affecting.

TABLE 1.10 INDEX OF FINANCIAL INCLUSION FOR RURAL UTTAR PRADESH

Districts	Penetration Dimension Value	Availability Dimension Value	Usage Dimension 1 Value	Usage Dimension 2 Value	IFI Value
Agra	0.30	0.35	0.05	0.01	0.29
Aligarh	0.51	0.32	0.08	0.02	0.35
Allahabad	0.52	0.24	0.03	0.03	0.31
Ambedkar Nagar	0.49	0.14	0.08	0.06	0.30
Auraiya	0.47	0.15	0.04	0.03	0.29
Azamgarh	0.57	0.11	0.07	0.11	0.33
Baghpat	0.47	1.00	0.05	0.02	0.44
Bahraich	0.46	0.13	0.12	0.04	0.30
Ballia	0.62	0.18	0.05	0.06	0.34
Balrampur	0.58	0.44	0.11	0.06	0.40
Banda	0.50	0.35	0.14	0.03	0.37
Bara Banki	0.52	0.27	0.10	0.03	0.34
Bareilly	0.44	0.46	0.03	0.01	0.35
Basti	0.44	0.04	0.07	0.06	0.27
Bijnor	0.43	0.40	0.07	0.02	0.34
Budaun	0.28	0.20	0.06	0.01	0.25
Bulandshahr	0.50	0.24	0.07	0.02	0.32
Chandauli	0.65	0.28	0.09	0.07	0.38
Chitrakoot	0.61	0.37	0.14	0.04	0.40
Deoria	0.55	0.07	0.06	0.06	0.29
Etah	0.53	0.35	0.07	0.01	0.35
Etawah	0.38	0.21	0.04	0.03	0.28
Faizabad	0.64	0.19	0.64	0.48	0.58
Farrukhabad	0.50	0.23	0.06	0.01	0.31
Fatehpur	0.41	0.29	0.06	0.03	0.32
Firozabad	0.38	0.24	0.04	0.01	0.28
Gautam Buddha Nagar	0.29	0.71	0.01	0.01	0.35
Ghaziabad	0.35	0.60	0.01	0.01	0.35
Ghazipur	0.61	0.24	0.08	0.09	0.36
Gonda	0.51	0.17	0.11	0.05	0.33
Gorakhpur	0.54	0.14	0.05	0.06	0.31
Hamirpur	0.42	0.47	0.08	0.01	0.36
Hardoi	0.46	0.17	0.08	0.03	0.30
Hathras	0.48	0.46	0.08	0.02	0.37

Districts	Penetration Dimension Value	Availability Dimension Value	Usage Dimension 1 Value	Usage Dimension 2 Value	IFI Value
Jalaun	0.59	0.35	0.07	0.02	0.36
Jaunpur	0.57	0.14	1.00	1.00	0.67
Jhansi	0.43	0.33	0.04	0.01	0.32
Jyotiba Phule Nagar	0.41	0.58	0.08	0.02	0.38
Kanauj	0.61	0.36	0.05	0.01	0.36
Kanpur Dehat	0.13	0.18	0.09	0.05	0.22
Kanpur Nagar	1.00	0.81	0.01	0.01	0.49
Kanshiram Nagar	0.34	0.46	0.03	0.00	0.32
Kaushambi	0.48	0.36	0.06	0.05	0.35
Kheri	0.60	0.22	0.09	0.02	0.34
Kushi Nagar	0.40	0.00	0.07	0.05	0.24
Lalitpur	0.56	0.23	0.13	0.02	0.35
Lucknow	0.29	0.48	0.00	0.00	0.30
Maharajganj	0.35	0.02	0.06	0.04	0.22
Mahoba	0.63	0.12	0.06	0.01	0.31
Mainpuri	0.05	0.09	0.05	0.01	0.14
Mathura	0.00	0.17	0.09	0.02	0.16
Mau	0.65	0.19	0.06	0.07	0.35
Meerut	0.44	0.54	0.04	0.01	0.36
Mirzapur	0.65	0.20	0.09	0.05	0.36
Moradabad	0.55	0.59	0.05	0.01	0.40
Muzaffarnagar	0.22	0.53	0.05	0.01	0.31
Pilibhit	0.42	0.35	0.06	0.01	0.33
Pratapgarh	0.53	0.23	0.09	0.10	0.35
Rai Bareli	0.50	0.63	0.08	0.05	0.41
Rampur	0.49	0.58	0.06	0.01	0.39
Saharanpur	0.35	0.21	0.09	0.02	0.28
Sant Kabir Nagar	0.53	0.11	0.08	0.07	0.31
Sant Ravidas Nagar	0.63	0.27	0.07	0.06	0.36
Shahjahanpur	0.62	0.38	0.08	0.02	0.38
Shravasti	0.46	0.09	0.14	0.05	0.30
Siddharthanagar	0.48	0.08	0.07	0.06	0.28
Sitapur	0.64	0.37	0.06	0.02	0.37
Sonbhadra	0.37	0.06	0.06	0.04	0.24
Sultanpur	0.63	0.20	0.07	0.07	0.35
Unnao	0.48	0.14	0.06	0.04	0.29
Varanasi	0.44	0.27	0.04	0.04	0.31
Rural U.P	**0.48**	**0.30**	**0.09**	**0.05**	**0.34**

Source : Calculated by the Researcher

CONCLUSION

Concerning the above analysis of Uttar Pradesh, including economic status and banking status, we can say that Uttar Pradesh is a developing but rich state of India. Its culture and geographical situation make it prosperous. On the one hand, its high population creates poverty and inequalities among the region, but on the other hand states, geographical situation enlightened the way to enlarge its industrial and business area. As far as we are concerned about its financial sector, it is continuously growing since 2011, but due to regional imbalances, we can also see some disparities in the development of the financial sector among the districts/region of the state. Furthermore, as part of financial inclusion, the IFI value also shows improvement from the IFI value of .09 for U.P (Pandey. A, 2009). Hence, being an overpopulated state of the nation, the path of development is long but achievable.

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EFFECT OF THE CONTENT OF MICRO SILICA AND SUPERPLASTICIZER ON THE STRENGTH OF CONCRETE

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ABSTRACT

Concrete is the most popular construction material everywhere in the world. It is the second most consumed material, next to the water. From a historical point of view, in the middle of the 20th century, concrete with characteristic strength of 30 MPa was considered high-strength concrete and later in the 1980s, Concrete is said to be HSC when the compressive strength exceeds 50 MPa. Nowadays, HSC has sufficiently advanced such that concretes with compressive strengths of more than 120 MPa are commercially known as high-strength concrete that can be produced in laboratories.

In this study, Laboratory tests were performed in the Lohara Khola bridge site and Ruma Khola bridge site with the bridge span 25-meter meter to investigate the ranging percentage of silica and superplasticizer on compressive strengths of the different mix proportions of concrete. A total of 12 trail mix proportions were used for the tests. Those were compared with the approved field applied test. Primary data were collected in laboratory tests whereas secondary data were collected from standard specifications for road and bridge-2073 and Is 10262: 1982. These data were analyzed by regression analysis for the comparison between micro silica and superplasticizer verse average compressive strength in MPa.

From 7 days and 28 days of concrete cube tests, it was found the increasing trend of the compressive strengths while increasing the content of the silica. The relationship between the content of micro silica and Superplasticizer with the compressive strength was found almost linear. From the experiment results, the optimum content of micro silica and superplasticizer were found by 5 % and 1.25% respectively by weight of cement for bridges, roads, and other structures. Among these different types of material used in concrete, micro silica, and superplasticizer have high strength than the rest of the other admixtures by doing 12 trial mixtures in a laboratory test in the field. Also, from several test results, the strength of concrete in the Lohara bridge site and Ruma bridge site have used normal concrete strength (NSC). In these sites, if micro silica and superplasticizer were used the strength of concrete may increase up to the level of moderate-high strength concrete which make the bridge high load-bearing capacity and more durable.

Therefore, to make the bridge structures of higher strength and more durability, the use of micro silica and superplasticizer becomes necessary in the bridge construction sites.

KEYWORDS: *superplasticizer, concrete, durability, construction, investigate.*

INTRODUCTION

Mostly in the world, Concrete material is used in the construction field. For many years ago, lightweight aggregate has been used for structural purposes. They are normally working in structures for which the dead load participates in a major part of the total load. Lime and Portland cement are used as the binder. By using such aggregates, structural lightweight concrete with 28-day compressive strength of up to 30 MPa has been produced. higher adhesion between reinforcing steel and concrete, and enhanced durability characteristics, are special properties of lightweight concrete that make it different from normal-weight concrete (Erhan, et al., 2015).

From a historical point of view, in the middle of the 20th-century concrete with characteristic strength of 30MPa was considered high strength and later in the 1980s, Concrete is said to be high-strength concrete when the compressive strength exceeds 50 MPa. Nowadays, HSC has sufficiently advanced such that concretes with compressive strengths of more than 120MPa are commercially known as high-strength concrete that can be produced in laboratories (Ajay & Mahesh, 2021). Several methods exist for the mix design of strength of concrete. The overall purpose of the mixed design method was first developed by Okamura and Ozawa (1995).

The high flow ability of self-compaction concrete mixtures is achieved by using a super plasticizer which influences many fresh and hardened properties of concrete mixtures. Nippon Shokubai and Nippon Master Builder Technology invented the polycarboxylate-based super plasticizer (PC) in the middle of the 1980s in Japan. The effect of the type of new generation super plasticizer, air-entraining, viscosity modifying, and anti-foaming admixtures on the air content and workability for high performance of concrete (Ali Mardani, et al., and 2013).

Ordinary Portland Cement (OPC) is used in all test specimens, the tests are carried out on the used cement to determine its physical properties according to the Egyptian Code of Practice. Fly ash and silica fume are used as a replacement for the cement content by different percentages to reduce the dosage of chemical admixtures needed. The suitable percentage of fly ash, and silica fume that gives the highest value of concrete compressive strength. Its self-weight with little or no vibration effort gives cohesion enough to be handled without segregation or bleeding of fresh concrete. These mixes usually contain super plasticizers, silica fume, high content of fines, and/or viscosity-modifying additives (Mohamed, 2011).

Silica fume is a mineral admixture that improves mechanical properties and reduced permeability. Secondly, the super-plasticizer (SP) is a chemical admixture used for water-reducing, increasing cohesiveness, improve the passing and filling ability of the strength of concrete (Waseem Khairi, et al., 2020).

Super plasticizers are chemical admixtures used where well-dispersed particle suspension is required. They have become indispensable constituents of any designed cement mortar mix today. The property of fresh and hardened cement mortar is strongly influenced by the interaction of super plasticizers and cement Conventional concrete is a cost-effective material that is relatively easy to make, transport, and place (Alsadey & Omran, 2018).

The water/powder (cement, fly ash, limestone filler, silica fume, etc.) ratio of mortar and the type of chemical admixtures should be determined, to place the fresh mortar without any external compaction and at the same time without causing any segregation (Burak, et al., 2006).

Research Question

Based on the above problems, the following research questions are formulated:

- What is a suitable ratio of Silica and Super plasticizer on strength of concrete?
- How to compare the concrete strength between Field works and Laboratory test works?

Research Objectives

The main objective of the research is to determine the effect of the content of silica and super plasticizer on strength of concrete. The Specific objectives of the study are:

- To determine a suitable ratio of Silica and Super plasticizer on strength of concrete.
- To compare the concrete strength between Field works and Laboratory test works.

Significance of the study

The study is helpful to choose the suitable ratio of binder used on high-strength concrete for many structural works in the construction field. It reduces the cost of construction and the long life of the concrete and minimizes cracks like i.e. Shrinkage cracks, creep cracks, hairline cracks, etc. The study also suggests a better ratio of silica and Super plasticizer.

The study has seen various types of binder used on high-strength concrete for bridges and roads by using appropriate types of binder, which are more cost-effective, have longer life spans with higher durability and less maintenance; adaptability to new traffic; improved reliability and safety; environmental friendliness; easier and faster construction.

RESEARCH METHODOLOGY

The data was collected from different sources which were analyzed and verified. This chapter discusses the various frameworks, methodologies, and underlying theories used in developing appropriate admixtures and the suitable types of admixtures. The methodology was designed not only to address the study objectives but also to help facilitate reliable data analysis and interpretation that is critical for studies of this nature. Various steps adopted for completing the research are mentioned in figure 3.1.

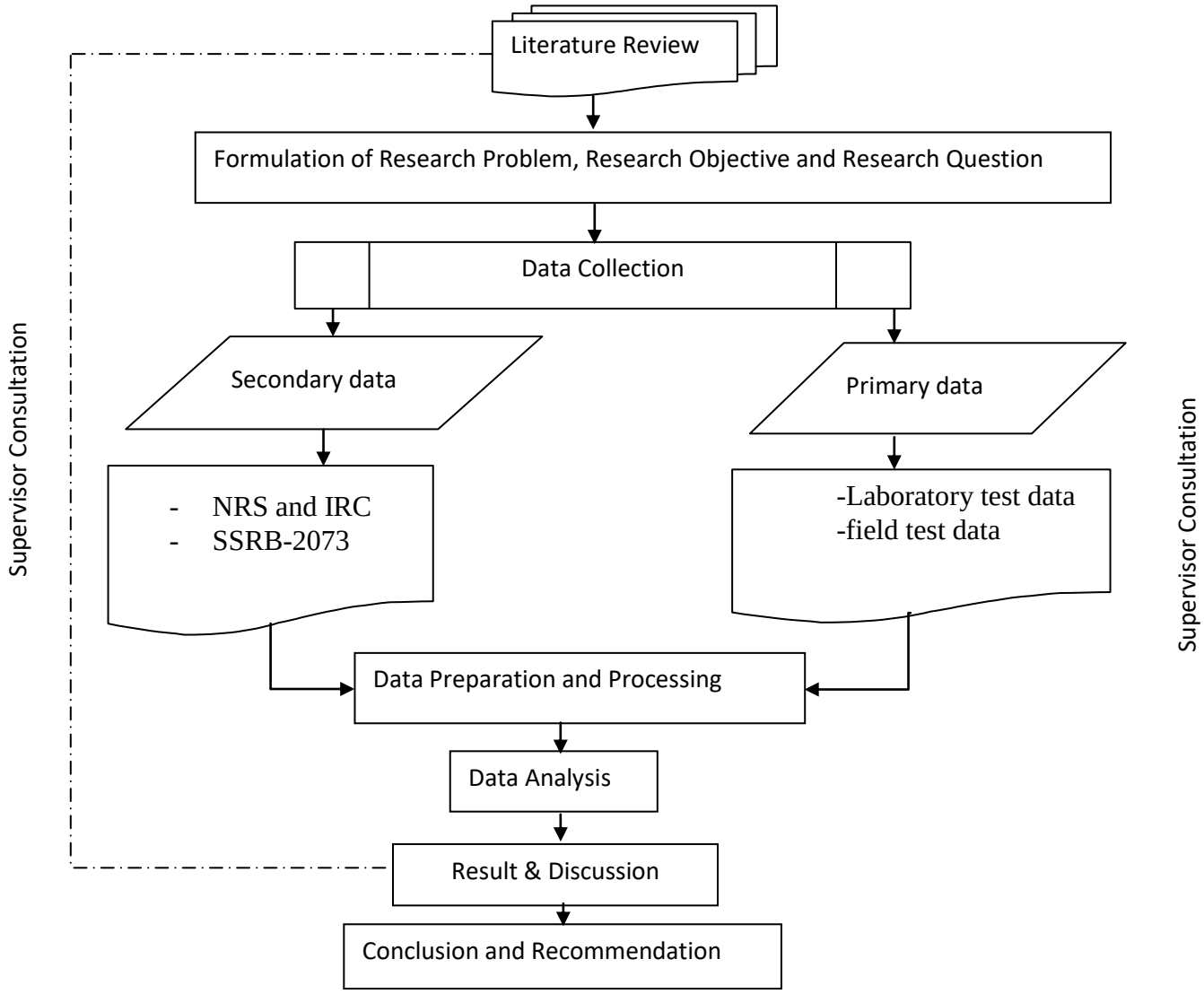

Figure 3.1: Research Flow Chart

Two Bridge locations of the Mid Hill Highway were taken as a study area where several laboratory test trials have been done for this research work. These two locations along Mid Hill Highway are Lohara Bridge and Ruma Bridge which is situated in the hilly region of Nepal. These road sections are characterized by highly broken relief with vastly differing elevations, steep slopes, and geological condition varies from place to place figure 3.2. These bridges are double-lane road bridges where Lohara Bridge was selected 25-meter span bridge, whereas Ruma Bridge was selected 25-meter span bridge.

Lohara Bridge Location

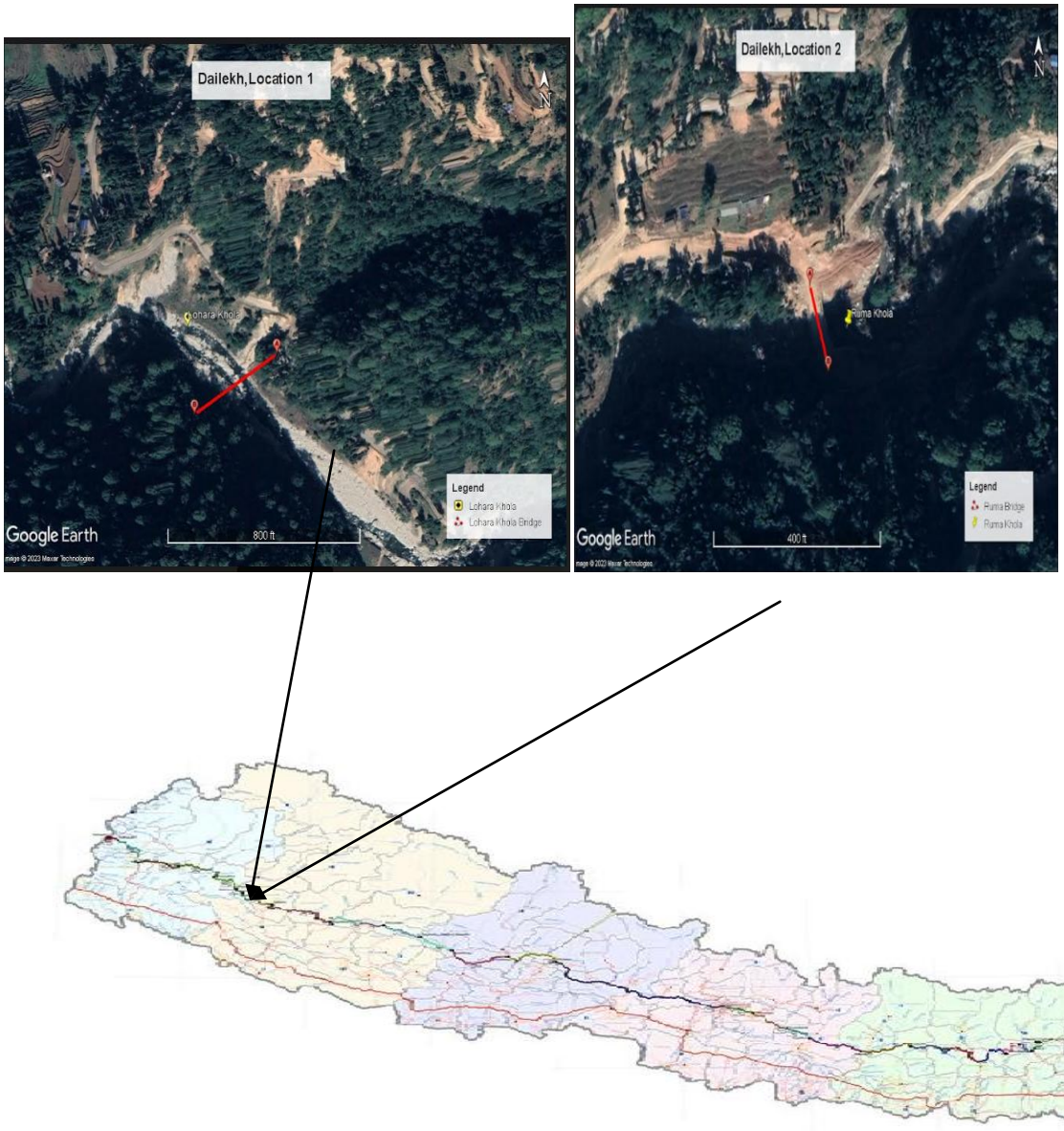

Figure 3.2: Map of Mid Hill Highway

Source: (Google Map)

Data Collection

These are ways used to gather information from various sources. Primary data were collected by Laboratory tests, measurement and calculation, and also Field investigation whereas secondary data were collected Standard Specification for Road and Bridge and Indian Road congress, etc. The following information was required for this study, Number of a cube, Date of casting, Age of concrete, strength of concrete, and weight.

Primary Data

The primary data were collected through Laboratory Tests and Field Tests. This was focused to address the following Cubes test:-

Number of Cubes

Date of Casting

Date of Testing

Age

Dimession

Surface Area (mm2)

Volume (m3)

Weight (KG)

Density (kg/m3)

Breaking Load (KN)

Breaking Strength (MPa)

Average Breaking Strength

Compressive strength(MPa)

Secondary Data

Secondary data refer to the data which have already been collected and analyzed by someone else. Most of the data were collected by Standard Specification for Road and Bridge works(2073) and Indian Road Congress IRCs 10262: 1982, Some of the data were collected from the literature.

Data collected by Standard Specification for Road and Bridge works(2073) and IRCs are:-

Initial setting time

Final setting time

Aggregate Percentage

Fine sand percentage

High-range water-reducing admixture

Water/Cement (W/C Ratio)

Data collected from the literature are:-

Strength of concrete

Cement percentage

Silica fume Percentage

Mix Design

The M50 grade of the HSC mix has been designed based on Indian standard IRC 10262: 1982. The details are given in the flow chart below.

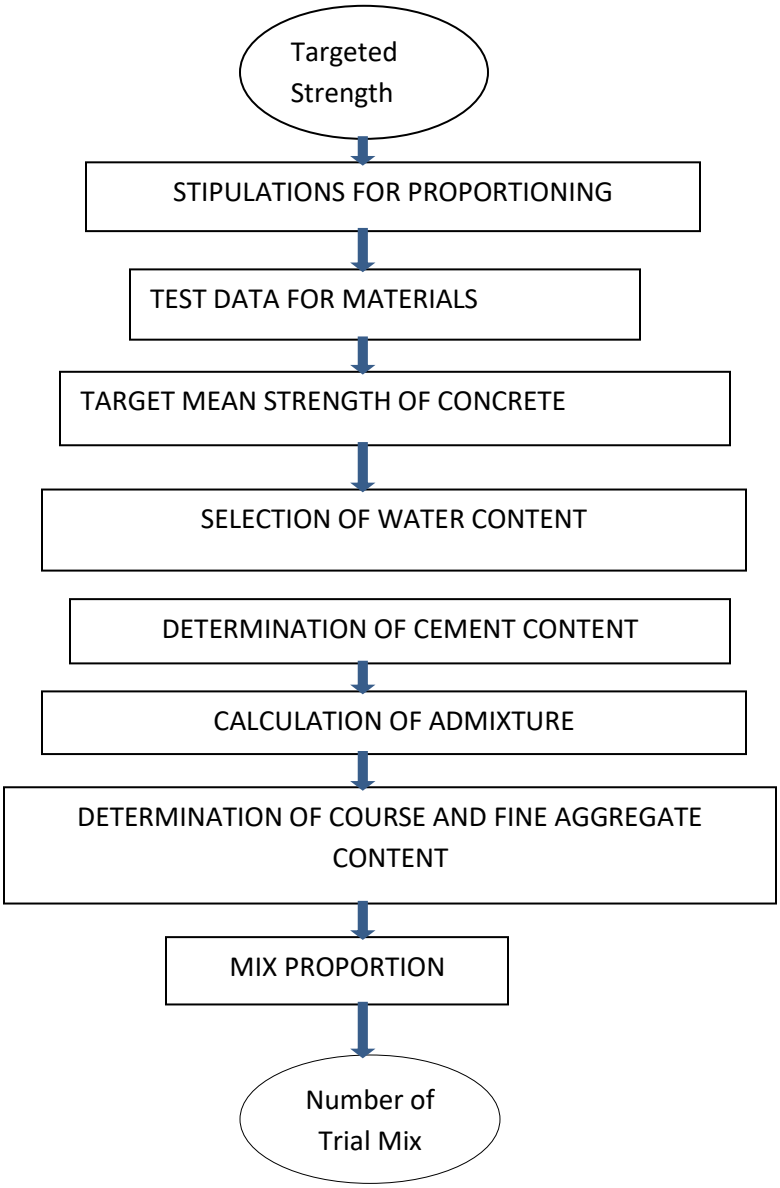

Figure 3.3: Mix Design

Data Analysis

This study was based on the quantitative method. Quantitative analysis was done by comparison of well-known standards and calculations on MS Excel software. This study finds a suitable ratio

of Silica and Superplasticizer in high-strength concrete for these calculation Regression analysis was used. By using statistical average calculation and these value was compared with Standard Specification for Road and Bridge in the form of numeric value. These manipulations were presented in the form of graphical representation, i.e. Line chart, and tabulation. Appropriate types of admixture were analyzed from Statistical averages in terms of percentage or number and analysis by logical tools i.e. greater than or less than after that compare with each other. These manipulations were presented in the form of a graphical representation, i.e. Line chart.

Finally, the strength of concrete between Field works and Laboratory test works were investigated by comparing with each other by using well-known standards and calculations on MS-Excel software. The manipulations were also presented in the form of a Bar chart, and tabulation after that was compared with Fieldworks and Laboratory tests of concrete strength.

Research Matrix

The data collection, analysis and its conclusion process are mentioned in this table 3.2:

TABLE 3.1: RESEARCH MATRIX

Objective	**Data required**	**Collection Technique**	**Analytical tools**	**Expected outcome**
To determine a suitable ratio of Silica and Superplasticizer strength of concrete.	Primary data: • Weight (KG) • Density (kg/m3) • Breaking Load (KN) • Breaking Strength (MPa) • Strength of concrete Secondary data: • Fine sand percentage • Stength of concrete • Cement percentage • Silica fume Percentage	Field Test, Laboratory test, and specification of Road and bridge of DoR, IRC	Average statistical by MS-excel with Linear Regression analysis	Finding suitable ratio of Silica and Superplasticizer in high strength concrete.
To compare the concrete strength between Field works and Laboratory test works.	Primary data: • Weight (KG) • Density (kg/m3) • Breaking Load (KN) • Breaking Strength (MPa) • Strength of concrete Secondary data: • Fine sand percentage • Stength of concrete	Field Test, Laboratory test, and specification of Road and bridge of DoR, IRC	simple arithmetic calculation by MS-Excel	Compare Field and Laboratory Test

	• Cement percentage • Silica fume Percentage			

RESULTS AND DISCUSSSION

It should be noted that the method described in this research paper deals with the effect of strength on high-strength concrete by using silica and superplasticizer by number by trial mixture test and identifying the suitable ratio of silica fume and superplasticizer. It also evaluates the appropriate type of binder used as an admixture on high-strength of concrete in the field as well as a laboratory test. In this study, several laboratory test trials have been done within the Lohara Khola bridge site and the Ruma Khola bridge site.

High strength concrete ratio by using silica and superplasticizer

In this study, the appropriate ratio was obtained through the Number of trail Mixtures of concrete by varying their percentage of ingredients. This ratio was compared with the standard specification for road and bridge and IS 10262:1982 Procedures and values. In the Standard specification for roads and bridges and IS, M50 concrete which has maximum compressive strength for 7 days, generally is in the range of 60 to 65% depending on Concrete Mix, and 28 days, 100% strength for concrete. Similarly, in IS maximum strength is 65 % and 100% for 7 days and 28 days respectively.

High Strength Concrete While Use In Silica Fume

From this compressive strength concrete for 7 days test trial by using Micro silica, it was seen when the percentage of micro silica was taken as zero percentage, the average compressive strength was 25.05 MPa which is a similar value to Lohara and Ruma bridge site laboratory test. When the percentage of micro silica was taken as 2.5% wt. of cement, average compressive strength was increased by 26.44 MPa, and it was seen when the percentage of micro silica percentage 3 % wt. of average compressive strength was increased by 26.88 MPa. Similarly, the ratio of micro silica percentage of 3.5 % wt. of cement's average compressive strength was increased by 27.2 MPa respectively which is shown in the figure below.

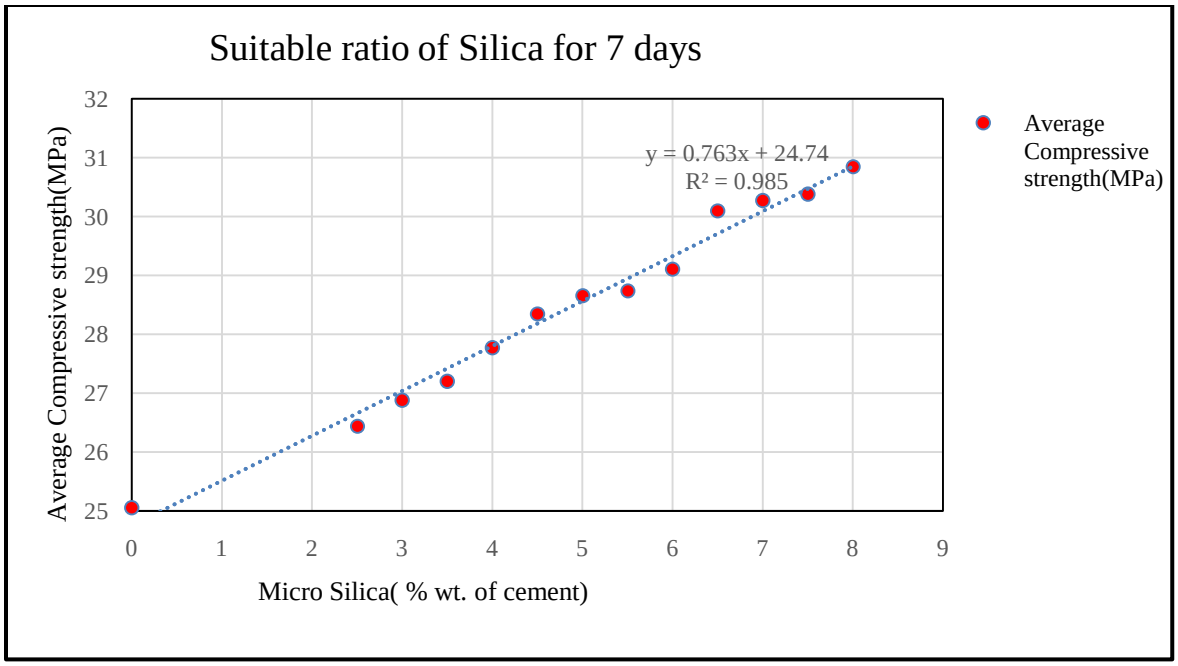

Figure 4.4: Suitable ratio of Silica for 7days of concrete

Hence, from the above figure, when the Micro silica percentage increases the average compressive strength also increases simultaneously.

The regression analysis between Micro silica and average compressive strength for 7 days had a significantly high linear relationship ($p<0.0001$), with the equation of $Y=0.7633x+24.747$ ($R2=0.9853$) from Appendix 1. There was a significant difference ($p<0.05$) between means of average compressive strength in a different range of micro silica. The detailed calculation was given in Appendix 1.

From this compressive strength concrete for 28 days test trial by using between Micro silica, it was seen when the percentage of micro silica was taken as zero percentage, the average compressive strength 39.25 MPa. It was seen when the percentage of micro silica percentage 2.5% wt. of cement average compressive strength was increased by 41.40 MPa, it was seen when the percentage of micro silica percentage 3 % wt. of cement average compressive strength was increased by 41.78 MPa. Similarly, the ratio of micro silica percentage of 3.5 % wt. of cement's average compressive strength was increased by 42.44 MPa respectively which is shown in the figure below. Hence, from the above figure, when the Micro silica percentage increases the average compressive strength also increases simultaneously

The regression analysis between Micro silica and average compressive strength for 28 days had a significantly high linear relationship ($p<0.0001$), with an equation of $Y=2.042x+37.18$ ($R2=0.9116$) from Appendix 1. There was a significant difference ($p<0.05$) between means of average compressive strength in a different range of micro silica. The detailed calculation was given in Appendix 1.

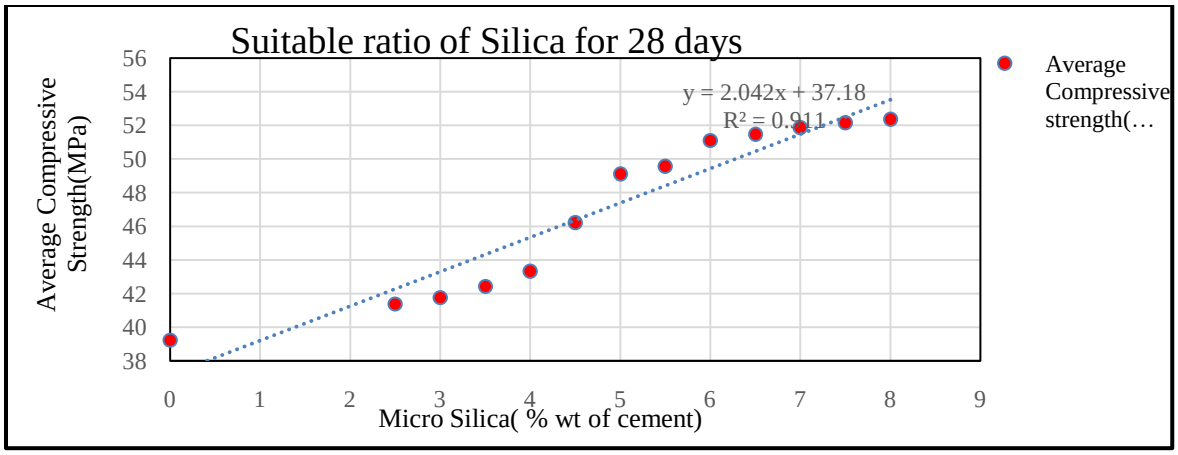

Figure 4.5: Suitable ratio of Silica for 28 days of concrete

Therefore, when the percentage of micro silica increase, the average compressive strength also increase. Thus, there was direct relation between Micro silica with the average compressive strength of concrete of high strength concrete (HSC). This indicates when Micro silica percentage low is not favorable to construct bridge and any structure in the context of safety, durability, and strength of construction structure. Whereas micro silica is very high is also not favorable in the context of cost of construction and environmental condition. Hence from statistical average calculation from appendix. Thus, this ratio is suitable for construction field to gain the strength and durability by minimizing high cost. The ratio of Micro silica were 5% as per IS 10262:1982. This ratio is an appropriate for Construction Bridge and road by comparison standards. It reduces all problems caused by very high and very low ratio of Micro silica.

From above 7days and 28days casting of concrete, if Micro silica increased then average compressive strength of concrete has been increased. There was a direct relation between micro silica with the compressive strength. It is also significantly affecting the appropriate type of admixture. Thus, the micro silica should be Chosen in 5 % wt. of cement for bridge, road and other structures, which is comparatively suitable ratio for mix design of concrete.

High strength concrete while use in Superplasticizer

From this compressive strength concrete for 7 days test trial by using between superplasticizer, it was seen when the percentage of micro silica was taken as zero percentage, the average compressive strength 25.01 MPa which is a similar value to like Lohara and Ruma bridge site. It was seen when the percentage of Superplasticizer 0.8% wt. of cement average compressive strength was increased to 25.86 MPa, it was seen when the percentage of superplasticizer 0.85 % wt. of cement average compressive strength was increased to 26.12 MPa. Similarly for a ratio of Superplasticizer percentage, 0.9 % wt. of cement average compressive strength was increased by 26.61 MPa respectively which is shown in the figure below. The regression analysis between Micro silica and average compressive strength for 7 days had a significantly high linear relationship ($p<0.0001$), with an equation of $Y=3.2469x+24.152$ ($R2=0.8145$) from Appendix 1. There was a significant difference ($p<0.05$) between means of average compressive strength in a different range of superplasticizers. The detailed calculation was given in Appendix 1.

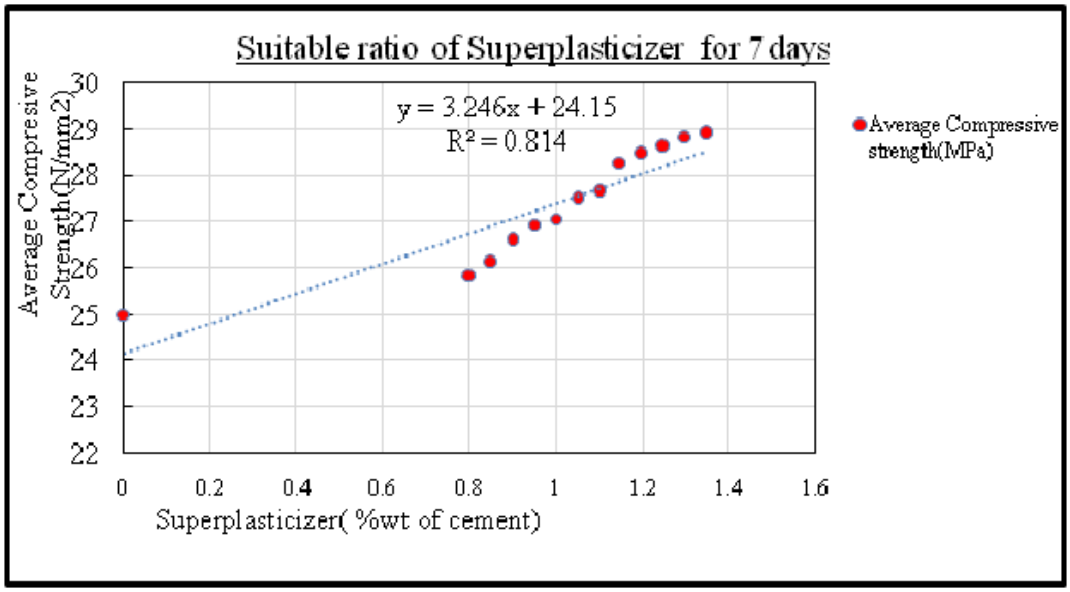

Figure 4.6: Suitable ratio of Superplasticizer for 7 days of concrete

From this compressive strength concrete for 28 days test trial by using Superplasticizer, it was seen when the percentage of micro silica was taken as zero percentage, the average compressive strength was 39.35 MPa which is a similar value to like Lohara and Ruma bridge site. it was seen when the percentage of Superplasticizer 0.8% wt. of cement average compressive strength was increased to 43.12 MPa, it was seen when the percentage of Superplasticizer 0.85 % wt. of cement average compressive strength was increased to 45.12 MPa. Similarly for a ratio of Superplasticizer percentage, 0.9 % wt. of cement average compressive strength was increased by 45.87 MPa respectively which is shown in the figure below. Hence, from the above figure when the Superplasticizer percentage increases the average compressive strength also increases simultaneously

The regression analysis between Micro silica and average compressive strength for 28 days had a significantly high linear relationship ($p<0.0001$), with an equation of $Y=12.696x+36.01$ ($R2=0.8029$) from Appendix 1. There was a significant difference ($p<0.05$) between means of average compressive strength in a different range of superplasticizers. The detailed calculation was given in Appendix 1.

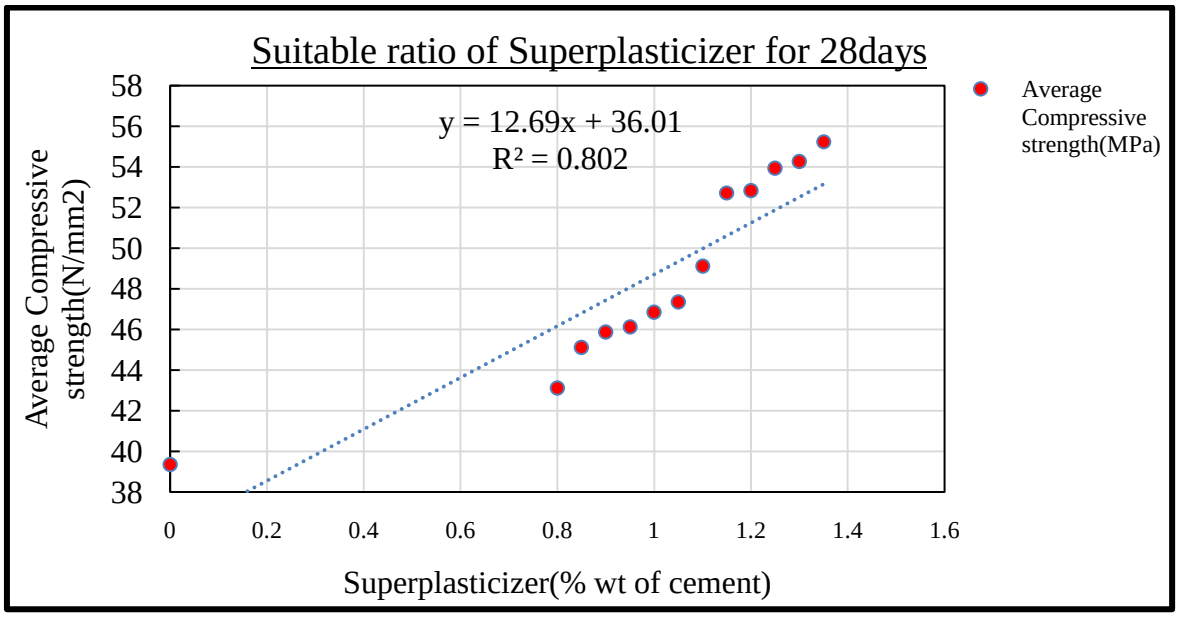

Figure 4.7: Suitable ratio of Superplasticizer for 28 days of concrete

Therefore, also when the percentage of Superplasticizer and flow gel increases, the average compressive strength also increases. Thus, there was a direct relation between Superplasticizer and flow gel with the average compressive strength of concrete of high-strength concrete (HSC). This indicates when Superplasticizer and flow gel percentage low is not favorable for constructing the bridge, roads, and any other structure for safety, durability, and strength of the construction structure. Whereas Superplasticizer and flow gel is very high is also not favorable in the context of the cost of construction and environmental condition. Hence from a statistical average calculation from the appendix, the Ratio of silica is between 5, and for Superplasticizer it is 1.25% wt of cement. Thus, this ratio is suitable for the construction field to gain strength and durability by minimizing high costs. The ratio of Superplasticizer and 1.25% as per IS 10262:1982. This ratio is appropriate for the construction of bridges and roads by comparison standards. It reduces all problems caused by a very high and very low ratio of Superplasticizer.

From the above 7-day and 28-day casting of concrete, if Micro silica, Superplasticizer, and flow gel increased then the average compressive strength of concrete has been increased. There was a direct relation between Micro silica, Superplasticizer, and flow gel with the compressive strength. It is also significantly affecting the appropriate type of admixture. Thus, the Superplasticizer value should be Chosen in 1.25% wt. of cement for bridges, roads, and other structures, which is a comparatively suitable ratio for the mix design of concrete in the construction field.

Different types of Admixture

Though several studies have considered the development of a balanced or standardized method of concrete mix design for High strength concrete. Sustainable high-strength concrete does not contain any special or unusual ingredients. A common mix includes cement, superplasticizers, micro silica fume, flow gel, fly ash, and slag, with a relatively large number of cementitious by-products for cement replacement. This led to various studies starting to produce concrete with

higher strength where workability was a major challenge and the use of a superplasticizer made it possible and paved the way for the production of HSC (ACI, 1997).

Compressive strength of admixture for 7 days

This study contains four different types of admixture in laboratory tests on the Bridge location site. The average compressive strength of concrete was calculated for each type of admixture and compared with each other. For Cement only when twelve trial mixtures have been done in the laboratory, it has low strength of 26.11 MPa and high strength of 27.12 MPa, and detailed calculation was given in Appendix. For Fly ash and cement when twelve trial mixtures have been done in a laboratory, it has low strength of 25.46 MPa and high strength of 27.12 MPa. For Slag and cement when twelve trial mixtures have been done in a laboratory, it has low strength of 26.01 MPa and high strength of 27.23 MPa. For Micro silica and cement, it had low strength of 26.44 MPa and high strength of 30.84 MPa, and last For Superplasticizer when twelve trial mixtures have been done in a laboratory, it has low strength of 25.86 MPa and high strength of 28.89 MPa and detail calculation was given in Appendix. Therefore, there was a huge difference between the different types of admixture uses strength which is shown in the figure below.

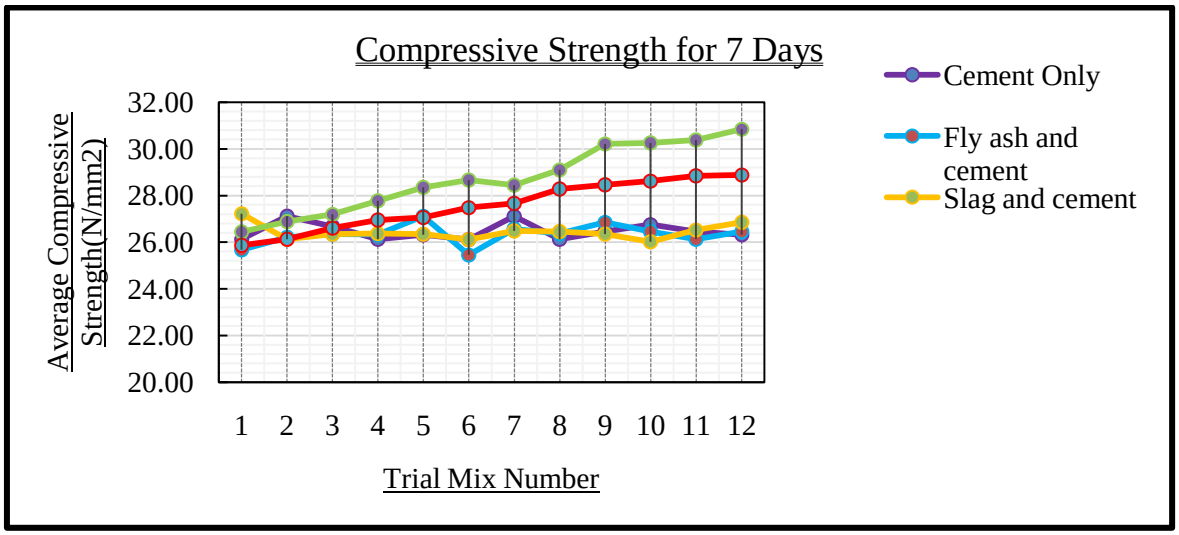

Figure 4.8: Different type of admixture compressive strength for 7 days

Compressive strength of admixture for 28 days

This study contains four different types of admixture in laboratory tests on the Bridge location site. The average compressive strength of concrete was calculated for each type of admixture and compared with each other. For Cement only when twelve trial mixtures have been done in a laboratory, it has low strength of 39.11 MPa and high strength of 39.87 MPa, and detailed calculation was given in Appendix. For Fly ash and cement when twelve trial mixtures have been done in a laboratory, it has low strength of 39.21 MPa and high strength of 40.32 MPa. For Slag and cement when twelve trial mixtures have been done in a laboratory, it has low strength of 39.54 MPa and high strength of 40.63 MPa. For Micro silica and cement when twelve trial mixtures have been done in a laboratory, it had low strength of 41.78 MPa, and high strength of 52.45 MPa, and last For Superplasticizer, it has low strength of 43.12 MPa and high strength of 55.25 MPa and detail calculation was given in Appendix. Therefore, there was a huge difference between the different types of admixture uses strength which is shown in the figure below.

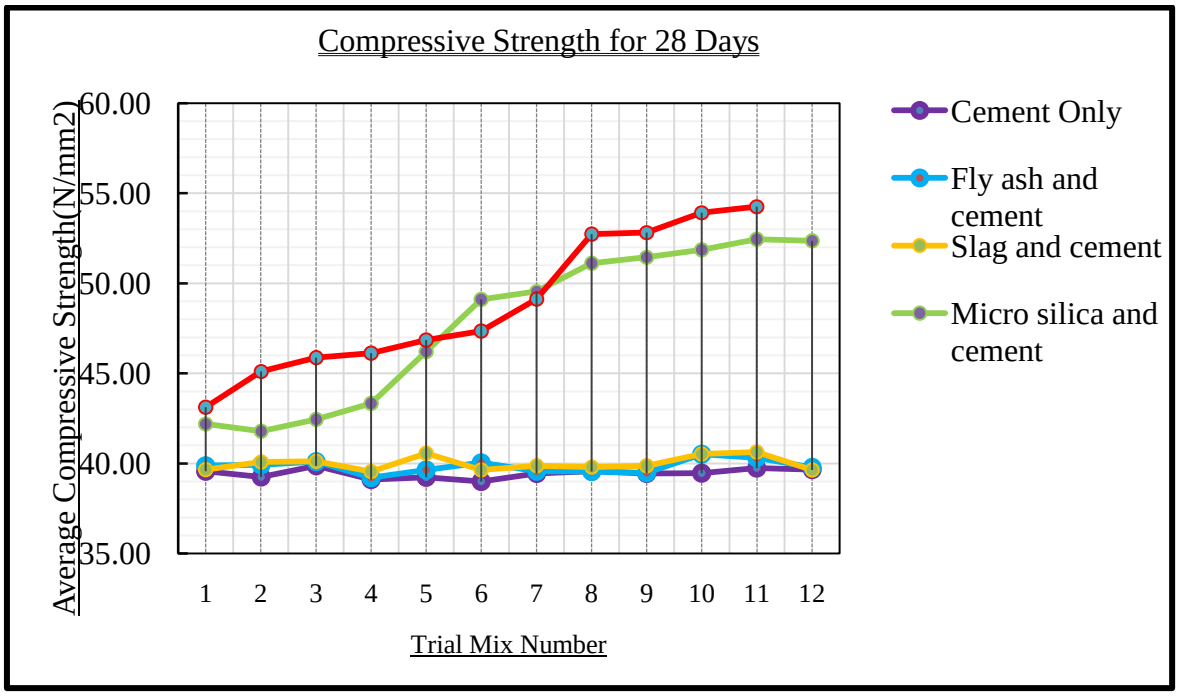

Figure 4.9: Compressive strength of admixtures for 28 days

From this study, among these different types of admixture Micro silica and superplasticizer have high strength than the rest of the admixture by doing 12 trial mixtures in a laboratory test in the field. Therefore high-strength concrete superplasticizer is the best admixture for use in bridges, roads, and other structures in construction fields.

Compare concrete strength of Lohara Bridge and Ruma Bridge test with Laboratory test

Topography is an important factor and influences the physical location of the Bridge. Geometric design standards are different for different terrain conditions. The hilly and mountainous regions are affected by valleys and deep gorges which increase the cost of construction and time of construction too. This study contains two different sites of a bridge with a double-lane carriageway spanning 25m. The following test result was found to compare this site and laboratory test.

Compare concrete strength of Lohara bridge test and Laboratory test

In the Lohara bridge site, when 12 trial mixtures have been done in a laboratory, TM1 it has a compressive strength of 26.20 MPa, TM2 it has a compressive strength of 27.16 MPa, similarly TM12 it has a compressive strength of 26.89 MPa found by investigation. For Micro silica and cement combination when twelve trial mixtures TM1, TM2, TM3, TM4, TM5, TM6, TM7, TM8, TM9, TM10, TM11, and TM12 have were done in a laboratory, it has compressive strength 26.44, 26.88, 27.2, 27.77, 28.35, 28.66, 28.44, 29.11, 30.22, 30.25, 30.38, 30.85 MPa respectively. Similarly for superplasticizer when twelve trial mixtures TM1, TM2, TM3, TM4, TM5, TM6, TM7, TM8, TM9, TM10, TM11, and TM12 have been done in a laboratory, it has compressive strength 25.86, 26.12, 26.61, 26.95, 27.06, 27.49, 27.66, 28.28, 28.46, 28.63, 28.84, 28.89 MPa respectively for 7 days.

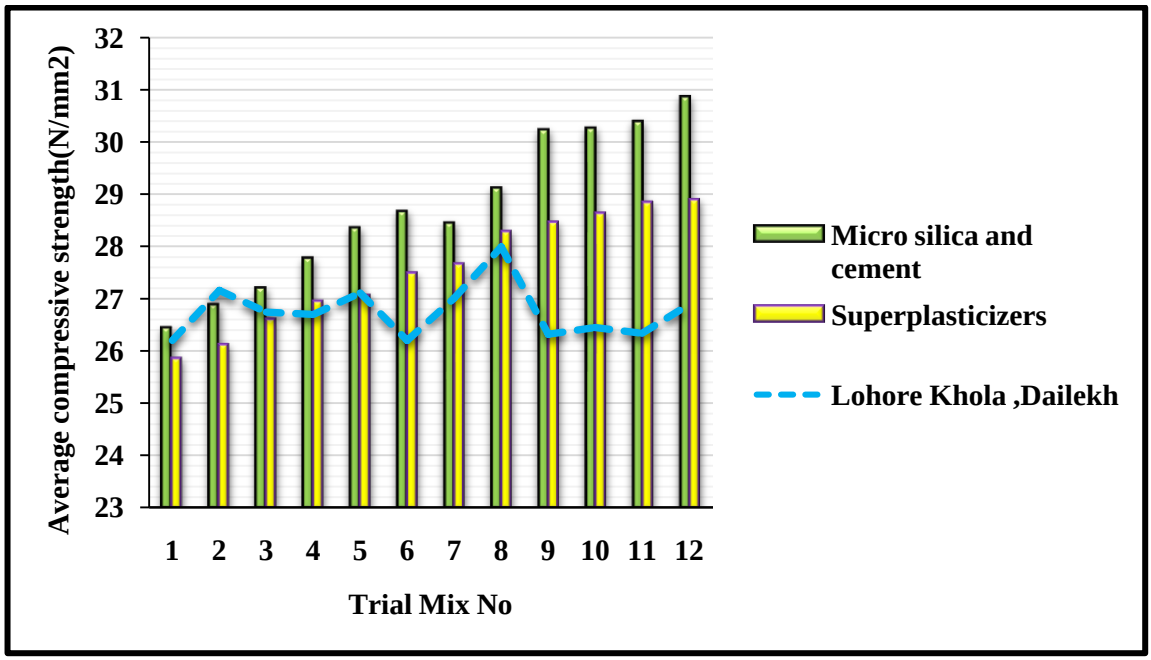

Figure 4.10: Comparing compressive strength for 7 days with Lohara Bridge site test

In the Lohara bridge site, when 12 trial mixtures have been done in a laboratory, in TM1, TM2, TM3, TM4, TM5, TM6, TM7, TM8, TM9, TM10, TM11, and TM12 have been done in a laboratory, it has compressive strength 39.23, 38.93, 39.53, 39.23, 39.5, 39.21, 39.61, 39.34, 38.99, 38.96, 39.78, 39.4 respectively found by investigation. For Micro silica and cement combination when twelve trial mixtures TM1, TM2, TM3, TM4, TM5, TM6, TM7, TM8, TM9, TM10, TM11, and TM12 have were done in a laboratory, it has compressive strength 42.20, 41.78, 42.44, 43.33, 46.22, 49.11, 49.56, 51.11, 51.46, 51.86, 52.45, 52.36 respectively. Similarly for superplasticizer when twelve trial mixtures TM1, TM2, TM3, TM4, TM5, TM6, TM7, TM8, TM9, TM10, TM11, and TM12 have been done in a laboratory, it has compressive strengths 43.12, 45.12, 45.87, 46.12, 46.85, 47.35, 49.12, 52.73, 52.83, 53.93, 54.27, 55.25 respectively for 28 days.

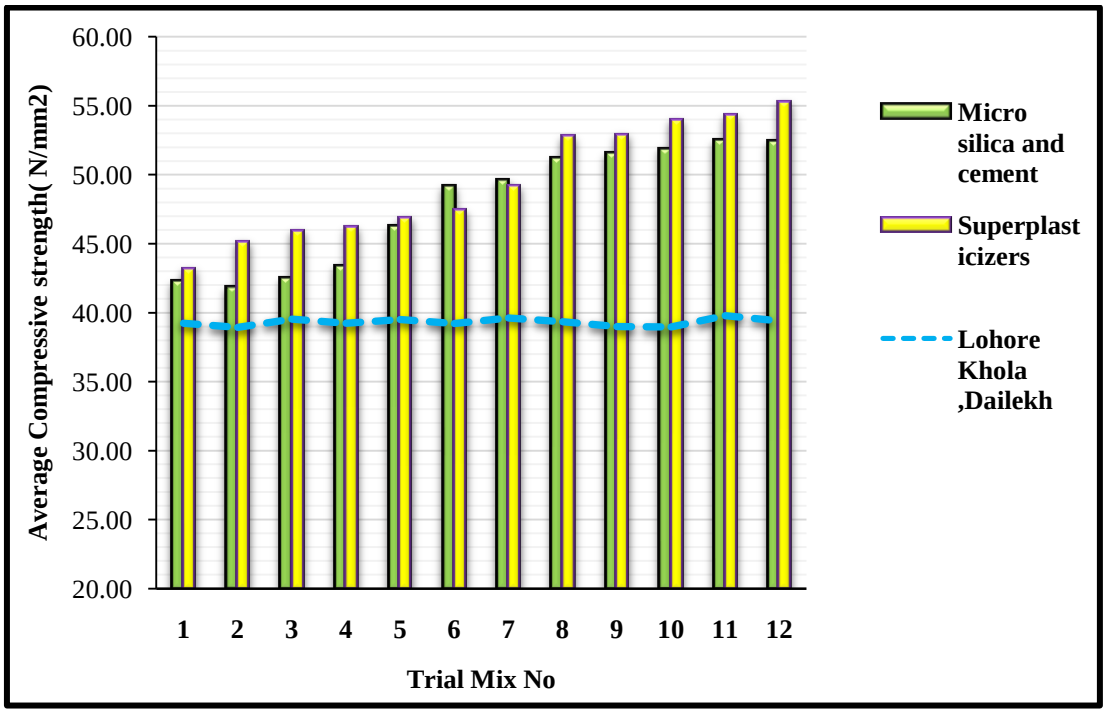

Figure 4. Comparing compressive strength for 28 days with Lohara Bridge site test

Hence, from these above test results, the strength of concrete in the Lohara bridge site has used normal concrete strength whereas the using of micro silica and superplasticizer strength of concrete makes high strength concrete which makes the bridge more durable and high load bearing capacity with little more addition of this types of admixture.

Compare concrete strength for 7days Ruma Bridge test and Laboratory test

In the Ruma Bridge site, when twelve trial mixtures TM1, TM2, TM3, TM4, TM5, TM6, TM7, TM8, TM9, TM10, TM11, and TM12 have were done in a laboratory, it has compressive strength 26.42, 26.86, 26.27, 25.75, 26.42, 26.21, 25.53, 27.31, 25.09, 26.68, 26.64, 25.98 MPa respectively. For Micro silica and cement combination when twelve trial mixtures TM1, TM2, TM3, TM4, TM5, TM6, TM7, TM8, TM9, TM10, TM11, and TM12 have were done in a laboratory, it has compressive strength 26.44, 26.88, 27.2, 27.77, 28.35, 28.66, 28.44, 29.11, 30.22, 30.25, 30.38, 30.85 respectively. Similarly for superplasticizer when twelve trial mixtures TM1, TM2, TM3, TM4, TM5, TM6, TM7, TM8, TM9, TM10, TM11, and TM12 have been done in a laboratory, it has compressive strength 25.86, 26.12, 26.61, 26.95, 27.06, 27.49, 27.66, 28.28, 28.46, 28.63, 28.84, 28.89 MPa respectively for 7 days.

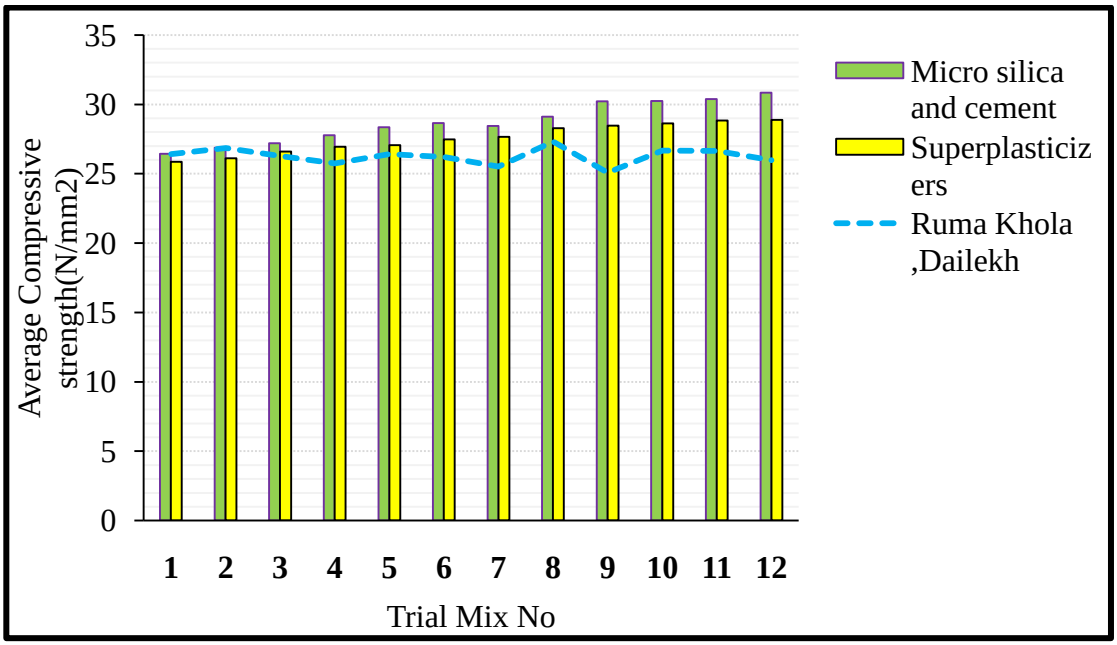

Figure 4.11: Comparing compressive strength for 7days with Ruma Bridge site test

In the Ruma Bridge site, when 12 trial mixtures have been done in a laboratory, in TM1, TM2, TM3, TM4, TM5, TM6, TM7, TM8, TM9, TM10, TM11, and TM12 have been done in a laboratory, it has compressive strength 39.89, 39.59, 39.52, 40.18, 39.96, 39.74, 39.96, 39.34, 39.07, 40.85, 39.56, 39.81 respectively found by investigation. For Micro silica and cement combination when twelve trial mixtures TM1, TM2, TM3, TM4, TM5, TM6, TM7, TM8, TM9, TM10, TM11, and TM12 have were done in a laboratory, it has compressive strength. 42.20, 41.78, 42.44, 43.33, 46.22, 49.11, 49.56, 51.11, 51.46, 51.86, 52.45, 52.36 respectively. Similarly for superplasticizer when twelve trial mixtures TM1, TM2, TM3, TM4, TM5, TM6, TM7, TM8, TM9, TM10, TM11, and TM12 have been done in the laboratory, it has compressive strength 43.12, 45.12, 45.87, 46.12, 46.85, 47.35, 49.12, 52.73, 52.83, 53.93, 54.27, 55.25 MPa respectively for 28 days.

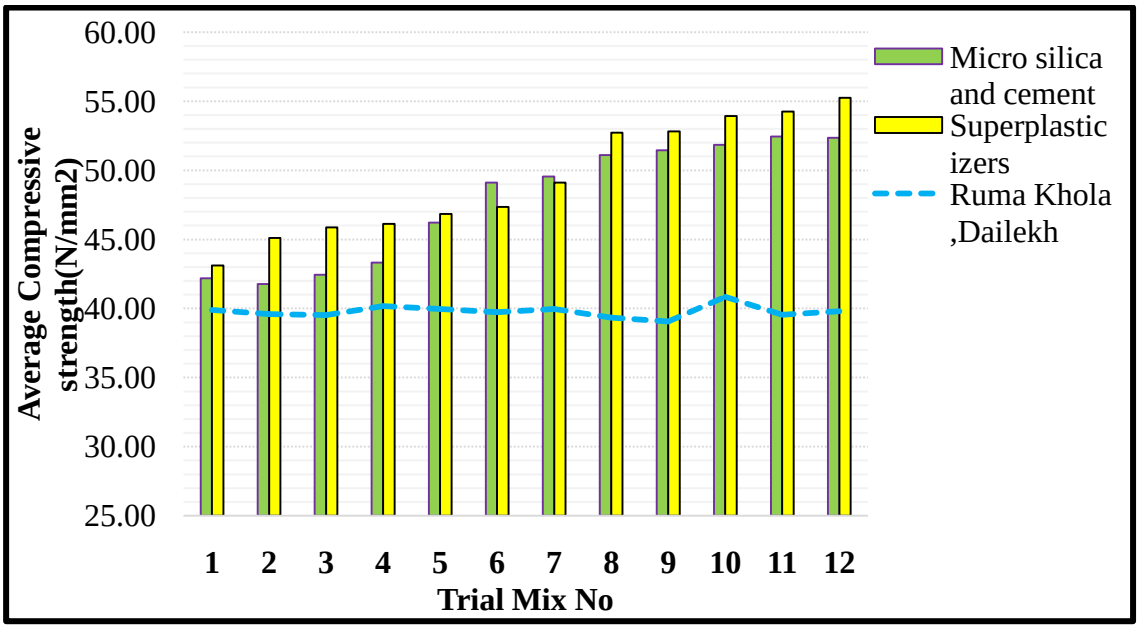

Figure 4.12: Comparing compressive strength for 28 days with Ruma Bridge site test

Hence, from these above test result, the strength of concrete in the Ruma bridge site has used normal concrete strength whereas the using of micro silica and superplasticizer strength of concrete make high-strength concrete which makes the bridge more durable and high load-bearing capacity with little more addition of this types of admixtures.

CONCLUSION AND RECOMMENDATION

Admixtures like Micro silica and superplasticizer appropriate ratio was obtained by a laboratory test in the field and compared with the standard specification for road and bridge, 2073 and IS 10262: 1982. It was found that the ratio of micro silica and superplasticizer 5% and 1.25% respectively weight of cement suitable for different grades of concrete strength. Micro silica and superplasticizer ratio increase with the increase the compressive strength and appropriate types of materials are found based on compressive strength that is superplasticizer and micro silica. While compare with this result on the Lohara bridge site and Ruma bridge site concrete test superplasticizers and micro silica type of admixture is needed to increase the strength of the bridge for more strength in any type of load and durability and environment friendly.

CONCLUSION

The specific conclusions of the study are as:

Therefore, from the above 7-day and 28-day casting of concrete when the percentage of micro silica and superplasticizer increase, the average compressive strength also increases. Thus, there was direct relation with the compressive strength of concrete. This indicates when Micro silica and superplasticizers have a low percentage is not favorable to construct a bridge and any structure in the context of safety, durability, and strength of the construction structure. Whereas micro silica and superplasticizer have very high percentages it is also not favorable in the context of the cost of construction and environmental condition. Hence, the Ratio of silica and superplasticizer has 5% and 1.25% respectively wt. of cement for bridges, roads, and other structures, which is a comparatively suitable ratio for the mixed design of concrete.

Different type of materials used in these studies is Cement, Fly ash and cement combination, Slag and cement combination, Micro silica fume, and Superplasticizer (SP). After several trial mixture tests in the laboratory, the conclusion was drawn by Micro silica and superplasticizer have high strength than the rest of the admixture. Therefore, high-strength concrete superplasticizer and micro silica fume is the best admixture for use in bridge, road, and other structure in construction fields.

Lohara bridge site and Ruma bridge site use concrete like normal strength concrete (NSC) because it has an almost compressive strength of 26 MPa for 7 days and 39 MPa for 28 days which is Normal strength concrete (NSC) but for high strength concrete it must be above M50 concrete. Thus micro silica and superplasticizer increase the strength of concrete make High strength concrete (HSC) which makes the bridge more durable and high load-carrying capacity by the addition of this type of admixture.

Recommendation

For the study following could be recommended:

Admixtures like silica and superplasticizer make the concrete high strength concrete so Micro silica and superplasticizer should choose 5% wt. of cement for bridges, roads, and other structures, which is a comparatively suitable ratio for the mix design of concrete.

Superplasticizer is the best admixture for high-strength concrete (HSC) for bridges, High rise buildings, roads, and other structures in construction fields.

Normal-strength concrete (NSC) has low strength than High strength concrete (HSC). So for a more durable and high load carrying capacity, safety environment-friendly structure, NSC is replaced by HSC by additional admixture available in the market.

Scope for further study

Recommended for further study as below:

This study could not cover the different type of admixture which is available in market.

A similar type of study can be done by a different method by cylinder cube test with a number for test trial mix and the result can be compared with the cube test for each substitute separately.

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SEISMIC VULNERABILITY ASSESSMENT OF INSTITUTIONAL RC BUILDING IN SURKHET VALLEY

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ABSTRACT

This study presents a seismic vulnerability assessment of existing institutional reinforced concrete (RC) buildings in Surkhet Valley, Nepal. The assessment is conducted using non-destructive testing (NDT) to obtain the material properties of the existing buildings, followed by a 3D modeling of the buildings using the Etabs 2000 software. The vulnerability assessment is conducted using a nonlinear static approach, which involves applying incremental displacement to the structure until it reaches a predefined limit state.

Based on the study results, some of the RC buildings in Surkhet Valley are vulnerable to seismic events, and some have low to moderate seismic performance. The study also identified the key factors contributing to the vulnerability of the structures, including insufficient seismic design and construction practices, lack of maintenance, and inadequate building codes and regulations.

Studies have shown that strengthening measure of buildings to improve their seismic performance can significantly enhance their overall performance. In this study, the recommended strengthening measure is to add shear walls at suitable locations in the building.

The findings of the study can be used to develop effective strategies for reducing the vulnerability of school buildings in Surkhet Valley to seismic events. These strategies may include retrofitting or strengthening measures of existing structures, improving construction practices, and enforcing stricter building codes and regulations. Overall, this study provides valuable insights into the seismic vulnerability of school buildings in Surkhet Valley and highlights the need for effective measures to reduce their vulnerability to seismic events.

KEYWORDS: *Vulnerability, Seismic Performance, Retrofitting***.**

INTRODUCTION

School buildings in Birendranagar Surkhet, like many other areas in Nepal, are at risk of earthquake damage due to the region's proximity to the Himalayan mountain range, which is highly seismically active. The risk of earthquake damage in school buildings in Birendranagar Surkhet can be attributed to several factors, many school buildings in Nepal, especially those in

rural areas, were constructed with poor construction practices and inadequate building materials, making them vulnerable to earthquake damage. Until recently, Nepal did not have mandatory seismic design codes for buildings. This resulted in many school buildings being constructed without adequate seismic design features. The region around Birendranagar Surkhet is geologically unstable, with active fault lines running through the area. This makes the area highly susceptible to earthquakes. The area around Birendranagar Surkhet has a high population density, with many people living in densely packed urban areas. In the event of an earthquake, this can increase the risk of casualties and property damage.

Given these factors, school buildings in Birendranagar Surkhet are at risk of earthquake damage. However, by conducting a seismic vulnerability assessment and implementing recommended retrofitting and strengthening measures, the risk can be significantly reduced, and the safety of students and staff can be ensured. It is important for schools in the area to take steps to assess and improve the seismic safety of their buildings to protect the lives of students and staff and ensure continuity of education in the event of an earthquake.

Rationale for the Selection of Study Area

The study area should be located in an area that is prone to seismic activity, particularly in Surkhet Valley, which is located in a seismically active region. The seismic hazard can be assessed by looking at the historical seismic activity of the region and considering the geological and tectonic setting of the area. The study area should have a significant number of RC buildings in the school sector. The building stock should be diverse, representing various types of schools, including primary, secondary, and higher secondary schools. Study area should have a high population density. This is important because high population density areas are more prone to the adverse effects of a seismic event. Additionally, the high population density also means that there is a greater need for safe school buildings. Study area should be easily accessible. This will enable easy access to data and information, and facilitate on-site inspections of the buildings.

There should be adequate data available about the buildings in the study area. This includes information on the construction material, building age, number of stories, occupancy, and usage. This data can be obtained through surveys, interviews, and visual inspections. The selection of the study area should be guided by the need to identify the seismic vulnerability of school RC buildings in a region with a high seismic hazard and a significant number of school buildings. The ultimate goal is to inform policy and decision-making on how to improve the safety of these buildings and protect the lives of the students and staff who use them.

Recent earthquakes have shown that older buildings, which were not designed to withstand earthquakes, have suffered damage, while buildings designed according to modern seismic codes have performed better. In Surkhet valley, many school buildings were constructed without seismic provisions and were designed only to support gravity loads. Following the Gorkha Earthquake in 2015, the Nepal National Building Code has been effectively applied, but most institutional buildings were constructed prior to the application of the code. Therefore, it is necessary to evaluate the vulnerability of these buildings to mitigate the risk of serious damage. This thesis focuses on evaluating the seismic vulnerability of old school RC buildings, which will help to identify the buildings that are capable of resisting seismic forces and suggest seismic strengthening measures for existing RC buildings.

Collection of Data

For the data collection the following methods are adopted:

i. Visual inspection and measurement of the building's structural geometry.

ii. Schmidt Hammer Test to determine the concrete strength.

iii. Rebar Scanner (Rebar Detection Test) to determine the reinforcement's number and size.

Data Analysis Procedures

Non-destructive testing (NDT) is conducted to determine the material properties of the building's components, such as concrete and rebar. The data obtained from NDT is used to build a 3D model of the building using ETABS 2000 software.

The demand capacity curve is determined using non-linear static analysis (pushover analysis) to evaluate the building's displacement and drift. The curve is then compared to the allowable limits specified in the Nepal National building design codes to determine the building's limit state.

Geometrical Description of Building

The research focuses on RC institutional buildings situated in the Surkhet District, specifically in the Birendranagar municipality area of Surkhet valley. The buildings, along with their plans and geometrical features, are illustrated in the below.

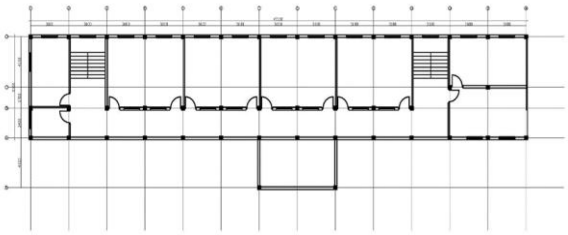

Figure 13: Building Type -

TABLE 2: DETAIL OF BUILDING TYPE -1

SN	Components	Dimension
1.	Length of Building	47.1 m
2.	Breadth of Building	8.5 m
3.	Height of Building	9 m
4.	Number of Storey	3
5.	Column Size	300*350 mm
6.	Beam Size	230*350 mm
7.	Slab thickness	125 mm
8.	No of column	43 nos.
9.	Brick Wall thickness	230 mm

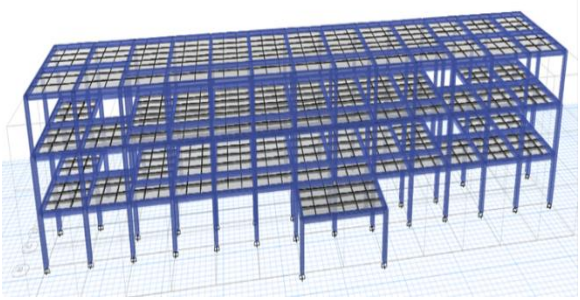

Figure 14: Model of Building Type -1

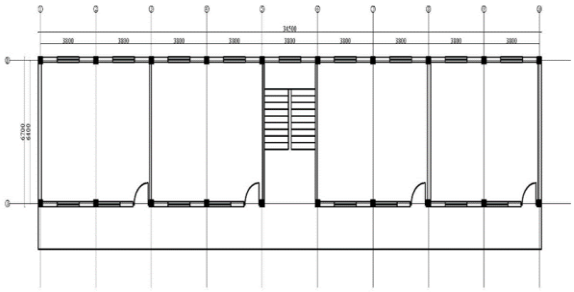

Figure 15: Building Type -2

TABLE 3: DETAIL OF BUILDING TYPE -2

SN	Components	Dimension
1.	Length of Building	34.5 m
2.	Breadth of Building	6.7 m
3.	Height of Building	9 m
4.	Number of Storey	3
5.	Column Size	300*300 mm
6.	Beam Size	230*350 mm
7.	Slab thickness	125 mm
8.	No of column	20 nos.
9.	Brick wall thickness	230 mm

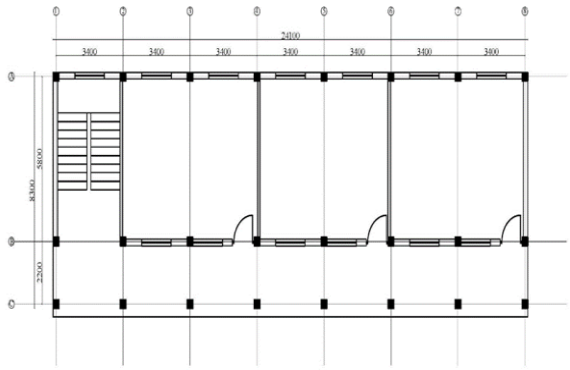

Figure 16: Building Type -3

TABLE 4: DETAIL OF BUILDING TYPE -3

SN	Components	Dimension
1.	Length of Building	24.1 m
2.	Breadth of Building	8.3 m
3.	Height of Building	9 m
4.	Number of Storey	3
5.	Column Size	300*350 mm
6.	Beam Size	230*350 mm
7.	Slab thickness	125 mm
8.	No of column	24 nos.
9.	Brick wall thickness	230 mm

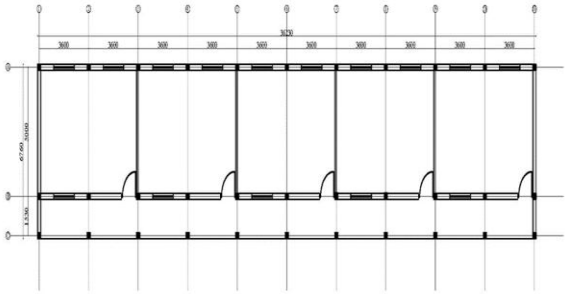

Figure 17: Building Type -4

TABLE 5: DETAIL OF BUILDING TYPE -4

SN	Components	Dimension
1.	Length of Building	36.23 m
2.	Breadth of Building	6.76 m
3.	Height of Building	6 m
4.	Number of Storey	2
5.	Column Size	230*230 mm
6.	Beam Size	230*300 mm
7.	Slab thickness	125 mm
8.	No of column	33 nos.
9.	Brick wall thickness	230 mm

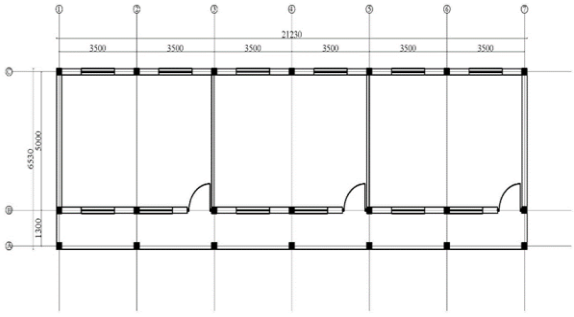

Figure 18: Building Type -5

TABLE 6: DETAIL OF BUILDING TYPE -5

SN	Components	Dimension
1.	Length of Building	21.23 m
2.	Breadth of Building	6.53 m
3.	Height of Building	6 m
4.	Number of Storey	2
5.	Column Size	230*230 mm
6.	Beam Size	230*300 mm
7.	Slab thickness	125 mm
8.	No of column	21 nos.
9.	Brick wall thickness	230 mm

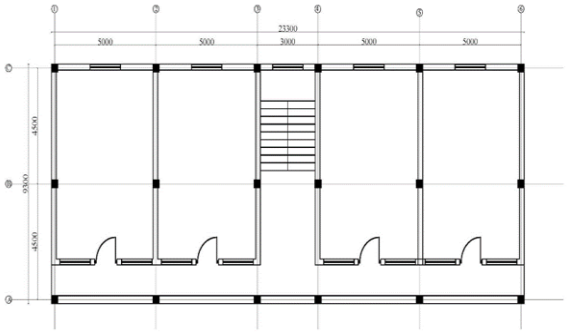

Figure 19: Building Type -6

TABLE 7: DETAIL OF BUILDING TYPE -6

SN	Components	Dimension
1.	Length of Building	23.3 m
2.	Breadth of Building	9.3 m
3.	Height of Building	6 m
4.	Number of Storey	2
5.	Column Size	300*300 mm
6.	Beam Size	230*355 mm
7.	Slab thickness	125 mm
8.	No of column	18 nos.
9.	Brick wall thickness	230 mm

Findings

A. Base Shear, Time Period, Drift, and Displacement

The seismic load, along with accidental eccentricity, was considered for the analysis of all types of RC institutional buildings. Seismic force was applied in both the X- and Y-directions, and some important results are presented below.

Base shear

TABLE 8: BASE SHEAR OF BUILDING.

Types of Building	Base Shear (KN)
Type -1	1860.456
Type -2	1178.7789
Type -3	881.0647
Type -4	639.1502
Type -5	443.4635
Type -6	702.1432

Time period

TABLE 9: TIME PERIOD OF BUILDINGS

Types of Building	Time Period (Sec)
Type -1	0.785
Type -2	0.855
Type -3	0.761
Type -4	0.696
Type -5	0.689
Type -6	0.599

Storey Drift

The storey drift values due to EQx and EQy in the x and y directions have been analyzed and tabulated below for all types of buildings.

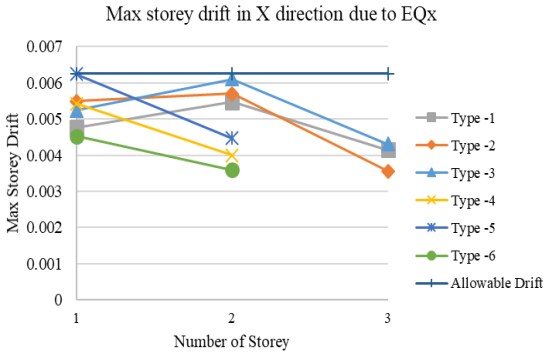

Figure 20: Max storey drift in X direction due to EQx

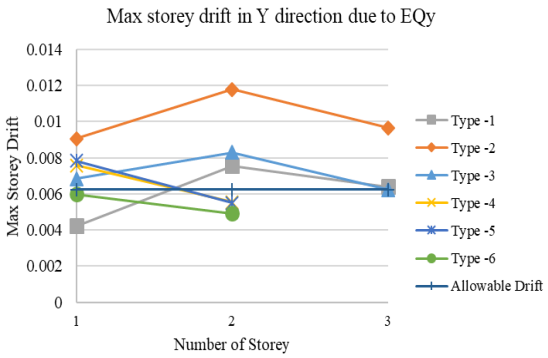

Figure 21: Max storey drift in Y direction due to EQy

The figure above displays the maximum drift values in Institutional RC buildings, as well as the allowable drift as specified by NBC, Ref (Cl 5.6.3). In this case, except building types -6, other all buildings fail the drift check as the ratio of inter-story deflection to the corresponding story height exceeds the allowable drift limit.

Storey Stiffness

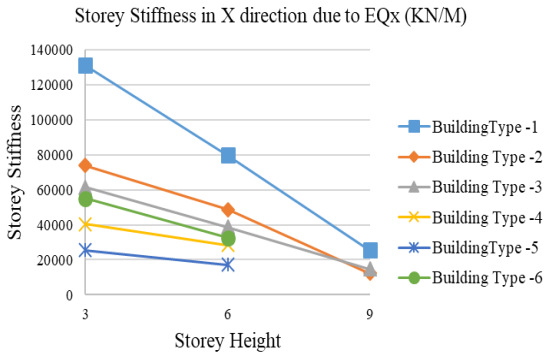

Figure 22: Storey Stiffness in X direction due to EQx.

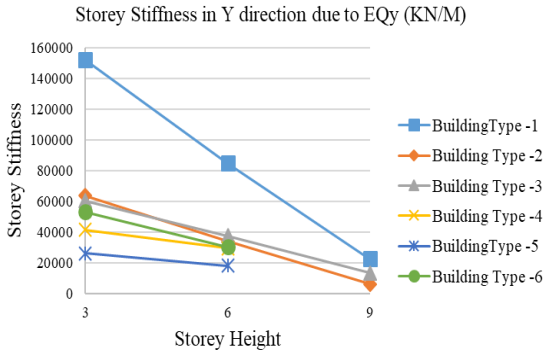

Figure 23: Storey Stiffness in Y direction due to EQy

A soft story is defined as having a lateral-force-resisting system stiffness that is either less than 70% of the stiffness of the lateral-force-resisting system in an adjacent story above or below, or less than 80% of the average lateral-force-resisting system stiffness of the three adjacent stories. Therefore, all buildings in this case have sufficient stiffness in their adjacent stories.

Storey Displacement

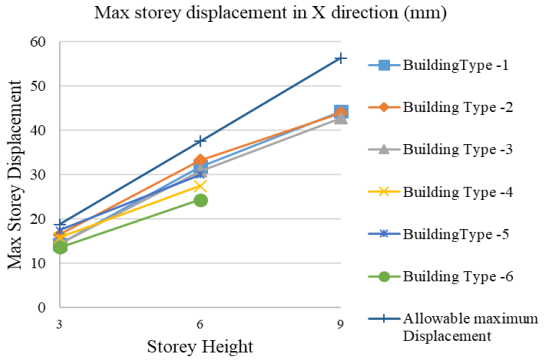

Figure 24: Max storey displacement in X direction

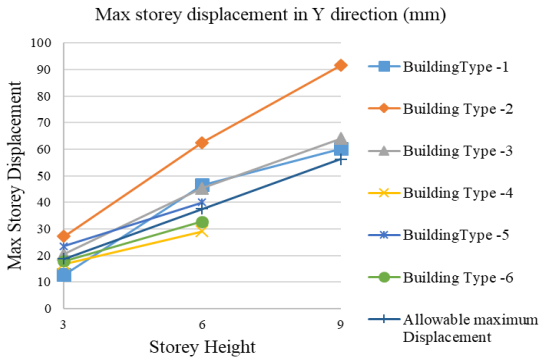

Figure 25: Max storey displacement in Y direction

The graphs shown above illustrate the maximum storey displacement values in Institutional RC buildings, along with the allowable maximum displacement as stated in NBC, Ref (Cl 5.6.3). All of the buildings, except the building type -4 and type -6, are surpass the permissible displacement.

INTERPRETATION OF REASULT

The main output of a pushover analysis is in terms of response demand versus capacity. If the demand curve intersects the capacity curve near the elastic range (Figure 14), then the structure has a good resistance. If the demand curve intersects the capacity curve with little reserve of strength and deformation capacity, Figure 14 (b), then it can be concluded that the building structure will behave poorly during the imposed seismic excitation and need to be retrofitted to avoid future major damage or collapse.

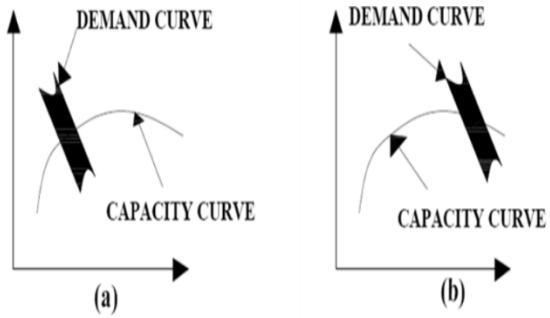

Figure 26: Typical seismic Demand vs. Capacity (a) Safe design (b) Unsafe design. (irjet.net)

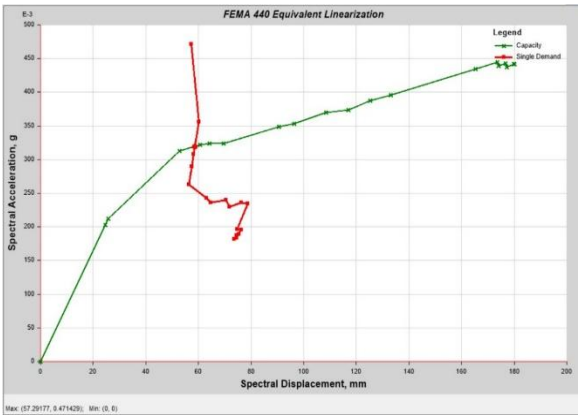

Figure 27: Seismic Demand vs. Capacity Curve for Building Type -1 in PAx

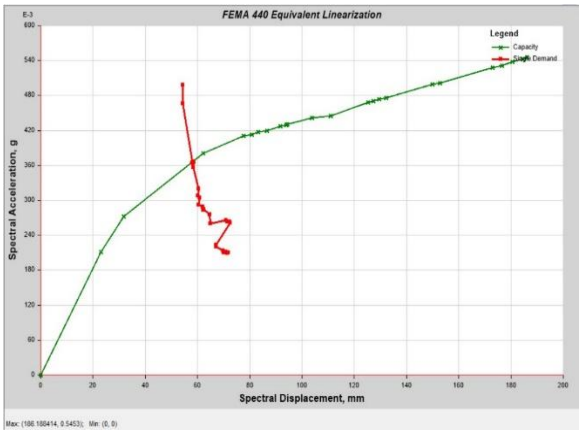

Figure 28: Seismic Demand vs. Capacity Curve for Building Type -1 in PAy.

It can be observed from the given curves that the intersection of the demand curve and the capacity curve occurs close to the elastic range, which falls within the level of immediate occupancy. As a result, retrofitting is not required for building type -1.

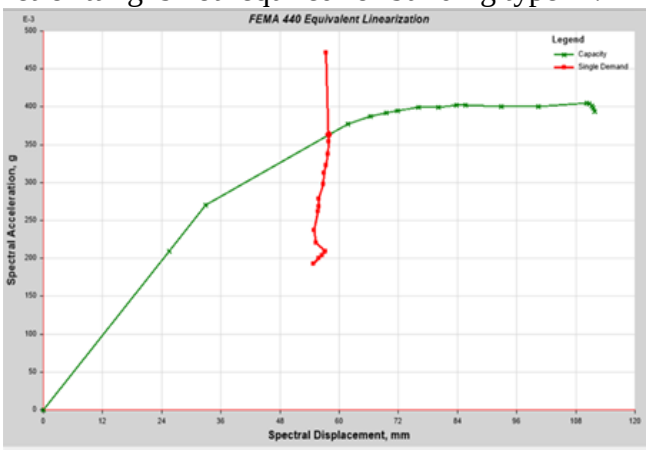

Figure 29: Seismic Demand vs Capacity Curve for Building Type -2 in PAx.

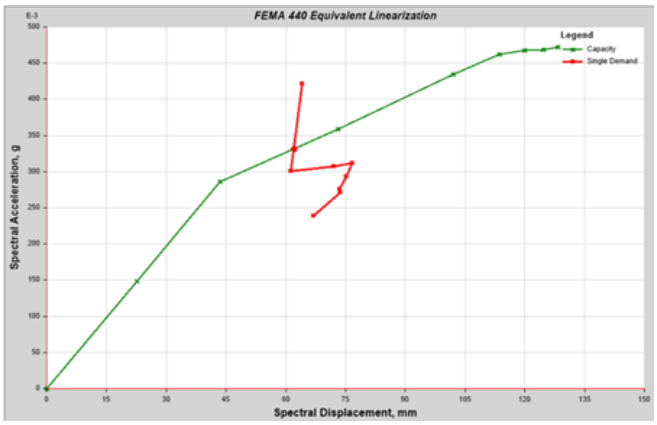

Figure 30: Seismic Demand vs Capacity Curve for Building Type -2 in PAy.

It can be observed from the curves that the intersection of the demand curve and the capacity curve is far away from the elastic range and well beyond the level of immediate occupancy. Hence, retrofitting is required for building type -2.

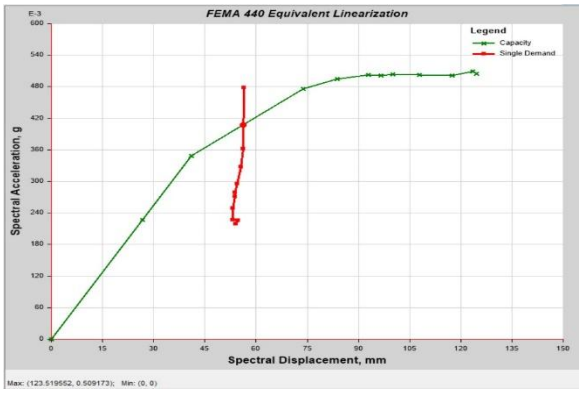

Figure 31: Seismic Demand vs. Capacity Curve for Building Type -3 in PAx

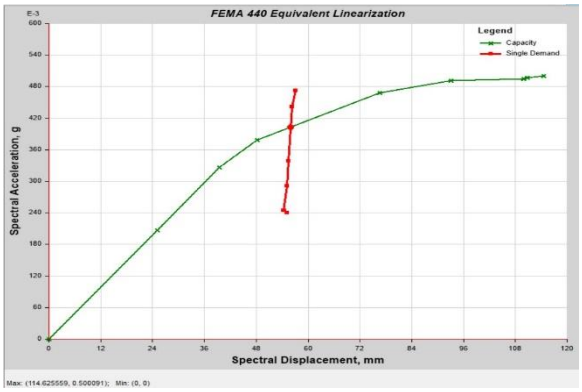

Figure 32: Seismic Demand vs. Capacity Curve for Building Type -3 in PAy.

It can be observed from the given curves that the intersection of the demand curve and the capacity curve occurs close to the elastic range, which falls within the level of immediate occupancy. As a result, retrofitting is not required for building type -3.

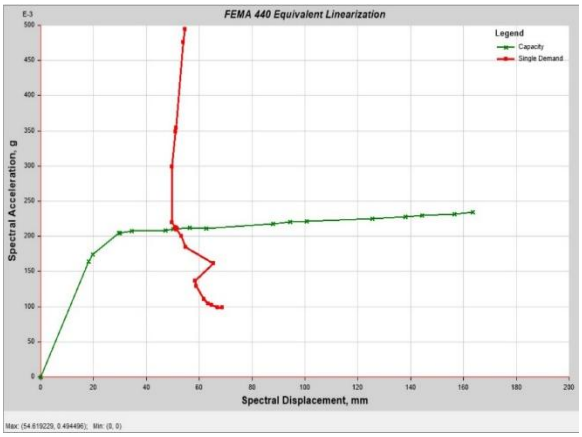

Figure 33: Seismic Demand vs. Capacity Curve for Building Type -4 in PAx.

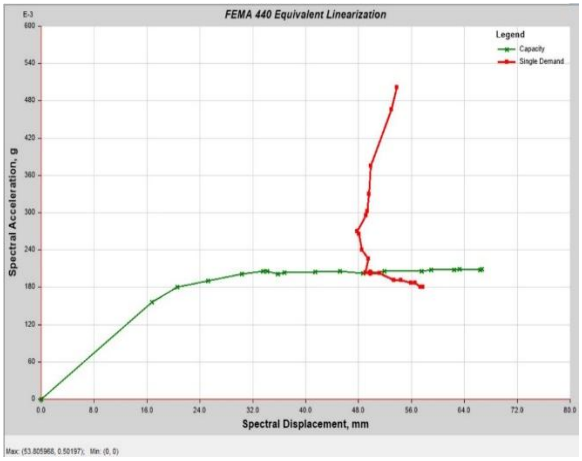

Figure 34: Seismic Demand vs. Capacity Curve for Building Type -4 in PAy.

It can be observed from the curves that the intersection of the demand curve and the capacity curve is far away from the elastic range and well beyond the level of immediate occupancy. Hence, retrofitting is required for building type -4.

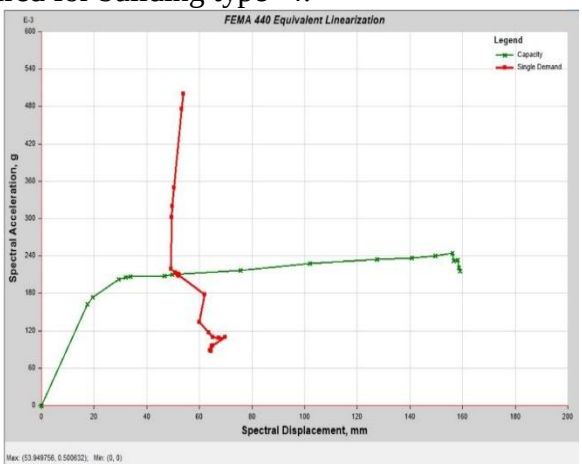

Figure 35: Seismic Demand vs. Capacity Curve for Building Type -5 in PAx.

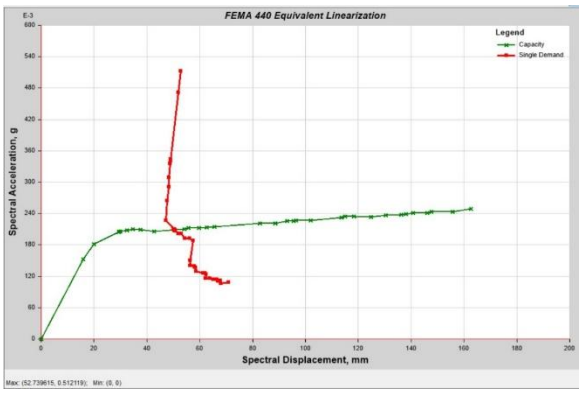

Figure 36: Seismic Demand vs. Capacity Curve for Building Type -5 in PAy.

It can be observed from the curves that the intersection of the demand curve and the capacity curve is far away from the elastic range and well beyond the level of immediate occupancy. Hence, retrofitting is required for building type -5.

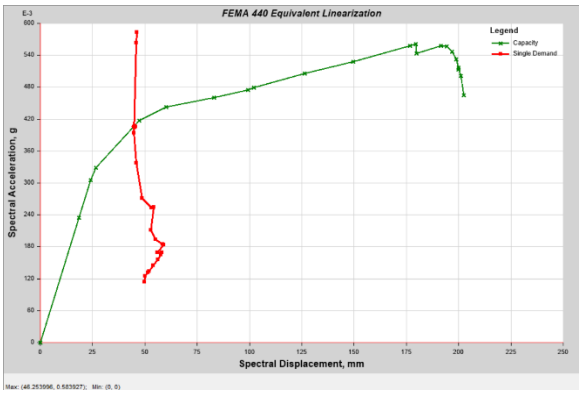

Figure 37: Seismic Demand vs. Capacity Curve for Building Type -6 in PAx.

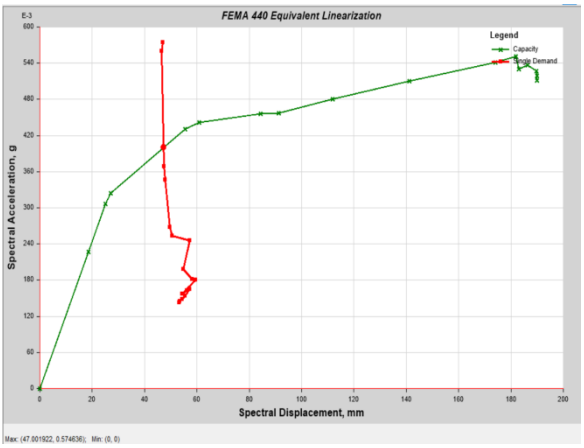

Figure 38: Seismic Demand vs. Capacity Curve for Building Type -6 in PAy.

It can be observed from the given curves that the intersection of the demand curve and the capacity curve occurs close to the elastic range, which falls within the level of immediate occupancy. As a result, retrofitting is not required for building type -6.

Strengthening Measure

The implementation of shear walls in specific areas of a building's structural system results in a change in its performance level. The following comparison of outcomes demonstrates the reinforcement of institutional buildings.

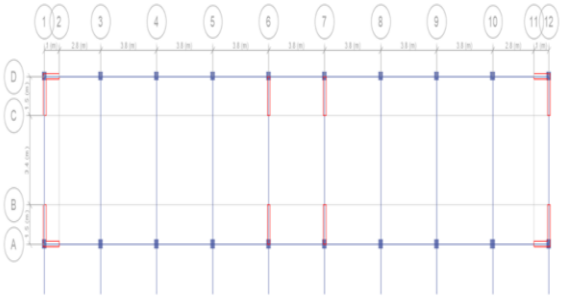

Figure 39: plan of building type -2 after inserting Shear wall.

Comparison In Base Shear

Below is a comparison of the building's analysis for base shear in both the existing case and after strengthening.

TABLE 10: COMPARISON OF BASE SHEAR OF BUILDING.

Types of Building	Base Shear (KN)	
	Existing	After Strengthen
Type -2	1178.7789	1244.28

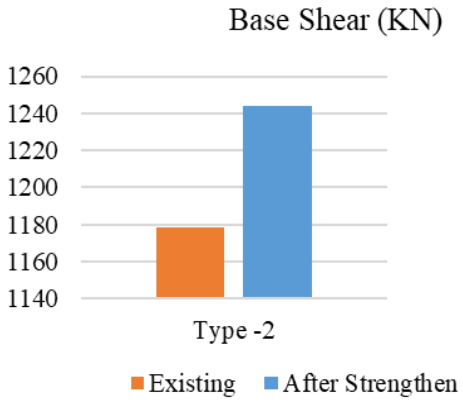

Figure 40: Comparison of Base Shear of Building.

Comparison in Time Period

Below is a comparison of the building's analysis for time period in both the existing case and after strengthening.

TABLE 11: COMPARISON OF TIME PERIOD OF BUILDINGS

Types of Building	Time Period (Sec)	
	Existing	After strengthen
Type -2	0.855	0.391

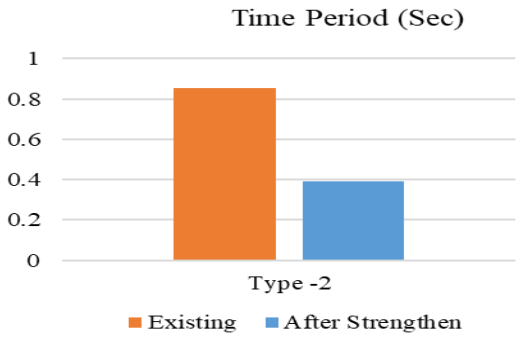

Figure 41: Comparison of Time Period of Buildings

After the strengthening of the building time period are less than the existing Condition.

Comparison in Storey Drift

For building type-2, the storey drift values in the x and y directions due to EQx and EQy were analyzed and tabulated to compare the values before and after the building was strengthened.

TABLE 12: COMPARISON OF MAX STOREY DRIFT IN X DIRECTION DUE TO EQX

Max storey drift in X direction due to EQx			
Storey Height	Type -2 existing	Type - 2 after strengthen	Allowable Drift
3	0.00549	0.000962	0.00625
6	0.00571	0.001857	0.00625
9	0.00356	0.002723	0.00625

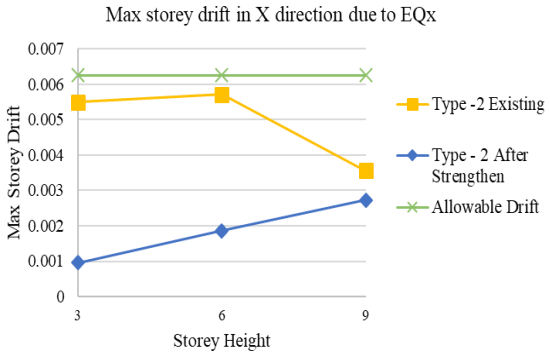

Figure 42: Comparison of Max storey drift in X direction due to EQx

TABLE 13: COMPARISON MAX STOREY DRIFT IN Y DIRECTION DUE TO EQY

Max storey drift in Y direction due to Eqy			
Storey Height	Type -2 Existing	Type - 2 After Strengthen	Allowable Drift
3	0.00907	0.000415	0.00625
6	0.01178	0.000807	0.00625
9	0.00966	0.003553	0.00625

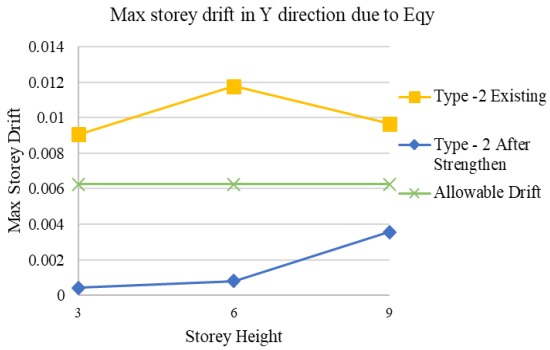

Figure 43: Comparison of Max storey drift in Y direction due to EQy

The graphs shown above illustrate the highest recorded drift values in Institutional RC buildings, along with the drift limit specified by NBC, Ref (Cl 5.6.3). For type-2 buildings, the maximum storey drift after the strengthening is within the allowable limit.

Comparison in Storey Stiffness

For building type-2, the storey Stiffness values in the x and y directions due to EQx and EQy were analyzed and tabulated to compare the values before and after the building was strengthening.

TABLE 14: COMPARISON OF STOREY STIFFNESS IN X DIRECTION DUE TO EQX (KN/M)

Storey Stiffness in X direction due to EQx (KN/M)		
Storey Height	Type -2 Existing	Type -2 After Strengthen
3	12321.876	433482.577
6	48565.795	167159.784
9	11970.78	15689.932

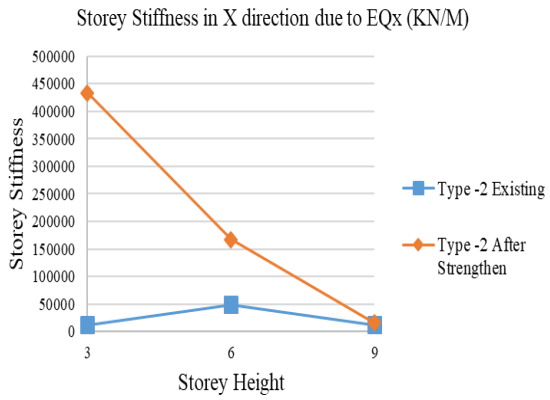

Figure 44: Comparison of Storey Stiffness in X direction due to Eqx

TABLE 15: COMPARISON OF STOREY STIFFNESS IN Y DIRECTION DUE TO EQY

Storey Stiffness in Y direction due to EQy (KN/M)

Storey Height	Type -2 Existing	Type -2 After Strengthen
3	63814.067	1291379.087
6	34007.534	475932.787
9	6241.107	12362.789

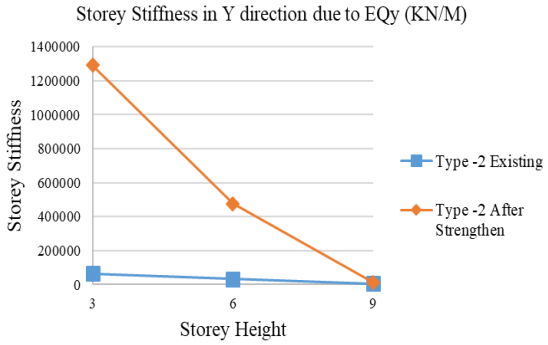

Figure 45: Comparison of Storey Stiffness in Y direction due to EQy

A soft story is defined as having a lateral-force-resisting system stiffness that is either less than 70% of the stiffness of the lateral-force-resisting system in an adjacent story above or below, or less than 80% of the average lateral-force-resisting system stiffness of the three adjacent stories. Therefore, building types -2 in this case have sufficient stiffness in their adjacent stories.

Comparison in Storey Displacement

For building type-2, the storey displacement values in the x and y directions due to EQx and EQy were analyzed and tabulated to compare the values before and after the building was strengthening.

TABLE 16: COMPARISON OF MAX STOREY DISPLACEMENT IN X DIRECTION

Max storey displacement in X direction (mm)			
Storey Height	Type -2 Existing	Type -2 After Strengthen	Allowable maximum Displacement
3	16.495	2.886	18.75
6	33.273	8.474	37.5
9	43.854	16.603	56.25

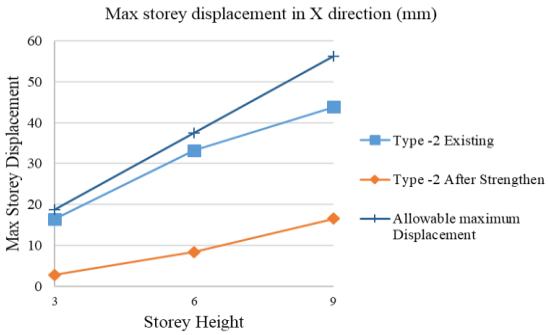

Figure 46: Comparison of Max storey displacement in X direction

TABLE 17: COMPARISON OF MAX STOREY DISPLACEMENT IN Y DIRECTION

		Max storey displacement in Y direction (mm)		
Storey Height	Type -2 Existing	Type -2 After Strengthen	Allowable maximum Displacement	
3	27.192	1.244	18.75	
6	62.543	3.74	37.50	
9	91.519	14.298	56.25	

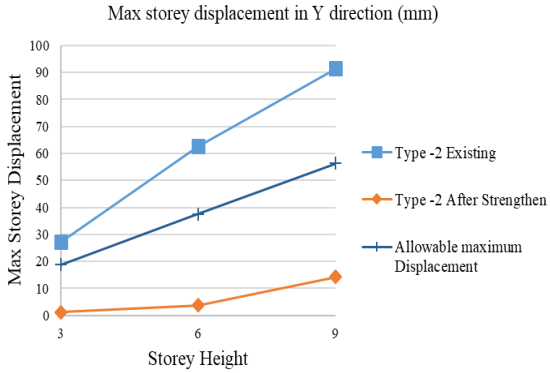

Figure 47: Comparison of Max storey displacement in Y direction

The graph indicates that the story displacement values for building type -2 in existing and after strengthen condition. In existing condition, the story displacement is surpassing the allowable maximum displacement while after the strengthening the building story displacement value is within the acceptable limit.

CONCLUSIONS

The conclusions from this study are summarized as follows:

1. Based on the results above, it has been determined that out of the six types of buildings, three do not require strengthening, while the remaining four are requiring strengthening.
2. The intersection of the Seismic demand curve and the Capacity curve occurs close to the elastic range, which falls within the level of immediate occupancy. As a result, it is not necessary to retrofit building type-1, type-3 and type -6.
3. Based on the Demand Capacity curves, it can be observed that the intersection of the seismic demand curve and the Capacity curve occurs far from the elastic range, which is also beyond the immediate occupancy level. Therefore, building types -2, -4, and -5 require retrofitting.
4. Shear walls are an efficient method for strengthening the structure and enhancing its performance level in the aforementioned types of buildings.

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SEISMIC BEHAVIOUR OF RC BUILDINGS IN SLOPING GROUND

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ABSTRACT

This thesis is the study of seismic behavior of RC building in hilly areas i.e sloping grounds. The study of dynamic response of structure on hilly areas has been done. Two combo building (half of building lies in sloping ground anf half portion lies on plain ground) are considered for analysis on sloping ground of uneven slope without changing existing ground profile with considering and without considering shear wall. All considered configuration of building is modeled using ETABS v20.0.0 and IS 1893:2016 and analysed by using equivalent static analysis and response spectrum methods. Then considered buildings has been compared in terms of base shear, Fundamental time period and top storey displacement, Storey stiffness, Storey drift and overturning moments.

KEYWORDS: *Combo Building, Storey Displacement, Storey Drift, Storey Stiffness, Overturning Moments.*

1. INTRODUCTION

1.1 Background

The Federal Democratic Republic of Nepal lies in one of the active continental collision zone of the world, the Himalaya, where the probability of Earthquake occurrence is very high. Many destructive Earthquakes have been reported in the historical records within the Himalayan arc. Out of which the 1934 Bihar-Nepal Earthquake and 2015 Gorkha Earthquake Mw 7.6 (Mw 7.8) occurred in the Nepal Himalaya (NEMRC, 2023).

Due to lack of plain areas in hilly areas steep ground adds additional challenges to seismic analysis of RC building because it may affect the stability and performance of the building during seismic activities. Due to steep nature of ground building are irregular and unsymmetrical in horizontal and vertical planes.

After the federalism in the country economic activities and rapid urbanization in hilly area has been increased. . So after the federalism, demand and necessity of construction of multi storey building in hilly areas has been increased. These needs and demands should be addressed with the proper study of seismic behavior of RC building in sloping areas.

1.2 Objective of Study

To evaluate seismic response (Fundamental time period, Base shear, Top storey displacement,

Storey drift, Storey Stiffness and Overturning Moments) of various RC buildings on uneven slope without changing it's existing ground profile by seismic coefficient method and response spectrum method.

1.3 Scope and limitation of study

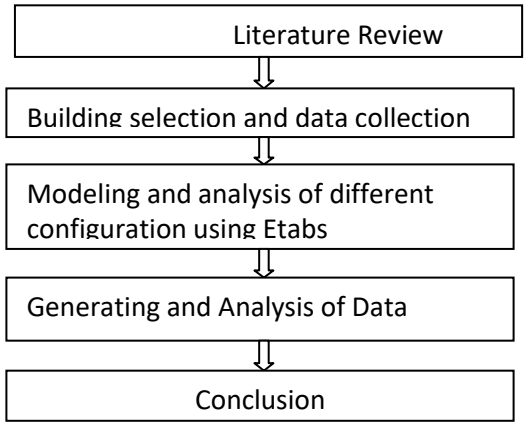
Two combo buildings of 4 storey on sloping ground of uneven slope without changing it's existing ground profile are analysed, one is building without shear wall and another is with shear wall. Equivalent static and response spectrum analysis are carried out to find the response of considered building in the form of Base shear, Fundamental Time Period, Top Storey Displacement, Storey Drift, Storey Stiffness, Overturning Moments and comparison is done. Finally Building configuration suitable in sloping ground of uneven slope is suggested based on finding of work.

This study does not consider the effects of other natural hazards such as floods, landslides etc. This work does not include detail study about effect of SSI on seismic performance of considered building.

2. Research Methodology

2.1 Conceptual Framework of Research Design

For seismic analysis of all considered building in ground of uneven slope without changing its existing ground profile, it is required assess all the point of the study area based on the set of selected criteria .overall methodology is shown in flowchart.

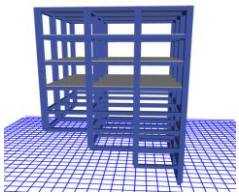
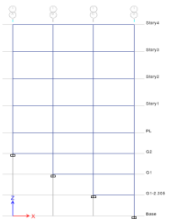


Building Frames

Step back (SB) frames

In this building configuration horizontal plane remains same but on the lower part it will maintain slope as per terrain or topography of the area. In these types of buildings the foundation of different grid columns are at different level.

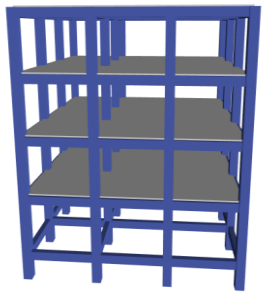
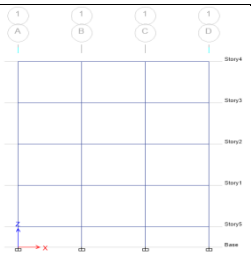
TABLE 18 3D FRAME AND ELEVATION OF STEP BACK BUILDING

3D Frame	Elevation
	

Building on plain land:

This types of building is normally constructed on plain land. They are regular structure with symmetry in both x and y direction.

TABLE 19 3D FREAME AND ELEVATION OF BUILDING ON PLAIN LAND

3D Frame	Elevation
	

Combo Building in Uneven Slope

This is the combination of step back building in slope and normal building in plain areas. It considered all factor considered on both step back building in slope and normal building in plain. In this building configuration half of the structure is arranged in stepping pattern in slope and half is like normal building in plain areas so the horizontal plane is not remains same along with lower part of the structure. In these type of structure the foundation level of different grids columns are at different level in sloping region but in plain region foundation level are at same level.

TABLE 20 3D FRAME AND ELEVATION OF COMBO BUILDING

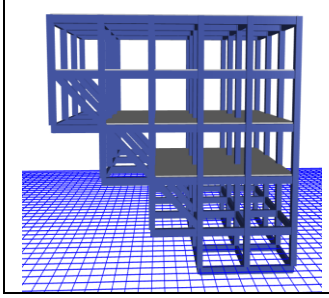
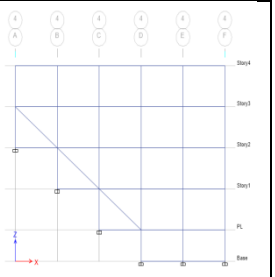
3D Frame	Elevation
	

TABLE 21 3D FRAME AND ELEVATION OF BUILDING WITH SHEAR

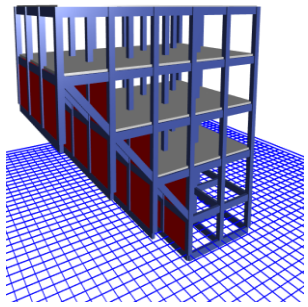
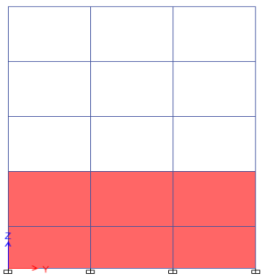
3D Frame	Elevation
	

TABLE 22 SIZES OF BEAM AND COLUM

Building Types	Column size	Beam size
All	500*500 mm	300*450 mm

TABLE 23 SPECIFICATION OF BUILDING

Seismic zone	V
Zone factor	0.36
Response reduction factor	5
All general buildings	1.5
Damping ratio	5%
Structure type	RC frame building
Soil type –medium	II
Concrete grade	M20
Steel grade	Fe500
Floor height	3 m
Depth of Foundation	m

2.2 Data Analysis Procedure

For the analysis of data, Analysis methods are widely characterized as linear and nonlinear, static and dynamic. Data analysis procedures adopted in research work are as follow:

1. Linear static Analysis (Equivalent Static Analysis)
2. Linear Dynamic Analysis (Response Spectrum Analysis)

IS 1893 (part 1) : 2016 is used for analysis of building by above mentioned methods.

2.3 Load C0mbination

Load Combinations are taken as per IS 1893:2016 code and are as follows:

1. 1.5(DL+LL)
2. 1.2(DL+LL±EL)
3. 1.5(DL±EL)
4. 0.9DL± 1.5EL
5. $\pm EL_x \pm 0.3\ EL_y \pm 0.3\ EL_Z$
6. $\pm 0.3\ EL_x \pm EL_y \pm 0.3\ EL_Z$
7. $\pm 0.3\ EL_x \pm 0.3\ EL_y \pm EL_Z$

3. Results and Discussions

For analysis of all considered building seismic load is considered along with accidental eccentricity. Data of combo building in uneven slope without changing it's existing ground profile with and without considering shear wall on building are presented and interpretation of data is done simultaneously.

3.1 Base shear

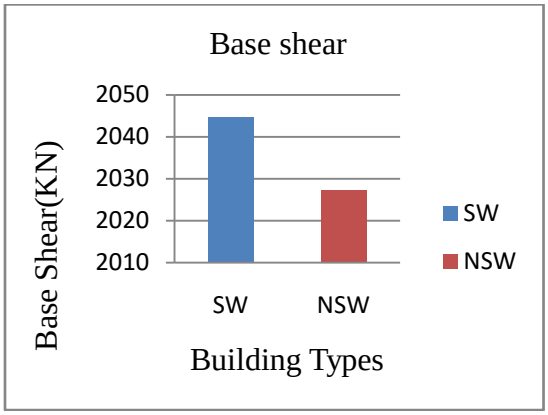


Figure 48 Base Shear of Buildings

From the chart we can see that addition of shear wall on building increase the value of base shear by 17.36

KN. This is due to load of shear wall greater than wall load.

3.2 Time Period

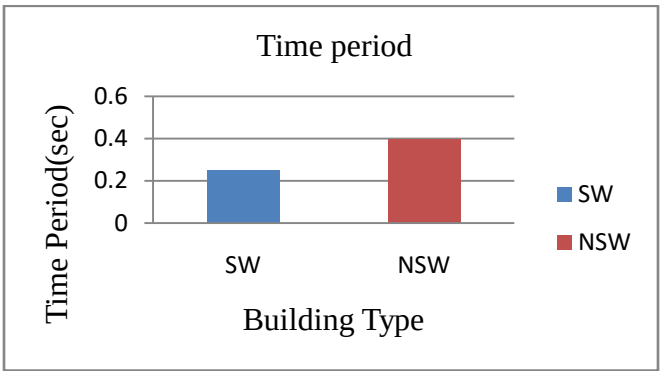


Figure 49 Time Period Of Buildings

From the Chart, Fundamental time period of building with provision of shear wall decrease by 36.20 %. It is due to rigidity provided by shear wall on building.

3.3 Storey Drift

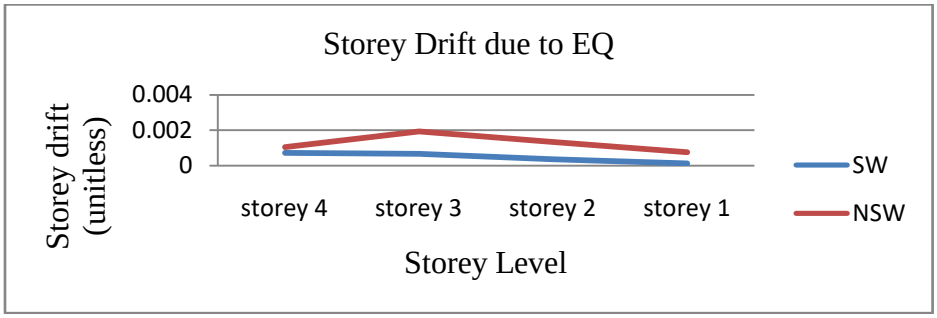


Figure 50 Storey Drift in building due to earthquake

From above graph it is seen that storey drift decreases with addition of shear wall on building. Average storey drift decrease by 30.29%, 64.76%, 71.64% and 81.75% in step 4, step 3, step 2 and step 1 respectively after the provision of shear wall. This is due to rigidity provided by shear wall.

3.4 Storey Stiffness

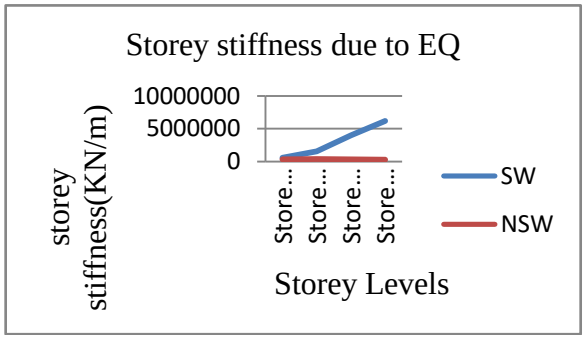


Figure 51 Storey Stiffness of Buildings

From the figure given above, we can see that storey stiffness increase in building after addition of shear wall on building. Lower storey shows high degree of stiffness than upper stories.

3.3 Storey Stiffness

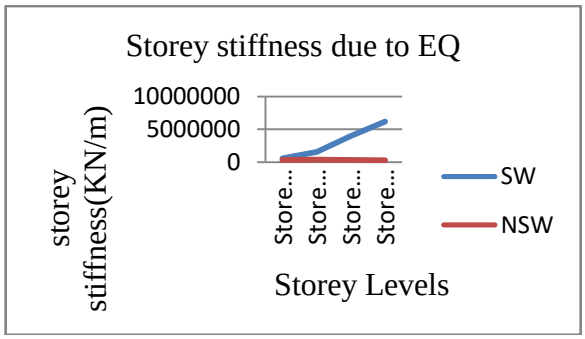


Figure 52 Storey Stiffness of Buildings

From the figure given above, we can see that storey stiffness increase in building after addition of shear wall on building. Lower storey shows high degree of stiffness than upper stories.

3.4 Top storey Displacement

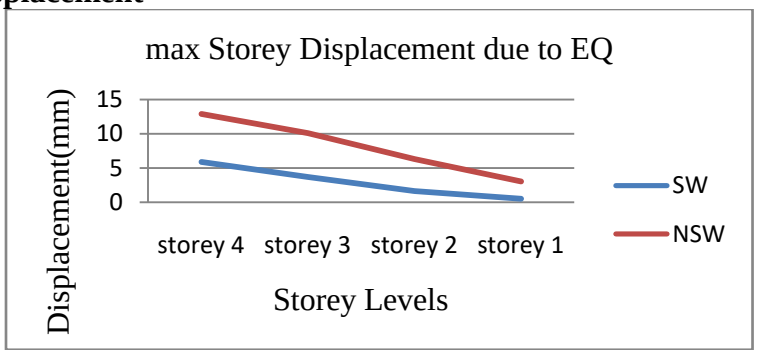


Figure 53 Top Storey Displacement in Buildings

From above figure, we can see that top storey displacement decreases after addition of shear wall. Here top stories decrease by 54%, 63.65%, 73.99% and 83.30% respectively in step 4, step3, and step 2and step 1 respectively.

3.5 Overturning Moments

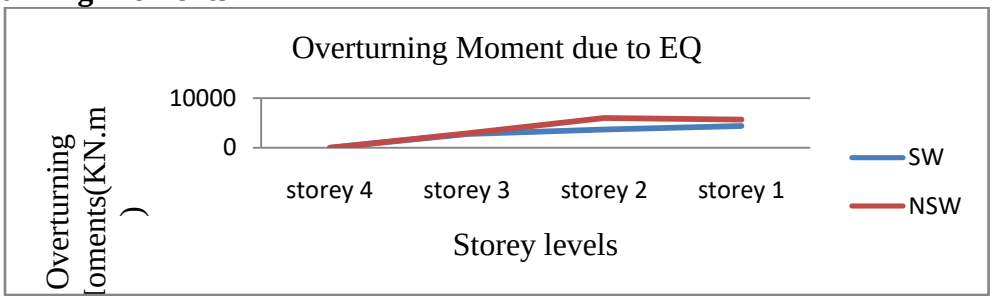


Figure 54 Overturning Moments in Buildings

From above figure, we can see that overturning moments reduces by addition of shear wall in building. The average reduction on overturning moments in building after addition of shear wall is 21.12%.

4. Conclusions and Recommendations

From above study following conclusion are made:

- On analyzing base shear, it can be concluded that addition of shear wall increase the base shear of building.
- On analyzing time period of buildings, time period for building with shear wall decrease than building without shear wall.
- On analyzing Storey drift of buildings, it is concluded that provision of shear wall reduces the storey drift in buildings.
- On analyzing storey stiffness of buildings, it is concluded that Storey stiffness of building increase greatly with provision of shear wall on building.
- On analyzing top storey displacement of buildings, it is concluded that top storey displacement of building with shear wall is less than building without shear wall.
- On analyzing overturning moments of buildings, it is concluded that overturning moments for building with shear wall is less than building without shear wall.
- Hence, building with shear wall is favored in sloping ground of uneven slope without changing its existing ground profile.
- In this study the buildings are analysed with linear static and linear dynamic analysis only, it is recommended to analysed buildings with non- linear dynamic analysis. Also it is recommended to consider natural hazards like landslides, flood etc.

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"A CRITICAL STUDY OF GEMELLI CARERI'S INDIAN JOURNEY WITH SPECIAL REFERENCE TO SOCIO –CULTURAL INFORMATION"

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ABSTRACT

The subject matter of History is the human past. A variety of materials are used in history to study the past. Although we have abundant court and non-court Persian sources available for the study of medieval India, yet the political content in those sources is more. And the details related to the then Socio-economic and religious life are less. In the context of medieval Indian history, this deficiency can befilled through the accounts of contemporary foreign travelers. Many European travelers visited India in the 17th century. But the place of Italian traveler Gemellicareri (1651-1725 AD) is very high among the European travellers of India.

In his travelogue- "A voyage round the world", careri has given a detailed description of the cities and vegetation, Society and religious beliefs of South and West Indian people. Although careri has tried to accurately describe the then Society and their religious beliefs, however he has not been able to deeply understand many of the traditions and customs of contemporary Indian Society. But there is no doubt, he accurately describes the Indian flora and cities of South and West India overall, both sides of his travel account – the beneficial and the flawed side are visible.

KEYWORDS: *Constantinople, Isfahan, Galgala, Caravan Inn, Bernier, Tavernier, Flora, Telangani, Persian, Eclipse, Vaitarni.*

INTRODUCTION

If we look in the context of Indian history, it is acknowledge that foreign travelers have been visiting India since ancient times. Even in the medieval period, many European travelers came to visit India for various purposes. Especially the name of Bernier, Tavernier, Thevnot, Manucci and careri is important in these European travelers.[1]These travelers have given a detailed description of the contemporary Society, economy and religious beliefs in their travelogues. Among these, especially Italian traveler Gemelli Careri (1651-1725 AD) travelogues has its own special historical significance.

In this research Paper, an attempt has been made to specifically see what information Italian traveller GemelliCarerihas given about the then Indian society culture, religion or religious beliefs and economy in his travelogue–"A voyage round the World" and from what point of view.Gemellicareri was a 17th century Italian adventurer and traveler. It is known from the available sources that Careriwas born in Italy in 1651 AD and received the education of law and

justice. After completing his education, he practiced law for a few years. After that careri had left the home. In 1685 AD he took time to travel to Europe (France, Spain Hungry etc), but in 1689 AD, he returned home due to his circumstances. But when careri did not get much success even in his legal profession, he went on a journey to eastern Countries.

When Gemelli Careri set foot in India, it had been fifteen years since shivaji's death. It is important to mention that this medieval traveler form Italy meet Mughal Emperor Aurangzeb, when he was caught in the middle of the Deccan Campaigns. He had toured the whole world of which India was actually a small part. Careri started his world tour from Naples in June 1693 AD and visited Egypt, Constantinople, Trebizond and Isfahan and returned to Europe via Pekin, Philippines and it was done via Vera Cruz. In the early part of 1695 AD, careriCame on a short visit to India.[2]

It is important to mention that careri travels from Goa to Galgala for the purpose of meeting, with Mughal EmperorAuranzeb. Careri describe travelling in India as expensive. He especially mentions the presence of guards and toll officials at the bottom of the mountain at Balaghati and they very greedy in nature.[3]Careri describes the entire travelling process as costly, inconvenient and difficult. He tells these guards and toll officers to the attracted to the goods of others.

Careri has also thrown on the lack of travel and passenger facilities in the state of Bijapur. He also complains of non-availability of draft animals for his carts. According to careri "there are not even Caravan inns at convenient distances".[4]And the fear of thieves always remained. And at the same time, he says that the fear of Maratha attacks always remained-even if it was near the Mughal camp that means there was no protection from Maratha attacks anywhere. But he mentions that apart from Bijapur state, travelling to other place of India is both convenient and safe.

Caren also describes the Mughal Camp at Galgala which was spread in a radius of thirty miles long According to Careri, a population of about one million lived in it. And the camps of the emperor Aurangzeb and his sons used to be spread over an area of about three miles. He sees that there is happiness, luxury and lack of virility everywhere. And the lack of discipline was evident even among the Mughal and mercenary European soldiers.

Careri appeared before the Mughal Emperor Aurangzeb on March 21, 1695.[5] He describes the emperor as an old man of eighty years, a king with white beard, tall and thin body, wheatish complexion and pointed nose. And the Emperor was dressed in simple white muslin, wearing a turban, in which a large emerald was attached. Surrounded by his Nobles (Umrah), with the help of a skick, he was taking reports from people and reading them without any spectacles. Careri was surprised that the king was doing this work with such a smile and happiness in this condition. The Emperor also talked to Careri with affection. The Emperor Aurangzeb also requested him (as he did to all visiting Europeans) that careri take a Job in the Mughal Empire.Careri also makes interesting and important comments on Mughal administrative systemand land revenue management.[6] He also discusses the revenue wealth of Emperor Aurangzeb. Besides this, he also throws light on the area expansion of his empire.

Careri discusses the autocratic authority of the Mughal Emperor and also throws light on militry, organization of the Mughals.[7] But it is. Important to mention only here that he only repeats the same old things, as written by other European travelers, So, it is neither important nor necessary to discuss these things in detail here.

The description of South and west India given by careriis very delightful and interesting. It is important to mention thatfor many years Modern Scholorsandexpert did not consider careri's adventurous journey authentic with time, howeverit's truthfulness was proved.

Gemellicareri has given a detailed description of the cities and vegetation especially located in the south and west of India. In particular, he describes the coastal cities i.e.-Goa, Camby Damen, Surat, Ahmedabad etc. and their commercial importance.[8] Similarly, careri has mentioned different types of Plants-trees and vegetation like coconut, Beetalnut, Palm, Jamun, Pappaya, Jaquers, cinnamon, Pineapple etc.[9] In this context it is important to mention that careri has given detail and accurate description of the Indian flora in his travelogue. This is probable not found in any other contemporary European traveller's account.

Gemelli careri, (who come to India in the late 17thcentury) has also given detail details about Indian social life and religious beliefs. In this context careri writes that religions (Dharm) are prominent in the social life of Indians. By the way defining the word 'Dharm' is a complex task, however "Dharm" is an important term., for Indian Socio-religions context. In Hindustan it means duty, virtue, morality, even religion and it refers to the power which upholds the universe and society. According to famous historian K.M. Ashraf - "Dharm is an attempt to determine the moral outlook of a social group.[10]It is essential to mention here that most of the travellers who visited India at that time found the social life and religious beliefs of Indian Society very different from their own motherland or their respective countries.

GemelliItalian traveler Careri divided the contemporary Indian society on the basis of religion and caste. He has written about Hindu religion that followers of Hindu religion had full faith in God, Soul, heaven-hell and rebirth.[11] French Traveler Tavernier[12] also corroborated careri's view.Regarding religious beliefs of the Hindus careri said, "Hindus believed in seven different worlds (lok).

They believed that these are the seven worlds (loks) — Bhu, Bhuva, Swah, Mah, Janah, Tappah, Satyam" And a person gets a place in these worlds according to their deeds.[13] In this context, NiccoloManucci, (anotherItalian travellor)also confirmed that the Hindus strongly believed in the Concept of multiple worlds and Heaven and Hell.[14] Besides this, they also believed that "Manu' was the first man of the Universe and the whole world is his Child.

GemelliCareri also informed us that the Hindu people worshipped. Many Gods andGoddessess. Regarding this Italian traveler manucci writes that Hindus used to believe in 33 crore Gods and Goddessess. And the Hindus did not even know the names of all of them.[15]

Careri mentions some other Socio–religious beliefs and superstitions of the Hindus. Especially at the time of eclipse, Brahmins and other Hindus used to break their utensils and used to beat the drums. Apart from this, Hindu's used to bath the river and used to give a lot of Charity at the time of eclipse. Careri's account is also corroborated by the some other European travellors of 17th century. It is important to point out that all these European travellers show that Hindus did not know the scientific reasons for eclipses. But their opinion does not seem to be correct. Because the scientific reasons for Lunar and Solar eclipses were known to Indian astrologers and astronomers since ancient times.[16]

GemelliCateri also informed us that superstition was very prevalent among the Hindus.[17]And due to this many times they used to kill their children too. The Hindus also considered the cow very sacred and gave it the name of 'Mother'. And whena Hindu died, cow urine was sprinkled on the

person's face. Another popular beliefs of the Hindus was that the 'Vaitarni River' could be Crossed only by holding the tail of cow. By the way, according to Hindu mythological belief crossing the vaitarni river was very painful.

Apart from this, careri also describes witchcraft and magicians of the contemporary society. But they used to mislead and deceive people by showing different types of shows. In this context, Gemellicareri is also corroborated by another traveller Frankos Martin. According to travellor Martin, "The Hindus were very superstitions and used to believe in witchcraft and also believed in Shakun vidya.[18]Carerihas also mentions that Hindus believed in Idol worship and their main deities were Sri Ram and Sri Krishna. And Hindus worshipped Sri Maha Lakshmi as the chief among the goddesses. Similarly, carerihas also thrown light on the places and methods of worship of the Hindus. He informs us that the temples of the Hindus were round. Careri has also given a brief description of some of the temples in the south.

In his travelogue, careri has given detail account of caste system prevalent among Hindus. In this system, the upper class was that of Brahmins, which was divided into several classes. Brahmins used to play the role of religious leader and teachers. There were sub classes of Brahmins such Marathi Brahmin, Telangani, Brahmin, Dravid Brahmin and Gujrati Brahmin were prominent. The Second class in Hindus society was that of the Rajputs. Polygamy and Jauhar system were prevalent among Rajputs. This has also been confirmed by some other contemporary and near contemporary European travellers. The third class among the Hindus was that of the 'Banias', which was divided into several sub classes. They were mainly traders and led a vegetarian life. Similarly Careri mentions Kurmi, Kansars and Carpenter class among other classes of the society. Careri also mentions Jogis-fakirs in the contemporary Hindu Society. These people led a difficult life but they were respected in the society. Careri also describes the practice of polygamy and the worse conditions of widows in the then Indian society.[19]

Gemellicareri also throws light on 'Gotra System' and states that among Hindus one could not marry within one's won gotra. Besides this, careri has also mentimed some festivals of Hindus especially Diwali and Holi of these, Diwali was celebrated on Amavasya and Holi was celebrated on Purnima. Carericommients that on the day of Holi, these were an atmosphere for joy all around. Some other foreign travellers have also given detailed description of Holi and Diwali. Father Monserrate[20]writesin this context that on the day of Holi people used to throw colors as well as mud among themselves. The way people celebrate this festival shown their ignorance but it seems that the European traveller including careri could not understand deeply the festivals and customs of the Indians. They have a positive attitude towards their western culture and a negative attitude towards the customs here.

In short, the place of Careri is very high among the European travellers of India. It is important to comment that Careri's interpretation of Emperor Aurangzeb military position in the middle of the deccan campaign is unique and valuable. But in terms of social description although careri has tried to accurately describe the then society and their religious beliefs However, he has not been able to deeply understand many of the traditions and customs of contemporary Indian society. Another short coming of careri was that he lived in India for a very short time. But there is no doubt; he accurately describes the Indian flora and cities of South and West India. Thus, both side of his travel account-the beneficial and the flawed side are visible.

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SEISMIC VULNERABILITY ASSESSMENT OF PUBLIC RC FRAMED BUILDING

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ABSTRACT

The existing structures built in seismically vulnerable regions at different times need to be assessed in view of the changing codal provisions. The various buildings owned by Government of Nepal and located in different parts of the country are the subjects of seismic assessment. Of the many buildings, one of them selected for a detailed assessment in the study at Kathmandu the capital of Nepal which is situated in prone zone of seismic vulnerability. The building is categorized as frame structures, built in different time with different modes of design and supervision. The building is analyzed with a 3D model using ETAB 2018 software for all the possible actions including possible earthquakes. The capacities of different components of the buildings are compared with the response by shifting of components of the buildings and by variation of size of members so as to overcome seismic vulnerability. From the result of the study and observation of structural parameters of the building, it is noted that some of the members are subjected to stresses higher than their capacities making the building vulnerable. For analysis even building consisting shear wall and basement are not analyzed yet releasing partial fixity at bottom of footing which leads error for comparison of vulnerability of such buildings ; this article enhance to recover the errors in analysis.

KEYWORDS: *Seismic Vulnerability Index, Seismic Capacity, Seismic Performance.*

INTRODUCTION

Background

Nepal has been recognized as one of the highly seismically vulnerable region of the world. The seismic activity of the region is primarily due to the neo-tectonic activities and the geo-technical conditions. Earthquakes of smaller & moderate magnitude occur frequently and earthquakes of magnitude greater than 6 occur on average once every 80 years in the region. The last great earthquake of magnitude 8.4 occurred in 1934

In view of the seismicity of the region it is imperative that the structures designed and built shall withstand the ground motion due to possible earthquakes the history of construction of buildings

with modern materials including concrete is relatively short. There has been an increasing trend in construction of many official building adopting the available new materials. Many of these buildings constructed in last decades may not have been designed or may not conform to the latest seismic code provisions. As the new knowledge and research in the area have implicated in more stringent provisions in the recent codes of practices, the structures existing are needed to be assessed for their performance during the possible earthquakes.

Earthquakes pose serious threat to life in many regions of the world. It poses engineering design problems in most civil engineering structures and the probability that a major earthquake will never affect any given structure is very low for locations near the boundary of major tectonic plates.

The construction of RC buildings only started after 1980; however, the mushrooming number of RC construction was started only after 1990. Even though the RC construction was started in early 1980s, engineered construction was only felt after enforcement of building codes in 2006 and almost 70 % of existing RC buildings are either owner-built construction constructed with the help of contractors following by-laws or constructed as per the mandatory rules of thumbs as suggested by Nepal Building Code. Smaller fraction of buildings is structurally analyzed, designed and constructed.

The seismic resistance of existing reinforced concrete structures may be inadequate due to weaknesses in the structural system and no ductile detailing. To mitigate the seismic and other natural hazards, existing inadequate or deteriorating structures should be rehabilitated. The evaluation of the seismic resistance of existing structures and their deficiencies is essential before an appropriate repair or upgrade.

A methodology to assess the seismic vulnerability of a building should consider its typology, the scale of the assessment, and resources available (economic and human). The methodology presented herein, based on post-earthquake damage observation and expert opinion, is thought to be a rapid screening approach to aid identifying more fragile and damage-prone buildings in the case of a strong earthquake.

Study Area

The Particular study area taken into consideration is located in Maitighar, Kathmandu,Nepal. The Site is located between 85.3230° E longitude and 27.6920°N latitude.

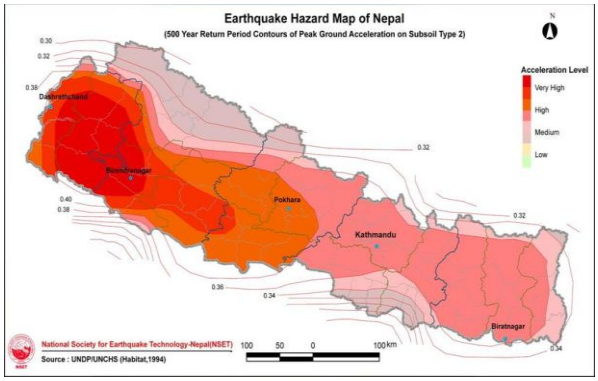


Figure 0-1: Earthquake Hazard Map of the study area

Figure 0-2: Existing Structure, Maitighar, Kathmandu

Need of the Study

Nepal lies in high seismic risk zone. In the Indian subcontinent seismological map, Nepal lies in seismic zone IV & V. the 1934 & 1988 earthquakes in Nepal showed the large scale of damage of the buildings Because of the distribution of the public buildings throughout the country, even may have to be converted into temporary shelter for homeless, medical clinics and other emergency functions following a disaster. However, these buildings are yet to be assessed for seismic vulnerability. A large number of those public buildings are assumed to be unsafe due to their improper seismic design & the lack of regular periodic maintenance. Majority of Public buildings are designed as per earlier codes, Due to the changes or amendments in codes because of the advances in knowledge on earthquake damage leads to the need of assessing the vulnerability of the public buildings.

Research Objectives

The principal objective of the study is to assess the capacity of the Public RC building and to use it to upgrade it and make functional for its purpose, if necessary, for expected performance according to the latest seismic and structural codes and implementing partial fixity in footing of shear walled building. The specific objectives of the study are as listed below:

To determine the seismic vulnerability of the proposed building

To purpose the deficiencies in the building specifically in the structural system and members, like column, beam and foundations

Comparative analysis result of building for story-drift, story-displacement, time period and base shear fluctuation under seismic loading

To work out for necessary strengthening and retrofitting measures:

Scope and Limitations of the study

The scope and limitations of the study are illustrated as follows:

Identification of the buildings representing the principal offices and sampling of the building for analysis.

Detailed analysis according to the prevalent codes, regularities and practices,

Identification of weak members of the structure.

METHODOLOGY

Overview

Methodology for this research with the theory and the mathematical formulation of the study. The general outline of the methodology used is given by figure. II -1

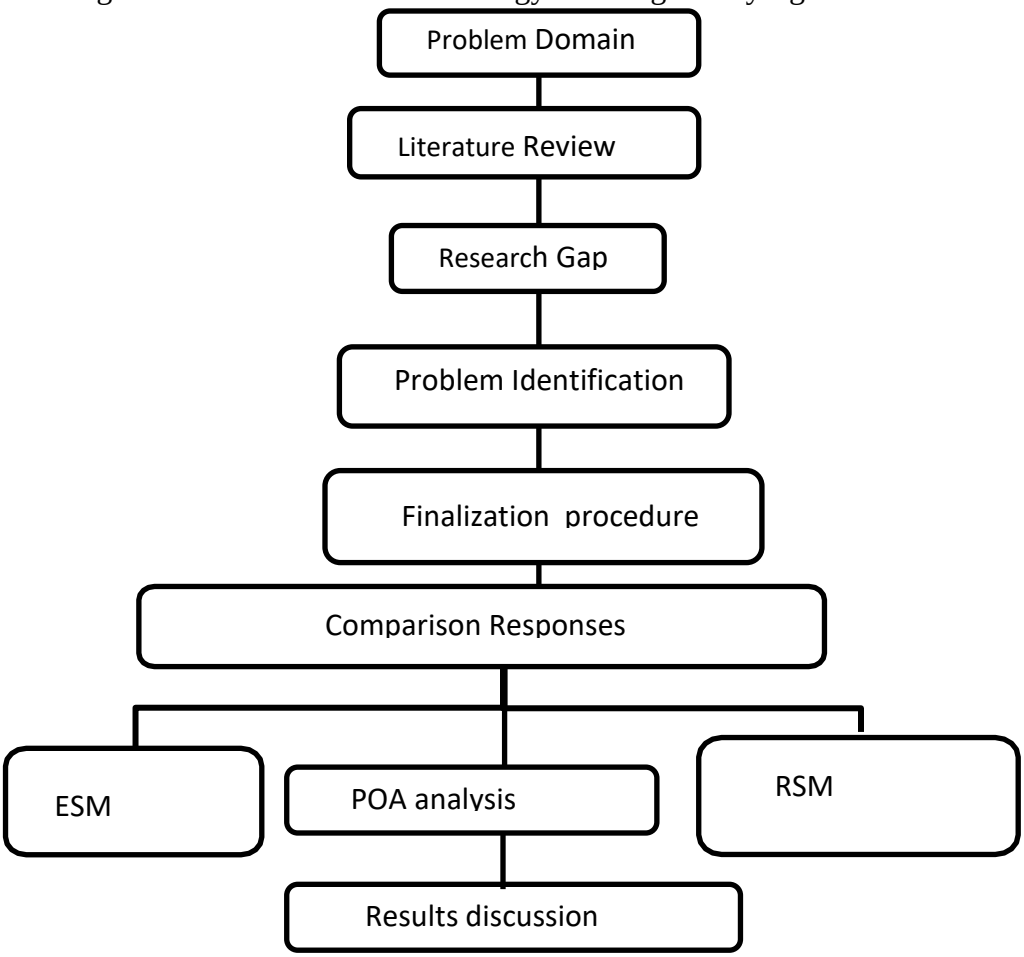


Figure II-1 : Flowchart of research methodolog

Seismic Analysis

Seismic force is an important force to be considered during the analysis of structures, especially for those located in seismic zones. During an earthquake, the ground motion caused due to the movement of tectonic plates underneath the surface also tends to move the structure along with it. But due to inertia, the structure tries to resist these motions. As a result, a shearing force (Base Shear) is imparted to the structure at the base and its acceleration as according to Newton's 2nd law of motion.

The force in the structure due to the dynamic ground motion can be analyzed by two methods.

Static method of analysis.

Dynamic method of analysis.

MODELLING AND ANALYSIS

General features of this model building are given.

TABLE III-1: GENERAL DESCRIPTION OF MODEL BUILDING

SN	Parameters	General Description
1	Type of building	Public building
2	Location	Zone II
3	Structure system	RCC frame structure
4	Plinth area	1441.28 m2
5	No. of story	Basement G+6
6	Floor to floor height	3.9 m
7	Types of Slabs	125 mm thick; Two-way Slab
8	Types of Beams	Rectangular main beam(300mm×500 mm)Secondary beam(230×400mm)
9	Types of Columns	Square(600×600) mm
10	Materials	Cement, Brick, Sand, Rebar etc.

TABLE III-2: RESPONSE SPECTRUM PARAMETERS

SN	Parameters	Input Value
1	Soil Type	B
2	Lower Period of the Flat Part of the Spectrum Ta	0.1
3	Upper Period of the Flat Part of the Spectrum Tc	0.7
4	Peak Spectral Acceleration Normalized by PGA α	2.5
5	Coefficient to control the descending branch of the Spectrum K	1.8

TABLE III-3: CHARACTERISTIC STRENGTH OF MATERIALS

SN	Parameters	General Description

1	Concrete	M20 for slab, M20 for beam, M20forcolumn Alteration will be done to upgrade using M30 in Columns and shear walls
2	Steel grade(fy)	Fe500
3	Methodof analysis	ETABS2018(Equivalent Static and Response Spectrum)

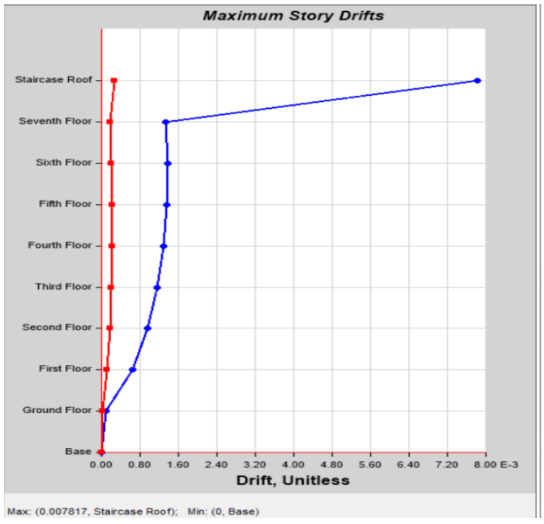
Loadings:

TABLE III-4: LOADS OCCURRING AT THE BUILDINGS IS IDEALIZED AND IS ACCORDING TO TABLE

SN	Parameters	General Description
1	Self-weight of Building	Program calculated
2	Floor finish	1.5 kN/m2
3	Live load	4 kN/m2
4	Partition wall load	1 kN/m2
5	Earthquake Load	As per NBC 105:2020code

Description of Model

Considering a building with B+G+ 6 storey which is in complex shape the analysis is performed using Etabs. Analysis is done using its architectural aesthetic plan with two stiff vertical shear wall and basement wall to optimize seismic vulnerability of the building. The model of the building and its Spectral Acceleration Vs Period is shown below in Figure III-1.



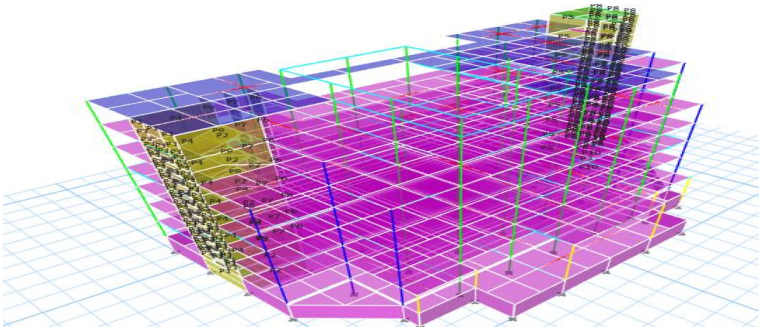


Figure III-1: Consider model for research

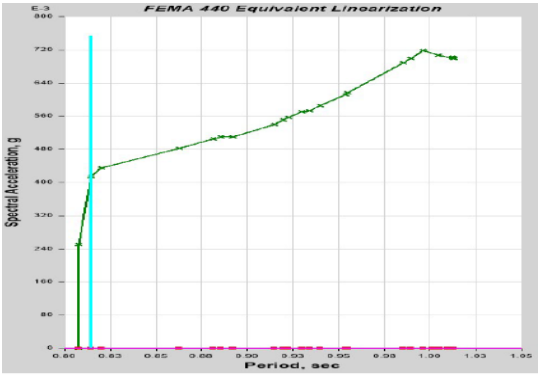


Figure III-2 Max storey displacement

Figure III-3 Max storey Drift

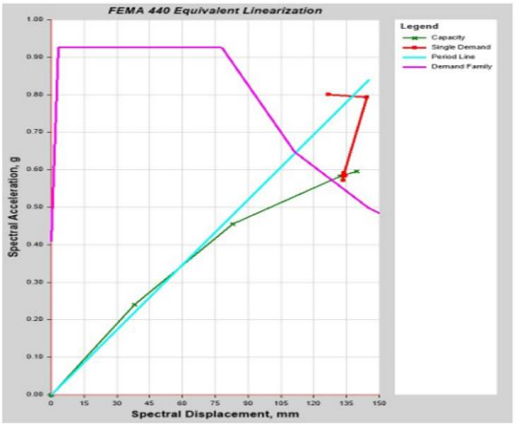


Figure III-4 Pushover curve of model with shear wall

Discussion on Research Gap

As we see many public RC buildings are just analyzed as one sample and same analysis is adopted in various places leading seismic vulnerability and mostly building with shear wall, basement wall are designed without concerning all effects of soil surcharge around buildings of various place. For this proper solution will be illustrated in this paper governing all structural parameters including pushover analysis

Results and Discussion

From this study, it is found that:

Building with shear wall seems more vulnerable without releasing partial fixity in footing.

As per building configuration and storey displacement we may note the max storey displacement in Y- dir is higher value than X-dir. So the building is more vulnerable in seismic response in Y dir. To minimize we may provide lateral shear wall along Y dir.

Storey Drift ratio obtained is higher value in Y- dir than X dir to generating more vulnerability in seismic response in Y dir

The member forces in Y- dir of the building are obtained as higher values than X- dir of building. And increasing reinforcements or section of members along y dir and making column section as rectangular type we may mitigate the seismic vulnerability of the building.

The auto- generation of member forces is also be seen affected by Beam column capacity ratio and diaphragm created by Shear walls in either side of X- direction of building. We may find appropriate location of shear wall so as to minimize seismic vulnerability of the building

CONCLUSION

Seismic vulnerably of complex building with basement and shear wall should be accounted by proper location of shear wall, opening, soft storey creation, beam column capacity.

By treating stiffness along Y dir of the building we may mitigate vulnerability in seismic response in Y- direction of building.

It will not be necessary the variation of column , beam size and rebar percentage if properly maintain diaphragm orientation and location within the building

Building with basement wall is seen to be optimized in various parameters considering soil interaction and springily footing laid in elastic foundation.

Several retrofitting technique will lead minimize vulnerability of building

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SEISMIC PERFORMANCE OF REINFORCED CONCRETE BUILDINGS WITH DIFFERENT LATERAL LOAD RESISTING SYSTEMS

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ABSTRACT

The objective of this research is to examine how well reinforced concrete buildings withstand seismic activity using various systems for resisting lateral loads. In this study, a reinforced concrete building with 11 floors (G+11) and 5 X 5 bays is selected, and various lateral load resisting frame systems are applied in different positions. These are shear wall, bracings, shear wall-bracings combinations (Combined) at five different locations/patterns i.e., at outer corners (Type- I), center of outer sides (Type- II), middle corners (Type- III), center of middle sides (Type- IV), and inner core and middle sides (Type- V) respectively. A total of sixteen models are created for this study, with one being a bare frame and the other fifteen consisting of three types of lateral load resisting systems arranged in five different configurations each. With the assistance of ETABS all models are analyzed by Equivalent Static Analysis and Response Spectrum Analysis. Earthquake load is calculated as per NBC 105:2020, the various parameters like response reduction factor, ductility factor, over strength factors, building importance factor, zone factor are taken and are applied to a building located in Birendranagar, Surkhet. The ETABS-2018 software was used to create models of the buildings.

The performance of building is evaluated on the basis of following parameters- maximum storey displacement, maximum storey drift, storey shear, storey stiffness, overturning moment and diaphragm maximum to average drift ratio (for torsion). At last the results are compared for different models. Among the three systems, the shear wall system exhibits the least displacement and the highest stiffness. Response of combined system is better than that of bracing system. Overall, the Type II shear wall model is more earthquake-resistant and structurally efficient than the other fifteen models.

KEYWORDS: *Equivalent Static Analysis, Response Spectrum Analysis, Maximum storey displacement, Maximum storey drift, Storey shear, Storey stiffness, Overturning moment, Torsion.*

INTRODUCTION

A. Background

Nepal, situated in one of the most seismically active regions of the world, has a lengthy record of earthquakes. The initial recorded earthquake in Nepal occurred on June 7, 1255, while Abahya Malla was the reigning king of the Malla Dynasty in Nepal. This earthquake, which registered 7.8 on the Richter scale, claimed the life of the king and 2200 individuals, about one-third of Kathmandu's population at the time. Throughout history, Nepal has experienced a significant earthquake at least once every century[1]. Nowadays most of the buildings are constructed with increased stories and height (multistoried). In other hand, Nepal lies in highly vulnerable earthquakes zones where next major earthquake becomes nearer by each passing days. After Gorkha earthquake people are more concern on earthquake resistance buildings. They are in search of efficient structural system. In other part people are attracting to construct multistoried buildings to maximize space for their commercial purpose and residential growth. Lateral forces like earthquake and wind forces are influenced by the shapes of buildings. Tall buildings attract the more seismic forces since they are more flexible. They absorb earthquake vibration along their height. So it is imperative to analyze these multi-storied buildings to check acceptability behavior (performance of buildings) against earthquake. For the improvement of performance of buildings towards earthquake loads different types of lateral load resisting frame system can be employed. The following are various lateral load resisting systems that can be employed in high-rise constructions: Shear wall system, Braced system, Outrigger system, Rigid frame system, Frame tube system, Bundle tube system, Trussed tube system, Diagrid system etc [2].

The Bracing system is capable of withstanding lateral forces predominantly through the compression or tension of its brace members, which renders the system highly effective in countering the lateral loads. In addition, the braced frame system's efficiency can be attributed to its ability to provide lateral stiffness to the structure. With least addition of the material to the frame and it forms economical structure for any heights [3].

This research is mainly concerned with the following system: Shear wall, Bracings, and Shear wall-bracings combination.

There are various methods available for the evaluation of seismic performance of any structures. According to NBC 105: 2020 they are categories as [4]:s

1) Equivalent Static Method/Analysis (ESA)
2) Linear Dynamic Analysis Method
    I. Modal Response Spectrum Method (RSM)
    II. Elastic Time History Analysis (ETHA)
3) Non-linear Methods
    I. Non-linear Static Analysis
    II. Non-linear Time History Analysis

For this study, ESM and RSM methods are adopted due to its simplicity and being the modeled structure regular.

B. Problem Statement

Numerous research studies aim to determine the most favorable location for installing shear walls and bracing systems in reinforced concrete (RC) buildings to improve their seismic performance. Many such studies compare the efficiency of the shear wall and bracing systems when placed in different positions. Although research shows that shear walls are the best system for lateral load resistance in RC buildings, the exclusive use of shear walls can become costly for multi-story buildings. Unfortunately, researchers have not focused on comparing the performance of combined shear wall and bracing systems when placed in various positions within a building. However, a combined system of shear walls and bracing may offer better structural efficiency for RC buildings. In this study, the performance of different lateral load resisting frame systems, including shear walls, bracing systems, and combined shear wall-bracing systems, is compared across various positions in the building, including outer corners (type-I), the center of outer sides (type-II), middle corners (type-III), the center of middle sides (type-IV), and the inner core and middle sides (type-V), with respect to different parameters.

A. Objectives

The main aim of this study is:

1) To investigate the seismic performance of RC buildings with different lateral load resisting system.

Other generalized objectives are as followings:

1) To compare the results of analysis using Equivalent static Method & Response Spectrum Method.

2) To compare the performance of structure for different lateral load resisting system with respect to different parameters: Storey displacement, Storey drift, Base shear, Stiffness, Storey overturning moment and Torsion in different position of building.

3) To find out the efficient system and its position in RC building.

LITERATURE REVIEW

Mehta and Dhameliya (2017) studied the (G+17) storey building was analyze with different shear-wall configuration. The modeling is done to examine the effect of different cases on seismic parameters like base shear, lateral displacements, lateral drifts and model time period for the zone-V in medium soil as specified in IS:1893-2002.

Model considered for analysis:

Model – 1: Bare frame

Model – 2: Shear wall along periphery

Model – 3: Shear wall at core and periphery

Model – 4: Shear wall at core

By comparing the storey drift values, it is apparent that the most significant reduction in drift values is achieved when the shear walls are placed at the center (core) of the structure.

Specifically, the results indicate that incorporating a shear wall in the center (Model-4) leads to a maximum decrease in displacement and drift, with a reduction of up to 62% in comparison to a bare frame. It observed that the shear wall at periphery (model-2) shows less time period than other model. It observed that as the lump mass of building is increased the time period is decrease [5].

Shaligram and Parikh (2018), In their review article, various lateral load resisting systems are compared based on parameters such as storey displacement, storey drift, modal time period, storey forces for seismic load using response spectrum method, and top storey displacement, axial forces, material consumption, and time period using Gust factor approach in accordance with IS 875 (Part-3)-1987 using ETABS-2015 software. The study's primary objective is to determine the most efficient and cost-effective system. Based on the literature review, steel bracings can be employed as a lateral load resisting system for multistory buildings with 10 to 20 stories, while Shear walls can be used for buildings with 20 to 35 stories. However, Shear walls are heavier in structure than steel bracings, which may be uneconomical for buildings with 10 to 15 stories. The Diagrid system is the most efficient and cost-effective for high-rise buildings with more than 35 stories, providing flexibility in building space planning and elevation. Therefore, the Diagrid system is the most suitable lateral load resisting system for high-rise buildings under seismic load and wind load.[6].

Dharanya A, Gayathri S and Deepika M (2017) analyzed a residential RC building with a soft storey that had four stories above ground level. They compared the performance of the building with cross bracing and shear wall lateral load resisting systems as per the IS 1893:2002 codal provision using ETABS software. The X-bracing was placed at the outer periphery of the column, while the shear walls were located at the building corners. The equivalent stiffness method was used to analyze the building models with ETABS software. The lateral displacement, base shear, storey drift, axial force, shear force, and time period were the main parameters analyzed. The natural time period of the structure was significantly reduced after placing the shear wall compared to the bracing system, which improved the structure's stability against earthquakes and made it more stable. The building had the least lateral displacement with the shear wall and bracing systems compared to the bare frame. Based on the analysis, it was concluded that the shear wall was more effective in improving the lateral stability of the structure than the bracing system. Future scope of this work is that it can be analyzed by using different locations of shear wall. Also different types of bracings such as V shape, inverted V shape and Y shape can be replaced and analyzed [7].

Islam, Kumawat, Bilonia, Ahmad and Kumar (2018), using of staad.pro v8i software 5 storey, 10 storey and 20 storey building frame with each storey in two zones (zone3 and zone5) were taken. This paper analyzed the cost and deflection of a reinforced concrete (RCC) framed structure with shear walls and bracing at different locations, in comparison to an ordinary building and results were presented using Staad pro v8i Software. By placing shear walls and bracing in periphery of buildings total 18 models were analyzed. In conclusion, the amount of concrete used in case of shear wall structure was more than that of bracing and RC-frame & the deflection and bending moment are significantly lower in the case of a shear wall compared to a RC-frame and bracing, making a shear wall structure more appropriate structurally [8].

Yizhen Yang and Hong Gan (2013), In this paper through the analysis of the different Angle fully reflects the location of shear wall structure seismic performance of the difference of influence and through the analysis the conclusion, uniform in the frame shear structure,

decentralized shear wall surrounding symmetrical arrangement ways to improve the seismic performance of the structure [16].

RESEARCH DESIGN

A. Details of Model

For this study, a G+11 storey building with 3 meters height for each story, regular in plan is modeled. This building consists of five spans of 4 meter in X direction and in Y direction as shown in figure. The square plan of all buildings measures 20 m x 20 m. Building with shear wall, bracing and combined system are modeled with four different positions named as Type- I, Type- II, Type- III, Type- IV and Type- V.

B. Modeling of Structure

Members of the structure like Beam, column and braces were modeled as frame element with prismatic section with specific defined material properties of concrete, steel (rebars) and structural steel. The foundation level was assumed fixed and meshing of the shell element i.e. slab and shear wall was done. Concrete grade of M 25 and steel (rebars) of grade Fe 500 as material for beam, slab, shear wall, M 30 for column and structural steel of Fy 250 for X-braces were assigned. Slab and shear wall were modeled as shell element with slab having rigid diaphragm in each story level. Each model was designed as per NBC 105:2020 load combinations for linear static and response spectrum method with soil type B and seismic zone region in Birendranagar, Surkhet.

B. Properties of Members

TABLE 5 DIFFERENT PROPERTIES AND PARAMETERS

Parameters	**Data**	**Units**
Grade of concrete, fck (Column)	M30	MPa
Grade of concrete, fck (others)	M25	MPa
Grade of Steel (rebars)	Fe 500	MPa
Grade of Structural Steel (braces)	Fy 250	MPa
Specific Weight of RCC	25	kN/m^3
Poisson's Ratio of Concrete	0.2	
Modulus of Elasticity Concrete	22360.68	MPa
Floor Height	3	m
Impose Load (Normal)	4	kN/m^2
Impose Load (Storage)	5	kN/m^2
Roof Live Load (accessible)	1.5	kN/m^2
Roof Live Load (inaccessible)	1.5	kN/m^2
Floor Finish Load	1.5	kN/m^2
Lift Load	15	kN/m^2
Water Tank Load	1.5	kN/m^2
Shear Wall Thickness	400	mm
Slab Thickness	125 for everymm	

	slab except for the top slab (250) that supports the elevator
Size of Column	625x625 mm x mm
Size of Beam	600x400 mm x mm
Type of Steel Bracing	X- Bracing (I section)

D. Figure of Models

Bared Frame:

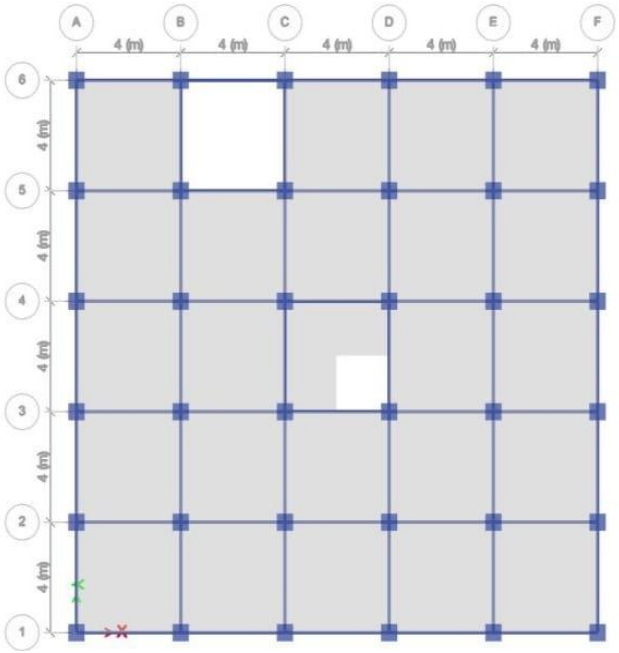


Figure 3 Plan of Bare Frame Model

Shear Wall System:

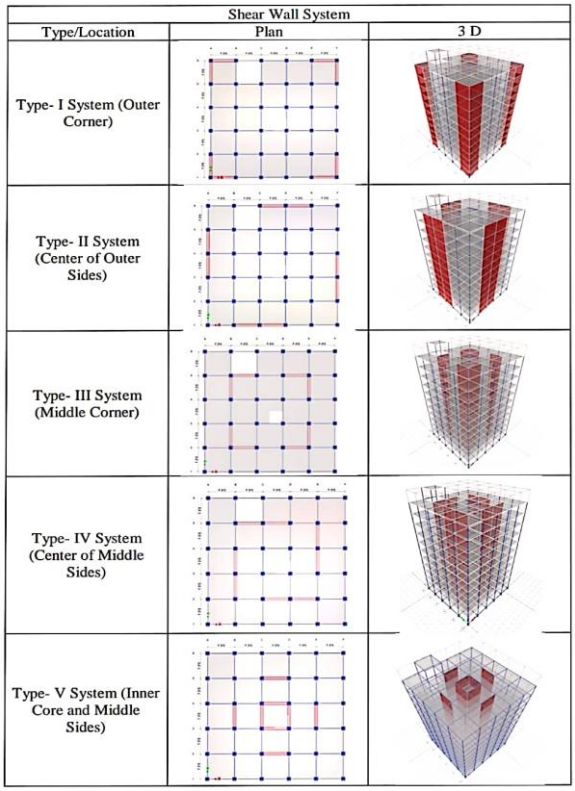


Figure 4 Different Locations of Shear Wall System

Bracing System:

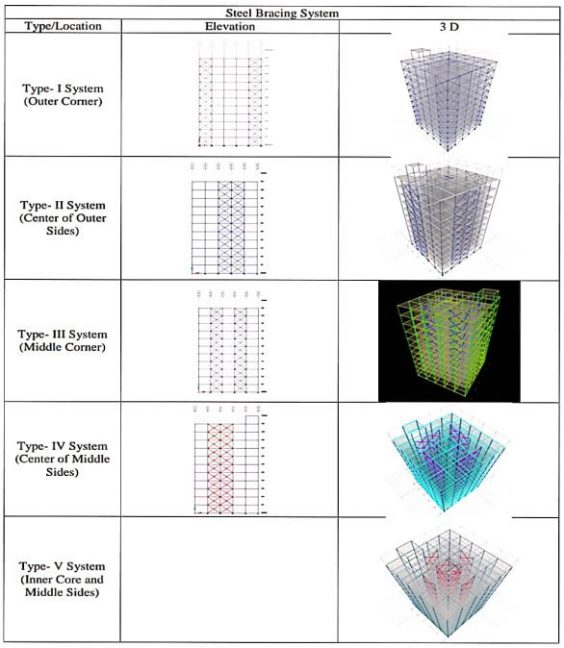


Figure 5 Different Locations of Bracing System

Combined (Shear Wall + Bracing) System:

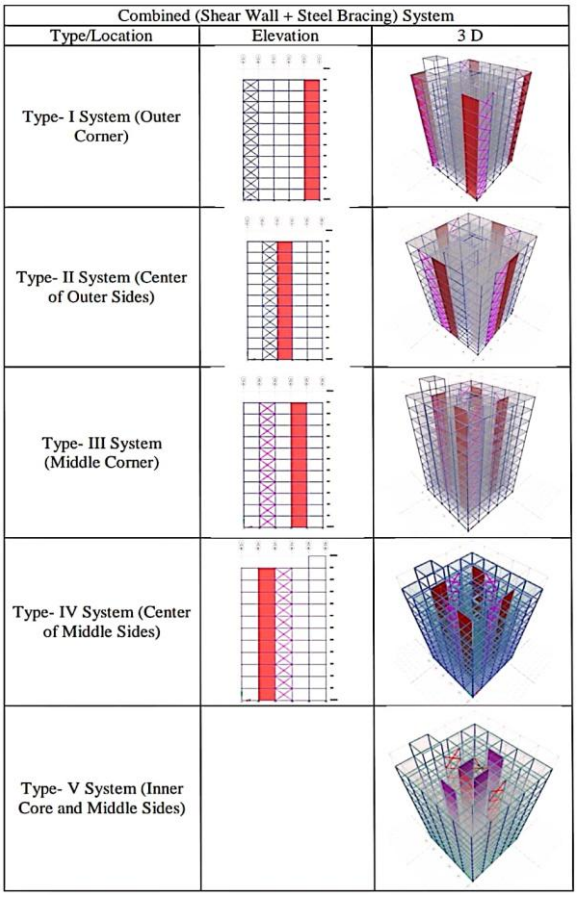


Figure 6 Different Locations of Combined System

METHODOLOGY

A. Modeling of the Building

To accomplish the above objectives of this thesis work, following procedure were adopted:

1. Regular Bare framed model for G +11 storeys is selected and each of four cases with different position of Shear Wall, Bracing and Combined System (Shear Wall + Bracing) are developed.
2. Preliminary sizing was done to fix the size of column, beam, shear wall and diagonal (X) steel braces of different models. The initial size of member's dimension was changed as per requirement.
3. Modeling and Analysis is done using ETABS 2018. The design check determines the size of frame members i.e. beam and column. Analysis is done by linear static analysis i.e. Equivalent Static Method and linear dynamic analysis i.e. Response Spectrum Method.
4. Seismic zone considered is Birendranagar, Surkhet with soil type B.
5. Parameters considered in this project are Storey displacement, Storey drift, Base shear, Stiffness, Storey overturning moment and Torsion (Maximum to Average drift ratio).

6. After analysis fundamental parameters were studied individually. Comparison between the different systems with different position with respect to different parameters are studied for all cases.

7. Based on the result obtained from analysis and design, the conclusion and recommendation are made.
8. Design as per NBC 105:2020 for earthquake, IS 456:2002 for RCC and IS 800:2007 for steel is done for respective cases.

G+11 Storey building with each floor height of 3m is selected in this research work because in our country Nepal, here has been a considerable increase in the construction of tall buildings both in case of residential and commercial too. The modern trend is towards more tall and slender structures. So, this G+11 storey building is a representative building for all tall buildings. If a result satisfies for the high rise structure, then it obviously satisfies for low rise structure.

There are two methods here we used for analyzing our research model: Equivalent Static Method (ESM) and Response Spectrum Method (RSM). The methodological flow chart is given as:

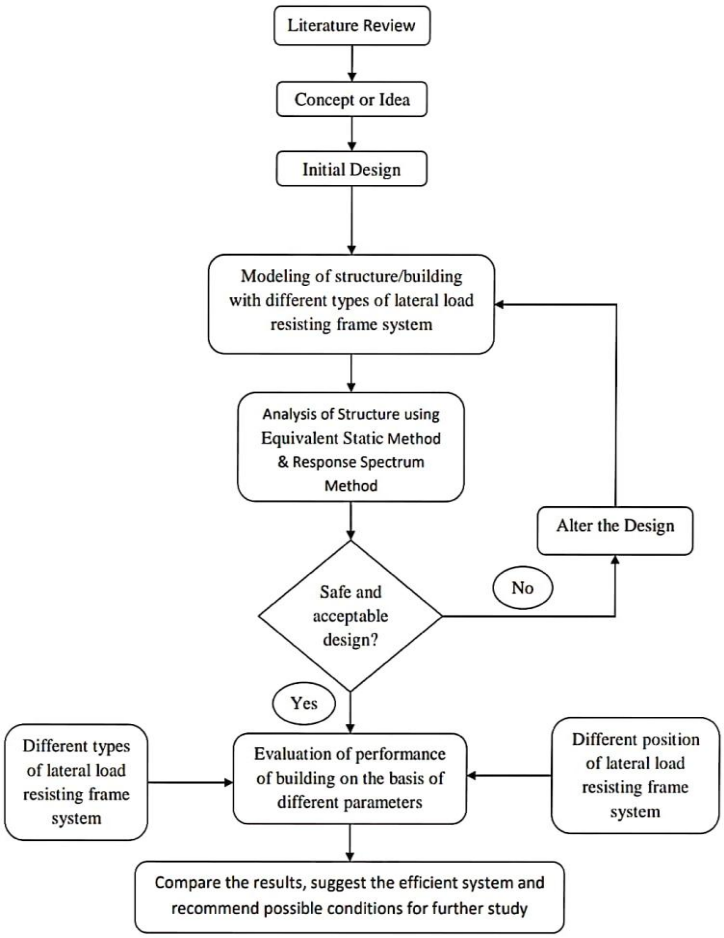


Figure 7 Methodological Framework

RESULTS AND DISCUSSION

A. Results

Parameters Discussed in Shear Wall System Using ESM and RSM:

a. Maximum Storey Displacement

TABLE 6 MAXIMUM STOREY DISPLACEMENT ALONG X- DIRECTION IN SHEAR WALL SYSTEM (ULS)

Maximum Storey Displacement Along X- Direction in Shear Wall System (ULS)											
Storey	Elevation (m)	Type I (mm)		Type II (mm)		Type III (mm)		Type IV (mm)		Type V (mm)	
		ESM	RSM	ESM	RSM	ESM	RSM	ESM	RSM	ESM	RSM
G+11	33	75.494	74.991	57.175	57.393	69.229	70.406	58.307	59.747	81.379	82.897
G+10	30	68.432	67.888	51.86	51.996	63.244	64.245	53.08	54.331	74.374	75.757
G+9	27	60.832	60.268	46.102	46.168	56.672	57.508	47.376	48.439	66.68	67.923
G+8	24	52.874	52.315	40.081	40.088	49.66	50.343	41.357	42.239	58.463	59.562
G+7	21	44.636	44.111	33.861	33.827	42.273	42.821	35.087	35.8	49.785	50.741
G+6	18	36.28	35.821	27.57	27.514	34.659	35.092	28.695	29.255	40.819	41.634
G+5	15	28.029	27.658	21.372	21.311	27.028	27.363	22.349	22.774	31.809	32.484
G+4	12	20.159	19.89	15.468	15.417	19.642	19.893	16.26	16.566	23.075	23.607
G+3	9	12.997	12.829	10.091	10.056	12.82	12.997	10.671	10.875	15.005	15.389
G+2	6	6.926	6.846	5.506	5.491	6.943	7.052	5.866	5.984	8.065	8.301
G+1	3	2.374	2.354	1.983	1.982	2.435	2.482	2.133	2.18	2.781	2.876
Base(G+0)	0	0	0	0	0	0	0	0	0	0	0

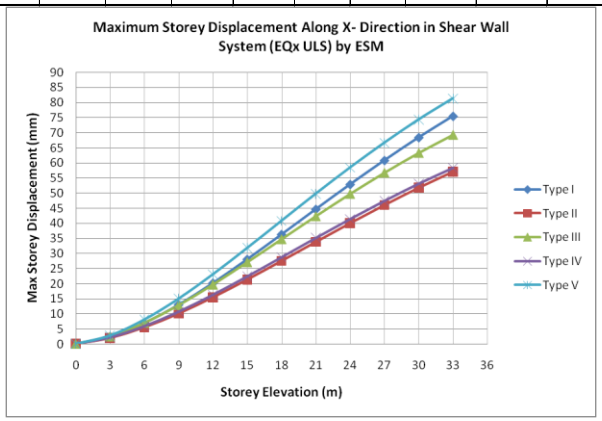


FIGURE 8 MAXIMUM STOREY DISPLACEMENT ALONG X- DIRECTION IN SHEAR WALL SYSTEM (EQX ULS) BY ESM

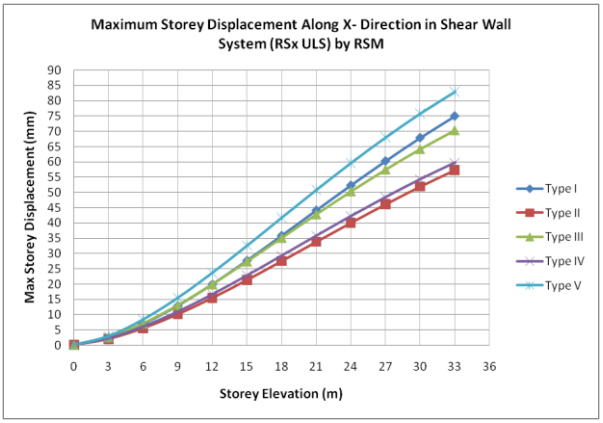


FIGURE 9 MAXIMUM STOREY DISPLACEMENT ALONG X- DIRECTION IN SHEAR WALL SYSTEM (RSX ULS) BY RSM

Maximum storey displacement due to seismic force along X- direction for all types (location) of shear wall system as per ESM and RSM are tabulated and shown graphically above. It is seen that Type- II location has lesser value of maximum storey displacement than that of others. The Type- II and Type- IV location has almost same values. The decreasing order of displacements are in type- V, type- I, type- III, type- IV and type- II position respectively. The top storey displacement by RSM is greater than that by ESM in all types except in type- I.

b. Maximum Storey Drift

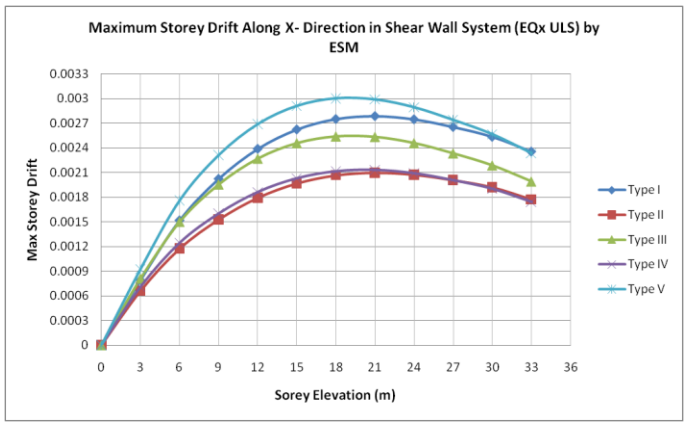


Figure 10 Maximum Storey Drift Along X- Direction in Shear Wall System (EQx ULS) by ESM

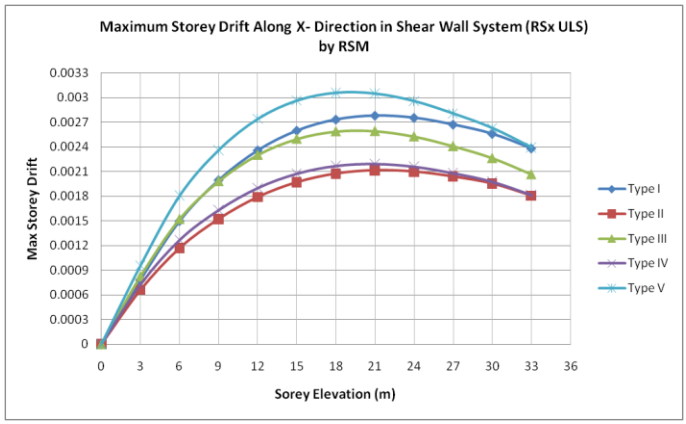


Figure 11 Maximum Storey Drift Along X- Direction in Shear Wall System (RSx ULS) by RSM

Maximum storey drift due to earthquake force along X- direction in shear wall system of all types (locations) using ESM and RSM are presented in graphical form as shown in figure above. From both method of analysis type- II system (location) has better response in term of maximum storey drift than that in rest other types (locations). It is observed that all storey drift of the shear wall system of all locations by RSM is greater than that by ESM. All types have maximum storey drift value at G+6 storey. Type- V, type- I, type- III, type- IV and type- II respectively have decreasing order of maximum storey drift values.

c. Storey Stiffnes

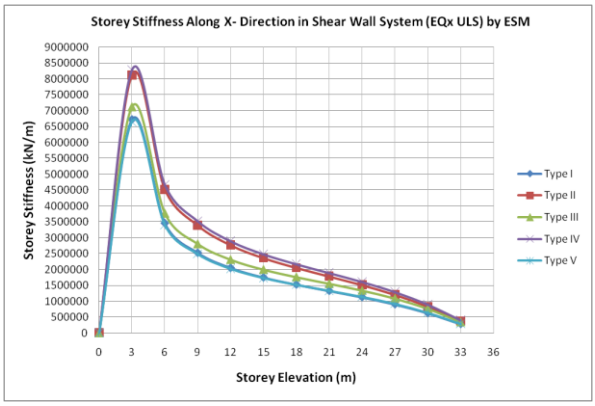


Figure 12 Storey Stiffness Along X- Direction in Shear Wall System (EQx ULS) by ESM

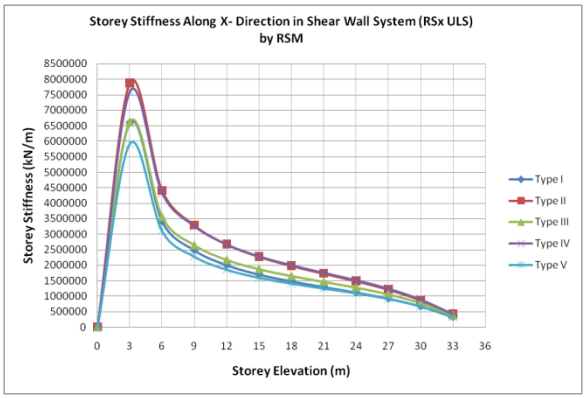


Figure 13 Storey Stiffness Along X- Direction in Shear Wall System (RSx ULS) by RSM

Values of storey stiffness in bracing system along X-direction by the action of seismic force for all locations of shear walls using ESM and RSM are plotted in figure. By analyzing these values, it can be concluded that type- II model of shear wall system has higher value of storey stiffness than that of other types (positions) by RSM but the same result is for type- IV model by using ESM. The decreasing order of storey stiffness by ESM are type- IV, type- II, type- III, type- I and type- V respectively and that by RSM are type- II, type- IV, type- III, type- I and type- V respectively. Type- II and type- IV curves in both methods of analysis and type- I and type- V curves in ESM nearly coincide with each others. In RSM, type- I and type- III curves nearly coincide at their peaks with each other. It can be concluded that the type (location of shear wall) with higher stiffness shows lesser deflection and vice versa.

d. Diaphragm Maximum to Average Drift Ratio

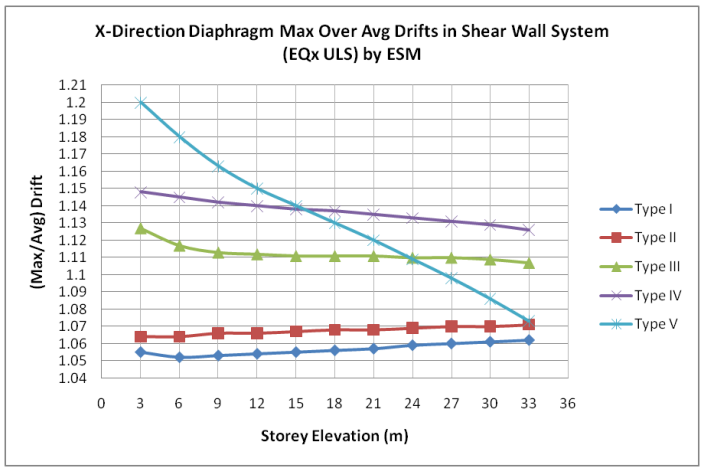


Figure 14 X- Direction Diaphragm Max to Avg Drift Ratio in Shear Wall System (EQx ULS) by ESM

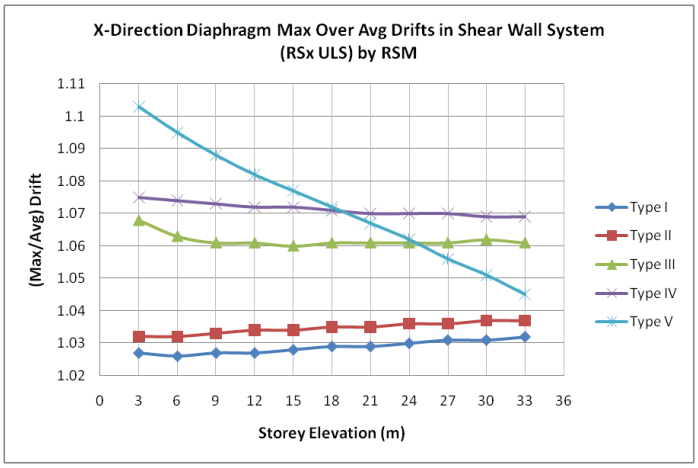


Figure 15 X- Direction Diaphragm Max to Avg Drift Ratio in Shear Wall System (RSx ULS) by RSM

Diaphragm maximum to average drift ratio in all types (locations) of shear wall system along X-direction by the effect of seismic force is presented graphically using ESM and RSM as shown in figure above. It is observed that for all types, the ratio by ESM is greater than that by RSM. In overall, type- I position has lesser value of diaphragm maximum to average drift ratio than that of other positions. The decreasing order of maximum value of the ratio in all types are as type- V, type- IV, type- III, type- II and type- I respectively. It can be concluded that the location of the shear wall with smaller value of diaphragm maximum to average drift ratio contributes less torsional susceptibility.

Parameters Discussed in Type- I of All Systems Using ESM and RSM:

a. Maximum Storey Displacement

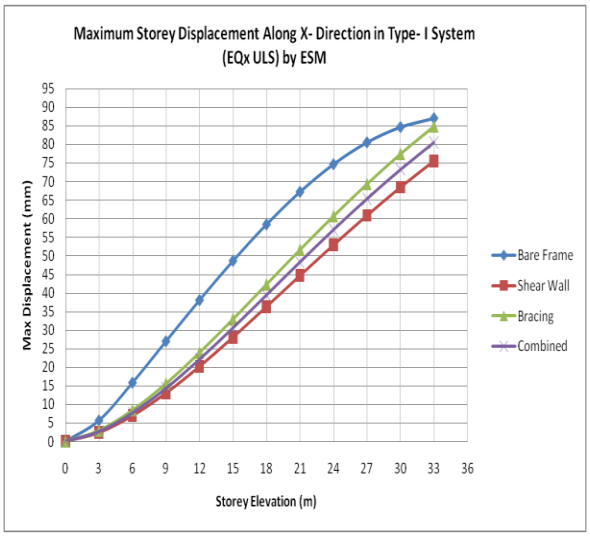


Figure 16 Maximum Storey Displacement Along X- Direction in Type- I System (EQx ULS) by ESM

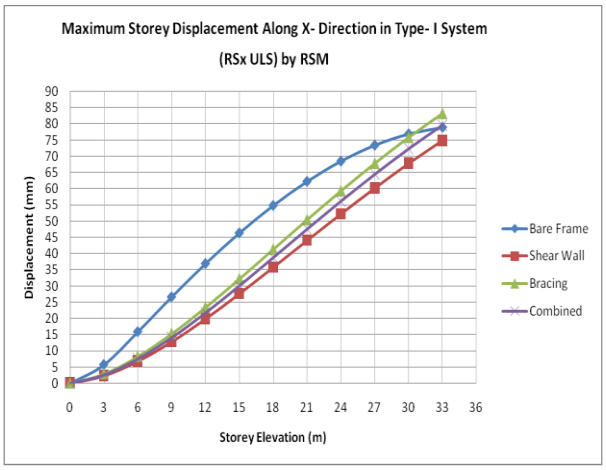


Figure 17 Maximum Storey Displacement Along X- Direction in Type- I System (RSx ULS) by RSM

By ESM and RSM, values of maximum storey displacement due to seismic forces in X-direction for all Type-I four models of building that is bare frame, shear wall, bracing and combined (shear wall + bracing) system are plotted as shown in figure above. By analyzing these values, it can be concluded that shear wall model has lesser values of displacement as compared to others. All the type I model has increasing order of value of displacement as: Bared frame > bracing > braced shear wall (combined) > shear wall system. The top storey displacement by RSM is greater than that by ESM in all systems.

b. Maximum Storey Drift

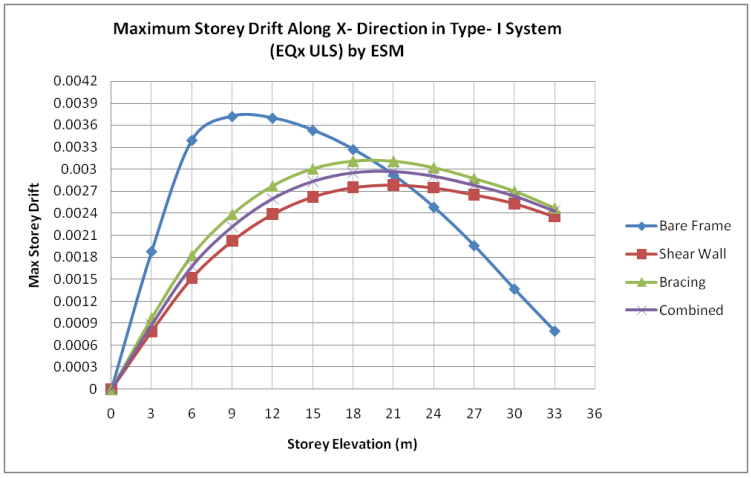


Figure 18 Maximum Storey Drift Along X- Direction in Type- I System (EQx ULS) by ESM

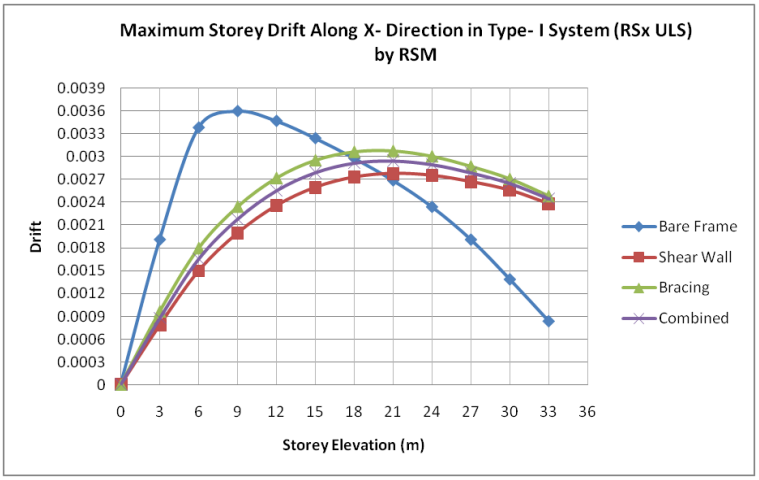


Figure 19 Maximum Storey Drift Along X- Direction in Type- I System (RSx ULS) by RSM

Maximum storey drift due to earthquake force along X- direction in Type- I position of all system using ESM and RSM are presented in graphical form as shown in figure above. From both method of analysis shear wall system has better response in term of maximum storey drift than rest others. Bare frame system has rapid variation in storey wise drift values. It is observed that all storey drift of all the system by RSM is greater than that by ESM. Bare frame system has maximum storey drift at G+3 storey and that at G+7 storey for rest other systems. Bare frame, bracing, combined and shear wall system respectively have decreasing order of maximum storey drift values.

c. Storey Shear

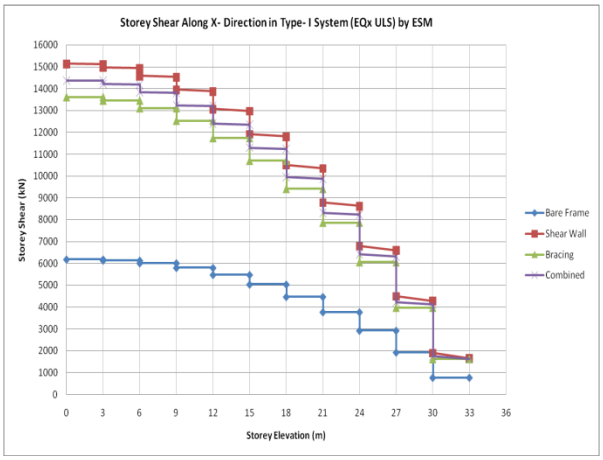


Figure 20 Storey Shear Along X- Direction in Type- I System (EQx ULS) by ESM

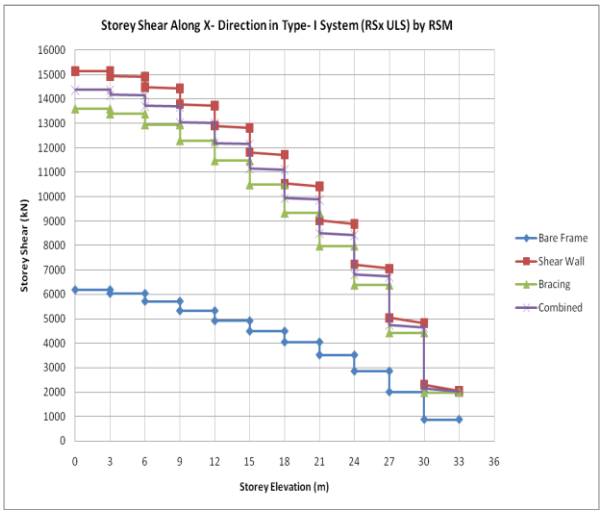


Figure 21 Storey Shear Along X- Direction in Type- I System (RSx ULS) by RSM

By ESM and RSM, storey shear due to earthquake load (EQx ULS) and (RSx ULS) along X-direction in Type- I position of all the system are shown graphically above. It is observed that at top storey, storey shear by RSM is greater than that by ESM but the base shear is equal from both methods. Base shear of shear wall system is greater than other systems. The decreasing order of base shear value is as from shear wall, combined, bracing and bare frame system. Also, it is concluded that if the storey height increases, storey shear decreases and vice versa.

d. Overturning Moment

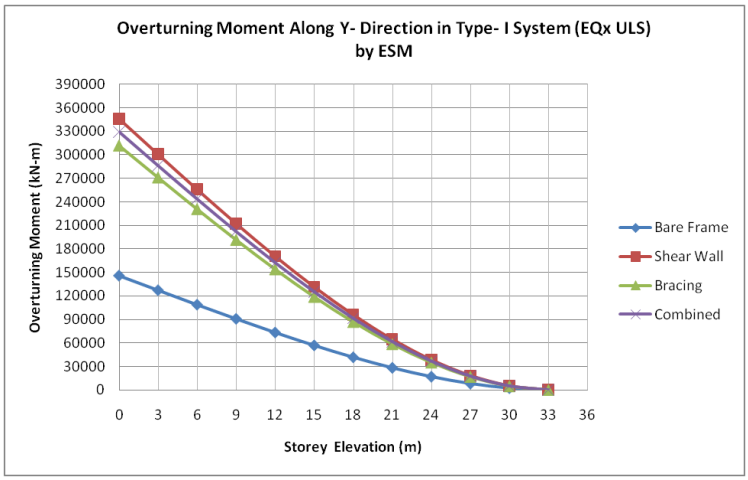


Figure 22 Overturning Moment Along Y- Direction in Type- I System (EQx ULS) by ESM

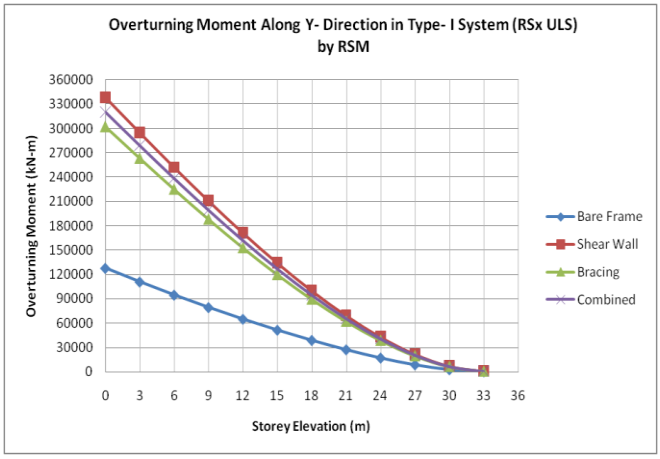


Figure 23 Overturning Moment Along Y- Direction in Type- I System (RSx ULS) by RSM

Absolute values of overturning moment in Y- direction using ESM and RSM by seismic forces (EQx ULS and RSx ULS) for all Type- I position systems (models) are plotted as shown in figure above. The maximum values of overturning moment at base (G+0) due to seismic force in X- direction are seen in ESM than that of RSM. In both methods the decreasing order of values of overturning moment are in the systems shear wall, combined, bracing and bare frame respectively. Also, it is concluded that if the storey height increases, overturning moment decreases and vice versa.

e. Storey Stiffness

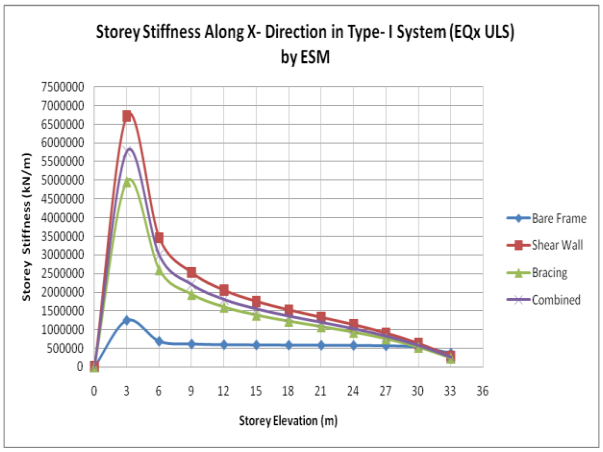


Figure 24 Storey Stiffness Along X- Direction in Type- I System (EQx ULS) by ESM

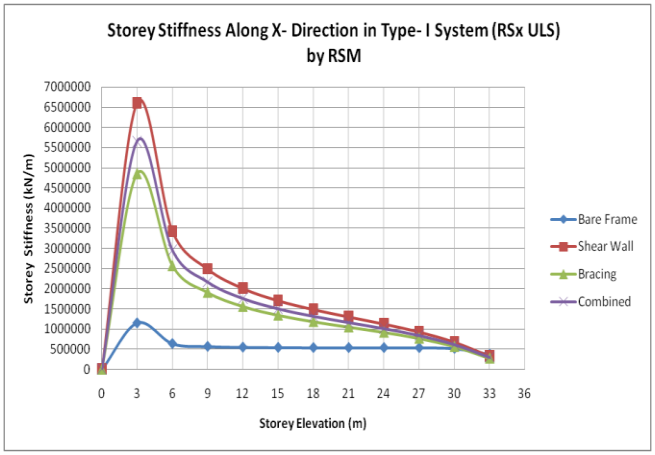


Figure 25 Storey Stiffness Along X- Direction in Type- I System (RSx ULS) by RSM

Storey stiffness by seismic forces along X-direction for all Type- I position systems (models) are plotted using ESM and RSM. By analyzing these values, it can be concluded that all the systems of Equivalent Static Method in X-direction have larger maximum value of storey stiffness at G+1 storey than that of Response Spectrum Method. Also it can be seen that model with shear wall system has higher stiffness than other system models. Shear wall, combined, bracing and bare frame system respectively have decreasing order of storey stiffness values. This storey stiffness can play a major role for lateral stability of the structure. Having higher stiffness, it shows lesser deflection & drift and vice versa.

f. Diaphragm Maximum to Average Drift Ratio

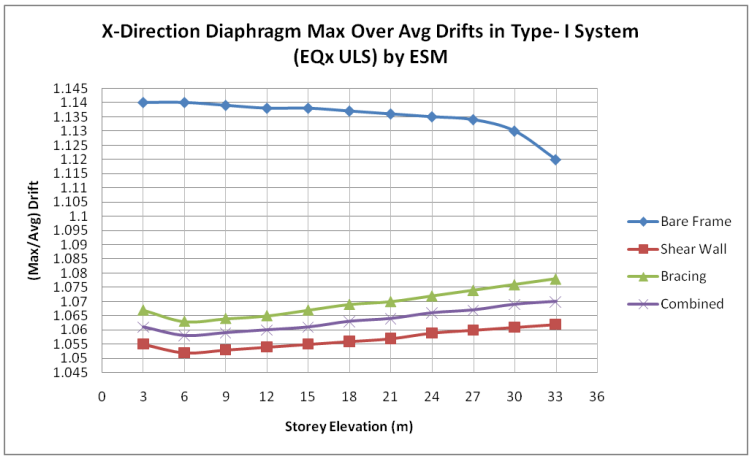


Figure 26 X- Direction Diaphragm Max to Avg Drift Ratio in Type- I System (EQx ULS) by ESM

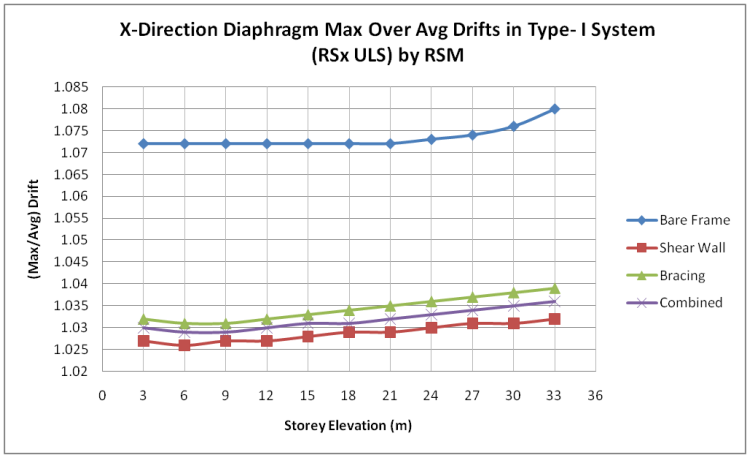
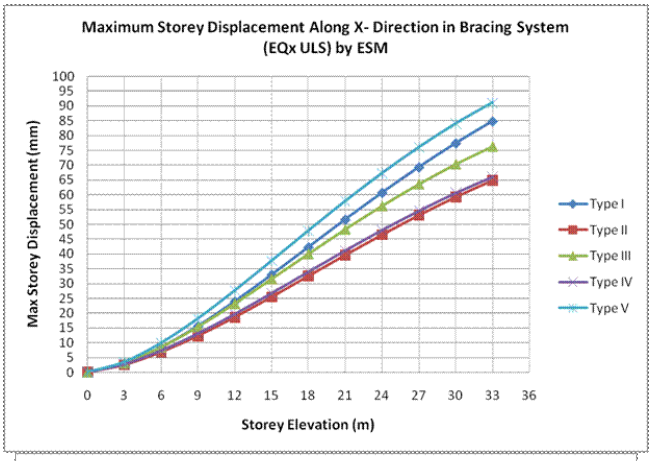
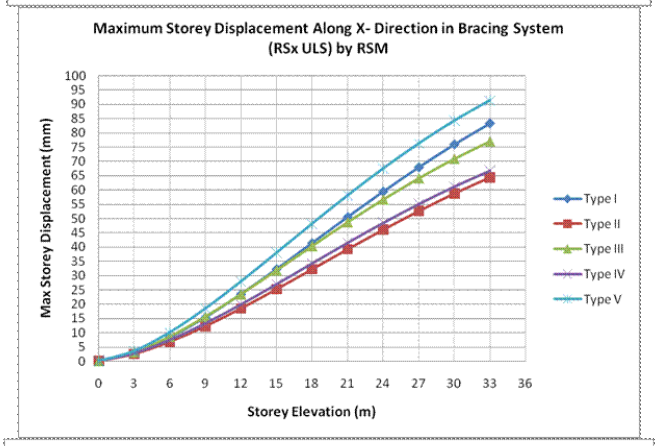


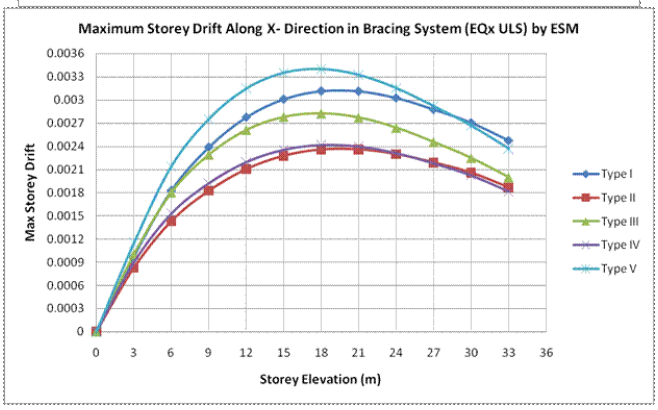
Figure 27 X- Direction Diaphragm Max to Avg Drift Ratio in Type- I System (RSx ULS) by RSM

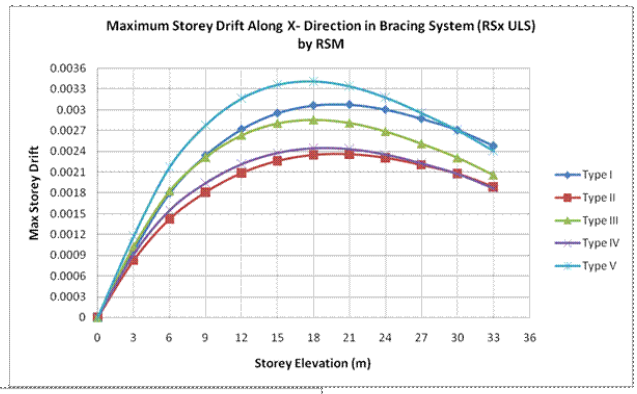
Diaphragm maximum to average drift ratio along X- direction in Type- I position of all the system due to seismic force effect is presented graphically using ESM and RSM as shown in figure above. It is observed that for all system, the ratio by ESM is greater than that by RSM. It is observed that shear wall system has lesser value of diaphragm maximum to average drift ratio than that of other systems by both RSM and ESM. Bare frame, bracing, combined and shear wall have decreasing order of the ratio. So, it can be concluded that shear wall system contributes less torsional susceptibility than other systems.

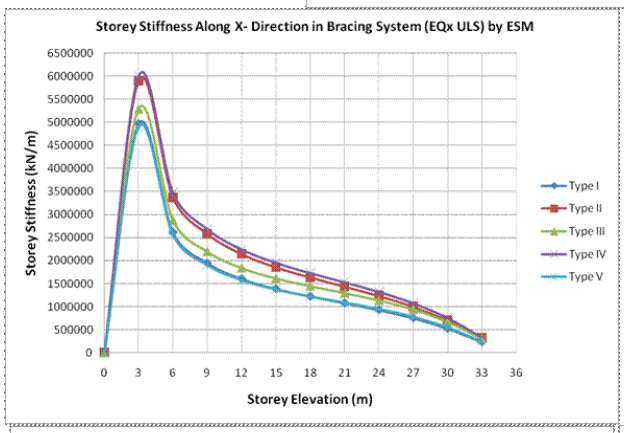
Other Graphs from Observations:

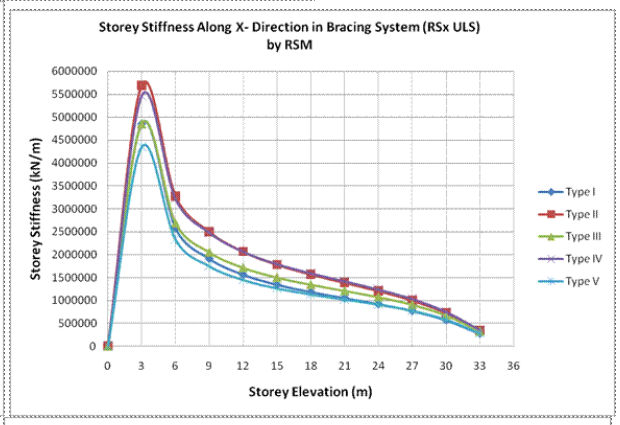


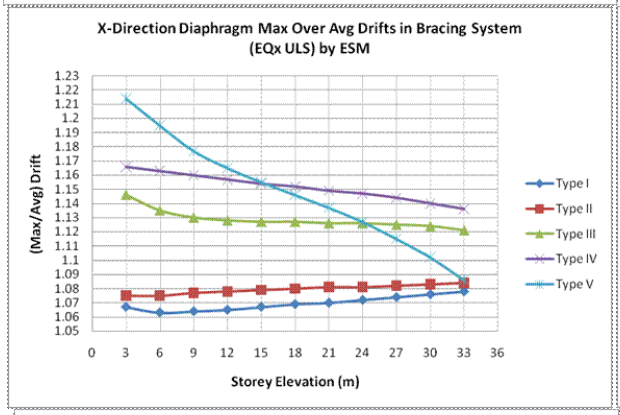


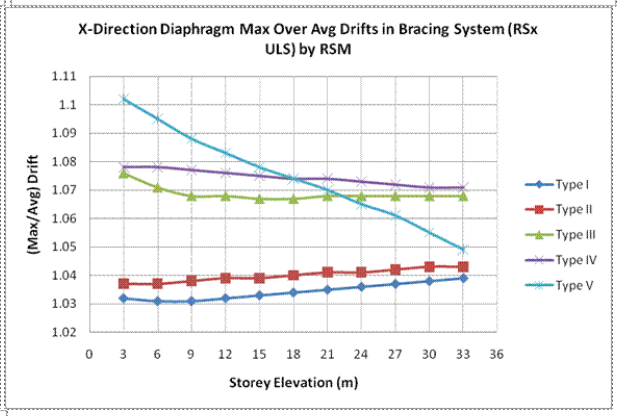


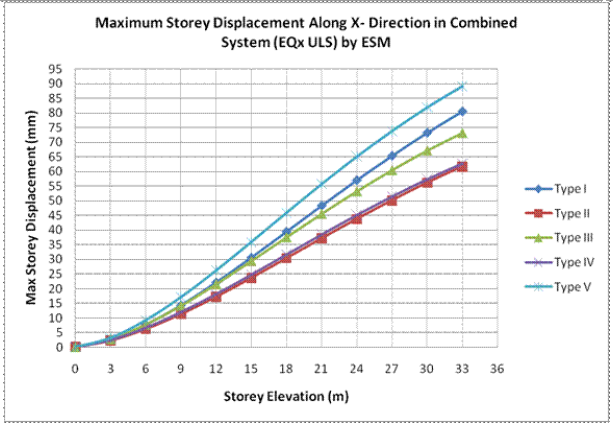

Maximum Storey Drift Along X- Direction in Bracing System (RSx ULS) by RSM
Max Storey Drift
Storey Elevation (m)
Type I
Type II
Type III
Type IV
Type V

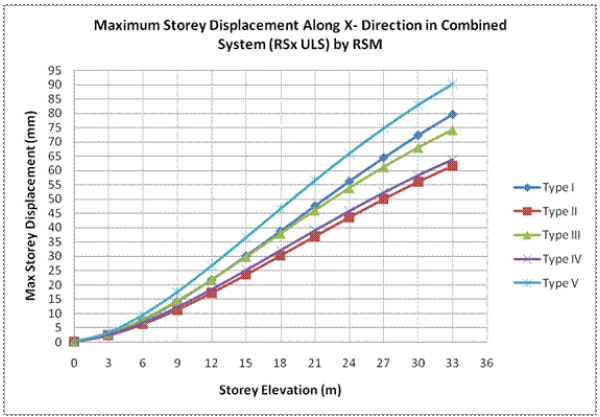

Storey Stiffness Along X- Direction in Bracing System (EQx ULS) by ESM
Storey Stiffness (kN/m)
Storey Elevation (m)
Type I
Type II
Type III
Type IV
Type V

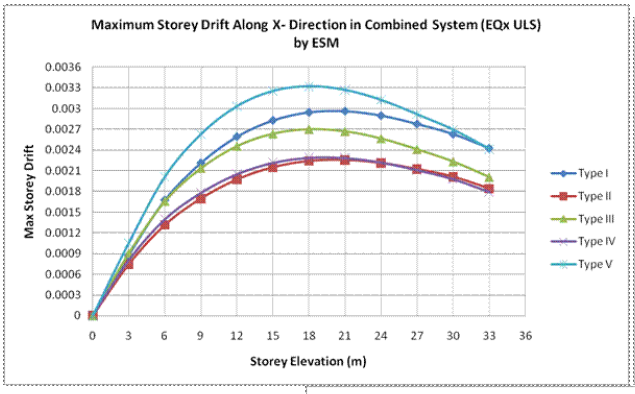

Storey Stiffness Along X- Direction in Bracing System (RSx ULS) by RSM
Storey Stiffness (kN/m)
Storey Elevation (m)
Type I
Type II
Type III
Type IV
Type V

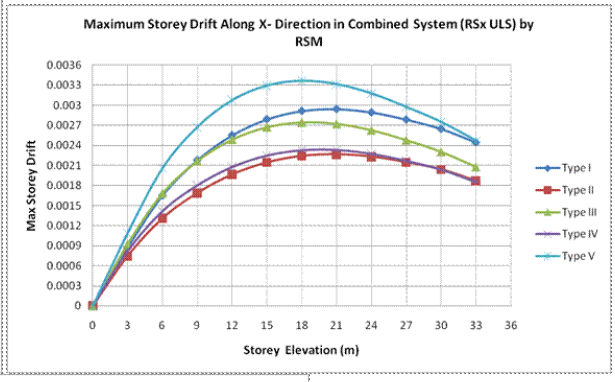

X-Direction Diaphragm Max Over Avg Drifts in Bracing System (EQx ULS) by ESM
(Max/Avg) Drift
Storey Elevation (m)
Type I
Type II
Type III
Type IV
Type V

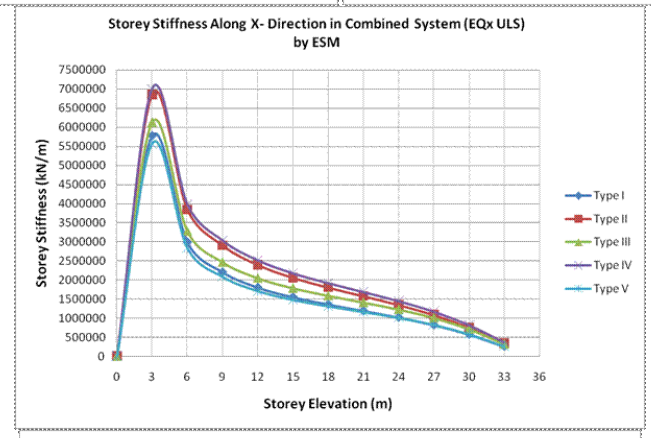

X-Direction Diaphragm Max Over Avg Drifts in Bracing System (RSx ULS) by RSM
(Max/Avg) Drift
Storey Elevation (m)
Type I
Type II
Type III
Type IV
Type V

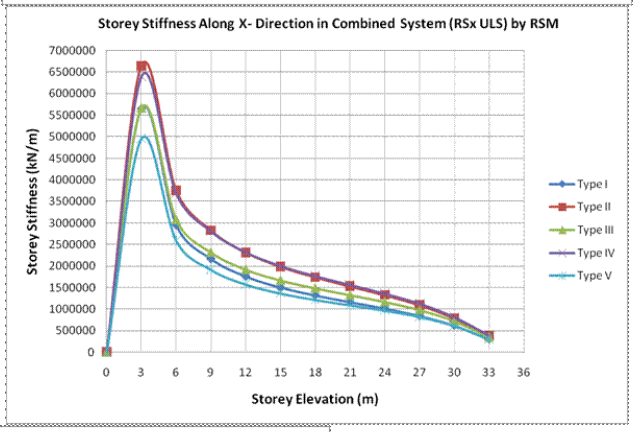

Maximum Storey Displacement Along X- Direction in Combined System (EQx ULS) by ESM
Max Storey Displacement (mm)
Storey Elevation (m)
Type I
Type II
Type III
Type IV
Type V

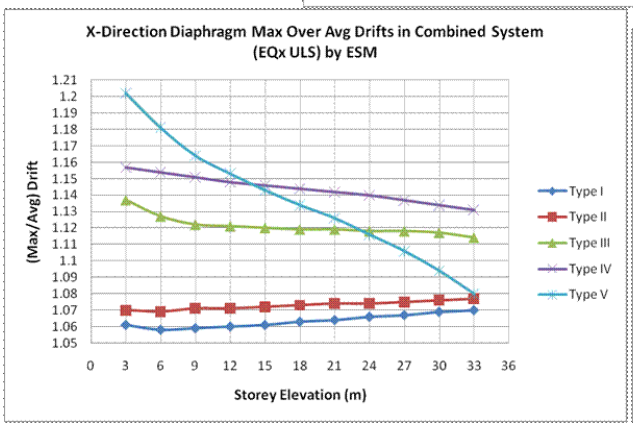

Maximum Storey Displacement Along X- Direction in Combined System (RSx ULS) by RSM
Max Storey Displacement (mm)
Storey Elevation (m)
Type I
Type II
Type III
Type IV
Type V

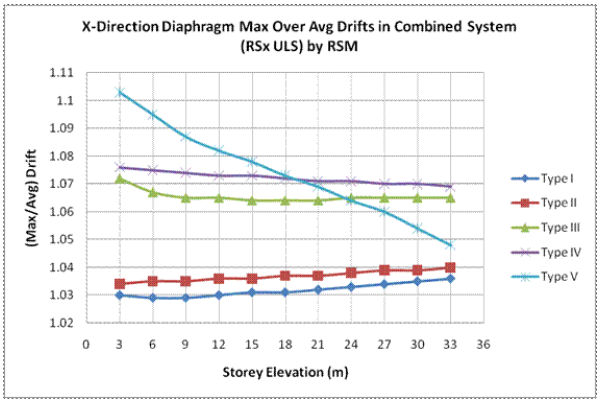

Maximum Storey Drift Along X- Direction in Combined System (EQx ULS) by ESM
Max Storey Drift
Storey Elevation (m)
Type I
Type II
Type III
Type IV
Type V

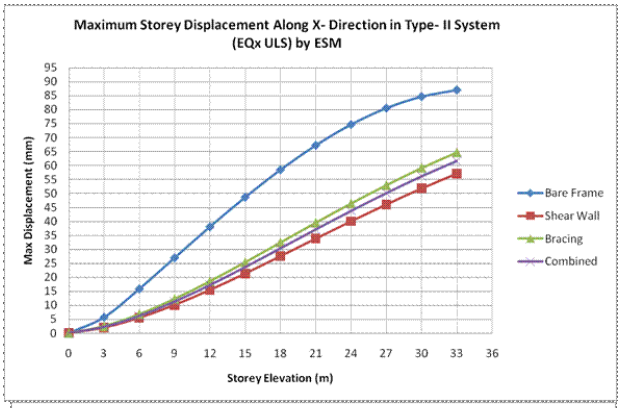

Maximum Storey Drift Along X- Direction in Combined System (RSx ULS) by RSM
Max Storey Drift
Storey Elevation (m)
Type I
Type II
Type III
Type IV
Type V

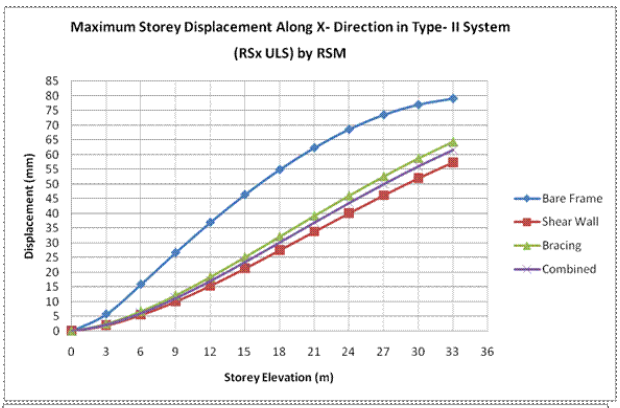

Storey Stiffness Along X- Direction in Combined System (EQx ULS) by ESM
Storey Stiffness (kN/m)
Storey Elevation (m)
Type I
Type II
Type III
Type IV
Type V

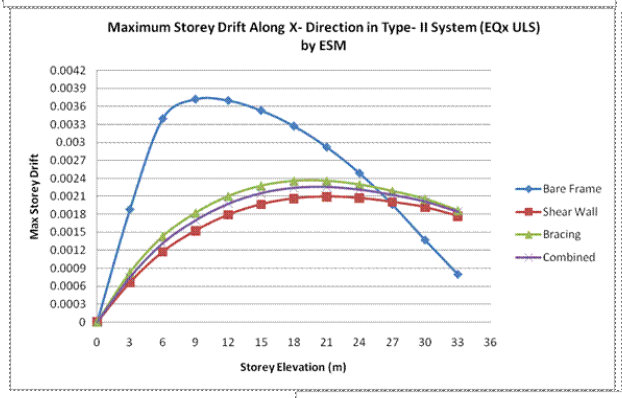

Storey Stiffness Along X- Direction in Combined System (RSx ULS) by RSM
Storey Stiffness (kN/m)
Storey Elevation (m)
Type I
Type II
Type III
Type IV
Type V

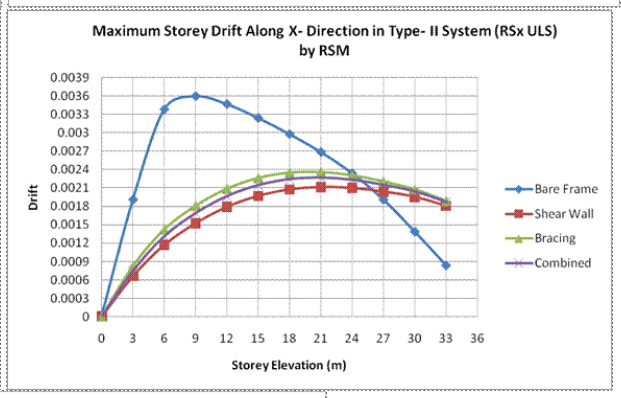

X-Direction Diaphragm Max Over Avg Drifts in Combined System (EQx ULS) by ESM
(Max/Avg) Drift
Storey Elevation (m)
Type I
Type II
Type III
Type IV
Type V

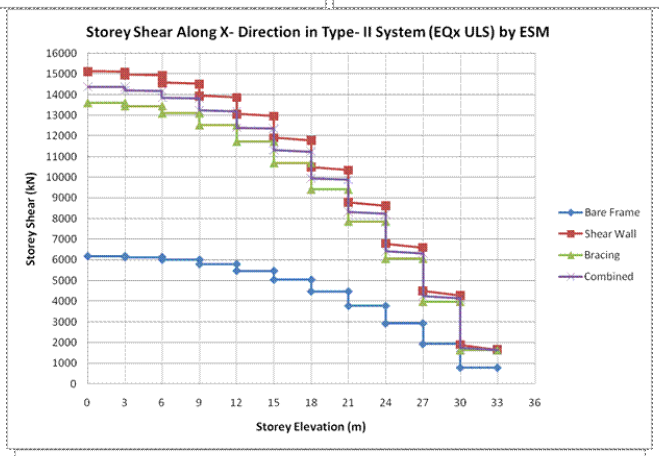

X-Direction Diaphragm Max Over Avg Drifts in Combined System (RSx ULS) by RSM
(Max/Avg) Drift
Storey Elevation (m)
Type I
Type II
Type III
Type IV
Type V

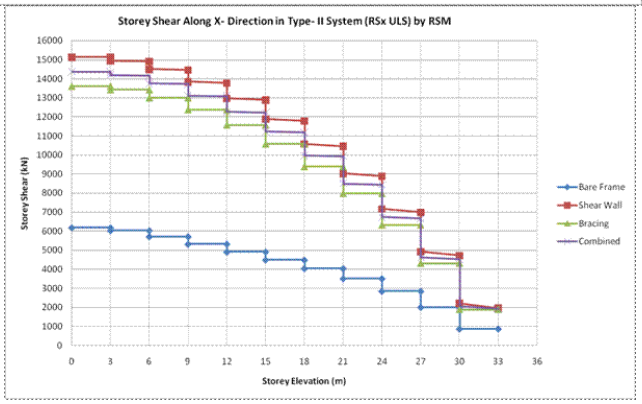

Maximum Storey Displacement Along X- Direction in Type- II System (EQx ULS) by ESM
Max Displacement (mm)
Storey Elevation (m)
Bare Frame
Shear Wall
Bracing
Combined

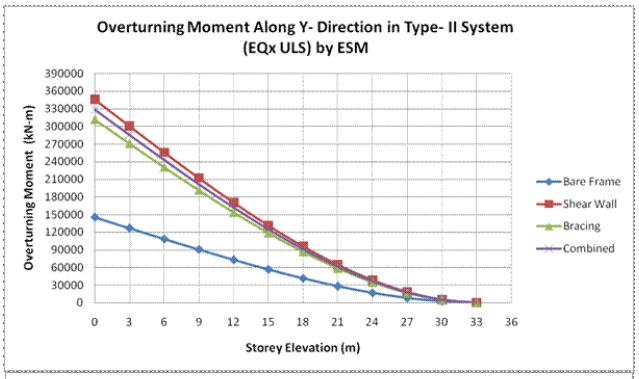

Maximum Storey Displacement Along X- Direction in Type- II System (RSx ULS) by RSM
Displacement (mm)
Storey Elevation (m)
Bare Frame
Shear Wall
Bracing
Combined

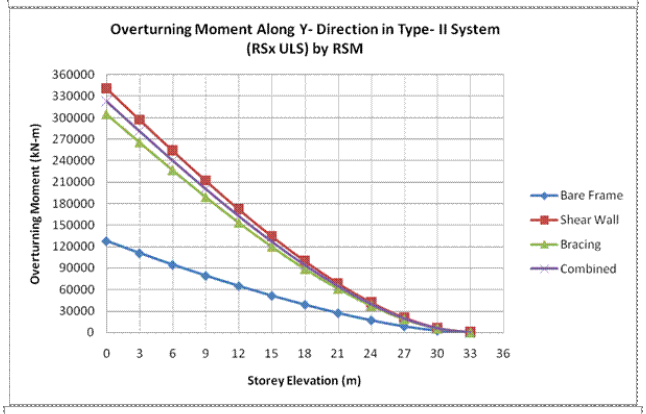

Maximum Storey Drift Along X- Direction in Type- II System (EQx ULS) by ESM
Max Storey Drift
Storey Elevation (m)
Bare Frame
Shear Wall
Bracing
Combined

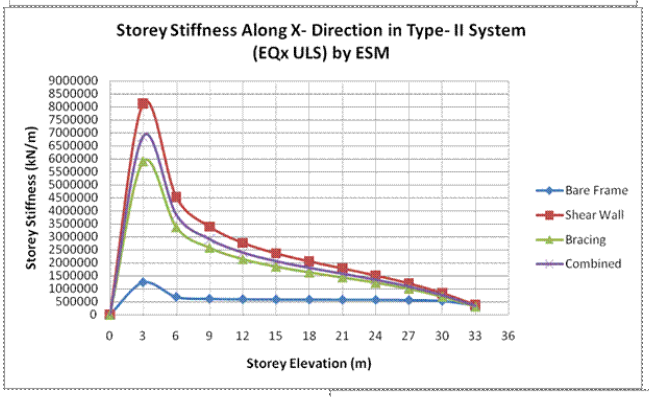

Maximum Storey Drift Along X- Direction in Type- II System (RSx ULS) by RSM
Drift
Storey Elevation (m)
Bare Frame
Shear Wall
Bracing
Combined

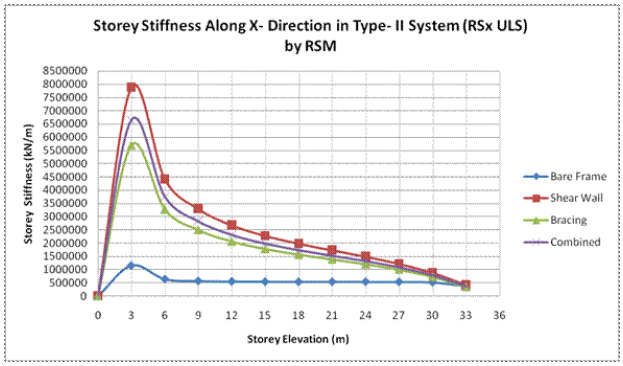

Storey Shear Along X- Direction in Type- II System (EQx ULS) by ESM
Storey Shear (kN)
Storey Elevation (m)
Bare Frame
Shear Wall
Bracing
Combined

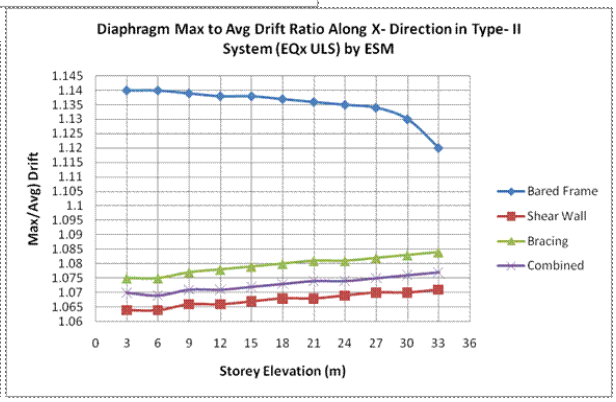

Storey Shear Along X- Direction in Type- II System (RSx ULS) by RSM
Storey Shear (kN)
Storey Elevation (m)
Bare Frame
Shear Wall
Bracing
Combined

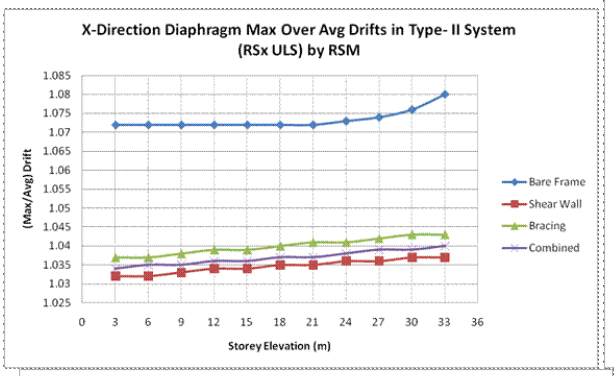

Overturning Moment Along Y- Direction in Type- II System (EQx ULS) by ESM
Overturning Moment (kN-m)
Storey Elevation (m)
Bare Frame
Shear Wall
Bracing
Combined

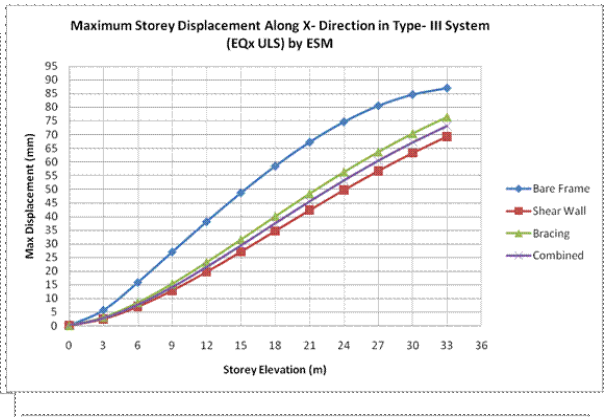

Overturning Moment Along Y- Direction in Type- II System (RSx ULS) by RSM
Overturning Moment (kN-m)
Storey Elevation (m)
Bare Frame
Shear Wall
Bracing
Combined

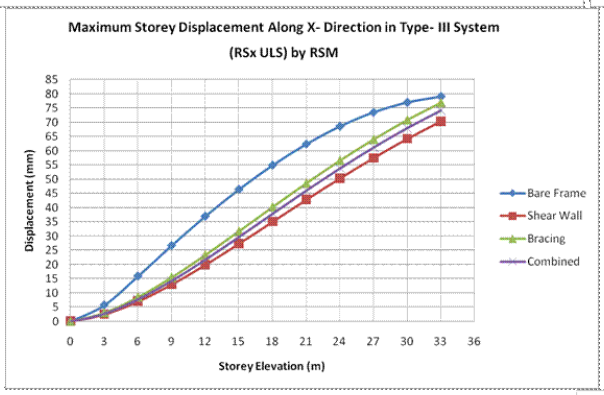

Storey Stiffness Along X- Direction in Type- II System (EQx ULS) by ESM
Storey Stiffness (kN/m)
Storey Elevation (m)
Bare Frame
Shear Wall
Bracing
Combined

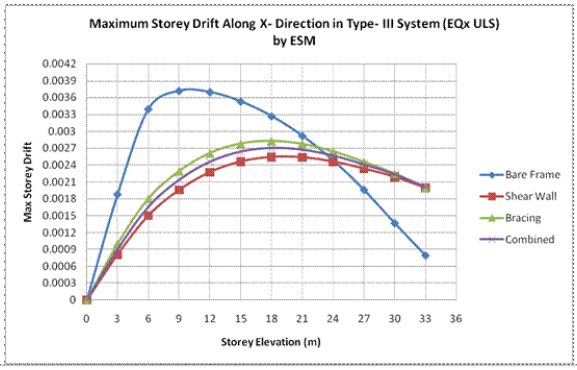

Storey Stiffness Along X- Direction in Type- II System (RSx ULS) by RSM
Storey Stiffness (kN/m)
Storey Elevation (m)
Bare Frame
Shear Wall
Bracing
Combined

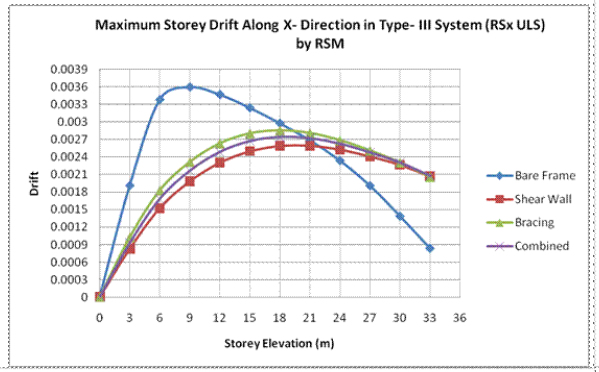

Diaphragm Max to Avg Drift Ratio Along X- Direction in Type- II System (EQx ULS) by ESM
Max/Avg) Drift
Storey Elevation (m)
Bared Frame
Shear Wall
Bracing
Combined

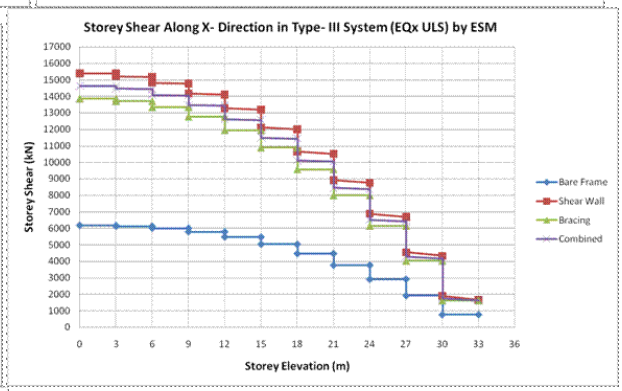

X-Direction Diaphragm Max Over Avg Drifts in Type- II System (RSx ULS) by RSM
(Max/Avg) Drift
Storey Elevation (m)
Bare Frame
Shear Wall
Bracing
Combined

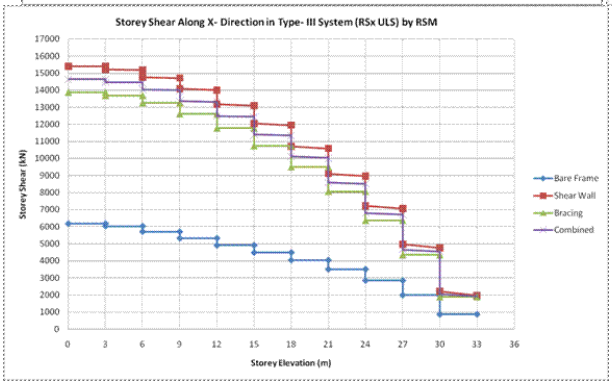

Maximum Storey Displacement Along X- Direction in Type- III System (EQx ULS) by ESM
Max Displacement (mm)
Storey Elevation (m)
Bare Frame
Shear Wall
Bracing
Combined

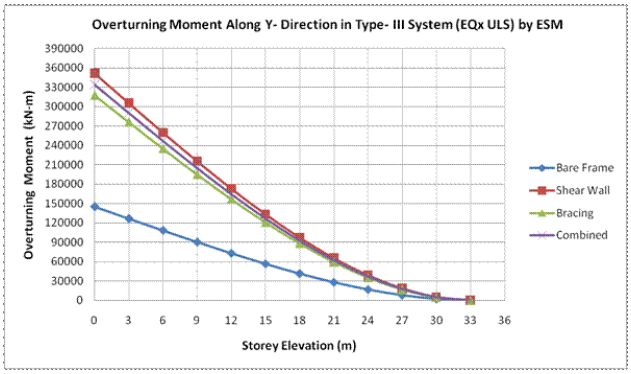

Maximum Storey Displacement Along X- Direction in Type- III System (RSx ULS) by RSM
Displacement (mm)
Storey Elevation (m)
Bare Frame
Shear Wall
Bracing
Combined


Maximum Storey Drift Along X- Direction in Type- III System (EQx ULS) by ESM
Max Storey Drift
Storey Elevation (m)
Bare Frame
Shear Wall
Bracing
Combined


Maximum Storey Drift Along X- Direction in Type- III System (RSx ULS) by RSM
Drift
Storey Elevation (m)
Bare Frame
Shear Wall
Bracing
Combined


Storey Shear Along X- Direction in Type- III System (EQx ULS) by ESM
Storey Shear (kN)
Storey Elevation (m)
Bare Frame
Shear Wall
Bracing
Combined


Storey Shear Along X- Direction in Type- III System (RSx ULS) by RSM
Storey Shear (kN)
Storey Elevation (m)
Bare Frame
Shear Wall
Bracing
Combined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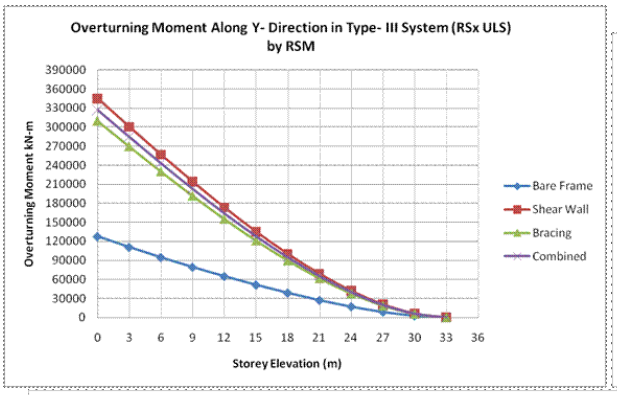
Overturning Moment (kN-m)
Storey Elevation (m)
Bare Frame
Shear Wall
Bracing
Combined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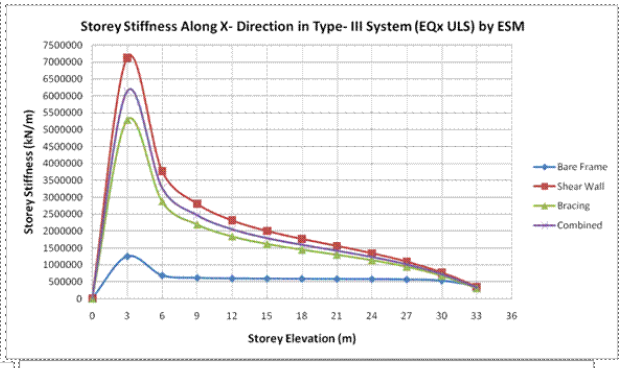
Overturning Moment kN-m
Storey Elevation (m)
Bare Frame
Shear Wall
Bracing
Combined


Storey Stiffness Along X- Direction in Type- III System (EQx ULS) by ESM
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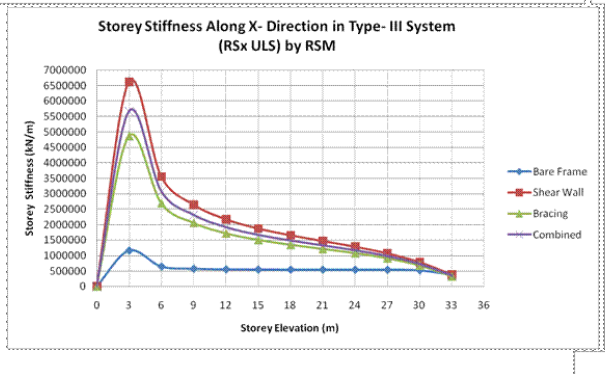
Storey Elevation (m)
Bare Frame
Shear Wall
Bracing
Combined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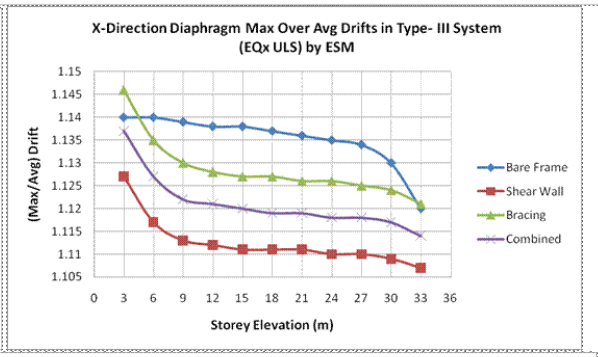
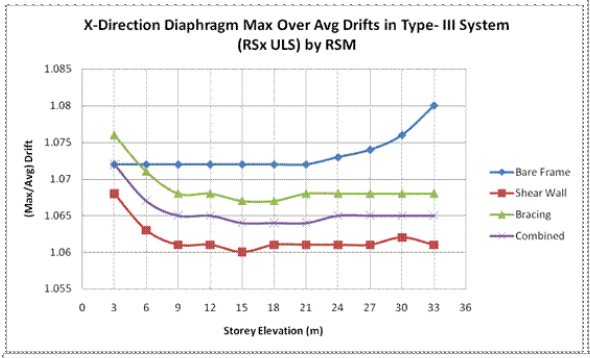
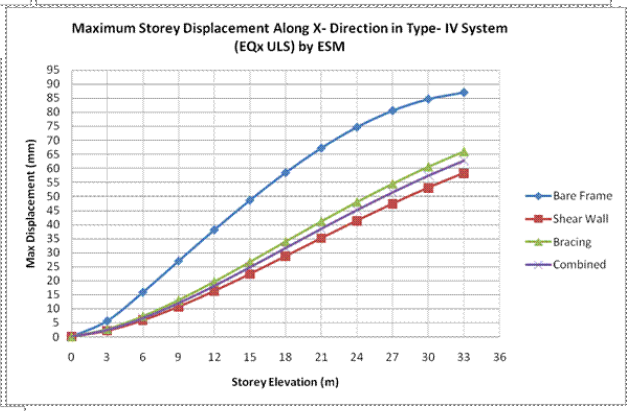
Storey Elevation (m)
Bare Frame
Shear Wall
Bracing
Combined


X-Direction Diaphragm Max Over Avg Drifts in Type- III System (EQx ULS) by ESM
(Max/Avg) Drift
Storey Elevation (m)
Bare Frame
Shear Wall
Bracing
Combined


X-Direction Diaphragm Max Over Avg Drifts in Type- III System (RSx ULS) by RSM
(Max/Avg) Drift
Storey Elevation (m)
Bare Frame
Shear Wall
Bracing
Combined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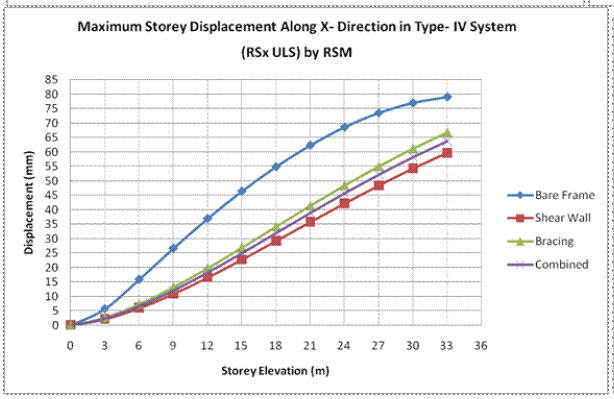
Max Displacement (mm)
Storey Elevation (m)
Bare Frame
Shear Wall
Bracing
Combined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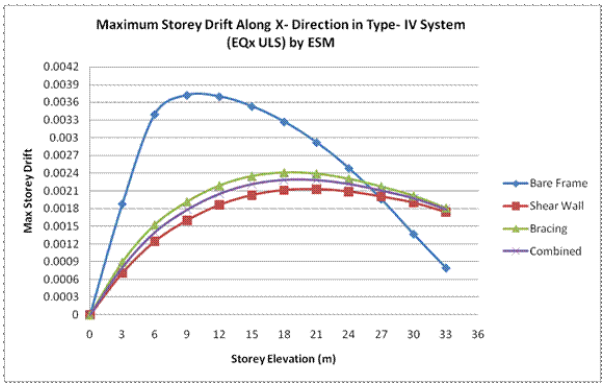
Displacement (mm)
Storey Elevation (m)
Bare Frame
Shear Wall
Bracing
Combined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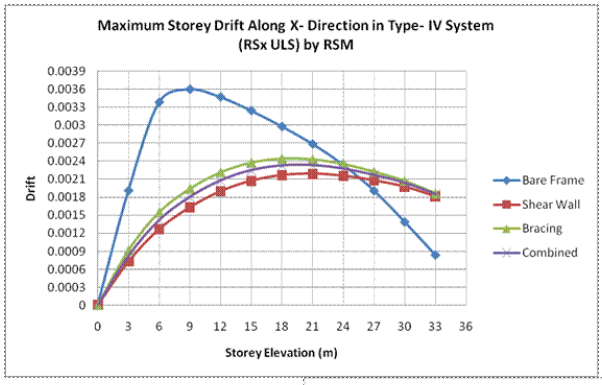
Max Storey Drift
Storey Elevation (m)
Bare Frame
Shear Wall
Bracing
Combined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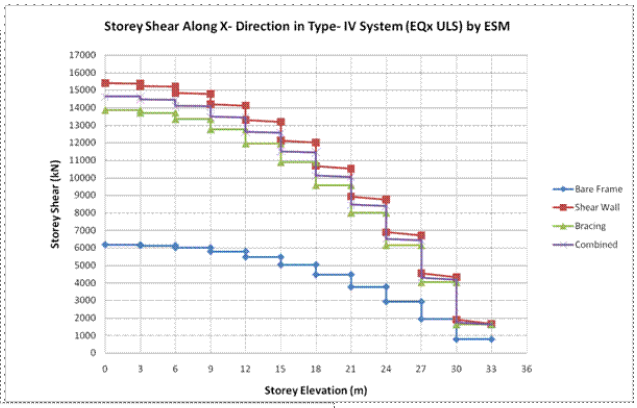
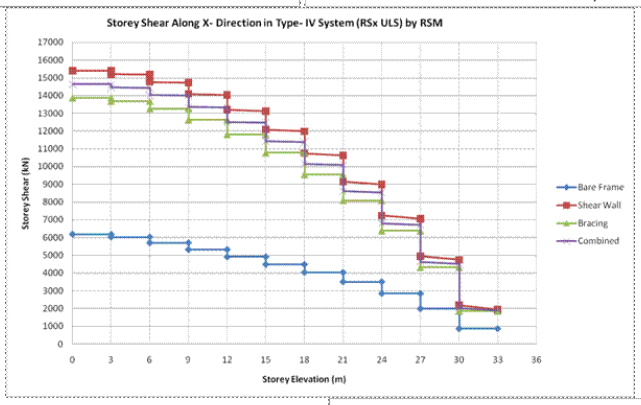
(RSx ULS) by RSM
Drift
Storey Elevation (m)
Bare Frame
Shear Wall
Bracing
Combined


Storey Shear Along X- Direction in Type- IV System (EQx ULS) by ESM
Storey Shear (kN)
Storey Elevation (m)
Bare Frame
Shear Wall
Bracing
Combined


Storey Shear Along X- Direction in Type- IV System (RSx ULS) by RSM
Storey Shear (kN)
Storey Elevation (m)
Bare Frame
Shear Wall
Bracing
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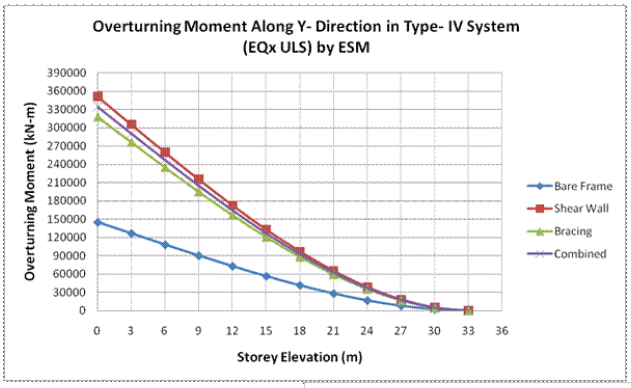
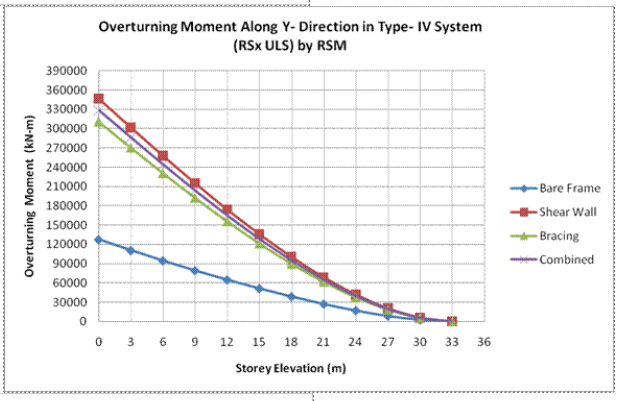
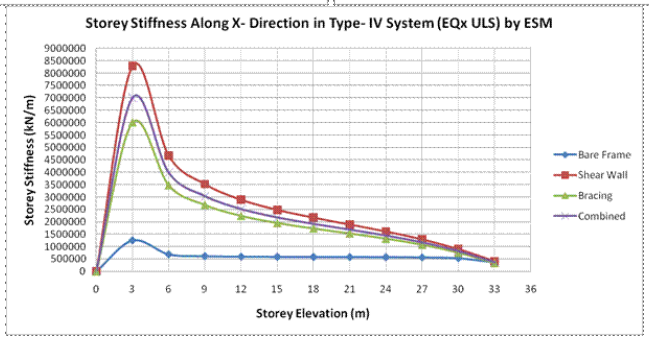

Overturning Moment Along Y- Direction in Type- IV System
(EQx ULS) by ESM
Overturning Moment (kN-m)
Storey Elevation (m)
Bare Frame
Shear Wall
Bracing
Combined


Overturning Moment Along Y- Direction in Type- IV System
(RSx ULS) by RSM
Overturning Moment (kN-m)
Storey Elevation (m)
Bare Frame
Shear Wall
Bracing
Combined


Storey Stiffness Along X- Direction in Type- IV System (EQx ULS) by ESM
Storey Stiffness (kN/m)
Storey Elevation (m)
Bare Frame
Shear Wall
Bracing
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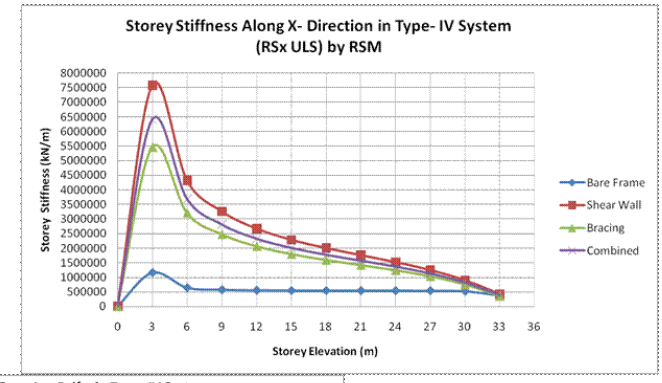
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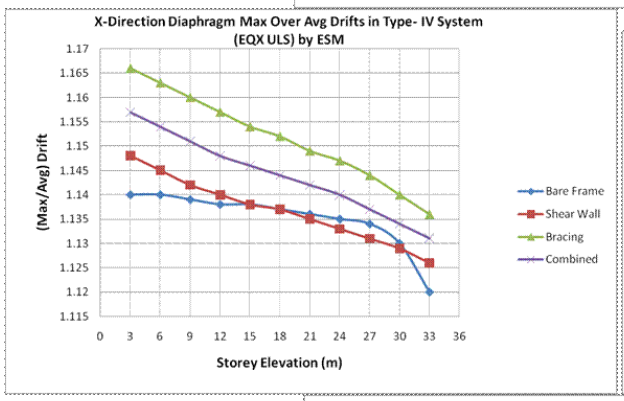
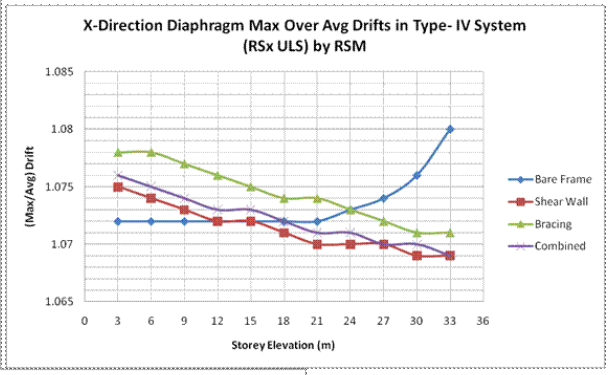
Storey Stiffness (kN/m)
Storey Elevation (m)
Bare Frame
Shear Wall
Bracing
Combined


X-Direction Diaphragm Max Over Avg Drifts in Type- IV System
(EQX ULS) by ESM
(Max/Avg) Drift
Storey Elevation (m)
Bare Frame
Shear Wall
Bracing
Combined


X-Direction Diaphragm Max Over Avg Drifts in Type- IV System
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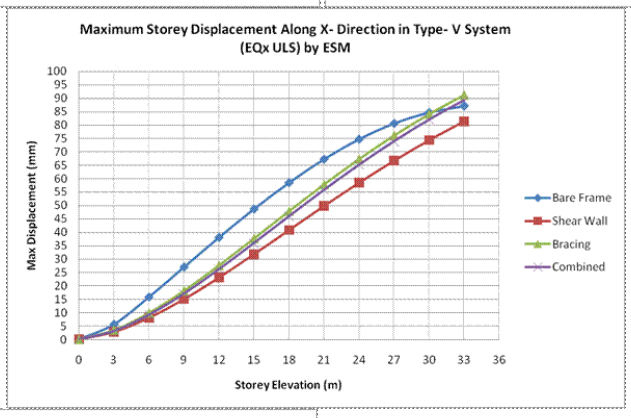
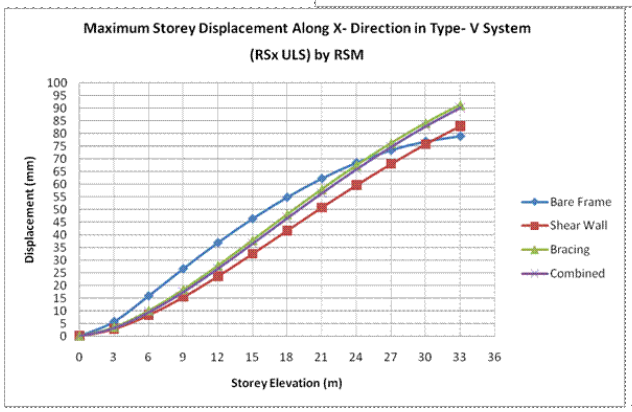
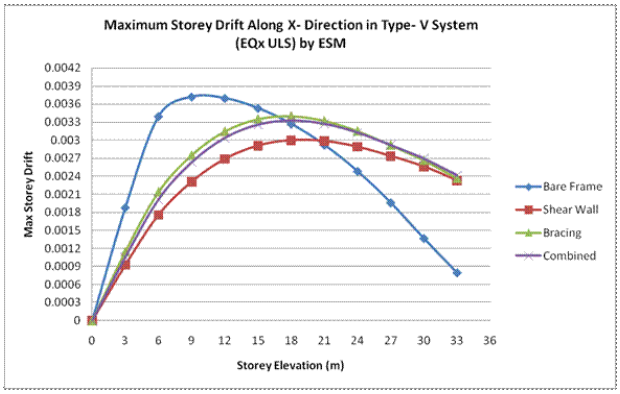
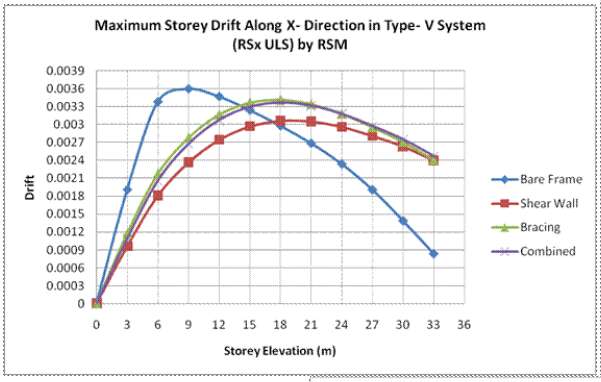
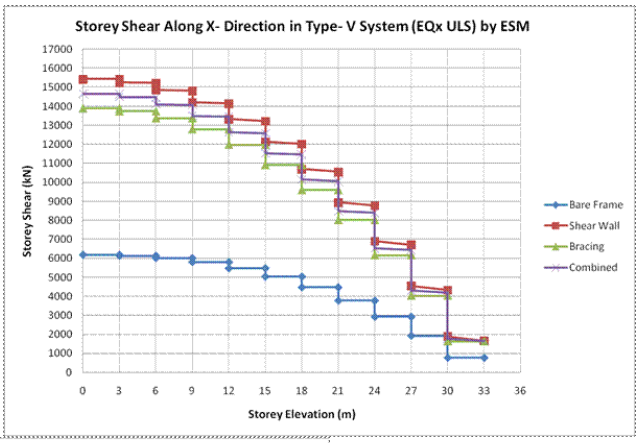
(Max/Avg) Drift
Storey Elevation (m)
Bare Frame
Shear Wall
Bracing
Combined

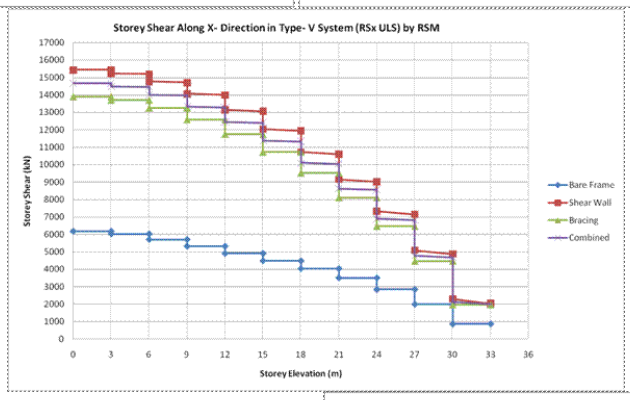

Maximum Storey Displacement Along X- Direction in Type- V System
(EQx ULS) by ESM
Max Displacement (mm)
Storey Elevation (m)
Bare Frame
Shear Wall
Bracing
Combined


Maximum Storey Displacement Along X- Direction in Type- V System
(RSx ULS) by RSM
Displacement (mm)
Storey Elevation (m)
Bare Frame
Shear Wall
Bracing
Combined


Maximum Storey Drift Along X- Direction in Type- V System
(EQx ULS) by ESM
Max Storey Drift
Storey Elevation (m)
Bare Frame
Shear Wall
Bracing
Combined


Maximum Storey Drift Along X- Direction in Type- V System
(RSx ULS) by RSM
Drift
Storey Elevation (m)
Bare Frame
Shear Wall
Bracing
Combined


Storey Shear Along X- Direction in Type- V System (EQx ULS) by ESM
Storey Shear (kN)
Storey Elevation (m)
Bare Frame
Shear Wall
Bracing
Combined


Storey Shear Along X- Direction in Type- V System (RSx ULS) by RSM
Storey Shear (kN)
Storey Elevation (m)
Bare Frame
Shear Wall
Bracing
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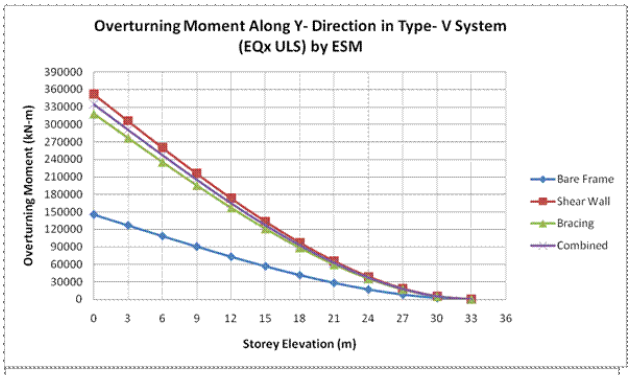
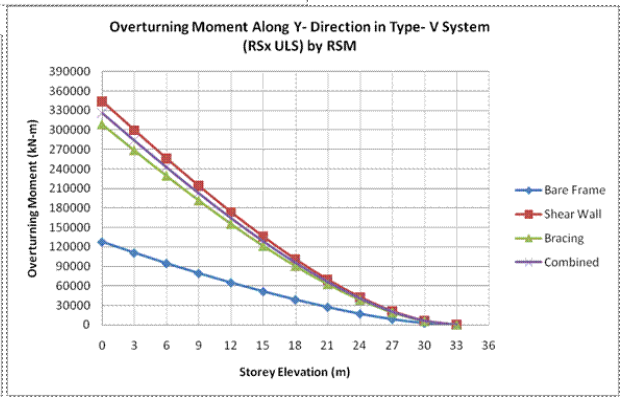
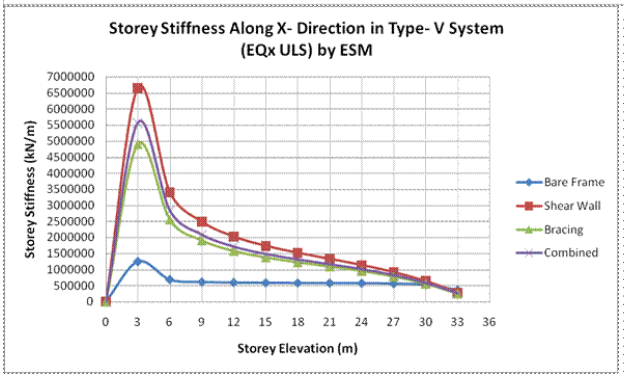
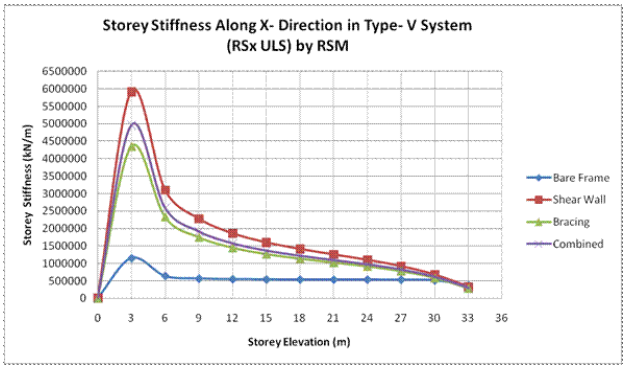

Overturning Moment Along Y- Direction in Type- V System
(EQx ULS) by ESM
Overturning Moment (kN-m)
Storey Elevation (m)
Bare Frame
Shear Wall
Bracing
Combined


Overturning Moment Along Y- Direction in Type- V System
(RSx ULS) by RSM
Overturning Moment (kN-m)
Storey Elevation (m)
Bare Frame
Shear Wall
Bracing
Combined


Storey Stiffness Along X- Direction in Type- V System
(EQx ULS) by ESM
Storey Stiffness (kN/m)
Storey Elevation (m)
Bare Frame
Shear Wall
Bracing
Combined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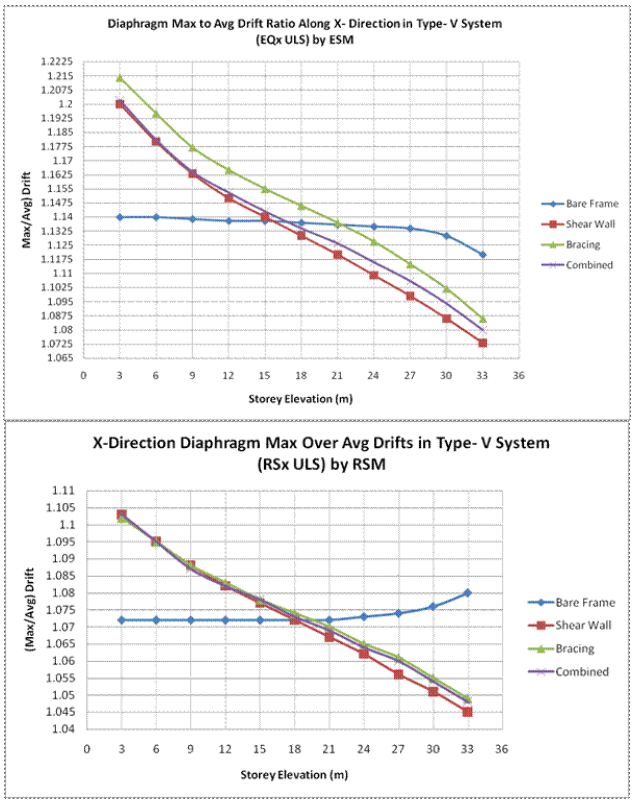
(RSx ULS) by RSM
Storey Stiffness (kN/m)
Storey Elevation (m)
Bare Frame
Shear Wall
Bracing
Combined



B. DISCUSSION

Equivalent Static Method (ESM) and Response Spectrum Method (RSM) with different position/locations (type- I, type- II, type- III, type- IV and type- V) of shear wall, steel bracing and combination of shear walls and braces (combined) systems are compared in terms of maximum storey displacement, maximum storey drift, storey shear, overturning moment, storey stiffness and diaphragm maximum to average drift ratio.

Following observations were noticed:

1. The displacement of all models remains below the limit of 0.004 times the building height.
2. It is seen that when the seismic force is in X-direction, the model having the shear wall system only in each type of arrangements/locations shows the better performance than other systems. Similar case is for Y-direction too, as the structural system being symmetric and regular.
3. In terms of location or type, the order of increasing storey stiffness values in ESM is type-V, type-I, type-III, type-II, and type-IV, while in RSM it is type-V, type-I, type-III, type-IV, and type-II.
4. Observations indicate that a combined system consisting of shear wall and bracing exhibits lower displacement, drift, and maximum to average drift ratio, as well as higher storey shear, overturning moment, and stiffness when compared to a bracing system alone.
5. It is observed that in each system, type- II and type- IV shows almost similar performance in terms of all analyzed parameters.

6. In all types/locations of any system there is no considerable difference in the distance between center of mass and center of rigidity.
7. It is seen that in continuous lateral load resisting system location without corners (i.e. type- II and type- IV) has greater stiffness than that in continuous lateral load resisting system with corners.
8. The stiffness of continuous systems (type-I, type-II, type-III, and type-IV) is higher than that of discontinuous systems (type-V), according to observations.
9. Outer sides (periphery) central location (Type- II position) of each system has better performance in terms of all considered parameters than other four type of location.
10. Hence, it can be observed that Type-II position of shear wall system is structurally more efficient than other location and systems to overcome the earthquake effect.

Shear wall system has higher base shear capacity than bracing and combined systems due to its higher in-plan stiffness. As per Response Spectrum Method (RSM), for type- II position of shear wall, bracing and combined system with respect to bare frame system, percentage reduction in top storey displacement are 27.35%, 18.46% and 21.95% respectively, percentage reduction in maximum storey drift are 41.22%, 34.50% and 37.06% respectively, percentage increase in base shear are 144.87%, 120.13% and 132.50% respectively, percentage increase in overturning moment are 167%, 138.93% and 152.97% respectively, percentage increase in maximum value of storey stiffness are 581.07 %, 392. 14% and 474.26% respectively and percentage decrease in maximum value of diaphragm maximum to average drift ratio are 3.98%, 3.43% and 3.70% respectively.

CONCLUSIONS AND RECOMMENDATIONS

A. Conclusions

After Equivalent Static Analysis and Response Spectrum Analysis of eleven storied buildings of sixteen different models using earthquake loading according to NBC 105:2020 by locating shear wall, steel bracing and combined system (shear walls + braces) at five different positions (type-I, type- II, type- III, type- IV and type- V), the following conclusions can be drawn:

1. Based on the analysis, it can be observed that placing the shear wall at the central location of the outer sides (Type-II) results in a better response with lower displacement and higher stiffness compared to other systems and locations. It is evident that by incorporating shear walls in the Type-II position, the displacement of the top storey can be reduced by 27.35% and maximum storey stiffness can be increased by 581.07% compared to a bare frame model.
2. In each position (type- I, type- II, type- III, type- IV and type- V) of the building, the seismic performance of a building with a shear wall system is superior to the other two systems. The performance improvement rates are as follows: shear wall system > combined system > bracing system > bare frame system.
3. In a continuous lateral load resisting system (type- II and type- IV) without corners, the lateral load is uniformly distributed throughout the wall, resulting in an even distribution of stress. In contrast, the system with corners (type- I and type- III) can create stress concentration points where the wall is more likely to fail under lateral load. The continuous lateral load resisting systems without corners has greater stiffness than continuous system

with corners due to its uniform distribution of load, symmetric design, and predictable structural behavior which leads to less deformation and better performance.

4. The continuous systems (type- I, type- II, type- III, type- IV) has greater stiffness than a discontinuous system (type- V) due to its uniform distribution of load, greater wall length, and fewer stress concentration points.
5. The order of increasing seismic performance for all considered systems, based on location, is as follows: type-II, type-IV, type-III, type-I, and type-V.

B. Recommendations

Different assumptions and limitations have been adopted for simplicity in modeling the proposed building. Thus all the factors which may influence on the behavior of the structures should be considered in the modeling.

The following suggestions are proposed for future studies to obtain more thorough and improved results.

1. In the current study, the analysis was conducted using ESM and RSM. Time History Analysis and Pushover Analysis can potentially provide more accurate results.
2. The study focused on a regular medium-rise building, but a comparison with low and high-rise buildings can also be conducted.
3. Since the structure analyzed was regular, the analysis was only conducted in one direction (X-direction). For an irregular structure, the analysis should be conducted in both directions.
4. An additional system called concealed bracing shear wall can be used for further analysis.
5. Soil-structure interaction analysis can be performed for cases involving high-rise and irregular buildings.

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IMPACT OF MODERN TECHNOLOGY IN THE PRESENT DAY EDUCATION SYSTEM

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ABSTRACT

Technology is a remarkable gift bestowed upon us by God. It is a great contributor to the development of civilization, arts, and sciences. The impact of technology on our lives is profound and has redefined the way we live. Undoubtedly, it plays an important role in every sphere of life. Technology has made possible the automation of several manual tasks, making them more efficient. Additionally, many complex processes can now be carried out with ease and precision thanks to modern technology. Technology has undoubtedly made our lives better. One of the significant areas where technology has revolutionized is the field of education. The use of technology in schools is now indispensable. With the advent of computers in education, teachers can now impart knowledge more effectively, and students can acquire it with greater ease. The use of technology has made the process of teaching and learning much more enjoyable for all involved.

KEYWORDS: *Education, Modern Technology, ICT, Teaching.*

INTRODUCTION

The 21st century, technology has become a defining feature of our lives, playing an essential role in various aspects of our society. Its impact on the economy is particularly significant, as it is viewed as a fundamental driver of growth. Without adequate technology, an economy is unlikely to thrive in the current climate. This is because technology has made our lives easier and more efficient, reducing the time it takes to complete tasks. Its influence is felt in all areas of life, including education, where technology has revolutionized the way we learn and interact with information.

Modern technology in education:

Recent research on the use of modern technology in education has demonstrated that it has a significant impact on students' learning and interaction with academic materials. By leveraging cutting-edge equipment and tools, students' engagement with the material is enhanced, resulting in a more stimulating and immersive learning experience. The transfer of knowledge is also expedited and made more effective through the use of technology, resulting in a more convenient and efficient educational process. The integration of modern technology in education has become an essential aspect of learning, as it facilitates faster cognitive processes and enhances the overall quality of education. Today's students are utilizing technology in a variety of ways, including:

1. Internet Connection and round the Clock Connectivity:

Over the past decade, the significance of the internet has increased exponentially. It has become an indispensable tool in the realm of education, despite some risks of fraud and other challenges. Nowadays, the internet is pervasive and ubiquitous, integrated into almost every aspect of our daily lives, including television, gaming consoles, and mobile phones. For students, the internet provides unparalleled convenience, offering access to a vast array of resources such as tutorials, instructional videos, and other materials to enhance their academic learning and development. The internet has truly become a valuable resource for students seeking to improve their educational outcomes.

2. Visual aids in Learning

Employing projectors and visuals can enhance learning experience significantly. Compared to words, visual images have a greater impact on human perception. The use of projectors and visuals is an excellent example of technological advancement in education. Many renowned educational institutions worldwide rely on fantastic PowerPoint presentations and projections to ensure interactive and engaging learning experiences. The use of projectors in schools and colleges increases interaction, interest, and motivation levels among students. Engaging visuals prompt students to think critically, which enhances the learning process's efficiency.

3. Digital Footprint in Education Sector

The impact of digital media on the education sector has been substantial. It has resulted in continuous connectivity between students and various forums available for assignments and academic support. As digital technology continues to advance, more applications will assist students in their learning and development.

4. Online degrees with the use of ICT

Online degrees have become increasingly popular, and top institutions offer remarkable online programs utilizing various applications and the internet. This trend is expected to continue to gain support and awareness, making online education a common phenomenon. The flexibility of online degrees has attracted working students worldwide, making it a popular choice for those seeking a convenient learning program.

The significance of technology in education

The significance of technology in education is multi-faceted. Technology plays a vital role in the curriculum, instructional delivery systems, aiding instructions, and enhancing the overall learning process. Technology has revolutionized education, making it interactive and proactive rather than passive and reactive. Education is crucial in both corporate and academic settings. In the former, education and training are used to promote novel approaches among workers. In the latter, education is aimed at stimulating students' curiosity. In either case, technology can aid in students' better understanding and retention of concepts.

Factors influence technology in education

The utilization of technology in education is influenced by a variety of factors. Firstly, Jung highlights the significant challenge that teachers face in keeping up with the rapid expansion of knowledge and the demand to incorporate technology into their teaching. As a result, teachers require training to adapt to these new technologies. Secondly, Gressard and Loyd (1985) posit that teachers' attitudes toward computers play a crucial role in the successful implementation of

ICT in education, and negative attitudes can impede computer-based projects. Additionally, common barriers to implementing technology in education include lack of time, access, resources, expertise, and support. Finally, Butler and Sellbom (2002) and Chizmar& Williams (2001) note that reliability is another significant barrier, including issues such as hardware failures, incompatible software, poor or slow internet connectivity, and outdated software, which can be available only at school while students and educators have more up-to-date software at home.

Impact of ICT on Education

The utilization of ICT in the field of education holds enormous potential for enhancing access, relevance, and quality. According to Tinio (2002), ICT has a significant impact on education by facilitating the acquisition and absorption of knowledge for both teachers and students. Specifically, ICT tools enable active learning, wherein learners engage in analyzing and interpreting information to solve real-world problems. This approach stands in contrast to traditional rote learning, as students can choose what to learn and work at their own pace.

Moreover, ICT also encourages collaborative and cooperative learning, allowing learners and teachers to interact and cooperate regardless of physical distance. This approach promotes cross-cultural exchange, enhances communicative skills, and promotes global awareness among learners. Research indicates that the use of ICT leads to increased cooperation among learners, fostering interactive relationships between students and teachers (Grégoire et al., 1996).

Additionally, ICT promotes creative learning by facilitating the manipulation of existing information and creating new knowledge that aligns with instructional goals. This integrative approach to teaching and learning eliminates the artificial separation between theory and practice and supports evaluative learning, which is student-centered and provides valuable feedback through interactive features.

Overall, the use of ICT in education aligns with constructivist theories of learning, promoting active engagement, collaboration, creativity, and evaluation, as opposed to traditional memorization and rote learning.

Positive Impact:

The impact of technology on education has been overwhelmingly positive, with significant benefits for both teachers and students. Here are a few ways in which technology has improved the teaching and learning experience:

Improved Teaching and Learning: The development of various technological tools such as digital cameras, projectors, mind training software, computers, Power point presentations, and 3D visualization tools have become invaluable resources for educators. These tools have made it easier for teachers to explain complex concepts and for students to grasp them easily. Visual aids also make learning more engaging and enjoyable for students, resulting in increased participation and interest in classroom activities.

Globalization: Technology has also facilitated globalization in education. Students from different parts of the world can now connect and learn from each other through video conferencing without leaving the classroom. There are even websites such as www.glovico.com that offer online foreign language courses, pairing students with teachers from other countries.

No Geographical Limitations: With the advent of online degree programs, there is hardly any need for students to be physically present in a classroom. Many foreign universities have started offering online degree courses, which means that students can join and study from anywhere in the world. Distance learning and online education have become essential parts of the education system, providing greater flexibility and accessibility for students.

Finally it is said that technology has had a tremendous positive impact on education by improving teaching and learning, facilitating globalization, and eliminating geographical barriers to education.

Negative Impact:

While technology has brought numerous benefits to education, there are also some negative impacts that need to be considered:

Declining Writing Skills: The excessive use of online chatting and shortcuts has led to a decline in the writing skills of today's young generation. Children rely heavily on digital communication and have lost touch with the importance of improving their writing skills. As a result, they struggle with spelling, grammar, and even cursive writing.

Increasing Incidents of Cheating: Technological advancements such as graphical calculators, high-tech watches, mini cameras, and other similar equipment have made it easier for students to cheat in exams. It is common for students to write formulas and notes on graphing calculators or use other devices to access information during exams, with little chance of being caught.

Lack of Focus: SMS or text messaging has become a favourite pastime for many students, and they are often seen playing with their cell phones or iPhones throughout the day and night, even during lectures or while driving. The constant connectivity to the online world has resulted in a lack of focus and concentration in academic, athletic, and extracurricular activities.

In summary, while technology has revolutionized education, it has also led to some negative consequences such as declining writing skills, increasing incidents of cheating, and lack of focus. It is important to recognize these downsides and work towards minimizing their impact on education.

CONCLUSION:

In conclusion, while technology has brought about positive changes in education, it has also created some negative effects. To fully benefit from technology, teachers and students should maximize its advantages while minimizing the negative effects. It is important for every country to prioritize the integration of technology in the education sector to achieve excellence in teaching and learning.

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STRUCTURAL PERFORMANCE OF STADIUM WITH THIN SHELL ROOF STRUCTURE

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ABSTRACT

Structural Engineers and Architects Focused on Shell Structures because of Aesthetic Concerns and their ability to cover large spans also in Extreme condition such as Earthquakes and Hurricanes. In this thesis, Analysis of dome form, Para sine form and Mongue's Surface of Thin Shell Roof Structure in stadium are analysed. Deflection, Moment, Stress variation are analysed based on with Bracing and uniform thickness of shell, Without Bracing and uniform thickness of shell, with bracing and varying thickness of shell and without bracing and varying thickness of shell. For the comparison propose and to observe effect of edge and mesh fineness, dome is modeled as an axi-symmetric model and two axi-symmetric load i.e. self-weight and Seismic Loads are applied to the dome roof in SAP 2000. With Bracing and uniform thickness of slab, Without Bracing and uniform thickness of shell, with bracing and varying thickness of shell and without bracing and varying thickness of shell Roof Structure in Stadium is compared.

KEYWORDS: *Dome, Parabolic Sinusoidal Curve, Bracing Etc.*

INTRODUCTION

The development and construction of thin concrete shell structures dates back to the early 1920's when modern architecture looked for new curvilinear type of free forms of long span, thin, and economical ways to build roof structures that would cover large assembly places, sports arenas, public markets, music halls, and some other similar outdoor and indoor spaces where large number of people could gather under a solid and sound roof structure. Shell structures are very interesting due to their impressive strength-to-weight ratios. They are able to span over large areas, while having an exceptionally less thickness. This is primarily due to their form based structural behavior. The shells earthquake resistance is determined directly by performing a response spectrum analysis, but also indirectly by evaluating the fundamental frequencies of the shell structures. The eigen values and corresponding Eigen modes of a shell are solely dependent on the shell's stiffness and mass distribution, and thus, are independent of loading. Because of difficult to construction, analysis and of shell structure, scope of the shell structure was not come in more practice before 1960's period (1). After some decade development of the computer, numerical method like finite difference method, finite element method etc and development of

the new technology of construction, scope of the shell structure start to rise due to aesthetic and structural point of view as impressive strength-to-weight ratios.

We see in shell structure a conventional type of the geometry is used in the field of research and construction example cylindrical shell, conical shell, paraboloid shell, hyperbolic-paraboloid shell etc. with the uniform thickness with or without edge beam. the purpose of this thesis is to use complex geometry like mongue carved surface structure to increase the field of research and to find the best approach geometry for construction of the roof structure keeping good aesthetics appearance and to see /analyse the thin shell roof with the different loading conditions example static, dynamic loading condition etc. Carved surfaces were first studied by the French mathematician-geometer Mongue Gaspard (1746-1818). A carved Mongue surface is a surface composed of orthogonal trajectories of a one-parameter family of planes. Juhanio M. A. was the first researcher who attempts to find the strength of shell in the form of carved Mongue's surface.

Simply Supported Shells (20):- The Term "Simply Supported Shells" describes shells, which terminate at transverse stiffeners that must be integral with the shell. Shell continuous over the stiffeners ate designated as "continuous Shells".

Shells Continuous Over Supports. -The effect of continuity over the supports on stresses in shells is similar to the effect of continuity on stresses in ordinary beams. End restraint of the shell by continuity creates longitudinal stresses at the support, whose magnitude (and sign) are approximately in the same ratio to the longitudinal stresses in the simply supported shell as the end moments in a continuous beam are to the positive (middle span) moment in the same beam, simply supported. In some cases, the values obtained by a rigorous satisfaction of the boundary conditions and those obtained by proportioning the internal forces based on the ratio of end moments to the moment in a simply supported beam are practically identical.

RESEARCH ANALYSIS:

Most of the thin shell roof structure is analysed based on the use of dead load and live load, which might be seen unsafe in Seismic load on structural system. So in this thesis we are going to use varied thickness on the basis of only live load, dead load stress distribution but we are taking in to account as Seismic load. Seismic load in the thin shell structure as roof of the stadium, the roof can bear the Seismic load edge beam of the structure to transfer the stress of one component to the other component or to prevent the edge of the support from punching. Similarly, we can see normally research on simple geometry form so to increase field of research, this thesis aim is to analyse the complex shell roof dynamically and statically by using latest advanced analysis method. The problem induced in the structure as buckling and stress concentration are normally prevented by using bracing which help to transfer stress.

- ✓ Every part of the roof, the stress due to loads induced and the stress is concentrate at the intersection of the roof as edge beam, we should analyse the structure by different method of analysis.
- ✓ Analysis of dome structure, Para sine form structure.

Different tools are used to analysis and of the structure. This first work while starting research is modeling in Sap 2000, Fortran etc. programming for the analysis, validation with manual sectored/discrete form and use of elastic theory, and seismic performance of shell roof Superstructure in Two consecutive direction with validation.

TABLE 1: DETAILING OF STADIUM

Description	Dimension(m)	Description	Dimension(m)	Description	Dimension(m)
Football Ground		Sine Part		Dome Part	
Length	180.10	Length	80.00	Radius	50.05
Breadth	100.10	Height	21.25	Height	21.41
		Curvature	2.00	slope height	
		Slope Length	34.43		

To create sample example of para sine detailed analysis in FORTRAN

Script of FORTRAN built in program for carved mongue's surface: -

NUMBER 0F PACES ALONG AXE X1 - 40 NUMBER OF PACES ALONG AXE X2 - 60

KUS= 8127

E=0.27000E+08 HU= 0.150 ALPHA0= -15.000 BITA0= .000 H=0.25

Nnc= 3. an= 0.050 bn= 0.000 Ln= 0.000 -= 0.000

Noc= 8. ao= 1.000 bn= 1.000 Ln= 16.000 x0 = .000 Theta= 90.000

PACES ALONG AXE X1

1 40 0.375 DLU= 15.00 DLSU= 15.0000

PACES ALONG AXE X2

1 60 0.13333 DLU= 8.00 DLSU= 8.00

CINEMATIC BOUNDARY CONDITION

0 0 1 0 60 1 0 0 0

-1 41 42 0 60 1 0 0 0

40 40 1 0 60 1 0 1 1

0 40 1 0 0 1 0 0 0

0 40 1 60 60 1 1 0 1

0 40 1 61 61 1 0 0 0

-2 0 0 0 0 0 0 0 0

No HOLEs LS= 362

KN = 7141 LS = 362 NMX = 2616676

NO ELASTIC FOUNDATION

DISTIBUTED LOAD ON A SURFACE

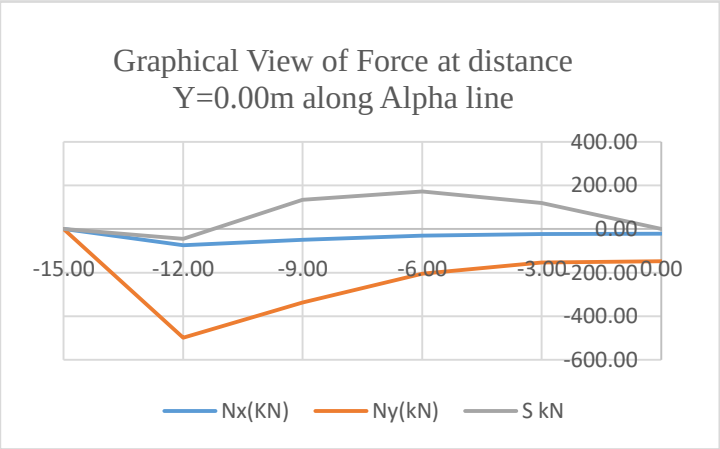
1 0 40 0 60 3 0 -30.00 .00 .00

-2 0 0 0 0 0 0 .00 .00 .00

1 2 0 40 8 0 60 5

TABLE 2 FORCE AT DISTANCE Y= 0M ALONG ALPHA LINE

X (m)	Nx(KN)	Ny(kN)	S kN
-15.00	0.00	0.00	0.00
-12.00	-74.76	-498.40	-45.52
-9.00	-50.49	-336.60	133.20
-6.00	-30.76	-205.10	172.10
-3.00	-23.16	-154.40	119.80
0.00	-22.11	-147.40	0.00



Stadium Roof Structure without Bracing and Uniform Thickness of Shell Model and Deformed Shape in Sap2000

TABLE 3 MODELLING DETAILS OF ROOF STRUCTURE WITHOUT BRACING AND UNIFORM THICKNESS.

Description	Dimension(m)	Description	Dimension(m)	Description	Dimension(m)
Frame Strucute Part		Sine Part		Dome Part	
Beam (M30)	0.4*0.6	slab (M30)	0.50	slab (M30)	0.50
Column (M30)	1.5*15	Intersection Slab		Sitting Slab	
Ties (M20)	0.3*0.3	slab (M20)	0.13	slab (M30)	0.25
Description			Description		
Grade of Concrete		M20	Grade of Concrete	M30	
Weight Per Unit Volume		24.9926 KN/m3	Weight Per Unit Volume	24.9926 KN/m3	
Poissions Ratio		0.2	Poissions Ratio	0.2	
Modulus of Elasticity		22360680 KN/m2	Modulus of Elasticity	27386128 KN/m2	
Coefficient of Thermal		0.0000055 m	Coefficient of Thermal	5.500E-06 m	
Shear Modulus		9316950 KN/m2	Shear Modulus	11410887 KN/m2	
Specified Compressive concrete strength		20000 KN/m2	Specified Compressive concrete strength	30000 KN/m2	
Expected Compressive concrete strength		20000 KN/m2	Expected Compressive concrete strength	30000 KN/m2	

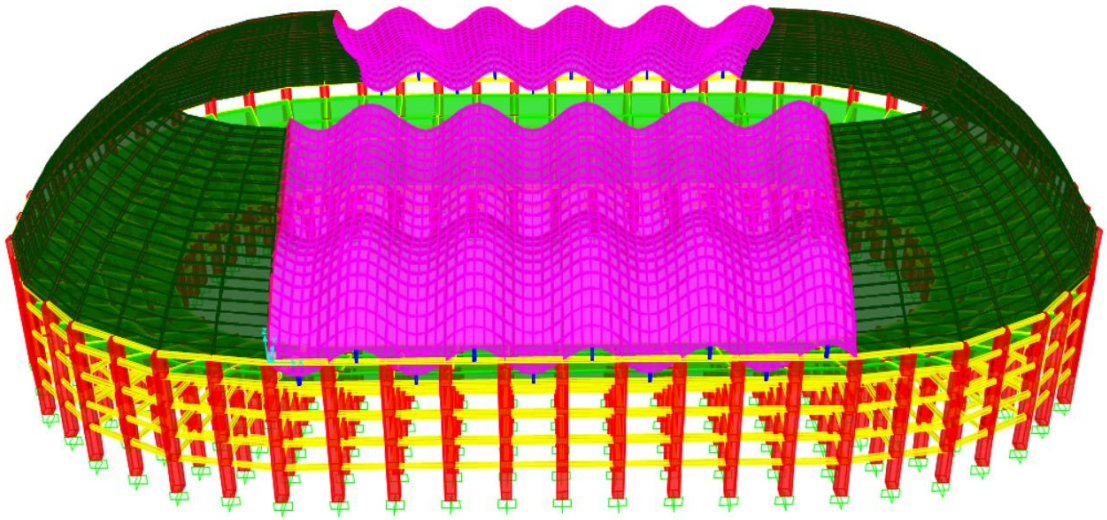


Figure 1 Stadium Roof Structure without Bracing and Uniform Thickness of Shell in Sap 2000

Stadium Roof Structure without Bracing and Varying Thickness of Shell Model and Deformed Shape in Sap 2000

TABLE 4 DETAILS OF STADIUM ROOF STRUCTURE WITHOUT BRACING AND VARYING THICKNESS

Description	Dimension(m)	Description	Dimension(m)	Description	Dimension(m)
Frame Strucute Part		Sine Part		Dome Part	
Beam (M30)	0.4*0.6	slab (M30)	0.40 to 0.50	slab (M30)	0.40 to 0.50
Column (M30)	1.5*15	Intersection Slab		Sitting Slab	
Ties (M20)	0.3*0.3	slab (M20)	0.13	slab (M30)	0.25
Description			Description		
Grade of Concrete		M20	Grade of Concrete		M30
Weight Per Unit Volume		24.9926 KN/m3	Weight Per Unit Volume		24.9926 KN/m3
Poissions Ratio		0.2	Poissions Ratio		0.2
Modulus of Elasticity		22360680 KN/m2	Modulus of Elasticity		27386128 KN/m2
Coefficient of Thermal		0.0000055 m	Coefficient of Thermal		5.500E-06 m
Shear Modulus		9316950 KN/m2	Shear Modulus		11410887 KN/m2
Specified Compressive concrete strength		20000 KN/m2	Specified Compressive concrete strength		30000 KN/m2
Expected Compressive concrete strength		20000 KN/m2	Expected Compressive concrete strength		30000 KN/m2

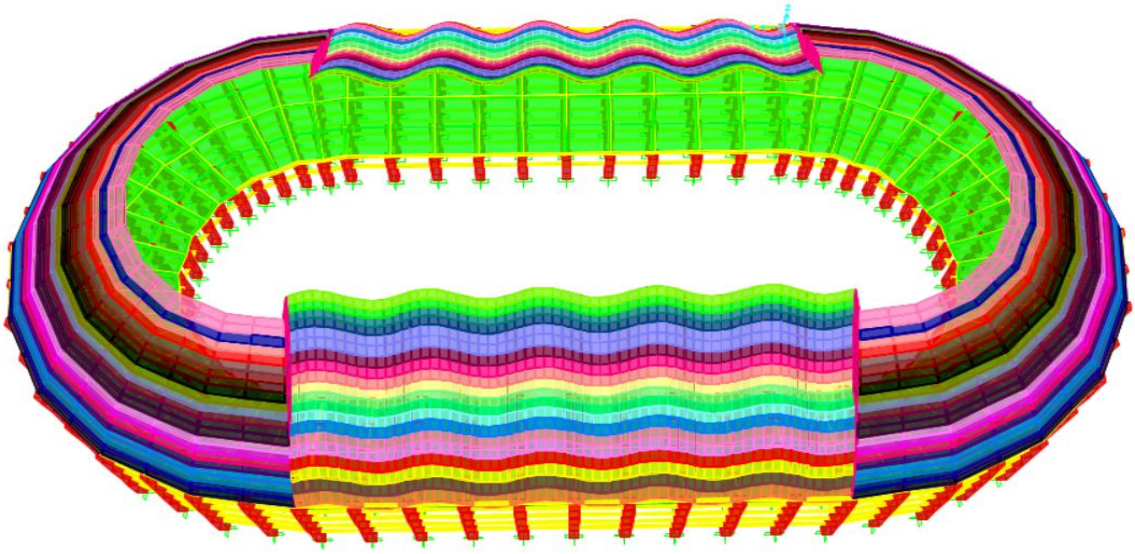


Figure 2 Stadium Roof Structure without Bracing and Varying Thickness of Shell in Sap 2000

Stadium Roof Structure with Bracing and Uniform Thickness of Shell Model and Deformed Shape in Sap 2000.

TABLE 5 MODELLING DETAILS OF STADIUM ROOF STRUCTURE WITH BRACING AND UNIFORM THICKNESS

Description	Dimension(m)	Description	Dimension(m)	Description	Dimension(m)
Frame Strucute Part		Sine Part		Dome Part	
Beam (M30)	0.4*0.6	Slab (M30)	0.50	Slab (M30)	0.50
Column (M30)	1.5*15	Intersection Slab		Sitting Slab	
Ties (M20)	0.3*0.3	Slab (M20)	0.13	Slab (M30)	0.25
Intersection Beam	0.3*0.3				
Bracing	0.4*0.6				
Description			Description		
Grade of Concrete		M20	Grade of Concrete		M30
Weight Per Unit Volume		24.9926 KN/m3	Weight Per Unit Volume		24.9926 KN/m3
Poissions Ratio		0.2	Poissions Ratio		0.2
Modulus of Elasticity		22360680 KN/m2	Modulus of Elasticity		27386128 KN/m2
Coefficient of Thermal Expansion		0.0000055 m	Coefficient of Thermal		5.500E-06 m
Shear Modulus		9316950 KN/m2	Shear Modulus		11410887 KN/m2
Specified Compressive concrete		20000 KN/m2	Specified Compressive		30000 KN/m2
Expected Compressive concrete		20000 KN/m2	Expected Compressive		30000 KN/m2

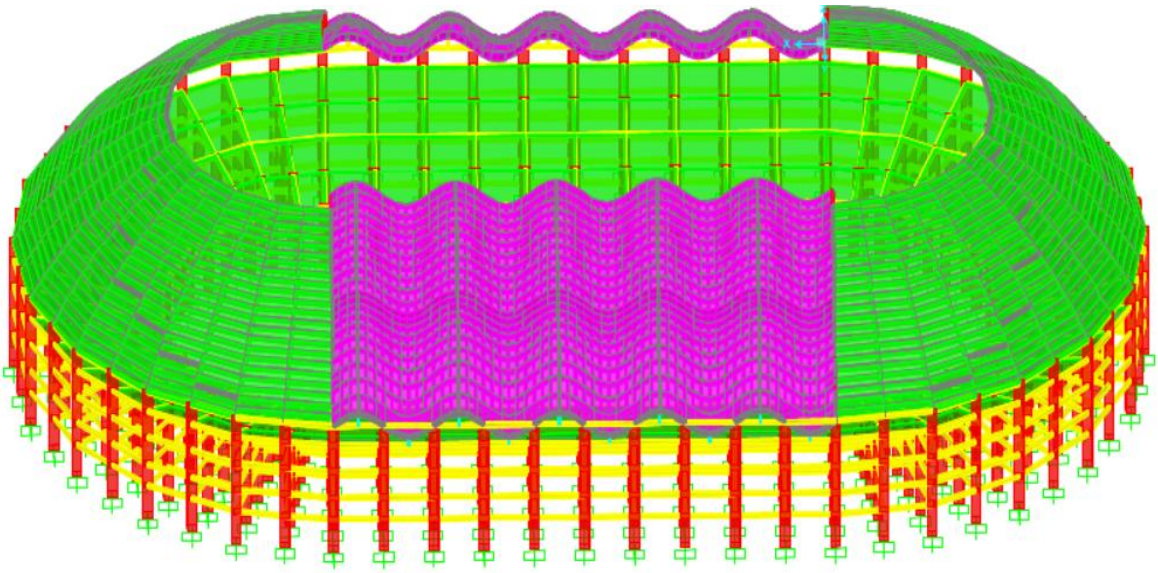


Figure 3 Stadium Roof Structure with Bracing and Uniform Thickness of Shell in Sap

Stadium Roof Structure with Bracing and Uniform Thickness of Shell Model and Deformed Shape in Sap 2000

TABLE 6 MODELLING DETAILS OF STADIUM ROOF STRUCTURE WITH BRACING AND UNIFORM THICKNESS

Description	Dimension(m)	Description	Dimension(m)	Description	Dimension(m)
Frame Strucute Part		Sine Part		Dome Part	
Beam (M30)	0.4*0.6	Slab (M30)	0.4 to 0.5	Slab (M30)	0.4 to 0.5
Column (M30)	1.5*15	Intersection Slab		Sitting Slab	
Ties (M20)	0.3*0.3	Slab (M20)	0.13	Slab (M30)	0.25
Intersection Beam	0.3*0.3				
Bracing	0.4*0.6				
Description			Description		
Grade of Concrete		M20	Grade of Concrete		M30
Weight Per Unit Volume		24.9926 KN/m3	Weight Per Unit Volume		24.9926 KN/m3
Poissions Ratio		0.2	Poissions Ratio		0.2
Modulus of Elasticity		22360680 KN/m2	Modulus of Elasticity		27386128 KN/m2
Coefficient of Thermal Expansion		0.0000055 m	Coefficient of Thermal		5.500E-06 m
Shear Modulus		9316950 KN/m2	Shear Modulus		11410887 KN/m2
Specified Compressive concrete		20000 KN/m2	Specified Compressive		30000 KN/m2
Expected Compressive concrete		20000 KN/m2	Expected Compressive		30000 KN/m2

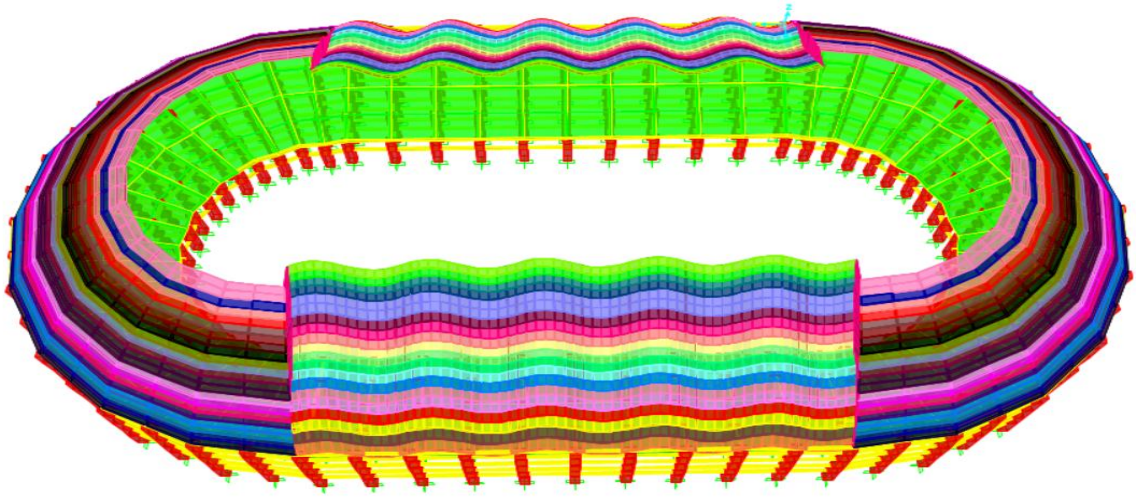


Figure 4 Stadium Roof Structure with Bracing and Varying Thickness of Shell in Sap 2000

Stadium Roof Structure Detailing and View of Different Model in Sap 2000

TABLE 7 MODELLING DETAILS OF STADIUM ROOF STRUCTURE WITH BRACING AT THE TOP ONLY AND UNIFORM THICKNESS

Description	Dimension(m)	Description	Dimension(m)	Description	Dimension(m)
Frame Strucute Part		Sine Part		Dome Part	
Beam (M30)	0.4*0.6	Slab (M30)	0.60	Slab (M30)	0.60
Column (M30)	1.5*15	Intersection Slab		Sitting Slab	
Bracing Beam	0.3*0.6	Slab (M20)	0.13	Slab (M30)	0.25
Intersection Beam	0.3*0.3	Sine Part for varying		Dome Part	
Steel Bracing	ISMC400	Slab (M30)	0.25 to 0.90	Slab (M30)	0.25 to 0.90
Description of Fe345			Description		
Grade of Steel		Fe345	Grade of Concrete		M30
Weight Per Unit Volume		76.9729 KN/m3	Weight Per Unit Volume		24.9926 KN/m3
Poissions Ratio		0.3	Poissions Ratio		0.2
Modulus of Elasticity		$2.1*10^8$ KN/m2	Modulus of Elasticity		27386128 KN/m2
Coefficient of Thermal Expansion		1.170E-05 m	Coefficient of Thermal		5.500E-06 m
Shear Modulus		80769231 KN/m2	Shear Modulus		11410887 KN/m2
Minimum Yield Stress,Fy		345000 KN/m2	Specified Compressive		30000 KN/m2
Minimum Tensile Stress,Fu		450000 KN/m2	Expected Compressive		30000 KN/m2
Description			Description		
Grade of Concrete		M20	Stell Channel		ISMC 400
Weight Per Unit Volume		24.9926 KN/m3	Weight Per Meter		49.4 N/m
Poissions Ratio		0.2	Sectional Area		62.93 cm^2
Modulus of Elasticity		22360680 KN/m2	Depth of Section		400 mm
Coefficient of Thermal Expansion		0.0000055 m	Width of flange		100mm
Shear Modulus		9316950 KN/m2	thickness of Flange		15.3 mm
Specified Compressive concrete		20000 KN/m2	Thickness of Web		8.6 mm
Expected Compressive concrete		20000 KN/m2	Center of Gravity		24.2 mm

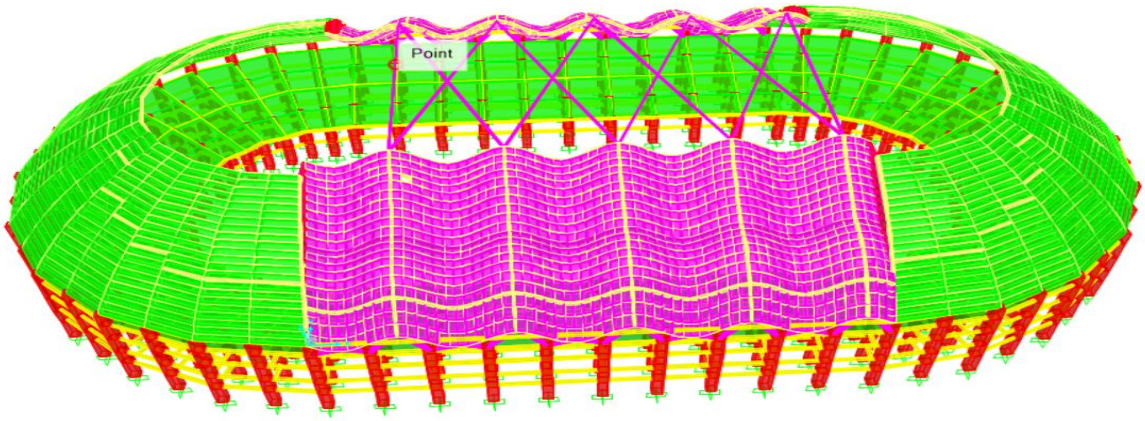


Figure 5 Bracing in roof as well as top of the stadium with Uniform Thickness of RCC Shell in Sap 2000

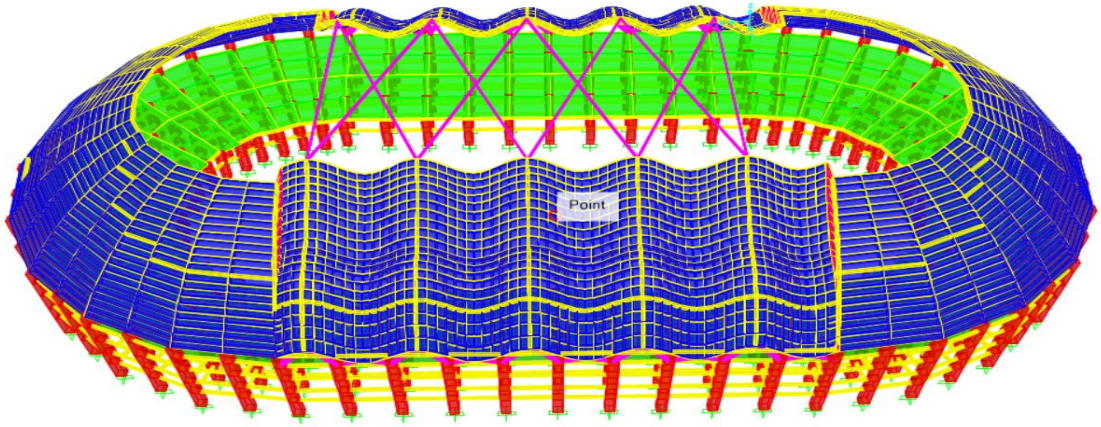


Figure 6: Bracing in roof as well as top of the stadium with Varying Thickness of RCC Shell in Sap 2000

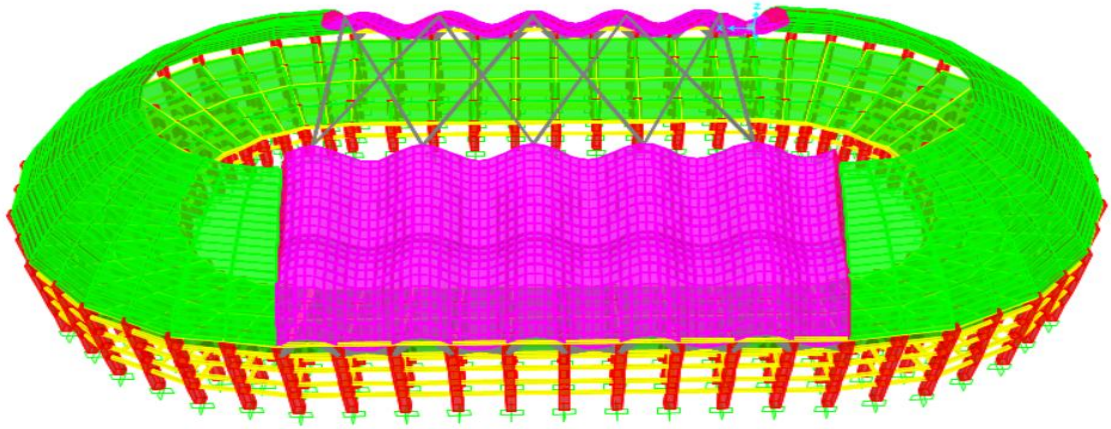


Figure 7 Bracing Only on top of the stadium with uniform Thickness of shell in RCC Sap 2000

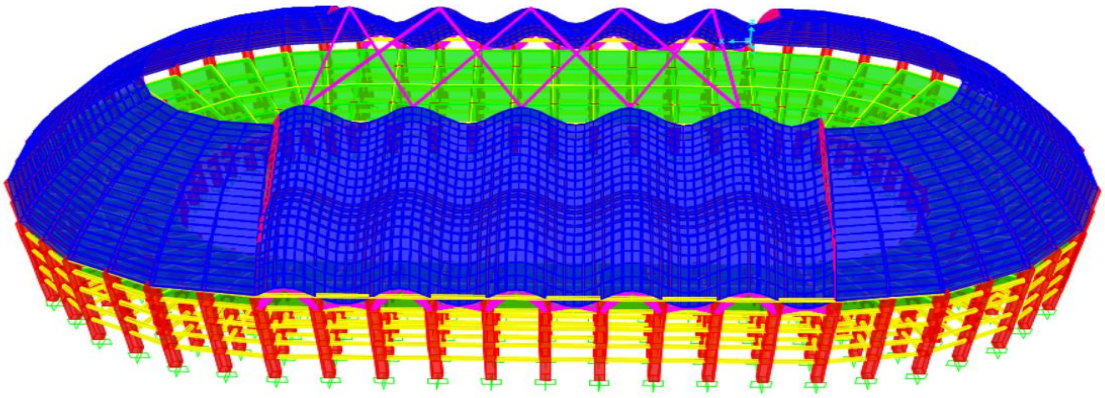


Figure 8 : Bracing Only on top of the stadium with Varying Thickness of Shell in RCC Sap 2000

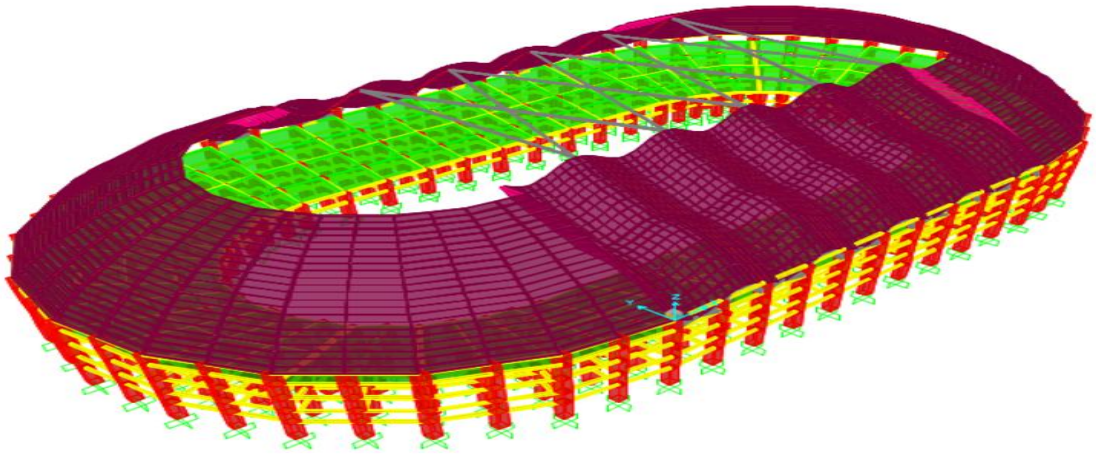


Figure 9: Bracing only on top of the stadium with uniform Thickness of Steel Shell in Sap 2000

RESULTS AND DISCUSSION

For observing structural performance using different methods the model of whole superstructure of stadium is modeled in Sap2000 (clause 2.5.2.2 to Clause 2.5.2.14) and analyse result are obtained and Para sine and Dome Part is coded in to the already build up program FORTRAN (clause 2.5.2.1 and Annex I) and analyse results are obtained then the output results are compared (clause 3.1 to 3.5).

For observing structural parameters the shell structure in sap2000 as well as FORTRAN are observe specific ultimate parameters subjected to gravity load.

For study structural parameters of roof shell structure models with varied and uniform thickness are modeled (Clause 2.5.2.16 to clause 2.5.2.24) then analsyed and the result are compared with structural parameters.

For observing structural performance shell roof structure with stiffeners and without stiffened bracing the deformation of the critical joint in the shell roof structure is obtained (clause 3.1 & 3.2) and bracing at the top of the roof (clause 3.3) is analysed to obtained the deformation of the critical joint is obtained then the results are compared to achieve permissible deflection.

Using FORTRAN complex, sap2000 and with manual verification (IS 456:2000 clause 23.2 span/350 or 20mm whichever is less) deviation in results are seen due to effect of methodologies empirical formulas and discontinuities of curvature under consideration. However, it is noted that not peak deviation is occurred while using various methods.

Stress goes increasing at the base of the dome and para sine part so contour act the stress variation of thickness of the slab is done for getting the structural performance. Also dead and lateral loads are decreased due to the thickness of the slab which ultimately decrease the permissible deflection of the tip of the stadium roof.

At the junction of roof and super structure and intersection of para sine and dome of the stadium stress concentration is maximum, to contour act this thickness of slab is vary.

Comparison Base Reaction of Four Models

TABLE 8 BASE REACTIONS DUE TO GLOBAL FZ (KN)

Output Case	Without Bracing and Unifrom Thickness	Without Bracing and Varying Thickness	With Bracing and Unifrom Thickness	With Bracing and Varying Thickness
DEAD	586568.10	570414.90	676595.98	660310.72
EQX	0.00	0.00	0.00	0.00
EQY	0.00	0.00	0.00	0.00
LIVE	36563.25	36563.25	36563.25	36563.25

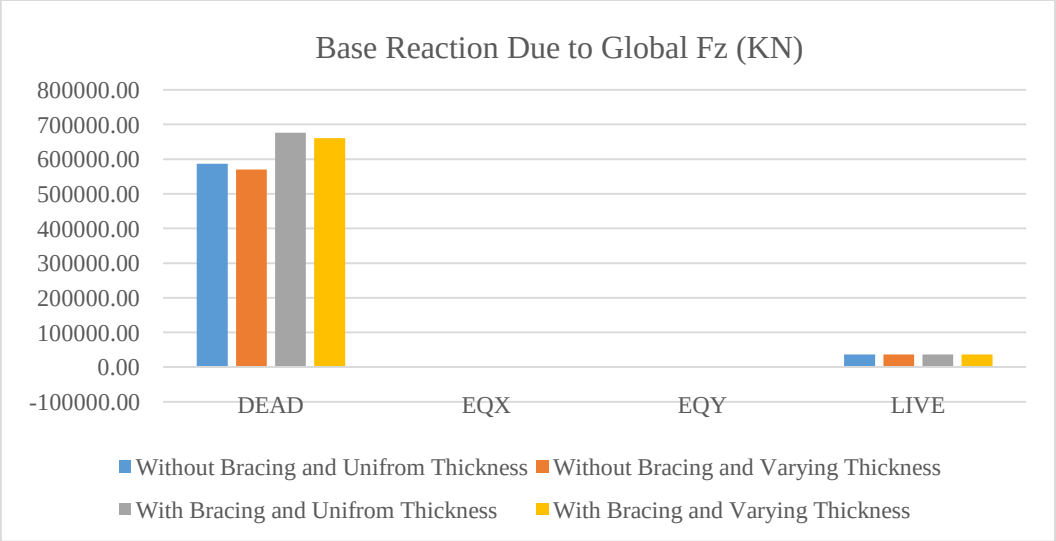


TABLE 9 BASE REACTIONS DUE TO GLOBAL FX (KN)

Output Case	Without Bracing and Unifrom Thickness	Without Bracing and Varying Thickness	With Bracing and Unifrom Thickness	With Bracing and Varying Thickness
DEAD	0.00	0.00	0.00	0.00
EQX	-841227.33	-819420.51	-962764.96	-940779.84
EQY	0.00	0.00	0.00	0.00
LIVE	0.00	0.00	0.00	0.00

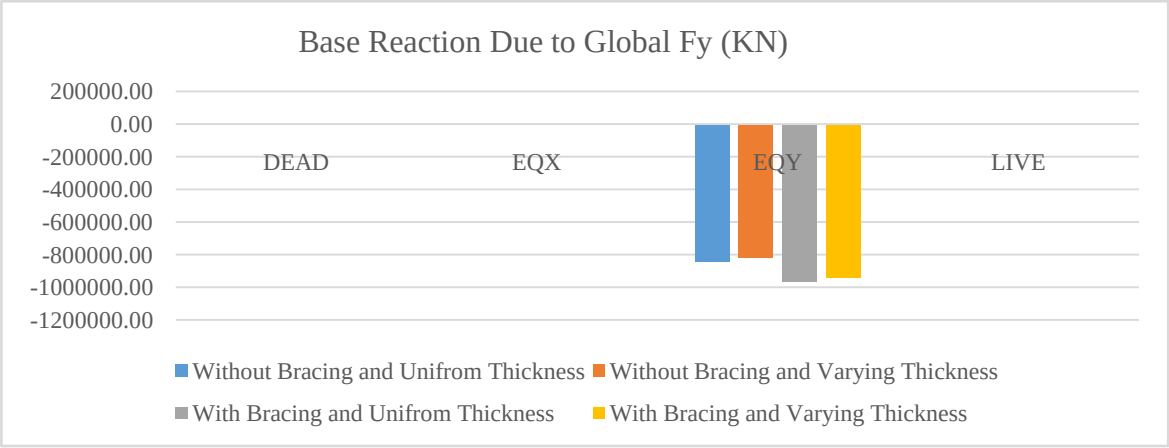


TABLE 10 BASE REACTIONS DUE TO GLOBAL F_Y (KN)

Output Case	Without Bracing and Unifrom Thickness	Without Bracing and Varying Thickness	With Bracing and Unifrom Thickness	With Bracing and Varying Thickness
DEAD	0.00	0.00	0.00	0.00
EQX	0.00	0.00	0.00	0.00
EQY	-841227.36	-819420.53	-962764.98	-940779.80
LIVE	0.00	0.00	0.00	0.00

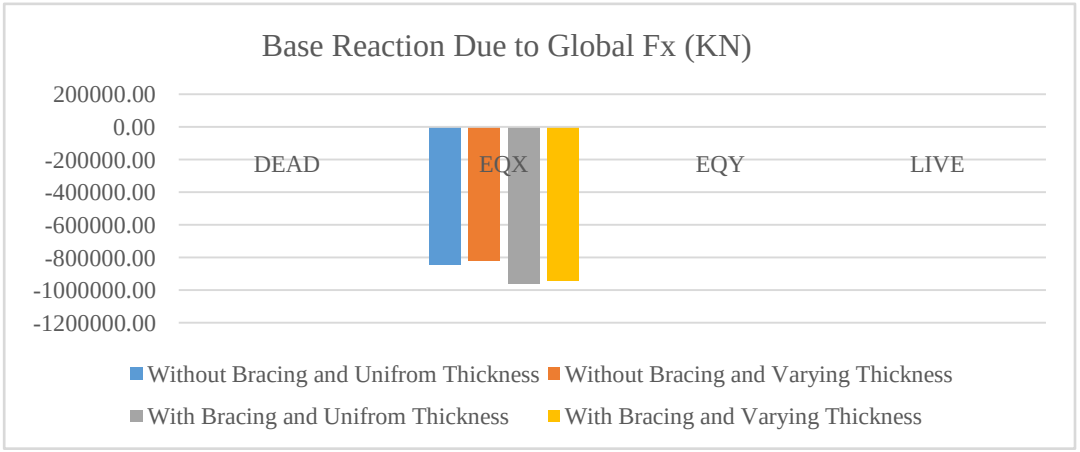


TABLE 11 BASE REACTIONS DUE TO GLOBAL M_Z (KN-M)

Output Case	Without Bracing and Unifrom Thickness	Without Bracing and Varying Thickness	With Bracing and Unifrom Thickness	With Bracing and Varying Thickness
DEAD	0.00	0.00	0.00	0.00
EQX	42103513.70	41014625.80	48181787.80	47093372.70
EQY	-33739480.00	-32864066.00	-38629929.00	-37737671.00
LIVE	0.00	0.00	0.00	0.00

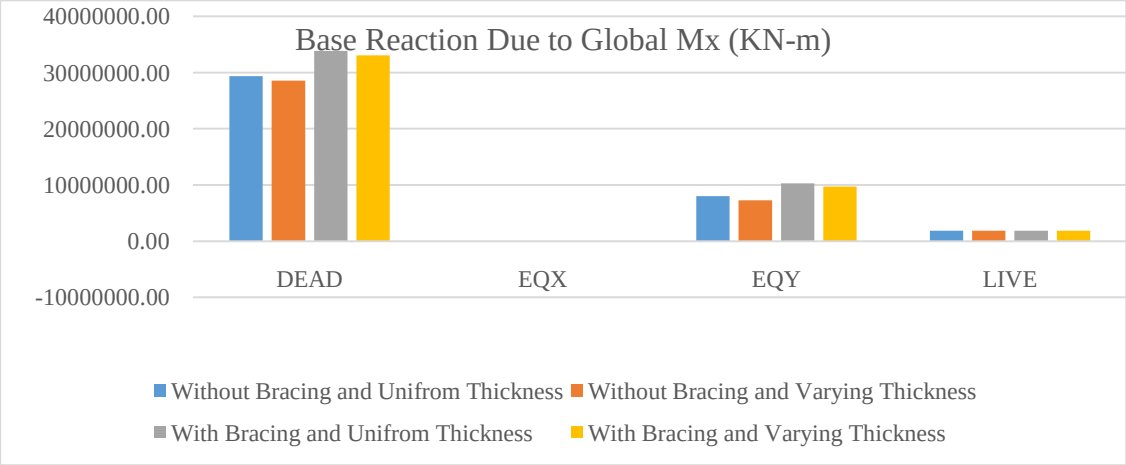


TABLE 12 BASE REACTIONS DUE TO GLOBAL M_X (KN-M)

Output Case	Without Bracing and Unifrom Thickness	Without Bracing and Varying Thickness	With Bracing and Unifrom Thickness	With Bracing and Varying Thickness
DEAD	29357793.27	28550849.54	33860316.10	33050887.30
EQX	0.00	0.00	0.00	0.00
EQY	7990814.33	7254729.66	10296099.29	9722439.50
LIVE	1829994.38	1829994.38	1829994.38	1829994.38

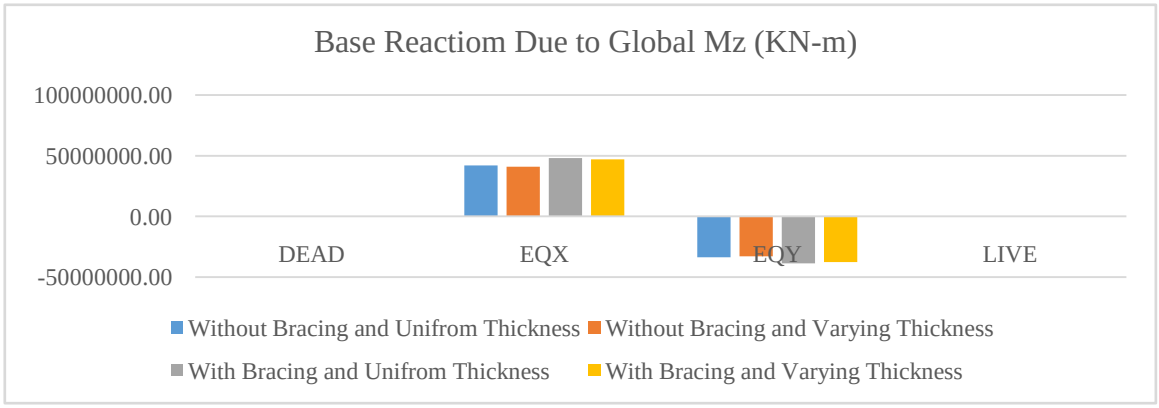
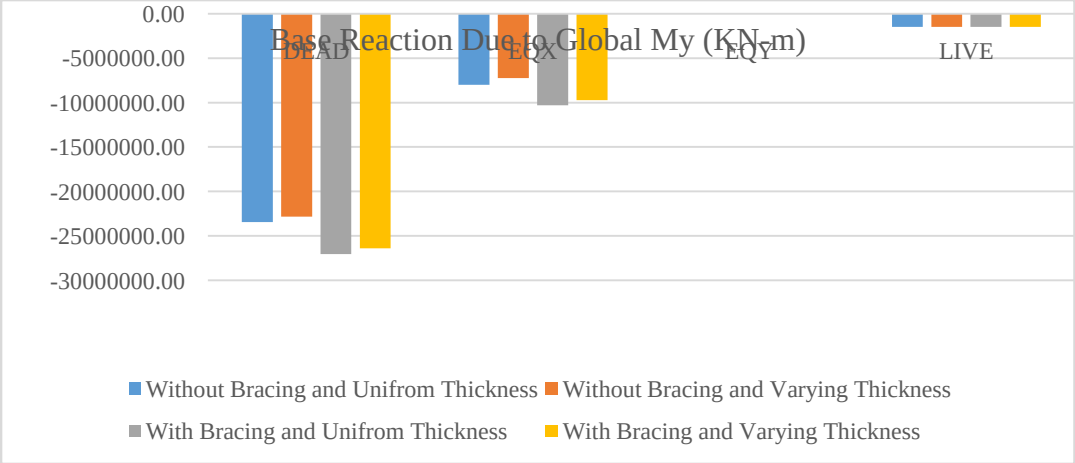


TABLE 13 BASE REACTION DUE TO GLOBAL MY (KN-M)

Output Case	Without Bracing and Unifrom Thickness	Without Bracing and Varying Thickness	With Bracing and Unifrom Thickness	With Bracing and Varying Thickness
DEAD	-23462787.00	-22816548.30	-27064243.00	-26411013.00
EQX	-7990814.00	-7254729.40	-10296099.10	-9722439.80
EQY	0.00	0.00	0.00	0.00
LIVE	-1462529.87	-1462529.87	-1462529.87	-1462529.87



Comparison Displacement of Four Models

TABLE 14 DISPLACEMENT U3 (M) DUE TO DEAD LOAD

Displacement U3 (m) due to Dead load	Without Bracing and Unifrom Thickness	Without Bracing and Varying Thickness	With Bracing and Unifrom Thickness	With Bracing and Varying Thickness
Joint 4443	-1.499236	-1.63802	-1.734651	-1.585052
Joint 4427	-2.157654	-2.354676	-2.497429	-2.284484
Joint 4416	-2.027666	-2.2132	-2.346938	-2.146438
Joint 4417	-1.89592	-2.069722	-2.194339	-2.006557
Joint 4386	-1.7639	-1.926	-2.0414	-1.866343
Joint 4330	-1.632066	-1.782557	-1.888593	-1.726215
Joint 4387	-2.340849	-2.553237	-2.708964	-2.479149
Joint 4393	-2.250026	-2.454928	-2.604151	-2.382614
Joint 4388	-2.431348	-2.651166	-2.813258	-2.575256
Joint 4394	-2.522515	-2.749865	-2.917964	-2.67181

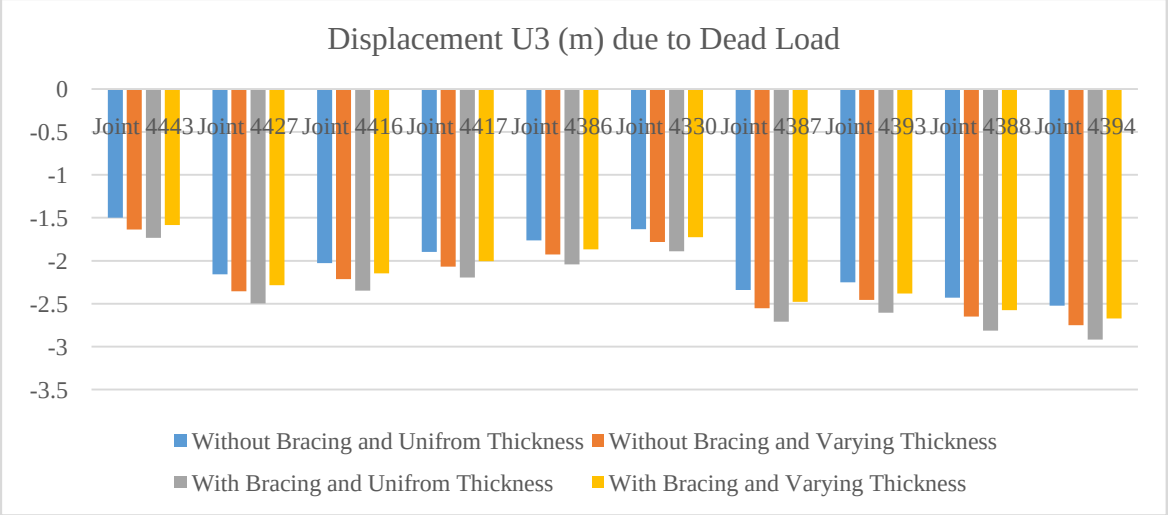


TABLE 15 DISPLACEMENT U1 (M) DUE TO EQX

Displacement U1 (m) due to Eqx	Without Bracing and Unifrom Thickness	Without Bracing and Varying Thickness	With Bracing and Unifrom Thickness	With Bracing and Varying Thickness
Joint 4330	0.170708	0.162946	0.18502	0.171444
Joint 4394	0.175495	0.168258	0.192257	0.178433
Joint 4393	0.174621	0.167263	0.190914	0.177136
Joint 4388	0.173708	0.166235	0.189524	0.175792
Joint 4387	0.172739	0.165161	0.188081	0.174398
Joint 4386	0.171763	0.164091	0.186584	0.172954
Joint 4417	0.175	0.167617	0.191967	0.178489
Joint 4416	0.175312	0.168021	0.192179	0.178518
Joint 4427	0.174627	0.167136	0.19167	0.178393
Joint 4443	0.174222	0.166603	0.191286	0.178238

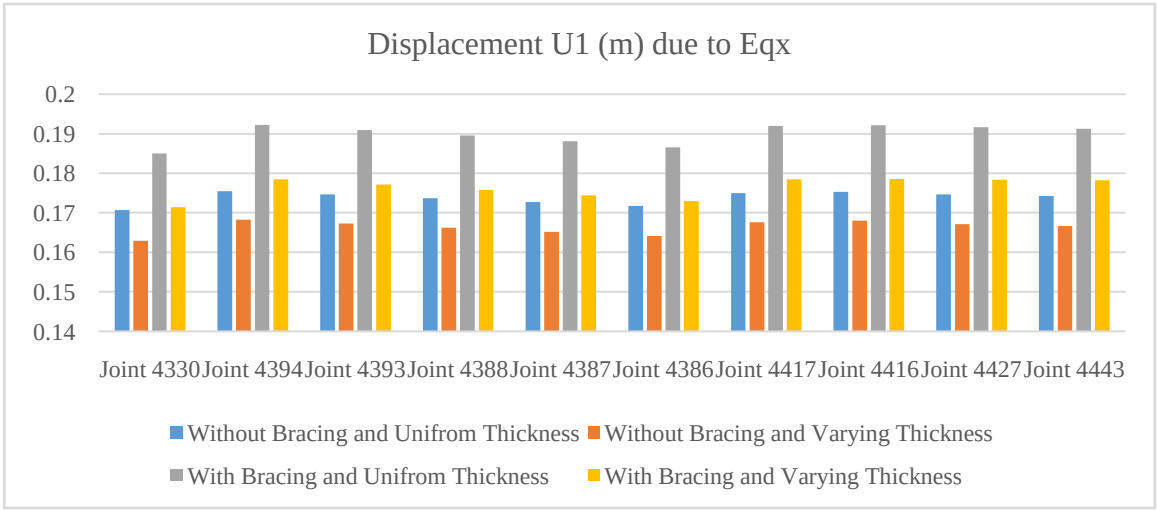


TABLE 16 DISPLACEMENT U2 (M) DUE TO EQY

Displacement U2 (m) due to EQy	Without Bracing and Unifrom Thickness	Without Bracing and Varying Thickness	With Bracing and Unifrom Thickness	With Bracing and Varying Thickness
Joint 4330	4.12389	4.430562	4.167875	3.686667
Joint 4394	5.580043	5.995938	5.619715	4.968169
Joint 4393	5.292151	5.68632	5.332872	4.714996
Joint 4388	5.000719	5.372887	5.042408	4.45868
Joint 4387	4.708982	5.059254	4.751516	4.201939
Joint 4386	4.417571	4.746116	4.460806	3.945303
Joint 4417	6.139296	6.595681	6.17561	5.459839
Joint 4416	5.861961	6.298568	5.900076	5.216001
Joint 4427	6.415535	6.891527	6.449682	5.702491
Joint 4443	6.69365	7.18943	6.724708	5.946204

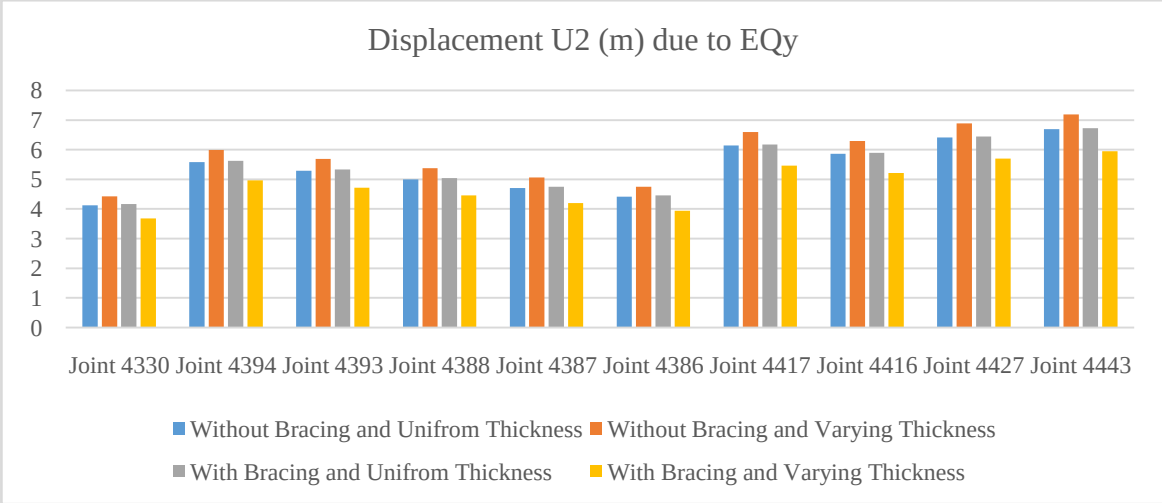
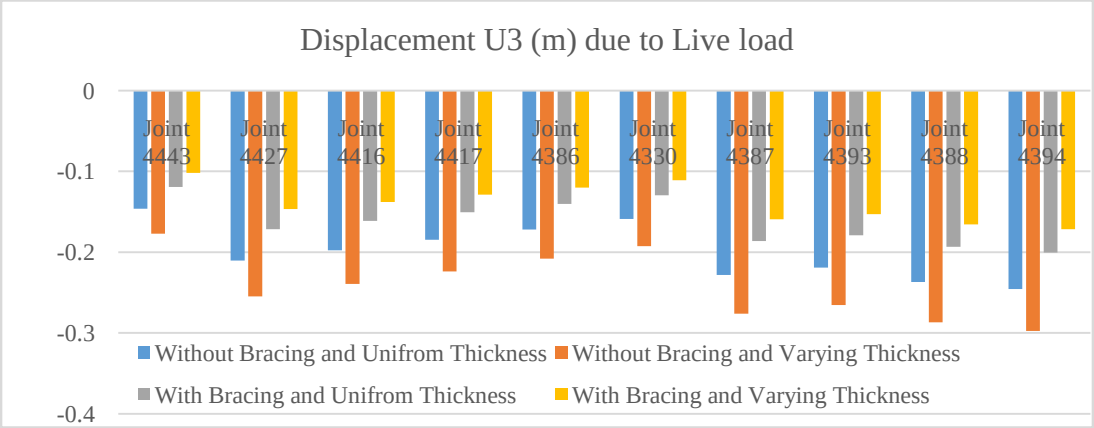


TABLE 17 DISPLACEMENT U3 (M) DUE TO LIVE LOAD

Displacement U3 (m) due to Live load	Without Bracing and Unifrom Thickness	Without Bracing and Varying Thickness	With Bracing and Unifrom Thickness	With Bracing and Varying Thickness
Joint 4443	-0.145964	-0.17696	-0.119079	-0.101734
Joint 4427	-0.210126	-0.254495	-0.171509	-0.146665
Joint 4416	-0.197457	-0.239185	-0.161163	-0.137795
Joint 4417	-0.184618	-0.223662	-0.150674	-0.12881
Joint 4386	-0.171753	-0.208113	-0.140162	-0.119803
Joint 4330	-0.158906	-0.192595	-0.129659	-0.110801
Joint 4387	-0.227989	-0.27599	-0.18606	-0.159179
Joint 4393	-0.219132	-0.265346	-0.178849	-0.152972
Joint 4388	-0.236814	-0.286593	-0.193236	-0.165358
Joint 4394	-0.245705	-0.297279	-0.20044	-0.171567



Comparison of Displacement of Four Models with Bracing at the Top

TABLE 18: DISPLACEMENT U3 (M) DUE TO COMBINATION OF DEAD AND LIVE LOAD

Displacement U3 (m) due to Combination of Dead and Live load	Without Bracing and Unifrom Thickness	Without Bracing and Varying Thickness	With Bracing and Unifrom Thickness	With Bracing and Varying Thickness
Joint 250	-0.251182	-0.19897	-0.309225	-0.255127
Joint 263	-0.261033	-0.206948	-0.321416	-0.265283
Joint 3924	-0.25228	-0.200373	-0.312779	-0.261172
Joint 3925	-0.243024	-0.192781	-0.301079	-0.251363
Joint 3934	-0.243626	-0.192909	-0.303073	-0.255585
Joint 7508	-0.251179	-0.20016	-0.310368	-0.255035
Joint 7509	-0.26103	-0.208188	-0.322608	-0.26519
Joint 7746	-0.252278	-0.201834	-0.314169	-0.261101
Joint 7747	-0.243023	-0.194179	-0.302416	-0.251291
Joint 7756	-0.243626	-0.19459	-0.304661	-0.255534

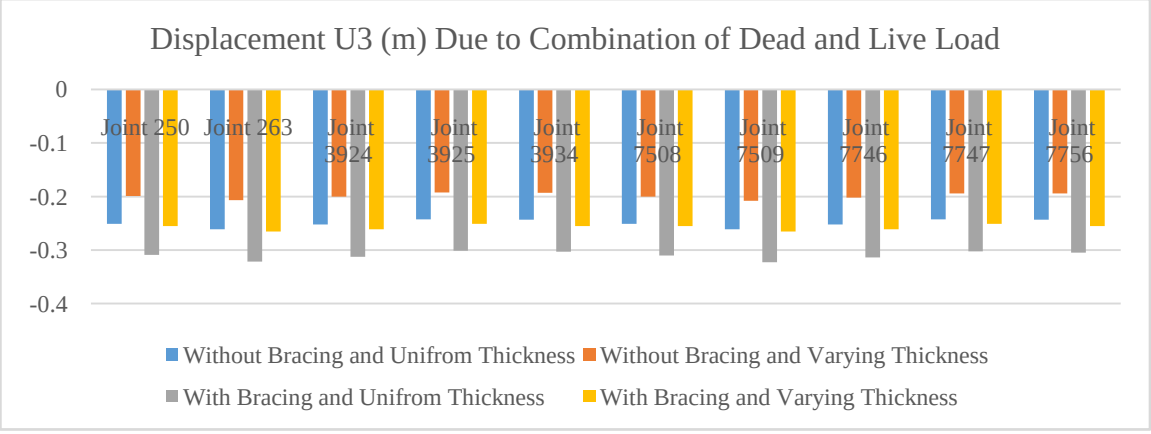


TABLE 19: DISPLACEMENT U3 (M) DUE TO DEAD LOAD

Displacement U3 (m) due to Dead Load	Without Bracing and Unifrom Thickness	Without Bracing and Varying Thickness	With Bracing and Unifrom Thickness	With Bracing and Varying Thickness
Joint 250	-0.150085	-0.115972	-0.18817	-0.156295
Joint 263	-0.155968	-0.120616	-0.195588	-0.162513
Joint 3924	-0.150892	-0.116924	-0.190514	-0.160136
Joint 3925	-0.145359	-0.112512	-0.183388	-0.154131
Joint 3934	-0.145868	-0.112723	-0.184783	-0.15686
Joint 7508	-0.150084	-0.116689	-0.188831	-0.156221
Joint 7509	-0.155966	-0.121363	-0.196277	-0.162437
Joint 7746	-0.150891	-0.117804	-0.19132	-0.160075
Joint 7747	-0.145358	-0.113353	-0.184164	-0.15407
Joint 7756	-0.145868	-0.113734	-0.185707	-0.156811

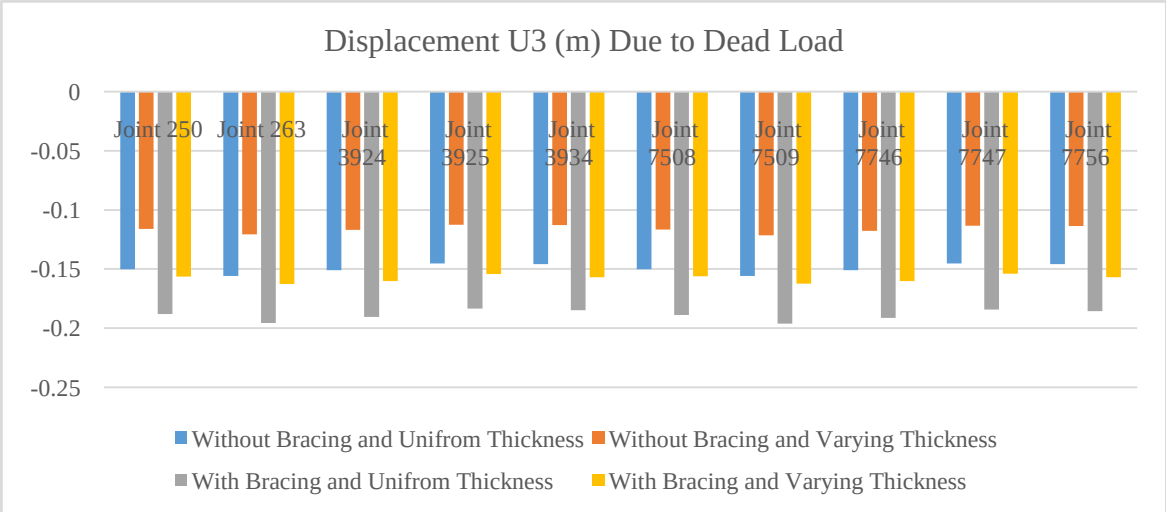


TABLE 20: DISPLACEMENT U3 (M) DUE TO LIVE LOAD

Displacement U3 (m) due to Live Load	Without Bracing and Unifrom Thickness	Without Bracing and Varying Thickness	With Bracing and Unifrom Thickness	With Bracing and Varying Thickness
Joint 250	-0.01737	-0.016675	-0.01798	-0.01798
Joint 263	-0.018054	-0.017349	-0.018689	-0.018689
Joint 3924	-0.017294	-0.016657	-0.018006	-0.018006
Joint 3925	-0.016657	-0.016009	-0.017331	-0.017331
Joint 3934	-0.016549	-0.015883	-0.017266	-0.017266
Joint 7508	-0.017369	-0.016751	-0.018081	-0.018081
Joint 7509	-0.018054	-0.017429	-0.018795	-0.018795
Joint 7746	-0.017294	-0.016752	-0.018126	-0.018126
Joint 7747	-0.016657	-0.016099	-0.017446	-0.017446
Joint 7756	-0.016549	-0.015993	-0.017401	-0.017401

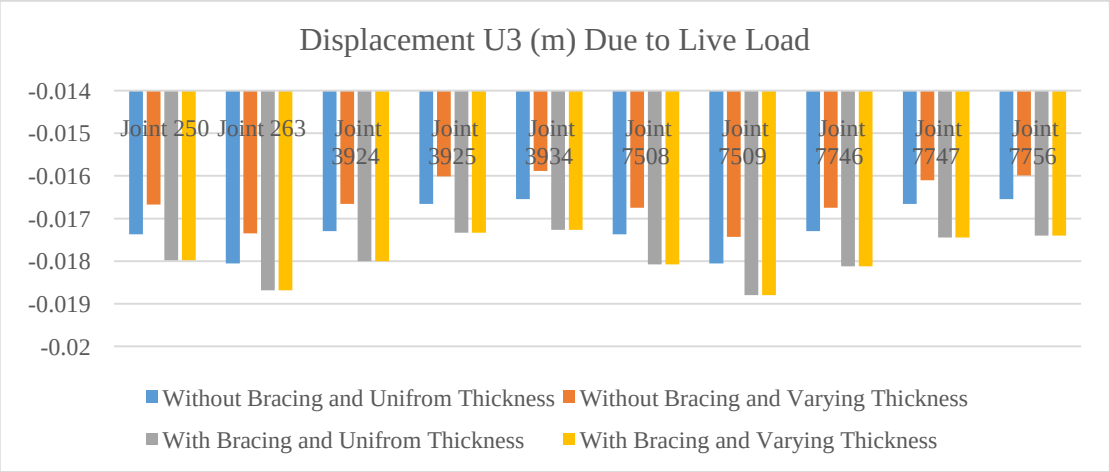


TABLE 21: DISPLACEMENT U1 (M) DUE TO E_{QX}

Displacement U1 (m) due to Eqx	Without Bracing and Unifrom Thickness	Without Bracing and Varying Thickness	With Bracing and Unifrom Thickness	With Bracing and Varying Thickness
Joint 4909	0.270648	0.26182	0.027503	0.300082
Joint 4914	0.267513	0.258045	0.027131	0.296018
Joint 4915	0.273278	0.263834	0.027806	0.302333
Joint 4916	0.270697	0.261938	0.027512	0.300097
Joint 4917	0.265082	0.256262	0.026856	0.293959
Joint 8729	0.265039	0.256174	0.026851	0.29335
Joint 8730	0.270651	0.261852	0.027503	0.29942
Joint 8735	0.267516	0.258078	0.027131	0.295399
Joint 8736	0.27328	0.263865	0.027806	0.301651
Joint 8737	0.270699	0.261969	0.027512	0.299439

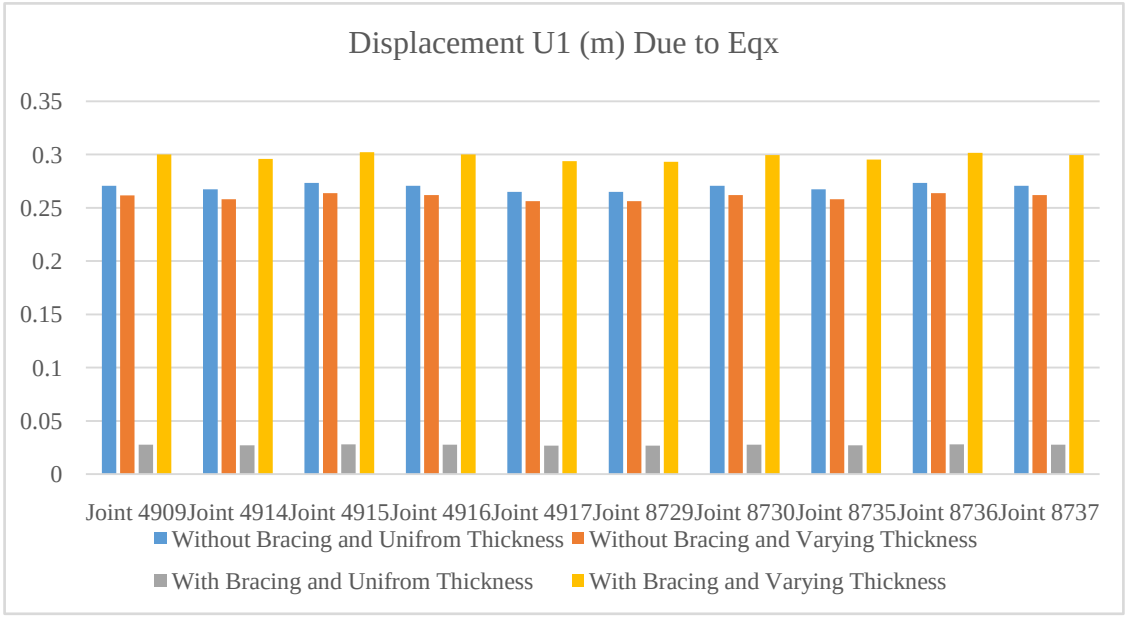


TABLE 22: DISPLACEMENT U2 (M) DUE TO EQY

Displacement U2 (m) due to Eqy	Without Bracing and Unifrom Thickness	Without Bracing and Varying Thickness	With Bracing and Unifrom Thickness	With Bracing and Varying Thickness
Joint 4151	18.281103	4.762014	0.553104	18.235122
Joint 4153	18.781083	4.875066	0.568899	18.727186
Joint 4159	18.901529	4.883385	0.573106	18.844203
Joint 4160	18.655757	4.859345	0.566272	18.630993
Joint 4405	18.656762	4.873174	0.562123	18.703877
Joint 4411	18.911894	4.900974	0.569722	18.920379
Joint 4412	18.784167	4.886688	0.565731	18.786696
Joint 4443	18.272707	4.766857	0.550123	18.273278
Joint 7973	18.281202	4.763121	0.553162	18.235263
Joint 7975	18.781179	4.876136	0.568955	18.727269

Comparison of Displacement of FORTAN and Model with Bracing and Uniform Thickness

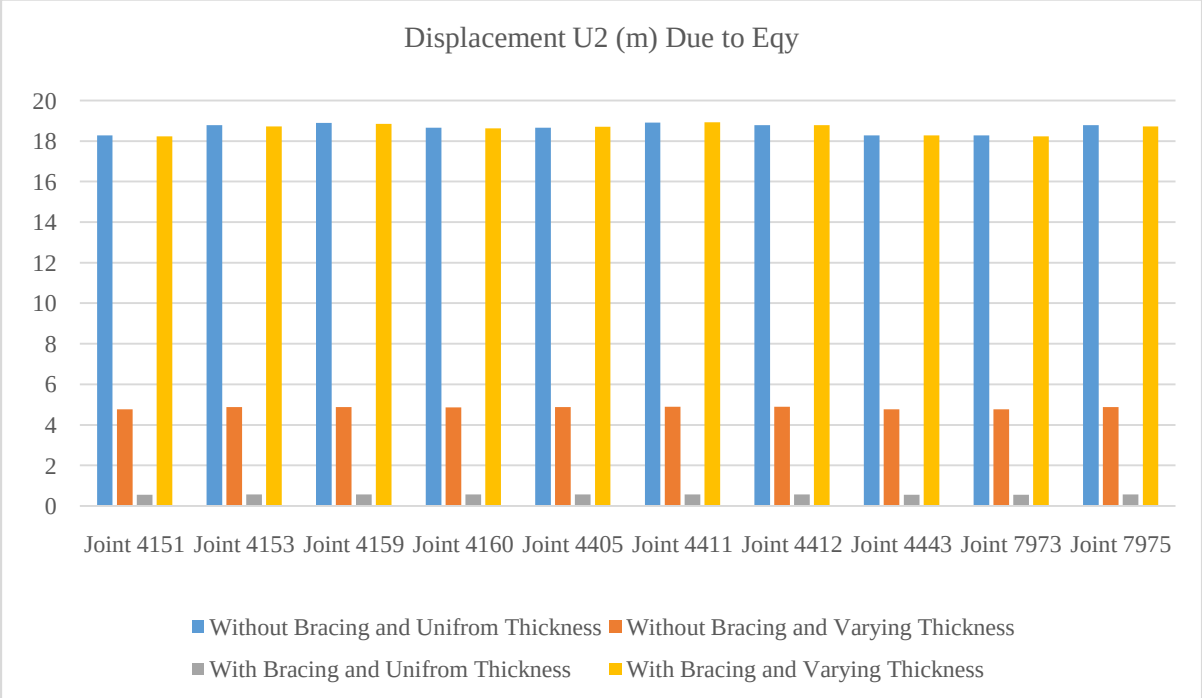


Table 23: Comparison of Displacement Result along Sine Part Due to Dead Load of FORTAN and Sap Model with Bracing and Uniform Thickness

Joints	FORTAN	With Bracing and Unifrom Thickness
Joint 7487	-0.07381	-0.10036
Joint 7495	-0.22350	-0.11631
Joint 7499	-0.37530	-0.11664
Joint 7501	-0.49380	-0.12108
Joint 7505	-0.56630	-0.12678
Joint 7509	-0.59050	-0.19132

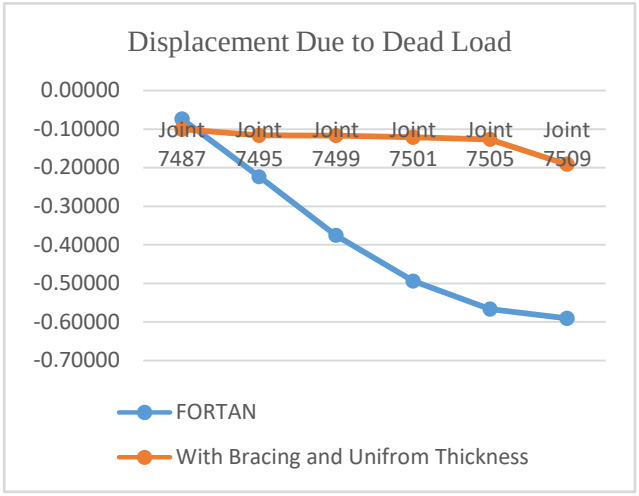


Table 24: Comparison of Displacement Result along Para Part Due to Dead Load of FORTAN and Sap Model with Bracing and Uniform Thickness

Joints	FORTAN	With Bracing and Unifrom Thickness
Joint 7487	0.00000	-0.01650
Joint 7495	0.01719	-0.05066
Joint 7499	0.01922	-0.09569
Joint 7501	-0.14340	-0.12640
Joint 7505	-0.39840	-0.16699
Joint 7509	-0.59050	-0.19628

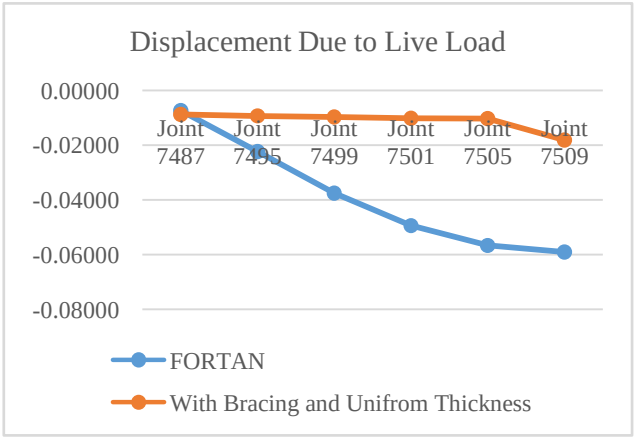


Table 25: Comparison of Displacement Result along Sine Part Due to Live Load of FORTAN and Sap Model with Bracing and Uniform Thickness

Joints	FORTAN	With Bracing and Unifrom Thickness
Joint 7487	0.00000	-0.00033
Joint 7495	0.00172	-0.00480
Joint 7499	0.00192	-0.00916
Joint 7501	-0.01434	-0.01211
Joint 7505	-0.03984	-0.01600
Joint 7509	-0.05905	-0.01880

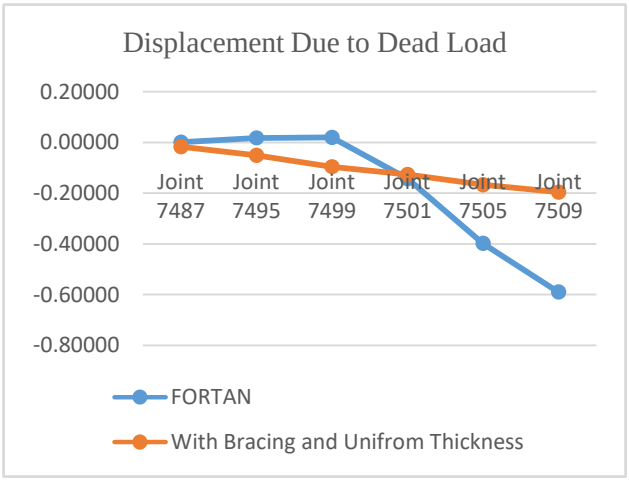
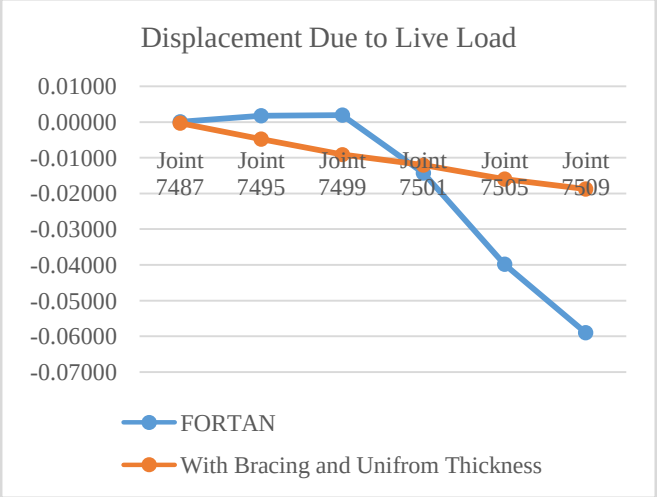


Table 26: Comparison of Displacement Result along Para Part Due to Live Load of FORTAN and Sap Model with Bracing and Uniform Thickness

Joints	FORTAN	With Bracing and Unifrom Thickness
Joint 7487	-0.00738	-0.00871
Joint 7495	-0.02235	-0.00925
Joint 7499	-0.03753	-0.00964
Joint 7501	-0.04938	-0.01013
Joint 7505	-0.05663	-0.01022
Joint 7509	-0.05905	-0.01813



Comparison of Displacement of FORTAN and Model without Bracing and Uniform Thickness of Steel Plate

Table 27: Comparison of Displacement Result Due to Dead Load of FORTAN and Sap Model without Bracing and Uniform Thickness of Steel Plate

Joints	FORTAN	With out Bracing and Unifrom Thickness of Stell Plate
Joints 8044	-0.00949	-0.10451
Joints 8092	-0.02873	-0.05471
Joints 8116	-0.04825	-0.02982
Joints 8206	-0.06349	-0.20024
Joints 8217	-0.07281	-0.15356
Joints 8264	-0.07592	-0.23290

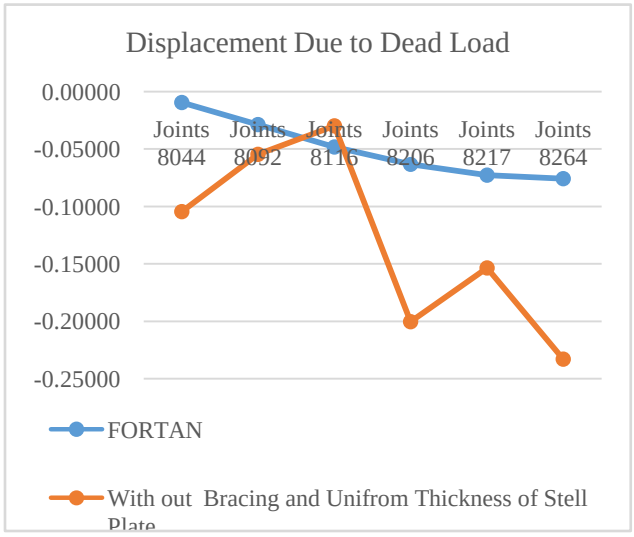
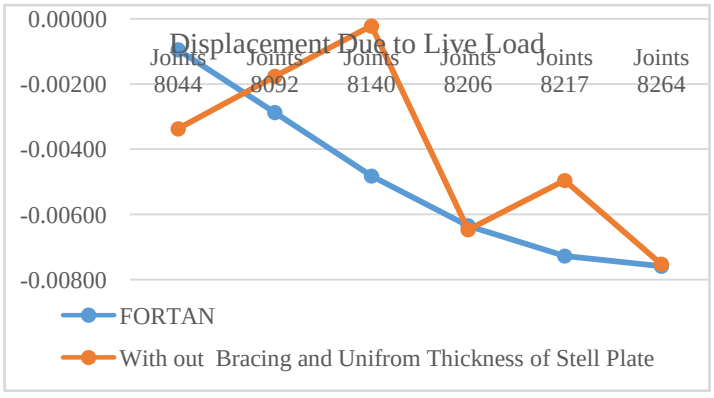


Table 28: Comparison of Displacement Result Due to Live Load of FORTAN and Sap Model without Bracing and Uniform Thickness of Steel Plate

Joints	FORTAN	With out Bracing and Unifrom Thickness of Stell Plate
Joints 8044	-0.00095	-0.00337
Joints 8092	-0.00287	-0.00177
Joints 8140	-0.00483	-0.00022
Joints 8206	-0.00635	-0.00647
Joints 8217	-0.00728	-0.00496
Joints 8264	-0.00759	-0.00753



DISCUSSION

Form the result obtained above, the following observation was made:

Discontinuous function is not calculated by sap2000 and FORTAN complex only perform by elastic theory approach. Due to this the variation of results occurs greater as we aspect.

Discussion no 1.

Stadium Roof Structure without Bracing Uniform Thickness of shell, without bracing Varying Thickness of Shell, with bracing uniform thickness of shell and with bracing varying thickness of shell Model

Through comparison of displacement obtained by different models of roof structure, the displacement of the critical point of the roof is over the permissible displacement.

Discussion no 2.

Stadium Roof Structure with bracing at the top of roof in four model without Bracing with Uniform Thickness of shell, without bracing and Varying Thickness of Shell, with bracing and uniform thickness of shell and with bracing and varying thickness of shell Model

Through comparison of displacement obtained by different models of roof structure, the displacement of the critical point of the roof is in the limit of permissible displacement.

Discussion no 3.

Stadium Roof Structure model bracing with Uniform Thickness of shell and FORTRAN

Through comparison of displacement obtained by models of roof structure and FORTRAN, the displacement of the critical point of the roof are observed due to adopting continuity by manual and FORTRAN complex are observed not exceeding permissible limit of deflection.

Discussion no 4.

Stadium Roof Structure model without bracing and Thickness steel plate of shell and FORTRAN

Through comparison of displacement obtained by models of roof structure without bracing and thickness steel plate and FORTRAN, the displacement of the critical point of the roof different deflections are observed for bracing system and material assigned converting RCC shell roof in to steel.

Final Real Stadium with dome as well as para sine parts

Using sap2000 and getting the results in FORTAN (specific parts) following outputs are achieved

1) In intersecting line of dome and para-sine stress concentration seen but rectified using connecting members.
2) The permissible limit of deflection is achieved by connecting peak of para sine.
3) Different deflections are observed for bracing system and material assigned converting RCC shell roof in to steel.

CONCLUSION

- The varying thickness of RCC shell has important rule to minimize tip deflection up to permissible limit, stress concentration and stiffness through bracing system of shell structure used in roof of stadium.
- The para sine form Mongue's surface curved shell roofs with super structure intersected to the adjacent dome structure are found stable in both gravity and lateral loads during analysis.
- The considerable alternation in different adapted methodology to achieve structural parameters of roof shell structure having uniform and varying thickness are observed due to adopting continuity by manual and FORTRAN complex are observed not exceeding permissible limit of deflection.
- The permissible deflection undergo by different kinds of load in shell roof structure is achieved with lateral, diagonal stiffeners at the roof top and bracing within shell structure.
- The intersection portion of dome and para sine should be braced by using stiffener to overcome stress concentration in intersection line of those connect parts of dome and para sine.

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