

第 4 章 付図・表

Table 2-1 Resultant Characteristics of Rotating Stall in A Rotor Blade Row with Guide Vanes

No.	β_1	N	Guide Vane		Initial disturbance		RESULT				amplitude of $\Delta\phi_s$	
			L/c	α_1	cells	amplitude	number of cells	T	V_p/V_1	V_p/U_1	max	min
J1	52.0	5	1.0	0.0	1	-20 %	1	6.2	0.20	0.26	+20 %	-25 %
J2	60.0	5	1.0	0.0	1	-30 %	1	6.4	0.18	0.31	+50 %	-40 %
J3	65.0	5	1.0	0.0	1	-100 %	1	6.0	0.18	0.39	+70 %	-50 %
J4	52.0	5	2.0	0.0	1	-20 %	1	6.2	0.20	0.26	+25 %	-25 %
J5	60.0	5	2.0	0.0	1	-40 %	1	6.0	0.19	0.33	+60 %	-45 %
J6	70.0	5	2.0	0.0	1	-100 %	1	4.6	0.23	0.64	+90 %	-60 %
J7	60.0	5	5.0	0.0	1	-100 %	1	4.0	0.29	0.50	+55 %	-70 %
A1	60.0	5	---	---	1	-100 %	1	4.0	0.29	0.50	+55 %	-70 %
B2	52.0	5	---	---	1	-5 %	1	6.0	0.21	0.27	+22 %	-35 %
K1	52.0	5	1.0	30.0	1	-20 %	1	5.6	0.16	0.29	+35 %	-35 %
K2	60.0	5	1.0	30.0	1	-40 %	1	6.2	0.14	0.32	+70 %	-55 %
K3	52.0	5	1.0	-45.0	1	-20 %	1	6.5	0.89	0.25	+22 %	-22 %
L1	52.0	10	1.0	0.0	1	-1 %	2	5.0	0.25	0.32	+15 %	-40 %
L2	53.0	10	1.0	0.0	1	-1 %	2	5.0	0.25	0.33	+20 %	-45 %
L3	55.0	10	1.0	0.0	2	-40 %	2	5.2	0.23	0.34	+40 %	-57 %
M1	53.0	10	1.0	30.0	1	-1 %	3 → 2	5.0	0.17	0.33	+25 %	-50 %
M2	55.0	10	1.0	30.0	2	-30 %	2	5.2	0.17	0.34	+45 %	-66 %
M3	60.0	10	1.0	30.0	2	-80 %	2	4.8	0.18	0.42	+75 %	-70 %
N1	53.0	10	1.0	-45.0	1	-1 %	3	5.0	1.02	0.33	+18 %	-36 %
N2	55.0	10	1.0	-45.0	3	-40 %	3	5.1	0.80	0.34	+27 %	-40 %
N3	60.0	10	1.0	-45.0	3	-80 %	3	5.1	0.54	0.39	+50 %	-50 %
N4	53.0	10	1.0	-45.0	1	-10 %	3 → 2	4.8	1.06	0.35	+18 %	-42 %
N5	53.0	10	2.0	-45.0	1	-1 %	2 → 1	4.6	1.10	0.36	+17 %	-55 %

V_1 : Rotor Speed, $V_s = W_1(\sin\beta_1 + \cos\beta_1 \tan\alpha_1)$

α_1 : Outlet Angle of Guide Vane, L : Distance Between Guide Vane and rotor

$\Delta\phi_s$: Mass Flow Rate through a Rotor Passage

$\Delta\phi_s$: Mass Flow Rate through a Rotor Passage

Table 2-2 Results of Nonlinear Analysis of Rotating Stall (G-R Cascade Combinations, by Kagano [18])

NO.	β_i	U/V _i	Guide Vane				initial disturbance		Results number of cells	Results		
			α_i	L/S	c/S	τ U/S	cells	amplitude		V _p /V _i	amplitude of u_s/U	
											max	min
a1	58.0	0.63	0.0	0.02	0.0	0.0	1	0.01	1	0.88	0.49	-0.59
a2	58.0	0.63	0.0	0.10	0.0	0.0	1	0.01	1	0.85	0.47	-0.57
a3	58.0	0.63	0.0	0.20	0.0	0.0	1	0.01	1	0.83	0.58	-0.56
b1	56.3	1.08	-30.0	0.10	0.0	0.0	1	0.01	2	1.22	0.42	-0.55
b2	58.0	0.98	-30.0	0.10	0.0	0.0	1	0.01	3	1.07	0.45	-0.54
b3	60.0	0.87	-30.0	0.10	0.0	0.0	1	0.01	4	0.98	0.54	-0.50
b4	55.3	1.15	-30.0	0.10	0.02	0.01	1	0.01	1	0.95	0.23	-0.57
b5	58.0	0.98	-30.0	0.10	0.02	0.01	1	0.01	1	0.88	0.43	-0.59
c1	56.3	0.48	+30.0	0.10	0.02	0.01	1	0.01	3 → 2	0.35	0.32	-0.54
c2	56.3	0.48	+30.0	0.10	0.02	0.01	3	0.01	3	0.27	0.34	-0.53
d1	56.3	2.00	-45.0	0.10	0.02	0.01	1	0.01	3 → 2	1.40	0.35	-0.58
d2	58.0	1.67	-45.0	0.10	0.02	0.01	1	0.01	2	1.30	0.48	-0.60
d3	60.0	1.37	-45.0	0.10	0.02	0.01	1	0.01	2	1.11	0.62	-0.62
d4	56.3	2.00	-45.0	0.10	0.02	0.01	1	0.10	1	1.64	0.35	-0.55
d5	58.0	1.67	-45.0	0.05	0.02	0.01	1	0.01	3	1.13	0.44	-0.54
d6	58.0	1.67	-45.0	0.20	0.02	0.01	1	0.01	1	1.55	0.63	-0.65

V_i : Rotor Speed, $V_i = W_i(\sin\beta_i + \cos\beta_i \cdot \tan\alpha_i)$

U : Mean Axial Flow Velocity, u_s : Variation of Axial Flow Velocity

α_i : Outlet Angle of Guide Vane, L : Distance Between Guide Vane and rotor S : Circumferential Length

c : Chord Length, τ : Time Delay of Boundary Layer Response

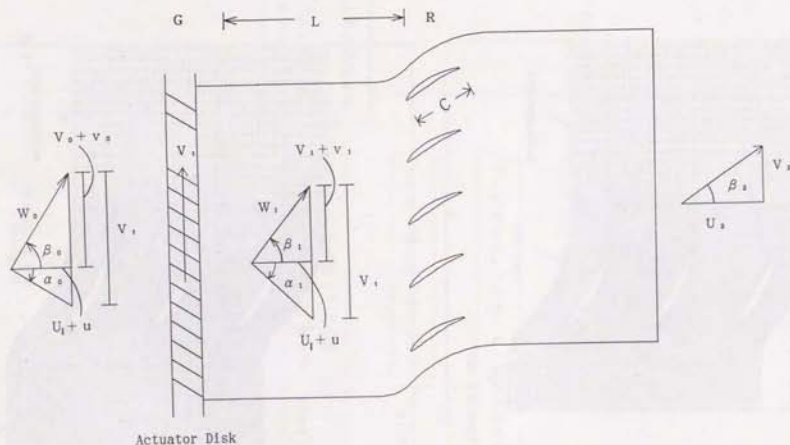
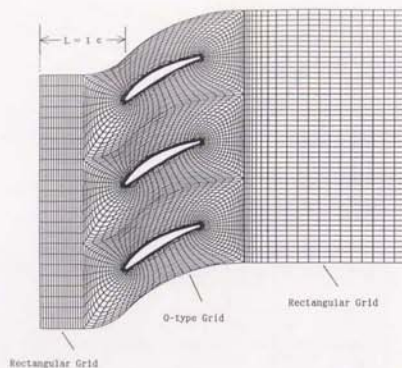


図 4-1-1 G-R 翼列のモデル

GRID PROFILE
65*29



GRID PROFILE
65*29

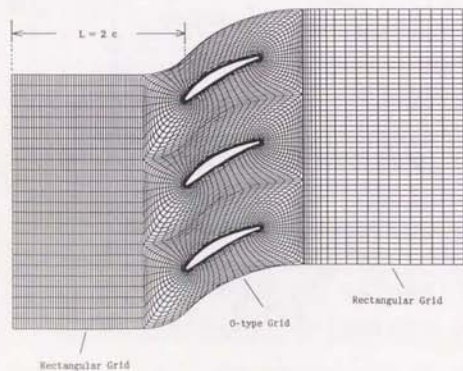


図4-1-2 計算格子 ($L/c = 1.0, 2.0$)
Gは上流境界の位置にある。

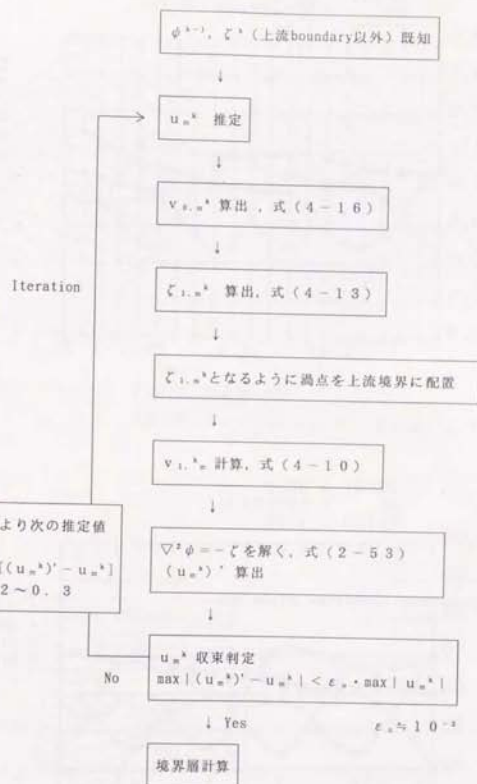


図4-1-3 G-R算列の計算アルゴリズム。

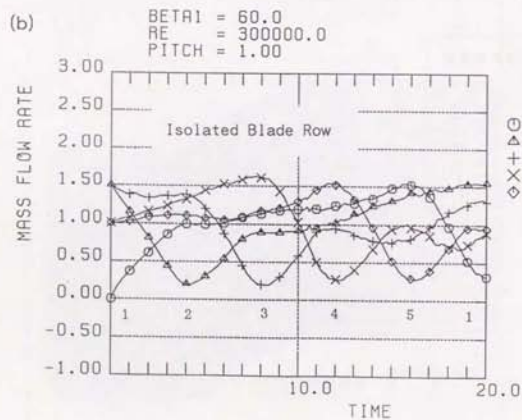
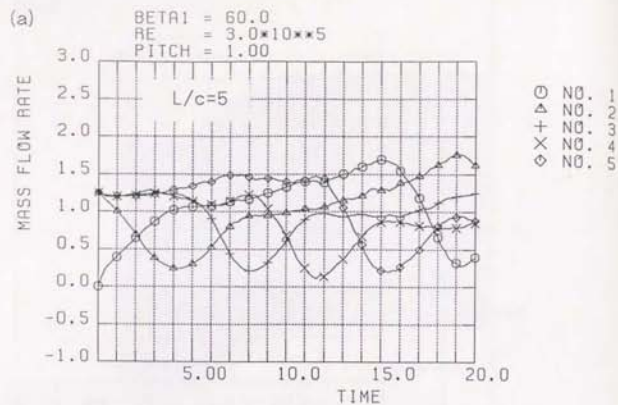


図4-2-1 GとRが十分に離れている場合の旋回失速：流量変動

(a) G-R翼列 ($L/c=5$, $\alpha_1=0^\circ$, $\beta_1=60^\circ$, 17)

(b) 単独翼列 ($\beta_1=60^\circ$, A1)

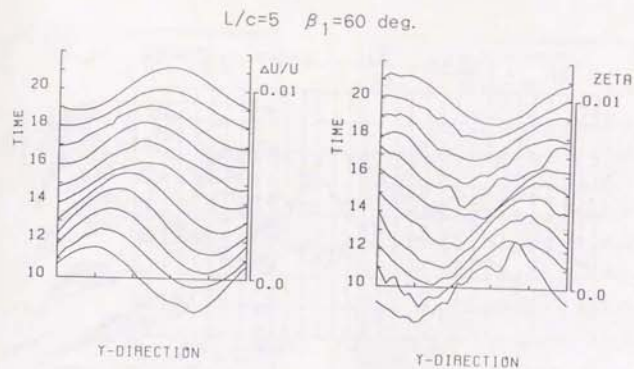


図4-2-2 (a) G出口の速度変動と渦度

(翼5枚, $L/c=5$, $\alpha_1=0^\circ$, $\beta_1=60^\circ$, 17)

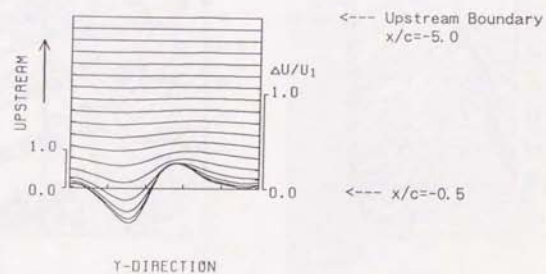


図4-2-2 (b) 翼列上流の軸流速度変動

(翼5枚, $\beta_1=60^\circ$)

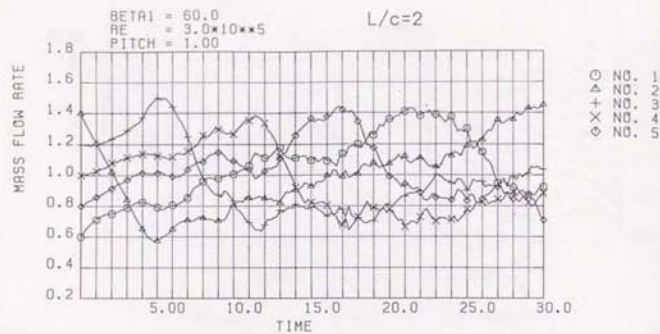


図4-2-3 (a) 翼列間隔の影響：流量変動
(翼5枚, $L/c=2$, $\alpha_1=0^\circ$, $\beta_1=60^\circ$, JS)

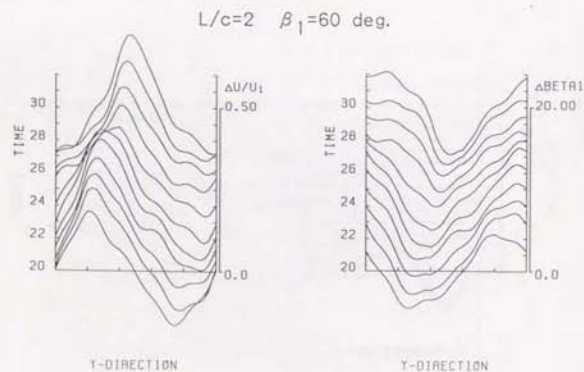


図4-2-3 (b) 翼列間隔の影響 (JS)
Rより0.53-1'上流の軸流速度と流れ角

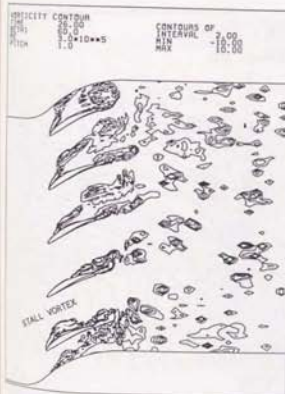
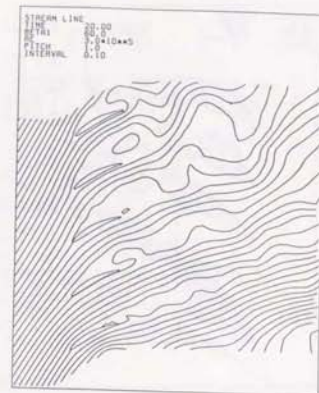
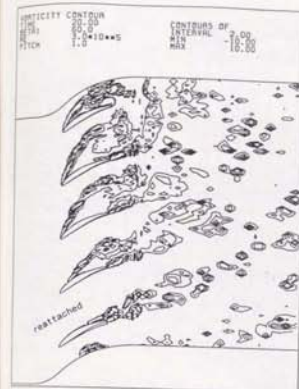


図4-2-4 (a) 翼列間隔の影響：渦度分布と流線
(翼5枚, $L/c=2$, $\alpha_1=0^\circ$, $\beta_1=60^\circ$, JS)

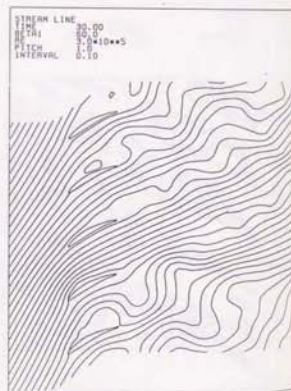
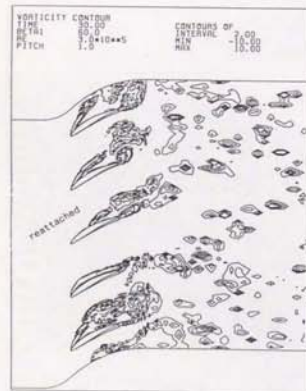
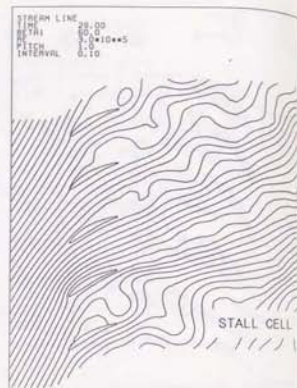
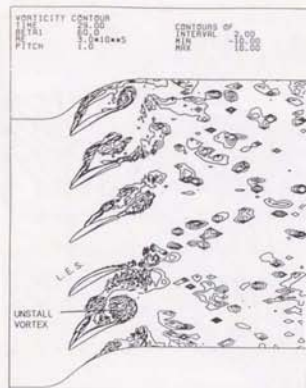


図4-2-4 (b) 翼列間隔の影響: 高度分布と流線 (J5)

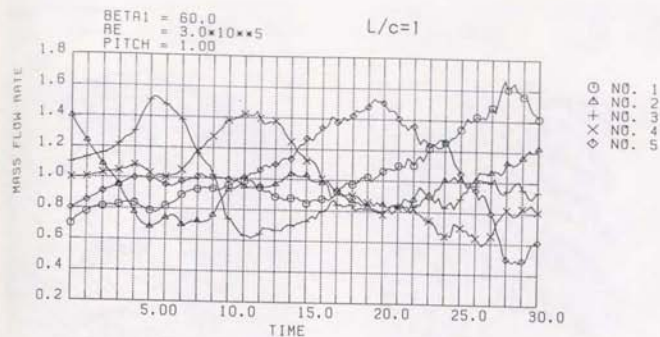


図4-2-5 (a) 翼列間隔の影響: 流量変動

(翼5枚, $L/c=1$, $\alpha_1=0^\circ$, $\beta_1=60^\circ$, J2)

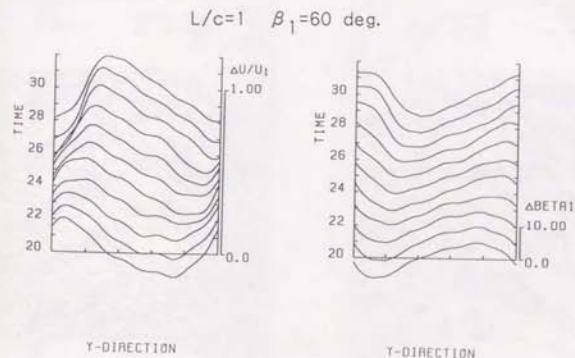


図4-2-5 (b) 翼列間隔の影響 (J2)

Rより0.53-1'上流の軸流速度と流れ角変動

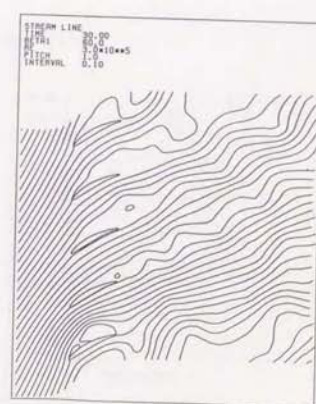
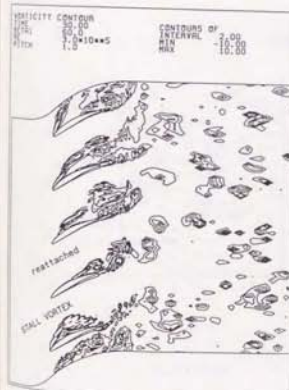
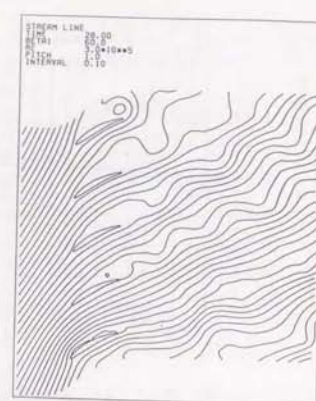
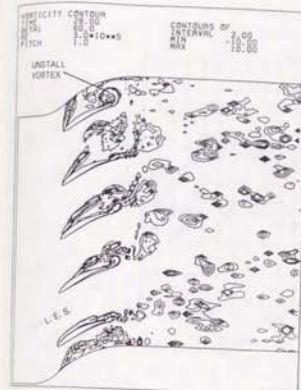
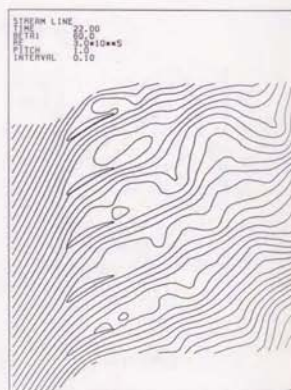
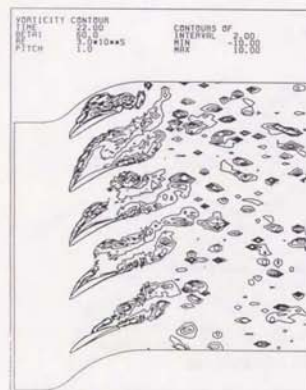
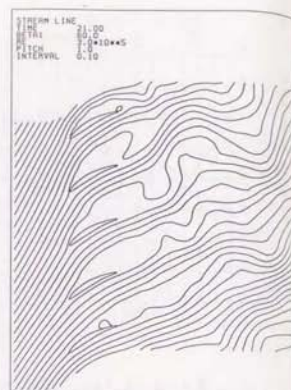
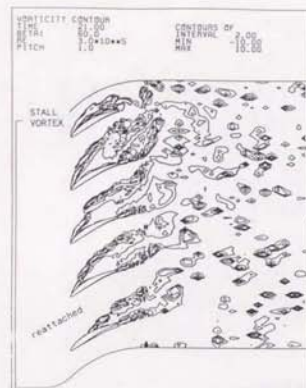


図4-2-6 (a) 翼列間隔の影響：渦度分布と流線
(翼5枚, $L/c=1$, $\alpha_1=0^\circ$, $\beta_1=60^\circ$, J2)

図4-2-6 (b) 翼列間隔の影響：渦度分布と流線 (J2)

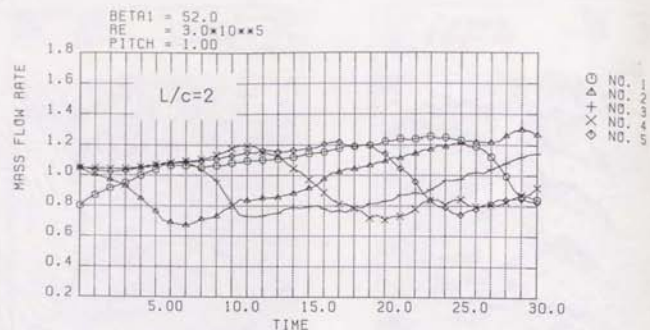


図4-2-7 (a) 翼列間隔の影響：流量変動

(翼5枚, $L/c=2$, $\alpha_i=0^\circ$, $\beta_1=52^\circ$, 14)

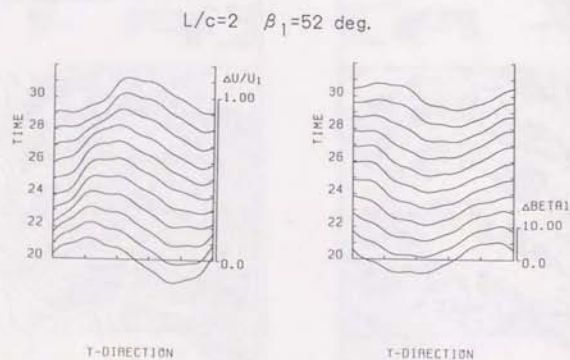


図4-2-7 (b) 翼列間隔の影響 (14)

Rより0.52-1'上流の軸流速と流れ角変動



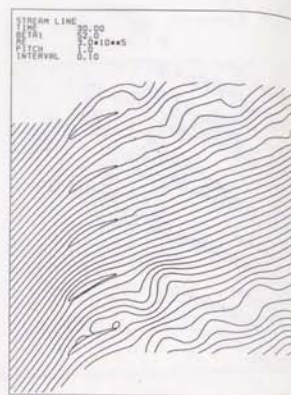
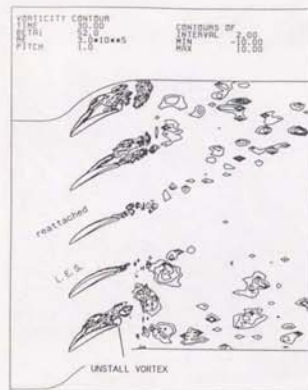


図4-2-8 (b) 翼列間隔の影響：渦度分布と流線 (J4)

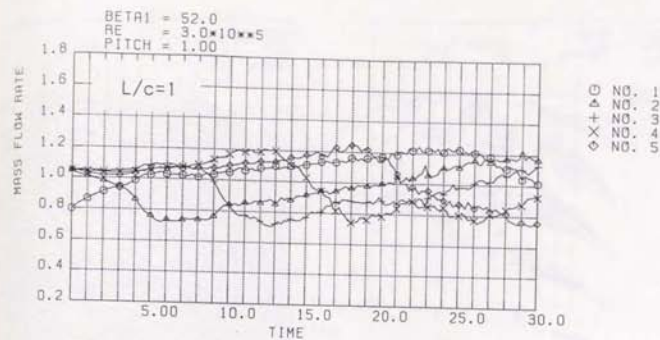


図4-2-9 (a) 翼列間隔の影響：流量変動
(翼5枚, $L/c=1$, $\alpha_1=0^\circ$, $\beta_1=52^\circ$, J1)

$L/c=1$ $\beta_1=52 \text{ deg.}$

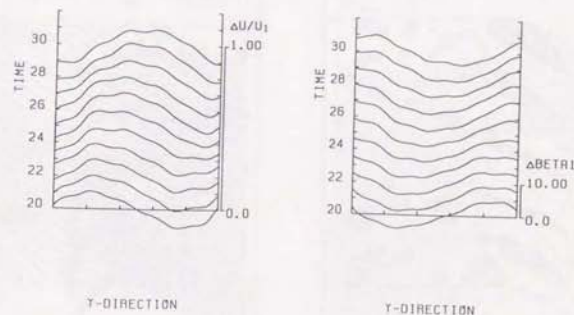


図4-2-9 (b) 翼列間隔の影響 (J1)
Rより0.51-上流の軸流速度と流れ角変動

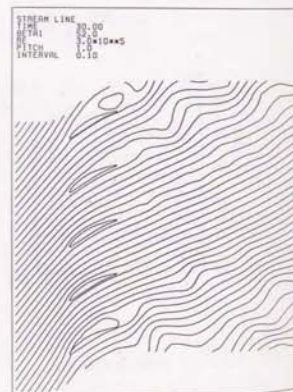
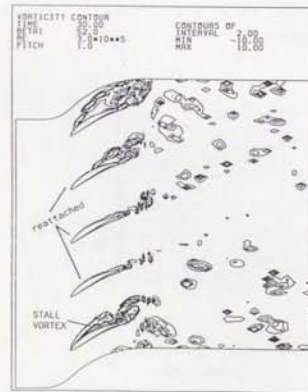
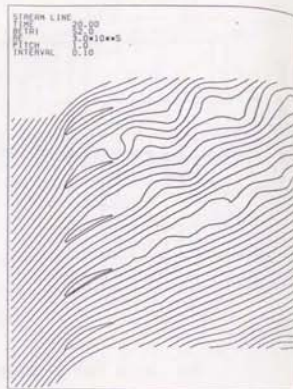
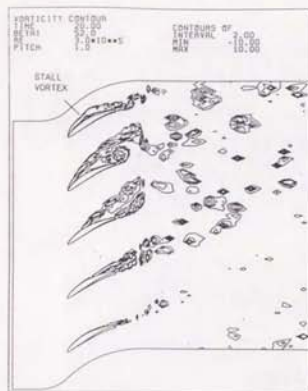


図4-2-10 翼列間隔の影響：渦度分布と流線
(翼5枚, $L/c=1$, $\alpha_1=0^\circ$, $\beta_1=52^\circ$, J1)

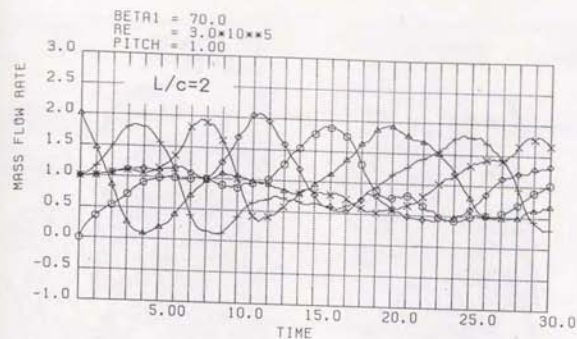


図4-2-11 翼列間隔の影響：流量変動
(翼5枚, $L/c=2$, $\alpha_1=0^\circ$, $\beta_1=70^\circ$, J6)

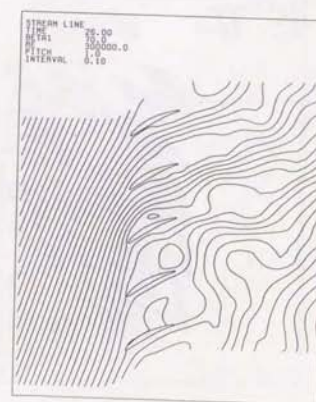
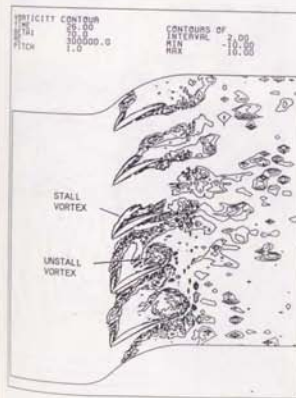


図4-2-12 (a) 翼列間隔の影響：渦度分布と流線
(翼5枚, $L/c=2$, $\alpha_1=0^\circ$, $\beta_1=70^\circ$, J6)

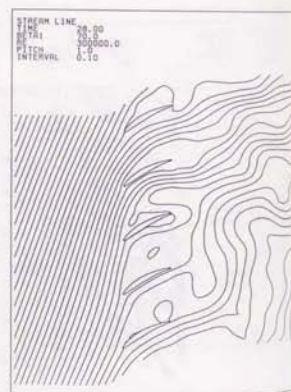
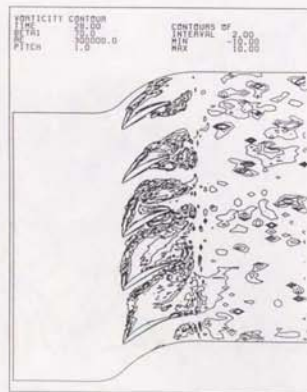
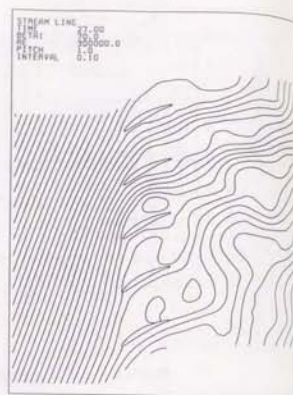
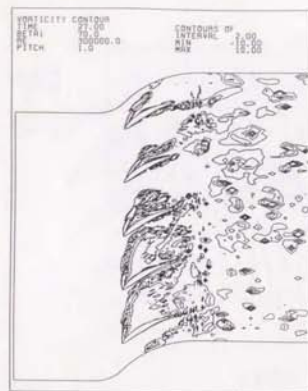


図4-2-12 (b) 翼列間隔の影響：渦度分布と流線 (18)

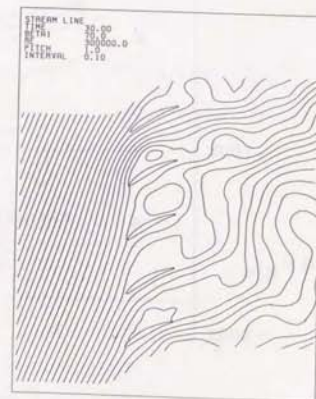
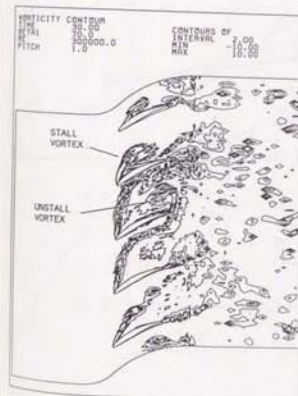
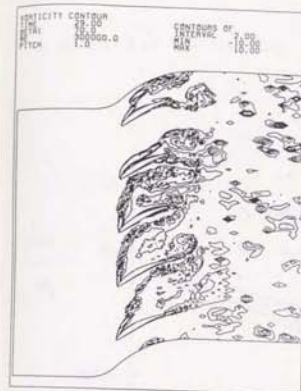


図4-2-12 (c) 翼列間隔の影響：渦度分布と流線 (16)

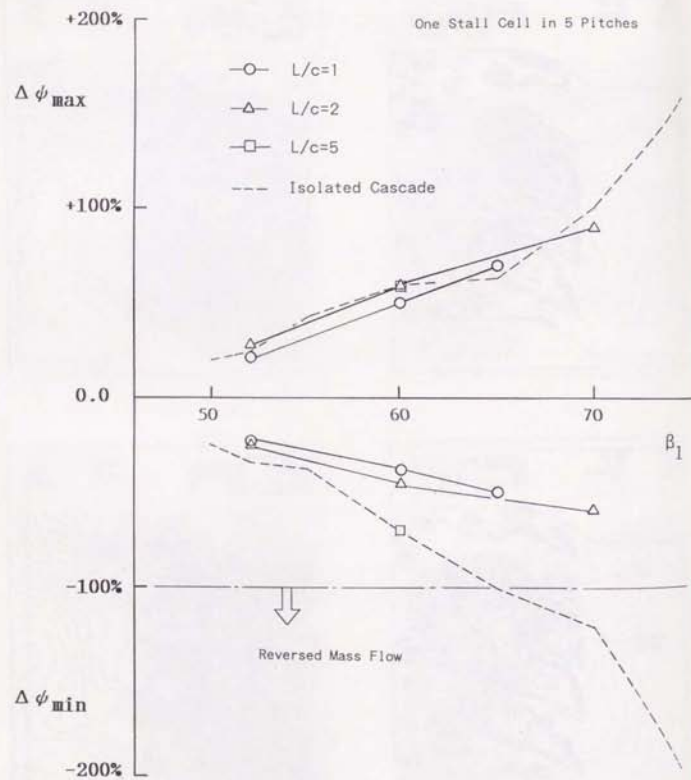


図4-2-13 流量変動振幅の流れ角による変化
($\alpha_1=0^\circ$, 5ピッチ周期条件)

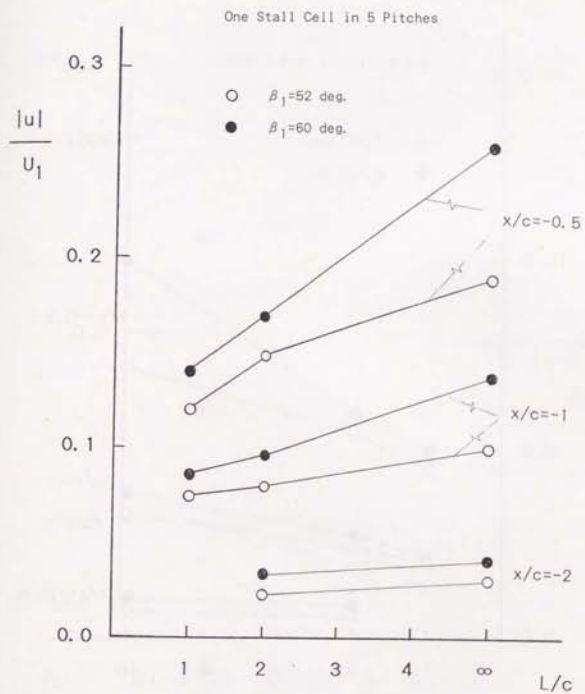


図4-2-14(a) 翼列間隔による軸流速度の振幅の変化
($\alpha_1=0^\circ$, 5ピッチ周期条件)

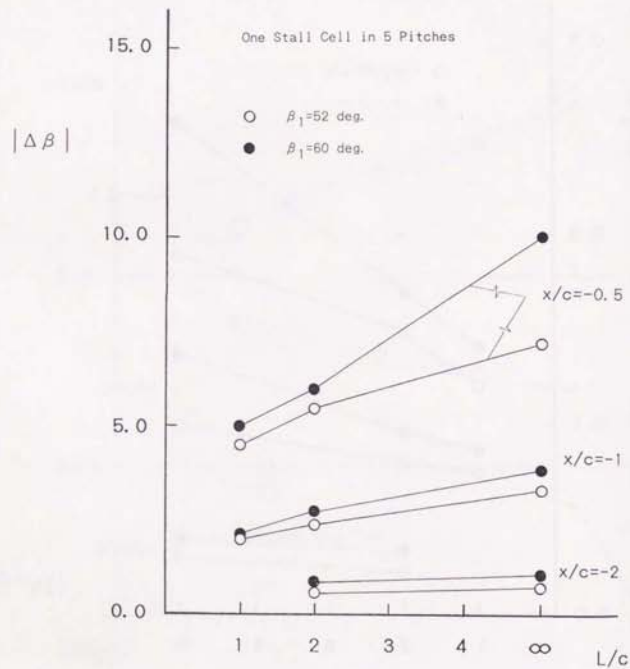


図4-2-14 (b) 翼列間隔による流れ角の振幅の変化
($\alpha_1=0^\circ$, 5ピッチ周期条件)

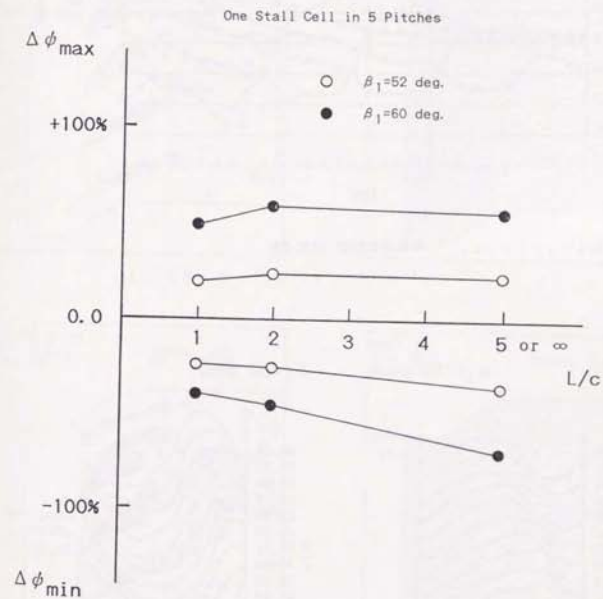


図4-2-15 翼列間隔による流量変動振幅の変化
($\alpha_1=0^\circ$, 5ピッチ周期条件)

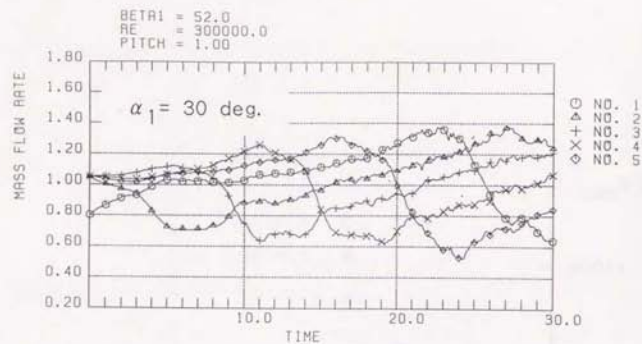


図4-2-16 (a) 予旋回の影響：流量変動
 $(L/c=1, \alpha_1=30^\circ, \beta_1=52^\circ, \kappa_1)$

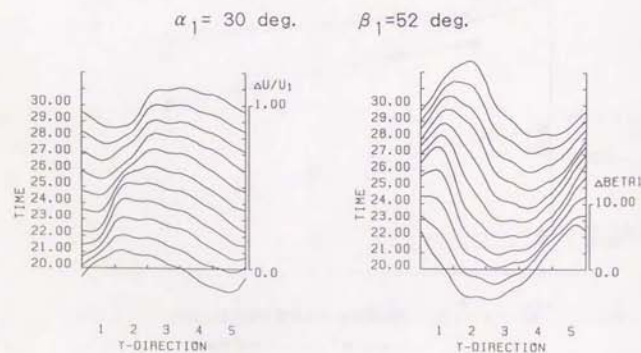


図4-2-16 (b) 予旋回の影響 (κ_1)
 R より0.53- Γ 上流の軸流速度と流れ角変動

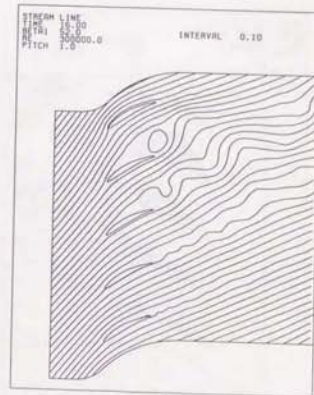
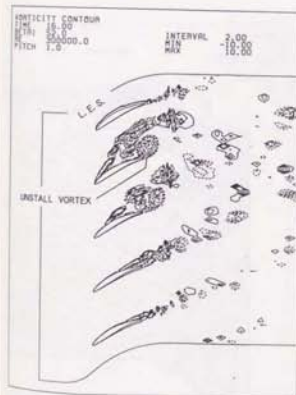
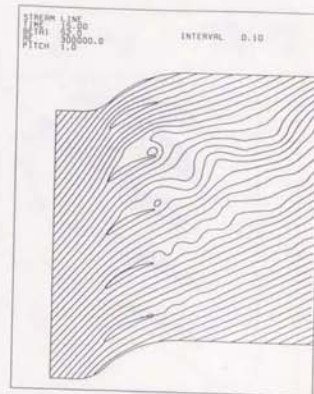
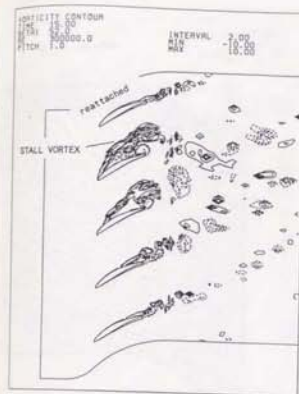


図4-2-17 (a) 予旋回の影響：渦度分布と流線
 $(L/c=1, \alpha_1=30^\circ, \beta_1=52^\circ, \kappa_1)$

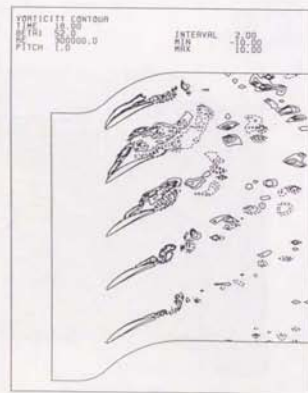
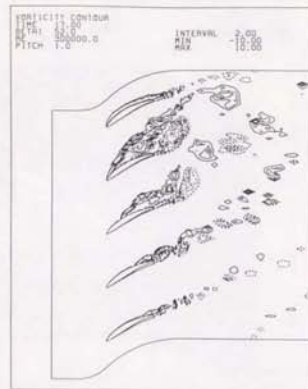


図4-2-17 (b) 予旋回の影響：渦度分布と流線 (K1)

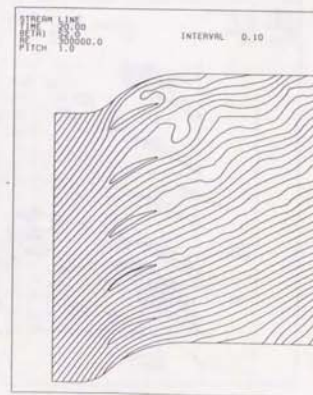
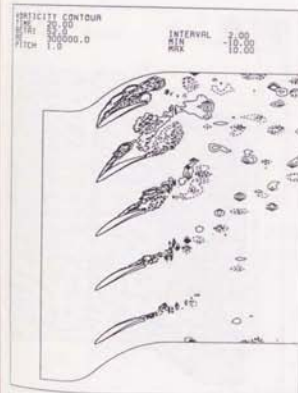
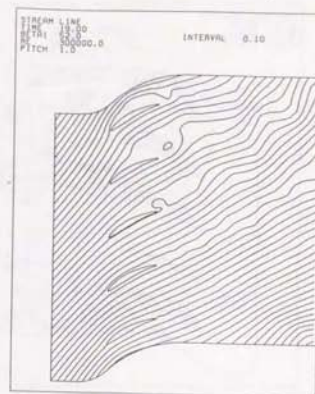
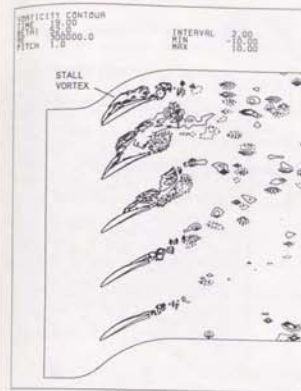


図4-2-17 (c) 予旋回の影響：渦度分布と流線 (K1)

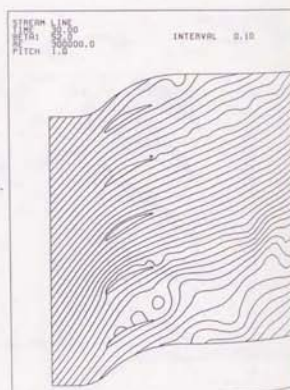
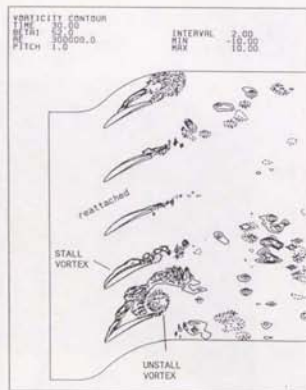
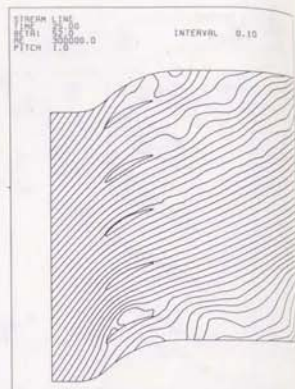
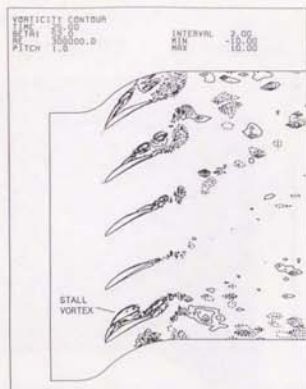


図4-2-17 (d) 予旋回の影響: 渦度分布と流線 (K1)

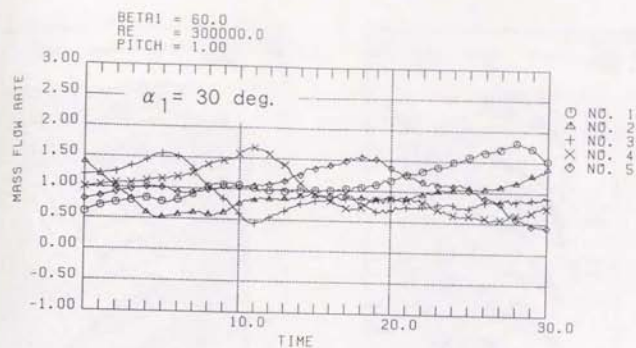


図4-2-18 (a) 予旋回の影響: 流量変動
($L/c = 1$, $\alpha_1 = 30^\circ$, $\beta_1 = 60^\circ$, K2)

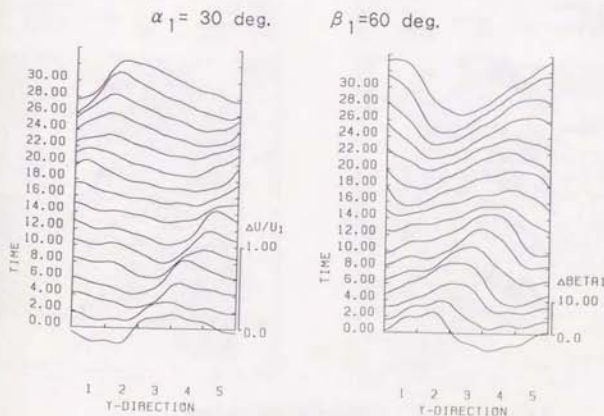


図4-2-18 (b) 予旋回の影響 (K2)
Rより0.57-D'上流の軸流速度と流れ角変動

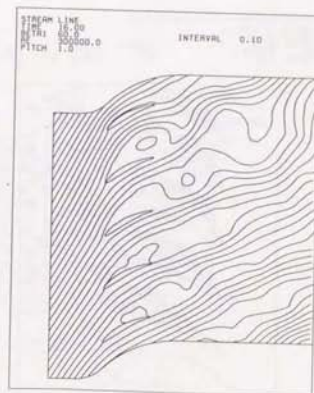
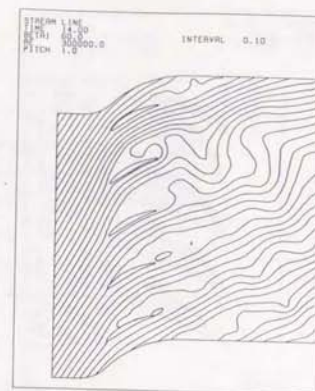
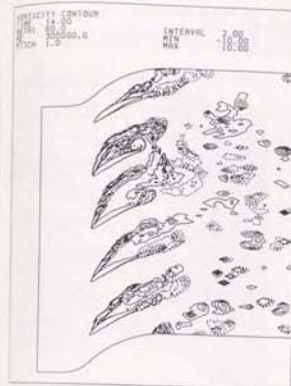
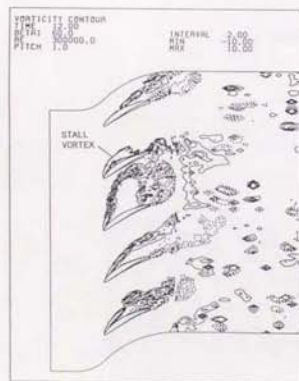
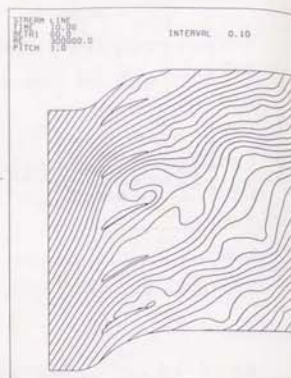
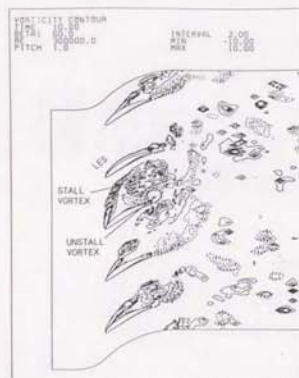


図4-2-19 (a) 予旋回の影響：渦度分布と流線
($L/c=1$, $\alpha_1=30^\circ$, $\beta_1=60^\circ$, K2)

図4-2-19 (b) 予旋回の影響：渦度分布と流線 (K2)

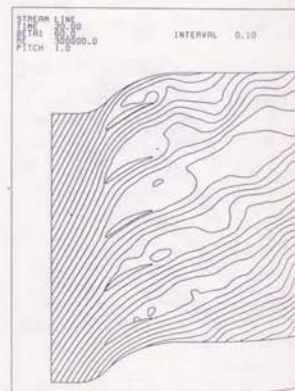
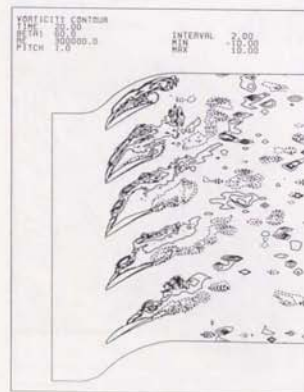
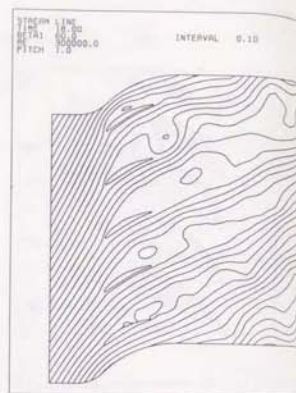
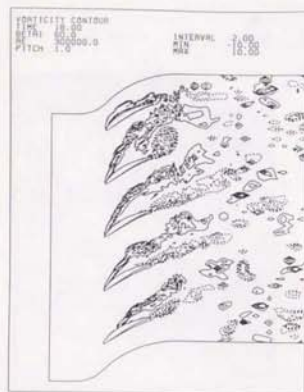


図4-2-19 (c) 予旋回の影響: 渦度分布と流線 (K2)

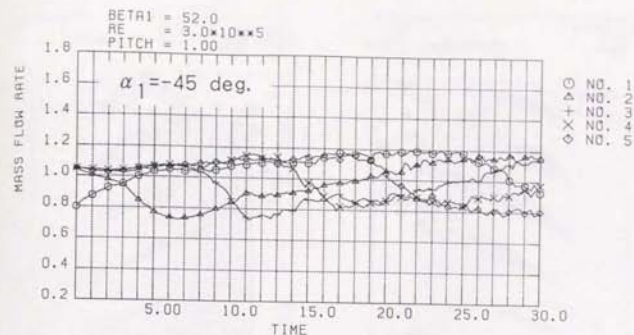


図4-2-20 (a) 予旋回の影響: 流量変動

($L/c=1$, $\alpha_1=-45^\circ$, $\beta_1=52^\circ$, K3)

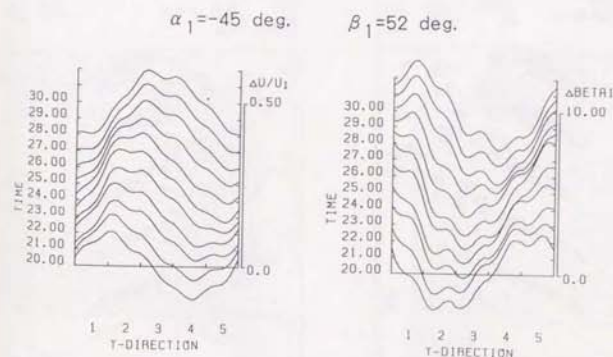


図4-2-20 (b) 予旋回の影響 (K3)

Rより0.52- β 上流の軸流速度と流れ角変動

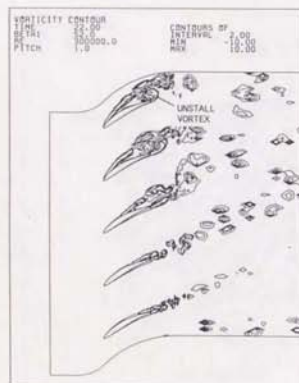
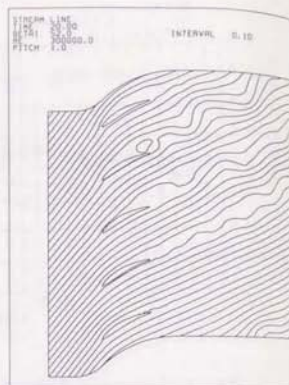
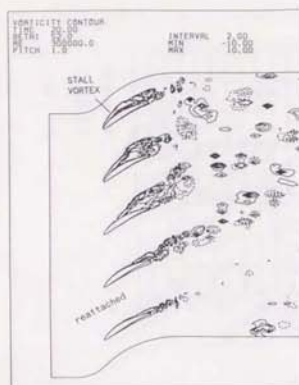


図4-2-21 (a) 予旋回の影響：渦度分布と流線
($l/c=1$, $\alpha_1=-45^\circ$, $\beta_1=52^\circ$, $K3$)

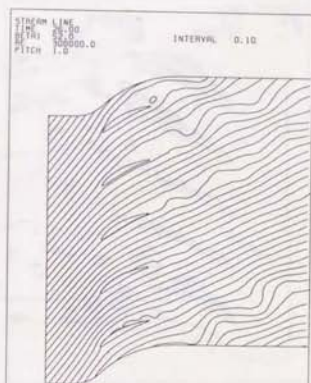
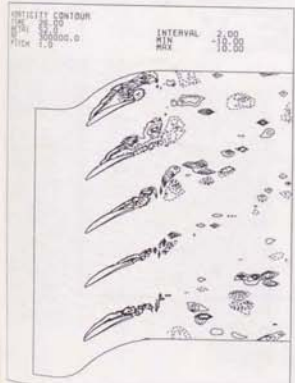
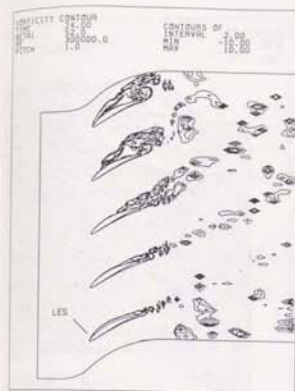


図4-2-21 (b) 予旋回の影響：渦度分布と流線 ($K3$)

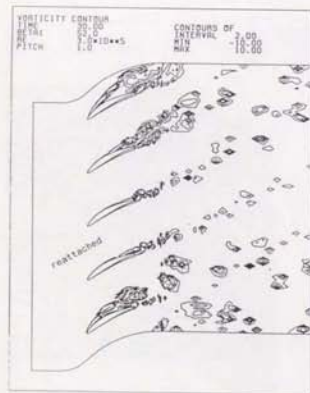
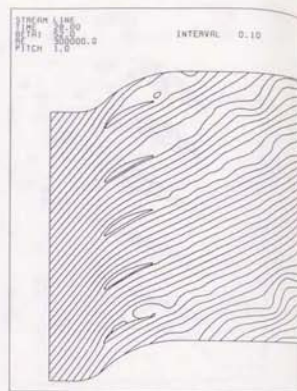
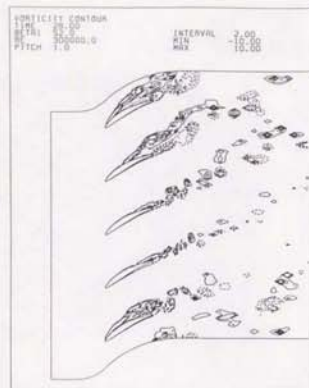


図4-2-21 (c) 予旋回の影響：渦度分布と流線 (E3)

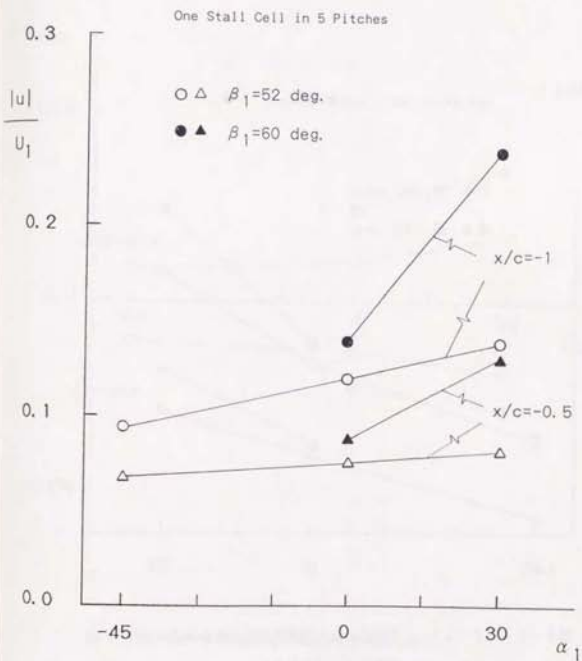


図4-2-22 (a) 予旋回による翼列間隔内の変動振幅の変化
軸流速度 ($L/c = 1$)

$|\Delta\beta|$ deg.

One Stall Cell in 5 Pitches

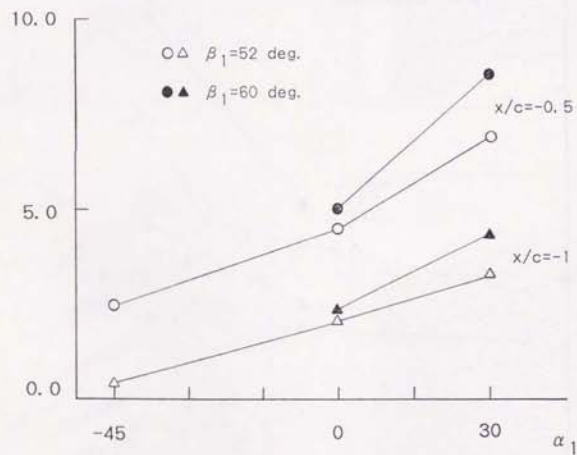


図4-2-22 (b) 予旋回による翼列間隔内の変動振幅の変化
流れ角 ($L/c = 1$)

One Stall Cell in 5 Pitches

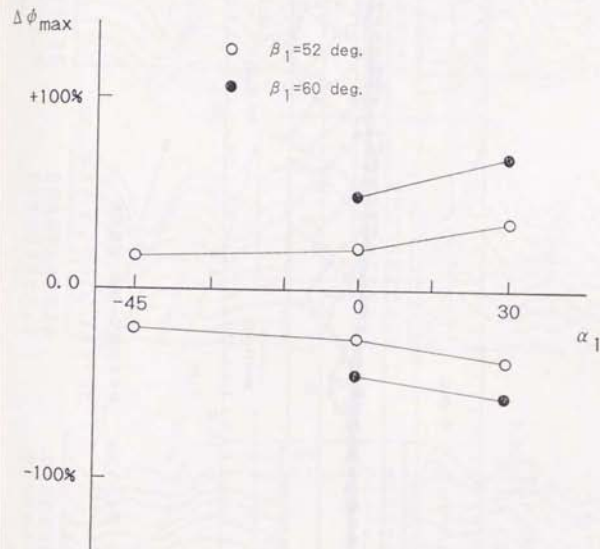


図4-2-23 予旋回による流量変動振幅の変化
($L/c = 1$)

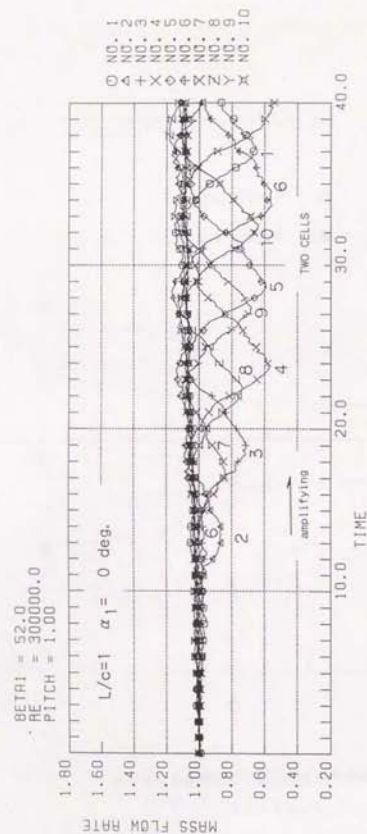


図4-3-1 多セルの発生・成長：流量変動
 ($L/c = 1$, $\alpha_1 = 0^\circ$, $\beta_1 = 52^\circ$, Li)

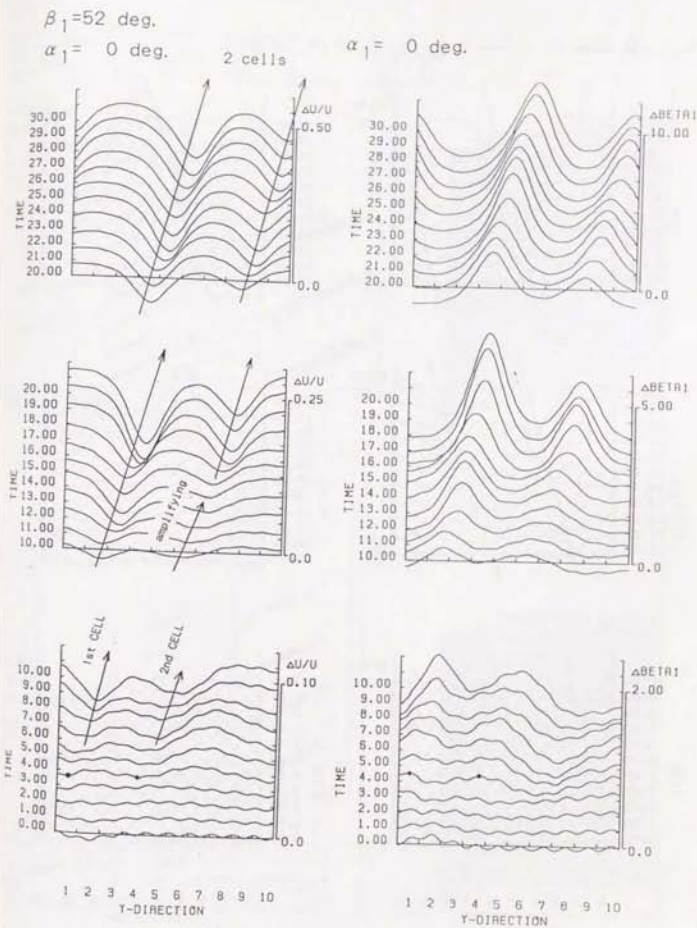


図4-3-2 (a) 多セルの発生・成長：G出口の軸流速度・流れ角変動
 ($L/c = 1$, $\alpha_1 = 0^\circ$, $\beta_1 = 52^\circ$, Li)

$\alpha_1 = 0 \text{ deg.}$

2 CELLS

$\alpha_1 = 0 \text{ deg.}$

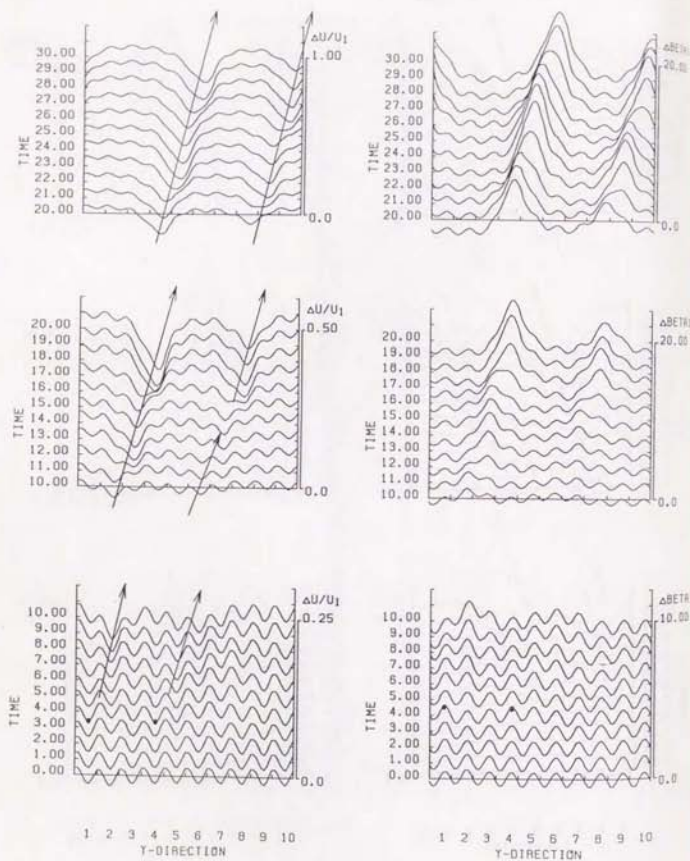


図4-3-2 (b) 多セルの発生・成長: Rより0.53- δ^+ 上流の軸流速度・流れ角変動
($L/c=1$, $\alpha_1=0^\circ$, $\beta_1=5.2^\circ$, $L1$)

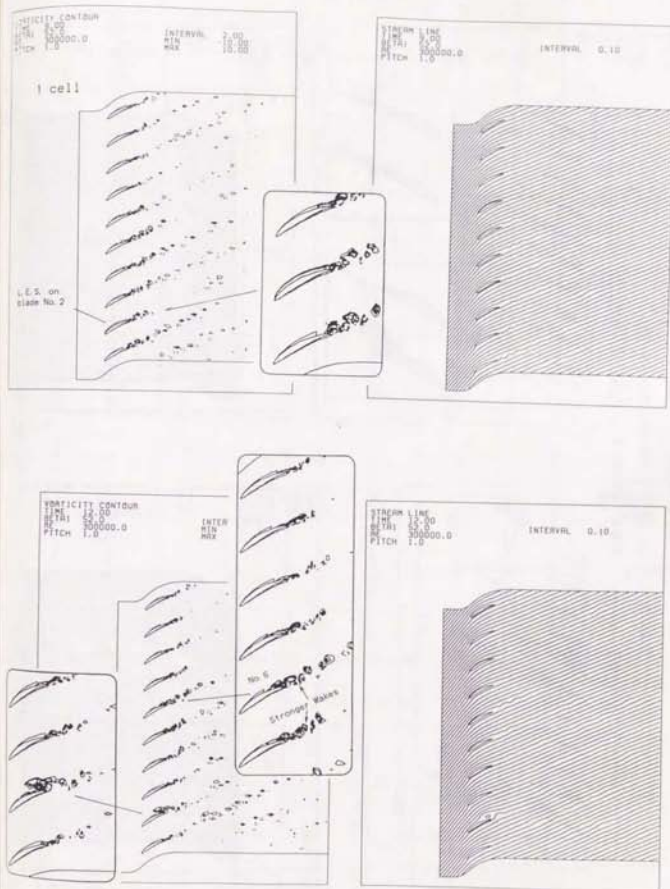


図4-3-3 (a) 多セルの発生・成長: 高度分布と流線
($L/c=1$, $\alpha_1=0^\circ$, $\beta_1=5.2^\circ$, $L1$)

図4-3-3 (b) モデルの発生・成長・減衰・渦度分布と流線 (1)

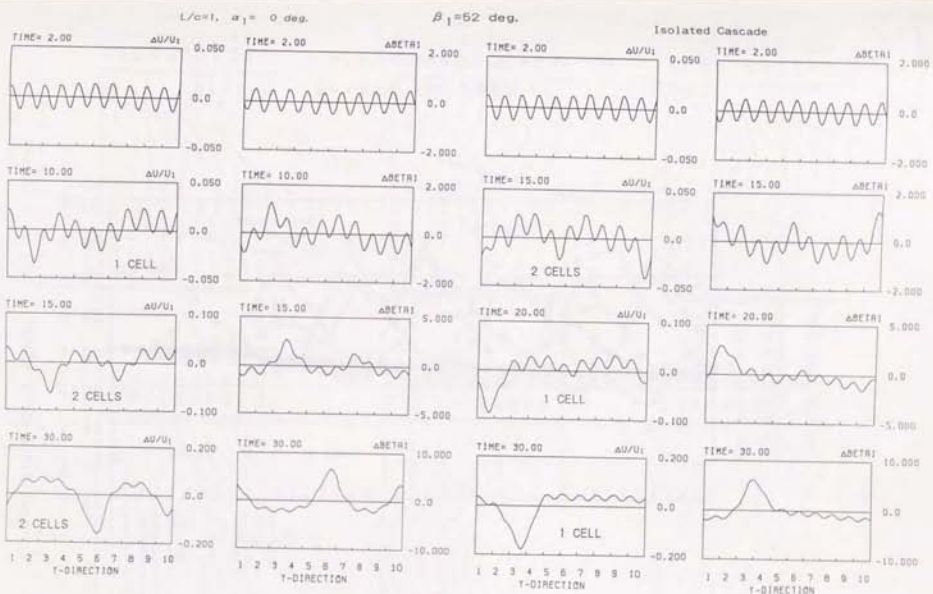
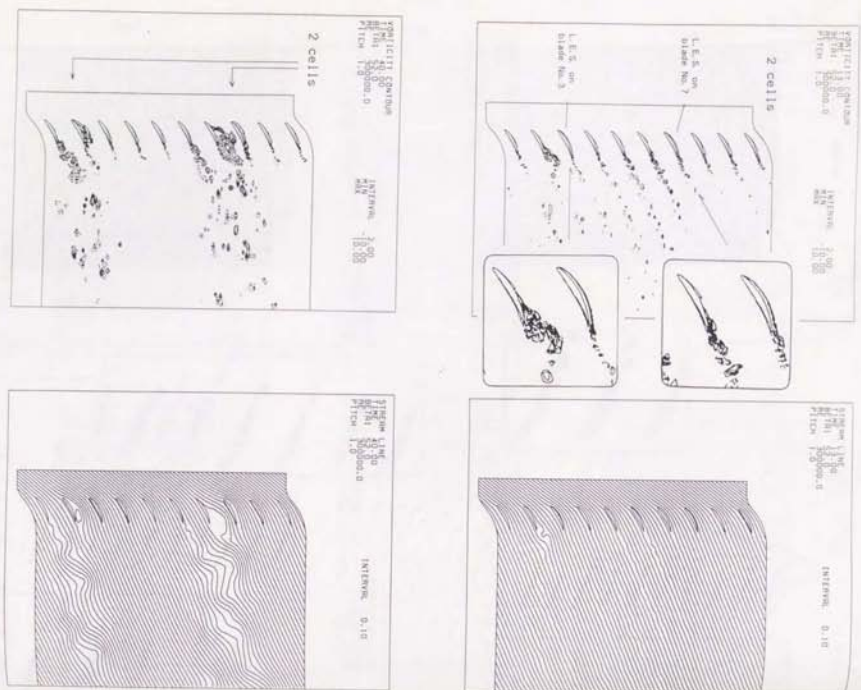


図4-3-4 失速セル数に関するG-R算列と単独算列との比較
Rより0.51°上流の軸流速度・流れ角
(10ピッチ周期, $\beta_1 = 5.2^\circ$)

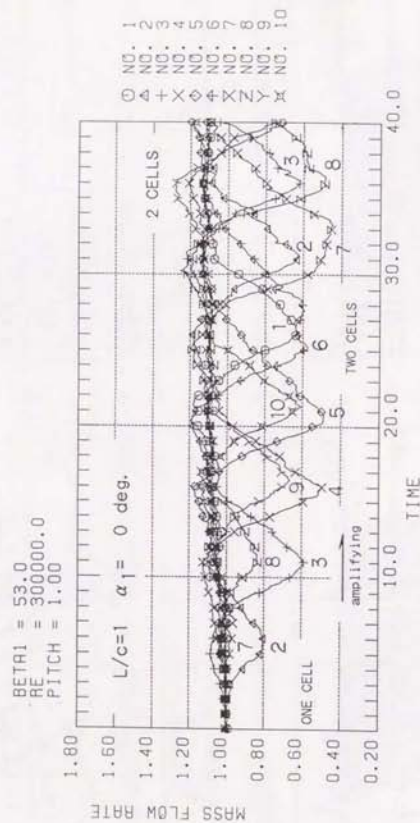


図4-3-5 多セルの発生・成長：流量変動

($L/c=1$, $\alpha_1=0^\circ$, $\beta_1=53^\circ$, 12)

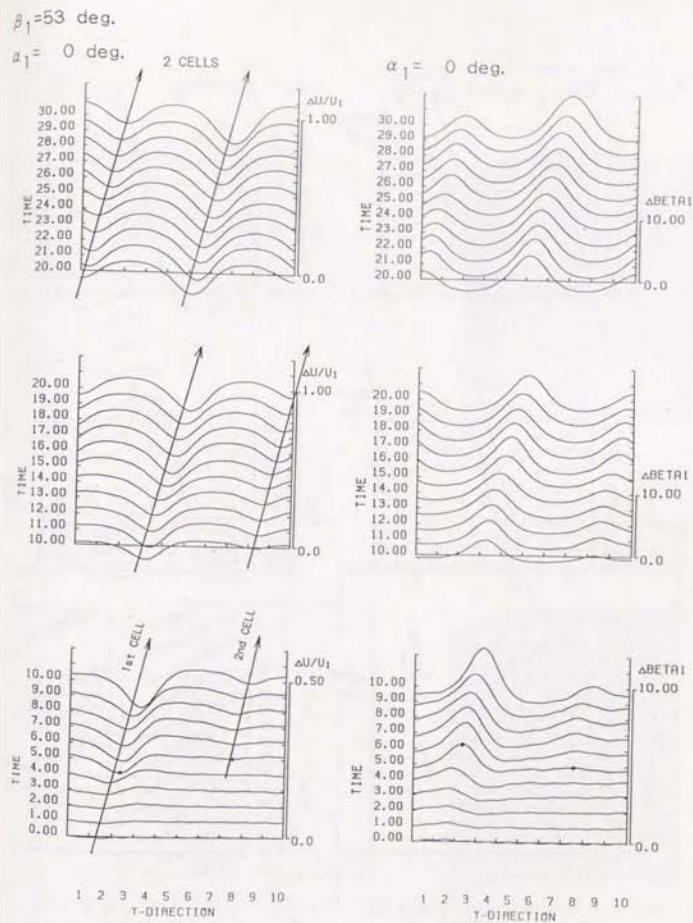


図4-3-6 (a) 多セルの発生・成長：G出口の軸流速・流れ角変動

($L/c=1$, $\alpha_1=0^\circ$, $\beta_1=53^\circ$, 12)

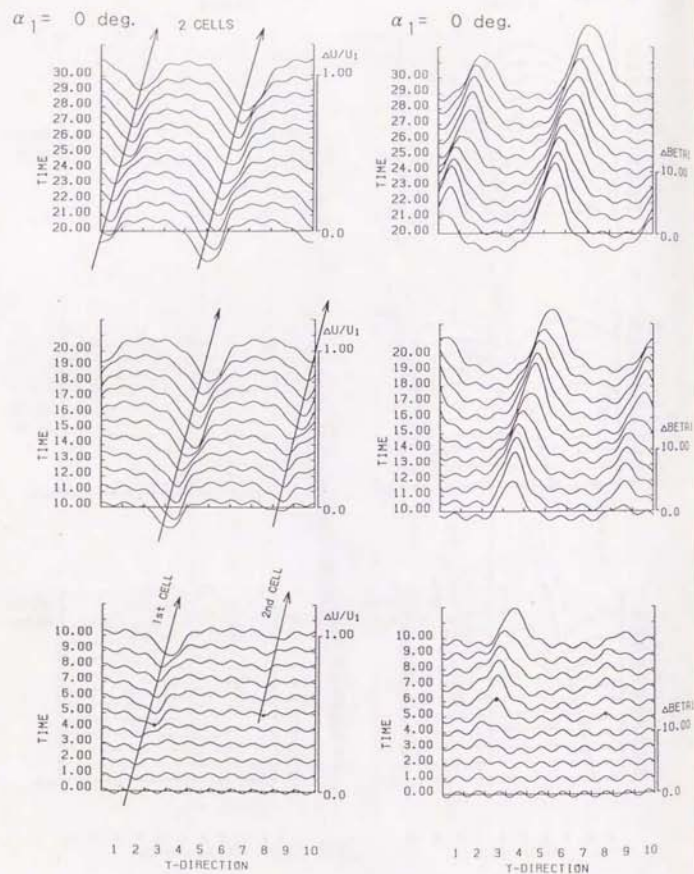


図4-3-6 (b) 多セルの発生・成長: Rより0.53- β 上流の軸流速度・流れ角変動

($L/c=1$, $\alpha_1=0^\circ$, $\beta_1=53^\circ$, L_2)

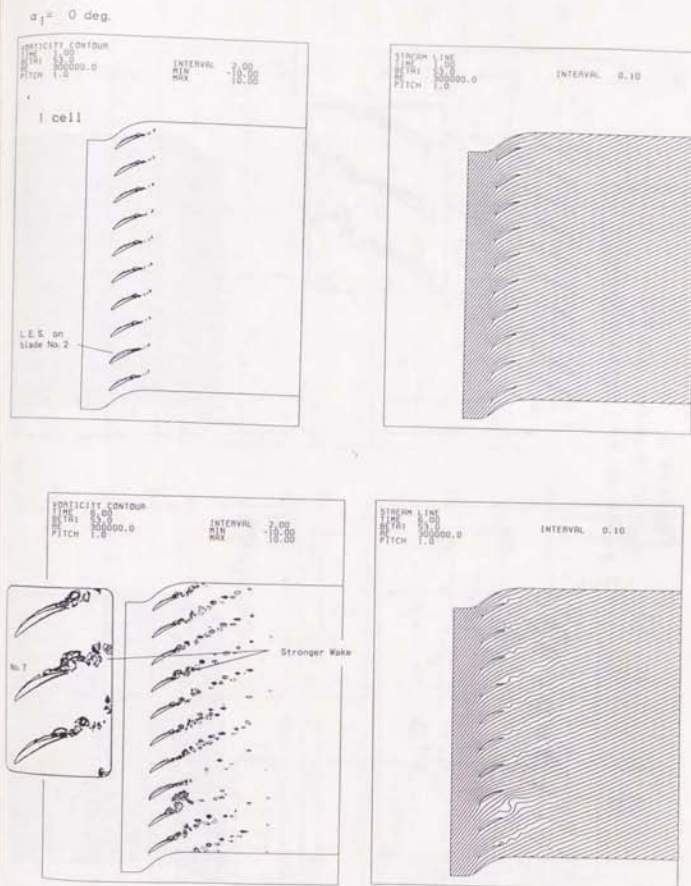
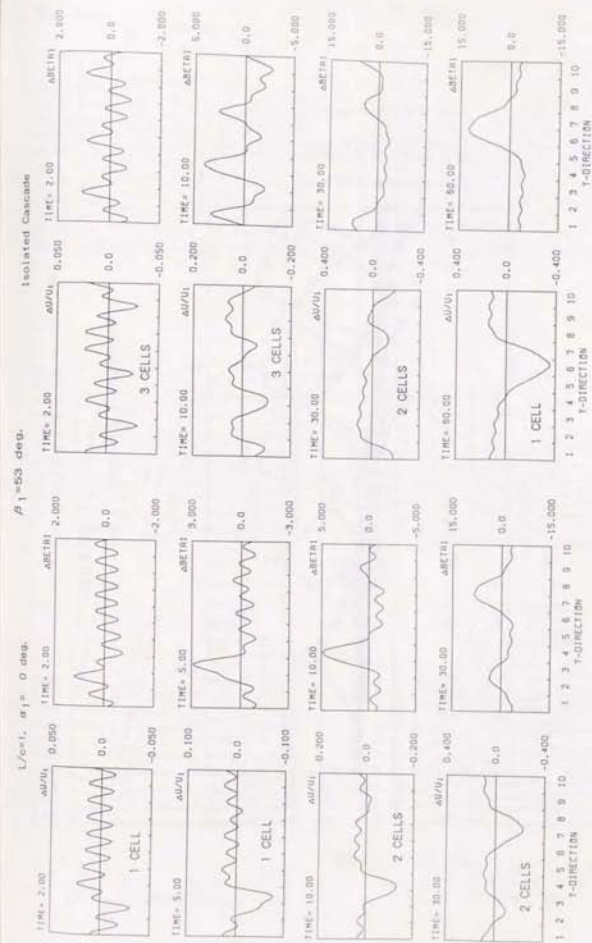
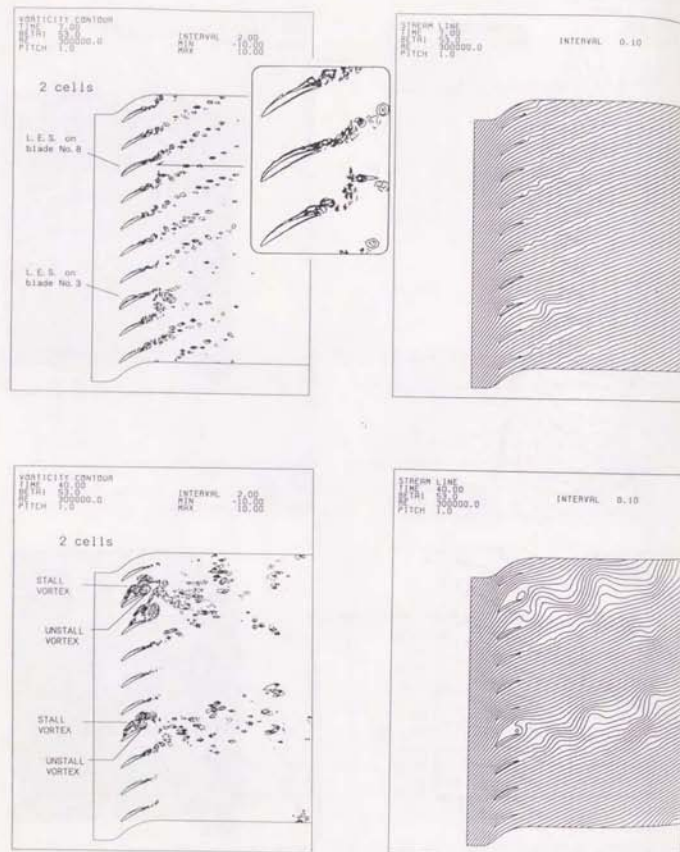


図4-3-7 (a) 多セルの発生・成長: 渦度分布と流線

($L/c=1$, $\alpha_1=0^\circ$, $\beta_1=53^\circ$, L_2)



BETA1 = 53.0
RE = 300000.0
PITCH = 1.00

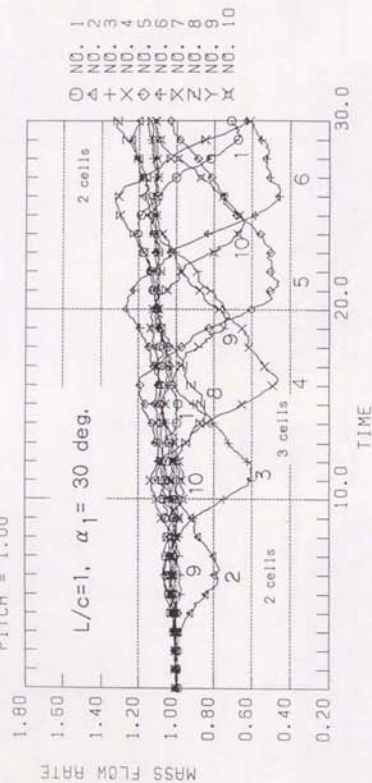


図4-3-9 多セルの発生・成長に対する予旋回の影響
流量変動

($L/c=1$, $\alpha_1=+30^\circ$, $\beta_1=53^\circ$, M_1)

$\beta_1=53 \text{ deg.}$
 $\alpha_1=30 \text{ deg.}$

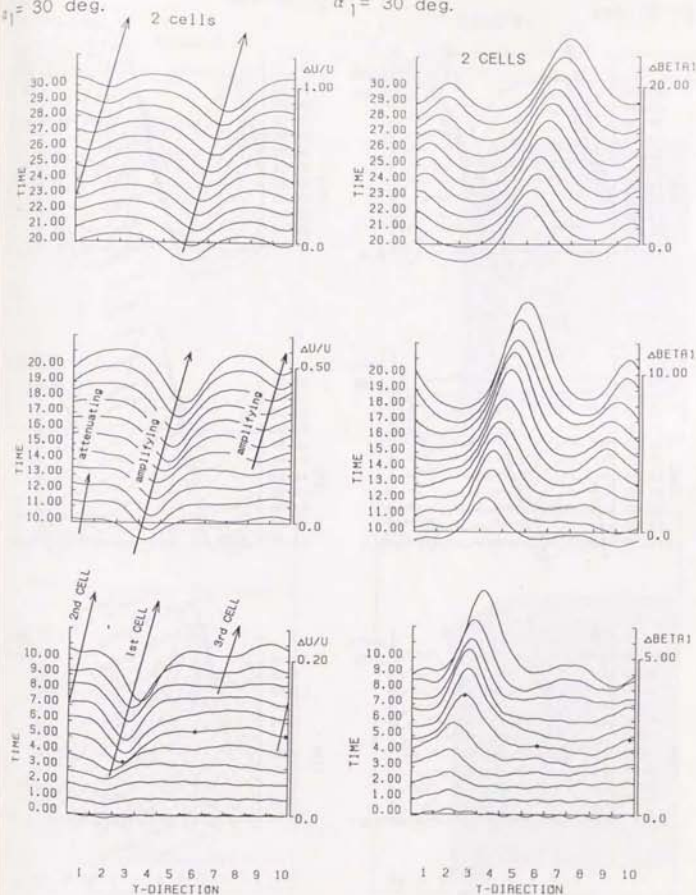


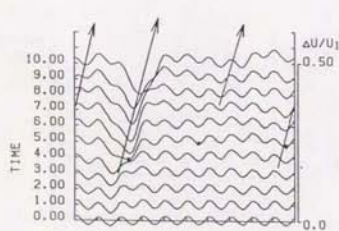
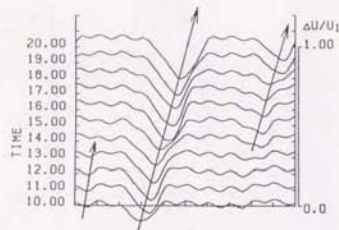
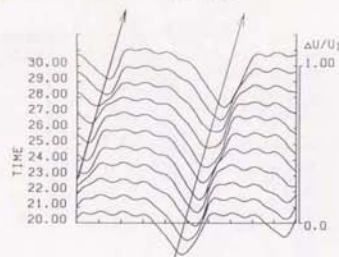
図4-3-10 (a) 多セルの発生・成長に対する予旋回の影響

G 出口の軸流速度・流れ角変動

($L/c=1$, $\alpha_1=+30^\circ$, $\beta_1=53^\circ$, M_1)

$\alpha_1 = 30 \text{ deg.}$

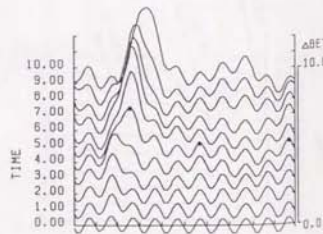
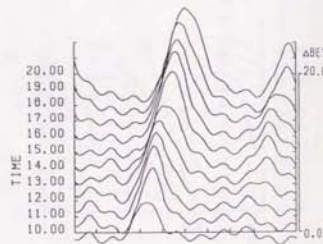
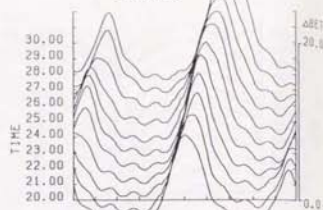
2 CELLS



1 2 3 4 5 6 7 8 9 10
Y-DIRECTION

$\alpha_1 = 30 \text{ deg.}$

2 CELLS



1 2 3 4 5 6 7 8 9 10
Y-DIRECTION

図4-3-10 (b) 多セルの発生・成長に対する予旋回の影響

Rより0.53- β 上流の軸流速度・流れ角変動

($L/c=1$, $\alpha_1=+30^\circ$, $\beta_1=5.3^\circ$, M1)

$\alpha_1 = 30 \text{ deg.}$

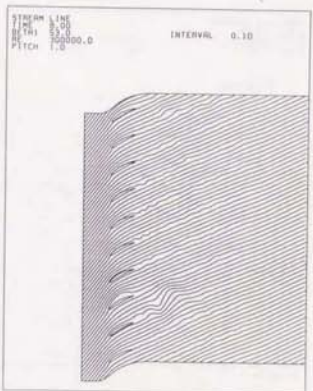
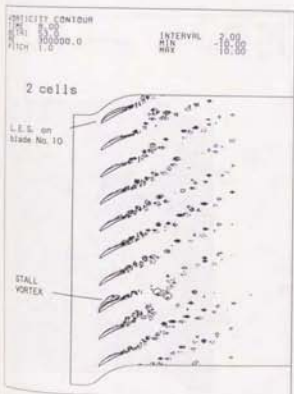
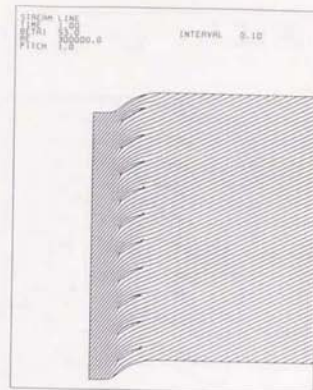
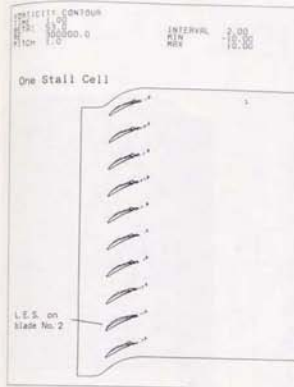


図4-3-11 (a) 多セルの発生・成長に対する予旋回の影響

渦度分布と流線

($L/c=1$, $\alpha_1=+30^\circ$, $\beta_1=5.3^\circ$, M1)

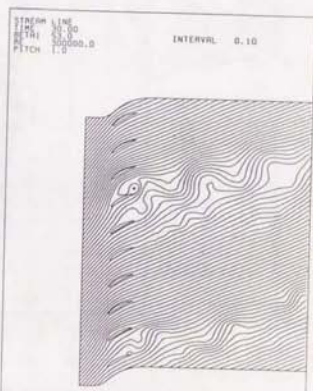
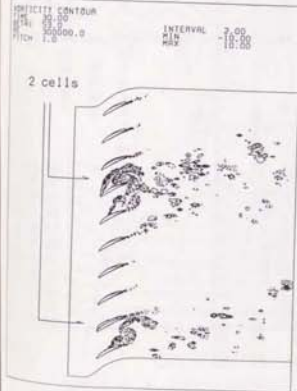
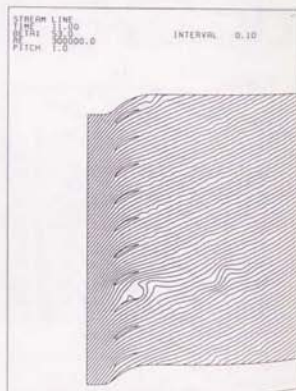
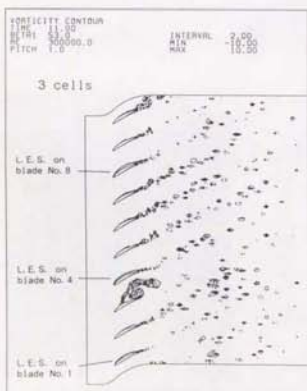
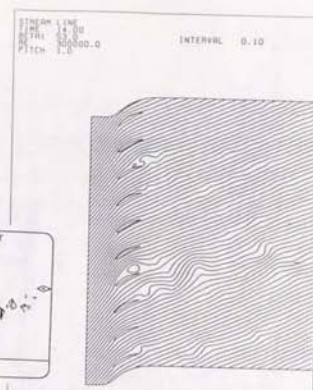
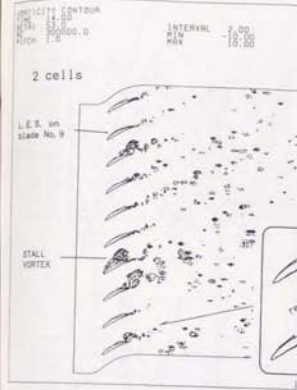
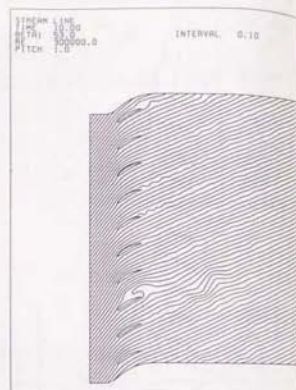
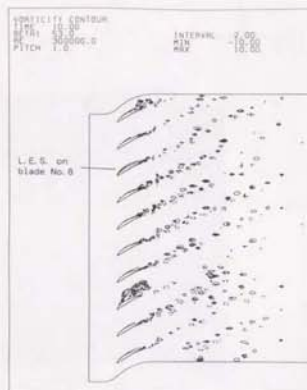


図4-3-11 (b) 多セルの発生・成長に対する予旋回の影響
渦度分布と流線 (M1)

図4-3-11 (c) 多セルの発生・成長に対する予旋回の影響
渦度分布と流線 (M1)

BETA1 = 53.0
RE = 300000.0
PITCH = 1.00

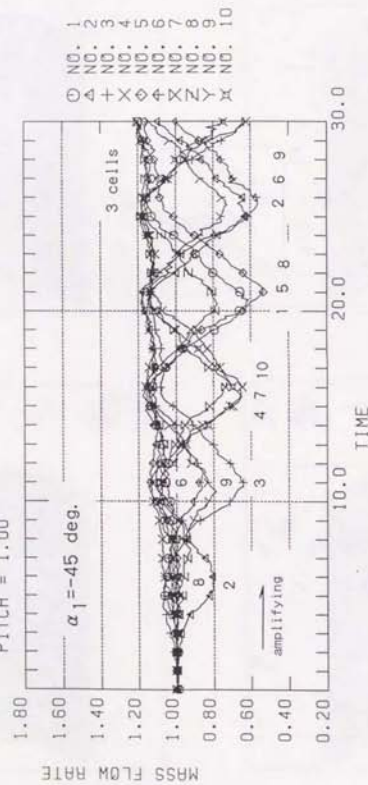


図 4-3-12 多セルの発生・成長に対する予旋回の影響

流量変動 ($L/c=1$, $\alpha_1=-4.5^\circ$, $\beta_1=53^\circ$
1%初期変動, N1)

$\beta_1=53$ deg.
 $\alpha_1=-45$ deg.

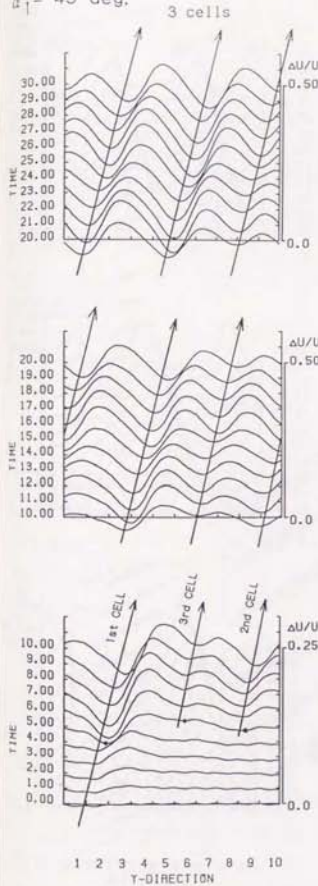
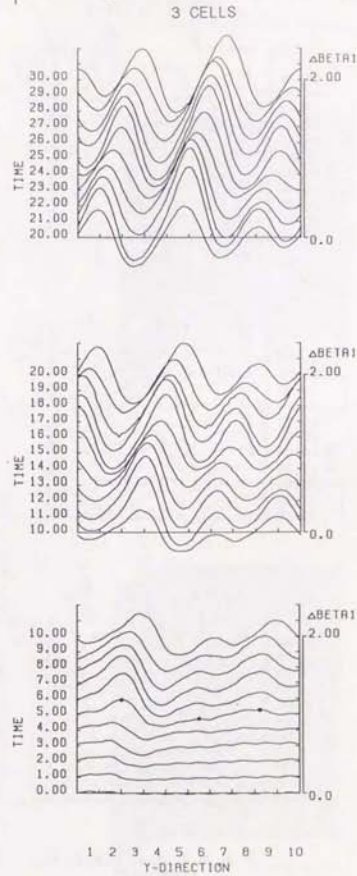


図 4-3-13 (a) 多セルの発生・成長に対する予旋回の影響

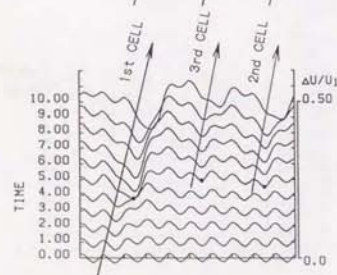
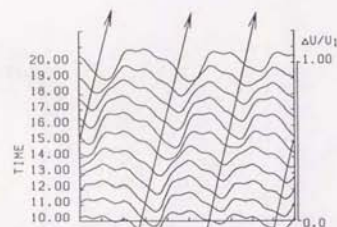
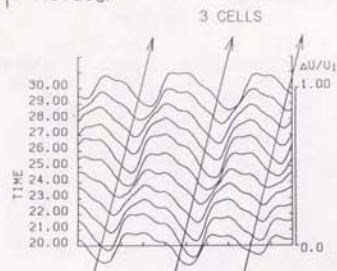
G 出口の軸流速度・流れ角変動

($L/c=1$, $\alpha_1=-4.5^\circ$, $\beta_1=53^\circ$, N1)

$\alpha_1=-45$ deg.

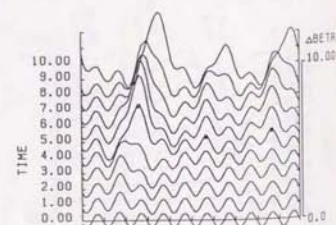
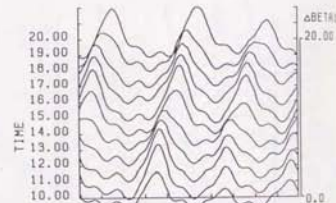
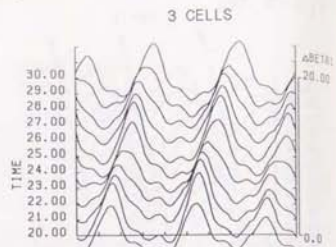


$\alpha_1 = -45 \text{ deg.}$



1 2 3 4 5 6 7 8 9 10
Y-DIRECTION

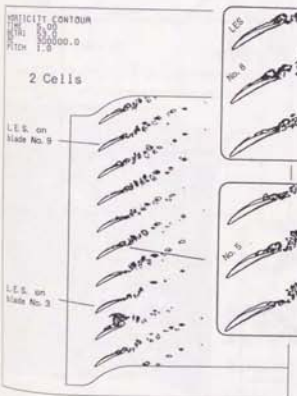
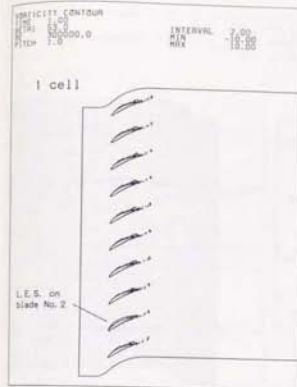
$\alpha_1 = -45 \text{ deg.}$



1 2 3 4 5 6 7 8 9 10
Y-DIRECTION

図4-3-13 (b) 多セルの発生・成長に対する予旋回の影響
Rより0.57-d上流の軸流速度・流れ角変動
($L/c=1$, $\alpha_1=-45^\circ$, $\beta_1=53^\circ$, $N1$)

$\alpha_1 = -45 \text{ deg. } L/c=1$



1 N Initial Reduction

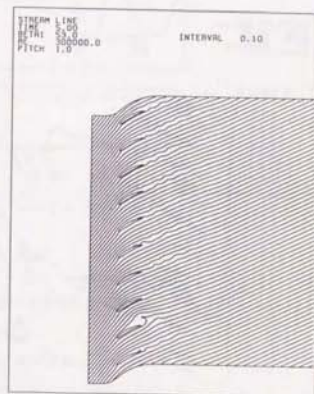
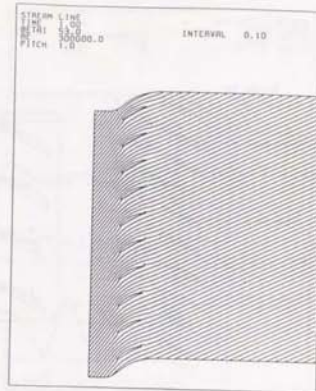


図4-3-14 (a) 多セルの発生・成長に対する予旋回の影響
渦度分布と流線
($L/c=1$, $\alpha_1=-45^\circ$, $\beta_1=53^\circ$, $N1$)

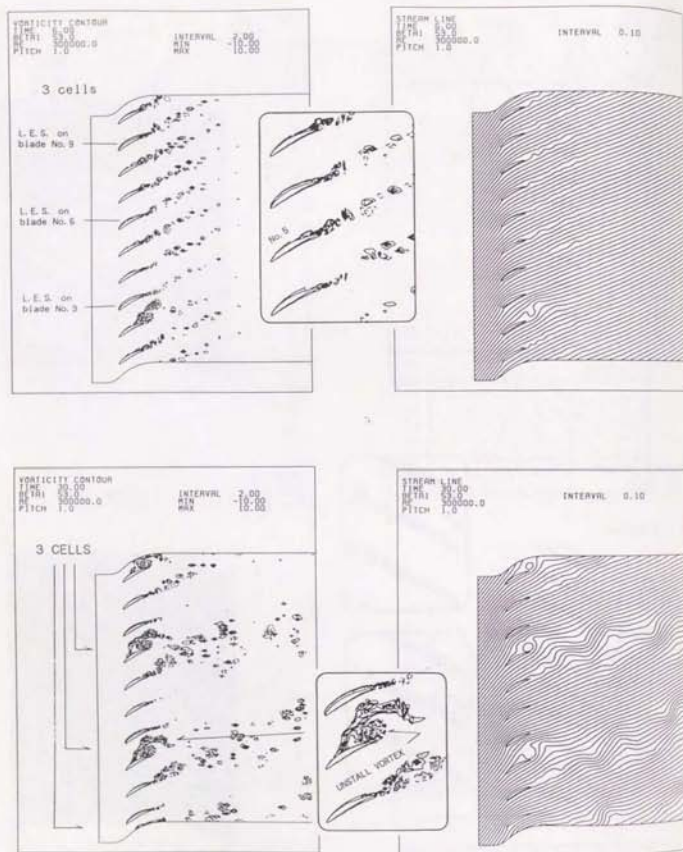


図4-3-14 (b) 多セルの発生・成長に対する予旋回の影響
渦度分布と流線 (N1)

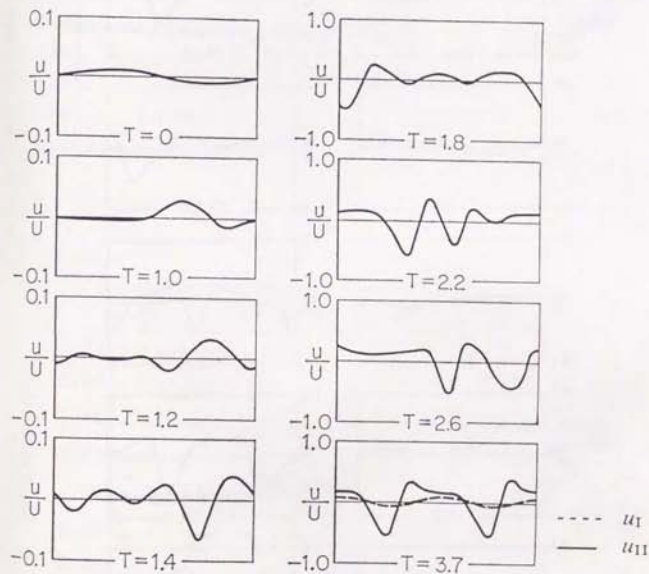


図4-3-15 (a) 翼列間干渉による失速セル数の変化

非線形解析 by Nagano[18]

$\beta_1=56.3^\circ$, $\alpha_1=30^\circ$, $L/S=0.1$.

$c/S=0.02$, $\tau U/S=0.01$ (No. c1 in Table 2-2)

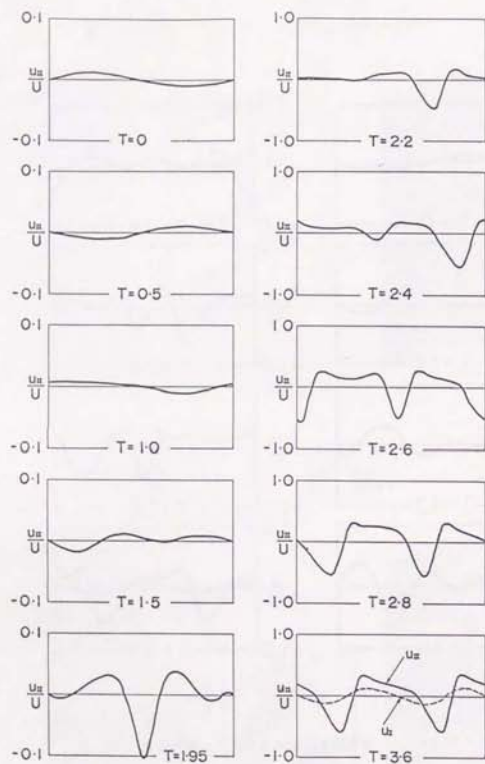


図4-3-15 (b) 翼列間干渉による失速セル数の変化

非線形解析 by Nagano[18]

$\beta_1 = 56.9^\circ$, $\alpha_1 = -45^\circ$, $L/S = 0.1$,

$c/S = 0.02$, $\tau U/S = 0.01$ (No. d1 in Table. 2-2)

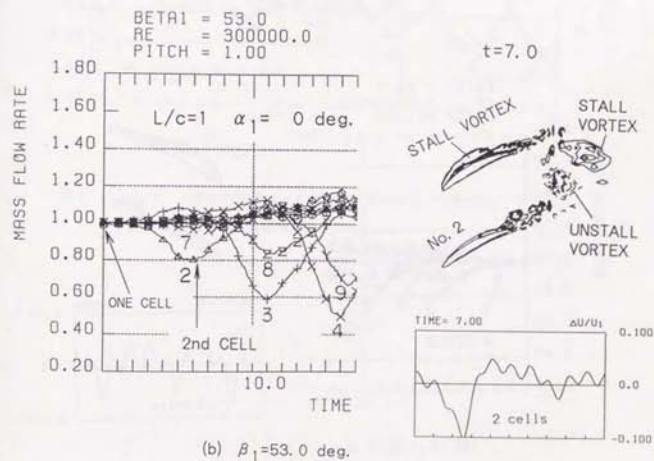
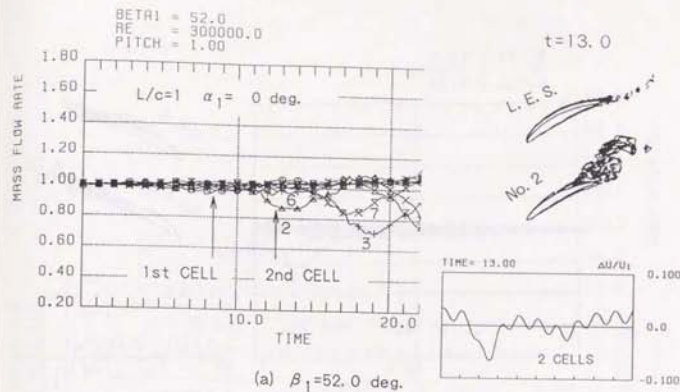
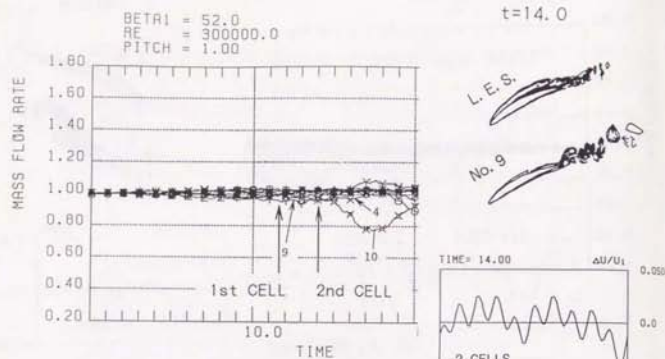
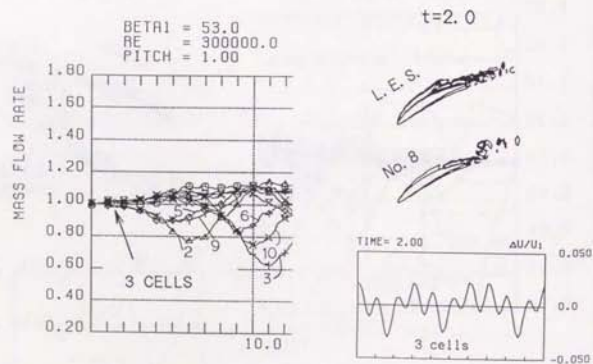


図4-3-16 多セル発生時の変動振幅: G-R翼列, $L/c=1$, $\alpha_1=0^\circ$

流量変動, 多セル発生時の翼周辺の速度分布と0.53-1上流の軸流速度



(a) $\beta_1 = 52.0$ deg.



(b) $\beta_1 = 53.0$ deg.

図4-3-17 多セル発生時の変動振幅：単独翼列

流量変動，多セル発生時の翼周辺の渦度分布と0.51-D'上流の軸流速度

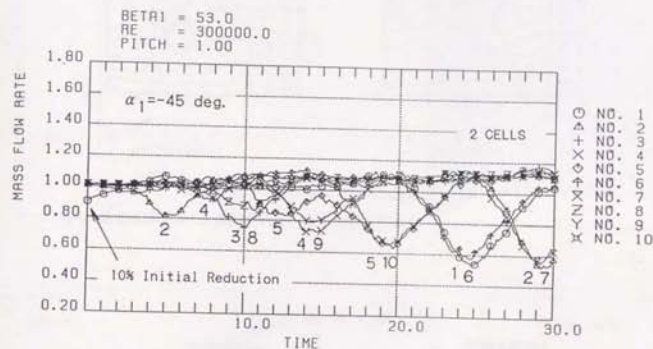


図4-3-18 擾乱の振幅による発生セル数の変化：流量変動

(10%初期変動， $L/c=1$ ， $\alpha_1=-45^\circ$ ， $\beta_1=53^\circ$ ， N_4)

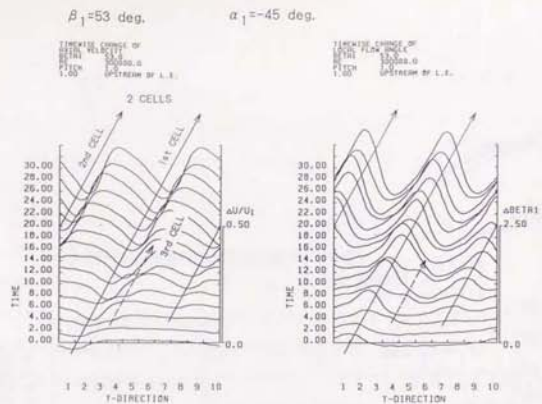


図4-3-19 (a) 擾乱の振幅による発生セル数の変化:
G出口の軸流速度・流れ角変動 (10%初期擾乱, N4)

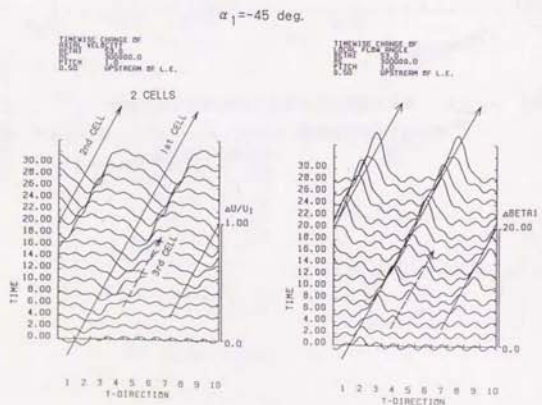


図4-3-19 (b) 擾乱の振幅による発生セル数の変化:
Rより0.51-d上流の軸流速度・流れ角変動
(10%初期擾乱, N4)

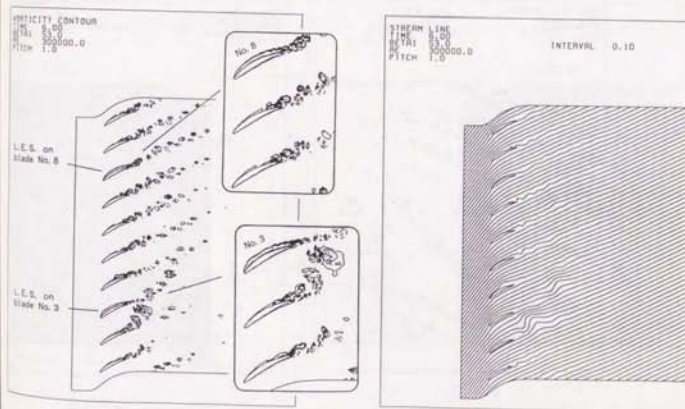
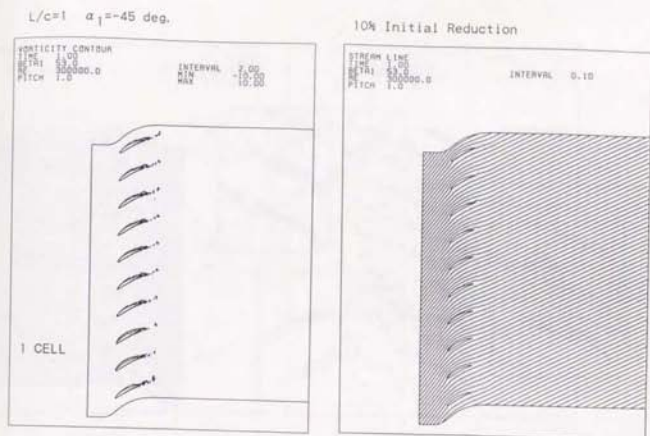


図4-3-20 (a) 擾乱の振幅による発生セル数の変化: 高度分布と流れ
(10%初期擾乱, $L/c=1$, $\alpha_1 = -45^\circ$, $\beta_1 = 53^\circ$, N4)

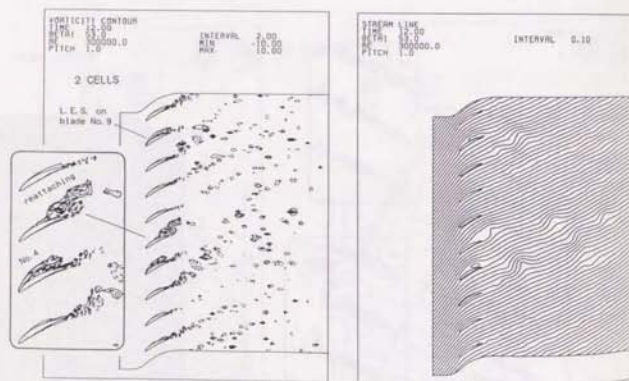
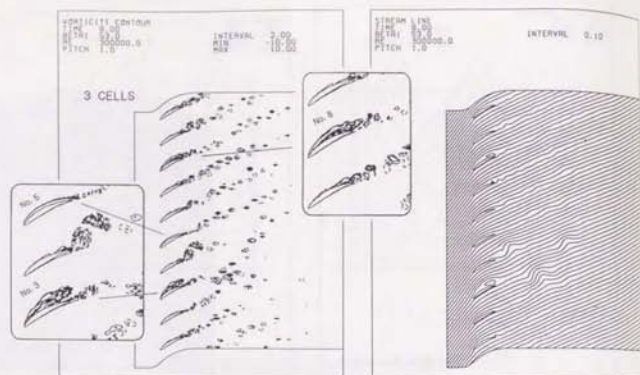


図4-3-20 (b) 擾乱の振幅による発生セル数の変化：
渦度分布と流線 (N4)

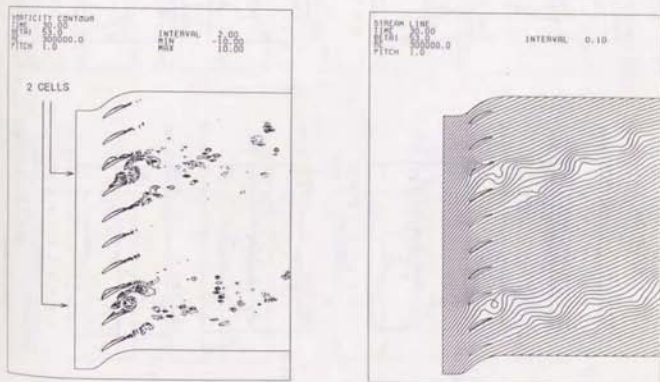
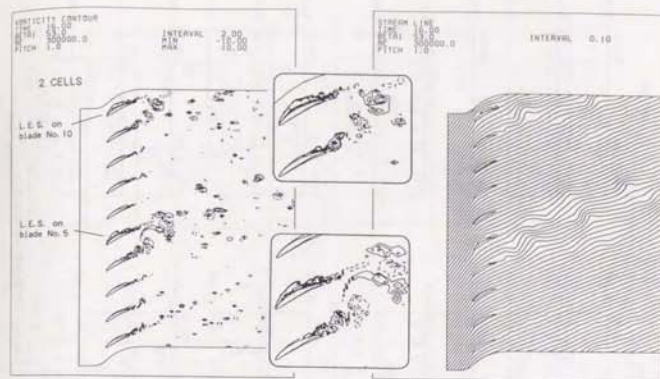


図4-3-20 (c) 擾乱の振幅による発生セル数の変化：
渦度分布と流線 (N4)

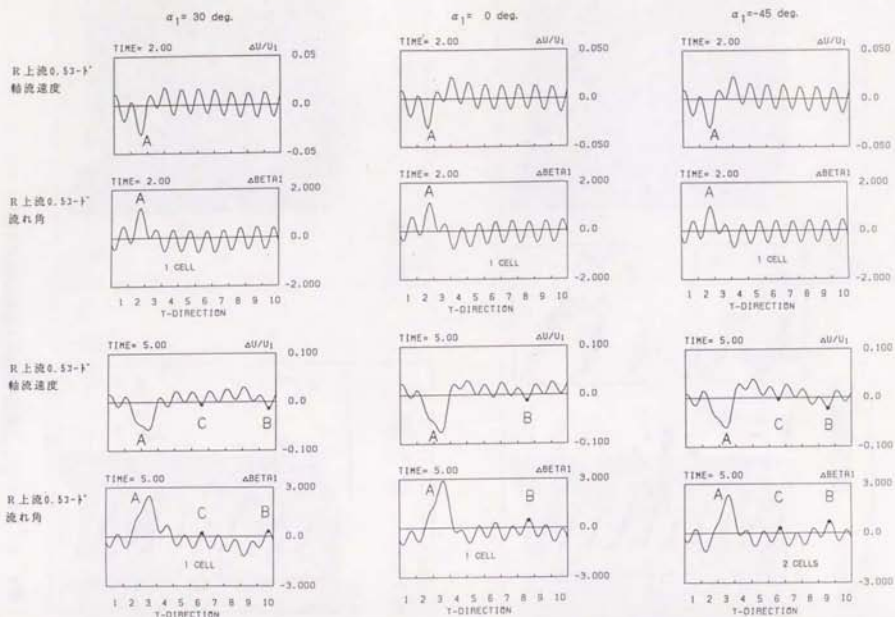


図4-3-21 (a)

G出口流出角による失速セル数および変動波形・振幅の変化
(10ピッチ周期, $\beta_1 = 63^\circ$)

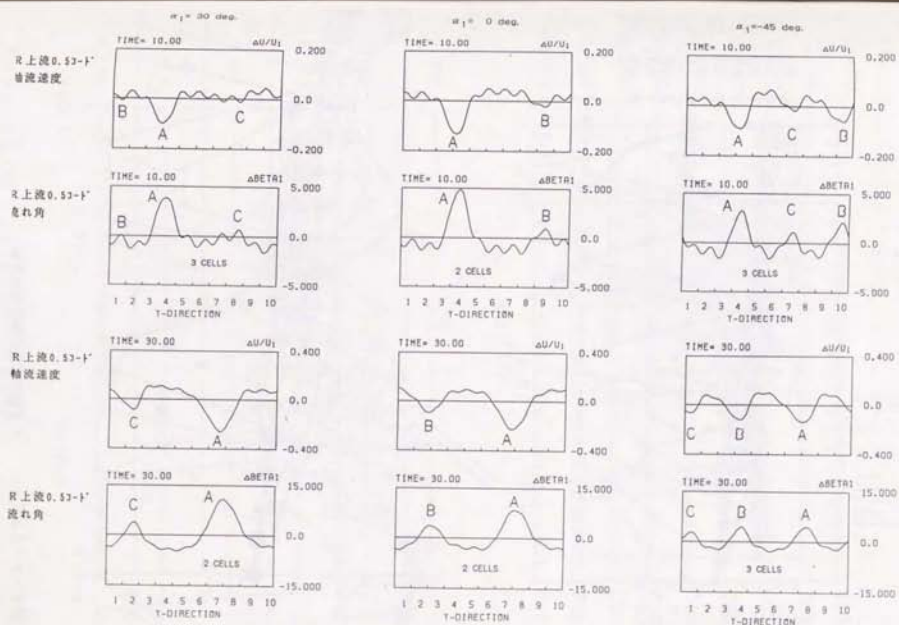


図4-3-21 (b)

G出口流出角による失速セル数および変動波形・振幅の変化
(10ピッチ周期, $\beta_1 = 53^\circ$)

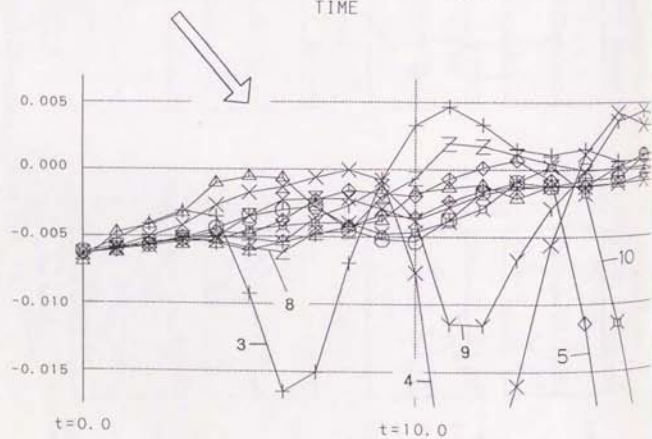
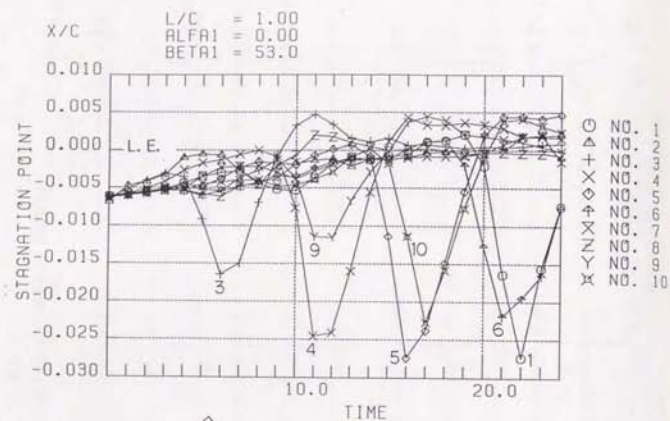


図4-3-22 (a) セル数変化時の境界層の挙動
 淀み点の移動 ($\beta_1 = 53^\circ$, $\alpha_1 = 0^\circ$, $L/c = 1$, $L2$)

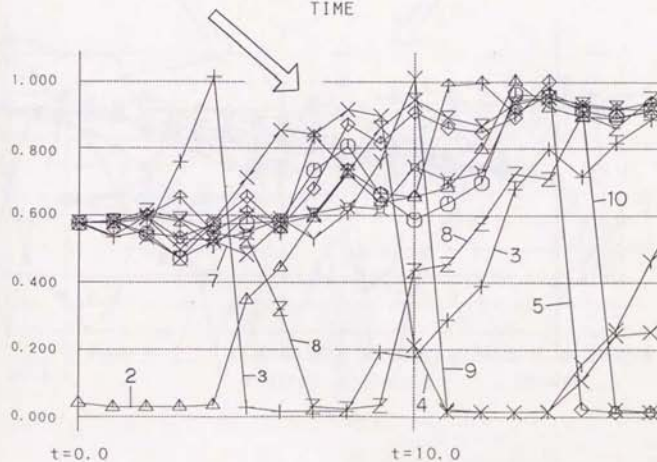
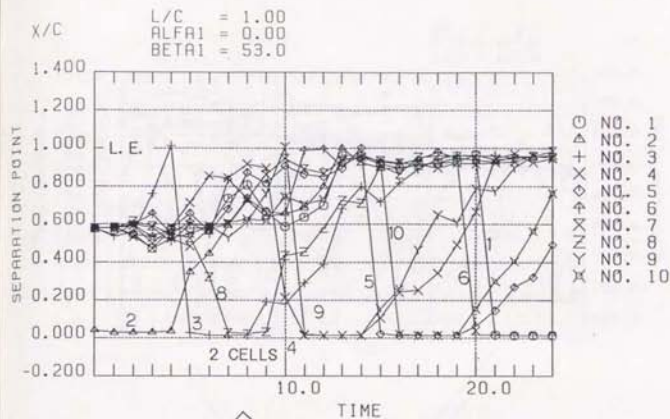


図4-3-22 (b) セル数変化時の境界層の挙動
 剥離点の移動 ($\beta_1 = 53^\circ$, $\alpha_1 = 0^\circ$, $L/c = 1$, $L2$)

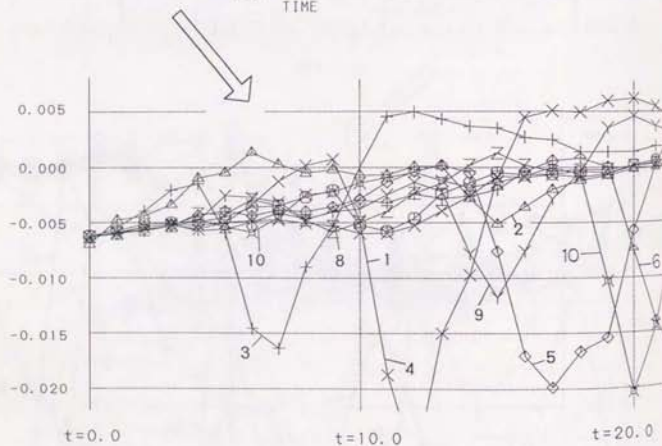
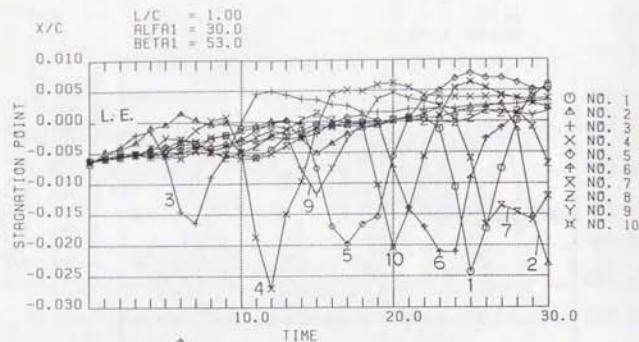


図4-3-22 (c) セル数変化時の境界層の挙動
 淀み点の移動 ($\beta_1 = 53^\circ$, $\alpha_1 = 30^\circ$, $L/c = 1$, M_1)

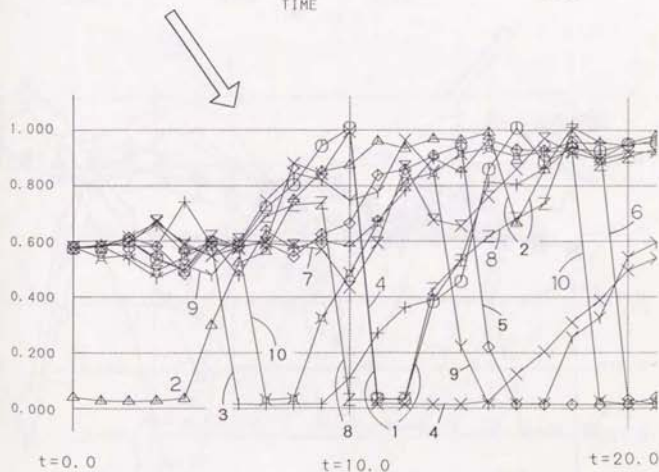
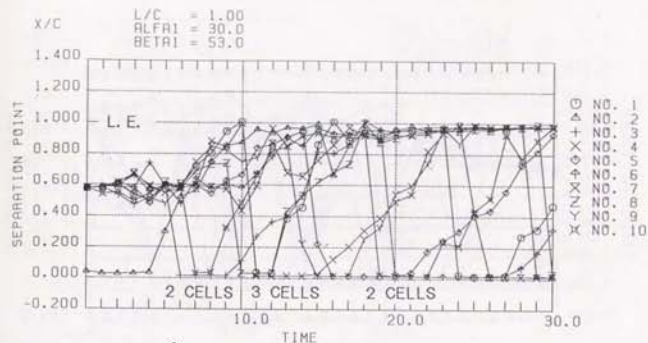


図4-3-22 (d) セル数変化時の境界層の挙動
 剥離点の移動 ($\beta_1 = 53^\circ$, $\alpha_1 = 30^\circ$, $L/c = 1$, M_1)

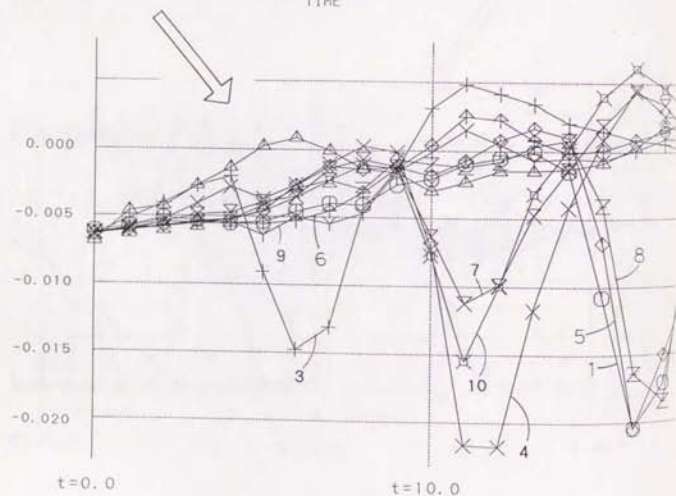
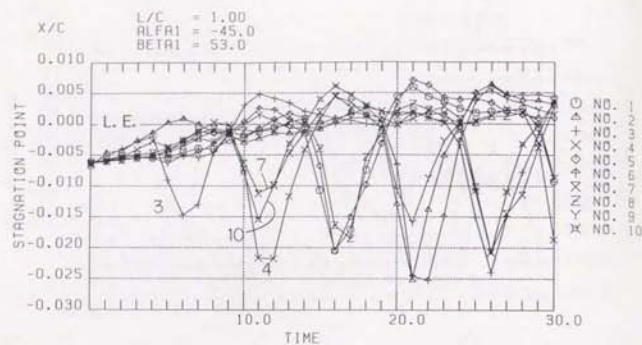


図4-3-22 (e) セル数変化時の境界層の挙動
 淀み点の移動 ($\beta_1 = 53^\circ$, $\alpha_1 = -45^\circ$, $L/C = 1$, N_1)

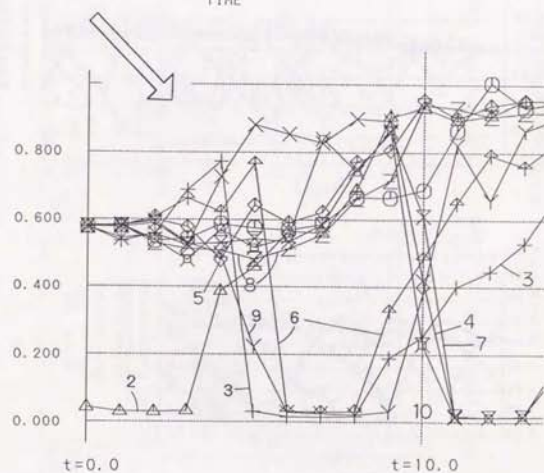
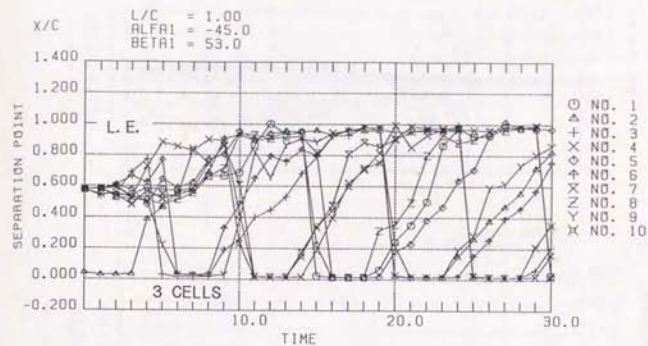


図4-3-22 (f) セル数変化時の境界層の挙動
 剥離点の移動 ($\beta_1 = 53^\circ$, $\alpha_1 = -45^\circ$, $L/C = 1$, N_1)

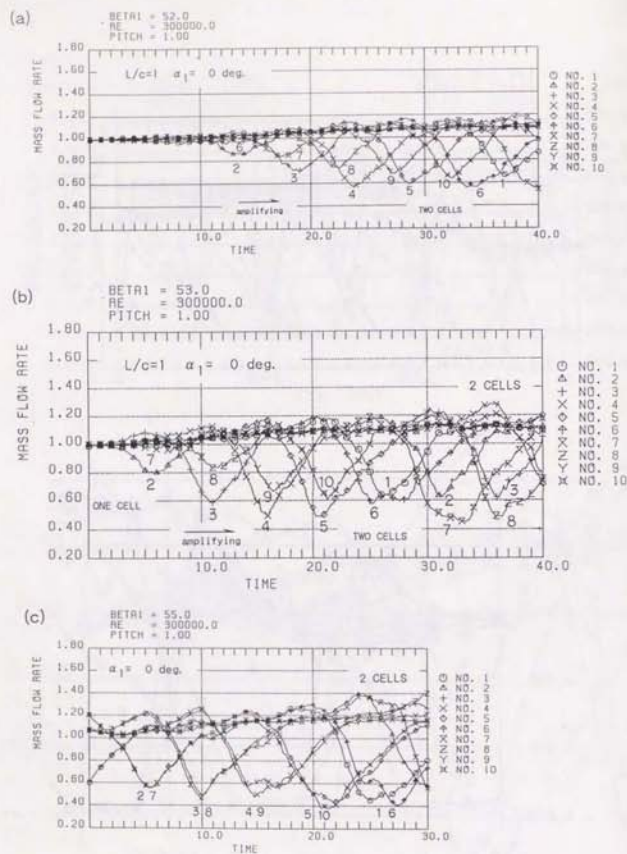
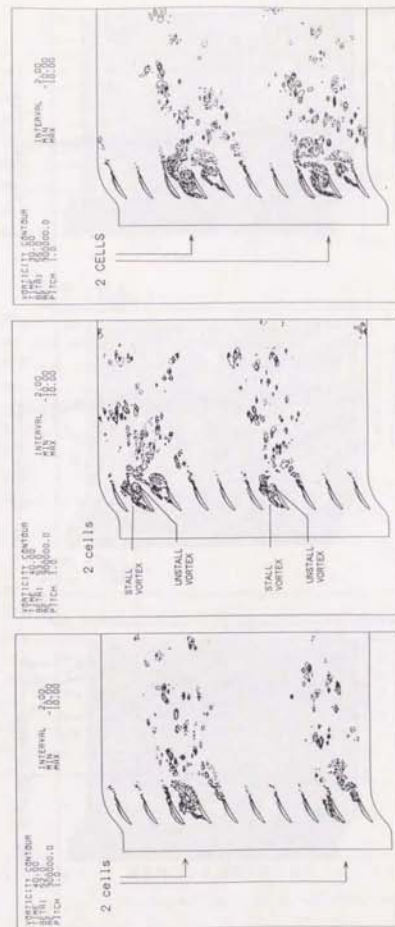


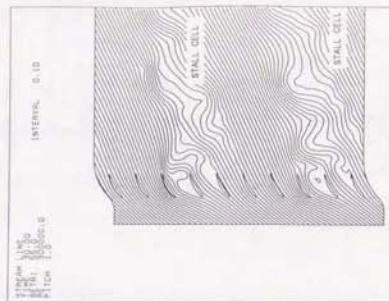
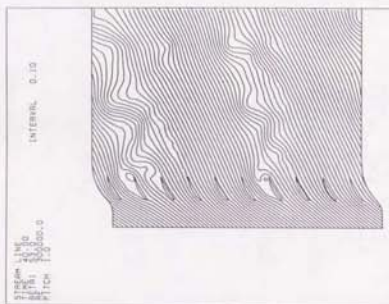
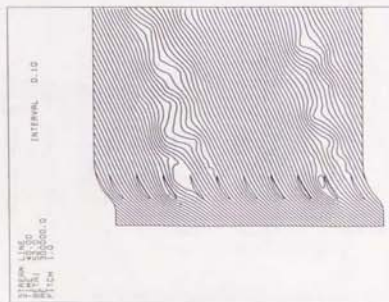
図4-3-2.3 流入角による流量変動の変化 ($\alpha_1 = 0^\circ$)
 (a) $\beta_1 = 52^\circ$ [L1], (b) $\beta_1 = 53^\circ$ [L2], (c) $\beta_1 = 55^\circ$ [L3]

$\alpha_1 = 0 \text{ deg.} \quad L/c=1$



流入角による速度分布の変化 ($\alpha_1 = 0^\circ$)
 (a) $\beta_1 = 52^\circ$, (b) $\beta_1 = 53^\circ$, (c) $\beta_1 = 55^\circ$

$\alpha_1 = 0 \text{ deg. } L/c=1$



(a) $\beta_1 = 52.0 \text{ deg.}$

(b) $\beta_1 = 53.0 \text{ deg.}$

(c) $\beta_1 = 55.0 \text{ deg.}$

図 4-3-25

流入角による流線の変化 ($\alpha_1 = 0^\circ$)
(a) $\beta_1 = 52^\circ$, (b) $\beta_1 = 53^\circ$, (c) $\beta_1 = 55^\circ$

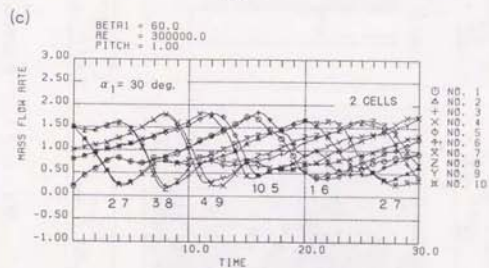
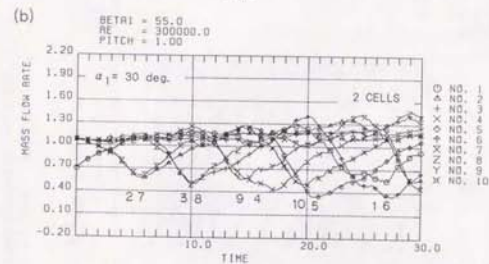
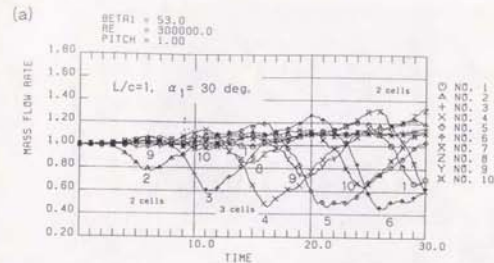
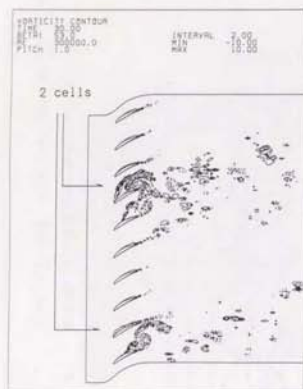


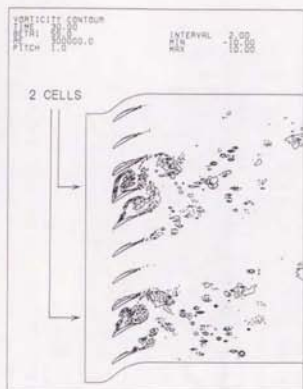
図 4-3-26 流入角による流量変動の変化 ($\alpha_1 = 30^\circ$)

(a) $\beta_1 = 53^\circ$ [M1], (b) $\beta_1 = 55^\circ$ [M2], (c) $\beta_1 = 60^\circ$ [M3]

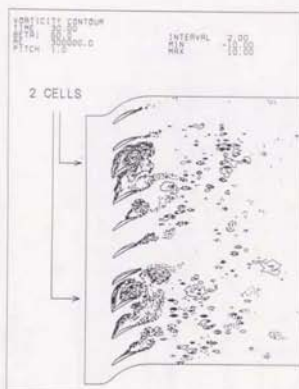
$\alpha_1 = 30 \text{ deg. } L/c=1$



(a) $\beta_1 = 53.0 \text{ deg.}$



(b) $\beta_1 = 55.0 \text{ deg.}$



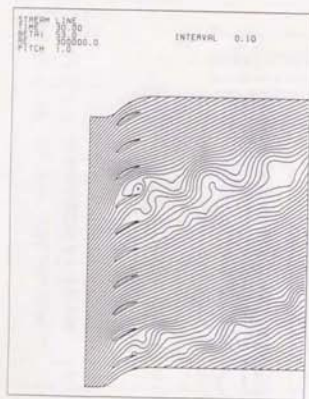
(c) $\beta_1 = 60.0 \text{ deg.}$

図 4-3-27

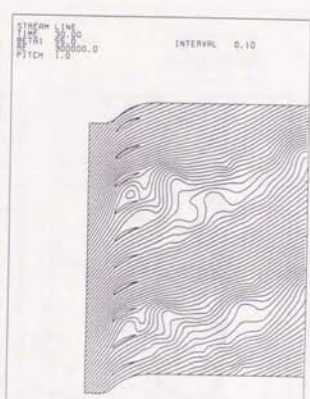
流入角による渦度分布の変化 ($\alpha_1 = 30^\circ$)

(a) $\beta_1 = 53^\circ$, (b) $\beta_1 = 55^\circ$, (c) $\beta_1 = 60^\circ$

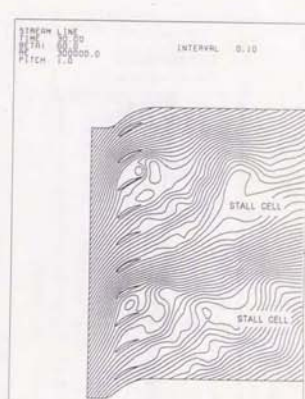
$\alpha_1 = 30 \text{ deg. } L/c=1$



(a) $\beta_1 = 53.0 \text{ deg.}$



(b) $\beta_1 = 55.0 \text{ deg.}$



(c) $\beta_1 = 60.0 \text{ deg.}$

図 4-3-28

流入角による流線の変化 ($\alpha_1 = 30^\circ$)

(a) $\beta_1 = 53^\circ$, (b) $\beta_1 = 55^\circ$, (c) $\beta_1 = 60^\circ$

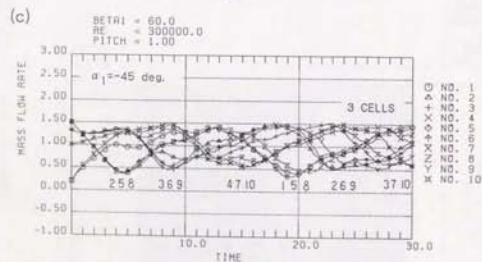
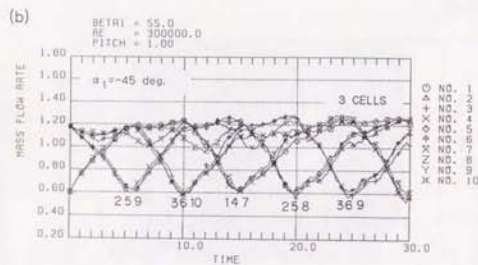
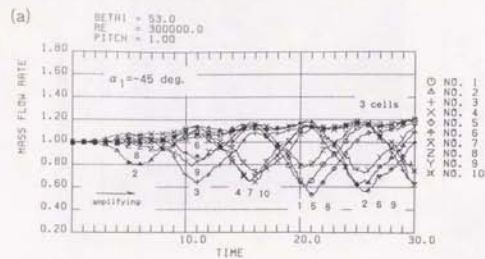
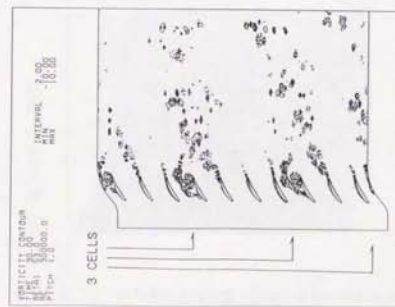
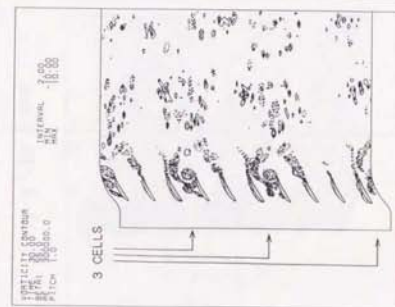
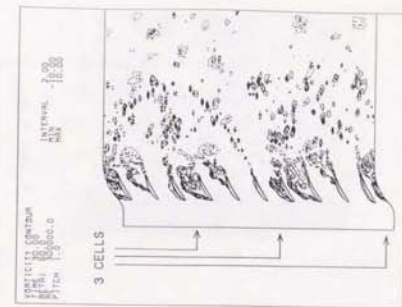


図4-3-29 流入角による流量変動の変化 ($\alpha_1 = -45^\circ$)
(a) $\beta_1 = 53^\circ$ [N1], (b) $\beta_1 = 55^\circ$ [N2], (c) $\beta_1 = 60^\circ$ [N3]



(c) $\beta_1 = 60.0^\circ$

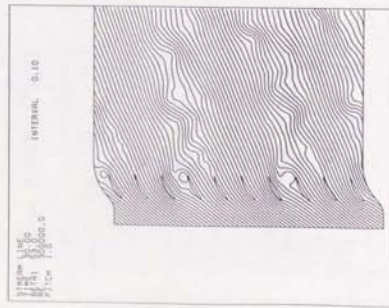
(b) $\beta_1 = 55.0^\circ$.

(a) $\beta_1 = 53.0^\circ$

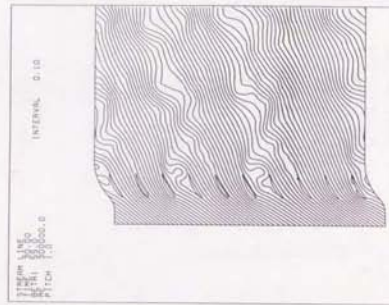
流入角による温度分布の変化 ($\alpha_1 = -45^\circ$)

(a) $\beta_1 = 53^\circ$. (b) $\beta_1 = 55^\circ$. (c) $\beta_1 = 60^\circ$.

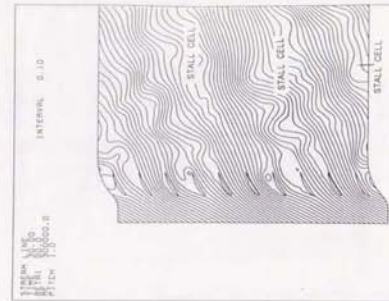
$\alpha_1 = -45 \text{ deg. } L/c=1$



(a) $\beta_1 = 53.0 \text{ deg.}$



(b) $\beta_1 = 55.0 \text{ deg.}$



(c) $\beta_1 = 60.0 \text{ deg.}$

図4-3-31

流入角による流線の变化 ($\alpha_1 = -45^\circ$)

(a) $\beta_1 = 53^\circ$, (b) $\beta_1 = 55^\circ$, (c) $\beta_1 = 60^\circ$

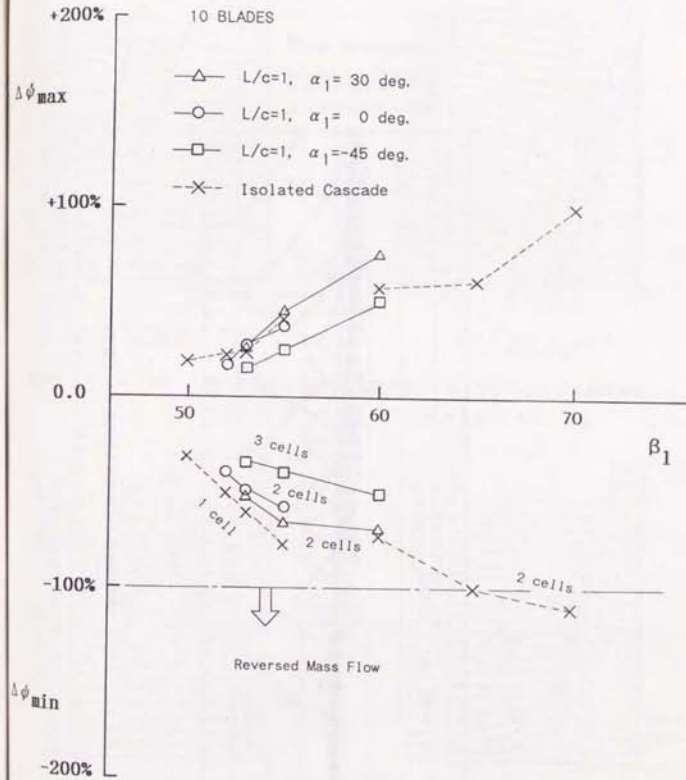


図4-3-32

流入角による失速セル数と変動振幅の変化

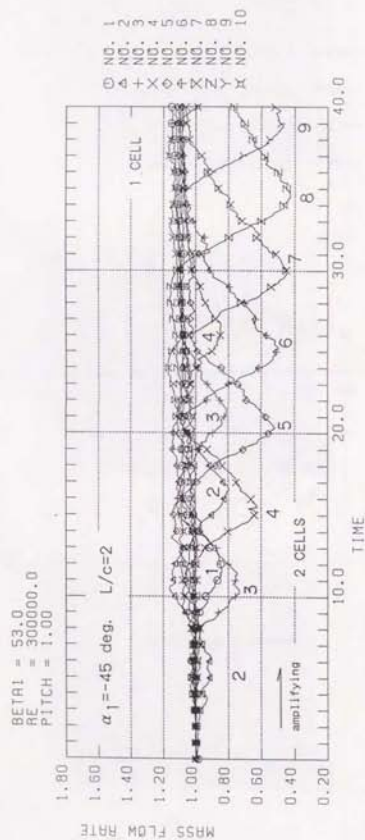


図4-3-33 翼列間隔による発生セル数の変化：流量変動
 ($L/c=2$, $\alpha_1=-45^\circ$, $\beta_1=53^\circ$, N_5)

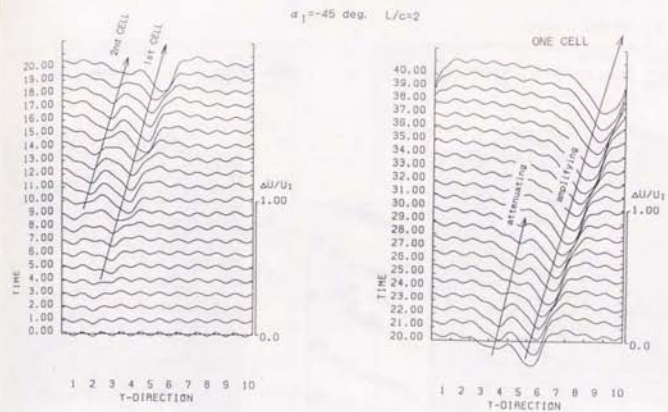


図4-3-34 (a) 翼列間隔による発生セル数の変化：Rより0.53-T'上流の軸流速
 ($L/c=2$, $\alpha_1=-45^\circ$, $\beta_1=53^\circ$, N_5)

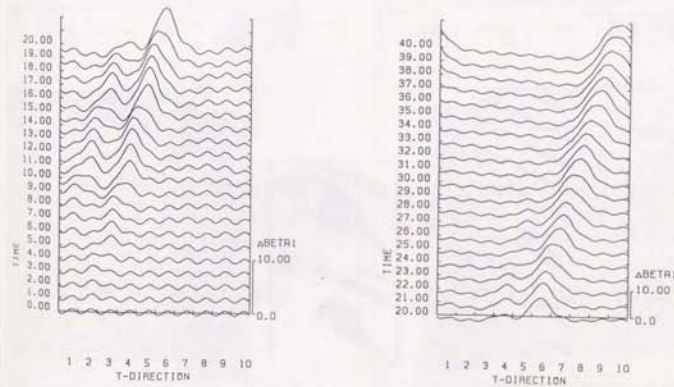


図4-3-34 (b) 翼列間隔による発生セル数の変化：Rより0.53-T'上流の流れ角
 ($L/c=2$, $\alpha_1=-45^\circ$, $\beta_1=53^\circ$, N_5)

$\alpha_1 = -45 \text{ deg. } L/c = 2$

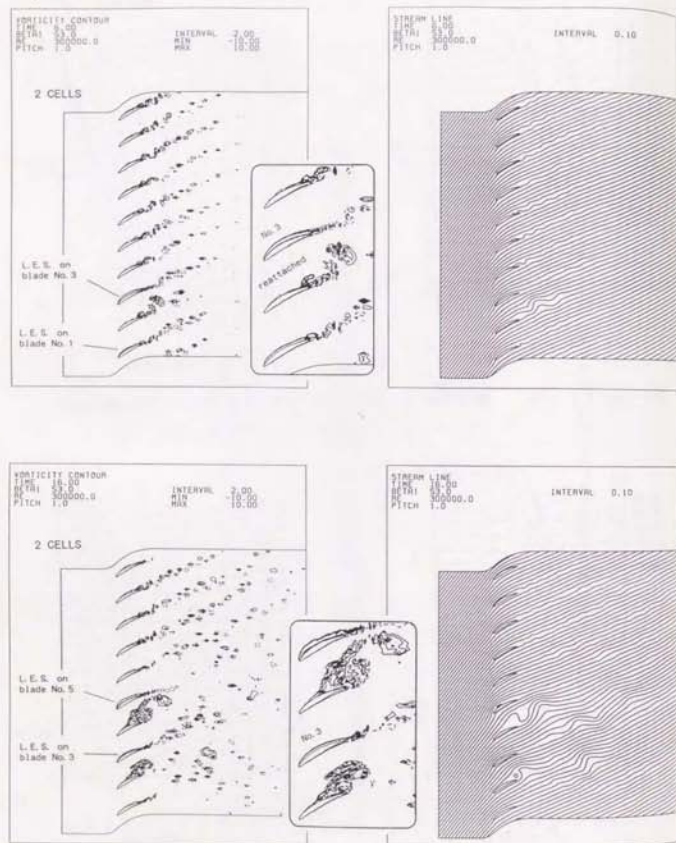


図4-3-35 (a) 翼列間隔による発生セル数の変化: 渦度分布と流線
($L/c = 2$, $\alpha_1 = -45^\circ$, $\beta_1 = 53^\circ$, NS)

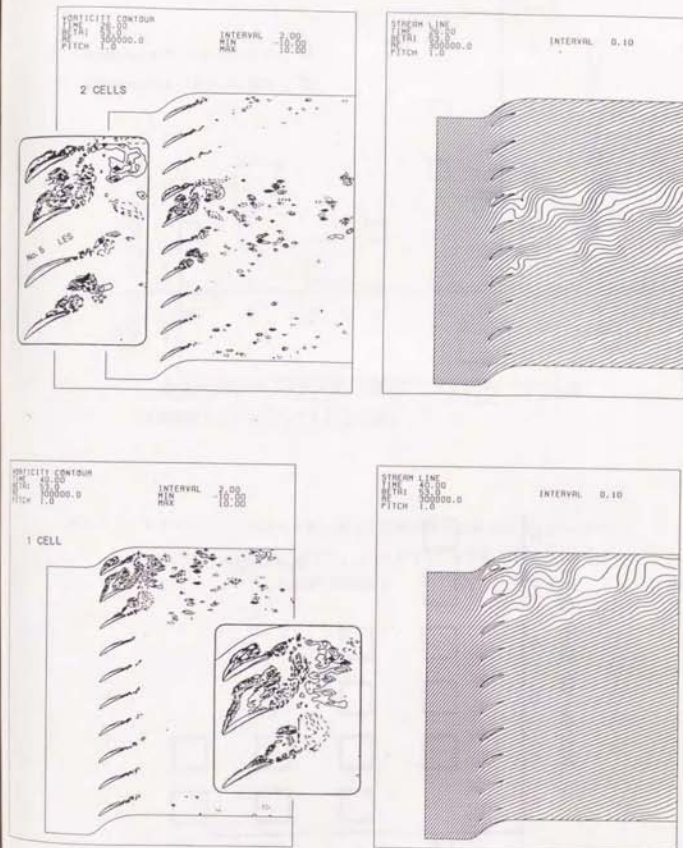


図4-3-35 (b) 翼列間隔による発生セル数の変化:
渦度分布と流線 (NS)

10 BLADES

$\alpha_1 = -45^\circ$

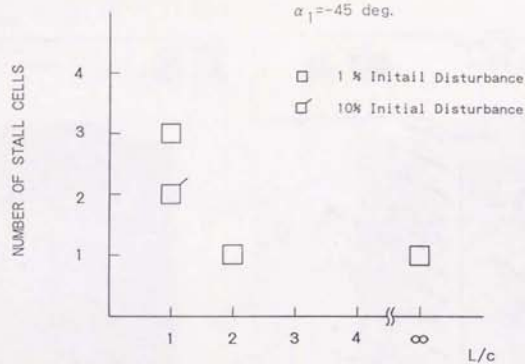


図4-3-36 (a) 失速セル数に対する翼列間隔の影響
($\alpha_1 = -45^\circ$, 10 ピッチ周期条件)

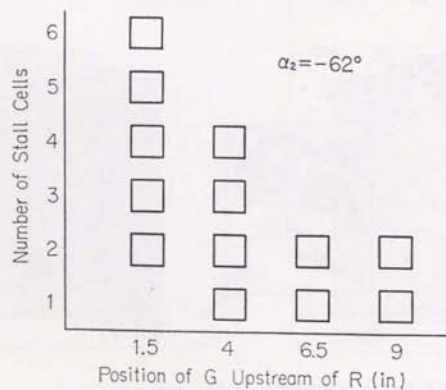


図4-3-36 (b) 失速セル数に対する翼列間隔の影響
($\alpha_1 = -62^\circ$, Experiment by Sovran [11])

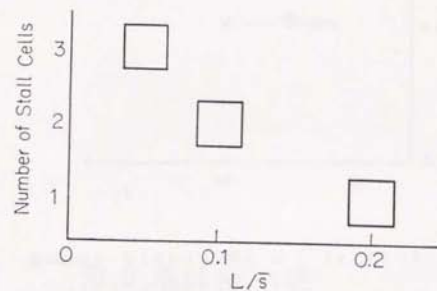


図4-3-36 (c) 失速セル数に対する翼列間隔の影響 (by Nagano [18])
 $\alpha_1 = -45^\circ$, $\beta_1 = 58^\circ$, $c/\bar{s} = 0.02$, $\tau U/\bar{s} = 0.01$
 \bar{s} : 圧縮機の円周長さ

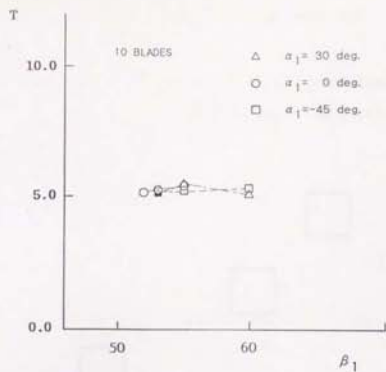


図4-3-37 (a) G-R翼列における1ピッチ伝播時間
(10ピッチ周期, $L/c = 1$)

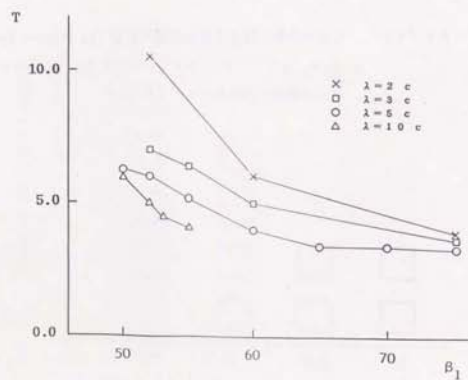


図4-3-37 (b) 単独翼列における1ピッチ伝播時間

第5章付図・表

Table 3 Resultant Characteristics of Rotating Stall in An Oscillating Blade Row $\beta_1 = 9.2^\circ$

No.	N	σ	k	α_s	γ'	RESULT					Y_p/V_1	Amplitude $\Delta\psi$	
						$Im(C_{L\alpha})$	$Re(C_{L\alpha})$	Flow	Cell	T		max	min
01	1	0.0	0.10	2.0	31.4	0.85	-0.59	En	---	---	---	---	---
02	1	0.0	0.20	2.0	15.7	1.19	0.07	En	---	---	---	---	---
03	1	0.0	0.30	2.0	10.5	1.18	0.86	En	---	---	---	---	---
04	1	0.0	0.48	2.0	6.5	0.08	1.48	En	---	---	---	---	---
05	1	0.0	0.60	2.0	5.2	0.07	0.61	En	---	---	---	---	---
06	6	0.0	0.10	2.0	31.4	0.0	0.0	RS	1	5.5	0.23	+30 %	-35 %
07	6	0.0	0.30	2.0	10.5	0.0	0.0	RS	1	5.5	0.23	+30 %	-40 %
08	6	0.0	0.60	2.0	5.2	0.15	0.99	MID	1	---	---	+15 %	-15 %
P1	2	180.0	0.10	2.0	15.7	0.23	-1.03	En	1	15.7	0.08	+20 %	-20 %
P2	2	180.0	0.15	2.0	10.5	2.30	0.02	En	1	10.5	0.12	+20 %	-20 %
P3	2	180.0	0.20	2.0	7.9	2.00	1.50	En	1	7.9	0.16	+18 %	-18 %
P4	2	180.0	0.30	2.0	5.2	-0.30	2.48	En	1	5.2	0.24	+15 %	-15 %
P5	2	180.0	0.40	2.0	3.9	-0.63	1.25	MID	1	---	---	+15 %	-15 %
P6	2	180.0	0.60	2.0	2.6	-0.48	0.99	RS	1	10.5	0.12	+15 %	-15 %
P7	6	180.0	0.10	2.0	15.7	0.0	0.0	RS	1	5.5	0.23	+25 %	-40 %
P8	6	180.0	0.20	2.0	7.9	2.10	1.05	EN	3	7.9	0.16	+20 %	-20 %
P9	6	180.0	0.40	2.0	3.9	-0.53	1.23	MID	3	---	---	+15 %	-15 %
P10	6	180.0	0.60	2.0	2.6	-0.52	1.15	RS	1	5.5	0.23	+25 %	-30 %
Q1	3	240.0	0.15	2.0	7.0	1.44	1.53	En	1	7.0	0.18	+25 %	-25 %
Q2	3	240.0	0.20	2.0	5.2	-0.34	1.80	En	1	5.2	0.24	+15 %	-15 %
Q3	3	240.0	0.30	2.0	3.5	-0.30	0.63	MID	1	---	---	+15 %	-20 %
Q4	3	240.0	0.60	2.0	1.7	-0.31	0.87	RS	1	7.0	0.18	+20 %	-20 %
Q5	6	240.0	0.15	2.0	7.0	1.40	1.88	En	2	7.0	0.18	+30 %	-30 %
Q6	6	240.0	0.30	2.0	3.5	-0.42	0.97	MID	2	---	---	+20 %	-20 %
Q7	6	240.0	0.40	2.0	2.6	0.0	0.0	RS	1	5.5	0.23	+30 %	-40 %
Q8	6	240.0	0.60	2.0	1.7	-0.34	0.96	RS	2	7.0	0.18	+20 %	-20 %

Table 3 --- continued

 $\beta_1 = 5.2^\circ$

RESULT													
NO.	N	σ	k	α_s	γ'	Im(C_u)	Re(C_u)	Flow	Cell	T	Vp/ V_1	amplitude $\Delta\phi$	
												max	min
R1	6	300.0	0.10	2.0	5.2	1.29	1.57	En	1	5.2	0.24	+30 %	-40 %
R2	6	300.0	0.20	2.0	2.6	0.0	0.0	RS	1	5.5	0.23	+30 %	-40 %
R3	6	300.0	0.30	2.0	1.7	0.0	0.0	RS	1	5.5	0.23	+30 %	-40 %
R4	6	300.0	0.60	2.0	0.9	-0.15	0.76	RS	1	6.1	0.21	+20 %	-30 %
S1	3	120.0	0.10	2.0	20.9	0.0	0.0	RS	1	9.0	0.14	+20 %	-20 %
S2	3	120.0	0.20	2.0	10.5	2.04	0.25	En	1	7.0	0.18	+15 %	-15 %
S3	3	120.0	0.30	2.0	7.0	1.26	0.66	En	1	7.0	0.18	+20 %	-30 %
S4	3	120.0	0.40	2.0	5.2	-0.34	2.35	En	1	5.5	0.23	+10 %	-10 %
S5	6	120.0	0.10	2.0	20.9	0.0	0.0	RS	1	5.5	0.23	+22 %	-36 %
S6	6	120.0	0.20	2.0	5.2	-0.15	2.04	En	1	5.5	0.23	+10 %	-10 %
S7	6	120.0	0.60	2.0	3.5	-0.34	1.54	RS	1	5.5	0.23	+20 %	-30 %
T1	6	60.0	0.10	2.0	26.2	0.0	0.0	RS	1	5.5	0.23	+28 %	-35 %
T2	6	60.0	0.30	2.0	8.7	0.0	0.0	RS	1	5.5	0.23	+30 %	-40 %
T3	6	60.0	0.48	2.0	5.5	0.77	1.11	En	1	5.5	0.23	+25 %	-25 %
T4	6	60.0	0.60	2.0	4.4	-0.26	1.40	MID	1	---	---	+20 %	-15 %
F1	2	---	---	0.0	---	---	---	RS	1	10.5	0.12	+10 %	-10 %
G1	3	---	---	0.0	---	---	---	RS	1	7.0	0.18	+20 %	-20 %
H1	6	---	---	0.0	---	---	---	RS	1	5.5	0.23	+25 %	-35 %

σ : Inter-blade Phase Angle, k : Reduced Frequency, α_s : Angular Amplitude
 $\gamma' = \gamma (180^\circ < \sigma < 360^\circ)$, $\tau = \gamma (0^\circ \leq \sigma \leq 180^\circ)$ τ : Period of Blade Vibration γ : Inter-blade Time Lag
 En : Synchronization and Entrainment Region
 RS : Rotating Stall Region
 MID : Intermediate Region
 2nd : Propagation Frequency of RS is Entrained with Every 2nd Period of Blade Vibration
 T : Period of Propagation $V_p (\pm 1/T)$: Propagation velocity of Rotating Stall
 Amplitude : Variation of Flow Rate through one Passage Expressed by Percent of Mean Flow Rate.

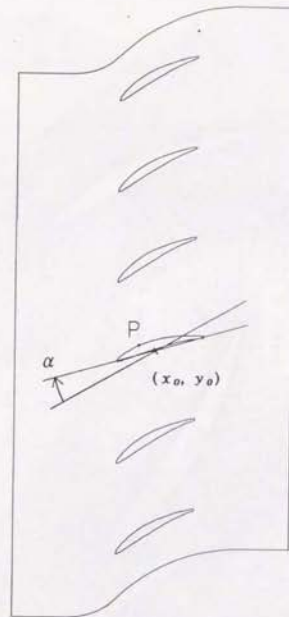
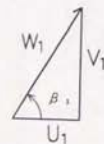


図5-1-1

振動異列のモデル

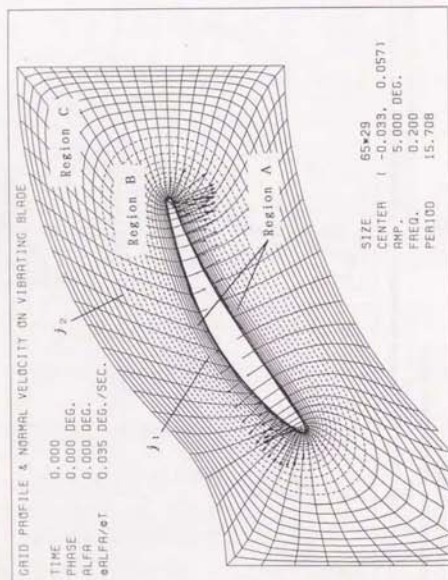


図5-1-2 時間依存格子の生成法

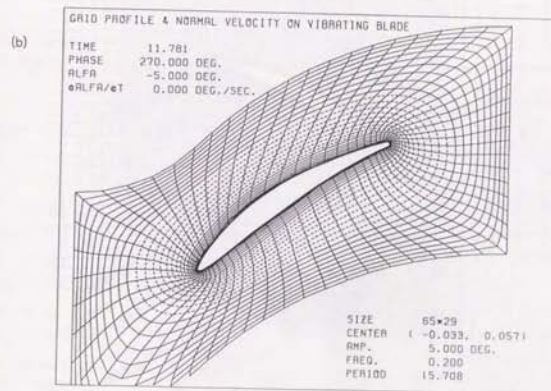
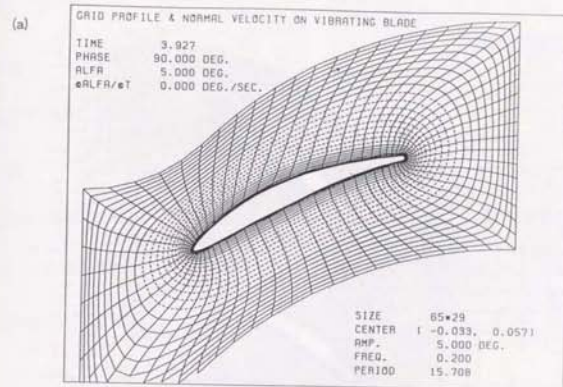


図5-1-3 時間依存格子の例

(a) $\alpha_s = 5^\circ$, $\theta = 90^\circ$

(b) $\alpha_s = 5^\circ$, $\theta = 270^\circ$

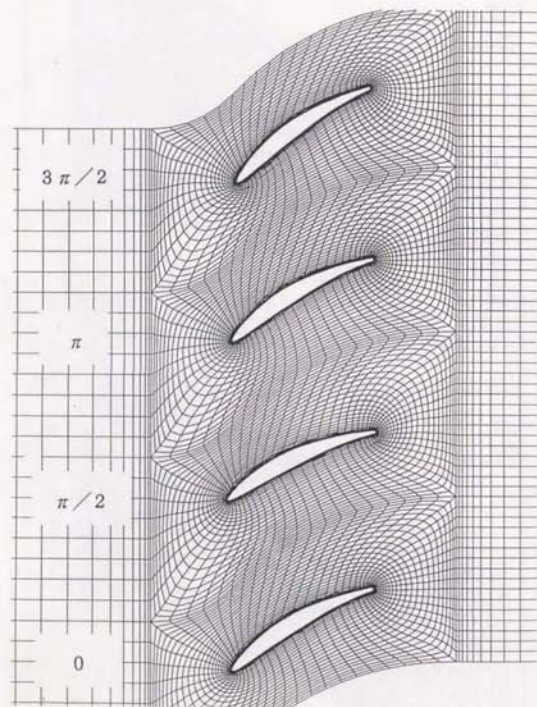


図5-1-4 時間依存格子の例
翼4枚, $\alpha_s = 5^\circ$, $\sigma = 90^\circ$
 $\theta_1 = 0^\circ$, $\theta_2 = 90^\circ$, $\theta_3 = 180^\circ$, $\theta_4 = 270^\circ$

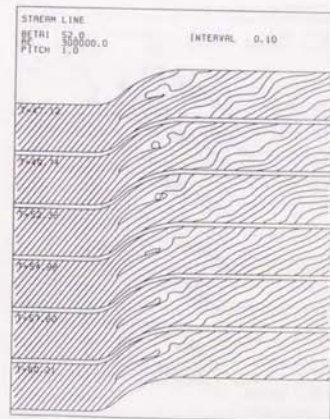
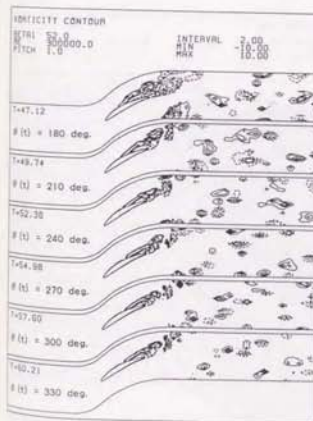
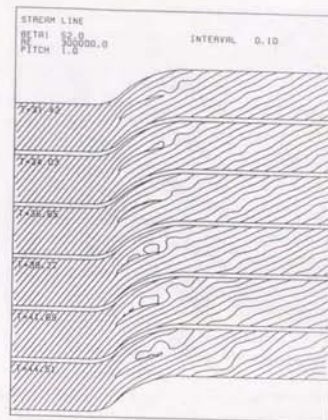
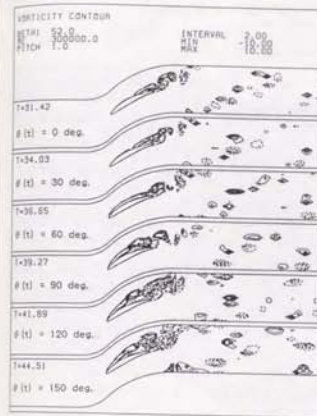


図5-2-1 周期的な前縁失速の発生：渦度分布と流線
($\sigma = 0^\circ$, $k = 0, 1, 01$)

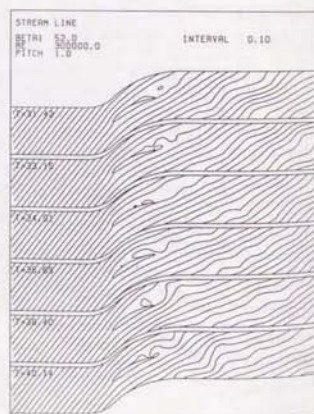
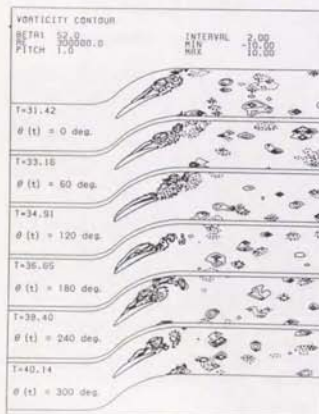
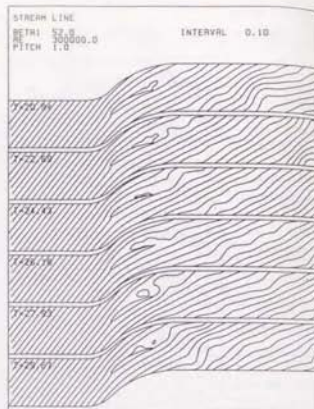
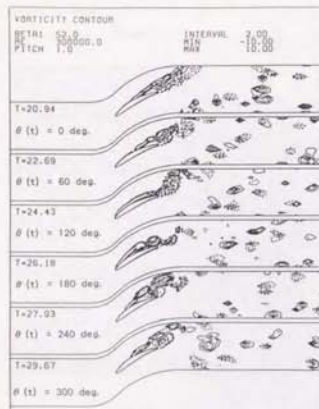


図5-2-2 周期的な前縁失速の発生：渦度分布と流線
($\sigma = 0^\circ$, $k = 0.3, 03$)

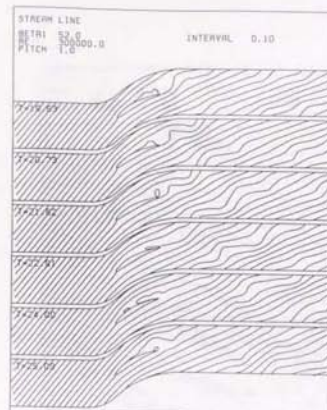
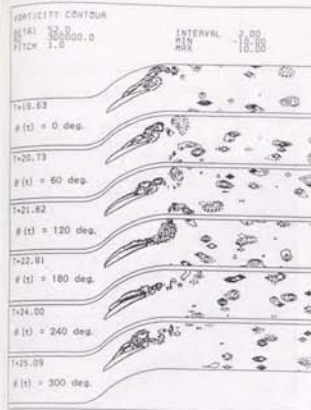


図5-2-3 周期的な前縁失速の発生：渦度分布と流線
($\sigma = 0^\circ$, $k = 0.48, 04$)

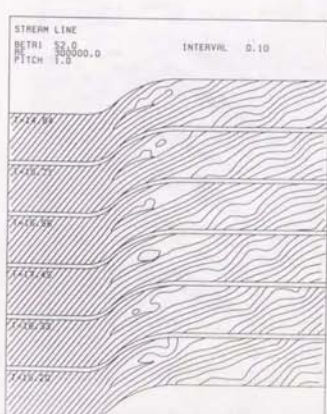
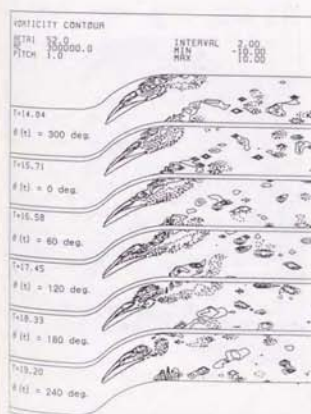


図5-2-4 1周期中常に前縁失速した流れ場：渦度分布と流線
($\sigma = 0^\circ$, $k = 0.6, 05$)

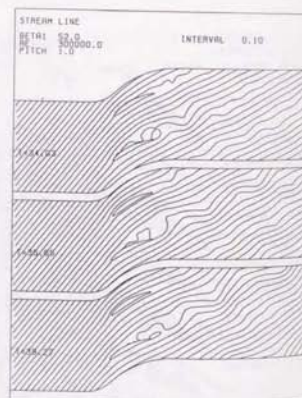
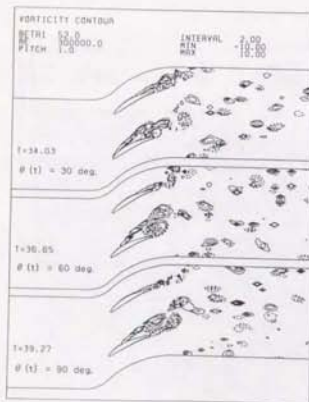
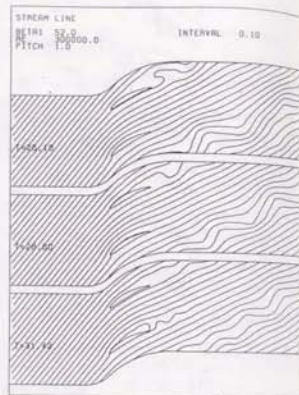
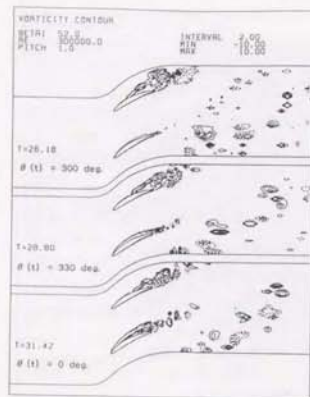


図5-2-5 (a) 周期的な前縁失速の発生：渦度分布と流線
 $(\sigma = 180^\circ, k = 0, 1, P1)$

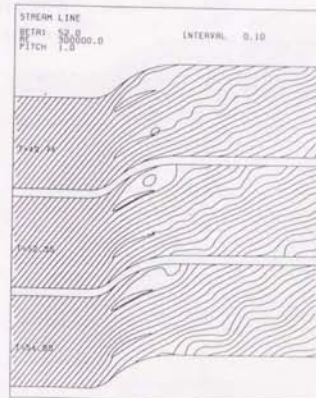
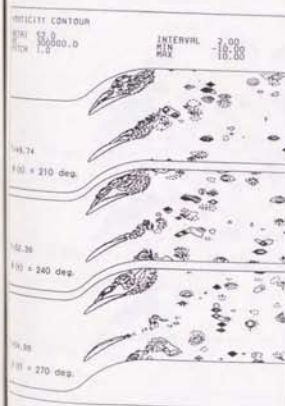
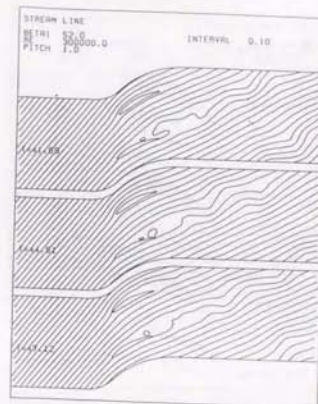
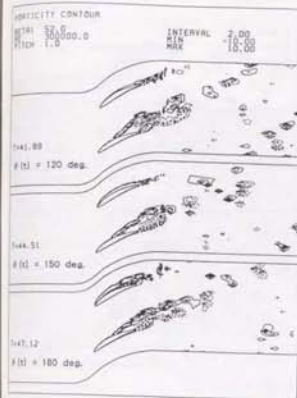


図5-2-5 (b) 周期的な前縁失速の発生
 $(\sigma = 180^\circ, k = 0, 1, P1)$

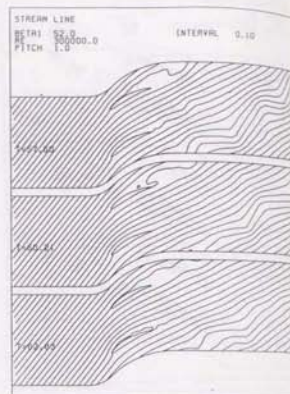
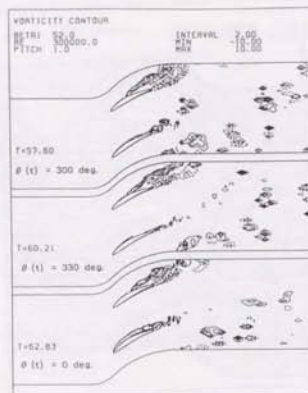


図5-2-5 (c) 周期的な前縁失速の発生
($\alpha = 180^\circ$, $k = 0.1, P1$)

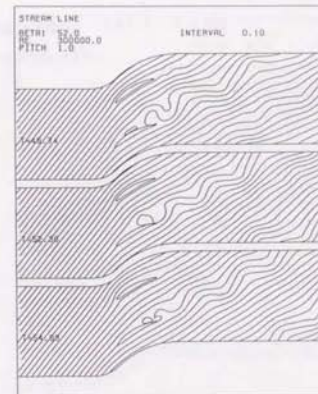
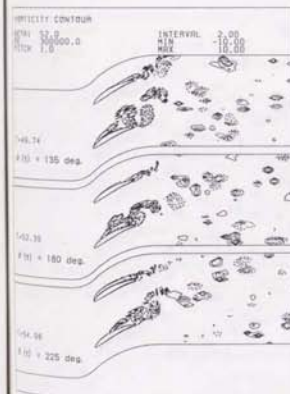
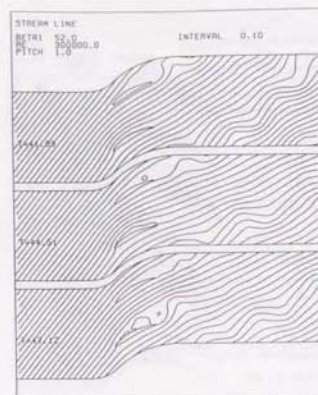
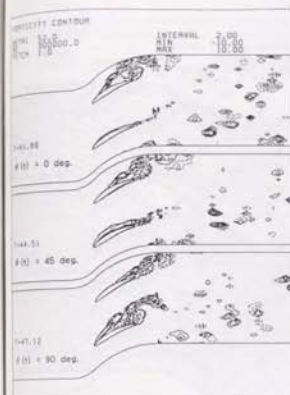


図5-2-6 (a) 周期的な前縁失速の発生：渦度分布と流線
($\alpha = 180^\circ$, $k = 0.15, P2$)

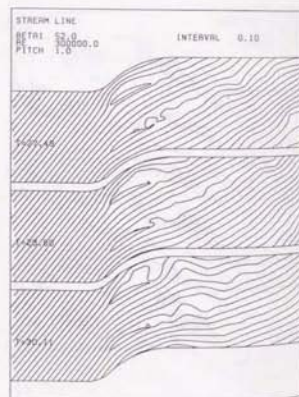
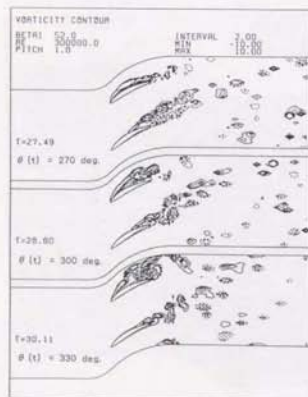
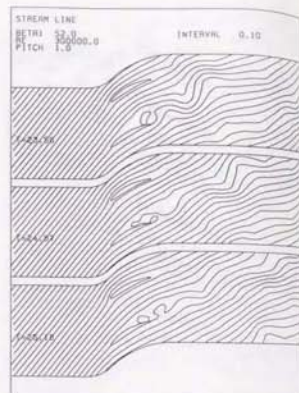
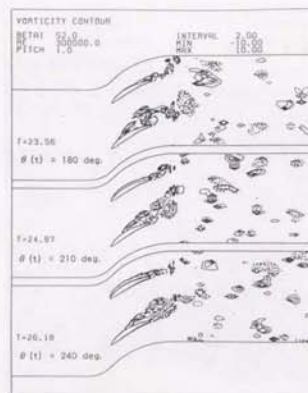


図5-2-7 (b) 周期的な前線失速の発生
 $(\sigma = 180^\circ, k = 0.2, P3)$

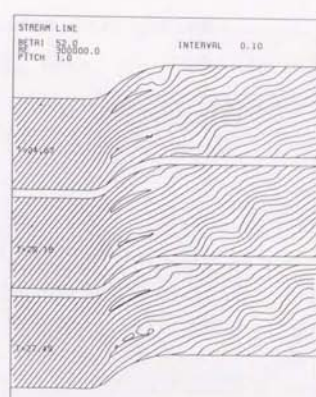
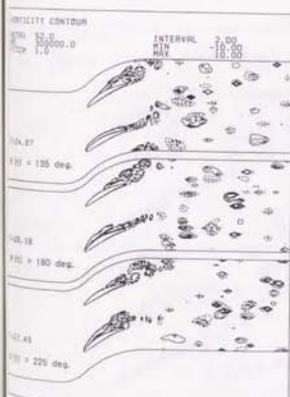
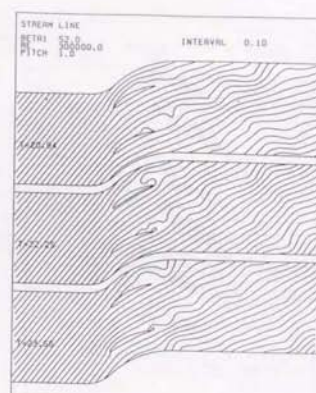
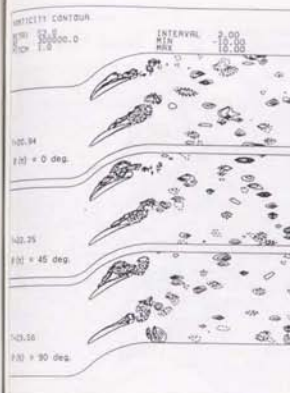


図5-2-8 (a) 周期的に前線失速の発生：渦度分布と流線
 $(\sigma = 180^\circ, k = 0.3, P4)$

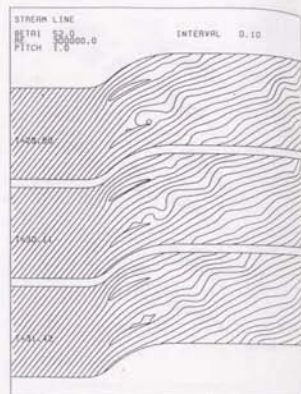
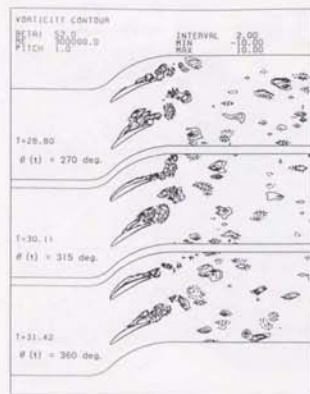


図 5-2-8 (b) 周期的に前縁失速の発生
($\alpha = 180^\circ$, $k = 0.3$, $P4$)

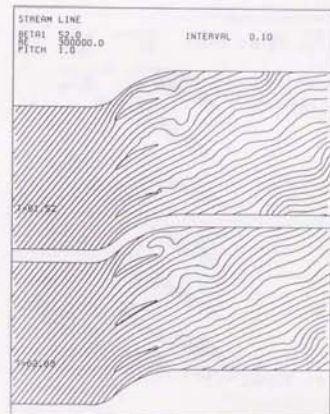
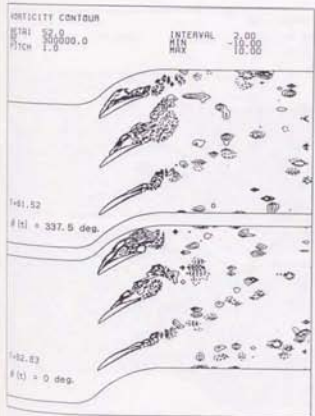
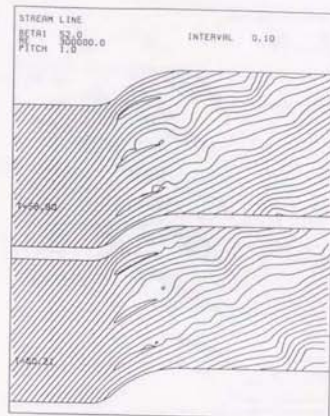
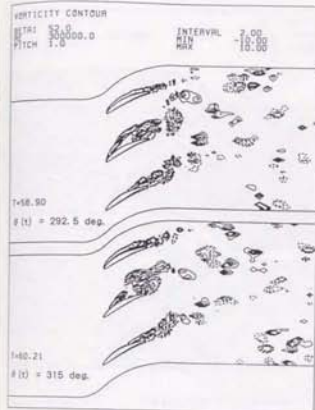


図 5-2-9 (a) 周期的な前縁失速の発生：渦度分布と流線
($\alpha = 240^\circ$, $k = 0.15$, $Q1$)

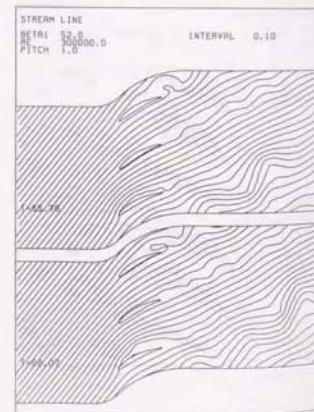
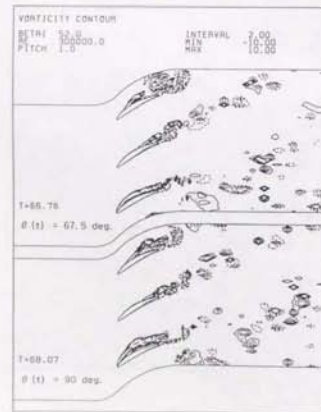
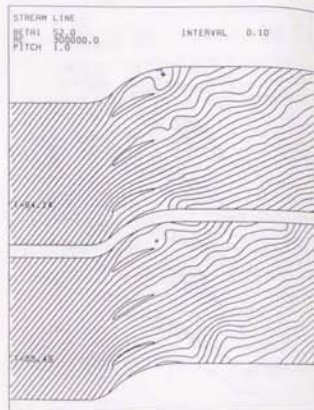
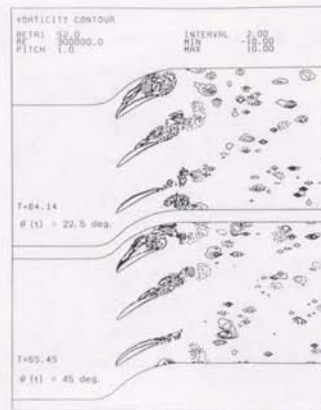


図5-2-9 (b) 周期的な前縁失速の発生

($\sigma = 2.40^*$, $k = 0, 1.5, Q1$)

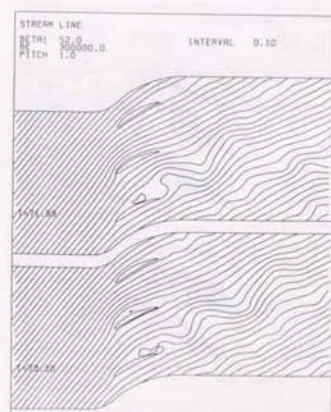
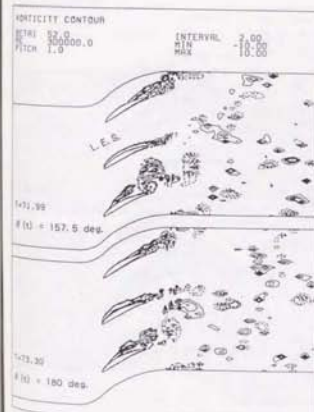
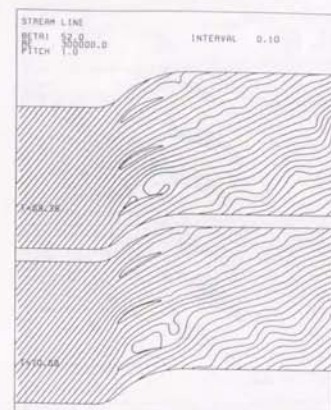
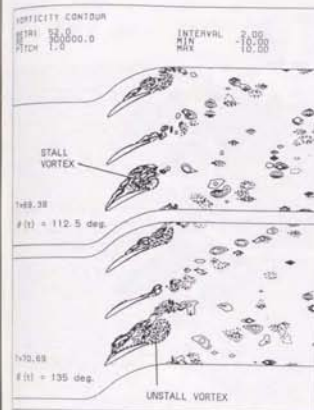


図5-2-9 (c) 周期的な前縁失速の発生

($\sigma = 2.40^*$, $k = 0, 1.5, Q1$)

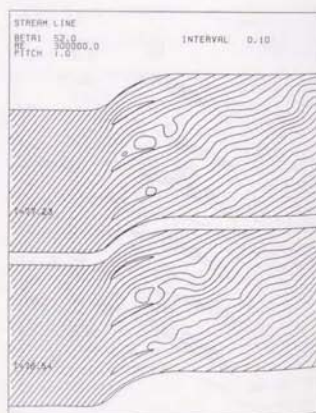
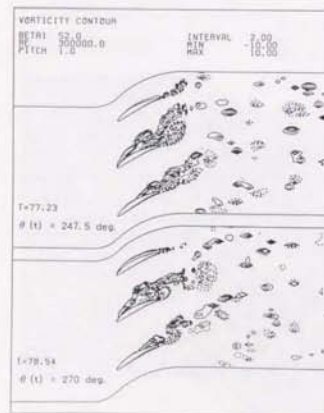
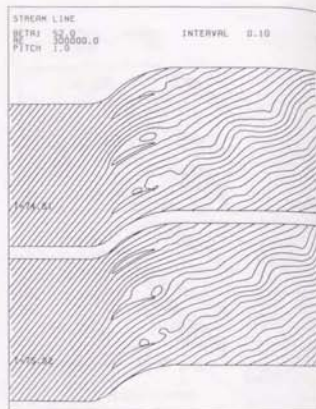
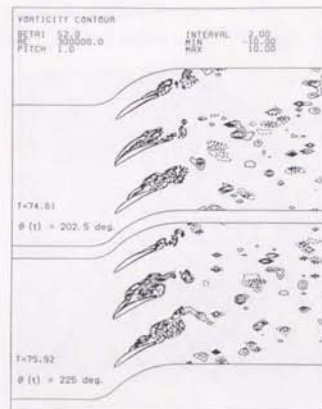


図5-2-9 (d) 周期的な前縁失速の発生
 $(\sigma = 240^\circ, k = 0.15, Q1)$

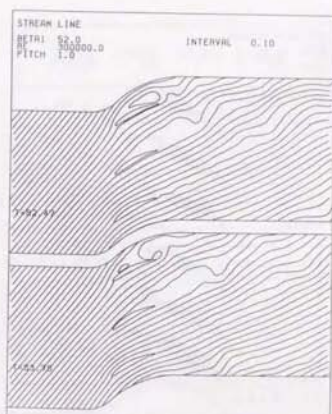
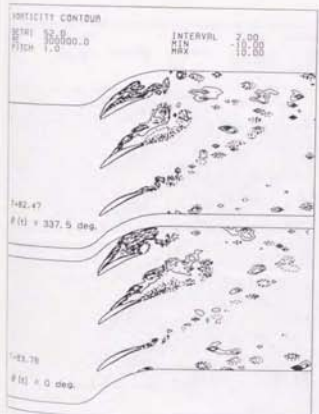
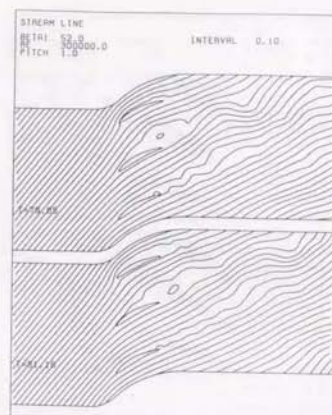
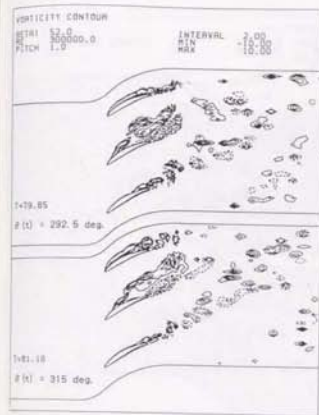


図5-2-9 (e) 周期的な前縁失速の発生
 $(\sigma = 240^\circ, k = 0.15, Q1)$

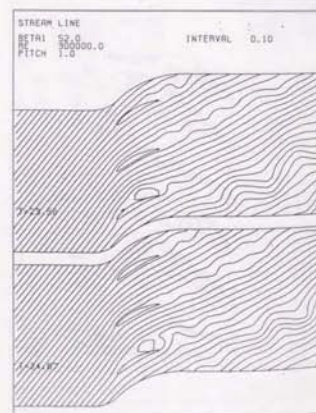
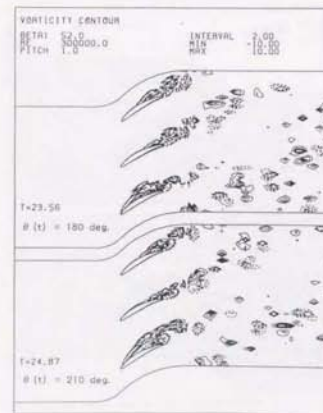
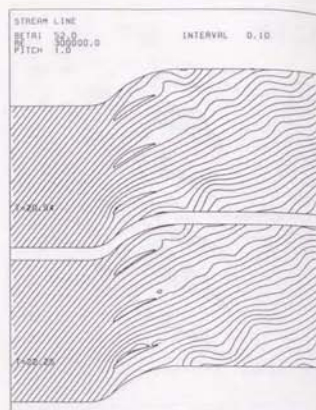
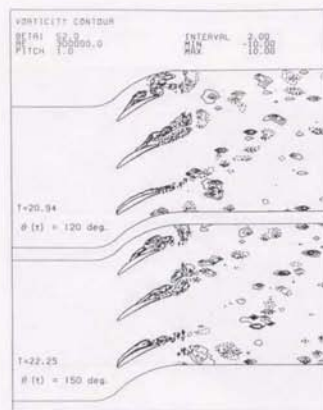


図5-2-10 (a) 周期的な前縁失速の発生：渦度分布と流線
 $(\sigma = 2.40^\circ, k = 0, 2, Q2)$

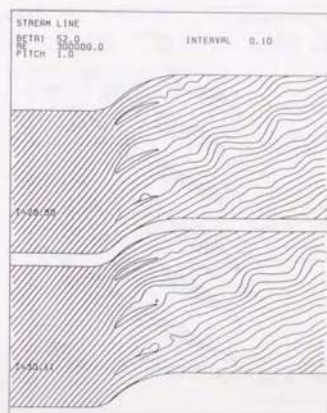
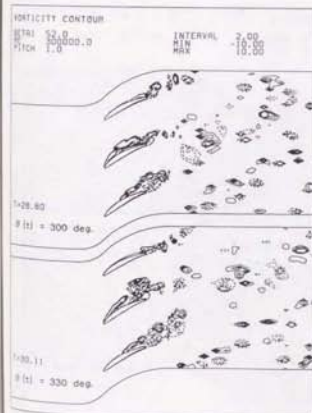
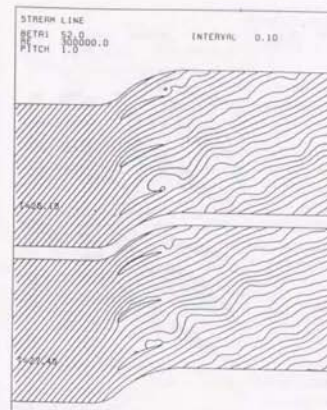
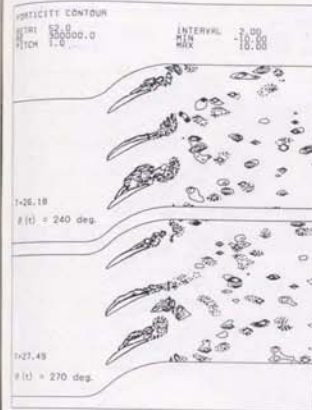


図5-2-10 (b) 周期的な前縁失速の発生
 $(\sigma = 2.40^\circ, K = 0, 2, Q2)$

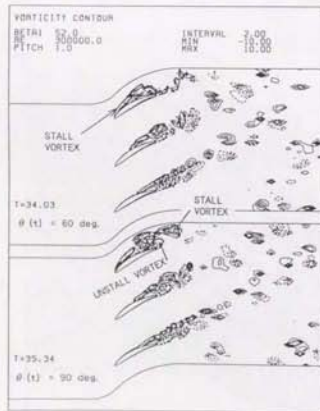
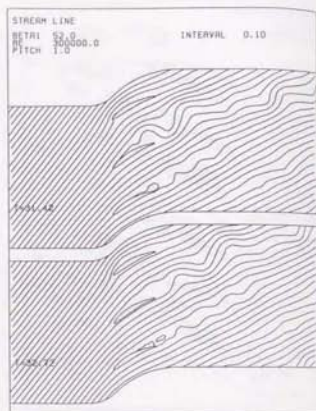
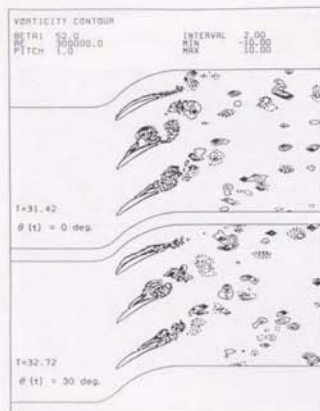


図5-2-10 (c) 周期的な前縁失速の発生

($\sigma = 240^\circ$, $k = 0.2, Q2$)

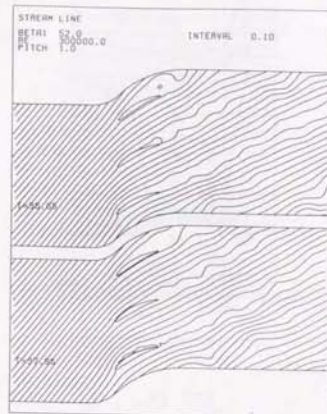
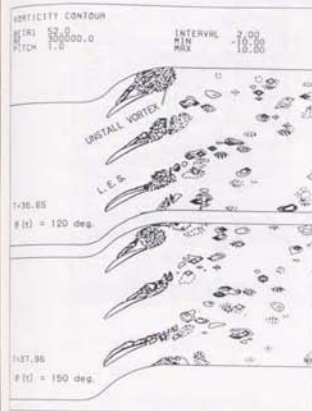


図5-2-10 (d) 周期的な前縁失速の発生

($\sigma = 240^\circ$, $k = 0.2, Q2$)

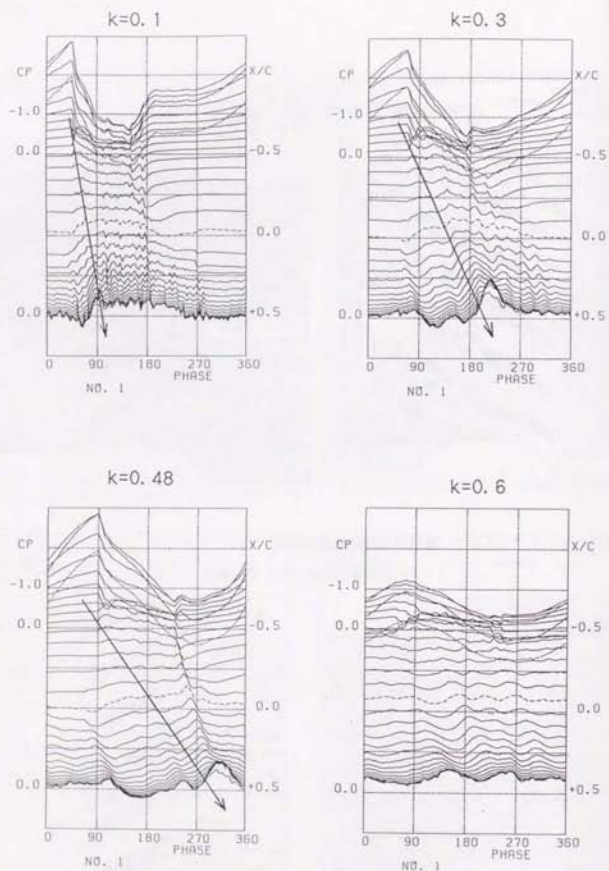


図5-2-11 翼面非定常圧力波形の比較: $\sigma = 0^\circ$

(a) $k=0.1$, (b) $k=0.3$, (c) $k=0.48$, (d) $k=0.6$

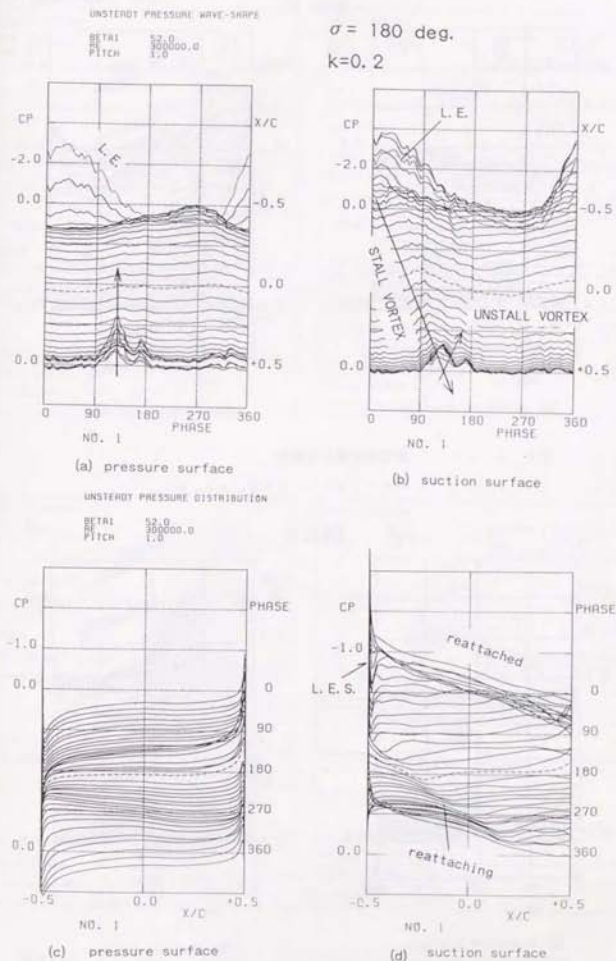


図5-2-12 翼面非定常圧力変動

(a) (b) 圧力波形, (c) (d) 圧力分布

($\sigma = 180^\circ$, $k = 0.2$, P3)

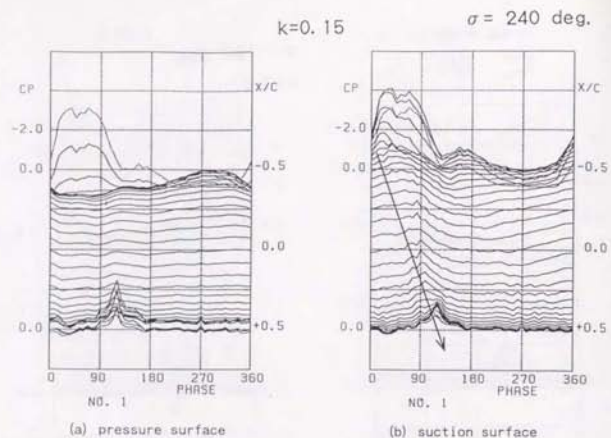


図5-2-13 翼面非定常圧力波形
($\sigma = 240^\circ$, $k = 0.15$, Q1)

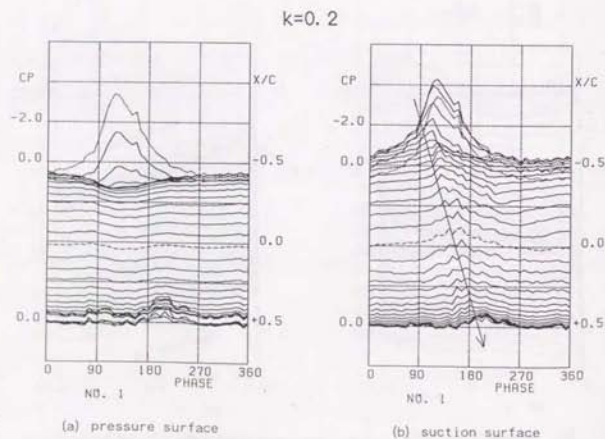


図5-2-14 翼面非定常圧力波形
($\sigma = 240^\circ$, $k = 0.2$, Q2)

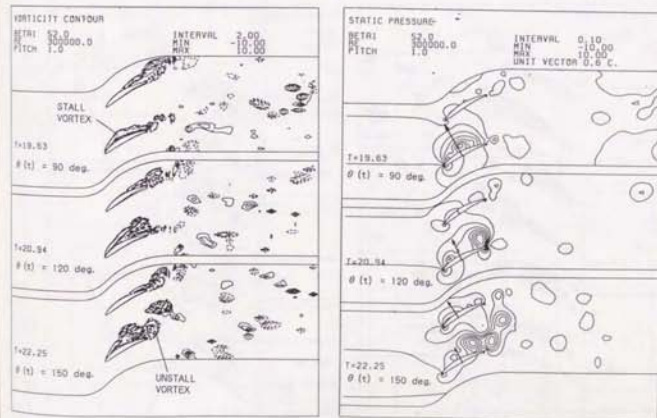
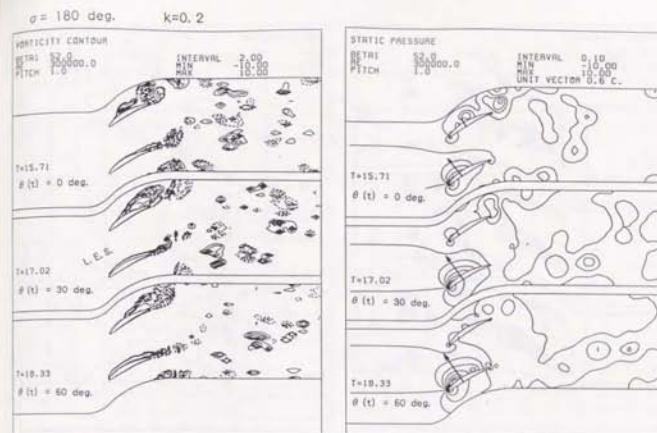


図5-2-15 (a) 振動翼列における失速渦放出現象：渦度分布と静圧分布
($\sigma = 180^\circ$, $k = 0.2$, P3)

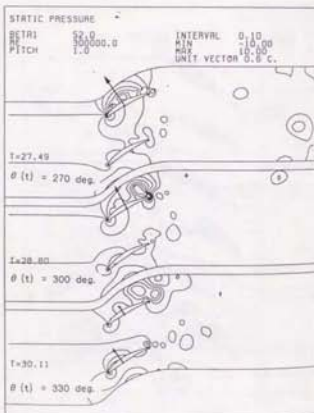
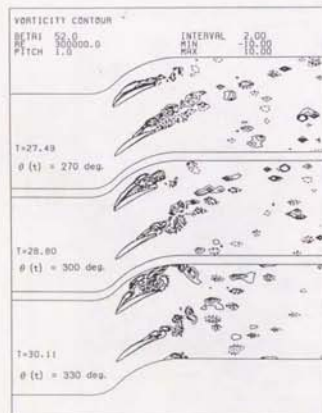
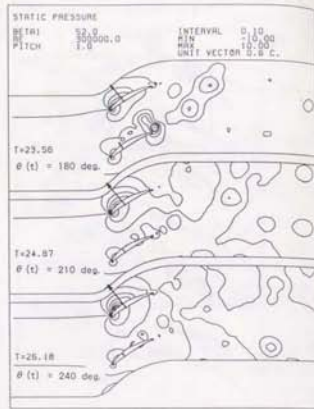
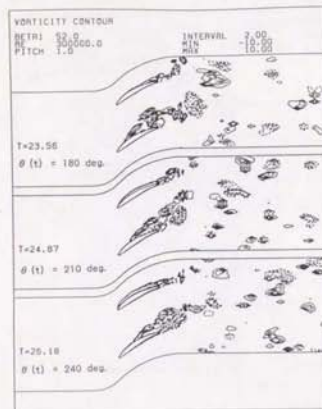


図5-2-15 (b) 振動翼列における失速渦放出現象
($\sigma = 180^\circ$, $k = 0.2, P3$)

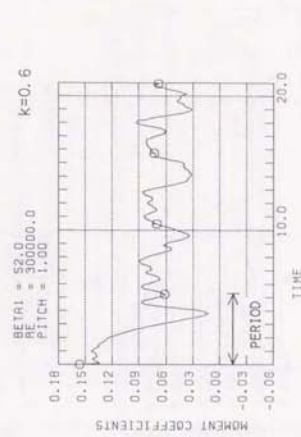
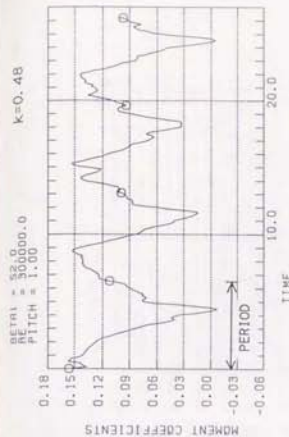


図5-2-16 非定常モーメントの時間変動の比較: $\sigma = 0^\circ$
(a) $k=0.1$, (b) $k=0.3$, (c) $k=0.48$, (d) $k=0.6$

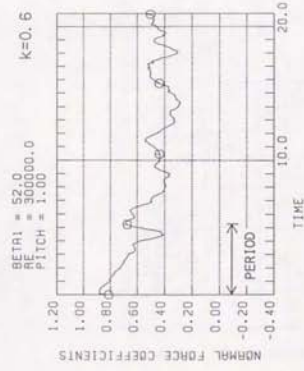
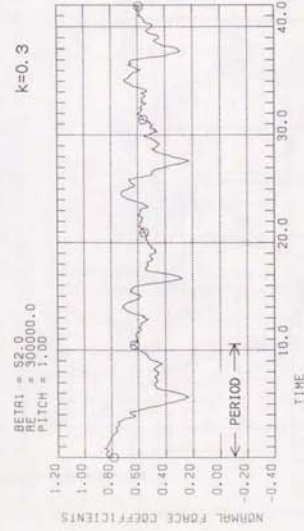


図 5-2-17 非定常空気の時間変動の比較：垂直方向成分， $\sigma = 0^\circ$
(a) $k=0.1$, (b) $k=0.3$, (c) $k=0.48$, (d) $k=0.6$

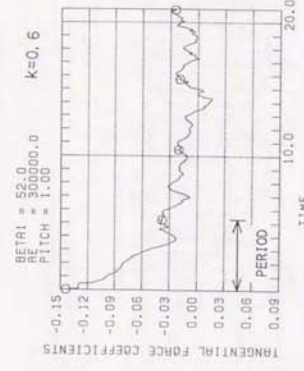
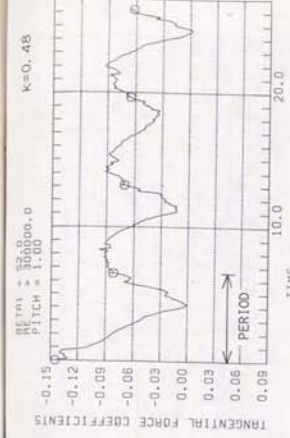
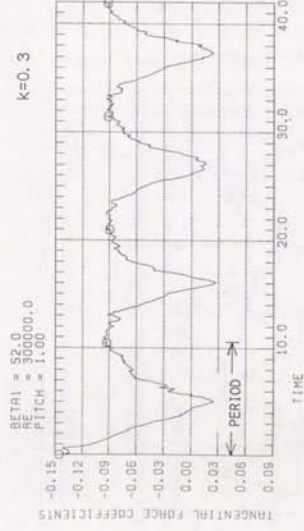
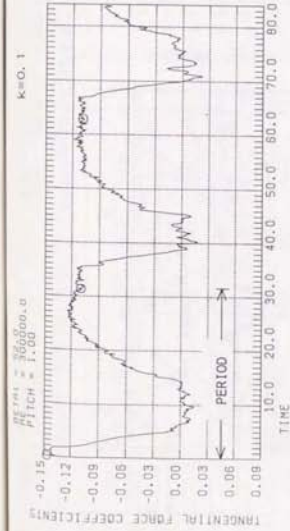


図 5-2-18 非定常空気の時間変動の比較：翼弦方向成分， $\sigma = 0^\circ$
(a) $k=0.1$, (b) $k=0.3$, (c) $k=0.48$, (d) $k=0.6$

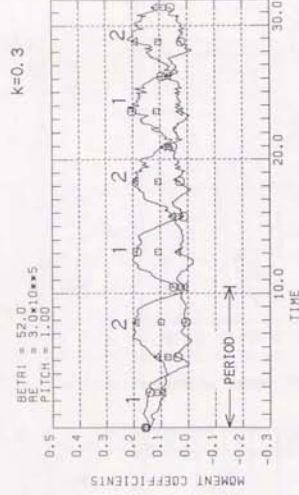
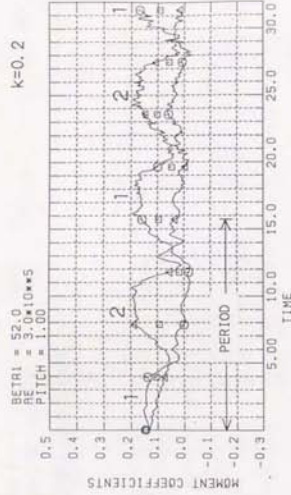
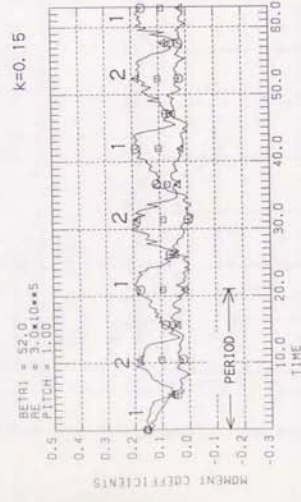
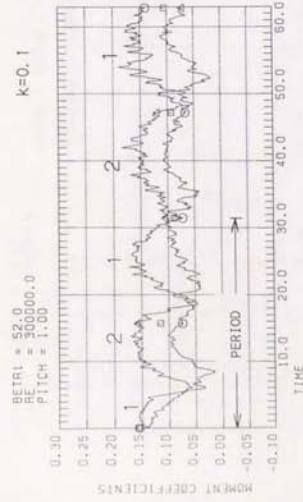


図5-2-1.9 非定常モーメントの時間変動の比較: $\sigma = 1.80^\circ$

(a) $k=0.1$, (b) $k=0.15$, (c) $k=0.2$, (d) $k=0.3$

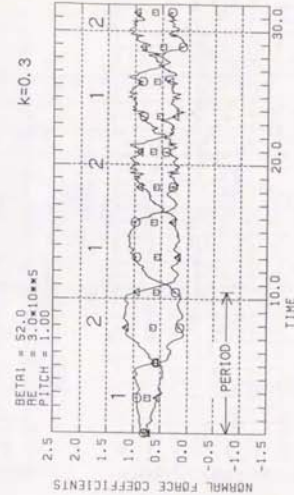
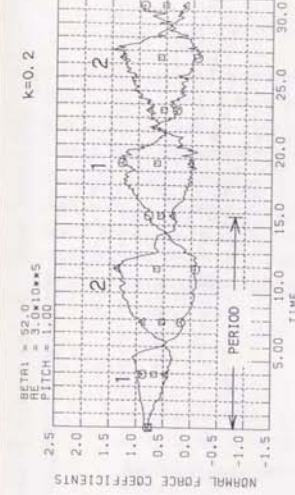
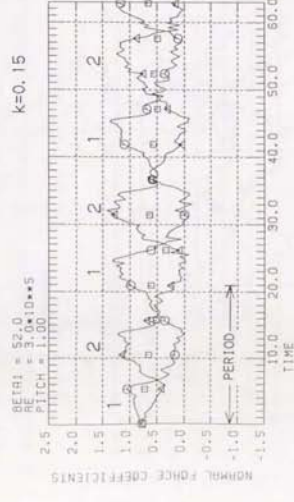
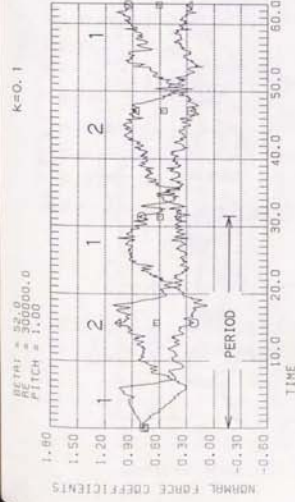


図5-2-2.0

非定常空気の時間変動の比較: 垂直方向成分, $\sigma = 1.80^\circ$

(a) $k=0.1$, (b) $k=0.15$, (c) $k=0.2$, (d) $k=0.3$

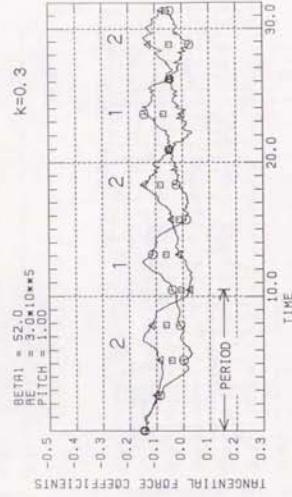
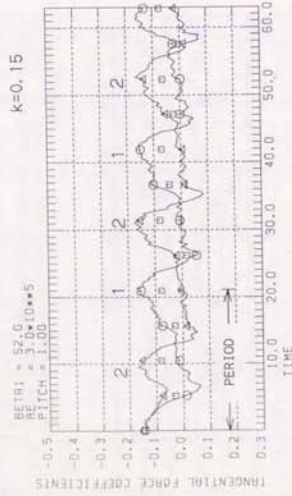
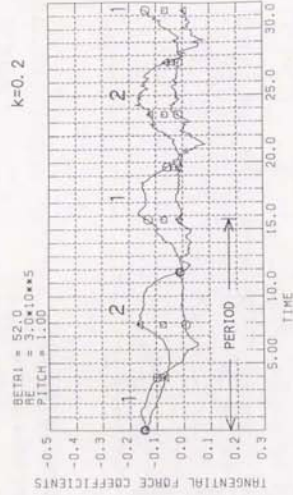
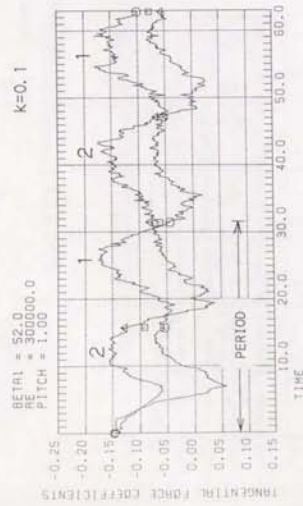
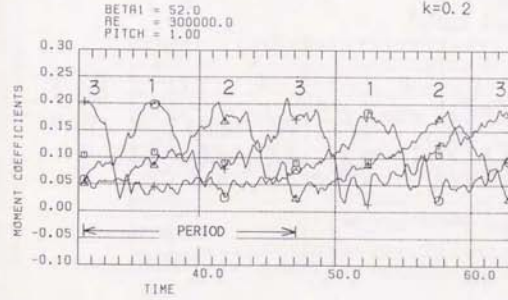


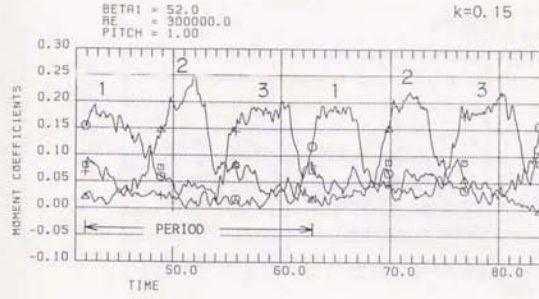
図5-2-21

非定常空気の時間変動の比較：翼弦方向成分， $\sigma = 180^\circ$

(a) $k=0.1$, (b) $k=0.15$, (c) $k=0.2$, (d) $k=0.3$



NO.1 Δ
NO.2 \circ
NO.3 $+$
AVE. \square



NO.1 Δ
NO.2 \circ
NO.3 $+$
AVE. \square

図5-2-22 非定常モーメントの時間変動の比較： $\sigma = 240^\circ$

(a) $k=0.15$, (b) $k=0.2$

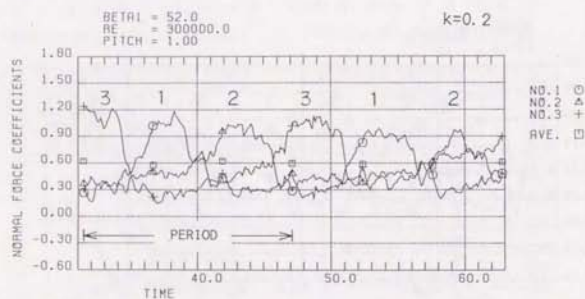
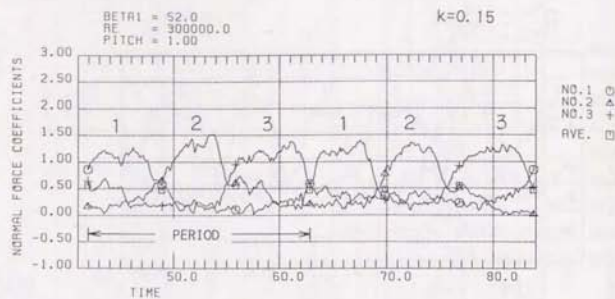


図5-2-23 非常空気の時間変動の比較：垂直方向成分， $\sigma = 24.0^\circ$
(a) $k=0.15$ ，(b) $k=0.2$

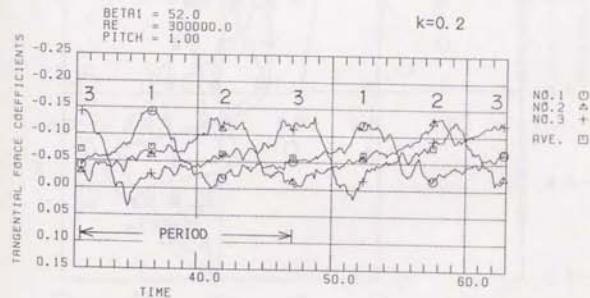
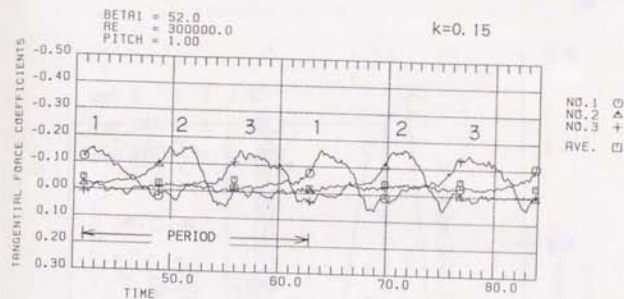


図5-2-24 非常空気の時間変動の比較：翼弦方向成分， $\sigma = 24.0^\circ$
(a) $k=0.15$ ，(b) $k=0.2$

$\text{Im}(C_M)$

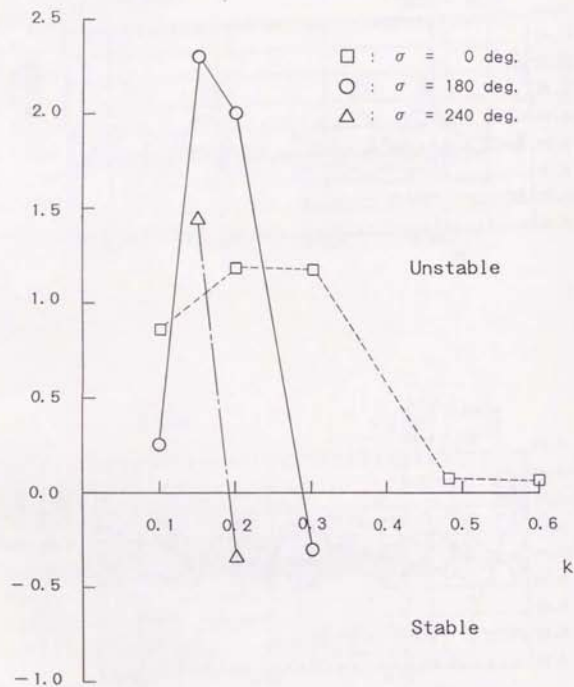


図5-2-25 無次元振動数に対する励振モーメントの変化
周期条件 (I), $\beta_1=52^\circ$, $s/c=1$, $\xi=30 \text{ deg.}$
 $\text{Re}=300,000$, $\alpha_s=2 \text{ deg.}$

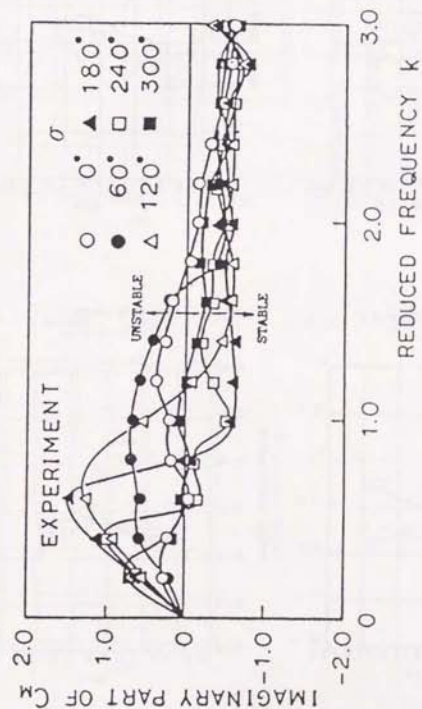
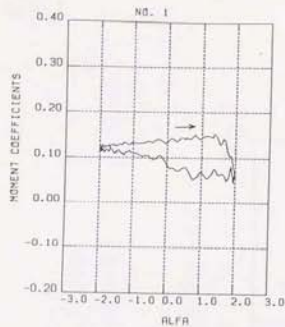


図5-2-26 無次元振動数に対する励振モーメントの変化
 $s/c=1$, $\xi=30 \text{ deg.}$, $\alpha_s=15^\circ$ (incidence)
 $\text{Re}=50,000$, ねじれ中心はミッドコード.
(by Yashima et al. [47])

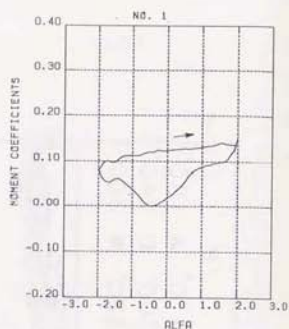
k=0.1

BETA1 = 52.0
RE = 300000.0
PITCH = 1.00



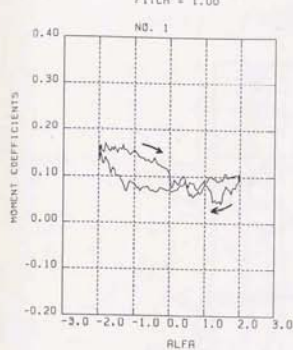
k=0.3

BETA1 = 52.0
RE = 300000.0
PITCH = 1.00



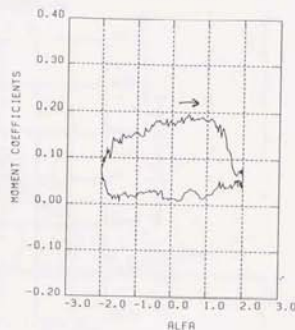
k=0.1

BETA1 = 52.0
RE = 300000.0
PITCH = 1.00



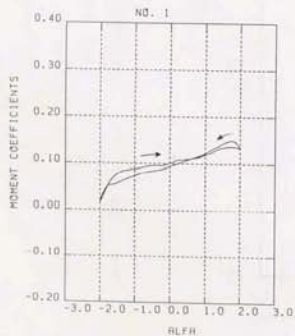
k=0.15

BETA1 = 52.0
RE = 300000.0
PITCH = 1.00



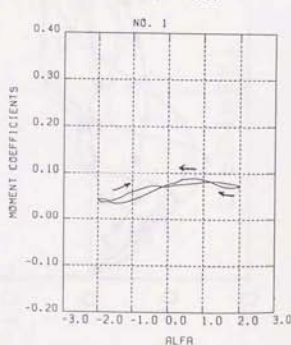
k=0.48

BETA1 = 52.0
RE = 300000.0
PITCH = 1.00



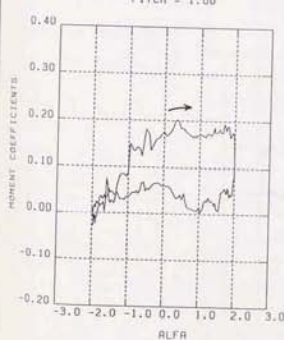
k=0.6

BETA1 = 52.0
RE = 300000.0
PITCH = 1.00



k=0.2

BETA1 = 52.0
RE = 300000.0
PITCH = 1.00



k=0.3

BETA1 = 52.0
RE = 300000.0
PITCH = 1.00

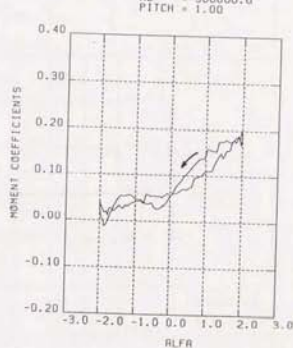


図5-2-27 非常常モーメントループの比較: $\sigma = 0^\circ$

(a) k=0.1, (b) k=0.3, (c) k=0.48, (d) k=0.6

図5-2-28

非常常モーメントループの比較: $\sigma = 180^\circ$

(a) k=0.1, (b) k=0.15, (c) k=0.2, (d) k=0.3

$k=0.15$

BETA1 = 52.0
RE = 300000.0
PITCH = 1.00



$k=0.2$

BETA1 = 52.0
RE = 300000.0
PITCH = 1.00



図5-2-29 非定常モーメントループの比較: $\sigma = 240^\circ$
(a) $k=0.15$, (b) $k=0.2$

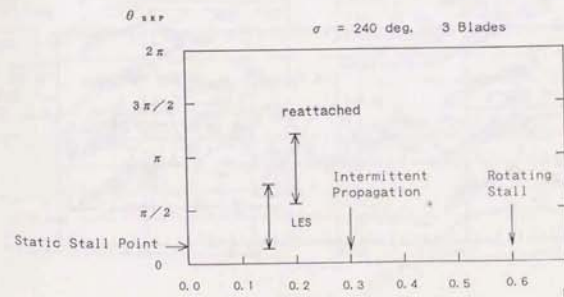
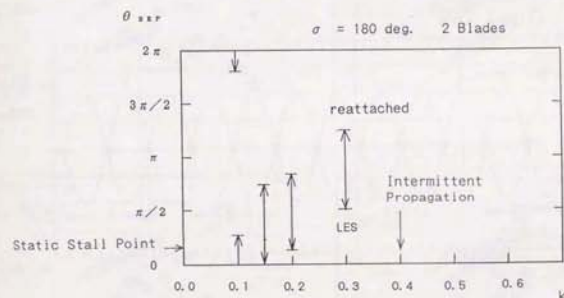
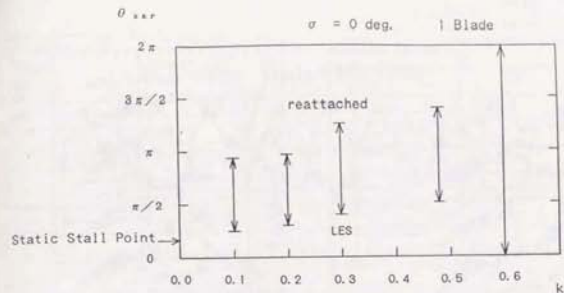


図5-2-30 翼背面境界層の前縁剥離と再付着の起きる位相
($\sigma = 0^\circ, 180^\circ, 240^\circ$)

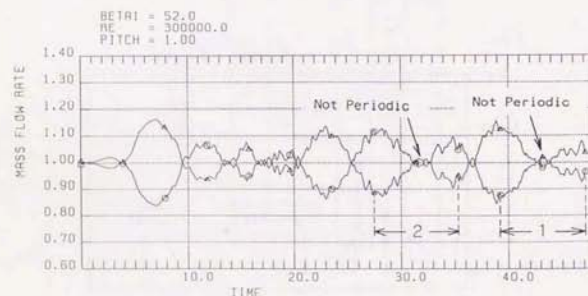
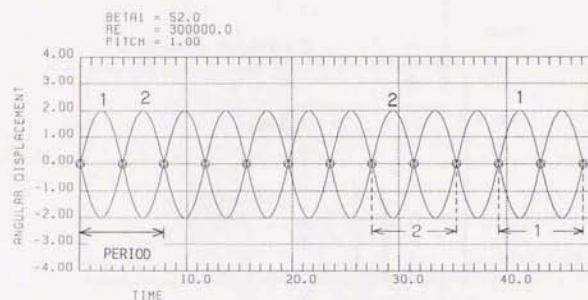
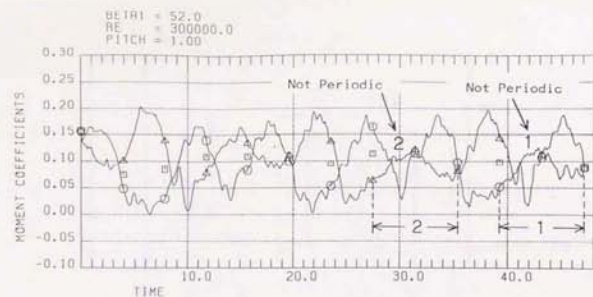


図5-3-1 モーメントと流量の非周期的変動
($\sigma = 180^\circ$, $k = 0.4$, $P5$)

NO. 1 ○
NO. 2 △
AVE. □

NO. 1 ○
NO. 2 △
AVE. □

○ NO. 1
△ NO. 2

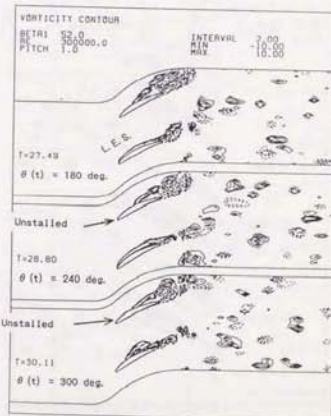
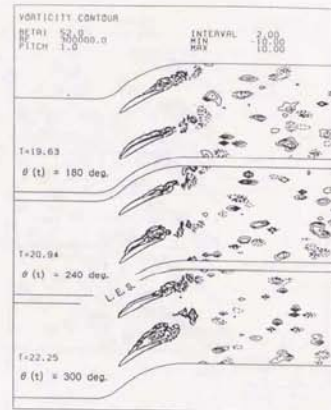
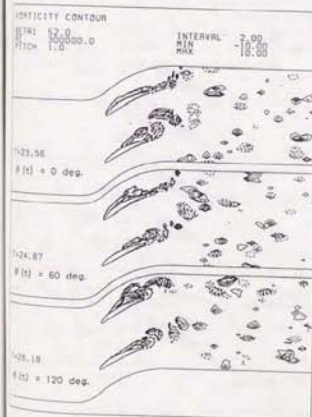
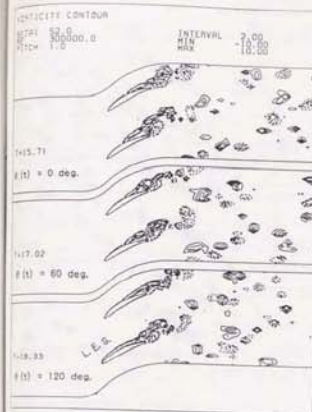


図5-3-2 (a) 非周期的な前縁失速の伝播：渦度分布
($\sigma = 180^\circ$, $k = 0.4$, $P5$)

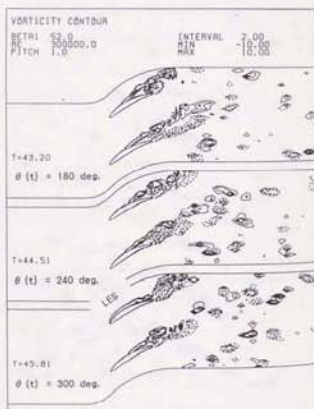
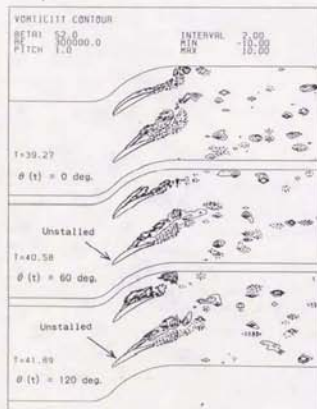
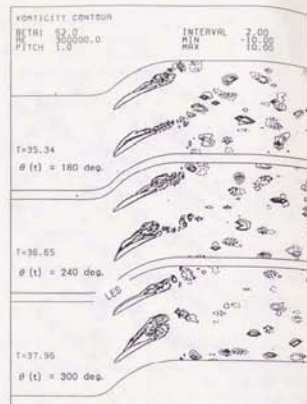
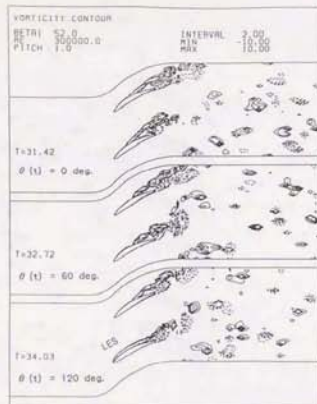


図5-3-2 (b) 非周期的な前縁失速の伝播
($\sigma = 180^\circ$, $k = 0.4$, PS)

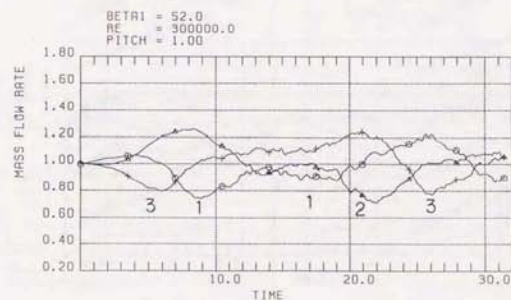
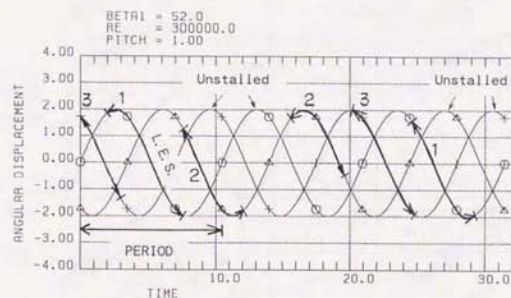
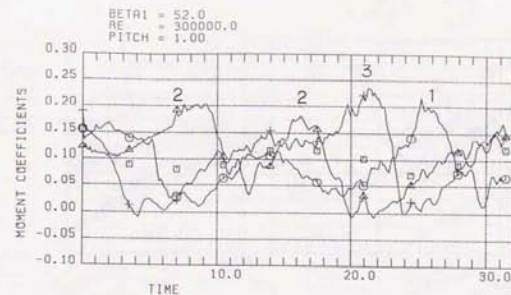


図5-3-3 (a) モーメントと流量の非周期的変動
($\sigma = 240^\circ$, $k = 0.3$, Q3)

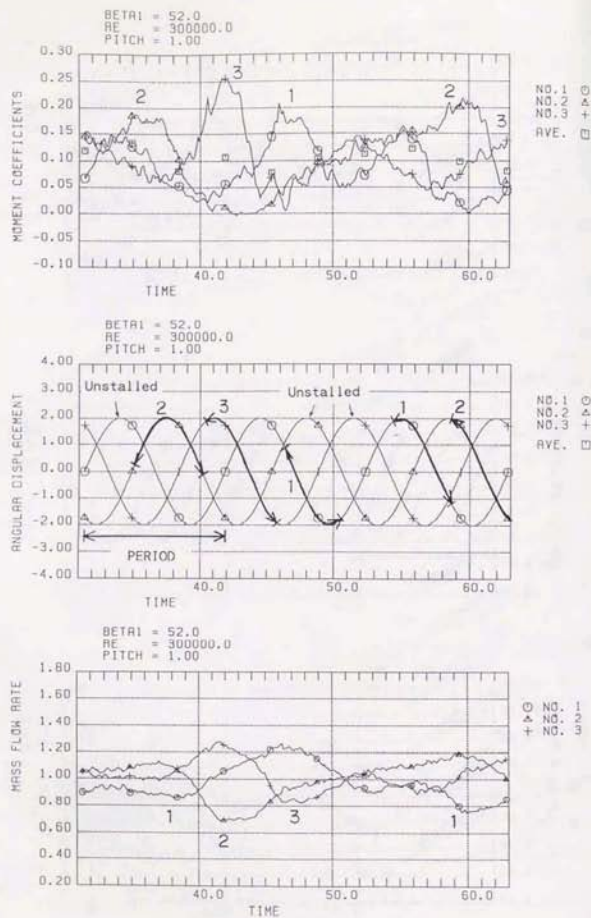


図5-3-3 (b) モーメントと流量の非周期的変動
($\sigma = 2.40^\circ$, $k = 0.3, Q3$)



図5-3-4 (a) 非周期的な前縁失速の伝播：渦度分布
($\sigma = 2.40^\circ$, $k = 0.3, Q3$)

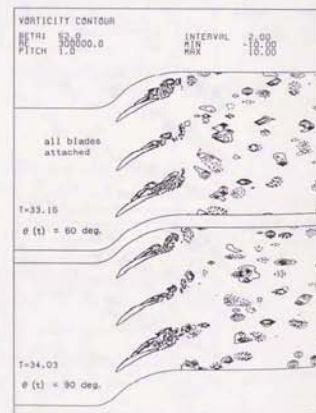
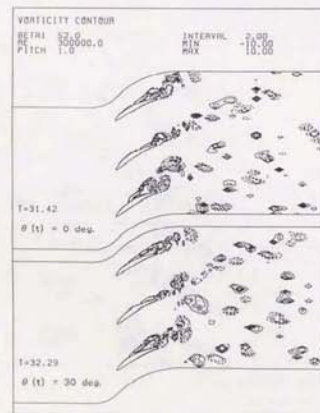
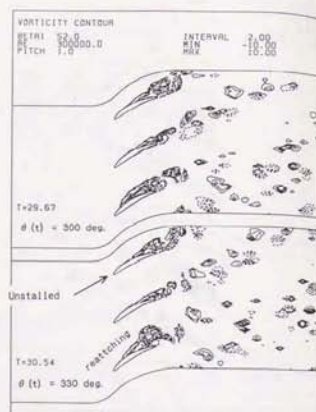
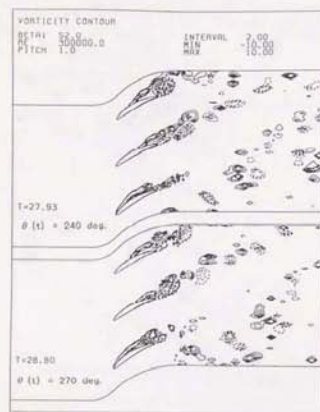


図 5-3-4 (b) 非周期的な前縁失速の伝播
 $(\sigma = 2.40^\circ, k = 0.3, Q3)$

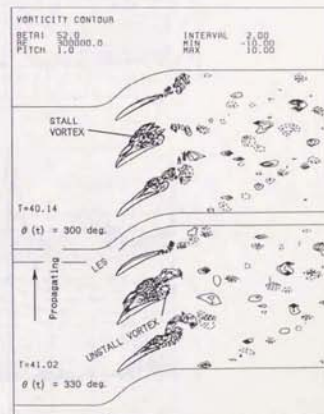
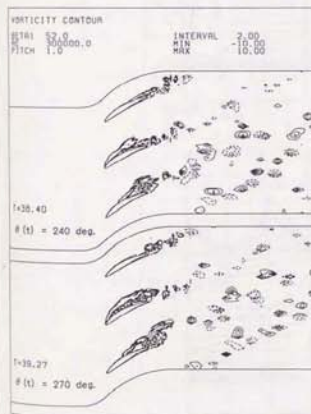
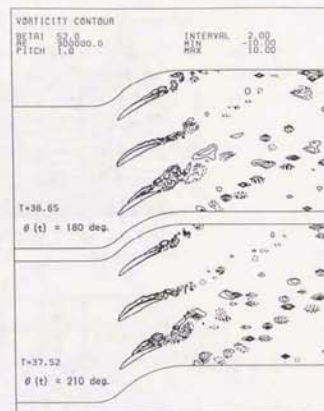
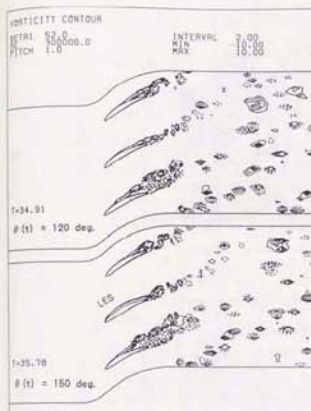


図 5-3-4 (c) 非周期的な前縁失速の伝播
 $(\sigma = 2.40^\circ, k = 0.3, Q3)$

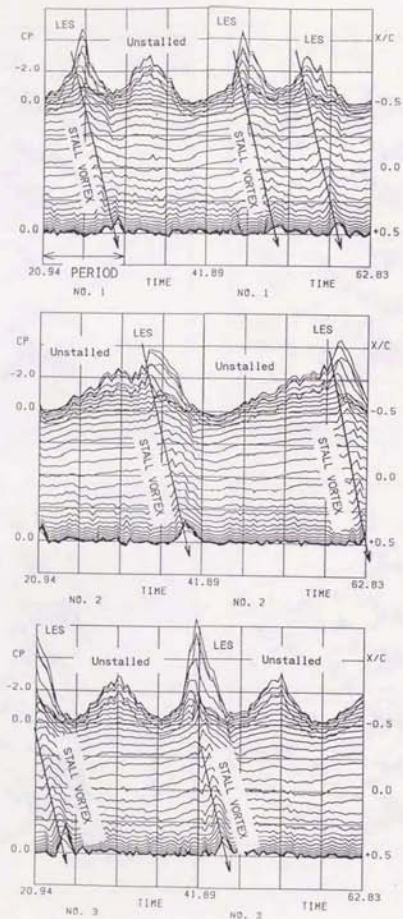


図5-3-5 翼背面非常圧力の時間変動
(翼No.1~No.3, $t=20.94 \sim 62.83$, Q3)

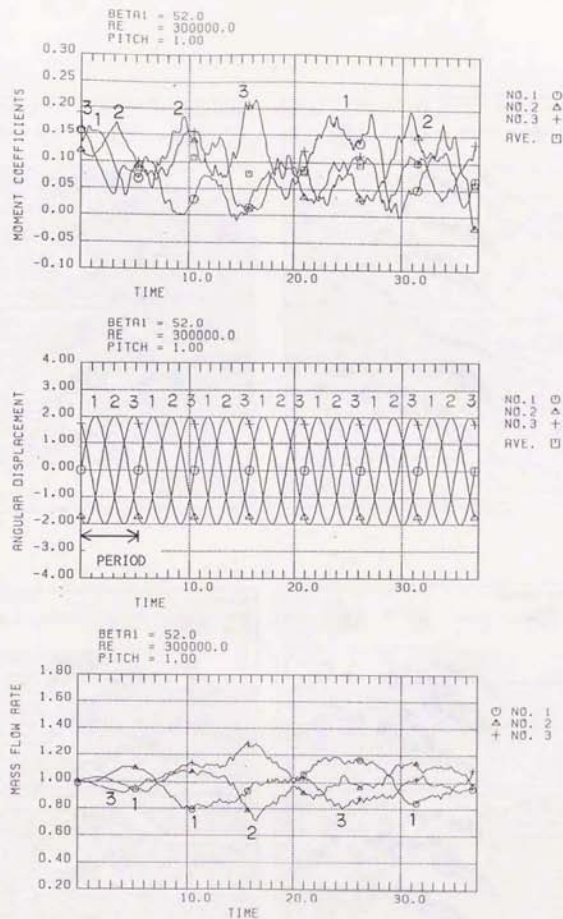


図5-3-6 振動翼列における旋回失速の伝播：モーメント、角変位、流量
($\sigma = 24.0^\circ$, $k = 0.6$, Q4)

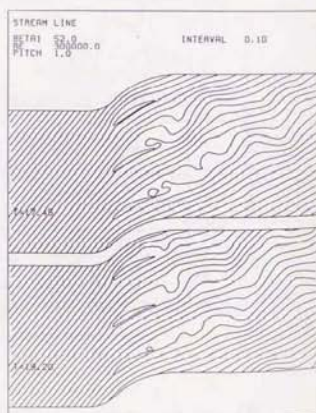
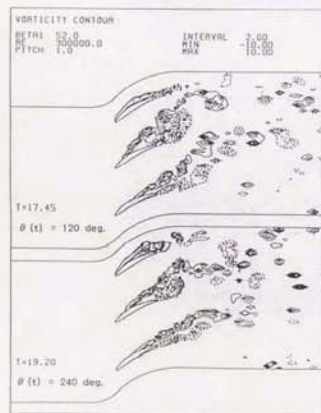
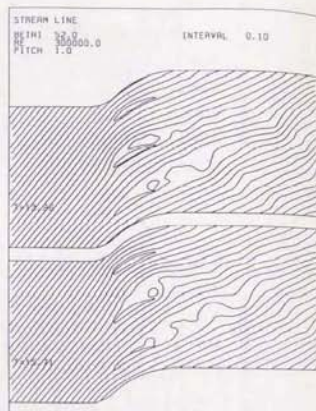
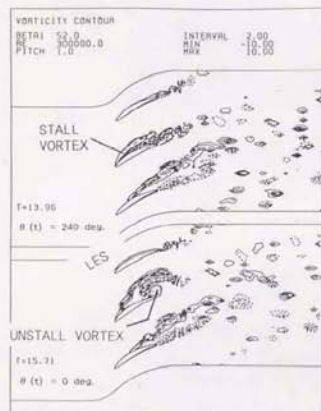


図 5-3-7 (a) 振動翼列における旋回失速の伝播：渦度分布と流線
 $(\sigma = 240^\circ, k = 0.6, Q4)$

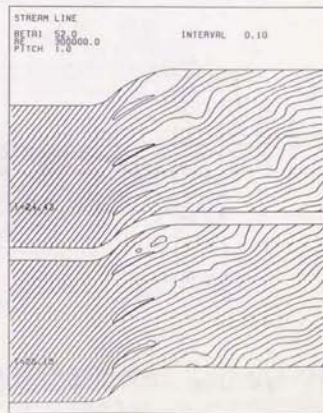
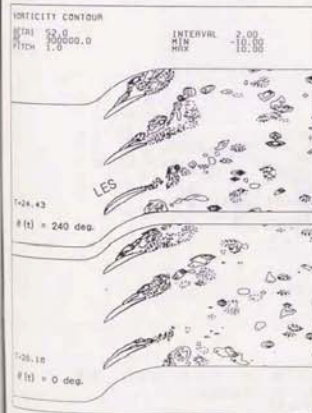
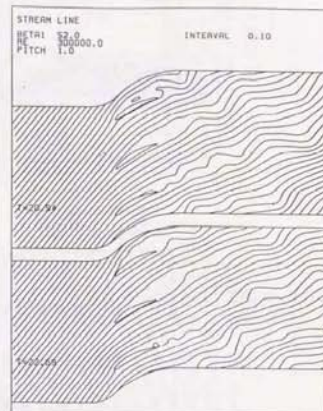
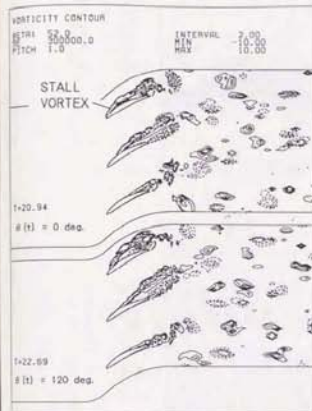


図 5-3-7 (b) 振動翼列における旋回失速の伝播
 $(\sigma = 240^\circ, k = 0.6, Q4)$

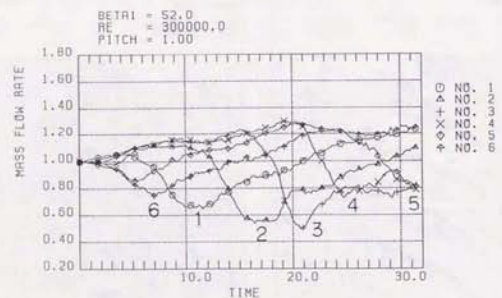
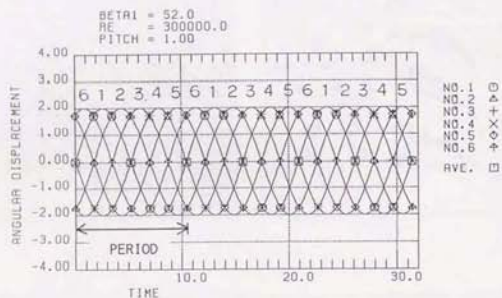
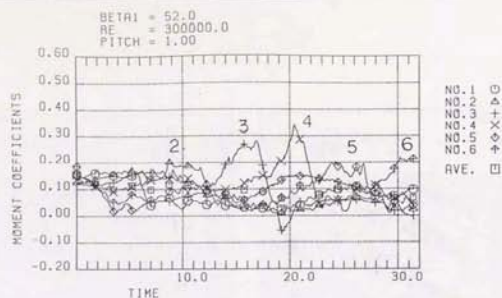


図5-3-8 (a)

振動翼列における旋回失速の伝播：モーメント，角変位，流量
($\sigma = 300^\circ$, $k = 0.3, R3$)

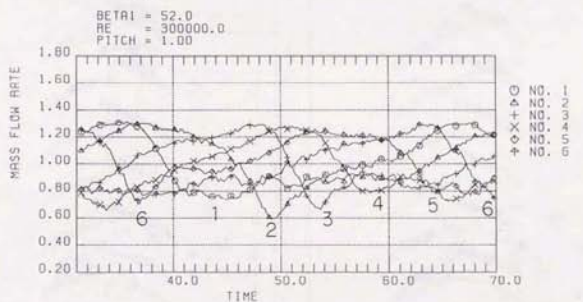
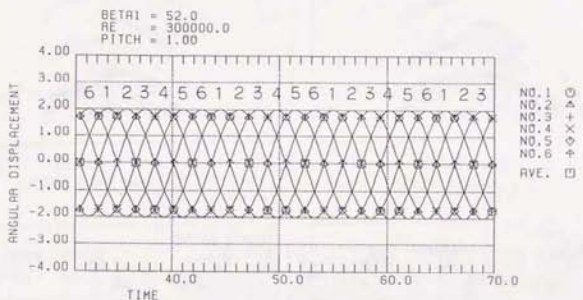
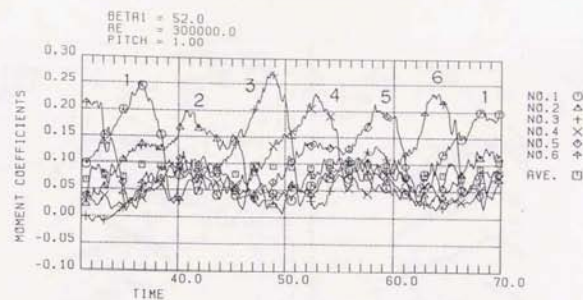
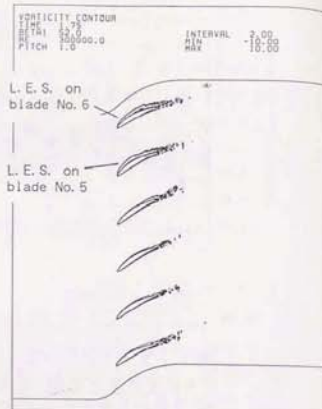


図5-3-8 (b)

振動翼列における旋回失速の伝播：モーメント，角変位，流量
($\sigma = 300^\circ$, $k = 0.3, R3$)



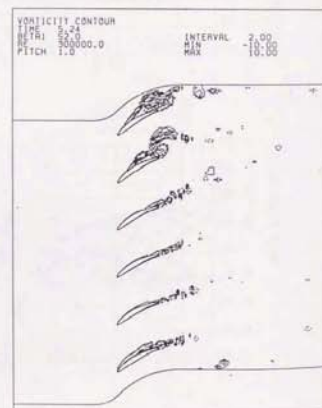
$\theta(t) = 0 \text{ deg.}$



$\theta(t) = 60 \text{ deg.}$



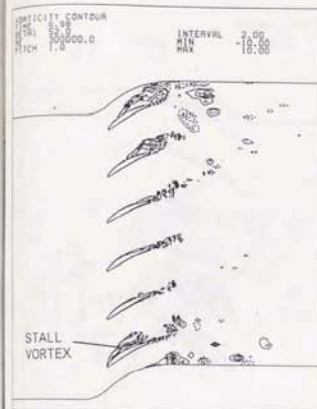
$\theta(t) = 120 \text{ deg.}$



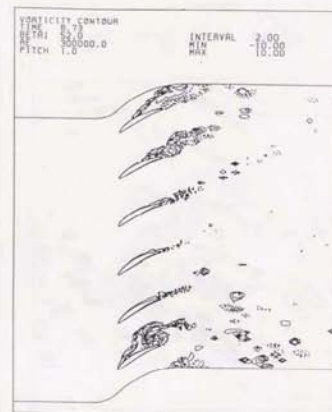
$\theta(t) = 180 \text{ deg.}$

図5-3-9 (a)

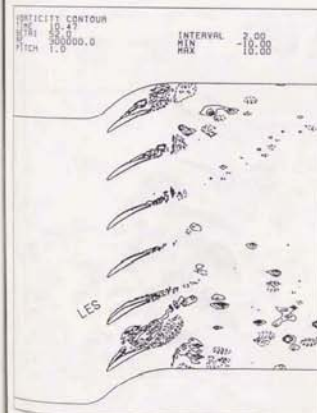
振動翼列における旋回失速の伝播：渦度分布
($\sigma = 3.00^\circ$, $k = 0.3, R3$)



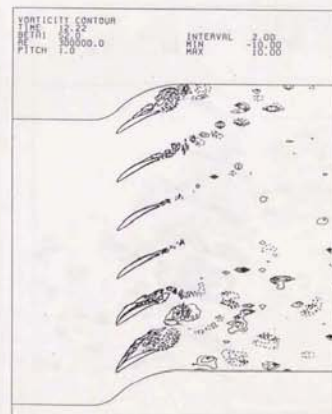
$\theta(t) = 240 \text{ deg.}$



$\theta(t) = 300 \text{ deg.}$



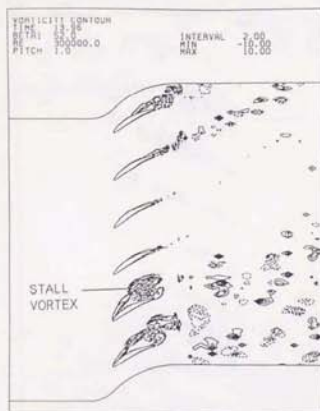
$\theta(t) = 0 \text{ deg.}$



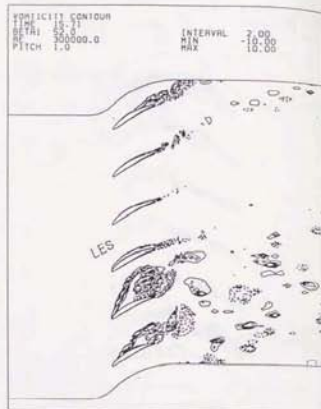
$\theta(t) = 60 \text{ deg.}$

図5-3-9 (b)

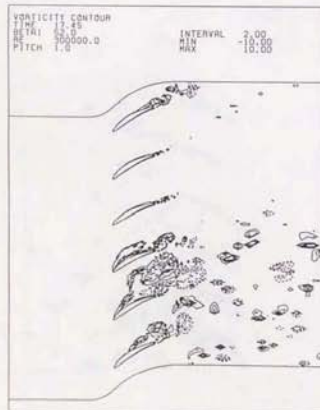
振動翼列における旋回失速の伝播
($\sigma = 3.00^\circ$, $k = 0.3, R3$)



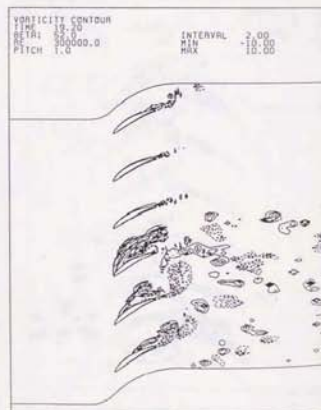
$\theta(t) = 120 \text{ deg.}$



$\theta(t) = 180 \text{ deg.}$

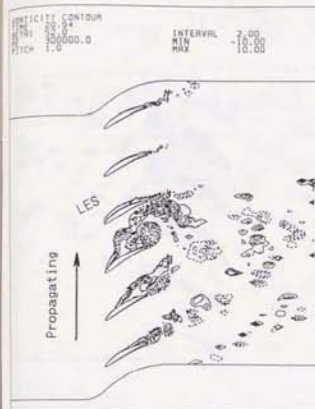


$\theta(t) = 240 \text{ deg.}$

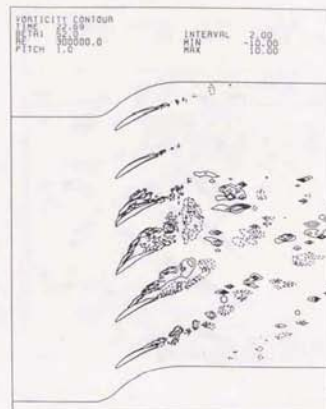


$\theta(t) = 300 \text{ deg.}$

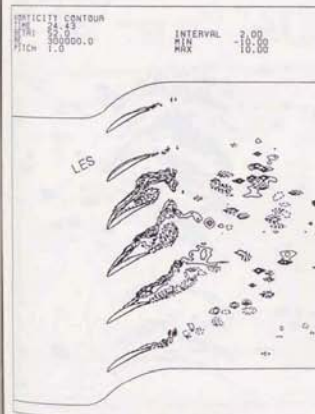
図 5-3-9 (c) 振動翼列における旋回失速の伝播
($\sigma = 30.0^\circ$, $k = 0.3, R_3$)



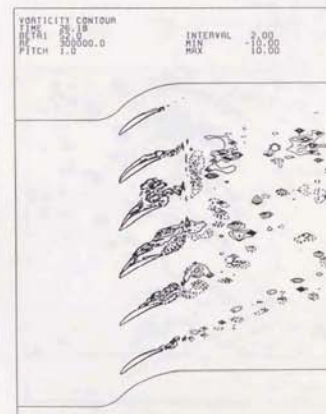
$\theta(t) = 0 \text{ deg.}$



$\theta(t) = 60 \text{ deg.}$

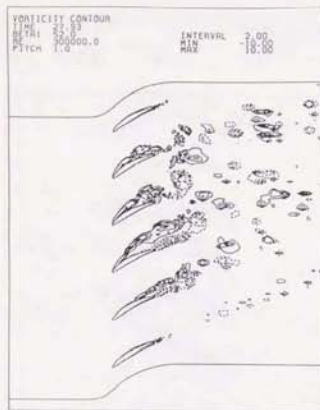


$\theta(t) = 120 \text{ deg.}$

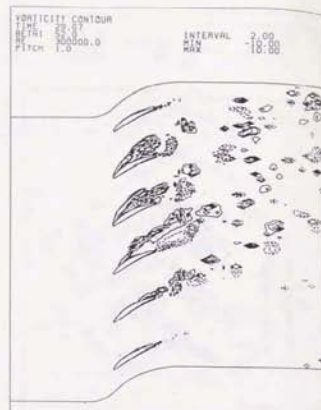


$\theta(t) = 180 \text{ deg.}$

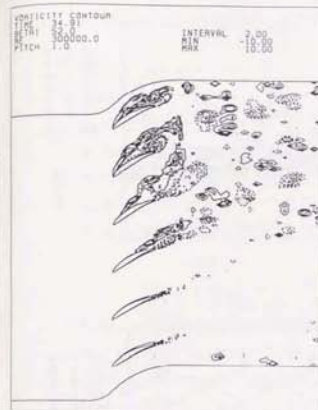
図 5-3-9 (d) 振動翼列における旋回失速の伝播
($\sigma = 30.0^\circ$, $k = 0.3, R_3$)



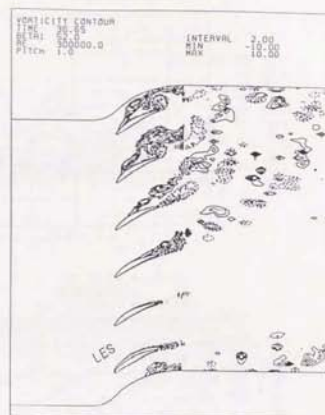
$\theta(t) = 240 \text{ deg.}$



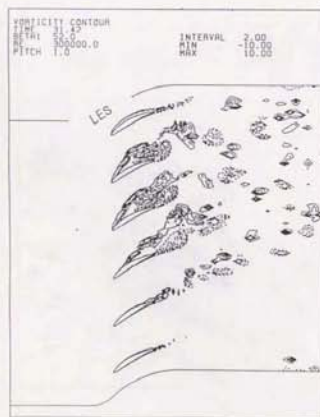
$\theta(t) = 300 \text{ deg.}$



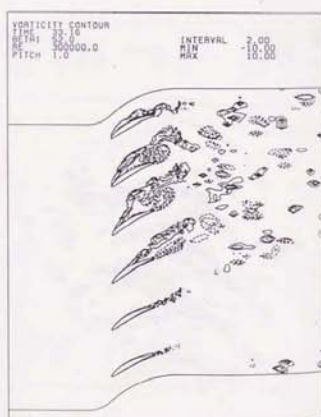
$\theta(t) = 120 \text{ deg.}$



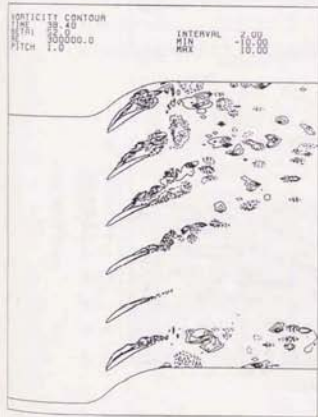
$\theta(t) = 180 \text{ deg.}$



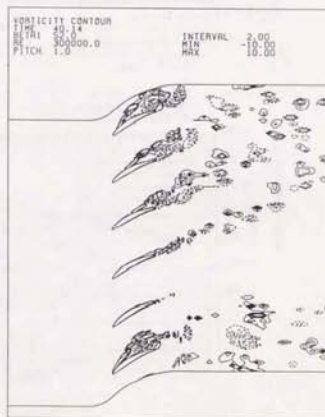
$\theta(t) = 0 \text{ deg.}$



$\theta(t) = 60 \text{ deg.}$



$\theta(t) = 240 \text{ deg.}$



$\theta(t) = 300 \text{ deg.}$

図5-3-9 (e)

振動翼における旋回失速の伝播

($\sigma = 3.00^*$, $k = 0.3$, R_3)

図5-3-9 (f)

振動翼における旋回失速の伝播

($\sigma = 3.00^*$, $k = 0.3$, R_3)

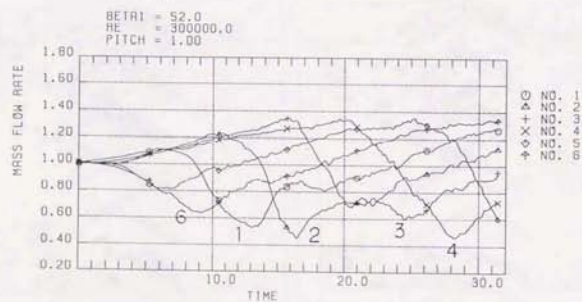
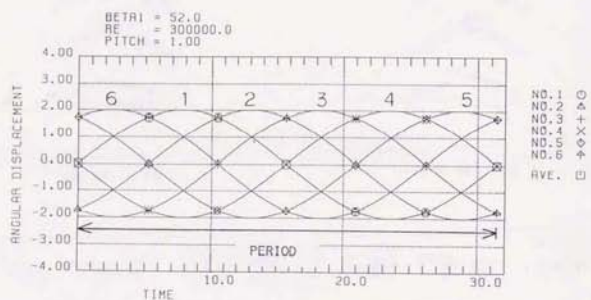
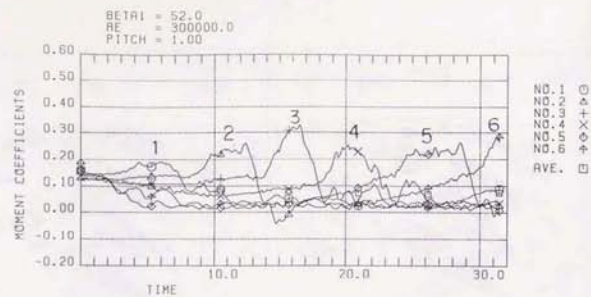


図5-3-10 (a) モーメントと流量の周期的変動
($\sigma = 3.00^\circ$, $k = 0.1, R1$)

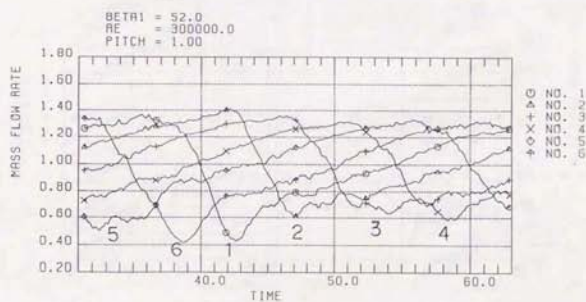
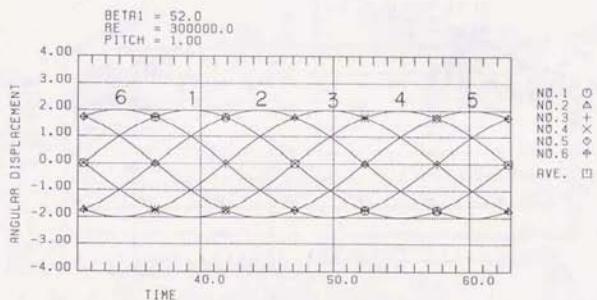
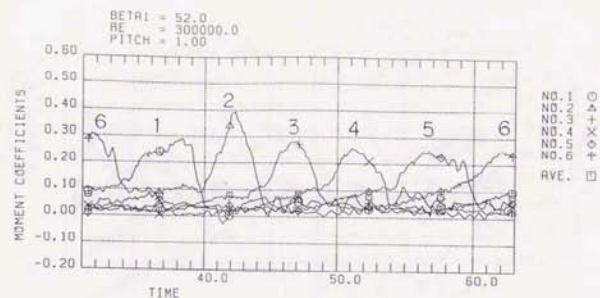


図5-3-10 (b) モーメントと流量の周期的変動
($\sigma = 3.00^\circ$, $k = 0.1, R1$)

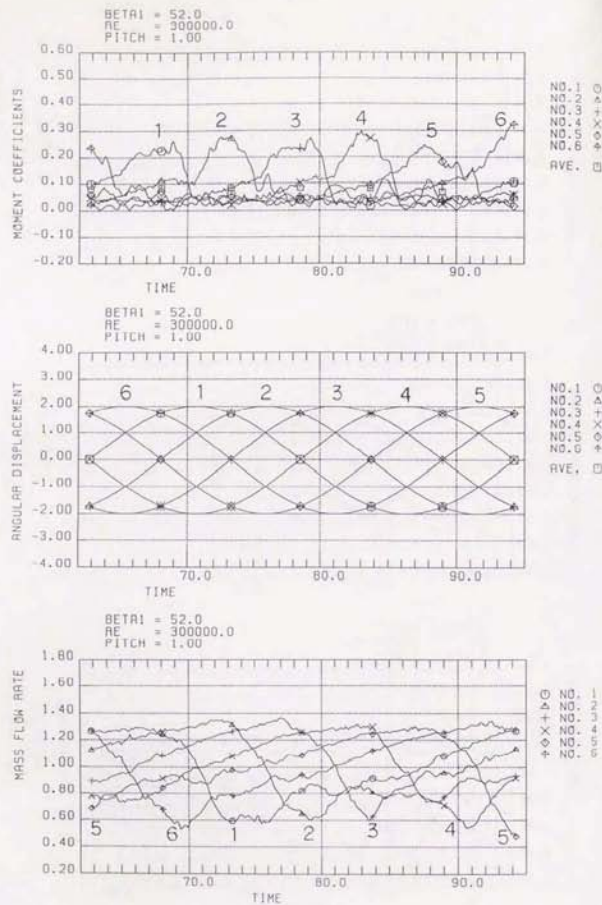
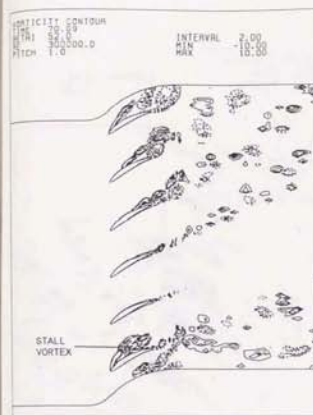


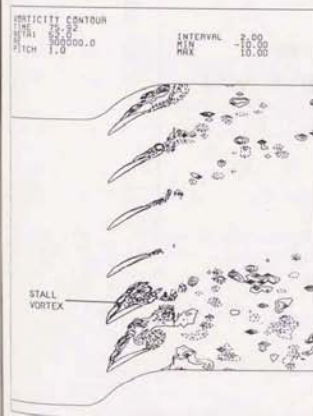
図5-3-10 (c) モーメントと流量の周期的変動
 ($\sigma = 30.0^\circ$, $k = 0, 1, R1$)



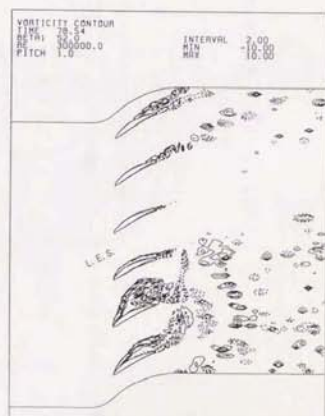
$\theta(t) = 90 \text{ deg.}$



$\theta(t) = 120 \text{ deg.}$



$\theta(t) = 150 \text{ deg.}$



$\theta(t) = 180 \text{ deg.}$

図5-3-11 (a) 周期的な前縁失速の発生：渦度分布
 ($\sigma = 30.0^\circ$, $k = 0, 1, R1$)

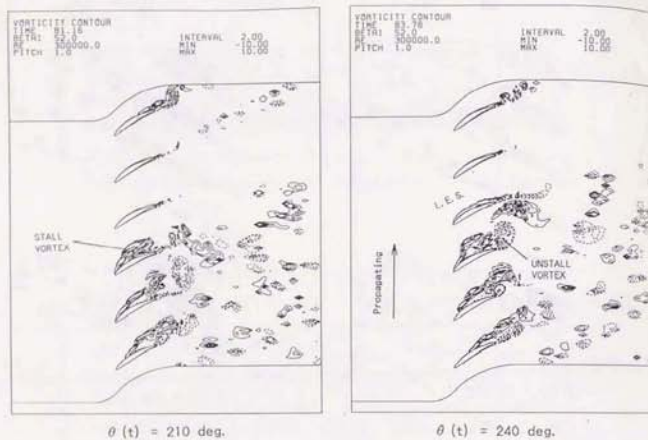


図5-3-11 (b) 周期的な前縁失速の発生
($\sigma = 300^\circ$, $k = 0.1, R1$)

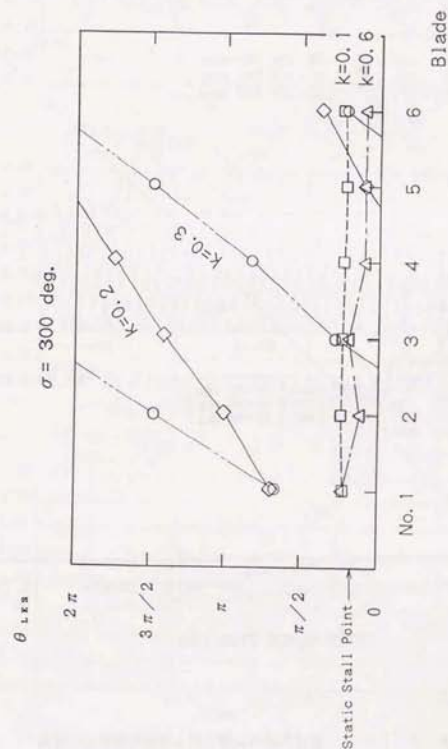


図5-3-12 前縁失速の起る位相の比較 ($\sigma = 300^\circ$)

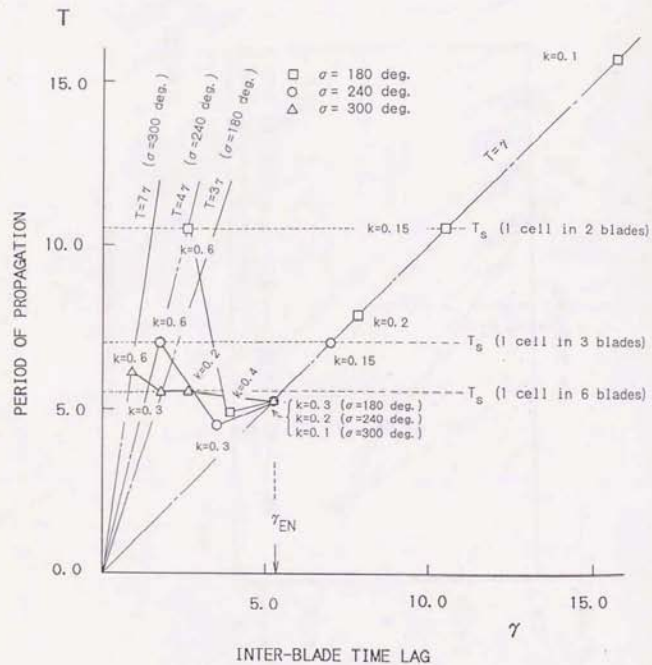


図5-3-13 旋回失速の伝播時間と翼間時間差との関係
($180^\circ \leq \sigma < 360^\circ$, 周期条件1)

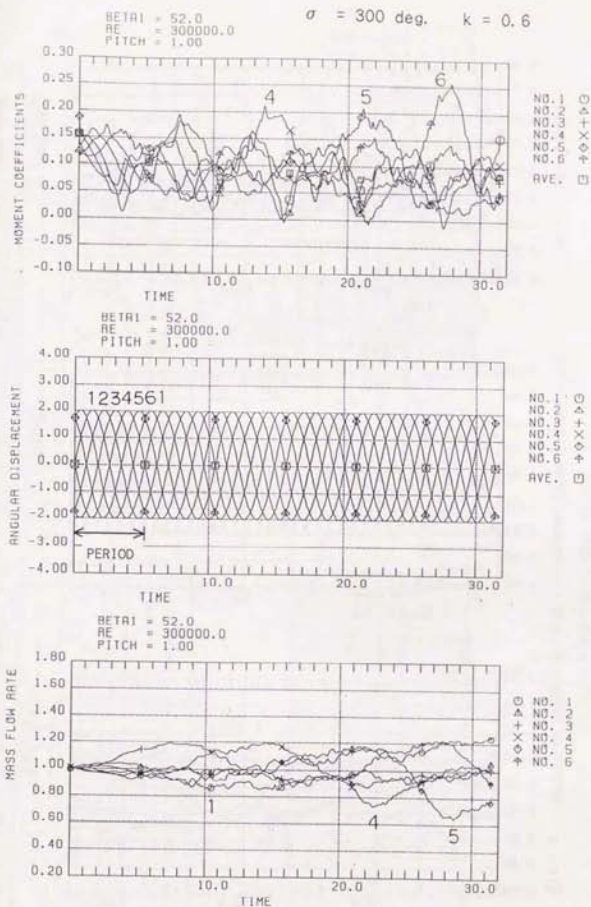


図5-3-14 (a) 第2周期との同期・引き込み現象:
モーメント, 角変位, 流量変動 ($\sigma = 300^\circ$, $k = 0.6$, 24)

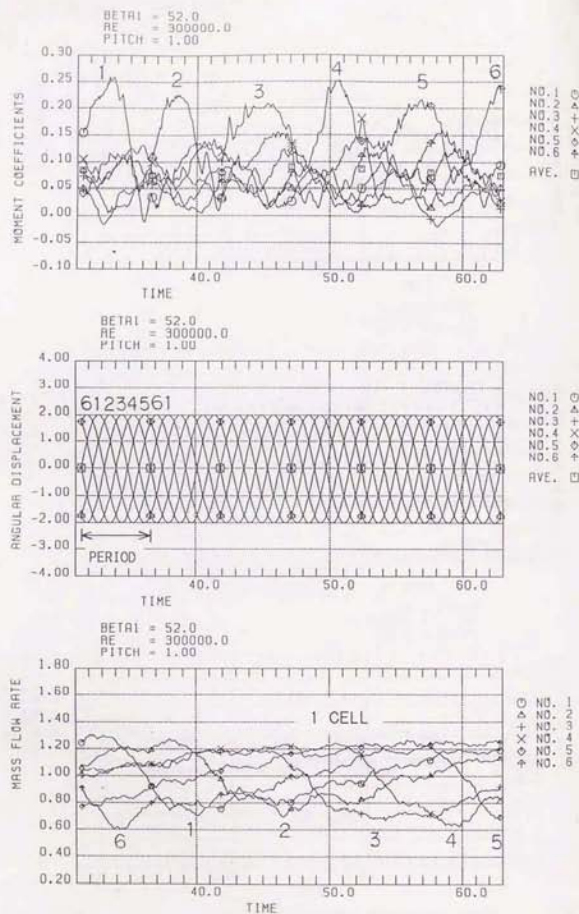


図5-3-14 (b) 第2周期との同期・引き込み現象:

モーメント, 角変位, 流量変動 ($\sigma = 300^\circ$, $k = 0.6, R4$)

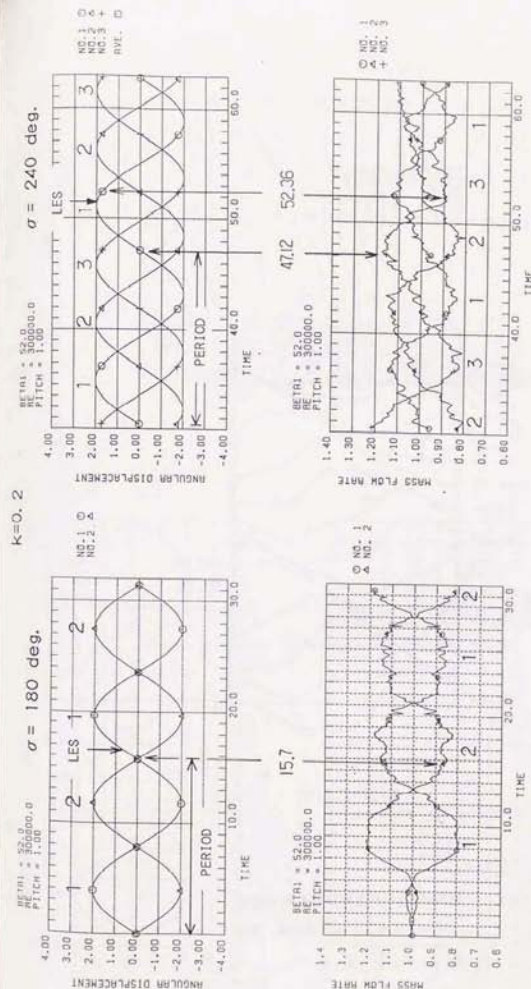


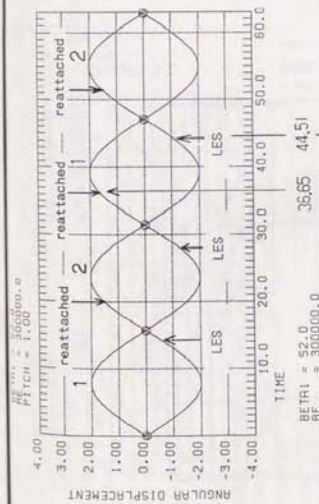
図5-3-15 (a)

前縁流速の起る位相に対する後縁の流速流の影響

角変位と流量変動との関係, $k = 0.2$

$\sigma = 180^\circ$ と 240° の比較

NO. 1	0.4	0.0
NO. 2	0.2	0.0
AVE.		



BETA1 = 52.0
RE = 300000.0
PITCH = 1.00

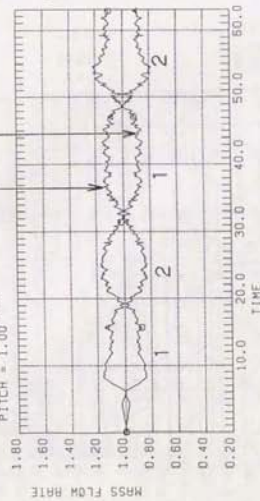
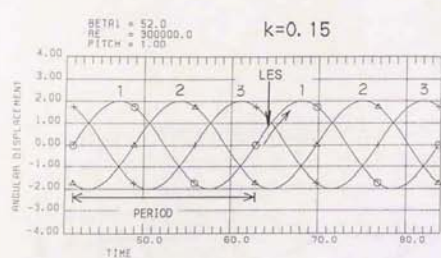


図5-3-16 前縁失速の起きる位相に対する腹側の流速流れの形質
角変位、流量、0.5 σ - Γ 上流の流れ角の相互関係
($\sigma=180^\circ$, $k=0.1$, Pl)



$\sigma = 240 \text{ deg.}$

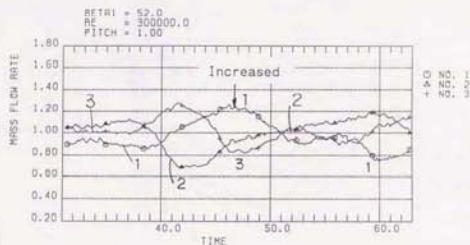
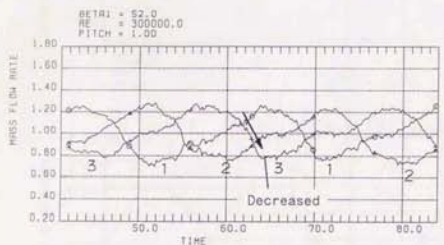
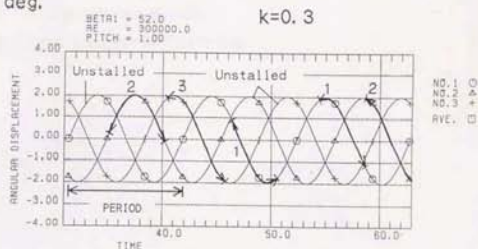
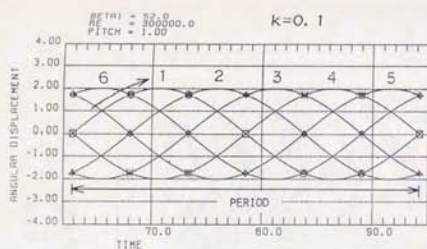


図 5-3-17 前縁失速の周期性に対する腹側の失速流れの影響

角変位と流量変動との関係, $\sigma = 240^\circ$

$k = 0.15$ と 0.3 との比較



$\sigma = 300 \text{ deg.}$

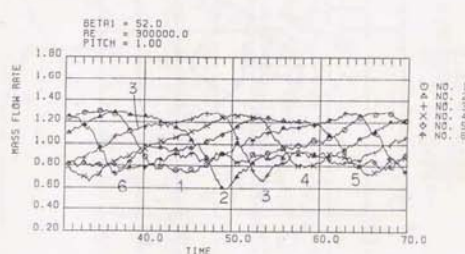
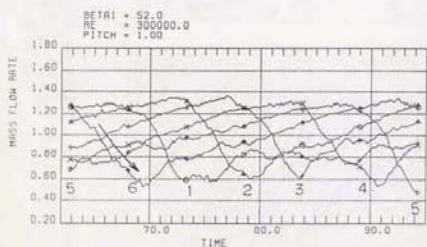
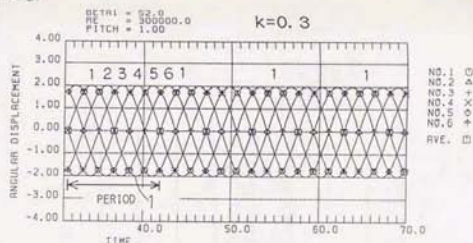


図 5-3-18 旋回失速発生時の腹側の失速流れの影響

角変位と流量変動との関係, $\sigma = 300^\circ$

$k = 0.1$ と 0.3 との比較

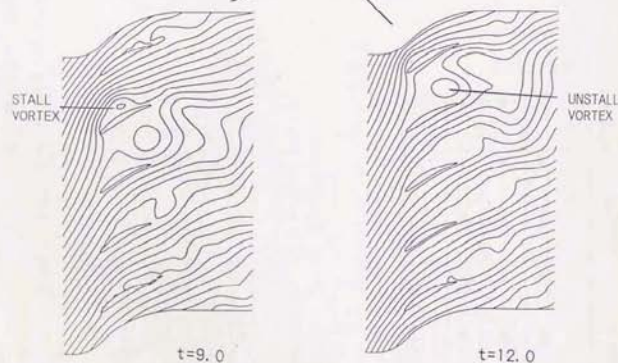
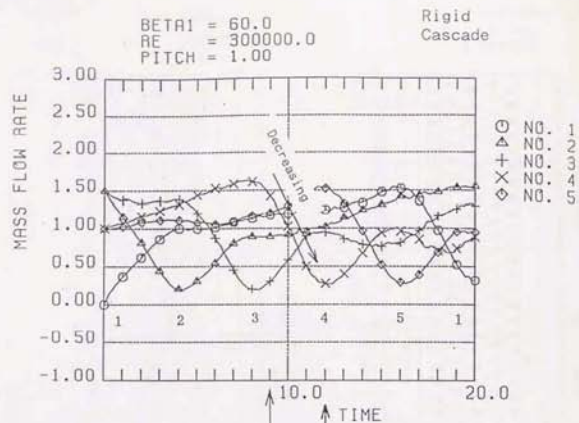


図5-3-19 剛翼列における失速渦と回復渦のせき止め作用
(翼5枚, $\beta_1 = 60^\circ$, A1)

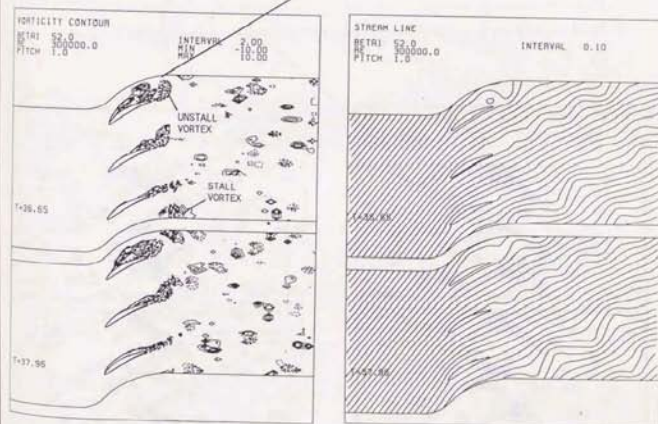
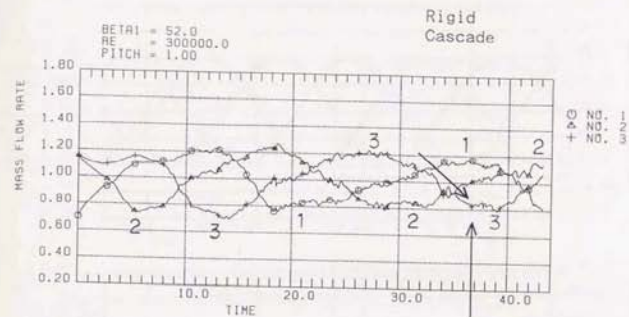


図5-3-20 剛翼列における失速渦と回復渦のせき止め作用
(翼3枚, $\beta_1 = 52^\circ$, G1)

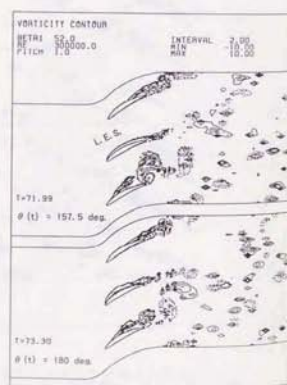
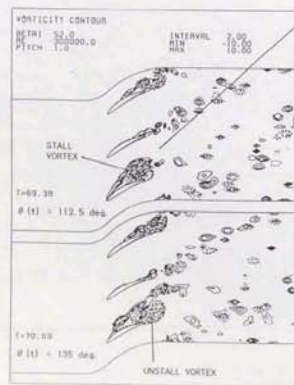
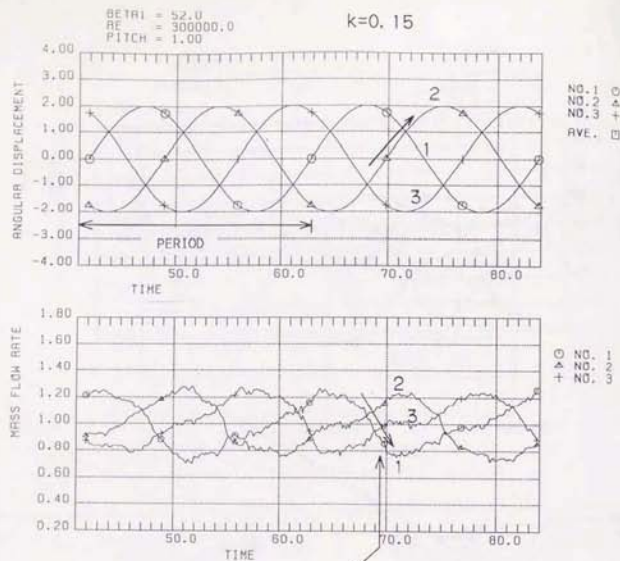


図5-3-21 同期・引き込み領域における失速渦と回復渦のせき止め作用
 ($\sigma = 240^\circ$, $k = 0.15$, Q1)

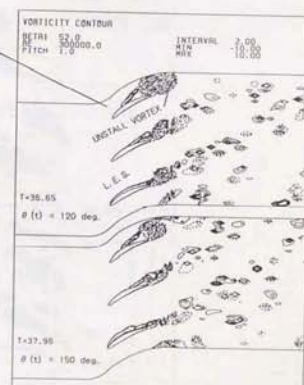
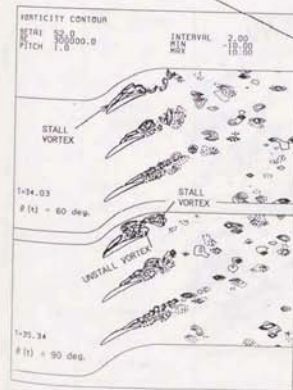
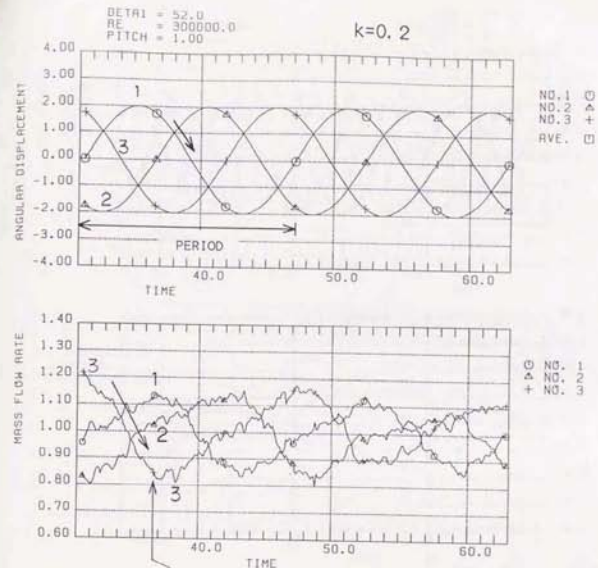


図5-3-22 同期・引き込み領域における失速渦と回復渦のせき止め作用
 ($\sigma = 240^\circ$, $k = 0.2$, Q2)

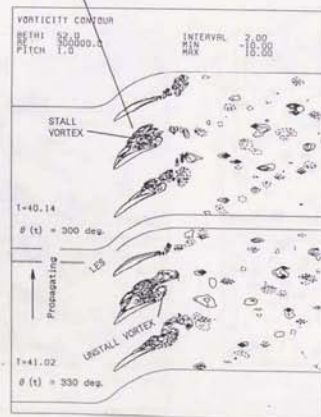
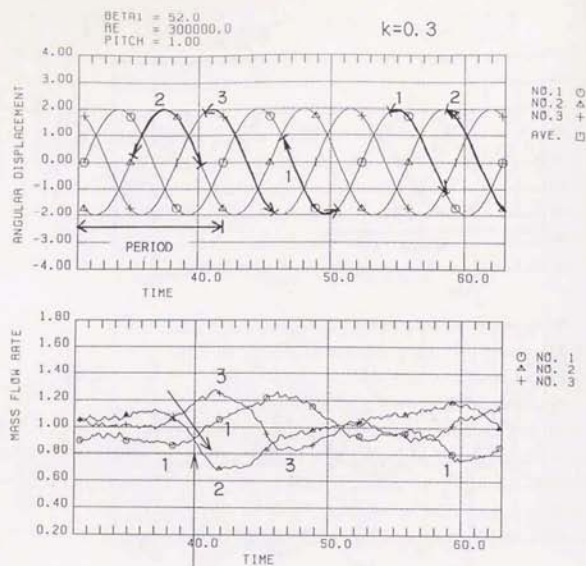


図5-3-23 中間領域における失速渦と回復渦のせき止め作用
($\sigma = 240^\circ$, $k = 0.3$, Q3)

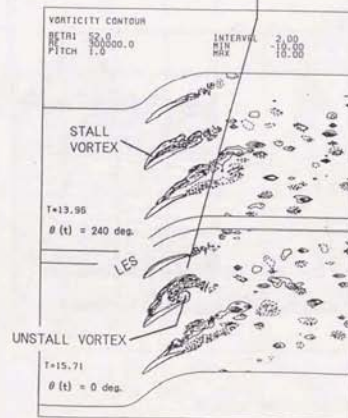
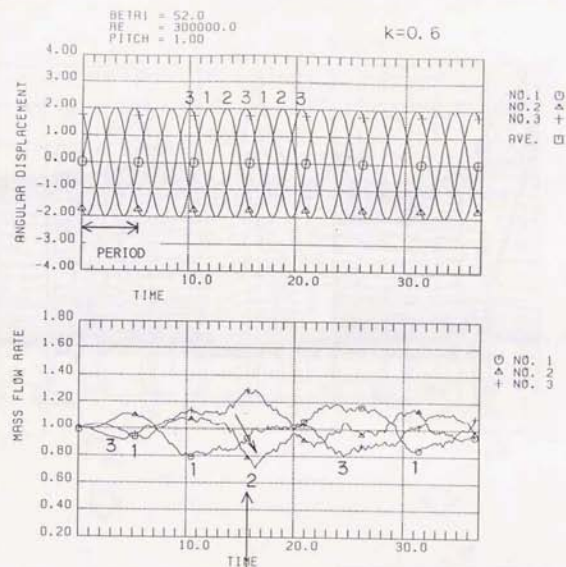
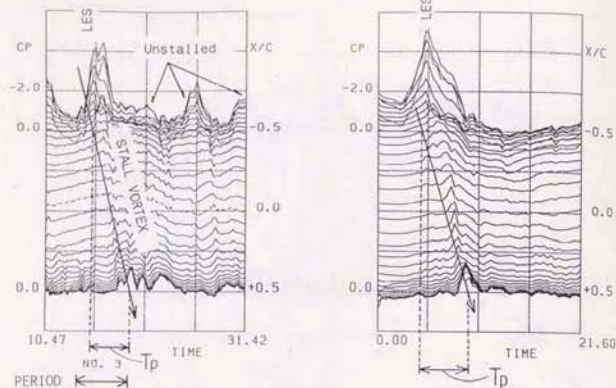


図5-3-24 RS領域における失速渦と回復渦のせき止め作用
($\sigma = 240^\circ$, $k = 0.6$, Q4)



(a) $k=0.6$

(b) Rigid Cascade

図5-3-27 RS領域と剛翼列における翼背面非定常圧力の時間変動:
負圧のピークと前縁失速の伝播
($\sigma = 240^\circ$, $k = 0.6$ (G4), および 剛翼列 (G1))

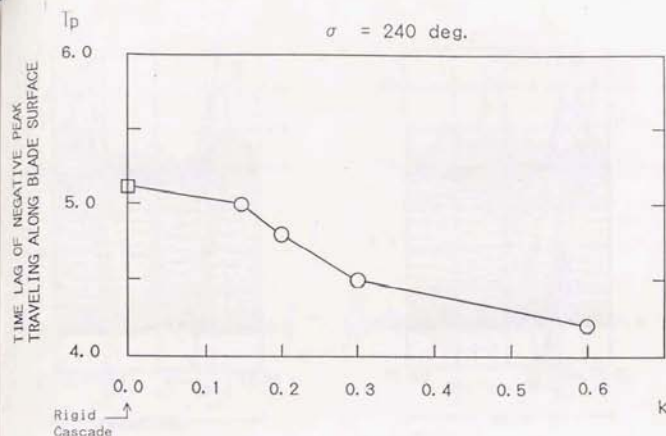


図5-3-28 失速渦放出現象の特性時間 ($\sigma = 240^\circ$)

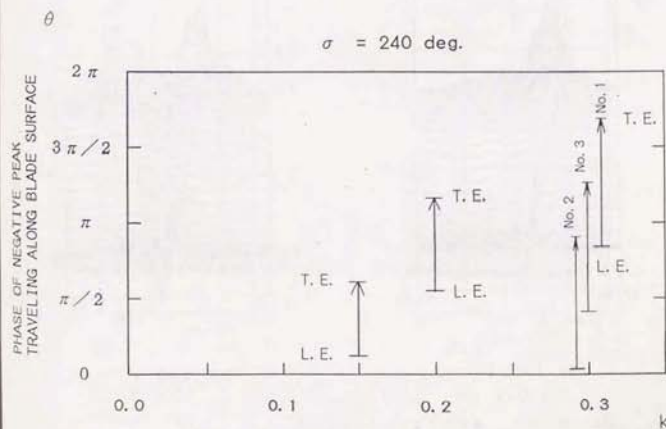
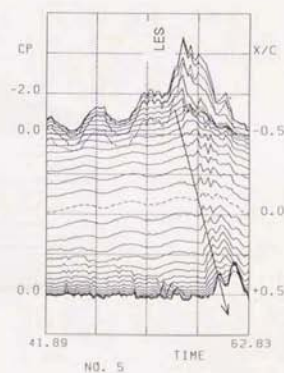
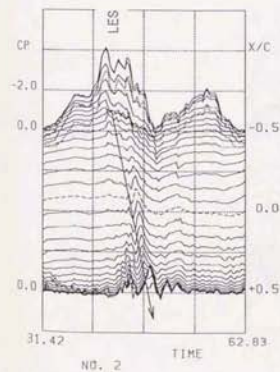
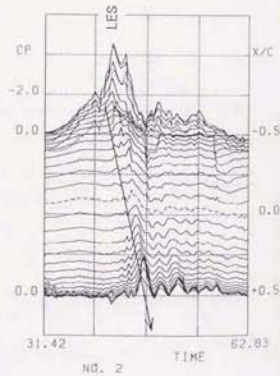
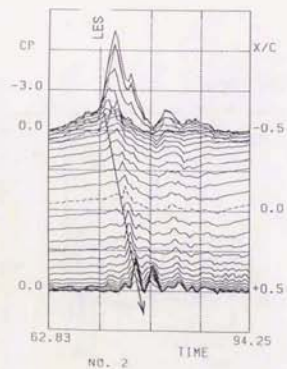
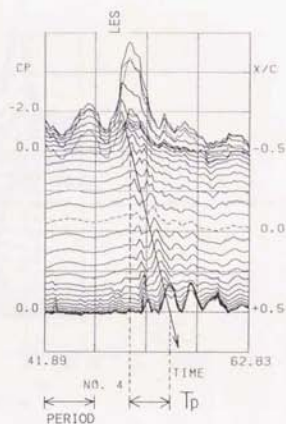
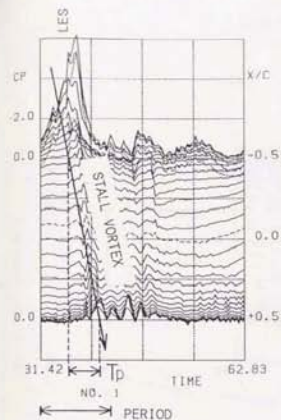
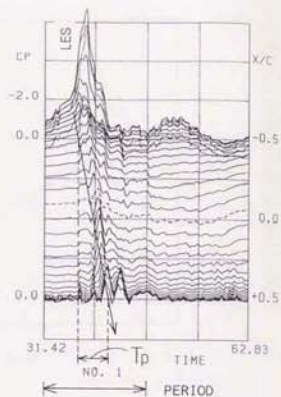
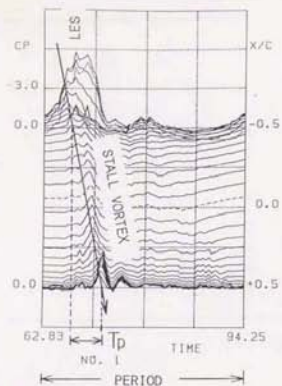


図5-3-29 負圧のピークが翼背面上を移動する位相 ($\sigma = 240^\circ$)



(a) $k=0.1$

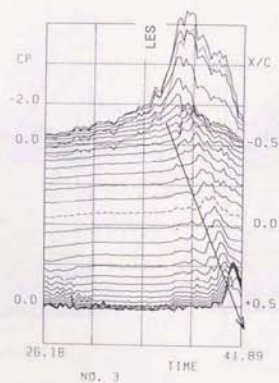
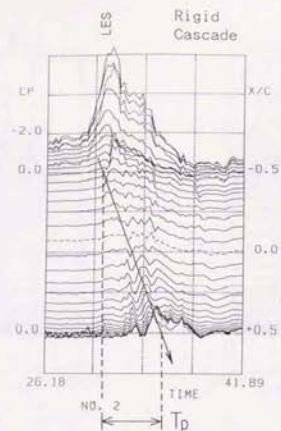
(b) $k=0.2$

(c) $k=0.3$

(d) $k=0.6$

図5-3-30 翼背面非定常圧力の時間変動:
負圧のピークと前縁失速の伝播 ($\sigma = 30.0^\circ$)

図5-3-30 翼背面非定常圧力の時間変動:
負圧のピークと前縁失速の伝播 ($\sigma = 30.0^\circ$)



(e) Rigid Cascade

図5-3-30 翼背面非常圧力の時間変動：
負圧のピークと前縁失速の伝播
(剛翼列，6ピッチ1セル， $\beta = 5.2^\circ$ ，H1)

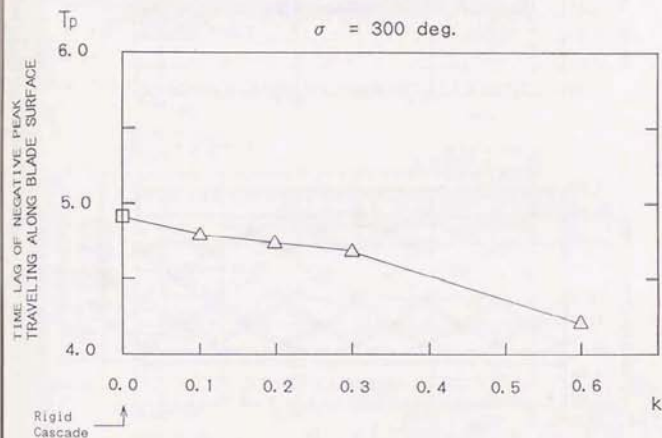


図5-3-31 失速渦放出現象の特性時間 ($\sigma = 300^\circ$)

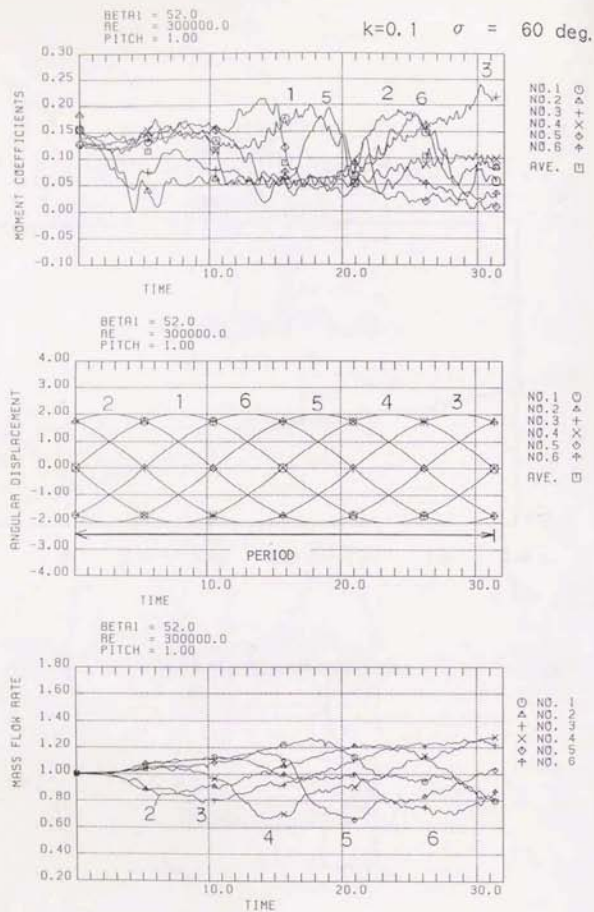


図5-3-32 (a) RS領域における旋回失速の伝播
モーメント, 角変位, 流量変動
($\sigma = 60^\circ$, $k = 0.1$, T1)

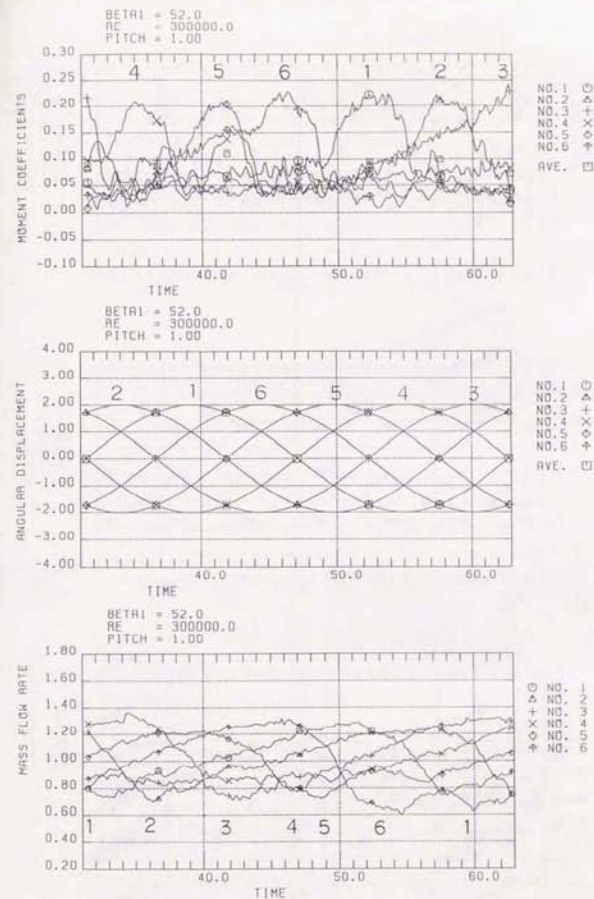


図5-3-32 (b) RS領域における旋回失速の伝播
モーメント, 角変位, 流量変動
($\sigma = 60^\circ$, $k = 0.1$, T1)

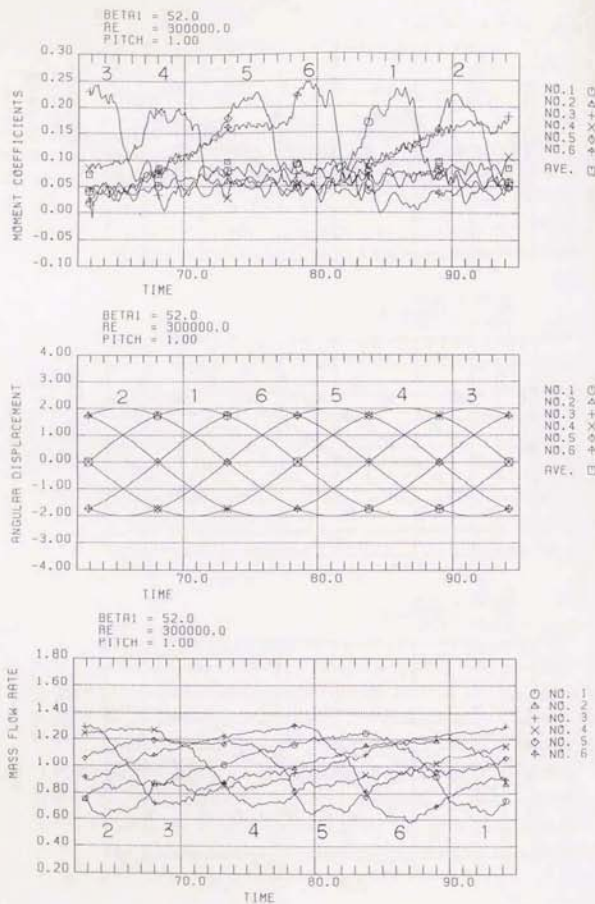
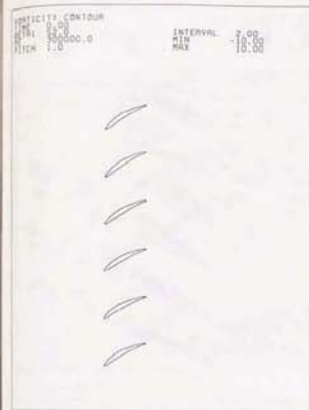


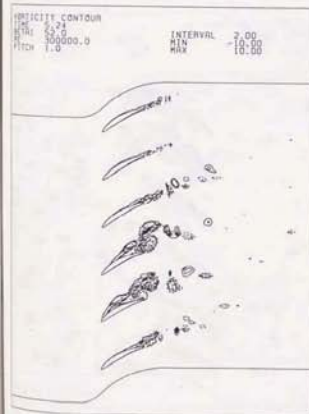
図5-3-32 (c) RS 領域における旋回失速の伝播
 モーメント、角変位、流量変動
 ($\sigma = 60^\circ$, $k = 0, 1, T1$)



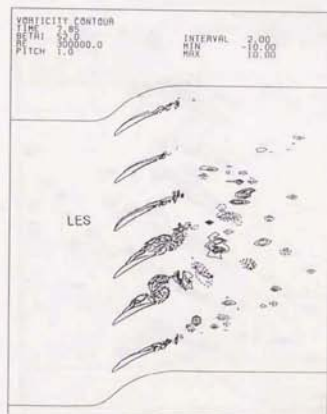
$\theta(t) = 0 \text{ deg.}$



$\theta(t) = 30 \text{ deg.}$

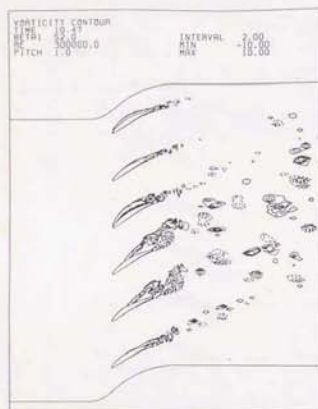


$\theta(t) = 60 \text{ deg.}$

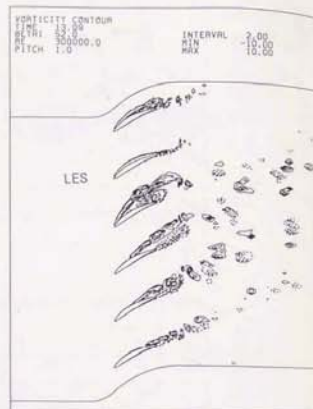


$\theta(t) = 90 \text{ deg.}$

図5-3-33 (a) RS 領域における旋回失速の伝播：温度分布
 ($\sigma = 60^\circ$, $k = 0, 1, T1$)



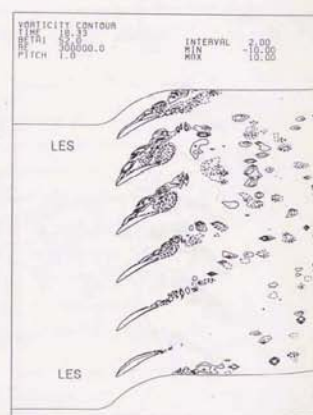
$\theta(t) = 120 \text{ deg.}$



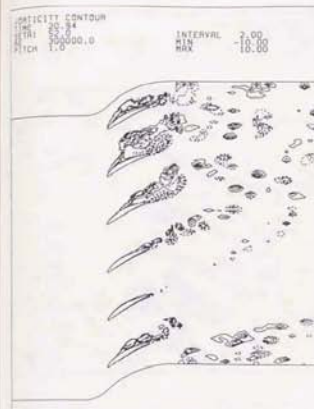
$\theta(t) = 150 \text{ deg.}$



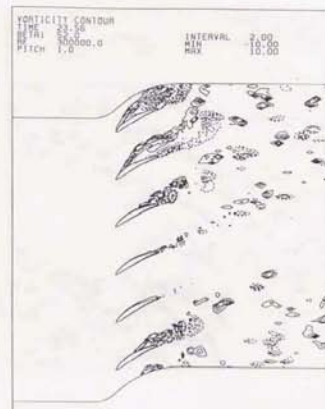
$\theta(t) = 180 \text{ deg.}$



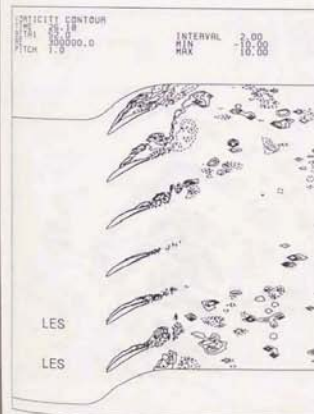
$\theta(t) = 210 \text{ deg.}$



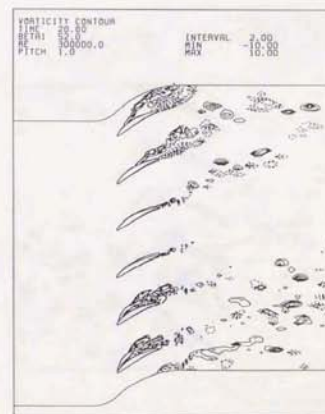
$\theta(t) = 240 \text{ deg.}$



$\theta(t) = 270 \text{ deg.}$



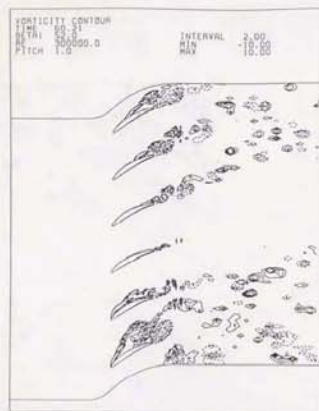
$\theta(t) = 300 \text{ deg.}$



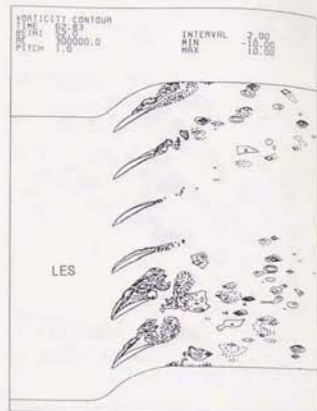
$\theta(t) = 330 \text{ deg.}$

図5-3-33 (b) RS領域における旋回失速の伝播 ($\sigma = 60^\circ$, $k = 0.1$, T1)

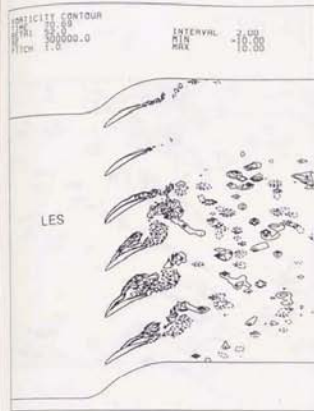
図5-3-33 (c) RS領域における旋回失速の伝播 ($\sigma = 60^\circ$, $k = 0.1$, T1)



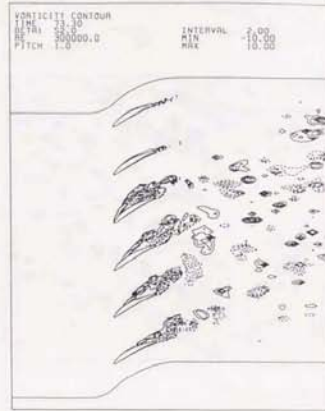
$\theta(t) = 330 \text{ deg.}$



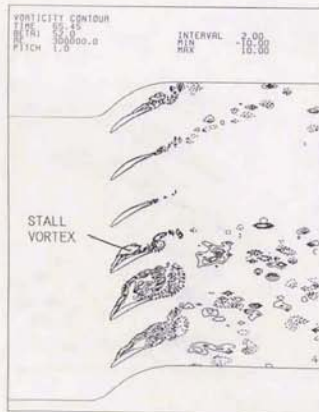
$\theta(t) = 0 \text{ deg.}$



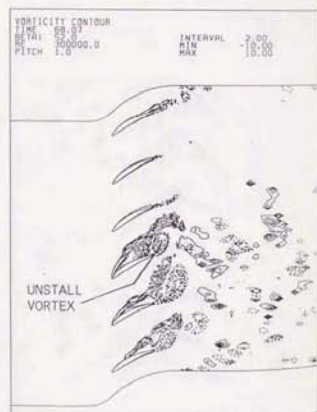
$\theta(t) = 90 \text{ deg.}$



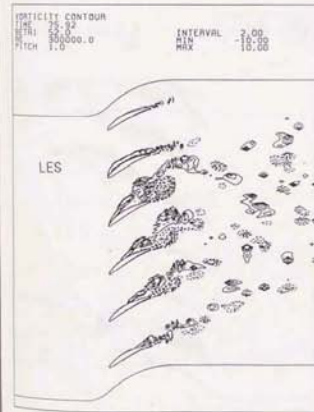
$\theta(t) = 120 \text{ deg.}$



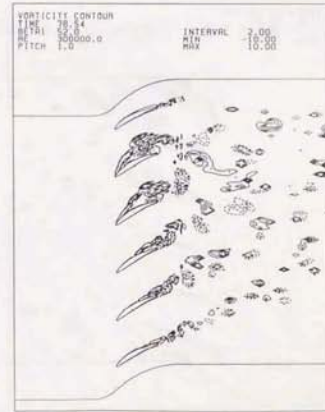
$\theta(t) = 30 \text{ deg.}$



$\theta(t) = 60 \text{ deg.}$



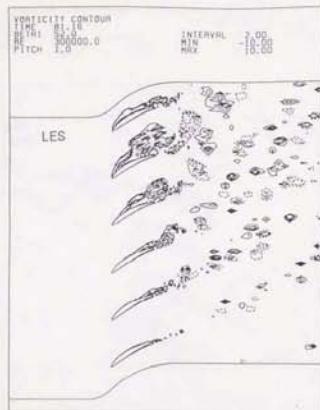
$\theta(t) = 150 \text{ deg.}$



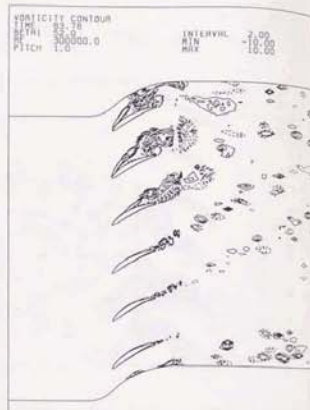
$\theta(t) = 180 \text{ deg.}$

図5-3-33 (d) RS領域における旋回失速の伝播 ($\sigma = 60^\circ$, $k = 0, 1, T1$)

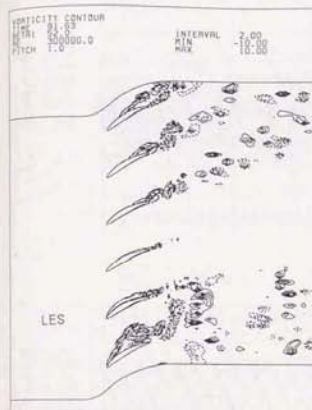
図5-3-33 (e) RS領域における旋回失速の伝播 ($\sigma = 60^\circ$, $k = 0, 1, T1$)



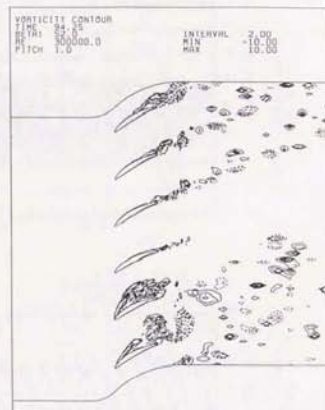
$\theta(t) = 210 \text{ deg.}$



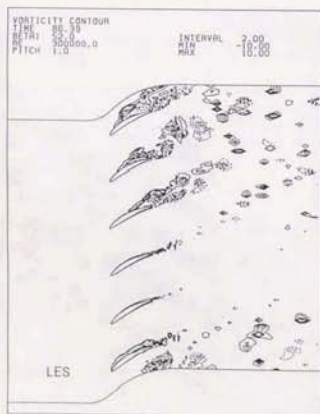
$\theta(t) = 240 \text{ deg.}$



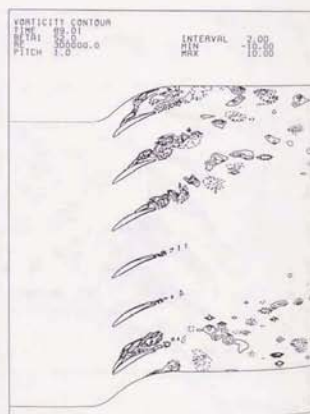
$\theta(t) = 330 \text{ deg.}$



$\theta(t) = 0 \text{ deg.}$



$\theta(t) = 270 \text{ deg.}$



$\theta(t) = 300 \text{ deg.}$

図5-3-33 (g) RS領域における旋回失速の伝播 ($\sigma = 6.0^\circ$, $k = 0, 1, T1$)

図5-3-33 (f) RS領域における旋回失速の伝播 ($\sigma = 6.0^\circ$, $k = 0, 1, T1$)

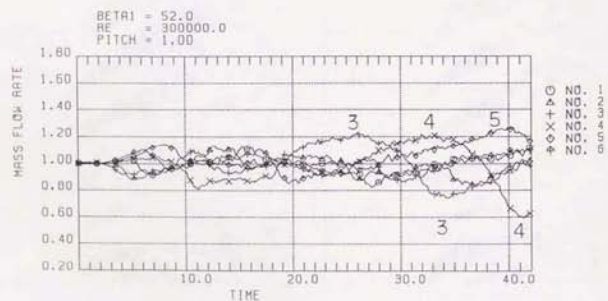
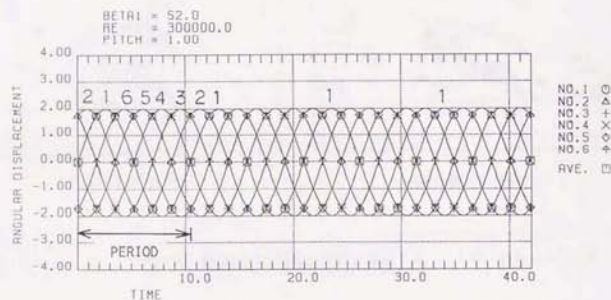
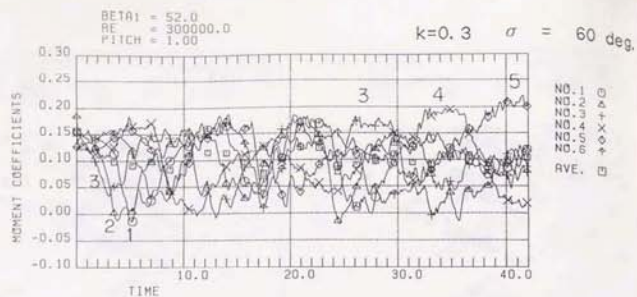


図5-3-34 (a) RS領域における旋回失速の伝播
モーメント, 角変位, 流量変動
($\sigma = 60^\circ$, $k = 0.3$, T2)

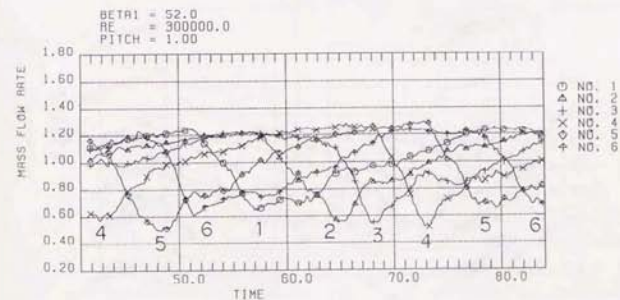
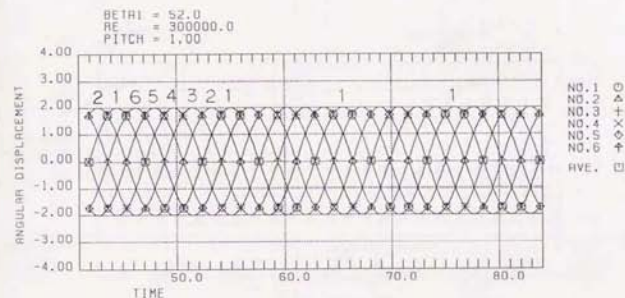
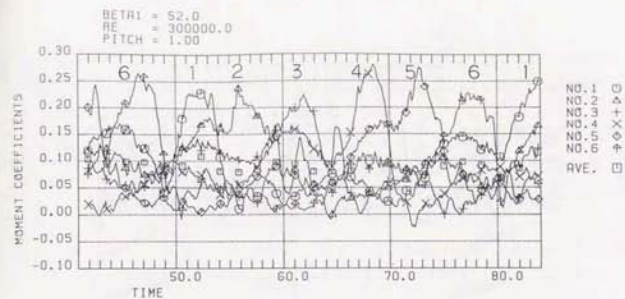


図5-3-34 (b) RS領域における旋回失速の伝播
モーメント, 角変位, 流量変動
($\sigma = 60^\circ$, $k = 0.3$, T2)

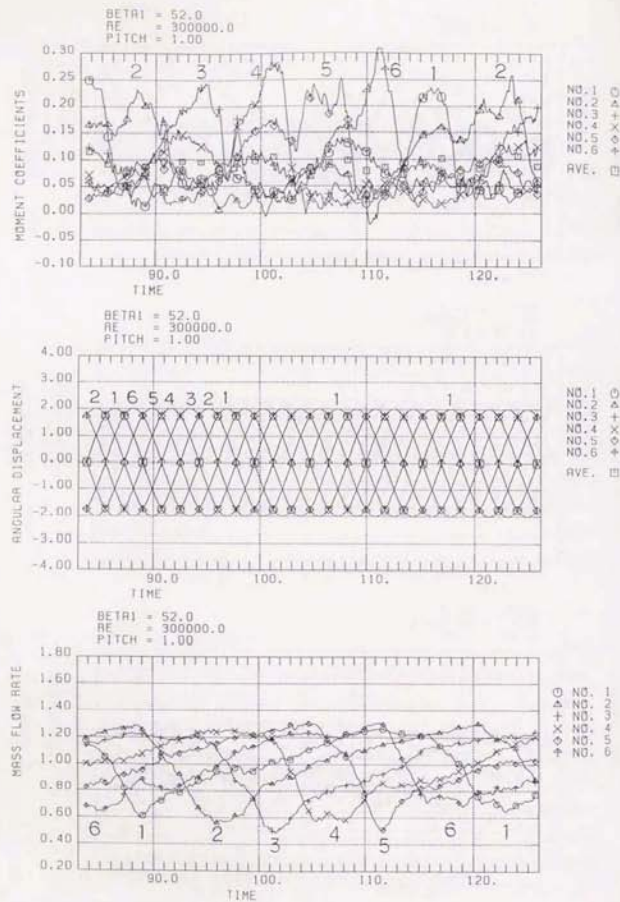
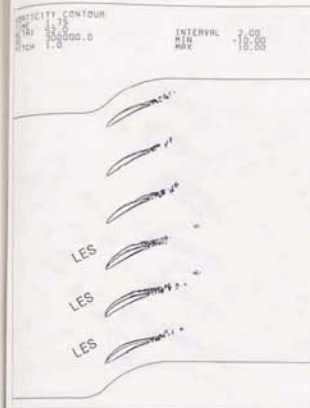


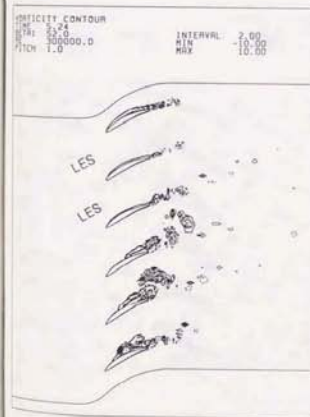
図5-3-34 (c) RS領域における旋回失速の伝播
モーメント, 角変位, 流量変動
($\sigma = 60^\circ$, $k = 0.3, T2$)



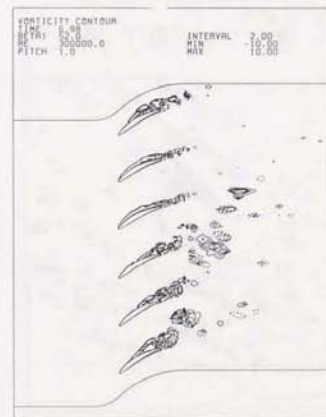
$\theta(t) = 60 \text{ deg.}$



$\theta(t) = 120 \text{ deg.}$

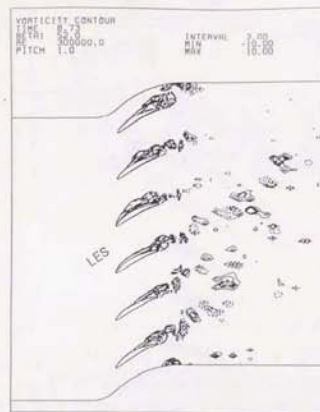


$\theta(t) = 180 \text{ deg.}$

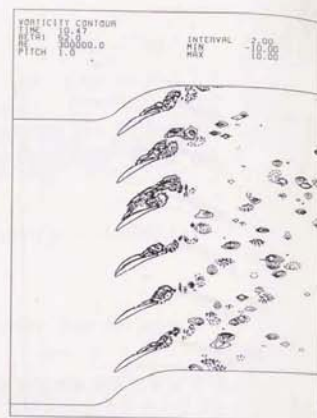


$\theta(t) = 240 \text{ deg.}$

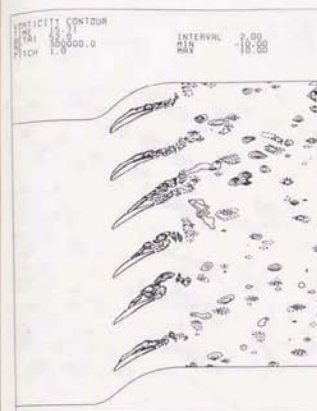
図5-3-35 (a) RS領域における旋回失速の伝播: 渦度分布
($\sigma = 60^\circ$, $k = 0.3, T2$)



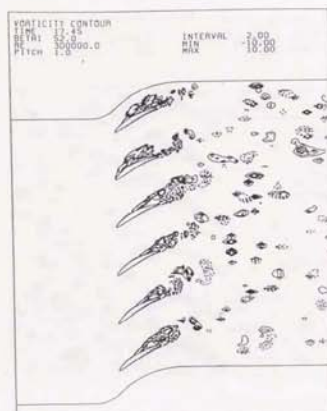
$\theta(t) = 300 \text{ deg.}$



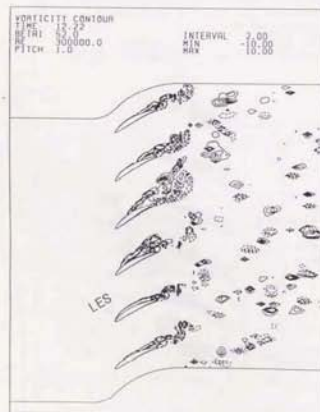
$\theta(t) = 0 \text{ deg.}$



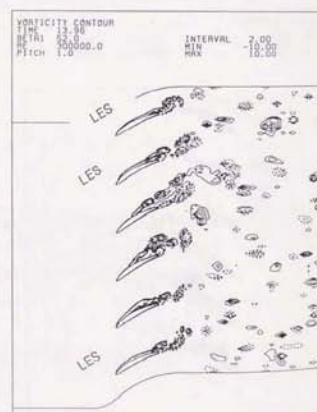
$\theta(t) = 180 \text{ deg.}$



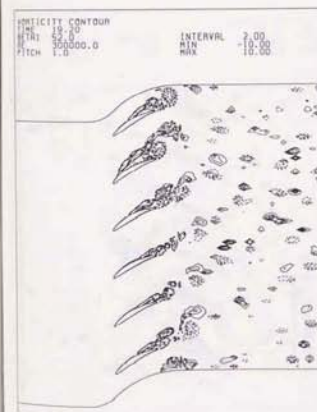
$\theta(t) = 240 \text{ deg.}$



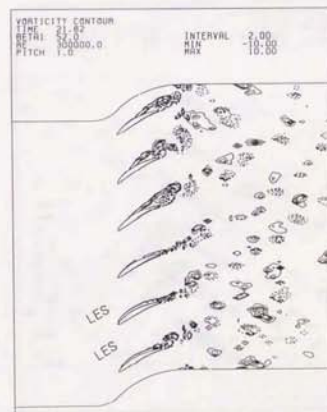
$\theta(t) = 60 \text{ deg.}$



$\theta(t) = 120 \text{ deg.}$



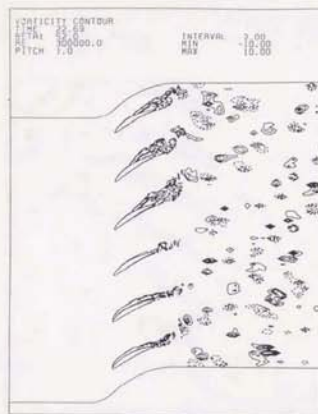
$\theta(t) = 300 \text{ deg.}$



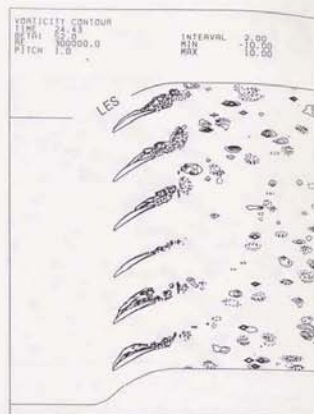
$\theta(t) = 330 \text{ deg.}$

図5-3-35 (b) RS領域における旋回失速の伝播 ($\sigma = 6.0^\circ$, $k = 0.3$, T2)

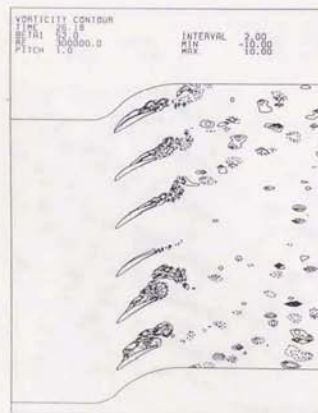
図5-3-35 (c) RS領域における旋回失速の伝播 ($\sigma = 6.0^\circ$, $k = 0.3$, T2)



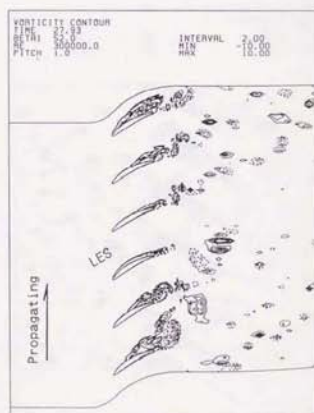
$\theta(t) = 60 \text{ deg.}$



$\theta(t) = 120 \text{ deg.}$

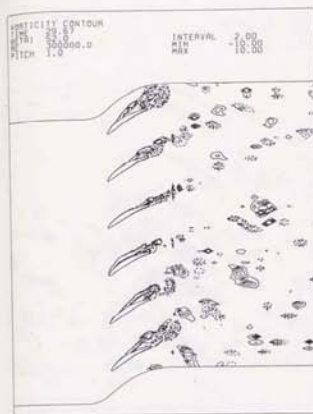


$\theta(t) = 180 \text{ deg.}$

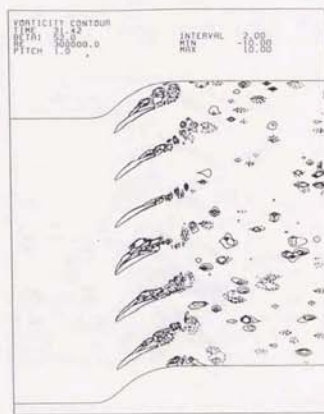


$\theta(t) = 240 \text{ deg.}$

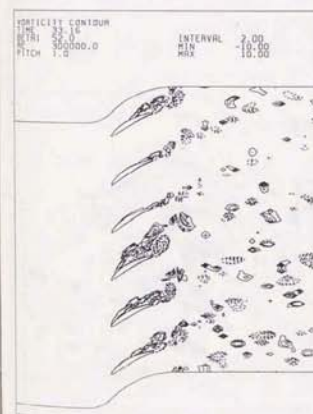
図5-3-35 (d) RS領域における旋回失速の伝播 ($\sigma = 6.0^\circ$, $k = 0.3$, T2)



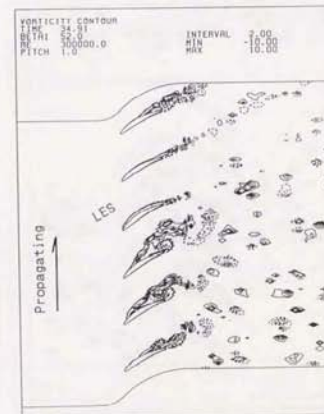
$\theta(t) = 300 \text{ deg.}$



$\theta(t) = 0 \text{ deg.}$

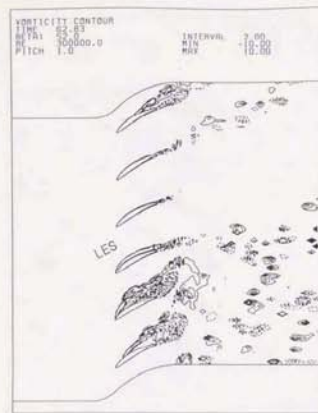


$\theta(t) = 60 \text{ deg.}$

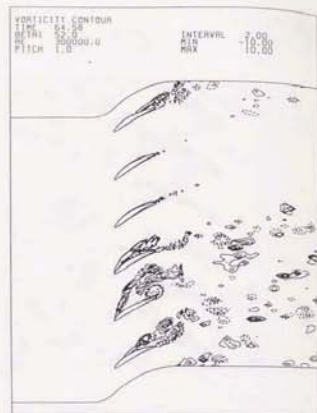


$\theta(t) = 120 \text{ deg.}$

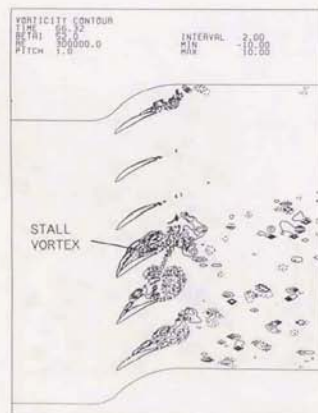
図5-3-35 (e) RS領域における旋回失速の伝播 ($\sigma = 6.0^\circ$, $k = 0.3$, T2)



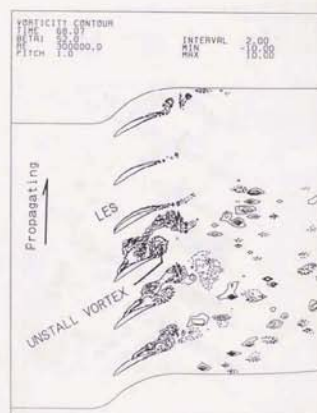
$\theta(t) = 0 \text{ deg.}$



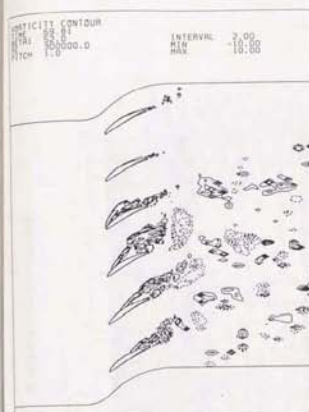
$\theta(t) = 60 \text{ deg.}$



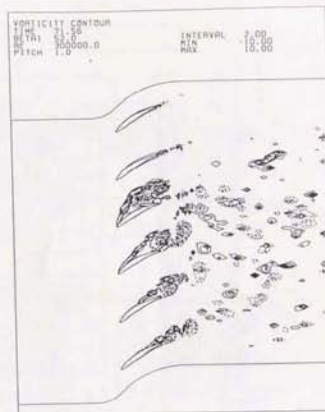
$\theta(t) = 120 \text{ deg.}$



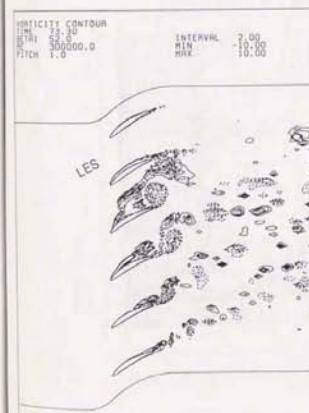
$\theta(t) = 180 \text{ deg.}$



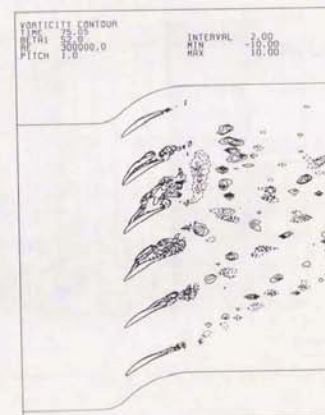
$\theta(t) = 240 \text{ deg.}$



$\theta(t) = 300 \text{ deg.}$



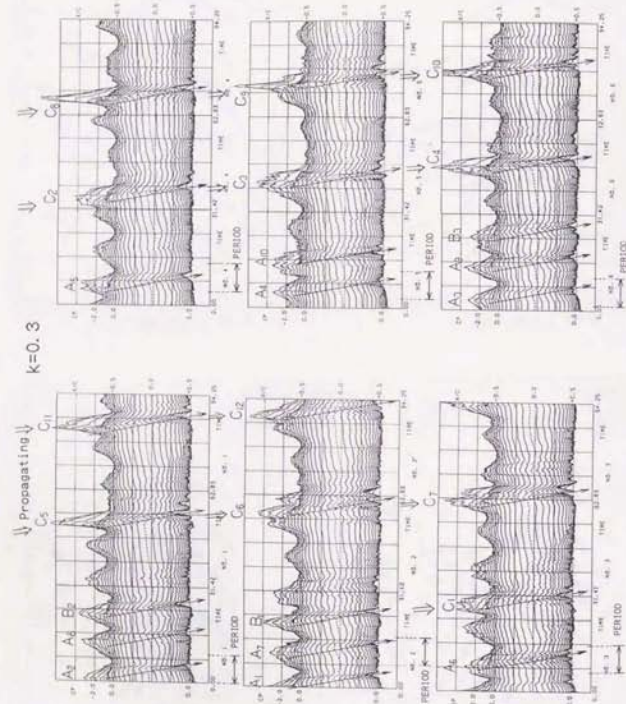
$\theta(t) = 0 \text{ deg.}$



$\theta(t) = 60 \text{ deg.}$

図5-3-35 (f) RS領域における旋回失速の伝播 ($\sigma = 6.0^\circ$, $k = 0.3$, T2)

図5-3-35 (g) RS領域における旋回失速の伝播 ($\sigma = 6.0^\circ$, $k = 0.3$, T2)



前線失速の発生順の逆転：翼背而非定常圧力の時間変動

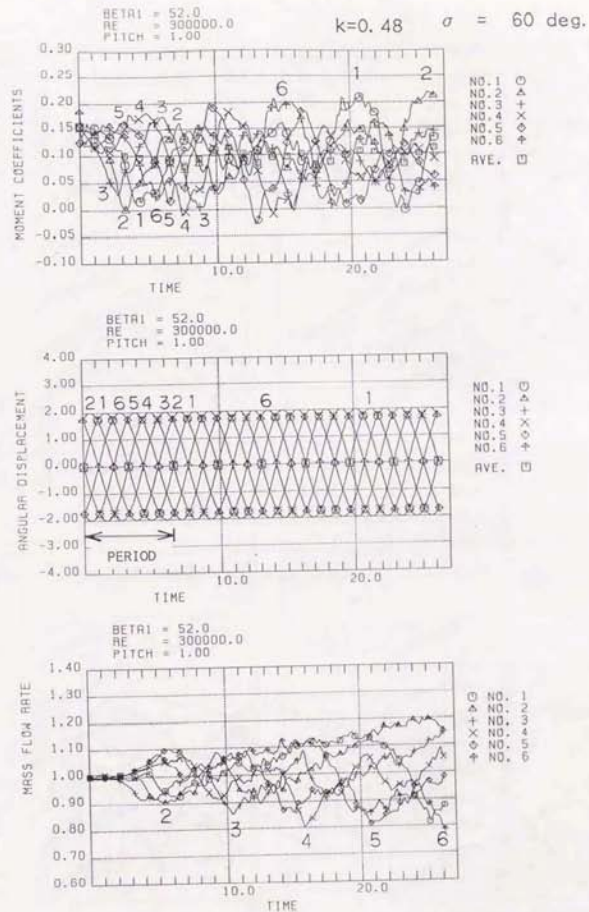


図5-3-37 (a) 同期・引き込み領域における旋回失速の伝播
モーメント，角変位，流量変動
($\sigma = 6.0^\circ$ ， $k = 0.48$ ，T3)

$$k=0.48 \quad \sigma = 60 \text{ deg.}$$

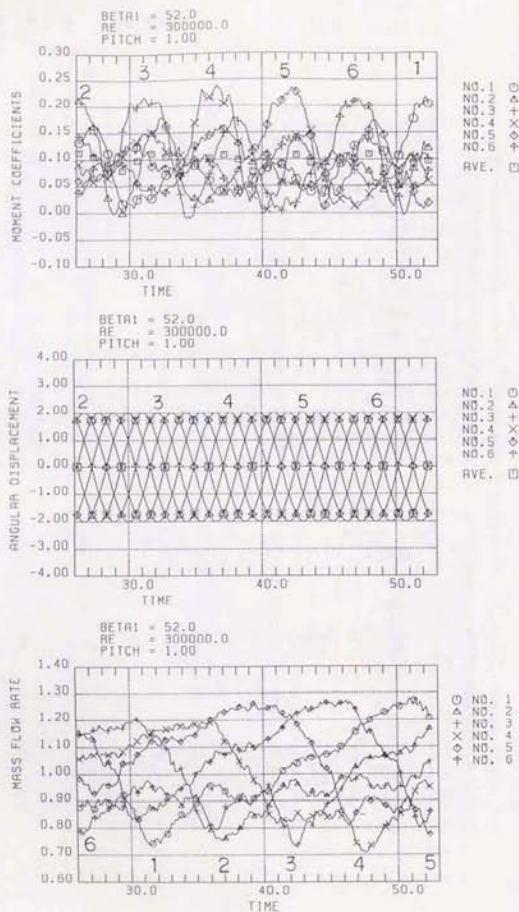


図 5-3-37 (b) 同期・引き込み領域における旋回失速の伝播
モーメント、角変位、流量変動
($\alpha = 6.0^\circ$, $k = 0.48$, T3)

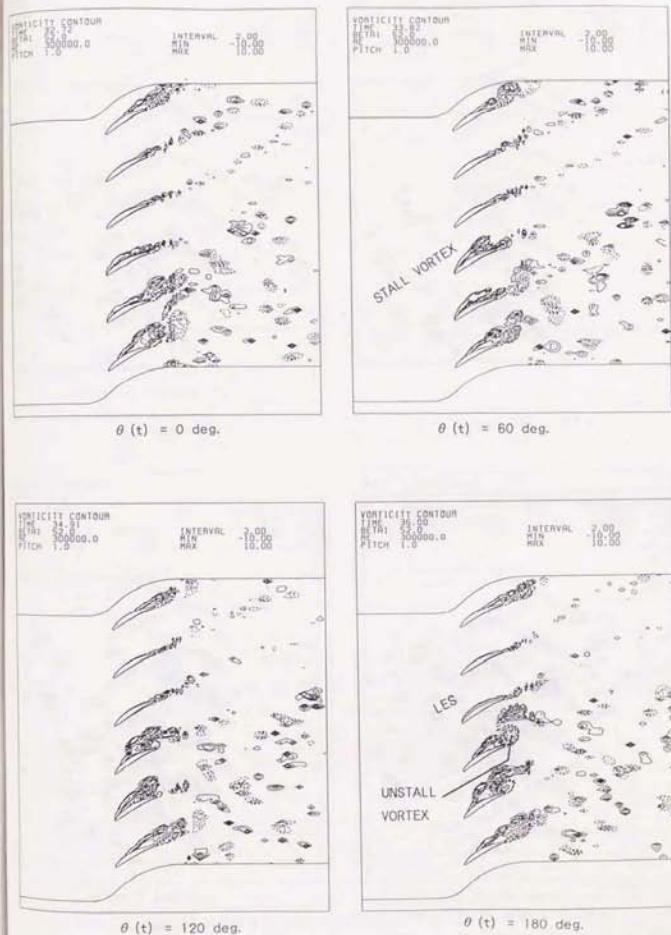
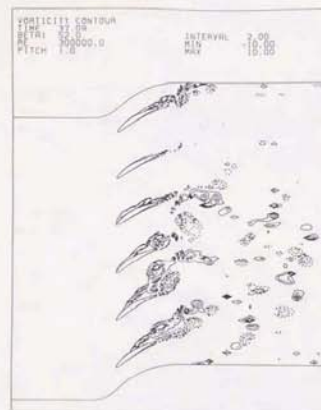
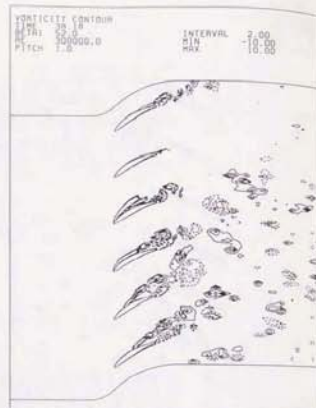


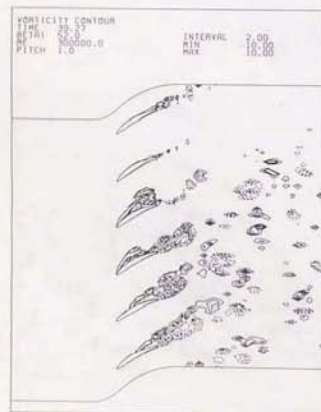
図 5-3-38 (a) 同期・引き込み領域における旋回失速の伝播：渦度分布
($\alpha = 6.0^\circ$, $k = 0.48$, T3)



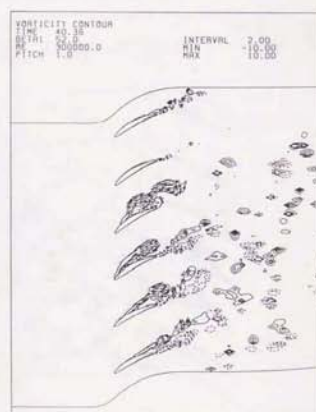
$\theta(t) = 240 \text{ deg.}$



$\theta(t) = 300 \text{ deg.}$

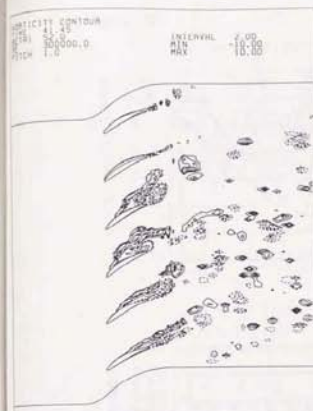


$\theta(t) = 0 \text{ deg.}$

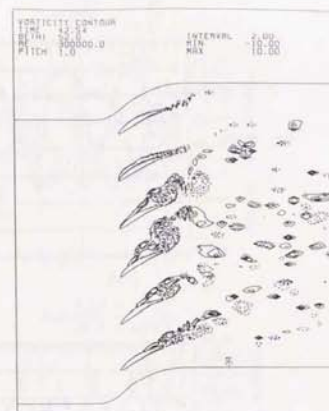


$\theta(t) = 60 \text{ deg.}$

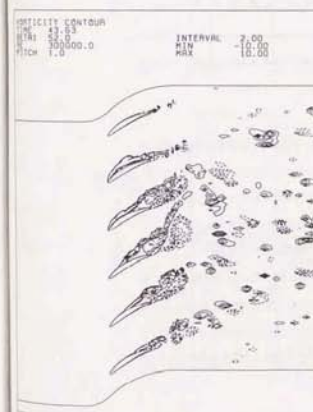
図5-3-38 (b) 同期・引き込み領域における旋回失速の伝播
($\sigma = 6.0^\circ$, $k = 0.48, T3$)



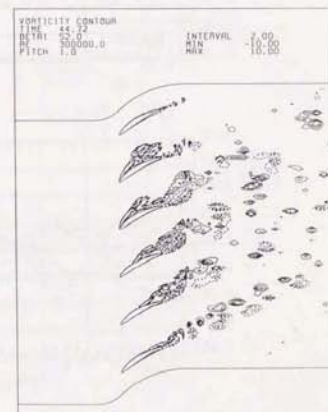
$\theta(t) = 120 \text{ deg.}$



$\theta(t) = 180 \text{ deg.}$



$\theta(t) = 240 \text{ deg.}$



$\theta(t) = 300 \text{ deg.}$

図5-3-38 (c) 同期・引き込み領域における旋回失速の伝播
($\sigma = 6.0^\circ$, $k = 0.48, T3$)

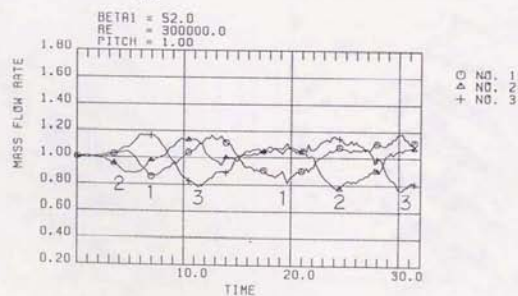
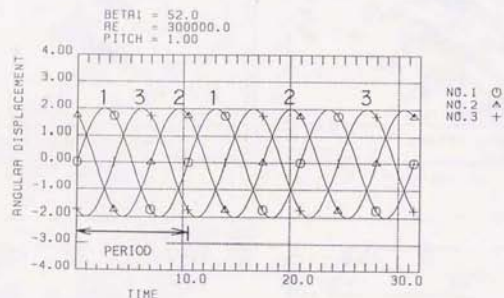
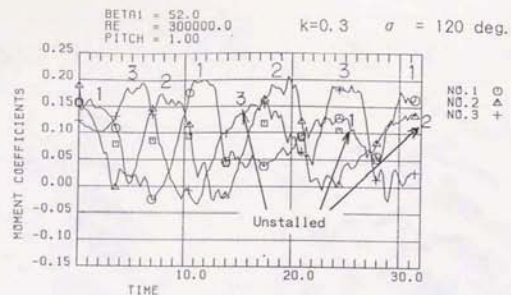


図5-3-39 (a) 同期・引き込み領域における旋回失速の伝播：
モーメント，角変位，流量変動
($\sigma = 120^\circ$, $k = 0.3$, S3)

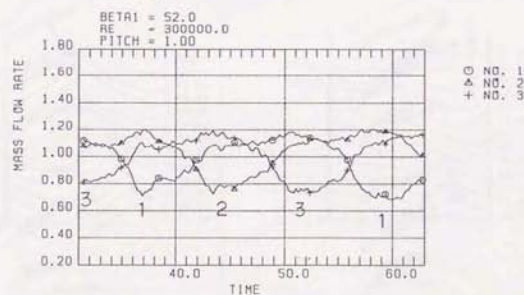
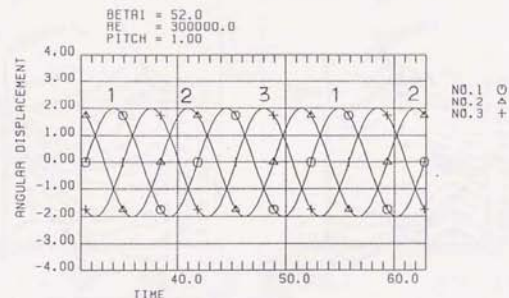
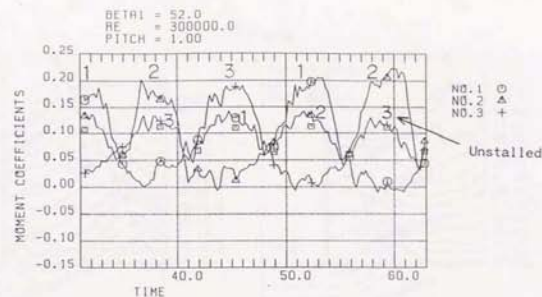


図5-3-39 (b) 同期・引き込み領域における旋回失速の伝播：
モーメント，角変位，流量変動
($\sigma = 120^\circ$, $k = 0.3$, S3)

$k=0.3$

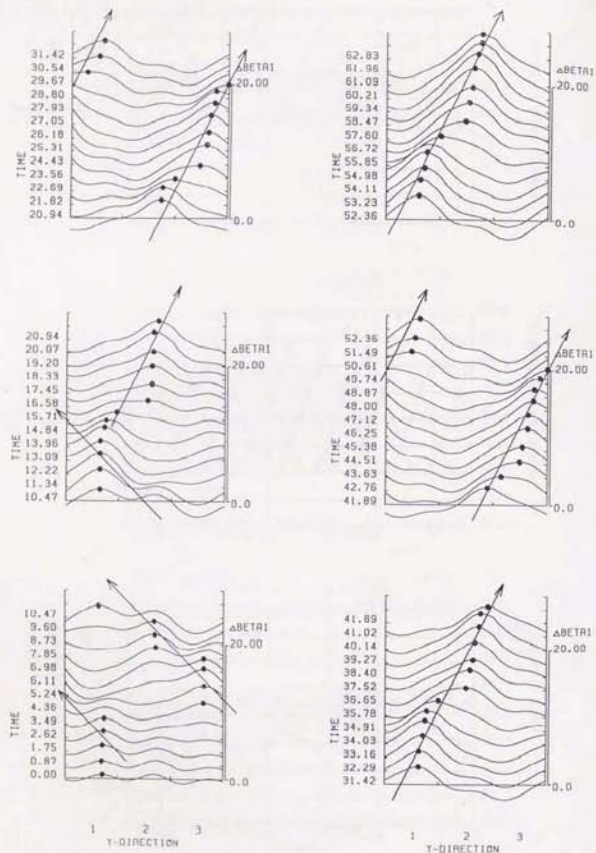


図5-3-40 流れ場の変動の伝播方向の逆転:
0.53- Γ 上流の流れ角分布
($\sigma = 120^\circ$, $k = 0.3$, S3)

$k=0.3$

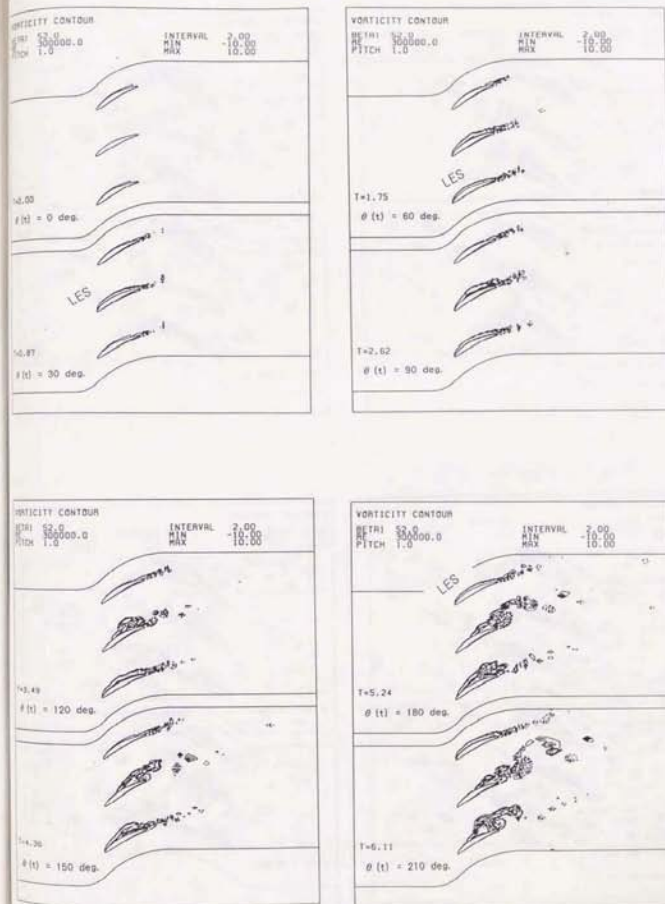


図5-3-41 (a) 同期・引き込み領域における旋回失速の伝播: 渦度分布
($\sigma = 120^\circ$, $k = 0.3$, S3)

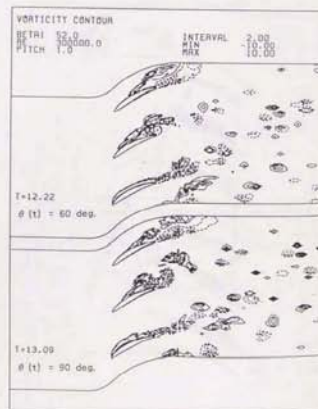
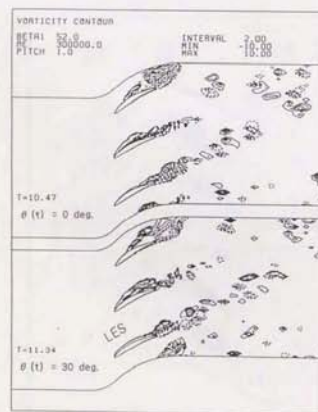
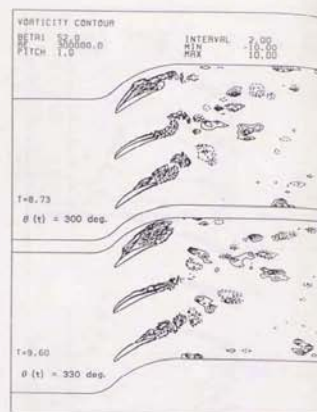
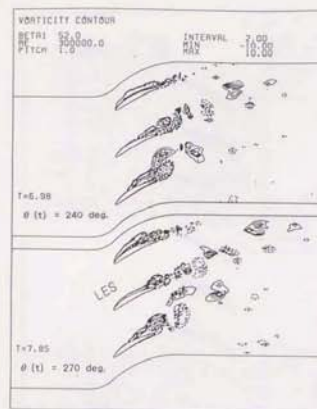


図5-3-41 (b) 同期・引き込み領域における旋回失速の伝播
 ($\sigma = 120^\circ$, $k = 0, 3, S3$)

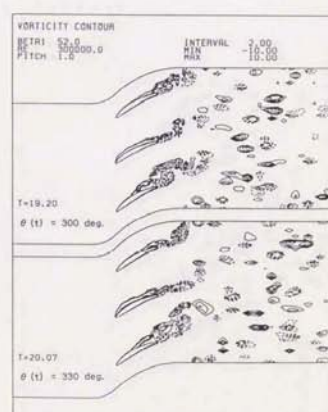
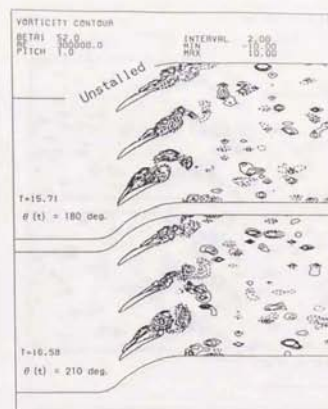
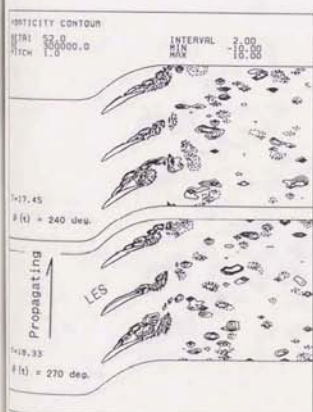
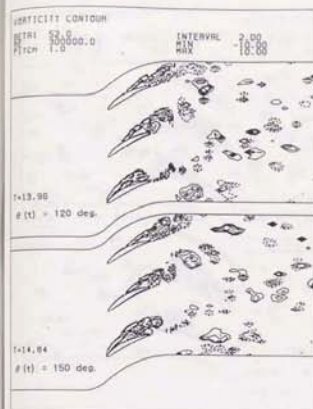


図5-3-41 (c) 同期・引き込み領域における旋回失速の伝播
 ($\sigma = 120^\circ$, $k = 0, 3, S3$)

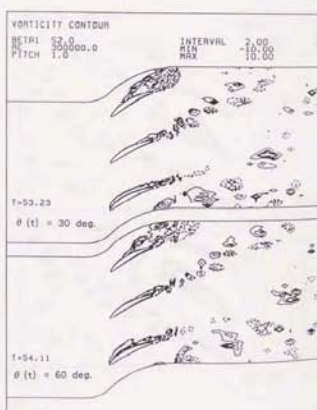
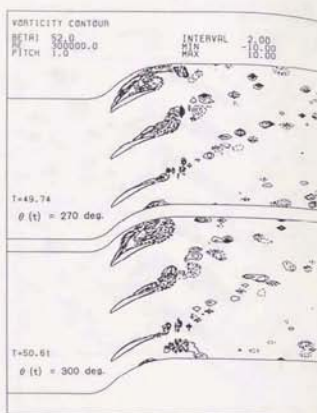
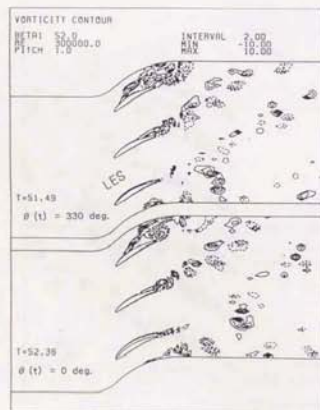
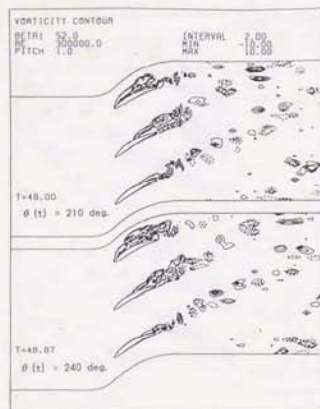


図5-3-4 1 (f) 同期・引き込み領域における旋回失速の伝播
 ($\sigma = 120^\circ$, $k = 0.3$, S3)

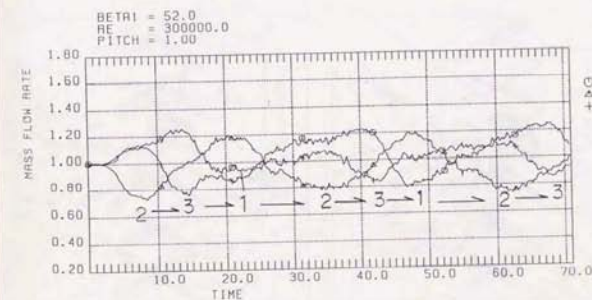
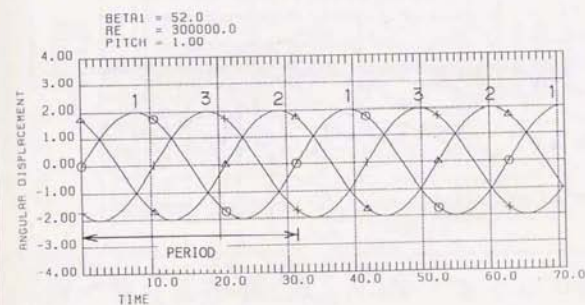
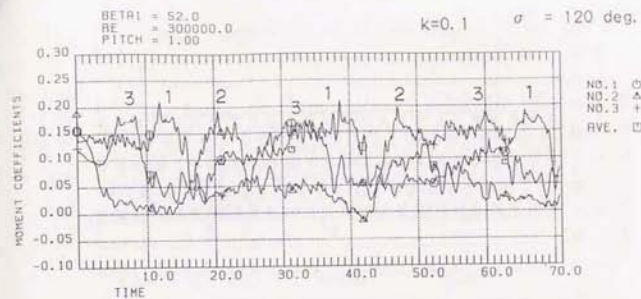
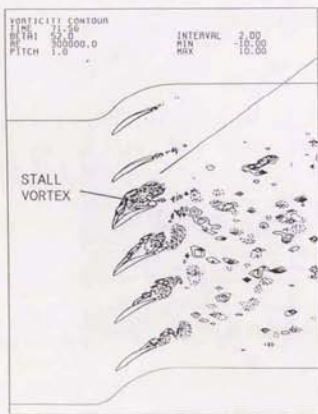
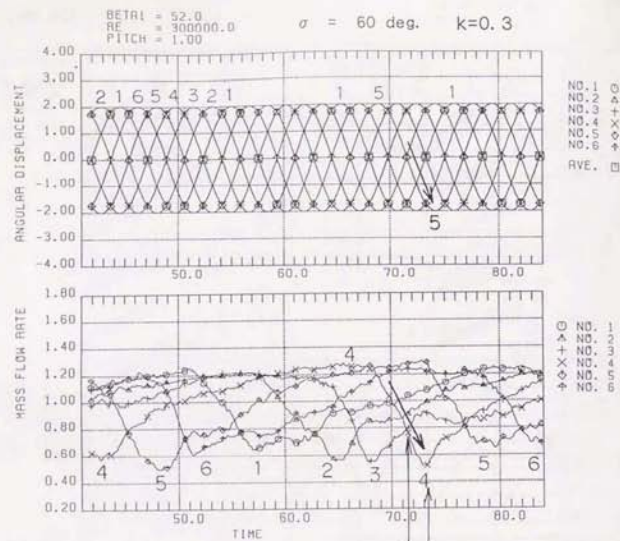


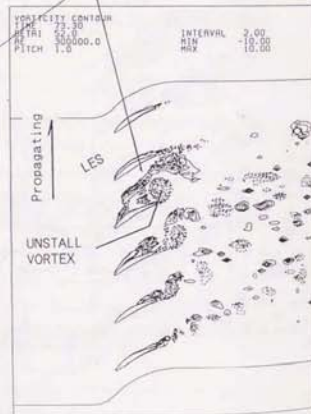
図5-3-4 2 RS領域における旋回失速の伝播:

モーメント, 角変位, 流量変動

($\sigma = 120^\circ$, $k = 0.1$, S1)

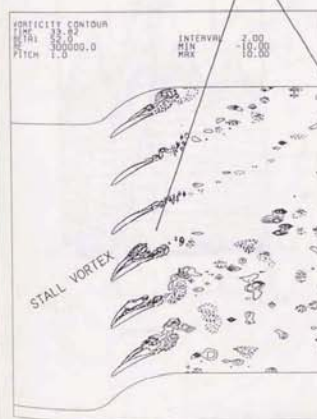
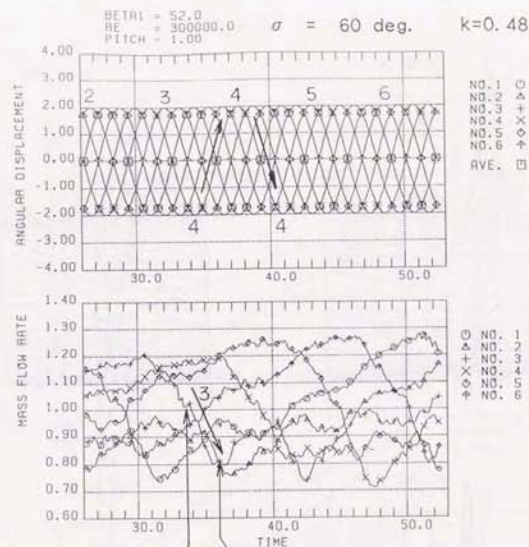


$\theta(t) = 300 \text{ deg.}$

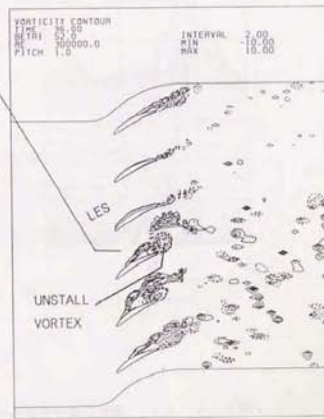


$\theta(t) = 0 \text{ deg.}$

図5-3-4-3 (a) R S領域における失速渦と回復渦のせき止め作用
 ($\sigma = 60^\circ$, $k = 0.3$, T2)



$\theta(t) = 60 \text{ deg.}$



$\theta(t) = 180 \text{ deg.}$

図5-3-4-3 (b) 同期・引き込み領域における失速渦と回復渦のせき止め作用
 ($\sigma = 60^\circ$, $k = 0.48$, T3)

$\sigma = 60 \text{ deg.}$

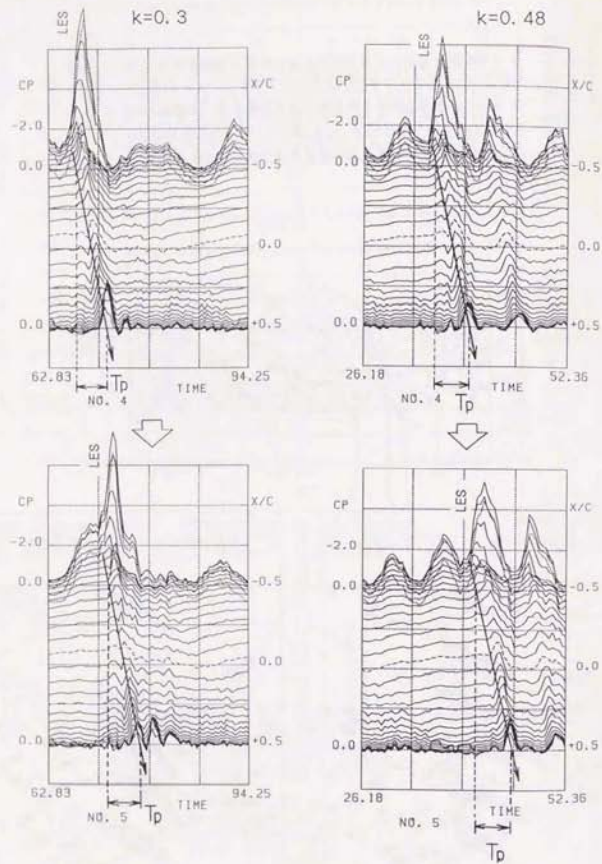


図5-3-4.4 翼背面非定常圧力の時間変動：負圧のピークと前縁失速の伝播
($k=0.3$ (T2)と 0.48 (T3)との比較, $\sigma=60^\circ$)

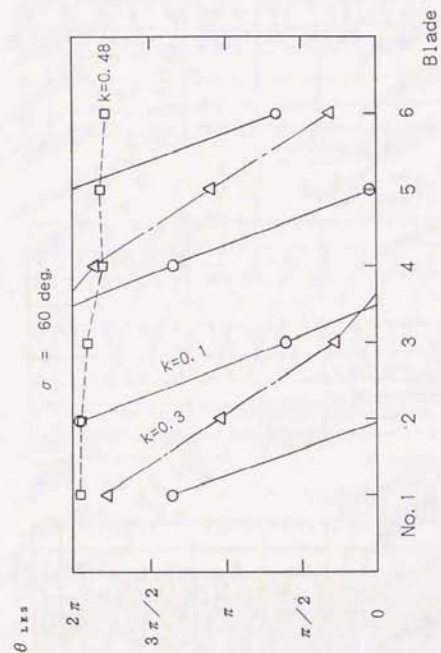


図5-3-4.5 前縁失速の起きる位相の比較 ($\sigma=60^\circ$)

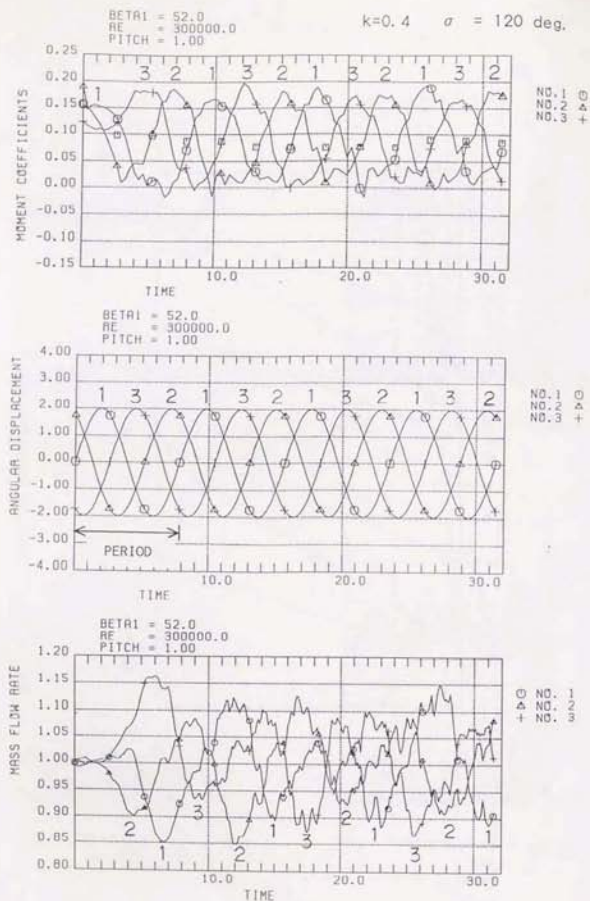


図 5-3-4 6 背面側位相進みで発生する翼の前縁失速
モーメント、角変位、流量変動
($\sigma = 120^\circ$, $k = 0.4$, S4)

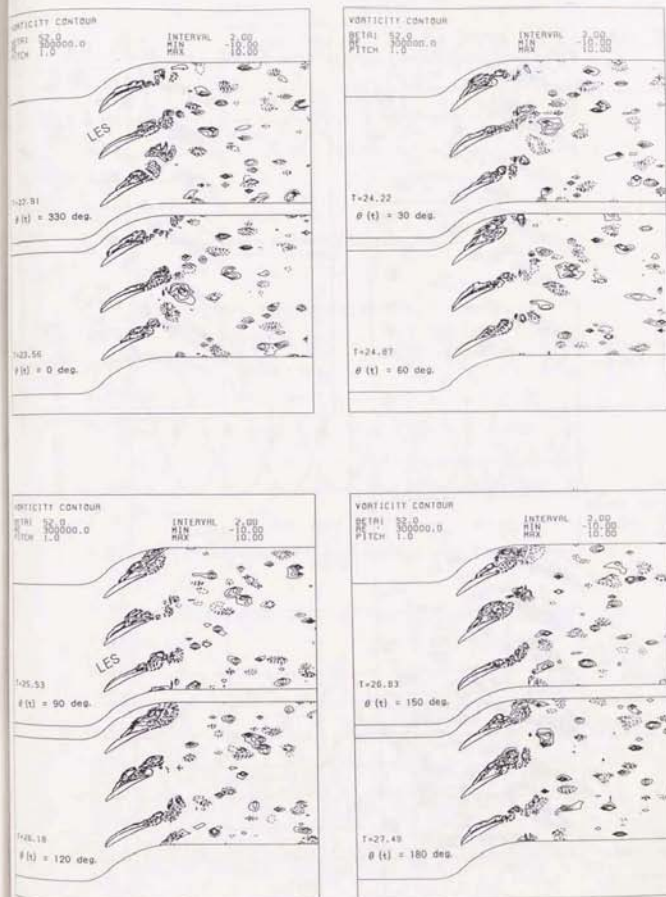


図 5-3-4 7 (a) 背面側位相進みで発生する翼の前縁失速：渦度分布
($\sigma = 120^\circ$, $k = 0.4$, S4)

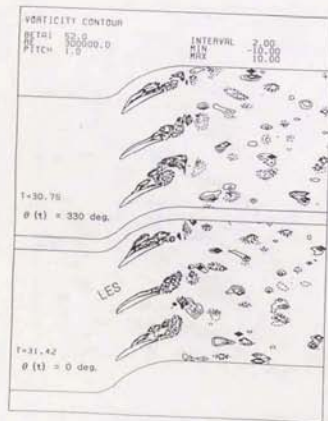
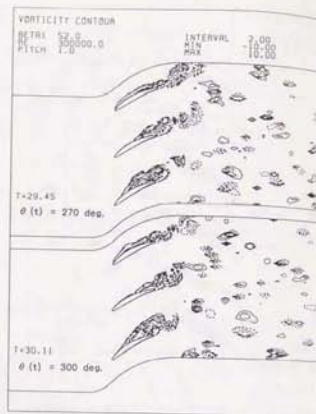
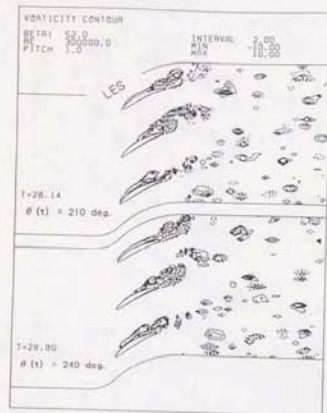


図5-3-47 (b) 背面側位相進みで発生する翼の前縁失速
 $(\sigma = 120^\circ, k = 0.4, S4)$

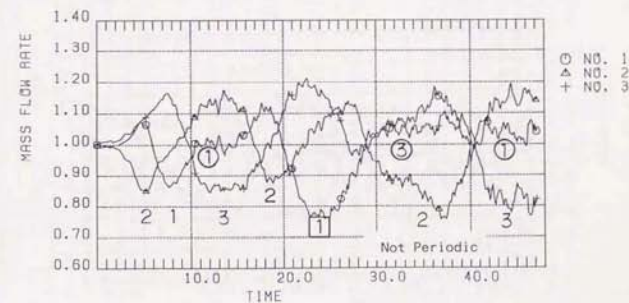
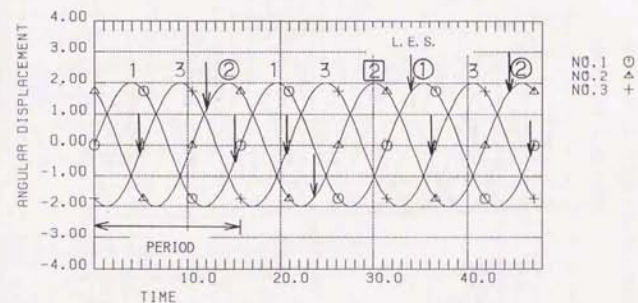
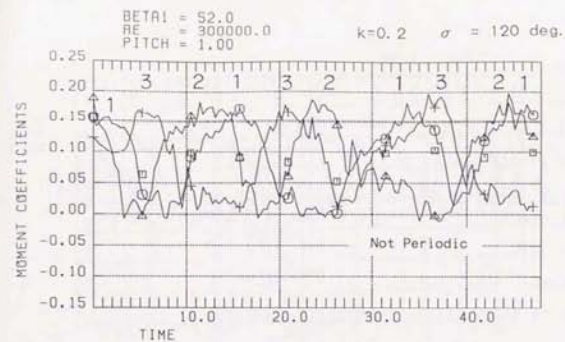


図5-3-48 (a) 背面側位相進みで発生する翼の前縁失速
 モーメント, 角変位, 流量変動
 $(\sigma = 120^\circ, k = 0.2, S2)$

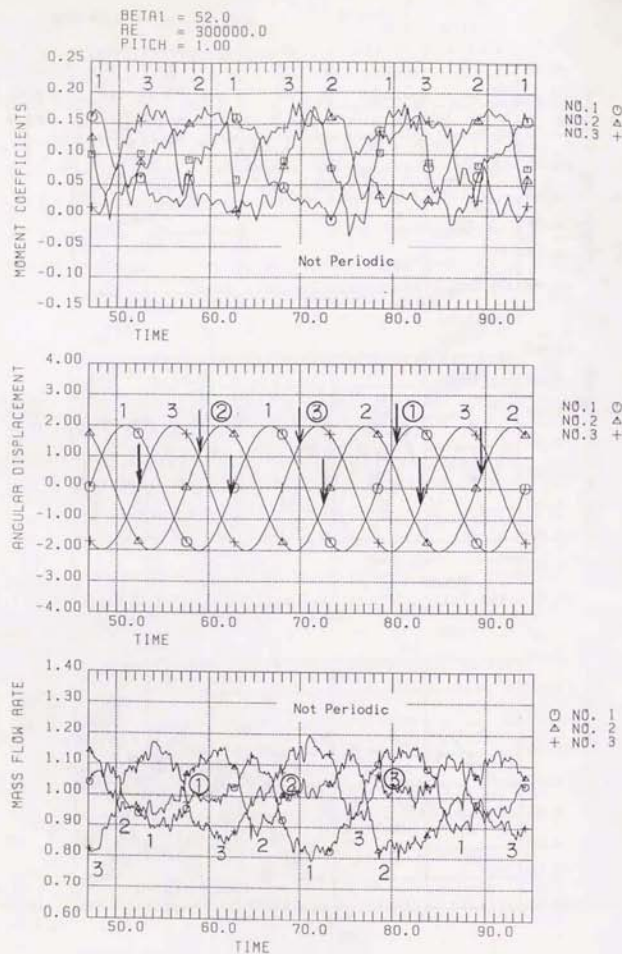


図5-3-48(b) 背面側位相進みで発生する翼の前縁失速
モーメント, 角変位, 流量変動
($\sigma = 120^\circ$, $k = 0.2$, S2)

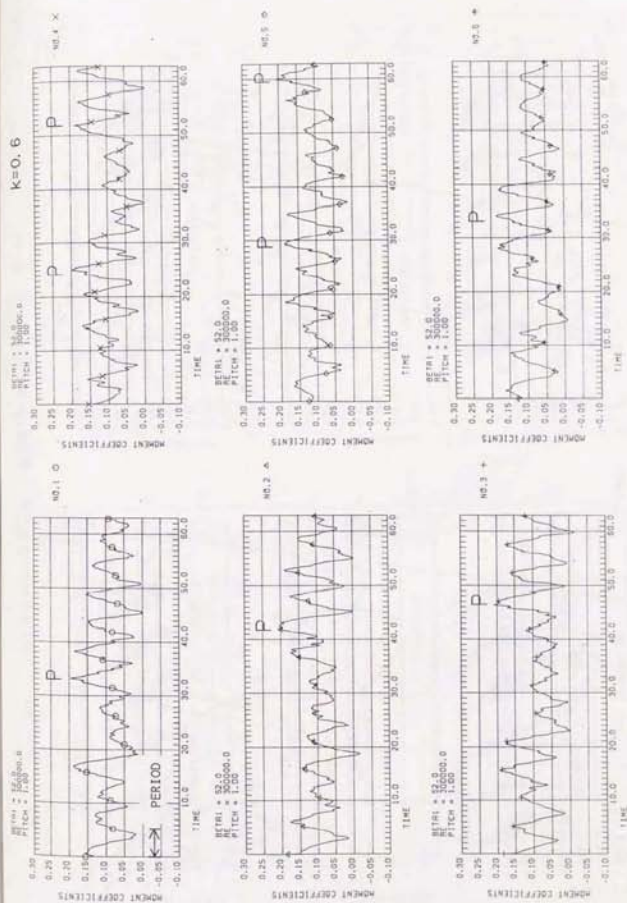


図5-3-49 (a) 不規則に伝播する横回波連； $\sigma = 60^\circ$, $k = 0.6, 14$

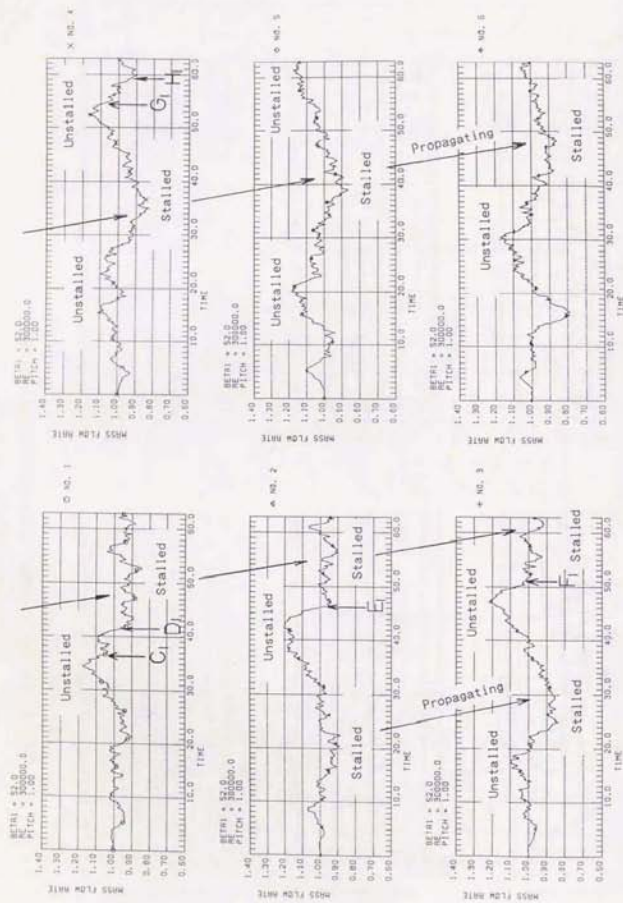
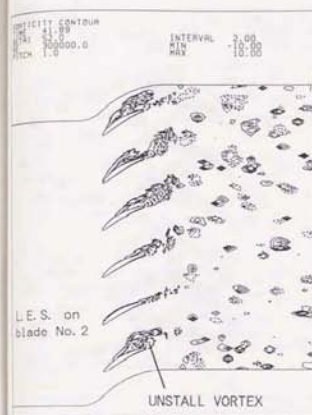
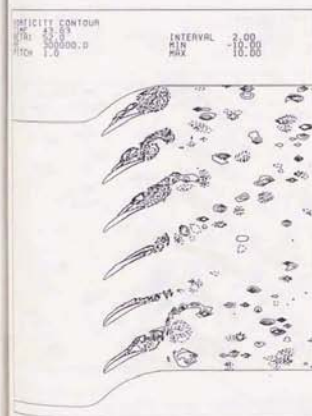


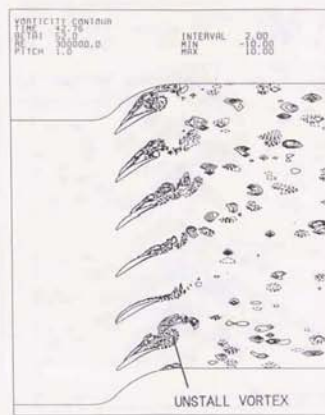
図5-3-49 (b) 不規則に伝播する旋回失速：流量変動 ($\sigma = 0.0^*$, $k = 0.6$, T_4)



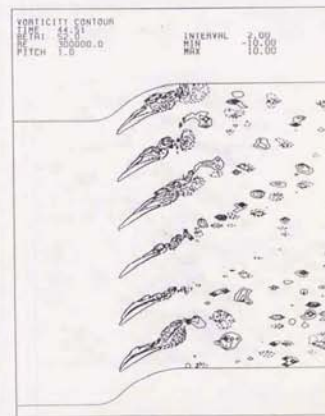
$\theta(t) = 0$ deg.



$\theta(t) = 120$ deg.

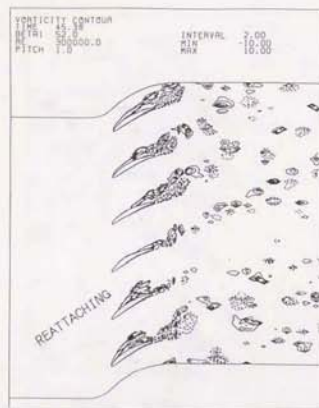


$\theta(t) = 60$ deg.

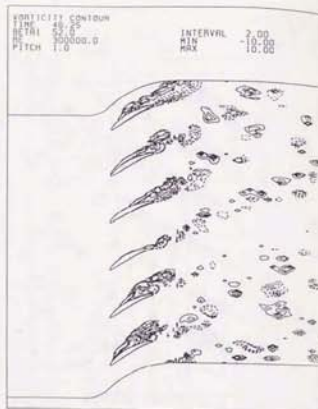


$\theta(t) = 180$ deg.

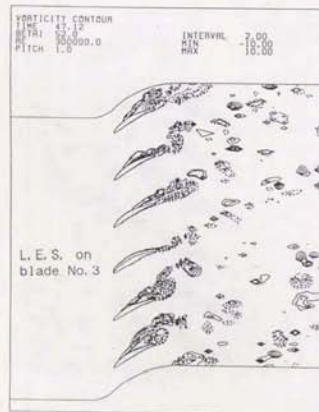
図5-3-50 (a) 不規則に伝播する旋回失速：渦度分布 ($\sigma = 0.0^*$, $k = 0.6$, T_4)



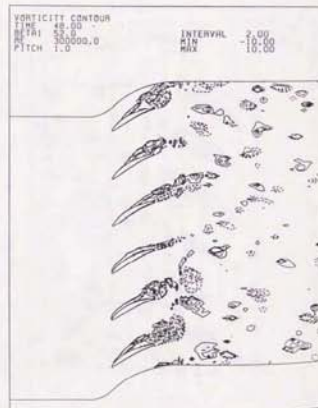
$\theta(t) = 240 \text{ deg.}$



$\theta(t) = 300 \text{ deg.}$

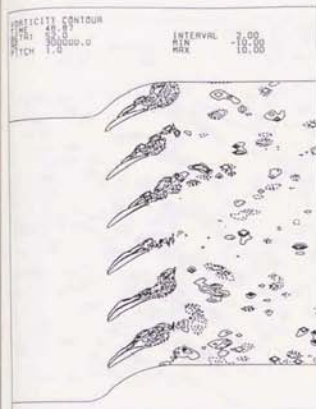


$\theta(t) = 0 \text{ deg.}$

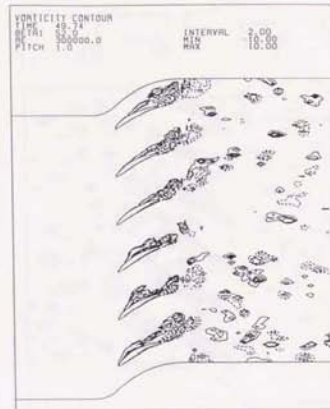


$\theta(t) = 60 \text{ deg.}$

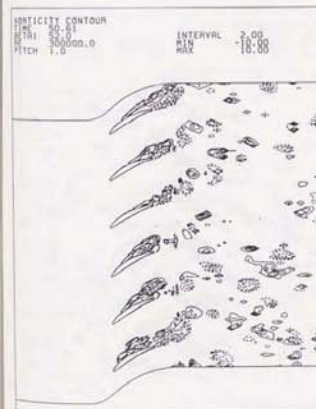
図5-3-50 (b) 不規則に伝播する旋回失速 ($\sigma = 6.0^\circ$, $k = 0.6$, $T4$)



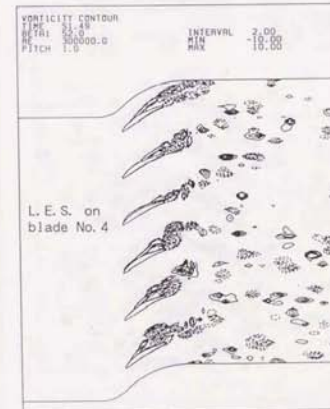
$\theta(t) = 120 \text{ deg.}$



$\theta(t) = 180 \text{ deg.}$

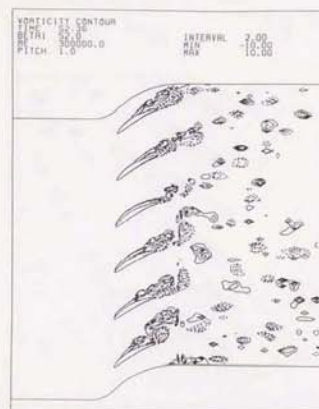


$\theta(t) = 240 \text{ deg.}$

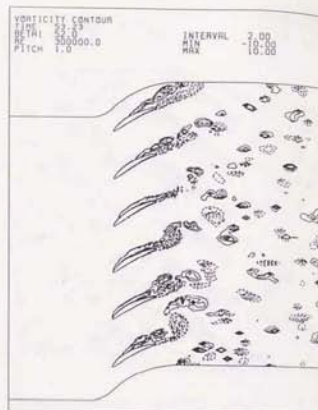


$\theta(t) = 300 \text{ deg.}$

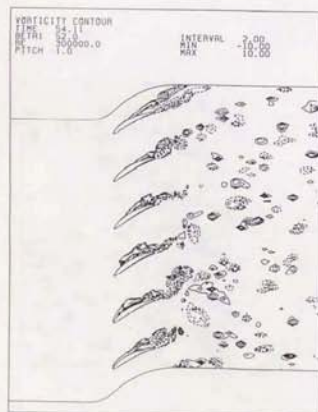
図5-3-50 (c) 不規則に伝播する旋回失速 ($\sigma = 6.0^\circ$, $k = 0.6$, $T4$)



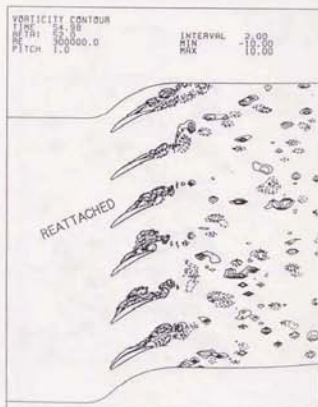
$\theta(t) = 0 \text{ deg.}$



$\theta(t) = 60 \text{ deg.}$

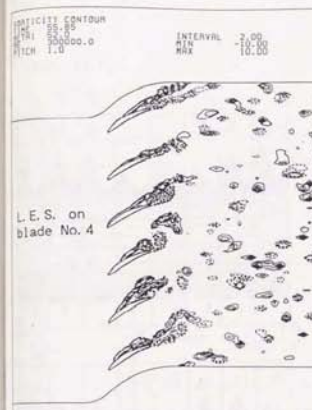


$\theta(t) = 120 \text{ deg.}$

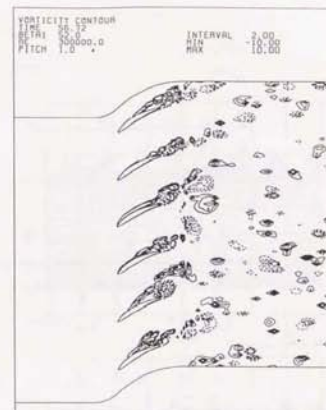


$\theta(t) = 180 \text{ deg.}$

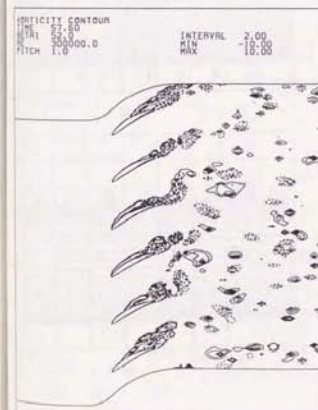
図5-3-50 (d) 不規則に伝播する旋回失速 ($\sigma = 6.0^\circ$, $k = 0.6$, $T4$)



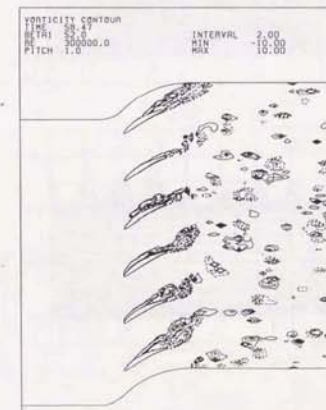
$\theta(t) = 240 \text{ deg.}$



$\theta(t) = 300 \text{ deg.}$



$\theta(t) = 0 \text{ deg.}$



$\theta(t) = 60 \text{ deg.}$

図5-3-50 (e) 不規則に伝播する旋回失速 ($\sigma = 6.0^\circ$, $k = 0.6$, $T4$)

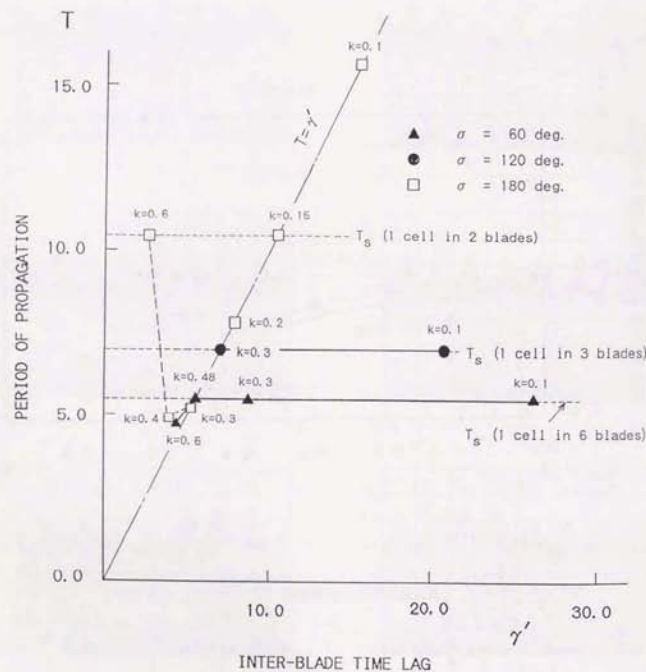


図5-3-53 旋回失速の伝播時間と背面遅れ翼間時間差との関係
($0^\circ < \sigma \leq 180^\circ$, 周期条件1)

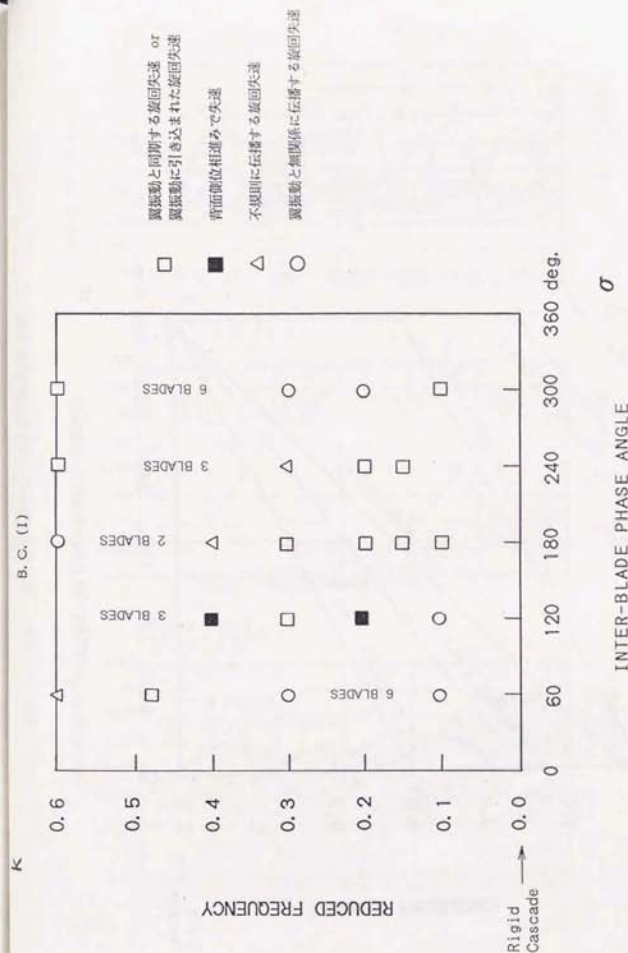


図5-3-54 旋回失速の発生状況 (周期条件1)

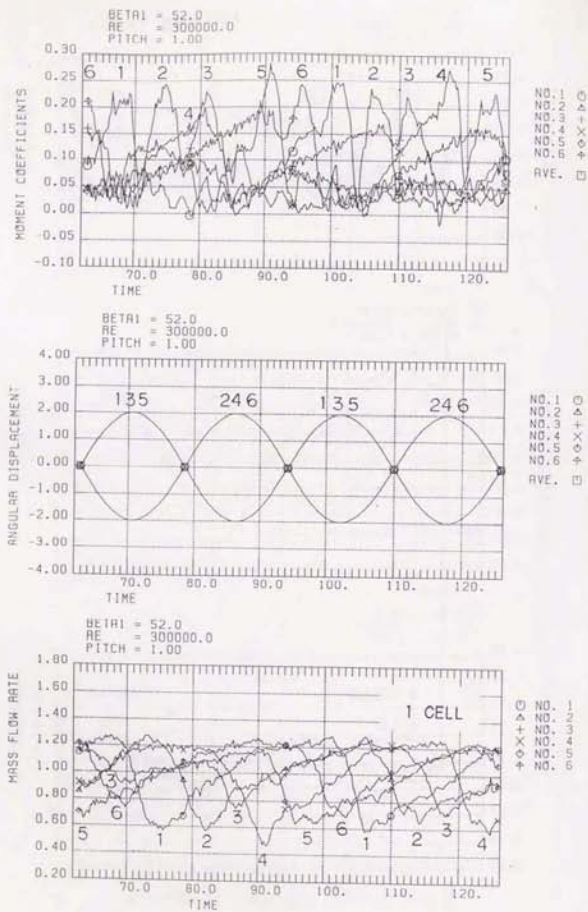


図5-4-1 (b) RS領域における1セルの旋回失速の成長
モーメント、角変位、流量変動
($\sigma = 180^\circ$, $k = 0, 1, P7$, 周期条件II)

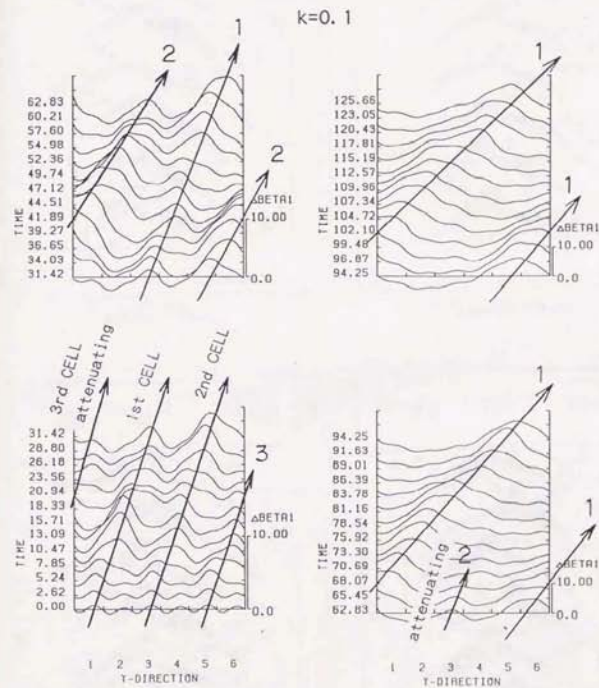
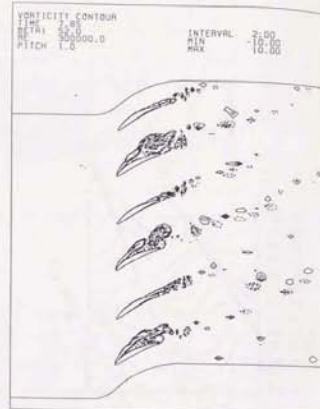


図5-4-2 失速セル数の減少: 0.53-d上流の流れ角分布
($\sigma = 180^\circ$, $k = 0.1, P7$, 周期条件II)

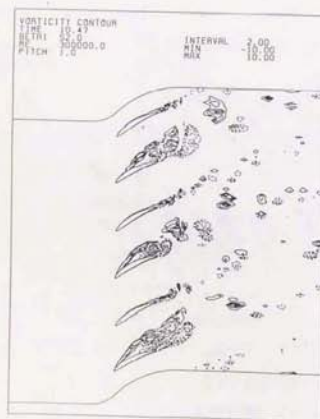
$k=0.1$



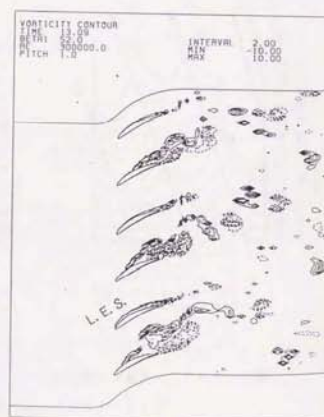
$\theta(t) = 60 \text{ deg.}$



$\theta(t) = 90 \text{ deg.}$

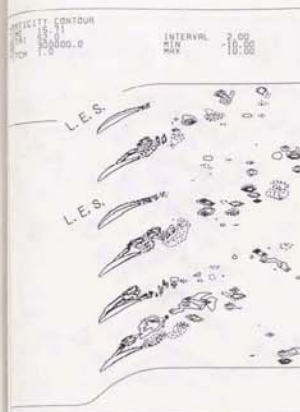


$\theta(t) = 120 \text{ deg.}$

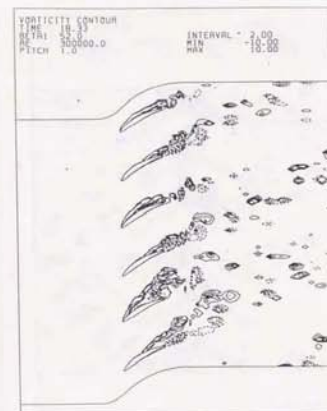


$\theta(t) = 150 \text{ deg.}$

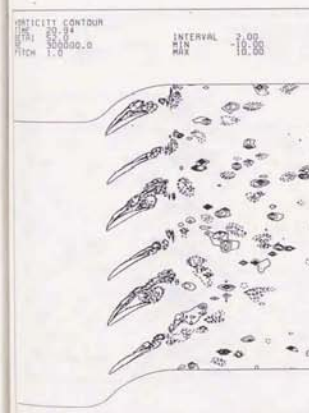
図5-4-3 (a) RS領域における1セルの旋回失速の成長：渦度分布
($\sigma = 180^\circ$, $k = 0.1$, P7, 周期条件II)



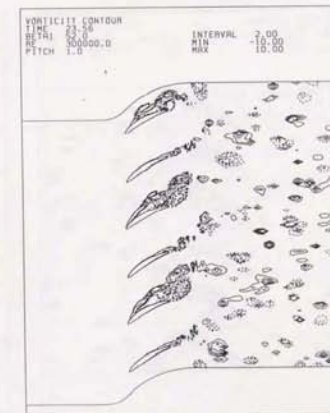
$\theta(t) = 180 \text{ deg.}$



$\theta(t) = 210 \text{ deg.}$

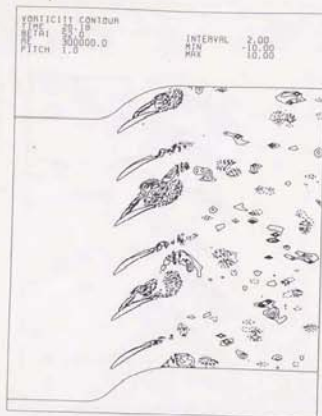


$\theta(t) = 240 \text{ deg.}$

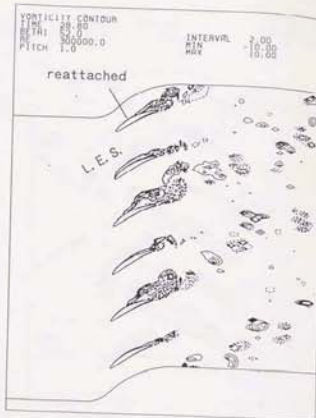


$\theta(t) = 270 \text{ deg.}$

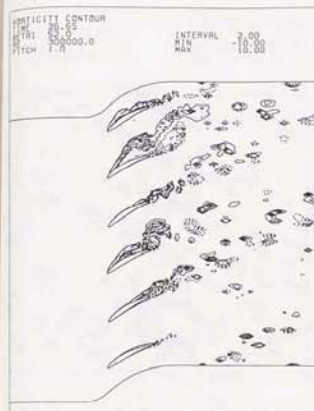
図5-4-3 (b) RS領域における1セルの旋回失速の成長
($\sigma = 180^\circ$, $k = 0.1$, P7, 周期条件II)



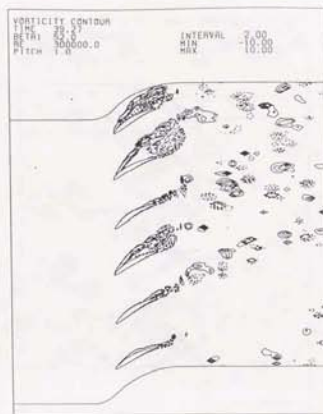
$\theta(t) = 300 \text{ deg.}$



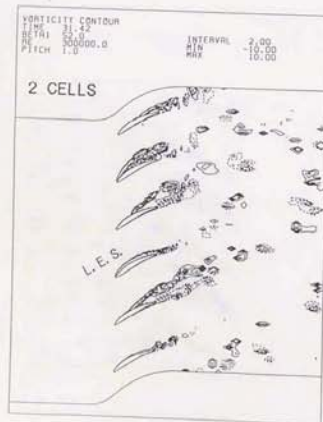
$\theta(t) = 330 \text{ deg.}$



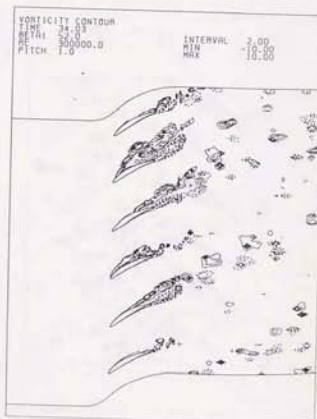
$\theta(t) = 60 \text{ deg.}$



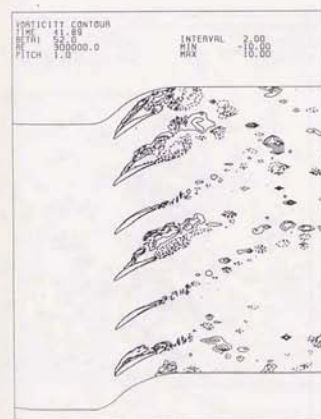
$\theta(t) = 90 \text{ deg.}$



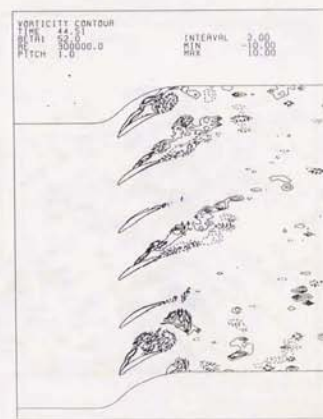
$\theta(t) = 0 \text{ deg.}$



$\theta(t) = 30 \text{ deg.}$



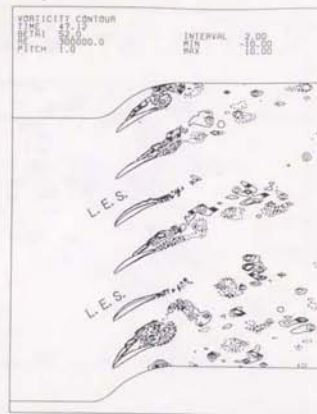
$\theta(t) = 120 \text{ deg.}$



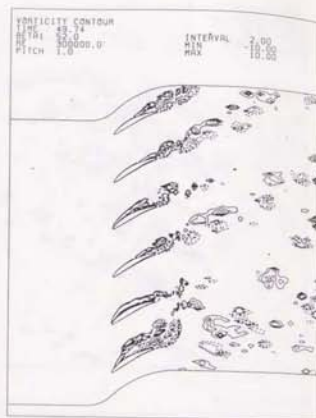
$\theta(t) = 150 \text{ deg.}$

図5-4-3 (c) RS領域における1セルの旋回失速の成長
($\sigma = 1.80^\circ$, $k = 0, 1, P7$, 周期条件II)

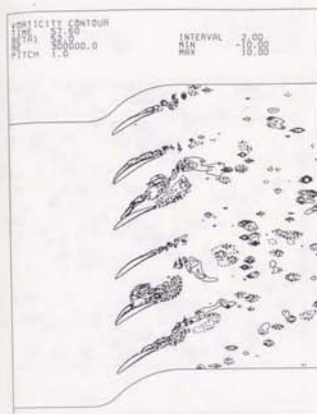
図5-4-3 (d) RS領域における1セルの旋回失速の成長
($\sigma = 1.80^\circ$, $k = 0, 1, P7$, 周期条件II)



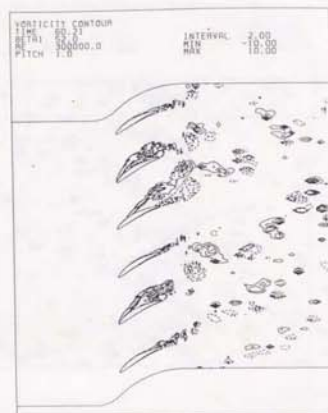
$\theta(t) = 180 \text{ deg.}$



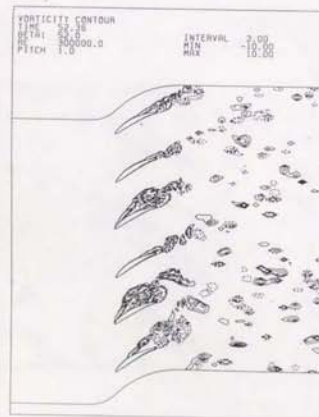
$\theta(t) = 210 \text{ deg.}$



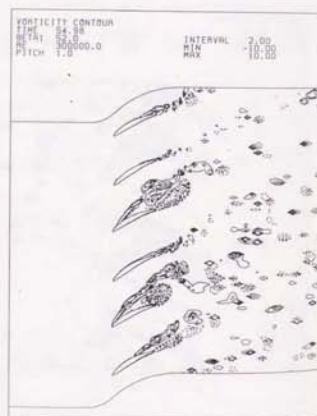
$\theta(t) = 300 \text{ deg.}$



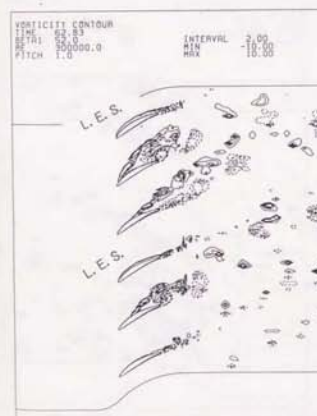
$\theta(t) = 330 \text{ deg.}$



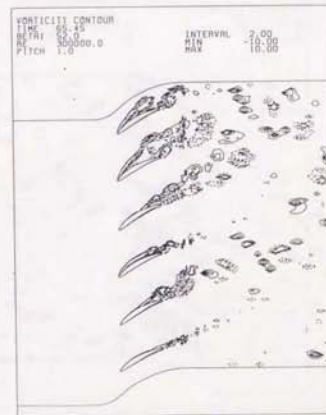
$\theta(t) = 240 \text{ deg.}$



$\theta(t) = 270 \text{ deg.}$



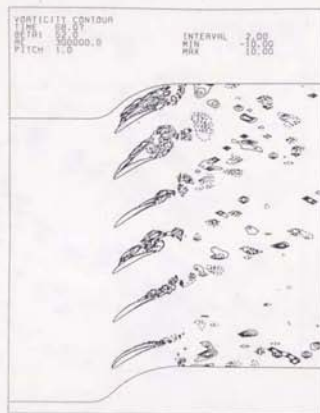
$\theta(t) = 0 \text{ deg.}$



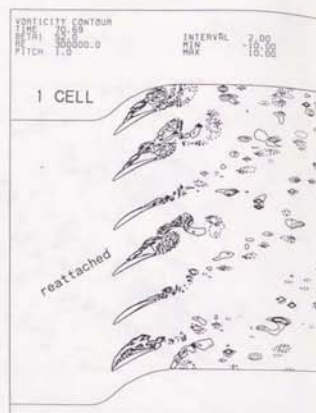
$\theta(t) = 30 \text{ deg.}$

図5-4-3 (e) RS領域における1セルの旋回失速の成長
($\sigma = 180^\circ$, $k = 0, 1, PT$, 周期条件II)

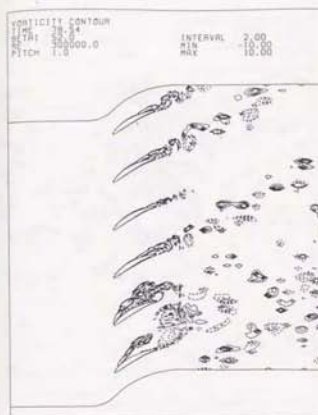
図5-4-3 (f) RS領域における1セルの旋回失速の成長
($\sigma = 180^\circ$, $k = 0, 1, PT$, 周期条件II)



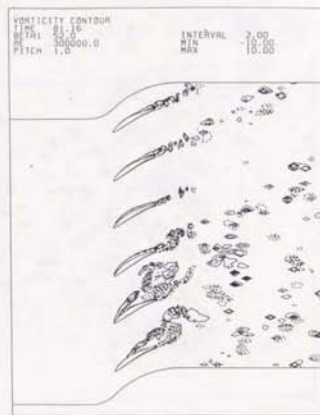
$\theta(t) = 60 \text{ deg.}$



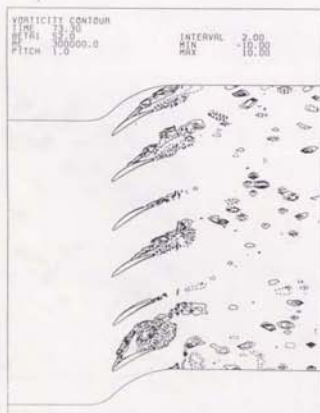
$\theta(t) = 90 \text{ deg.}$



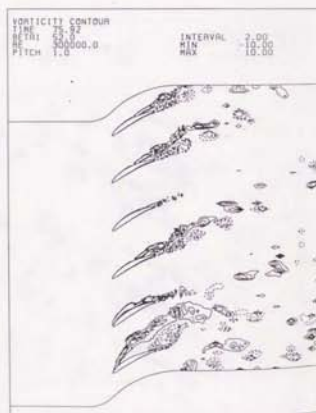
$\theta(t) = 180 \text{ deg.}$



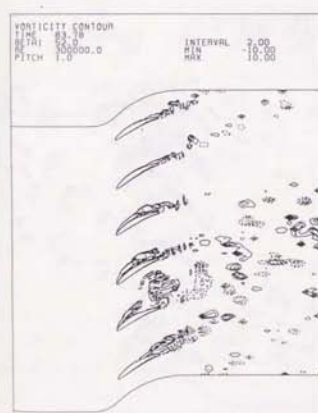
$\theta(t) = 210 \text{ deg.}$



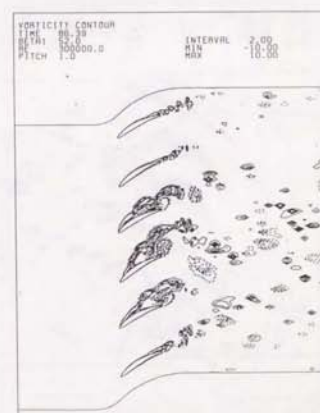
$\theta(t) = 120 \text{ deg.}$



$\theta(t) = 150 \text{ deg.}$



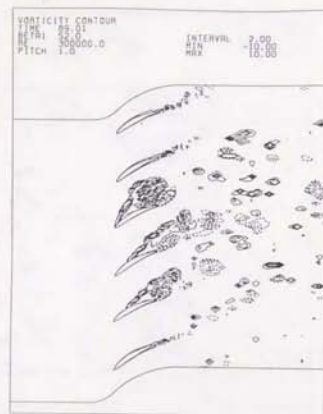
$\theta(t) = 240 \text{ deg.}$



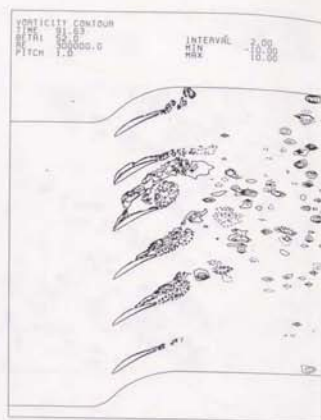
$\theta(t) = 270 \text{ deg.}$

図5-4-3 (g) RS領域における1セルの旋回失速の成長
 ($\sigma = 180^\circ$, $k = 0, 1$, P7, 周期条件II)

図5-4-3 (h) RS領域における1セルの旋回失速の成長
 ($\sigma = 180^\circ$, $k = 0, 1$, P7, 周期条件II)



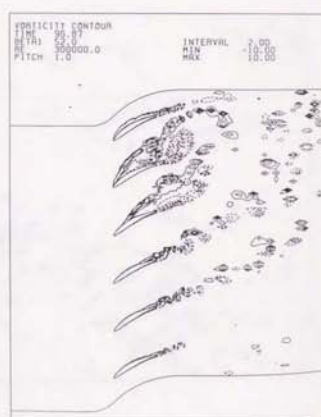
$\theta(t) = 300 \text{ deg.}$



$\theta(t) = 330 \text{ deg.}$

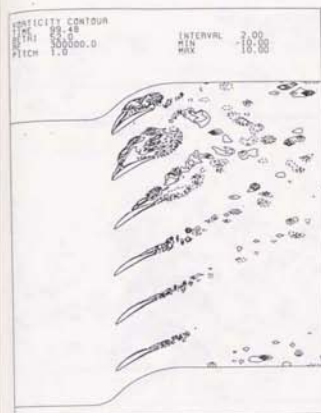


$\theta(t) = 0 \text{ deg.}$

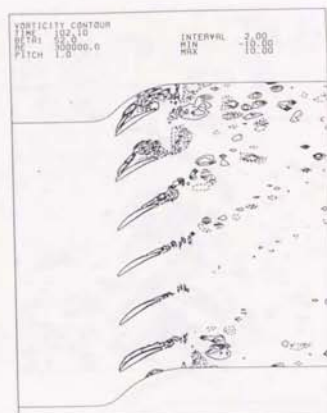


$\theta(t) = 30 \text{ deg.}$

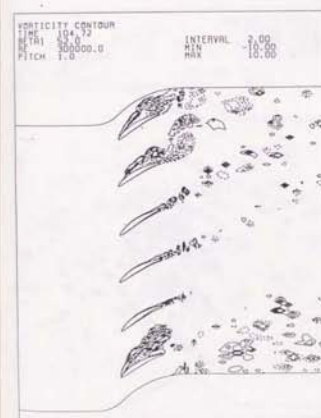
図5-4-3 (i) RS領域における1セルの旋回失速の成長
($\alpha = 180^\circ$, $k = 0, 1, P7$, 周期条件II)



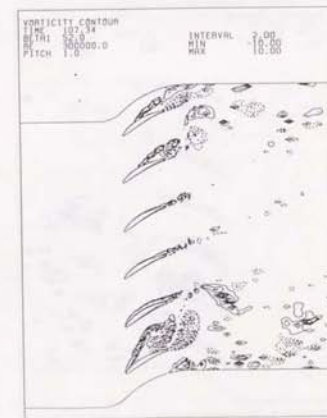
$\theta(t) = 60 \text{ deg.}$



$\theta(t) = 90 \text{ deg.}$

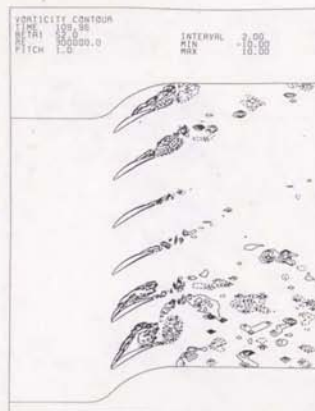


$\theta(t) = 120 \text{ deg.}$

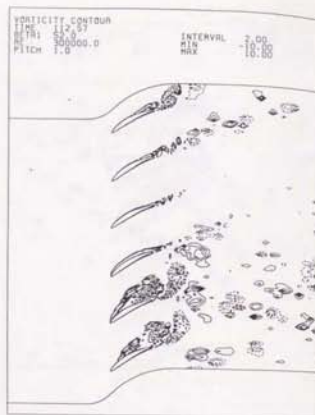


$\theta(t) = 150 \text{ deg.}$

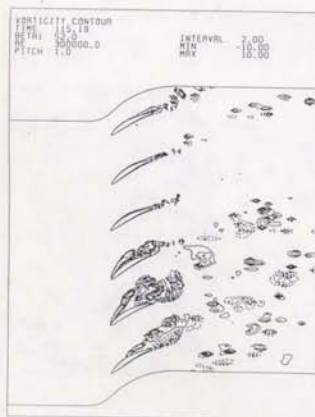
図5-4-3 (j) RS領域における1セルの旋回失速の成長
($\alpha = 180^\circ$, $k = 0, 1, P7$, 周期条件II)



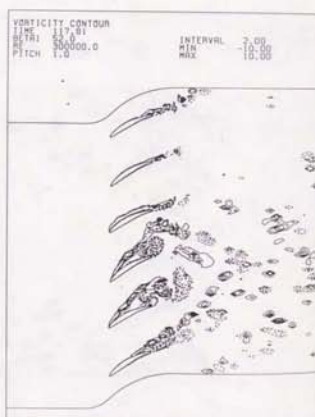
$\theta(t) = 180 \text{ deg.}$



$\theta(t) = 210 \text{ deg.}$

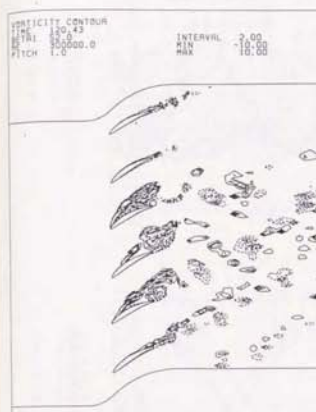


$\theta(t) = 240 \text{ deg.}$

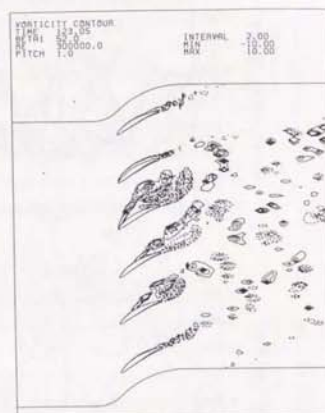


$\theta(t) = 270 \text{ deg.}$

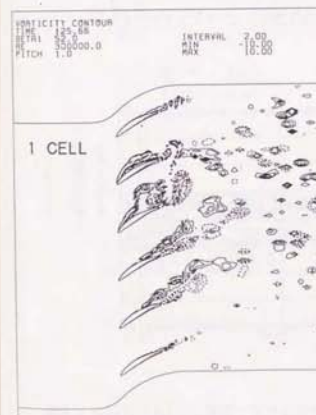
図5-4-3 (k) RS領域における1セルの旋回失速の成長
 ($\sigma = 1.80^*$, $k = 0, 1, P7$, 周期条件II)



$\theta(t) = 300 \text{ deg.}$



$\theta(t) = 330 \text{ deg.}$



$\theta(t) = 0 \text{ deg.}$

図5-4-3 (I) RS領域における1セルの旋回失速の成長
 ($\sigma = 1.80^*$, $k = 0, 1, P7$, 周期条件II)

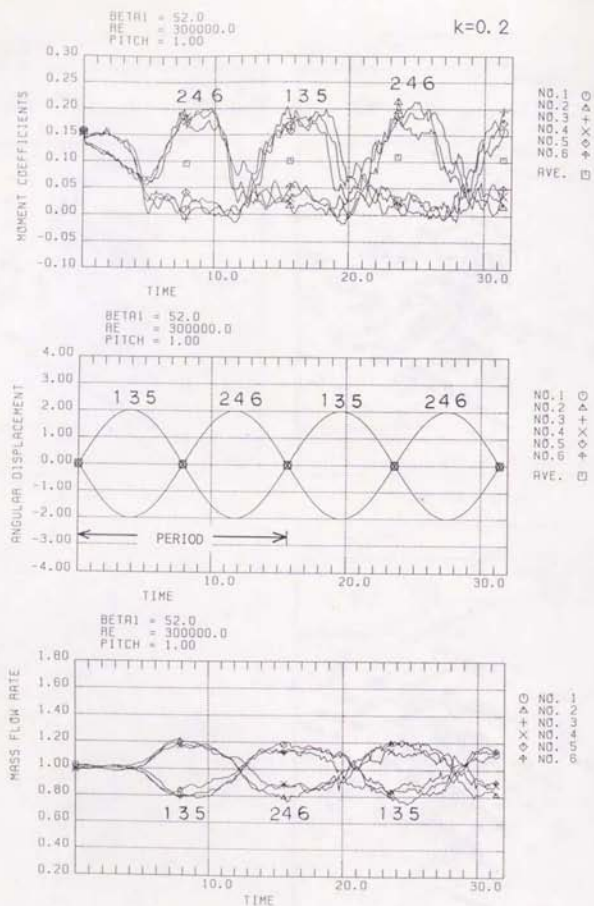


図5-4-4 (a) 同期・引き込み領域における3セルの旋回失速の成長
モーメント、角変位、流量変動
($\sigma = 180^\circ$, $k = 0.2$, P8, 周期条件II)

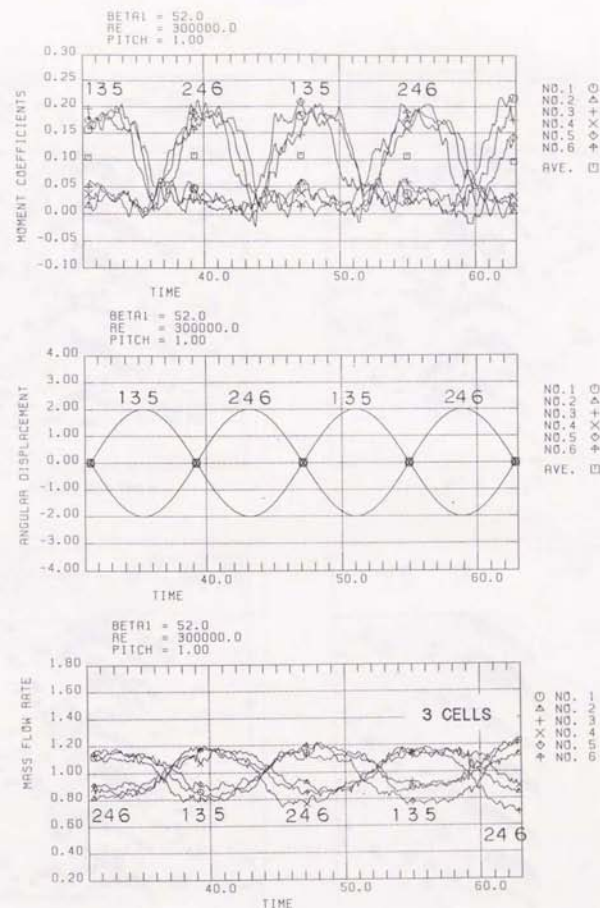
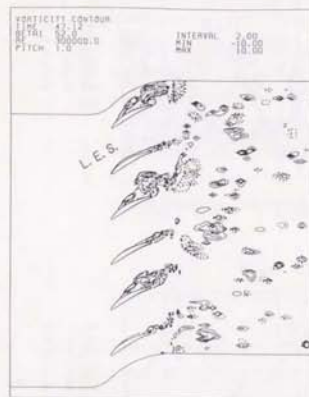
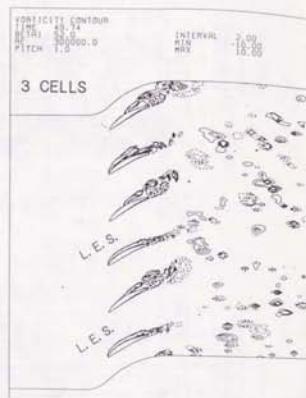


図5-4-4 (b) 同期・引き込み領域における3セルの旋回失速の成長
モーメント、角変位、流量変動
($\sigma = 180^\circ$, $k = 0.2$, P8, 周期条件II)

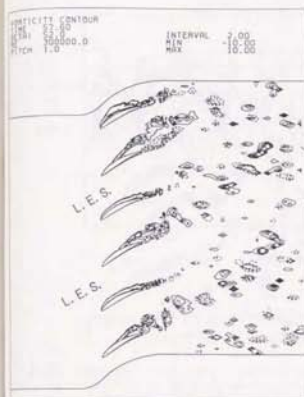
$k=0.2$



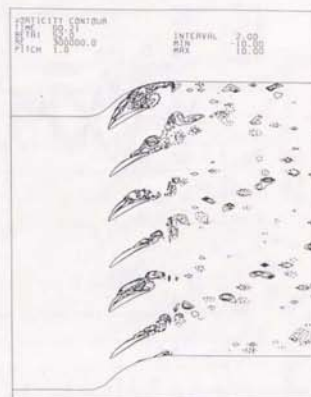
$\theta(t) = 0 \text{ deg.}$



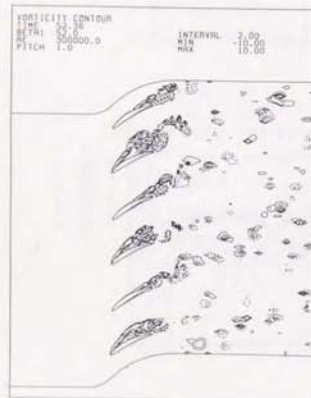
$\theta(t) = 60 \text{ deg.}$



$\theta(t) = 240 \text{ deg.}$



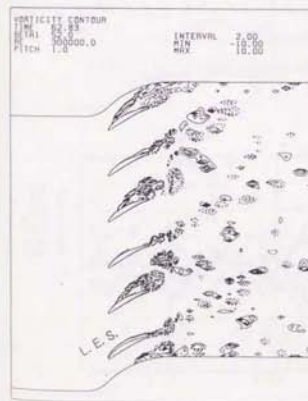
$\theta(t) = 300 \text{ deg.}$



$\theta(t) = 120 \text{ deg.}$



$\theta(t) = 180 \text{ deg.}$



$\theta(t) = 0 \text{ deg.}$

図5-4-5 (a) 同期・引き込み領域における3セルの旋回失速の発生：渦度分布
($\alpha = 180^\circ$, $k = 0.2$, P3, 周期条件II)

図5-4-5 (b) 同期・引き込み領域における3セルの旋回失速の発生
($\alpha = 180^\circ$, $k = 0.2$, P3, 周期条件II)

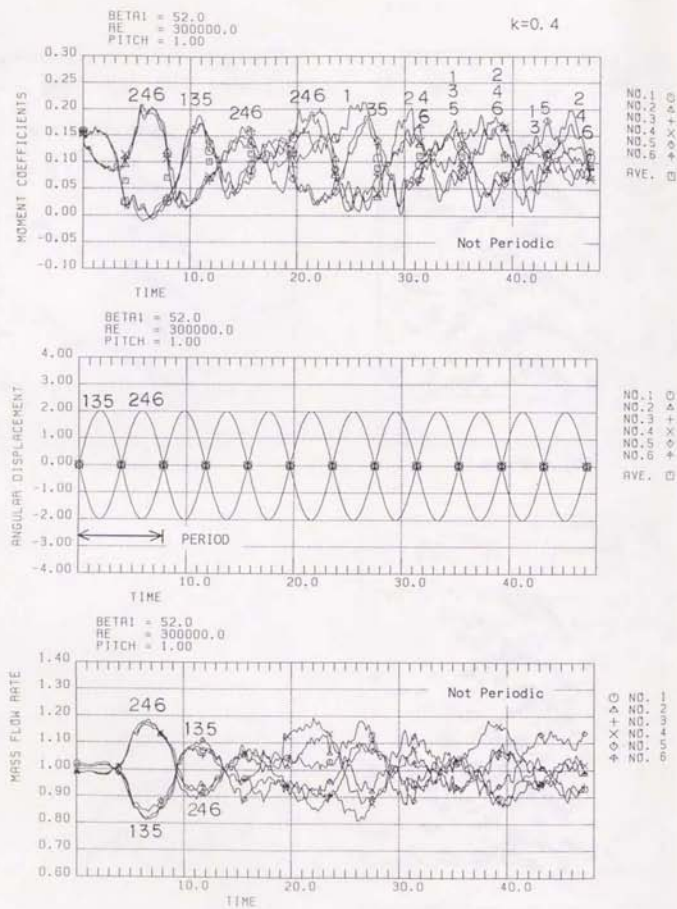


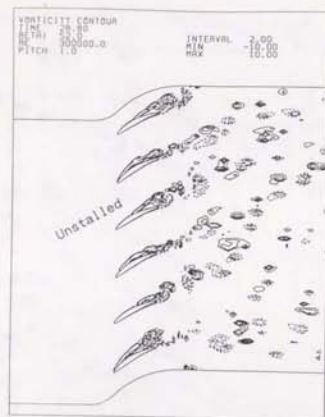
図5-4-6 中間領域における非周期的なモーメントと流量の変動

($\sigma = 180^\circ$, $k = 0.4$, P9, 周期条件II)

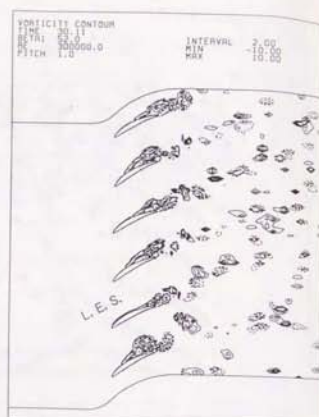


図5-4-7 (a) 中間領域における非周期的な前縁失速の伝播：渦度分布

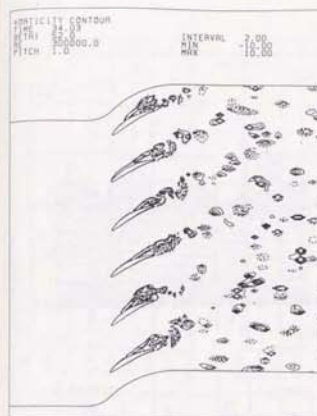
($\sigma = 180^\circ$, $k = 0.4$, P9, 周期条件II)



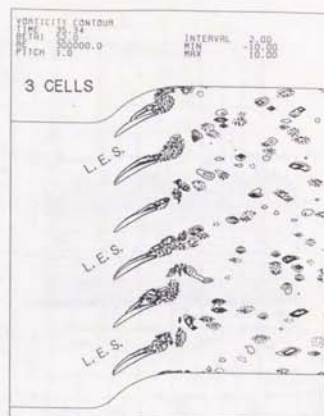
$\theta(t) = 240 \text{ deg.}$



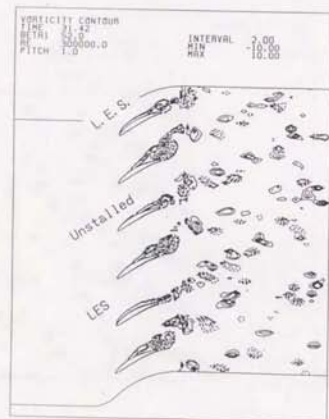
$\theta(t) = 300 \text{ deg.}$



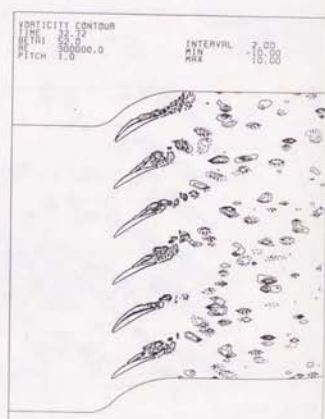
$\theta(t) = 120 \text{ deg.}$



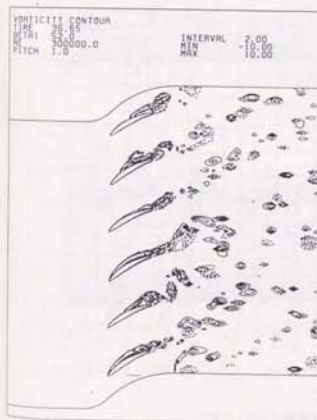
$\theta(t) = 180 \text{ deg.}$



$\theta(t) = 0 \text{ deg.}$



$\theta(t) = 60 \text{ deg.}$



$\theta(t) = 240 \text{ deg.}$



$\theta(t) = 300 \text{ deg.}$

図5-4-7 (b) 中間領域における非周期的な前縁失速の伝播
($\sigma = 180^\circ$, $k = 0.4$, P_9 , 周期条件II)

図5-4-7 (c) 中間領域における非周期的な前縁失速の伝播
($\sigma = 180^\circ$, $k = 0.4$, P_9 , 周期条件II)

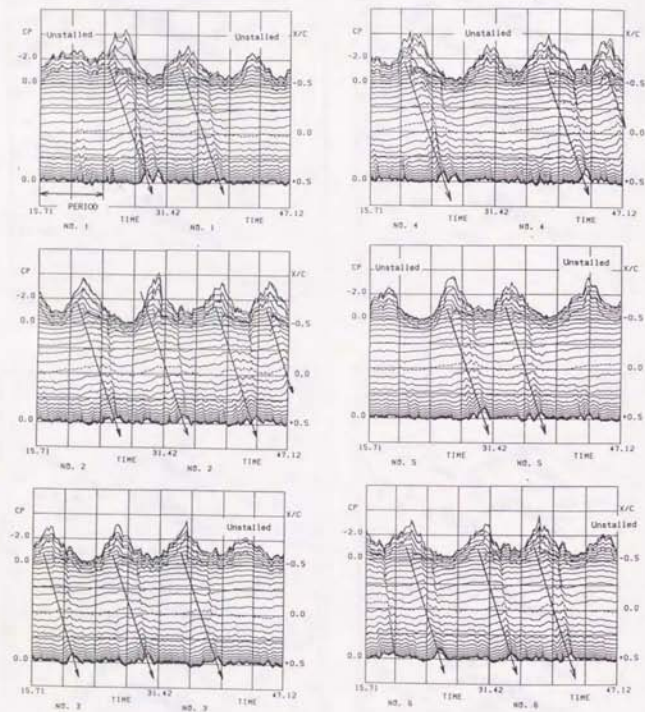


図5-4-8 中間領域における非周期的な前縁失速の伝播
翼背面非常圧力の時間変動: $t=15.7 \sim 47.12$
($\sigma=180^\circ$, $k=0.4$, P9, 周期条件II)

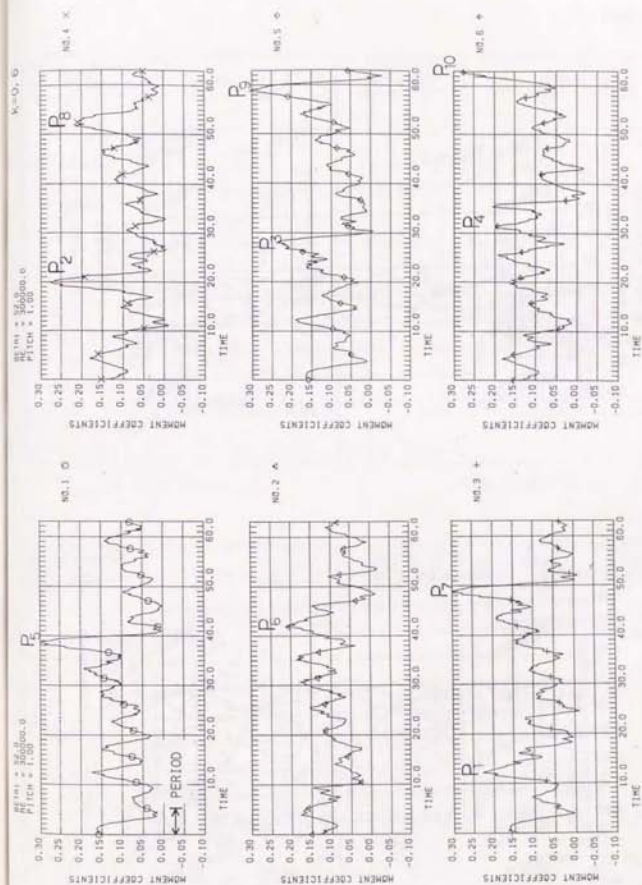


図5-4-9 RS領域における1セルの旋回失速の成長: モーメント変動
($\sigma=180^\circ$, $k=0.6$, P10, 周期条件II)

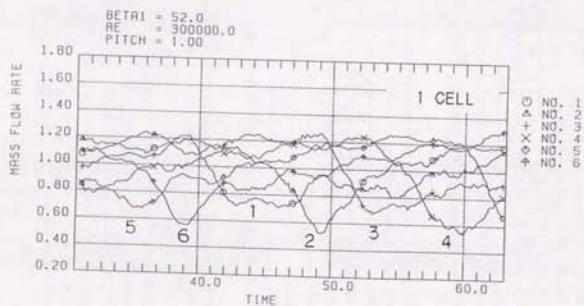
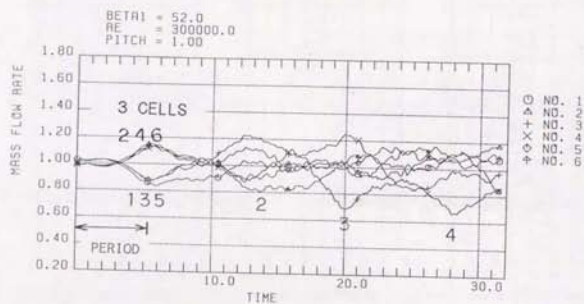
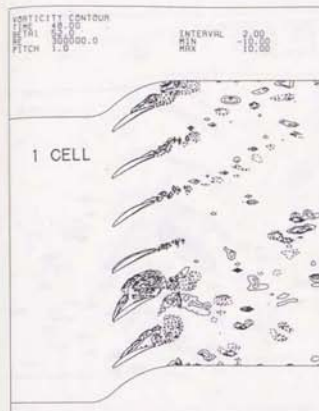
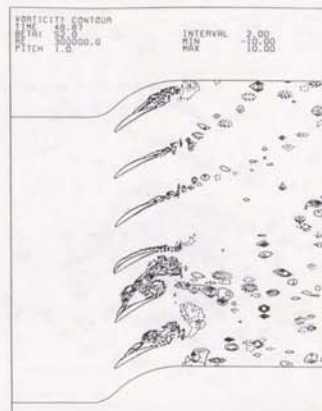


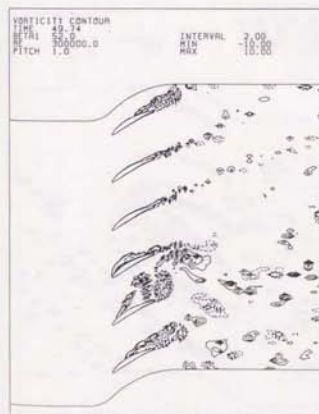
図5-4-10 RS領域における1セルの旋回失速の成長：流量変動
($\sigma = 180^\circ$, $k = 0.6$, P10, 周期条件II)



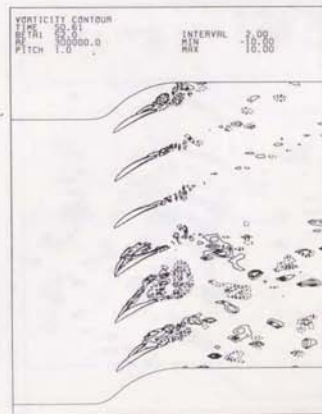
$\theta(t) = 60 \text{ deg.}$



$\theta(t) = 120 \text{ deg.}$

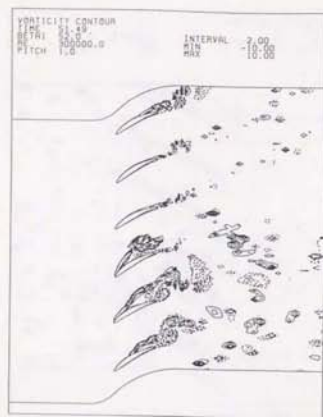


$\theta(t) = 180 \text{ deg.}$

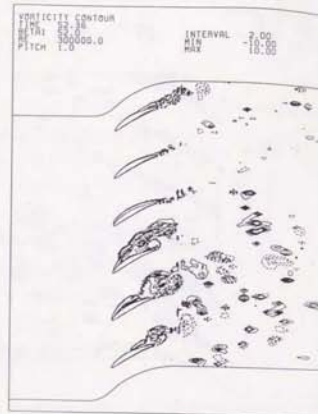


$\theta(t) = 240 \text{ deg.}$

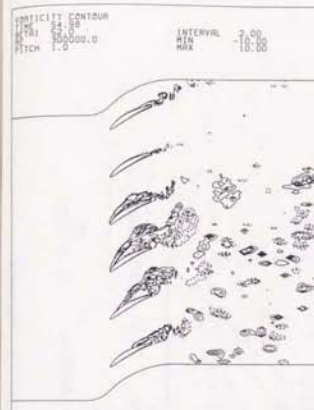
図5-4-11 (a) RS領域における1セルの旋回失速の成長：渦度分布
($\sigma = 180^\circ$, $k = 0.6$, P10, 周期条件II)



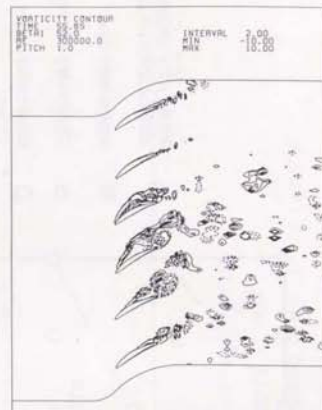
$\theta(t) = 300 \text{ deg.}$



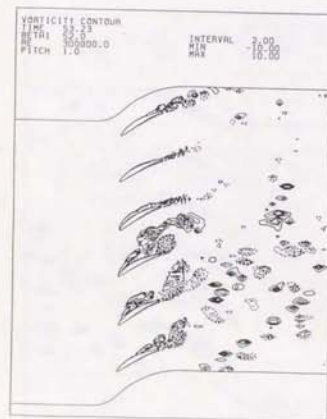
$\theta(t) = 0 \text{ deg.}$



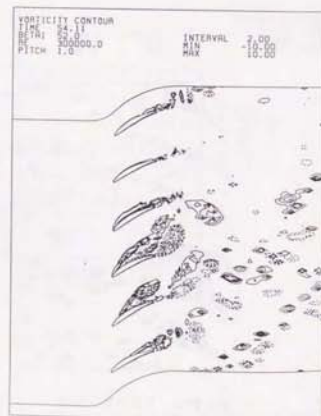
$\theta(t) = 180 \text{ deg.}$



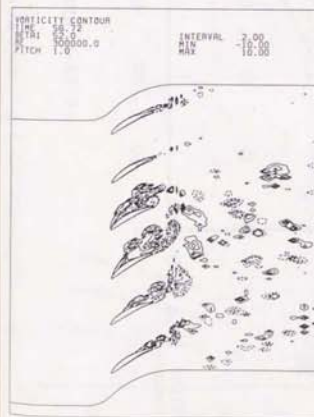
$\theta(t) = 240 \text{ deg.}$



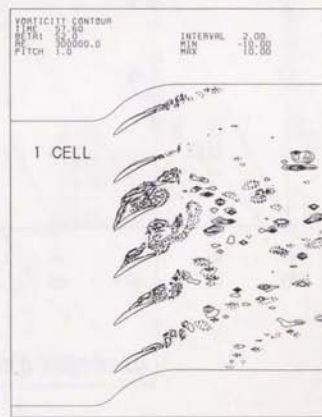
$\theta(t) = 60 \text{ deg.}$



$\theta(t) = 120 \text{ deg.}$



$\theta(t) = 300 \text{ deg.}$



$\theta(t) = 0 \text{ deg.}$

図5-4-11 (b) RS領域における1セルの旋回失速の成長
($\sigma = 1.80^\circ$, $K = 0.6$, $P10$, 周期条件II)

図5-4-11 (c) RS領域における1セルの旋回失速の成長
($\sigma = 1.80^\circ$, $K = 0.6$, $P10$, 周期条件II)

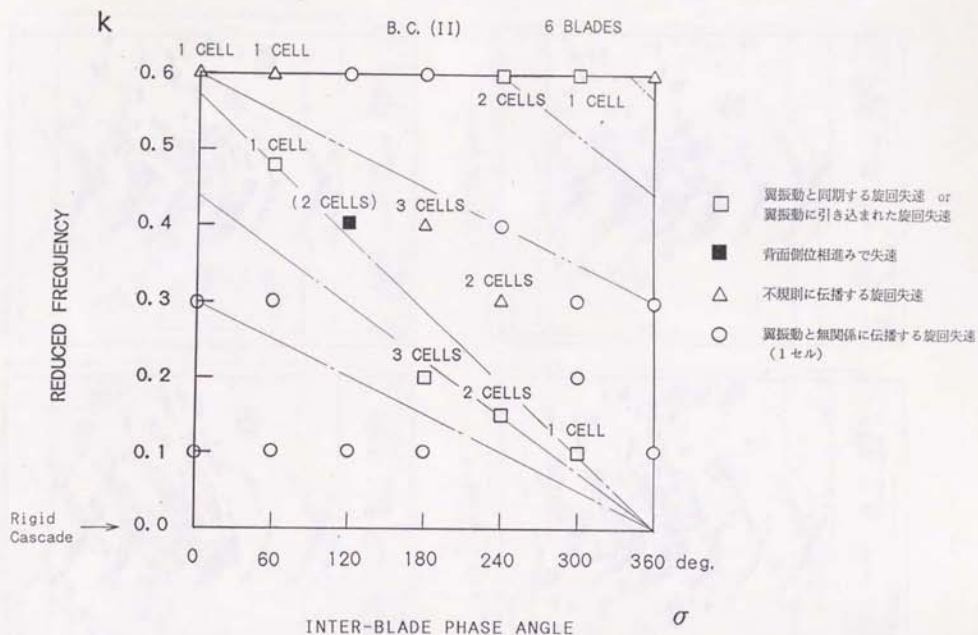


図5-4-12 旋回失速の発生状況と失速セル数 (周期条件 II)

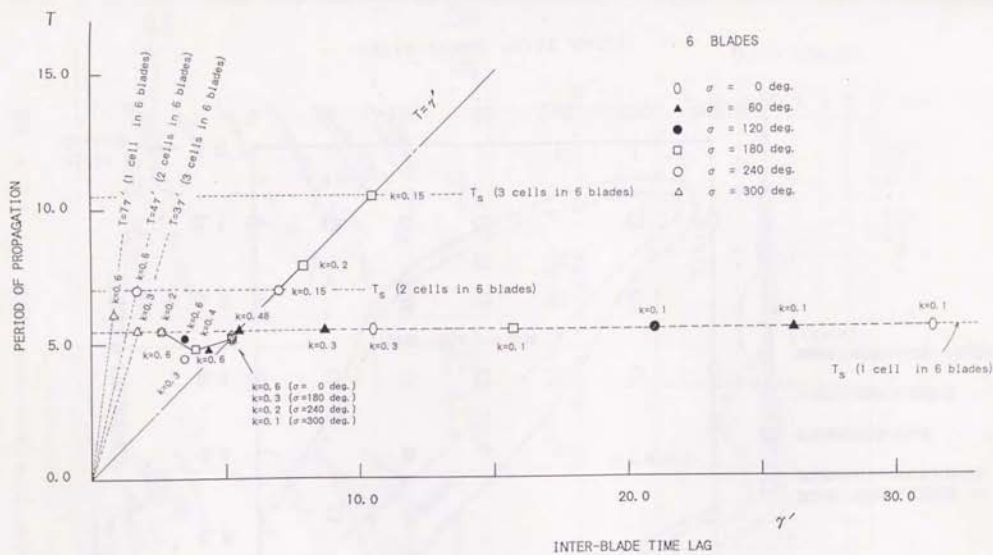


図5-4-13 旋回失速の伝播時間と背面遅れ翼間時間差との関係 ($0^\circ \leq \sigma < 360^\circ$)

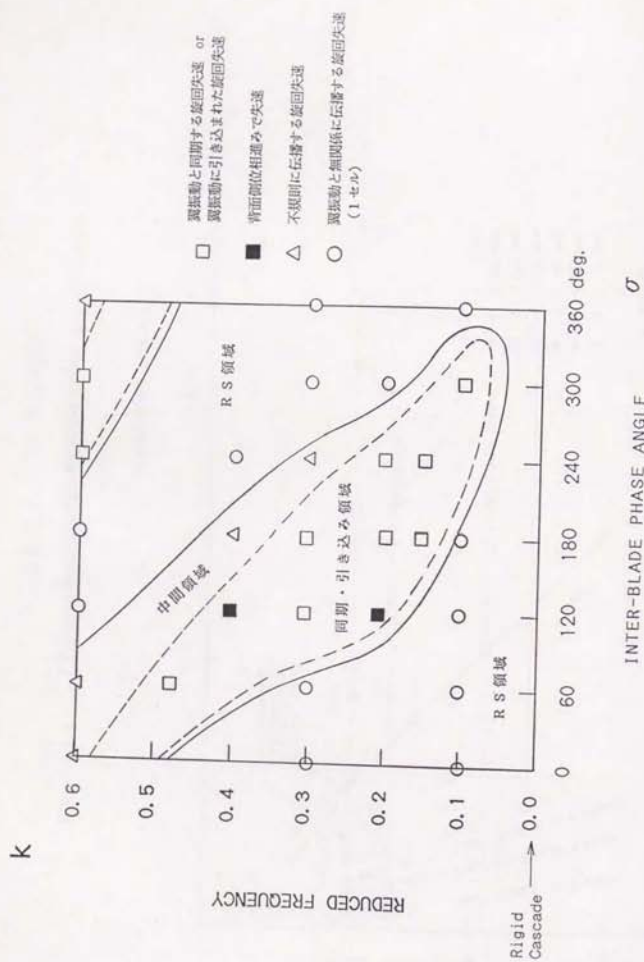


図5-4-14 同期・引き込み現象による流れ場の変化

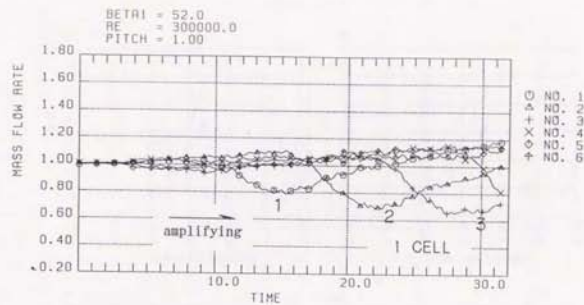


図5-4-15 (a) 剛翼列における微小変動から成長する1セルの旋回失速
(翼6枚, $\beta_1 = 52^\circ$, H2)

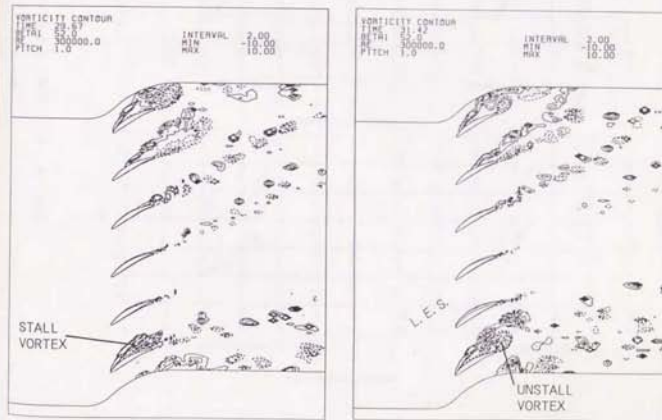


図5-4-15 (b) 剛翼列における1セルの旋回失速：渦度分布
(翼6枚, $\beta_1 = 52^\circ$, H2)

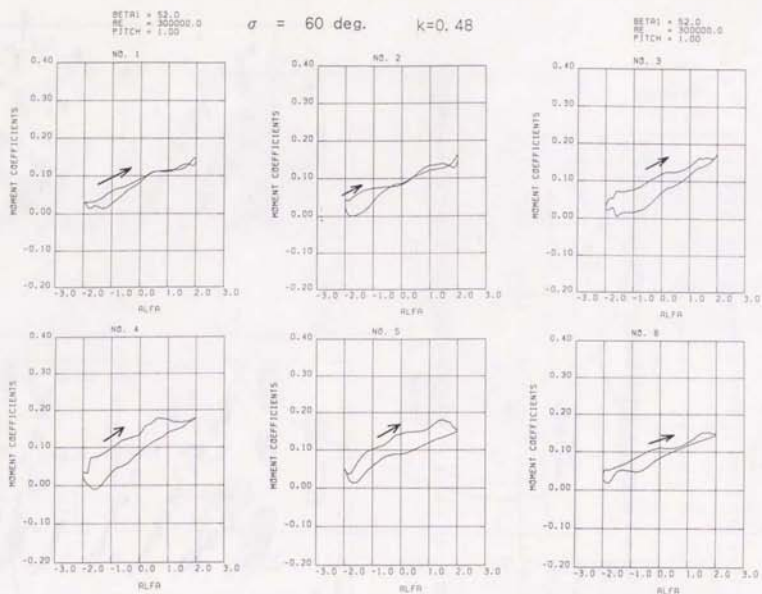


図5-5-1 同期・引き込み領域における非定常モーメントループ
 ($\sigma = 60^\circ$, $k = 0.48$, T3)

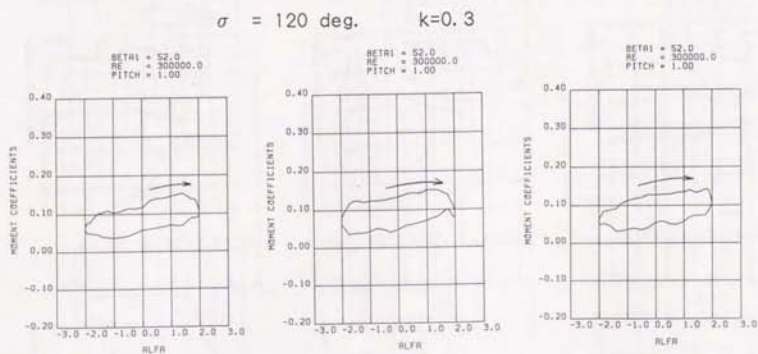


図5-5-2 同期・引き込み領域における非定常モーメントループ
 ($\sigma = 120^\circ$, $k = 0.3$, S3)

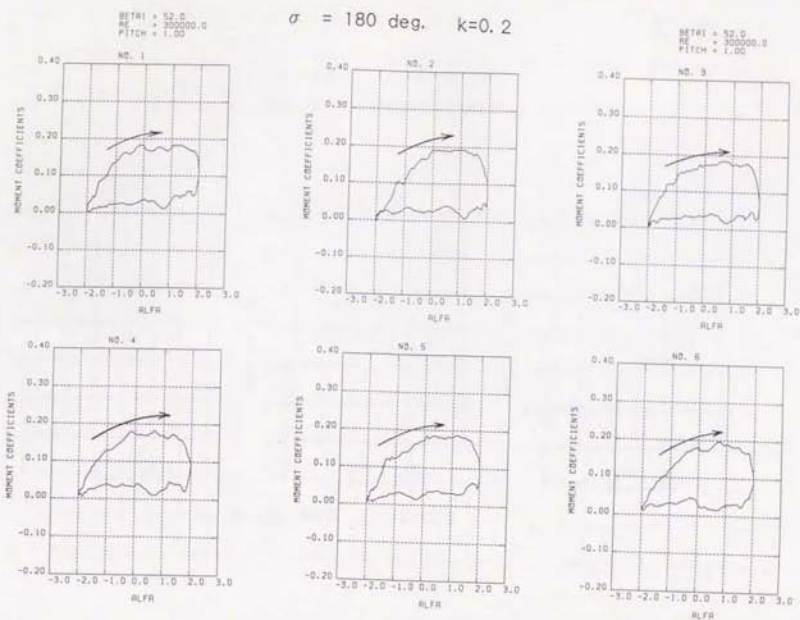


図 5-5-3 同期・引き込み領域における非定常モーメントループ
($\sigma = 180^\circ$, $k = 0.2$, P8)

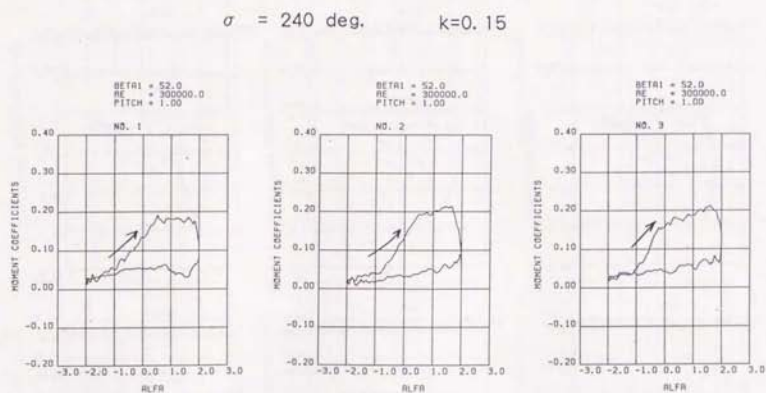


図 5-5-4 同期・引き込み領域における非定常モーメントループ
($\sigma = 240^\circ$, $k = 0.15$, Q1)

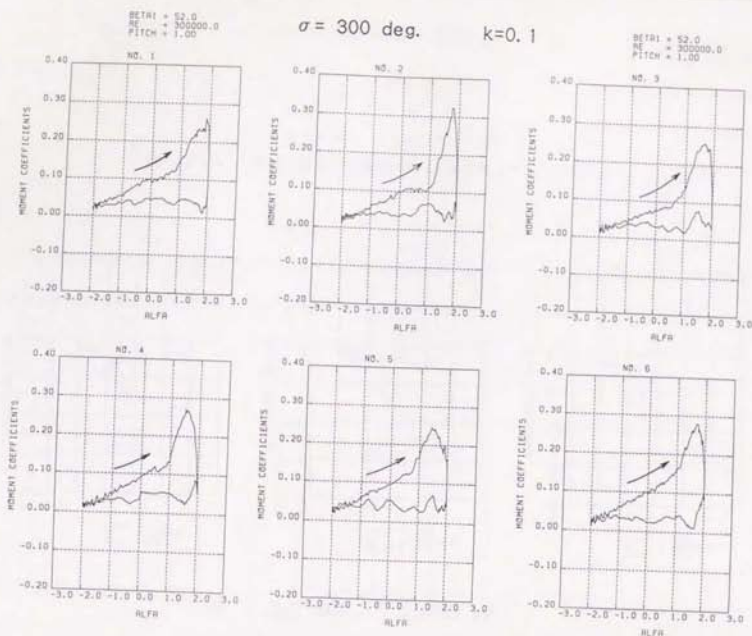


図 5-5-5 同期・引き込み領域における非定常モーメントループ
($\sigma = 300^\circ$, $k = 0.1$, R1)

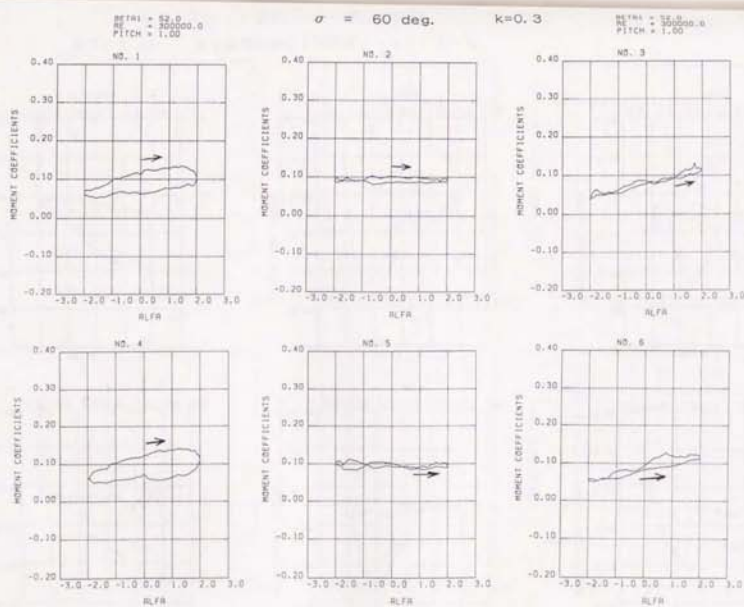


図 5-5-6 RS 領域における非定常モーメントループ
($\sigma = 60^\circ$, $k = 0.3$, T2)

REFVAL = 12.0
REFLEN = 10000.0
PTICM = 1.000

$\sigma = 180 \text{ deg.}$ $k=0.1$

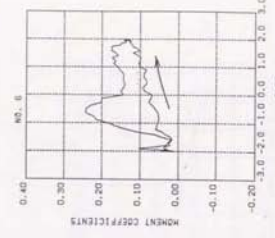
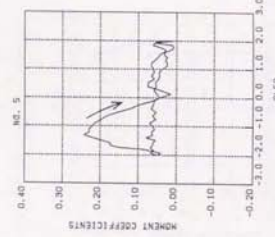
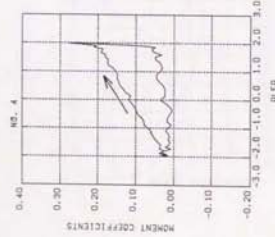
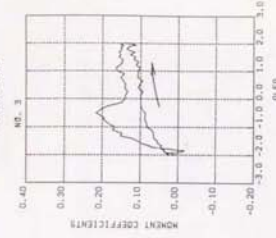
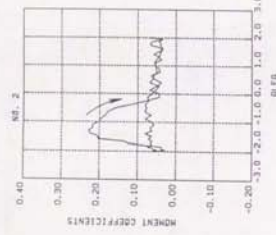
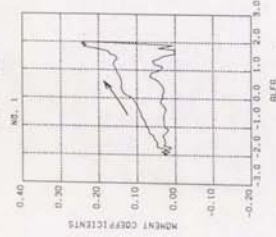


図5-5-7 RS領域における非定常モーメントループ
($\sigma = 180^\circ$, $k = 0.1$, PT)

REFVAL = 12.0
REFLEN = 10000.0
PTICM = 1.000

$\sigma = 300 \text{ deg.}$ $k=0.3$

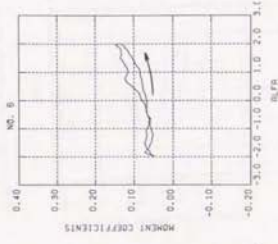
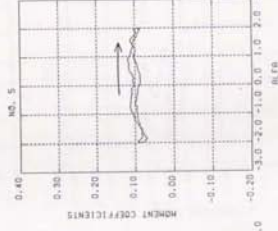
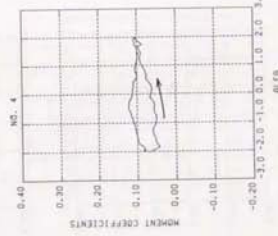
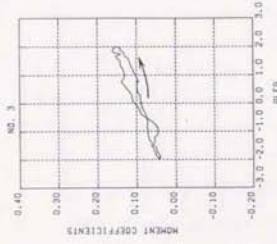
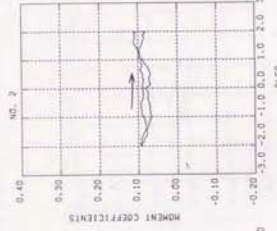
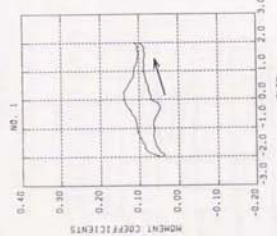


図5-5-8 RS領域における非定常モーメントループ
($\sigma = 300^\circ$, $k = 0.3$, R3)

$\sigma = 180 \text{ deg. } k=0.6$

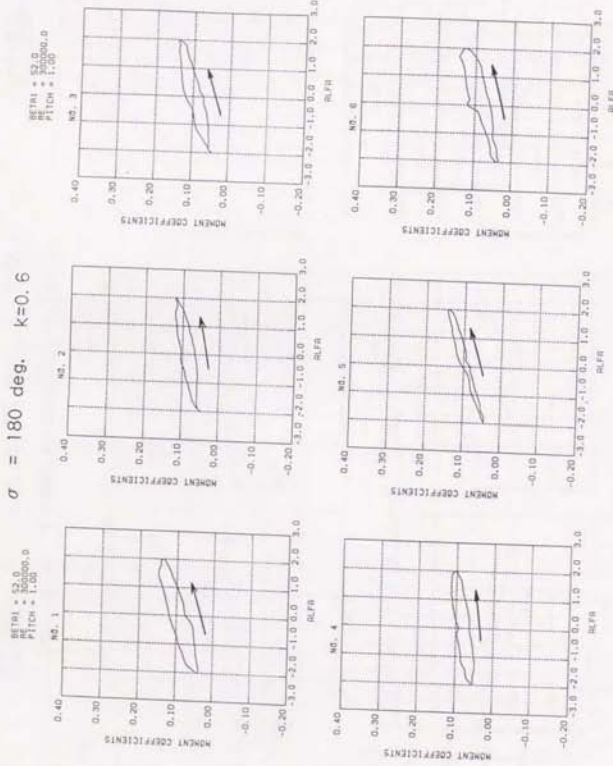


図 5-5-9

R/S 領域における非定常モーメントループ

($\sigma = 180^\circ$, $k = 0.6$, P10)

$\sigma = 60 \text{ deg. } k=0.6$

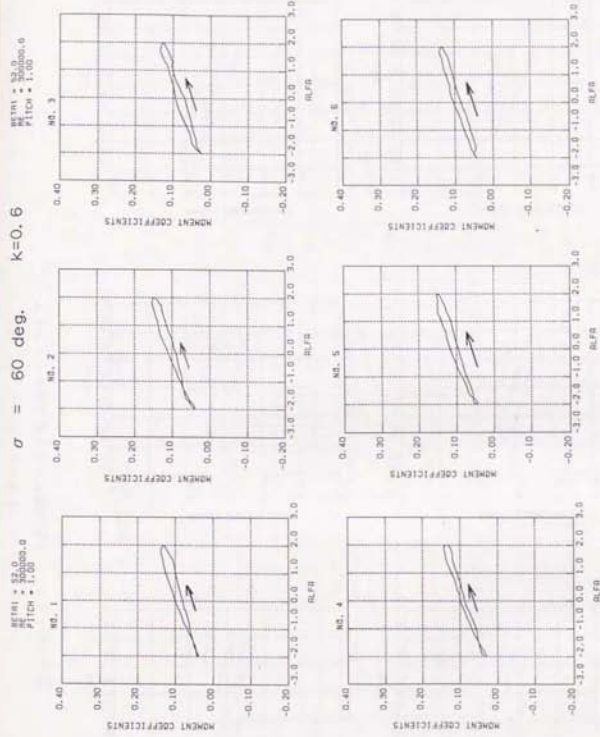


図 5-5-10 中間領域における非定常モーメントループ

($\sigma = 60^\circ$, $k = 0.6$, T4)

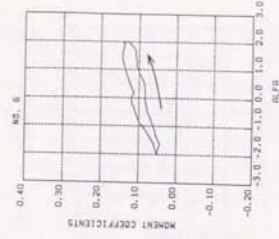
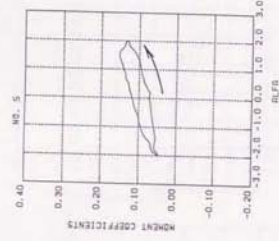
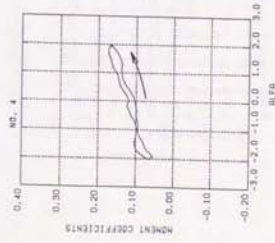
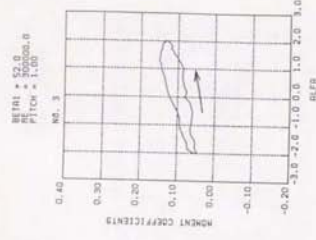
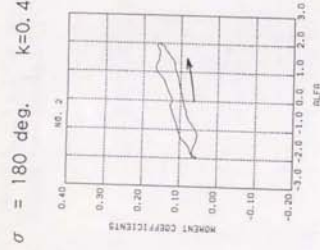
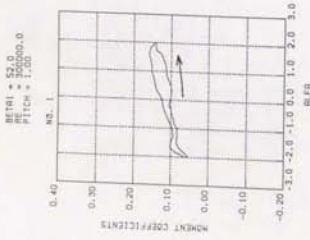


図5-5-11

中間領域における非定常モーメントループ
($\sigma = 180^\circ$, $k = 0.4$, pg)

$\sigma = 240 \text{ deg.}$

$k=0.3$

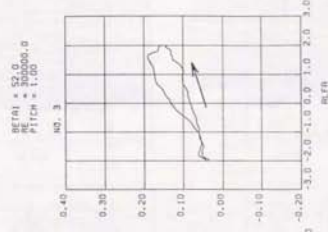
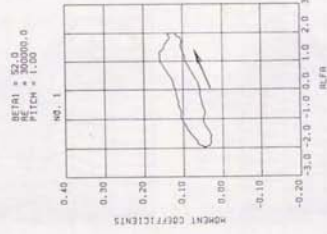


図5-5-12

中間領域における非定常モーメントループ
($\sigma = 240^\circ$, $k = 0.3$, $Q3$)

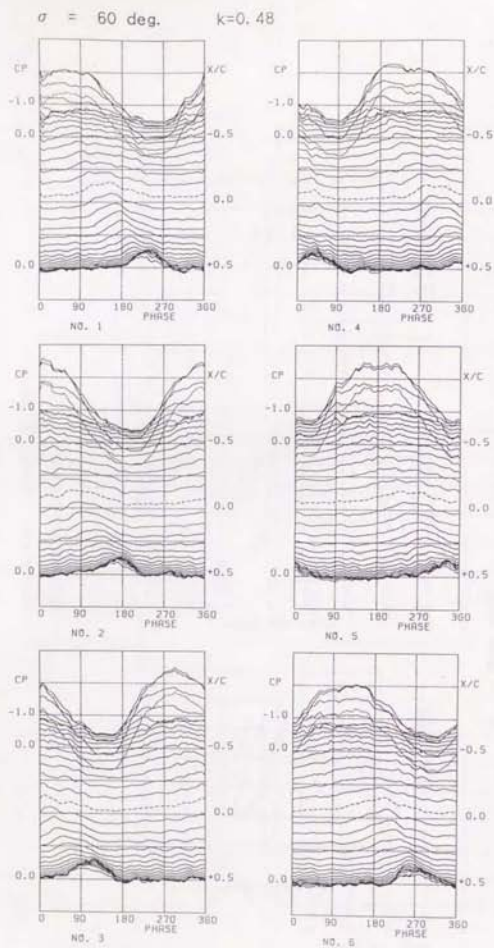


図5-5-13 同期・引き込み領域における翼背面非定常圧力波形
($\sigma = 60^\circ$, $k = 0.48$, T3)

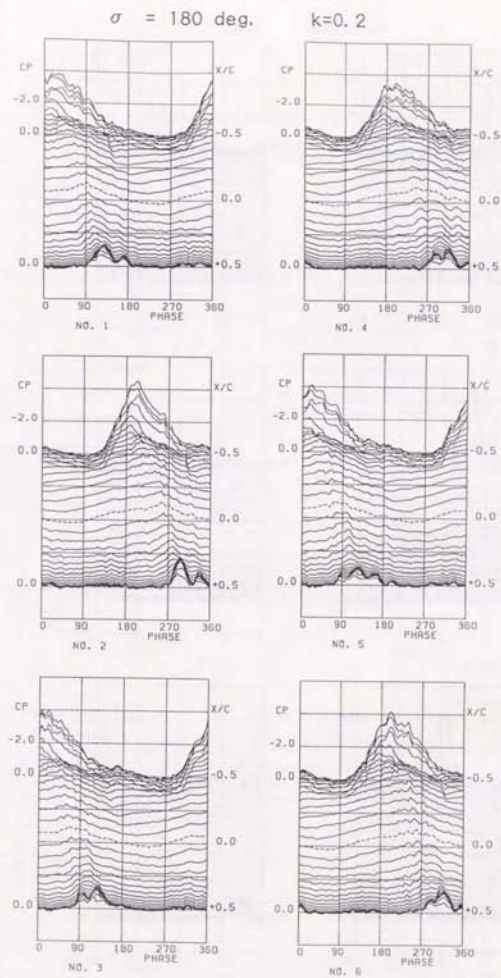


図5-5-14 同期・引き込み領域における翼背面非定常圧力波形
($\sigma = 180^\circ$, $k = 0.2$, P8)

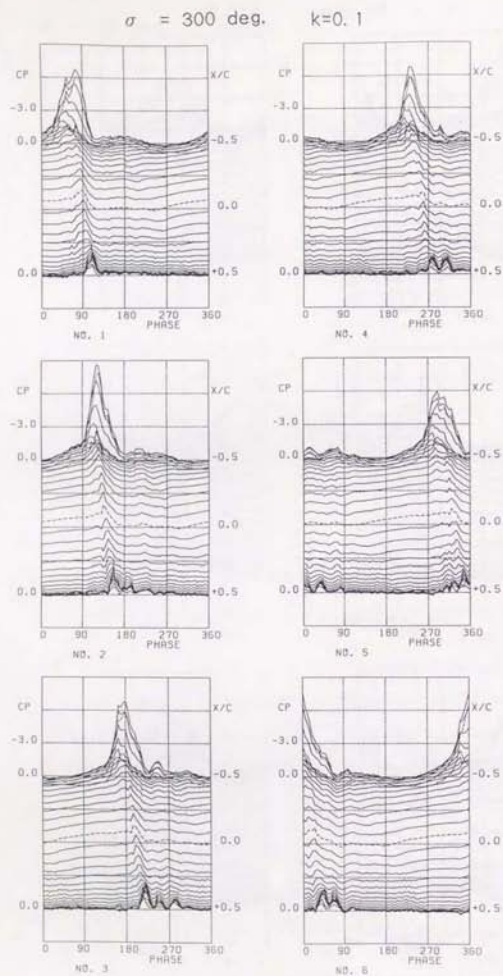


図5-5-15 同期・引き込み領域における翼背面非常圧力波形状
($\sigma = 300.0^\circ$, $k = 0.1, \text{R1}$)

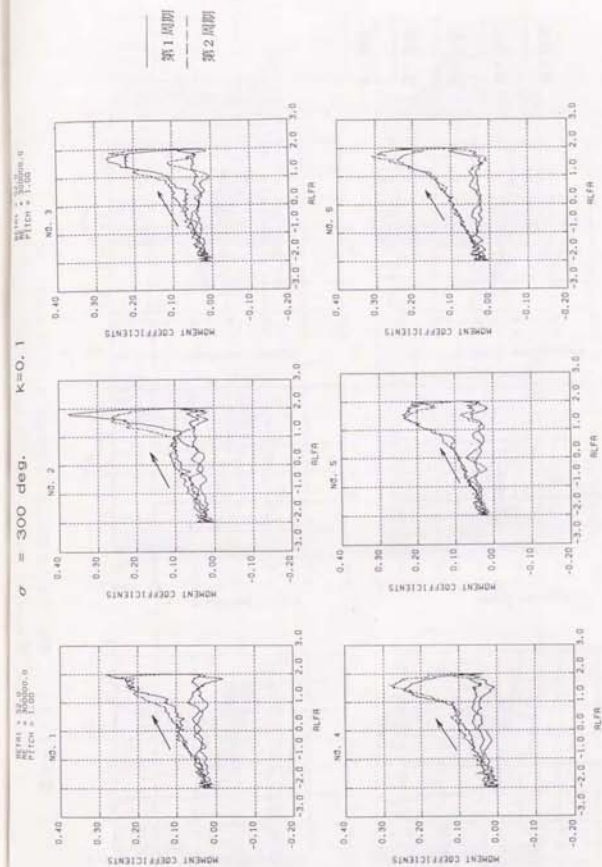
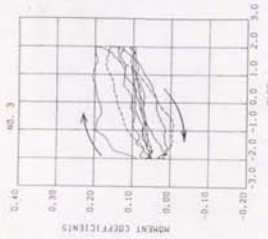
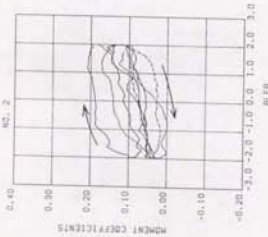
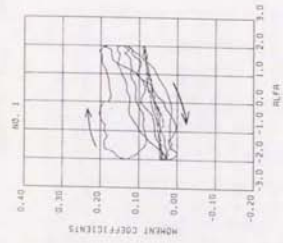


図5-5-16 同期・引き込み領域における各周期のモーメントループ
($\sigma = 300^\circ$, $k = 0.1, \text{R1}$)

REF. = 92.0
Pitch = 1.00

$\sigma = 60 \text{ deg.}$ $k=0.48$



第1周期

第2周期

第3周期

第4周期

第5周期

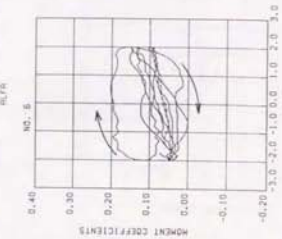
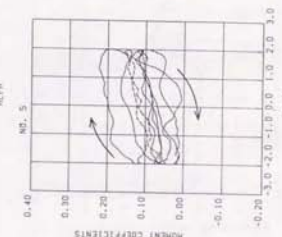
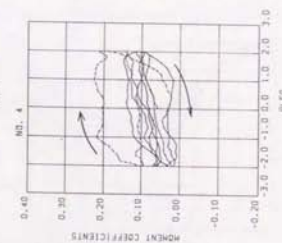


図5-5-17 同期・引き込み領域における各周期のモーメントカージ
($\sigma = 60^\circ$, $k = 0.48$, T2)

$\sigma = 60 \text{ deg.}$ $k=0.3$

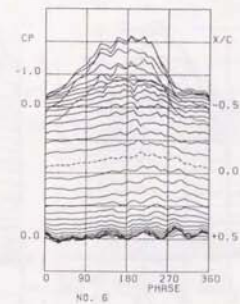
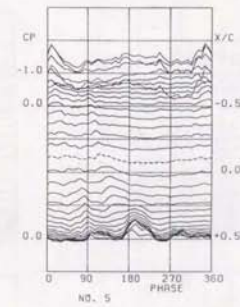
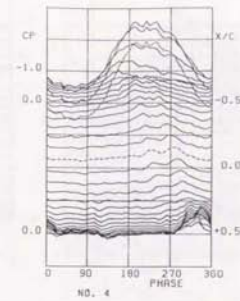
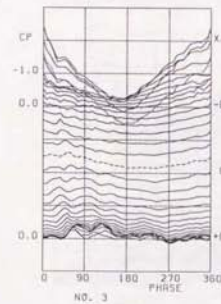
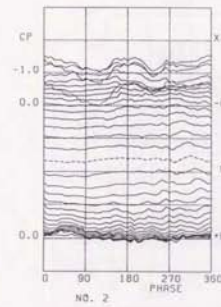
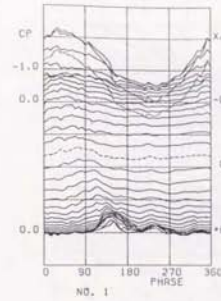


図5-5-18 RS 傾域における翼背面非定常圧力波形
($\sigma = 60^\circ$, $k = 0.3$, T2)

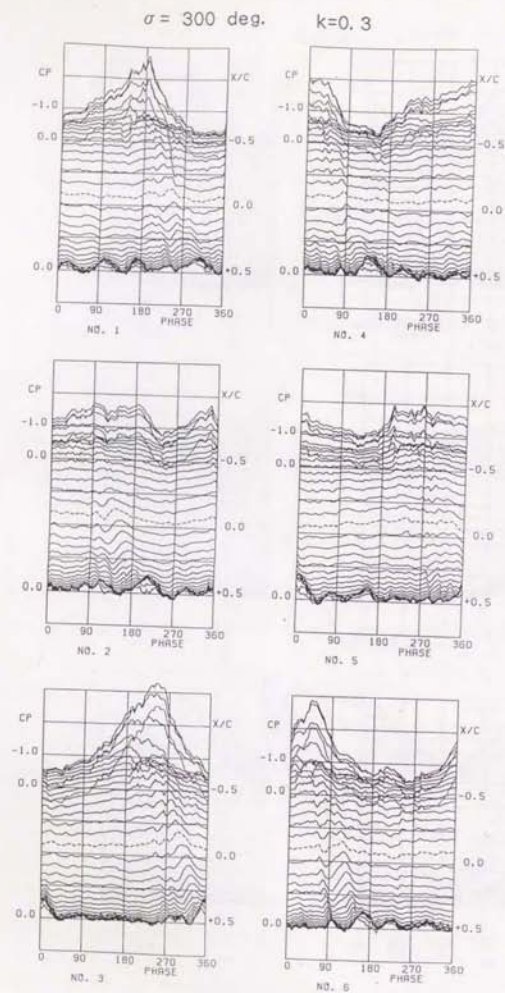


図5-5-19 R S 領域における翼背面非定常圧力波形
($\sigma = 300^\circ$, $k = 0.3$, 83)

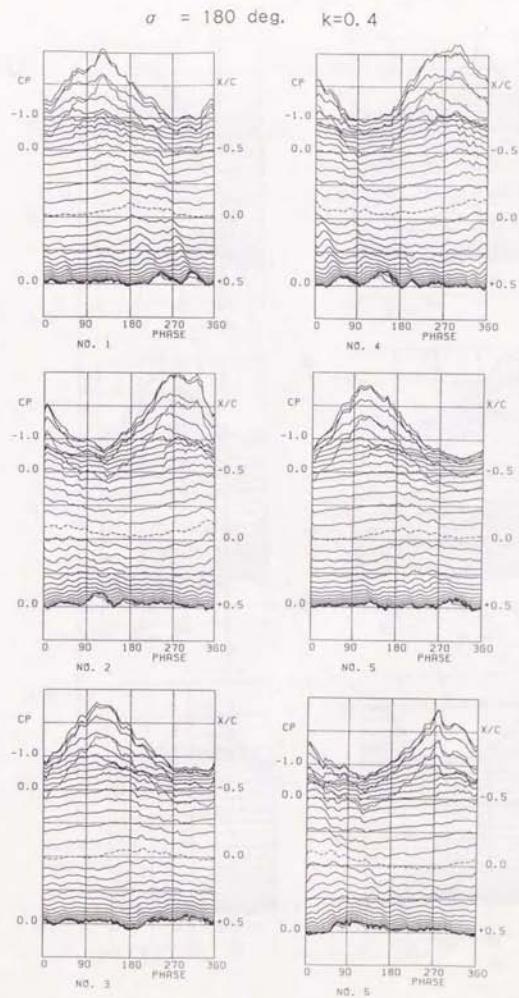


図5-5-20 中間領域における翼背面非定常圧力波形
($\sigma = 180^\circ$, $k = 0.4$, 89)

$\sigma = 60 \text{ deg.}$ $k=0.6$

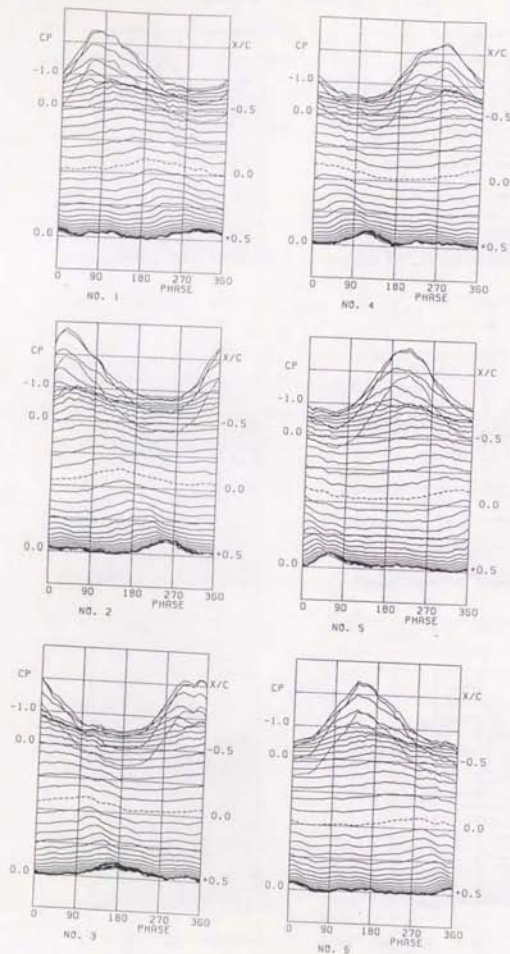


図5-5-21 中間領域における翼背面非定常圧力波形
($\sigma = 60^\circ$, $k = 0.6$, $P10$)

$\text{Im}(C_M)$

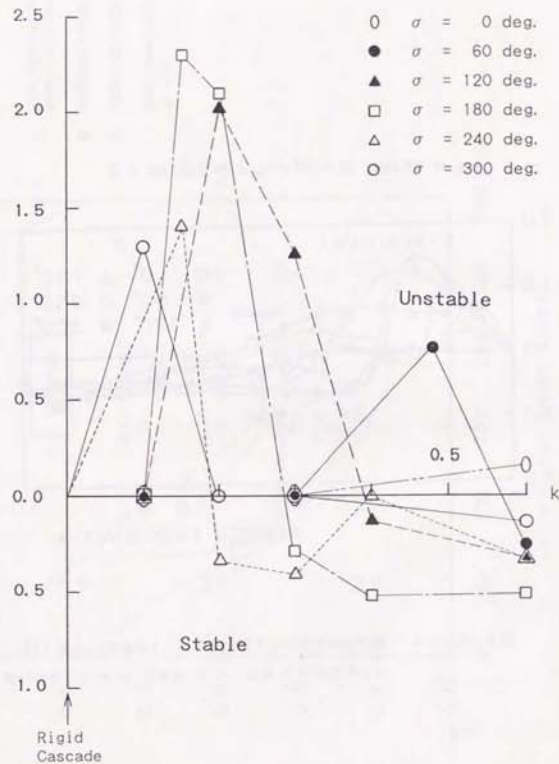


図5-5-22 無次元振動数による筋振モーメントの変化

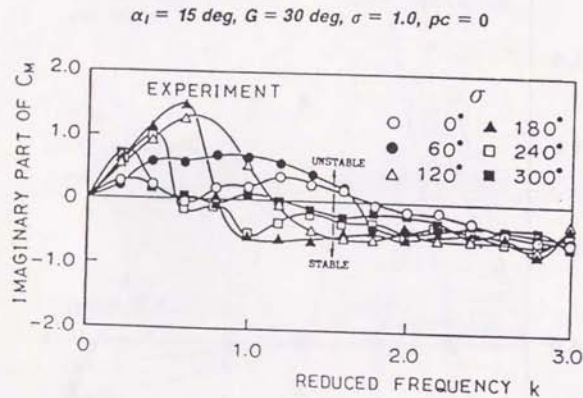


図5-5-23 無次元振動数による励振モーメントの変化 (八島 [67])
 α_l : 平均迎角, G : 食違い角, σ : 弦節比, pc : ねじり中心位置

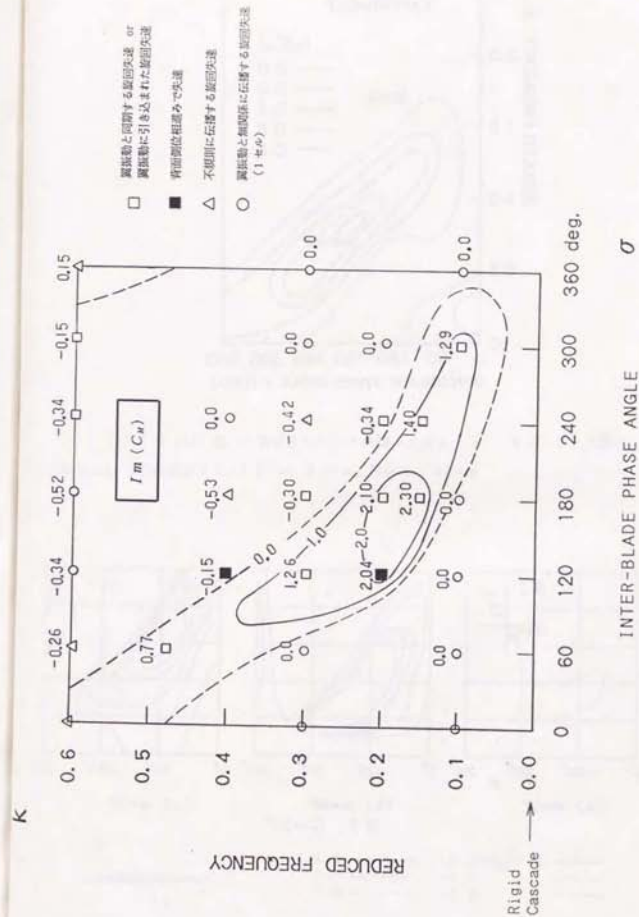


図5-5-24 $\sigma-k$ 面上の励振モーメント分布 (図中の数値は $I_m (C_m)$)

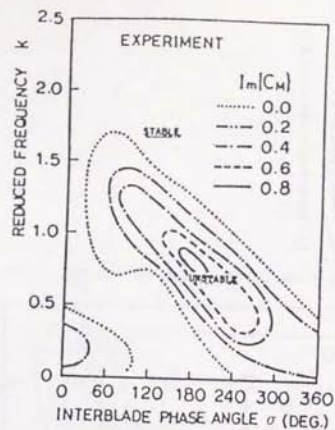


図5-5-25 σ - k 面上の助振モーメント分布 (八島 [87])
 $\alpha = 15^\circ$, $\xi = 30^\circ$, $\sigma = 1.0$, $pc = 0.5$ (2.5% 翼弦点がねじり中心)

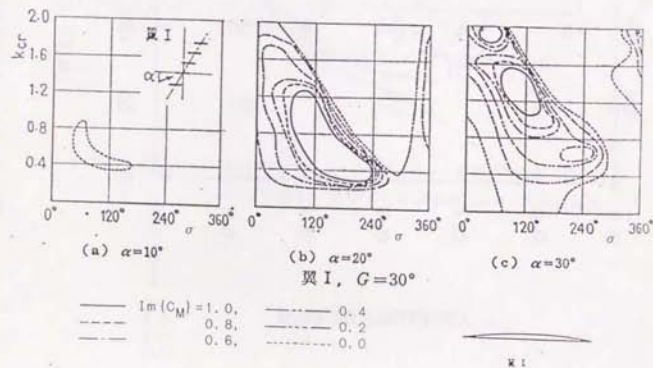


図5-5-26 σ - k 面上の助振モーメント分布 (八島 [86])
 $\xi = 30^\circ$, $\sigma = 1.0$, $pc = 0$ (2.5% 翼弦点がねじり中心)



$\sigma = 60 \text{ deg.}$ $k=0.6$

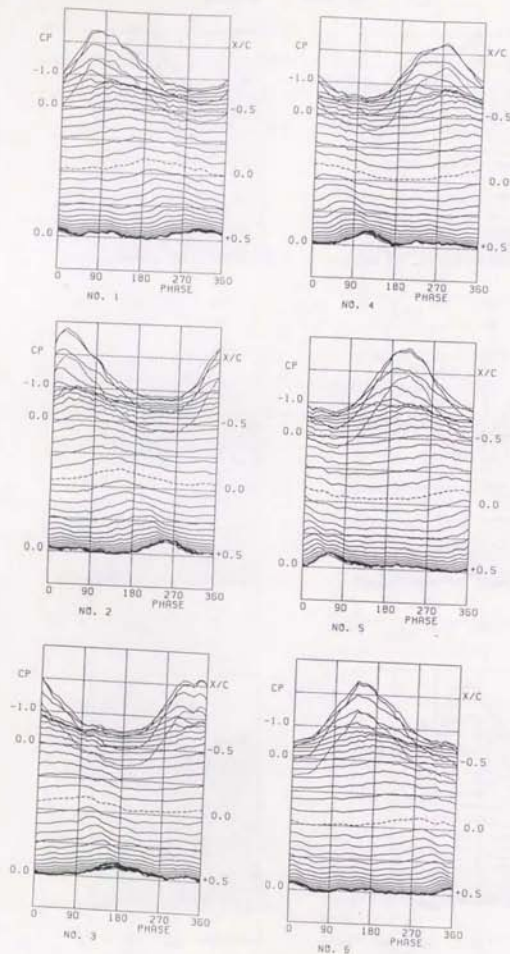


図5-5-21 中間領域における翼背面非定常圧力波形
($\sigma = 60^\circ$, $k = 0.6$, $P10$)

$\text{Im}(C_M)$

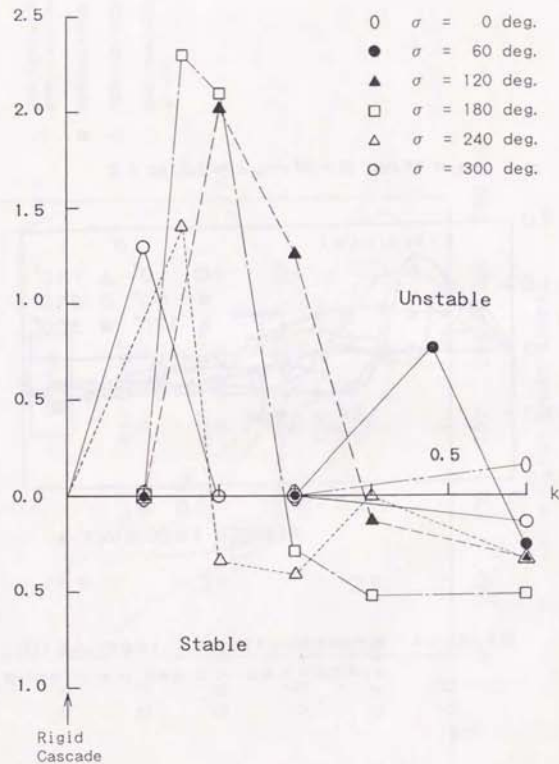


図5-5-22 無次元振動数による筋振モーメントの変化

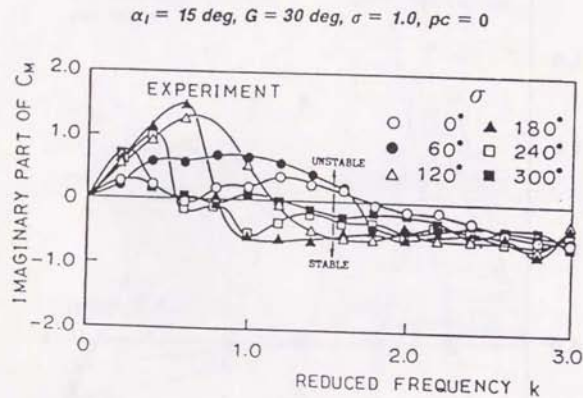


図5-5-23 無次元振動数による励振モーメントの変化(八島[67])
 α : 平均迎角, θ : 食違い角, σ : 弦節比, pc : わじり中心位置

α_1 :平均迎角, δ :食違い角, σ :弦節比, pc :ねじり中心位置

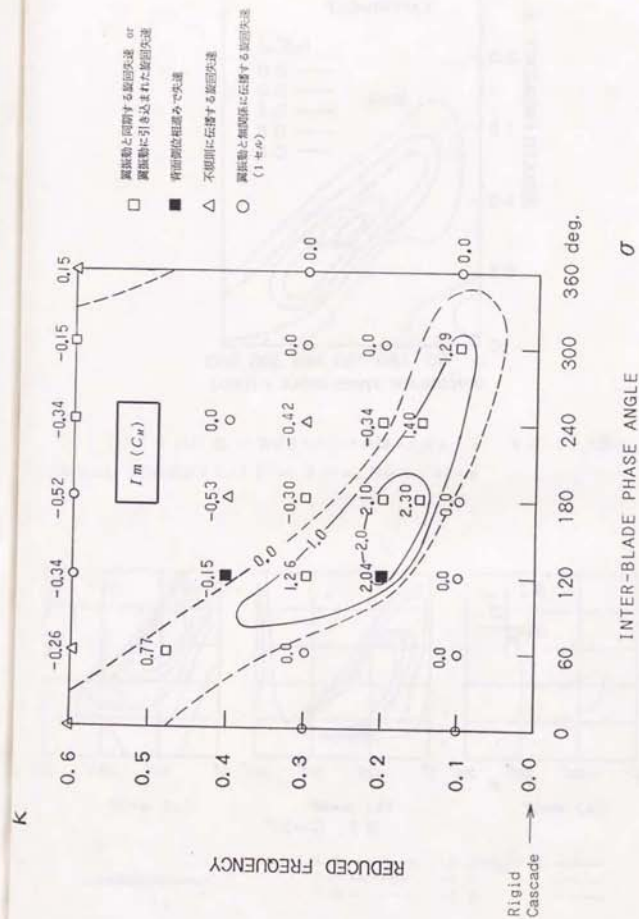


図5-5-24 $\sigma-k$ 面上の励振モード分布 (図中の数値は1m (C_u))

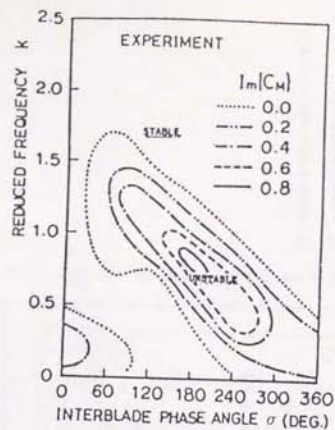


図5-5-25 σ - k 面上の助振モーメント分布 (八島 [87])
 $\alpha = 15^\circ$, $\xi = 30^\circ$, $\sigma = 1.0$, $pc = 0.5$ (2.5% 翼弦点がねじり中心)

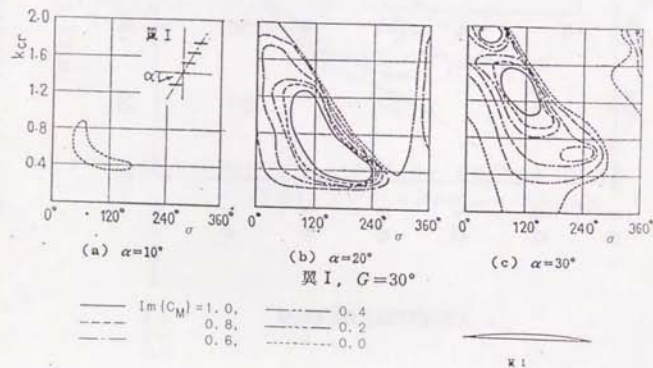


図5-5-26 σ - k 面上の助振モーメント分布 (八島 [86])
 $\xi = 30^\circ$, $\sigma = 1.0$, $pc = 0$ (1/3 翼弦点がねじり中心)

