SIDANG
TUGAS AKHIR
LABORATORIUM MEKANIKA DAN MESIN-MESIN FLUIDA

STUDI EKSPERIMEN KARAKETRISTIK ALIRAN MELINTASI SILINDER SIRKULAR YANG DIBERI PENGGANGGU BERBENTUK PRISMA SEGITIGA SAMASISI DAN PRISMA SEGIEMPAT

"Studi Kasus Untuk S/D = 0,60 - 0,85"

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INSTITUT TEKNOLOGI SEPULUH NOPEMBER
SURABAYA
2015

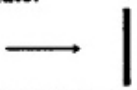
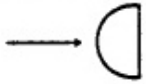
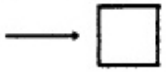
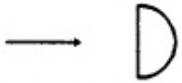
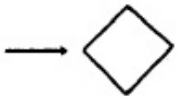
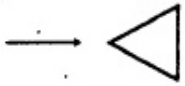
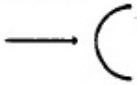
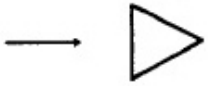
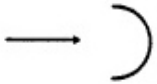
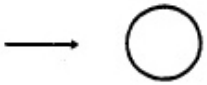
LATAR BELAKANG

TINJAUAN PUSTAKA

Drag Coeficient C_D

Table 7.2

DRAG OF TWO-DIMENSIONAL BODIES AT Re = 10^5

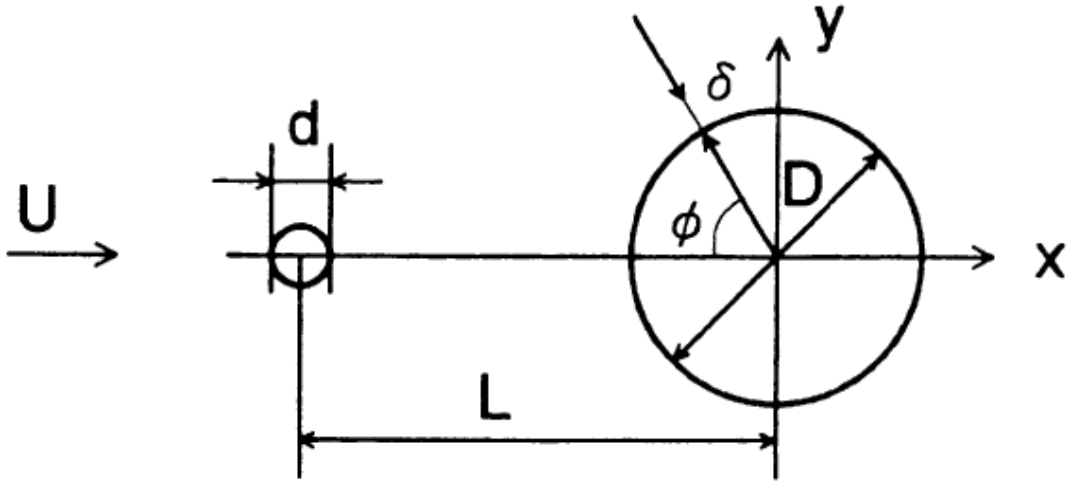
Shape	*C_D based on frontal area*	*Shape*	*C_D based on frontal area*
Plate:		Half-cylinder:	
	2.0		1.2
Square cylinder:			
	2.1		1.7
	1.6	Equilateral triangle:	
			1.6
Half tube:			
	1.2		2.0
	2.3		1.2

Sumber : **Fred Stern Fall (2009)**

PENELITIAN TERDAHULU

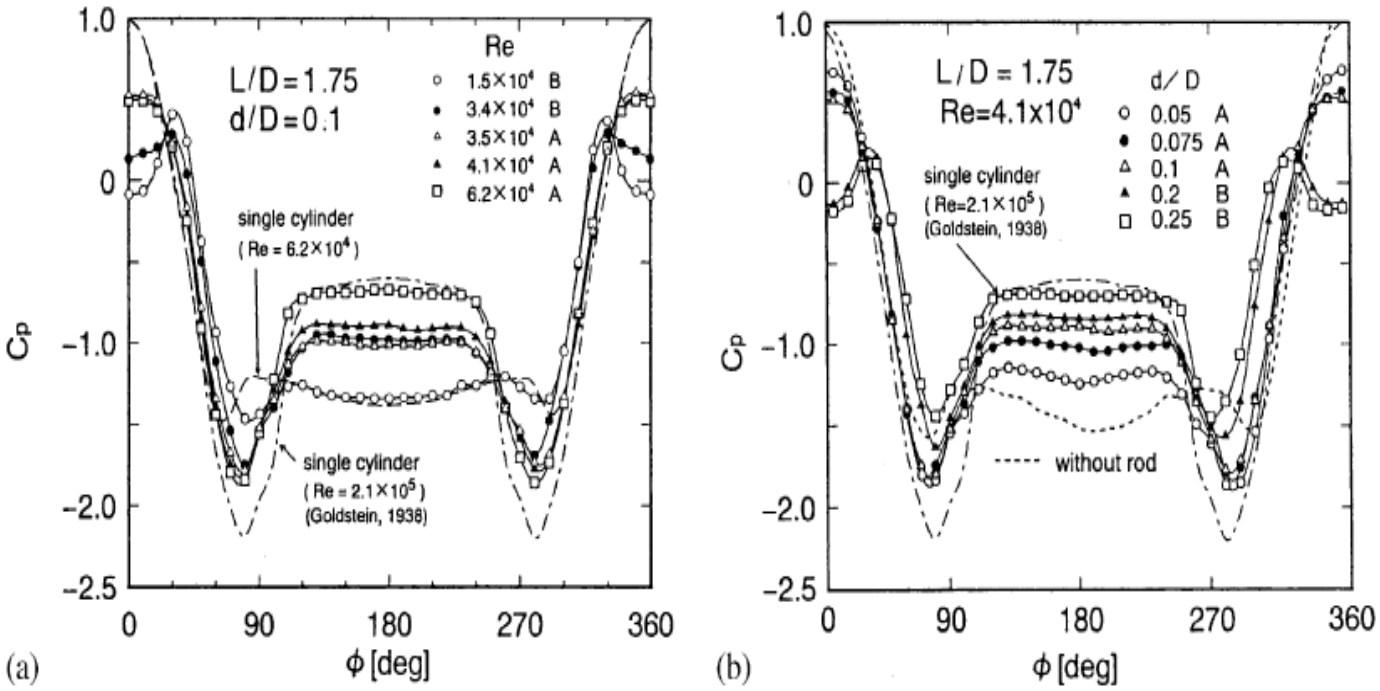
TSUTSUI dan IGARASHI (2002)

- Memvariasikan :
  1. Jarak antara kedua pusat silinder (L/D) = 1,25-3
  2. Diameter silinder pengganggu (d) = 1- 10 mm
  3. Bilangan Reynolds Re = $1,5 \times 10^4 \leq Re \leq 6,2 \times 10^4$



Ket :
D = 40 mm

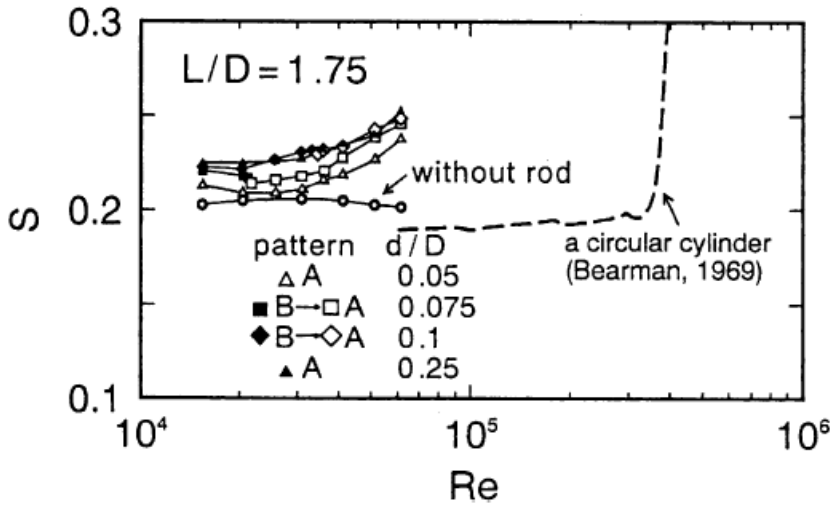
Skema penelitian

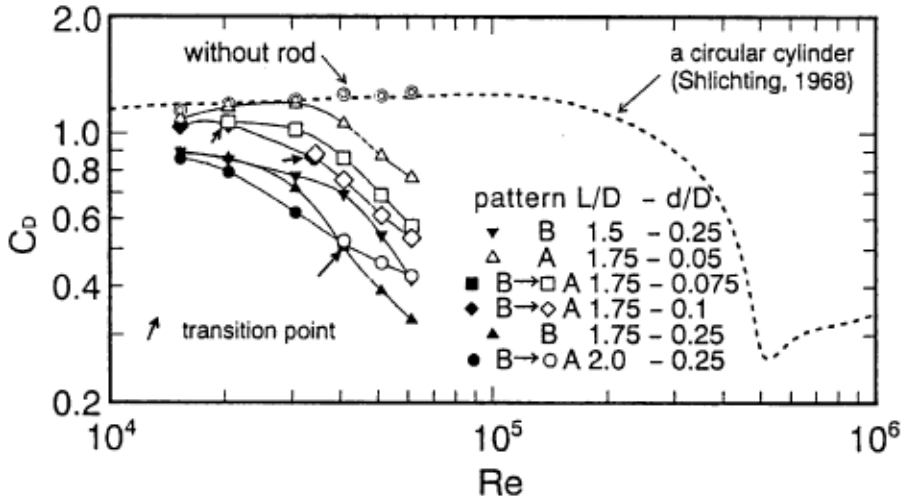


Cp terendah pada Re 1,5 x 10^4

Cp terendah d/D 0,05

PENELITIAN TERDAHULU



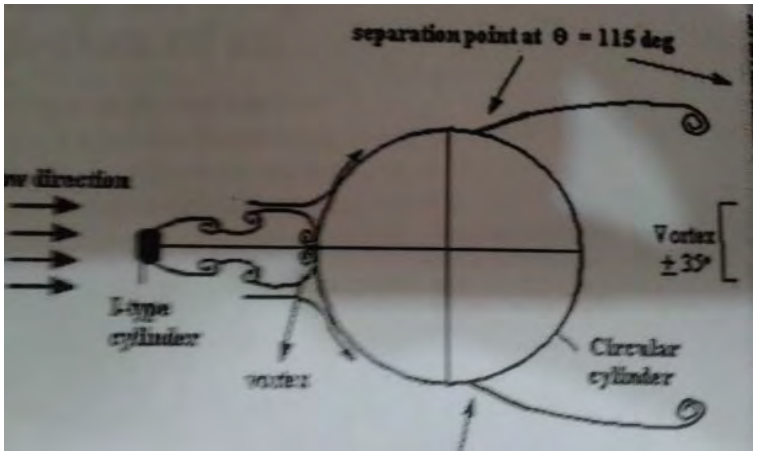


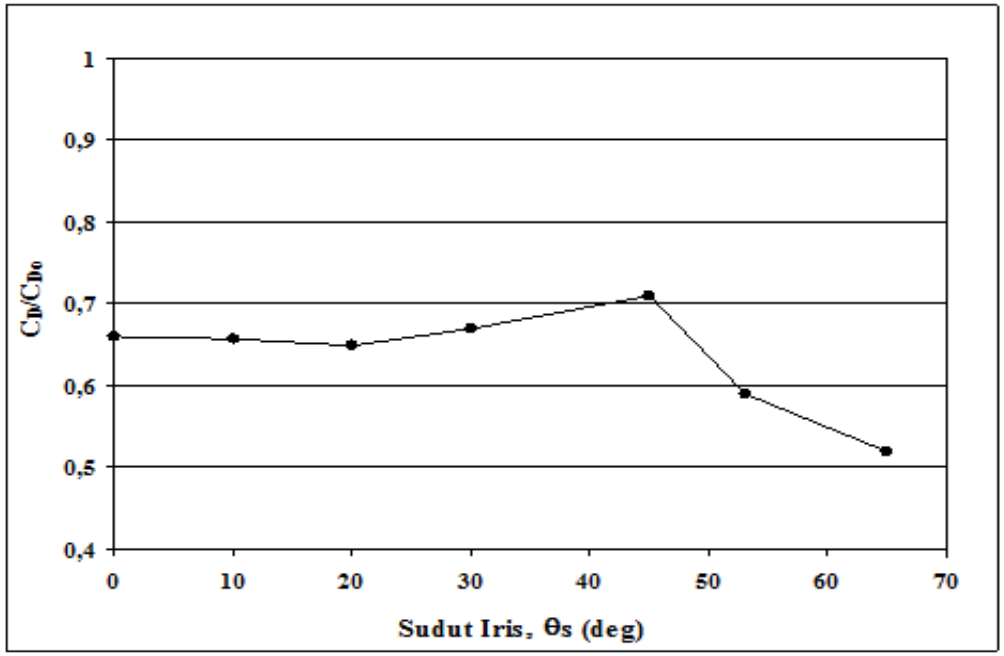
- *Body* pengganggu menaikkan bilangan Strouhal (St) dan menurunkan koefisien drag C_D
- Peningkatan Re meningkatkan St namun Menurunkan koefisien Drag C_D

PENELITIAN TERDAHULU

TRIYOGI ET AL (2009)

- Meneliti tentang aliran melintasi silinder sirkular dengan pengganggu berupa silinder teriris tipe I





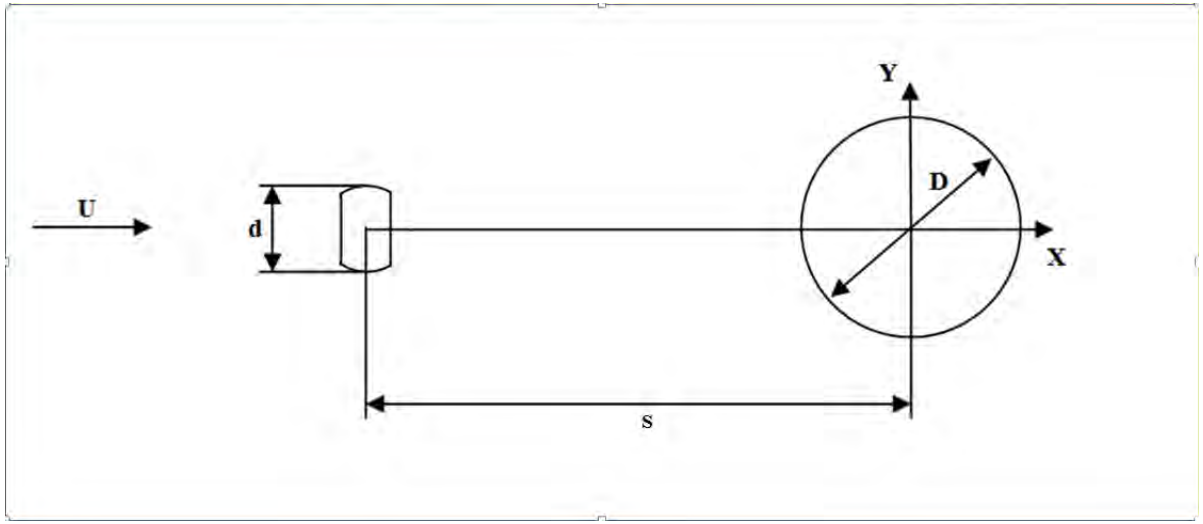
Kesimpulan :

- C_D minimum pada sudut iris $\theta_s = 65^o$
- Sudut iris $\theta_s = 65^o$ efektif menurunkan gaya *drag* pada silinder utama sebesar 52%

PENELITIAN TERDAHULU

RIZAL (2010)

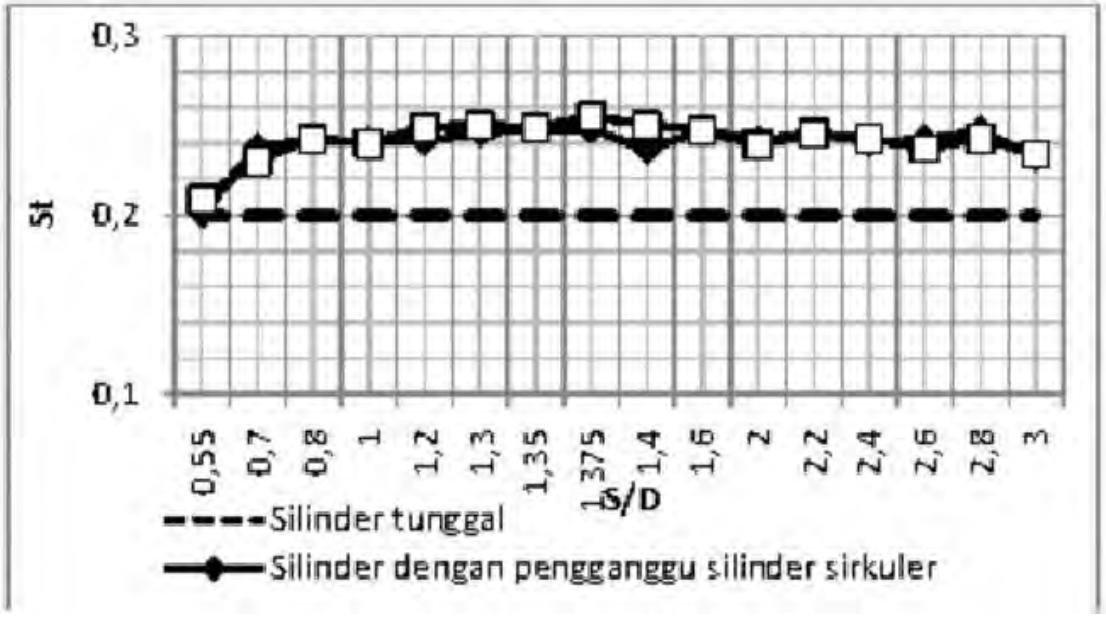
- Sudut iris $\theta_s = 0^0$ dan $\theta_s = 65^0$
- Memvariasikan jarak antar pusat silinder S/D = 0,55 – 3,0



Skema Penelitian

Ket :
Re = 5,3 x 10^4

PENELITIAN TERDAHULU



Kesimpulan :

- Adanya silinder penggangu tipe I mampu meningkatkan bilangan Strouhal (St)
- Paling efektif reduksi tipe I θ=65 pada S/D = 1,375

PERUMUSAN MASALAH

Penambahan Body Pengganggu

Profil Body Pengganggu → Aliran lebih cepat turbulen → Titik separasi tertunda → Daerah *wake* silinder utama menyempit → C_D menurun

HIPOTESA AWAL

1. *body* pengganggu menurunkan gaya *drag* pada silinder utama
2. Profil *body* pengganggu berpengaruh terhadap karakteristik aliran pada silinder utama, apabila C_D body pengganggu besar → Wake silinder utama menyempit → gaya drag menurun
3. frekuensi *vortex shedding* membesar → daerah *wake* dibelakang silinder utama mengecil
4. Variasi jarak S/D berpengaruh terhadap besarnya frekuensi *vortex shedding*

BATASAN MASALAH

Batasan masalah yang digunakan dalam penelitian ini antara lain:

1. Fluida yang mengalir adalah udara dalam kondisi *steady*, *incompressible* dan *uniform* pada sisi *upstream*.
2. Re = 5,3 x 10^4.
3. Kemungkinan perpindahan panas diabaikan.
4. Analisa aliran dua dimensi.

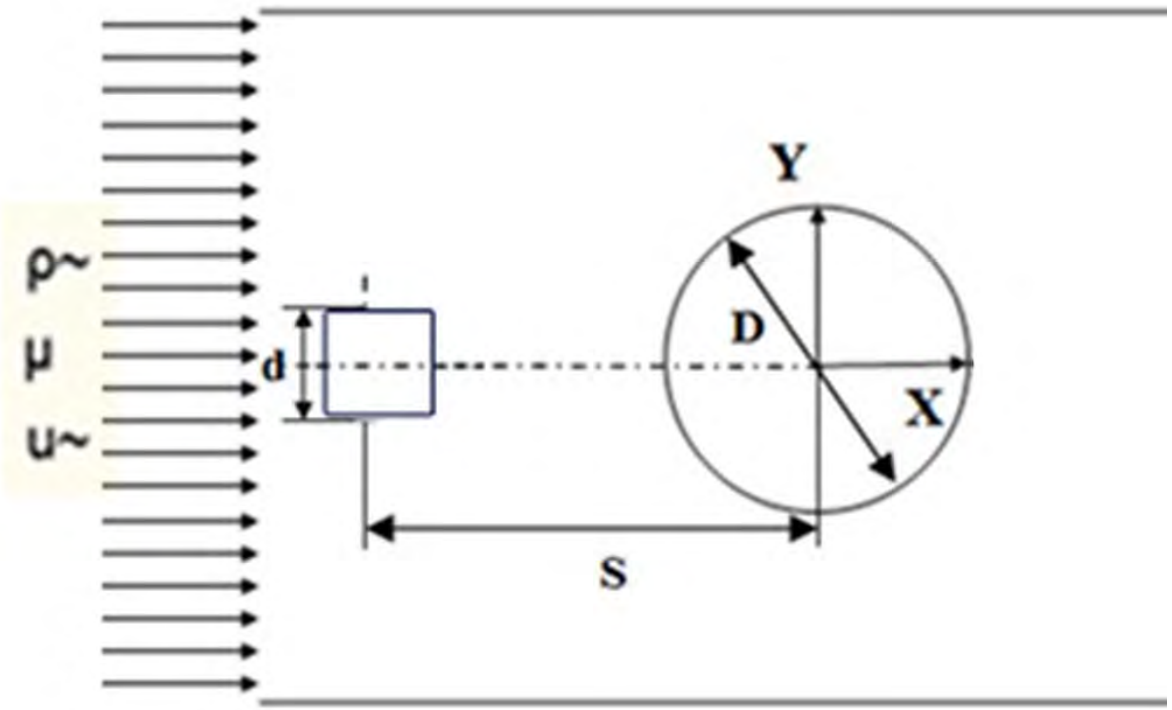
TUJUAN PENELITIAN

Tujuan dari penelitian ini adalah :

1. Mengetahui dan menganalisa karakteristik aliran
2. Mengetahui tipe dan jarak terbaik mereduksi drag

METODE PENELITIAN

SKEMA PENGAMBILAN DATA

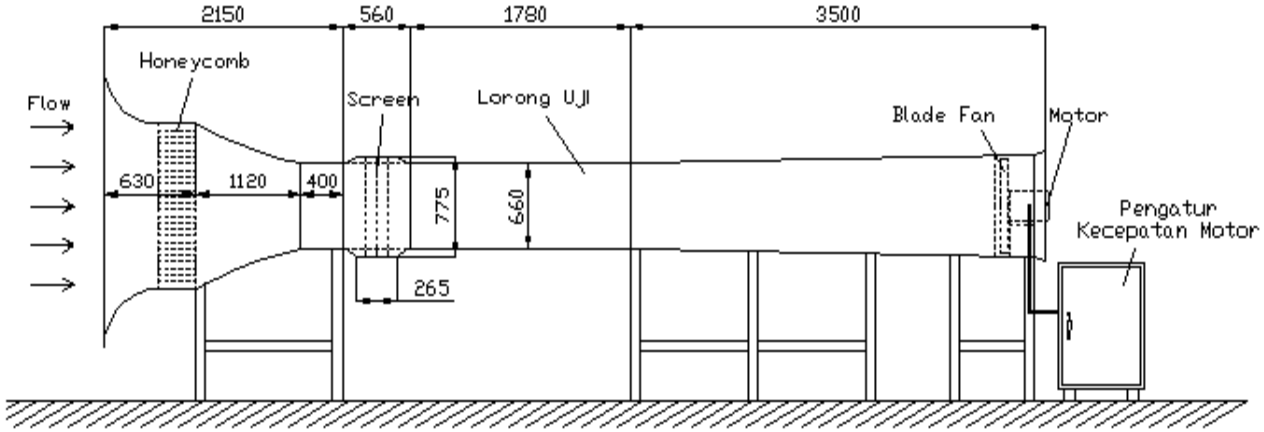


Re = 53000

PERALATAN PENELITIAN

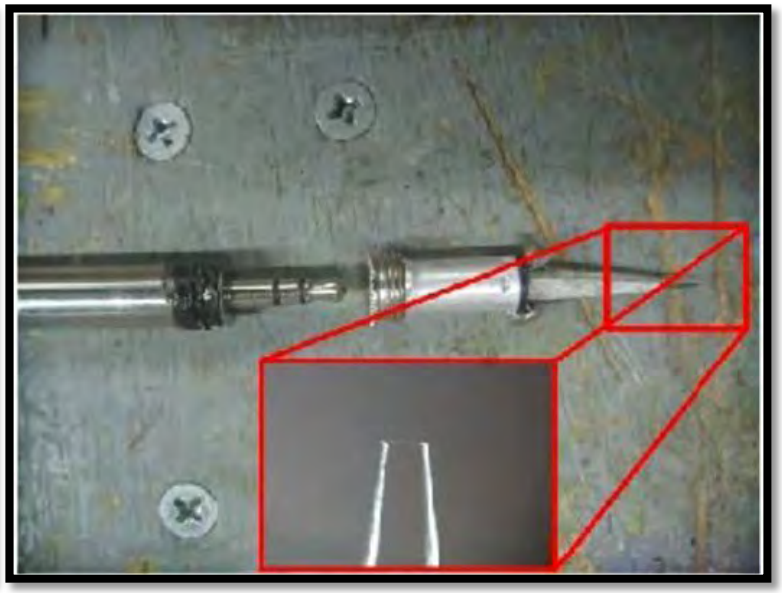
1. *Wind Tunnel*

- Jenis : *subsonic, open circuit wind tunnel*
- Bentuk *test section* : penampang balok
  - Panjang : 1780 mm
  - Tinggi : 660 mm
  - Lebar : 660 mm



Ket :
Skema *Wind Tunnel*

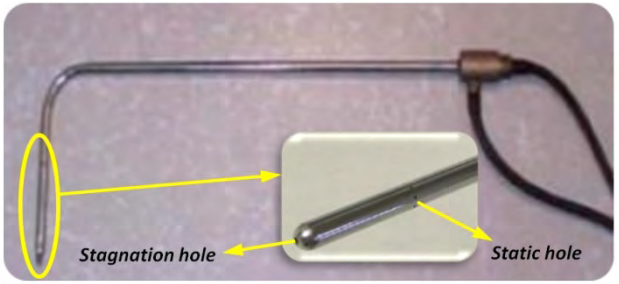
2. HWA (*Hot Wire Anemometer*)



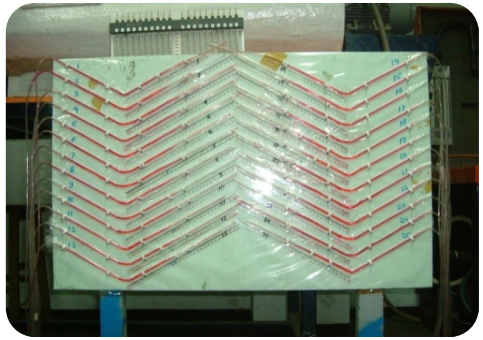
- Sensor *HWA* : *Single Normal Probe*
- Constant temperatur mode
- Kawat sensor : tungsten, D = 0,005 mm dan

  l = 1 mm

ALAT UKUR


Stagnation hole
Static hole

OMEGA
DIFFERENTIAL PRESSURE TRANSMITTER
HIGH
LOW
SPAN
ZERO



C
F

OM-DAQPRO-5300
OMEGA

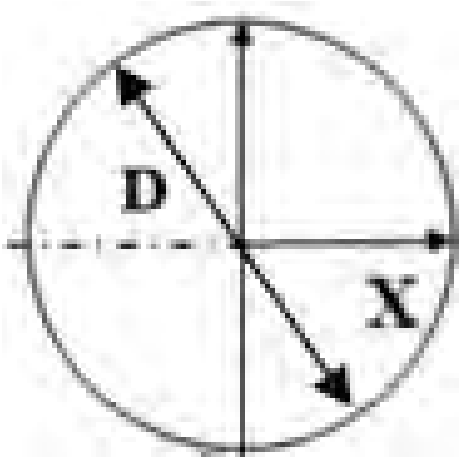
3. Benda Uji

Silinder Utama

Profil Silinder Utama

Diameter (D) : 60 mm

Panjang (L) : 600 mm

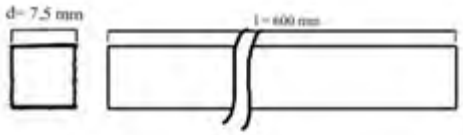


Silinder Pengganggu

Tipe A (bujur sangkar)

lebar sisi (d) : 7,5 mm

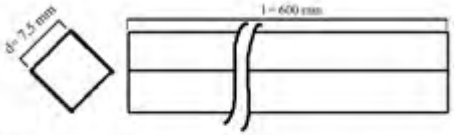
panjang (l) : 600 mm



Tipe B (bujur sangkar diputar 45^0)

lebar sisi (d) : 7,5 mm

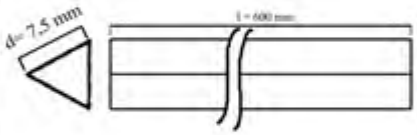
panjang (l) : 600 mm



Tipe C (segitiga samasisi diputar 30^0)

lebar sisi (d) : 7,5 mm

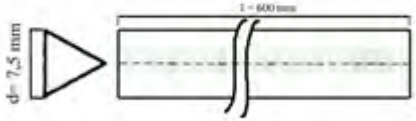
panjang (l) : 600 mm



Tipe D (segitiga samasisi diputar 210^0)

lebar sisi (d) : 7,5 mm

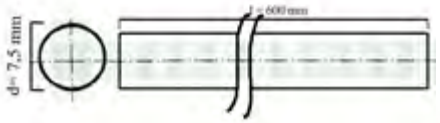
panjang (l) : 600 mm



Tipe E (silinder pejal)

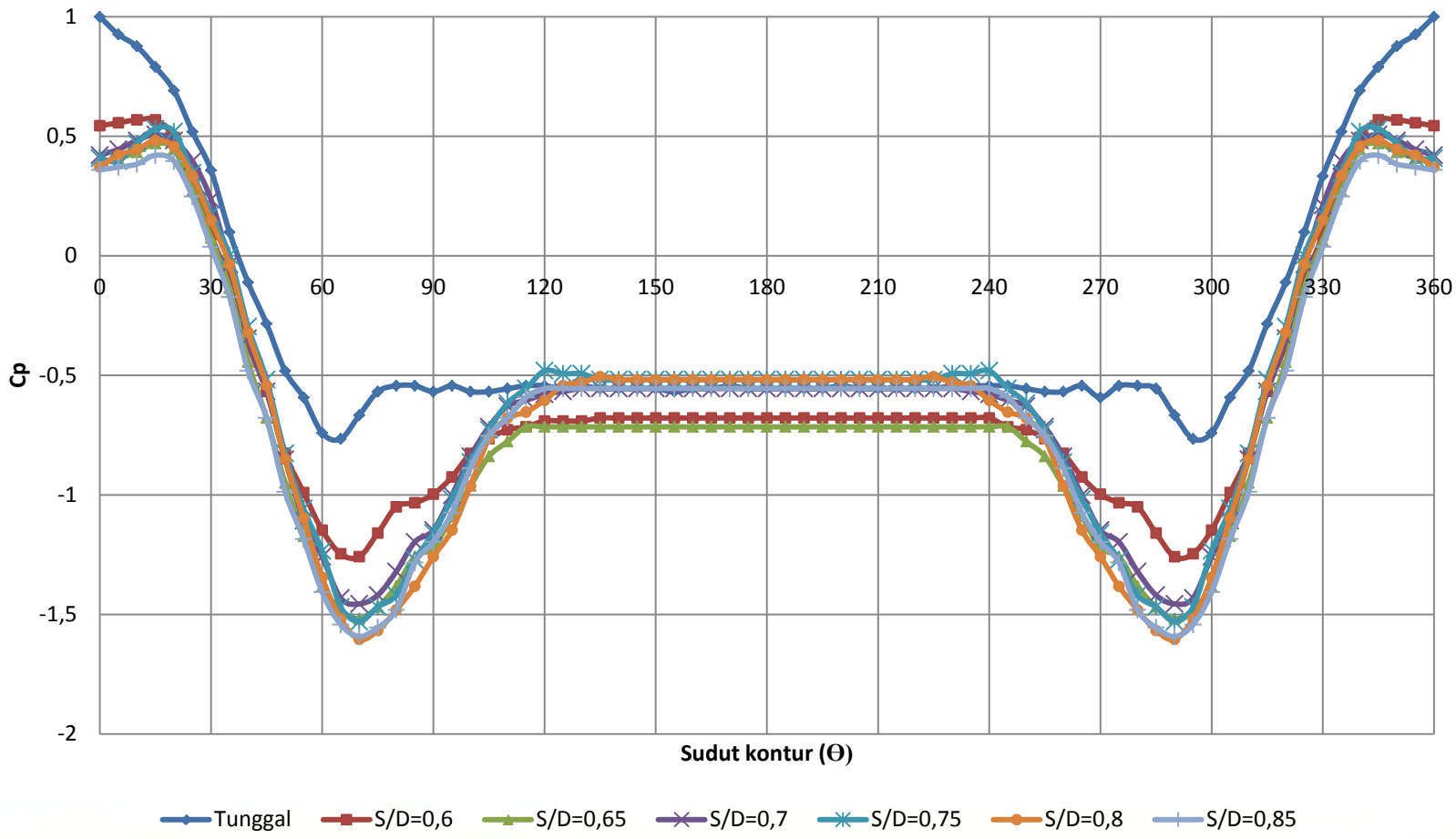
Diameter (d) : 7,5 mm

Panjang (l) : 600 mm



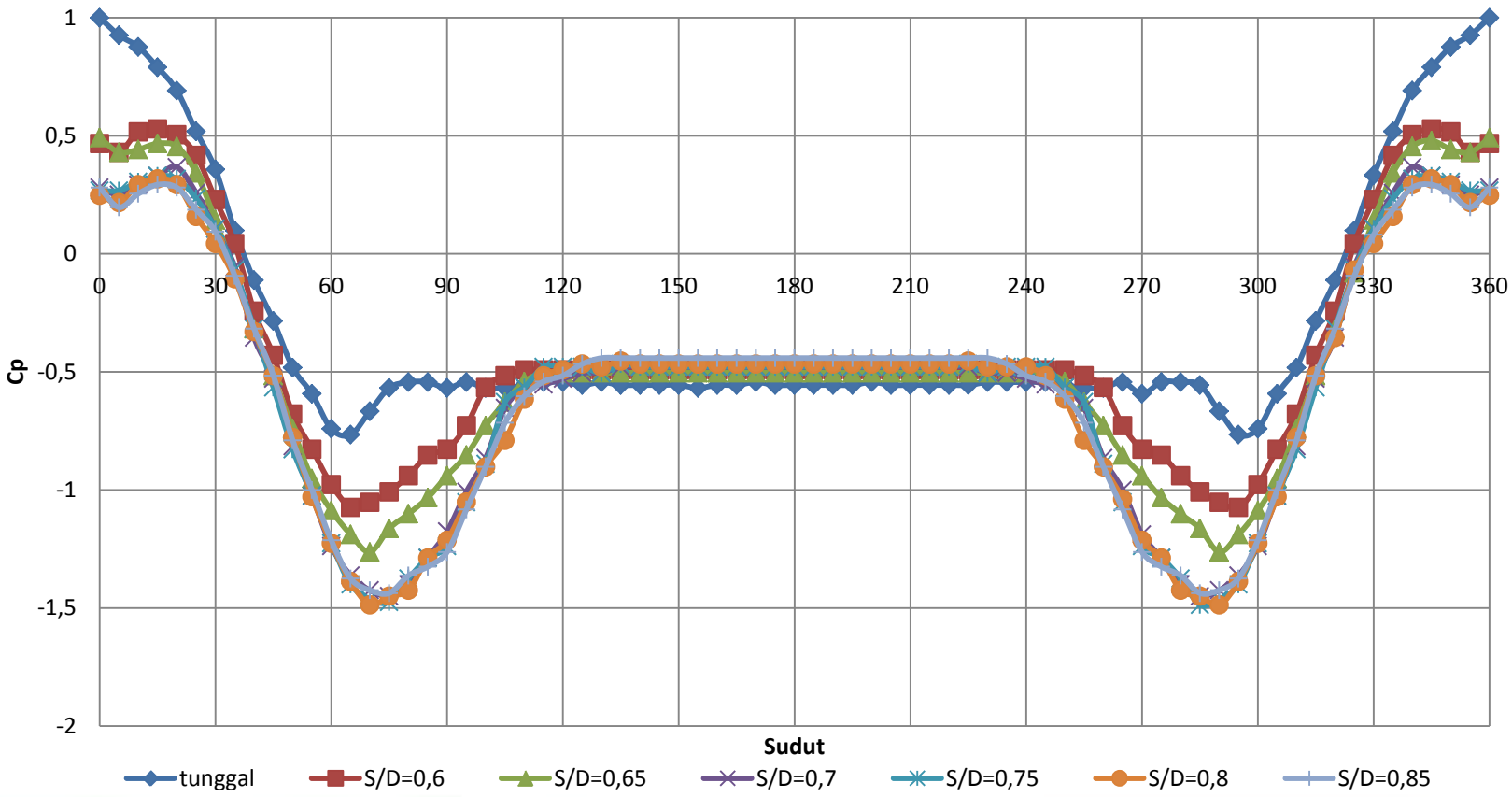
HASIL PENELITIAN

❖ **Grafik distribusi kontur tekanan silinder sirkular dengan pengganggu tipe E (silinder berdiameter 7,5 mm) pada jarak S/D=0,6-0,85**



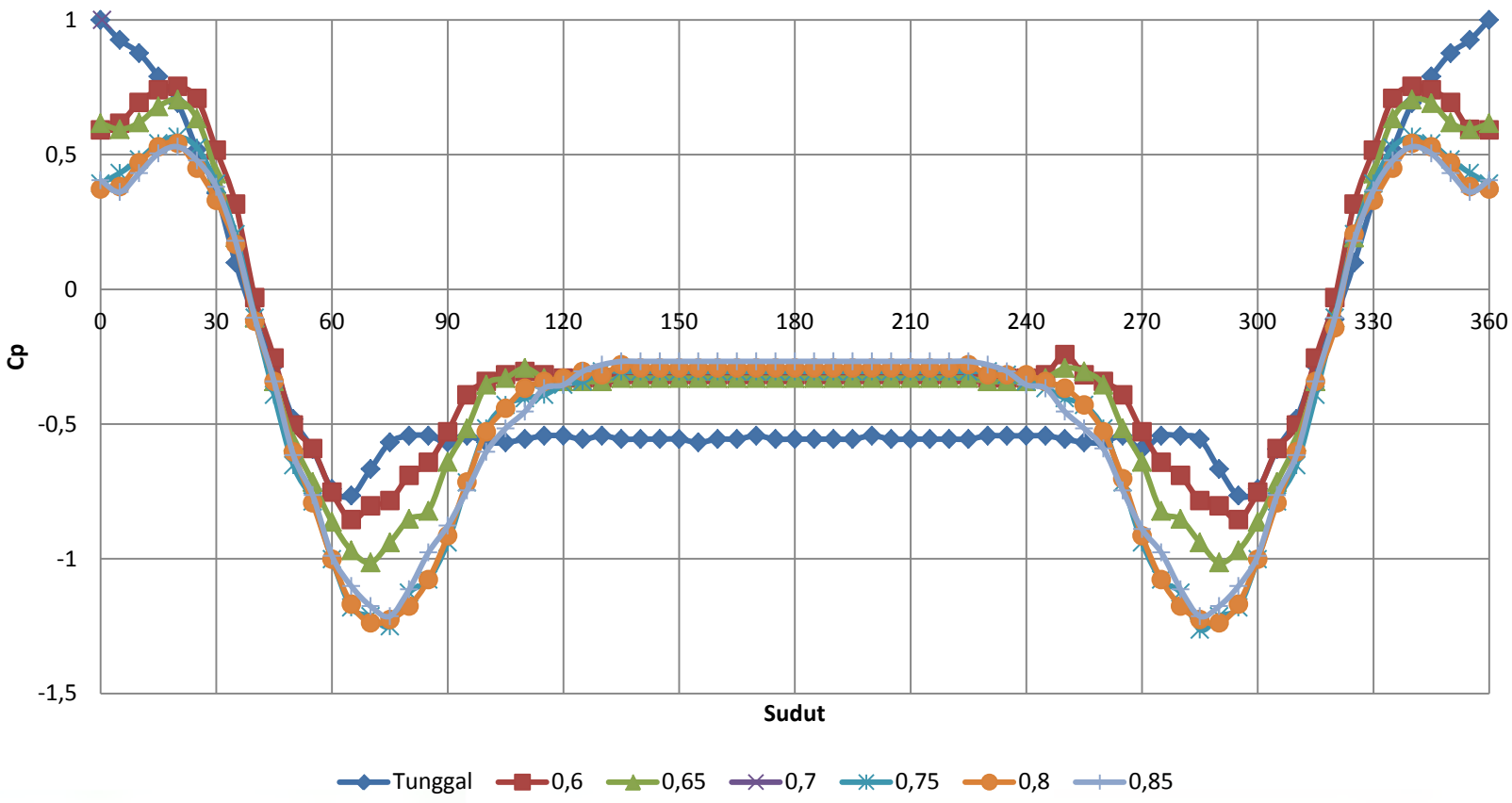
HASIL PENELITIAN

❖ **Grafik distribusi kontur tekanan silinder sirkular dengan pengganggu tipe A pada jarak S/D=0,6-0,85**



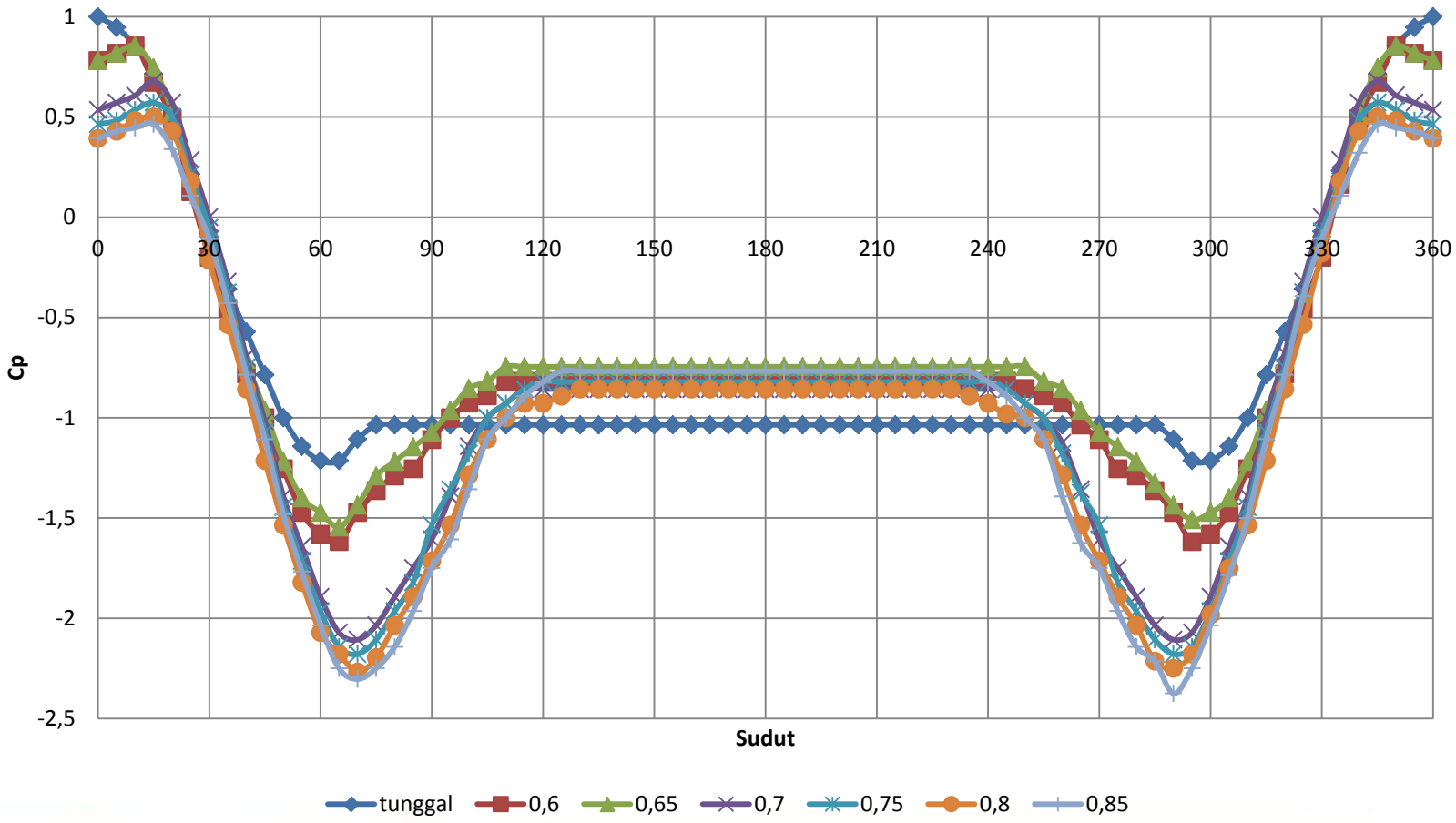
HASIL PENELITIAN

❖ **Grafik distribusi kontur tekanan silinder sirkular dengan pengganggu tipe B pada jarak S/D=0,6-0,85**



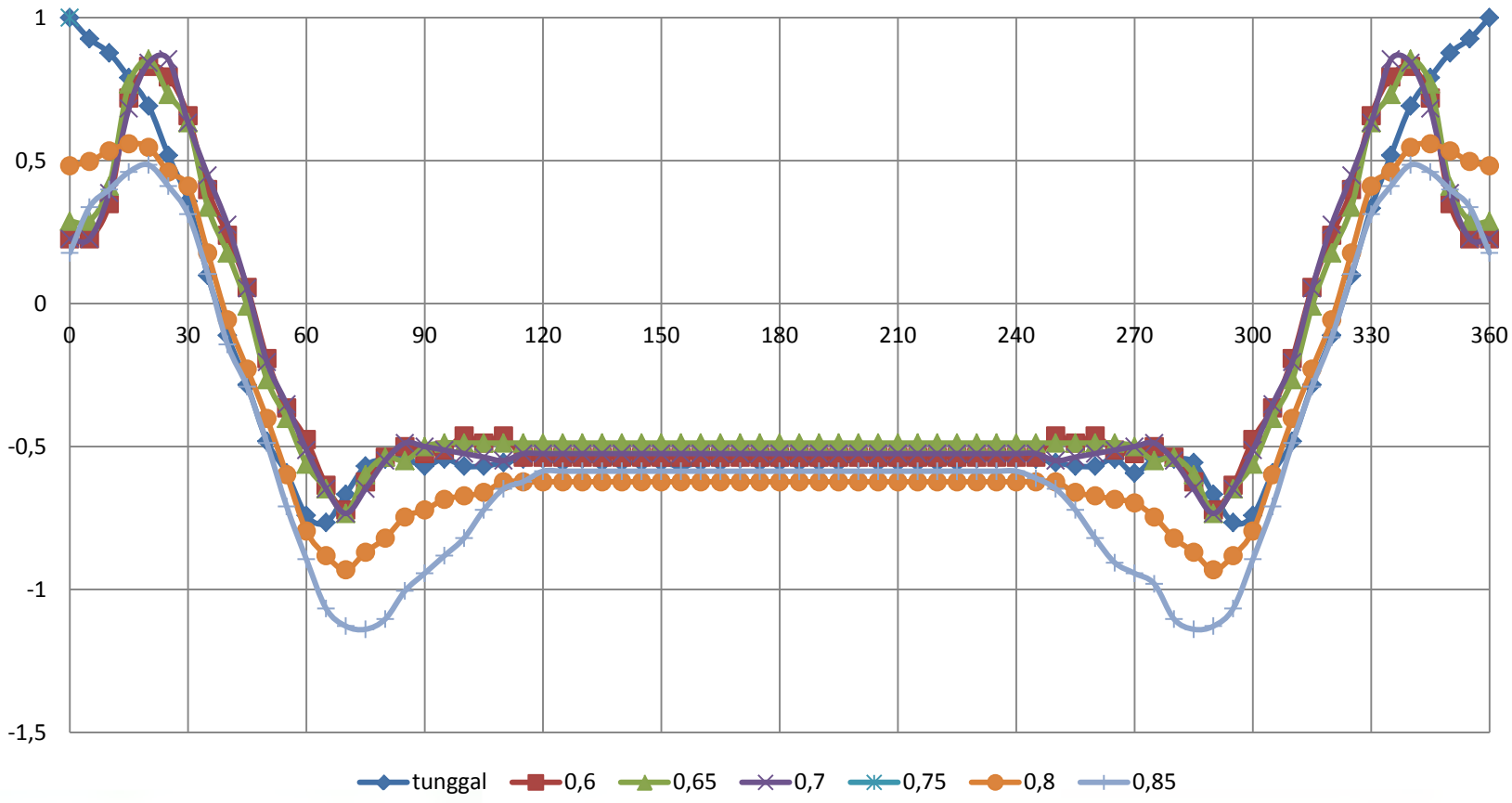
HASIL PENELITIAN

❖ **Grafik distribusi kontur tekanan silinder sirkular dengan pengganggu tipe C pada jarak S/D=0,6-0,85**



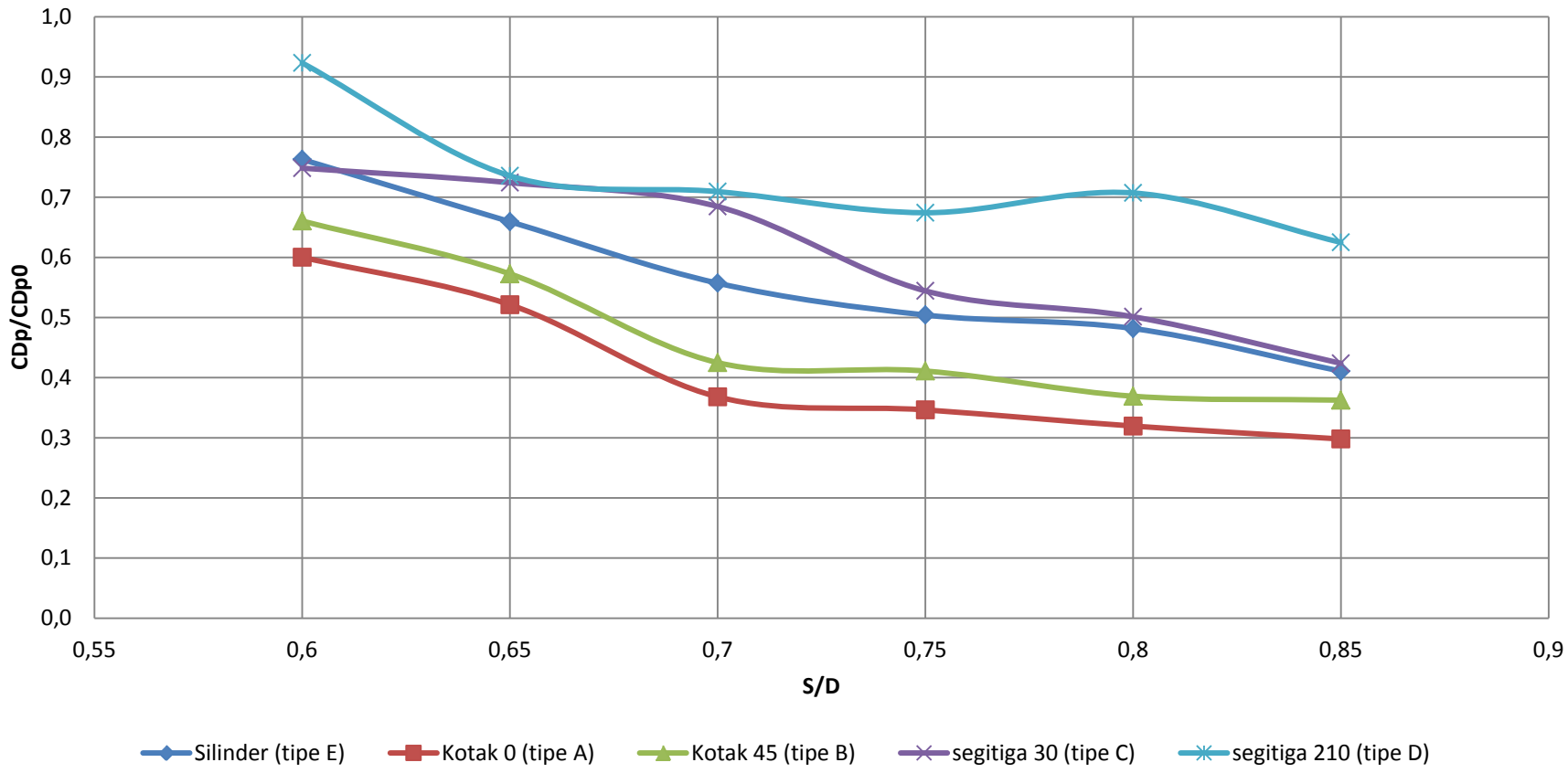
HASIL PENELITIAN

❖ **Grafik distribusi kontur tekanan silinder sirkular dengan pengganggu tipe D pada jarak S/D=0,6-0,85**



HASIL PENELITIAN

❖ **Grafik CDp/CDp0 pada silinder sirkular dengan 5 tipe pengganggu pada jarak S/D=0,6-0,85**



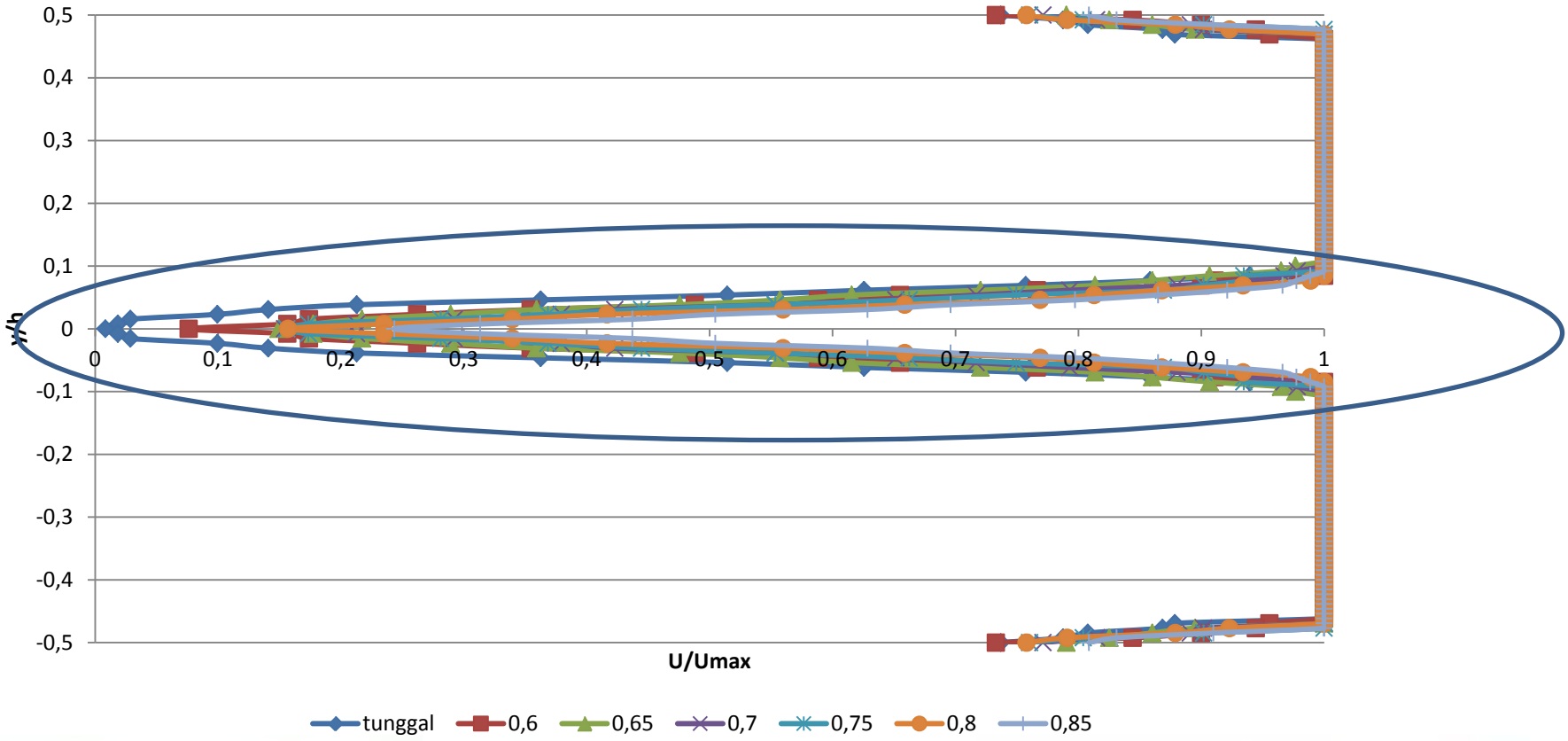
HASIL PENELITIAN

❖ **Tabel CDp/CDp0 pada silinder sirkular dengan 5 tipe pengganggu pada jarak S/D=0,6-0,85**

Tipe pengganggu	$C_{Dp}/C_{Dp0} = f\ (S/D)$					
	0.6	**0.65**	**0.7**	**0.75**	**0.8**	**0.85**
Silinder (tipe E)	0.7628	0.6593	0.5571	0.5041	0.4817	0.4107
kotak 0 (tipe A)	0.6002	0.5213	0.3681	0.3464	0.3195	0.2980
kotak 45 (tipe B)	0.6604	0.5726	0.4250	0.4110	0.3691	0.3626
segitiga 30 (tipe C)	0.7483	0.7242	0.6846	0.5443	0.5013	0.4237
segitiga 210 (tipe D)	0.9233	0.7356	0.7093	0.6742	0.7071	0.6249

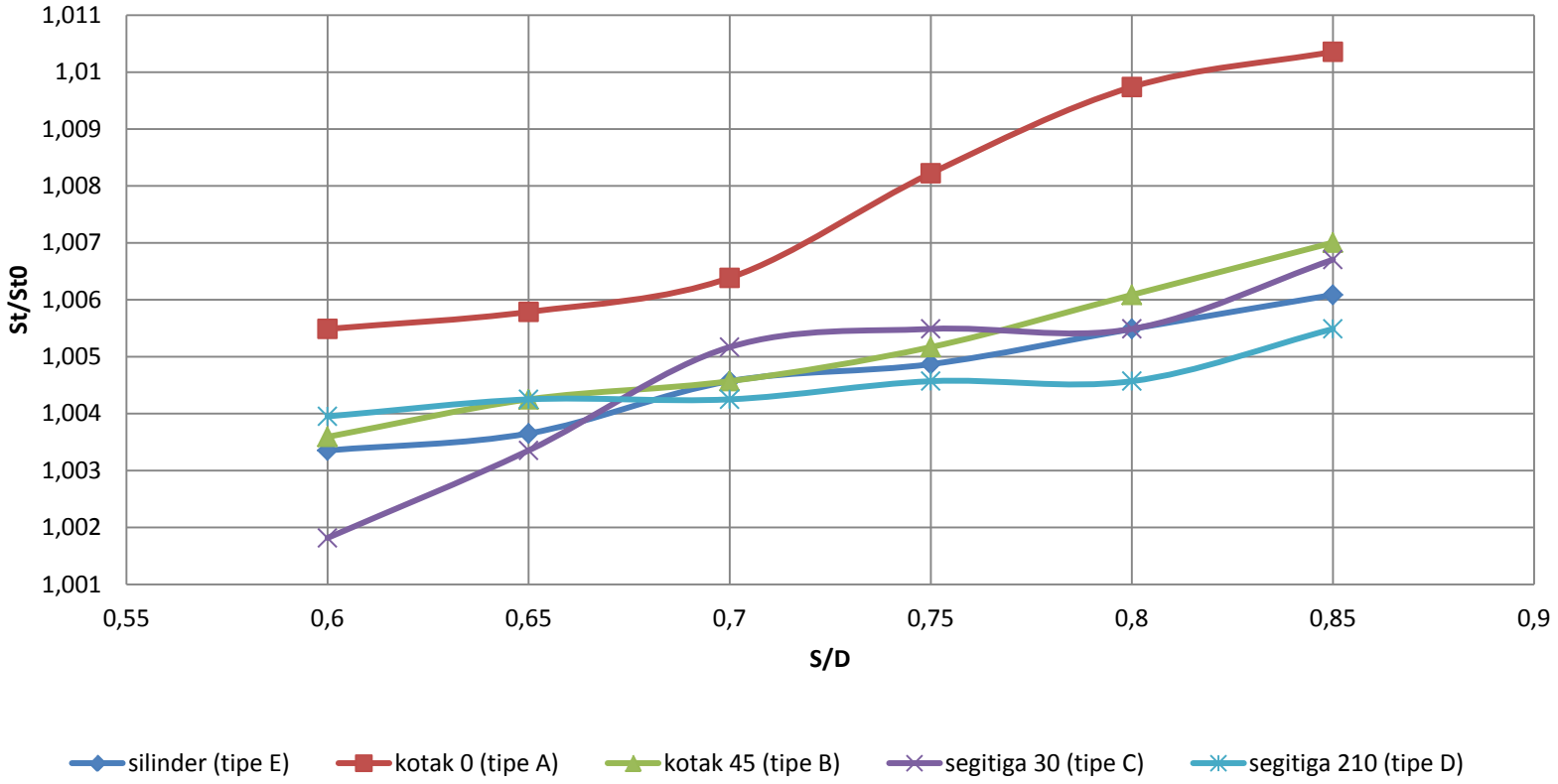
HASIL PENELITIAN

❖ **Grafik U/Umax pada silinder sirkular dengan pengganggu tipe E pada jarak S/D=0,6-0,85**



HASIL PENELITIAN

❖ **Grafik St/St0 di belakang silinder sirkular dengan 5 tipe pengganggu pada jarak S/D=0,6-0,85**



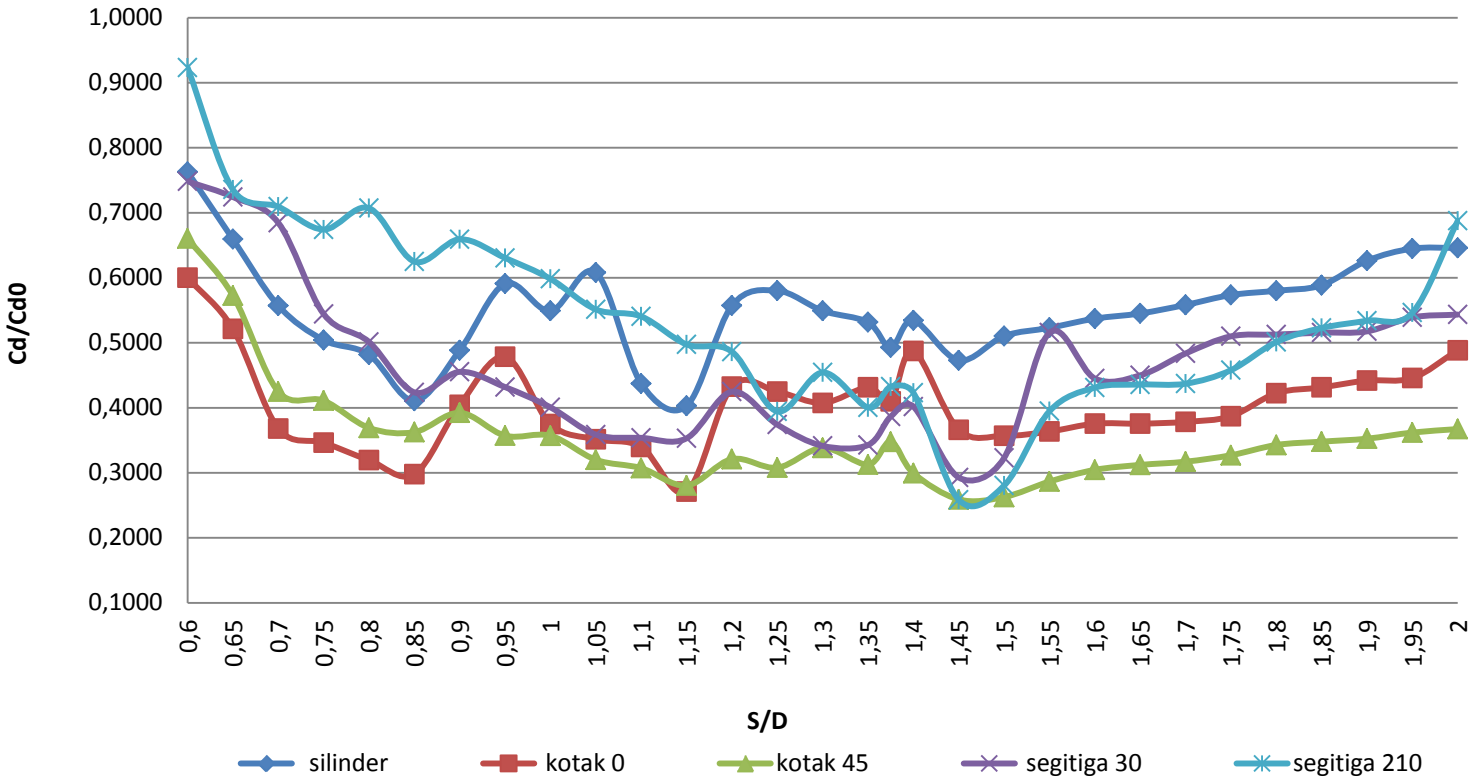
HASIL PENELITIAN

❖ **Tabel St/St0 di belakang silinder sirkular dengan 5 tipe pengganggu pada jarak S/D=0,6-0,85**

Jenis penggangu	St/St0 = f (S/D)					
	0.6	0.65	0.7	0.75	0.8	0.85
Silinder (tipe E)	1.003353	1.003652	1.00457	1.004869	1.005488	1.006087
kotak 0 (tipe A)	1.005488	1.005787	1.006386	1.008222	1.009739	1.010357
kotak 45 (tipe B)	1.003592	1.004251	1.00457	1.005169	1.006087	1.007005
Segitiga 30 (tipe C)	1.001816	1.003353	1.005169	1.005488	1.005488	1.006705
Segitiga 210 (tipe D)	1.003951	1.004251	1.004251	1.00457	1.00457	1.005488

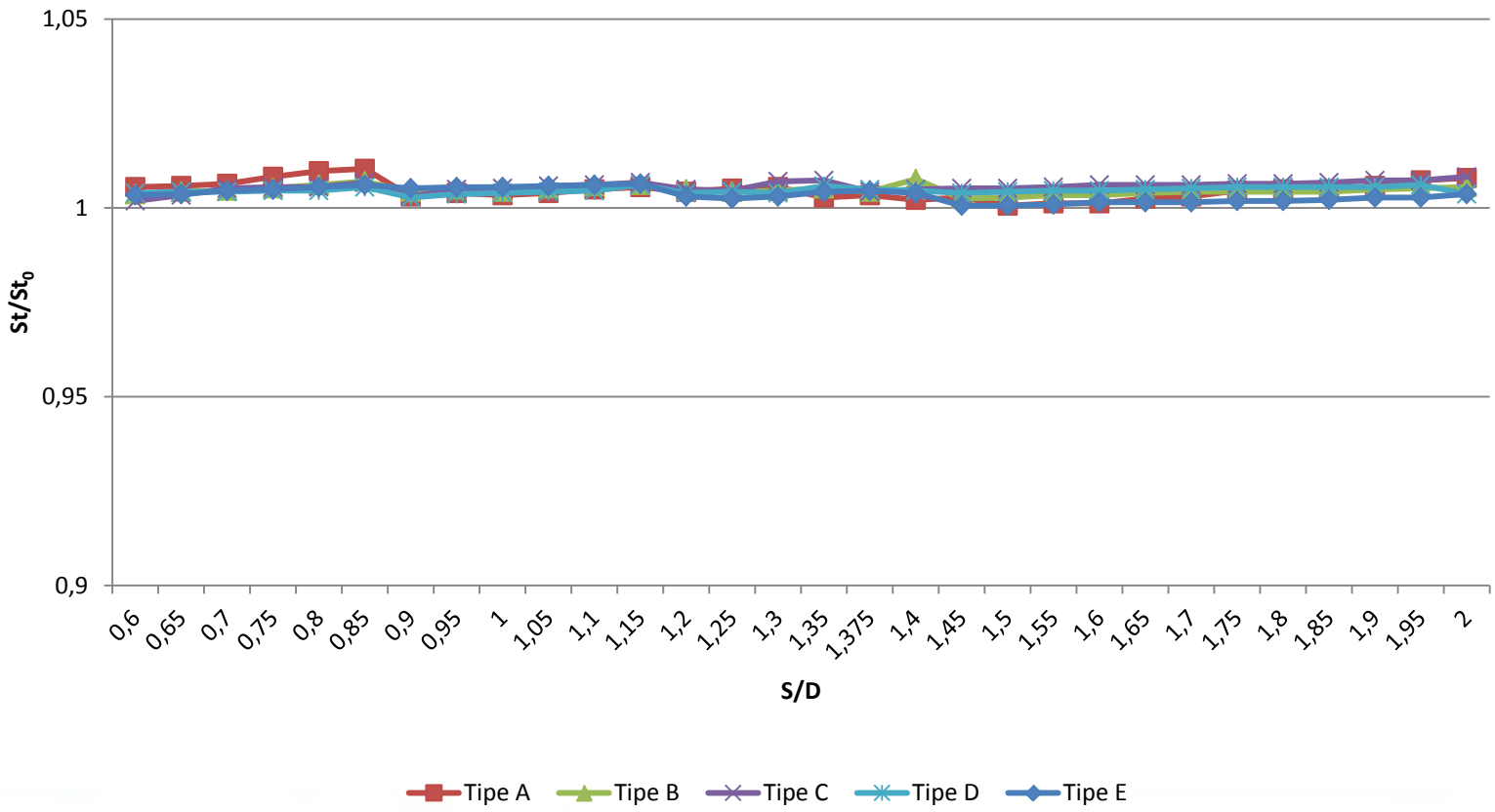
HASIL PENELITIAN

❖ **Grafik CDp/CDp0 pada silinder sirkular dengan 5 tipe pengganggu pada jarak S/D=0,6-2,0**



HASIL PENELITIAN

❖ **Grafik St/St0 di belakang silinder sirkular dengan 5 tipe pengganggu pada jarak S/D=0,6-2,0**



KESIMPULAN

1. Adanya pengganggu mampu menurunkan nilai CDp pada silinder utama
2. Adanya pengganggu mampu menaikkan Frekuensi vortex shadding di belakang silinder utama
3. Pengganggu tipe A pada jarak S/D 0,85 paling efektif menurunkan nilai CDp pada silinder utama pada rentang jarak S/D 0,6-0,85
4. Pengganggu tipe A pada jarak S/D 0,85 paling efektif menaikkan frekuensi vortex shadding di belakang silinder utama pada rentang jarak S/D 0,6-0,85 dengan nilai bilangan Strouhal (St) = 0,2201