Click to prove you're human

Design Base Shear Computation as per NSCP 2015, 7th edition by Static Force Procedure (Section 208.5.4)Seismic Factors:1. Importance Factor I (Section 208.4.2)2. Seismic Zone Factor Z (Section 208.4.4.1)3. Seismic Soil Profile Type (Section 208.4.3.1)4. Seismic Source Type (Section 4.4.2)5. Near Source Factor (Section 4.4.3)note: The largest value of the Near Source Factor considering all sources shall be use for the design.6. Seismic Response Coefficient7. Structural System Classification8. Response Modification Factor9. Elastic Fundamental VibrationNote: h sub n is the height measured from the ground.10. Design Base Shear (Section 208.5.2.1) Getting Started SkyCiv Beam SkyCiv Structural 3D SkyCiv Section Builder SkyCiv RC Design SkyCiv Member Design SkyCiv Load Generator SkyCiv Foundation SkyCiv Connection Design SkyCiv Base Plate Design SkyCiv Retaining Wall Detailed Shell FEA SkyCiv API TechNotes Tutorials Education SkyCiv Load Generator has recently added seismic load calculation in accordance with ASCE7-16. This involves integrating the USGS Seismic Data and processing it to generate the seismic base shear using Section 12.8 Equivalent Lateral Procedure. In this article, we will dive deeper into the process of calculating the seismic loads for a building using ASCE 7-16. SkyCiv now integrated the site seismic data from USGS Web API. Try our SkyCiv Load Generator! Structure Data In this example, we will use the following data in calculating the seismic load: Table 1. Building data needed for our seismic load calculation. Location 8050 SW Beaverton Hillsdale Hwy, Portland, OR 97225, USA Occupancy Residential Building Dimensions 64 ft (4 bays) 104 ft (6 bays) in planFloor height 15 ftRoof height at elev. 75 ftFlat roofColumn: 20x20Beam: 14x20Slab: 8 thickness Loading Concrete unit weight : 156 pcfSuperimposed dead load (on floor): 100 psfSuperimposed dead load (on roof): 50 psf Figure 1. Site location (from Google Maps). Figure 2. Structure for this example. USGS Seismic Data USGS has an open-source site seismic data which can be used from their Design Web Services API. In this calculation, we will only need the following data: \({S}_{D1}\) is the design spectral response acceleration parameters at a period of 1.0 s \({S}_{1}\) is the mapped maximum considered earthquake spectral response acceleration parameters \({S}_{DS}\)is the design spectral response acceleration parameter in the short period range \({T}_{L}\) is the long-period transition period Figure 3. USGS Seismic Design Web Services. In order to request the data above we will need the following data: Latitude, Longitude which we can get from Google Maps Risk Category of the structure based on Section 1.5 of ASCE 7-16 Site Class based on Table 20.3-1 of ASCE 7-16 Equivalent Lateral Force Procedure The seismic design base shear can be calculated using Equation 12.8-1 of ASCE 7-16: \(V = {C}_{S} W \) (Eq. 12.8-1) Where:\(V \) is the seismic design base shear\({C}_{s} \) is the seismic response coefficient based on Section 12.8.1.1\(W \) is the effective seismic weight as per Section 12.7.2 The formula for determining the seismic response coefficient is: \({C}_{s} = \frac{{S}_{DS}}{ \frac { R }{ {I}_{e} } } \) (Eq. 12.8-2) Where:\({S}_{DS} \) is the design spectral response acceleration parameter in the short period range (from USGS Data)\(R \) is the response modification factor as per Table 12.2-1\({I}_{e} \) is the importance factor determined from Section 11.5.1 However, we need to satisfy Equations 12.8-3 to 12.8-6: The value of \({C}_{s}\) should not exceed 12.8-3 or 12.8-4 For \(T {T}_{L}\): \({C}_{s,max} = \frac { {S}_{D1}}{ \frac{T R}{{I}_{e}}} \) (Eq. 12.8-3) For \(T > {T}_{L}\) : \({C}_{s,max} = \frac { {S}_{D1} {T}_{L} }{ \frac{ {T}^{2} R}{{I}_{e}}} \) (Eq. 12.8-4) Moreover, \({C}_{s} \) shall not be less than Equation 12.8-5 \({C}_{s,min} = 0.044 {S}_{DS} {I}_{e} 0.01 \) (Eq. 12.8-5) In addition, for structures located where \({S}_{1} 0.6g\): \({C}_{s,min} = 0.5 \frac {{S}_{1}} { \frac{R}{{I}_{e}}} \) (Eq. 12.8-6) Where\({S}_{D1} \) is the design spectral response acceleration parameter at period of 1.0 s (from USGS Data)\(T \) is the fundamental period of the structure\({T}_{L} \) is the long period transition period (from USGS Data)\({S}_{1} \) is the mapped maximum considered earthquake spectral response acceleration parameter (from USGS Data) Once we calculate the value of the seismic design base shear \(V \), we need to distribute the forces along the height of the structure using Section 12.8.3 of ASCE 7-16. In this example, we will assume that the structure has no vertical or horizontal irregularities. \({F}_{x} ={C}_{vx} V \) (Eq. 12.8-11) \({C}_{vx} = \frac {{w}_{x}{{h}_{x}}^{k}} { \sum_{i=1}^n{w}_{i}{{h}_{i}}^{k}} \) (Eq. 12.8-12) Where\({C}_{vx} \) is the vertical distribution factor\({w}_{i} \) and \({w}_{x} \) is the portion of the total effective seismic weight of the structure \(W \) located or assigned to level i or x\({h}_{i} \) and \({h}_{x} \) is the height from the base to level i or x\(k \) is defined as the following: \(k = 1 \) for structures with \(T 0.5 s\) \(k = 2 \) for structures with \(T 2.5 s\) linear interpolation of \(k \) for \(0.5 < T < 2.5 s \) In addition, floor and roof diaphragm forces can be determined using Section 12.10.1 of ASCE 7-16. The design force can be calculated using Equations 12.10-1 to 12.10-3: \({F}_{px} =\frac { \sum_{i=x}^n {F}_{i}} { \sum_{i=x}^n {w}_{i} }{w}_{px} \) (Eq. 12.10-1) \({F}_{px,min} = 0.2 {S}_{DS}{I}_{e}{w}_{px} \) (Eq. 12.10-2) \({F}_{px,max} = 0.4 {S}_{DS}{I}_{e}{w}_{px} \) (Eq. 12.10-3) Where\({F}_{px} \) is the diaphragm design force at level x\({F}_{i} \) is the design force applied at level i\({w}_{i} \) is the weight tributary to level i\({w}_{px} \) is the weight tributary to diaphragm at level x We will dive deeper into these parameters below and apply the concept to our structure. Importance Factor, \({I}_{e} \) The importance factor, \({I}_{e} \), for the structure can be determined from Section 11.5.1 which points to Table 1.5-2 of ASCE 7-16. Figure 4. Table 1.5-2 of ASCE 7-16 indicating importance factor values per Risk Category. Since the structure falls under Risk Category II, the corresponding importance factor \(I_{e} \) is equal to 1.0 based on Table 1.5-2. \({I}_{e} = 1.0 \) Response Modification Factor, \(R \) The response modification factor, \(R \), can be determined from Table 12.2-1 depending on the structural system used. In this example, we will assume that the structural system used is Special Reinforced Concrete Moment Frames for both X and Z directions. From this, we can determine that value of \(R \) is equal to 8as per Table 12.2-1. Figure 5. Truncated values of Table 12.2-1 of ASCE 7-16 indicating Response Modification Coefficient, \(R \), per structural system. Site Class To calculate for our seismic load, the location we will be using is at Raleigh Hills, Portland, OR, USA based on Seismic Loads: Guide to the Seismic Load Provisions of ASCE 7-16 (Charney et al., 2020) which is classified as Site Class C. USGS Seismic Data .The USGS Seismic Data for the location are the following: SkyCiv now integrated the site seismic data from USGS Web API. Try our SkyCiv Load Generator! Figure 6. Site seismic data from USGS Web Services. \({S}_{D1} = 0.402 \)\({S}_{1} = 0.402 \)\({S}_{DS} = 0.708 \)\({T}_{L} = 16 s \)\({T}_{0} = 0.114 \) Seismic Design Category Section 11.6 of ASCE 7-16 details how the procedure in determining the Seismic Design Category of the structure based on the Risk Category and Site Class for the structure. For \({S}_{1} 0.75 \) and Risk Category I, II, or III, the Seismic Design Category shall be assigned to Seismic Design Category E For \({S}_{1} 0.75 \) and Risk Category IV, the Seismic Design Category shall be assigned to Seismic Design Category F Otherwise, Table 11.6-1 and Table 11.6-2 shall be used, whichever is more severe. Figure 7. Seismic design category from Section 11.6 of ASCE 7-16. For this structure, with Risk Category II, \({S}_{D1} = 0.402 \), and \({S}_{DS} = 0.708 \) the Seismic Design Category is D based on both tables 11.6-1 and 11.6-2 of ASCE 7-16. The Seismic Design Category will be used for redundancy factor \(\) in calculating diaphragm design forces. Fundamental Period of the Structure \(T \) The fundamental period of a structure can be determined from the modal analysis of the structure. ASCE 7-16 allows the approximation of the fundamental period of a structure using Section 12.8.2.1. \({T}_{a} = {C}_{t} {{h}_{n}}^{x} \) Where \({h}_{n} \) is the structural height of the structure (vertical distance from the base to the highest level of the seismic force-resisting system of the structure), and \({C}_{t} \) and \(x \) can be determined from Table 12.8-2. Figure 8. Values of \({C}_{t} \) and \(x \) from Table 12.8-2 of ASCE 7-16. Since the structure is a concrete moment-resisting frame: \({C}_{t} = 0.016\) \(x = 0.9\) Therefore, using structure height \({h}_{n} \) equal to 75 ft., the approximate fundamental period of the structure \({T}_{a} \) can be determined: \({T}_{a} = {C}_{t} {{h}_{n}}^{x} = (0.016) {(75)}^{0.9}\)\(T = {T}_{a} = 0.7792 s\) Seismic Response Coefficient \({C}_{s}\) From the values above, we can already calculate for Seismic Response Coefficient \({C}_{s}\): \({C}_{s} = \frac{ {S}_{DS} }{ \frac {R}{{I}_{e}} } = \frac{ 0.402 }{ \frac {8}{1.0} } \)\({C}_{s} = 0.0885\) Since \(T {T}_{L}\): \({C}_{s,max} = \frac { {S}_{D1}}{ \frac{T R}{{I}_{e}}} = \frac { (0.402)}{ \frac{(0.7792)(8)}{(1.0)}} \)\({C}_{s,max} = 0.0645 \) In addition, the minimum value of \({C}_{s} \) shall not be less than: \({C}_{s,min} = 0.044 {S}_{DS} {I}_{e} 0.01 \)\({C}_{s,min} = 0.044 (0.402) (1.0) 0.01 \)\({C}_{s,min} = 0.0312 \) The final value of \({C}_{s} \) to be used in calculation shall be: \({C}_{s} = 0.0645\) Effective Seismic Weight \(W \) In this example, we will calculate the effective seismic weight using the dead and superimposed dead load applied to floors. External and internal walls are assumed to be incorporated in the superimposed floor dead load equal to 100 psf. Using concrete unit weight equal to 156 lb/cu.ft.: For typical floor level (excluding ground and roof levels): Column: Typical story height x cross-sectional area x unit weight of concrete x total no. of columns = 15 ft x 156 lb/cu.ft. x (20x20) x 35 = 227.5 kipsSlab: Floor area x thickness x unit weight of concrete = 64ft (104 ft) x 8 x 156 lb/cu.ft. = 692.224 kipsBeams: Total length x cross-sectional area x unit weight of concrete = 968 ft x 156 lb/cu.ft. x (14x20) = 293.627 kipsSuperimposed dead load: Floor area x load= 64ft (104 ft) x 100 psf= 665.6 kipsTotal dead load per level: 1878.951 kips For roof level: Column: Typical story height x cross-sectional area x unit weight of concrete x total no. of columns = 7.5 ft x 156 lb/cu.ft. x (20x20) x 35 = 113.75 kipsSlab: Floor area x thickness x unit weight of concrete = 64ft (104 ft) x 8 x 156 lb/cu.ft. = 692.224 kipsBeams: Total length x cross-sectional area x unit weight of concrete = 968 ft x 156 lb/cu.ft. x (14x20) = 293.627 kipsSuperimposed dead load: Floor area x load= 64ft (104 ft) x 50 psf= 332.8 kipsTotal dead load at roof level: 1432.401 kips In summary: Floor Level Elevation, ft Weight, wx, kips Roof 75 1432.401 5th level 60 1878.951 4th level 45 1878.951 3rd level 30 1878.951 2nd level 15 1878.951 Effective Seismic Weight, W 8948.203 \(W = 8949.203 kips\) Seismic Base Shear \(V \) Using Equation 12.8-1 of ASCE 7-16, the seismic base shear can be calculated: \(V = {C}_{S} W = (0.0645)(8948.203) \)\(V = 577.159 kips \) Vertical Distribution of Seismic Forces \({F}_{x} \) We need to distribute the seismic load throughout the structure. Since the fundamental period of the structure is \(T = {T}_{a} = 0.7792 s\), therefore: \(k = 1.1396\) To calculate the seismic force \({F}_{x} \) per level, the best approach is to tabulate the seismic weights per level: Floor Level \({w}_{x} \) kips \({h}_{x} \) ft \({w}_{x} {{h}_{x}}^{k} \) \({C}_{vx} \) \({F}_{x} \) kips Roof 1432.401 75 196303.644 0.2923 168.6950 5th level 1878.951 60 199681.715 0.2973 171.5980 4th level 1878.951 45 143865.010 0.2142 123.6315 3rd level 1878.951 30 90631.141 0.1349 77.8845 2nd level 1878.951 15 41135.482 0.0612 35.3501 = 671616.992 \(V \) = 577.1591 Diaphragm Forces \({F}_{px} \) The calculation of the diaphragm forces are shown below. Since we assumed there are no irregularities, the redundancy factor \(\) is set to 1.0. This parameter shall be multiplied to \({F}_{px} \): Floor Level \({w}_{px} \) kips \({w}_{i} \) \({F}_{i} \) \({F}_{px,min} \) \({F}_{px,max} \) \({F}_{px} \) Design \({F}_{px} \) Roof 1432.401 1432.401 168.6950 202.8279 405.6559 168.6950 202.8279 5th level 1878.951 3311.351 340.2930 266.0594 532.1188 193.0915 266.0594 4th level 1878.951 5190.302 463.9245 266.0594 532.1188 167.9461 266.0594 3rd level 1878.951 7069.253 541.8090 266.0594 532.1188 144.0085 266.0594 2nd level 1878.951 8948.203 577.1591 266.0594 532.1188 121.1923 266.0594 SkyCiv Load Generator All these calculations are already incorporated in the SkyCiv Load Generator. Streamline your calculation using our Free Seismic Load Calculator for ASCE 7-16! Try our Free Seismic Load Calculator Site Seismic Data The USGS Seismic Data can be obtained once the Risk Category, Site Class, and Project Address are defined. Note that the parameters \({S}_{D1} \), \({S}_{1} \), \({S}_{DS} \), and \({T}_{L} \) should have values in order to proceed with the Seismic Load Calculation. Figure 9. Parameters needed to get the USGS Seismic data for the location. Figure 9. Results from USGS Seismic data. Users can modify the parameters obtained from USGS Web Services to obtain the most appropriate seismic load for the structure. Try our Free Load Generator Structure Data On the Structure Data tab, you just need to define the standard building data: Roof Profile, Building Length, Building Width, Mean Roof Height, and Roof Pitch Angle. Figure 10. Building data input. Seismic Data To proceed with the seismic calculations, the required are the following: Structure system for determining the values of \({C}_{t} \) and \(x \) which will be used in calculating the approximate fundamental period of the structure \({T}_{a} \) Approximate fundamental period of the structure \({T}_{a} \) can be user-defined to more appropriate seismic load calculation Response Modification Factor \(R \) default value is 8.5 and be modified for more appropriate seismic results Redundancy factor, \(\) default value is 1.0 and can be modified. Used in diaphragm forces calculation Floor Weights used for the vertical distribution of base shear and for diaphragm forces. Data per level required are: Level (for designation), Elevation, and Weight Figure 11. Seismic parameters required for the seismic calculation. Results The output of the calculation is the seismic parameters used and the calculated seismic base shear \(V \), seismic forces per level, and diaphragm forces per level. Figure 12. Input parameters and results for seismic load calculation. Figure 13. Tabulated seismic forces per level including the diaphragm design forces. Detailed Report Upon generating the results, Professional account users and those who purchased the standalone load generator module can generate a detailed seismic calculation. The report displays all the parameters and assumptions used in the seismic calculation to make it transparent to the user. The generated report for this example calculation can be accessed through this link. Purchase the Standalone Load Generator Module Figure 14. Detailed seismic load calculation of SkyCiv Load Generator. Take advantage of this feature by signing up for a Professional Account or by purchasing the standalone Load Generator module! For existing users, a FREE DEMO is also available if you require a more comprehensive solution for load calculations. Sign Up for Professional Account Today For additional resources, you can use these links: Introduction to SkyCiv Load Generator ASCE 7-16 Seismic Load Calculations Patrick Aylsworth Garcia Structural Engineer, Product DevelopmentMS Civil EngineeringLinkedIn References: American Society of Civil Engineers. (2017, June). Minimum design loads and associated criteria for buildings and other structures. American Society of Civil Engineers. Charney, F., Heausler, T., and Marshall, J. (2020). Seismic loads: Guide to the seismic load provisions of ASCE 7-16. American Society of Civil Engineers. Google Maps Still stuck? How can we help? Updated on April 22, 2024 Wind Load Calculation for Signs - EN 1991 Was this article helpful to you? Yes No 0 ratings0% found this document useful (0 votes)73 viewsThe document provides an example calculation of seismic loads on a building according to ASCE 7-16. It details collecting data on the building properties and location, obtaining seismic dataAI-enhanced title and descriptionSaveSave seismic_load_calculation_example For Later0%0% found this document useful, undefined100%(1)100% found this document useful (1 vote)891 viewsThe document discusses seismic load calculation methods in the National Structural Code of the Philippines (NSCP) 2015 edition. It provides several links to PDF documents on seismic analysisAI-enhanced title and descriptionSaveSave Nscp 2015 Seismic Load Calculation Sample PDF - Go... For Later100%100% found this document useful, undefined100%(4)100% found this document useful (4 votes)5K views1) This section outlines the procedures for determining earthquake loads on structures based on the Philippine building code. 2) It describes the simplified static and static force proceduraI-enhanced title and descriptionSaveSave 3. Earthquake Loads - NSCP 2015 For Later100%100% found this document useful, undefined100%(2)100% found this document useful (2 votes)526 viewsThe document summarizes the step-by-step process for calculating seismic load for a proposed four-story dwelling unit based on the National Structural Code of the Philippines 2015. It providSaveSave Seismic Load Computation For Later100%100% found this document useful, undefinedFull text (1)UPDATESONCHAPTER2:MINIMUMDESIGNLOADSNATIONALSTRUCTURALCODEOFTHEPHILIPPINESNSCP2015,VOLUME1RonaldoS.Ison,F.ASEP,PP20022004,FPICEChancellor,CollegeofFellows (2) Loadcombinationsforarechangedduetotheuseofstrengthbasedwindloadingbasedon ASCE710 Additionalliveloaddesignationsforparking,garage,andrampliveloading Basicwindspeedarerevisedbasedonlateststudies Forcommunicationtowers,ANSITIA/EIA222GlatesteditionisfullyreferencedintheNSCPSignificantChangestoChapter2MinimumDesignLoads(3) Nearsourcefactorsarerevisedtoconsiderdistancetosource0.7second, elseFt=0wx :massatfloorlevelhx :heightoffloorfromgroundlevelEarthquakeLoadsVerticalDistribution(52)(53)Buildings,towers andotherverticalstructuresandallportionsthereofshallbedesignedtoresisttheloadcombinationsinNSCPSection203.Thecriticaleffectcanoccurwhenoneormoreofthecontributingloadsarenotacting.LoadCombinations(54) D =deadload E =earthquakeload Em =estimatedmaximumearthquakeforcethatcanbedevelopedinthestructure F =loadduetofluidswithwelldefinedpressuresandmaximumheights H =loadduetolateralpressureofsoilandwaterinsoil L =liveload,exceptrooflivelоad,includinganypermittedliveloadreduction Lr =rooflivelоad,includinganypermittedliveloadreductionLoadDefinitions(55) L =liveload,exceptrooflivelоad,includinganypermittedliveloadreduction Lr =rooflivelоad,includinganypermittedliveloadreduction R =rainloadontheundeflected roof T = selfstrainingforceandeffectsarisingfromcontractionorexpansionresultingfromtemperaturechange, shrinkage,moisturechange,creepincomponentmaterials,movementduetodifferentialsettlement,orcombinationsthereof W =loadduetowindpressureLoadDefinitions(56)LoadCombinationsforRCDesignandSteelDesign U=1.4(D+F) U =1.2(D+F+T)+1.6(L+H)+0.5(Lr orR) U =1.2D+1.6(Lr orR)+(f1L or0.50W) U =1.2D+1.0 W+f1 L+0.5(Lr orR) U =1.2D +1.0E+f1 L U= 0.9 D+1.0 W+1.6 H U =0.9D +1.0E +1.6Hf1 =1.0forloorsinplacesofpublicassembly,forliveloadsinexcessof4.8kPa,andforgaragelіveload=0.5forotherliveloads(57)LoadCombinationforStrengthDesignApplicationofthestrengthdesignloadcombinationsthatinvolvetheseismicload Eforthemomentresistingframe Z=0.4Ca =0.44I =1.0 =1.1f1 =0.5(58)BeamABandColumnCDareelementsofthespecialmomentresistingframe.Structuralanalysishasprovidedthefollowingindividualbeammomentsat A,andthecolumnaxialloadsandmomentsatCduetodeadload,officebuildingliveload,andlateralseismicforces.DeadLoadDLiveLoadLLateralSeismicLoadEhBeamMomentatA 135kNm 65kNm 165kNmColumnCDaxialload400kN 180kN 490kNColumnMomentatC55kNm 30kNm 220kNmPROBLEM:Findthestrengthdesignmomentatbeamend Aandstrengthdesignaxialloadandmomentatcolumntop C. LoadCombinationforStrengthDesign(59)Strengthdesignmomentatbeamend A. Determineearthquakeload E:Theearthquakeload E consistsoftwocomponentsasshownbelowinequation(2081).Eh isduetohorizontalforces,andEv isduetoverticalforces.E =Eh +Ev (Section2081)Themomentduetoverticalearthquakeforcesiscalculated Ev =0.5CaID =0.5(0.44)(1.0)(135)=29.7kNm(60)Themomentduetohorizontalearthquakeforcesisgivenas Eh =165kNmTherefore=Eh +Ev =1.1(165)+29.7=211kNmLoadCombinationforStrengthDesign(61) U=1.4(D+F)=1.4D U =1.2(D+F+T)+1.6(L+H)+0.5(Lr orR)=1.2D+1.6L U =1.2D+1.6(Lr orR)+(f1L or0.50W)=1.2D+0.5L U =1.2D +1.0 W+f1 L+0.5(Lr orR)=1.2D+0.5L U =1.2D +1.0E+f1 L=1.2D+1.0E +0.5L U= 0.9 D+1.0 W+1.6 H=0.9D U =0.9D +1.0E +1.6H =0.9D+1.0ELoadCombinationforStrengthDesign(62)Applyearthquakeloadcombinations Thebasicloadcombinationsforstrengthdesign(orLRFD)aregiveninSection203.3.1.Forthisexample,theapplicableequationsare:1.2D +1.0E +f1L (Section2035)0.9D 1.0E (Section2036)UsingEquation(2035)andEquation(2036),thestrengthdesignmomentatAforcombineddead,live,andseismicforcesaredetermined.MA = 1.2MD+1.0ME+ f1ML=1.2(135)+1.0(211)+0.5(65)=406kNmMA = 0.9MD1.0ME=0.9(135)1.0(211)=333kNmor90kNmMA = 1.2MD+1.6ML=1.2(135)+1.6(65)=266kNmTherefore,MA =406kNmor90kNm (64)Strengthdesignaxialloadandmomentatcolumntop C. DetermineEarthquakeload E:E =Eh +EvwhereEv =0.5CaID =0.22DforaxialloadE =Eh +Ev =1.1(490)+0.22(400)=627kNformomentE =Eh +Ev =1.1(220)+0.22(55)=254kN(65)ApplyEarthquakeLoadcombinations:1.2D+1.0E+f1L (Section2035)0.9D 1.0E (Section2036)DesignaxialforcePc atpointC iscalculatedasPc =1.2D+1.0E+f1L=1.2(400)+1.0(627)+0.5(180)=1197kNPc =0.9D 1.0E=0.9(400) 1.0(627)=987kNmor267kNTherefore,Pc =1197kNor267kN(66)ApplyEarthquakeLoadcombinations,continued1.2D+1.0E+f1L (Section2035)0.9D 1.0E (Section2036)DesignaxialforcePc atpointC iscalculatedasPc =0.9D 1.0E=0.9(400) 1.0(627)=987kNmor267kN(67)DesignmomentMc atpointC iscalculated:Mc =1.2D +1.0E +f1L=1.2(55)+1.0(254)+0.5(30)=335kNmMc =0.9D 1.0E=0.9(55) 1.0(254)=304kNmor205kNTherefore,Mc =335kNmor205kNm Notethatthecolumnsectioncapacitymustbedesignedfortheinteractionof Pc=1197kN compressionandMc=335kNm(fordead,liveand(68)DesignmomentMc atpointC iscalculated,continuedNotethatthecolumnsectioncapacitymustbedesignedfortheinteractionofPc =1197kNcompressionandMc =335kNm(fordead,liveandearthquake),andtheinteractionofPc =267kNtensionandMc =205kNm(fordeadand(69) Loadcombinationsforarechangedduetotheuseofstrengthbasedwindloadingbasedon ASCE710 Additionalliveloaddesignationsforparking,garage,andrampliveloading Basicwindspeedarerevisedbasedonlateststudies Forcommunicationtowers,ANSITIA/EIA222GlatesteditionisfullyreferencedintheNSCPSignificantChangestoChapter2MinimumDesignLoads(70) Nearsourcefactorsarerevisedtoconsiderdistancetosource