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Wind load calculation example as per is 875

Given article text here 100%(3)100% found this document useful (3 votes)1K views2 pagesThe document provides details on calculating wind loads for a structural analysis project. It includes dimensions and geometry of the building, wind speed and pressure calculations considering various factors such as building height, width, and shape. The tool also takes into account different types of buildings, including residential, commercial, and industrial structures. This Excel-based tool is designed specifically for Wind Load Calculation, adhering to the Indian Standards IS 875, Part 3, 2015. It streamlines the process of determining wind loads for buildings by providing a structured approach to this critical aspect of structural design. When using this tool, it's essential to cross-reference the input values with IS 875 Part 3. Wind load refers to the force exerted by the wind on structures like buildings, bridges, towers, and other architectural elements. It is a crucial factor to consider in structural engineering as excessive wind loads can lead to structural failures, compromising safety and integrity of buildings and constructions. The calculation of wind load serves several purposes: - Ensures safety by designing structures that can withstand maximum wind forces, minimizing the risk of failure or collapse. - Maintains structural integrity by understanding wind loads and designing buildings that can maintain their structural integrity under varying wind conditions, ensuring longevity and durability. - Enhances cost efficiency by providing more efficient designs that potentially reduce material costs without compromising safety or functionality. - Ensures compliance with standards by adhering to regulatory requirements and obtaining necessary approvals. Calculating wind load is a fundamental step in structural design, ensuring safety, durability, and adherence to regulatory standards. An Excel-based tool specifically designed for wind load calculation has been developed in-house, meticulously crafted to align with the guidelines of IS code 875 Part 3. Calculating wind loads for projects in India just got a whole lot easier with this user-friendly calculator! This free tool is compatible with Microsoft Excel 2016 and above, making it accessible to anyone who needs to crunch numbers quickly. Before using the calculator, make sure you have the 'ifs' function available in your version of Excel - it's essential for the wind load calculations. To get started, update the input data highlighted in red font and grey background. These cells are locked except for the ones with red font and grey background, so be sure to only edit those. Don't worry if you're new to wind load calculations; this calculator guides you through each step of the process. Let's take a look at an example calculation using the SkyCiv S3D Barnhouse model. For this scenario, we'll consider a building in Walwane, Maharashtra, India with specific dimensions and design features. The wind loads will be calculated according to IS 875-3:2015 standards. To calculate the design wind speed and pressure, you can use equations (1) and (2), respectively. These formulas take into account various factors such as basic wind speed, terrain roughness, topography, and importance factor for cyclonic regions. Once you have the design wind pressure, you can distribute it to the structural members using equation (3). For this example calculation, we'll be using a rectangular building with a pitched roof and specific dimensions. The calculations will provide us with the necessary information to determine the wind forces on various surfaces or members of the structure. By following these steps and formulas, you'll be able to accurately calculate the wind loads for your projects in India using this calculator. Happy calculating! Based on IS 875-3:2015 Figure 1, SkyCiv's wind speed calculator can be used by simply defining the site location in India. Try our free wind load calculator, which includes a Probability Factor (Risk Coefficient) k1 table. According to Table 1 of IS 875-3, since this barnhouse has low hazard classification due to its isolated location and agricultural use, the corresponding k1 value is 0.92. Refer to Figure 4 for the risk coefficients table. For terrain roughness and height factor k2, as the structure is situated in an open farm area with no immediate obstructions, it can be classified as Category 1. Using Table 2 of IS 875-3, we can obtain k2 values based on the considered height: H = 2.4 m, resulting in a k2 value of 1.05. The topography factor k3 is generally assumed to be 1.0 for flat terrain, which is confirmed by Google elevation API data for all eight cardinal directions (N, S, W, E, NW, NE, SW, and SE). The importance factor k4 is equal to 1.0 as the site location is not on the east coast of India and the structure's use is limited to agriculture. Using these factors, we can calculate the design wind speed Vz using Equation (1). The design wind pressure pd can then be determined, followed by calculations for the Wind Directionality Factor Kd (equal to 1.0 for purlins and wall studies, and 0.9 for columns and trusses). Lastly, the Area Averaging Factor Ka is calculated based on tributary areas of various components, such as columns, truss, wall studs, and purlins. The combination factor Kc considers the interactions between these factors to determine the final design wind speed Vz. To calculate the design wind pressure, pd, the combination factor Kc is assumed to be 0.9 as specified in IS 875-3:2015. The calculation involves determining the internal pressure coefficients Cpi, external pressure coefficients Cpe, and wall and roof external pressure coefficients based on various parameters such as opening sizes, building dimensions, and roof angles. For this example, it is assumed that the total opening on the wall is less than 5% of the total wall area, resulting in internal pressure coefficients of +0.2 and -0.2 for the walls. The external pressure coefficients for walls depend on the h/w and l/w ratio, which are calculated to be 0.6 and 3.5, respectively. The roof external pressure coefficients are determined based on Table 6 of IS 875-3:2015, taking into account the roof profile (gable or duopitch), height-to-width ratio, and wind angle. The final roof pressure coefficients are calculated as: * Zone EF - Windward: -0.109 * Zone GH - Leeward: -0.5 * Zone EG - Crosswind: -0.8 * Zone FH - Crosswind: -0.6 * Gable ends: -1.172 * Ridge zones: -1.0 The combined internal and external pressures are then used to calculate the design wind force, which is calculated by multiplying the pressure coefficients with the area A. Note that the design pressure should not be less than 0.7 of the internal pressure pz (851.598 Pa), and the values for pd can be calculated using Equation (2). The wind direction angle is 0 degrees for the main frame, which includes columns and trusses. The frame spacing is 3.5 meters. The pressure difference (pd) is 766.438 Pascals for both column and wall studs. For the columns and wall studs at a 0-degree angle: * Zone A: Windward side +0.7 +0.2 -0.2 +0.5 +0.938 Pa * Zone B: Leeward side -0.3 +0.2 -0.2 -0.5 -0.1 -383.219 Pa For the truss and purlins at a 0-degree angle: * Zone EF: Windward side -0.109 +0.2 -0.2 -0.309 +0.091 -229.725 Pa * Zone GH: Leeward side -0.5 +0.2 -0.2 -0.7 -0.3 -520.412 Pa To calculate the uniform load, the pressures will be multiplied by 3.5 meters for the columns and 0.8 meters for the wall studs. The design wind loads are: * Wall stud: -797.096 N/m * Purlins: -783.407 N/m These calculations can be performed using SkyCiv's Load Generator Software or the company's free wind tool. Note: The text also provides information on the building's parameters, such as height, length, and width, as well as the dead load (self-weight of the beam) and wind speed. To calculate the wind load pressure, we first need to determine the design wind speed and pressure for the building. The design wind speed at height Z can be calculated using the equation Vz = Vb × k1 × k2 × k3 × k4, where Vb is the basic wind speed, k1-k4 are factors based on different IS 875-3 standards. The design wind pressure (pd) can be calculated using the equation pd = Kd × Ka × Kc × pz. The values of these coefficients depend on various factors such as wind directionality, area averaging, and combination. Once we have the design wind pressure, we need to calculate the wind force on the surface or members of the building using the equation F = (Cpe - Cpi) × Ad, where A is the surface area of the structural element or cladding unit and Cpe and Cpi are coefficients based on the type of cladding. The result shows that the design wind speed for this example is 0.662 KN/sqm, which is higher than 0.7 PN/sqm. The internal wind pressure is +0.2 and external wind pressure is -0.2. The critical coefficient (Cl) is 0.7, indicating a suction effect. The wind load on every vertical support can be calculated using the equation W = F × L, where W is the wind load, F is the force, and L is the length of the support. The result shows that the reaction on the support is positive (15.63 KN) and negative (-12.2 KN). The article goes on to describe how to calculate the wind loads for a building in Walwane, Maharashtra, India using the IS 875-3:2015 wind load calculations. It provides an example of a barnhouse model and describes the site location, occupancy, terrain, and other relevant data. To solve this problem, we need to use the equations provided by the IS 875-3 standard, taking into account various factors such as design wind speed, pressure, and coefficient values. The result will give us an accurate calculation of the wind loads on the building. External pressure coefficientsCpi is the internal pressure coefficients We will dive deep into the details of each parameter below Basic Wind Speed Vb From Figure 1 of IS 875-3, the site location is situation of the map where the basic wind speed Vb is equal to 39 m/s. The basic wind speed data based on Figure 1 of IS 875-3: 2015 SkyCiv can automate the wind speed calculations just defining the site location in India. Try our SkyCiv Free Wind Tool. Probability Factor (Risk Coefficient) k1 Table 1 of IS 875-3 presents the risk coefficients for different classes of structures in different wind speed zones For this structure, since it is a barnhouse and will be used to shelter some livestock animals, the structure is classified under "Buildings and structures presenting a low degree of hazard to life and property in the event of failure, such as isolated towers in wooded areas, farm buildings other than residential buildings." Hence, from Table 1 of IS 875-3, the corresponding probability factor (risk coefficient) k1 is equal to 0.92. Terrain Roughness and Height Factor k2 For this structure, it is located at the center of a farm where there are no immediate obstructions. Hence, the terrain can be classified as Category 1. Using Table 2 of IS 875-3:2015, we can obtain k2 values (which varies depending on the height being considered): Heightk2Reference height, H = 2.4 m1.05 Topography Factor k3 In order to account for topographic effects, we need to get the elevation data of the location for the eight (8) cardinal directions – N, S, W, E, NW, NE, SW, and SE – using Google elevation API. Based on the data, we can generally assume that the terrain is "Flat" for all directions. Importance Factor k4 Since the site location is not located within the east coast of India and the structure will only be used for agricultural purposes, the value of k4 is equal to 1.0 based on 6.3.4 of IS 875-3:2015 Design Wind Speed Vz From the factors above, we can already solve the design wind speed Vz using Equation (1): LevelVb m/sk1k2k3k4Vz m/sH = 2.4 m39.00.921.051.01.037.674 The design process involves calculating various loads on a structure, including wind pressure and internal pressures. To determine these loads, several components need to be considered, such as wall studs, purlins, columns, and trusses. When calculating wind pressure, the tributary area of each component is taken into account. The combination factor (Kc) is used to account for simultaneous actions of various loads, which in this case is set at 0.9 based on IS 875-3:2015 standards. The design wind pressure (pd) is calculated using Equation (2), with a minimum value of 596.119 Pa or 0.7 times the reference pressure (pz = 851.598 Pa). The pressure coefficients for each component are then determined to distribute the load accordingly. Internal pressures are calculated based on the total opening area in relation to the wall area, which is assumed to be less than 5%. The internal pressure coefficients (Cpi) are +0.2 and -0.2 for this structure. External pressures depend on various parameters such as height, width, length, roof angle, and profile. For walls, the external pressure coefficients (Cpe) are determined using h/w and l/w ratios from IS 875-3:2015 standards. For the wind direction of 0 degrees, the Cpe values for each zone/surface are: * Zone A (windward wall): +0.7 * Zone B (leeward wall): -0.3 * Zone C (sidewall): -0.7 * Zone D (sidewall): -0.7 * Local zone: -1.1 For the wind direction of 90 degrees, the Cpe values for each zone/surface are: * Zone A (windward wall): -0.5 * Zone B (leeward wall): -0.5 * Zone C (sidewall): +0.7 * Zone D (sidewall): -0.1 * Local zone: -1.1 For the roof, the external pressure coefficients are determined using Table 6 of IS 875-3:2015 standards and interpolated based on h/w ratio and roof angle. The final roof pressure coefficients for each zone/surface are: * Zone EF (windward): -0.109 * Zone GH (leeward): -0.5 * Zone EG (crosswind): -0.8 * Zone FH (crosswind): -0.6 These values will be used to calculate the final roof pressure coefficients for each zone/surface. **Wind Load Calculations for Building Structures** To calculate wind loads, we use Equation (3), but for simplicity, we'll focus on design pressures without considering the area affected. The frame spacing is 3.5m, and we'll consider a wind direction angle of 0 degrees. For columns and wall studs at 0 degrees: * Zone A (windward): +0.7 to -0.2 Pa * Zone B (leeward): -0.3 to -1.3 Pa * Local zone (near edge): -1.1 to -1.3 Pa We'll multiply the pressures for columns by 3.5m and for wall studs by 0.8m. For truss and purlins at 0 degrees: * Zone EF (windward): -0.109 to -1.372 Pa * Zone GH (leeward): -0.5 to -1.2 Pa We'll multiply the pressures for trusses by 3.5m and for purlins by 0.745m. The design wind loads are: * For wall studs: -797.096 N/m * For purlins: -783.407 N/m These calculations can be performed using SkyCiv's Load Generator Software, which allows users to input site location data and generate wind pressures. To calculate the design wind speed for a roof truss, we need to determine the basic wind speed first. This can be found in the Indian Standard 875 (IS) Part 3: 2015, which varies depending on the location. Once the basic wind speed is obtained, we multiply it by several factors to get the design wind speed. The basic wind speed for major cities in India is provided in a table. To calculate the design wind speed, we need to know: 1. Basic wind speed (Vb) 2. Risk coefficient (K1) 3. Terrain roughness and height factor (K2) 4. Topography factor (K3) 5. Importance factor for cyclonic regions (K4) The values of K1, K2, K3, and K4 depend on various factors such as the class and life of the structure, terrain category, and height of the structure. To calculate the design wind pressure (Pz), we multiply the basic wind speed squared by a combination factor. The design wind load on individual members is determined by a formula that involves the external pressure coefficient, internal pressure coefficient, surface area, and design wind pressure. The formulas for calculating these factors are provided in the IS 875 Part 3: 2015 document, which can be consulted to obtain accurate values for each location. Obtaining values from IS 875 part-3, 2015, Table 6 reveals that an industrial shed's roofing system consists of trusses spaced at 6 meters apart. The roof truss spans 18 meters with a rise of 3 meters. Assuming a suitable truss configuration, the eaves level is 7 meters above ground on flat terrain with sparsely populated buildings and less than 20% permeability. A Howe-type truss is assumed for an 18-meter span. Step-1: Determine the angle of the roof truss using tan-1(Rise / (Span/2)), resulting in 18.43 degrees. Step-2: Calculate the basic wind speed (Vb) for Chennai, which is 50 m/s as per IS 875 part-3, page 51. Step-3: Compute wind pressure by finding coefficients Kd, Ka, and Kc from IS 875 part-3 and applying them to Vb. This results in a design wind pressure (Pd) of 1478.29 N/m2 or 1.478 KN/m2, which is less than the permissible limit. Step-4: Calculate wind load on individual members by determining coefficients Cpe and Cpi based on truss angle and terrain conditions. The area A for each panel is calculated as Spacing × ((Span/2)^2 × Rise^2)^(0.5)) / number of panels, resulting in 7.115 m^2. With Pd = 1478.29 N/m2 or 1.478 KN/m2, the total wind load on individual members can be determined using the formula F = (Cpe - Cpi) × A × Pd.

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