The primary aim of this project was to design & investigate steel airplane hangar that could withstand seismic and wind forces. A thorough review was conducted to gain insights into the use of steel structures in large span buildings, factors affecting seismic design, and the application of STAAD Pro for modeling hangar structures. Based on the design requirements, suitable steel components were opted. Specifications for columns, beams, rafters, purlins, & bracing members was done. The design was then created in STAAD Pro & evaluated by imposing various loading in structure for zones IV and V. Key structural parameters were analyzed to validate the design's adherence with safety regulations.

32.2 Objectives

The project aim was to model & investigate steel airplane hangar structure that could withstand seismic as well as forces due to wind. Minor objectives were:

To uplift design stability & load-carrying ability of the hangar design by using high strength & ductile steel materials.

To improve the compliance of the design with relevant seismic and structural safety standards.

32.3 ature of Works

I guided analyze & design of steel aircraft hangar structure, utilizing STAAD Pro. I assisted in selecting appropriate steel grade, member sizes, and loading considerations to ensure structural stability and compliance with seismic and wind standards. I performed detailed modeling, evaluated displacements, forces, and moments, and validated the design meets performance requirements, particularly in high seismic zones. I supervised the entire process, from conceptual design to structural analysis, to deliver an optimized solution that satisfied the project's functional and safety needs. I devised project structure, led the various phases and kept the team intact with project objectives. I led discussion meeting with supervisor for effective solutions to issues aroused during project.

1

33 PEAs

33.1

I got information on some basic concepts and basics of steel structures and the use of steel structures in building large span building such as the aircraft hangar. I realized that steel provides the required strength and ductility for withstanding the special loads that such structures experience. I gained a good background on the factors to consider with regard to seismicity and its effect on the design of the hangars particularly in areas of high seismic activities. Other important factors which I considered for analyzing seismic risk. I looked at the effects of structural geometry because features such as unusually shaped or sized buildings or buildings elevated against a slope can really magnify seismic responses. I understood such aspects of material properties which included ductility and strength of steels particularly under dynamic loads. I gathered information on design codes on compliance to seismic and structural standards. I gained understanding on connection detailing whereby I learned how good connections enhance prevention of structural failure during earthquakes. I had researched about STAAD Pro for modeling hangar structures. In this evaluation I evaluated effects of diaphragms and frame systems for self-weight forces as well as effective distribution of seismic forces.

33.2

I preferred to design the airplane hangar using STAAD Pro as the design platform. I opted to design an 18m tall steel hanger with a I Sm column height and a 3m truss height, ensuring sufficient clearance for airplanes. I selected a plan dimension of 18m x 45.5m to accommodate the operational requirements. I decided on Fe345 grade steel for its excellent strength & ductility thereby meeting structural demands. I picked ISWB550 for columns to provide the necessary load-carrying capacity with high stability. I chose ISLB450 for beams to achieve effective span coverage & load distribution. I resolved to use ISLB450 for rafters and purlins due to their compatibility with the design load & material specifications. I preferred ISA 90x60x!0 for vertical and inclined struts for efficient bracing and lateral stability. I considered seismic zones

IV & V with a wind speed of 34m/s to ensure safety against natural forces. I analyzed displacements, end forces, reactions, and structural diagrams to validate the design. I chose these specifications to optimize strength, durability, and compliance with safety standards.

33.3

I performed modeling of steel hanger in STAAD Pro to ensure precision and efficiency. I began by setting up the project with overall width of I 8m, I Sm height for column & 3m height for truss. I specified the plan dimensions as I 8m x 45 .Sm to align with the functional requirements. I specified Fe345 steel for its high strength and durability. I used ISWB550 for columns to handle axial loads effectively. I defined ISLB450 for beams, rafters, and purlins for uniformity and efficient load distribution. I defined ISA 90x60x!0 for vertical and inclined struts to enhance bracing. For the outline, I used Geometry tool to make the changes and give the design its initial form. I used " ode" in order to define important spots for the framework. For joining the nodes and forming basic structures I employed the "Beam" tool. When extending the structure uniformly across the length of the 45.5m span, I chose the "Translational Repeat" command. I used the .cMirror" option in order to copy structures and objects which have equal parts to mirror their likeness. In this occasion I apply the "View" tab to explore the look at the virtual model from different position. For purposes of making some corrections, I used the "Edit" tab and created plan(figure2) elevation(figure3), & 3D shapes(figure4) of design.

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Figure 2: Visualizing plan of hanger

Figure 3: Illustrate of design elevation

Figure 4: Depict of 3D design shapes

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X-direction

Z-direction

Figure 6: Depict of seismic load assignment

X-direction

Z-direction

Figure 7: Depict of wind loading

33.5

I found that in Zone IV, peak displacement along the x was -46.834mm at node 217 under load case (L/C) 18. I observed y displacement of-4.273mm at node 189 under L/C3 and a maximum z displacement of 36.768mm at node 89 under L/C9(figure8). I noted that negative displacement values indicated motion opposite to the load direction. I recorded the peak horizontal (x) moment as 2.211kNm at node 169, 0.166kNm at node 113 in y, and 211.944kNm at node 141 in

z(figure9). I found the highest force as l 7 l.703kN along x at beam 641 under L/C9. I identified a y force of -39.808kN at node 570 under L/Cl8 and a z force of 10.183kN at beam 91 under L/CI!(table!). I observed in Zone V peak x displacement of 60.114mm at node 185 under L/C8, a y displacement of -4.328mm at node 189 under L/CI0, and z disp. of 55.145mm at node 89

under L/C9(figurei3). I found peak horizontal moment of 3.I93kNm at node 169, 0.i66kNm at node I 13, and -234.62lkNm at node 141 along x, y & z(figurel4). I noted the highest force as 221.0!0kN in x at beam 925 under L/C9. I recorded y force of -39.808kN at node 570 under L/Cl8 and a z force of 0.139kN at beam 966 under L/C9(table2). I observed structural Axial(AF), shear(SF) & moment (BM)diagrams(figures 10, II, 12, 15, 16 & 17) for both models that depicted model safety under the analyzed circumstances. I thus realized that structural functioning of design in ZoneV was more enhanced with higher displacement tolerance as well as force resistance. Thus, I ascertained that Zone V offered the highest performance.

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Figure 8: Depict of disp. at nodes

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Figure 9: Presentation of rxns at support Table I: Illustrate ofBEF

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Figure IO: AF visualization

Figure 11: SF illustrate

Figure 12: Showing BM

Results for Zone V

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Figure 13: Illustrate and details of nodal disp.

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Figure 14: Visualization of reactions Table 2: Depict of end forces

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Figure I 6: SF depiction

Figure 17: BM profile

3.4 Problem and Solution

I got more nodal displacement m initial hangar design where the design attempted to provide unstable hangars which proved to cause a failure in the models during simulations. In a project meeting with other team members, I asked them what could have caused the problem and what can be done about it. I could see that the free moving in the base setup could be leading to this much displacement. I went to my supervisor who gave me helpful tips on base stability for seismically relevant ones. In addition, I read several design articles and journal publications which focused on the issue of hangar stability under seismic loads to broaden my knowledge. Finally, I realized that choosing a fixed base most definitely had the potential of addressing the problem by restricting unnecessary motion. I created a fixed base for the base of the hangar, & repeated the simulation with this fixed base configuration. I determined that the results become much better as the design exhibits reasonable displacement quotas consistently without compromising with the structure's structural integrity when carrying load.

3.5 Creative Works

I set hanger base fixed to restrict the motion of structure and prevented design from higher displacement. I modelled and analyzed design in STAAD Pro depicting robust capabilities for modelling & evaluation. I used Fe3 l 5 steel for structural strength of design.

3.6 Team Management

I also held meetings on frequent basis to keep the team moving forward into a clearly defined direction. I frequently checked the update tab so that I was on the same page with the supervisor and so that I could get my work reviewed as soon as possible. I organized creative meetings to come up with innovative working solutions in regard to certain cases we encountered. I carefully assigned roles and ensured deadlines set were reasonable. I motivated members by congratulating them and offering suggestions when they encountered a problem on the project. I set a schedule to meet with the guide as talked about the technical issues and how problems that we would have considered difficult can be surmounted. I checked in on the progress from time to time in case we required a new plan on the timeline to continue with the project. I ensured that each person in my team was appreciated and had the best reason to work hard. I openly communicated with both supervisor & team to always keep the flow of the project going without issues.

3.7 Codes

I studied IS 800 (2007) guidelines for designing steel hangar & followed University ethical conduct during the project.

3.8 Summary

3.8.1

The general purpose of this project was to analyze & design the steel airplane hangar structure that is capable of bearing seismic and wind loads. A review of literature was also done to understand the general and specific information about the use of steel structures. The design of the 18m tall steel hangar was optimized, selecting ISWB550 columns, ISLB450 beams, rafters, & purl ins, and ISA 90x60x IO vertical and inclined struts using Fe345 grade steel. Modeling in STAAD Pro allowed for precise geometry, loading, and structural detailing, various loads for

analyzed zones. Structural evaluation in STAAD Pro revealed that the design performed better in the more severe earthquake Zone V, with higher displacement tolerance and force resistance. Key performance indicators were thoroughly analyzed to validate the design's compliance with safety standards. The objectives were met by using high strength and ductile steel materials for structure, determining the size and position of members such that seismic and wind loading are met, and checking the structural members to ensure that they meet with required standard.

3.8.2

I developed competencies on how to arrange group meetings and conversadons to improve teamwork. I got better at assigning tasks according to the members' skills and abilities of the respective teams. I honed personal self confidence in decision making and developed interpersonal skills.