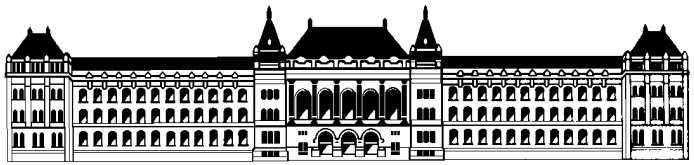
Determination of drag force acting on two main beams of a bridge by using CFD

Budapest University of Technology and Economics

Dep  anics

February 2004.

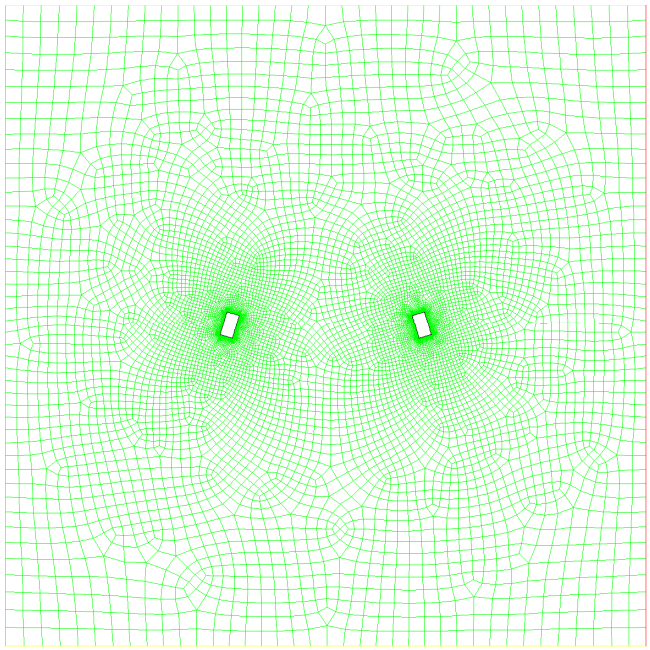
Aim and method of investigation

Aim: Determination of the aerodynamic drag of two interacting beams in case of changing distance between them.

Method 2D simulation of flow by using Fluent

Numerical model:

- **steady k-ω turbulence model**
- **Number of cells: appr. 9000**
- **Thicknes of cells close to the wall: 0,007 m**
- **size of modelled area: 100 x 100 m**
- **size of cross section of beams: 3,8 x 2 m tilted at angle 16,5°**



Buundary conditions at inlet:

- **wind velocity: 25 m/s**
- **turbulence intensity: 5%**

Steps of implementation

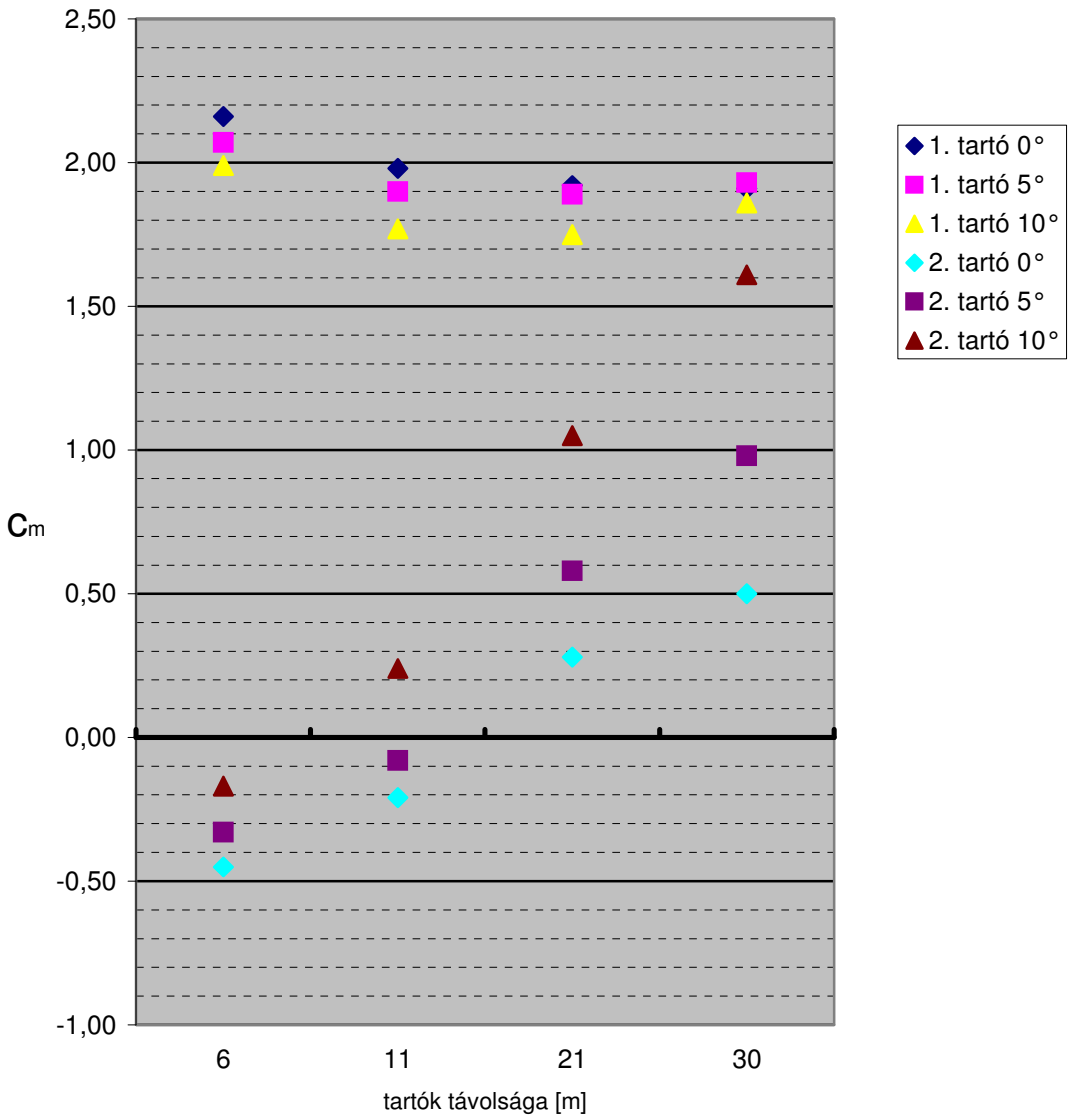
1. Value of reference drag coefficient of a 3,8 m high and 2 m wide beam determined by CFD is c_m = 2,1 (in literature: c_m=2 - 2,2).

2. Numerical simulation of flow field at 4 different distances separating the beams: 30m, 21m, 11m, 6m and at 3 wind directions (0°, 5°, 10°) with respect to the horizontal plane.

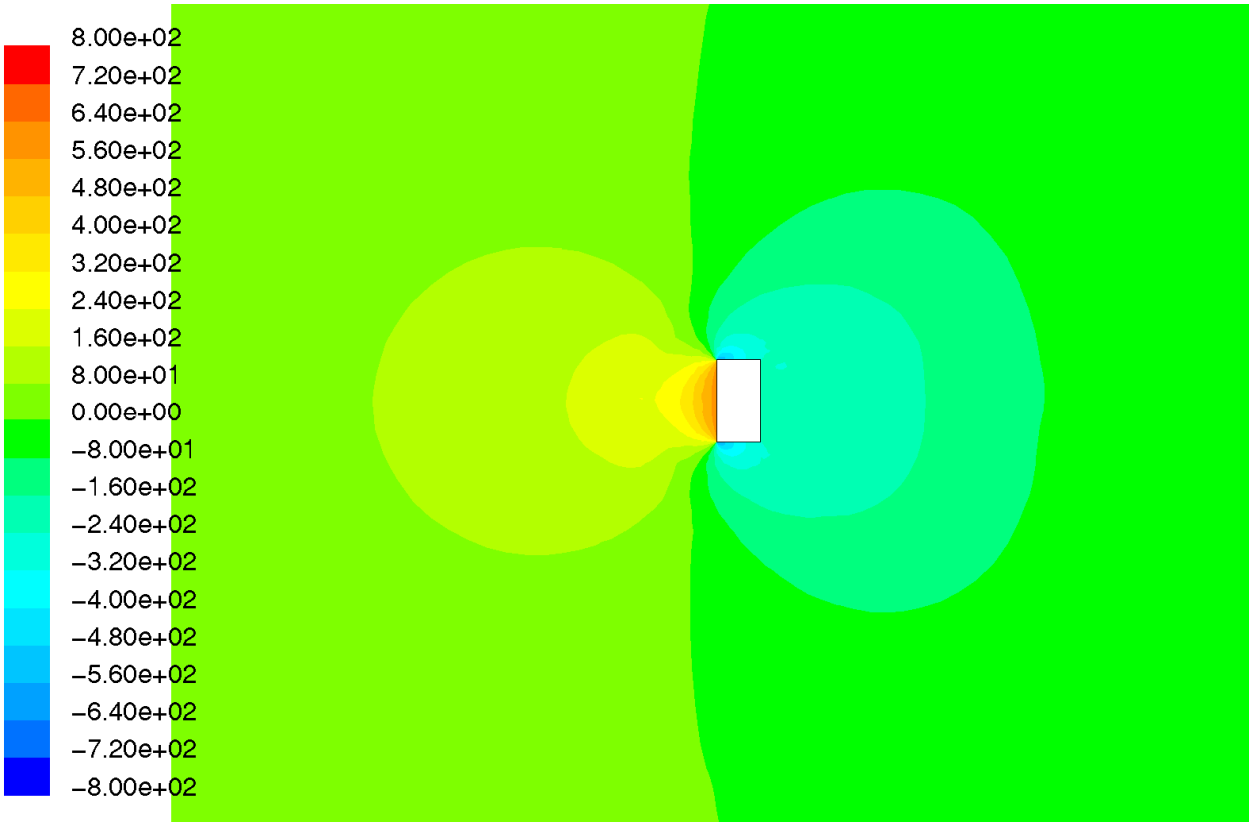
3. Drag coefficients (c_m) are calculated from horizontal component of the force acting on two beams. Reference cross section is 3,8 m multiplied by length for each beam.

		Cm értékek
referencia tartó		2,10
30m	1. tartó	1,91
	2. tartó	0,50
30m 5°	1. tartó	1,93
	2. tartó	0,98
30m 10°	1. tartó	1,86
	2. tartó	1,61
21m	1. tartó	1,92
	2. tartó	0,28
21m 5°	1. tartó	1,89
	2. tartó	0,58
21m 10°	1. tartó	1,75
	2. tartó	1,05
11m	1. tartó	1,98
	2. tartó	-0,21
11m 5°	1. tartó	1,90
	2. tartó	-0,08
11m 10°	1. tartó	1,77
	2. tartó	0,24
6m	1. tartó	2,16
	2. tartó	-0,45
6m 5°	1. tartó	2,07
	2. tartó	-0,33

Drag coefficients of upstream (1) and downstream (2) beam as function distance and wind direction.

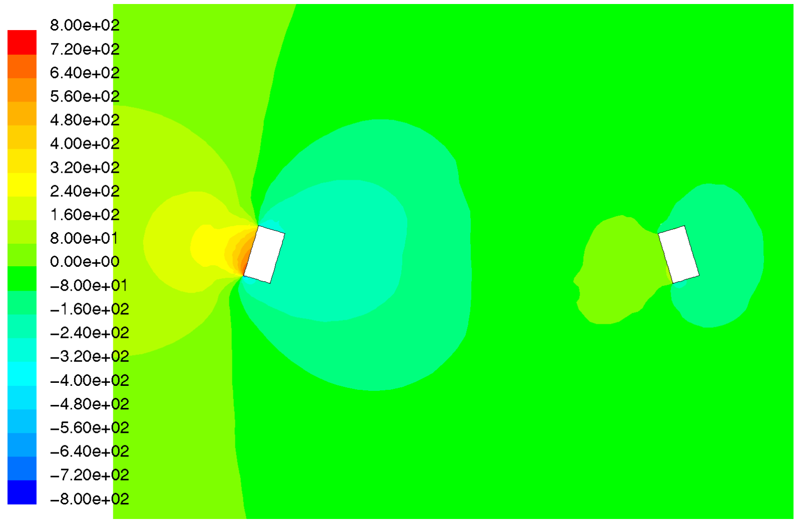


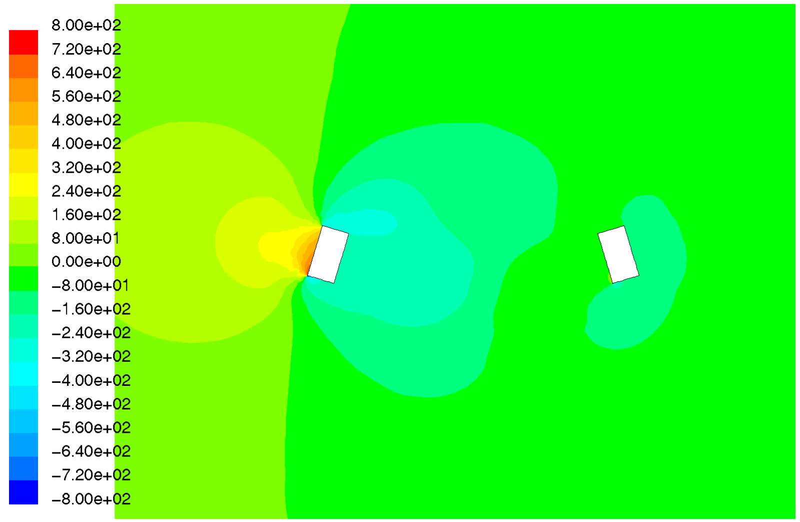
Pressure distribution

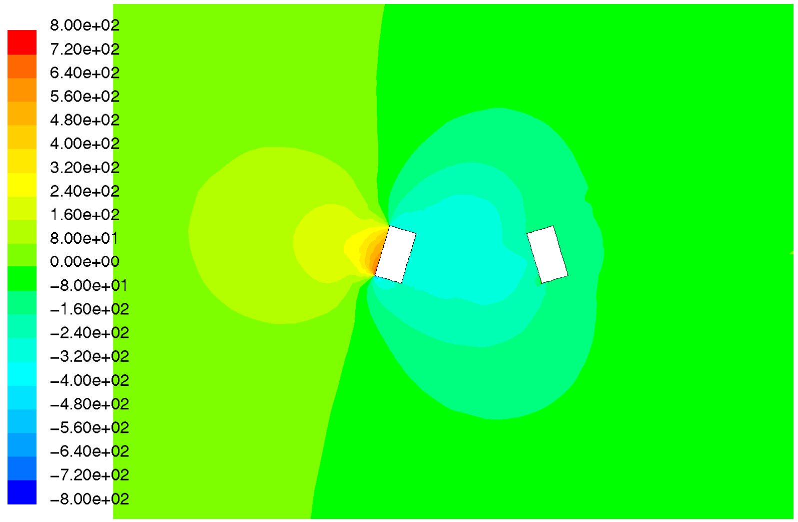


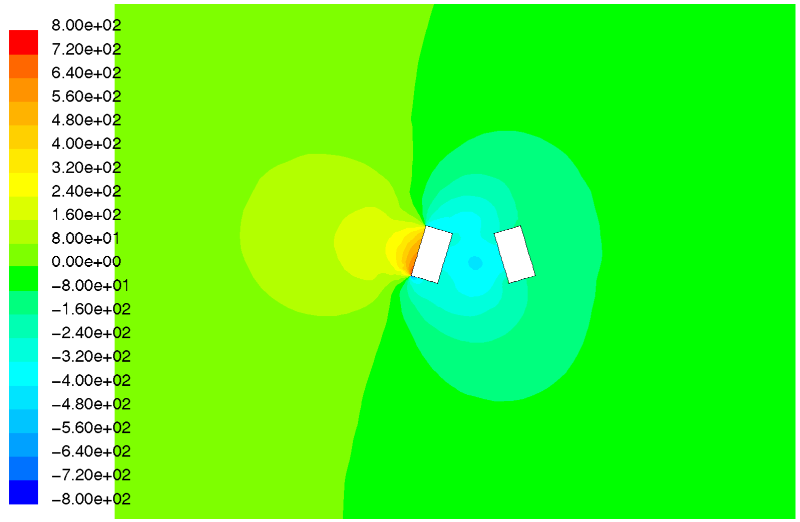
Reference beam

Pressure distributions at wind direction 0^0

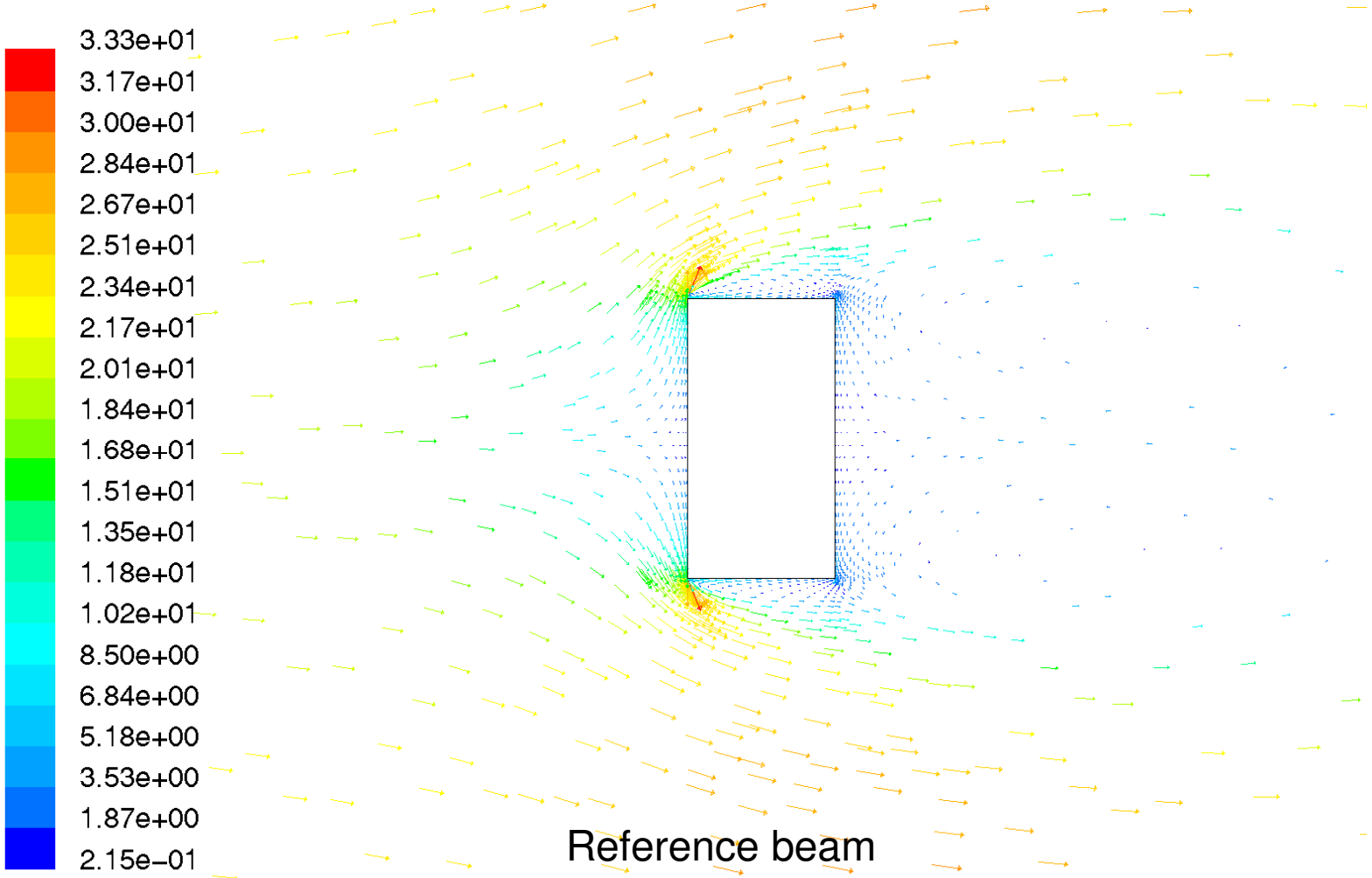








Velocity vectors



Velocity vectors at wind direction 0^0