



EVALUATION OF WIND EFFECTS ON BUILDINGS USING DESIGN CODES AND NUMERICAL WIND TUNNEL TESTS

OCENA WPŁYWU WIATRU NA BUDYNKI Z WYKORZYSTANIEM NORM PROJEKTOWYCH I TESTÓW NUMERYCZNYCH W METODZIE TUNELU AERODYNAMICZNEGO

Imam Hossain*

Bangladesh Army International University of Science and Technology (BAIUST)

Md Jahidul Islam

Military Institute of Science and Technology (MIST)

Al Amin

European University of Bangladesh (EUB)

Abstract

The evaluation of wind effect on the regular shape and simple diaphragm buildings and structures due to wind load has been calculated by several international codes and standards where wind gust nature and dynamic effect could not capture. Bangladesh National Building Code (BNBC) provides the tools for engineers to calculate the wind pressures for the design of a regular-shaped structure with a height to width ratio of less than 5.0, a simple diaphragm, and no unusual geometrical irregularity. If these conditions do not satisfy a wind tunnel testing is required. In this study, a comparative study between two codes in Bangladesh (BNBC-2006 and BNBC-2020), and wind tunnel test results are conducted. An investigation is carried out on four typical buildings with variable heights located within Dhaka, Bangladesh. A computational fluid dynamics (CFD) program RWIND is used to calculate the wind loads on buildings and are compared with those obtained by Bangladesh National Building Codes. Storey shear of four different building models is compared. Between BNBC-2006 and BNBC-2020, there is up to a 53% difference in storey shear. Whereas, up to 30% variation in storey shear is observed between the numerical wind tunnel test data and the data calculated using the BNBC-2020 equations. Finally, this study will help in improving BNBC code provisions for wind load calculations.

Keywords: wind load analysis, wind tunnel test, wind simulation, reinforced cement concrete structure, computational fluid dynamics, Bangladesh National Building Code

Streszczenie

Kalkulację wpływu wiatru na budynki i budowle o regularnych kształtach i prostych konstrukcjach pod obciążeniem wiatrem przedstawiono w kilku normach międzynarodowych, w których jednak nie uwzględniono charakteru podmuchów wiatru i efektu dynamicznego. Bangladeska Krajowa Norma Budowlana (BNBC) zapewnia inżynierom narzędzia do obliczania ciśnienia wiatru przy projektowaniu konstrukcji o regularnym kształcie, o stosunku wysokości do szerokości mniejszym niż 5,0, prostej konstrukcji oraz bez nietypowych nieregularności geometrycznych. Jeśli warunki te nie są spełnione, wymagane jest przeprowadzenie testów w tunelu aerodynamicznym. W niniejszym opracowaniu przeprowadzono badanie porównawcze między dwiema normami obowiązującymi w Bangladeszu (BNBC-2006 i BNBC-2020) oraz wyni-

*Bangladesh Army International University of Science and Technology (BAIUST), Bangladesh, e-mail: imam.ce.bd@gmail.com

kami testów w tunelu aerodynamicznym. Badanie przeprowadzono na czterech typowych budynkach o różnej wysokości zlokalizowanych w Dhace w Bangladeszu. Program RWIND do obliczeń i symulacji dynamiki płynów (CFD) został wykorzystany do obliczenia obciążeń wiatrem na budynkach i porównany z wynikami uzyskanymi według bangladeskich norm budowlanych. Porównano ścinanie kondygnacji czterech różnych modeli budynków. W tym względzie różnice pomiędzy BNBC-2006 i BNBC-2020 wynoszą do 53%. Natomiast między danymi z numerycznego testu w tunelu aerodynamicznym a danymi obliczonymi przy użyciu równań BNBC-2020 zaobserwowano do 30% różnic w odniesieniu do ścinania kondygnacji. Badanie to pomoże też ulepszyć przepisy norm BNBC dotyczące obliczeń obciążenia wiatrem.

Słowa kluczowe: analiza obciążenia wiatrem, test w tunelu aerodynamicznym, symulacja oddziaływania wiatru, konstrukcja żelbetowa, obliczeniowa dynamika płynów, bangladeska krajowa norma budowlana

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