Technical Note by P. F. Pallett - Wind calculations for falsework

General

BS 5975:2019 significantly updated Section 2 on Temporary Works Procedure on the understanding that the technical items on design of falsework would be updated when the Procedures and Design sections were split at the next revision. The BSI committee completed the significant technical rewriting and completed an agreed Draft for Public Comment in August 2021. Due to BSI secretariat issues the BSI managers have yet to complete the necessary approvals and currently (Summer 2022) there is a dispute between BSI secretariat wanting to alter previously agreed wording and rescinding on agreements.

Peter Pallett, a long standing member of BSI falsework committee has been responsible for writing the wind calculations. He, and the committee are acutely aware that the 2010 published method for calculating the peak velocity wind pressure, stated in BS5975 is incorrect and does not conform to current good practice.

This technical note discusses the rationale and publishes the correct formula.

BS5975:2019 Clause 17.5.1.3 Equation 2

The basic values of wind velocity, which should be determined using NA to BS EN 1991-1-4:2005+A1, assume a mean return period of 50 years. To take account of a structure being erected for a shorter period, and therefore less likely to be exposed to the peak wind, a probability factor, c_{prob}, should be applied. BS EN 12812:2008 allows the velocity pressure to be modified to take account of the period of use of the falsework; the minimum value of probability on all temporary works, including falsework structures, that are likely to be erected for less than one year, should be based on a ten year return period as recommended in BS EN 1991-1-6:2005, Table 3.1. This gives the probability factor of c_{prob} = 0.90.

The peak velocity pressure falsework and formwork erected for durations up to one year is:-

$$\boldsymbol{q_p = 0.81 \times 0.613 c_e(z) c_{e,T} S_{wind}^2} \qquad (2)$$

where:

q_p	is the peak velocity pressure in N/m^2;
0.81	is the relevant probability factor as $c_{prob}^2 = 0.90^2 = 0.81$
S_{wind}	is the wind factor;
$c_e(z)c_{e,T}$	is the combined exposure factor

{COMMENT: The change in EN probability factor effectively increases the peak pressure, and therefore the force, on falsework and formwok by 15% }

Probability factor, c_{prob}

The basic wind speed $v_{b,map}$ is defined as having a mean recurrence interval of 50 years. As temporary works are generally erected for periods substantially less than this period, it is appropriate to take the reduced risk for shorter duration exposure into account.

The NA to BS EN 1991-1-4:2005+A1 uses the probability factor c_{prob} to reduce the site wind velocity with a shape factor K = 0.2 and exponent n = 0.5 in the probability equation in BS EN 1991-1-4:2005+A1, **4.2.**

The calculated values of c_{prob} for different return periods for structures exposed during their construction are given in BS EN 1991-1-6:2005 and Table 1.

Table 1 – Values of probability factor, c_{prob} for return periods

Return period	Duration	Factor, c_{prob}
2 years	≤ 3 days	0.78
5 years	≤ 3 months (but > 3 days)	0.85
10 years	≤ 1 year (but > 3 months)	0.90 (recommended)
50 years	> 1 year	1.00

In the standard for falsework, BS EN 12812:2008, **8.2.4.1**, the velocity pressure may be modified taking the period of use into account.

The recommendation for falsework and all temporary works erected for less than one year is to use a minimum value of $c_{prob} = 0.90$. As the factor c_{prob} is applied to the velocity, which is then squared to obtain the pressure, the effect of probability factor c_{prob} on the pressure is equivalent to introducing a 0.81 factor on the pressure as $c_{prob}^2 = 0.90^2 = 0.81$.

BS EN 12812:2008, **8.2.4.1**, specifies that the velocity pressure be considered for a 50 year return period, but notes that the velocity pressure can be modified taking the period of use of the falsework into account. This justifies the use of the shorter 10-year return period for UK falsework erected for less than one year. It is noted that when designing facade retention structures, C579 recommends $c_{prob} = 1.00$, and the 0.81 reduction factor is not applied. It is also recommended that unless it can be assured (see design brief) that a hoarding will be erected for less than one year, all hoardings are designed with $c_{prob} = 1.00$.

The working wind

It is both unrealistic and unsafe to carry out work on site and use any cranage when the wind exceeds a certain speed. This is known as the “working wind” and is used in the design to determine stability on the actual day of construction. The assumption is that the UK is not prone to sudden large squalls, and construction would not have started had a severe gale been forecast.

The recommended working wind velocity pressure is unchanged at **200N/m^2**.

This value equates to wind on the Beaufort Scale of Force (11 m/s to 14 m/s). In practice, working operations are likely to have ceased when a person has difficulty in standing, i.e. at Beaufort Scale Force 4. The Beaufort scale does not allow for gusts, so an allowance for likely gusts is included in the determination.

The values of force coefficient, site coefficients, shielding factors and effective frontal area are the same as used for evaluation of the maximum wind condition.

As the working velocity pressure is related to the value experienced at the site actual location, and is not dependent on the location, altitude, season or direction then $c_{dir} = c_{season} = c_{alt} = 1.00$. Hence the working wind velocity pressure is given by:

$$q_w = 0.613 c_{prob}^2 v_{b,wind}{}^2$$

Assuming a gust velocity at working conditions of 18 m/s and all factors as unity, i.e. probability factor $c_{prob} = 1.00$, gives a working wind velocity pressure of

$$q_w = 198.6 \text{ N/m}^2 .$$