where

b : Width of the building in the across-wind direction.

f_{0y} : Natural frequency of the building in the across-wind direction (in Hz).

S_t : The Strouhal number.

For buildings with circular cross-sections, the Strouhal number is 0.18. For buildings with sharp-edged rectangular cross-sections the Strouhal number varies as a function of depth/width ratio, *d/b*, and is given in Table 7.1 below. Stouhal numbers corresponding to the intermediate values of *d/b* can be found by linear interpolation.

TABLE 7.1. Variation of Strouhal number in rectangular cross-sections as a function of *d/b*.

d/b	1	2	3	3.5	5	10
S_t	0.12	0.06	0.06	0.15	0.11	0.09

For non-circular cross-sections, a step-by-step analytical procedure to determine the possibility of vortex shedding is provided in ESDU 90036 [11]. The analysis is based on the assumptions that for many sharp-edged structures the separation points of the flow around the structure are fixed over the whole range of flow conditions and Reynolds numbers. If the analysis predicts a predominantly narrow-band type response, the structural design should be considered unsatisfactory. If the analysis predicts a predominantly broad-band type response, the structural design should still be checked for fatigue and serviceability.

Similar analytical procedures are given for the vortex-induced response of circular and polygonal sections in ESDU 96030 [12], and for the galloping response in ESDU 91010 [13].

Another alternative to investigate across-wind response, as well as torsional response, is to use the electronic database assisted system as recommended in the ASCE Standard 7-05 [8]. The database can be accesed through Internet at *http://aerodata.ce.nd.edu/interface/interface.html* and consists of high-frequency base balance measurements of seven rectangular building models with depth-to-width ratios from 1/3 to 3, three height-to-width ratios for each model, and two incoming flow types representing an open and an urban environment. Using this interactive web site, users can select the geometry and the dimensions of the model building, and the flow condition, and automatically obtain the dynamic load spectra for along-wind, across-wind, and torsional directions. The web site includes documentation, analysis procedure, and examples. The web site is not intended to replace the wind tunnel testing, but provides useful tools for preliminary design.

Any analytical study should be done under the supervision of a consultant who is familiar with the theory.