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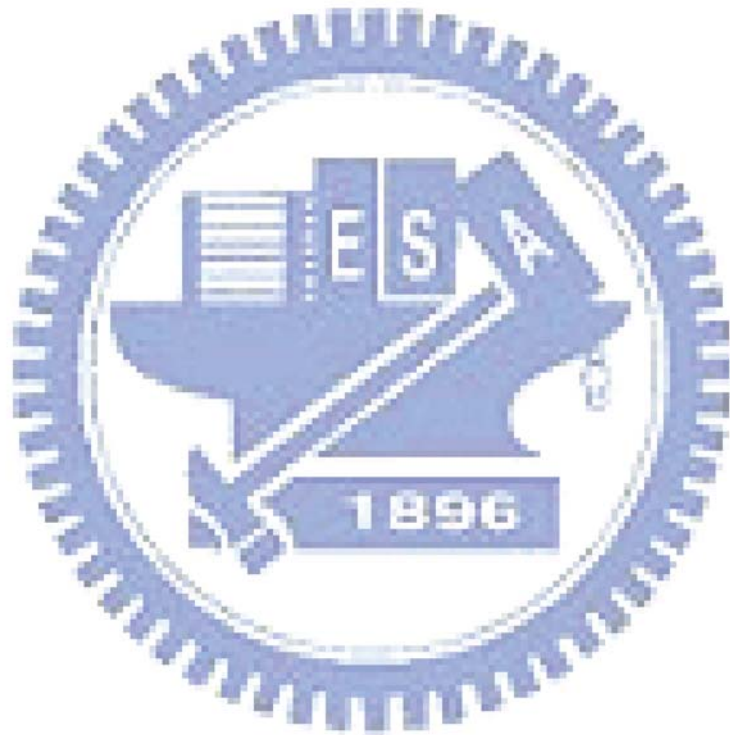


表 2.1 IFS 補強接頭試體鋼材材料性質

Specimen	Member	Location	σ_y (MPa)	σ_u (MPa)	A36	Gr.50
					$R_y = \frac{\sigma_{yb}}{\sigma_{yn}}$	$R_y = \frac{\sigma_y}{\sigma_{yn}}$
UR	Beam	Flange	275	485	1.11	-
		Web	288	495	1.16	-
IFS1	Beam	Flange	330	-	1.33	-
	Stiffener	-	370	500	-	1.07
IFS2	Beam	Flange	275	485	1.11	-
		Web	288	495	1.16	-
	Stiffener	-	391	525	-	1.13
IFS3	Beam	Flange	285	440	1.16	-
		Web	280	435	1.13	-
	Stiffener	-	370	500	-	1.07
	Column	Column	385	530	-	1.12
		Contiunity PL	387	518	-	1.12
IFS4	Beam	Flange	287	441	1.16	-
		Web	281	434	1.13	-
	Stiffener	-	368	520	-	1.07
	Column	Column	385	530	-	1.12
		Contiunity PL	387	518	-	1.12
IFS5	Beam	Flange	285	440	1.16	-
		Web	280	435	1.13	-
	Stiffener	-	371	500	-	1.08
	Column	Column	385	530	-	1.12
		Contiunity PL	387	518	-	1.12

表 2.2 FDWS 補強接頭試體鋼材材料性質

Specimen	Member	Location	σ_y (MPa)	σ_u (MPa)	A36	Gr.50
					$R_y = \frac{\sigma_{yb}}{\sigma_{yn}}$	$R_y = \frac{\sigma_y}{\sigma_{yn}}$
UR	Beam	Flange	275	485	1.11	-
		Web	288	495	1.16	-
FDWS1	Beam	Flange	250	418	1.01	-
		Web	385	437	1.13	-
	Stiffener	-	400	557	-	1.16
FDWS2	Beam	Flange	250	418	1.01	-
		Web	280	437	1.13	-
	Stiffener	-	370	500	-	1.07
	Column	Column	385	530	-	1.12
		Contiunity PL	387	518	-	1.12
FDWS3	Beam	Flange	251	413	1.01	-
		Web	281	434	1.13	-
	Stiffener	-	400	532	-	1.16
	Column	Column	385	530	-	1.12
		Contiunity PL	387	518	-	1.12

表 2.3 各試體梁柱接頭之尺寸及強柱弱梁比

Specimen NO.	Column Size	Beam Size	Stiffener Size ($t_s \times d_s \times L_s$)	$\frac{\sum M_{pc}^*}{\sum M_{pb}^*}$
UR	□700×700×35×35	H702×254×16×28	-	10.0
IFS1	□700×700×35×35	H702×254×16×28	22×175×300	7.8
IFS2	□700×700×35×35	H702×254×16×28	22×175×300	7.8
IFS3	□550×550×35×35	H702×254×16×28	22×175×300	4.8
IFS4	□550×550×35×35	H702×254×16×28	28×175×300	4.8
IFS5	□550×550×35×35	H702×254×16×28	22×308×300	4.8
FDWS1	□700×700×35×35	H688×255×13×21	20×646×300	10.4
FDWS2	□550×550×35×35	H702×254×16×28	22×646×300	4.8
FDWS3	□550×550×35×35	H702×254×16×28	18×646×254	5.0

表 2.4 IFS 加勁板之設計值

Specimen	β	M_{pb}	M_{PH}	M_{dem}	M_{ps}	M_{cap}	α	L_s (Assume)	L_s (Calculate)
		(kN-m)						(mm)	
IFS1	1.2	2133	2560	2958	762	2895	0.98	300	231
IFS2	1.38	1800	2484	2870	805	2605	0.91	300	231
IFS3	1.27	1834	2329	2683	762	2596	0.97	300	231
IFS4	1.27	1845	2343	2697	965	2810	1.04	300	231
IFS5	1.27	1834	2329	2683	1345	3179	1.19	300	231

表 2.5 FDWS 加勁板之設計值

Specimen	β	M_{pb}	M_{PH}	M_{dem}	M_{ps}	M_{cap}	α	L_s (Assume)	L_s (Calculate)
		(kN-m)						(mm)	
FDWS1	1.34	1273	1705	1969	1669	2942	1.49	300	297
FDWS2	1.34	1666	2232	2572	1699	3364	1.31	300	297
FDWS3	1.32	1672	2207	2506	1502	3175	1.27	254	297

表 3.1 IFS 試體破壞模式與梁端最大塑性轉角

Specimen	Maximum test story drift (%)		Failure Mode
UR	-3.0	+4.0*	梁往 $\theta = -4.0\%$ 弧度移動時，上翼板於梁柱接頭焊道上方母材發生斷裂。
IFS1	-3.0	+4.8*	在 $\theta = -3.0\%$ 弧度第二圈時，梁上翼板焊道發生破壞，使得加勁板沿柱面焊道亦整個拉斷。
IFS2	-4.8*	+3.0	梁往 $\theta = +3.0\%$ 弧度移動時，梁下翼板焊道沿柱面將柱表面拉起。
IFS3	-3.0	+5.0*	梁往 $\theta = -4.0\%$ 弧度移動時，梁上翼板與柱接之焊道延柱面被拉起。
IFS4	-4.4	+4.4	-
IFS5	-4.7	+4.7	-

註：*破壞發生後，千斤頂單向加載至極限層間側位移角。

表 3.2 IFS 試體最大挫屈幅度與位置 (mm)

Specimen	1 st Test				2nd Test			
	挫屈幅度		挫屈位置		挫屈幅度		挫屈位置	
	Flange	Web	Flange	Web	Flange	Web	Flange	Web
UR	-	-	-	-	-	-	-	-
IFS1	-	-	-	-	-	-	-	-
IFS2	-	-	-	-	-	-	-	-
IFS3	-	-	-	-	-	-	-	-
IFS4	2	14	322	322	27	52	322	322
IFS5	7	18	550	550	21	32	560	580

註：挫屈位置由柱面起算。

表 3.3 IFS 試體之彎矩強度

Specimen	Maximum story drift	Maximum cyclic moment		Plastic flexural strength		Ratio of α and β	
		Column face M_{dem} (kN-m)	Plastic hinge M_{PH} (kN-m)	Column face M_{Cap} (kN-m)	Plastic hinge M_{pb} (kN-m)	$\alpha = \frac{M_{cap}}{M_{dem}}$	$\beta = \frac{M_{PH}}{M_{pb}}$
UR	+3%	2516	2516	1799	1799	0.72	1.4
	-3%	-2517	-2517			0.72	1.4
IFS1	+3%	2917	2524	2895	2133	0.99	1.19
	-3%	-2524	-2184			1.15	1.03
IFS2	+3%	2653	2296	2605	1799	0.98	1.28
	-2%	-2547	-2204			1.02	1.23
IFS3	+3%	2746	2383	2596	1834	0.95	1.3
	-3%	-2723	-2363			0.95	1.29
IFS4	+4%	2924	2538	2810	1845	0.96	1.36
	-4%	-2802	-2432			1	1.32
IFS5	+4%	2948	2559	3179	1834	1.08	1.4
	-4%	-2832	-2458			1.12	1.34

表 3.4 IFS 試體於各層間側位移角之梁彎矩強度需求比 α

Specimen	Moment (kN-m)		Story Drift				
			0.5%	1%	2%	3%	4%
IFS1	M_{dem}	Positive Bending	1200	2147	2647	2917	-
		Negative Bending	-1126	-1885	-2330	-2524	-
	M_{cap}		2895				
	$\alpha = \frac{M_{cap}}{M_{dem}}$	Positive	2.41	1.35	1.09	0.99	-
Negative		-2.57	-1.54	-1.24	-1.15	-	
IFS2	M_{dem}	Positive Bending	1055	1984	2494	2652	-
		Negative Bending	-1213	-2050	-2547	-	-
	M_{cap}		2605				
	$\alpha = \frac{M_{cap}}{M_{dem}}$	Positive	2.47	1.31	1.05	0.98	-
Negative		-2.15	-1.27	-1.02	-	-	
IFS3	M_{dem}	Positive Bending	1161	2003	2498	2746	-
		Negative Bending	-1187	-2018	-2511	-2723	-
	M_{cap}		2596				
	$\alpha = \frac{M_{cap}}{M_{dem}}$	Positive	2.24	1.30	1.04	0.95	-
Negative		-2.19	-1.29	-1.03	-0.95	-	
IFS4	M_{dem}	Positive Bending	1170	2014	2529	2755	2924
		Negative Bending	-1190	-2003	-2459	-2656	-2802
	M_{cap}		2810				
	$\alpha = \frac{M_{cap}}{M_{dem}}$	Positive	2.40	1.40	1.11	1.02	0.96
Negative		-2.36	-1.40	-1.14	-1.06	-1.00	
IFS5	M_{dem}	Positive Bending	1154	2014	2544	2773	2948
		Negative Bending	-1198	-2012	-2457	-2685	-2832
	M_{cap}		3179				
	$\alpha = \frac{M_{cap}}{M_{dem}}$	Positive	2.76	1.58	1.25	1.15	1.08
Negative		-2.65	-1.58	-1.29	-1.18	-1.12	

表 3.5 IFS 試體之加勁板降伏範圍

Specimen	Location	Yield Depth Positive Bending		Yield Depth Negative Bending	
		3% Story Drift	4% Story Drift	3% Story Drift	4% Story Drift
IFS1	Top Stiffener	-	-	-	-
	Bottom Stiffener	-80 mm	-	+100 mm	-
IFS3	Top Stiffener	+81 mm	-	-46 mm	-
	Bottom Stiffener	-68 mm	-	+69 mm	-
IFS4	Top Stiffener	+78 mm	+90 mm	-40 mm	-45 mm
	Bottom Stiffener	-45 mm	-55 mm	+60 mm	+74 mm
IFS5	Top Stiffener	-	+89 mm	-	-
	Bottom Stiffener	-71 mm	-80 mm	+62 mm	+80 mm

註：+ 為正號代表拉降伏範圍，- 為負號代表壓降伏範圍。

(降伏範圍由梁翼板與加勁板接合處起算)

表 4.1 FDWS 試體最大挫屈幅度與位置 (mm)

Specimen	1 st Test				2nd Test			
	挫屈幅度		挫屈位置		挫屈幅度		挫屈位置	
	Flange	Web	Flange	Web	Flange	Web	Flange	Web
UR	-	-	-	-	-	-	-	-
FDWS1	105	70	630	580	-	-	-	-
FDWS2	20	31	520	600	22	31	500	600
FDWS3	4	9	254	490	8	21	254	485

註：挫屈位置由柱面起算。

表 4.2 FDWS 試體之彎矩強度

Specimen	Maximum story drift	Maximum moment		Plastic flexural strength		Ratio of α and β	
		Column face M_{dem} (kN-m)	Plastic hinge M_{PH} (kN-m)	Column face M_{Cap} (kN-m)	Plastic hinge M_{pb} (kN-m)	$\alpha = \frac{M_{cap}}{M_{dem}}$	$\beta = \frac{M_{PH}}{M_{pb}}$
UR	+3%	2516	2516	1799	1799	0.72	1.4
	-3%	-2517	-2517			0.72	1.4
FDWS1	+4%	1885	1633	2942	1273	1.56	1.28
	-4%	-1952	-1691			1.51	1.33
FDWS 2	+4%	2948	2559	3364	1666	1.14	1.54
	-4%	-2896	-2514			1.16	1.51
FDWS 3	+4%	2866	2524	3175	1672	1.11	1.51
	-4%	-2830	-2492			1.12	1.49

表 4.3 FDWS 試體之加勁板降伏範圍

Specimen	Location	Yield Depth Positive Bending		Yield Depth Negative Bending	
		3% Story Drift	4% Story Drift	3% Story Drift	4% Story Drift
FDWS2	Top Stiffener	+ 83 mm	+ 100 mm	- 68 mm	- 92 mm
	Bottom Stiffener	- 66 mm	- 99 mm	+ 89 mm	+ 99 mm
FDWS3	Top Stiffener	+ 91 mm	+ 103 mm	- 67 mm	- 90 mm
	Bottom Stiffener	- 75 mm	- 93 mm	+ 68 mm	+ 72 mm

註：+ 為正號代表拉降伏範圍，- 為負號代表壓降伏範圍。

(降伏範圍由梁翼板與加勁板接合處起算)



表 5.1 A572 Gr.50 鋼材之 ABAQUS 硬化參數輸入指令

Material (Grade)	A572 Gr.50
Input Statement	*Material, Name = Gr.50 *Elastic 203000, 0.3 *Plastic, Hardening = Combined, Data Type = Parameters 370, 29390, 266 *Cyclic Hardening, Parameter 370, 150, 12
Isotropic Hardening Parameters	Q = 150 b = 12
Kinematic Hardening Parameters	C = 29390 γ = 266

表 5.2 A36 鋼材之 ABAQUS 硬化參數輸入指令

Material (Grade)	A36
Input Statement	*Material, Name = A36 *Elastic 203000, 0.3 *Plastic, Hardening = Combined, Data Type = Parameters 285, 17888, 331 *Cyclic Hardening, Parameter 285, 90, 6
Isotropic Hardening Parameters	Q = 90 b = 6
Kinematic Hardening Parameters	C = 17888 γ = 331

表 5.3 TEST 與 ABAQUS 之彎矩及彈性勁度比較表

Moment (kN×m)		Drift						K _E (kN×m)
		-0.5%	+0.5%	-2%	+2%	-4%	+4%	
UR	Test	-1091	1088	-2285	2279	-	2572	213486
	ABAQUS	-1185	1185	-2266	2248	-2507	2502	226964
	Ratio	92%	92%	101%	101%	-	103%	94%
IFS1	Test	-1200	1126	-2647	2330	-	-	240217
	ABAQUS	-1205	1204	-2518	2495	-2877	2902	236124
	Ratio	100%	94%	105%	93%	-	-	102%
IFS2	Test	-1155	1213	-2494	2547	-	-	227578
	ABAQUS	-1208	1207	-2528	2478	-2957	2933	238139
	Ratio	96%	100%	99%	103%	-	-	96%
IFS3	Test	-1161	1187	-2498	2511	-	-	243006
	ABAQUS	-1155	1155	-2549	2567	-2983	3011	230158
	Ratio	101%	103%	98%	98%	-	-	106%
IFS4	Test	-1170	1190	-2529	2459	-2924	2802	242131
	ABAQUS	-1162	1161	-2577	2595	-3006	3002	231546
	Ratio	101%	102%	98%	95%	97%	93%	105%
IFS5	Test	-1154	1198	-2544	2457	-2948	2832	243403
	ABAQUS	-1161	1161	-2613	-2613	-3011	3041	231481
	Ratio	99%	103%	-97%	-94%	98%	93%	105%
FDWS2	Test	-1186	1146	-2532	2547	-2896	2948	241095
	ABAQUS	-1162	1162	-2596	2592	-3009	3039	231650
	Ratio	102%	99%	98%	98%	96%	97%	104%
FDWS3	Test	-1190	1146	-2479	2481	-2829	2866	232799
	ABAQUS	-1151	1151	-2514	2534	-2917	2941	229084
	Ratio	103%	100%	99%	98%	97%	97%	102%

表 5.4 IFS 加勁板中性軸分析值及計算值之比較圖 (Positive Bending)

Specimen NO.	Location	Yield Depth (mm)		ABAQUS N.A. (mm)		Calculate N.A. (mm)		Ratio	
		3% Drift	4% Drift	3% Drift	4% Drift	3% Drift	4% Drift	3% Drift	4% Drift
IFS3	Top Stiffener	+61.5	+66	118	119	119	120	99%	99%
	Bottom Stiffener	-61.5	-66						
IFS4	Top Stiffener	+45	+53	118	119	118	118	100%	101%
	Bottom Stiffener	-45	-53						
IFS5	Top Stiffener	+53	+63	195	196	206	206	95%	95%
	Bottom Stiffener	-53	-63						

Note: + 為正號代表拉降伏範圍，- 為負號代表壓降伏範圍，且距離均由梁翼板內側與加勁板交接面算起。

表 5.5 梁柱接頭梁強度需求比 α (IFS 組)

L_s (mm)	d_s (mm)	t_s (mm)	
		22	28
208	175	0.93	1.01
	245	1.04	1.14
	308	1.14	1.27
254	175	0.92	0.99
	245	1.03	1.13
	308	1.12	1.25
300	175	0.90	0.98
	245	1.01	1.11
	308	1.11	1.23

Note : $\beta=1.36$ and use IFS3 coupon

表 5.6 試體 IFS4 改變柱尺寸參數表

Specimen NO.	Column Size	Beam Size	Stiffener Size ($t_s \times d_s \times L_s$)	$\frac{\sum M_{pc}^*}{\sum M_{pb}^*}$
C1	□550×550×20×20	H702×254×16×28	28×175×300	2.8
C2	□550×550×28×28	H702×254×16×28	28×175×300	3.9
C3	□550×550×35×35	H702×254×16×28	28×175×300	4.7
C4	□700×700×35×35	H702×254×16×28	28×175×300	7.6

表 5.7 梁柱接頭梁強度需求比 α (FDWS 組)

L_s (mm)	t_s (mm)		
	14	18	22
208	0.98	1.09	1.20
254	0.96	1.07	1.18
300	0.94	1.05	1.16

Note : $\beta=1.51$ and use FDWS2 coupon

表 5.8 試體 FDWS2 改變柱尺寸參數表

Specimen NO.	Column Size	Beam Size	Stiffener Size ($t_s \times d_s \times L_s$)	$\frac{\sum M_{pc}^*}{\sum M_{pb}^*}$
C1	□550×550×20×20	H702×254×16×28	22×646×300	3.1
C2	□550×550×28×28	H702×254×16×28	22×646×300	4.3
C3	□550×550×35×35	H702×254×16×28	22×646×300	5.2
C4	□700×700×35×35	H702×254×16×28	22×646×300	8.4

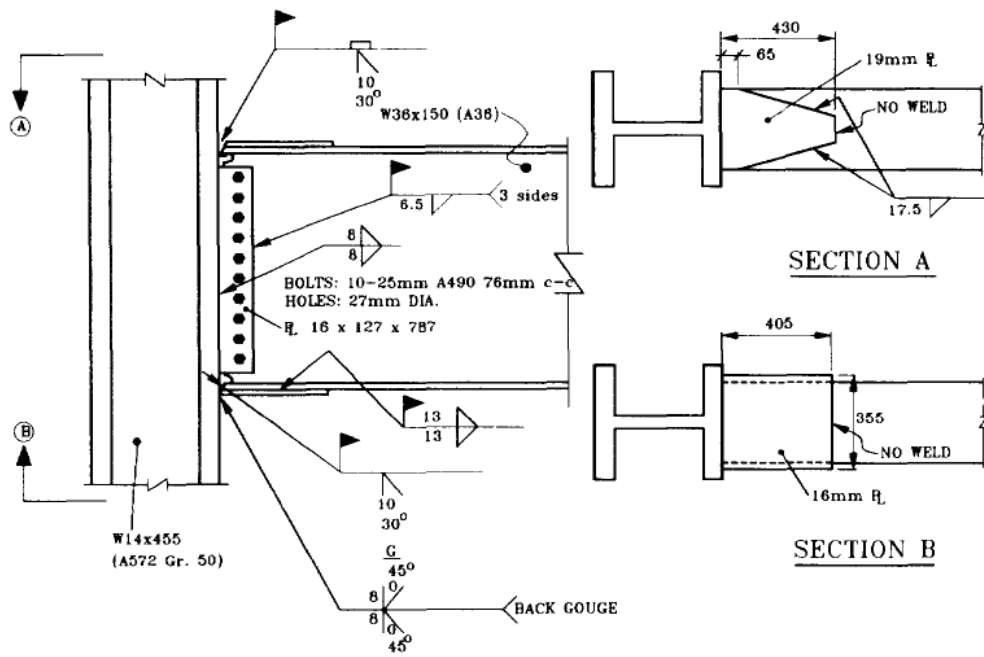
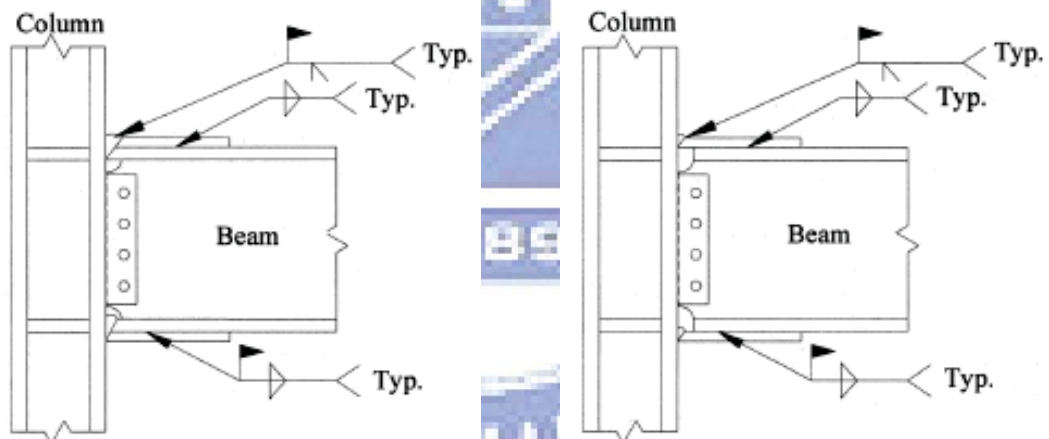
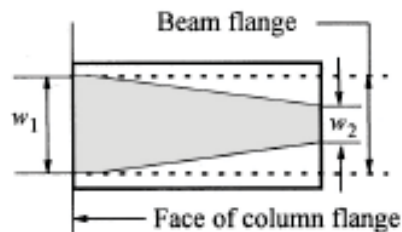


圖 1.1 Engelhardt 和 Sabol (1997) 之蓋板補強式梁柱接頭



(a) Cover-Plate Connection

(b) Flange-Plate Connection



(c) Reinforcing Plate Profiles

圖 1.2 Whittaker 和 Kim (2002) 之蓋板補強式梁柱接頭

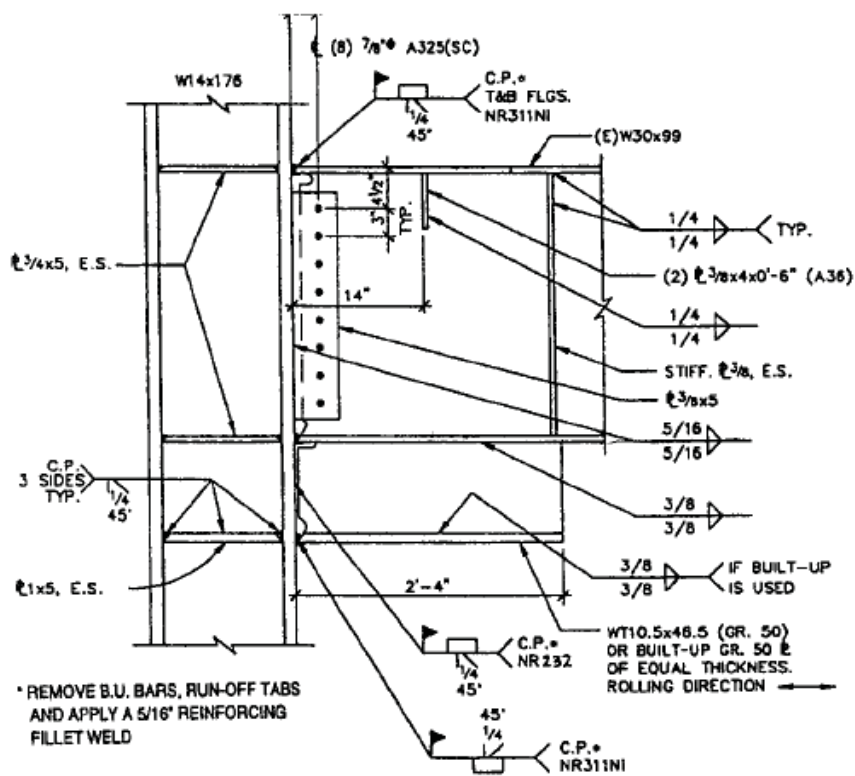


圖 1.3 Lee 和 Uang (2001) 之托梁補強式梁柱接頭

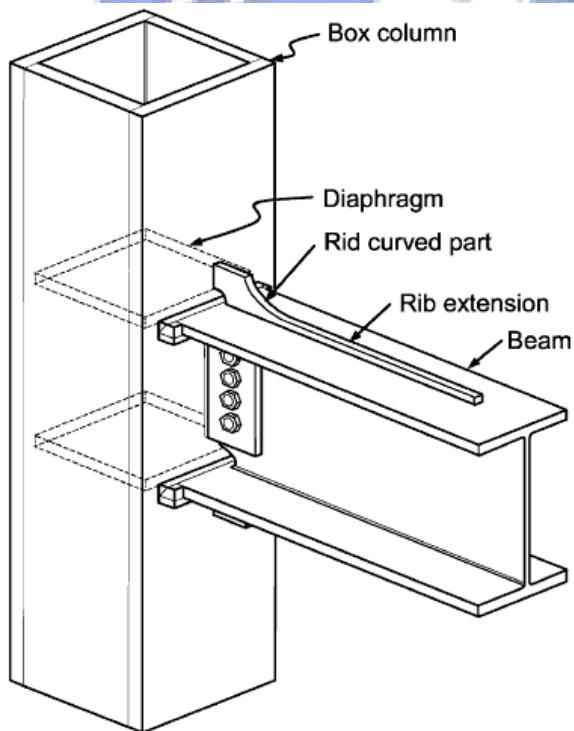


圖 1.4 Chen 和 Lin (2004) 肋板補強式梁柱接頭

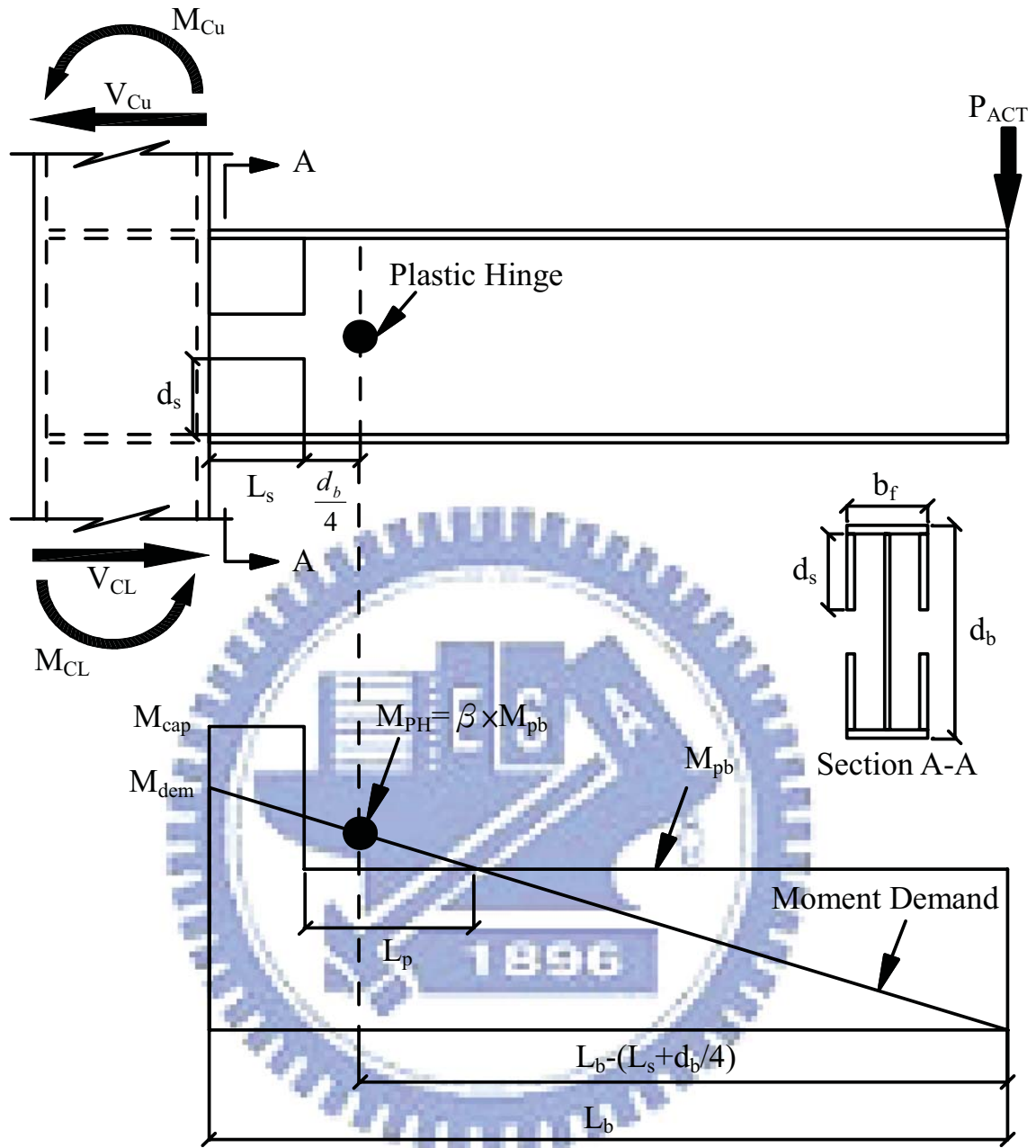


圖 2.1 IFS 梁柱梁翼內側補強接頭強度需求

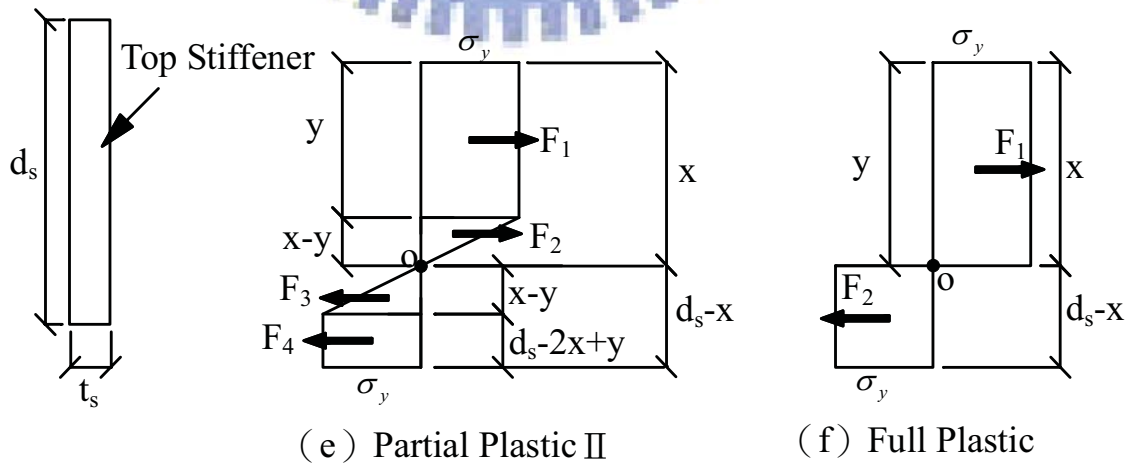
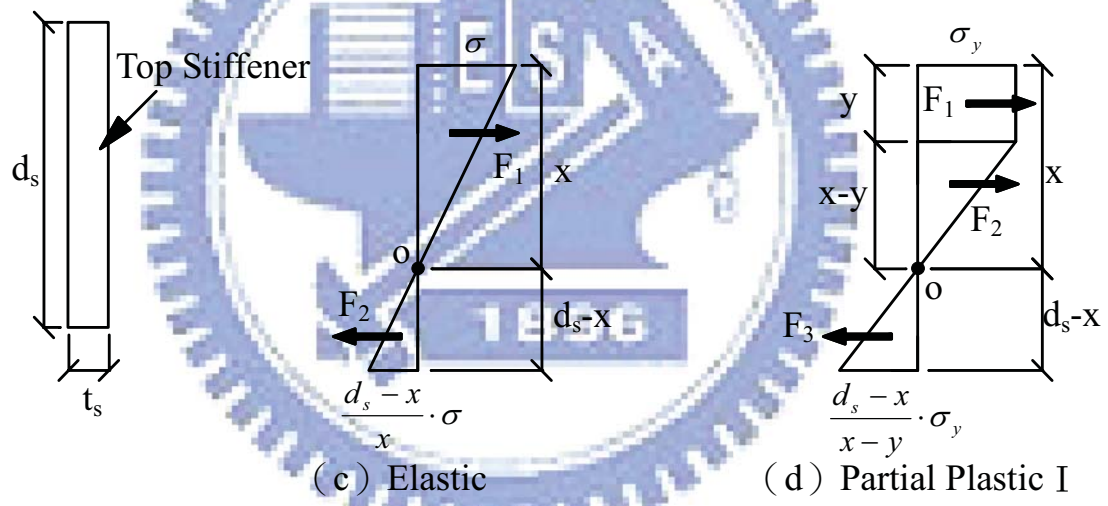
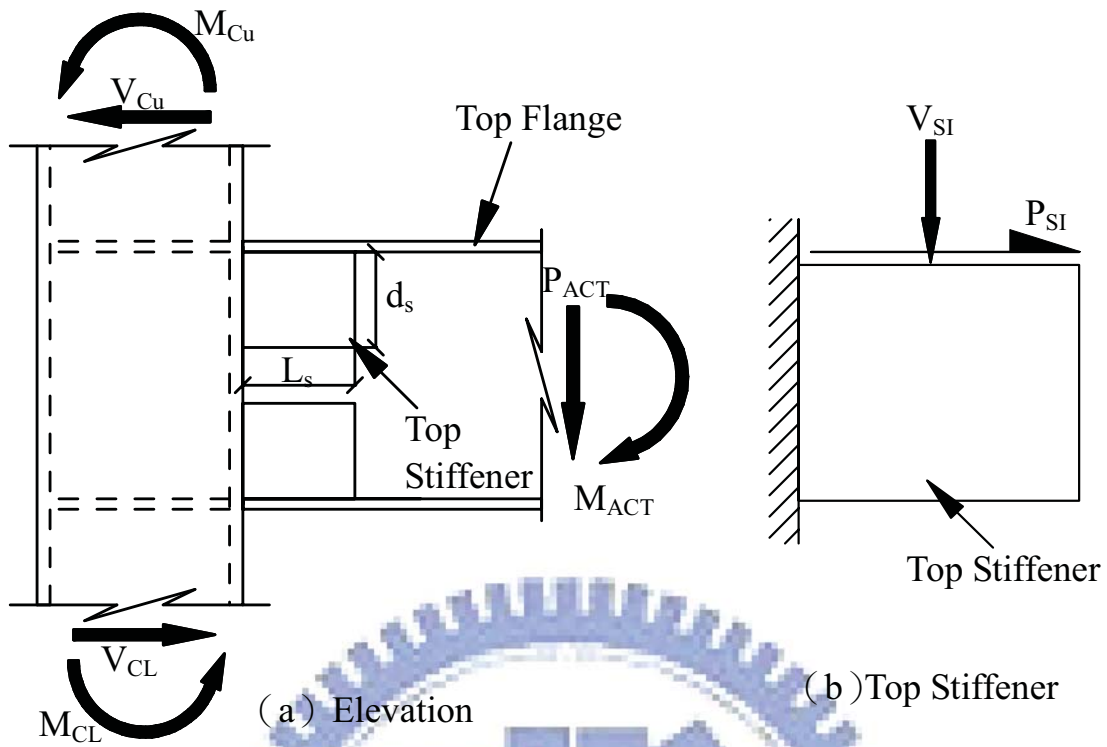


圖 2.2 IFS 加勁板受力情形與應力分佈狀態

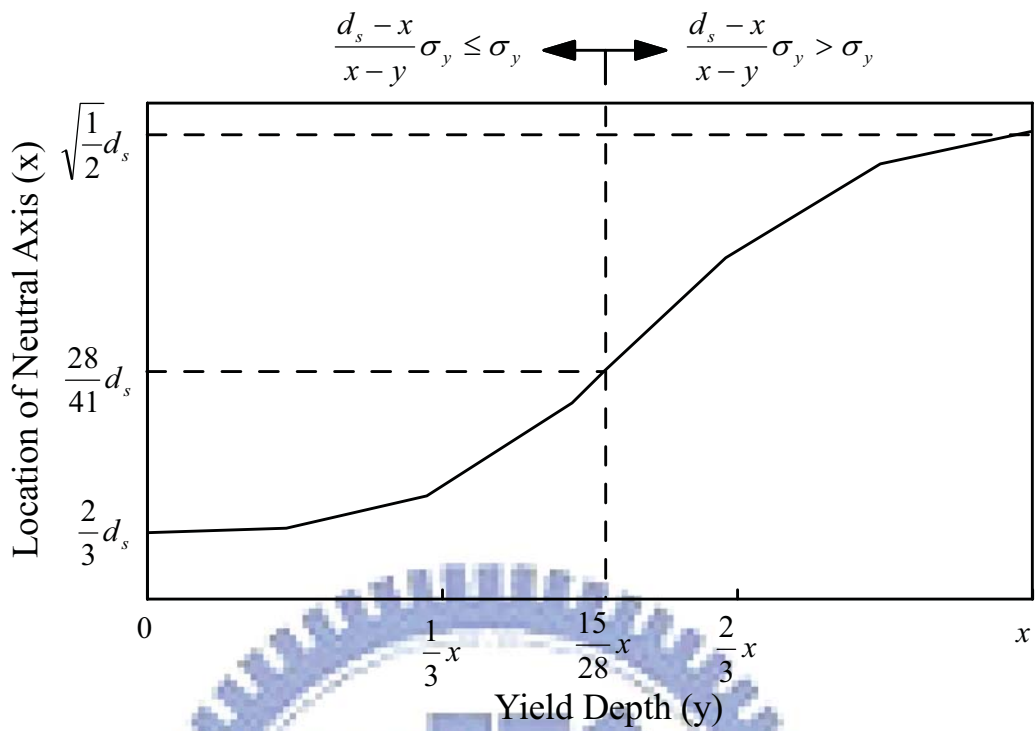


圖 2.3 IFS 加勁板中性軸延深度 d_s 之變化

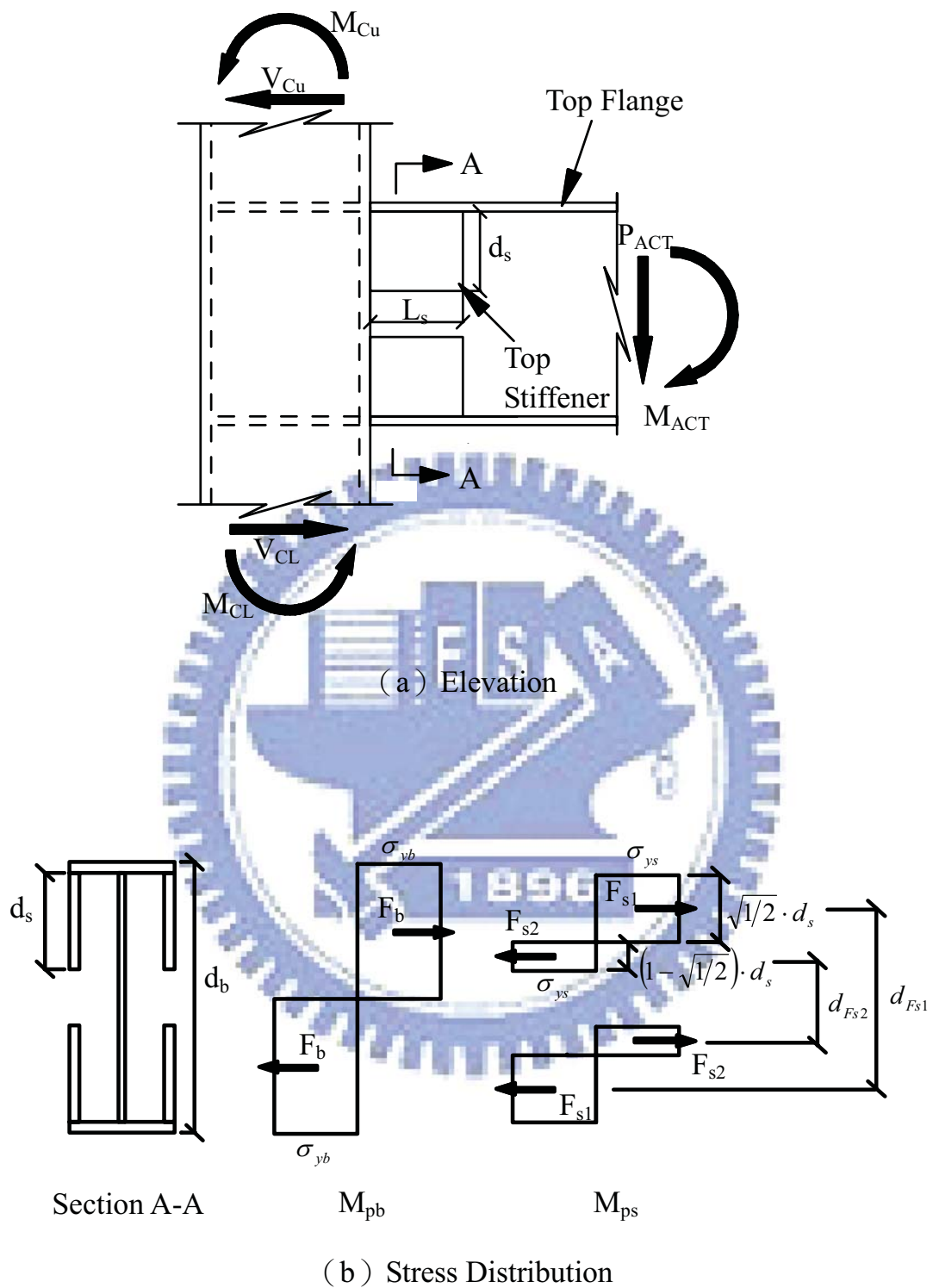


圖 2.4 IFS 加勁補強接頭所提供之彎距容量 M_{cap} 示意圖

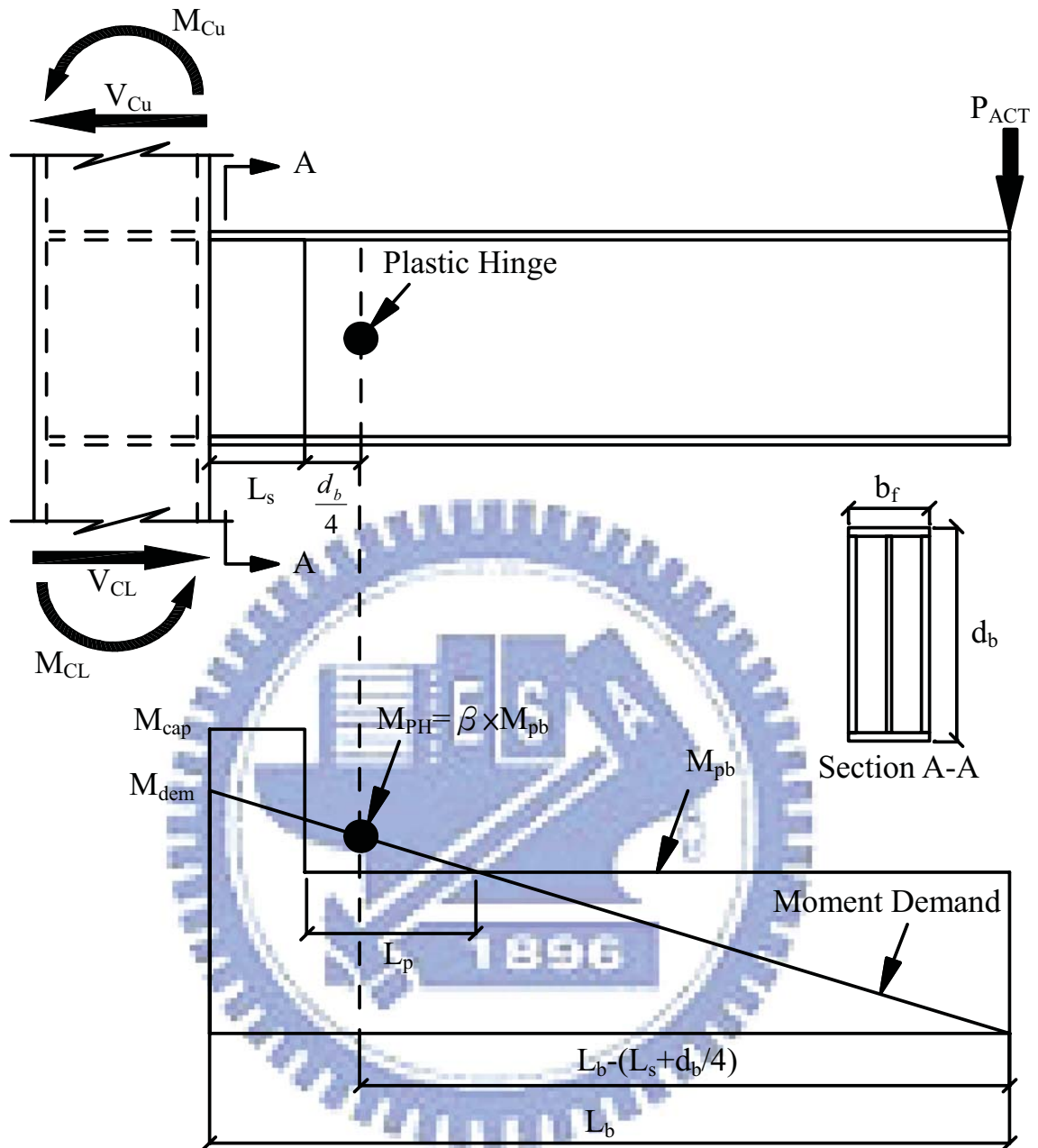


圖 2.5 FDWS 梁柱梁翼內側補強接頭強度需求

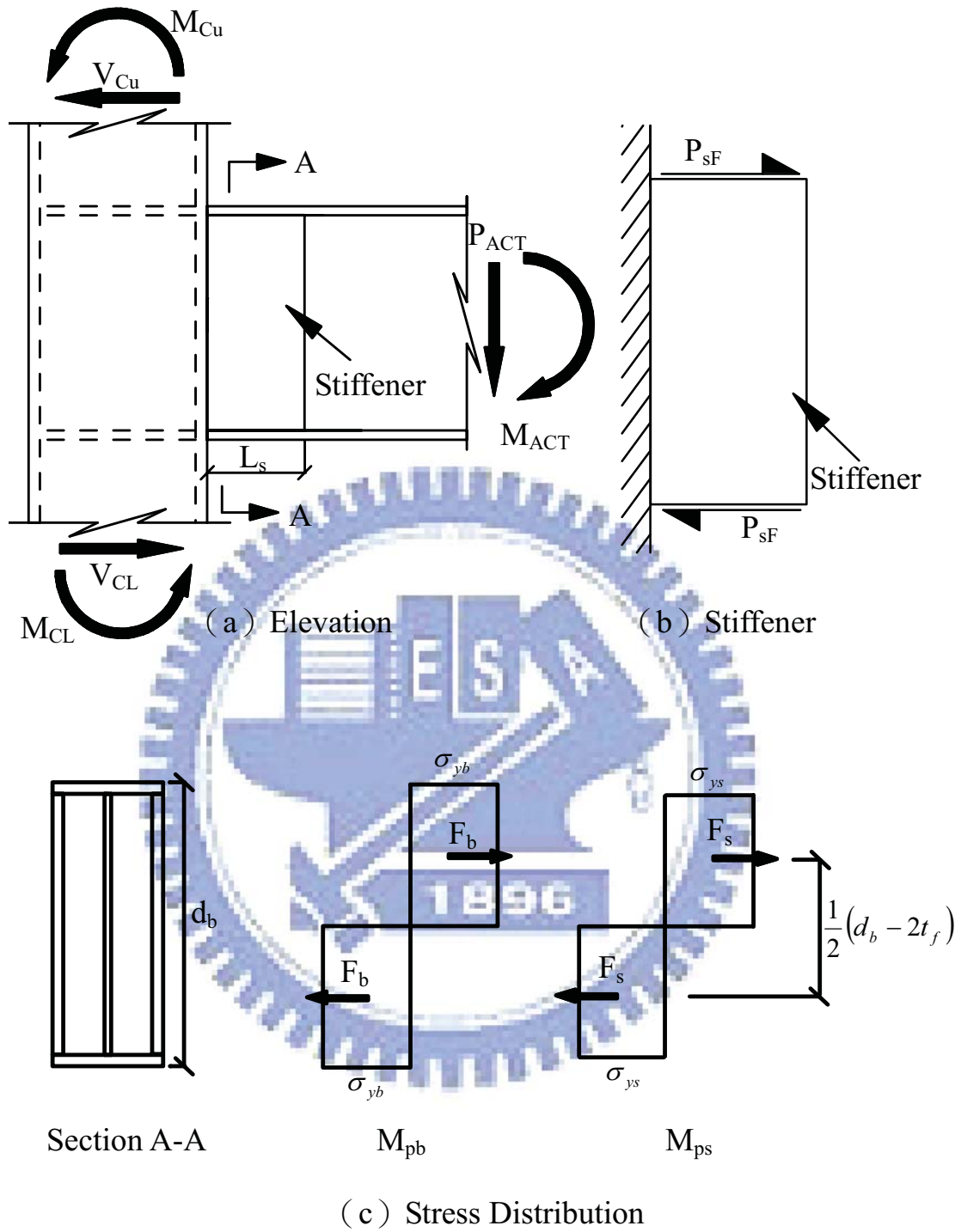


圖 2.6 FDWS 加勁補強接頭所提供之彎距容量 M_{cap} 示意圖

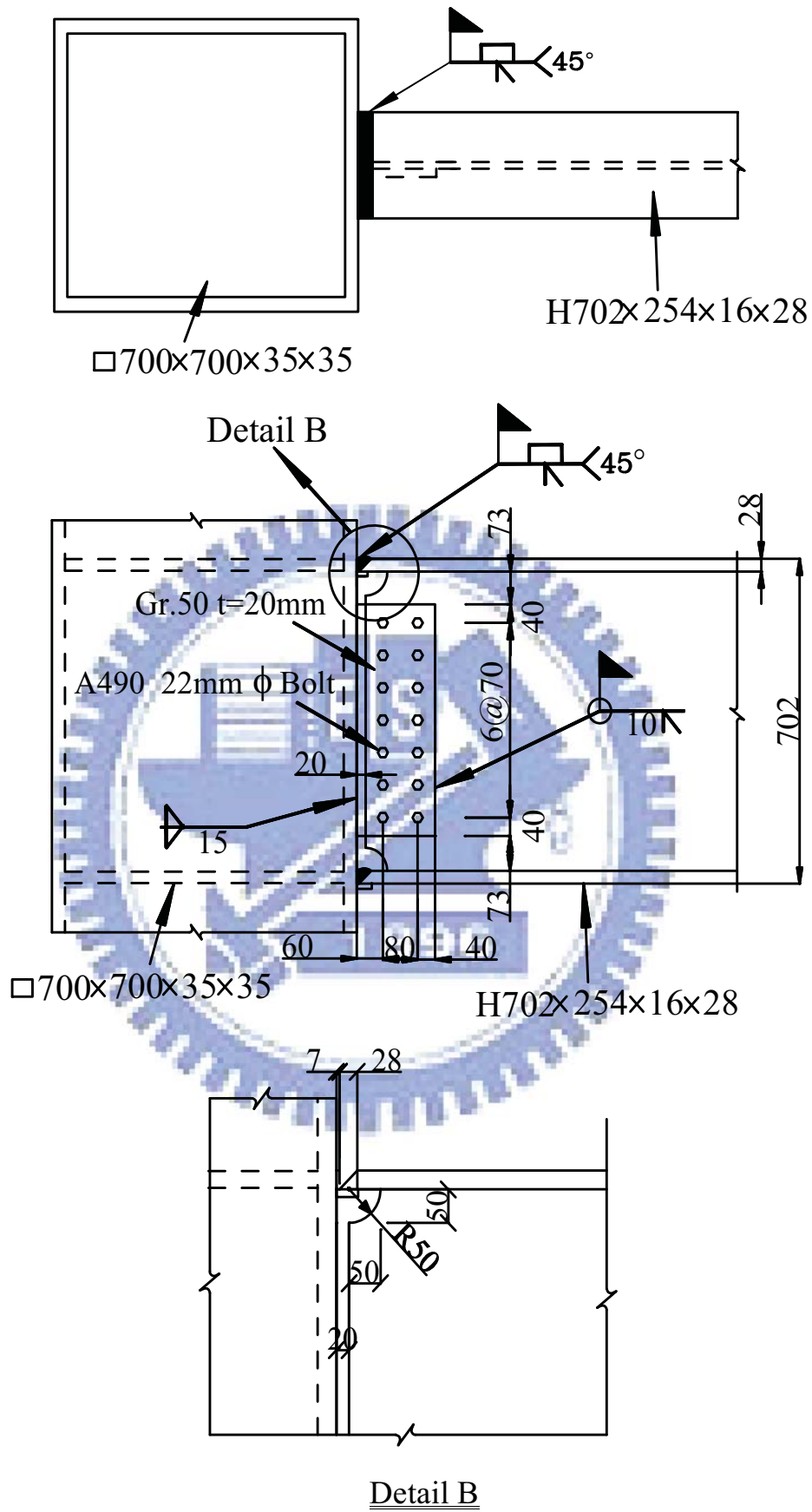


圖 2.7 試體 UR 之梁柱接頭接合細節

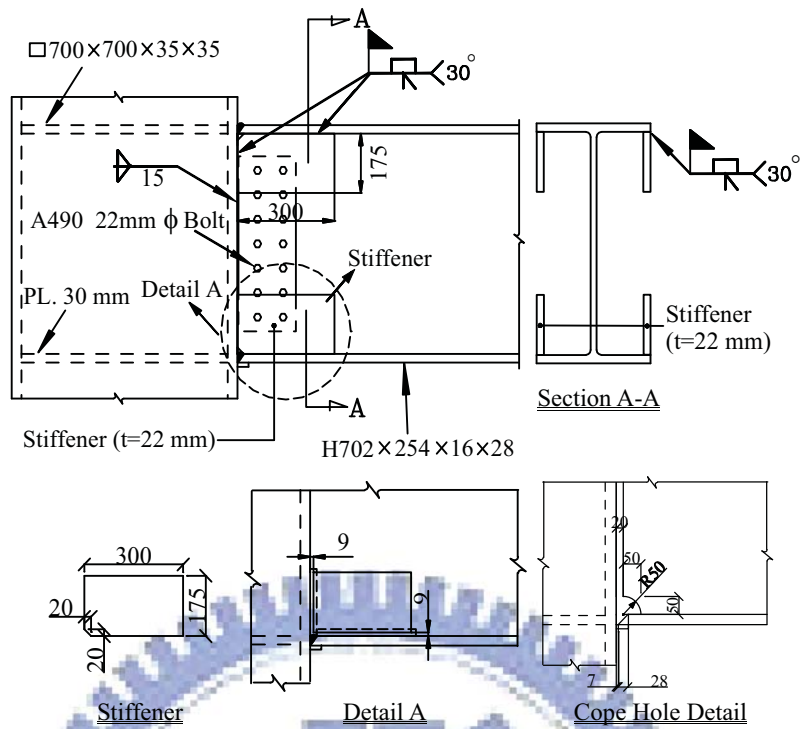


圖 2.8 試體 IFS1 之加勁板與梁柱接頭接合細節

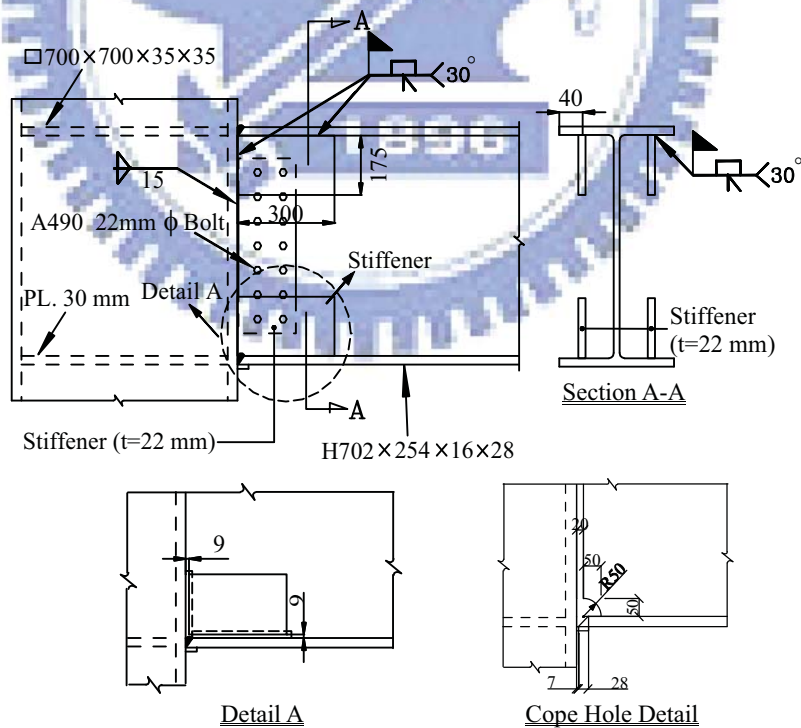


圖 2.9 試體 IFS2 之加勁板與梁柱接頭接合細節

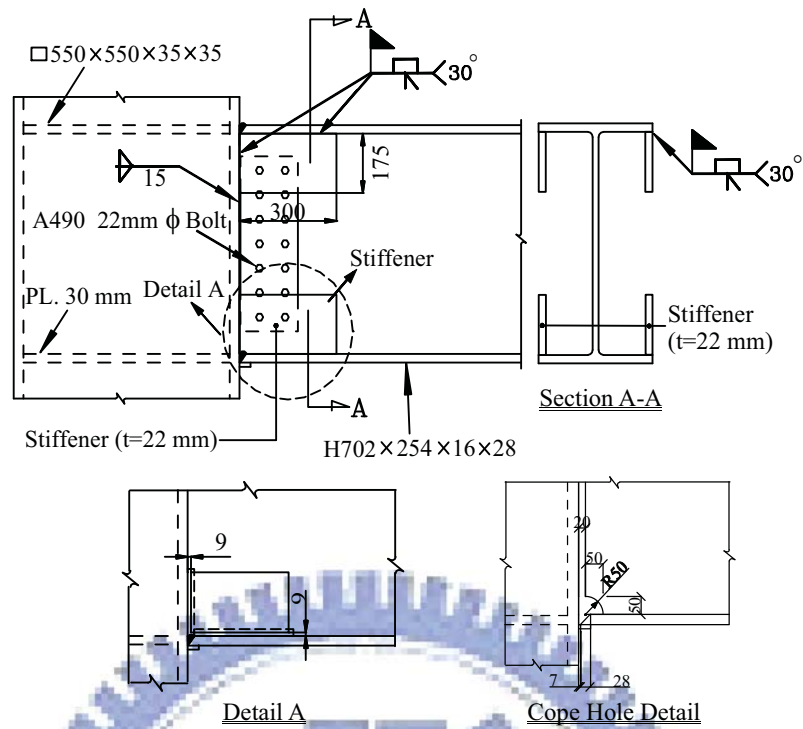


圖 2.10 試體 IFS3 之加勁板與梁柱接頭接合細節

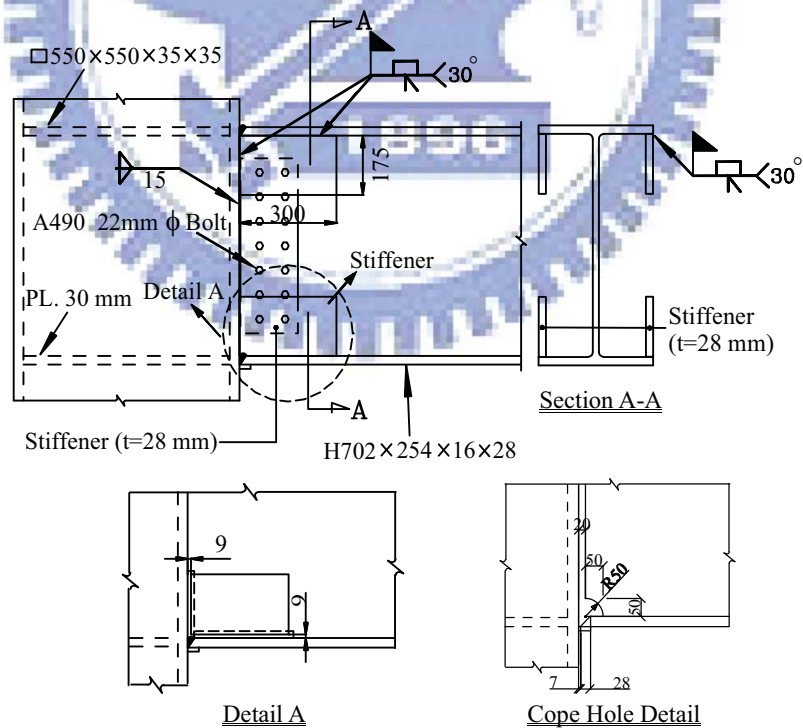


圖 2.11 試體 IFS4 之加勁板與梁柱接頭接合細節

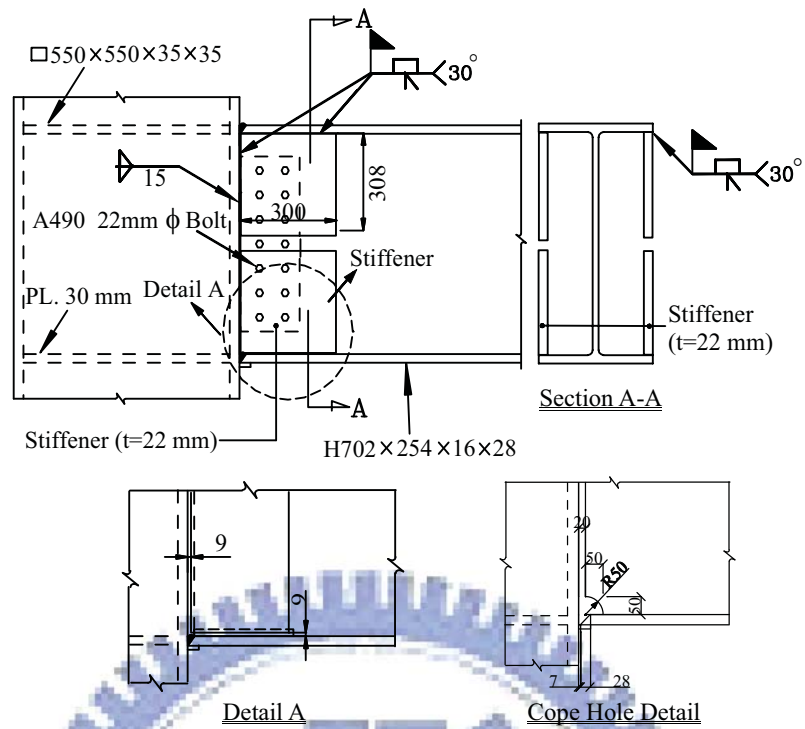


圖 2.12 試體 IFS5 之加勁板與梁柱接頭接合細節

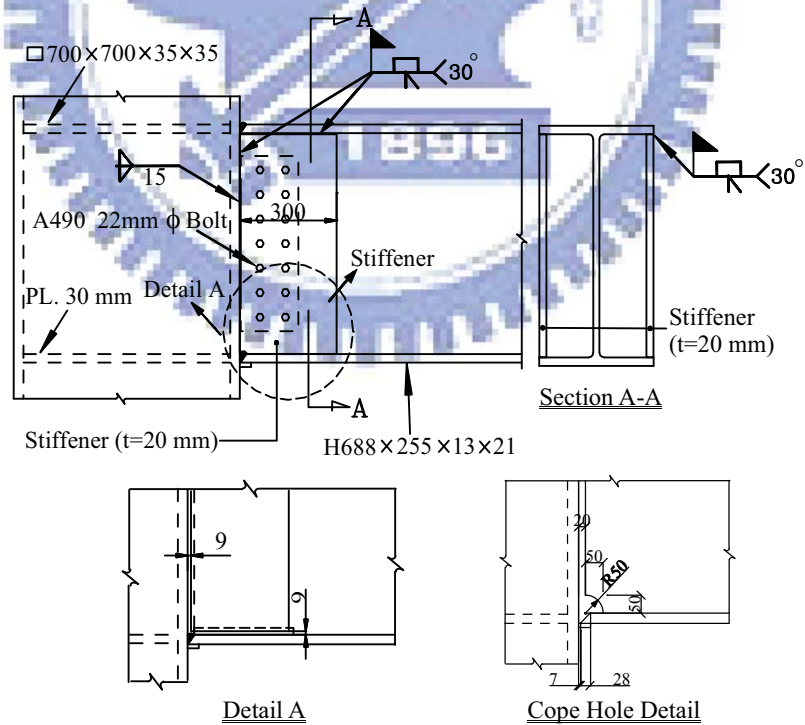


圖 2.13 試體 FDWS1 之加勁板與梁柱接頭接合細節

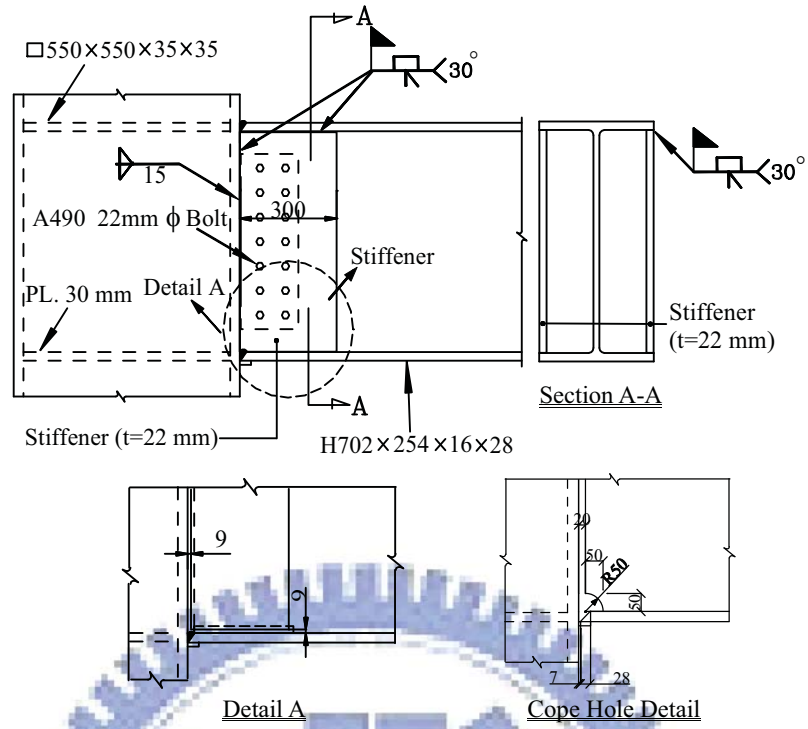


圖 2.14 試體 FDWS2 之加勁板與梁柱接頭接合細節

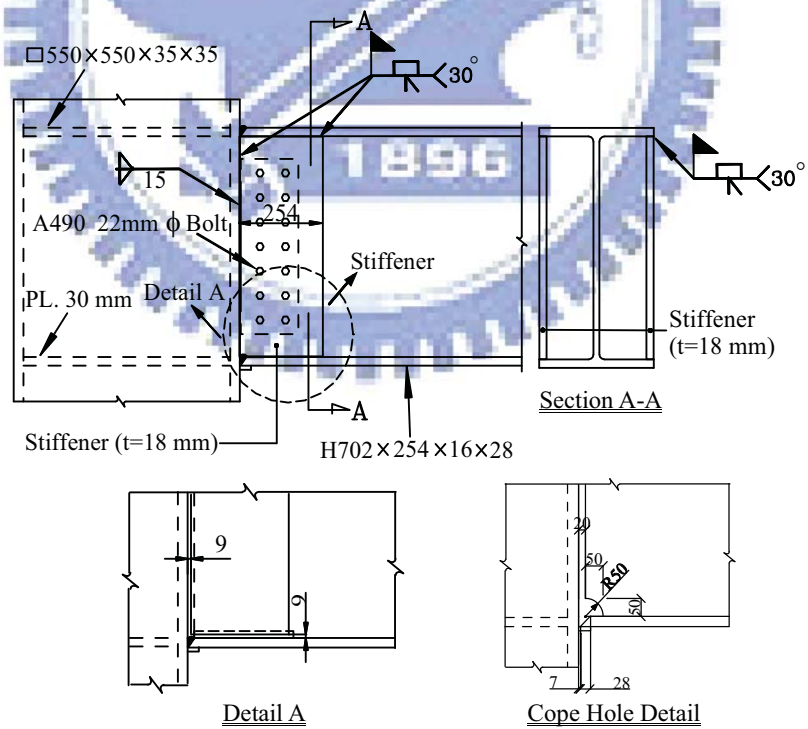


圖 2.15 試體 FDWS3 之加勁板與梁柱接頭接合細節

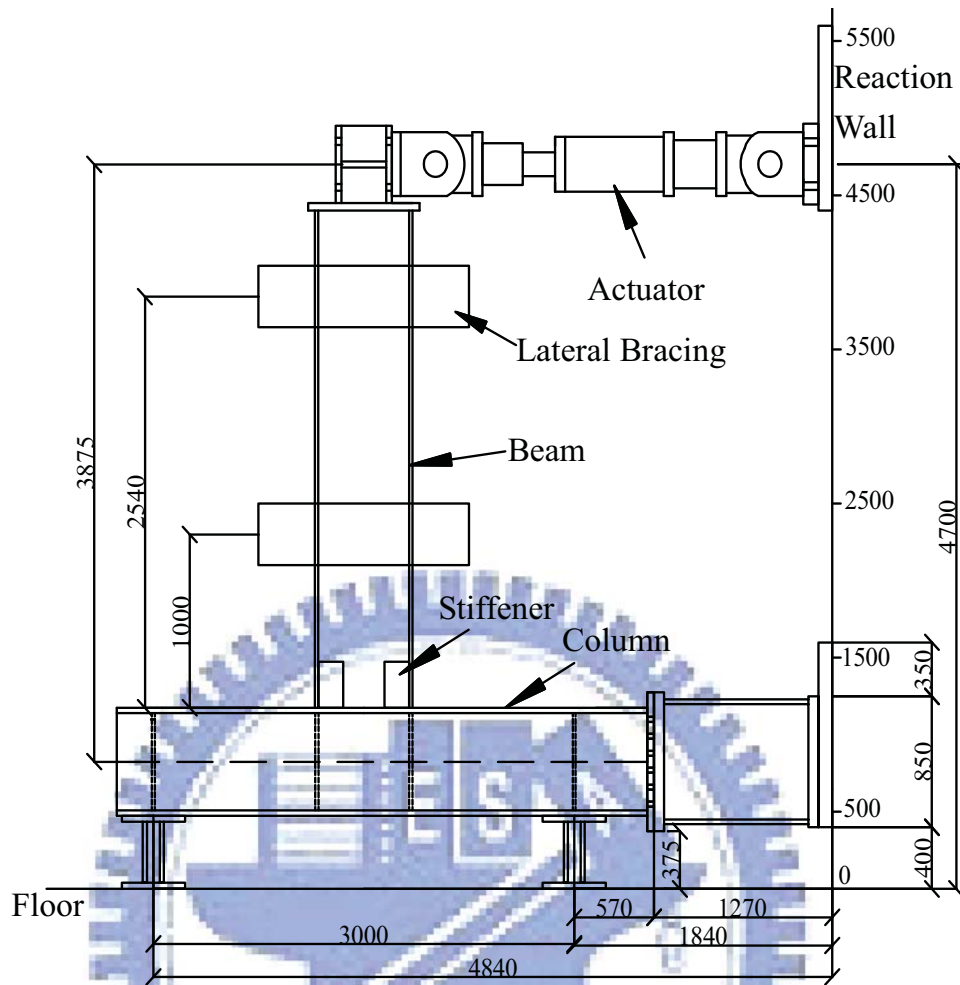


圖 2.16 試體試驗設備裝置圖

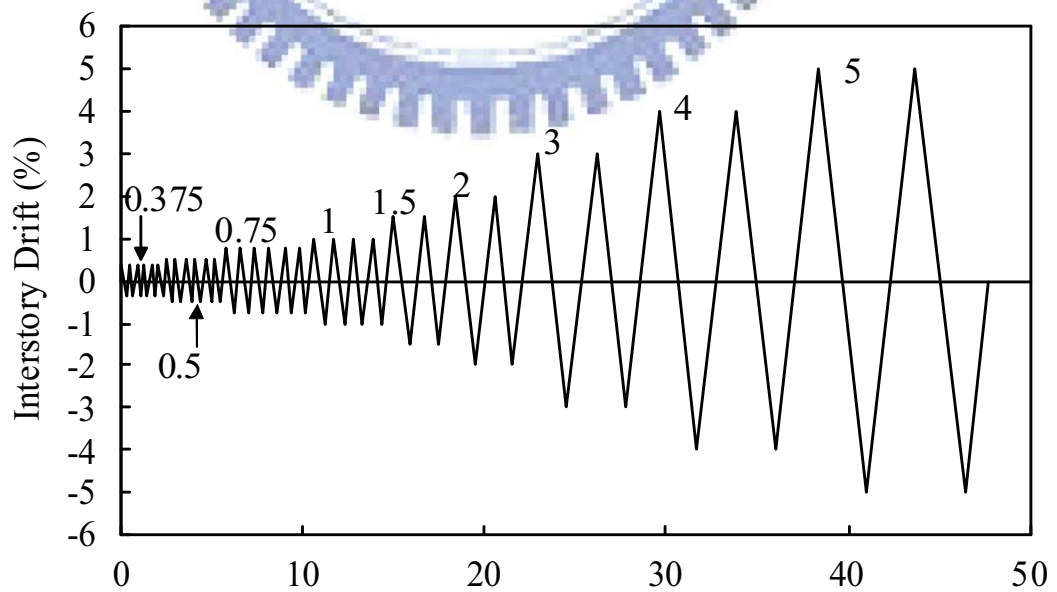


圖 2.17 試體載重歷時圖

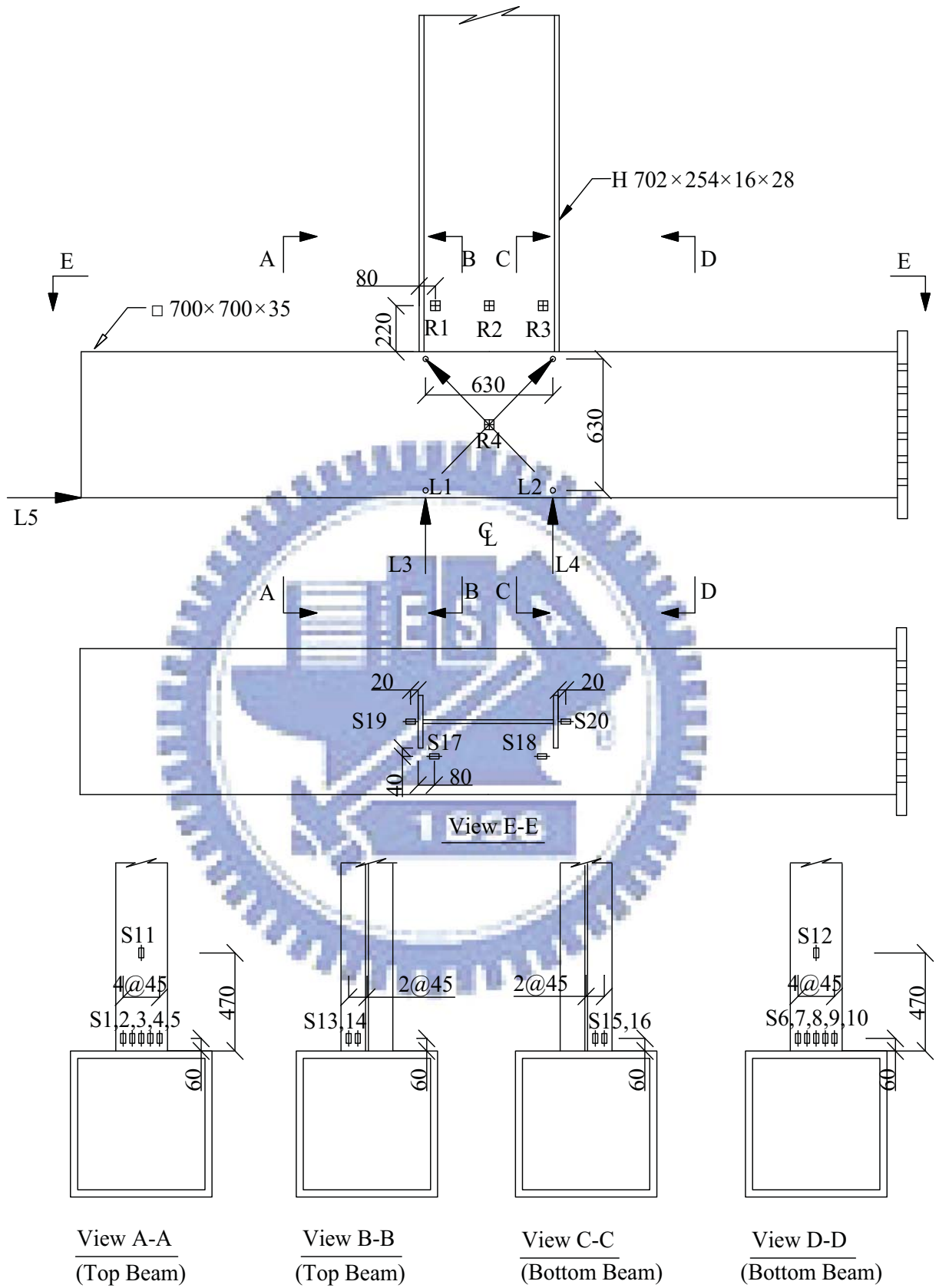


圖 2.18 試體 UR 量測儀器規劃圖

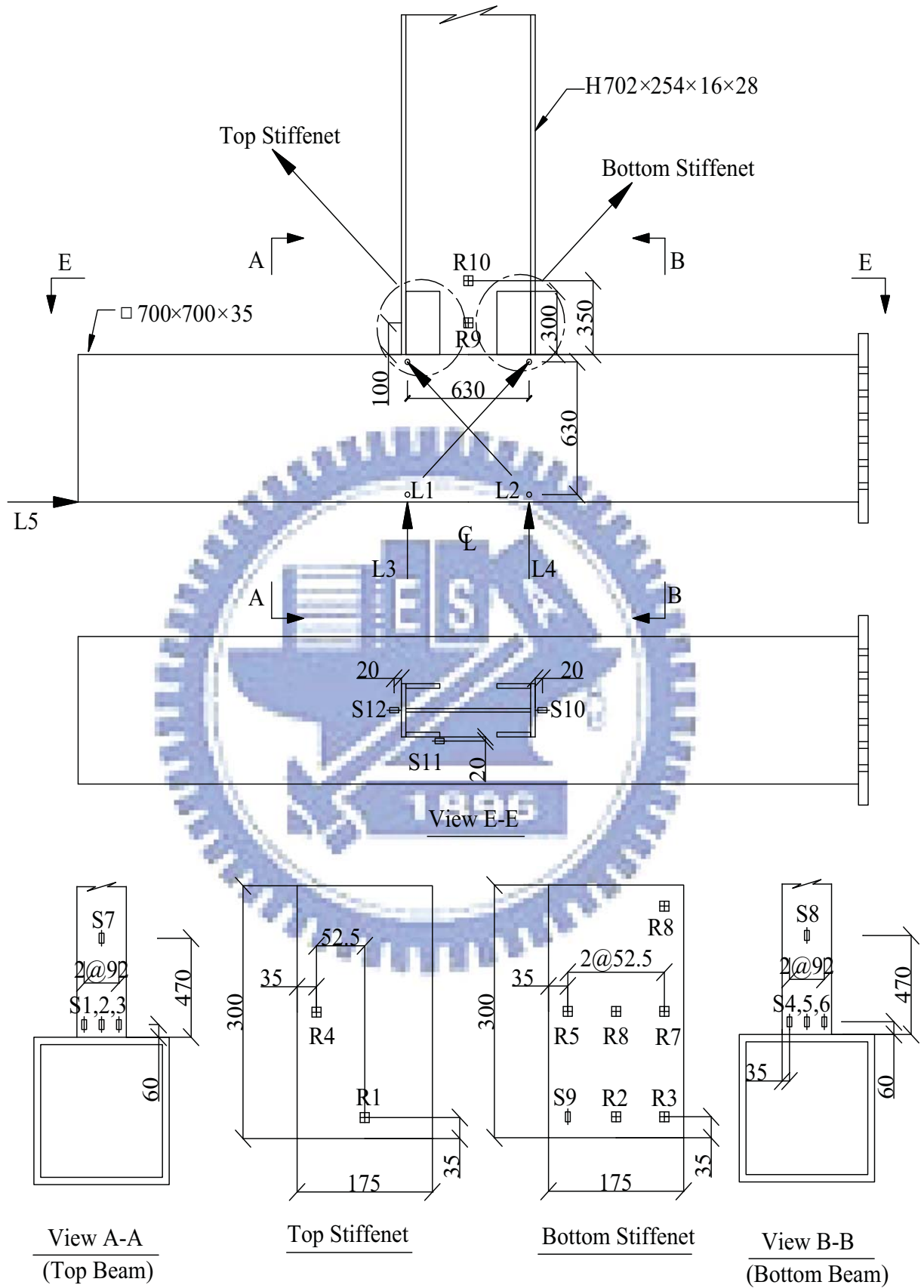


圖 2.19 試體 IFS1 量測儀器規劃圖

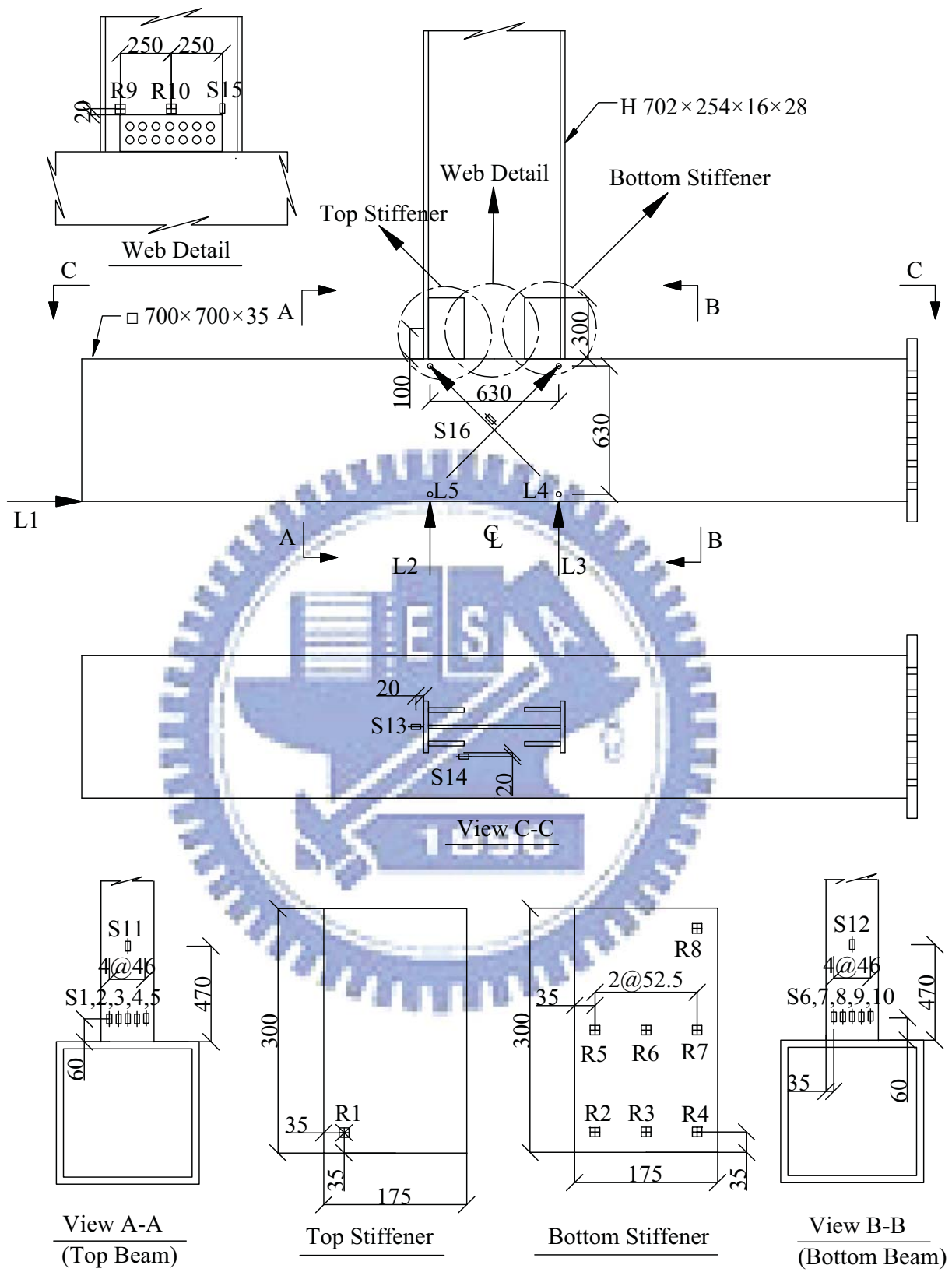


圖 2.20 試體 IFS2 量測儀器規劃圖

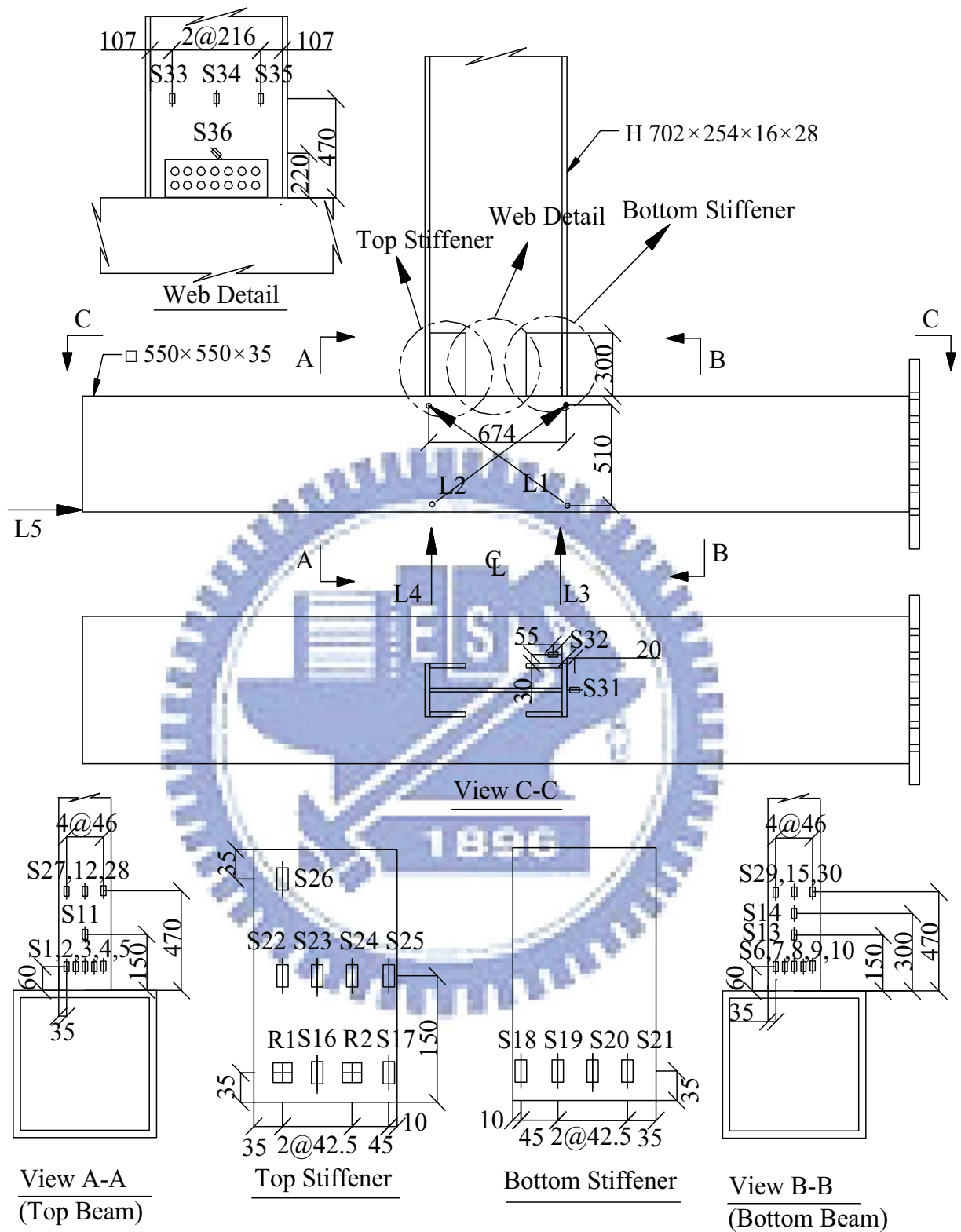


圖 2.21 試體 IFS3 量測儀器規劃圖

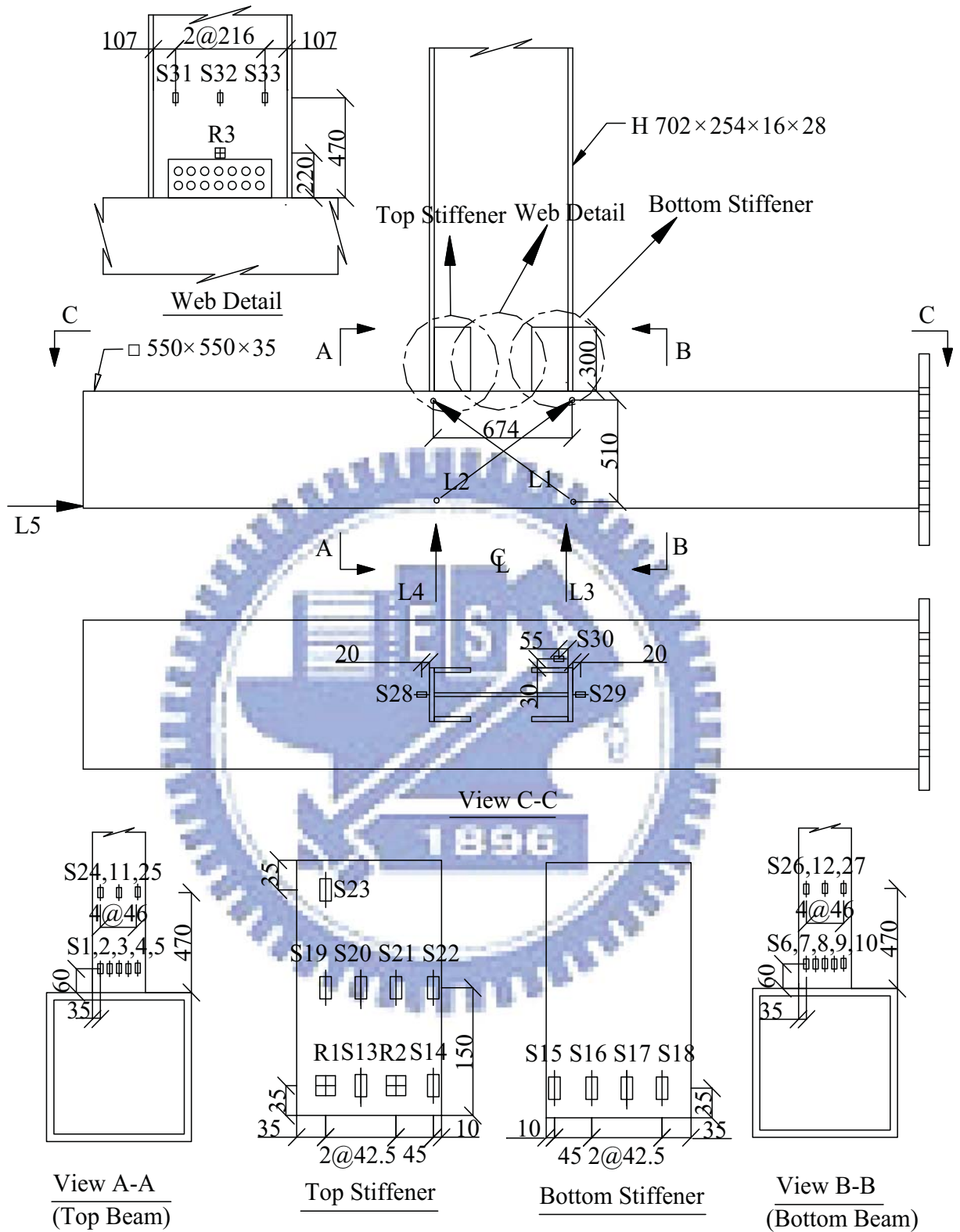


圖 2.22 試體 IFS4 量測儀器規劃圖

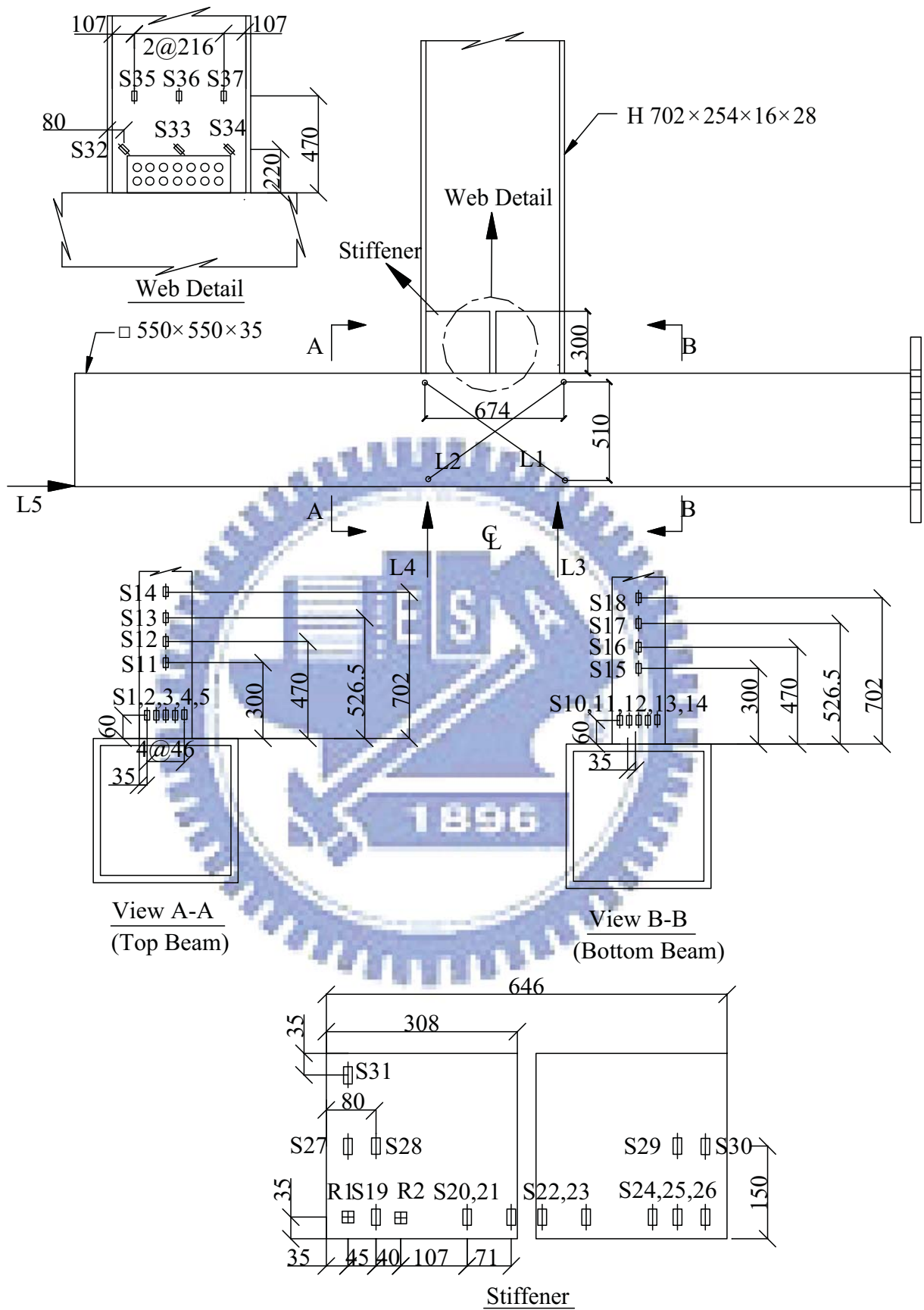


圖 2.23 試體 IFS5 量測儀器規劃圖

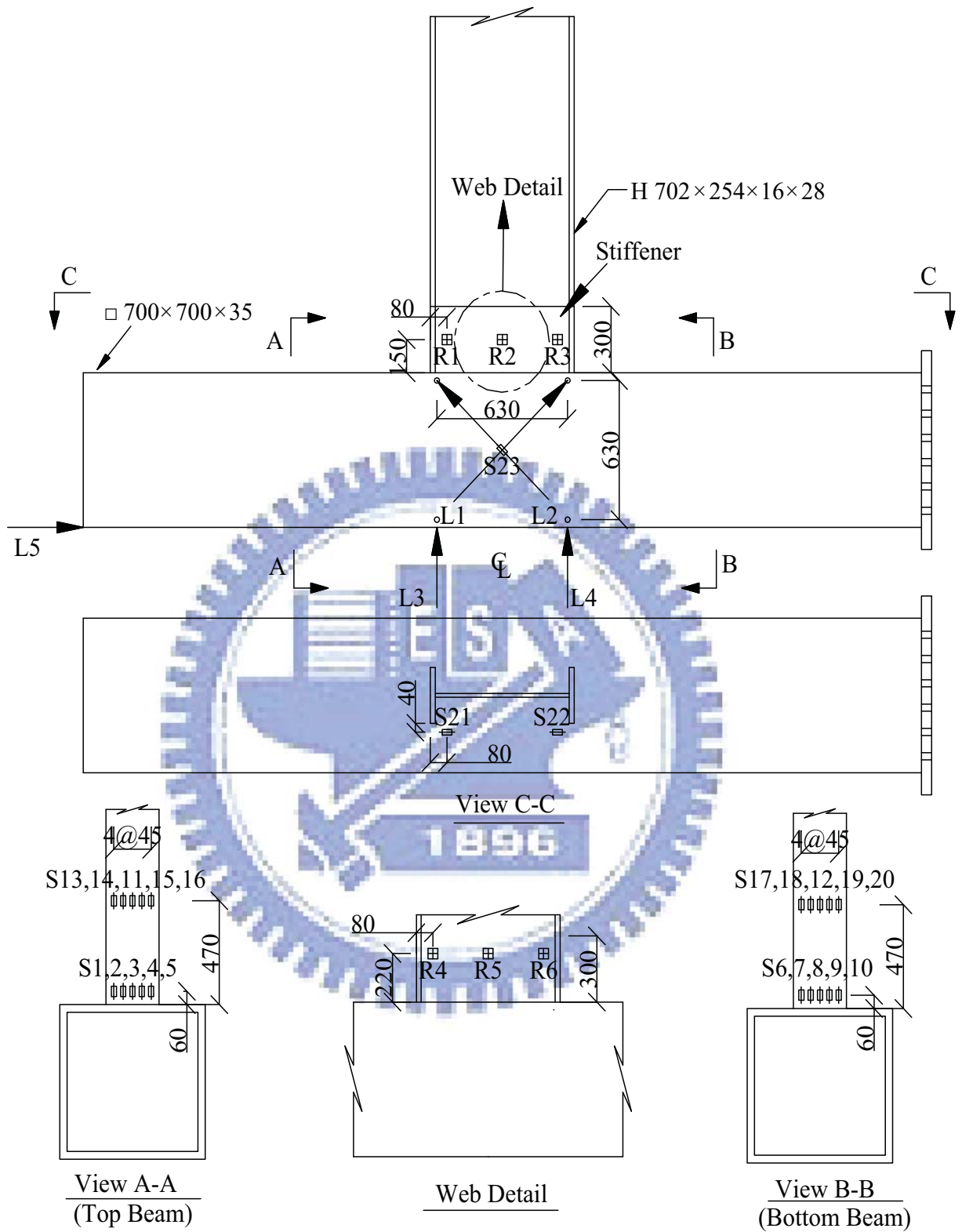


圖 2.24 試體 FDWS1 量測儀器規劃圖

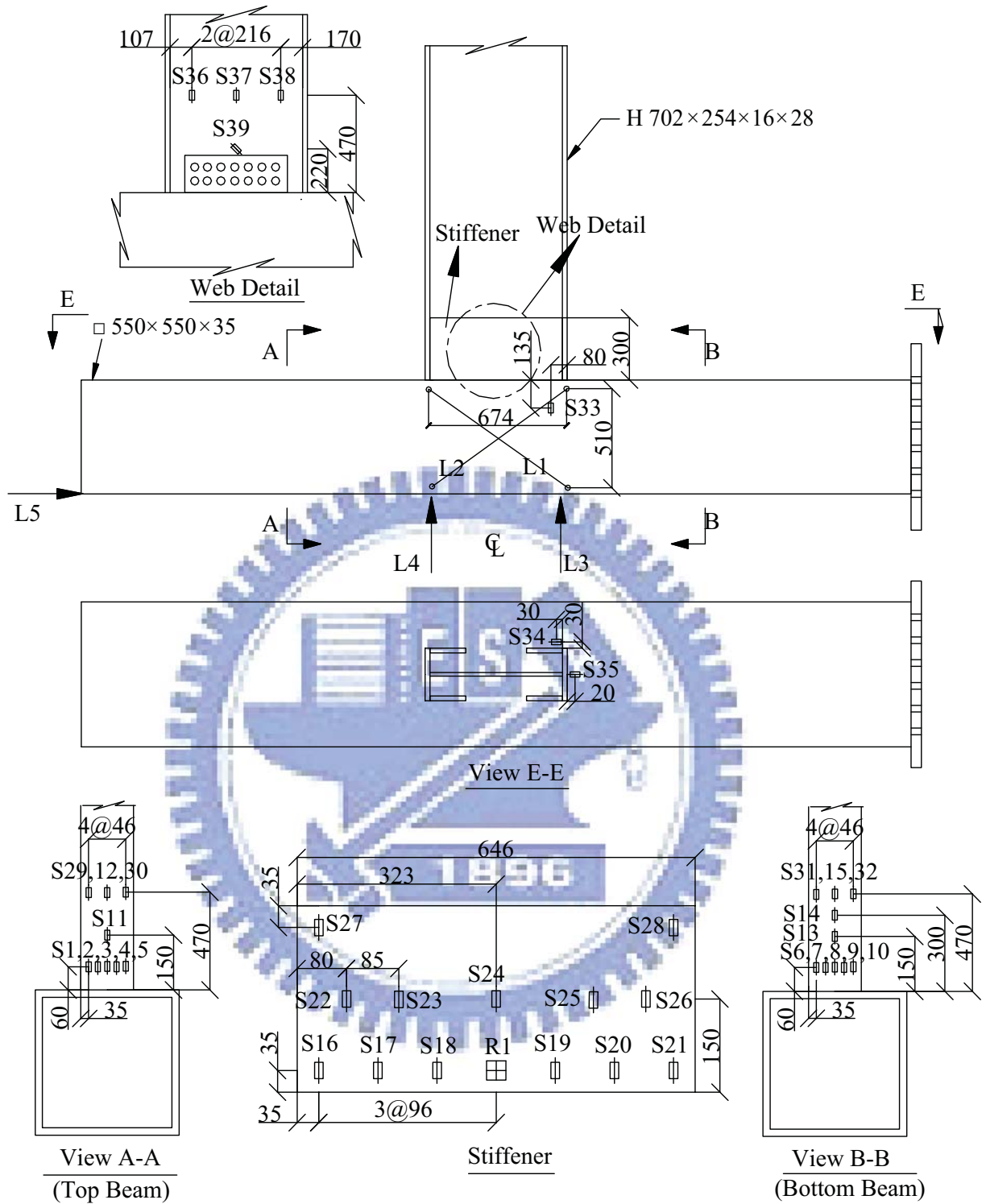


圖 2.25 試體 FDWS2 量測儀器規劃圖

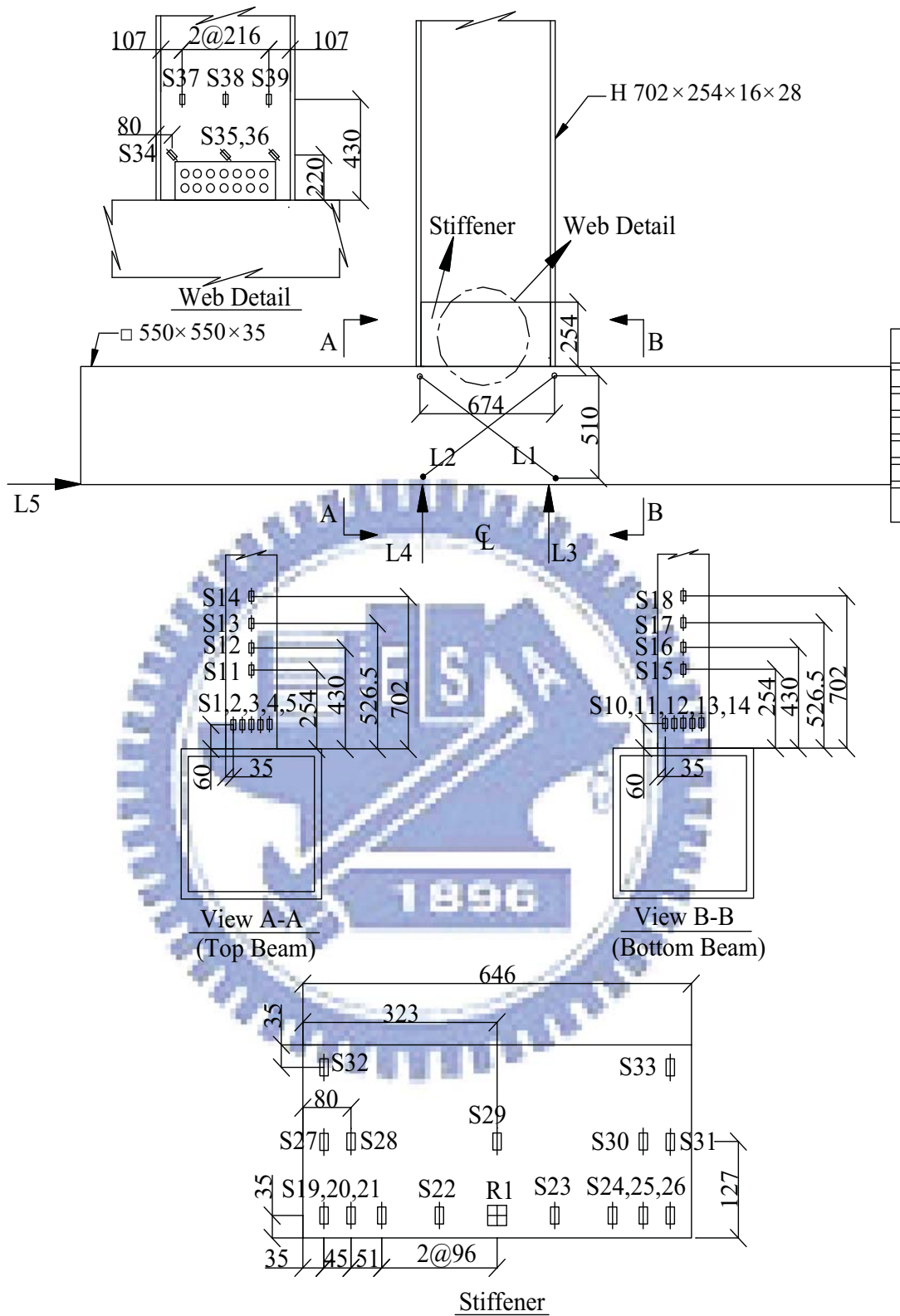


圖 2.26 試體 FDWS3 量測儀器規劃圖

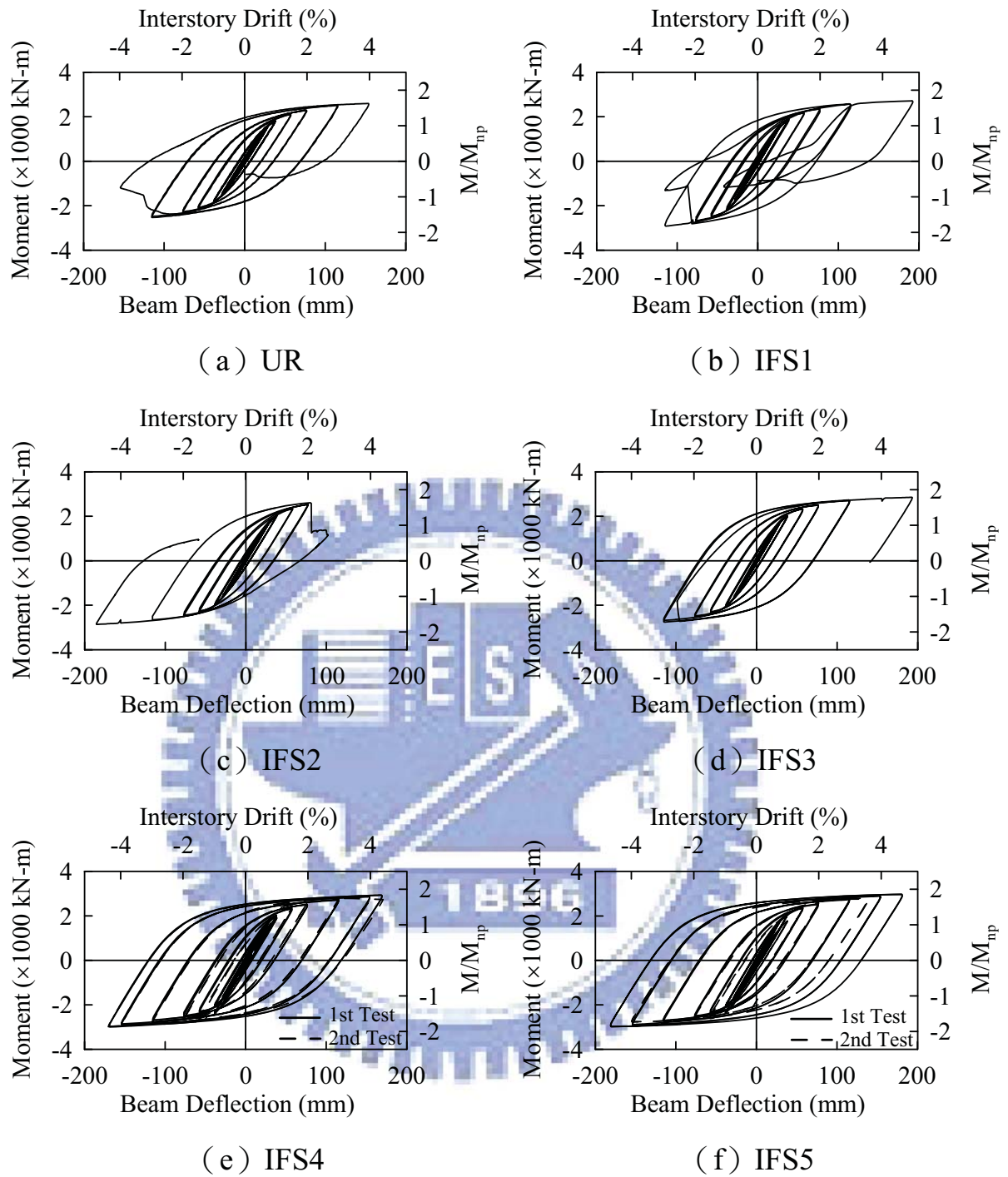
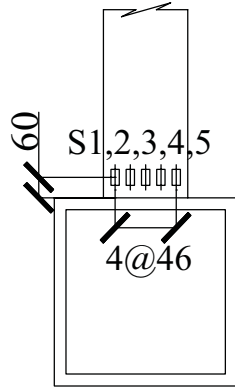
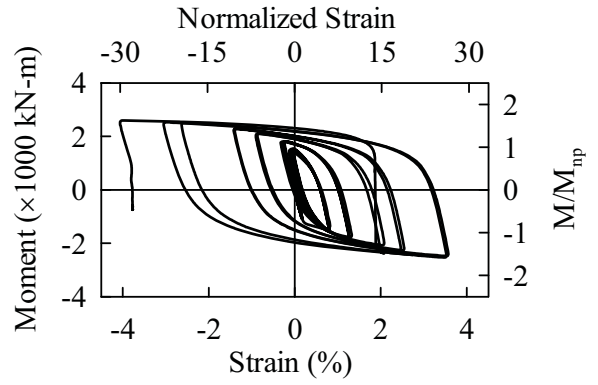


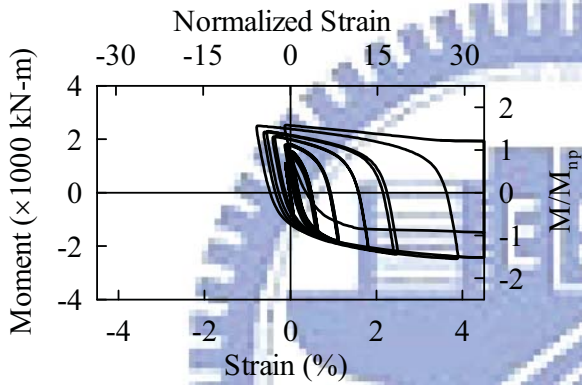
圖 3.1 試體 IFS 彎矩與梁端位移關係圖



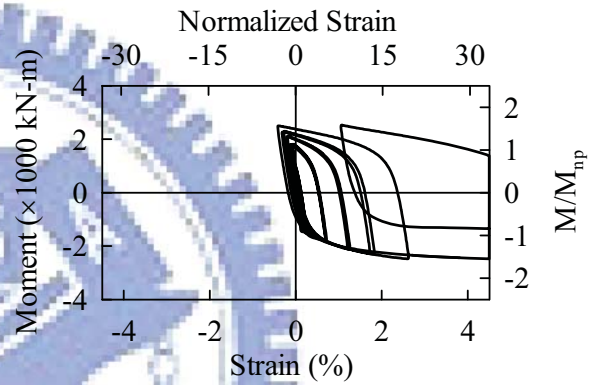
(a) Strain Gauge Location



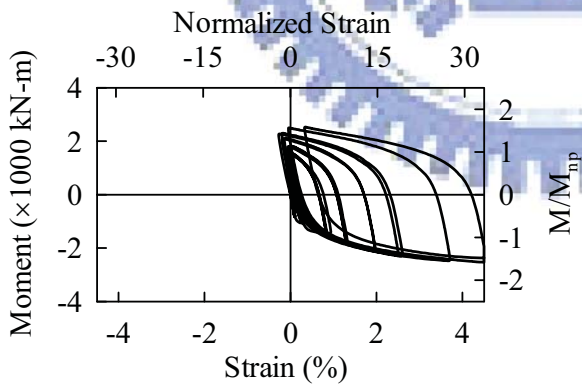
(b) Strain Gauge S1



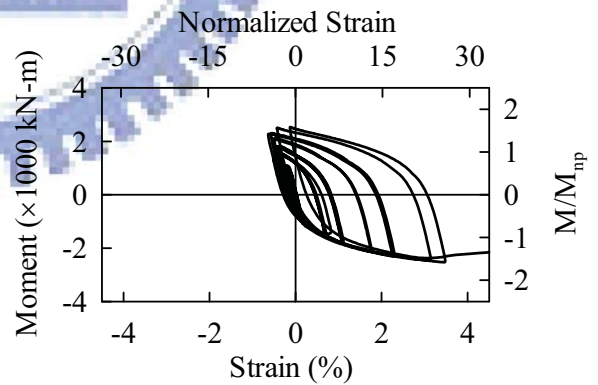
(c) Strain Gauge S2



(d) Strain Gauge S3

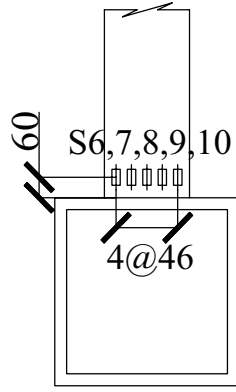


(e) Strain Gauge S4

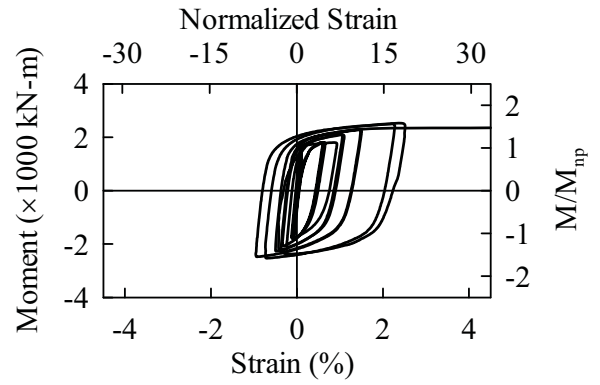


(f) Strain Gauge S5

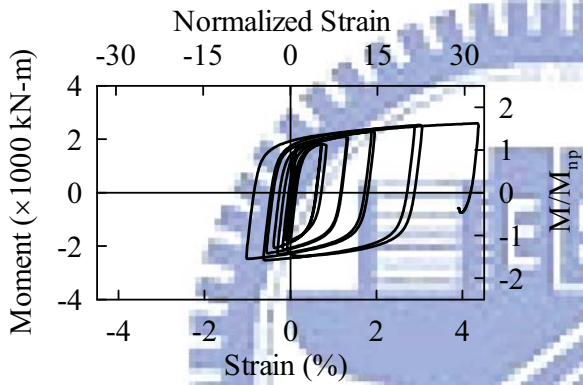
圖 3.2 試體 UR 彎矩與上翼板橫向應變關係



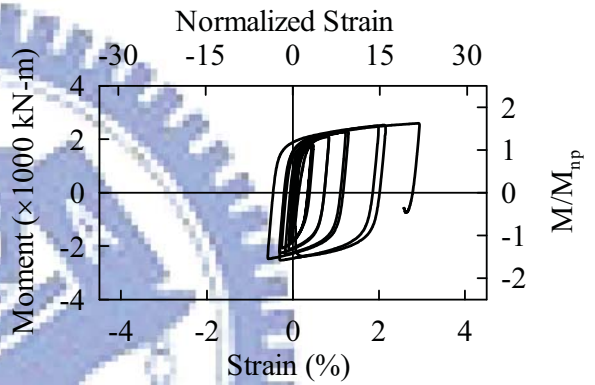
(a) Strain Gauge Location



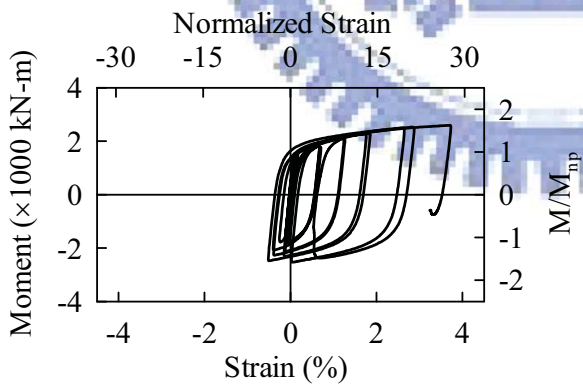
(b) Strain Gauge S6



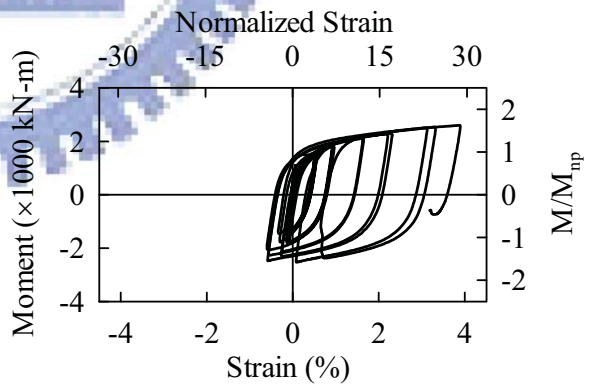
(c) Strain Gauge S7



(d) Strain Gauge S8

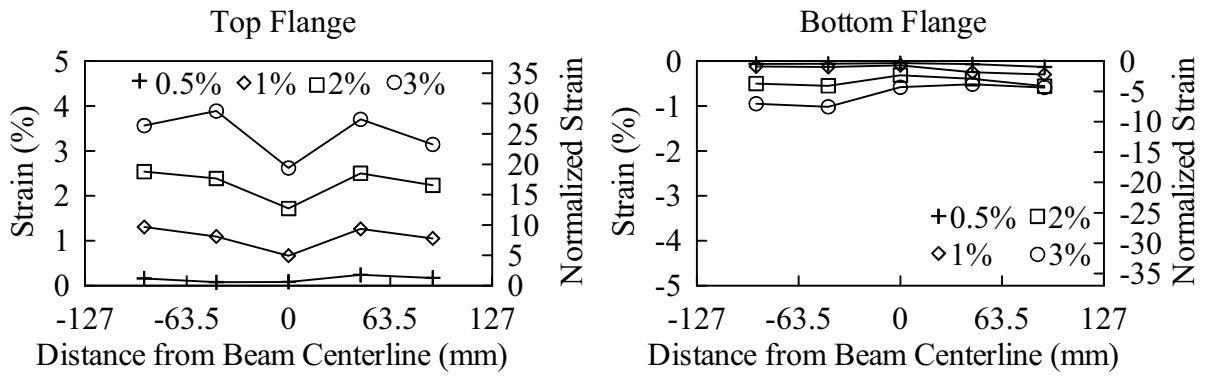


(e) Strain Gauge S9

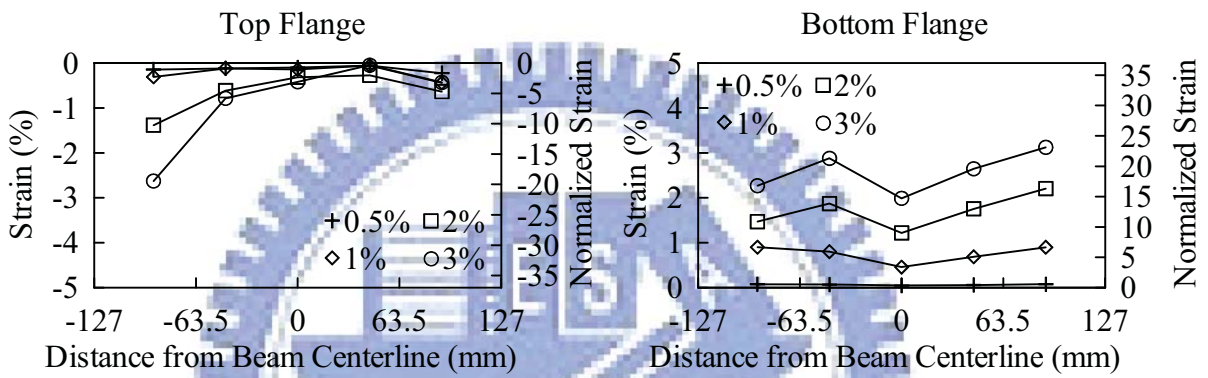


(f) Strain Gauge S10

圖 3.3 試體 UR 彎矩與下翼板橫向應變關係



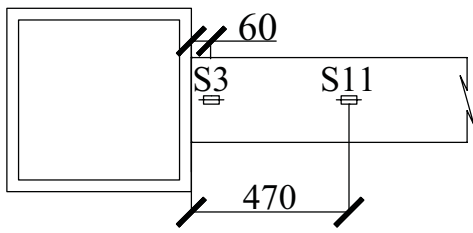
(a) Negative Bending



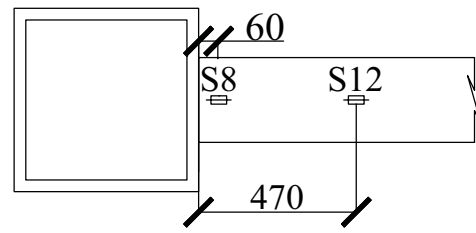
(b) Positive Bending

圖 3.4 試體 UR 梁翼板橫向應變分佈圖

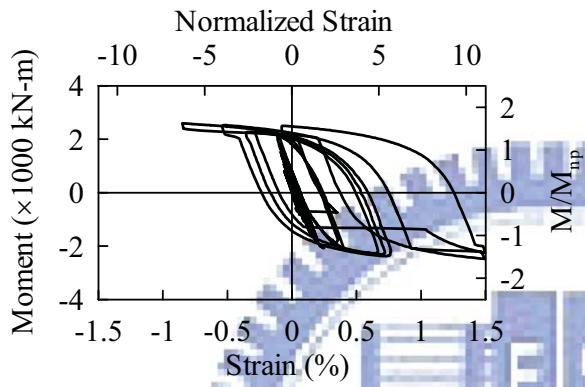
Strain Gauge Location



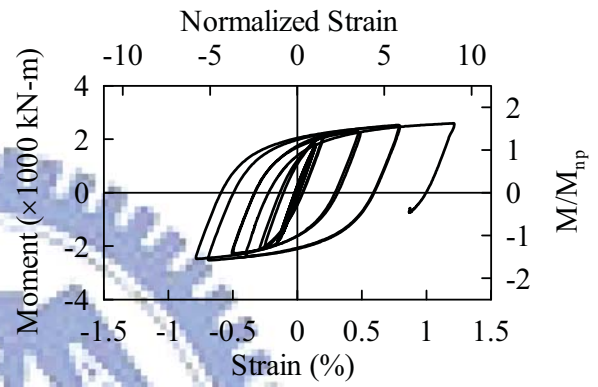
(a) Top Flange



(b) Bottom Flange

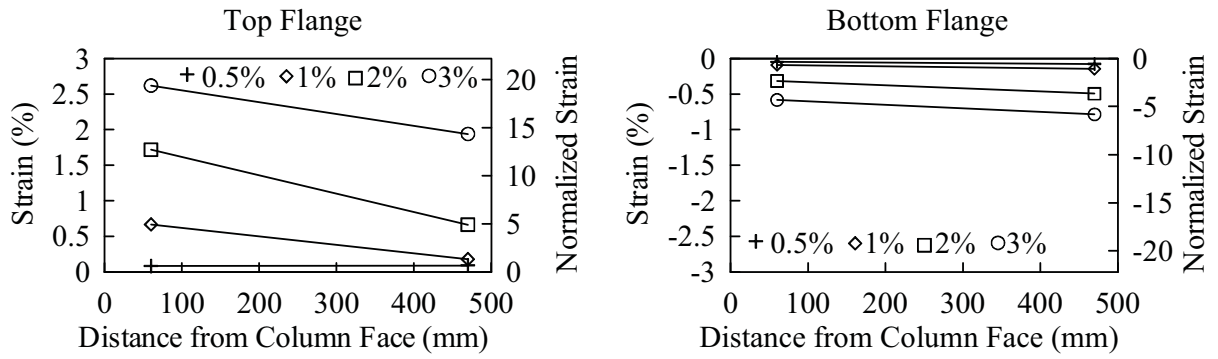


(c) Strain Gauge S11

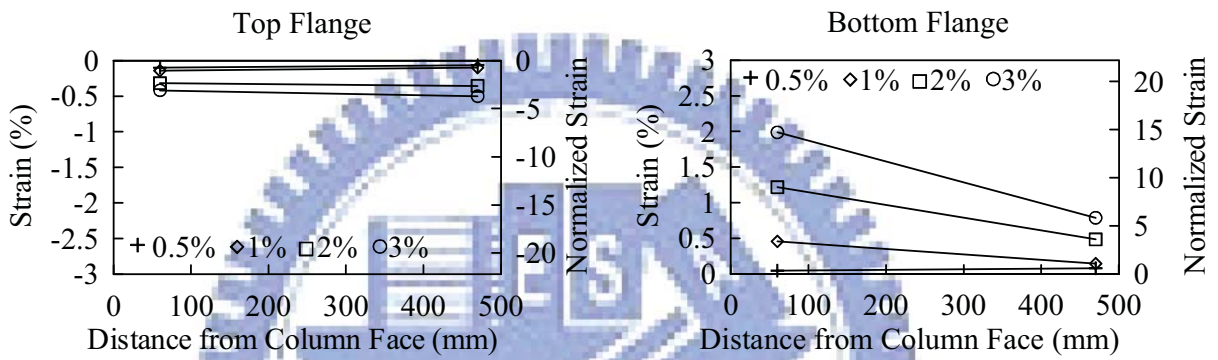


(d) Strain Gauge S12

圖 3.5 試體 UR 彎矩與梁翼板縱向應變關係

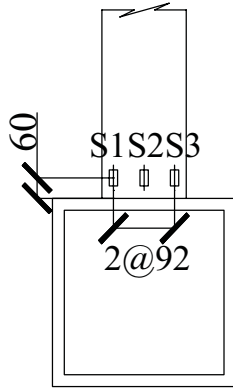


(a) Negative Bending

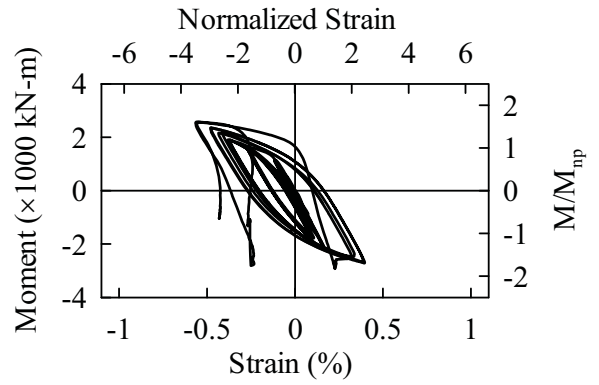


(b) Positive Bending

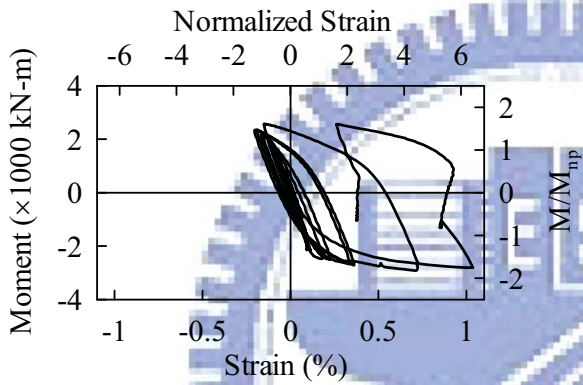
圖 3.6 試體 UR 梁翼板縱向應變關係



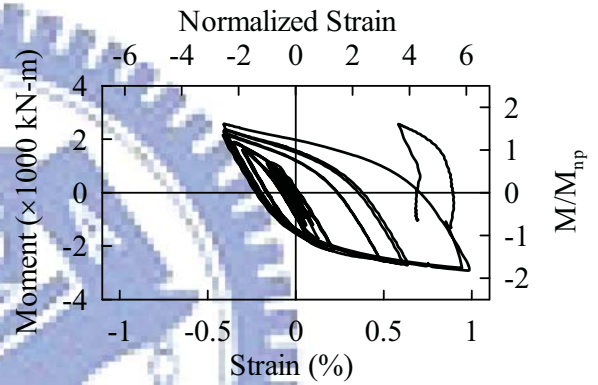
(a) Strain Gauge Location



(b) Strain Gauge S1

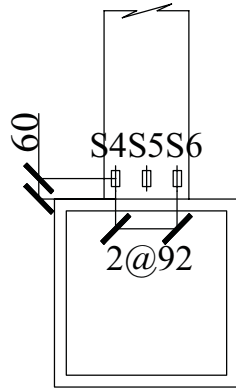


(c) Strain Gauge S2

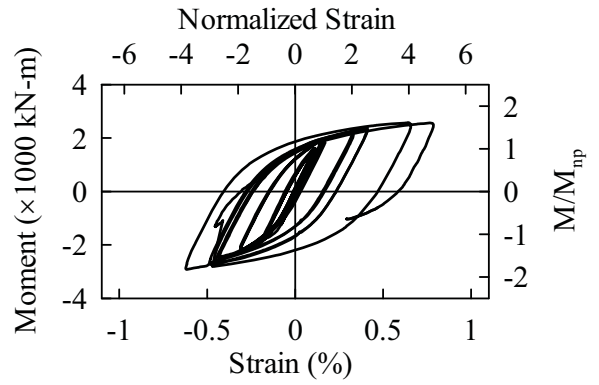


(d) Strain Gauge S3

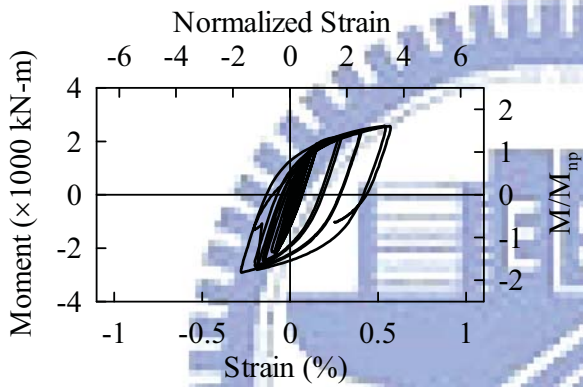
圖 3.7 試體 IFS1 彎矩與上翼板橫向應變關係



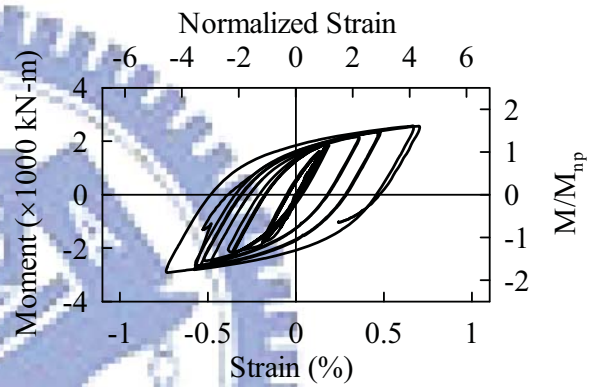
(a) Strain Gauge Location



(b) Strain Gauge S4

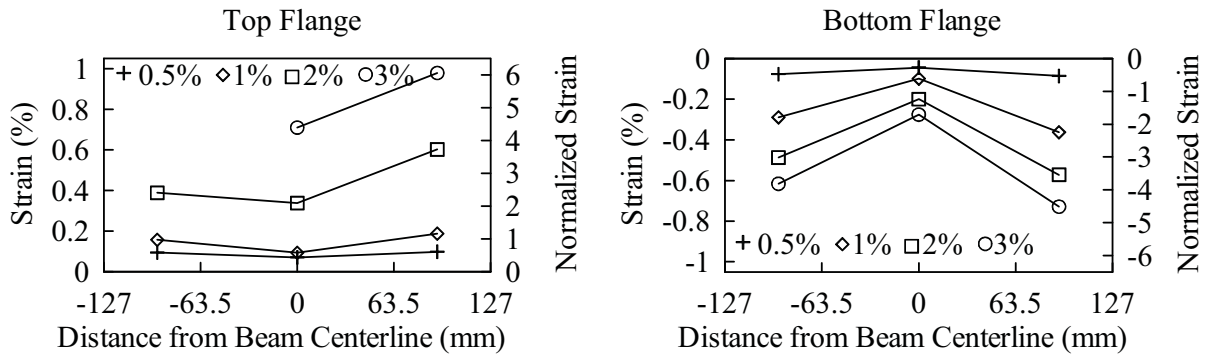


(c) Strain Gauge S5

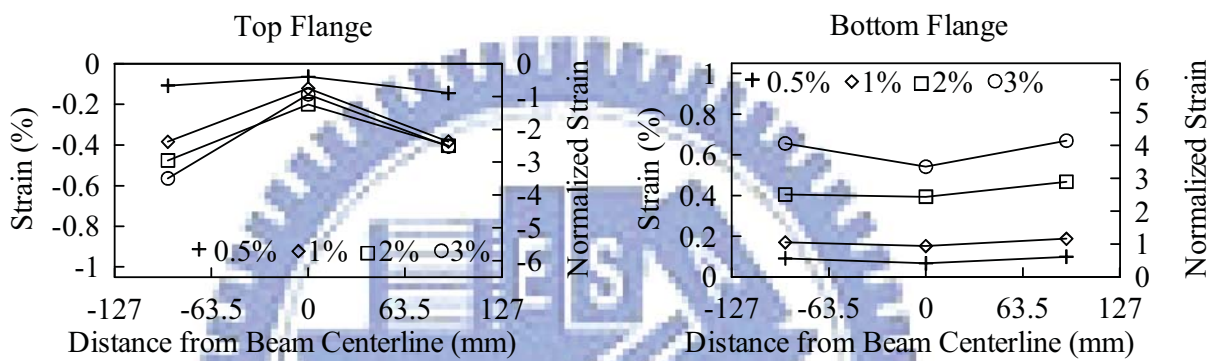


(d) Strain Gauge S6

圖 3.8 試體 IFS1 彎矩與下翼板橫向應變關係



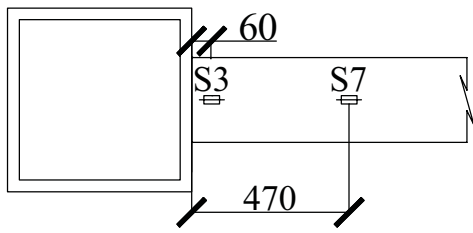
(a) Negative Bending



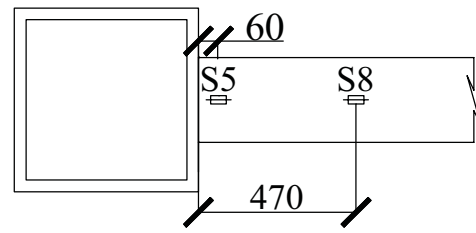
(b) Positive Bending

圖 3.9 試體 IFS1 梁翼板橫向應變分佈圖

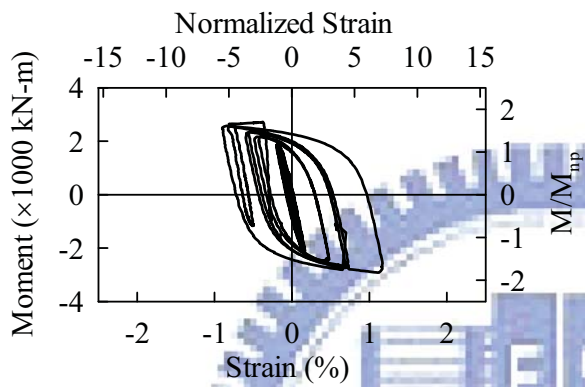
Strain Gauge Location



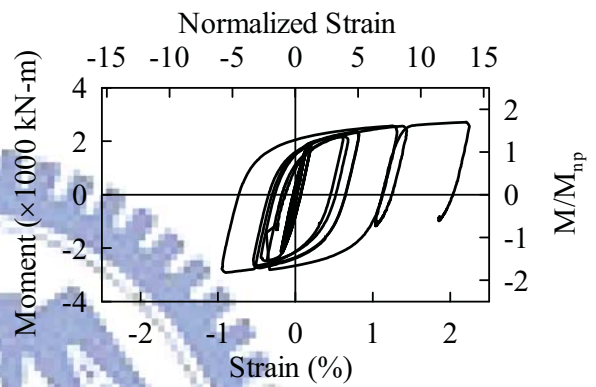
(a) Top Flange



(b) Bottom Flange

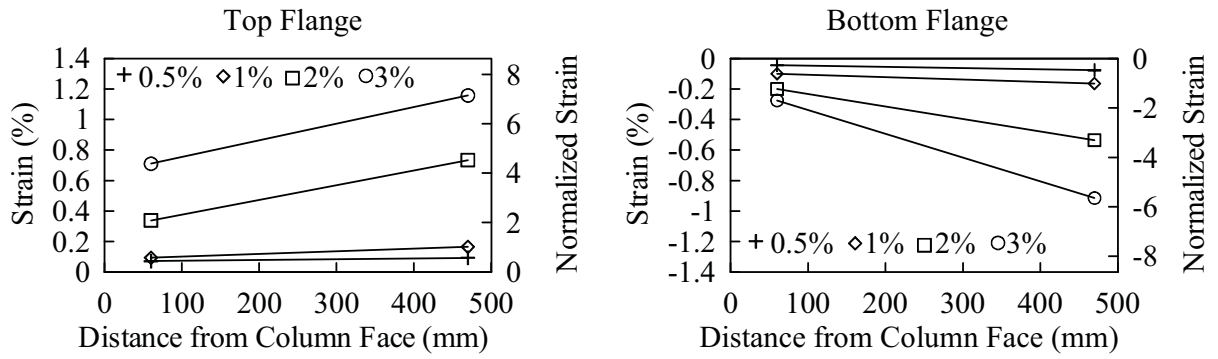


(c) Strain Gauge S7

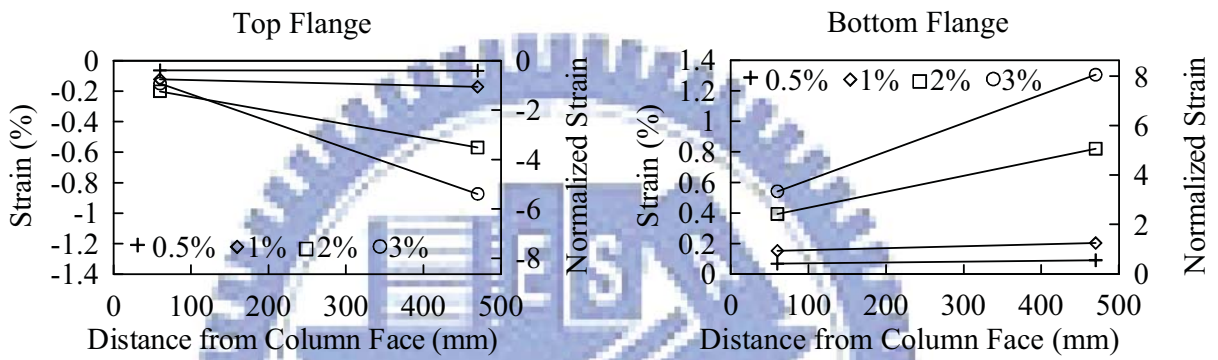


(d) Strain Gauge S8

圖 3.10 試體 IFS1 彎矩與梁翼板縱向應變關係

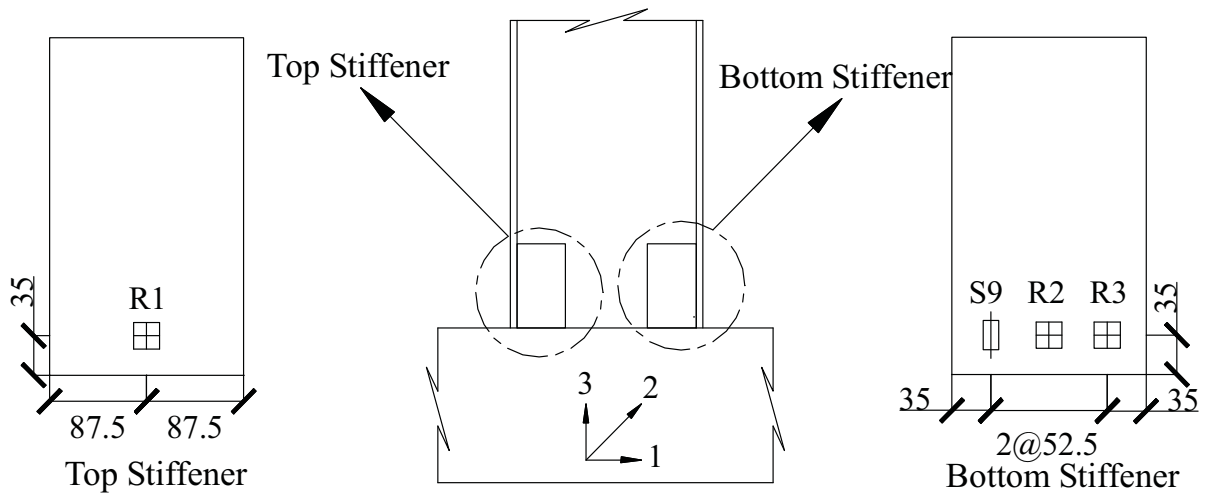


(a) Negative Bending

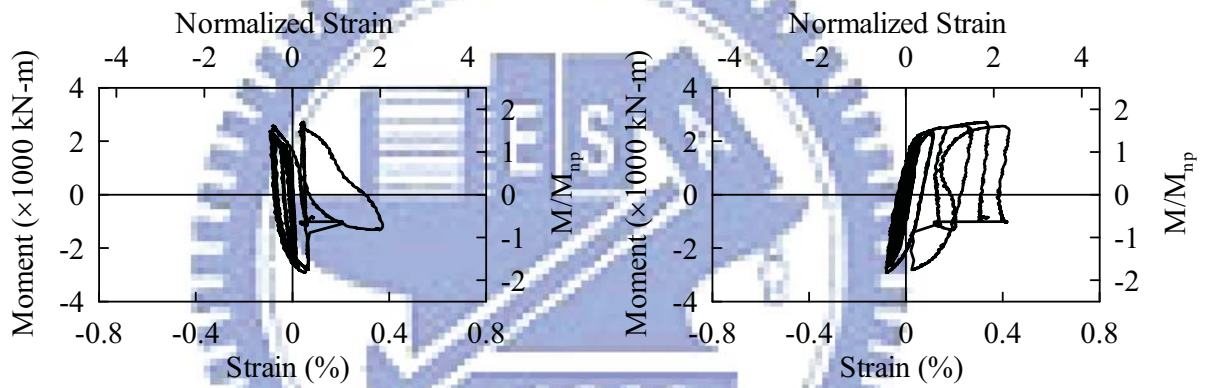


(b) Positive Bending

圖 3.11 試體 IFS1 梁翼板縱向應變關係

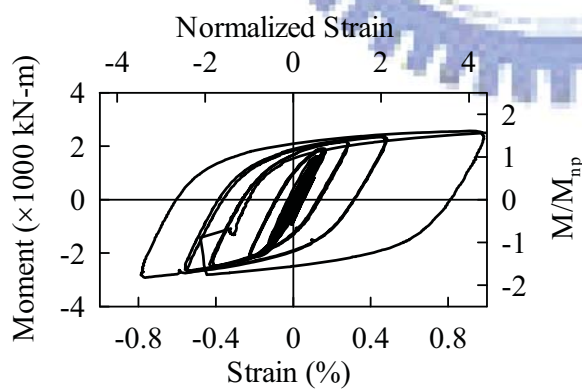


(a) Strain Gauge Location



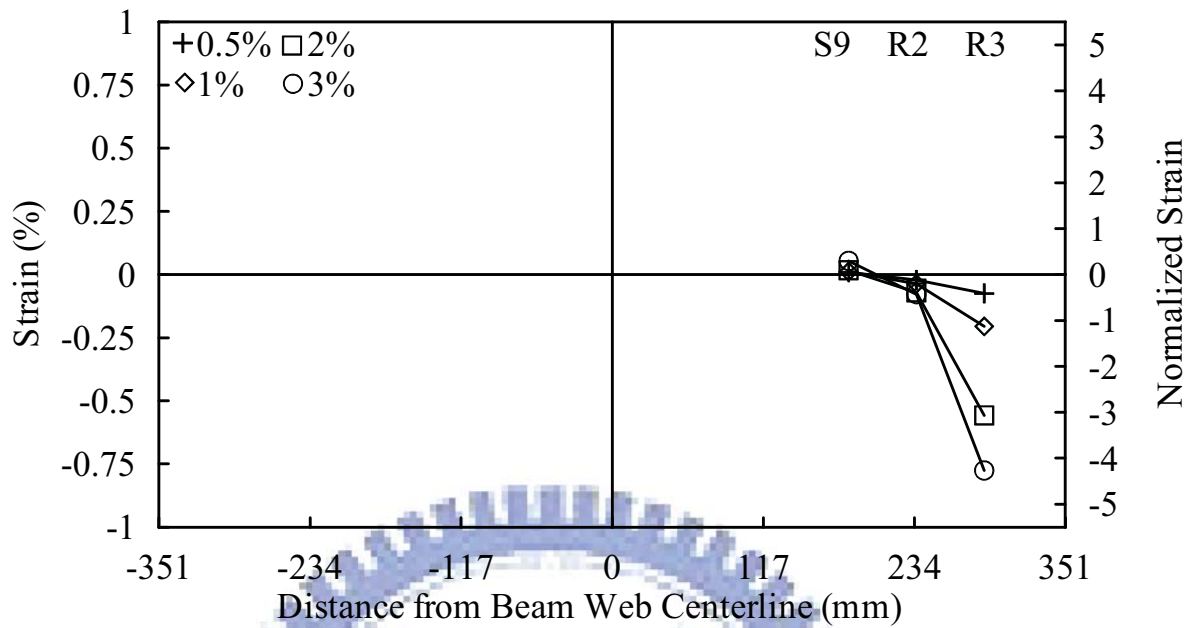
(b) Strain Gauge S9

(c) Strain Gauge R2-3

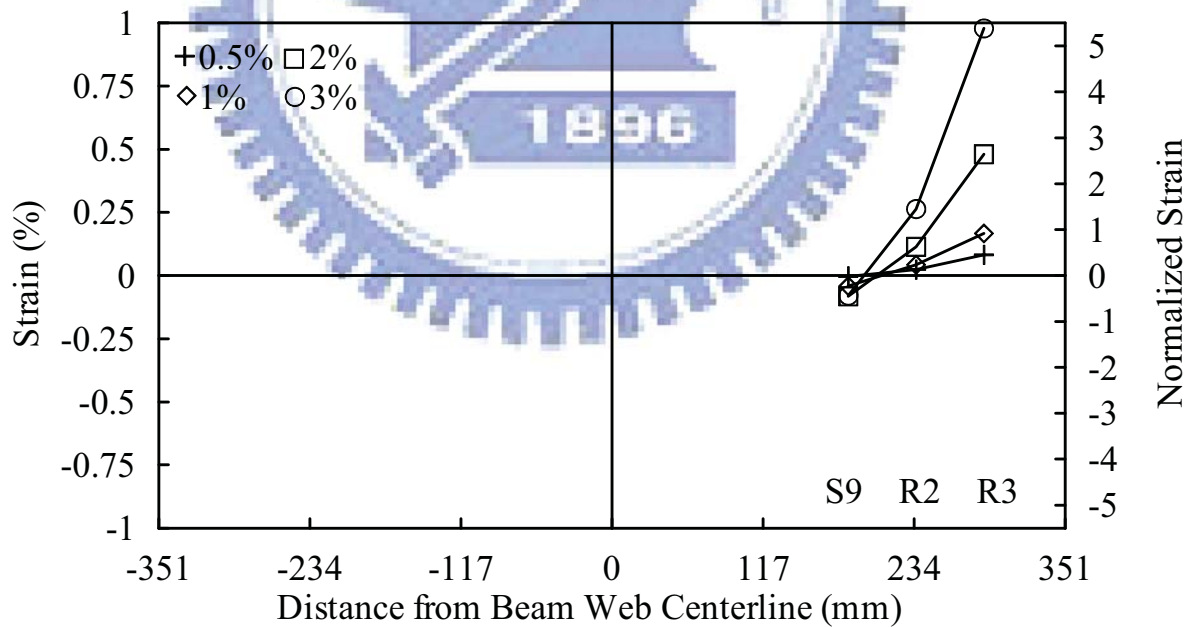


(d) Strain Gauge R3-3

圖 3.12 試體 IFS1 彎矩與加勁板應變關係

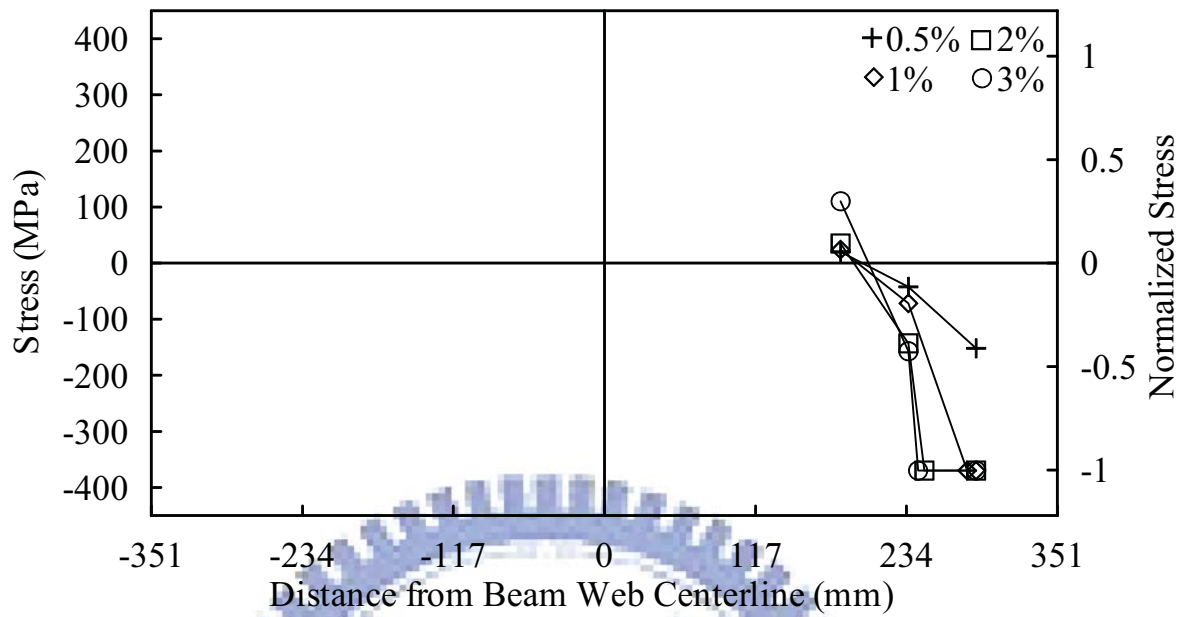


(a) Negative Bending

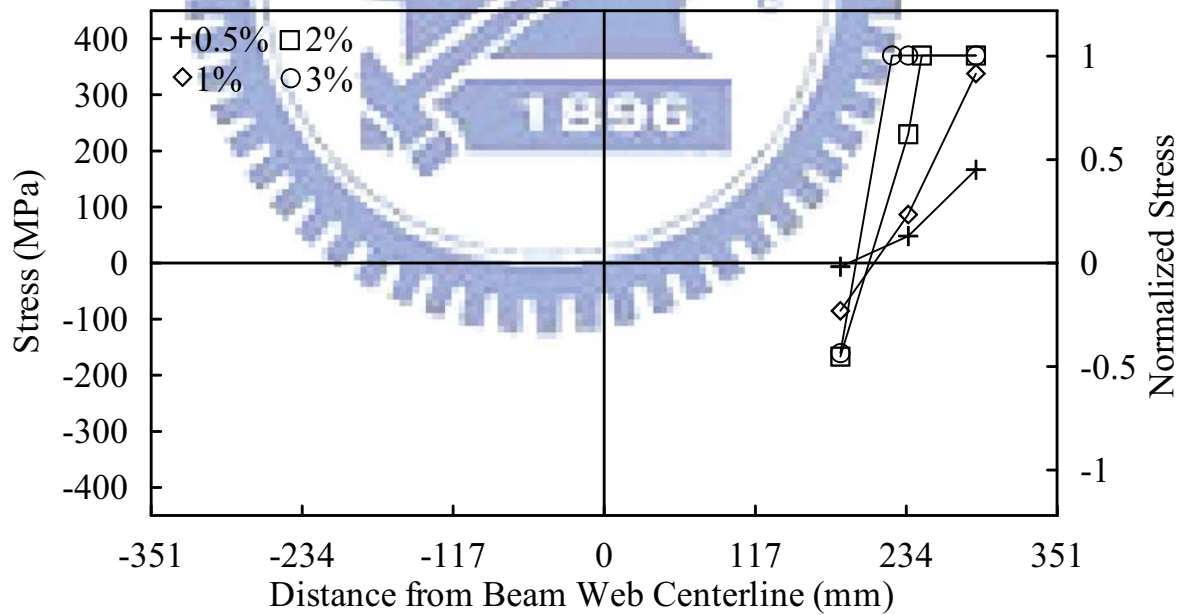


(b) Positive Bending

圖 3.13 試體 IFS1 加勁板應變分佈

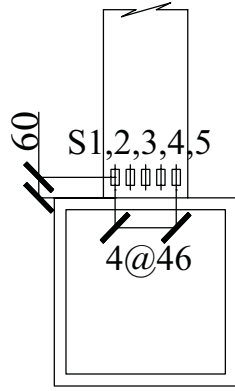


(a) Negative Bending

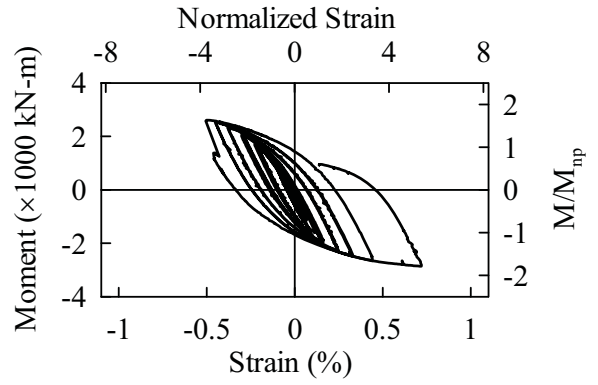


(b) Positive Bending

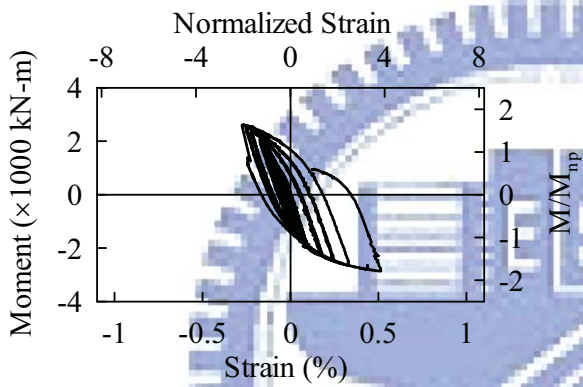
圖 3.14 試體 IFS1 加勁板應力分佈



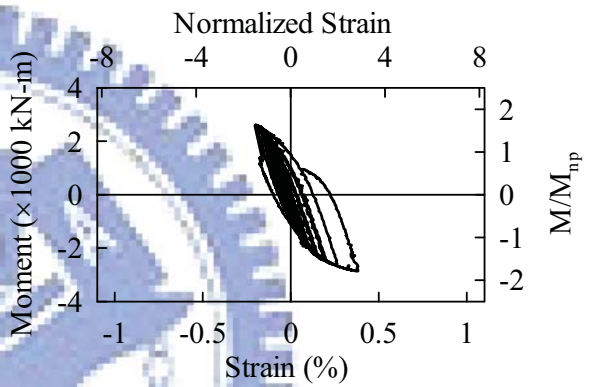
(a) Strain Gauge Location



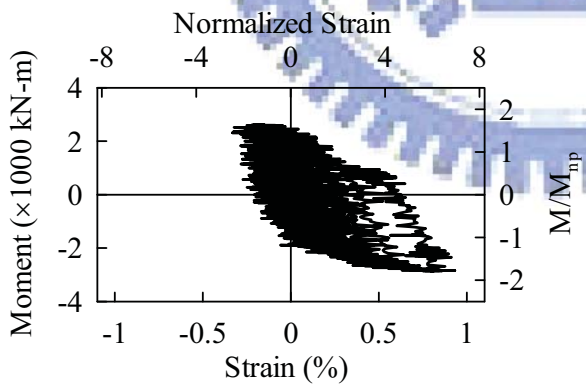
(b) Strain Gauge S1



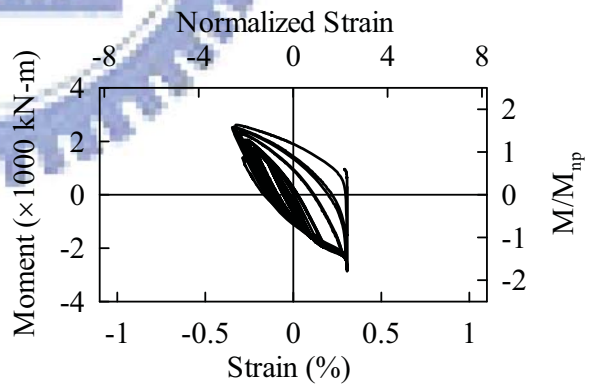
(c) Strain Gauge S2



(d) Strain Gauge S3

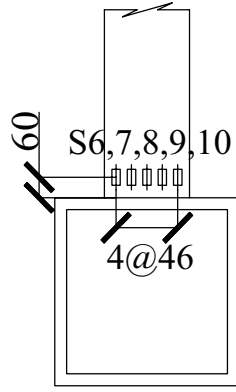


(e) Strain Gauge S4

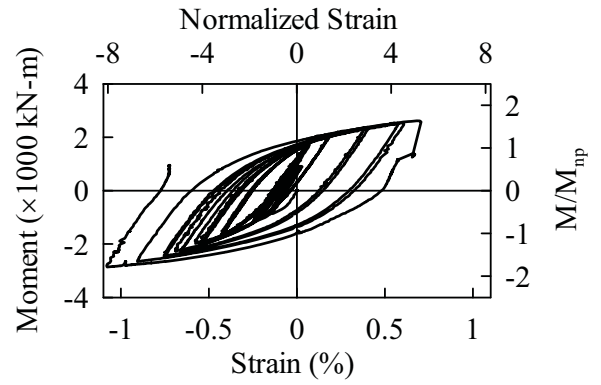


(f) Strain Gauge S5

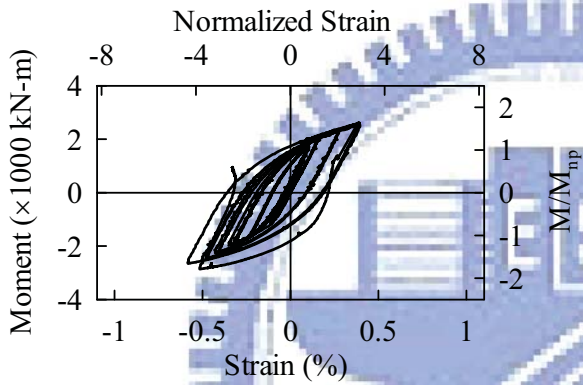
圖 3.15 試體 IFS2 彎矩與上翼板橫向應變關係



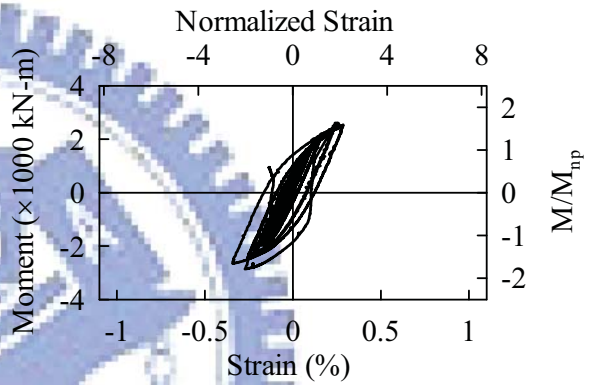
(a) Strain Gauge Location



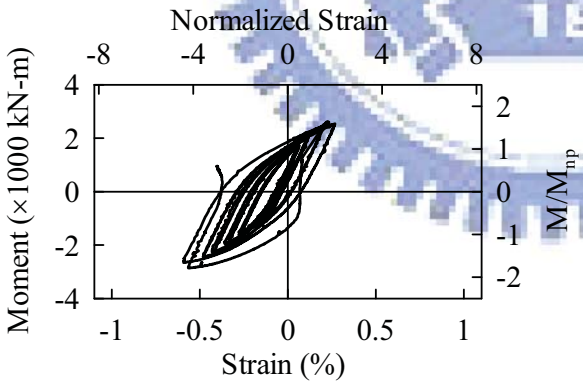
(b) Strain Gauge S6



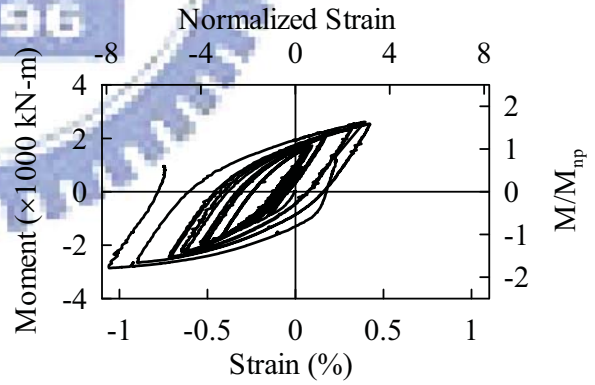
(c) Strain Gauge S7



(d) Strain Gauge S8

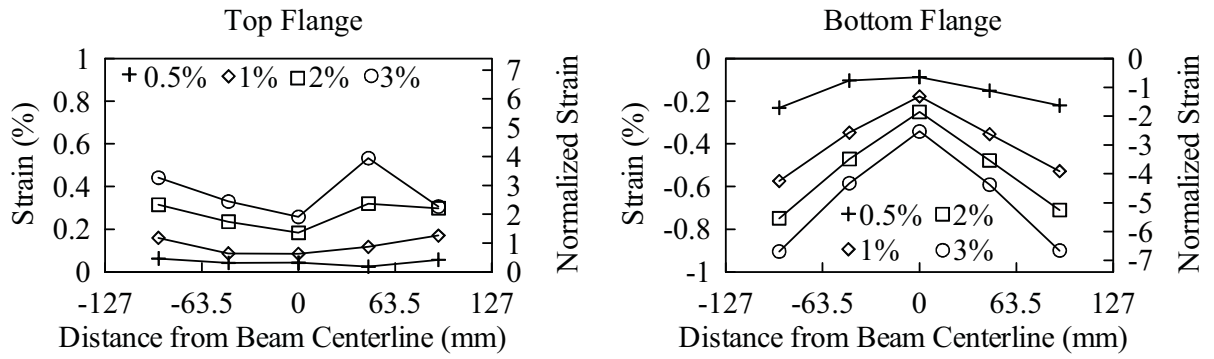


(e) Strain Gauge S9

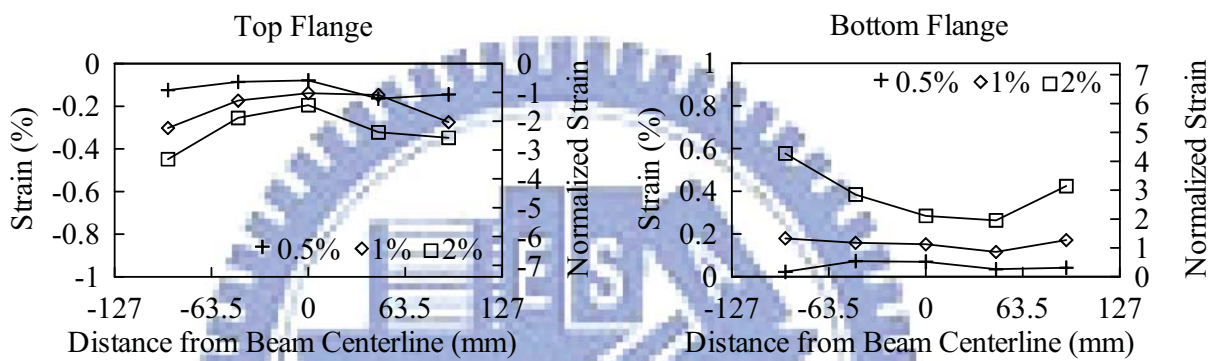


(f) Strain Gauge S10

圖 3.16 試體 IFS2 彎矩與下翼板橫向應變關係



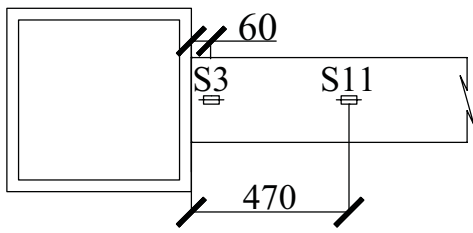
(a) Negative Bending



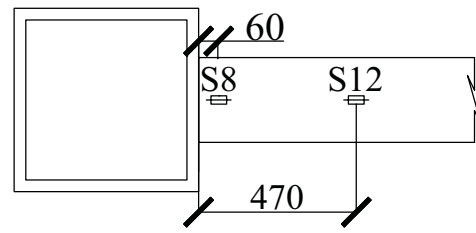
(b) Positive Bending

圖 3.17 試體 IFS2 梁翼板橫向應變分佈圖

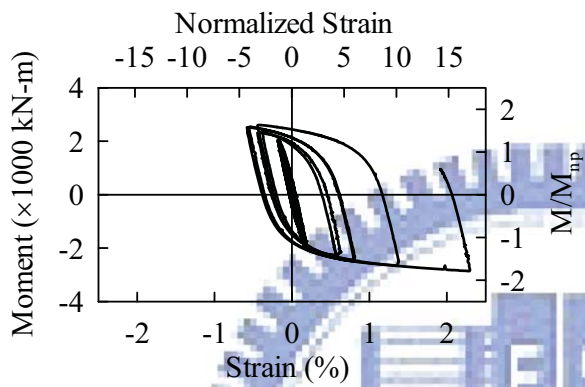
Strain Gauge Location



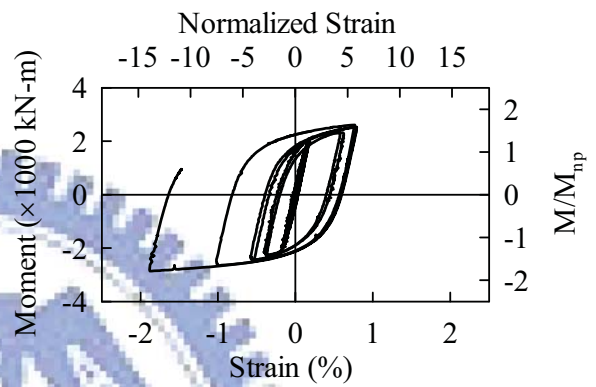
(a) Top Flange



(b) Bottom Flange

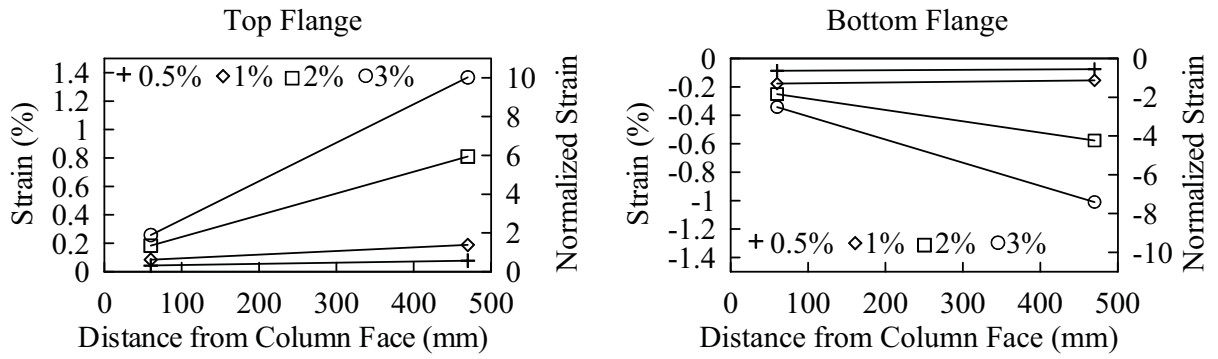


(c) Strain Gauge S11

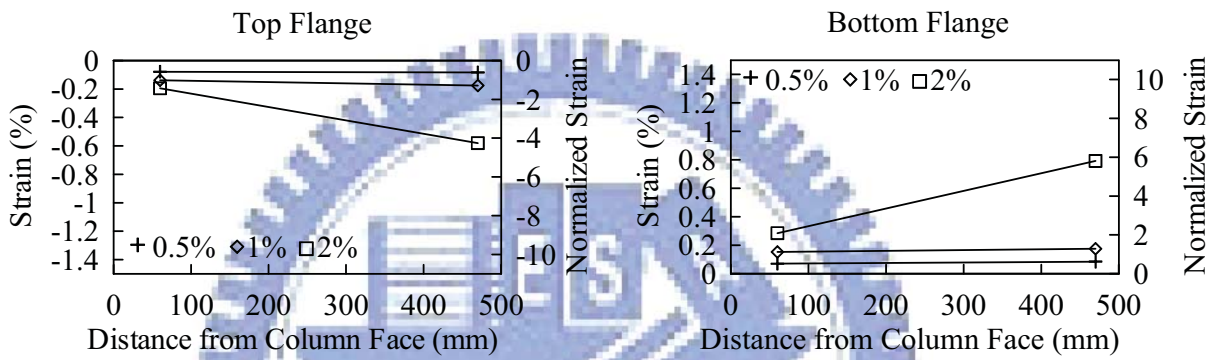


(d) Strain Gauge S12

圖 3.18 試體 IFS2 彎矩與梁翼板縱向應變關係

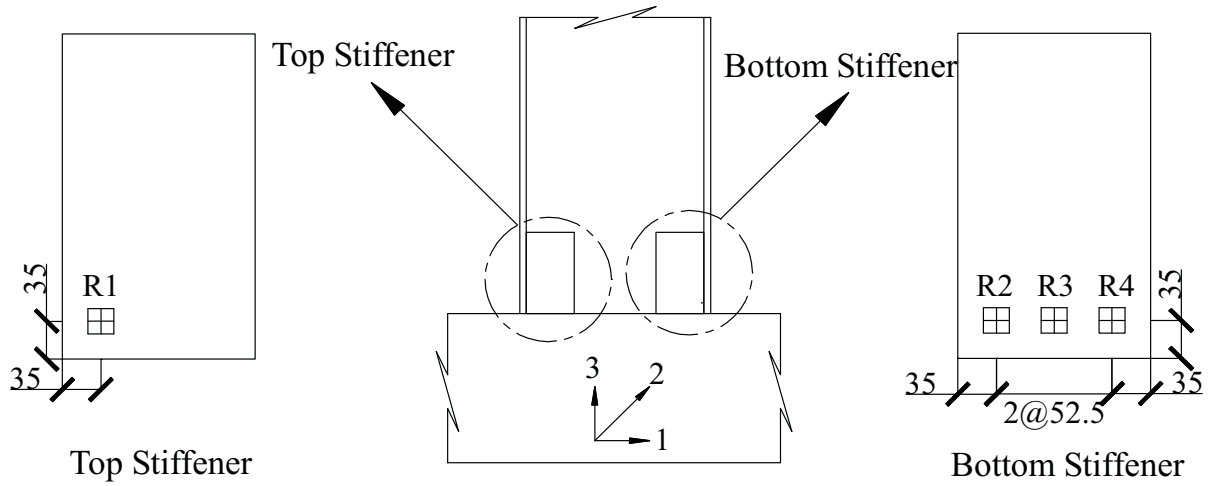


(a) Negative Bending

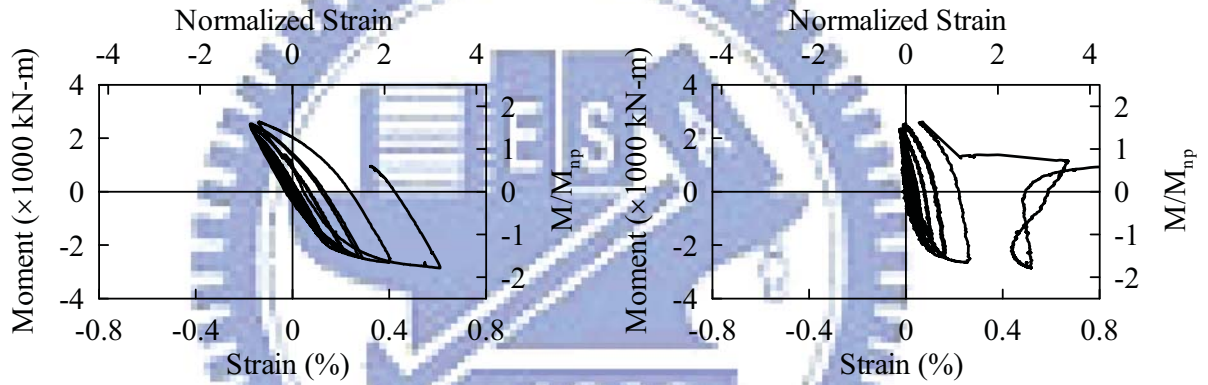


(b) Positive Bending

圖 3.19 試體 IFS2 梁翼板縱向應變關係

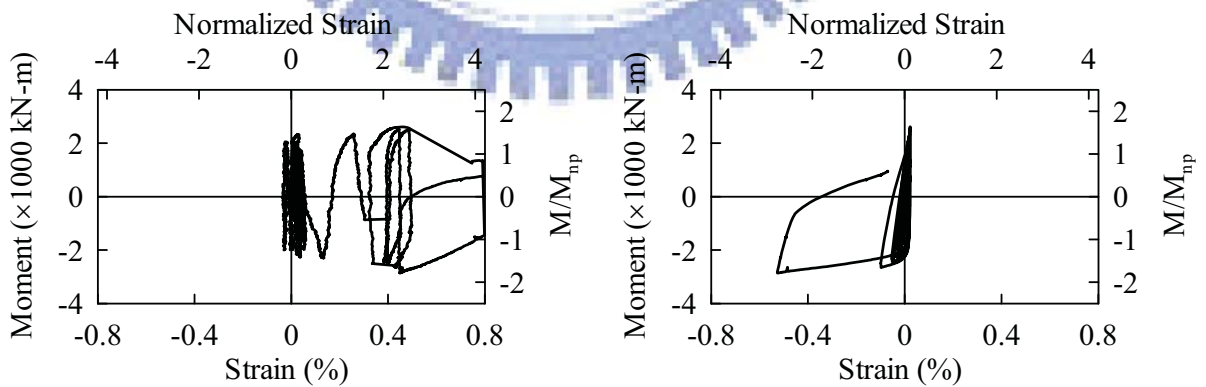


(a) Strain Gauge Location



(b) Strain Gauge R1-3

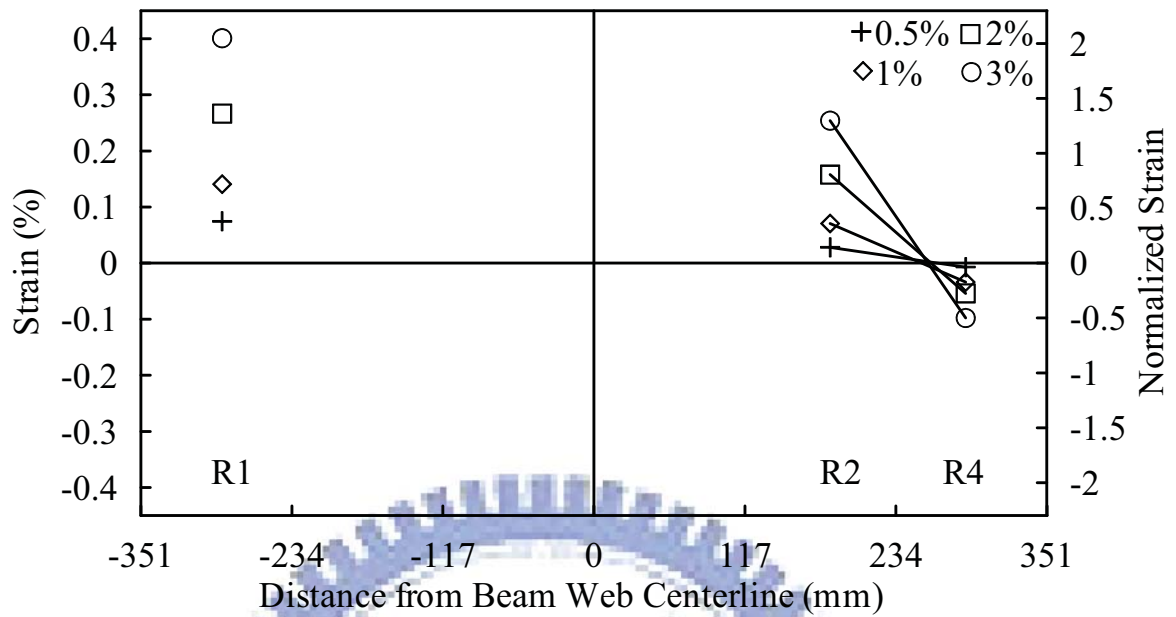
(c) Strain Gauge R2-3



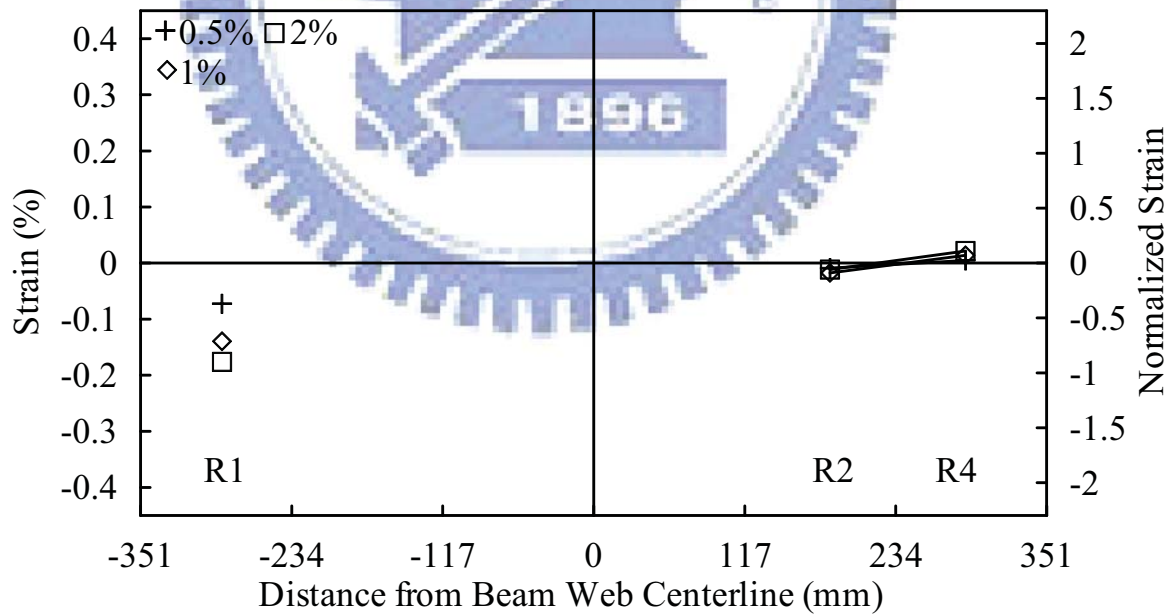
(d) Strain Gauge R3-3

(e) Strain Gauge R4-3

圖 3.20 試體 IFS2 彎矩與加勁板應變關係

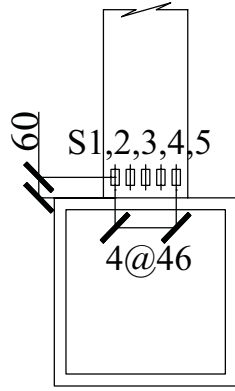


(a) Negative Bending

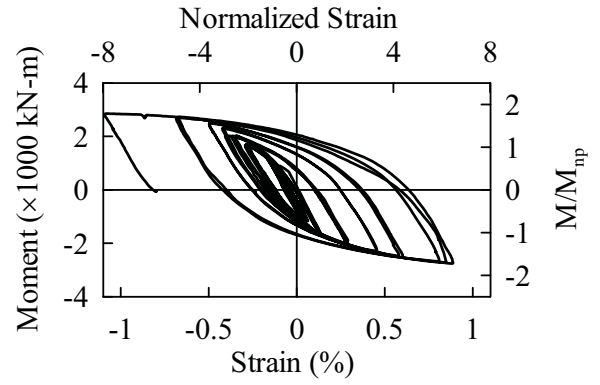


(b) Positive Bending

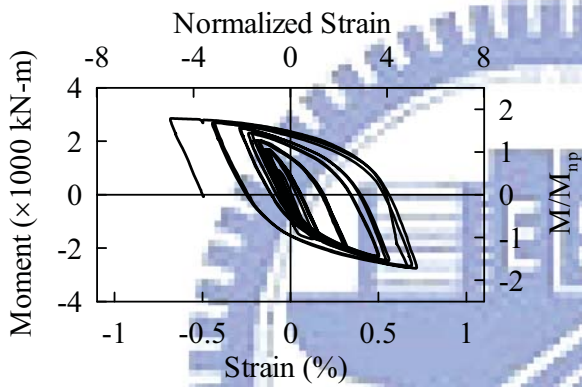
圖 3.21 試體 IFS2 加勁板應變分佈



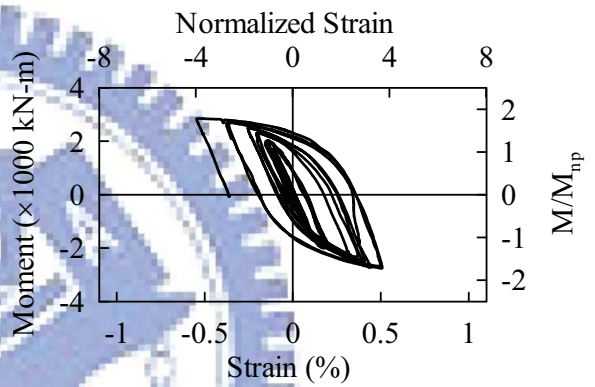
(a) Strain Gauge Location



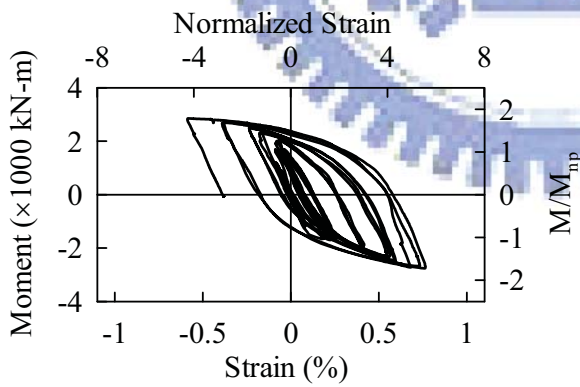
(b) Strain Gauge S1



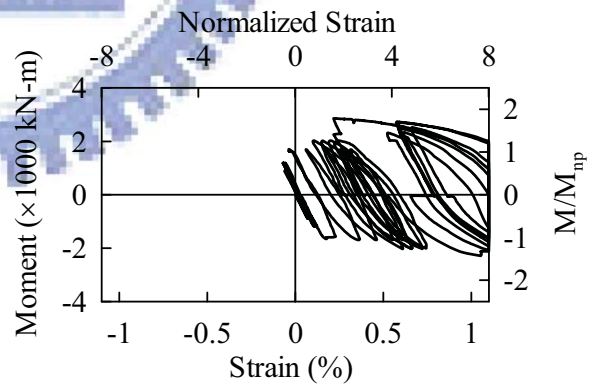
(c) Strain Gauge S2



(d) Strain Gauge S3

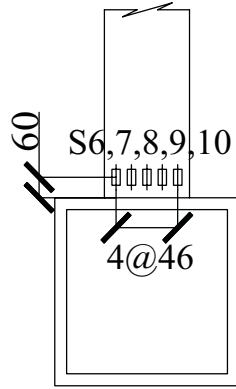


(e) Strain Gauge S4

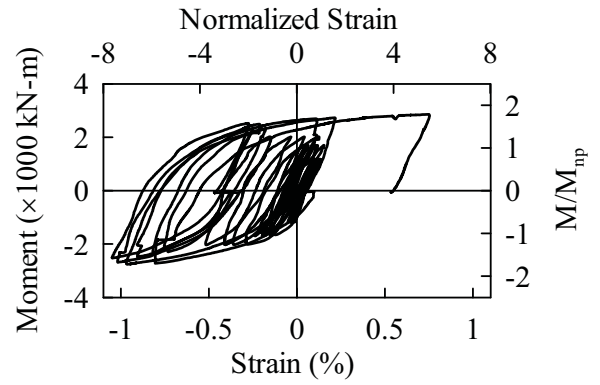


(f) Strain Gauge S5

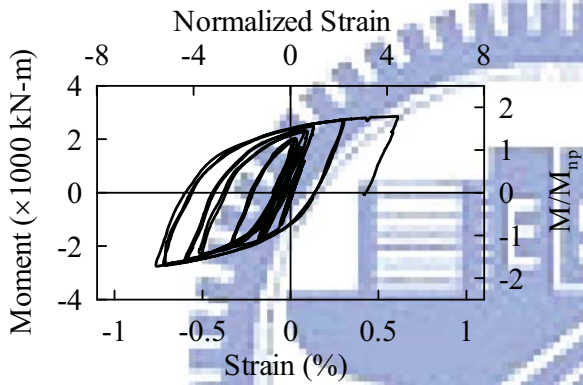
圖 3.22 試體 IFS3 彎矩與上翼板橫向應變關係



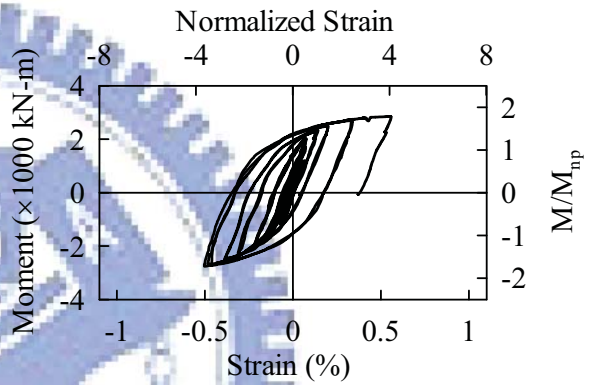
(a) Strain Gauge Location



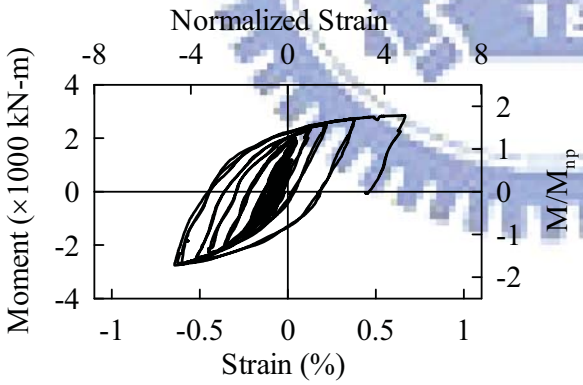
(b) Strain Gauge S6



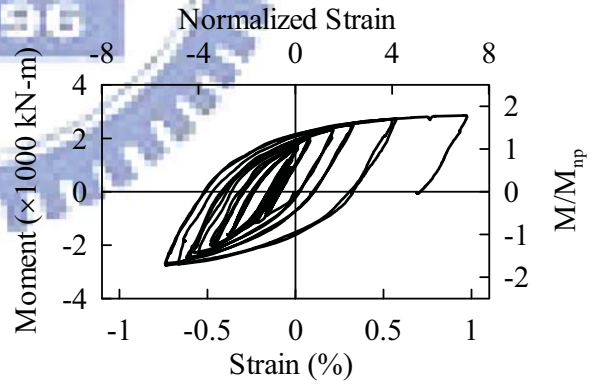
(c) Strain Gauge S7



(d) Strain Gauge S8

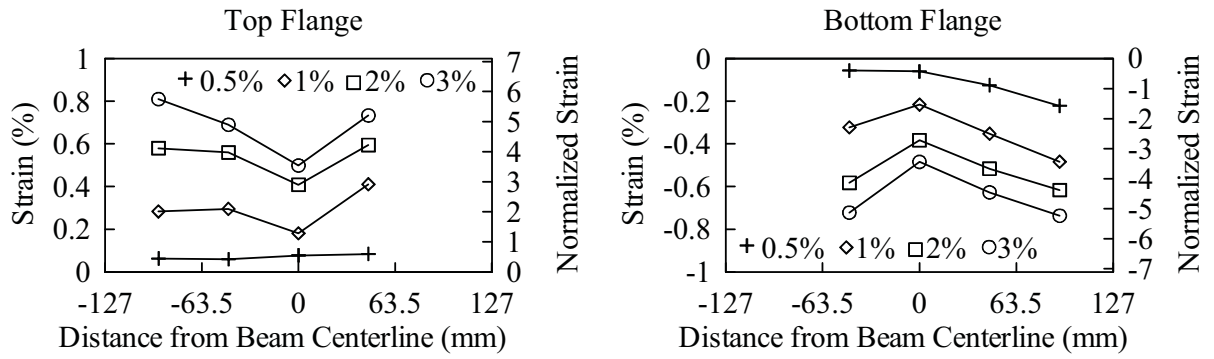


(e) Strain Gauge S9

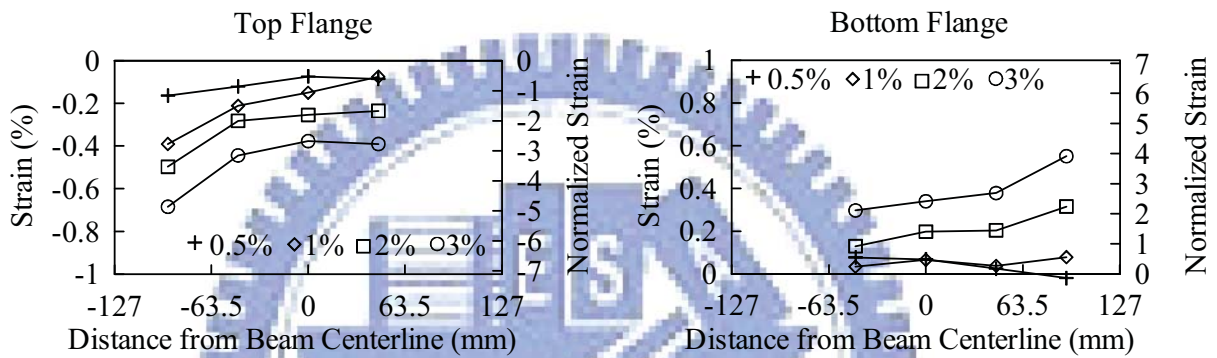


(f) Strain Gauge S10

圖 3.23 試體 IFS3 彎矩與下翼板橫向應變關係

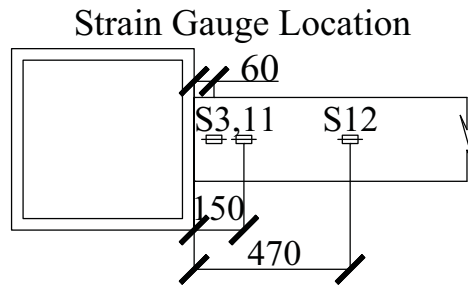


(a) Negative Bending

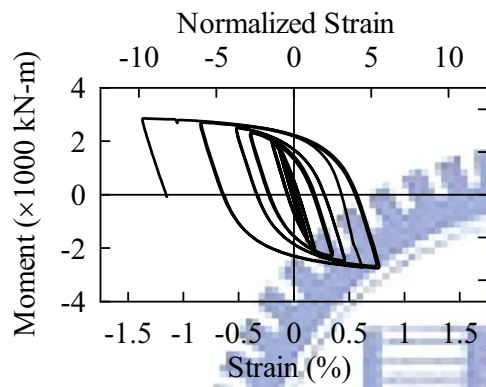


(b) Positive Bending

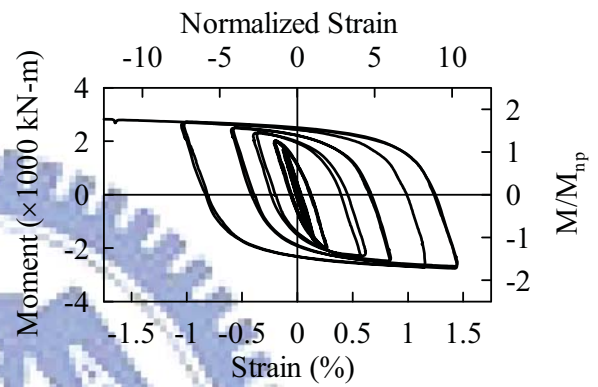
圖 3.24 試體 IFS3 梁翼板橫向應變分佈圖



(a) Top Flange



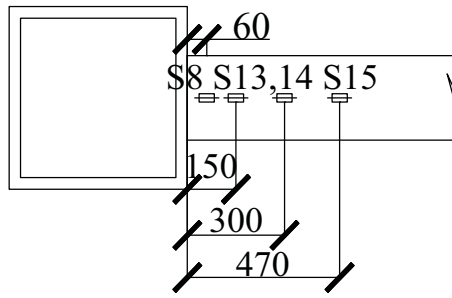
(b) Strain Gauge S11



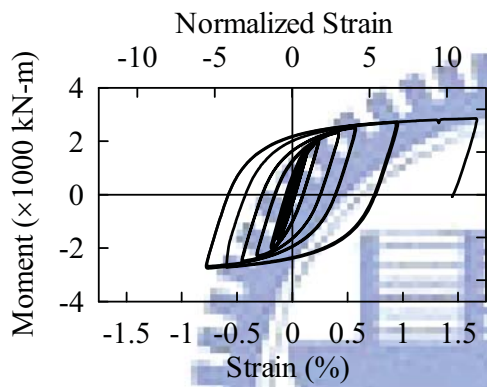
(c) Strain Gauge S12

圖 3.25 試體 IFS3 彎矩與梁上翼板縱向應變關係

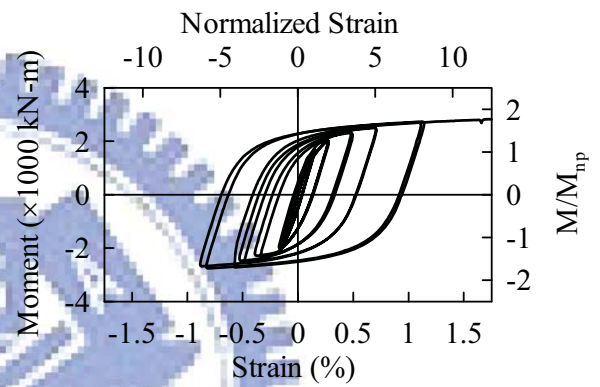
Strain Gauge Location



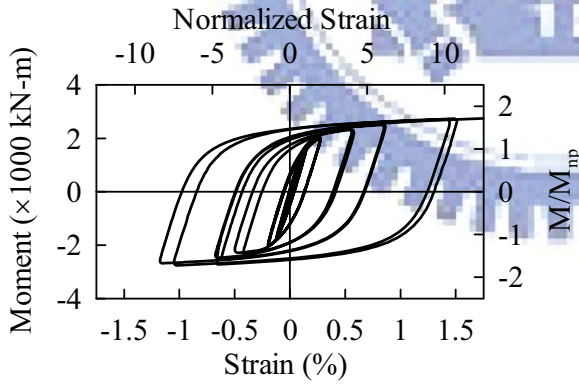
(a) Bottom Flange



(b) Strain Gauge S13

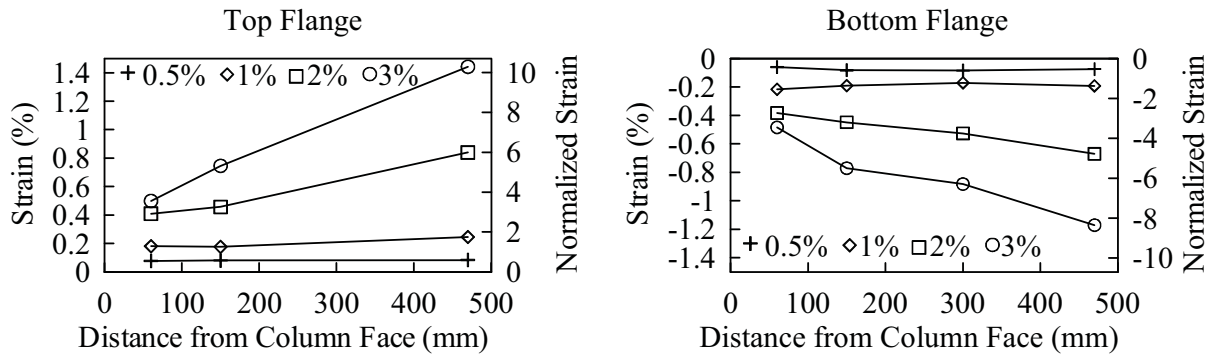


(c) Strain Gauge S14

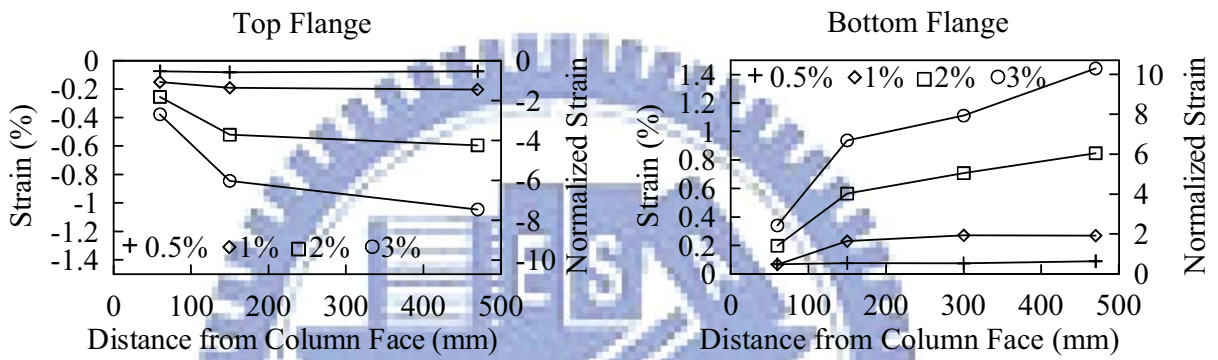


(d) Strain Gauge S15

圖 3.26 試體 IFS3 彎矩與梁下翼板縱向應變關係

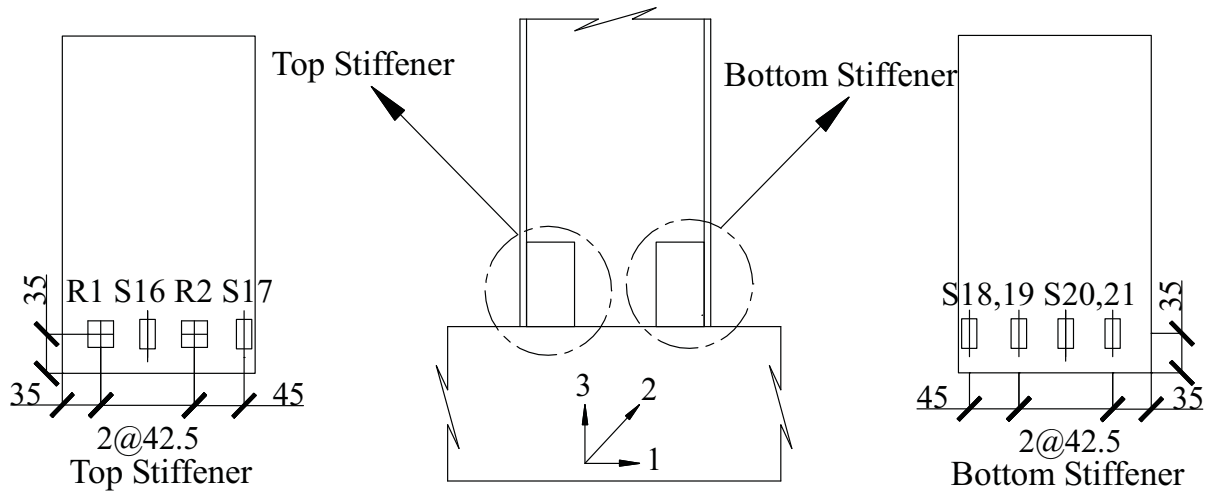


(a) Negative Bending

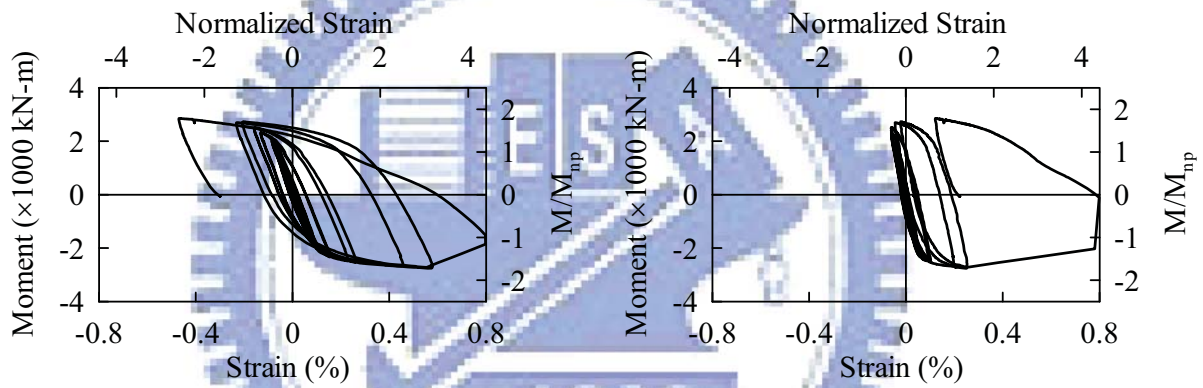


(b) Positive Bending

圖 3.27 試體 IFS3 梁翼板縱向應變關係

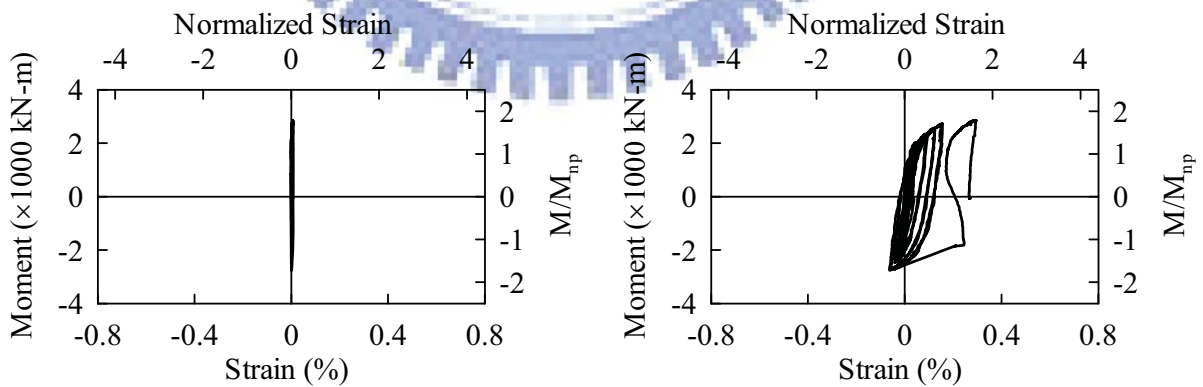


(a) Strain Gauge Location



(c) Strain Gauge R1-3

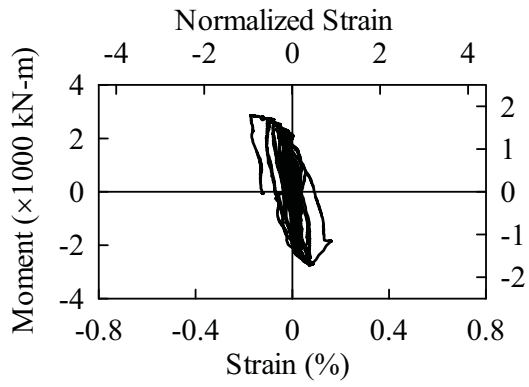
(d) Strain Gauge S16



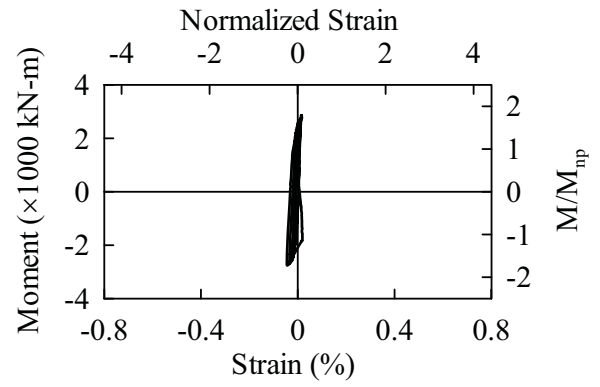
(e) Strain Gauge R2-3

(f) Strain Gauge S17

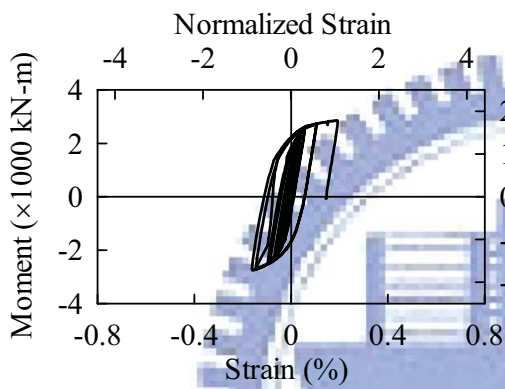
圖 3.28 試體 IFS3 彎距與加勁板應變關係



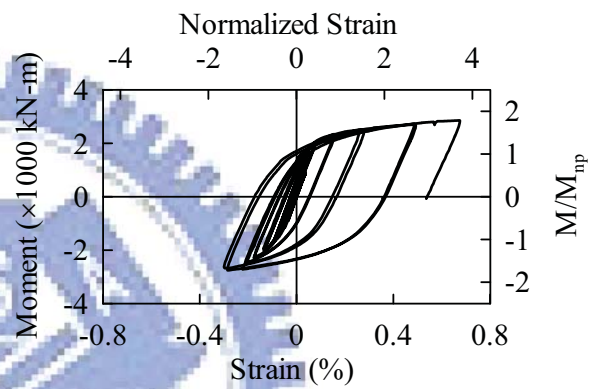
(a) Strain Gauge S18



(b) Strain Gauge S19

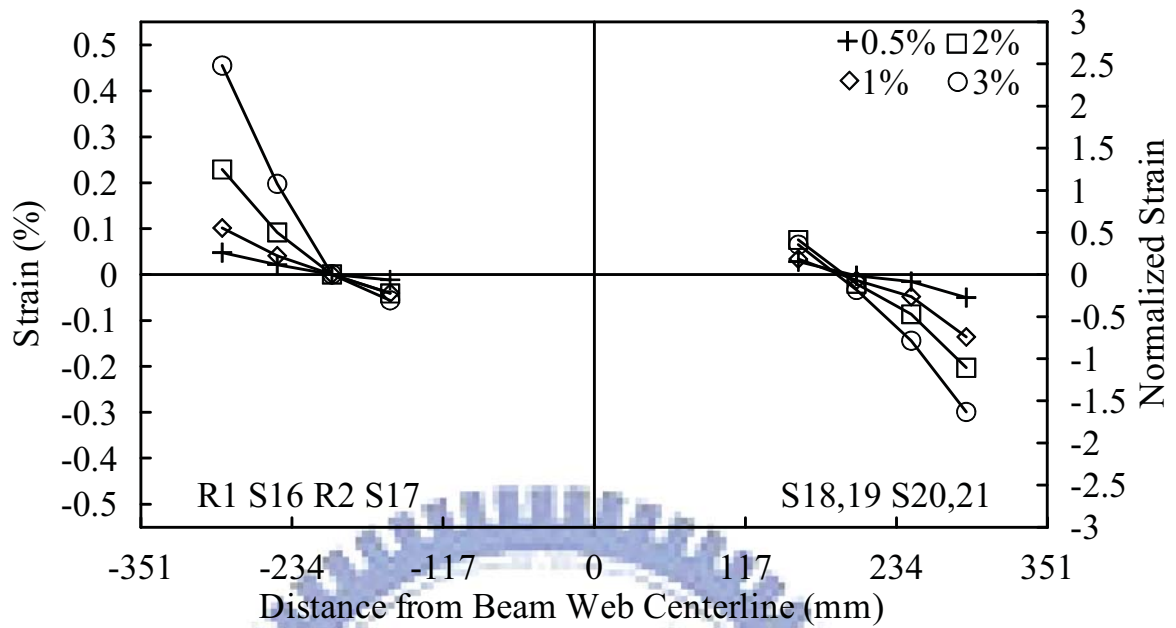


(c) Strain Gauge S20

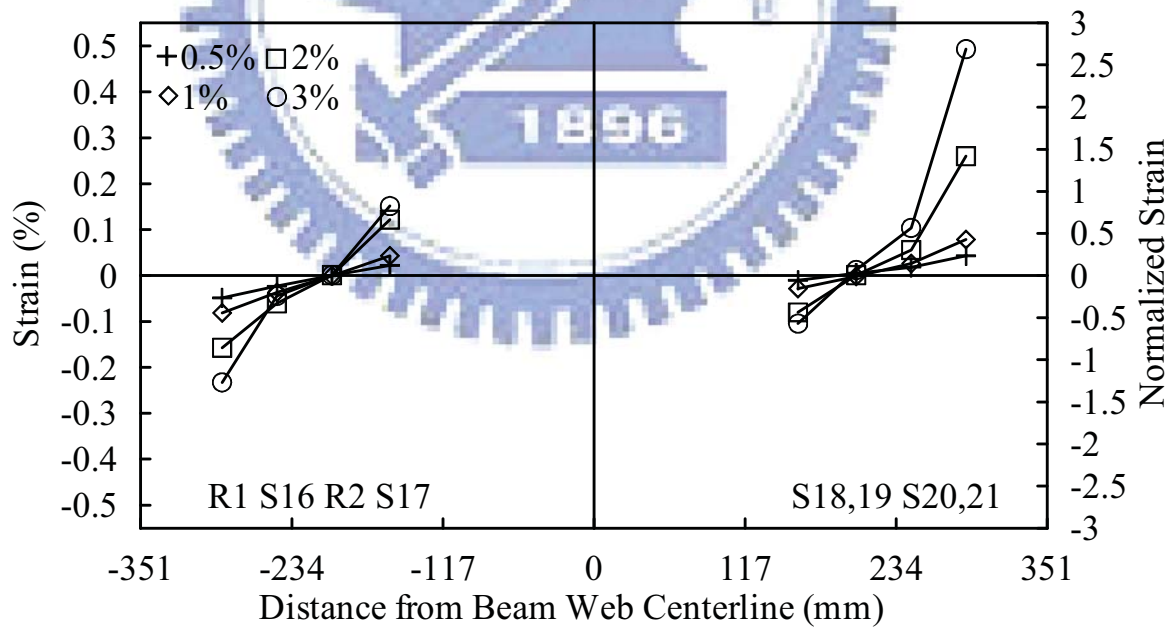


(d) Strain Gauge S21

圖 3.29 試體 IFS3 彎距與加勁板應變關係 (續)

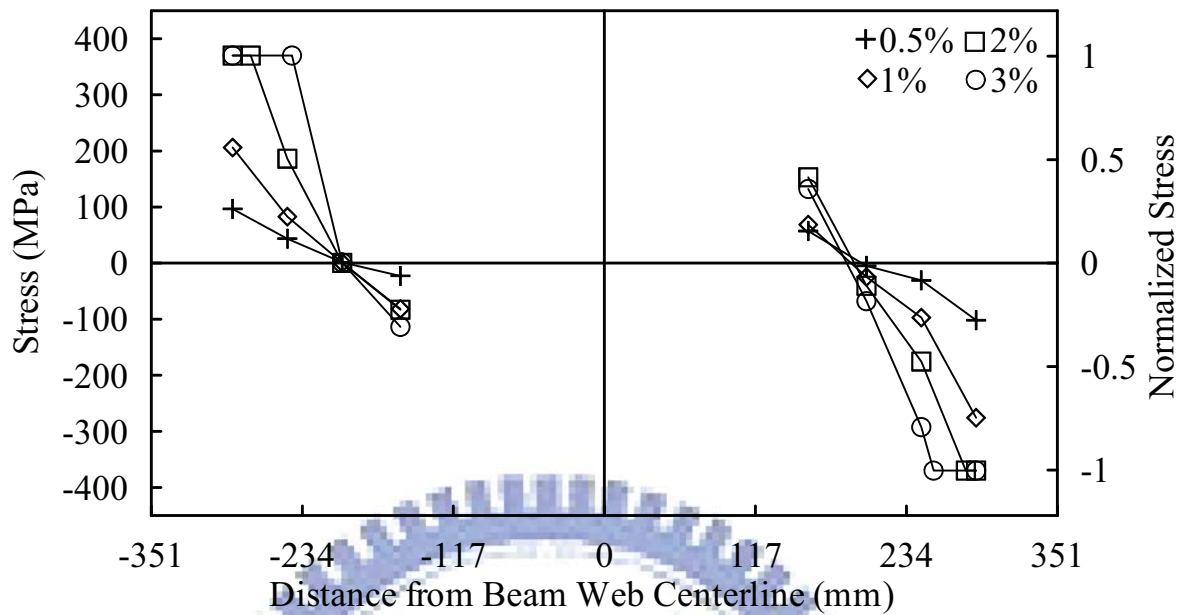


(a) Negative Bending

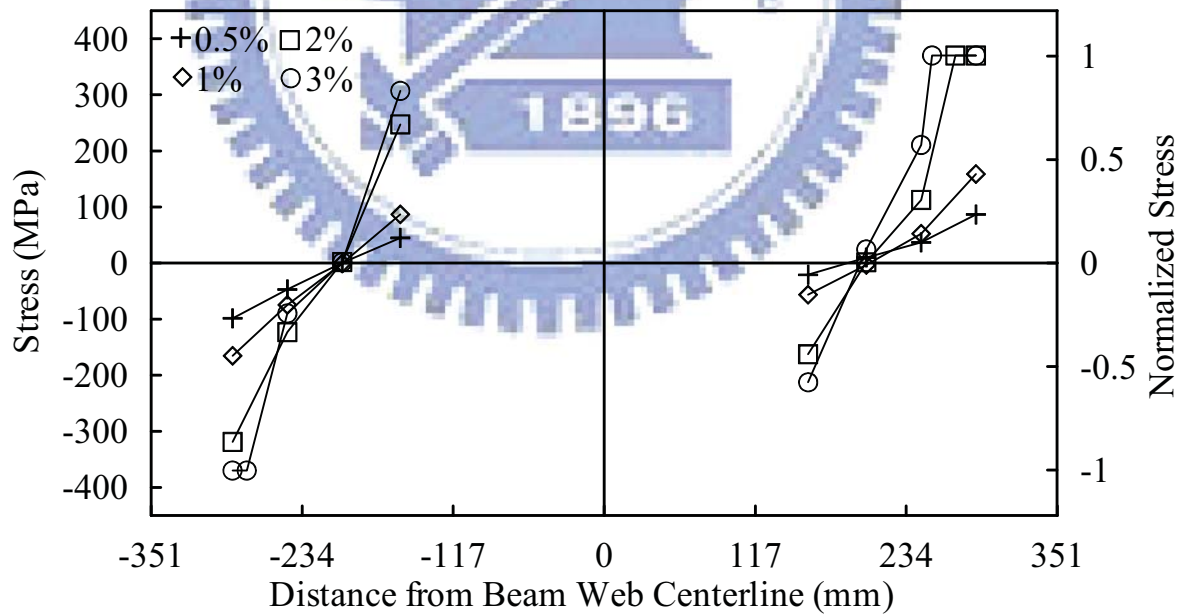


(b) Positive Bending

圖 3.30 試體 IFS3 加勁板應變分佈

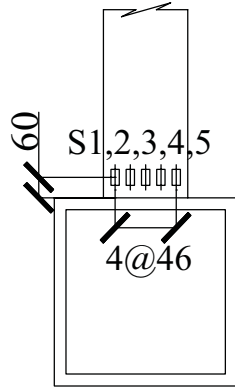


(a) Negative Bending

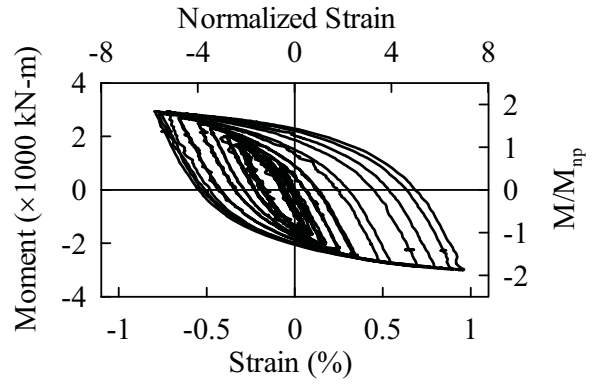


(b) Positive Bending

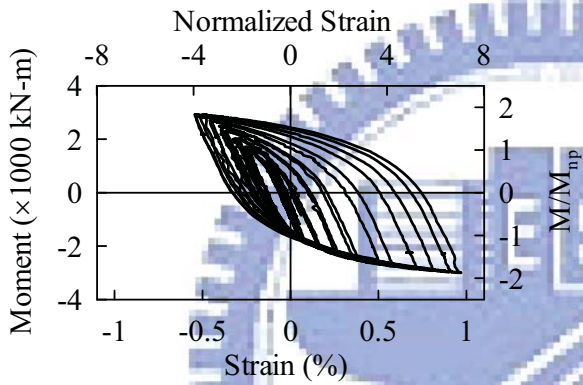
圖 3.31 試體 IFS3 加勁板應力分佈



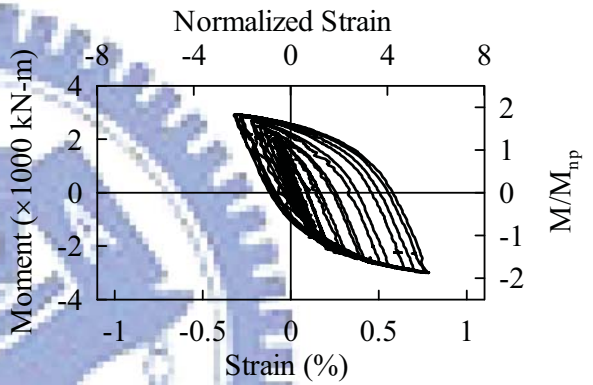
(a) Strain Gauge Location



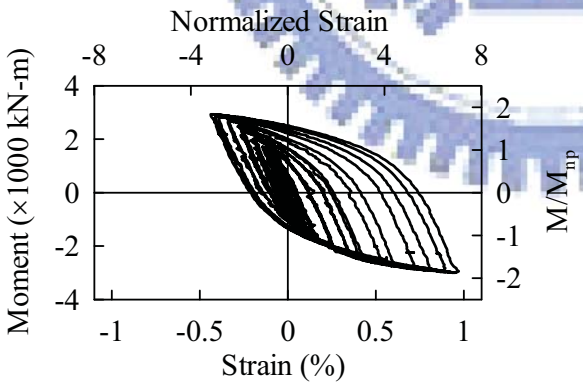
(b) Strain Gauge S1



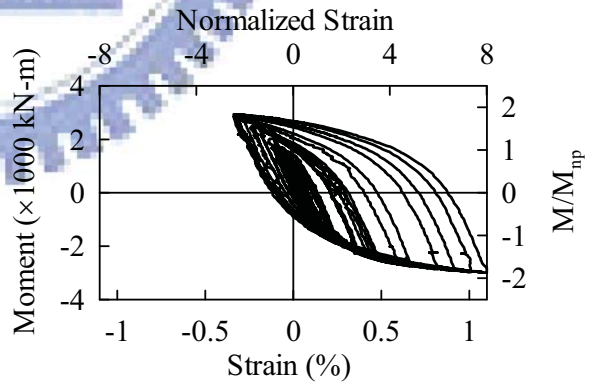
(c) Strain Gauge S2



(d) Strain Gauge S3

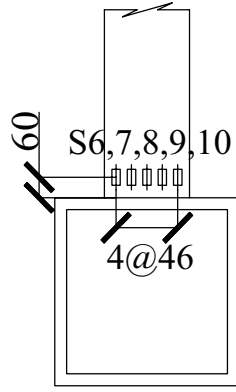


(e) Strain Gauge S4

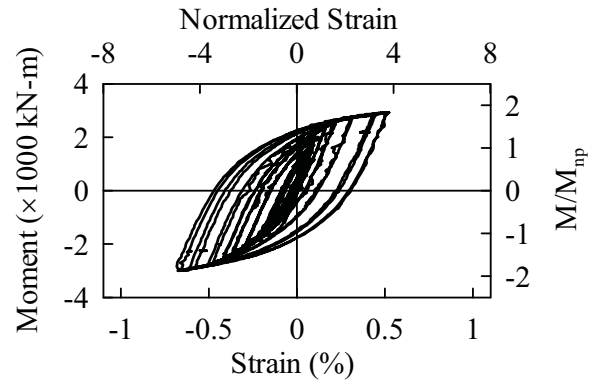


(f) Strain Gauge S5

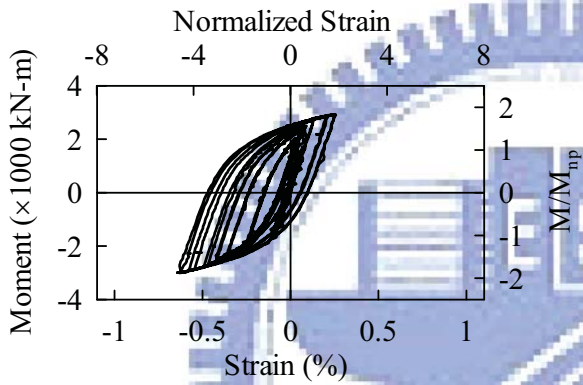
圖 3.32 試體 IFS4 彎矩與上翼板橫向應變關係



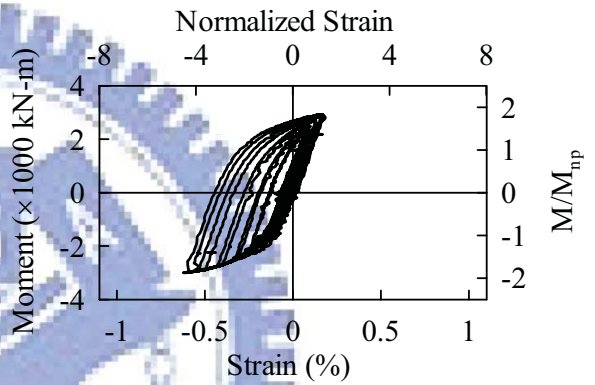
(a) Strain Gauge Location



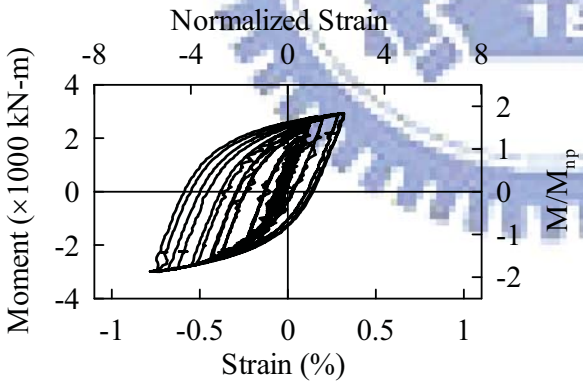
(b) Strain Gauge S6



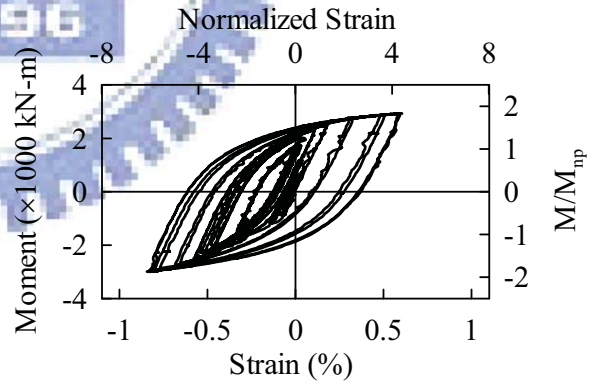
(c) Strain Gauge S7



(d) Strain Gauge S8

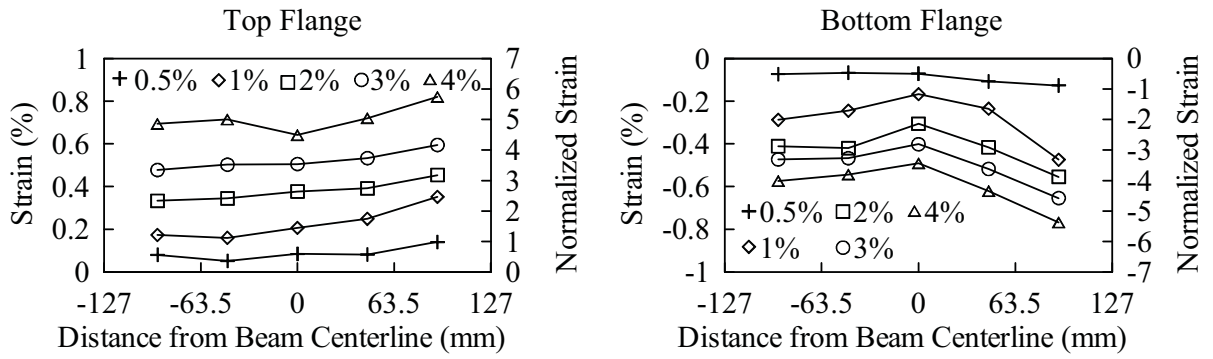


(e) Strain Gauge S9

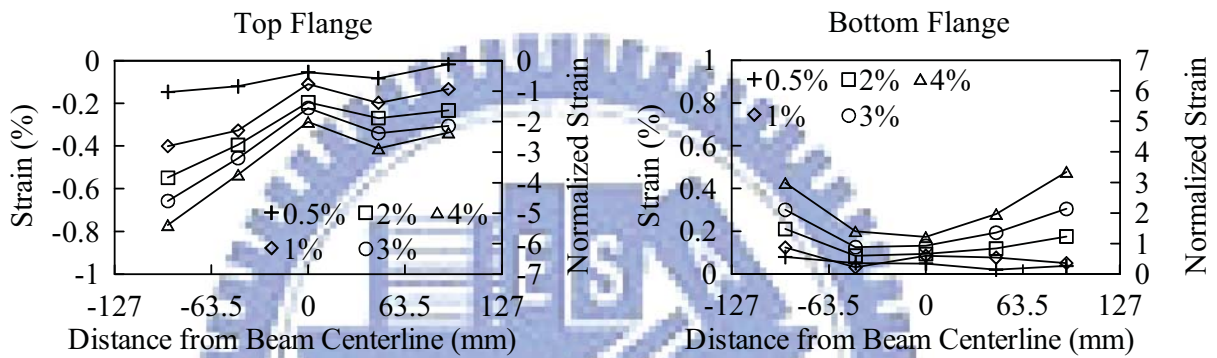


(f) Strain Gauge S10

圖 3.33 試體 IFS4 彎矩與下翼板橫向應變關係



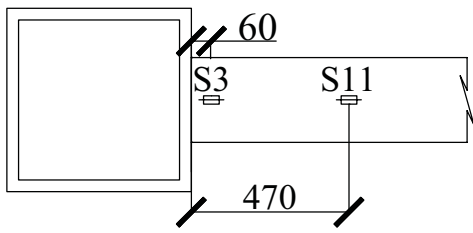
(a) Negative Bending



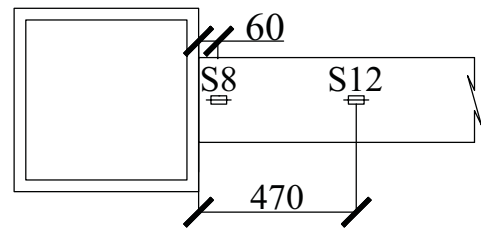
(b) Positive Bending

圖 3.34 試體 IFS4 梁翼板橫向應變分佈圖

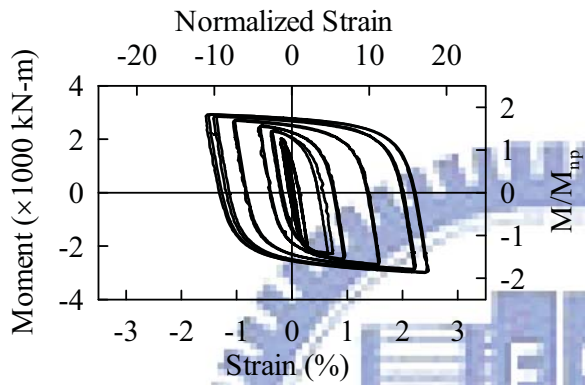
Strain Gauge Location



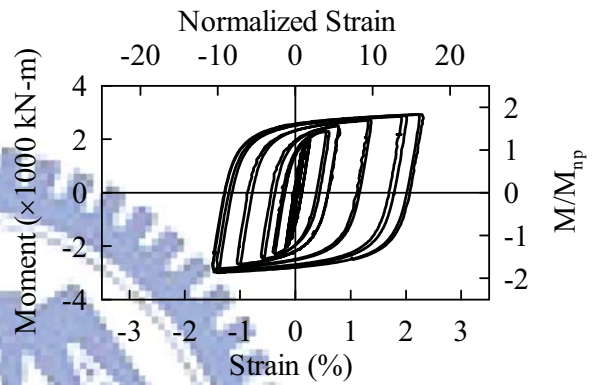
(a) Top Flange



(b) Bottom Flange

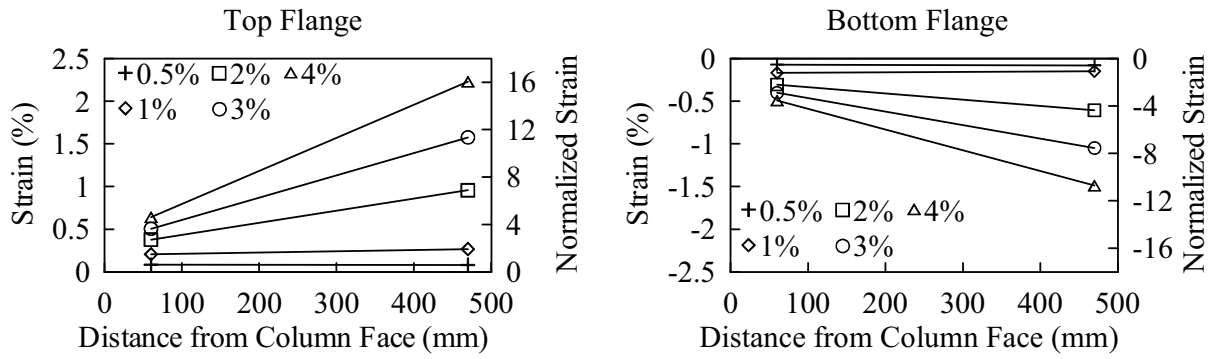


(c) Strain Gauge S11

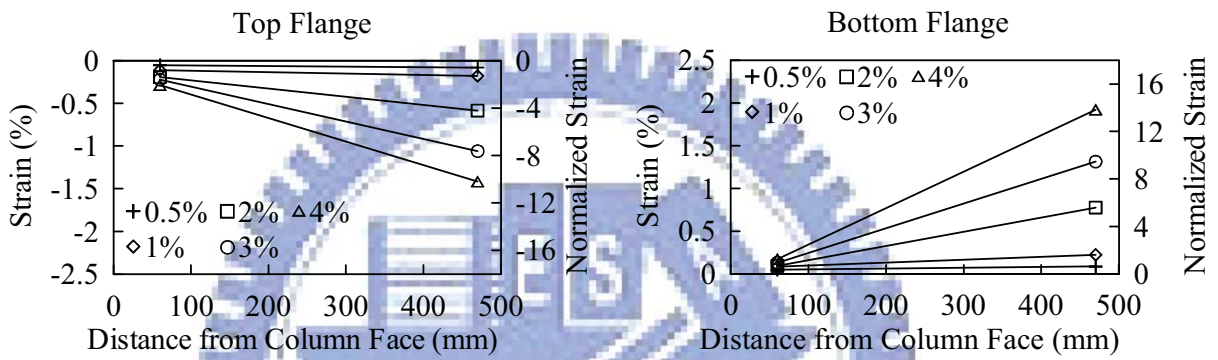


(d) Strain Gauge S12

圖 3.35 試體 IFS4 彎矩與梁翼板縱向應變關係

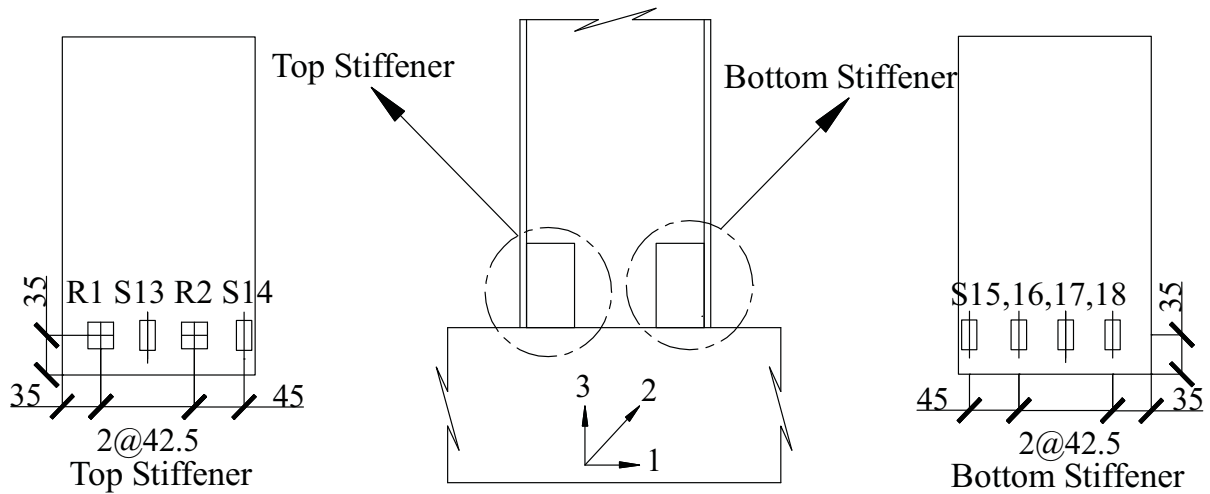


(a) Negative Bending

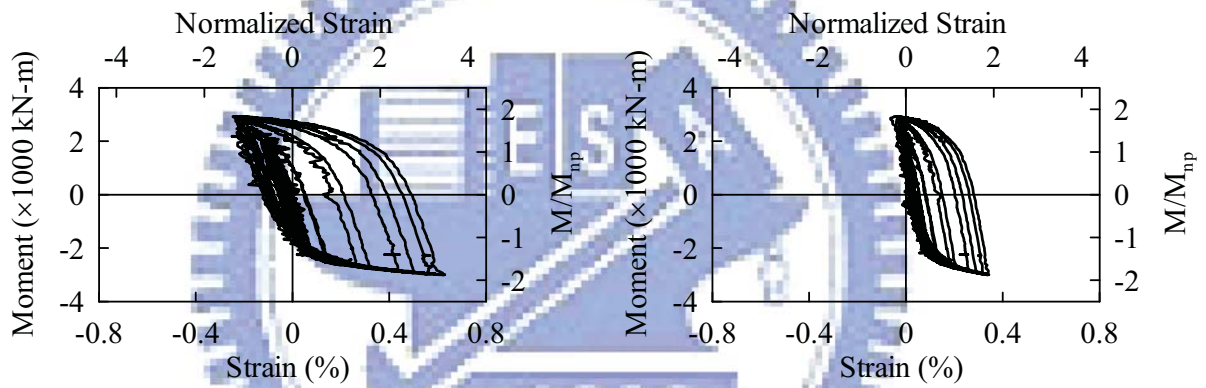


(b) Positive Bending

圖 3.36 試體 IFS4 梁翼板縱向應變關係

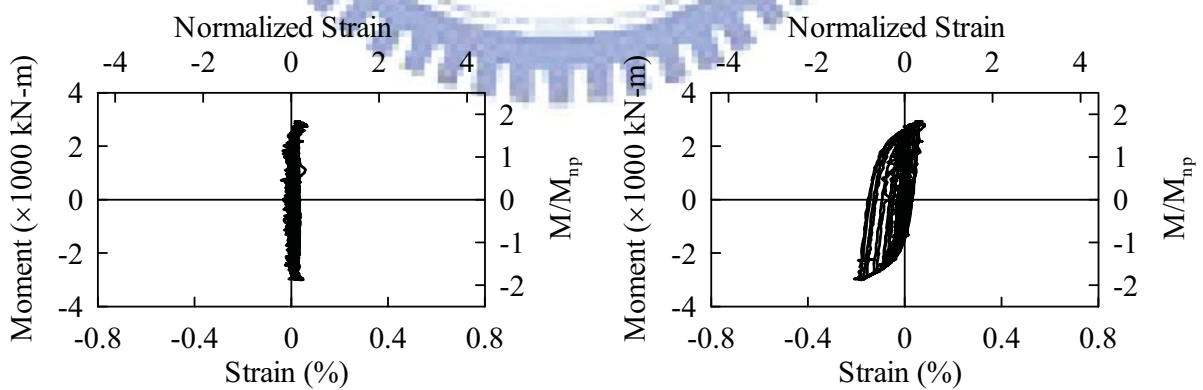


(a) Strain Gauge Location



(c) Strain Gauge R1-3

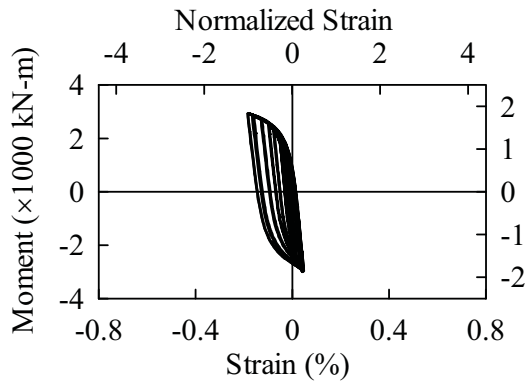
(d) Strain Gauge S13



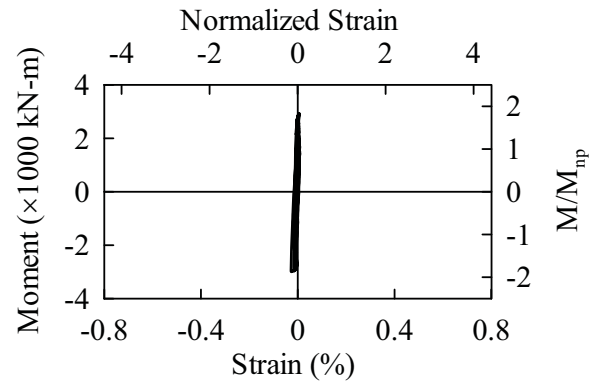
(e) Strain Gauge R2-3

(f) Strain Gauge S14

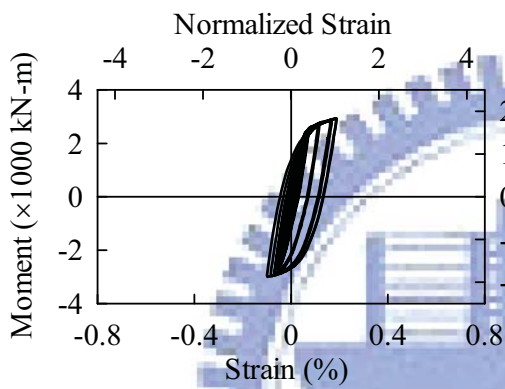
圖 3.37 試體 IFS4 彎距與加勁板應變關係



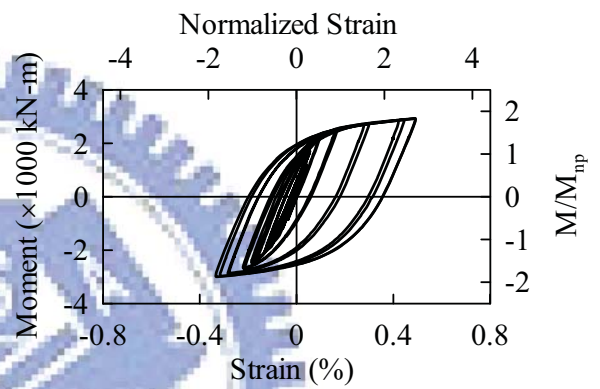
(a) Strain Gauge S15



(b) Strain Gauge S16

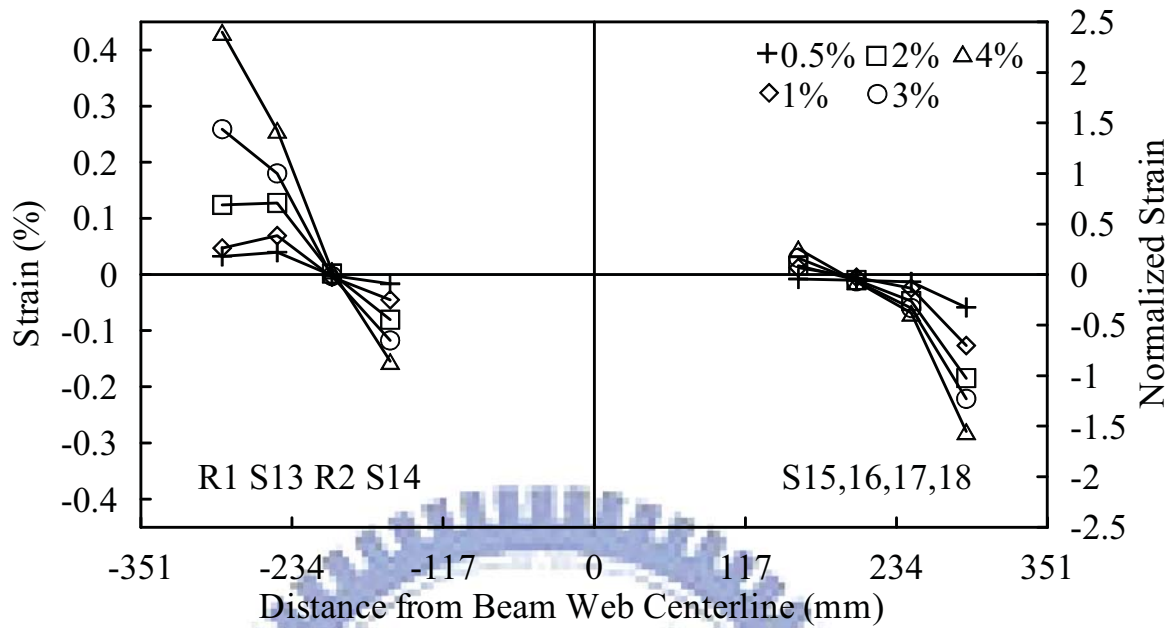


(c) Strain Gauge S17

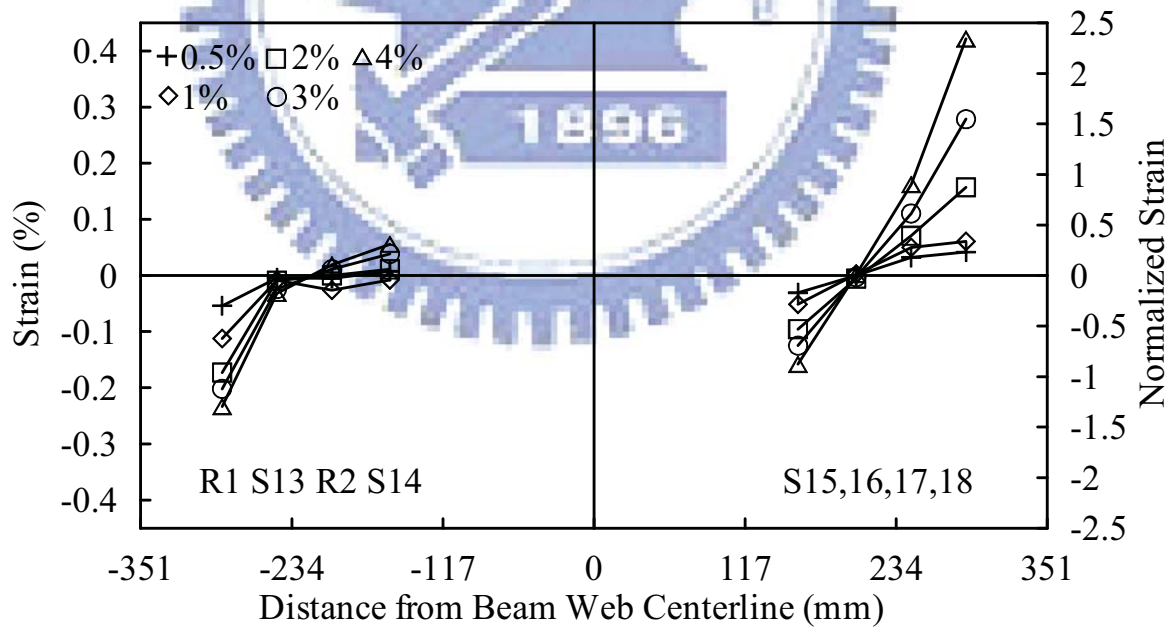


(d) Strain Gauge S18

圖 3.38 試體 IFS4 彎距與加勁板應變關係 (續)

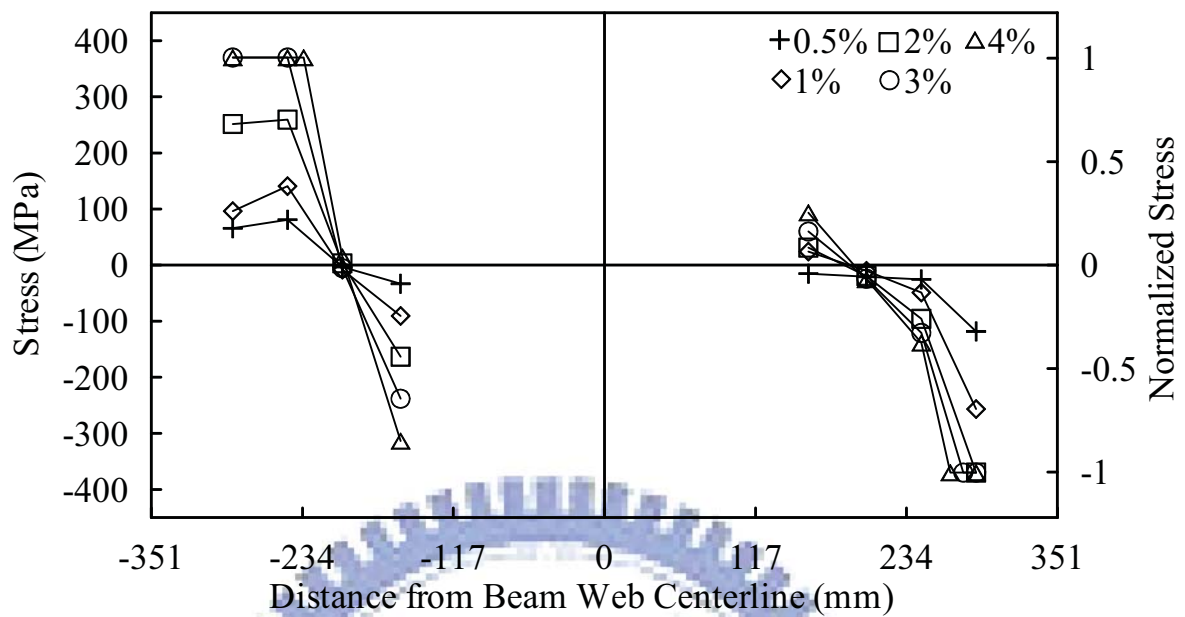


(a) Negative Bending

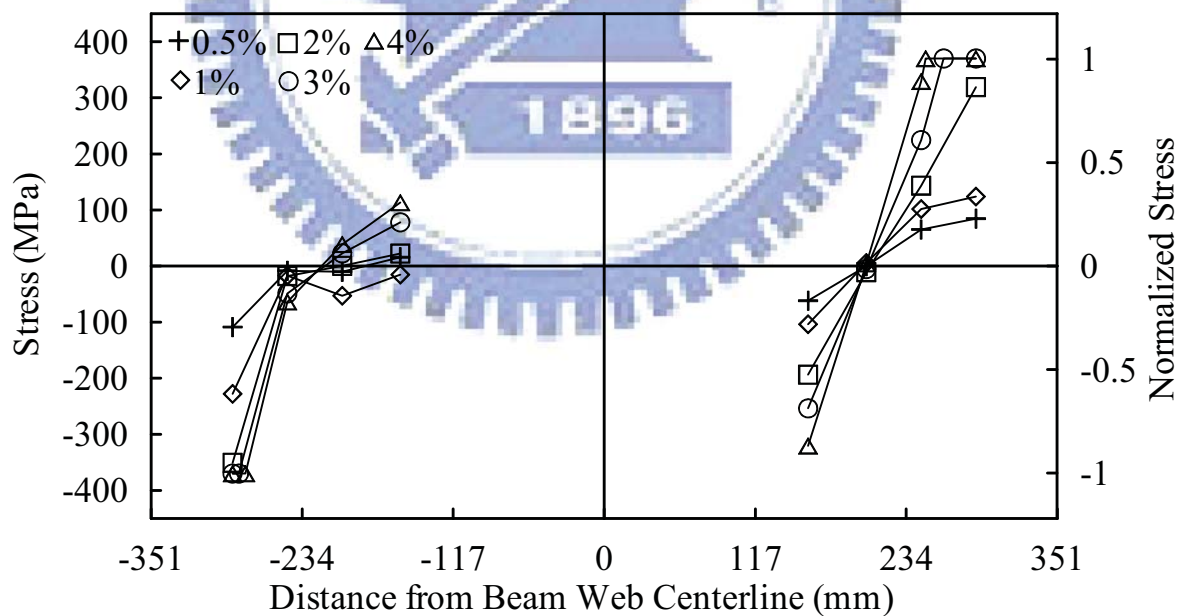


(b) Positive Bending

圖 3.39 試體 IFS4 加勁板應變分佈

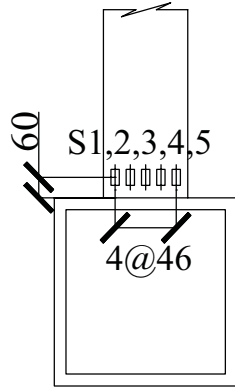


(a) Negative Bending

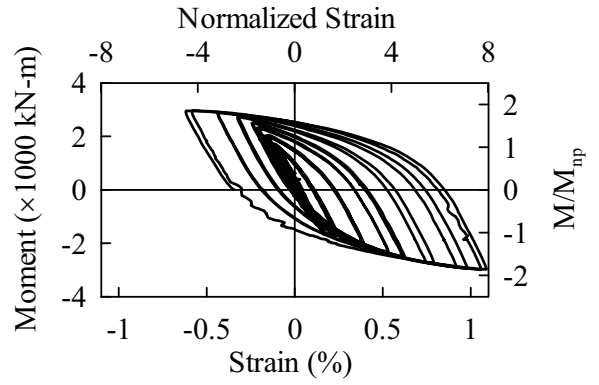


(b) Positive Bending

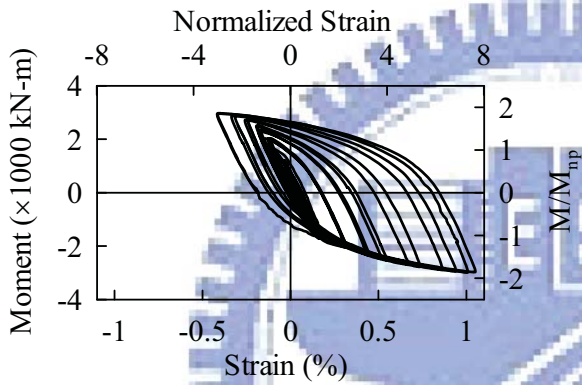
圖 3.40 試體 IFS4 加勁板應力分佈



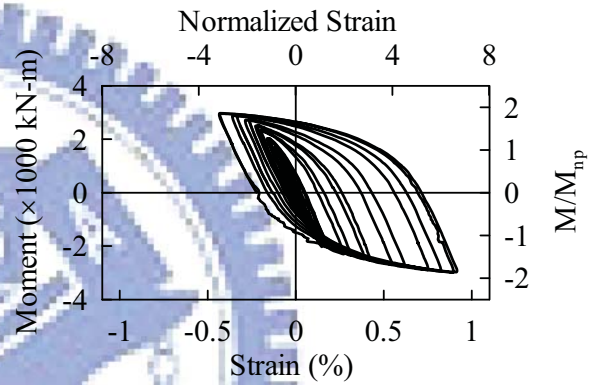
(a) Strain Gauge Location



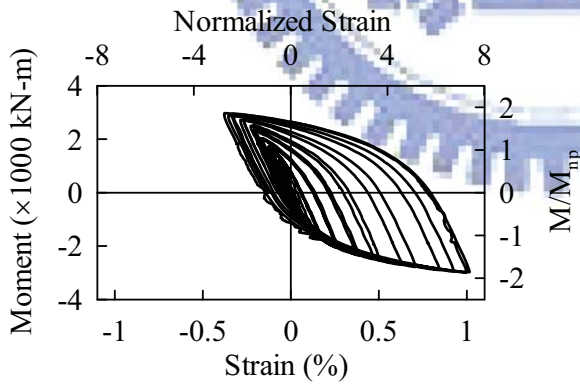
(b) Strain Gauge S1



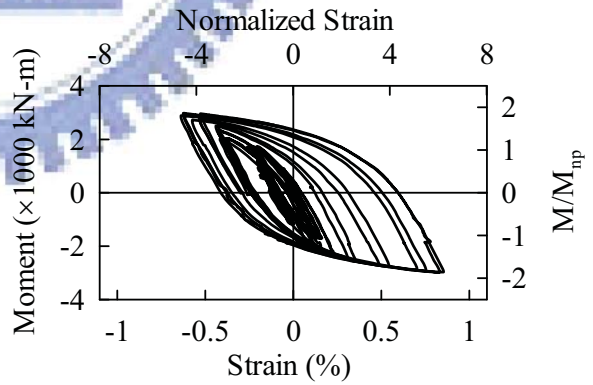
(c) Strain Gauge S2



(d) Strain Gauge S3

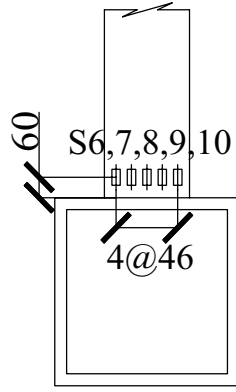


(e) Strain Gauge S4

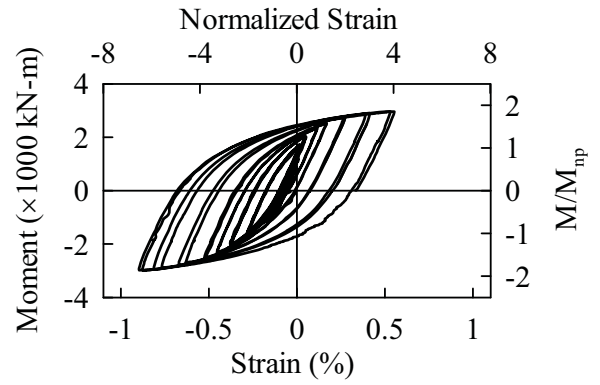


(f) Strain Gauge S5

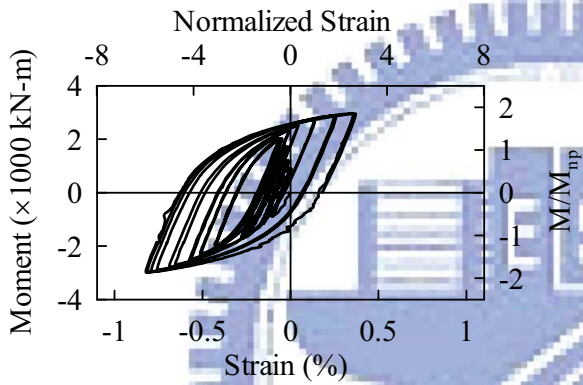
圖 3.41 試體 IFS5 彎矩與上翼板橫向應變關係



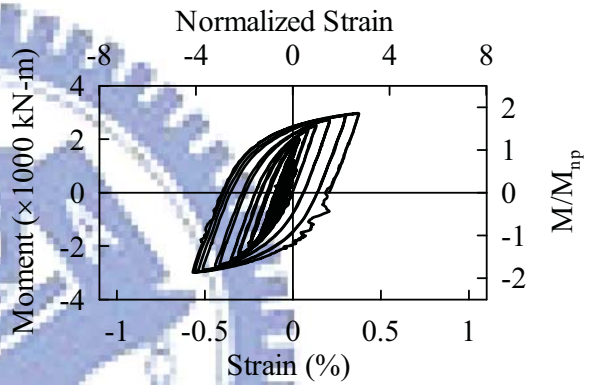
(a) Strain Gauge Location



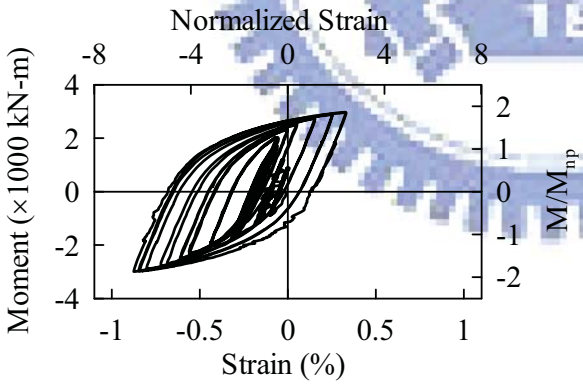
(b) Strain Gauge S6



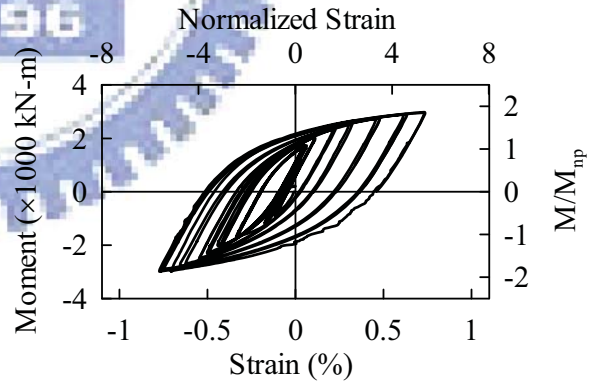
(c) Strain Gauge S7



(d) Strain Gauge S8

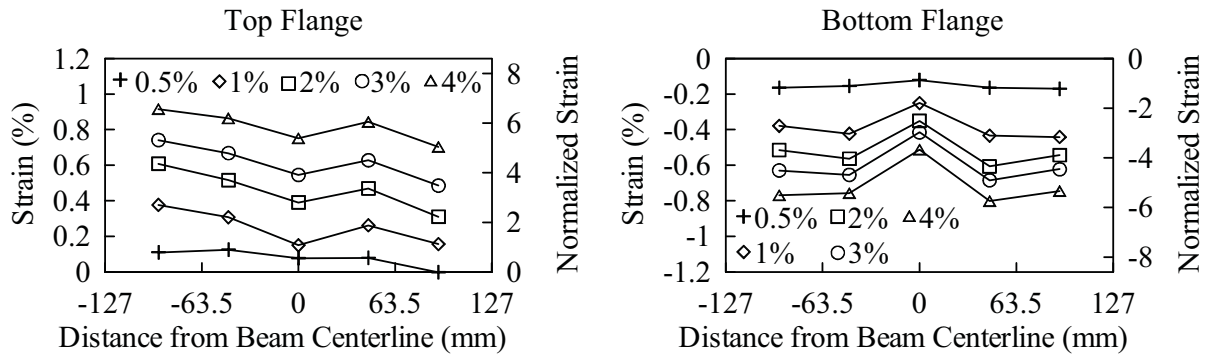


(e) Strain Gauge S9

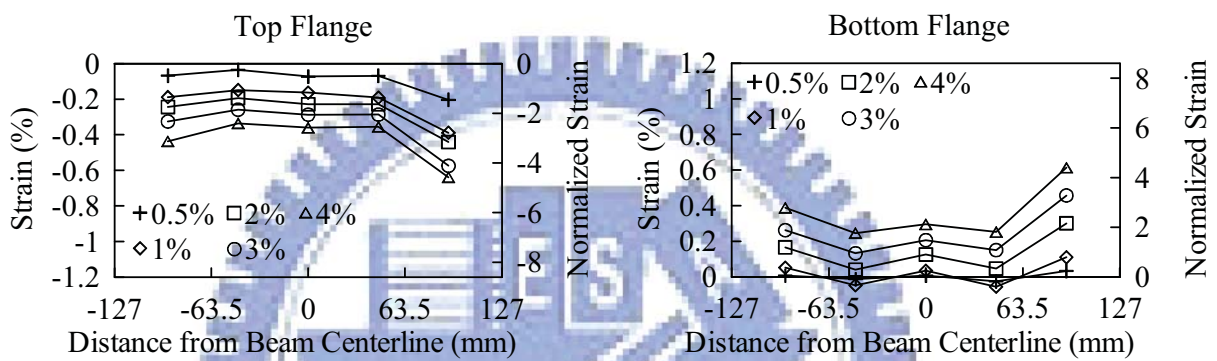


(f) Strain Gauge S10

圖 3.42 試體 IFS5 彎矩與下翼板橫向應變關係



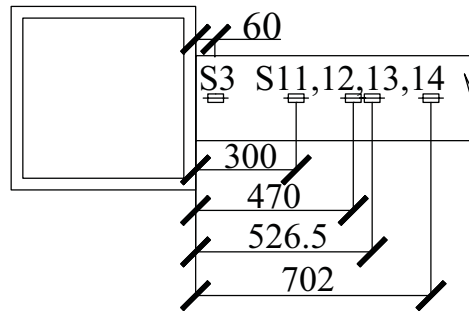
(a) Negative Bending



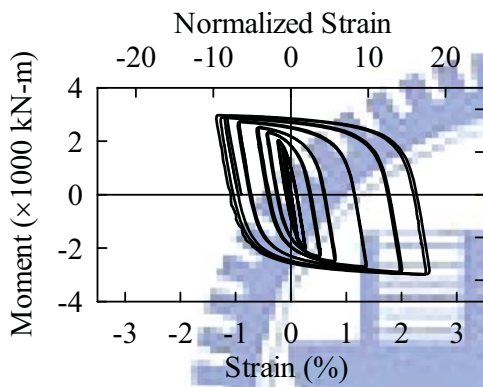
(b) Positive Bending

圖 3.43 試體 IFS5 梁翼板橫向應變分佈圖

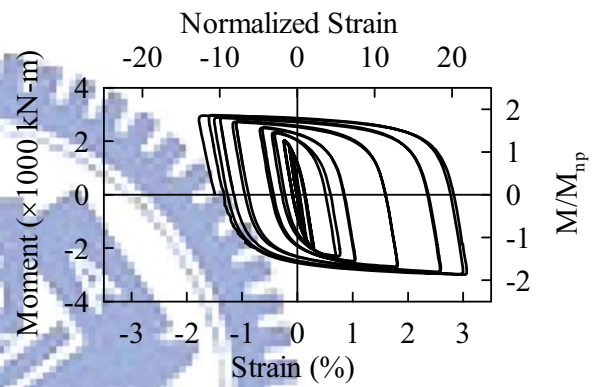
Strain Gauge Location



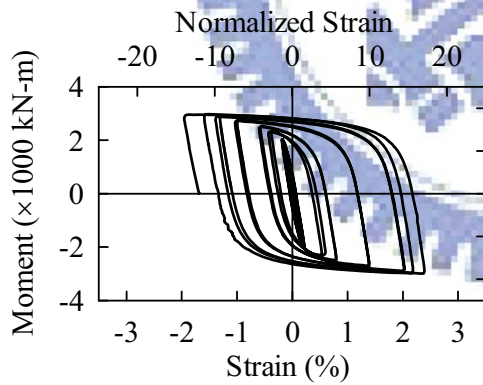
(a) Top Flange



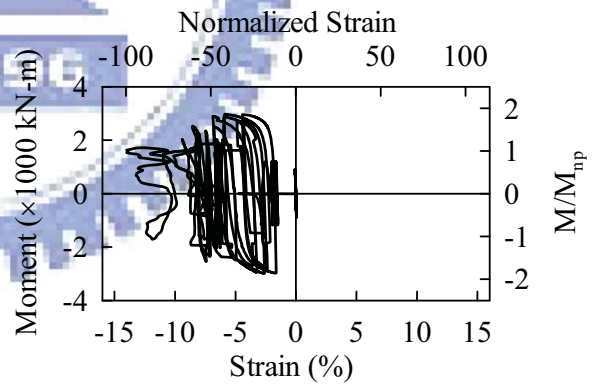
(b) Strain Gauge S11



(c) Strain Gauge S12



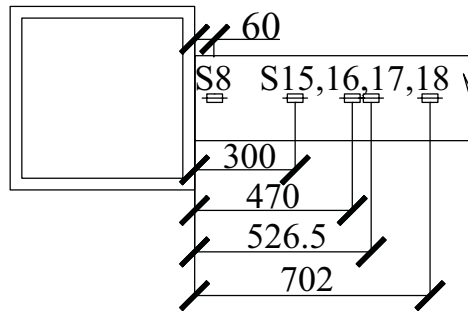
(d) Strain Gauge S13



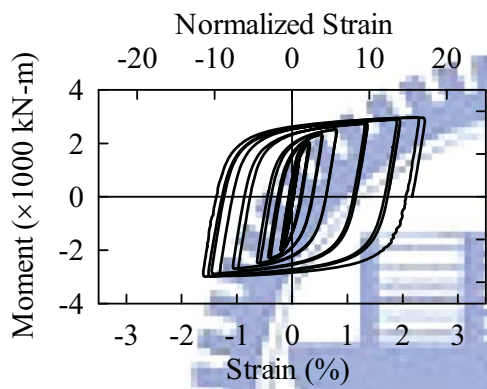
(e) Strain Gauge S14

圖 3.44 試體 IFS5 彎矩與梁上翼板縱向應變關係

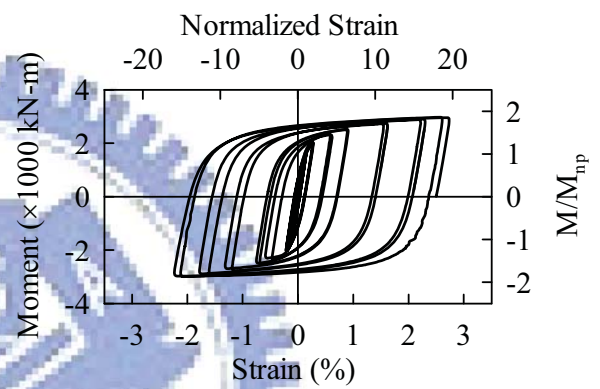
Strain Gauge Location



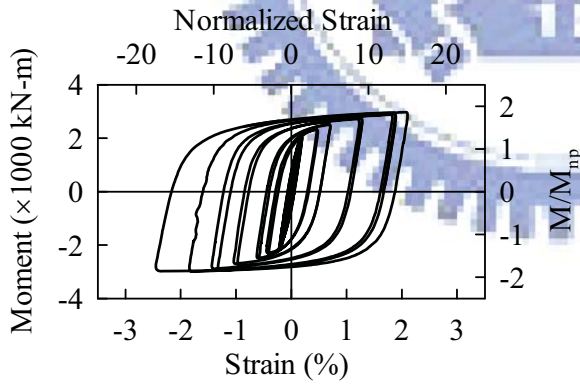
(a) Bottom Flange



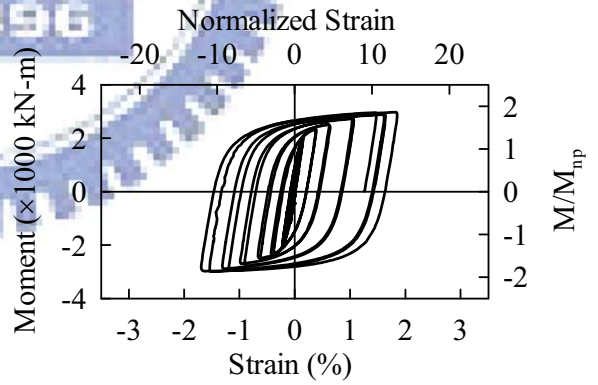
(b) Strain Gauge S15



(c) Strain Gauge S16

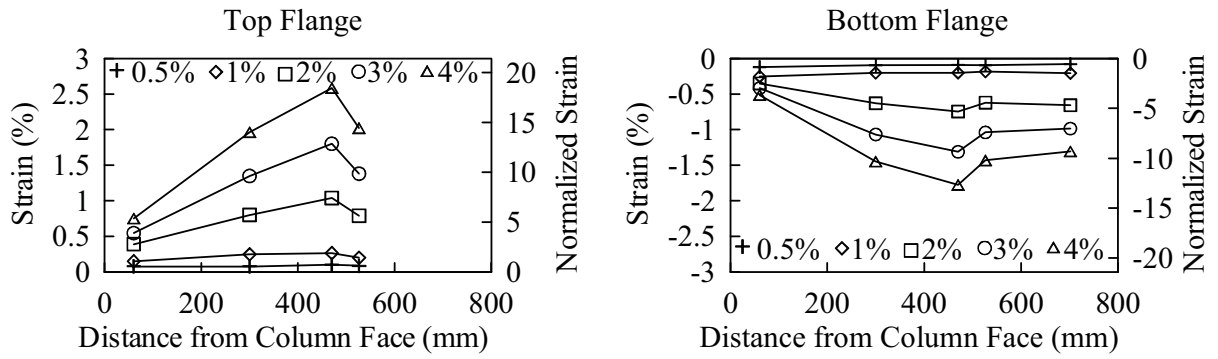


(e) Strain Gauge S17

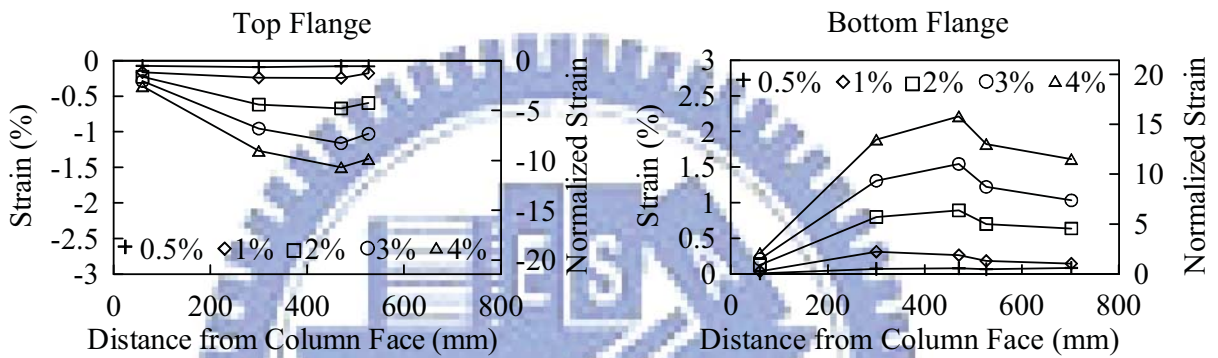


(f) Strain Gauge S18

圖 3.45 試體 IFS5 彎矩與梁下翼板縱向應變關係

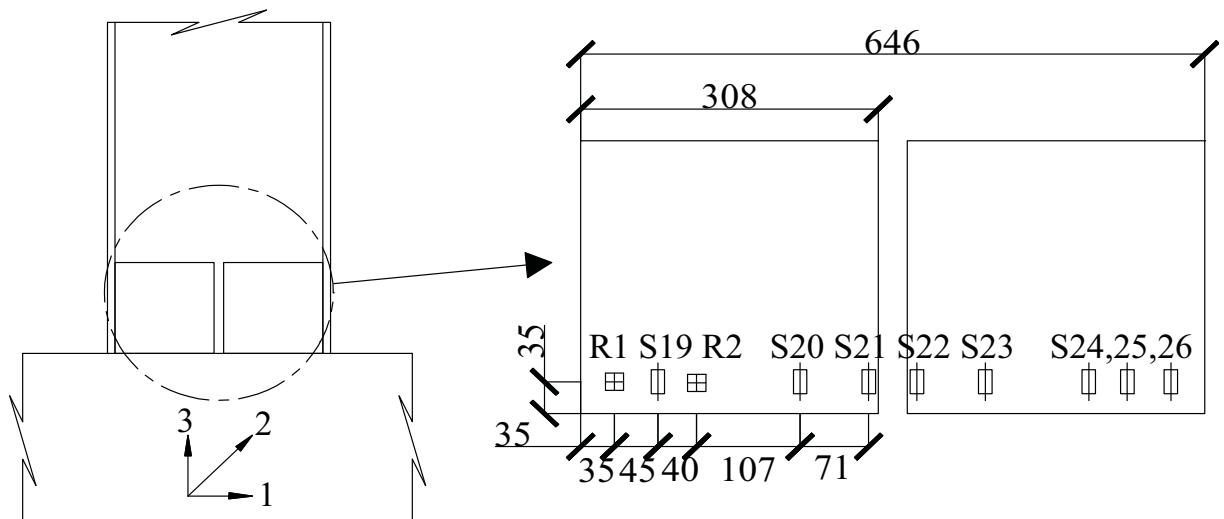


(a) Negative Bending

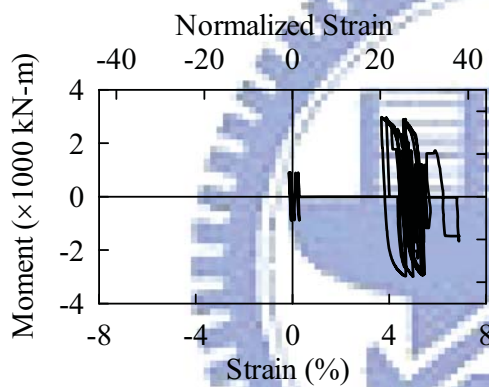


(b) Positive Bending

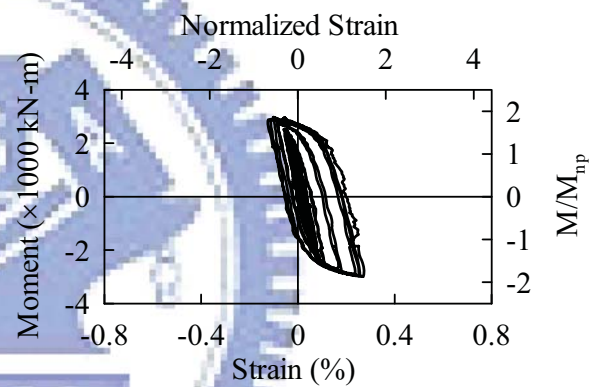
圖 3.46 試體 IFS5 梁翼板縱向應變關係



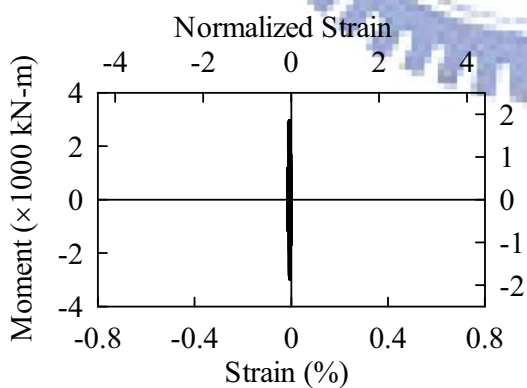
(a) Strain Gauge Location



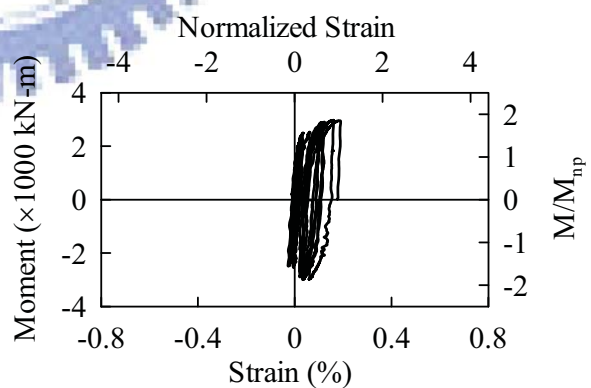
(c) Strain Gauge R1-3



(d) Strain Gauge S19

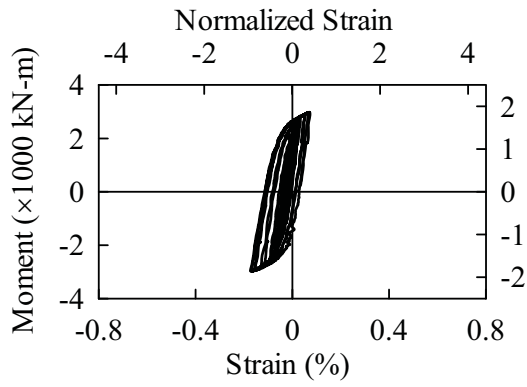


(e) Strain Gauge R2-3

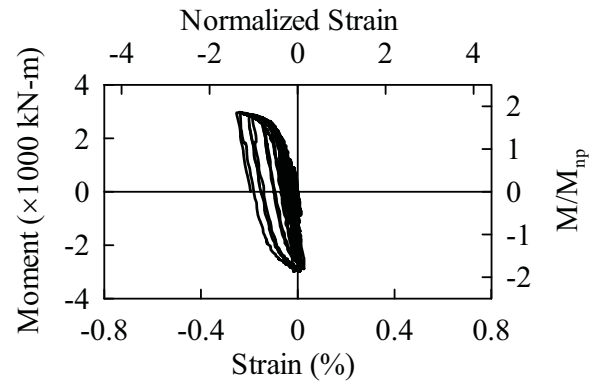


(f) Strain Gauge S20

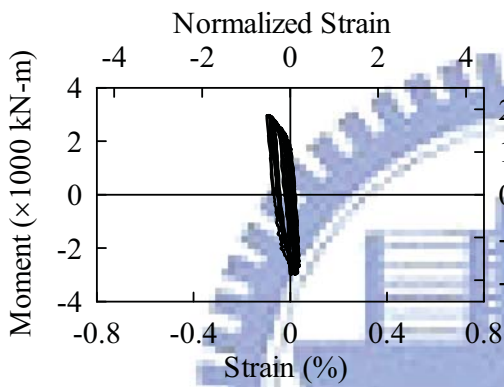
圖 3.47 試體 IFS5 彎距與加勁板應變關係



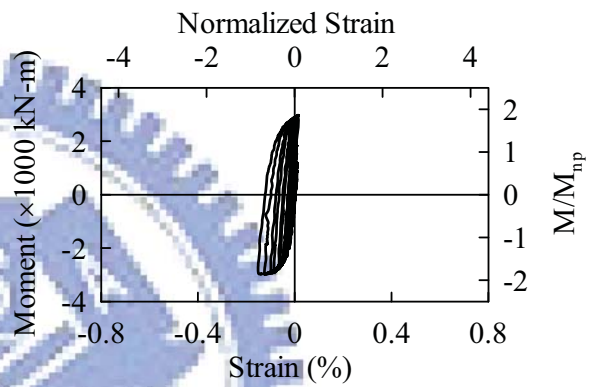
(a) Strain Gauge S21



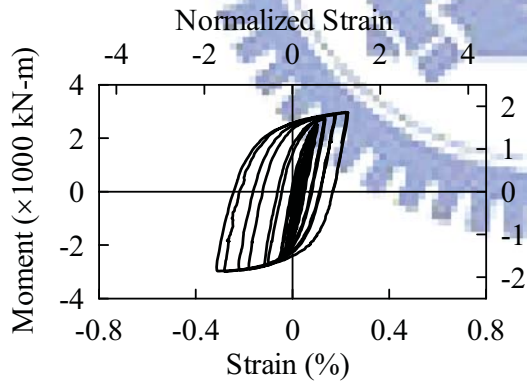
(b) Strain Gauge S22



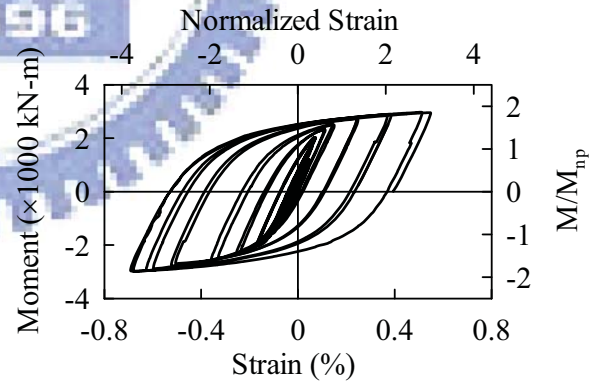
(c) Strain Gauge S23



(d) Strain Gauge S24

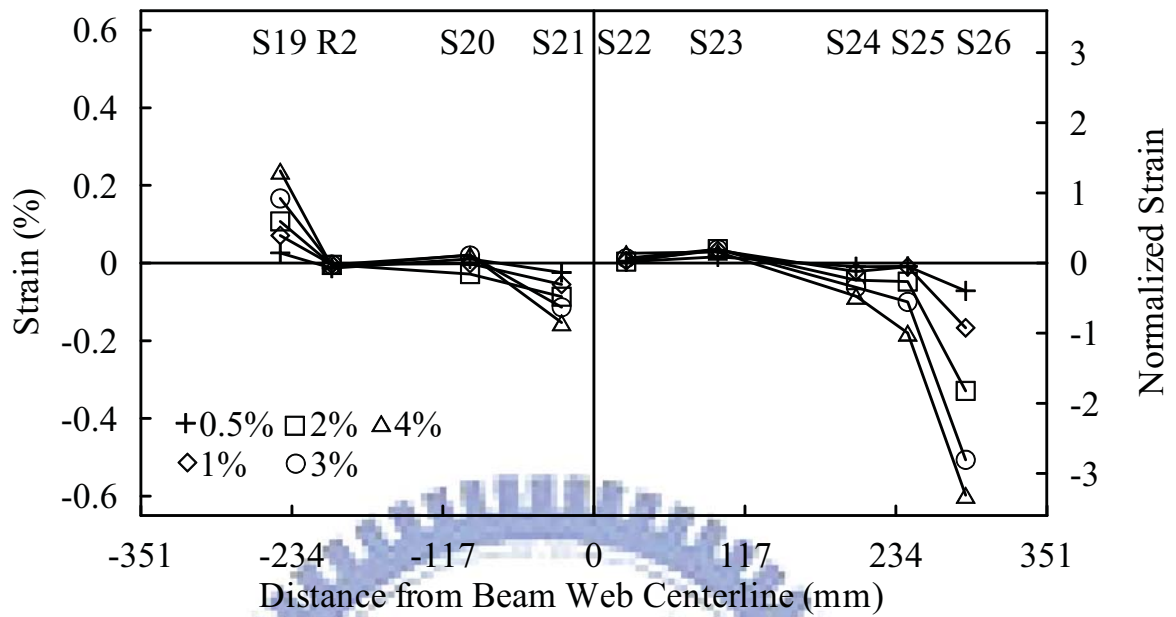


(e) Strain Gauge S25

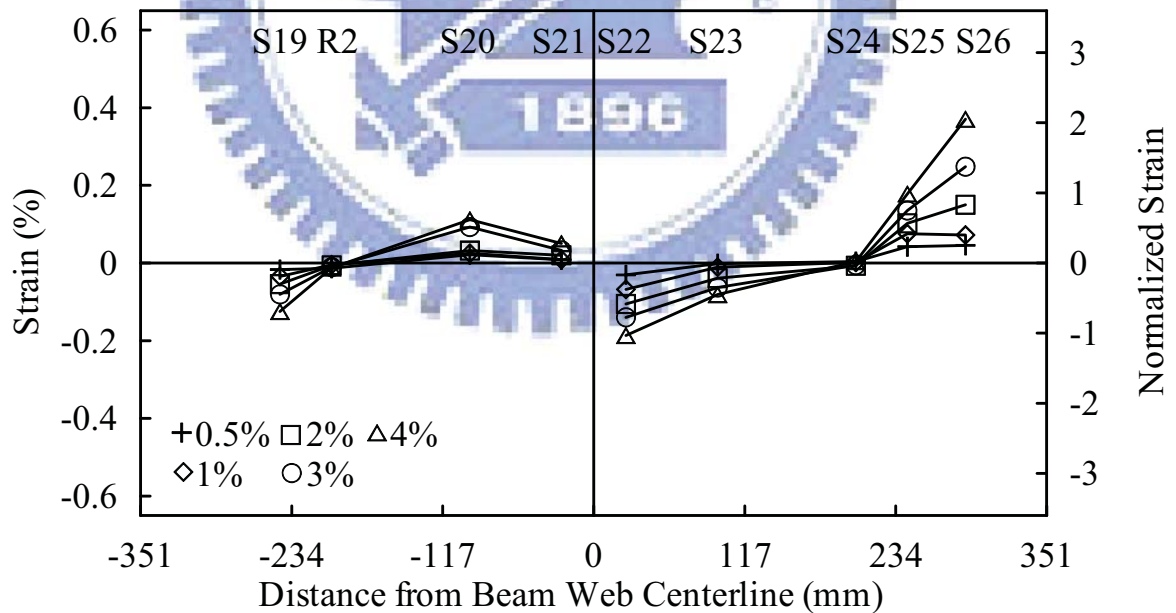


(f) Strain Gauge S26

圖 3.48 試體 IFS5 彎距與加勁板應變關係 (續)

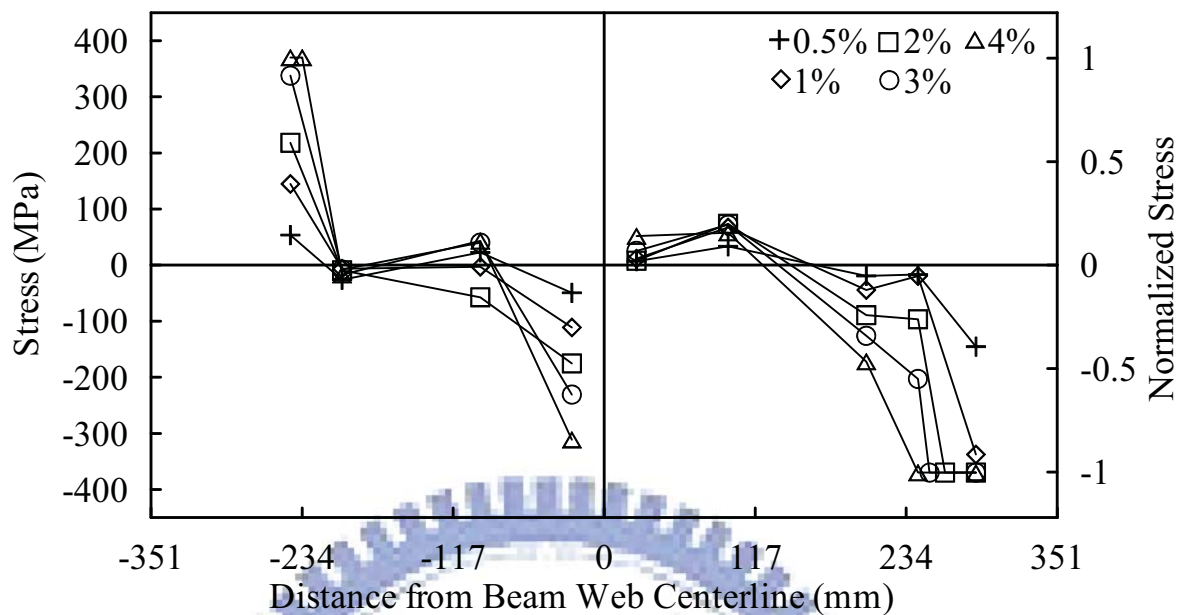


(a) Negative Bending

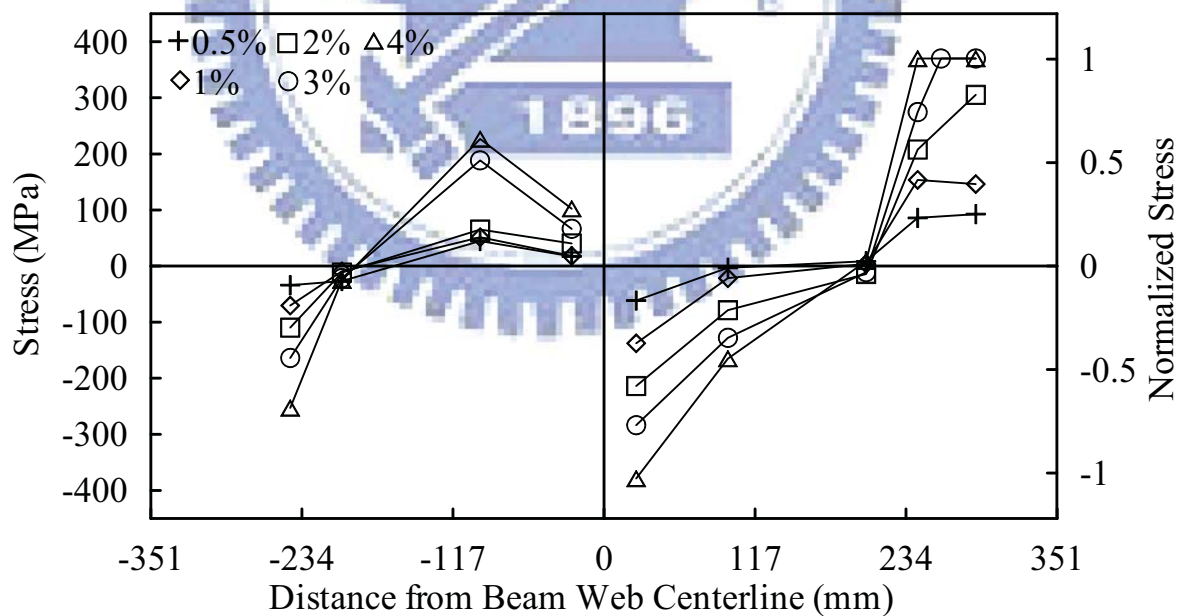


(b) Positive Bending

圖 3.49 試體 IFS5 加勁板應變分佈

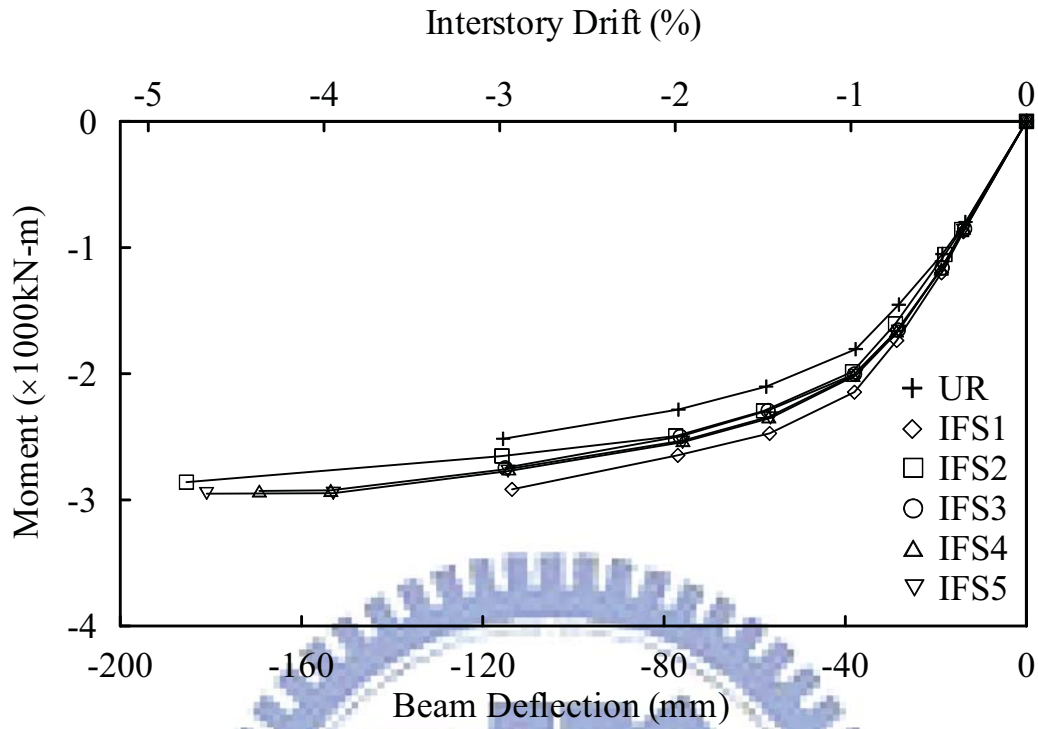


(a) Negative Bending

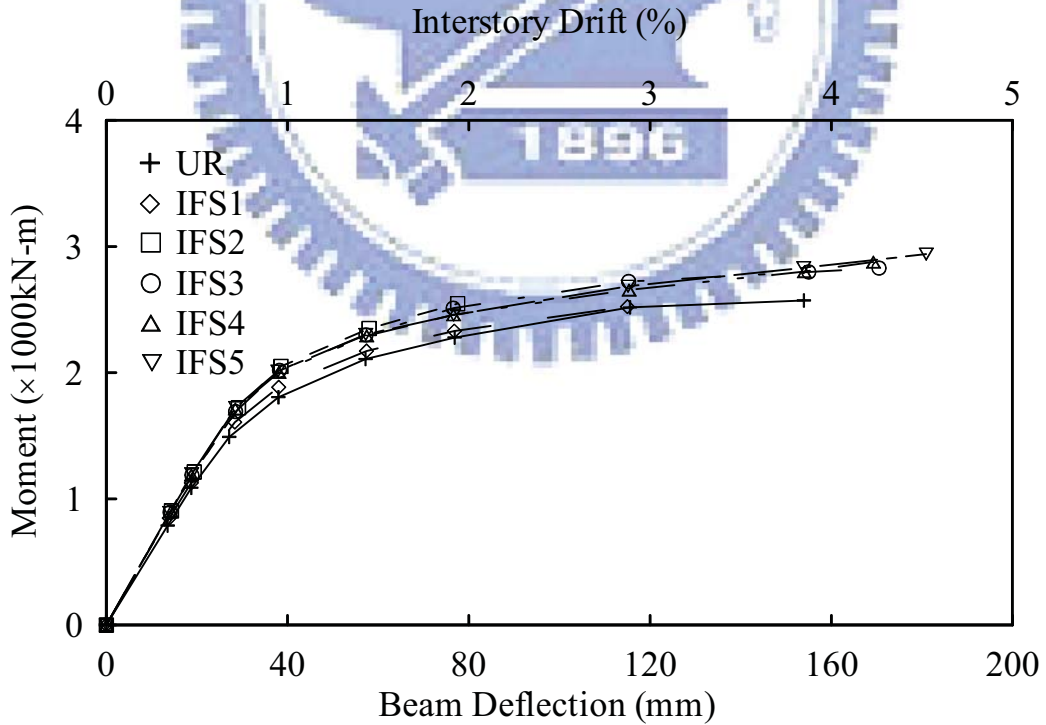


(b) Positive Bending

圖 3.50 試體 IFS5 加勁板應力分佈

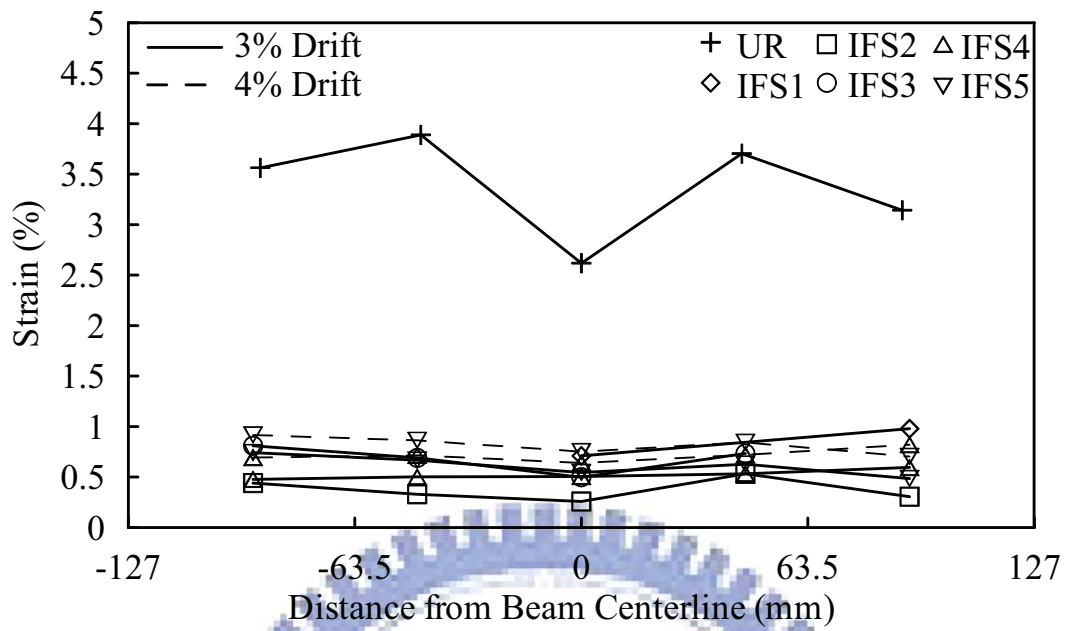


(a) Negative Bending

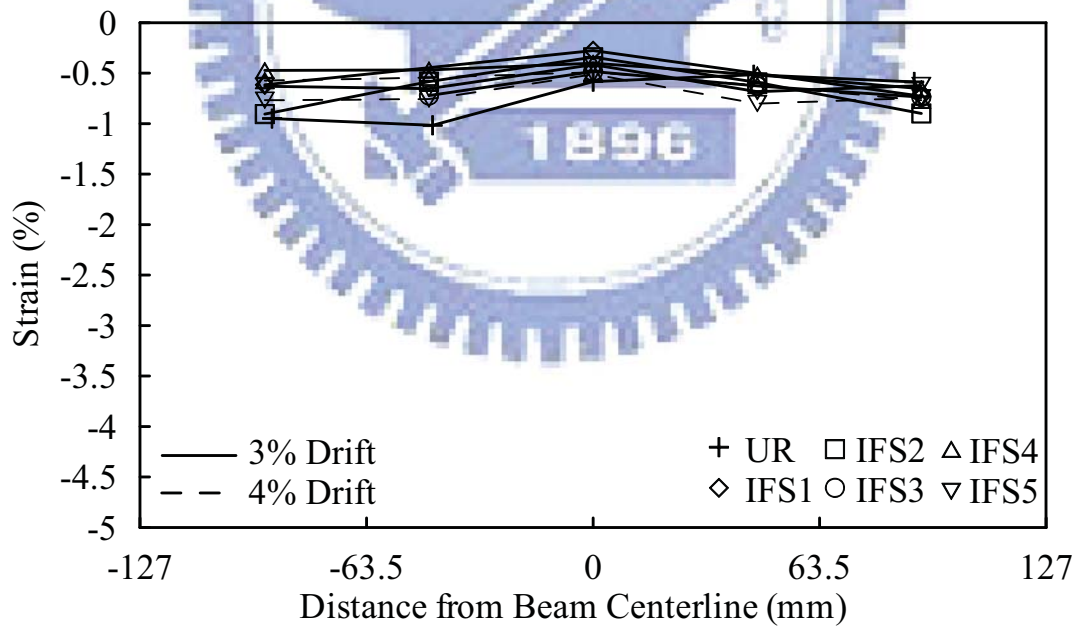


(b) Positive Bending

圖 3.51 所有 IFS 試體彎矩與位移關係包絡線圖比較

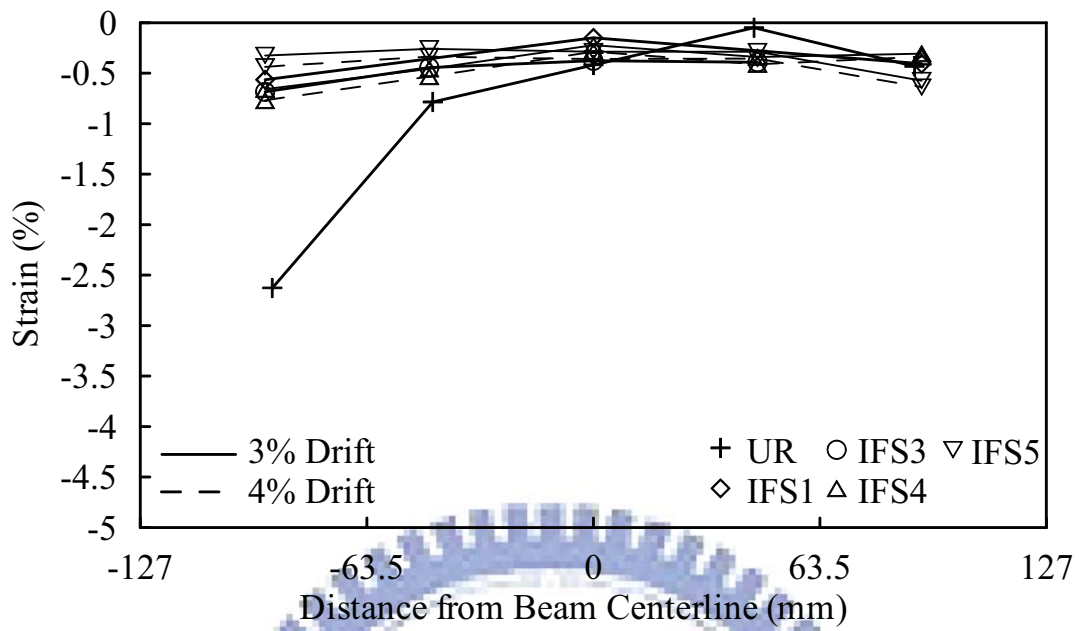


(a) Top Flange

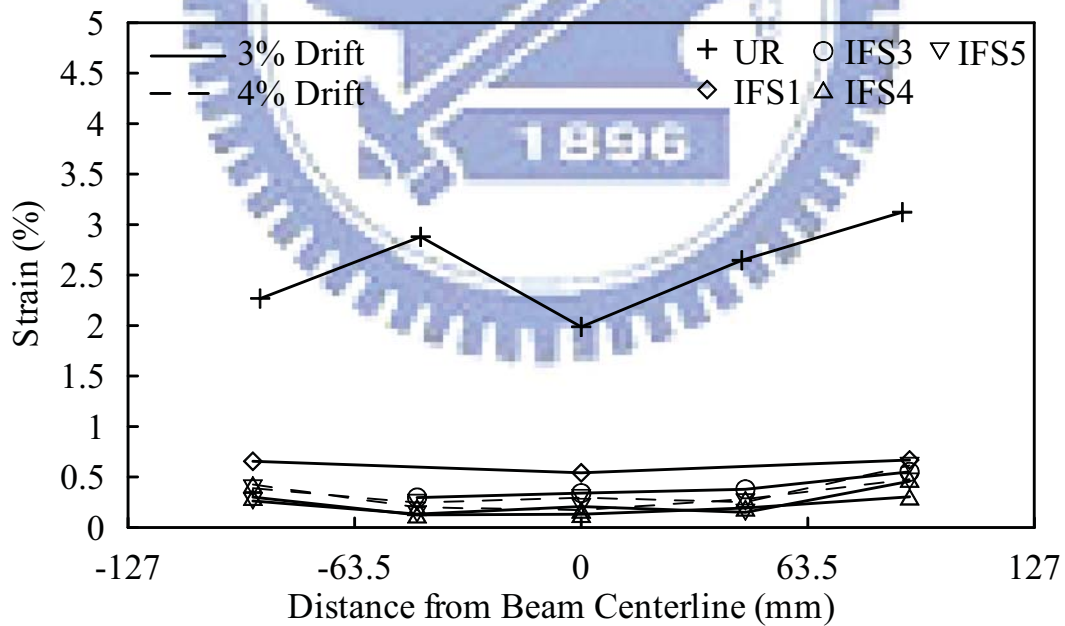


(b) Bottom Flange

圖 3.52 IFS 試體與未加勁梁柱 UR 橫向應變比較(Negative Bending)

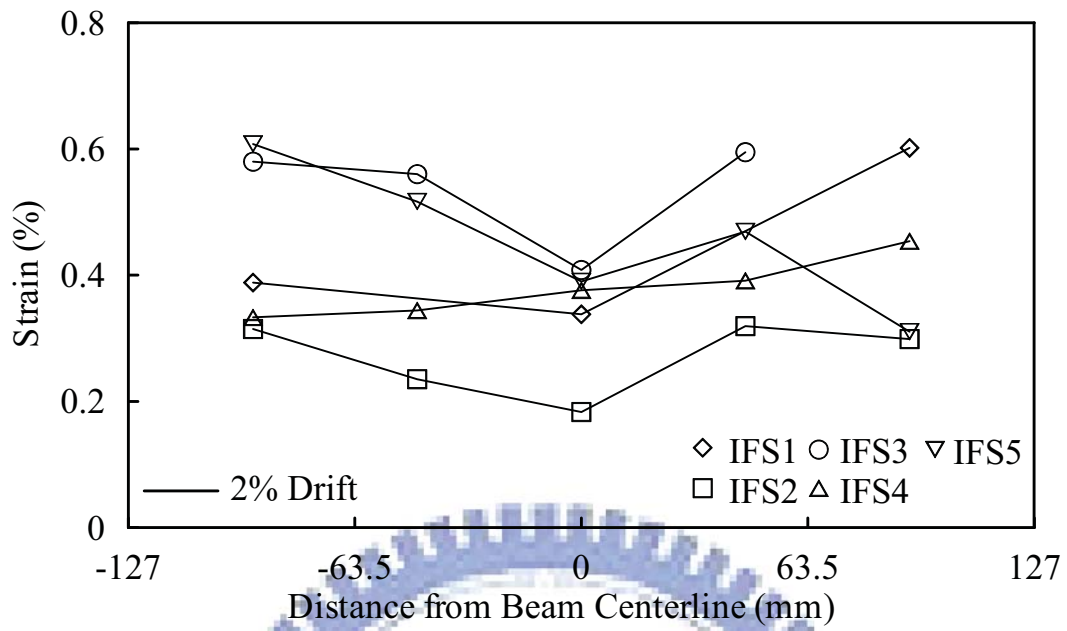


(a) Top Flange

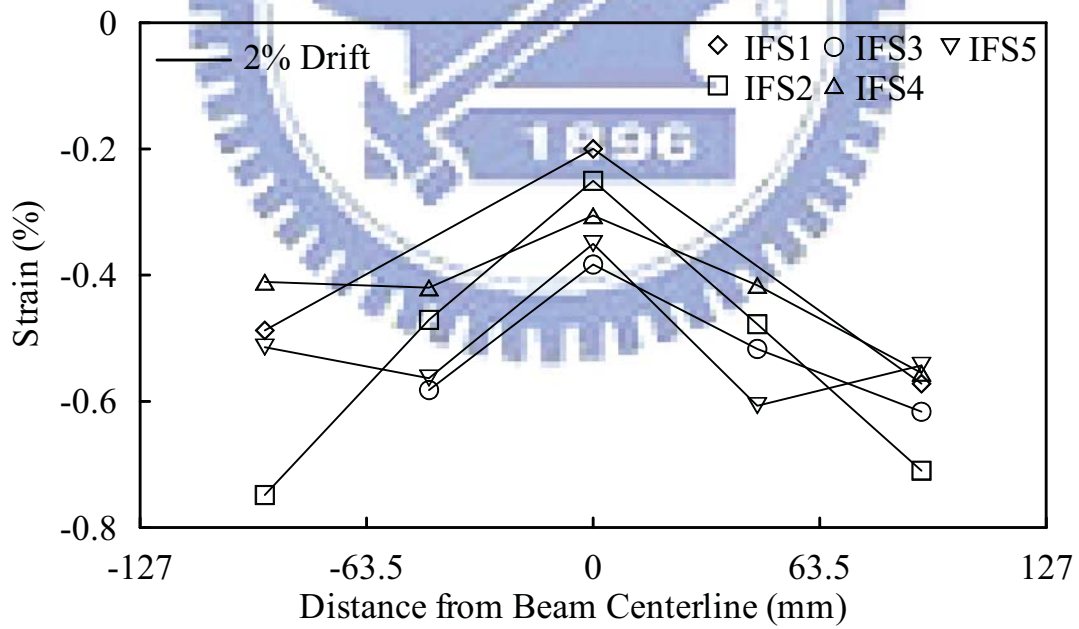


(b) Bottom Flange

圖 3. 53 IFS 試體與未加勁梁柱 UR 橫向應變比較(Positive Bending)

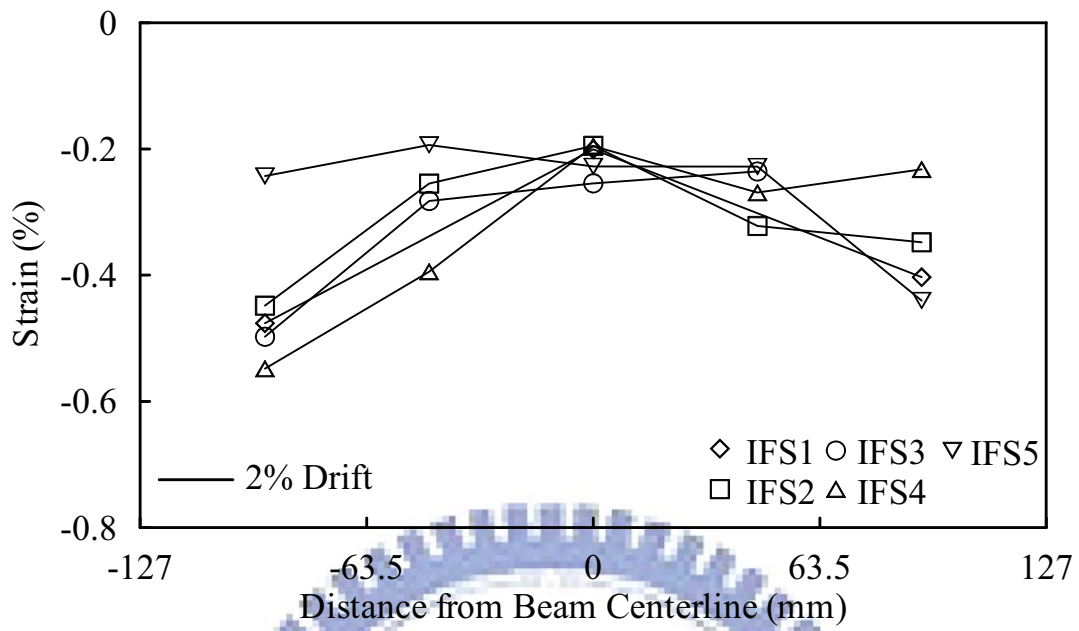


(a) Top Flange

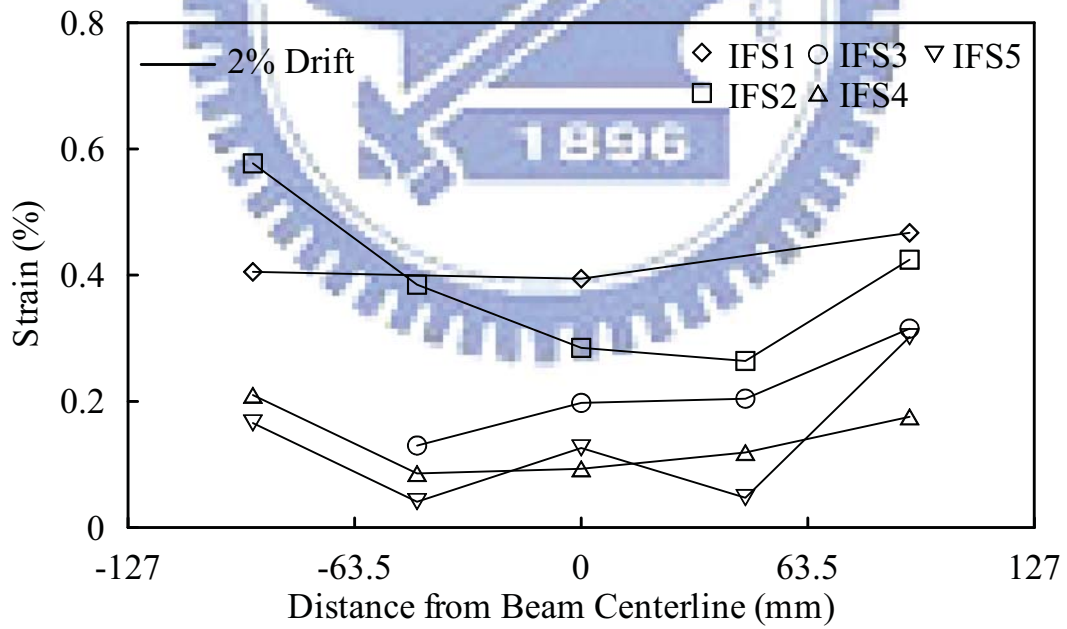


(b) Bottom Flange

圖 3.54 IFS 試體橫向應變比較(Negative Bending)

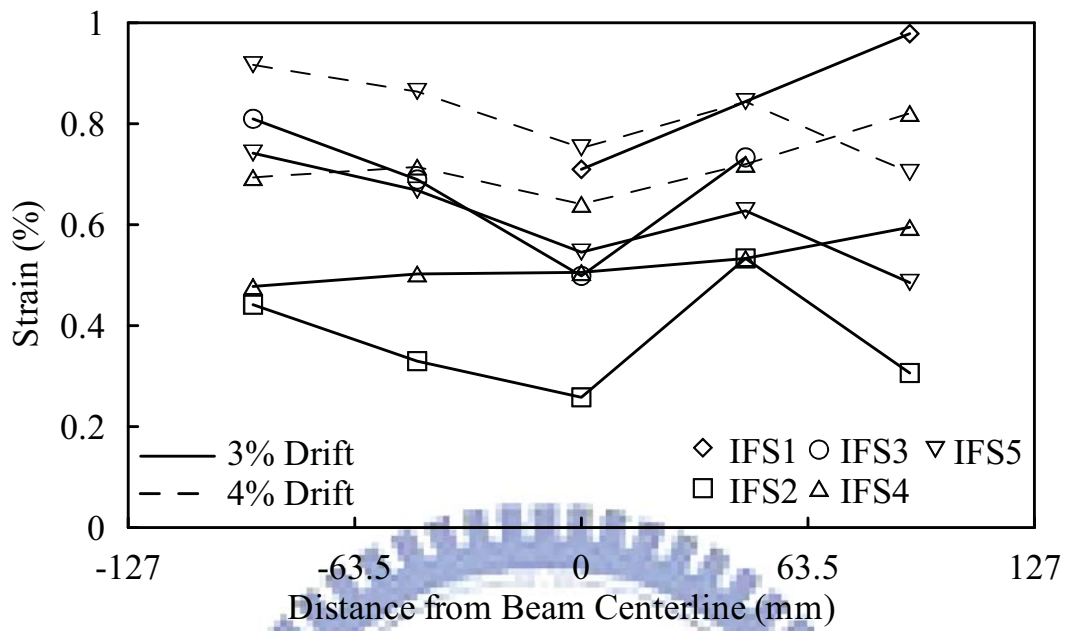


(a) Top Flange

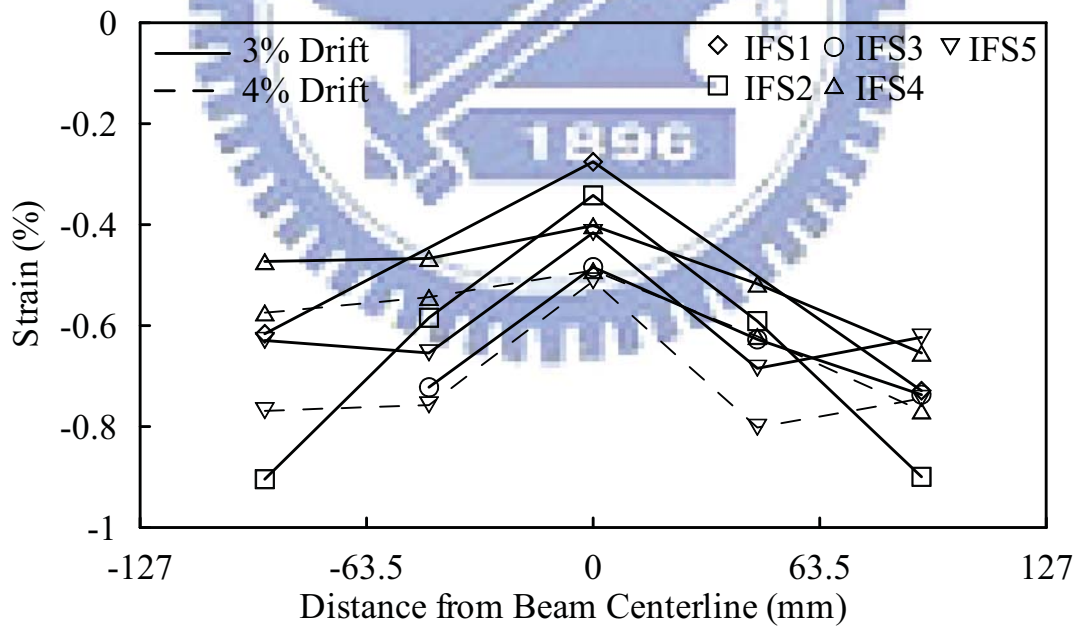


(b) Bottom Flange

圖 3.55 IFS 試體橫向應變比較(Positive Bending)

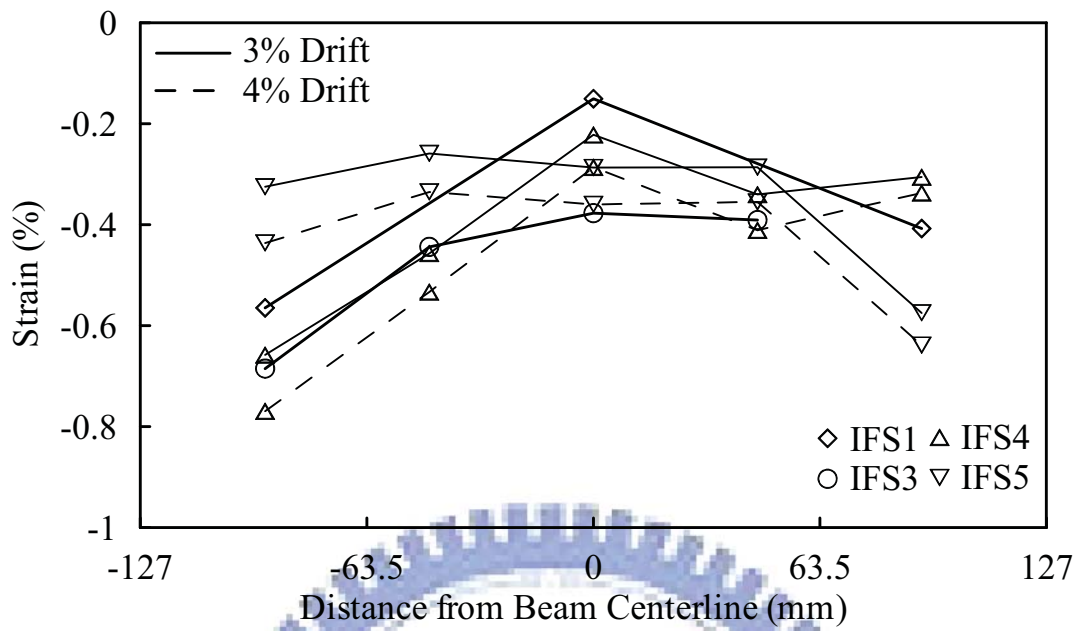


(a) Top Flange

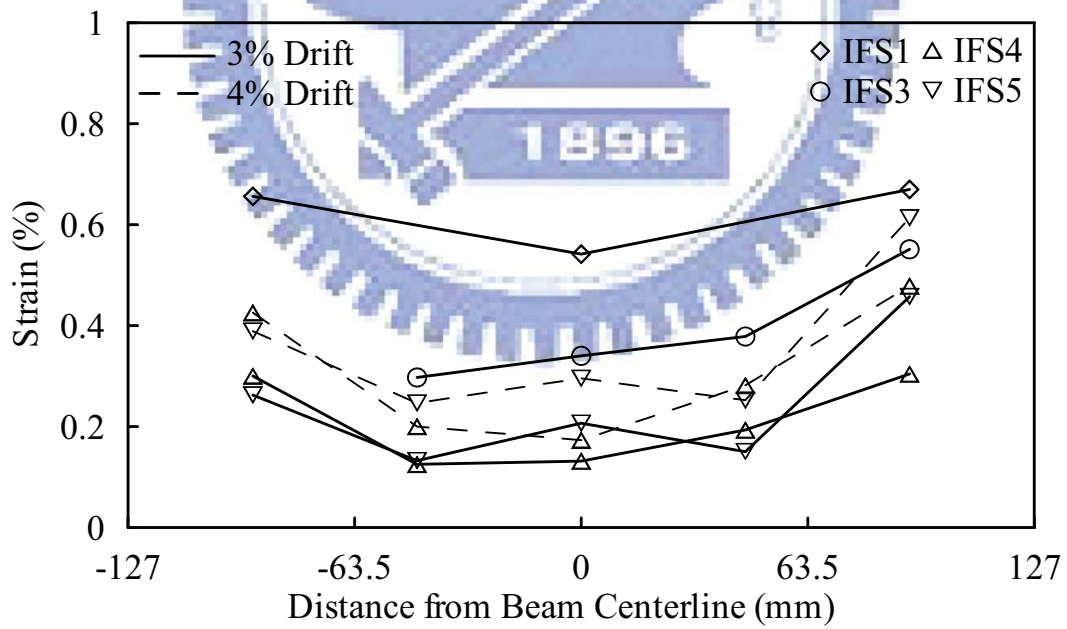


(b) Bottom Flange

圖 3. 56 IFS 試體橫向應變比較(Negative Bending)

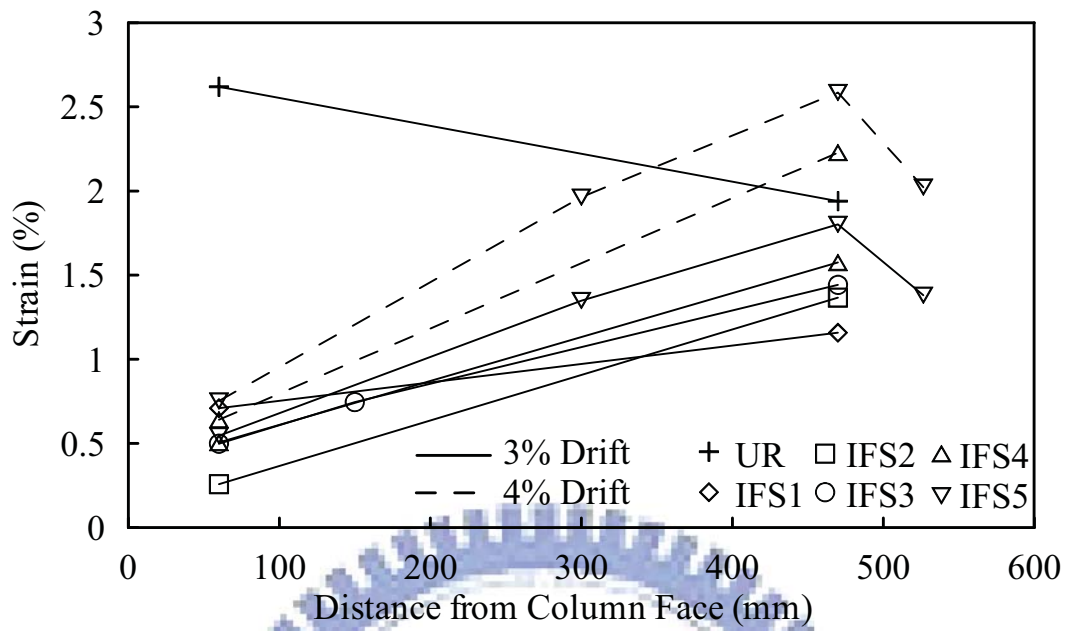


(a) Top Flange

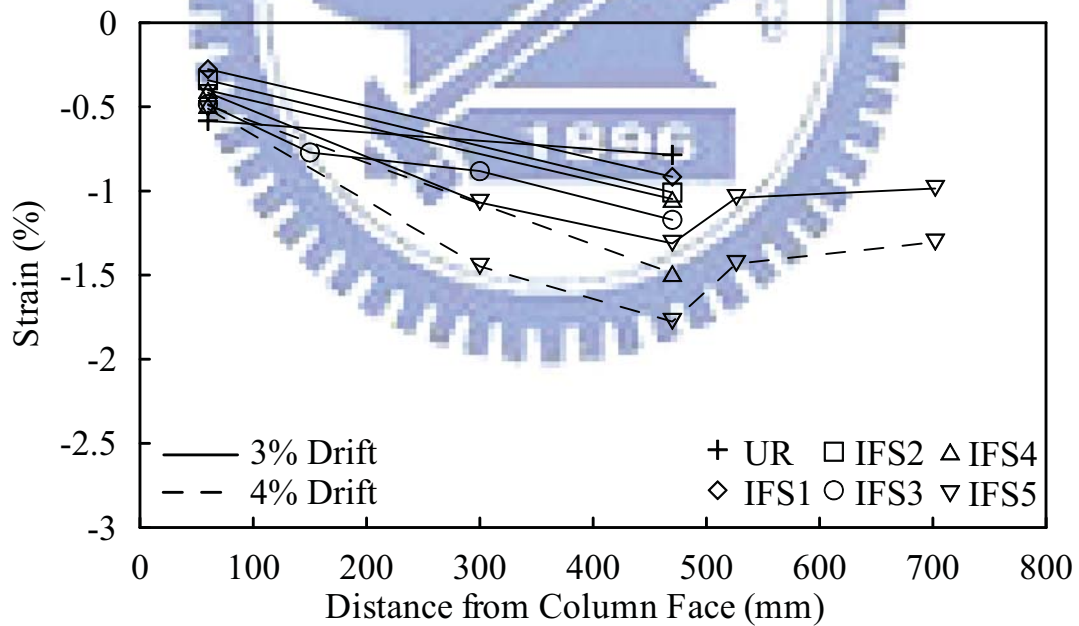


(b) Bottom Flange

圖 3.57 IFS 試體橫向應變比較(Positive Bending)

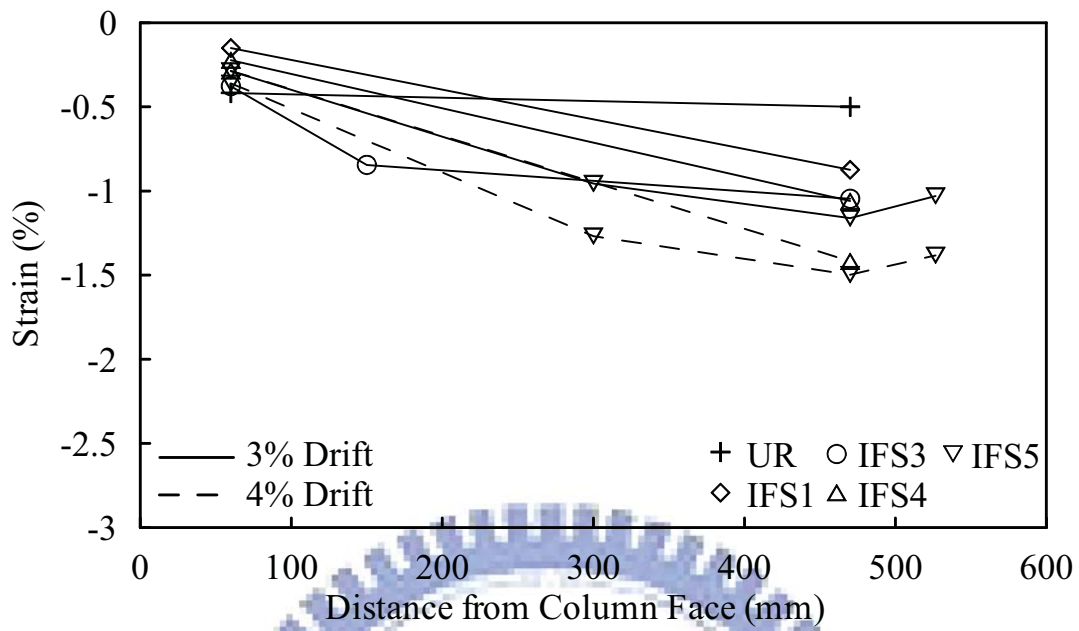


(a) Top Flange

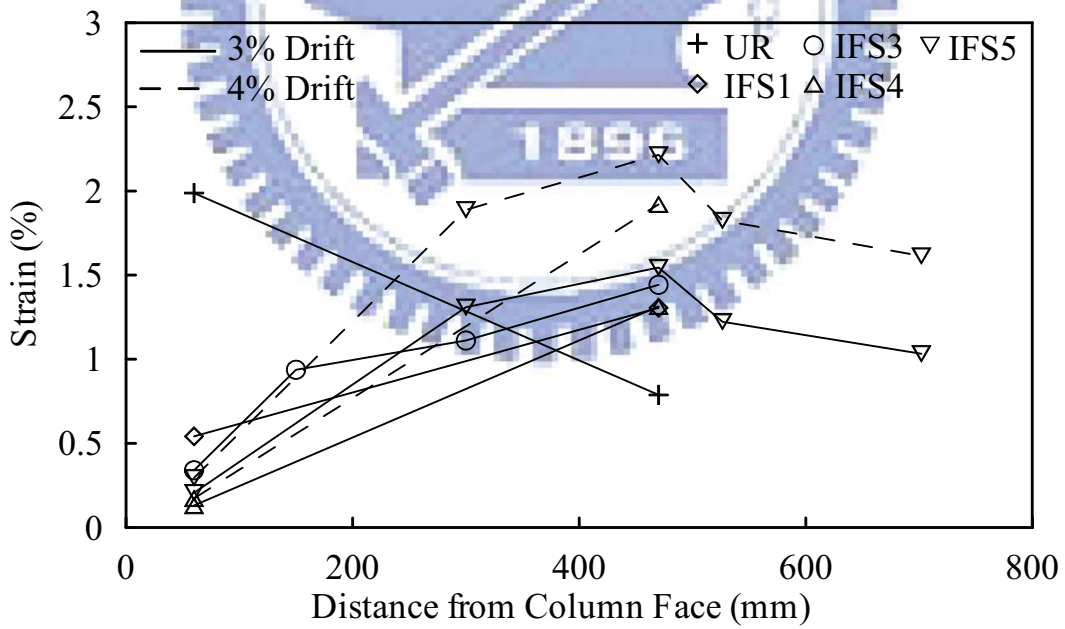


(b) Bottom Flange

圖 3.58 IFS 試體縱向應變比較圖(Negative Bending)

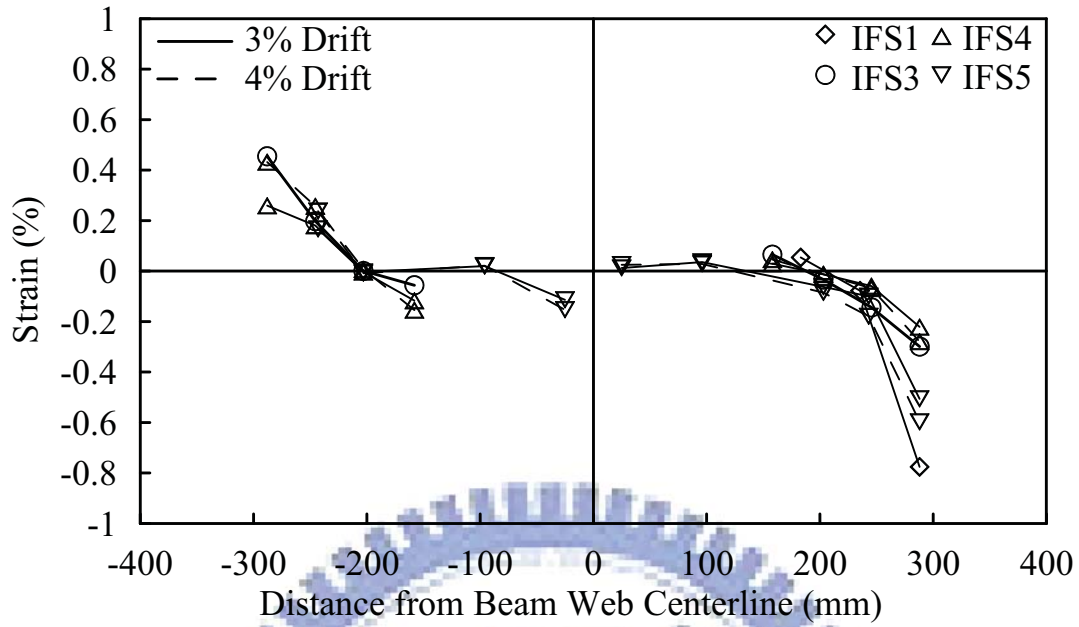


(a) Top Flange

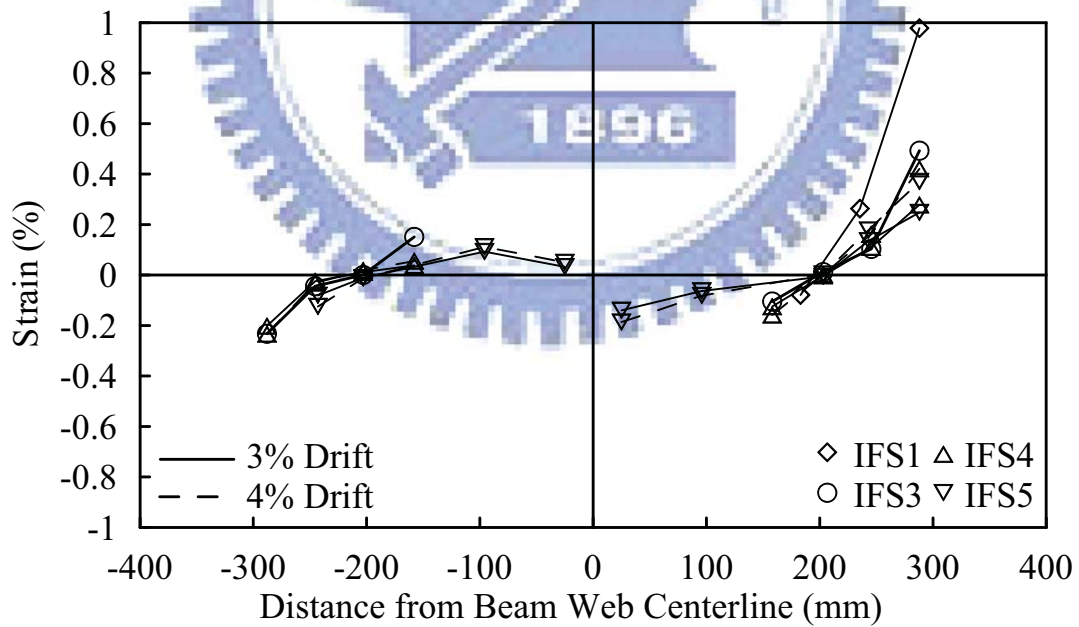


(b) Bottom Flange

圖 3. 59 IFS 試體縱向應變比較圖(Positive Bending)

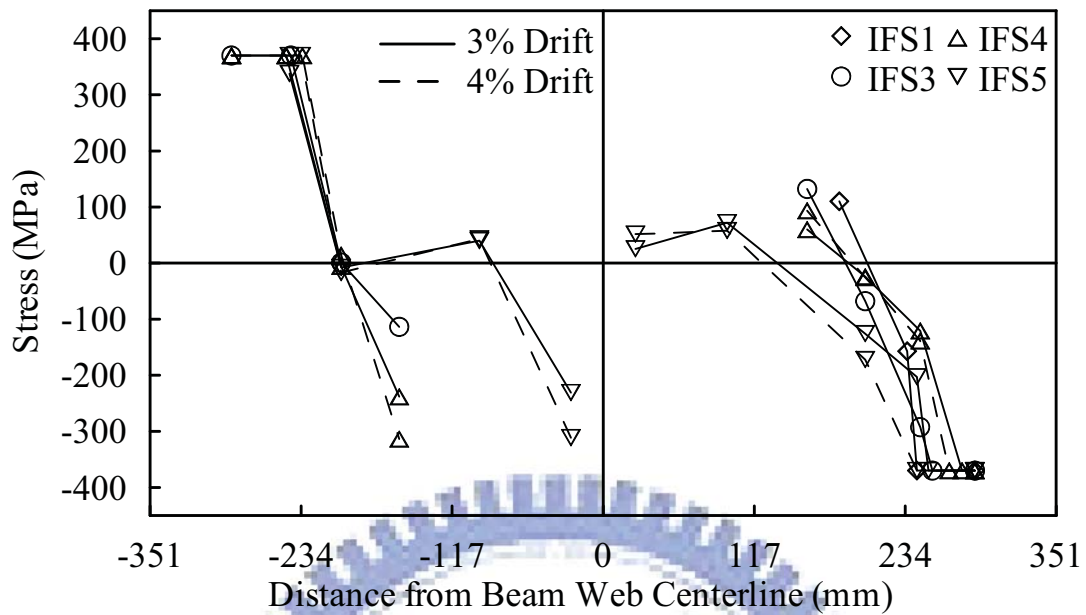


(a) Negative Bending

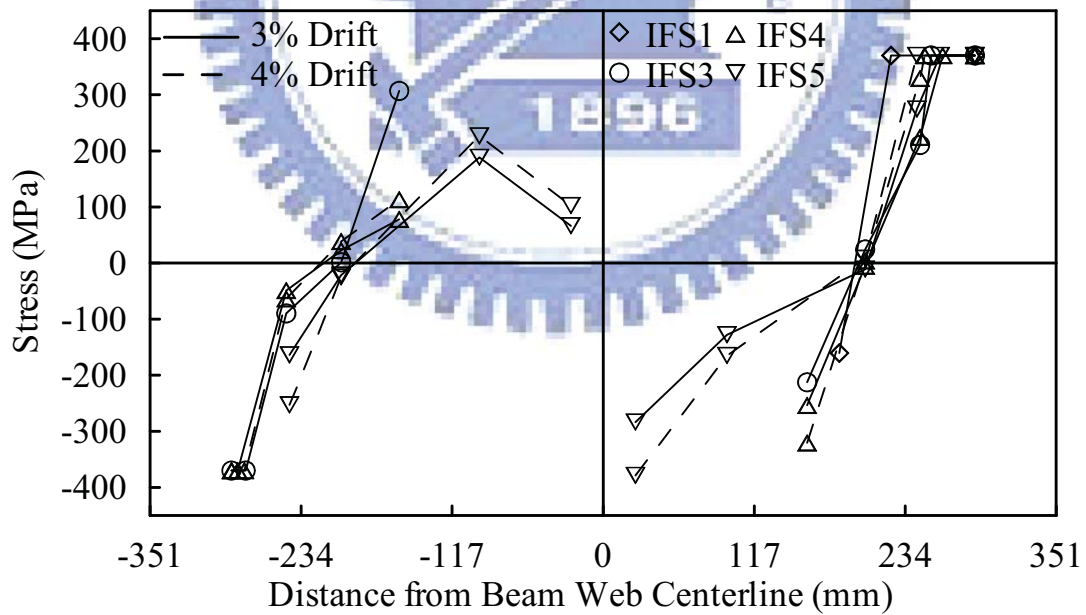


(b) Positive Bending

圖 3.60 IFS 試體加勁板應變比較



(a) Negative Bending



(b) Positive Bending

圖 3.61 IFS 試體加勁板應力比較

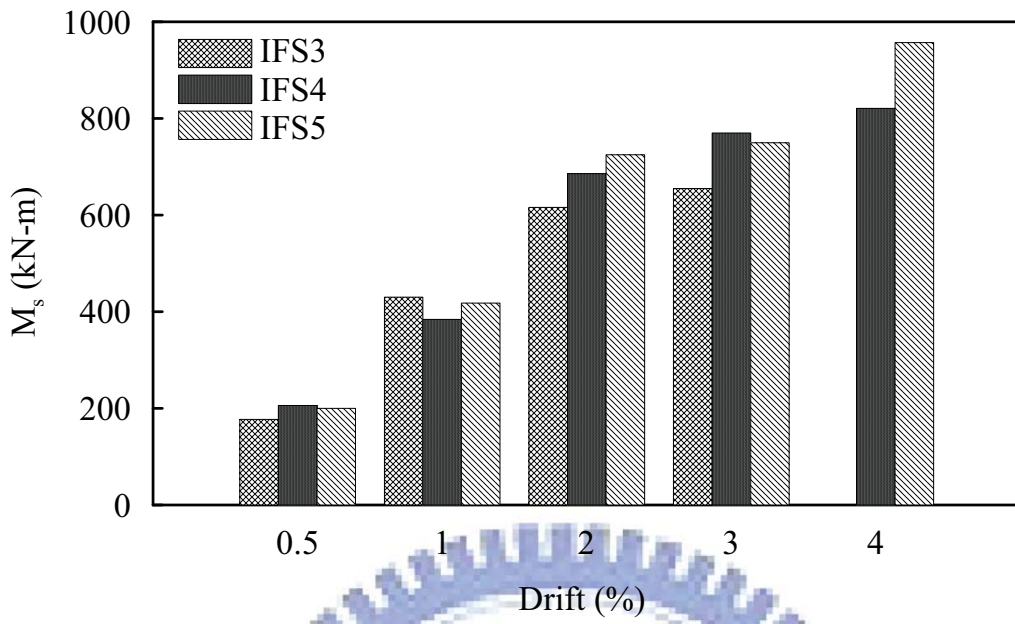


圖 3.62 IFS 試體加勁板提供之彎矩

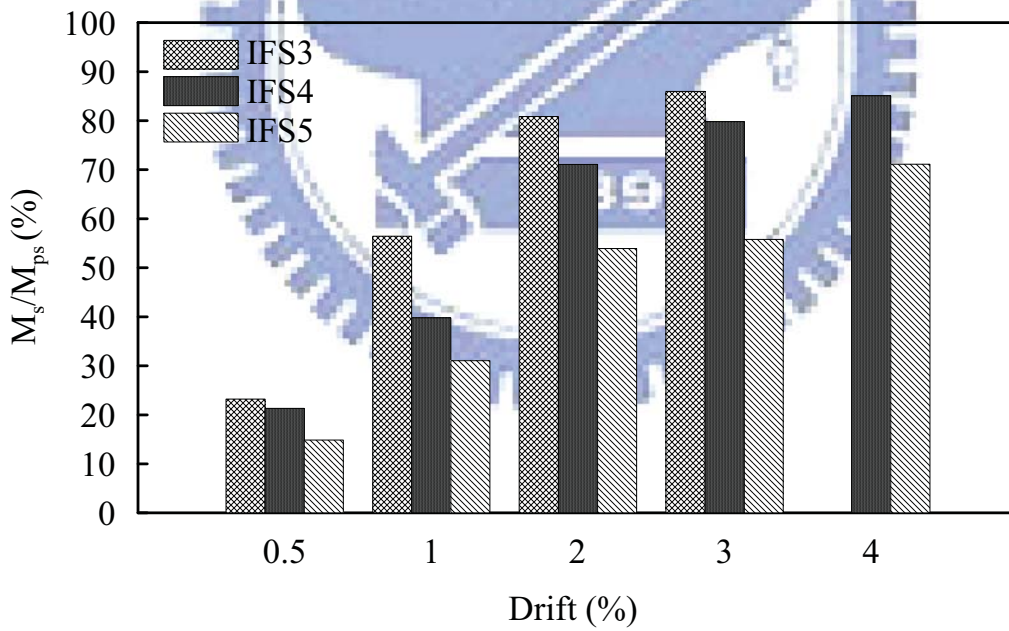


圖 3.63 IFS 試體加勁板提供之塑性彎矩 M_{ps} 比例

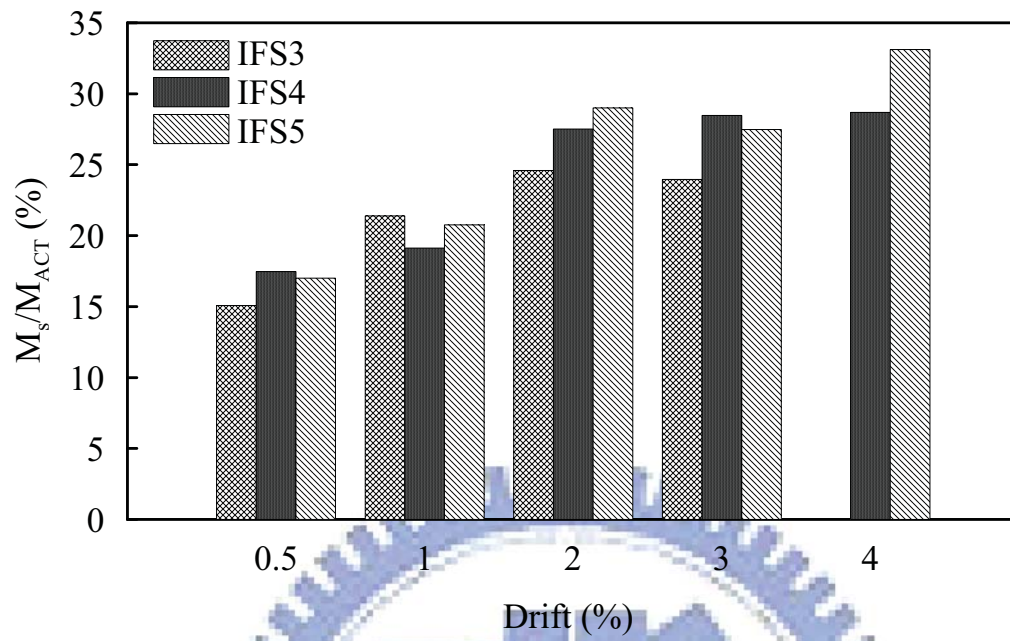
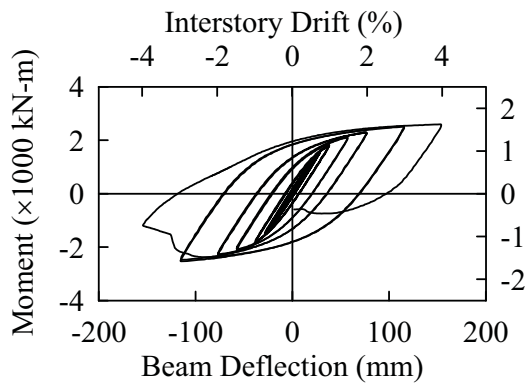
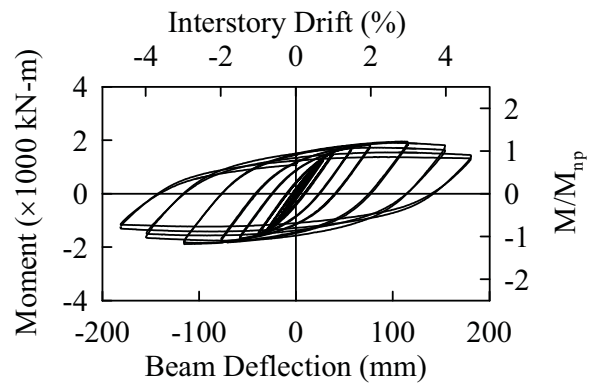


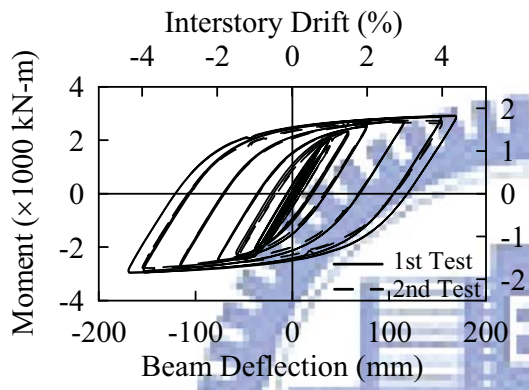
圖 3.64 IFS 試體加勁板提供的彎矩佔整體彎矩的比例



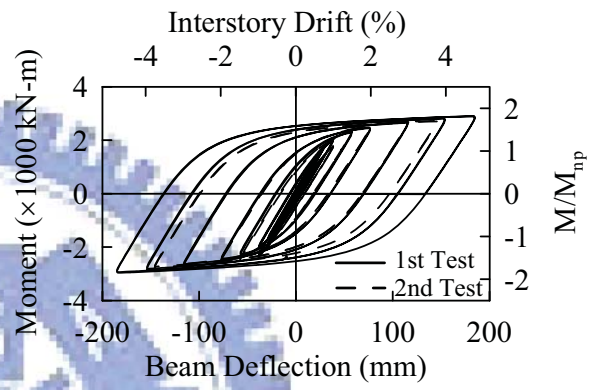
(a) UR



(b) FDWS1

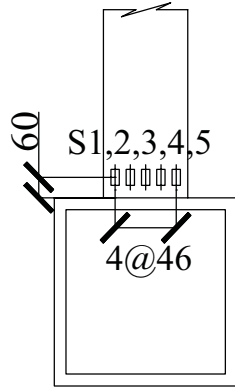


(c) FDWS2

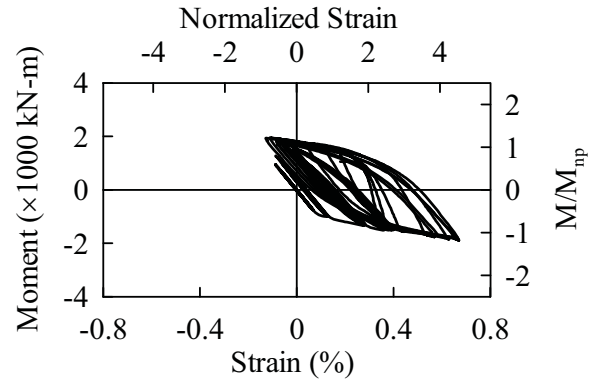


(d) FDWS3

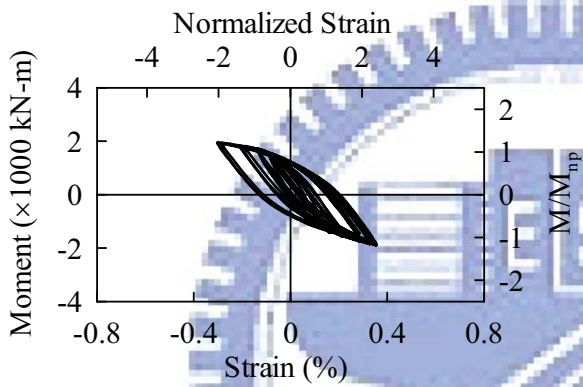
圖 4.1 試體 FDWS 彎矩與梁端位移關係圖



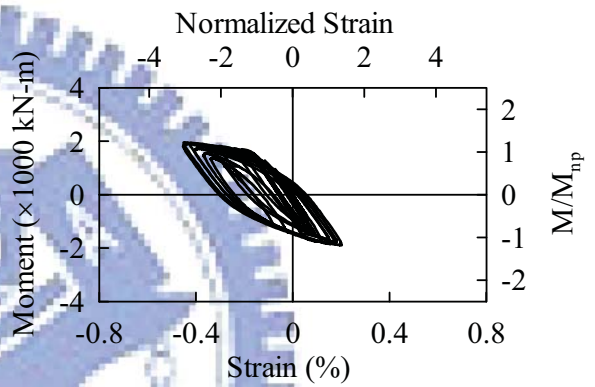
(a) Strain Gauge Location



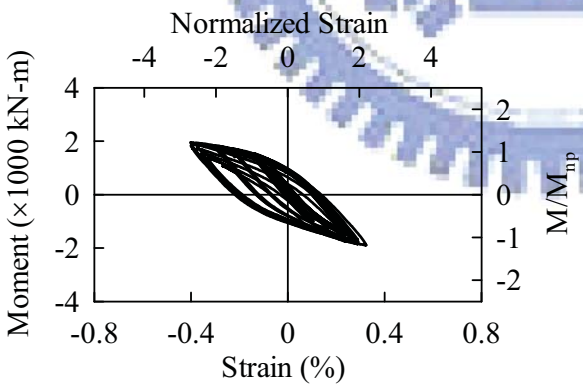
(b) Strain Gauge S1



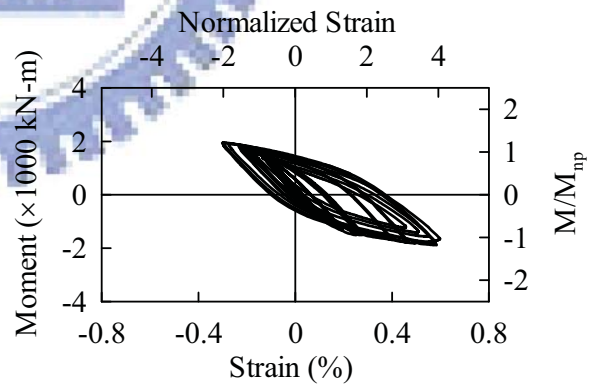
(c) Strain Gauge S2



(d) Strain Gauge S3

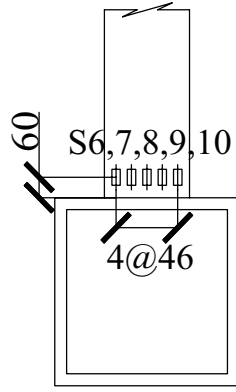


(e) Strain Gauge S4

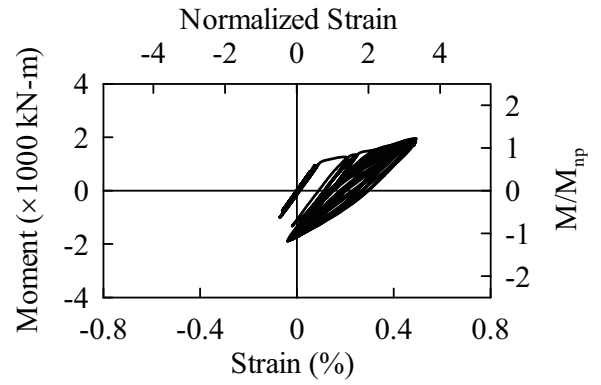


(f) Strain Gauge S5

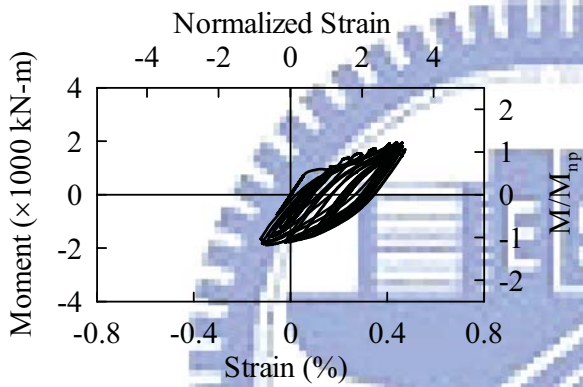
圖 4.2 試體 FDWS1 彎矩與上翼板橫向應變關係



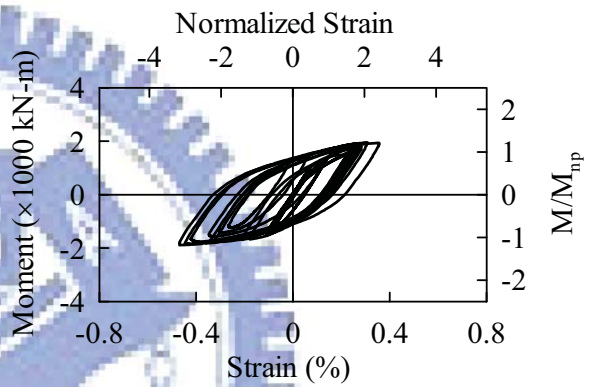
(a) Strain Gauge Location



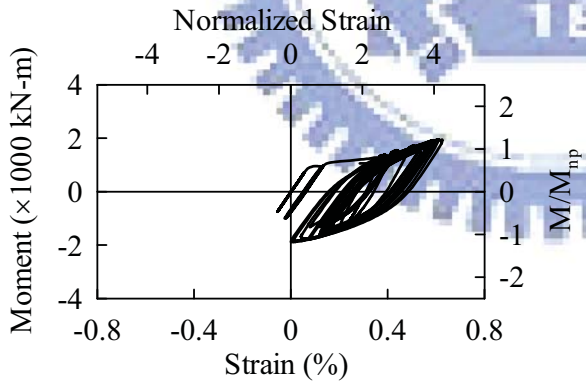
(b) Strain Gauge S6



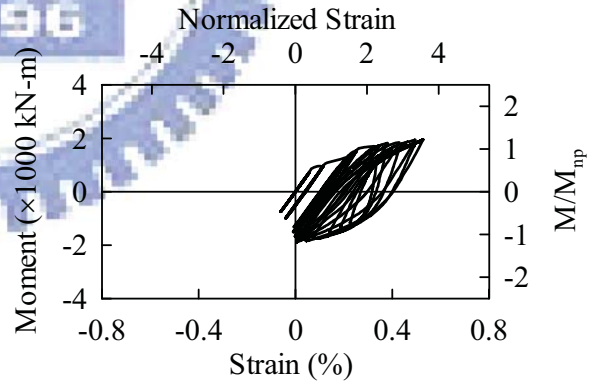
(c) Strain Gauge S7



(d) Strain Gauge S8

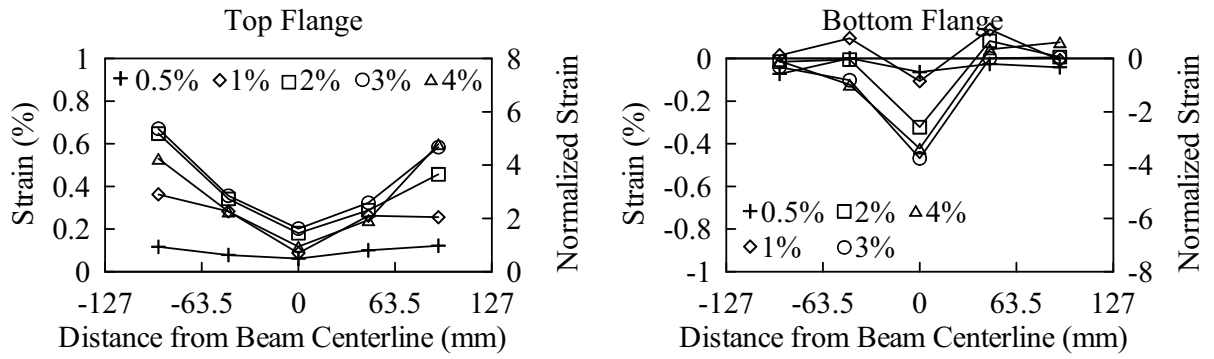


(e) Strain Gauge S9

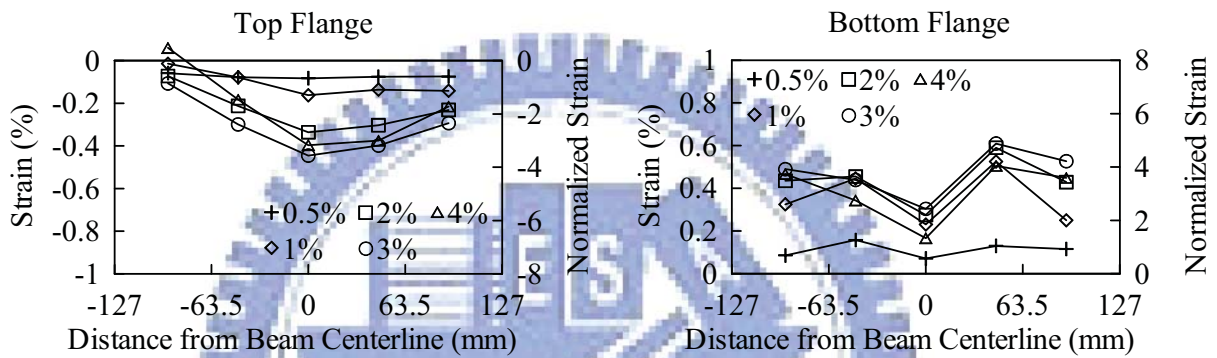


(f) Strain Gauge S10

圖 4.3 試體 FDWS1 彎矩與下翼板橫向應變關係



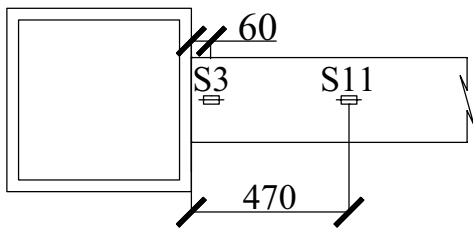
(a) Negative Bending



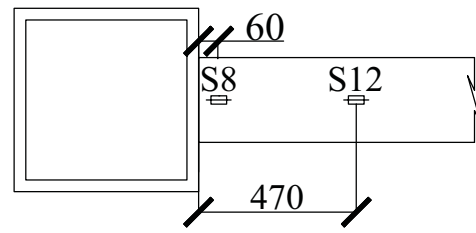
(b) Positive Bending

圖 4.4 試體 FDWS1 梁翼板橫向應變分佈圖

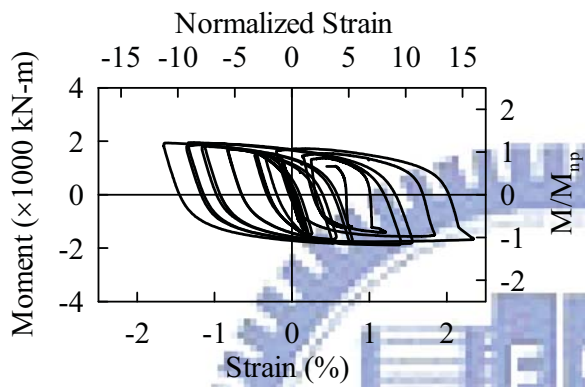
Strain Gauge Location



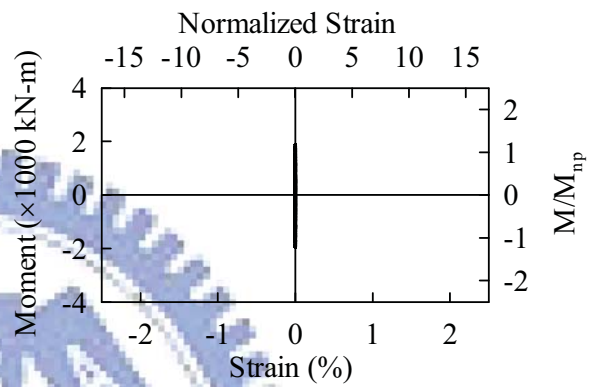
(a) Top Flange



(b) Bottom Flange

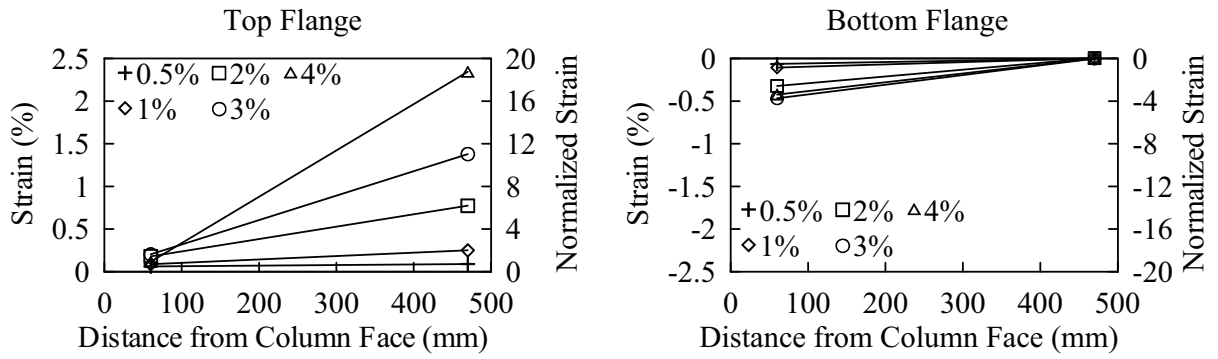


(c) Strain Gauge S11

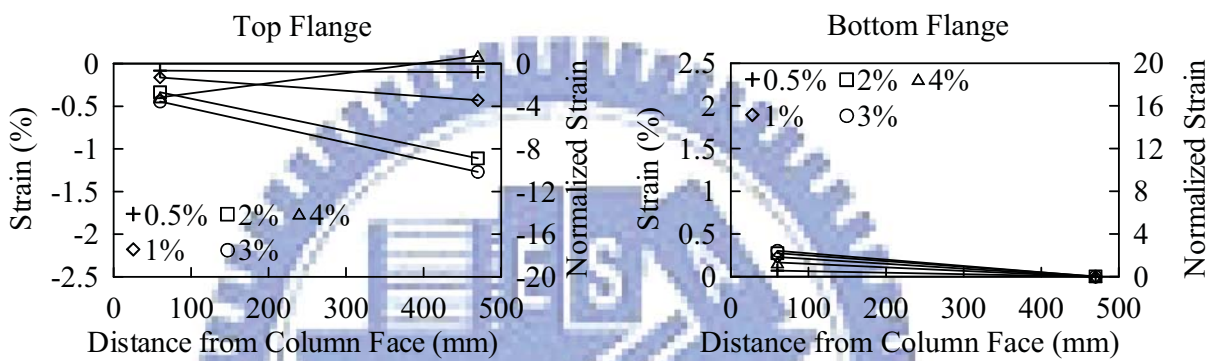


(d) Strain Gauge S12

圖 4.5 試體 FDWS1 彎矩與梁翼板縱向應變關係

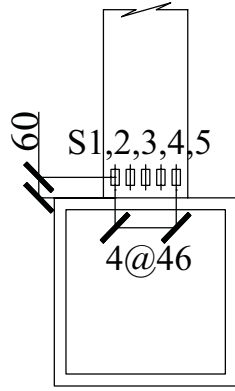


(a) Negative Bending

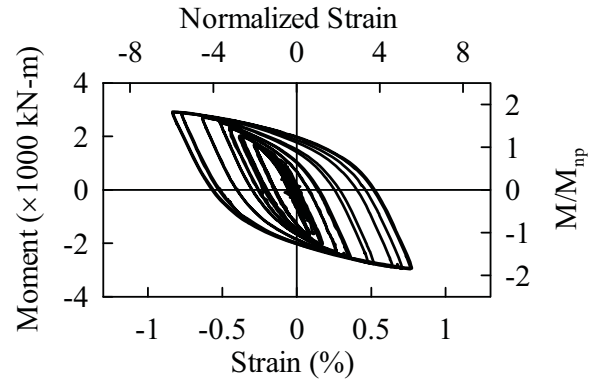


(b) Positive Bending

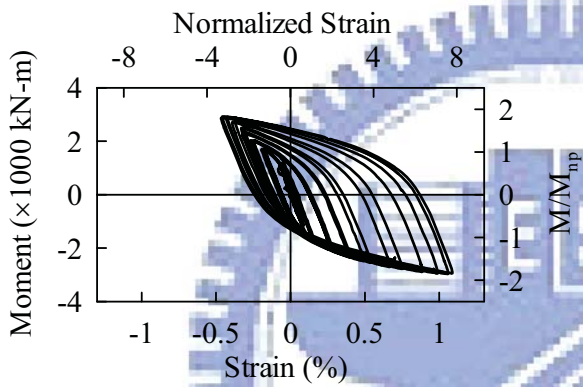
圖 4.6 試體 FDWS1 梁翼板縱向應變關係



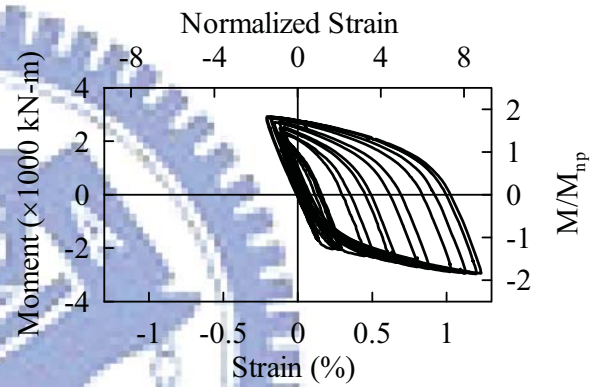
(a) Strain Gauge Location



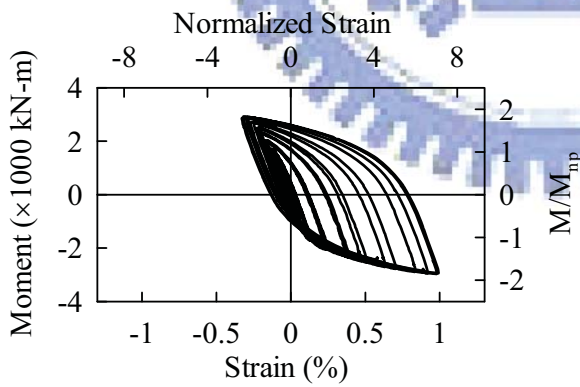
(b) Strain Gauge S1



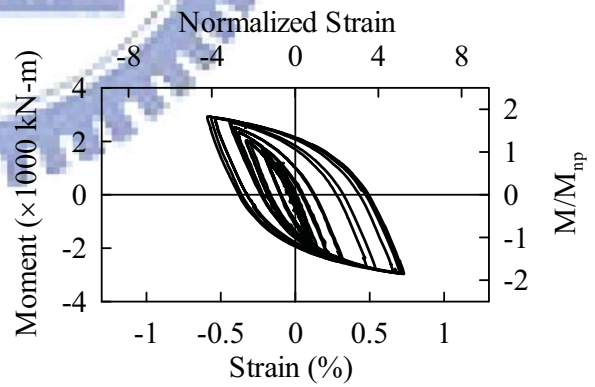
(c) Strain Gauge S2



(d) Strain Gauge S3

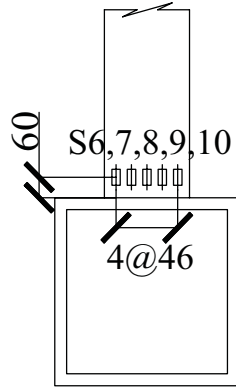


(e) Strain Gauge S4

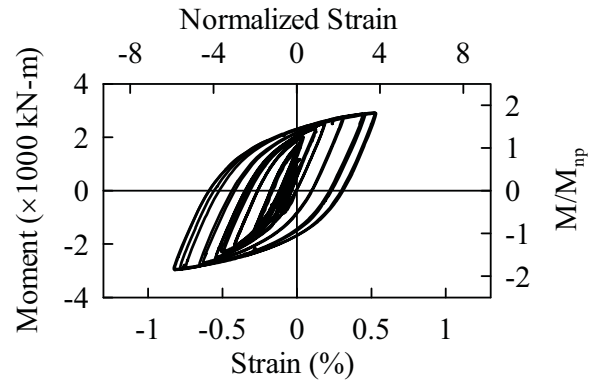


(f) Strain Gauge S5

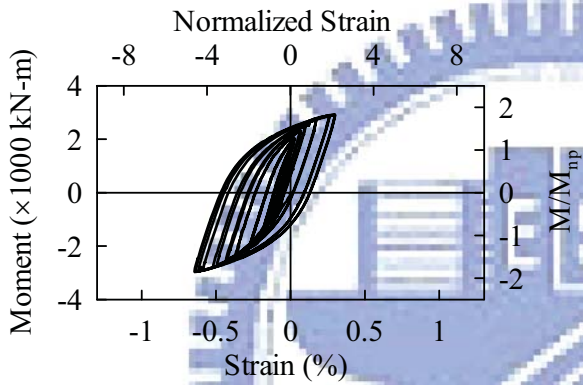
圖 4.7 試體 FDWS2 彎矩與上翼板橫向應變關係



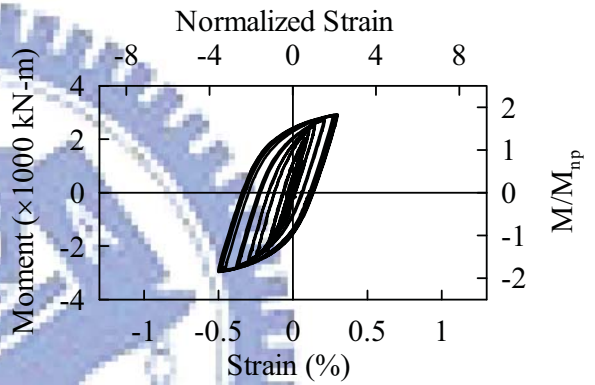
(a) Strain Gauge Location



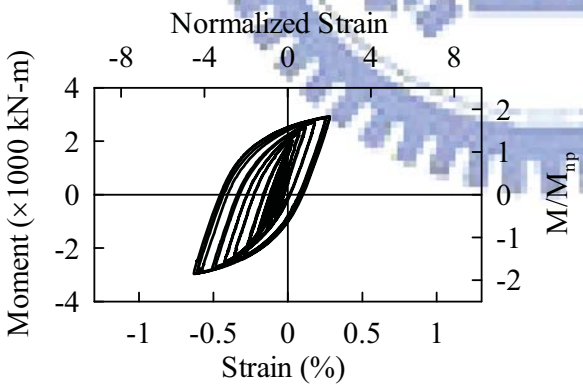
(b) Strain Gauge S6



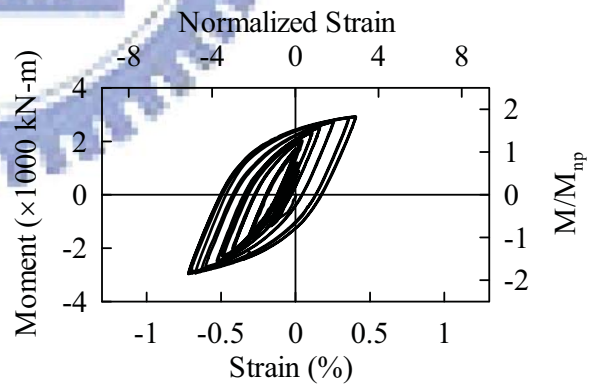
(c) Strain Gauge S7



(d) Strain Gauge S8

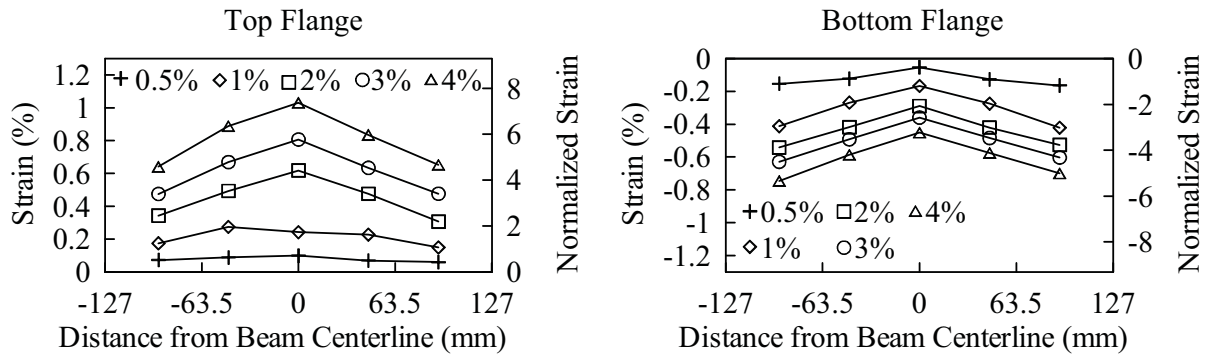


(e) Strain Gauge S9

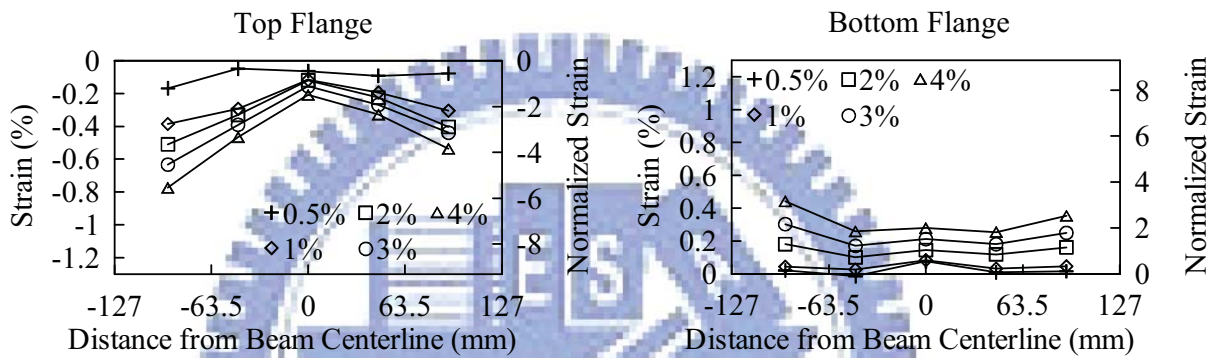


(f) Strain Gauge S10

圖 4.8 試體 FDWS2 彎矩與下翼板橫向應變關係

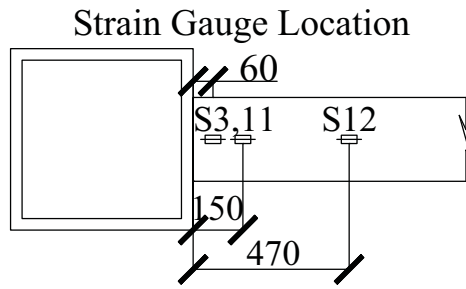


(a) Negative Bending

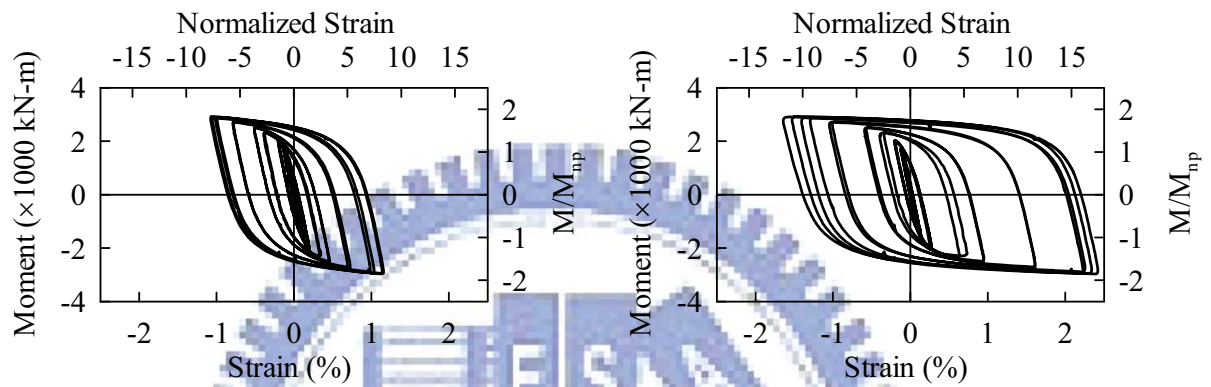


(b) Positive Bending

圖 4.9 試體 FDWS2 梁翼板橫向應變分佈圖



(a) Top Flange

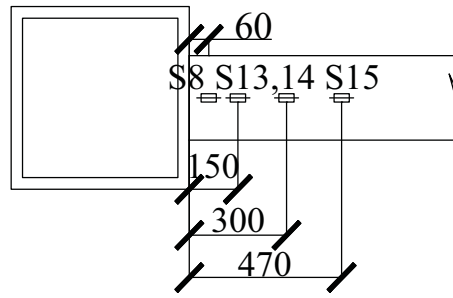


(b) Strain Gauge S11

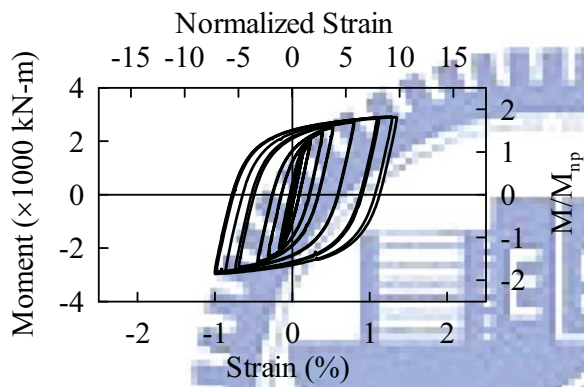
(c) Strain Gauge S12

圖 4.10 試體 FDWS2 彎矩與梁上翼板縱向應變關係

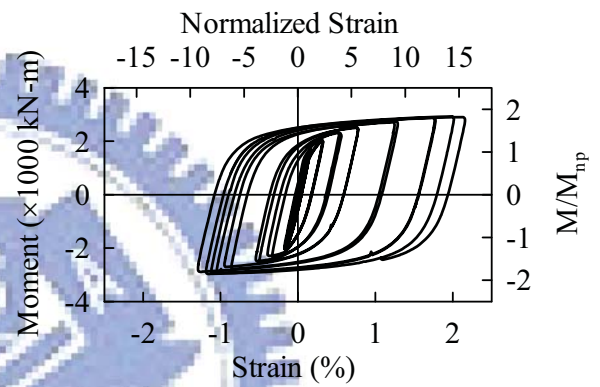
Strain Gauge Location



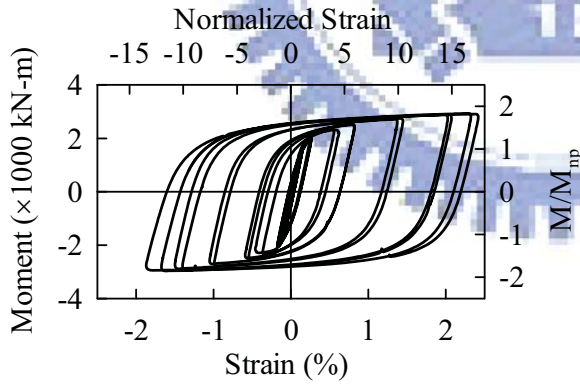
(a) Bottom Flange



(b) Strain Gauge S13

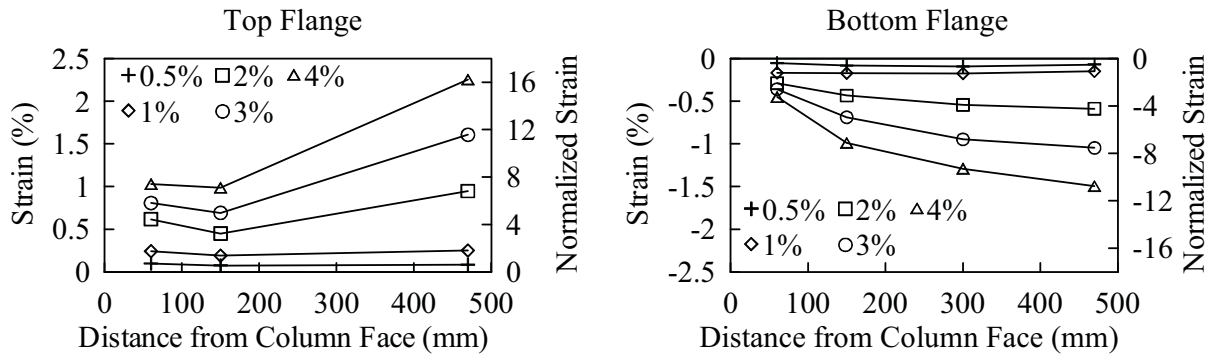


(c) Strain Gauge S14

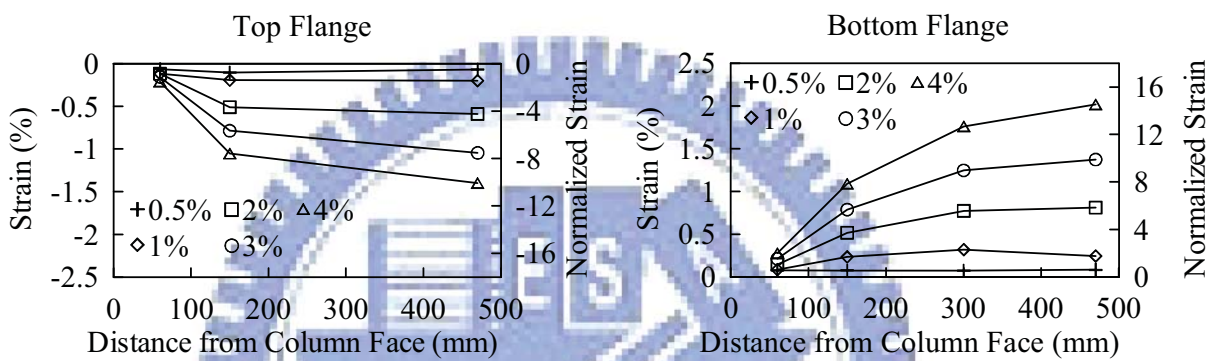


(d) Strain Gauge S13

圖 4.11 試體 FDWS2 彎矩與梁下翼板縱向應變關係

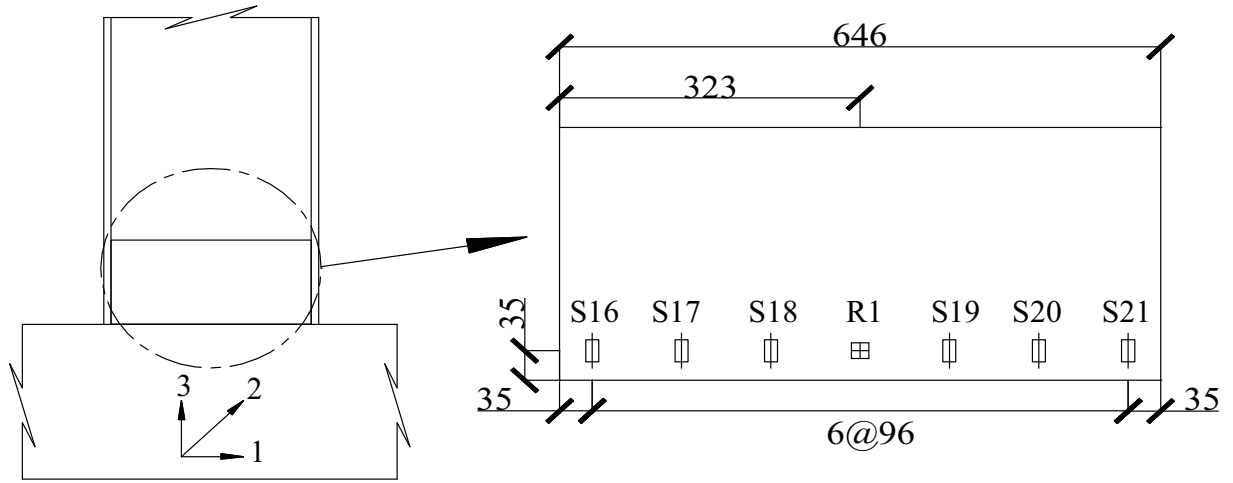


(a) Negative Bending

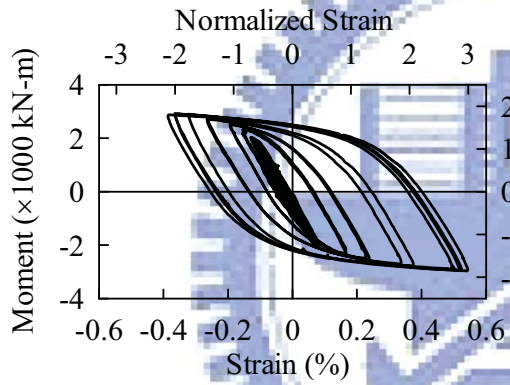


(b) Positive Bending

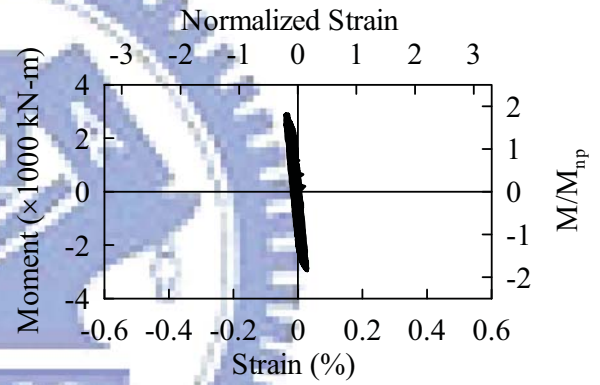
圖 4.12 試體 FDWS2 梁翼板縱向應變分佈圖



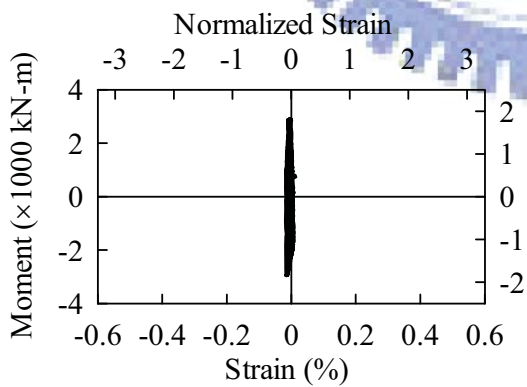
(a) Strain Gauge Location



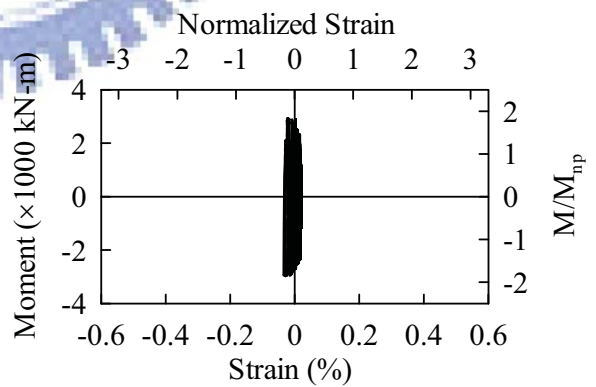
(c) Strain Gauge S16



(d) Strain Gauge S17

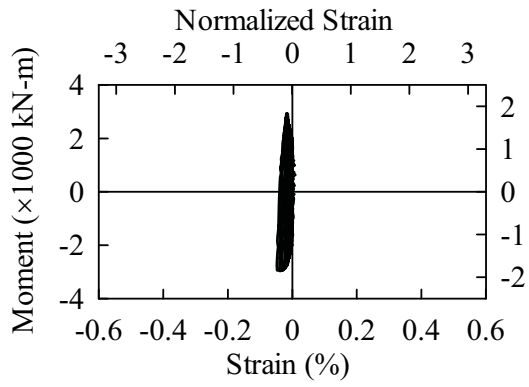


(e) Strain Gauge S18

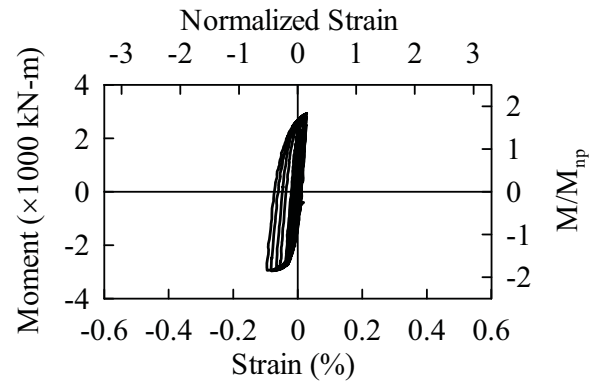


(f) Strain Gauge R1-3

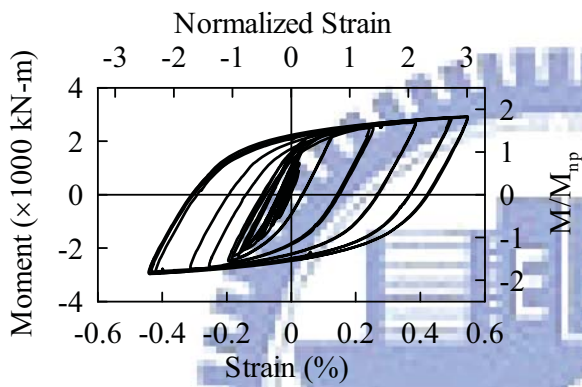
圖 4.13 試體 FDWS2 彎距與加勁板應變關係



(a) Strain Gauge S19

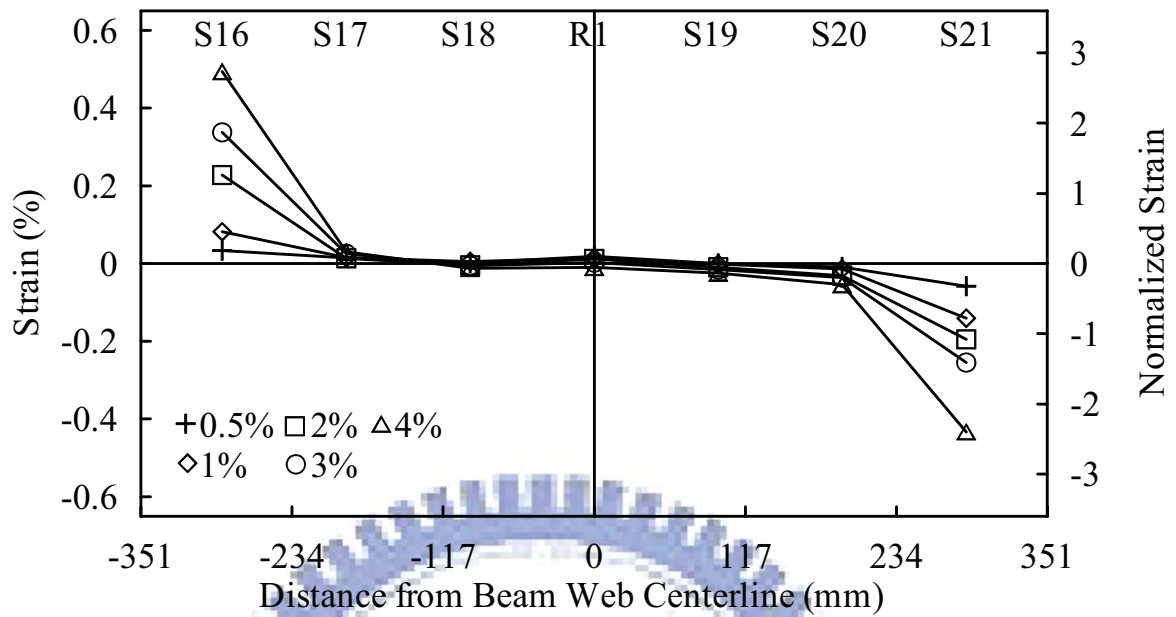


(b) Strain Gauge S20

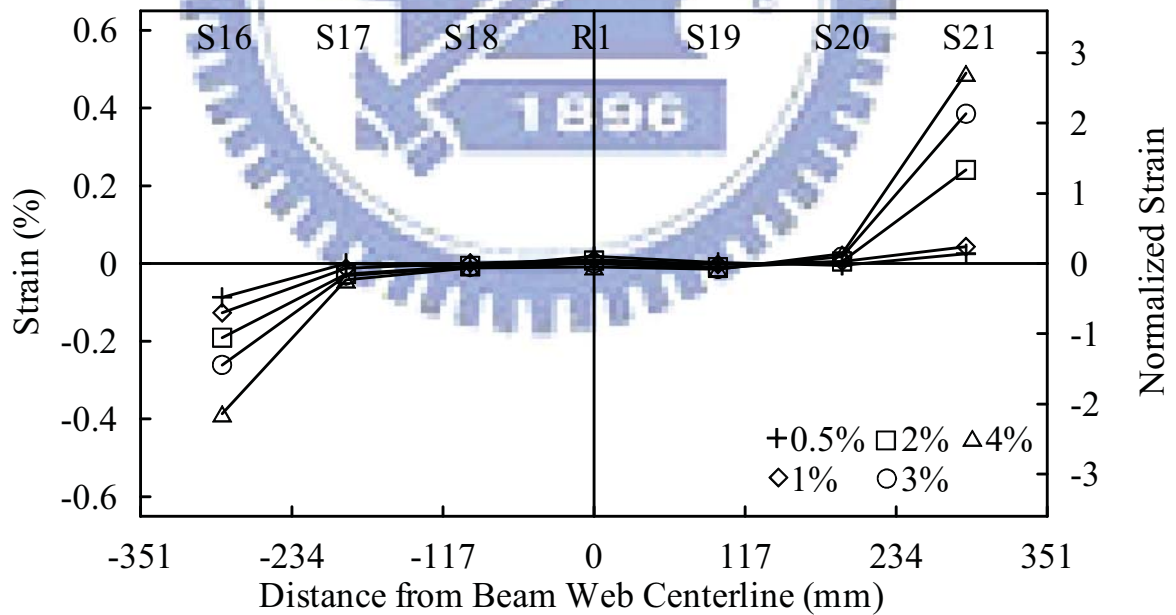


(c) Strain Gauge S21

圖 4.14 試體 FDWS2 彎距與加勁板應變關係 (續)

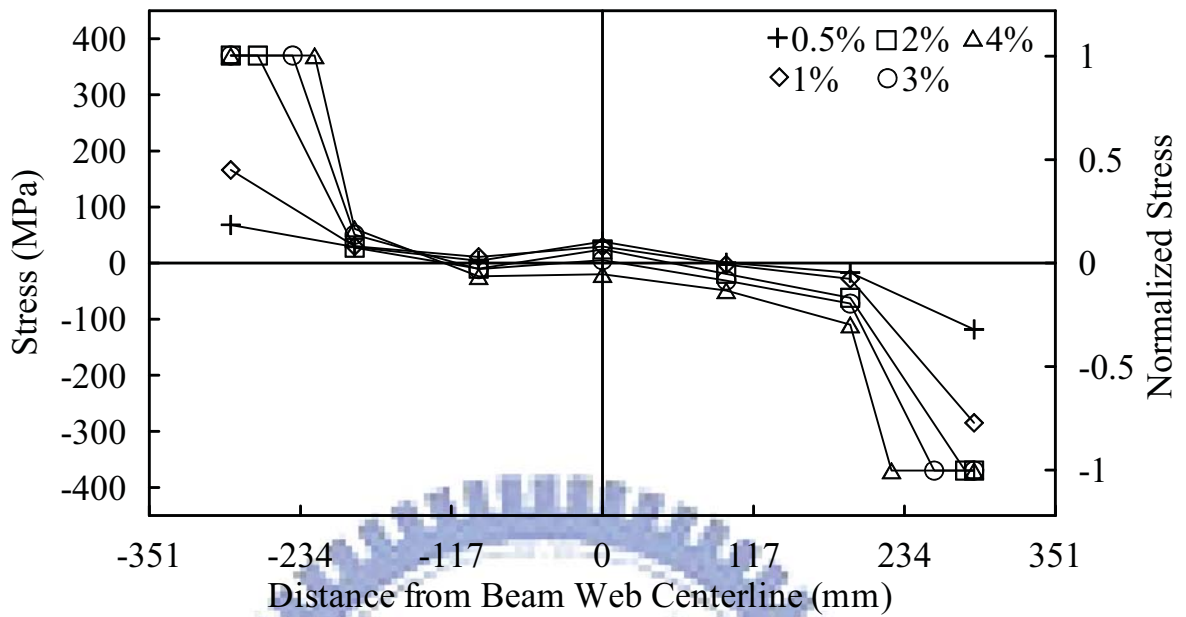


(a) Negative Bending

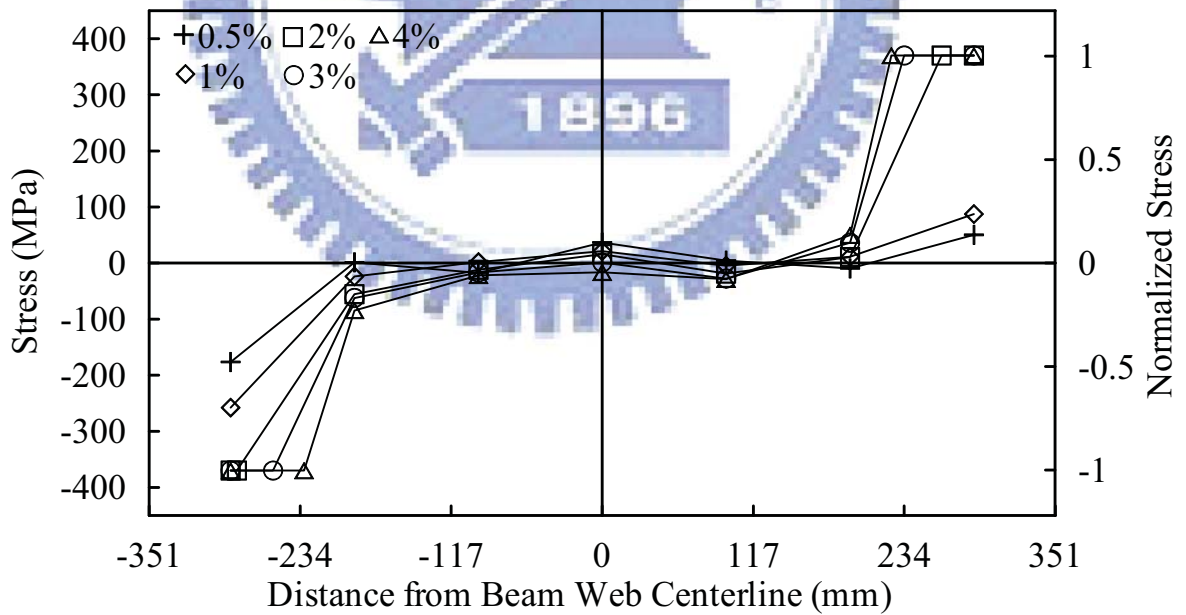


(b) Positive Bending

圖 4.15 試體 FDWS2 加勁板應變分佈

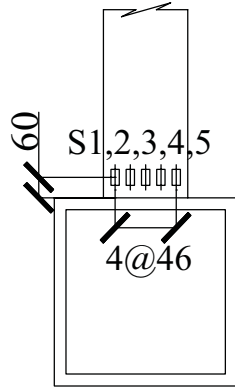


(a) Negative Bending

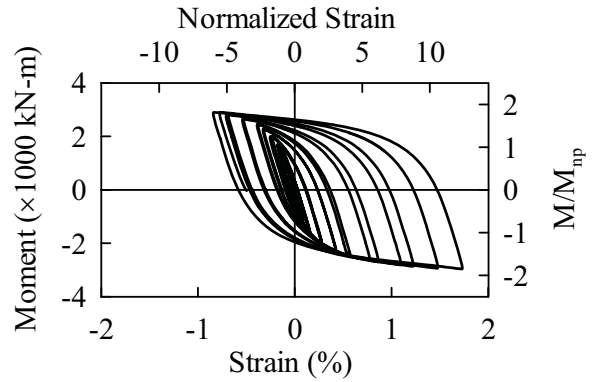


(b) Positive Bending

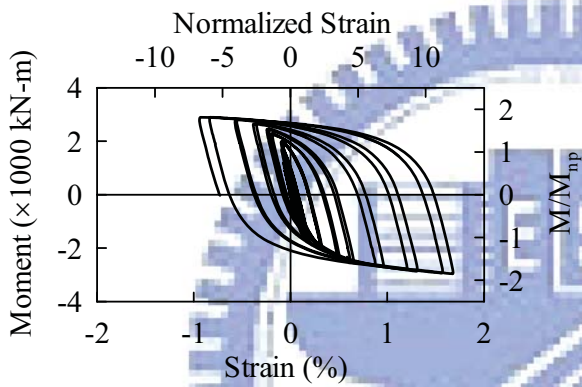
圖 4.16 試體 FDWS2 加勁板應力分佈



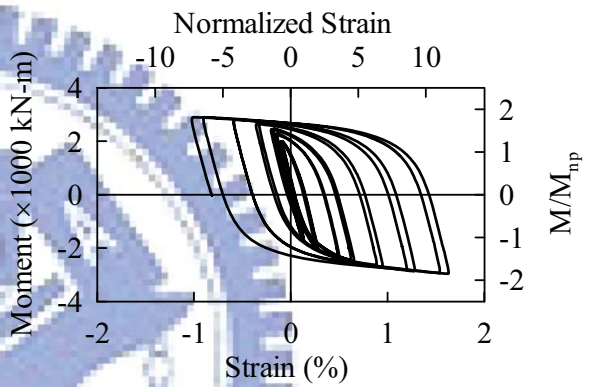
(a) Strain Gauge Location



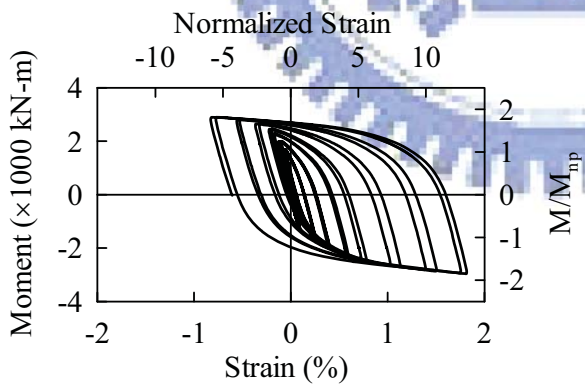
(b) Strain Gauge S1



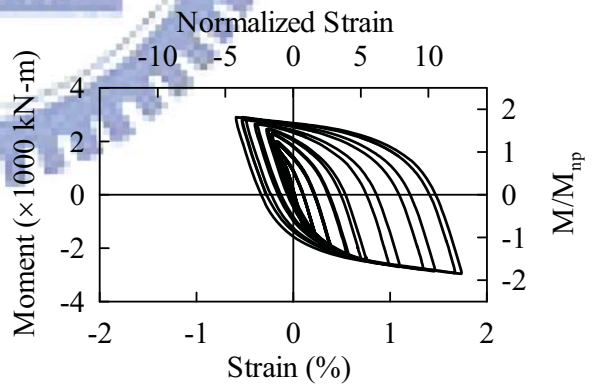
(c) Strain Gauge S2



(d) Strain Gauge S3

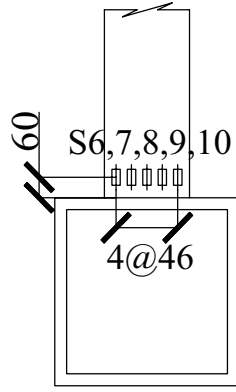


(e) Strain Gauge S4

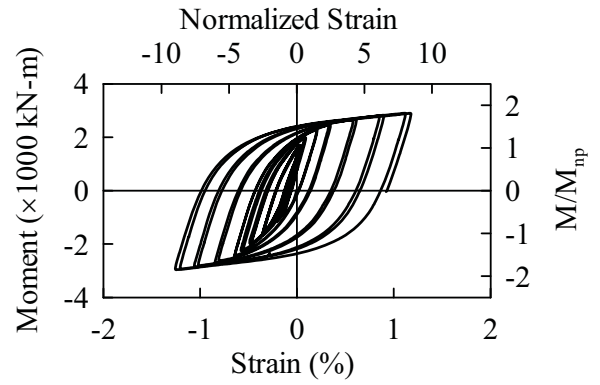


(f) Strain Gauge S5

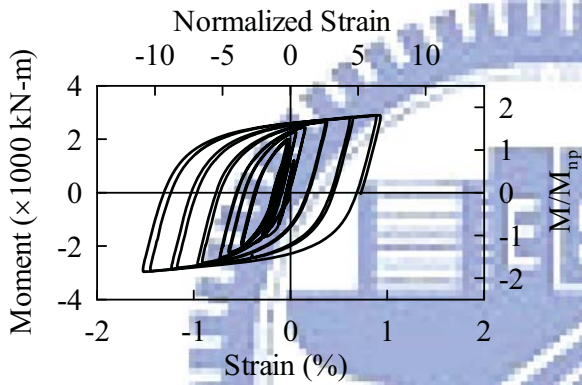
圖 4.17 試體 FDWS3 彎矩與上翼板橫向應變關係



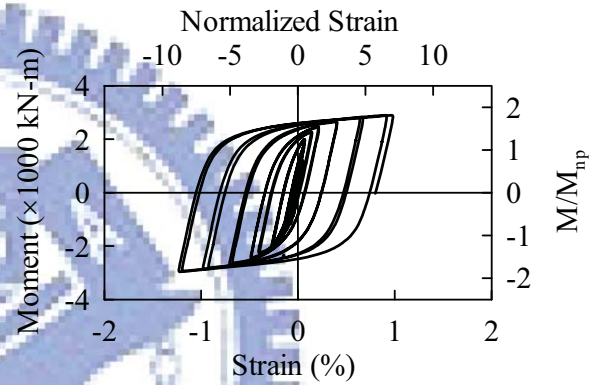
(a) Strain Gauge Location



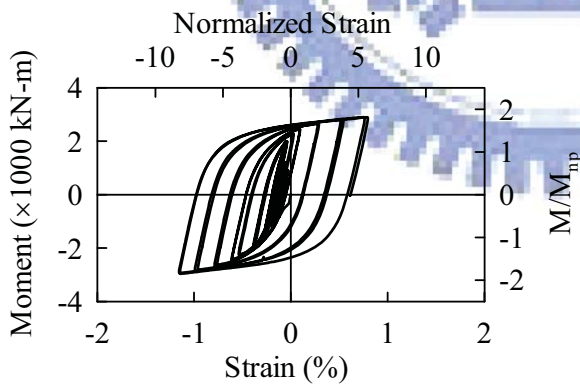
(b) Strain Gauge S6



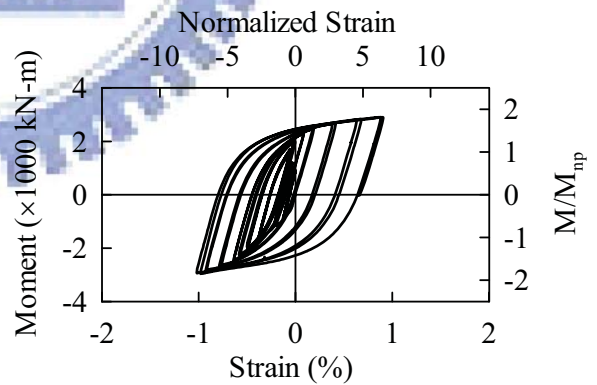
(c) Strain Gauge S7



(d) Strain Gauge S8

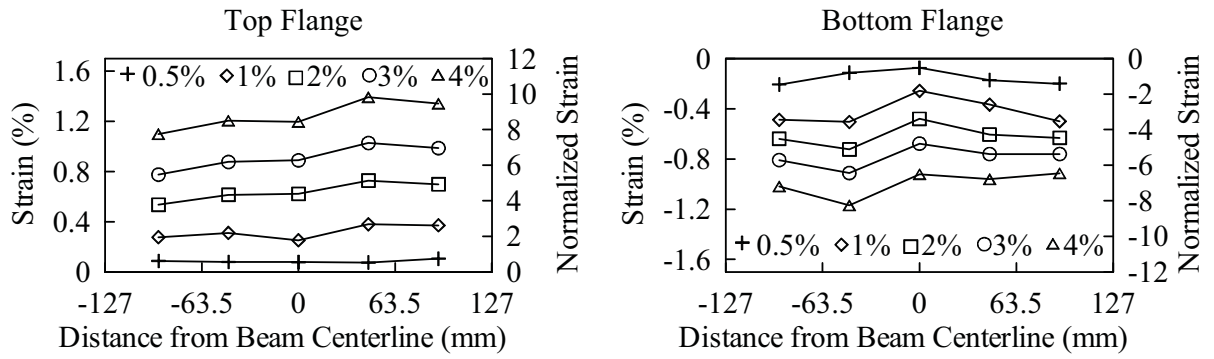


(e) Strain Gauge S9

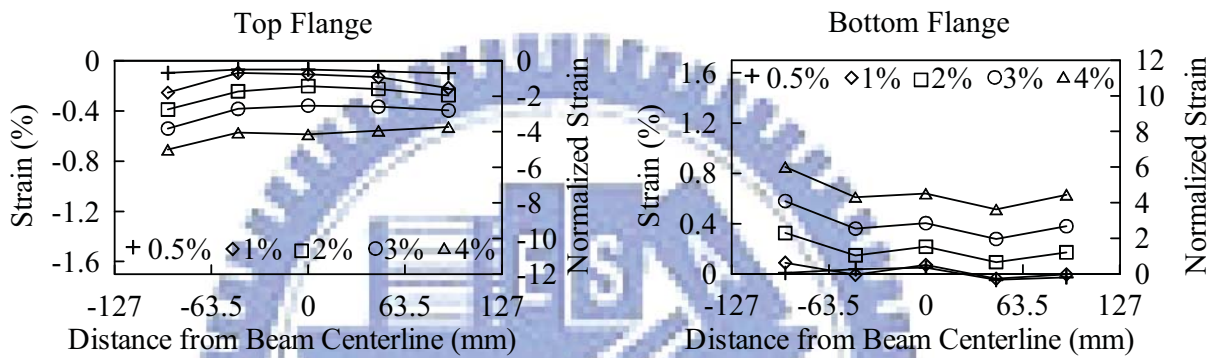


(f) Strain Gauge S10

圖 4.18 試體 FDWS3 彎矩與下翼板橫向應變關係



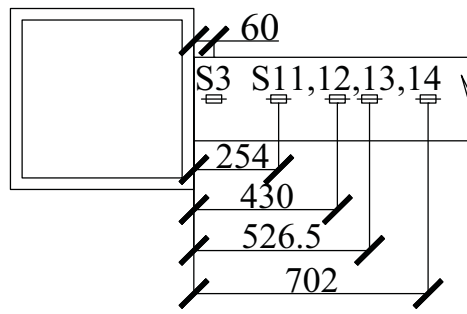
(a) Negative Bending



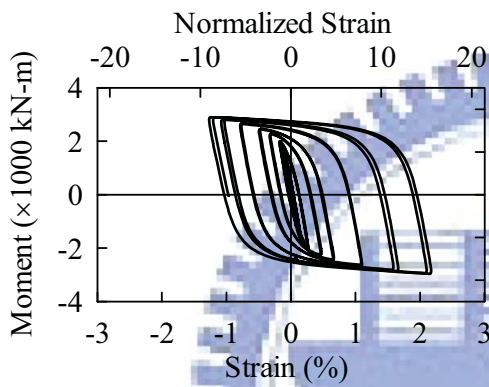
(b) Positive Bending

圖 4.19 試體 FDWS3 梁翼板橫向應變分佈圖

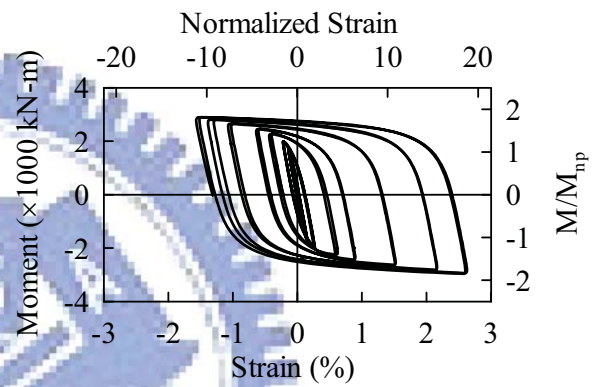
Strain Gauge Location



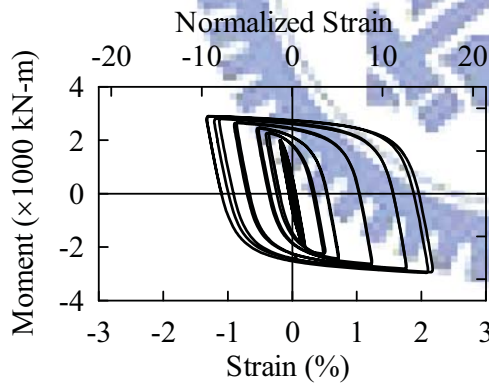
(a) Top Flange



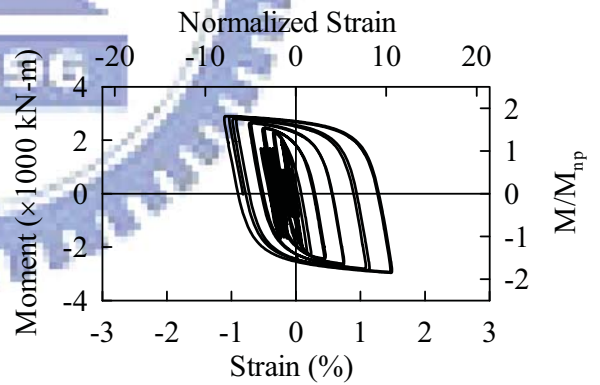
(b) Strain Gauge S11



(c) Strain Gauge S12



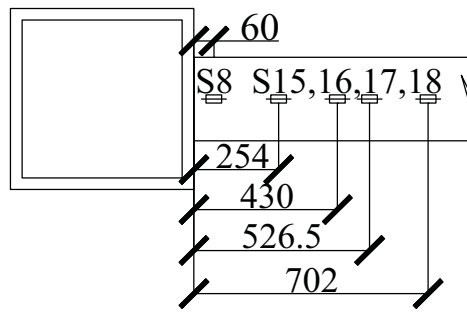
(d) Strain Gauge S13



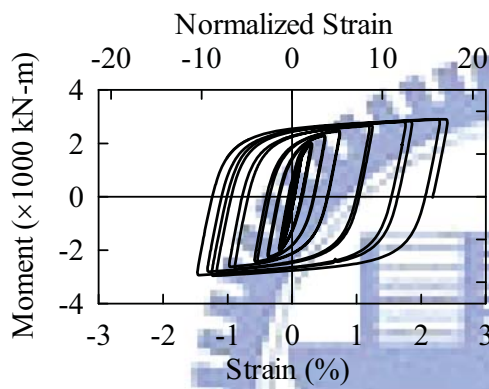
(e) Strain Gauge S14

圖 4.20 試體 FDWS3 彎矩與梁上翼板縱向應變關係

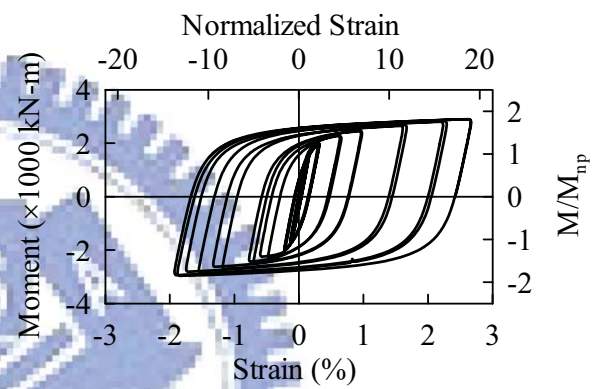
Strain Gauge Location



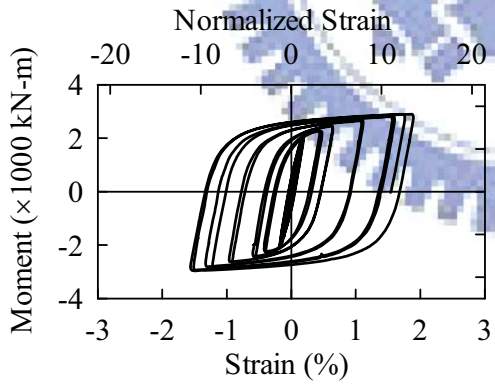
(a) Bottom Flange



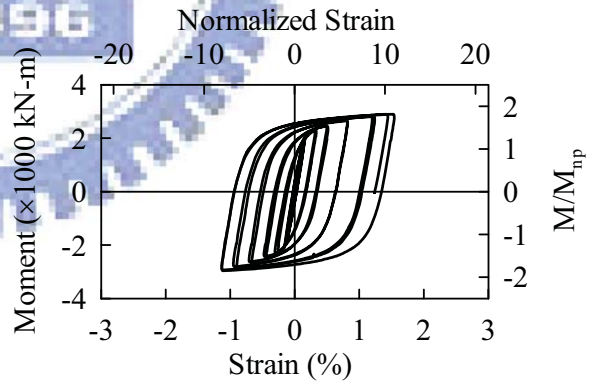
(b) Strain Gauge S15



(c) Strain Gauge S16

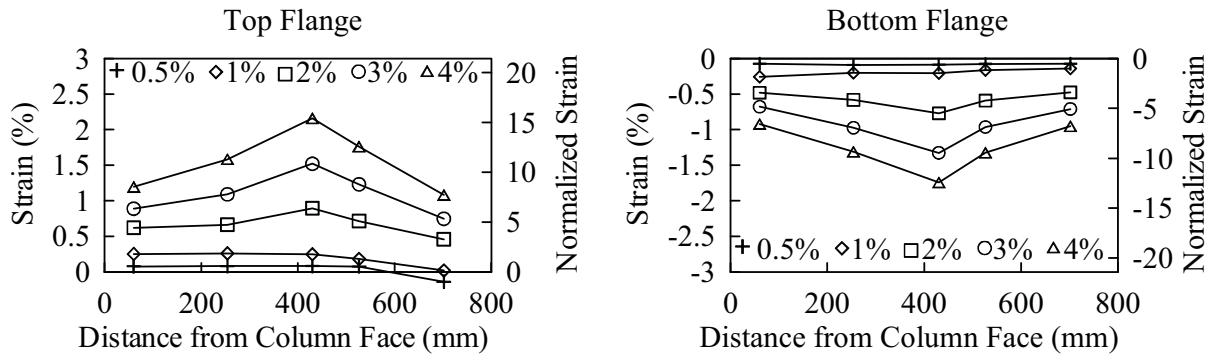


(d) Strain Gauge S17

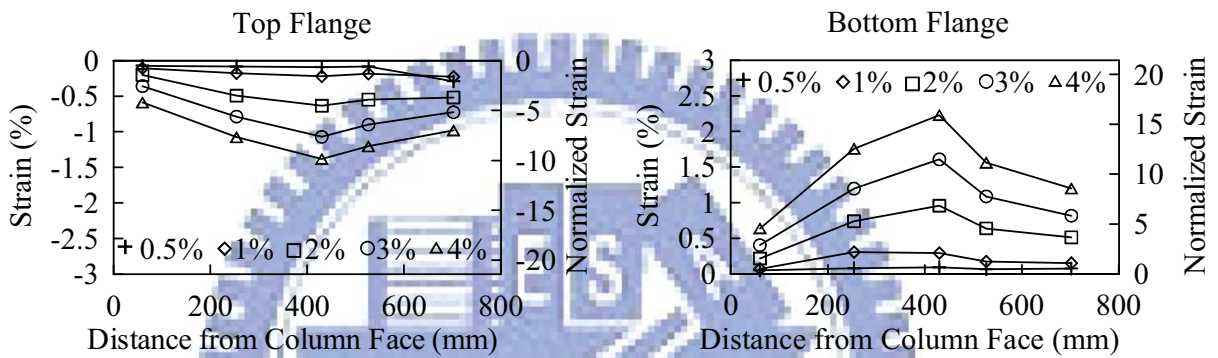


(e) Strain Gauge S18

圖 4.21 試體 FDWS3 彎矩與梁下翼板縱向應變關係

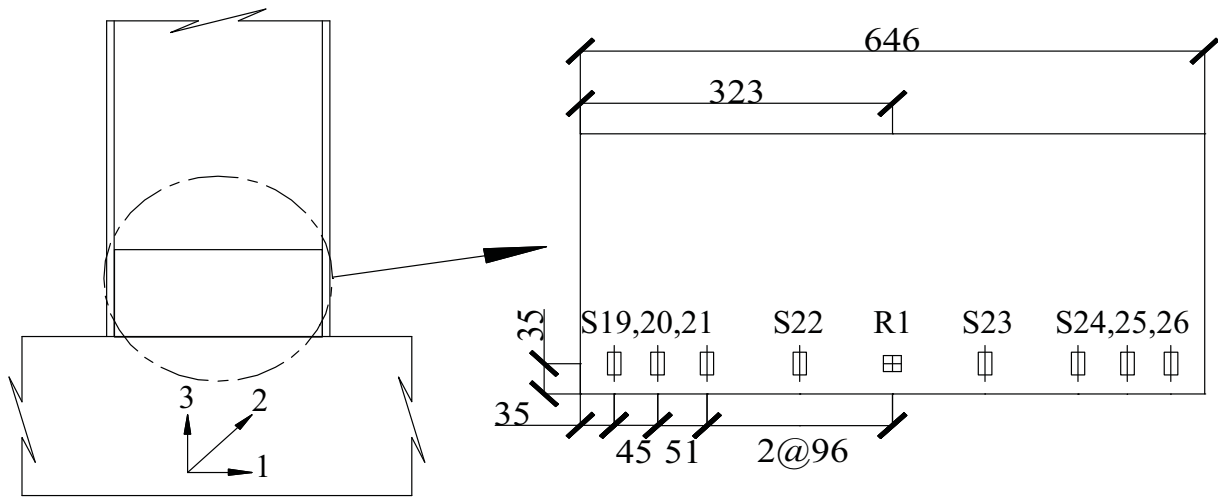


(a) Negative Bending

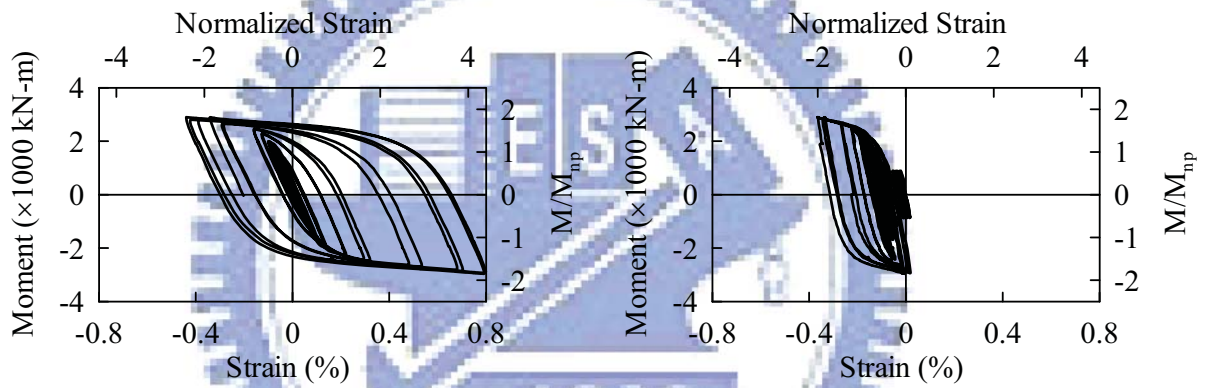


(b) Positive Bending

圖 4.22 試體 FDWS3 梁翼板縱向應變分佈圖

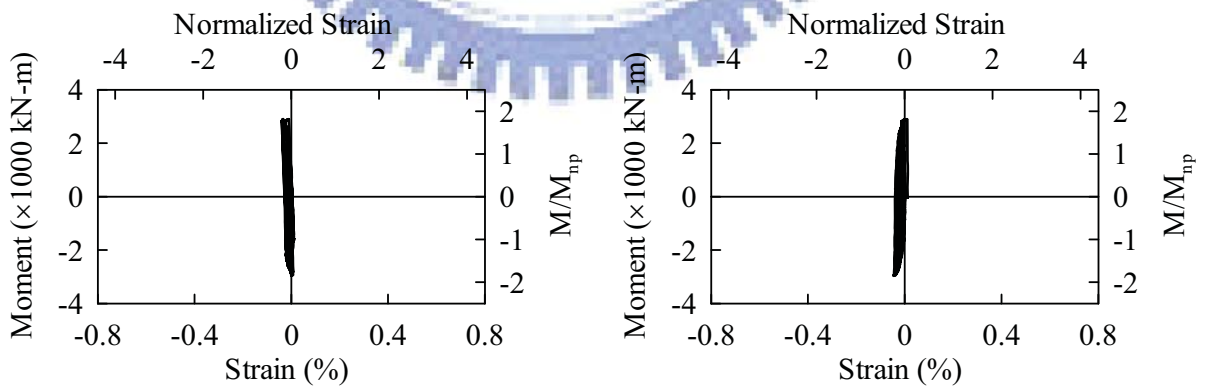


(a) Strain Gauge Location



(b) Strain Gauge S19

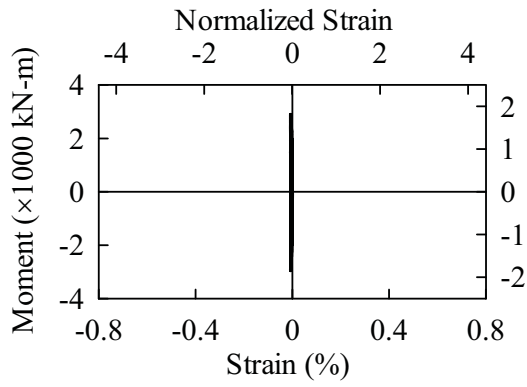
(c) Strain Gauge S20



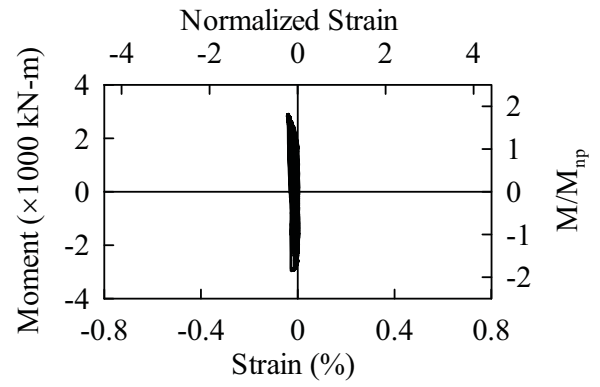
(d) Strain Gauge R21

(e) Strain Gauge S22

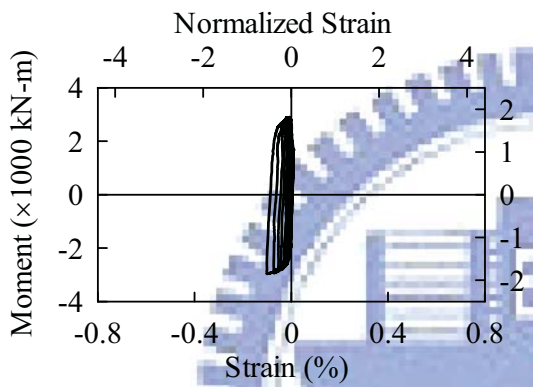
圖 4.23 試體 FDWS3 彎距與加勁板應變關係



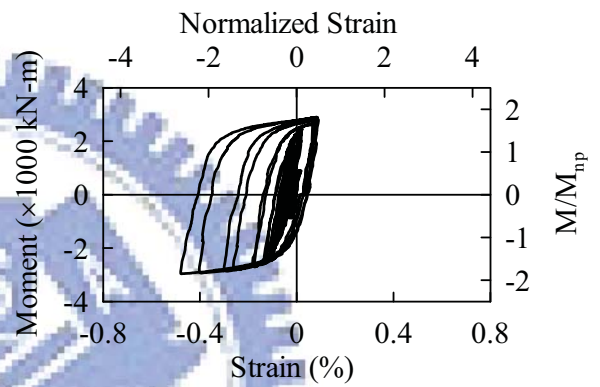
(a) Strain Gauge R1-3



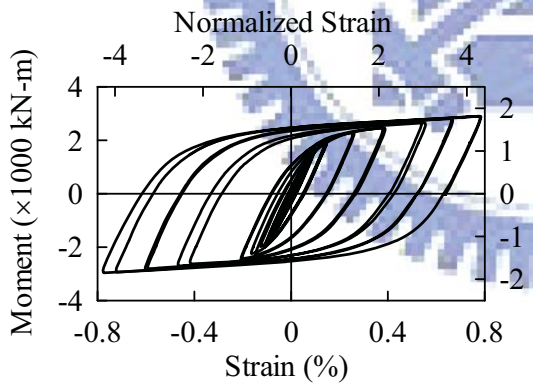
(b) Strain Gauge S23



(c) Strain Gauge S24

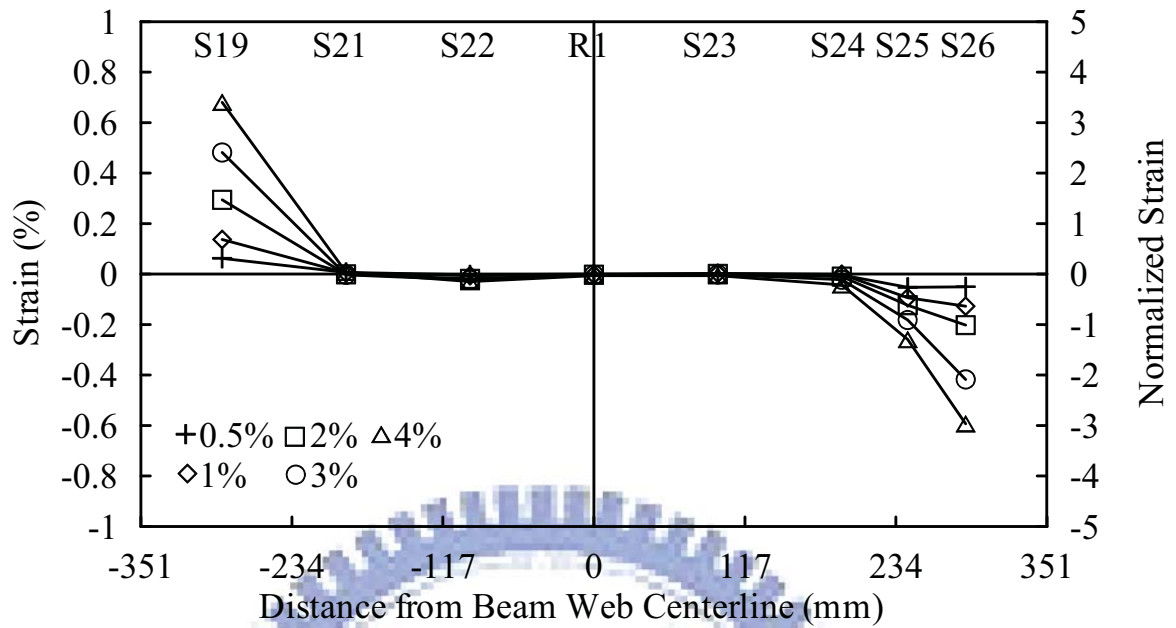


(d) Strain Gauge S25

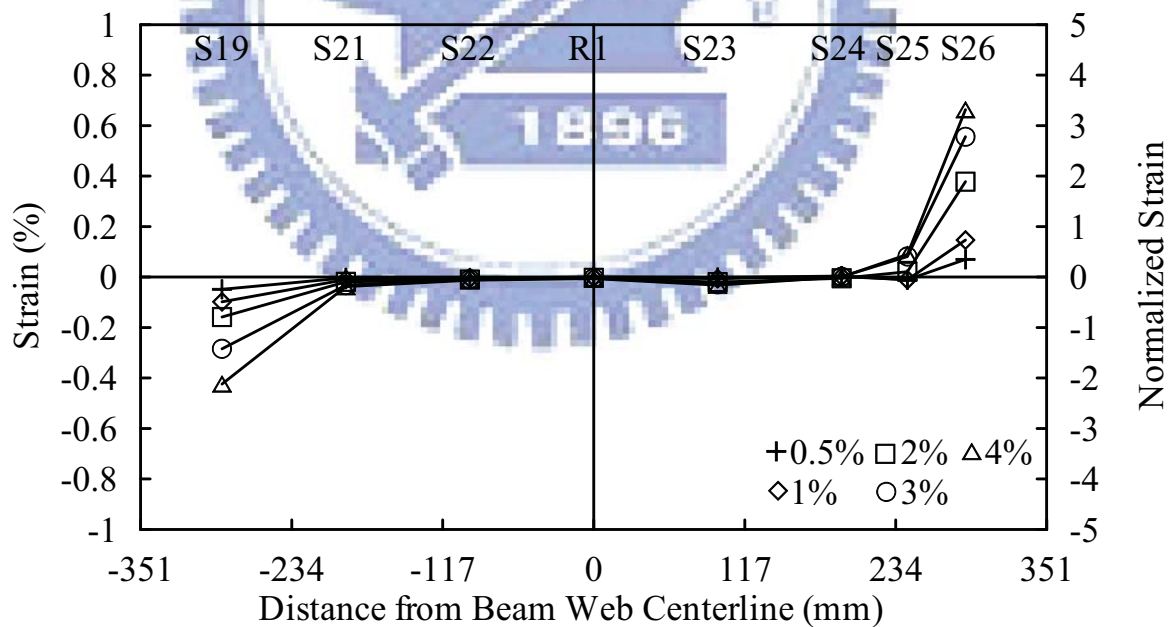


(e) Strain Gauge S26

圖 4.24 試體 FDWS3 彎距與加勁板應變關係 (續)

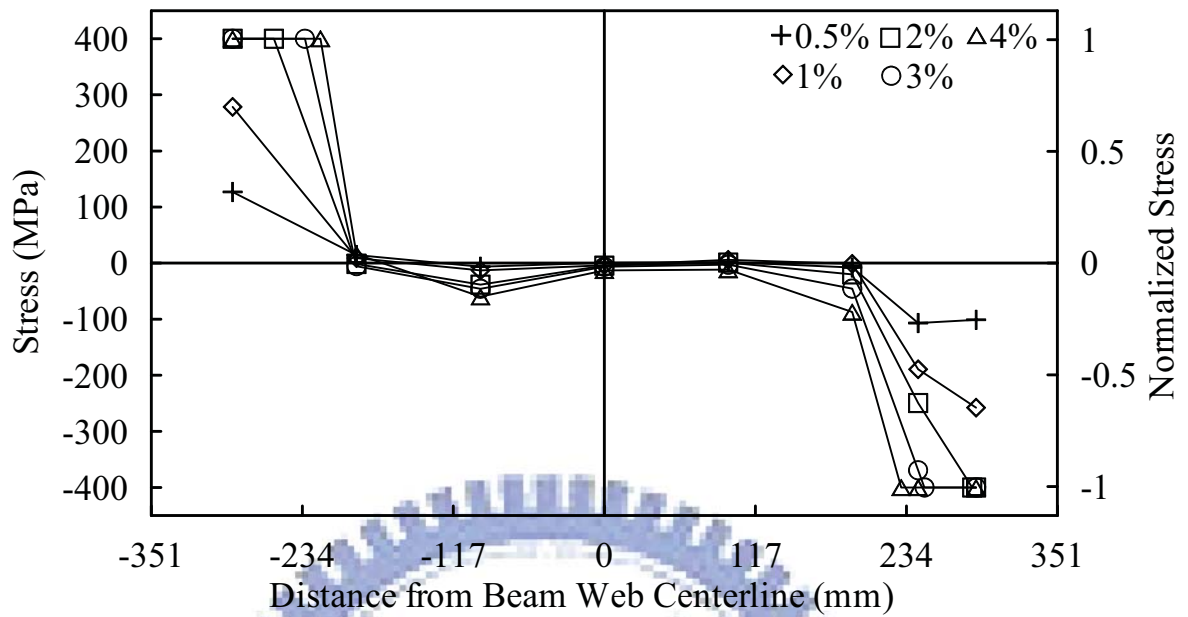


(a) Negative Bending

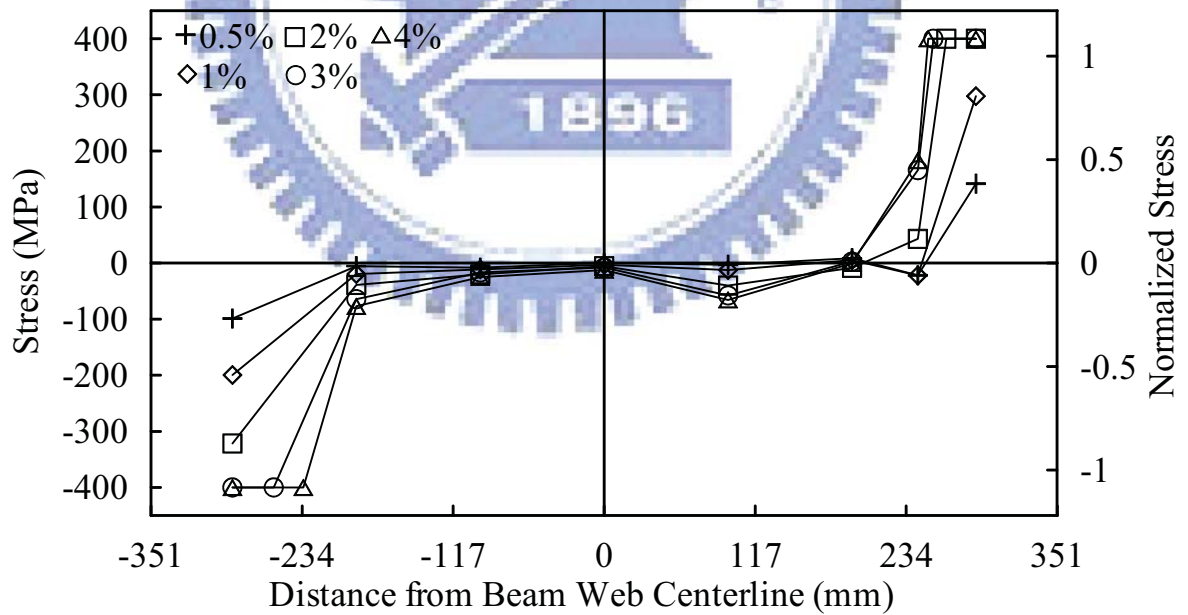


(b) Positive Bending

圖 4.25 試體 FDWS3 加勁板應變分佈

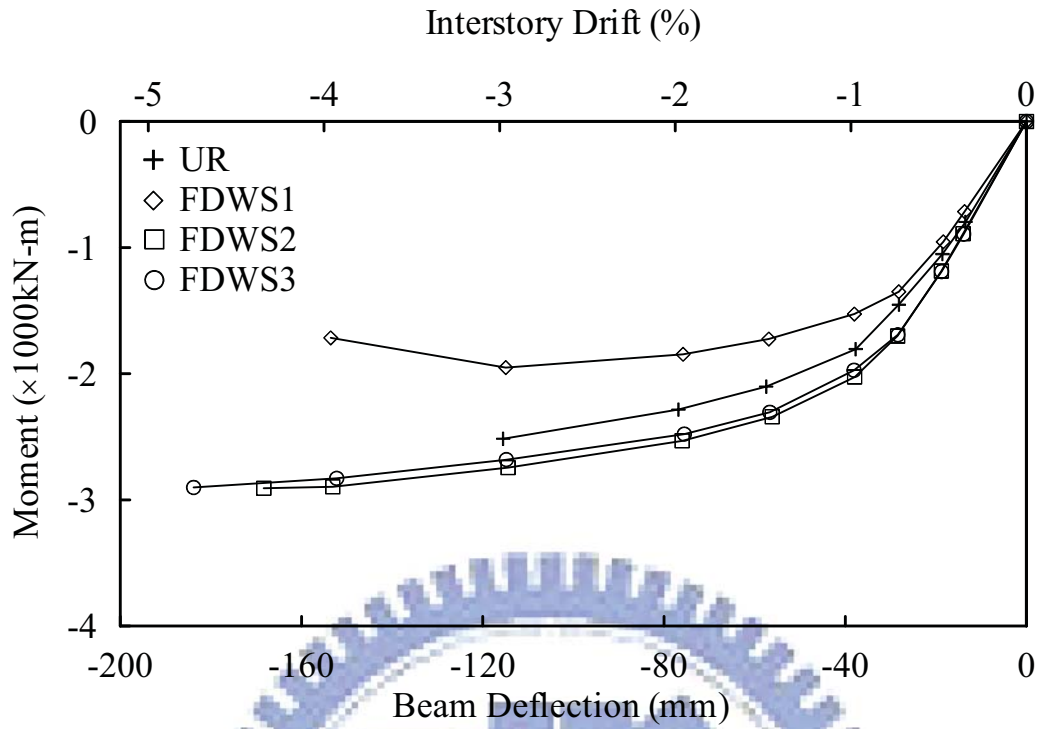


(a) Negative Bending

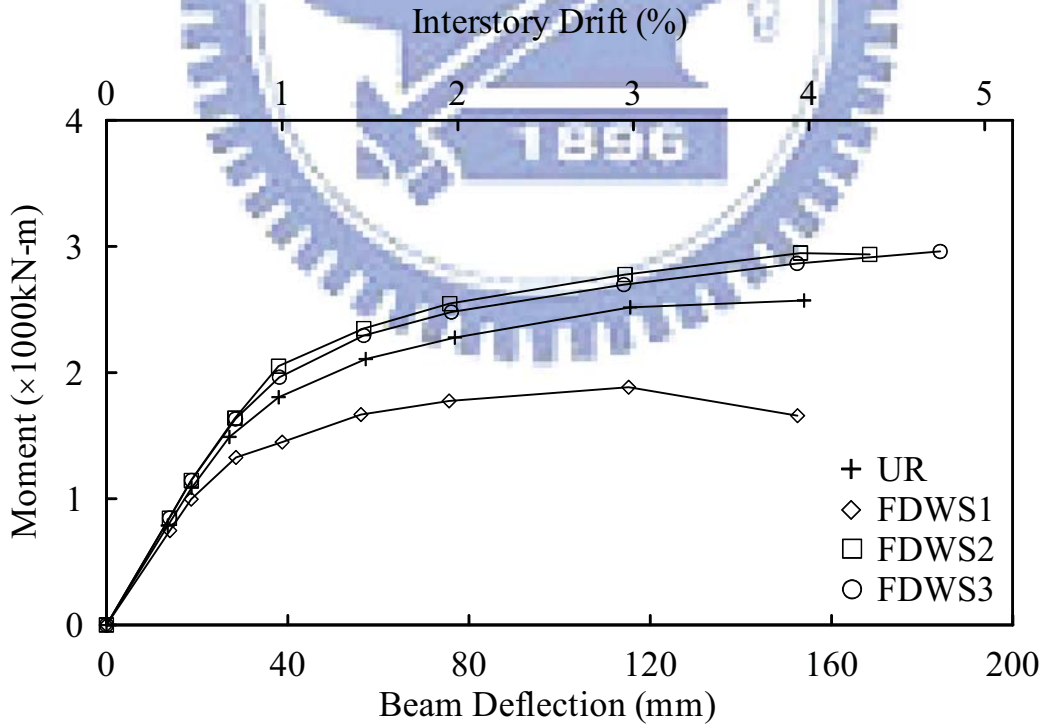


(b) Positive Bending

圖 4.26 試體 FDWS3 加勁板應力分佈

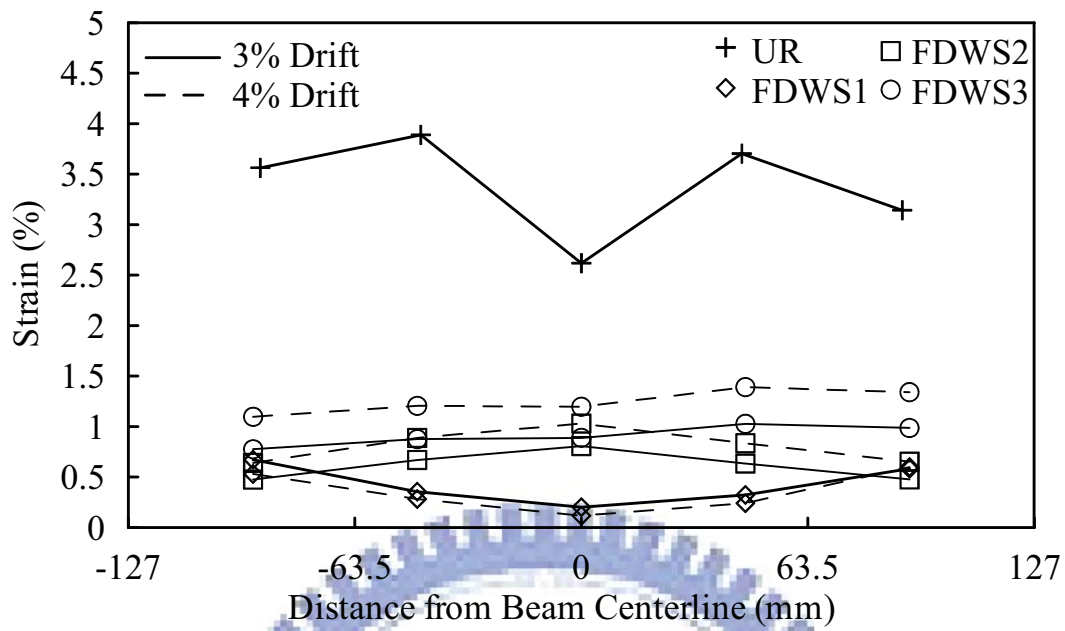


(a) Negative Bending

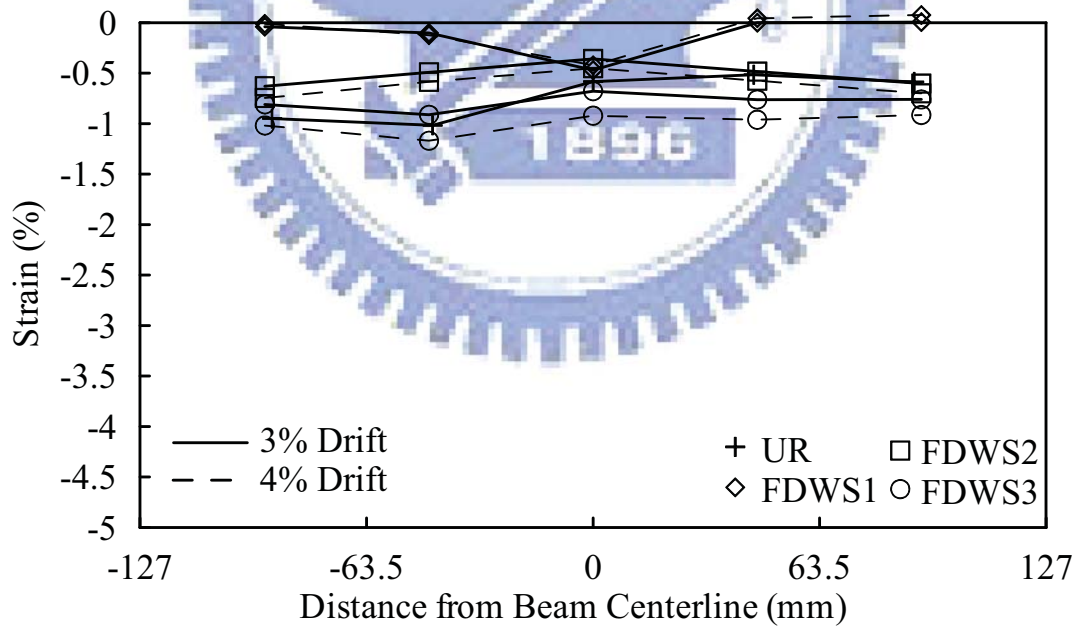


(b) Positive Bending

圖 4.27 所有 FDWS 試體彎矩與位移關係包絡線圖比較

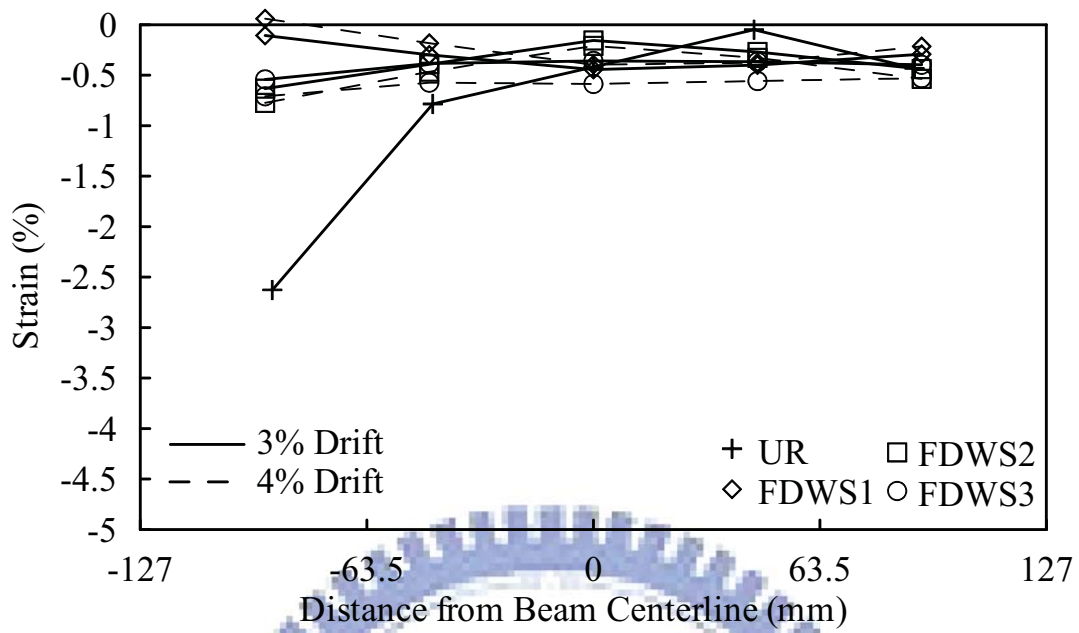


(a) Top Flange

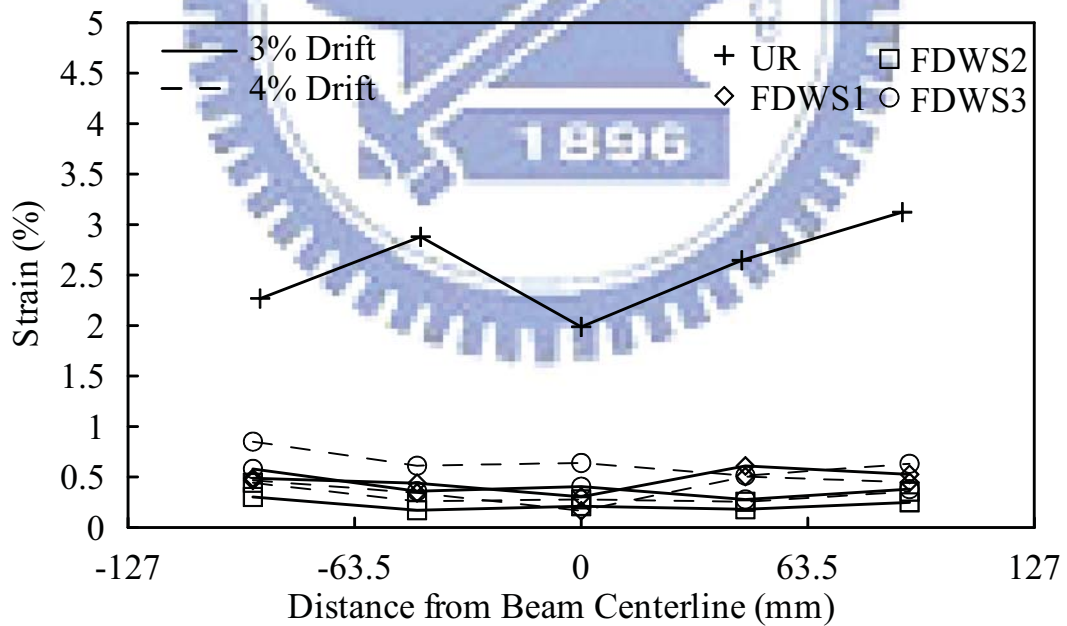


(b) Bottom Flange

圖 4. 28 FDWS 試體與未加勁梁柱 UR 橫向應變比較(Negative Bending)

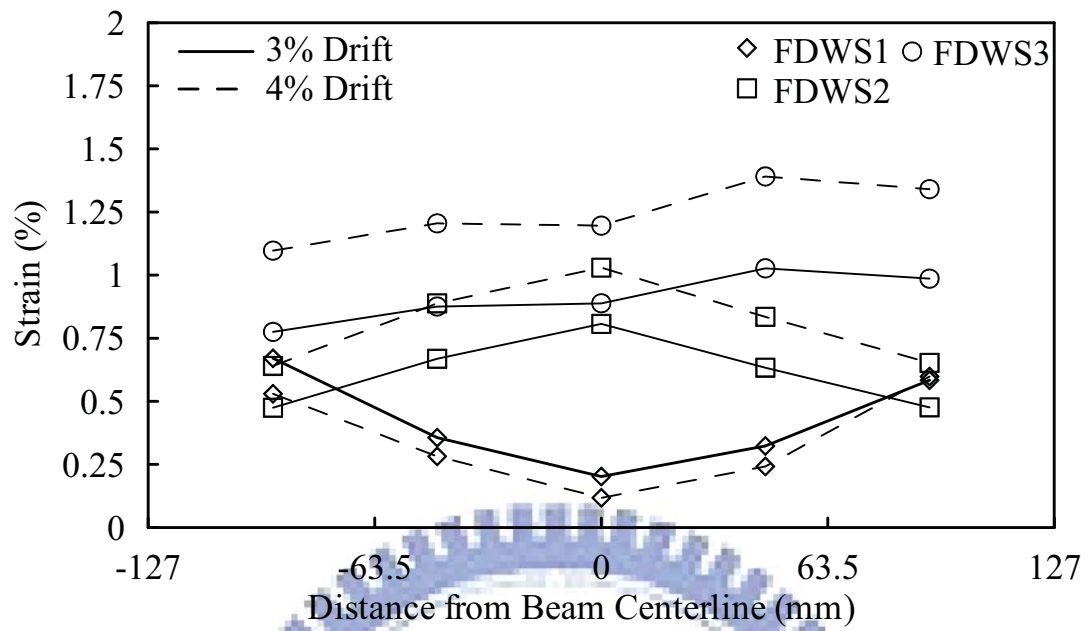


(a) Top Flange

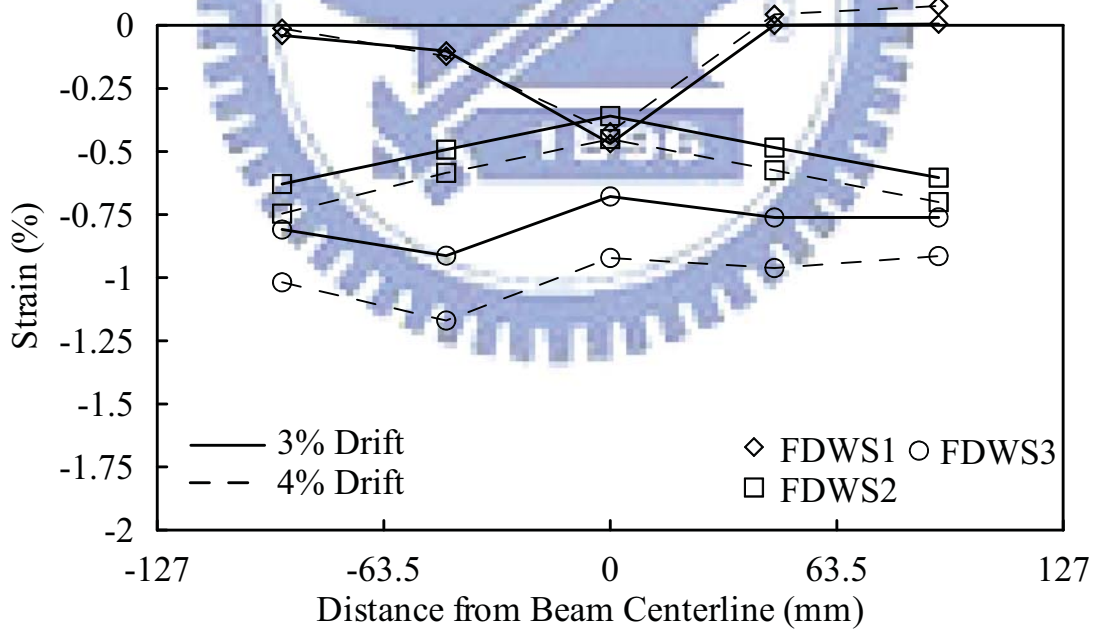


(b) Bottom Flange

圖 4. 29 FDWS 試體與未加勁梁柱 UR 橫向應變比較(Positive Bending)

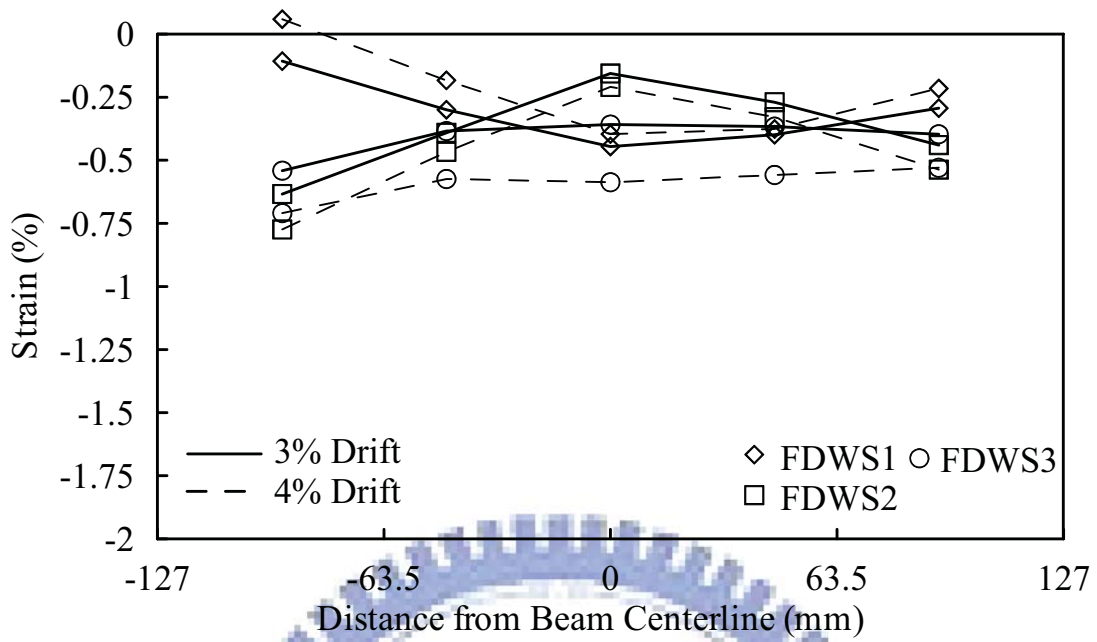


(a) Top Flange

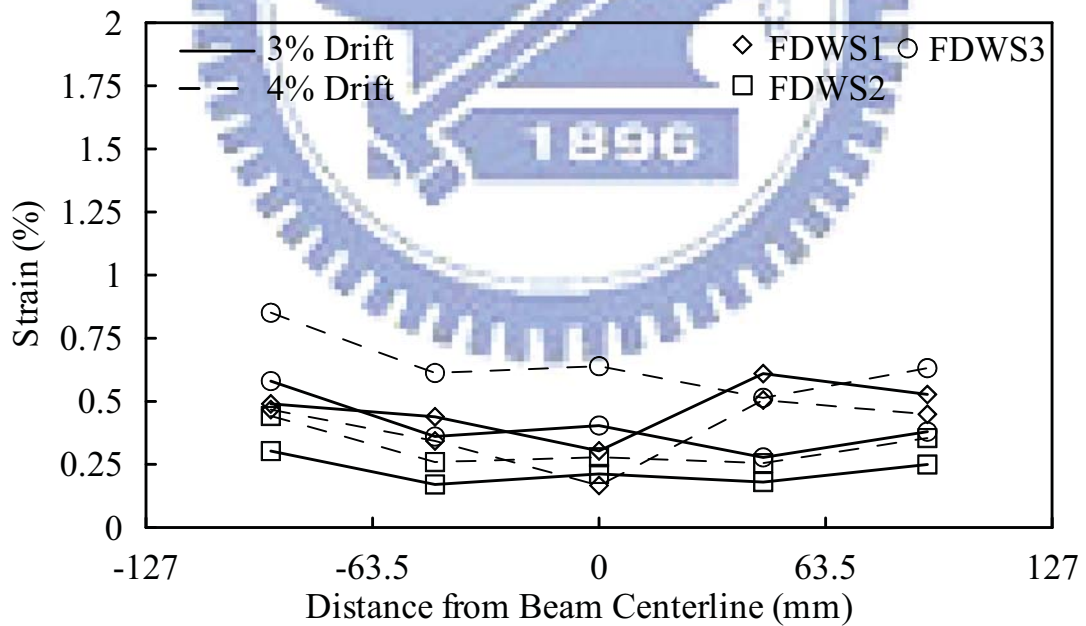


(b) Bottom Flange

圖 4.30 FDWS 試體橫向應變比較(Negative Bending)

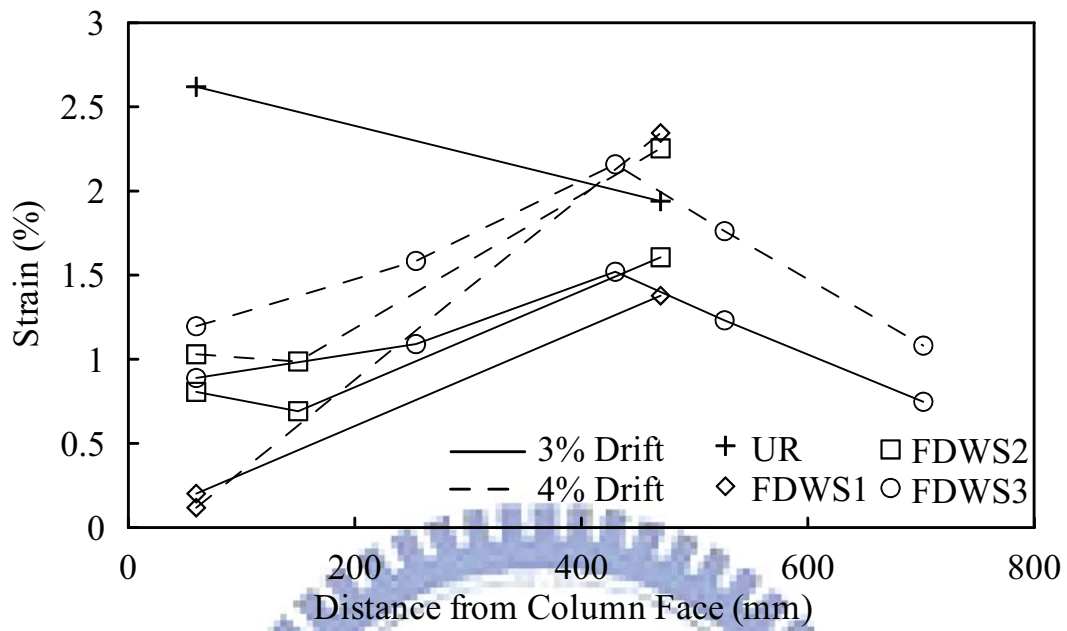


(a) Top Flange

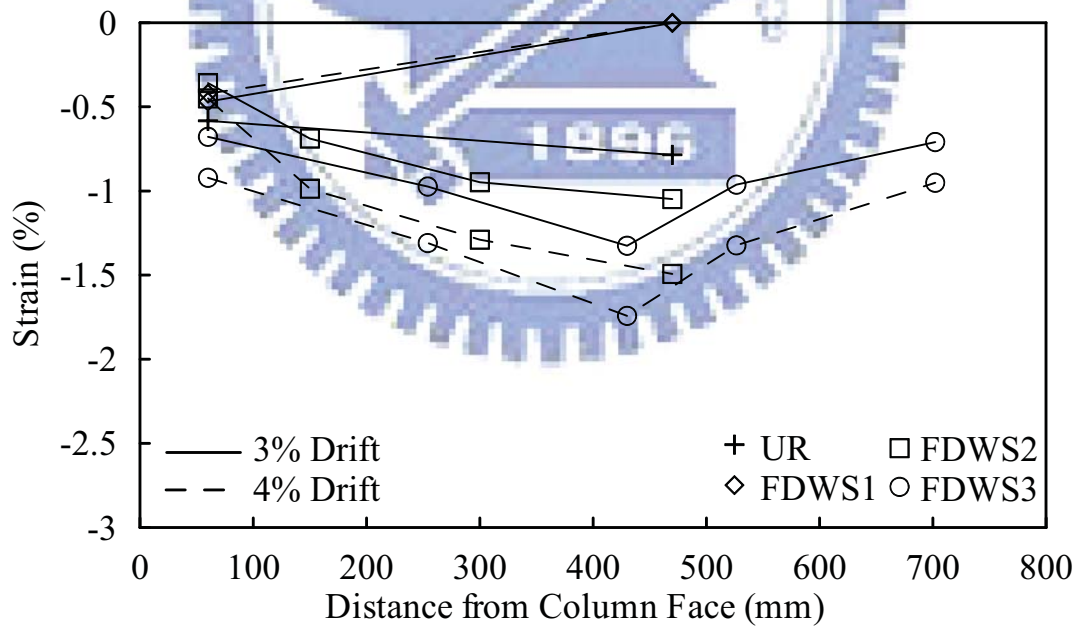


(b) Bottom Flange

圖 4.31 FDWS 試體橫向應變比較(Positive Bending)

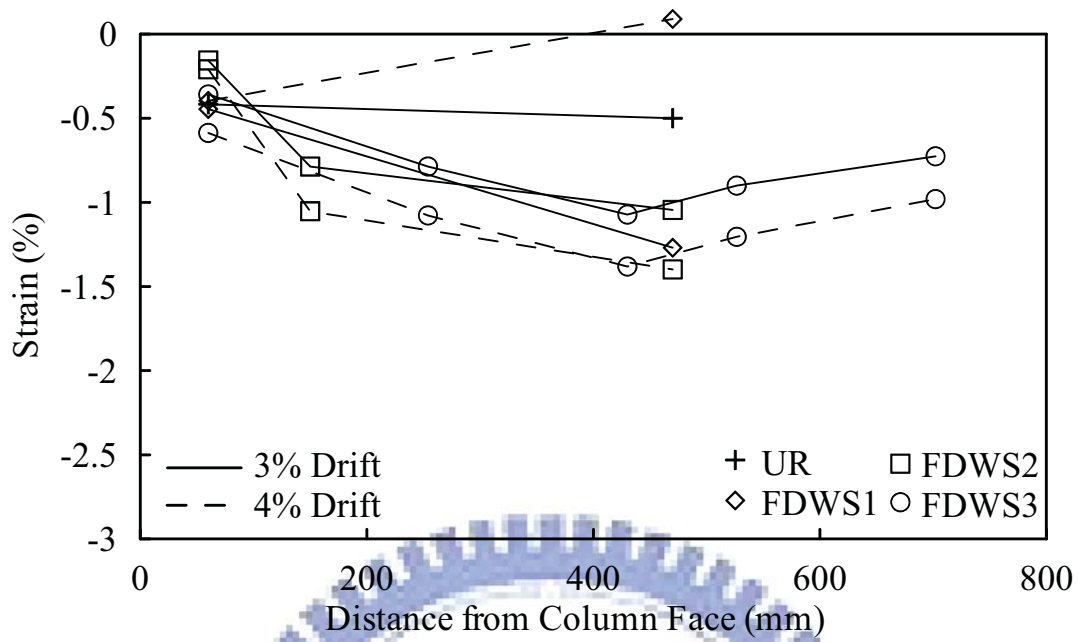


(a) Top Flange

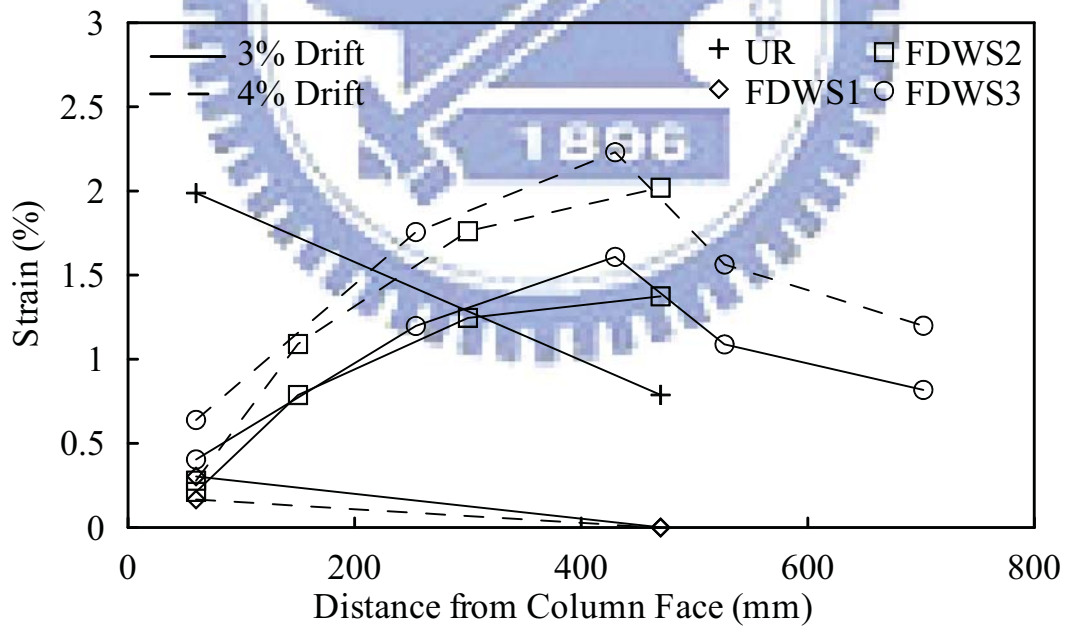


(b) Bottom Flange

圖 4. 32 FDWS 試體縱向應變比較圖(Negative Bending)

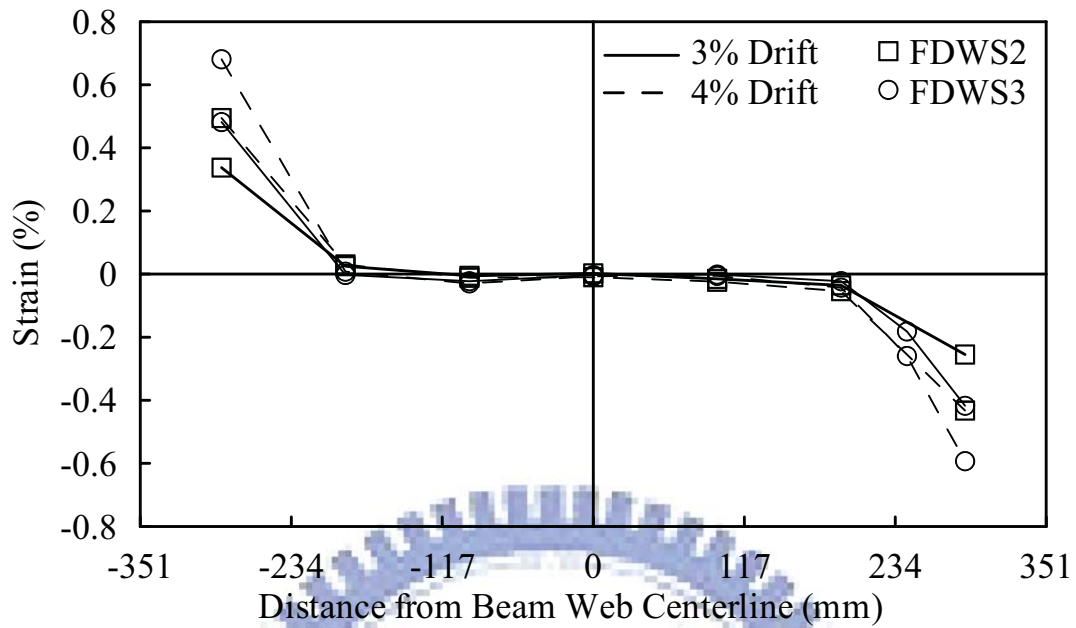


(a) Top Flange

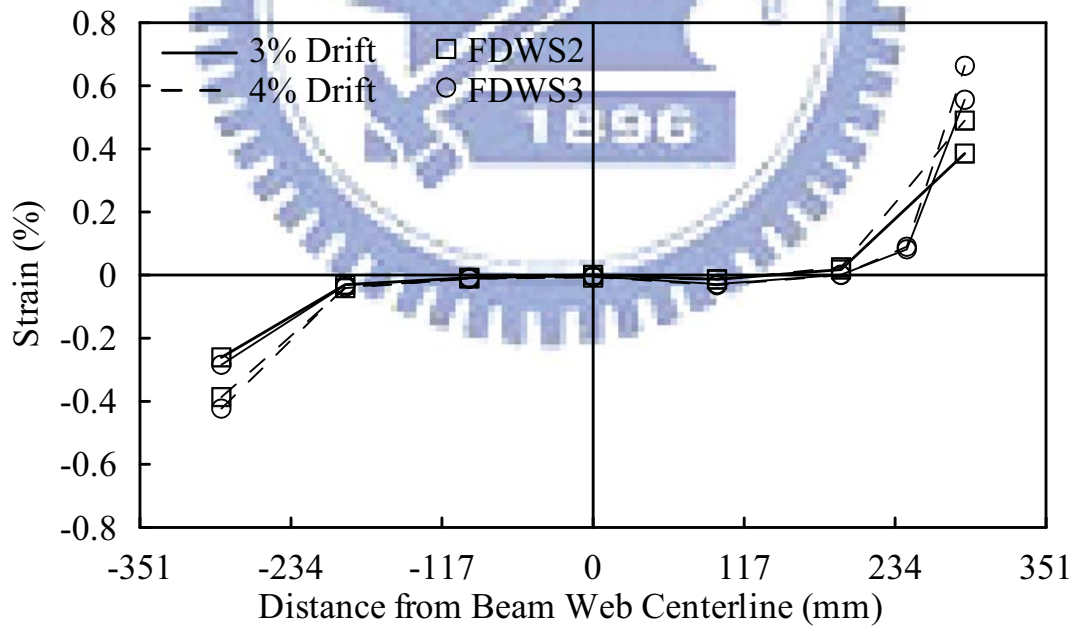


(b) Bottom Flange

圖 4.33 FDWS 試體縱向應變比較圖(Positive Bending)

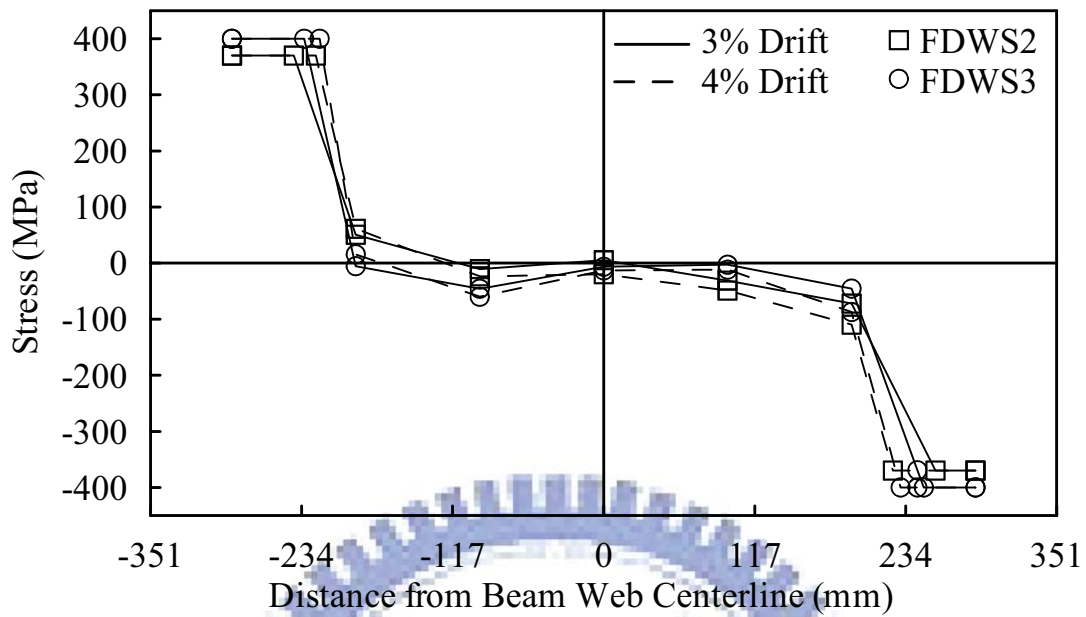


(a) Negative Bending

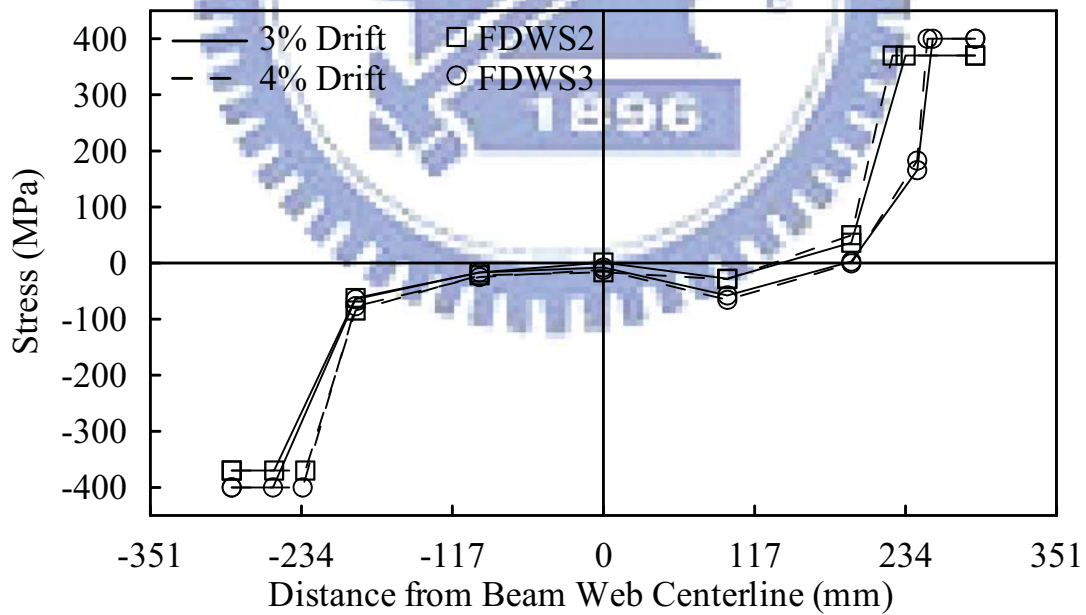


(b) Positive Bending

圖 4.34 FDWS 試體加勁板應變比較



(a) Negative Bending



(b) Positive Bending

圖 4.35 FDWS 試體加勁板應力比較

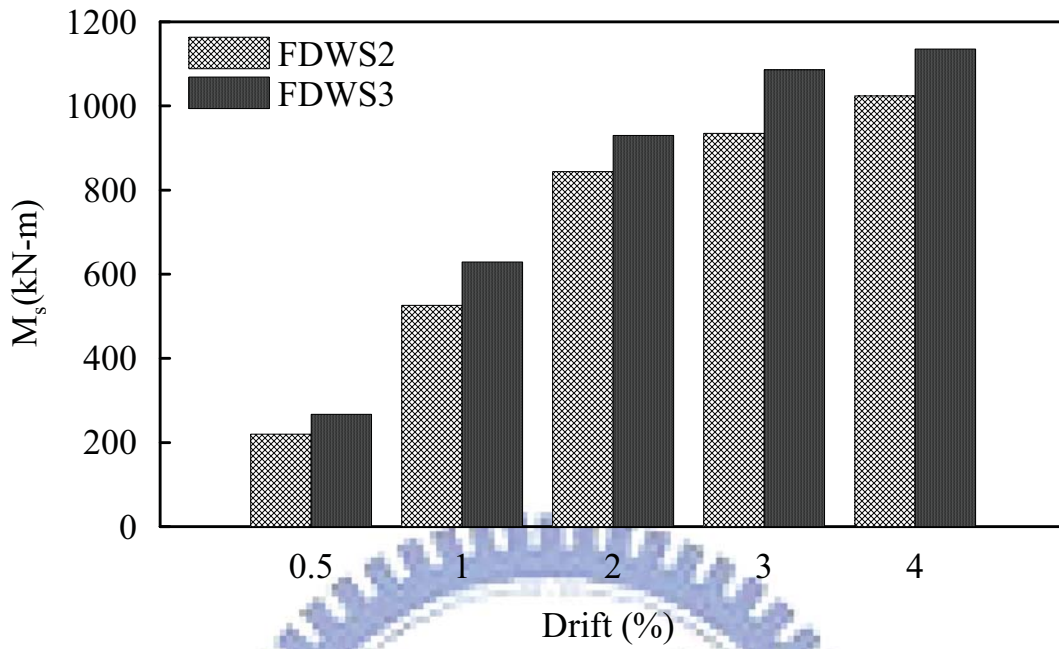


圖 4.36 FDWS 試體加勁板提供之彎矩貢獻量

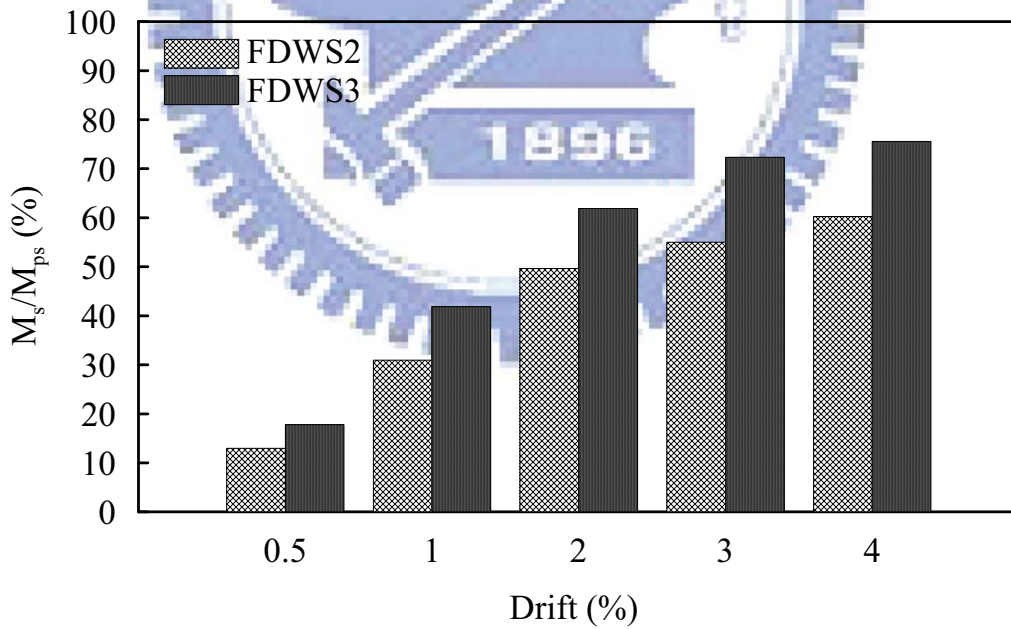


圖 4.37 FDWS 試體加勁板提供之塑性彎矩 M_{ps} 比例

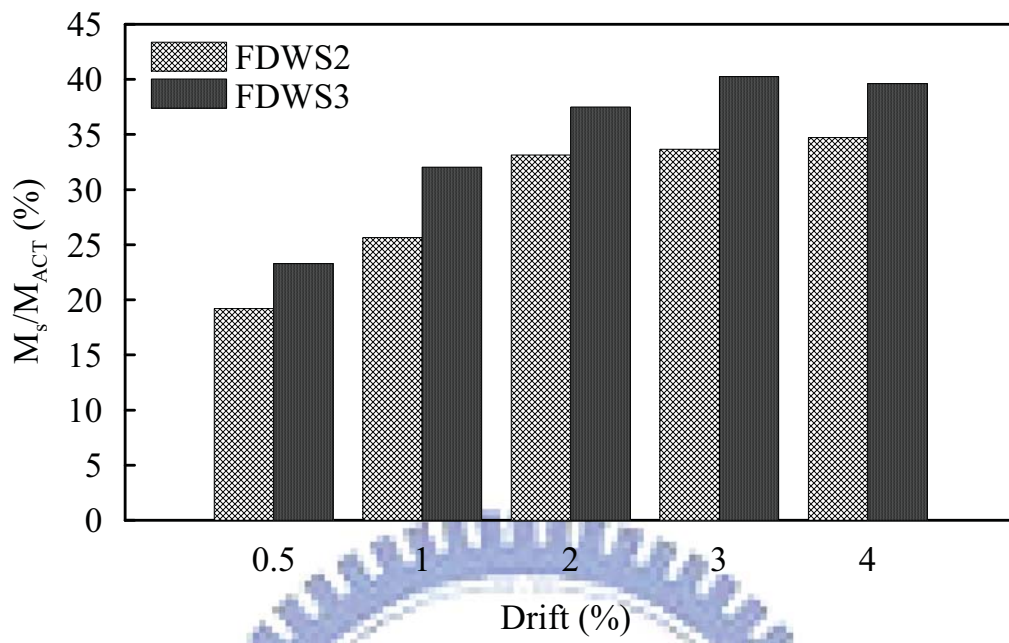
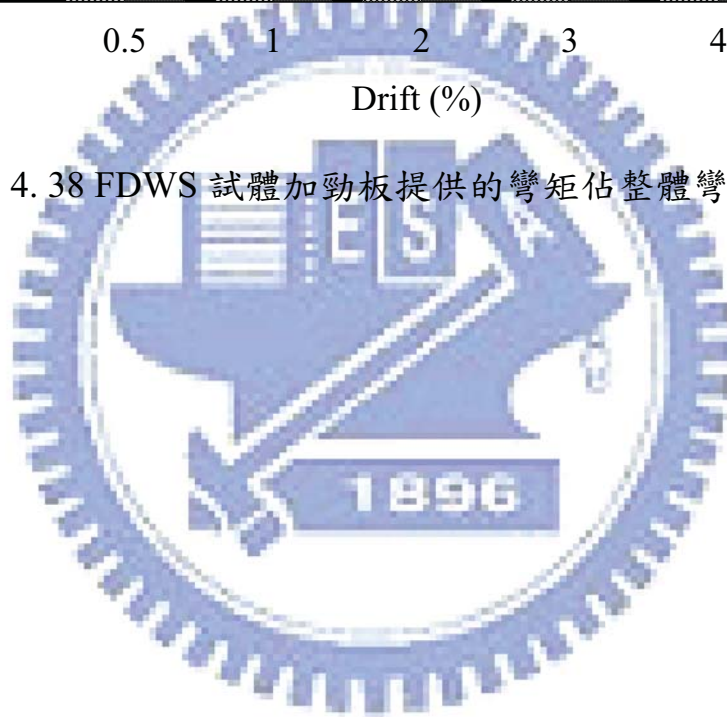
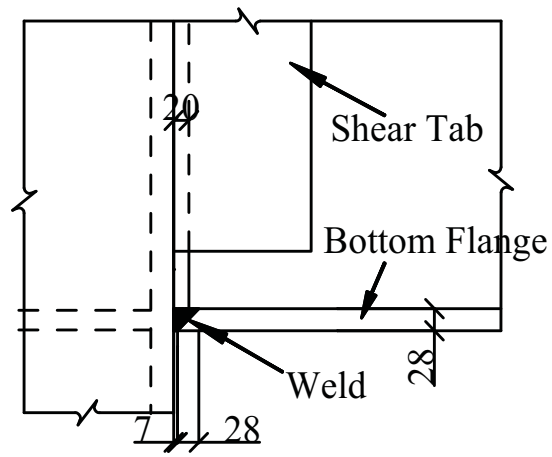
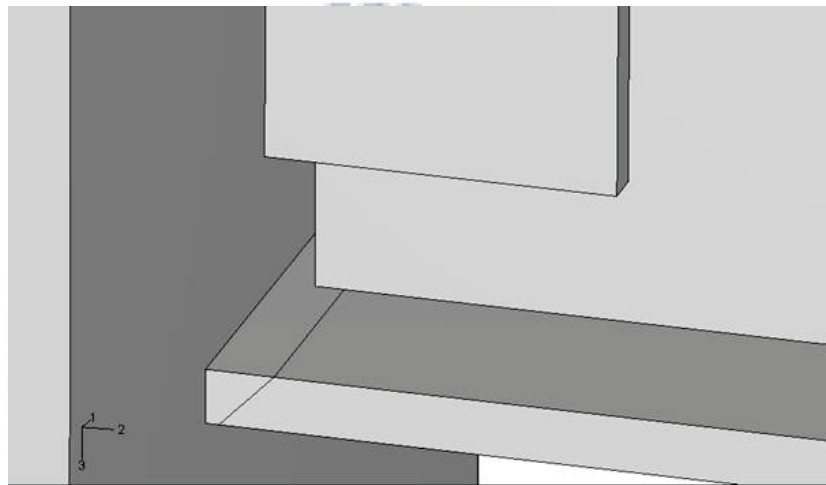


圖 4.38 FDWS 試體加勁板提供的彎矩佔整體彎矩的比例

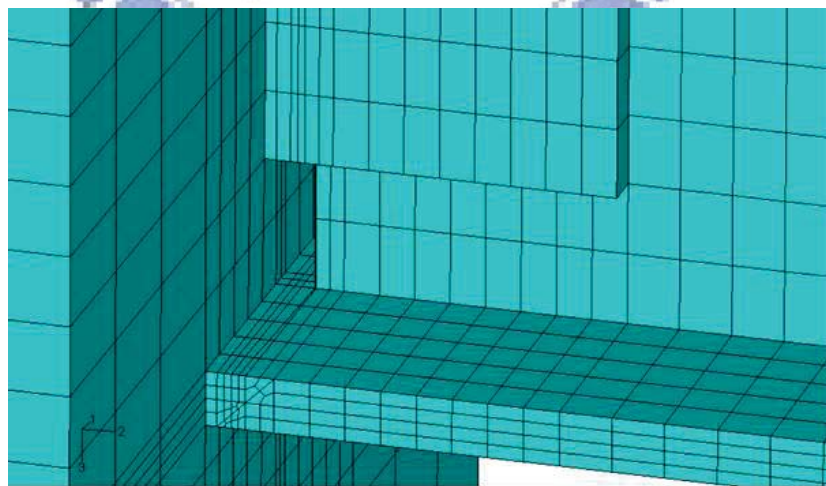




(a) Details of weld access hole

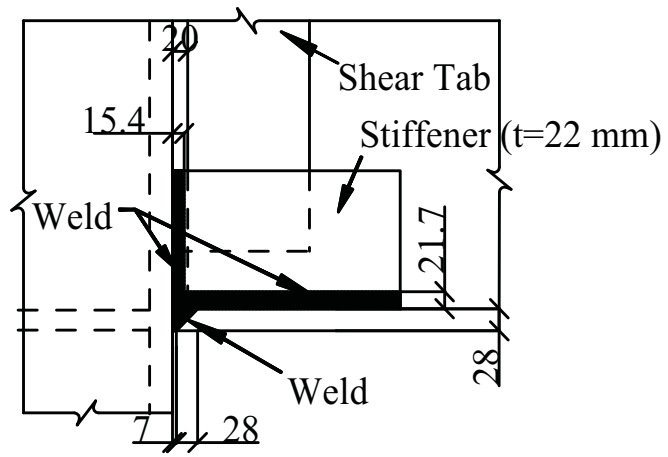


(b) Part

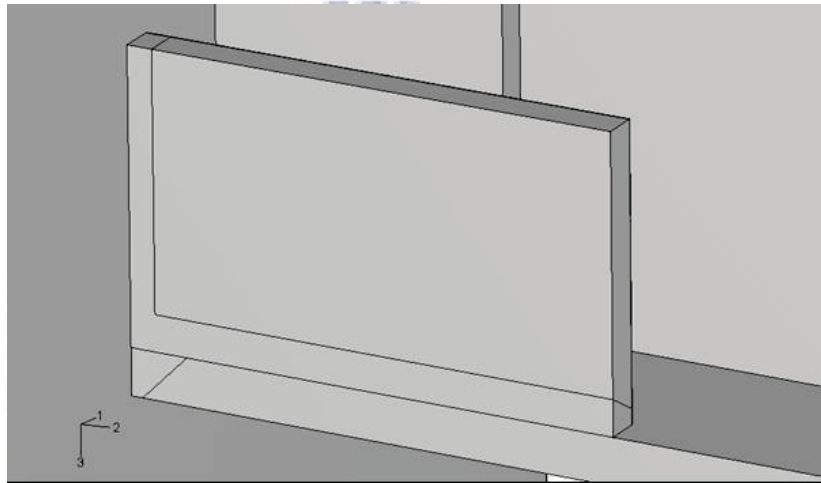


(c) Mesh

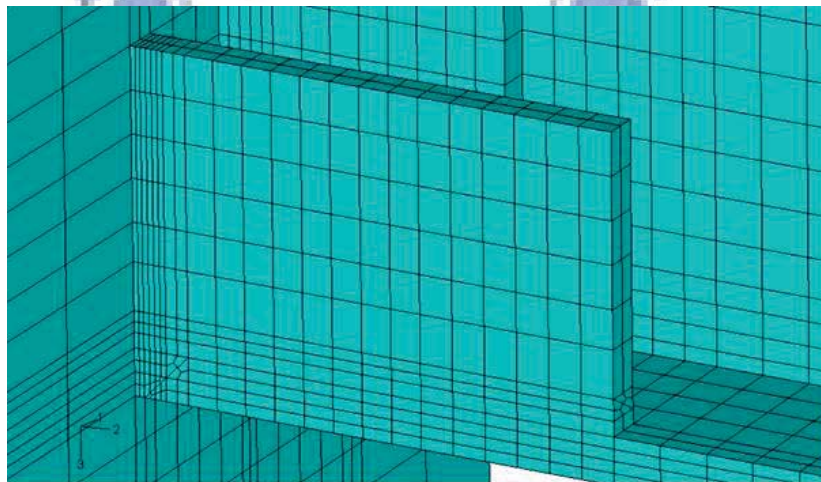
圖 5.1 梁柱接頭區之焊道及扇形開口模擬情形



(a) Details of weld

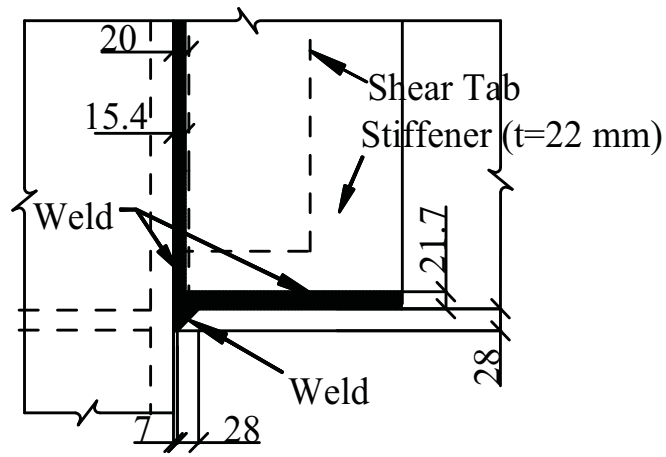


(b) Part

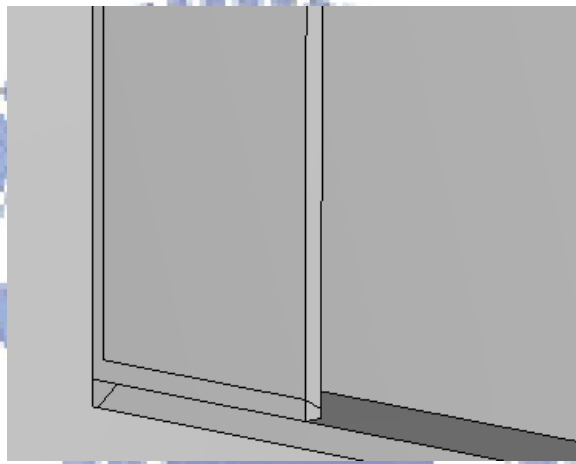


(c) Mesh

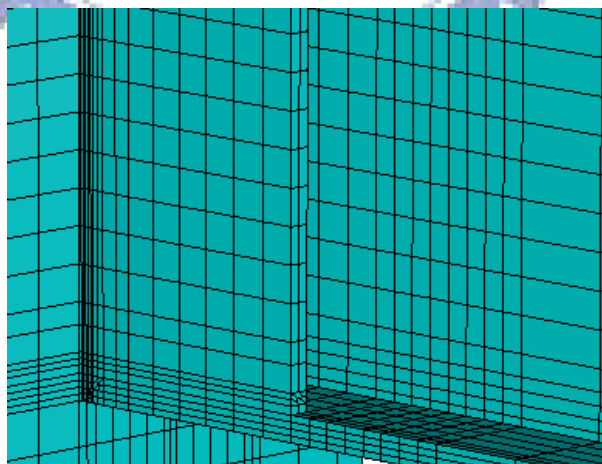
圖 5.2 IFS 加勁板與梁及柱接合之焊道模擬情形



(a) Details of weld



(b) Part



(c) Mesh

圖 5.3 FDWS 加勁板與梁及柱接合之焊道模擬情形

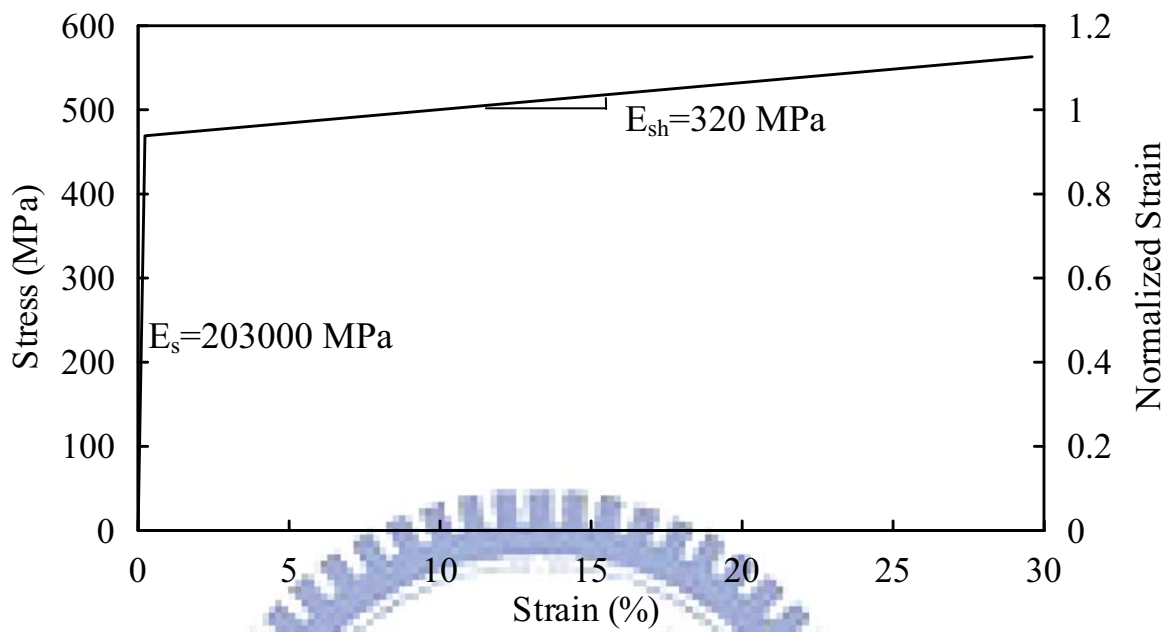


圖 5.4 焊道之單向加載應力應變曲線

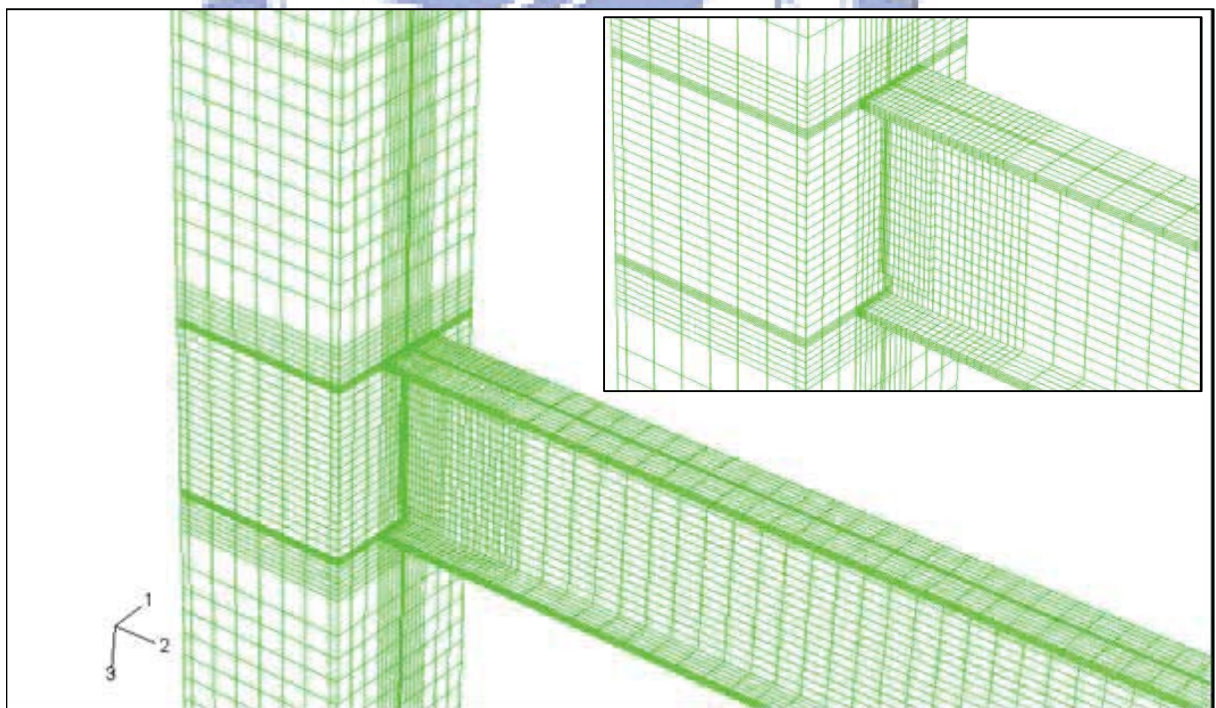


圖 5.5 試體 UR 之結構模型網格分佈

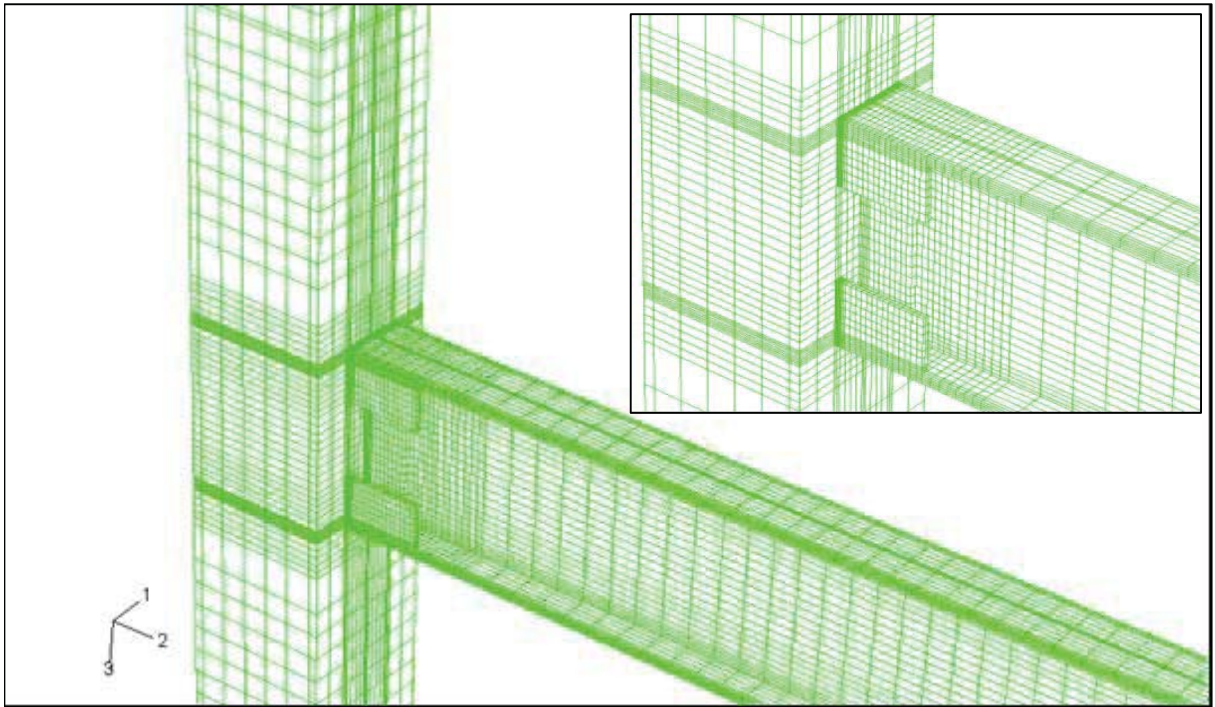


圖 5.6 試體 IFS3 之結構模型網格分佈

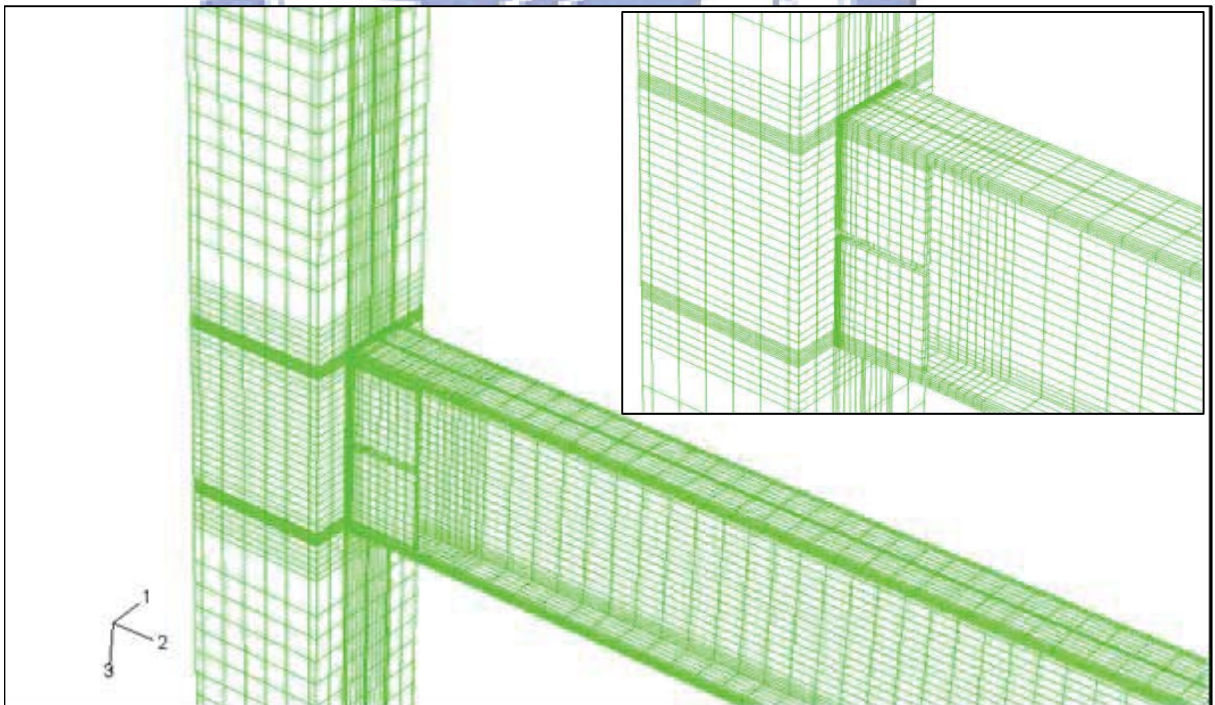


圖 5.7 試體 IFS5 之結構模型網格分佈

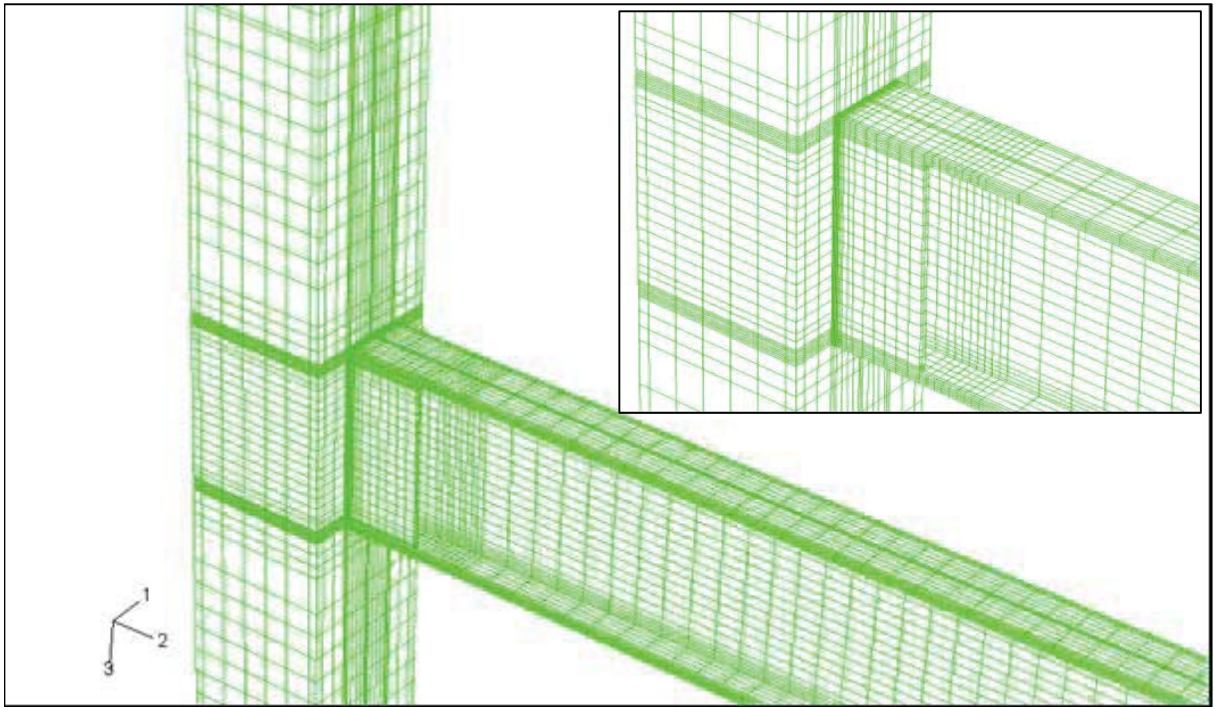
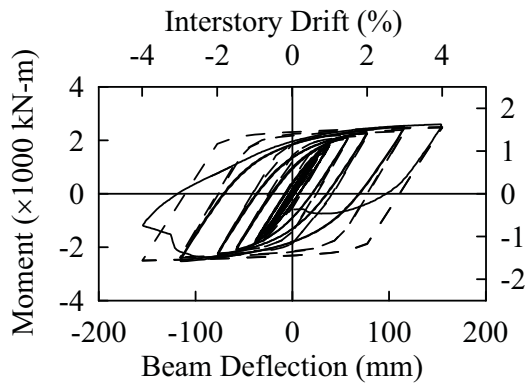
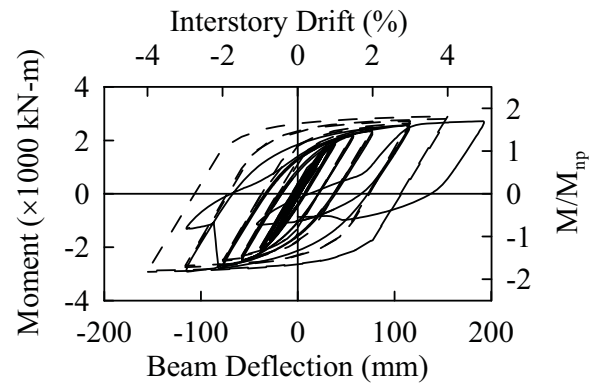


圖 5.8 試體 FDWS2 之結構模型網格分佈

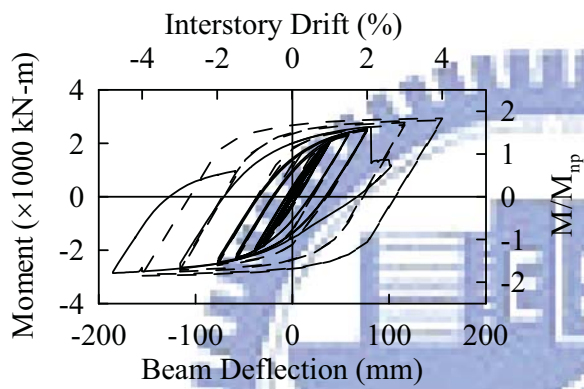




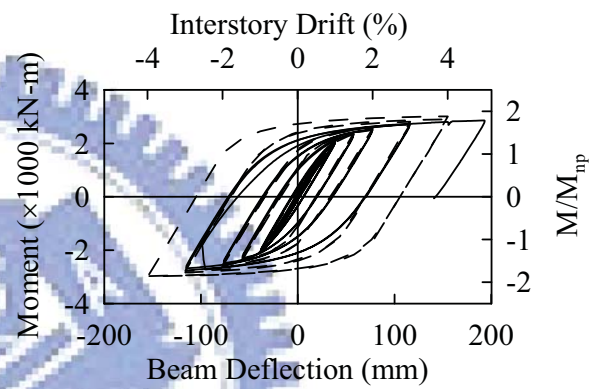
(a) UR



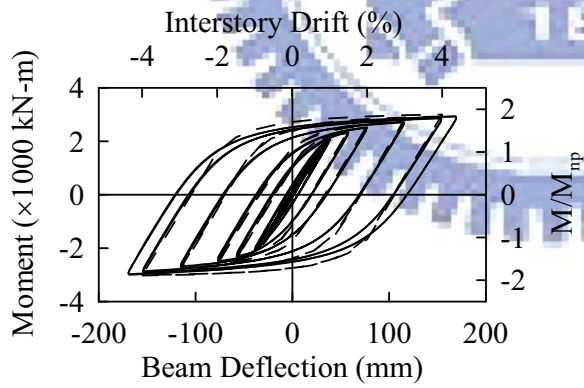
(b) IFS1



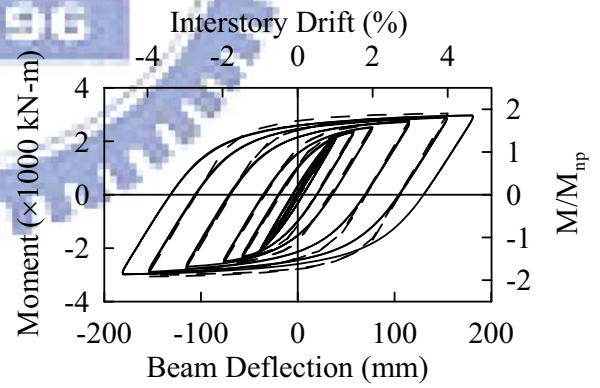
(c) IFS2



(d) IFS3



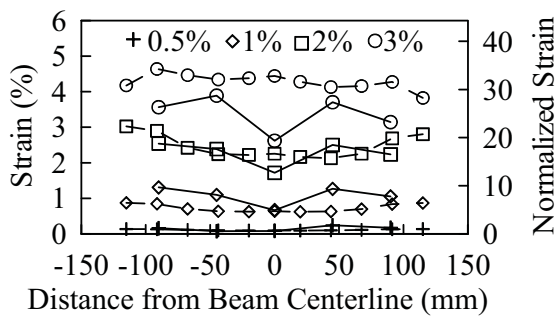
(e) IFS4



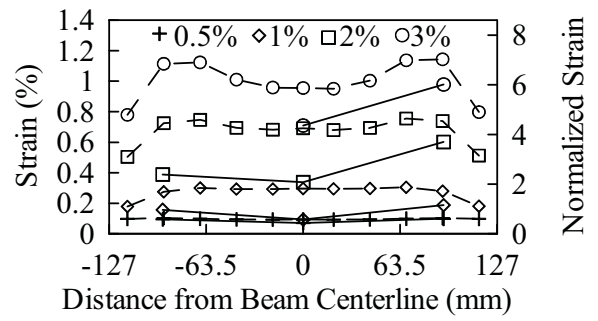
(f) IFS5

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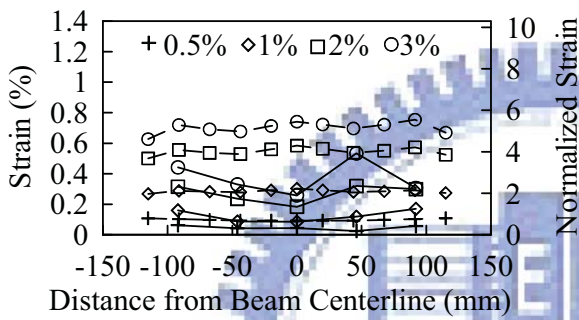
圖 5.9 試體 UR 及 IFS 試體之梁端彎矩與位移關係比較圖



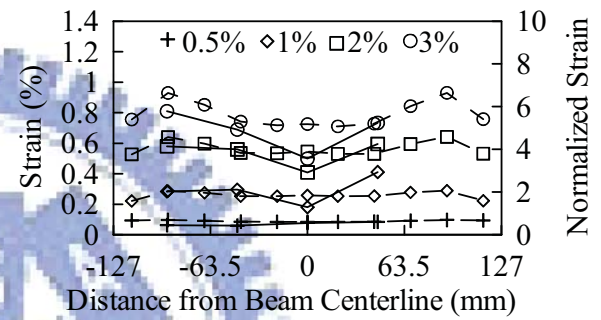
(a) UR



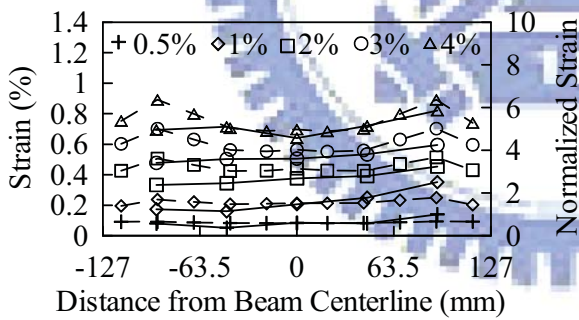
(b) IFS1



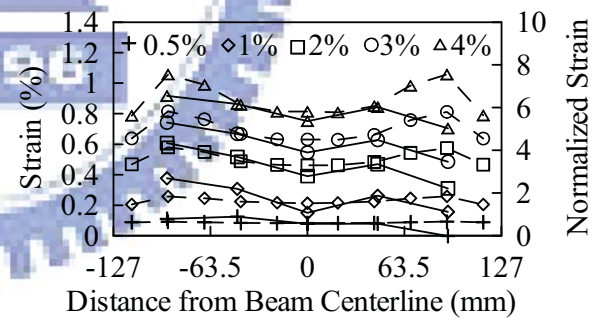
(c) IFS2



(d) IFS3



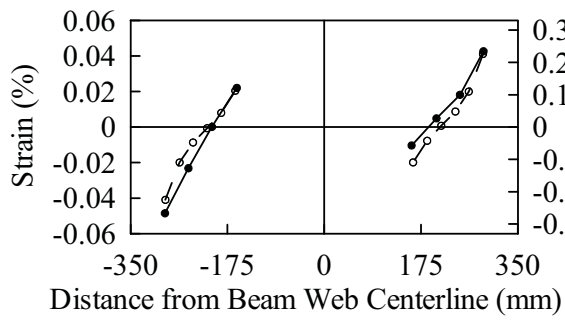
(e) IFS4



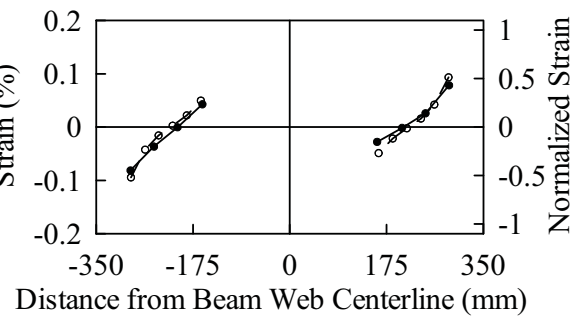
(f) IFS5

—— Test - - - ABAQUS

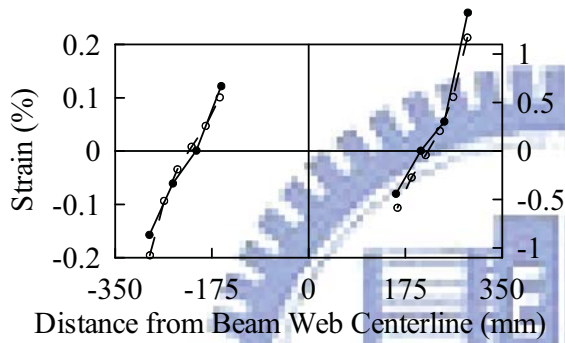
圖 5.10 試體 UR 及 IFS 試體之上翼板應變比較圖



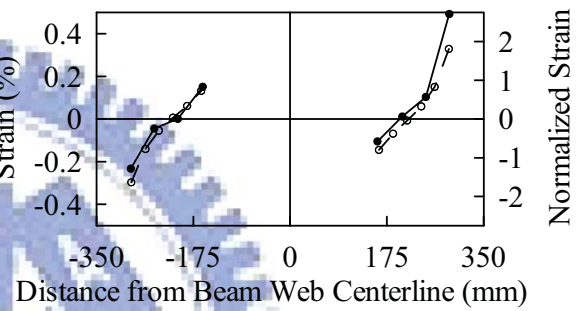
(a) 0.5% Drift



(b) 1.0% Drift



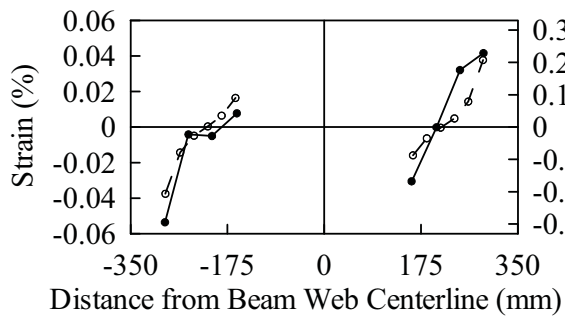
(c) 2.0% Drift



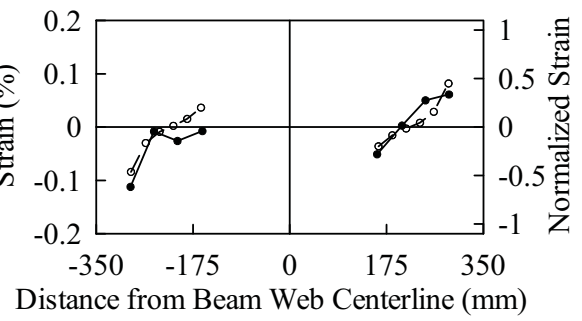
(d) 3.0% Drift

—●— Test -○- ABAQUS

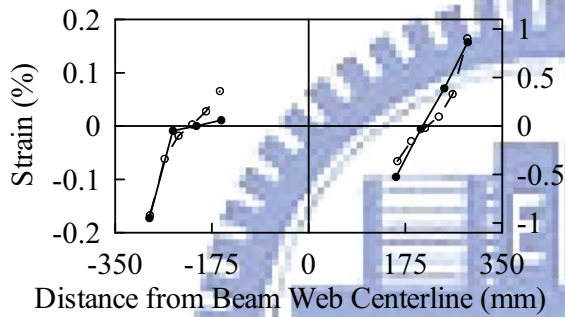
圖 5.11 試體 IFS3 之加勁板應變比較圖 (Positive Bending)



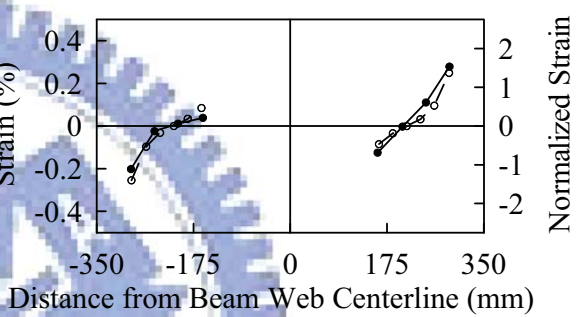
(a) 0.5% Drift



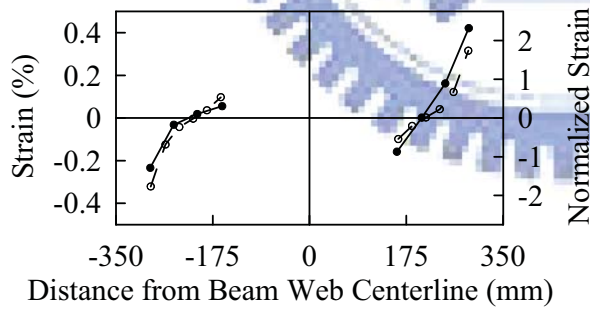
(b) 1.0% Drift



(c) 2.0% Drift



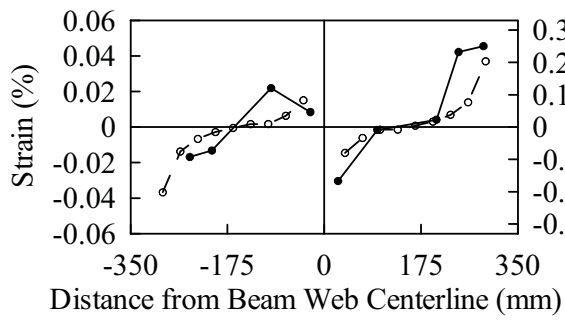
(d) 3.0% Drift



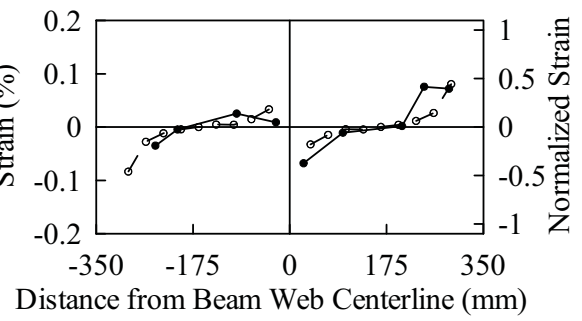
(d) 4.0% Drift

—●— Test -○- ABAQUS

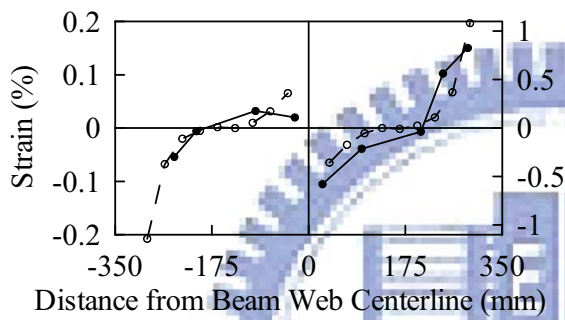
圖 5.12 試體 IFS4 之加勁板應變比較圖 (Positive Bending)



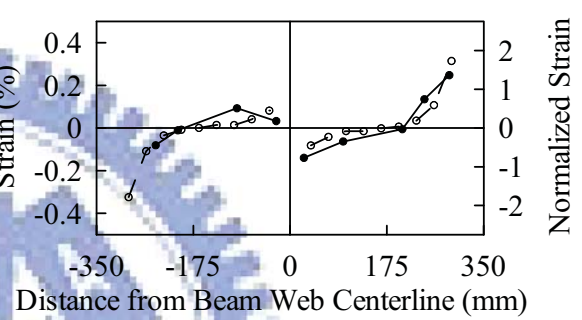
(a) 0.5% Drift



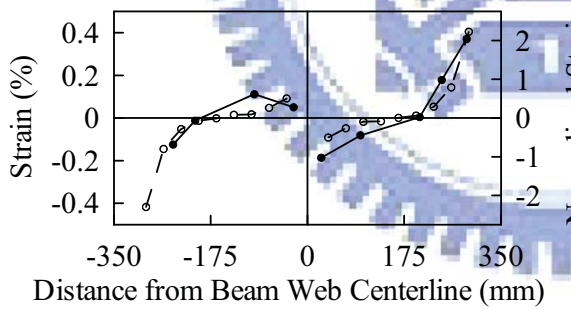
(b) 1.0% Drift



(c) 2.0% Drift



(d) 3.0% Drift



(d) 4.0% Drift

—●— Test -○- ABAQUS

圖 5.13 試體 IFS5 之加勁板應變比較圖 (Positive Bending)

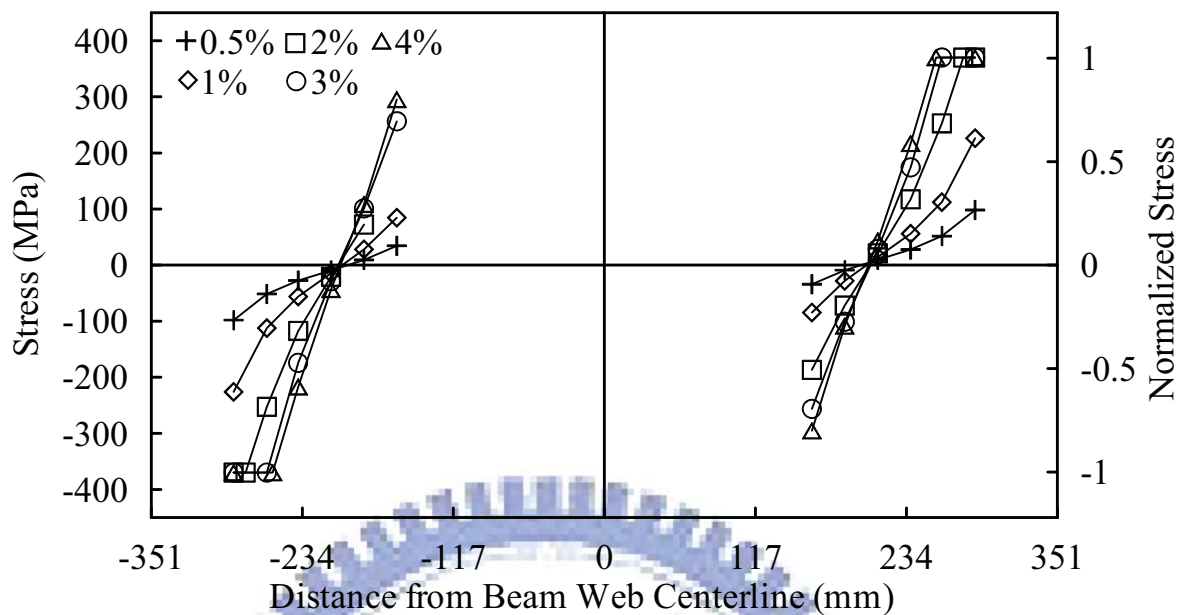


圖 5.14 試體 IFS3 之加勁板應力分佈圖 (Positive Bending)

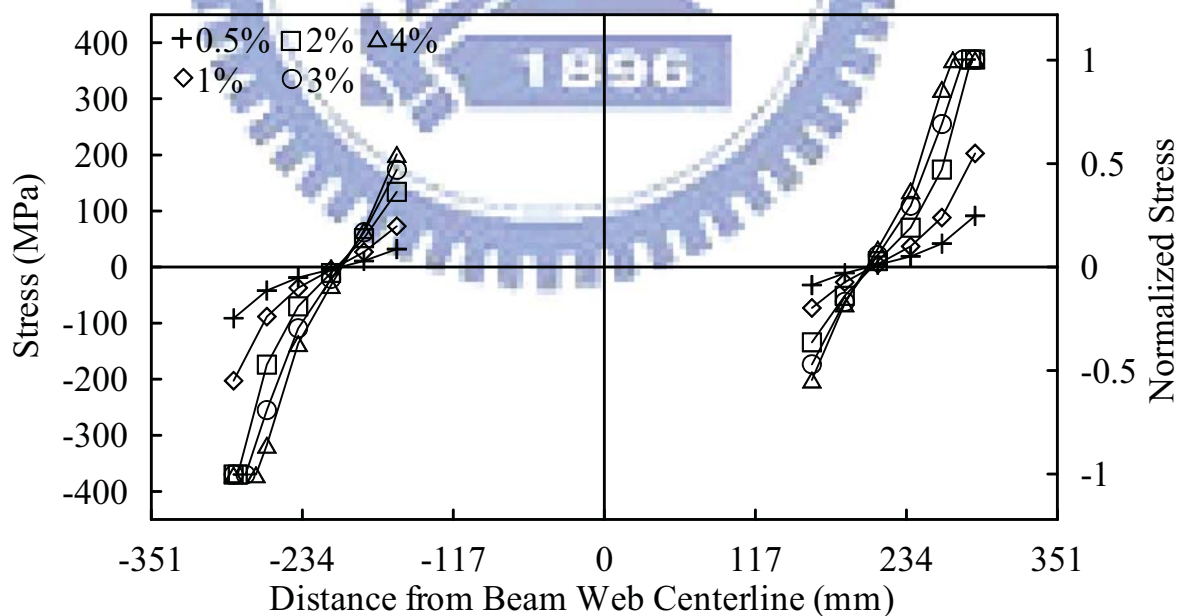


圖 5.15 試體 IFS4 之加勁板應力分佈圖 (Positive Bending)

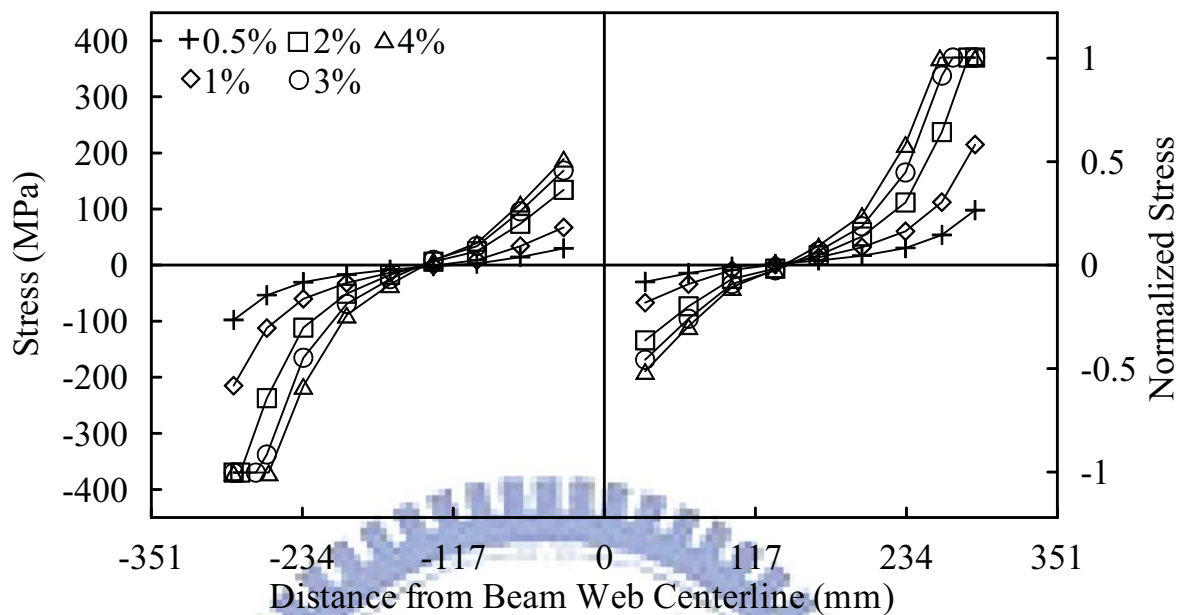


圖 5.16 試體 IFS5 之加勁板應力分佈圖 (Positive Bending)

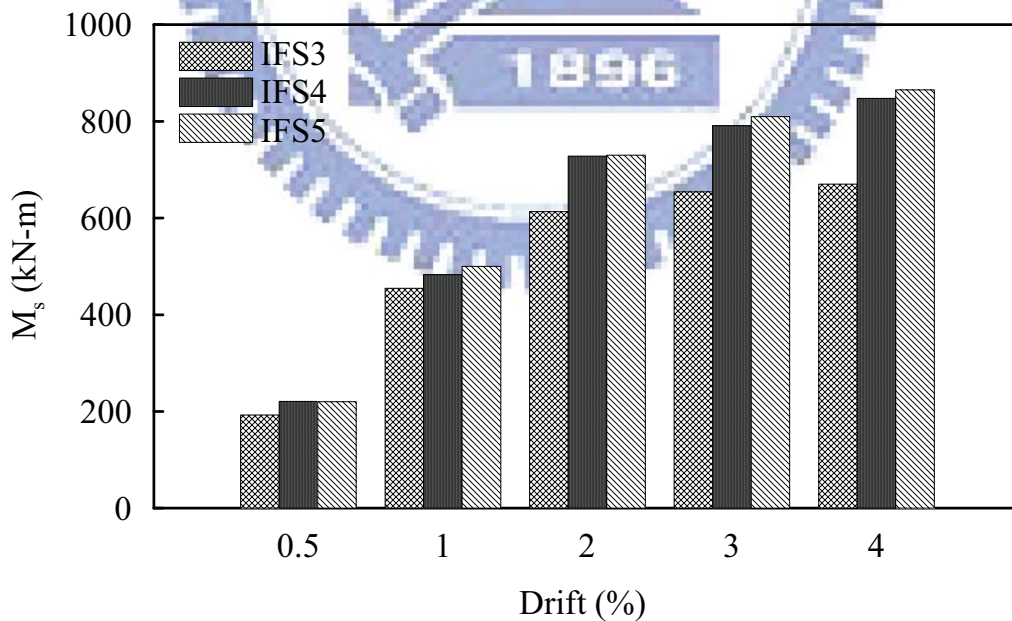


圖 5.17 IFS 試體加勁板提供之彎矩貢獻量

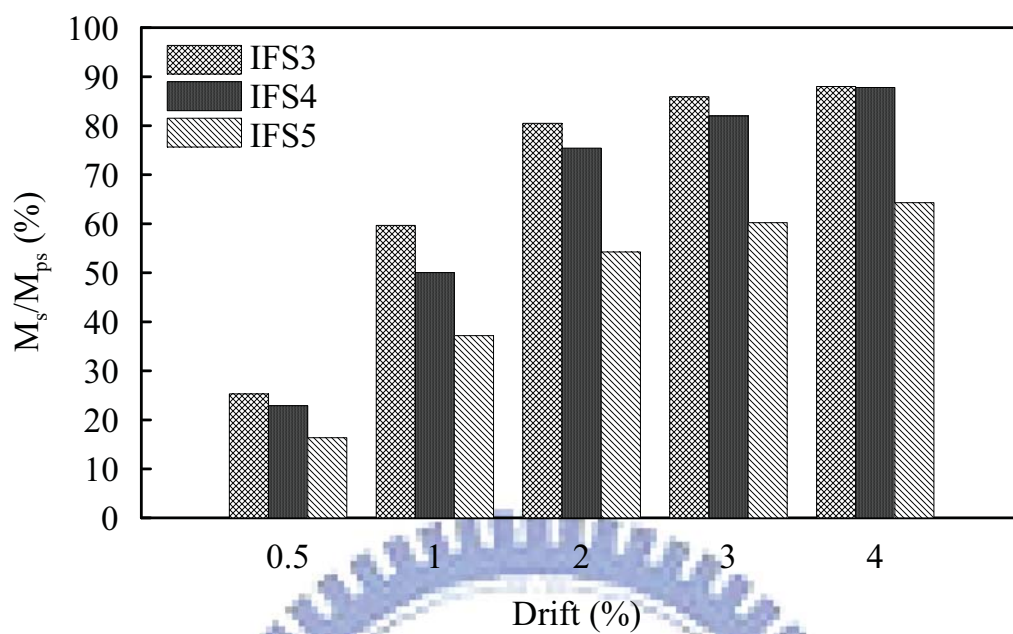


圖 5.18 IFS 試體加勁板提供之塑性彎矩 M_{ps} 比例

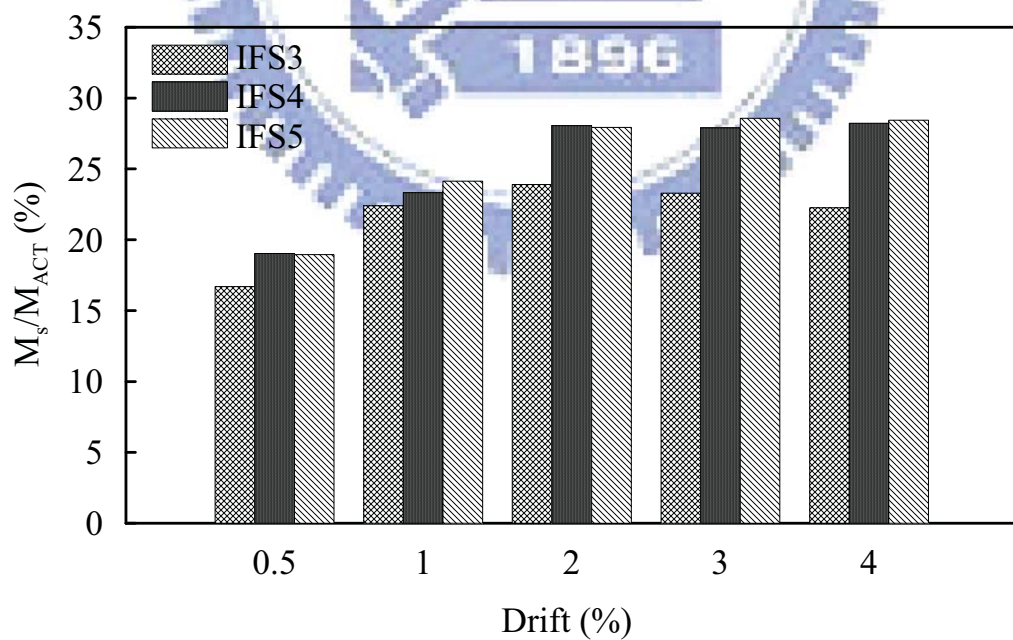


圖 5.19 IFS 試體加勁板提供之彎矩佔整體總彎矩的比例

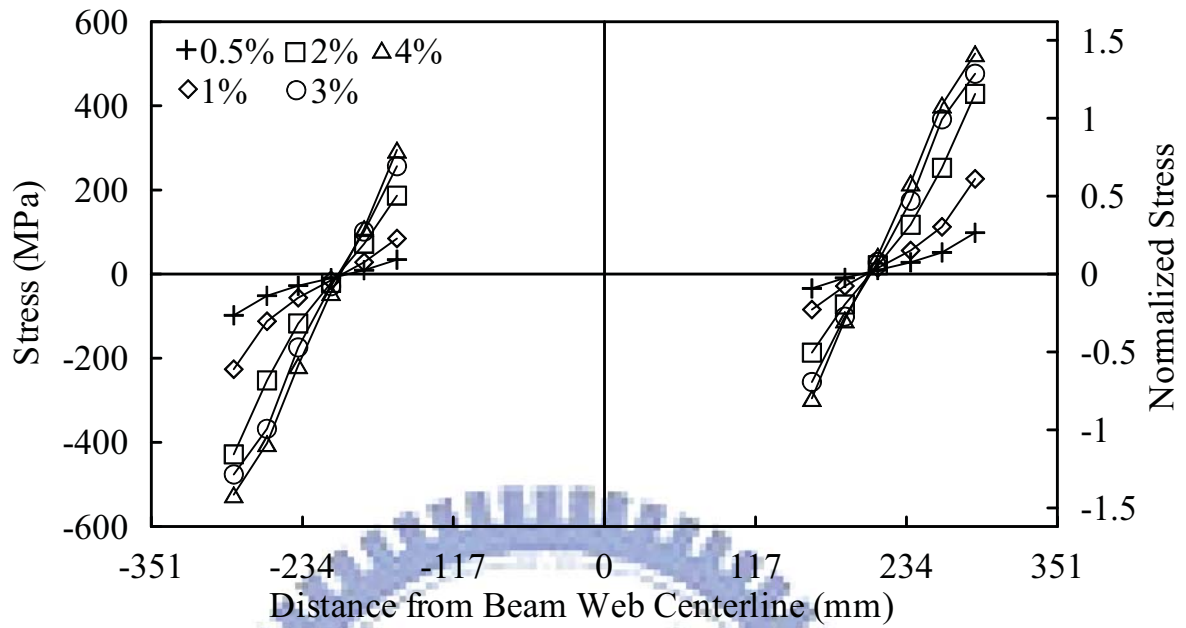


圖 5.20 試體 IFS3 之加勁板 ABAQUS 應力分佈圖 (Positive Bending)

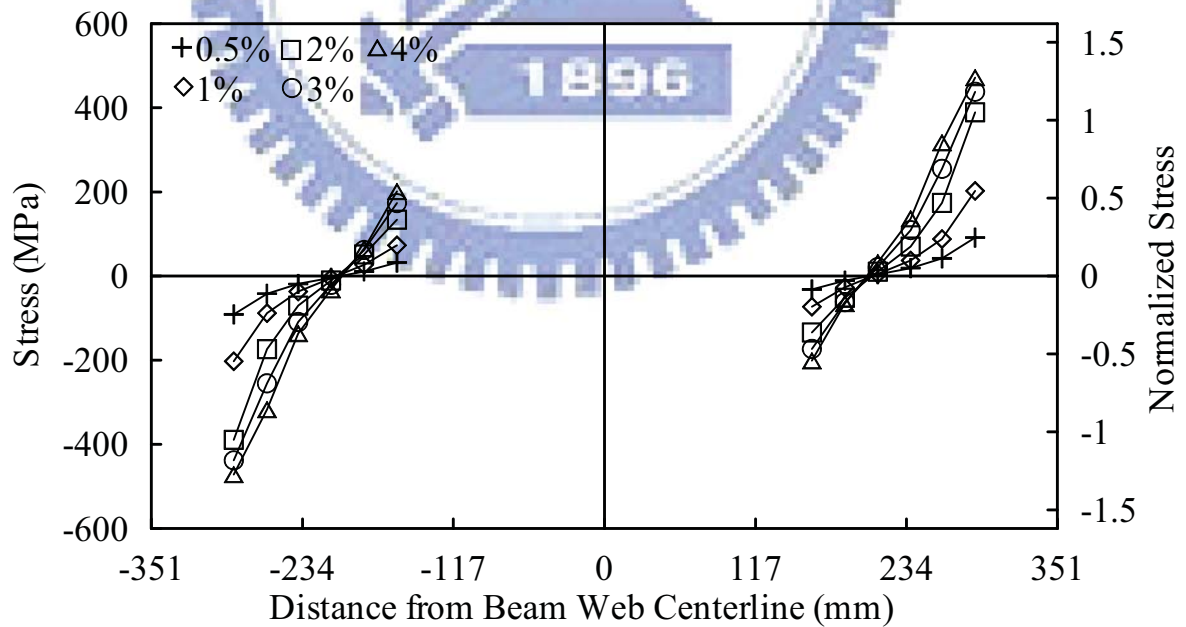


圖 5.21 試體 IFS4 之加勁板 ABAQUS 應力分佈圖 (Positive Bending)

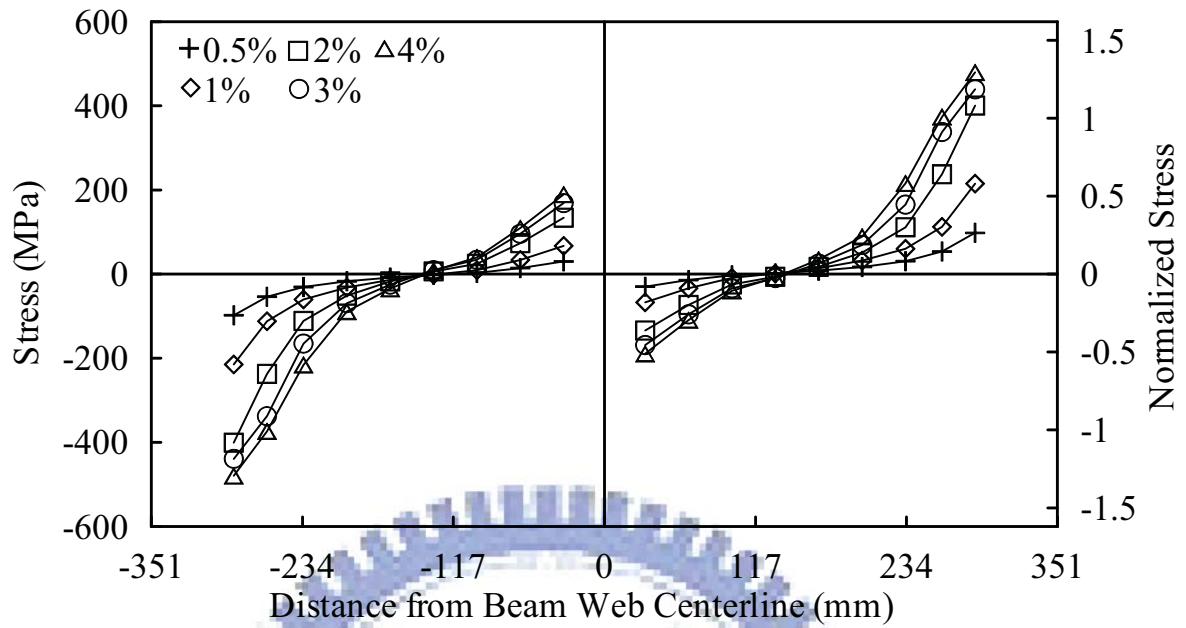


圖 5.22 試體 IFS5 之加勁板 ABAQUS 應力分佈圖 (Positive Bending)

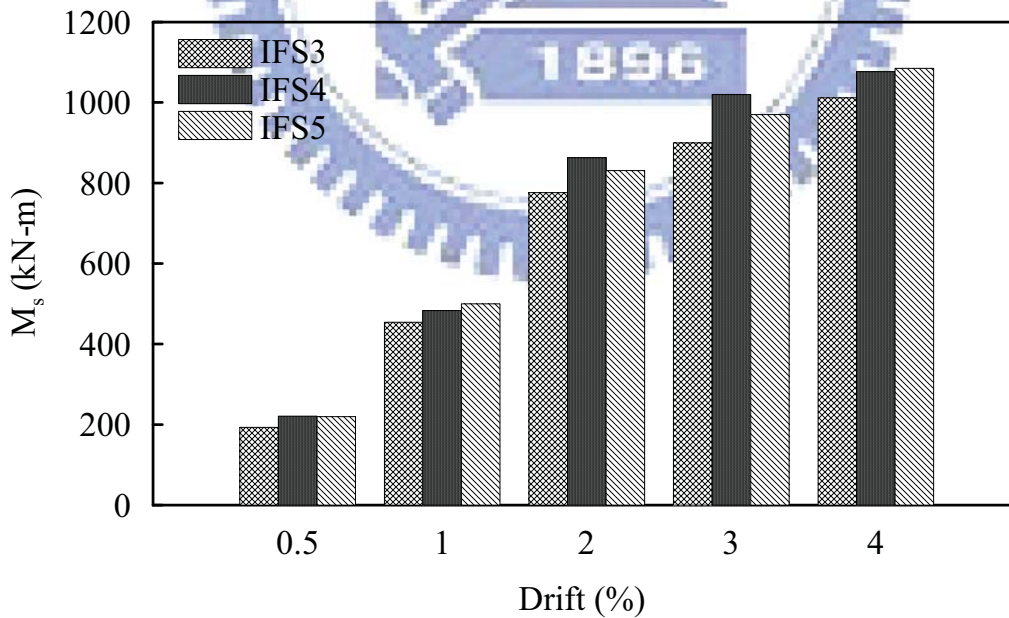


圖 5.23 IFS 試體加勁板 ABAQUS 提供之彎矩貢獻量

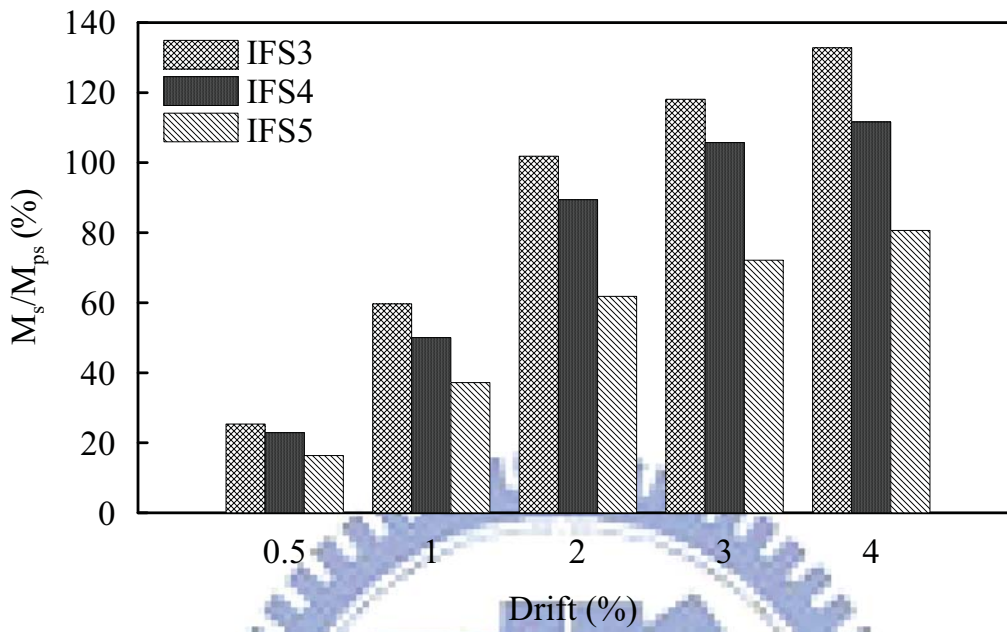


圖 5.24 IFS 試體加勁板 ABAQUS 提供之塑性彎矩 M_{ps} 比例

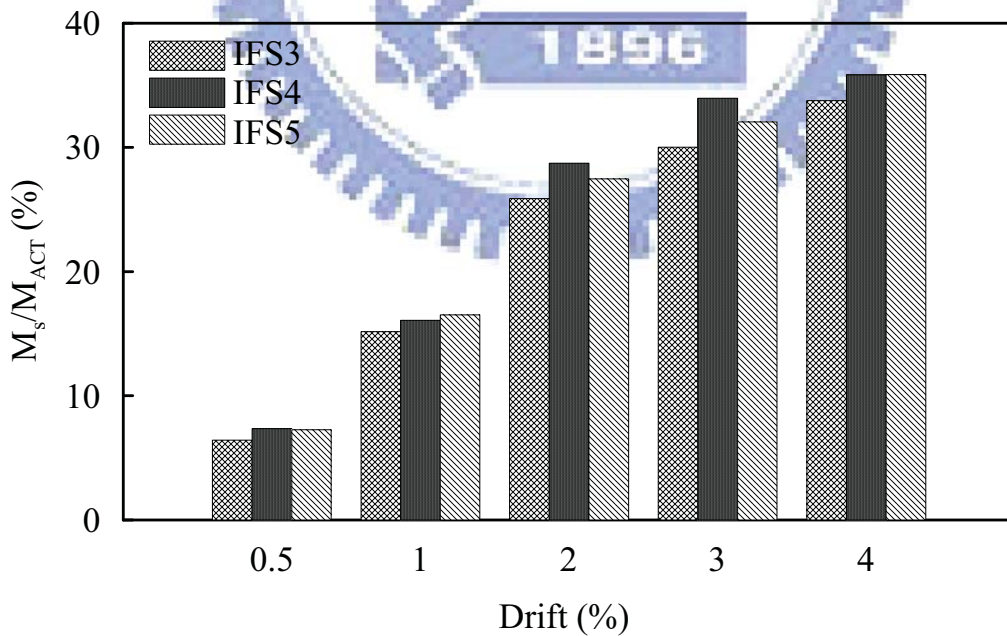


圖 5.25 IFS 試體加勁板 ABAQUS 提供之彎矩佔整體總彎矩的比例

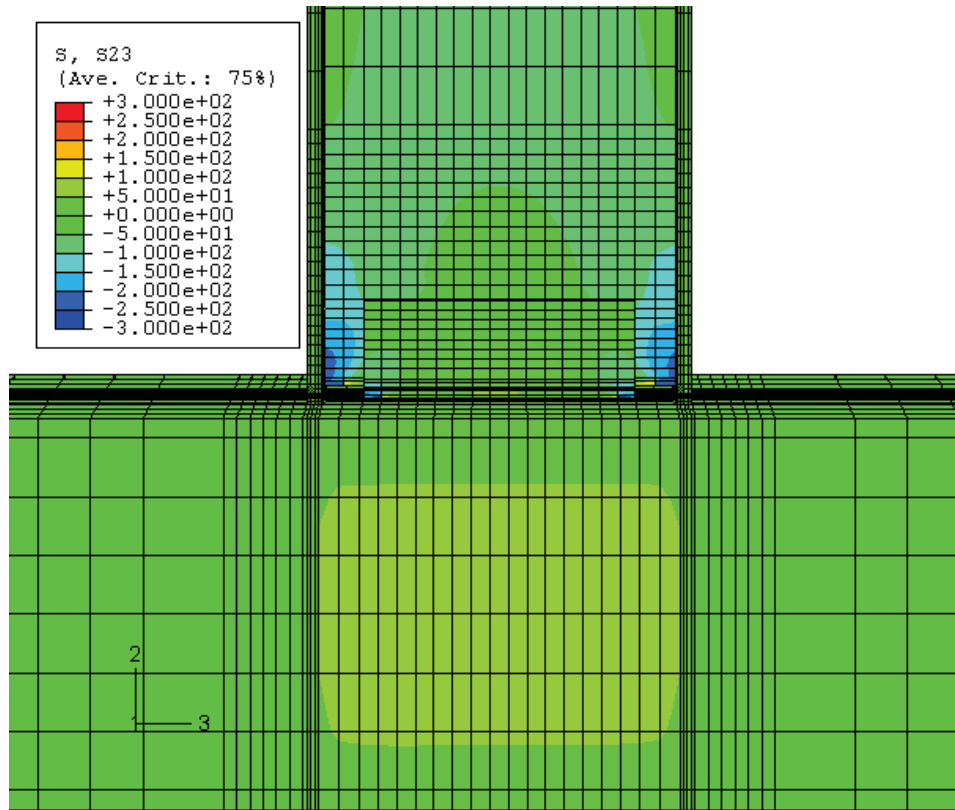


圖 5.26 試體 UR 於正彎矩時之梁腹剪應力分佈 (4% Drift)

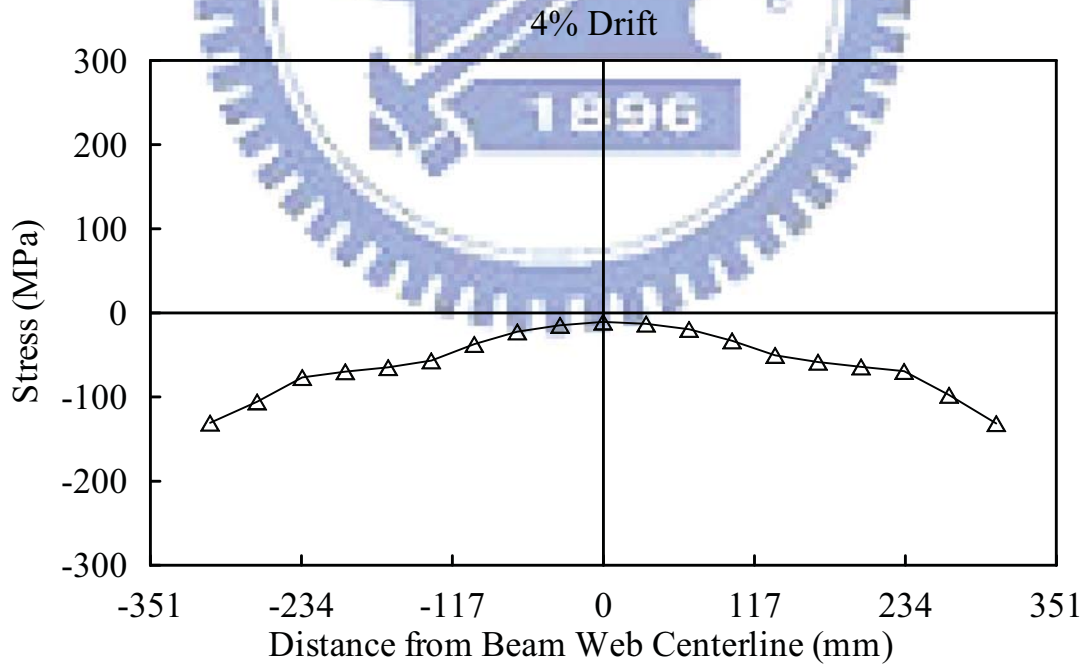


圖 5.27 試體 UR 之梁腹剪應力分佈 (Positive Bending)

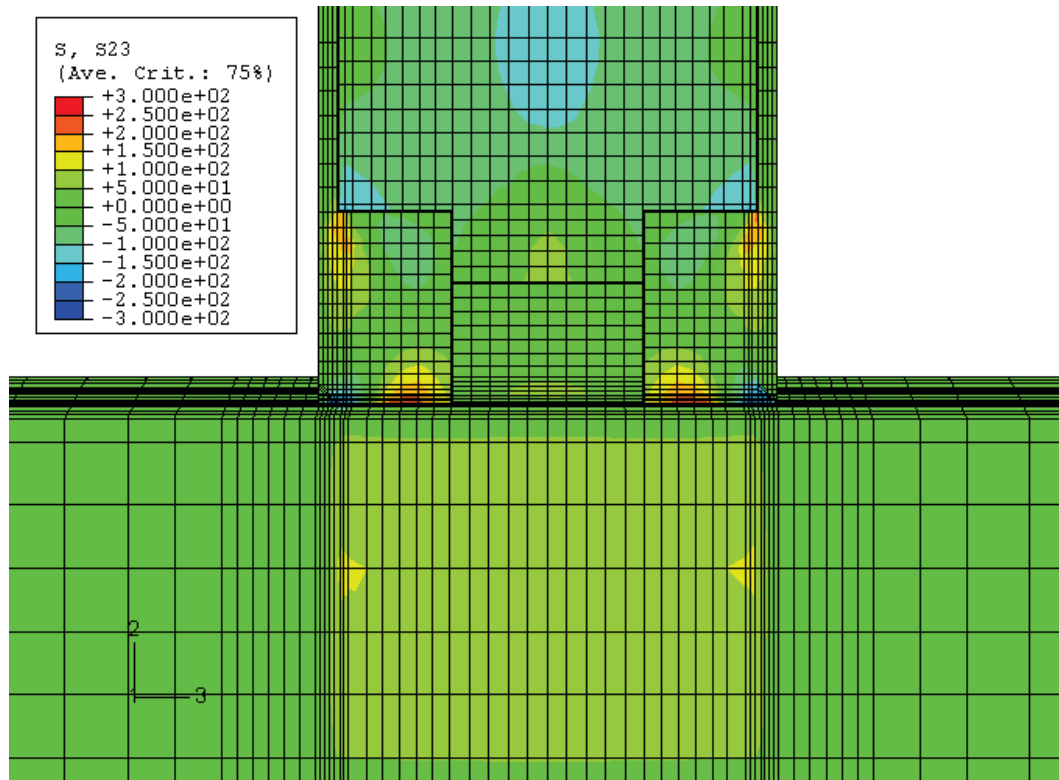


圖 5.28 試體 IFS4 加勁板於正彎矩時之剪應力分佈 (4% Drift)

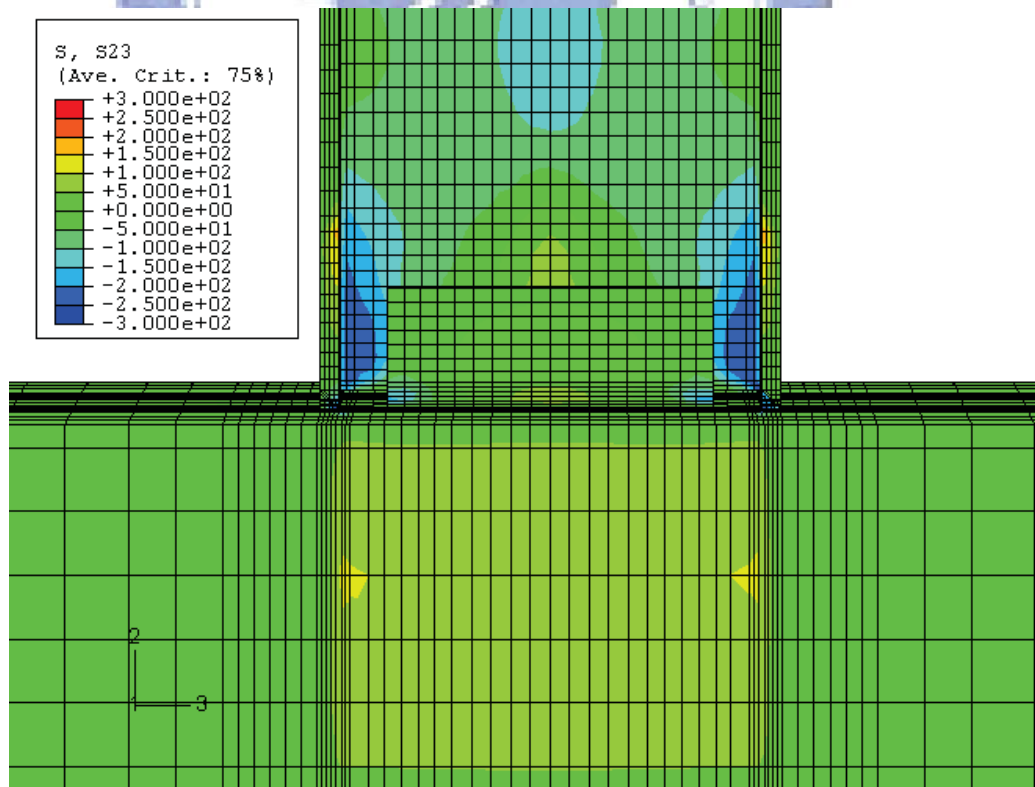


圖 5.29 試體 IFS4 梁腹板於正彎矩時之梁腹剪應力分佈 (4% Drift)

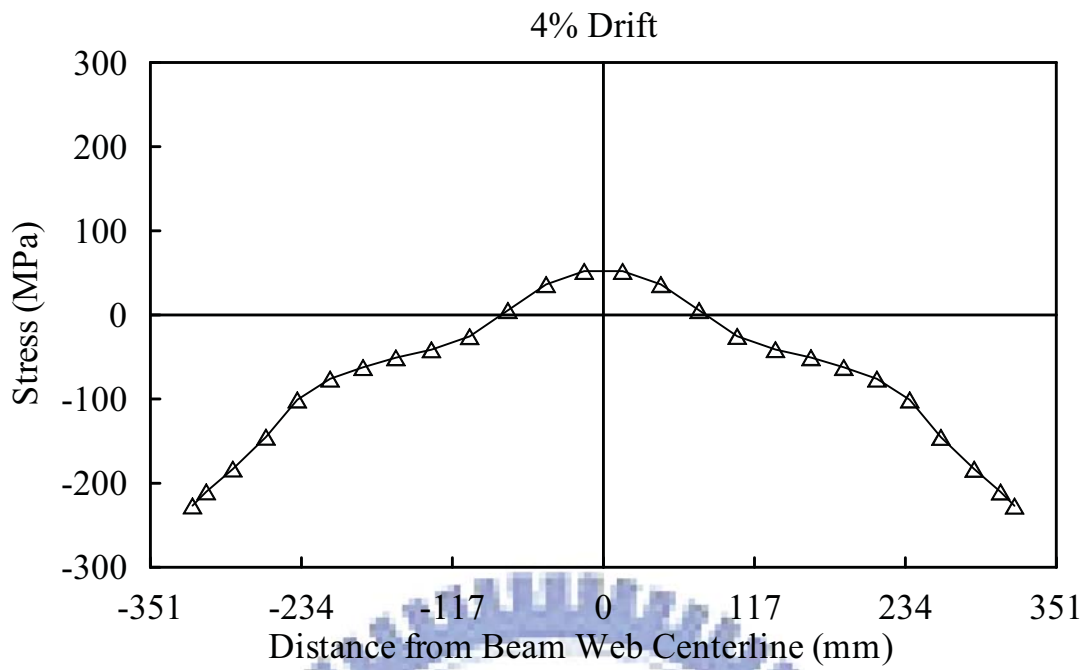


圖 5.30 試體 IFS4 之梁腹板剪應力分佈 (Positive Bending)



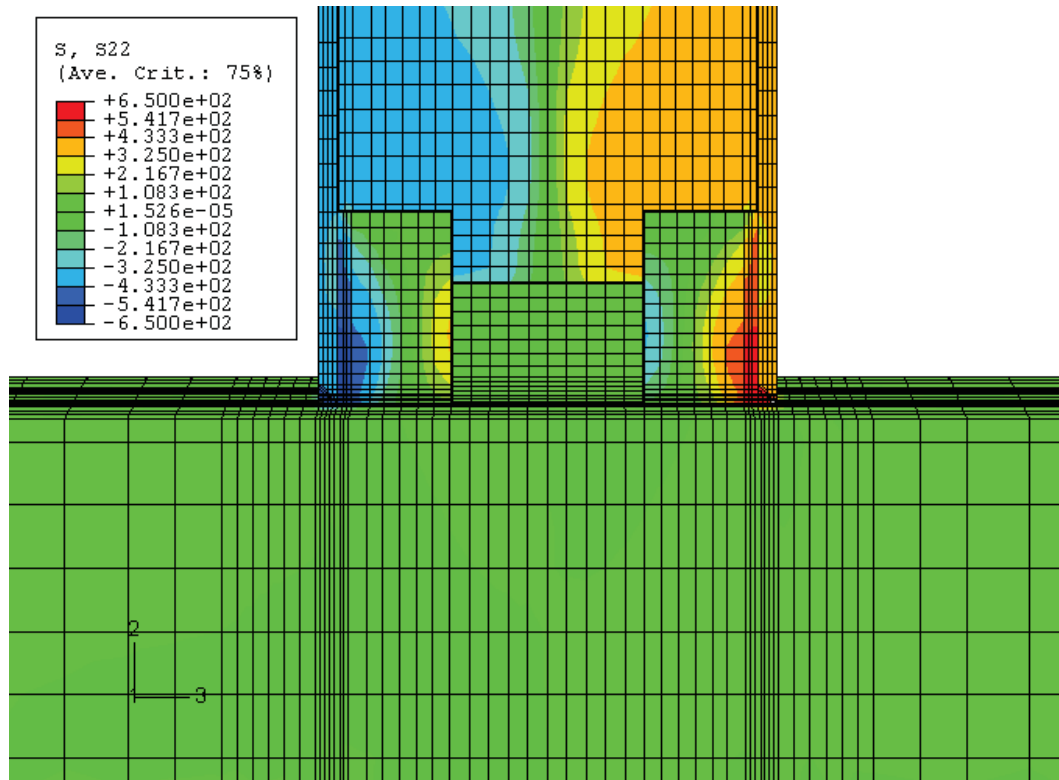


圖 5.31 試體 IFS4 加勁板於正彎矩時之軸向應力分佈 (4% Drift)

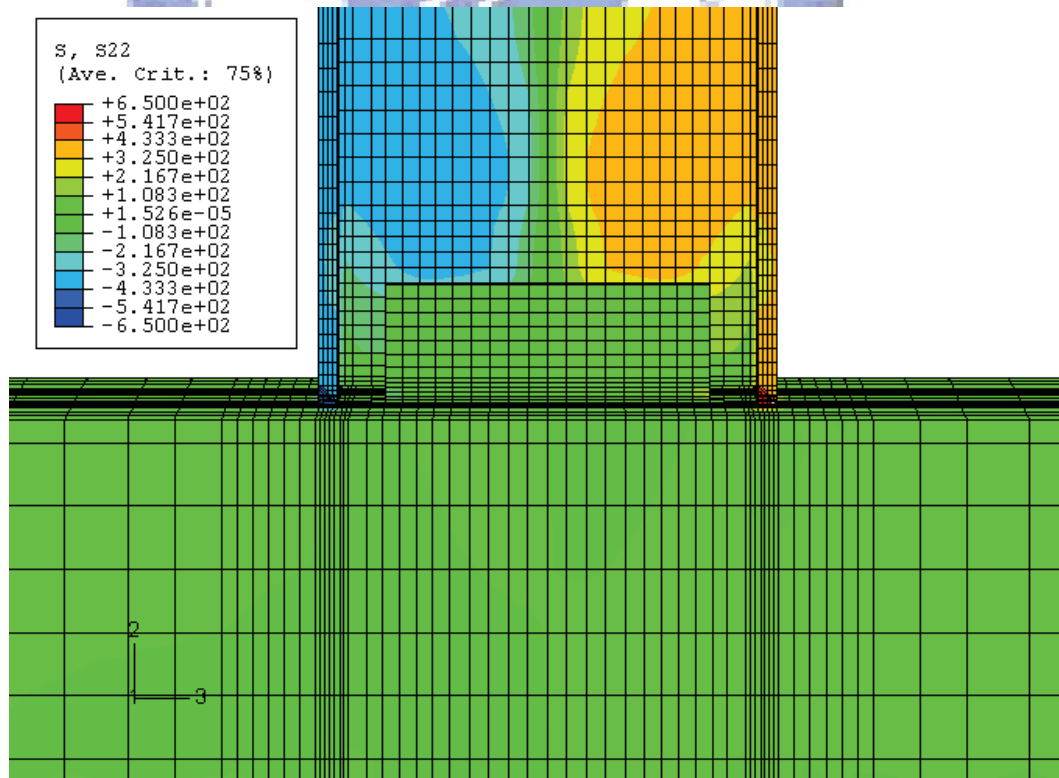


圖 5.32 試體 IFS4 梁於正彎矩時之軸向應力分佈 (4% Drift)

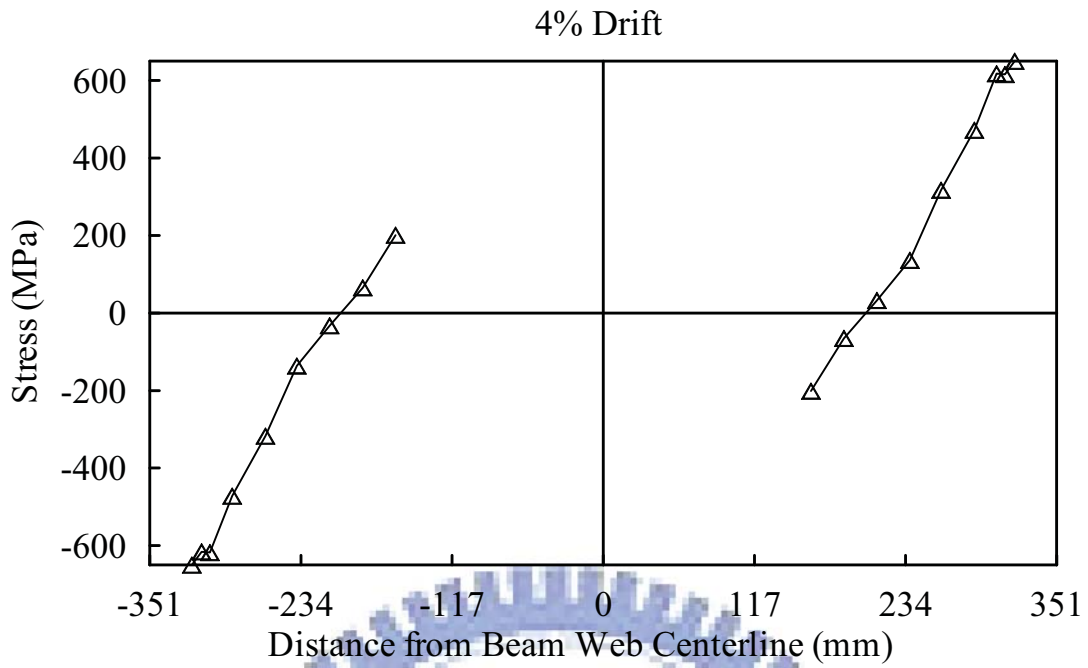


圖 5.33 試體 IFS4 之加勁板軸向應力分佈 (Positive Bending)

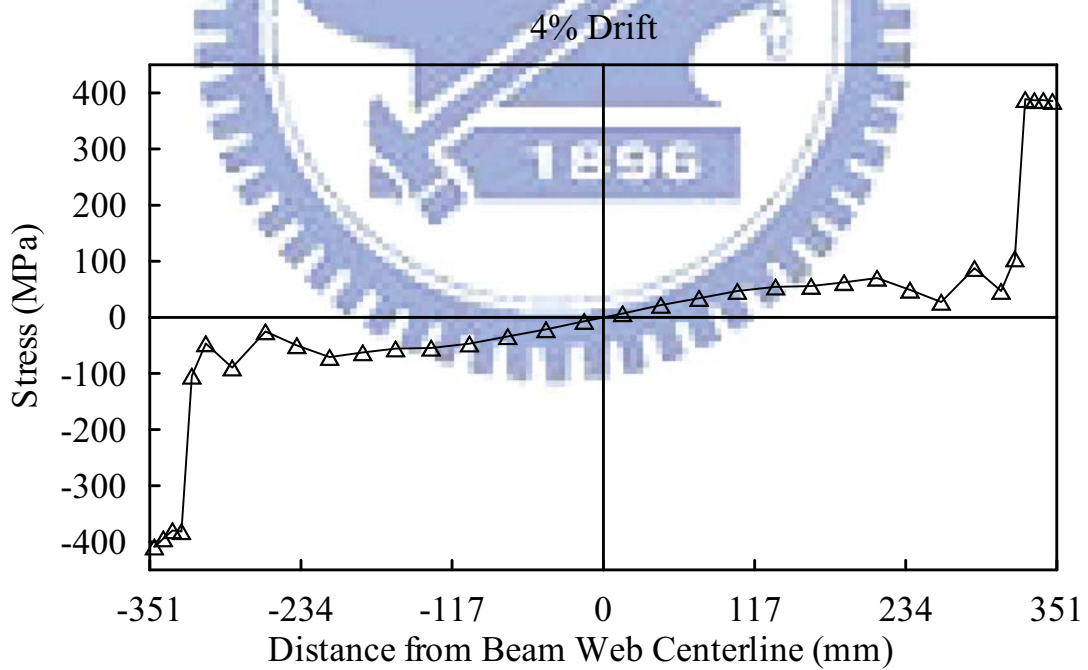
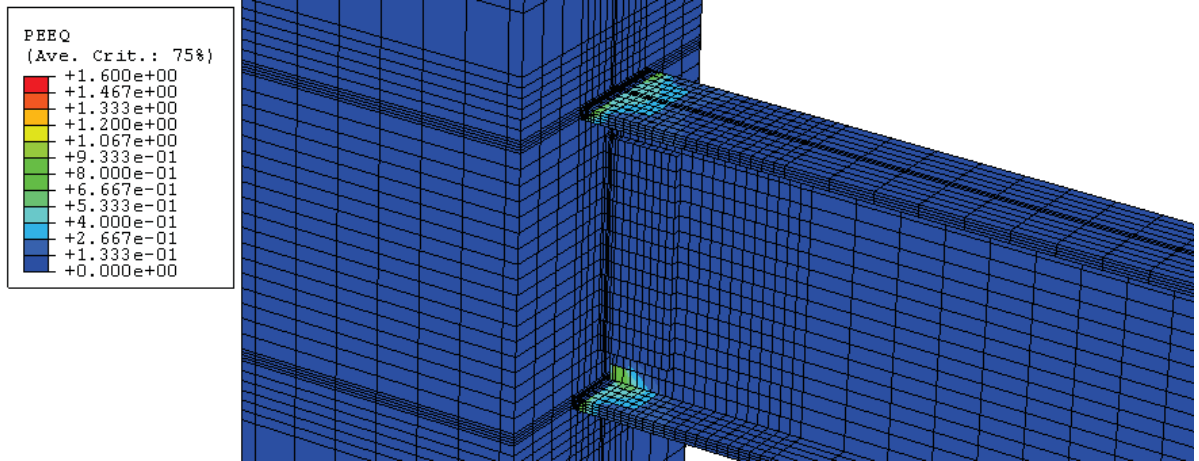
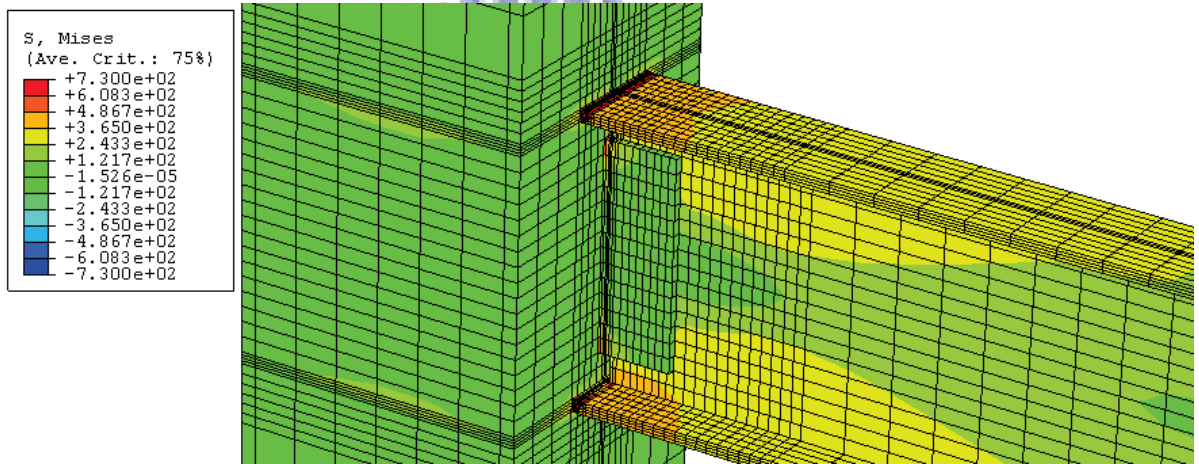


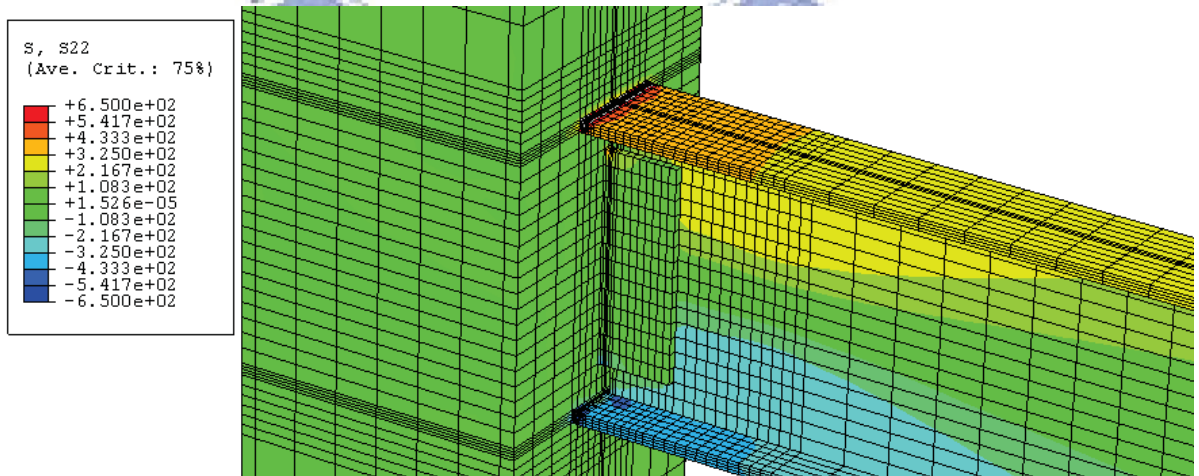
圖 5.34 試體 IFS4 梁之軸向應力分佈 (Positive Bending)



(a) PEEQ

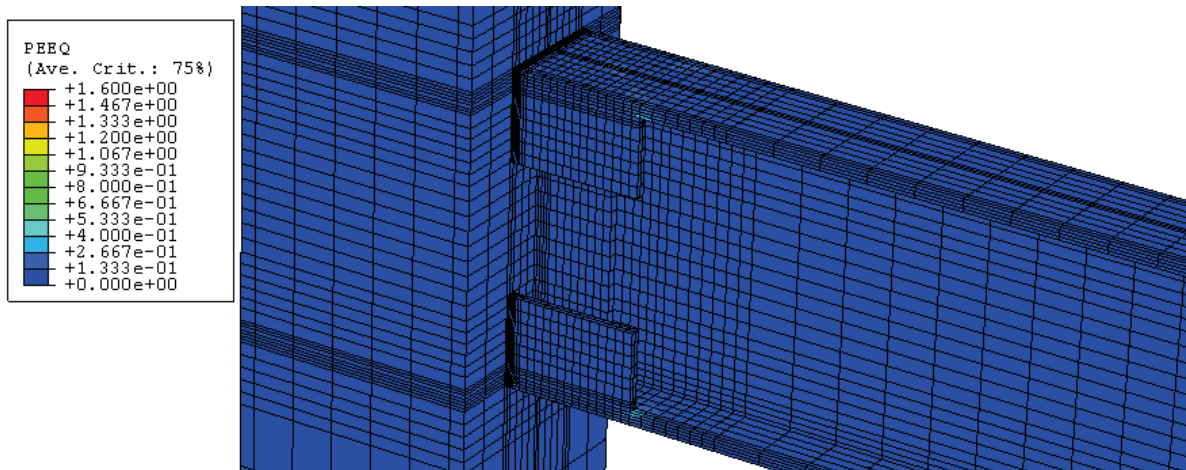


(b) Mises Stress

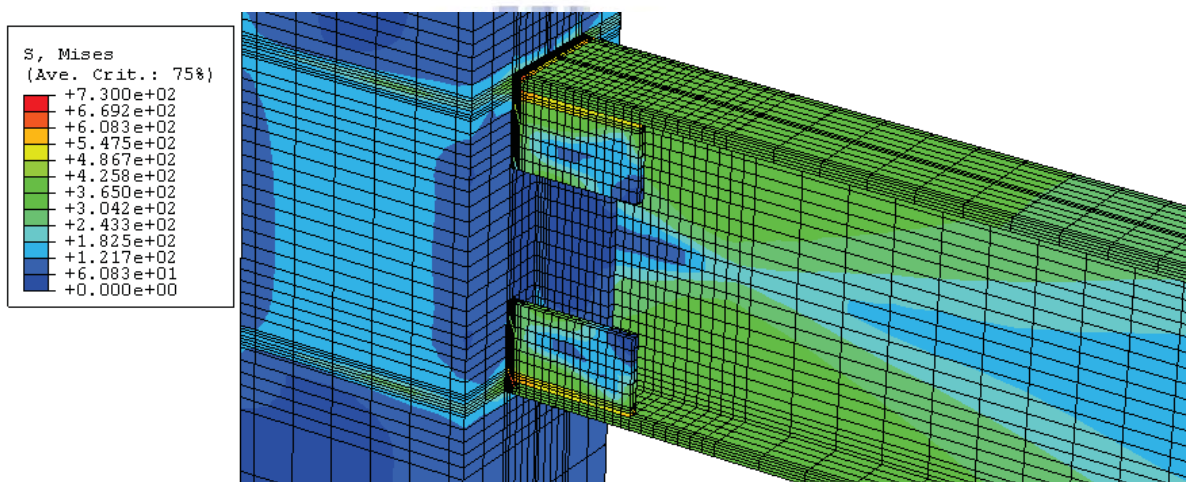


(c) S22

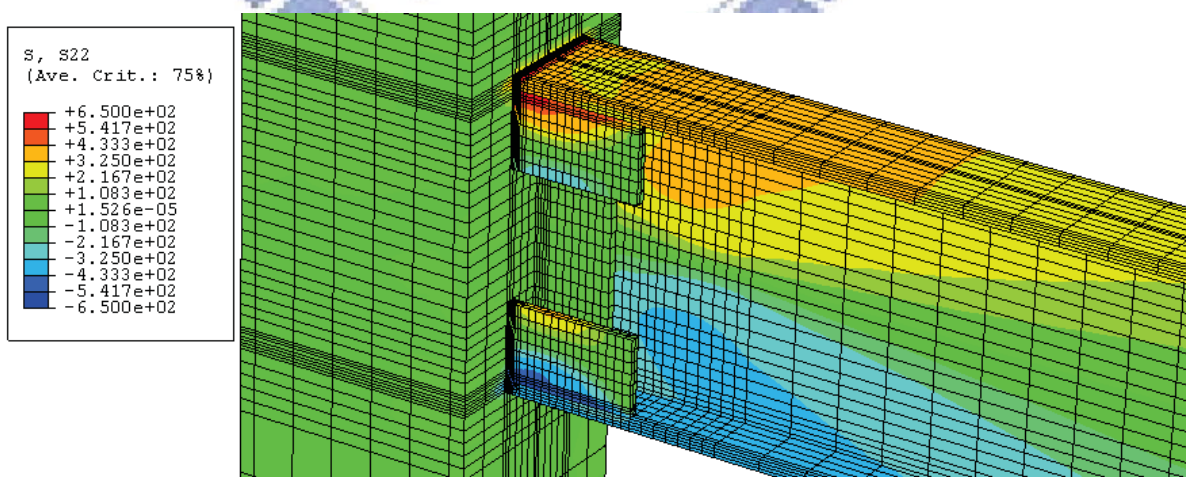
圖 5.35 試體 UR 分析模型之各項參數分佈圖 (3.0% Drift)



(a) PEEQ

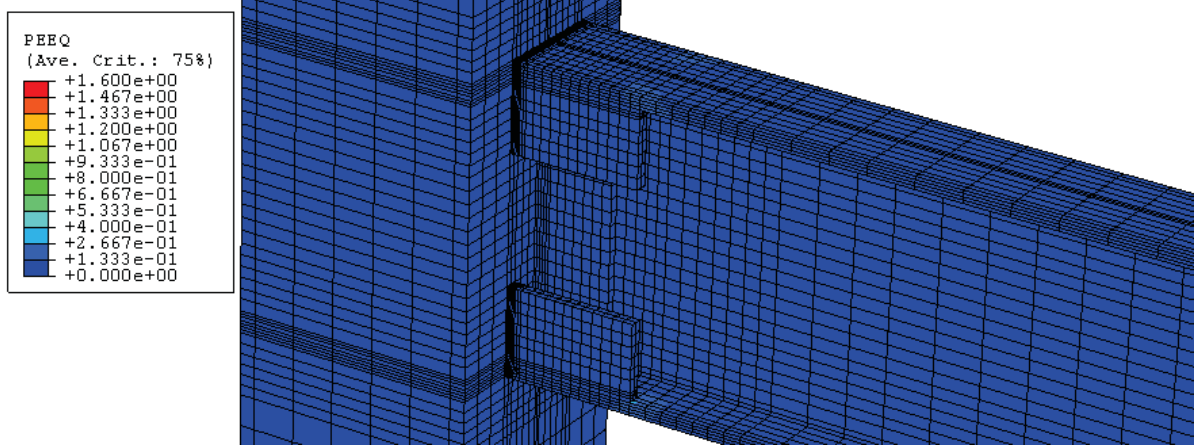


(b) Mises Stress

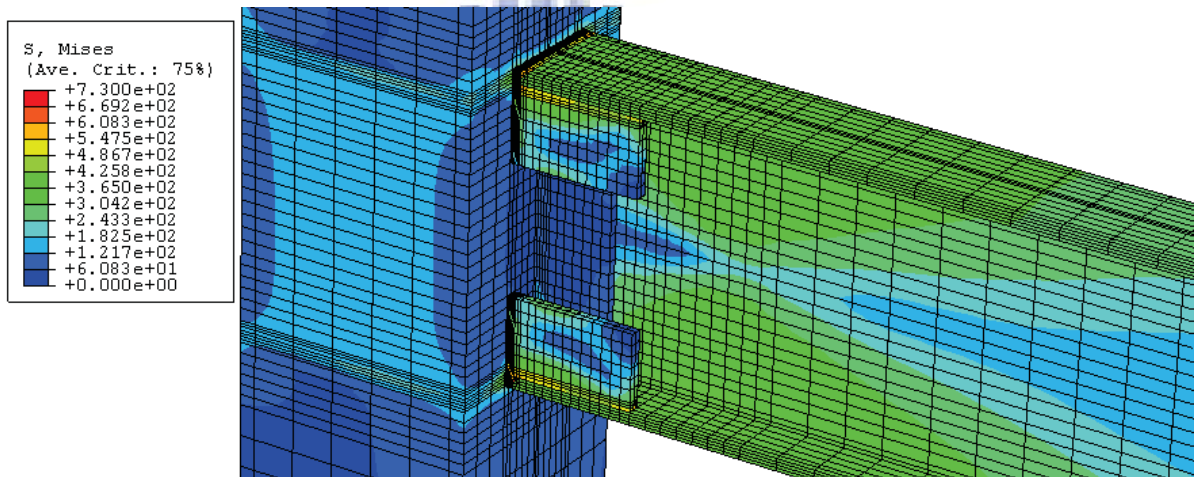


(c) S22

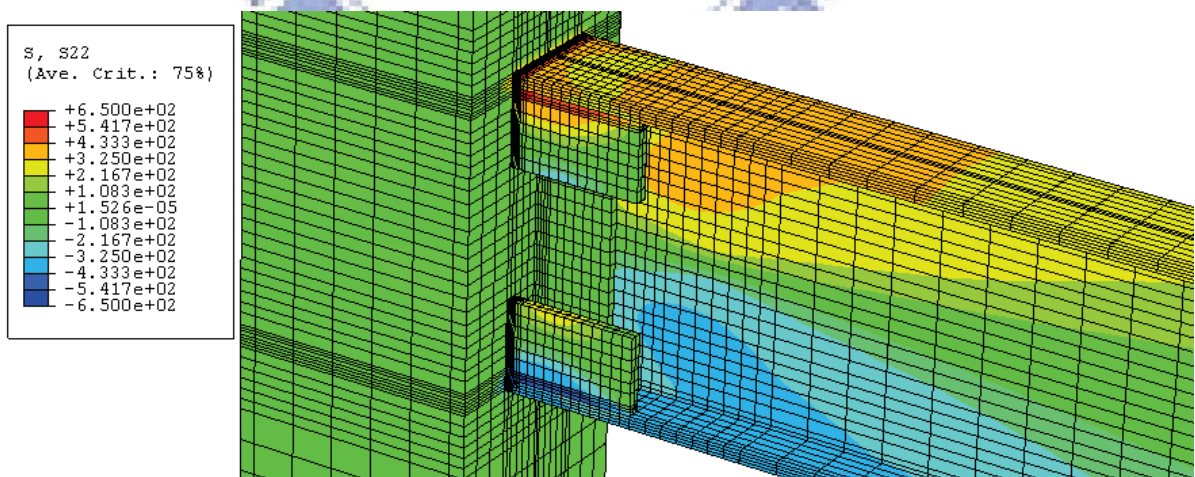
圖 5.36 試體 IFS3 分析模型之各項參數分佈圖 (3.0% Drift)



(a) PEEQ

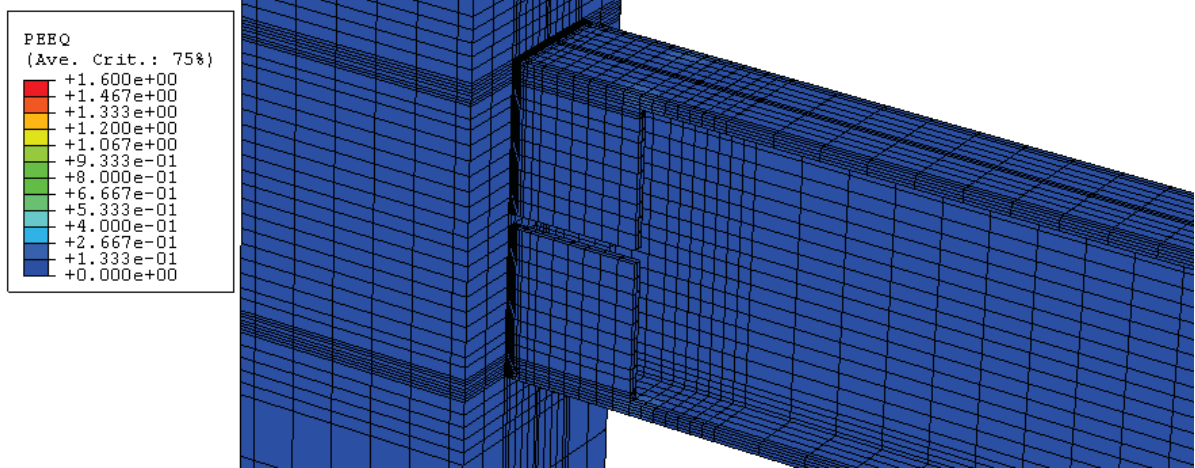


(b) Mises Stress

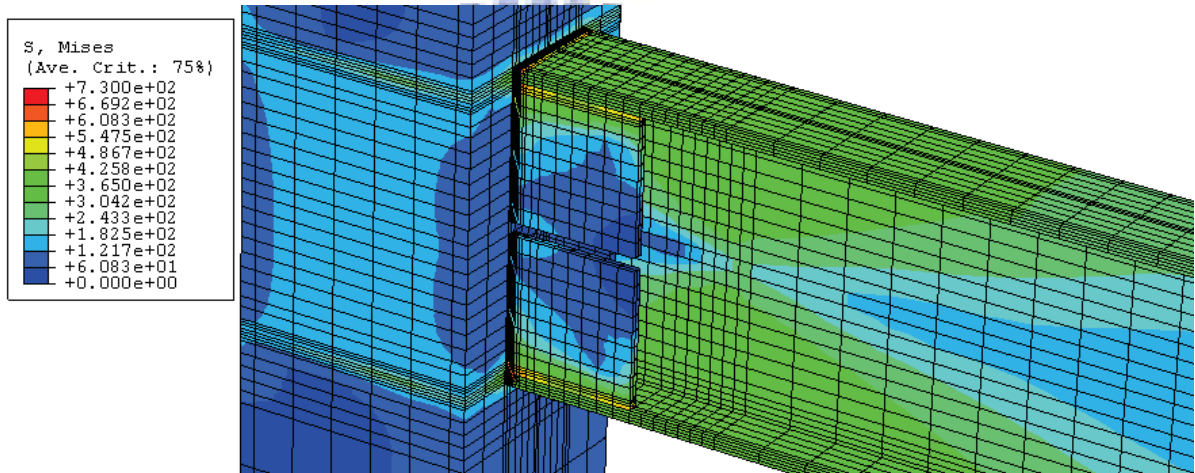


(c) S22

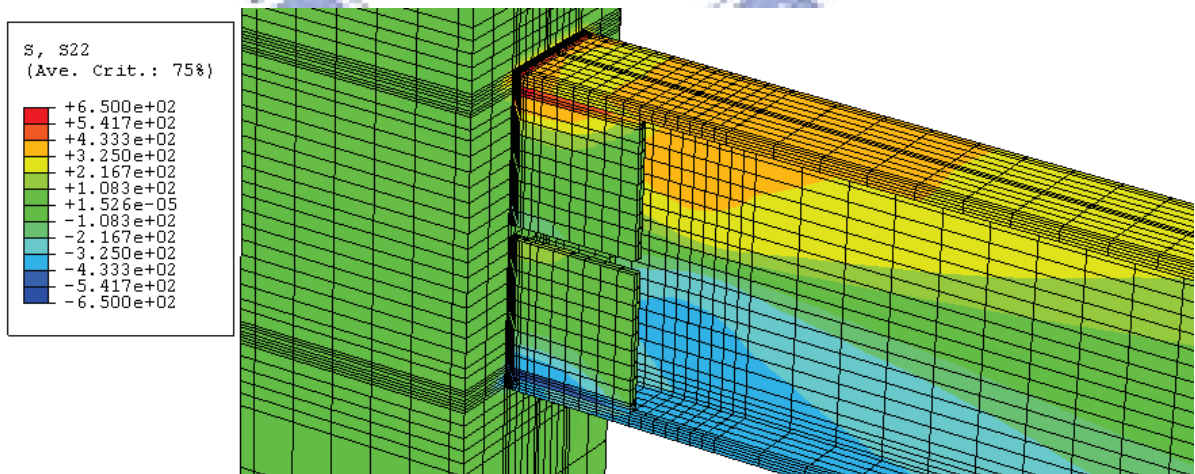
圖 5.37 試體 IFS4 分析模型之各項參數分佈圖 (3.0% Drift)



(a) PEEQ

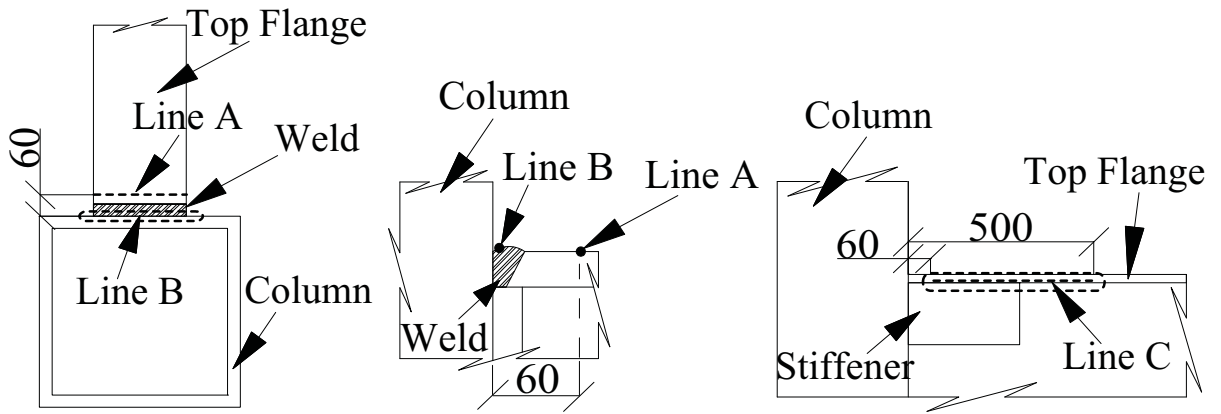


(b) Mises Stress

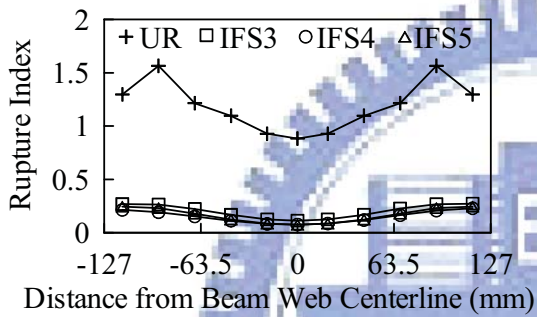


(c) S22

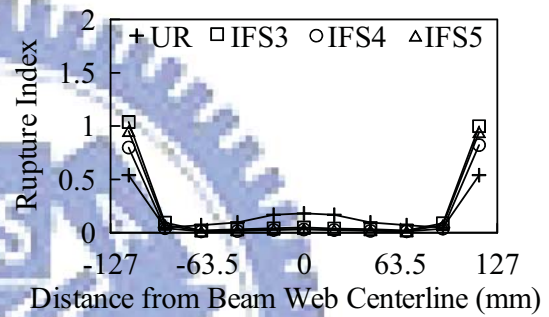
圖 5.38 試體 IFS5 分析模型之各項參數分佈圖 (3.0% Drift)



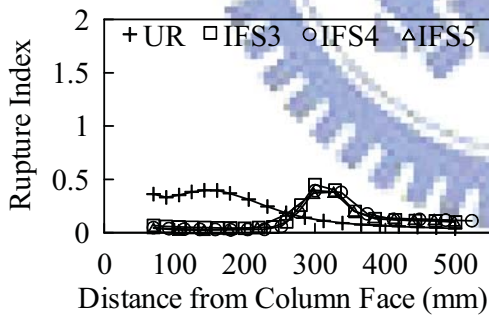
(a) Location



(b) Line A

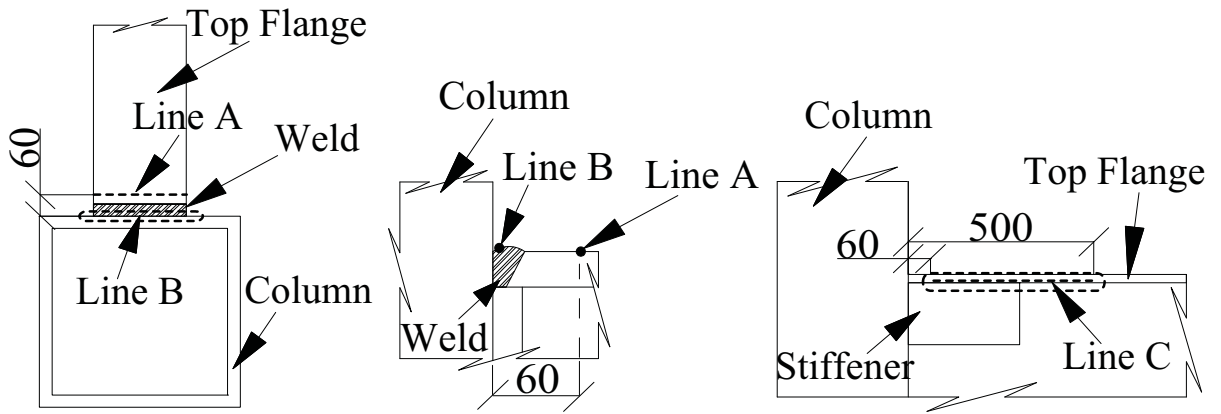


(c) Line B

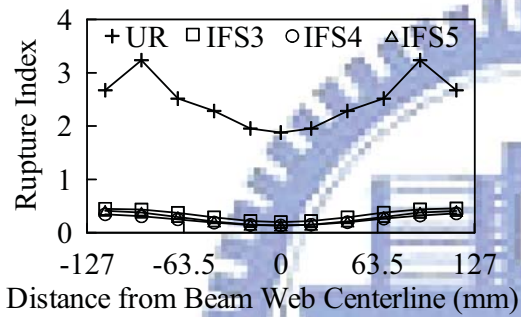


(d) Line C

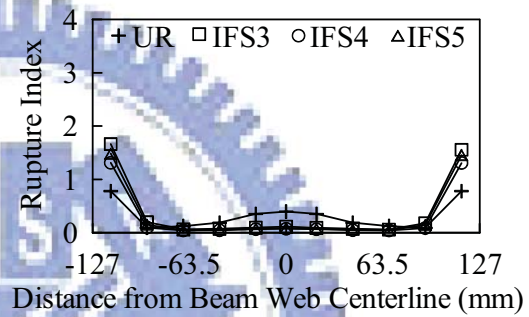
圖 5.39 試體 UR 及 IFS 試體之 Rupture Index 比較圖 (3.0% Drift)



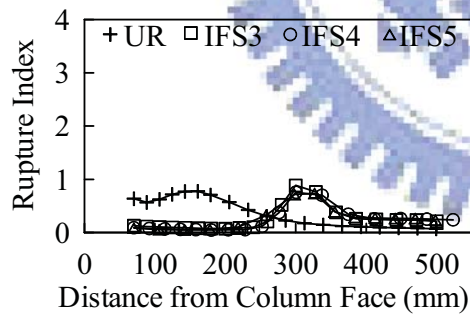
(a) Location



(b) Line A

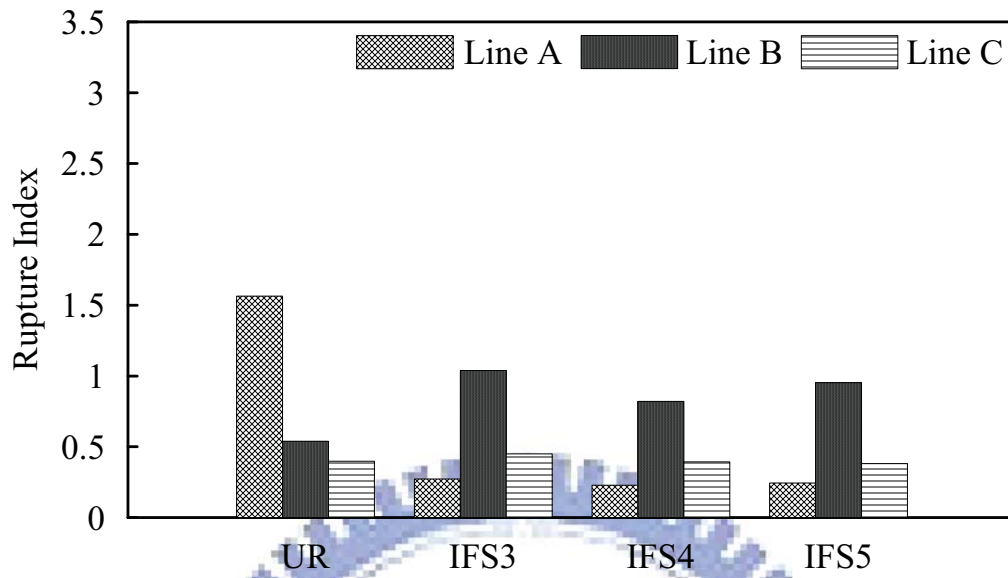


(c) Line B

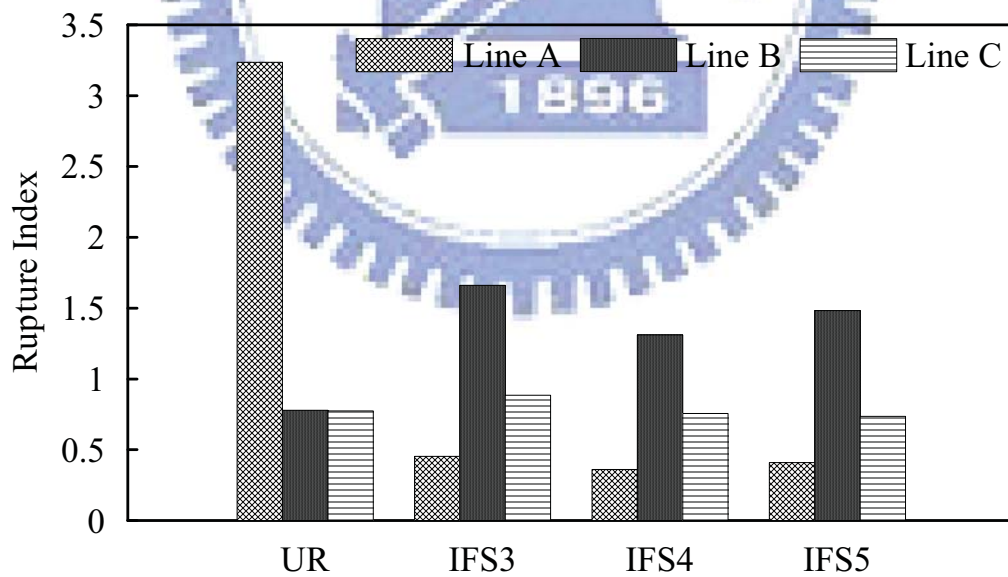


(d) Line C

圖 5.40 試體 UR 及 IFS 試體之 Rupture Index 比較圖 (4.0% Drift)

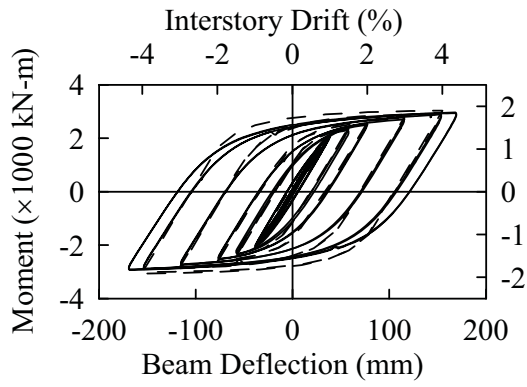


(a) 3.0% Drift

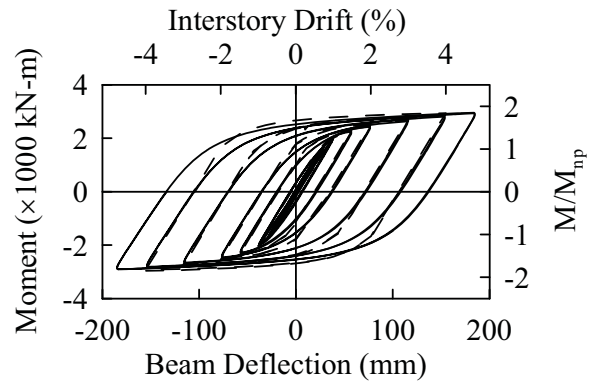


(b) 4.0% Drift

圖 5.41 試體 UR 及 IFS 試體之 Rupture Index 綜合比較圖



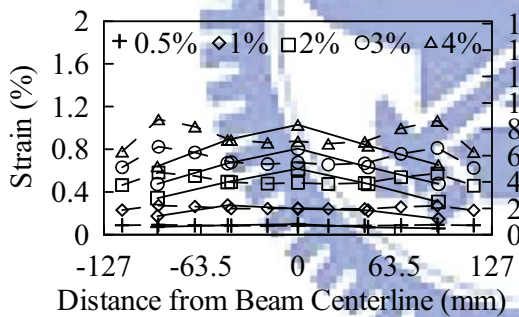
(a) FDWS2



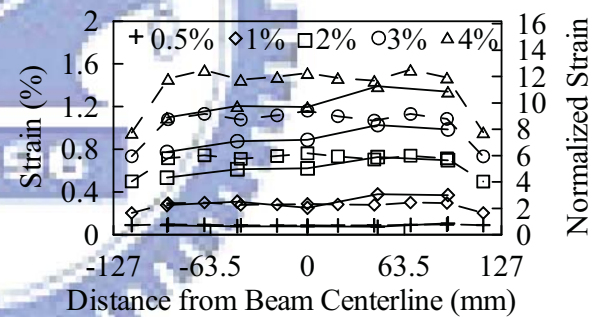
(b) FDWS3

—— Test - - - ABAQUS

圖 5.42 FDWS 試體之梁端彎矩與位移關係比較圖



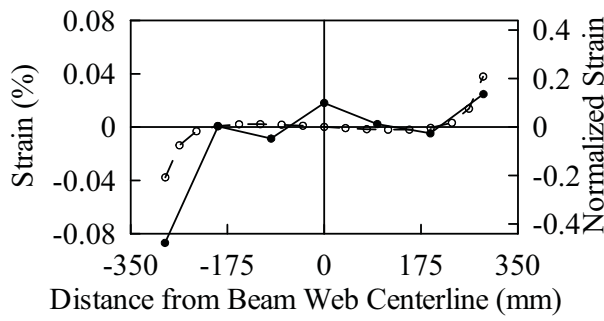
(a) FDWS2



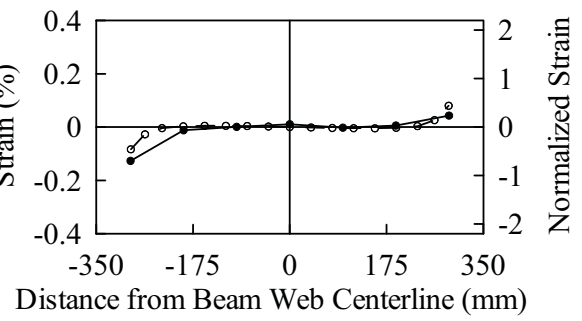
(b) FDWS3

—— Test - - - ABAQUS

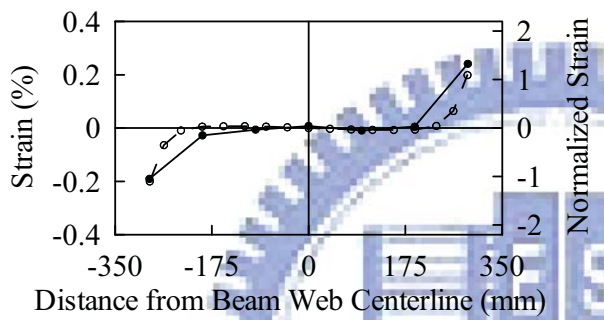
圖 5.43 FDWS 試體之上翼板應變比較圖



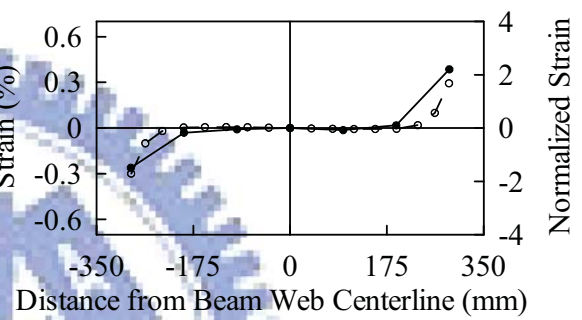
(a) 0.5% Drift



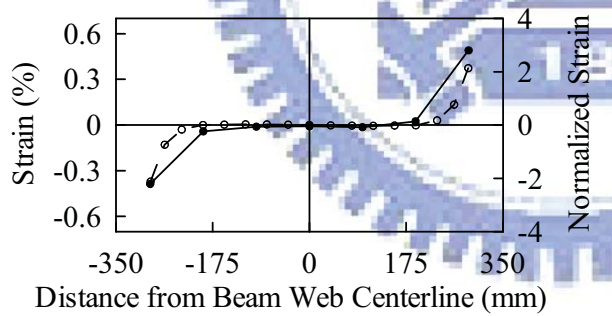
(b) 1.0% Drift



(c) 2.0% Drift



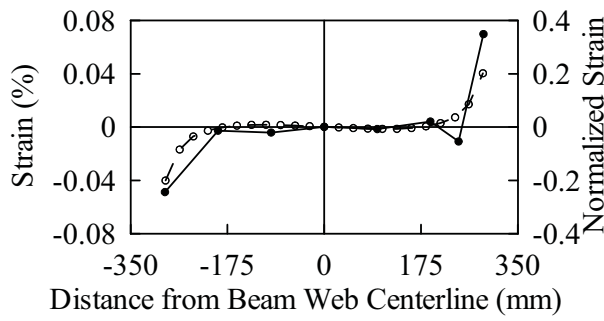
(d) 3.0% Drift



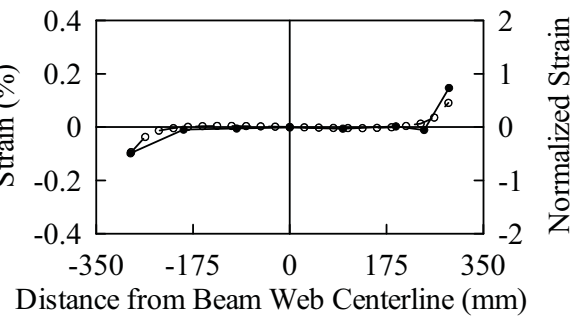
(d) 4.0% Drift

—●— Test -○- ABAQUS

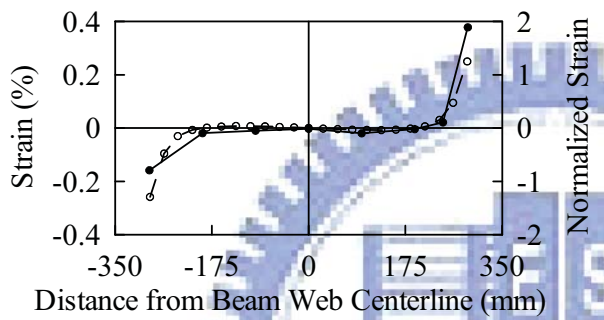
圖 5.44 試體 FDWS2 之加勁板應變比較圖 (Positive Bending)



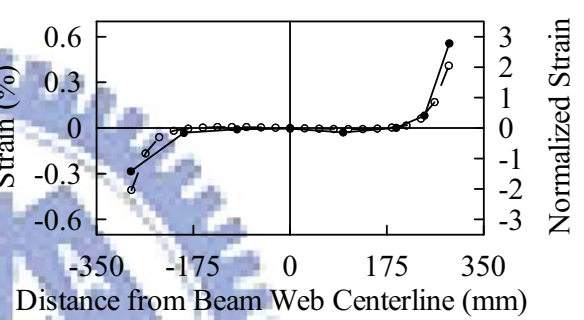
(a) 0.5% Drift



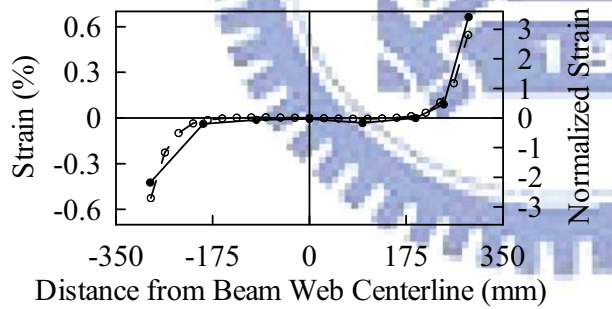
(b) 1.0% Drift



(c) 2.0% Drift



(d) 3.0% Drift



(d) 4.0% Drift

—●— Test -○- ABAQUS

圖 5.45 試體 FDWS3 之加勁板應變比較圖 (Positive Bending)

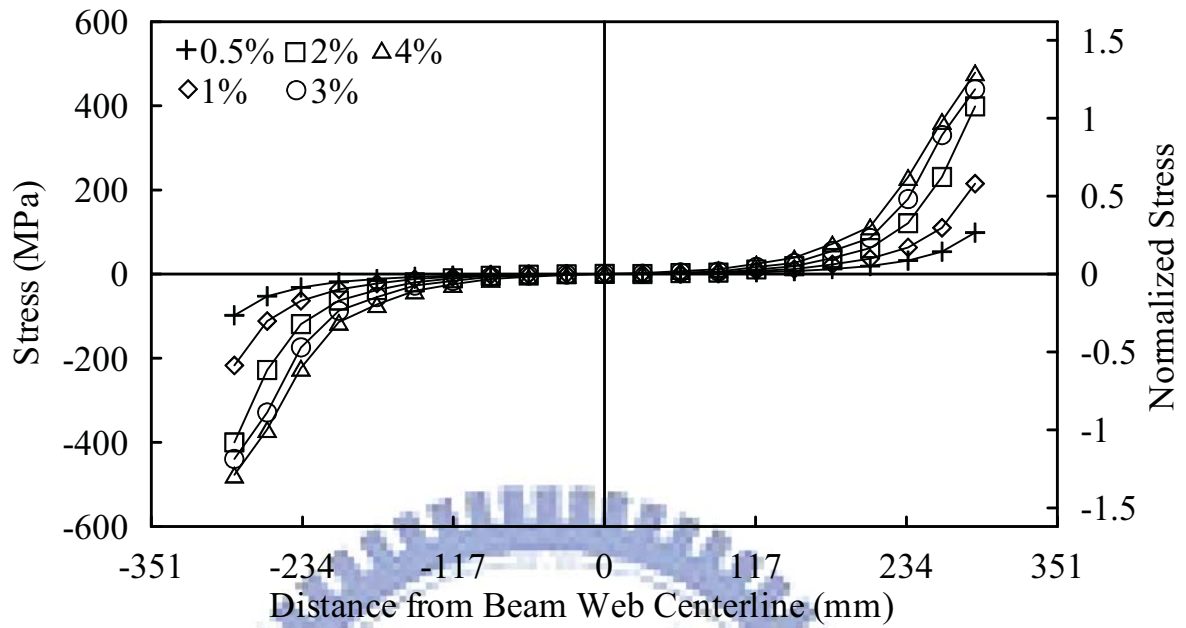


圖 5.46 試體 FDWS2 之加勁板 ABAQUS 應力分佈圖 (Positive Bending)

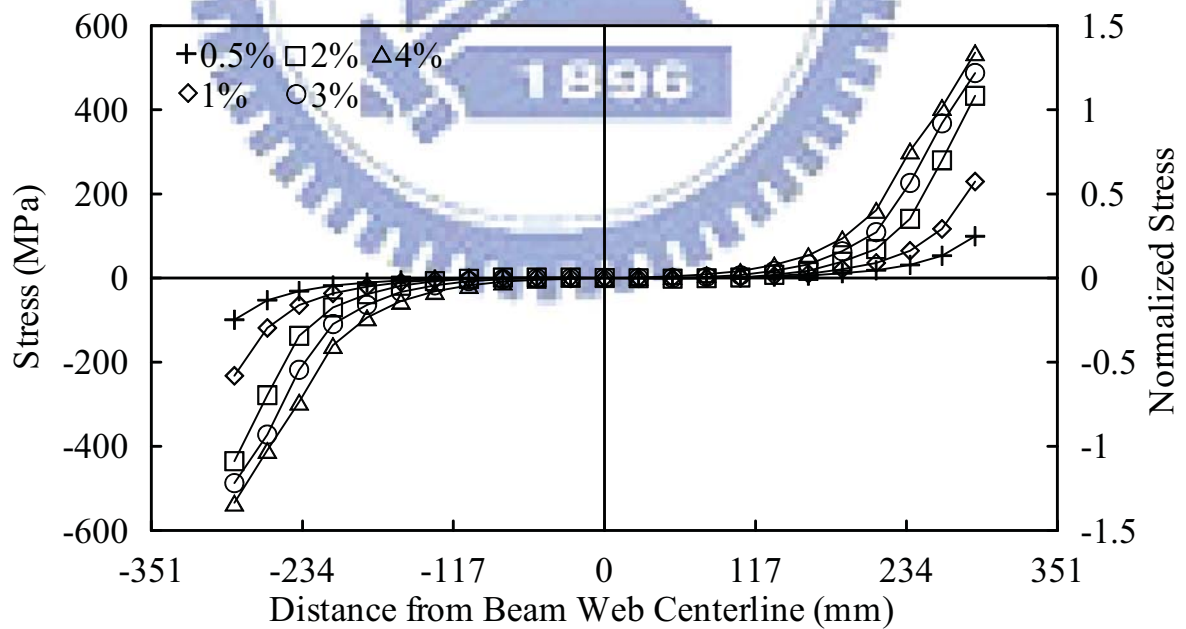


圖 5.47 試體 FDWS3 之加勁板 ABAQUS 應力分佈圖 (Positive Bending)

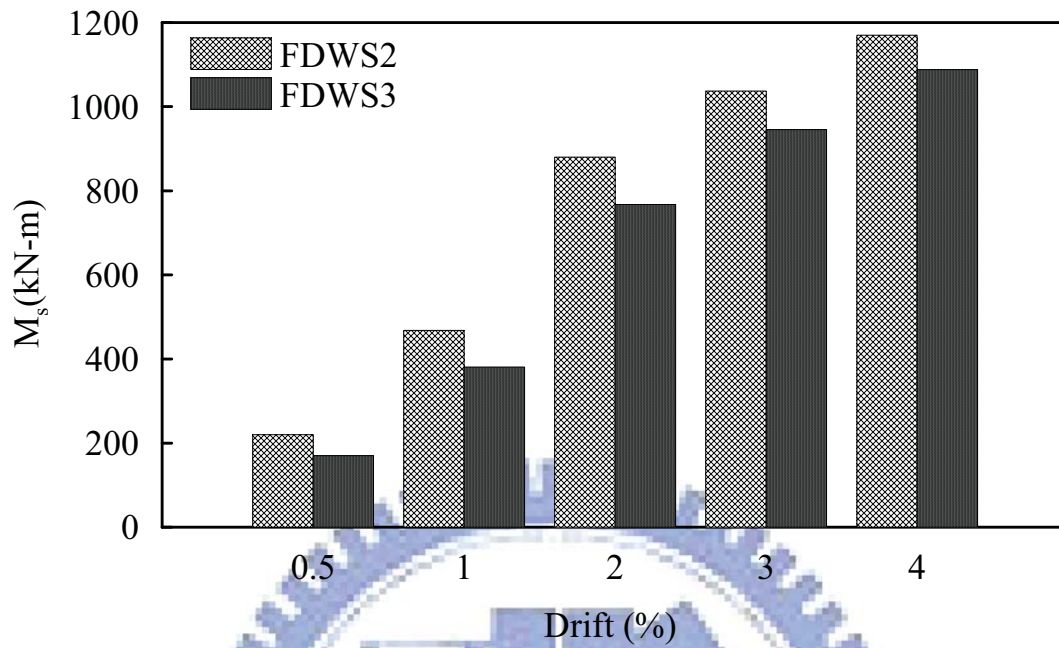


圖 5.48 FDWS 試體加勁板 ABAQUS 提供之彎矩貢獻量

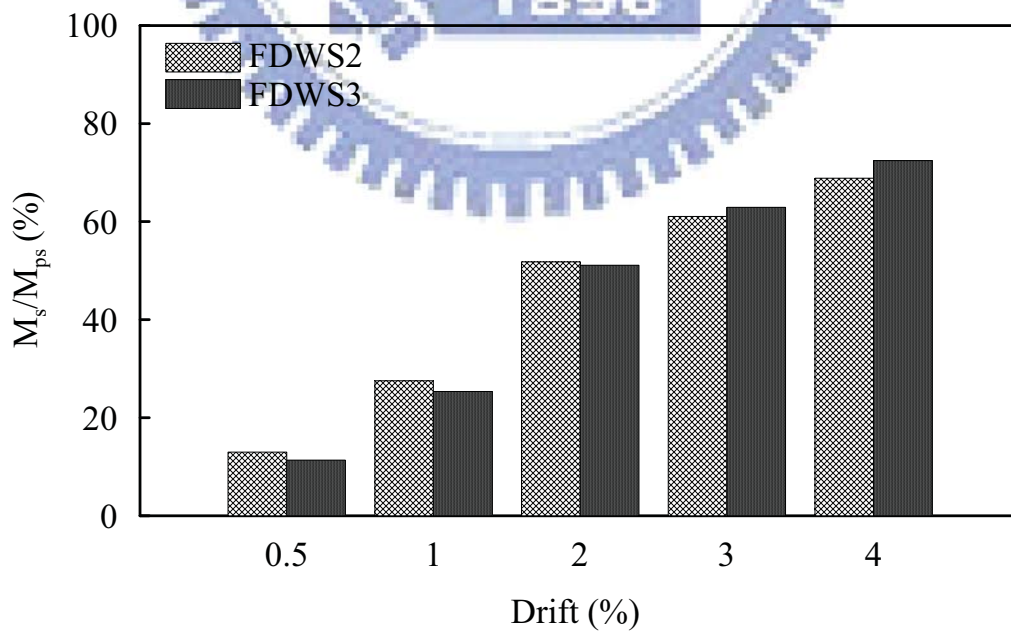


圖 5.49 FDWS 試體加勁板 ABAQUS 提供之塑性彎矩 M_{ps} 比例

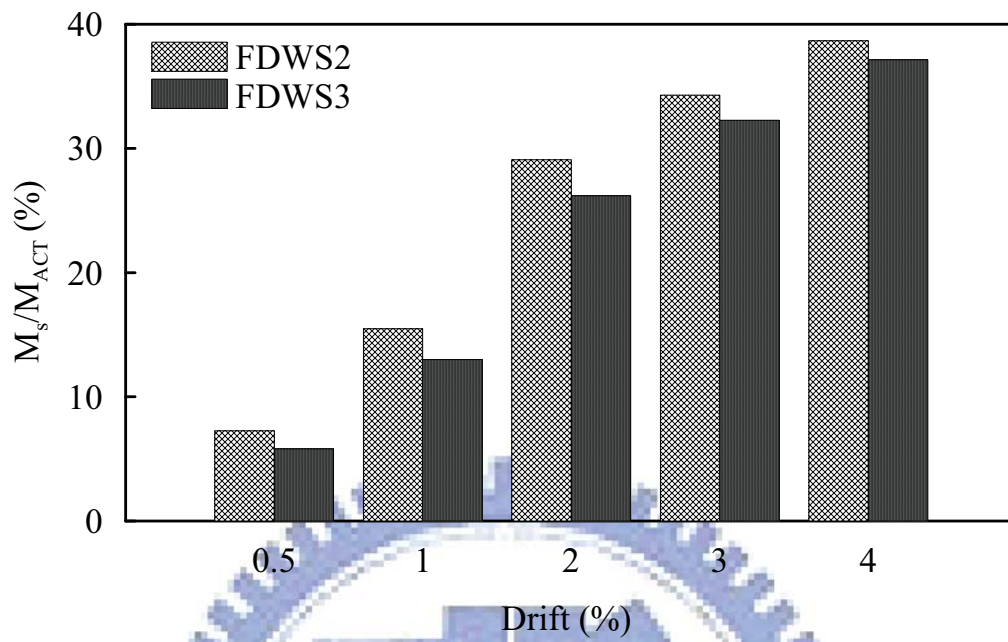


圖 5.50 FDWS 試體加勁板 ABAQUS 提供之彎矩佔整體總彎矩的比例

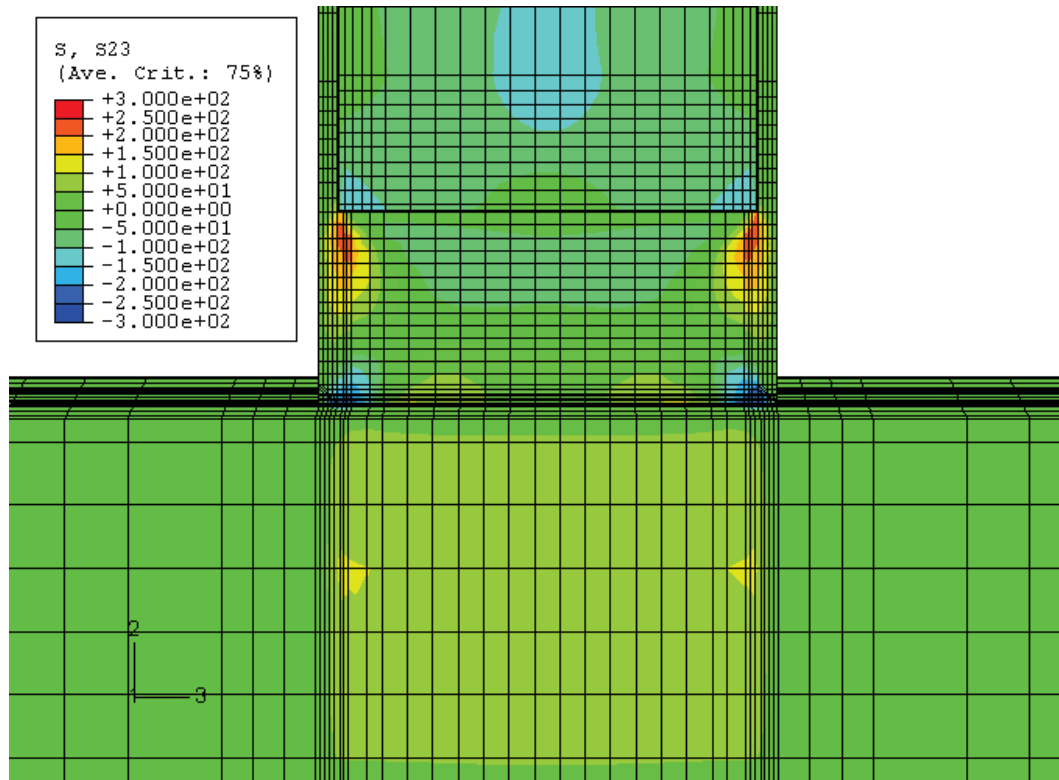


圖 5.51 試體 FDWS2 加勁板於正彎矩時之剪應力分佈 (4% Drift)

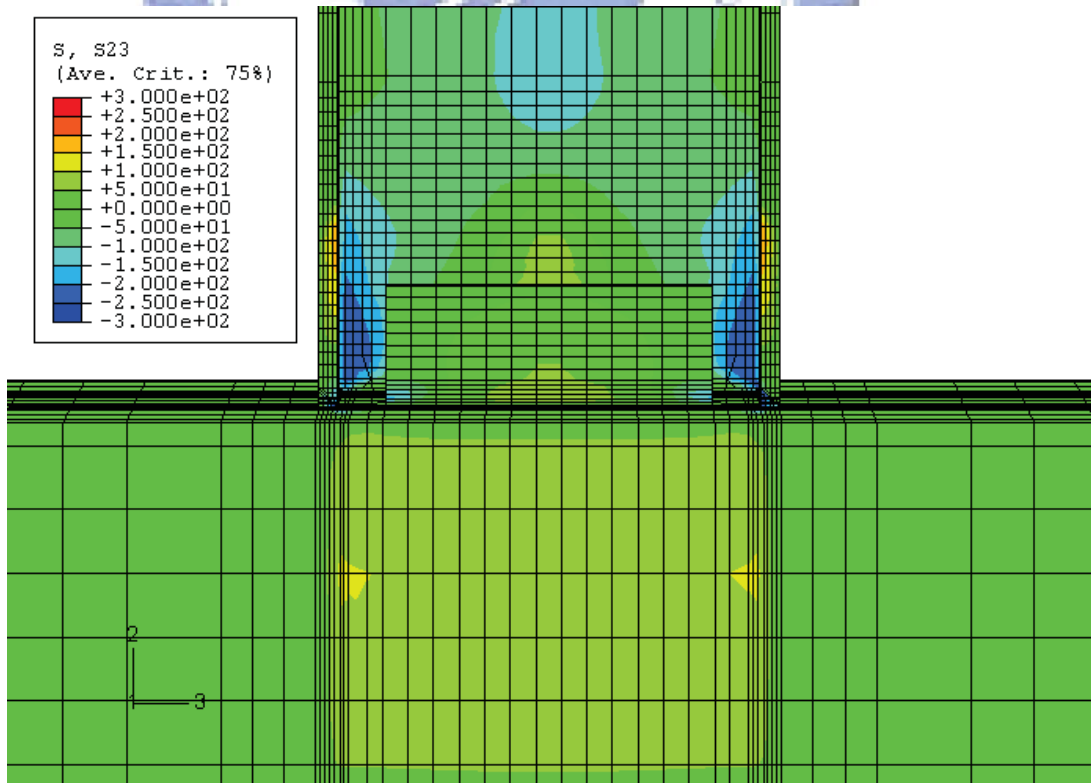


圖 5.52 試體 FDWS2 梁腹板於正彎矩時之剪應力分佈 (4% Drift)

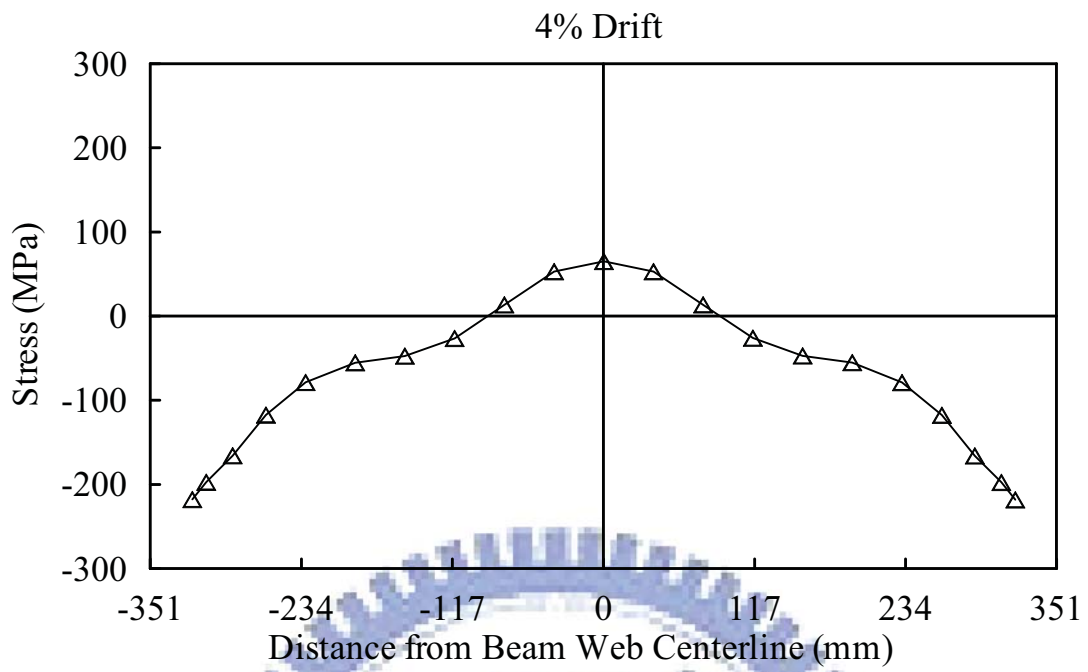
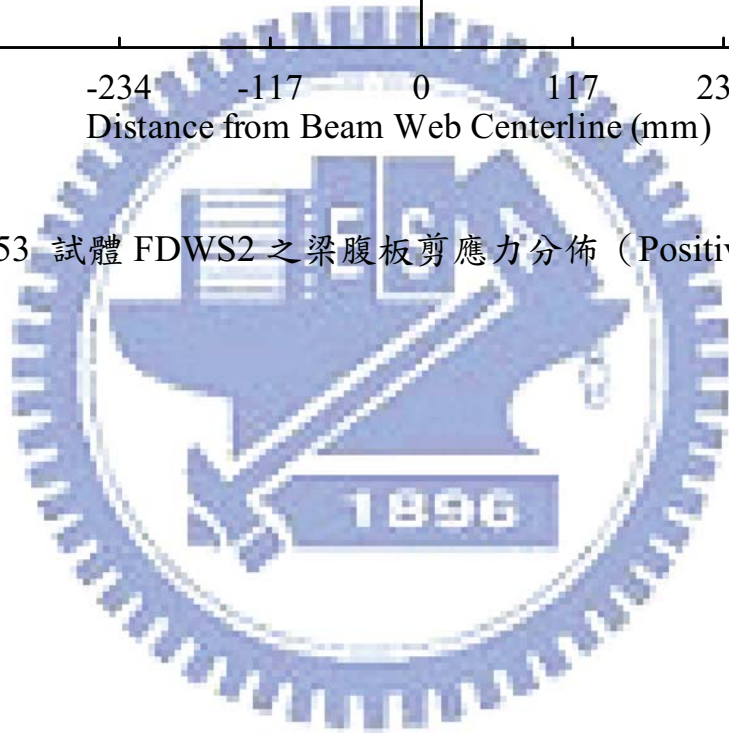


圖 5.53 試體 FDWS2 之梁腹板剪應力分佈 (Positive Bending)



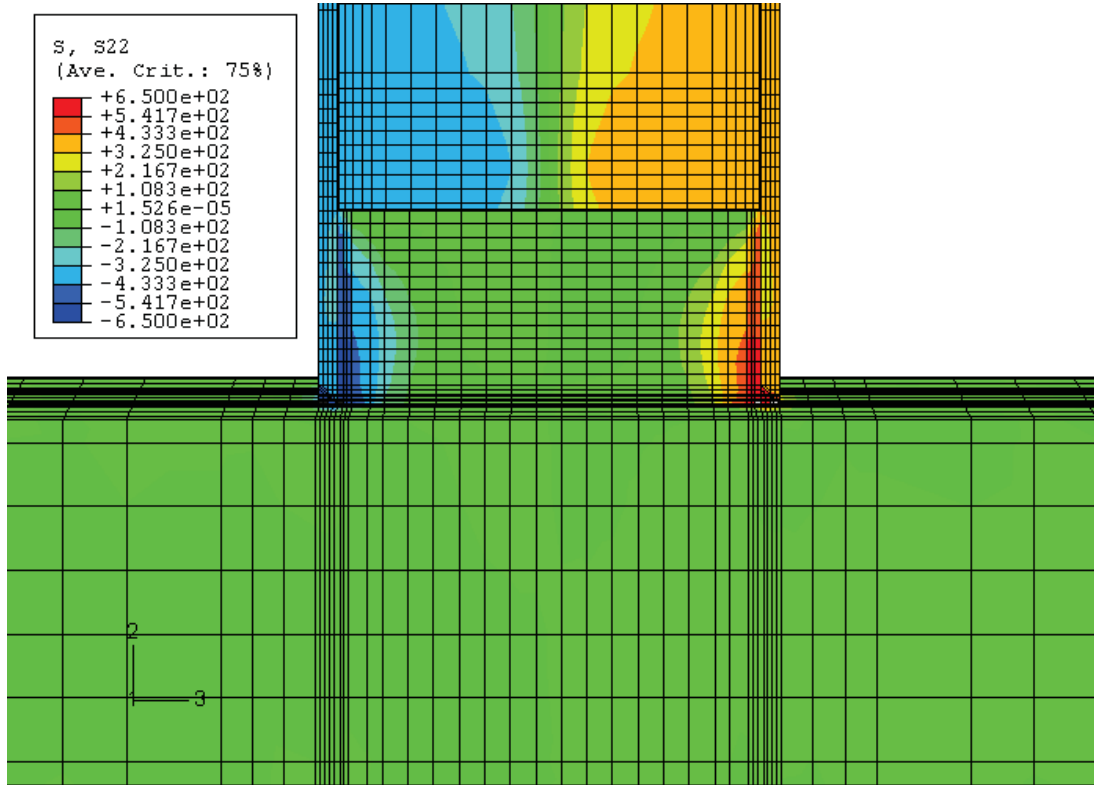


圖 5.54 試體 FDWS2 加勁板於正彎矩時之軸向應力分佈 (4% Drift)

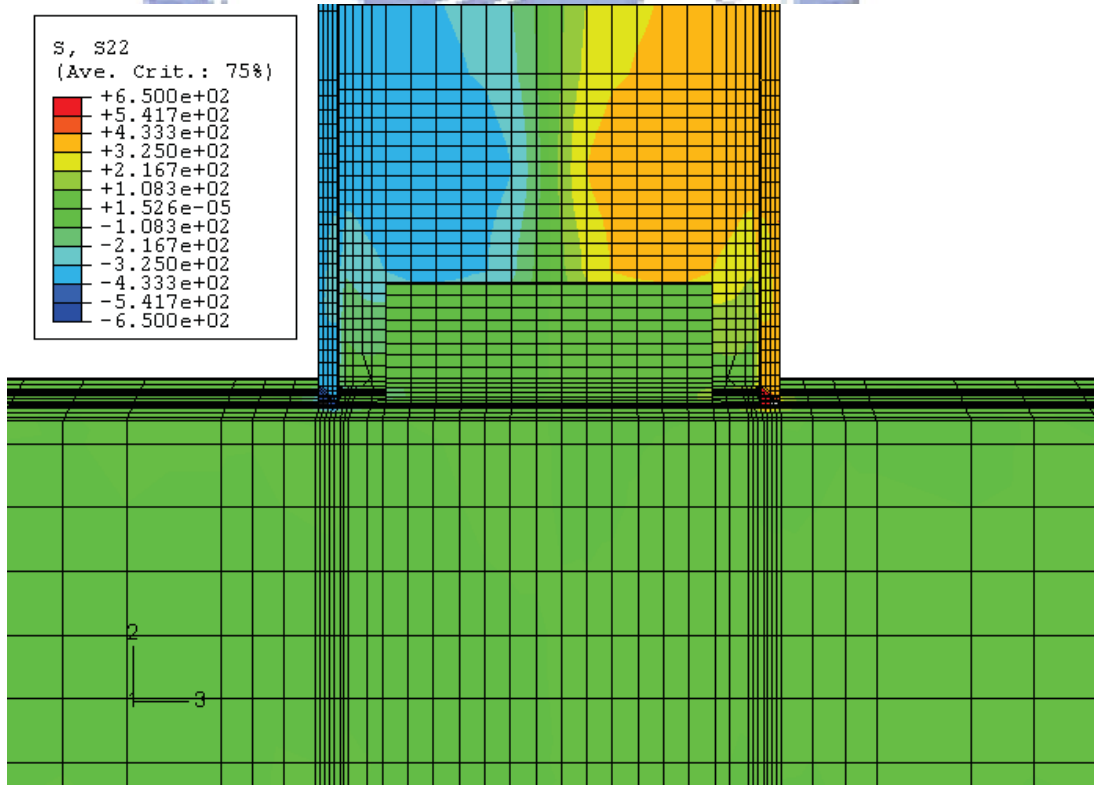


圖 5.55 試體 FDWS2 梁於正彎矩時之軸向應力分佈 (4% Drift)

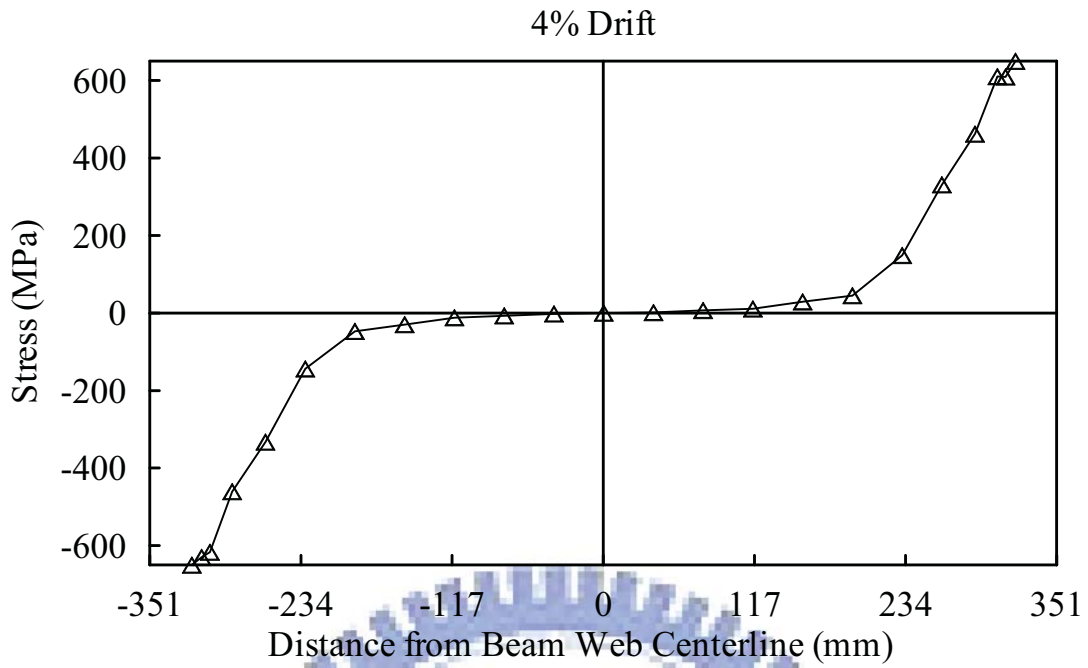


圖 5.56 試體 FDWS2 之加勁板軸向應力分佈 (Positive Bending)

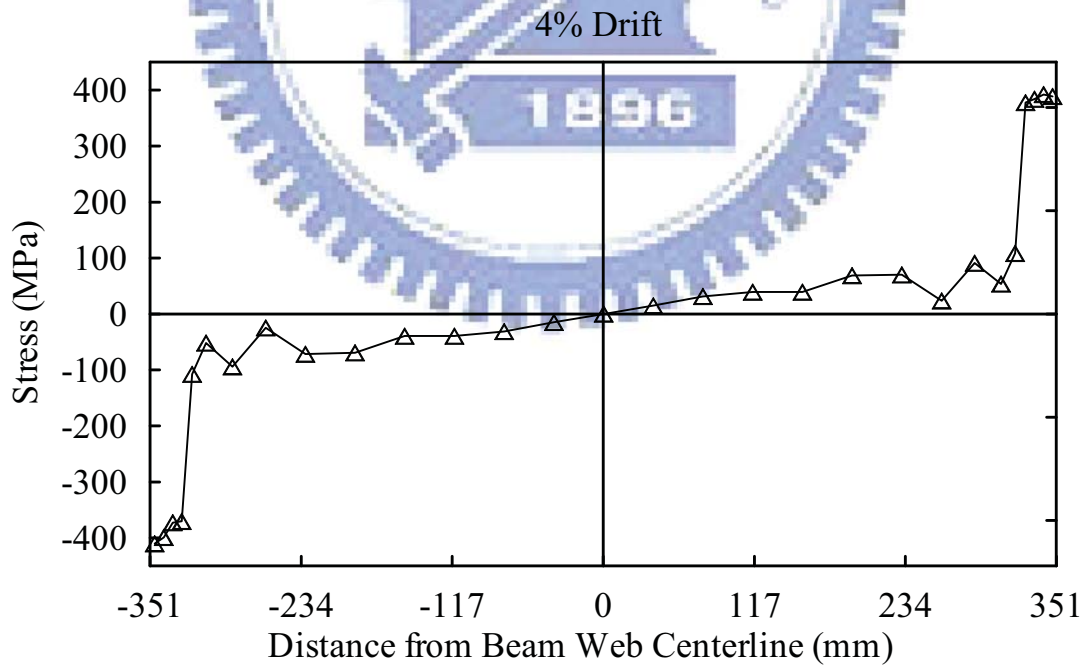
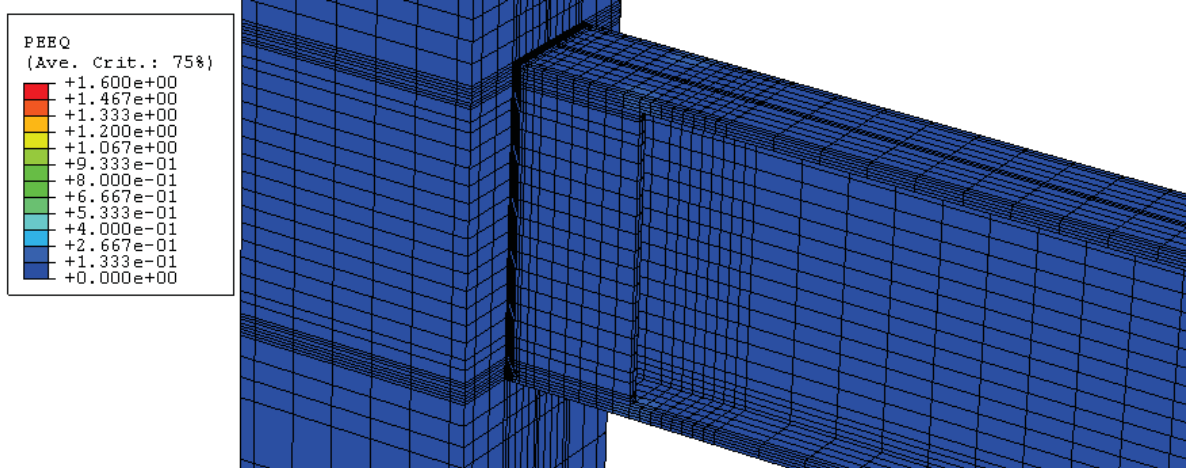
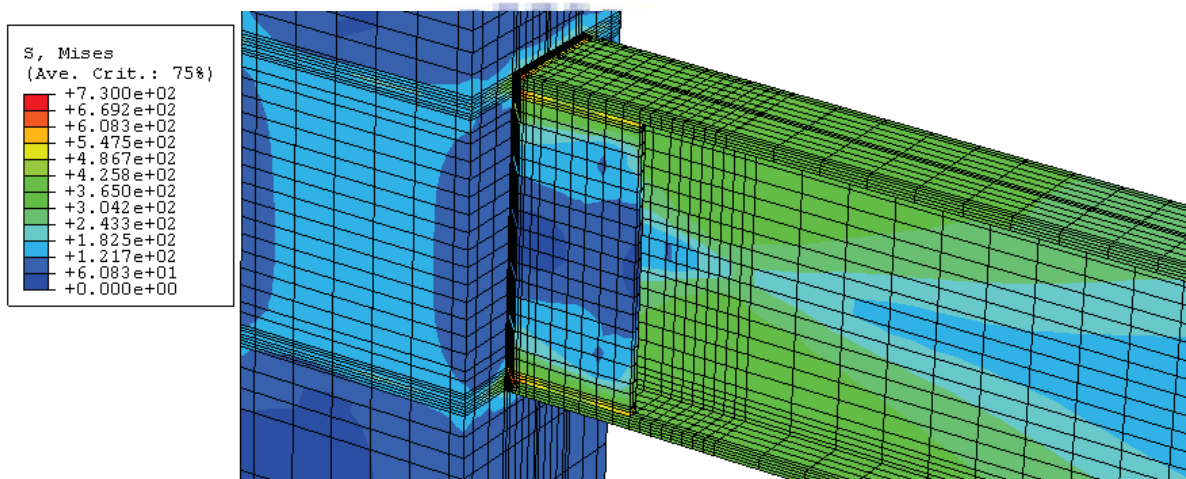


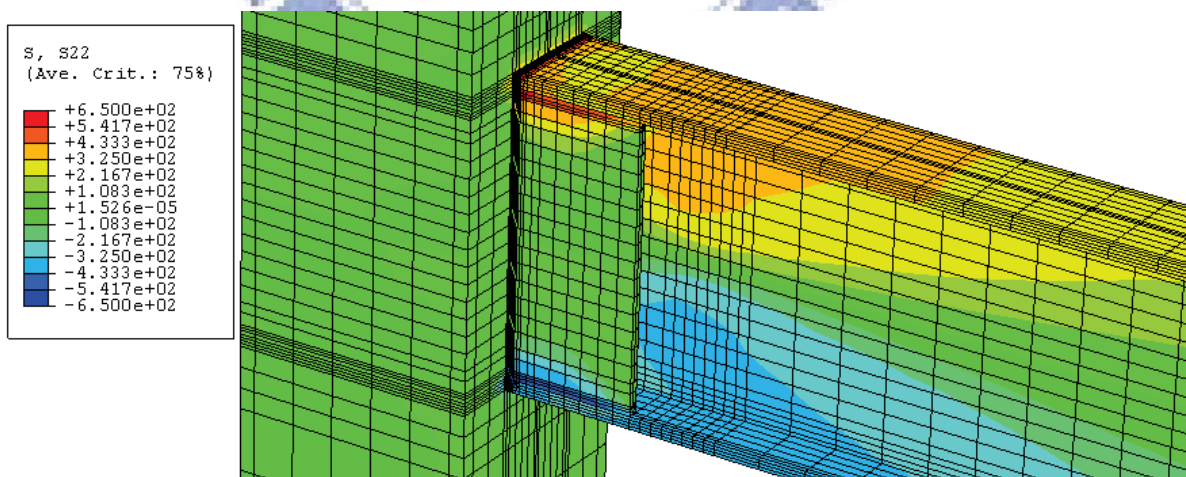
圖 5.57 試體 FDWS2 梁之軸向應力分佈 (Positive Bending)



(a) PEEQ

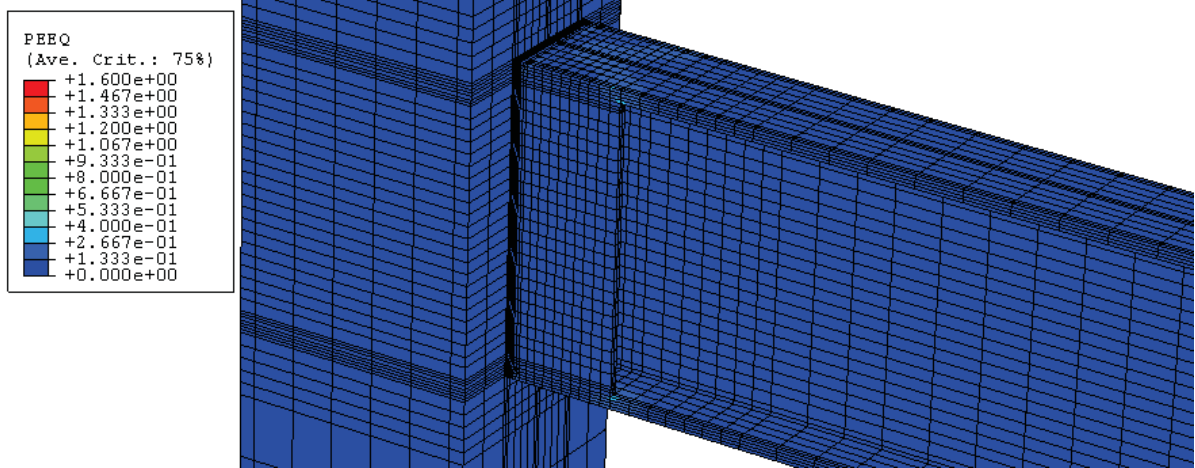


(b) Mises Stress

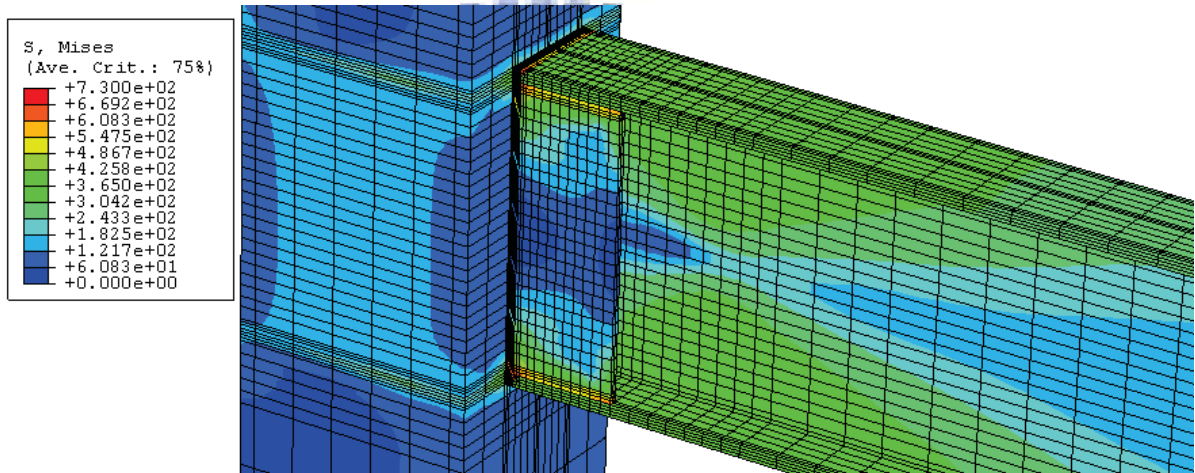


(c) S22

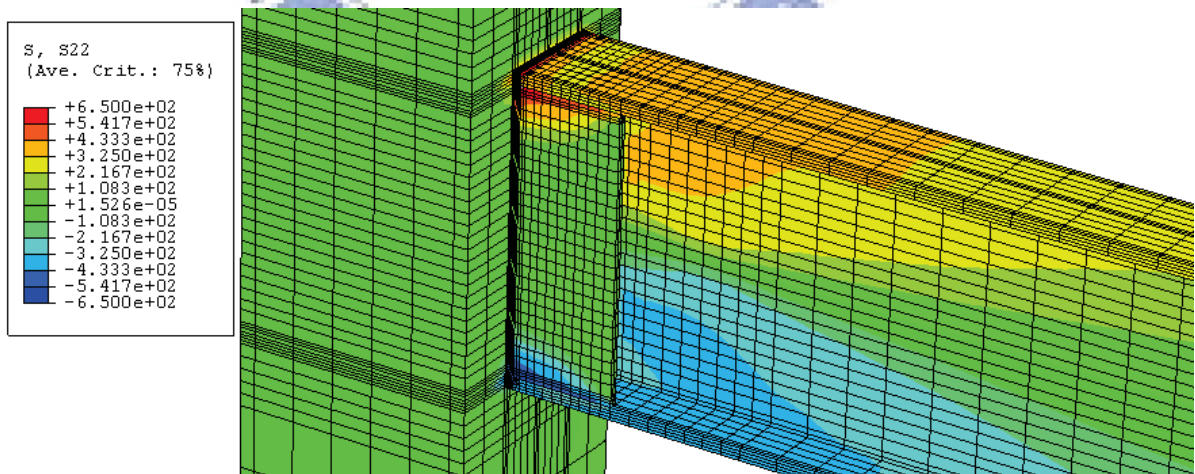
圖 5.58 試體 FDWS2 分析模型之各項參數分佈圖 (3.0% Drift)



(a) PEEQ

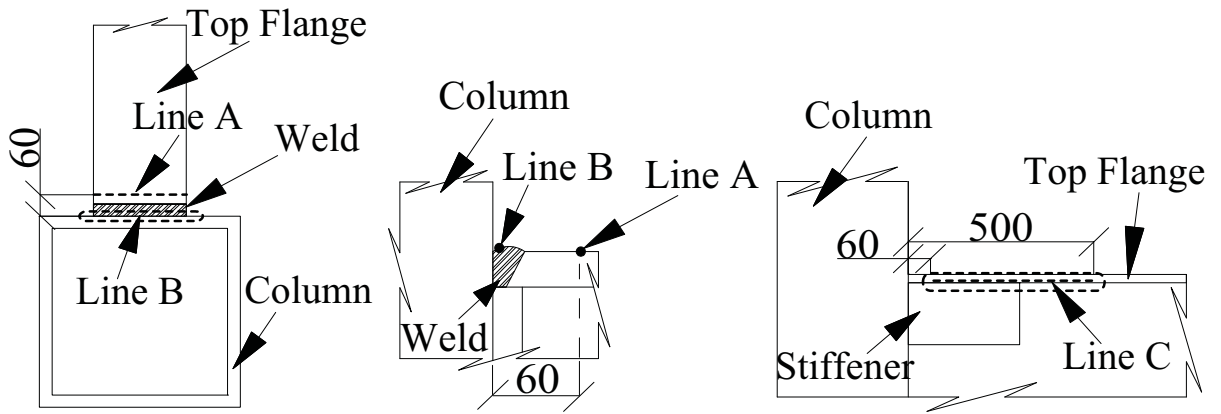


(b) Mises Stress

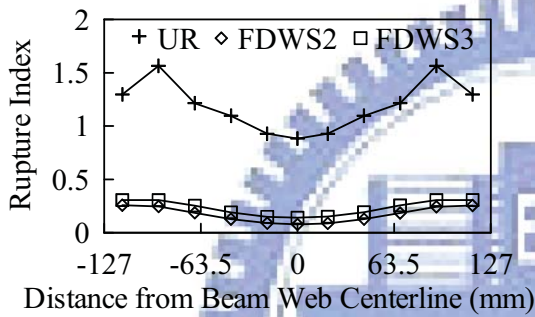


(c) S22

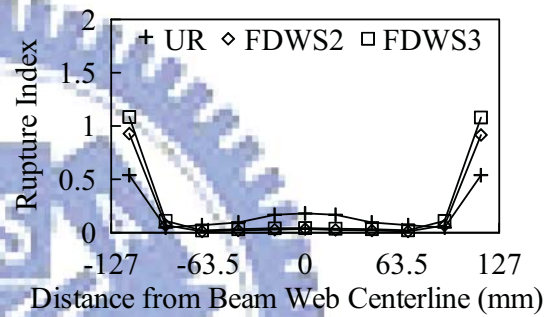
圖 5.59 試體 FDWS3 分析模型之各項參數分佈圖 (3.0% Drift)



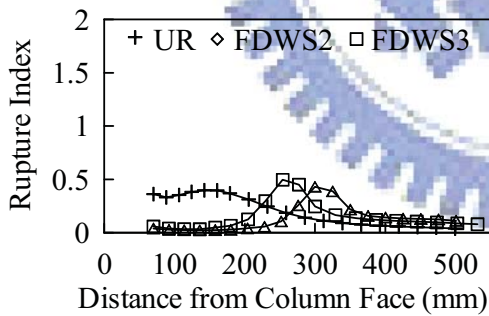
(a) Location



(b) Line A

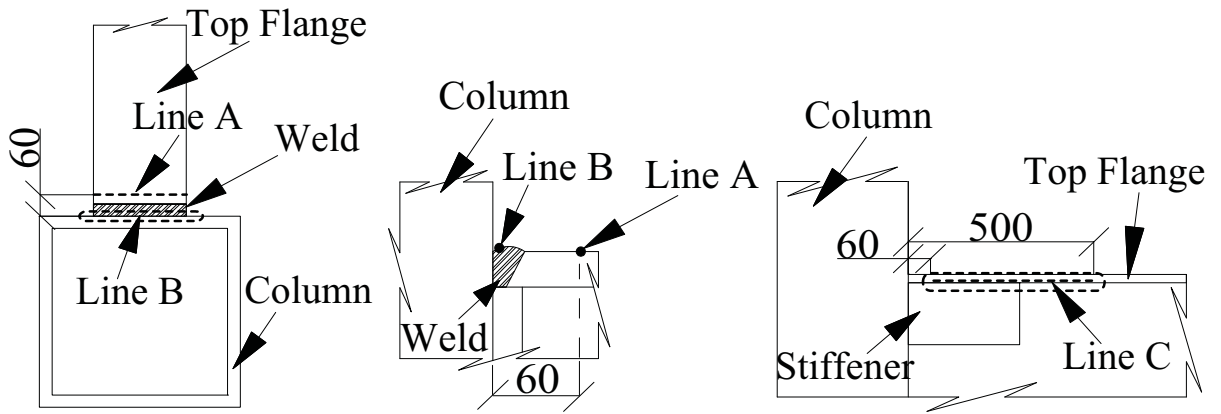


(c) Line B

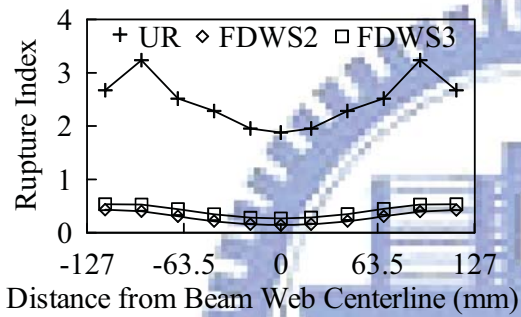


(d) Line C

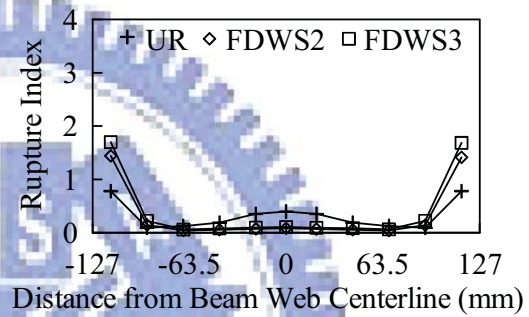
圖 5.60 試體 UR 及 FDWS 試體之 Rupture Index 比較圖 (3.0% Drift)



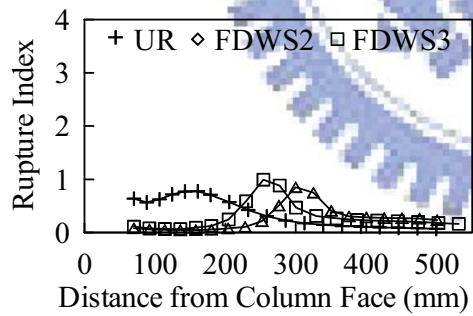
(a) Location



(b) Line A

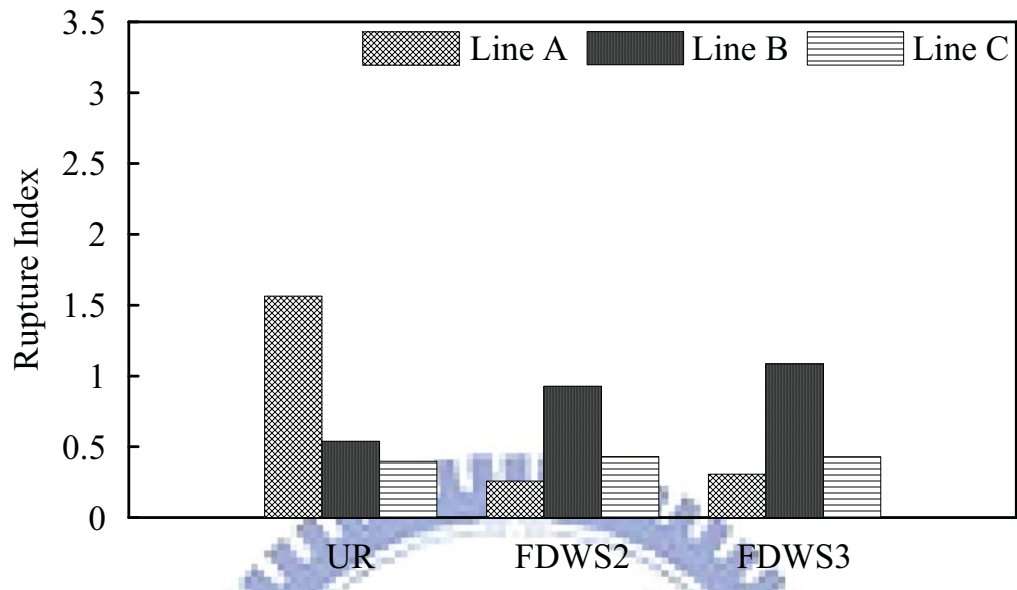


(c) Line B

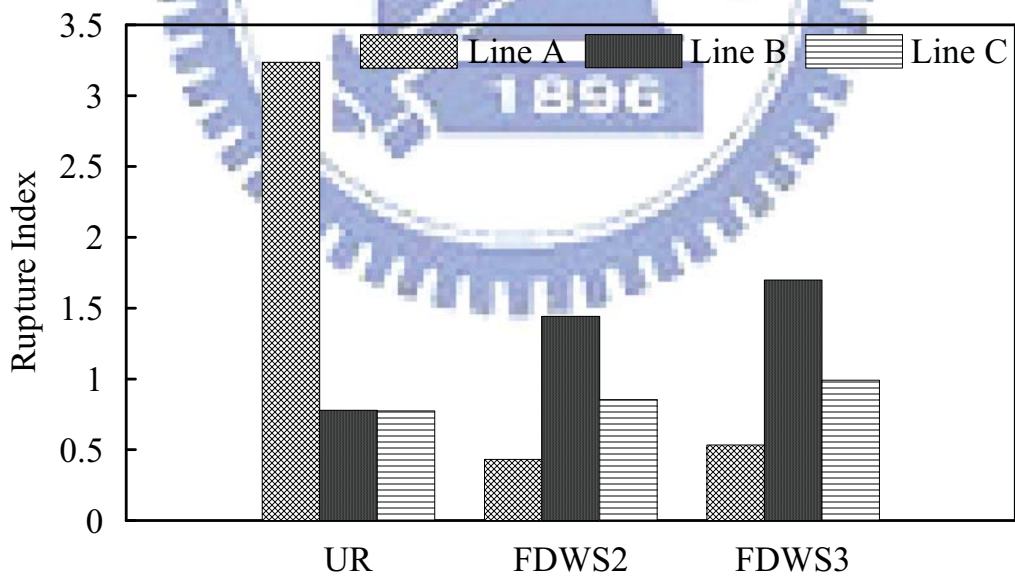


(d) Line C

圖 5.61 試體 UR 及 FDWS 試體之 Rupture Index 比較圖 (4.0% Drift)



(a) 3.0% Drift



(b) 4.0% Drift

圖 5.62 試體 UR 及 FDWS 試體之 Rupture Index 綜合比較圖

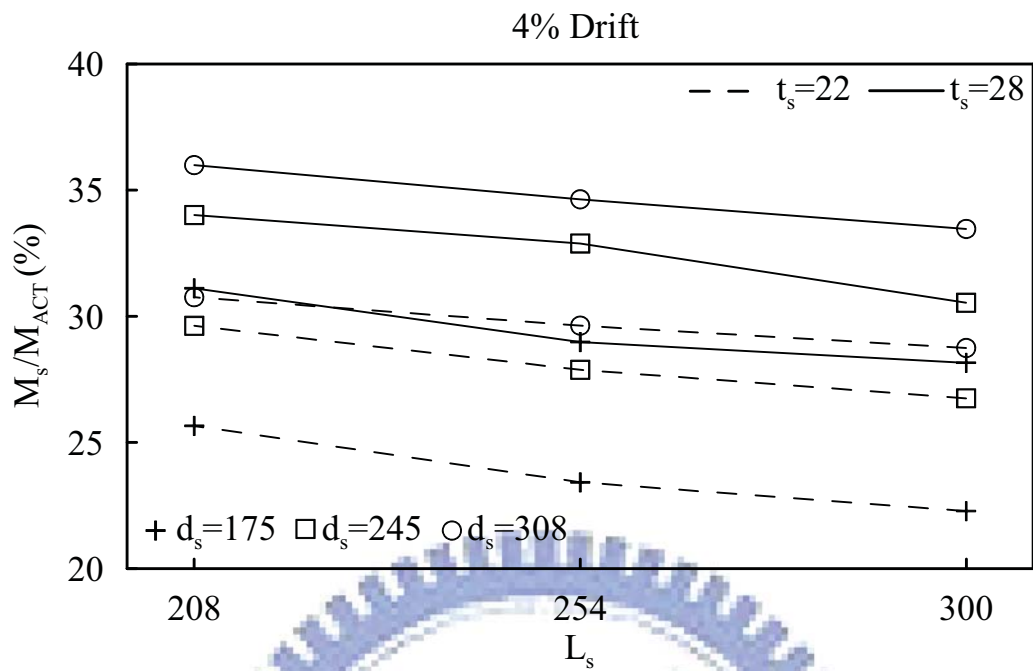


圖 5.63 IFS 加勁板各項參數對於整體彎矩貢獻量之關係圖 (應力分佈 I)

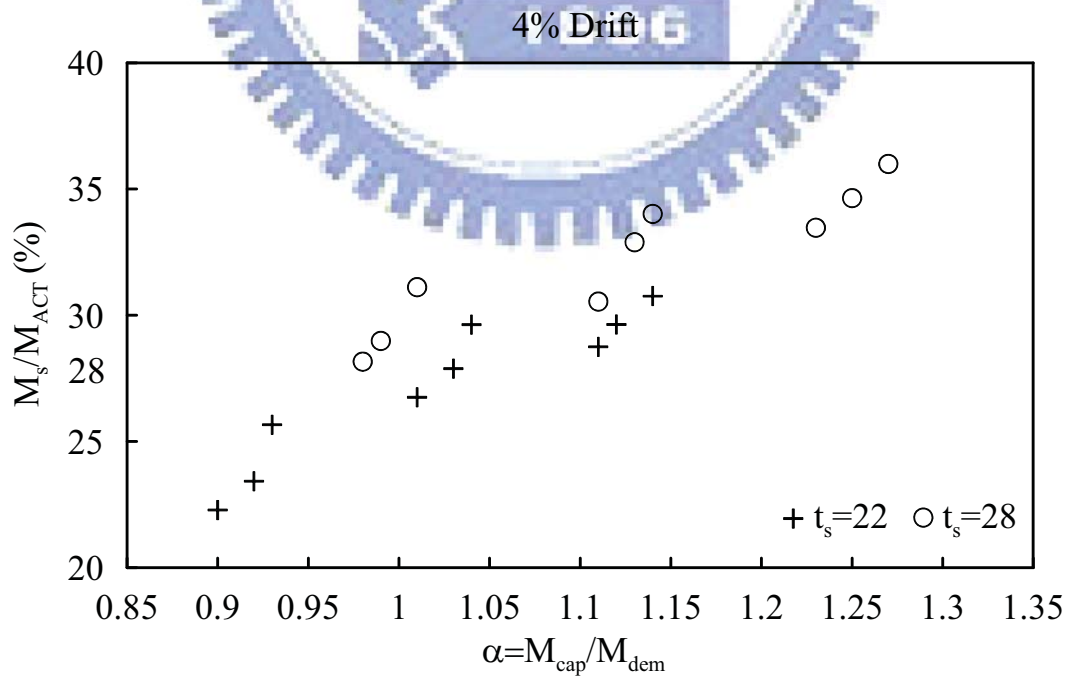


圖 5.64 IFS 加勁板 α 值與加勁板彎矩貢獻之關係圖 (應力分佈 I)

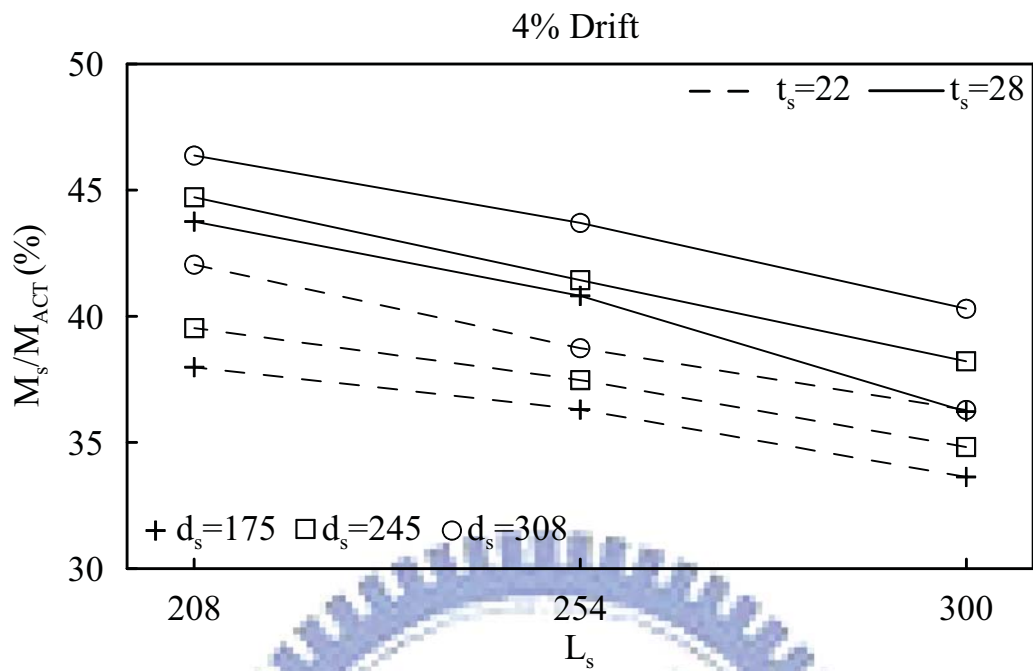


圖 5.65 IFS 加勁板各項參數對於整體彎矩貢獻量之關係圖 (應力分佈 II)

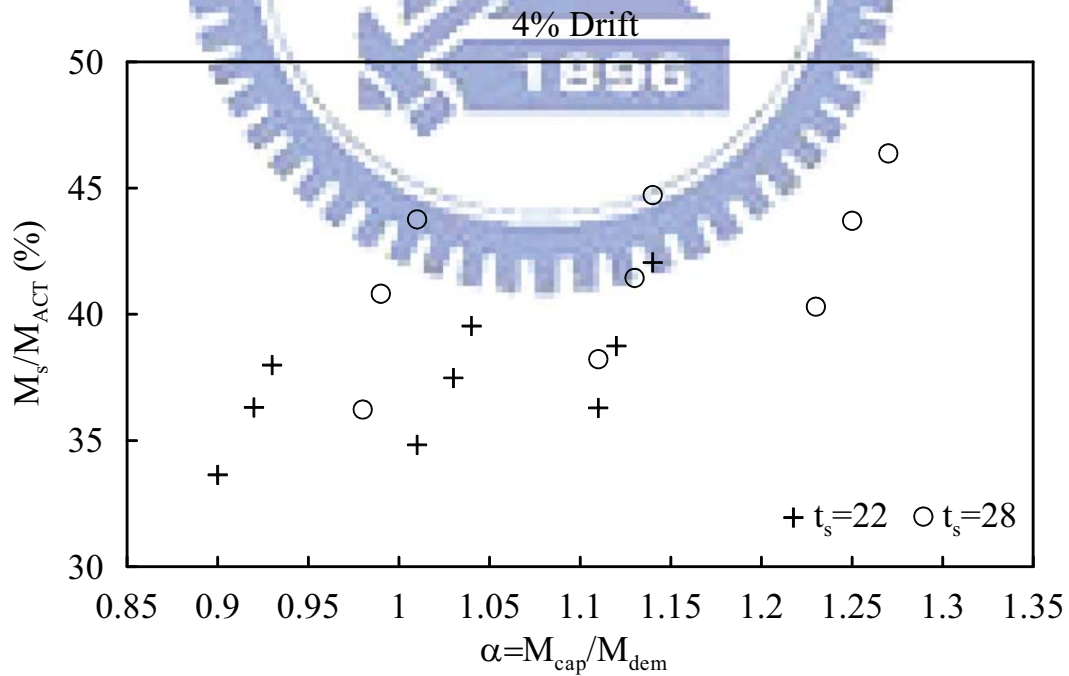
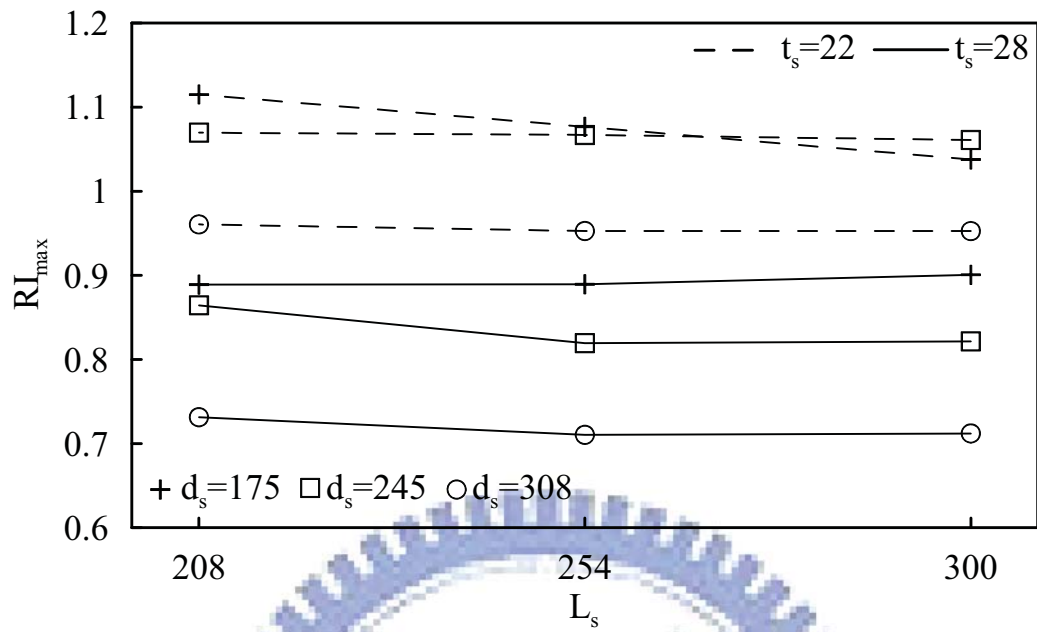
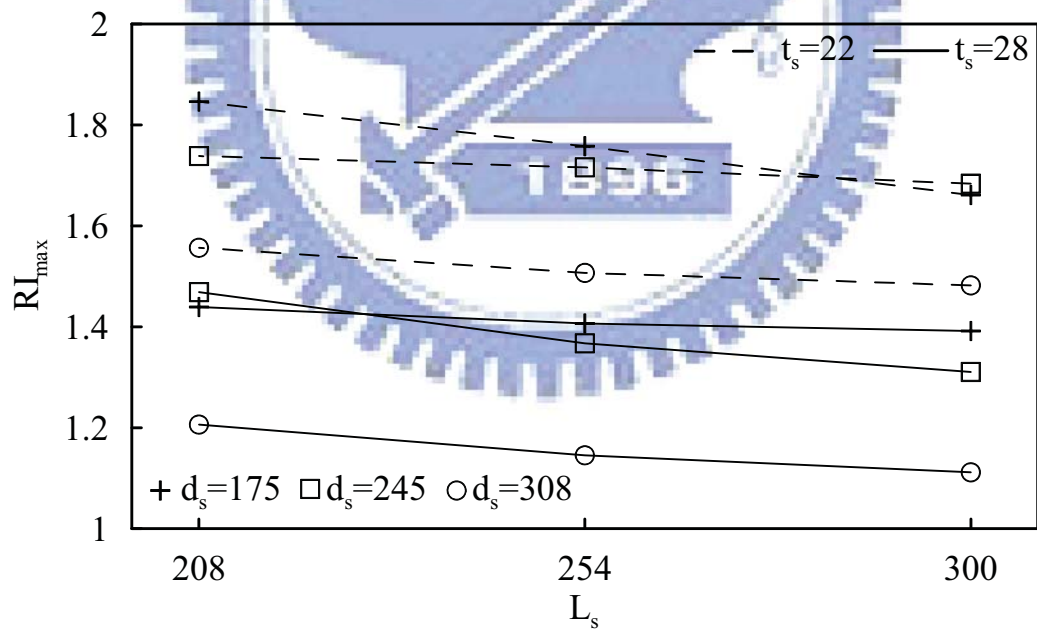


圖 5.66 IFS 加勁板 α 值與加勁板彎矩貢獻之關係圖 (應力分佈 II)

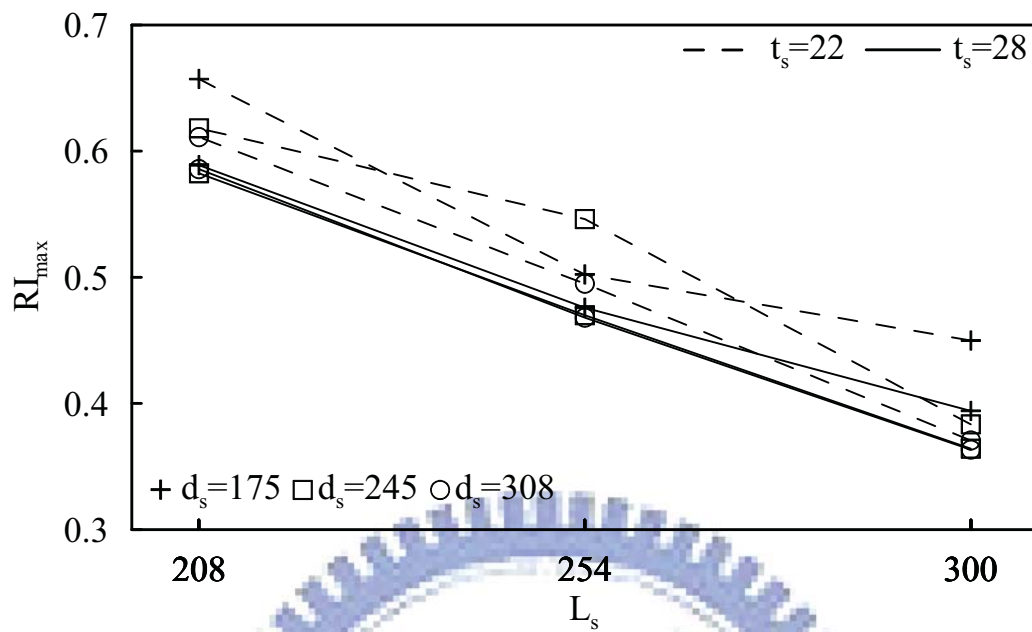


(a) 3% Drift

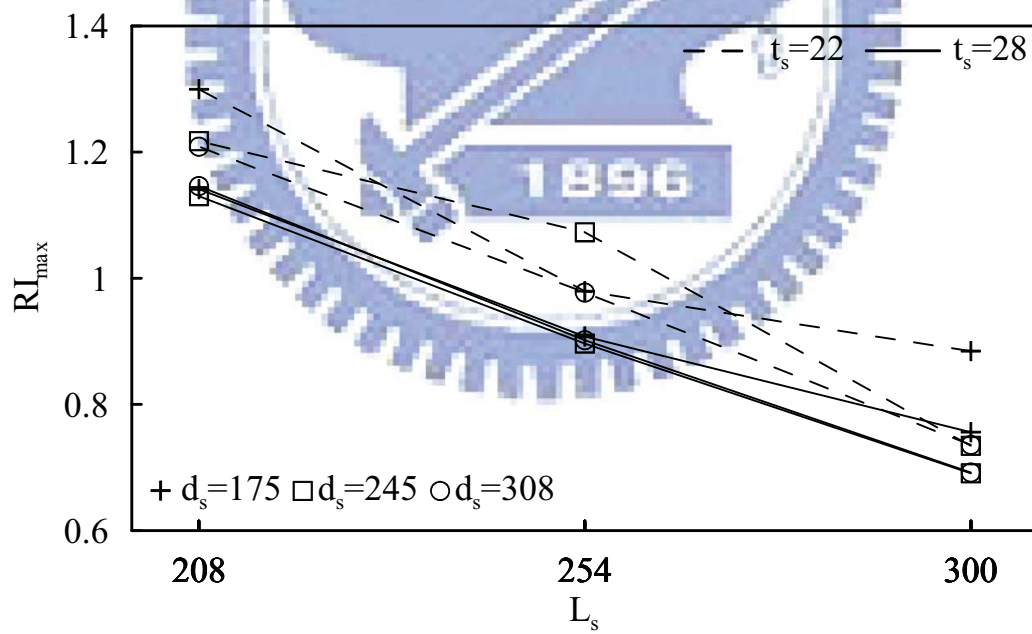


(b) 4% Drift

圖 5.67 IFS 加勁板參數對於 Line B 處之最大破裂參數 RI 關係圖



(a) 3% Drift



(b) 4% Drift

圖 5. 68 IFS 加勁板參數對於 Line C 處之最大破裂參數 RI 關係圖

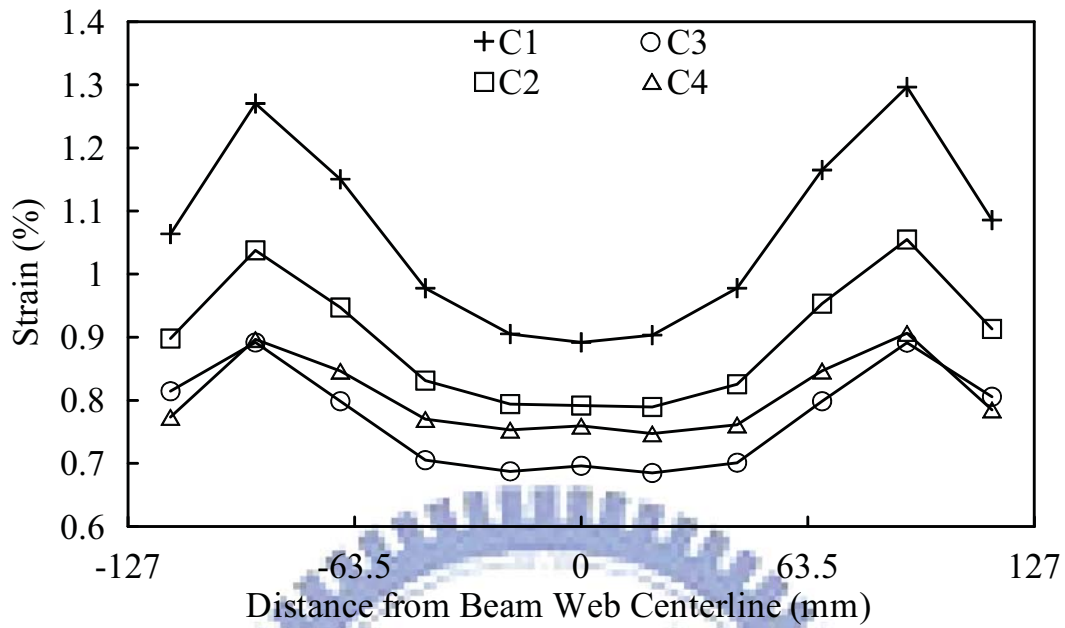


圖 5.69 IFS 加勁板柱參數對於 Line A 處之應變關係圖 (4% Drift)

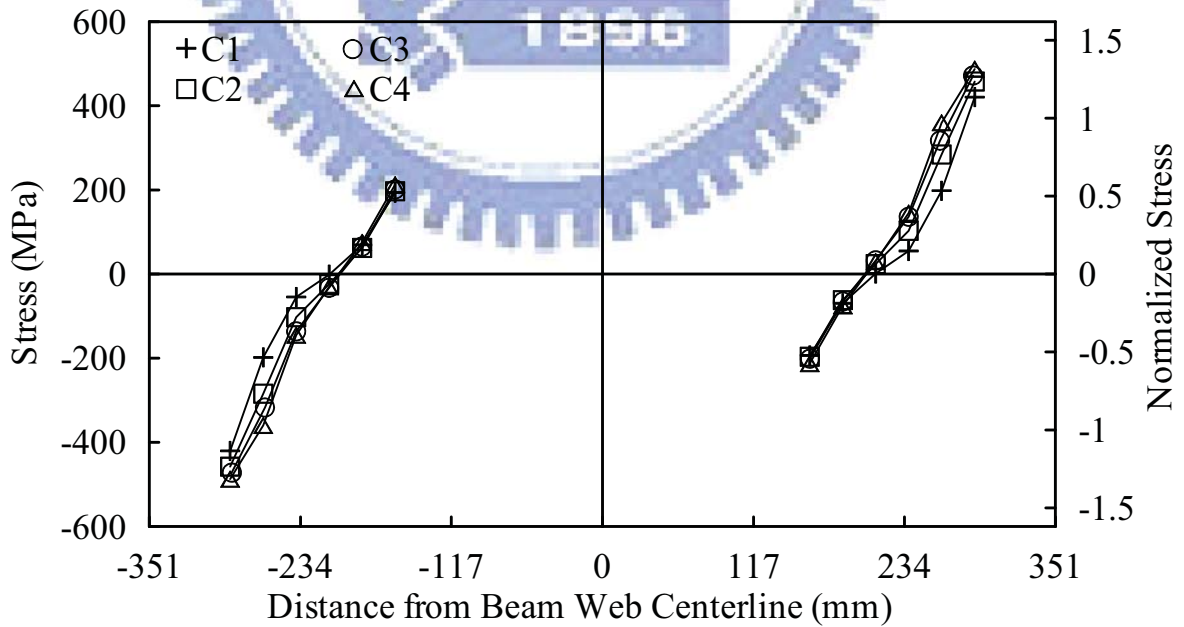


圖 5.70 IFS 加勁板柱參數對於加勁板之應力關係圖 (4% Drift)

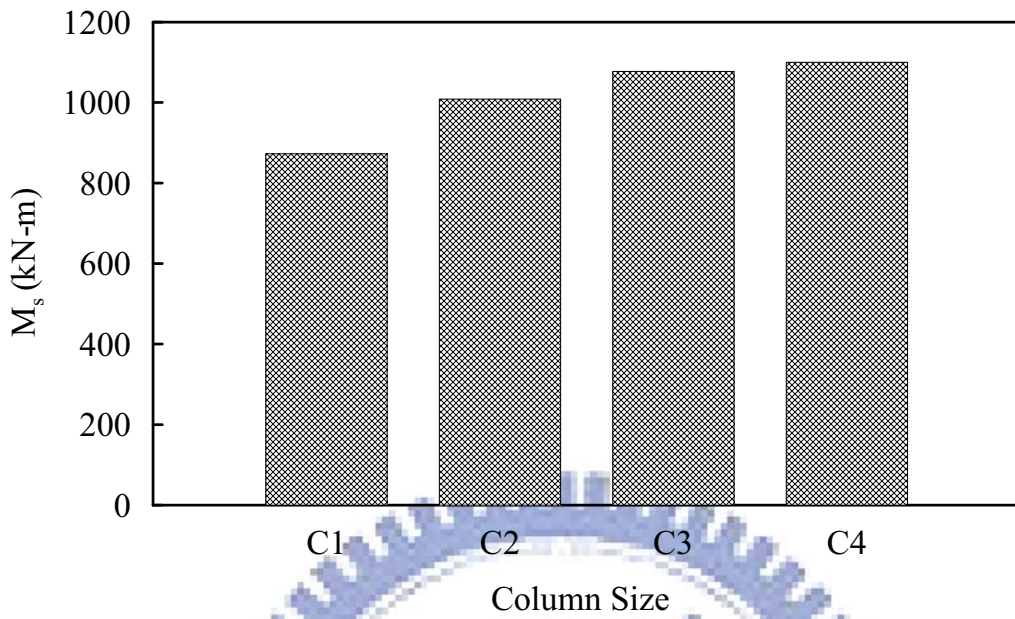


圖 5.71 IFS 加勁板柱參數對於加勁板之彎矩貢獻量比較圖 (4% Drift)

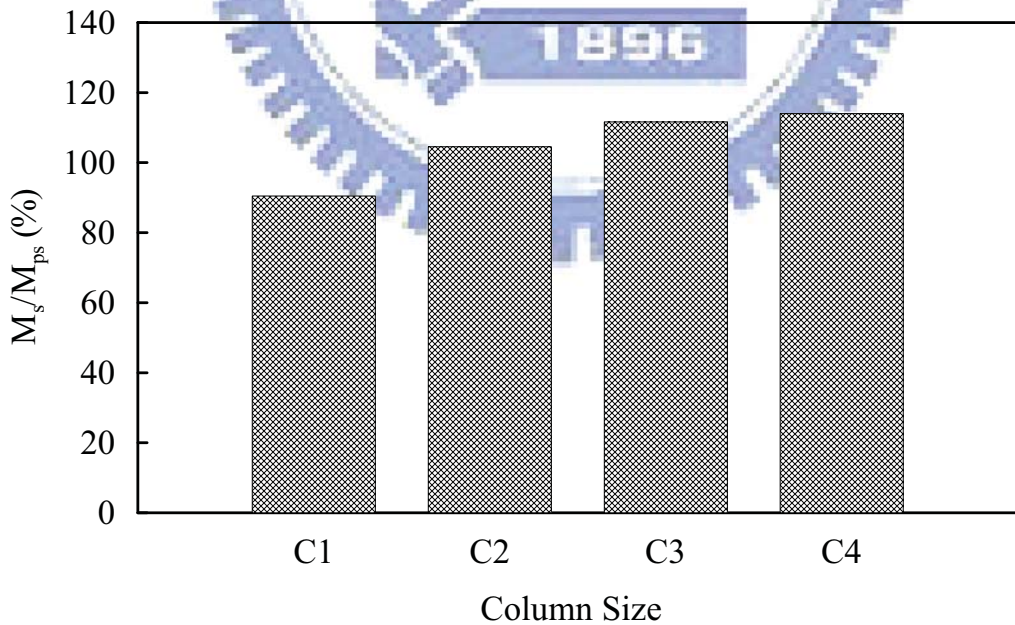


圖 5.72 IFS 加勁板柱參數對於提供之塑性彎矩 M_{ps} 比例圖 (4% Drift)

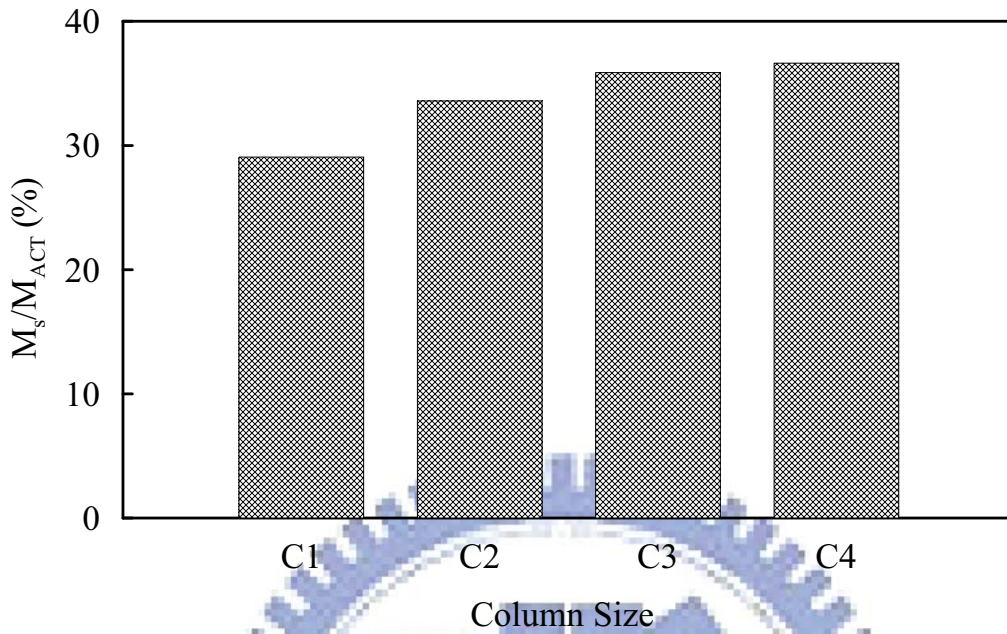


圖 5.73 IFS 加勁板柱參數於加勁板提供彎矩佔整體總彎矩比例 (4% Drift)

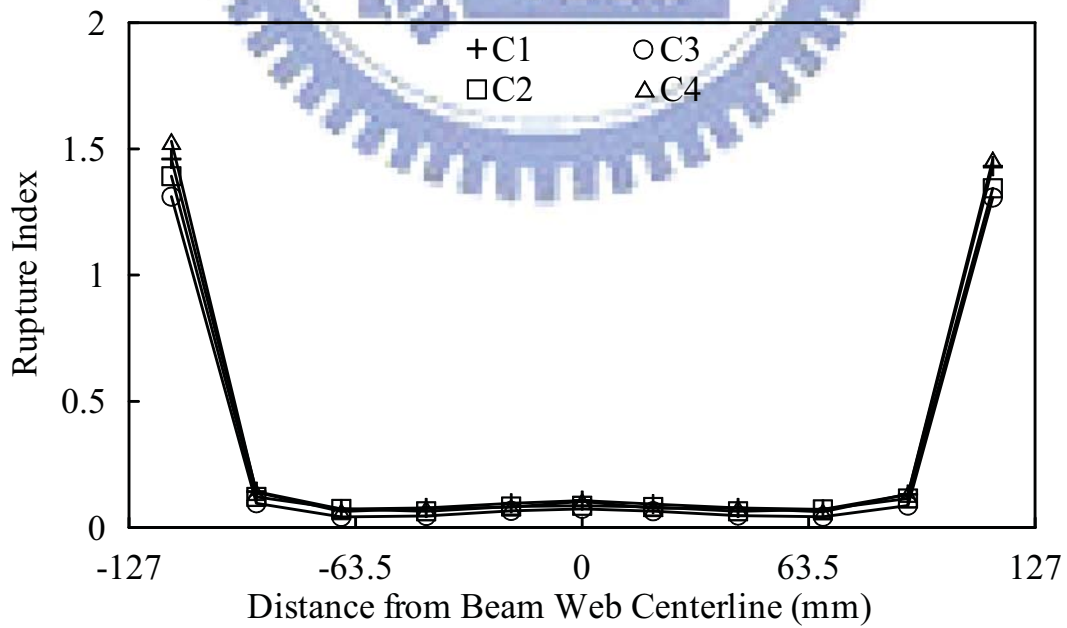


圖 5.74 IFS 加勁板柱參數對於 Line B 處之破裂參數 RI 關係圖 (4% Drift)

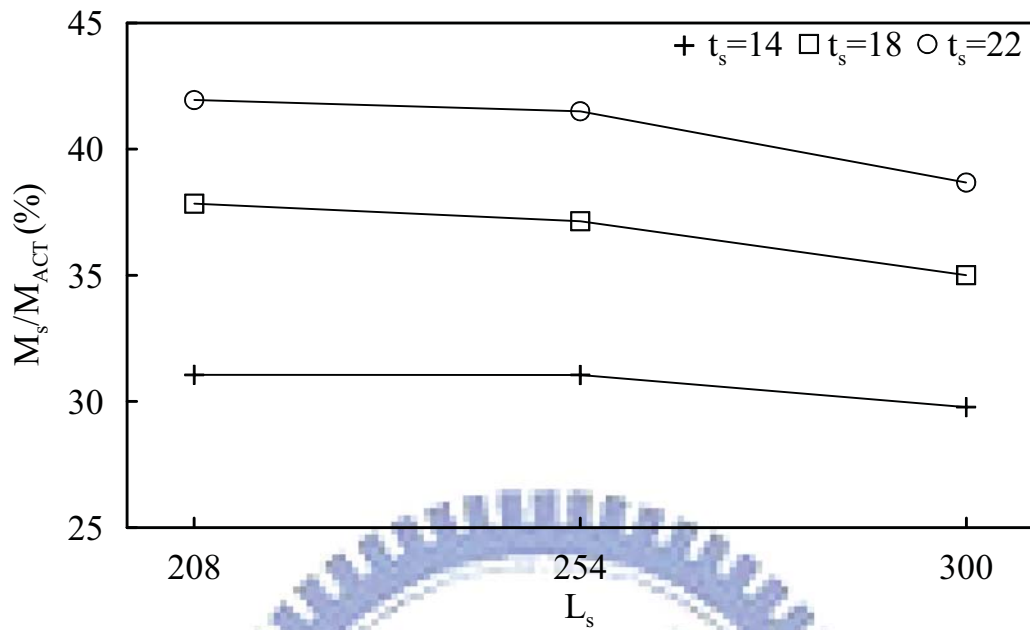


圖 5.75 FDWS 加勁板各項參數對於整體彎矩貢獻量之關係圖 (4% Drift)

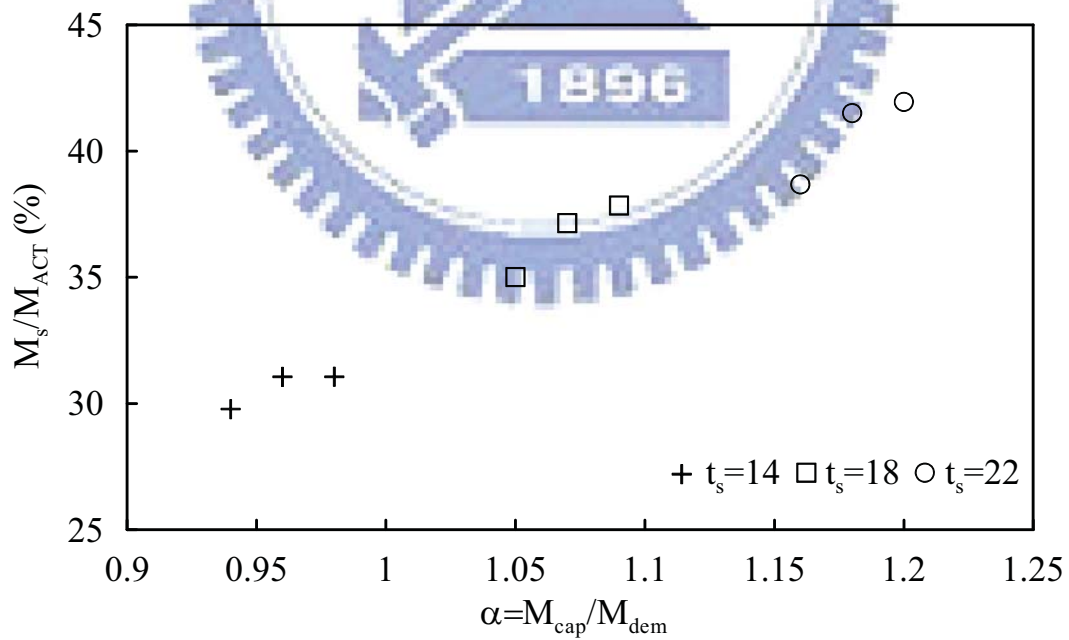
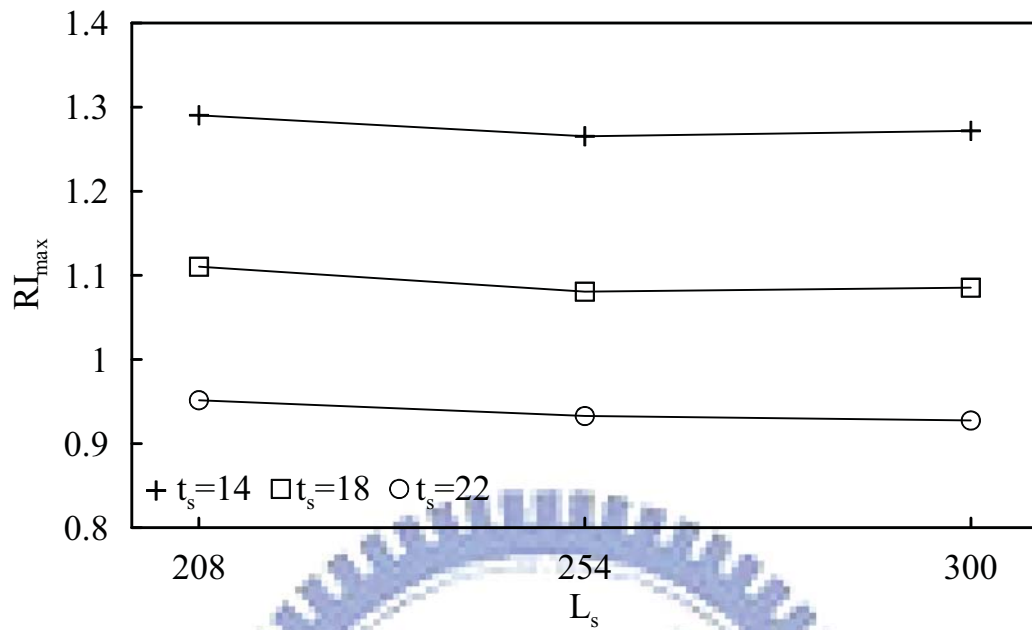
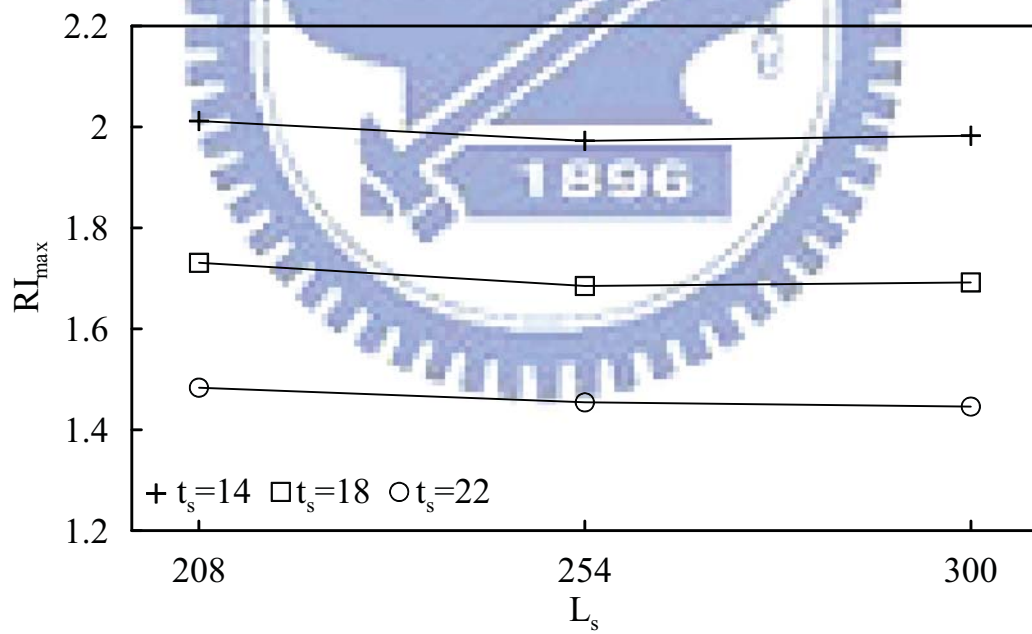


圖 5.76 FDWS 加勁板 α 值與加勁板彎矩貢獻之關係圖 (4% Drift)

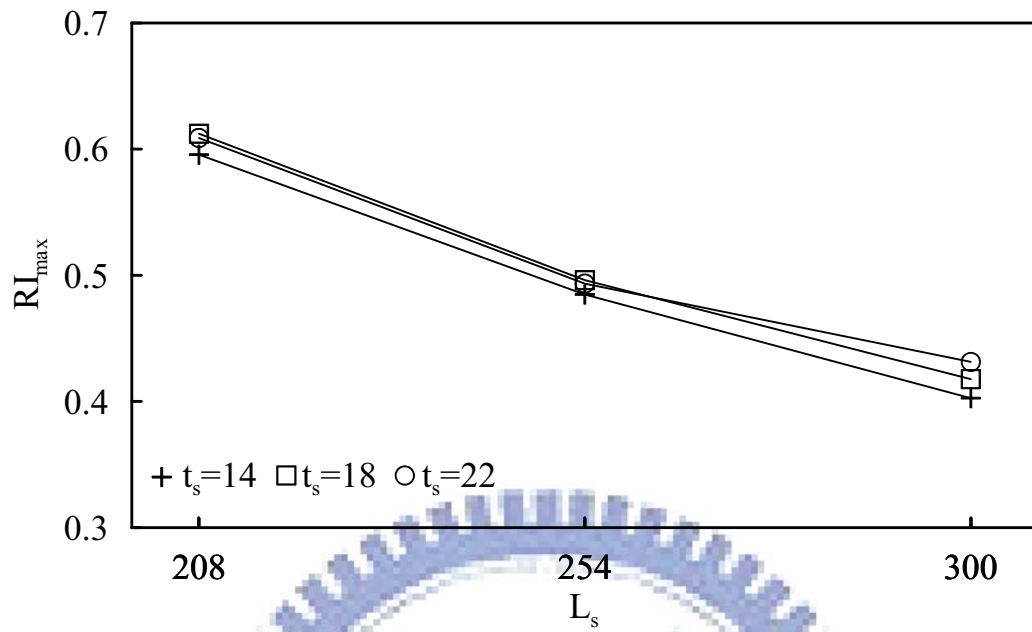


(a) 3% Drift

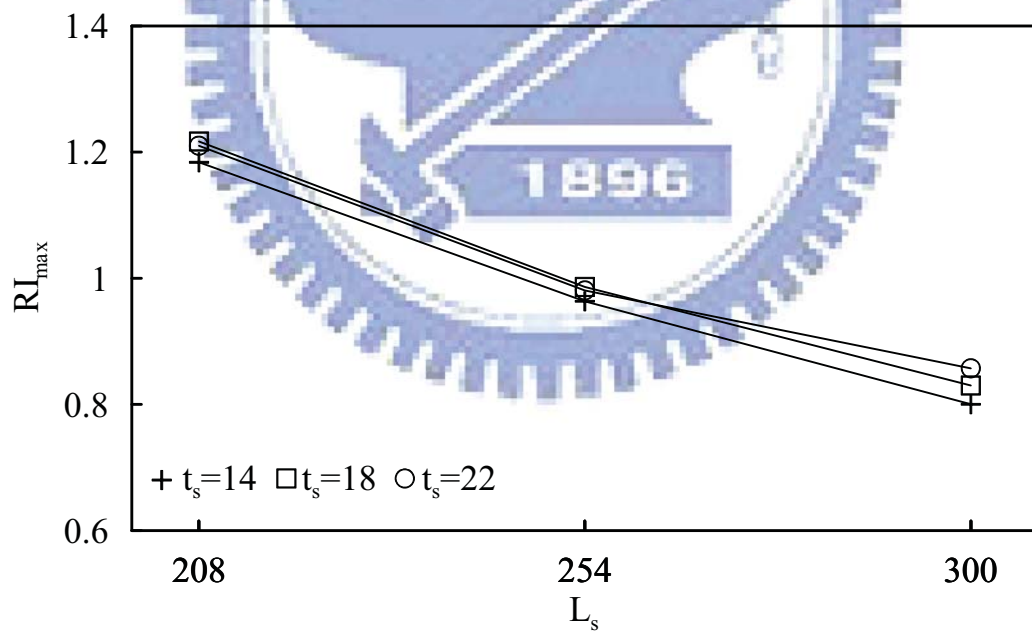


(b) 4% Drift

圖 5.77 FDWS 加勁板參數對於 Line B 處之最大破裂參數 RI 關係圖



(a) 3% Drift



(b) 4% Drift

圖 5.78 FDWS 加勁板參數對於 Line C 處之最大破裂參數 RI 關係圖

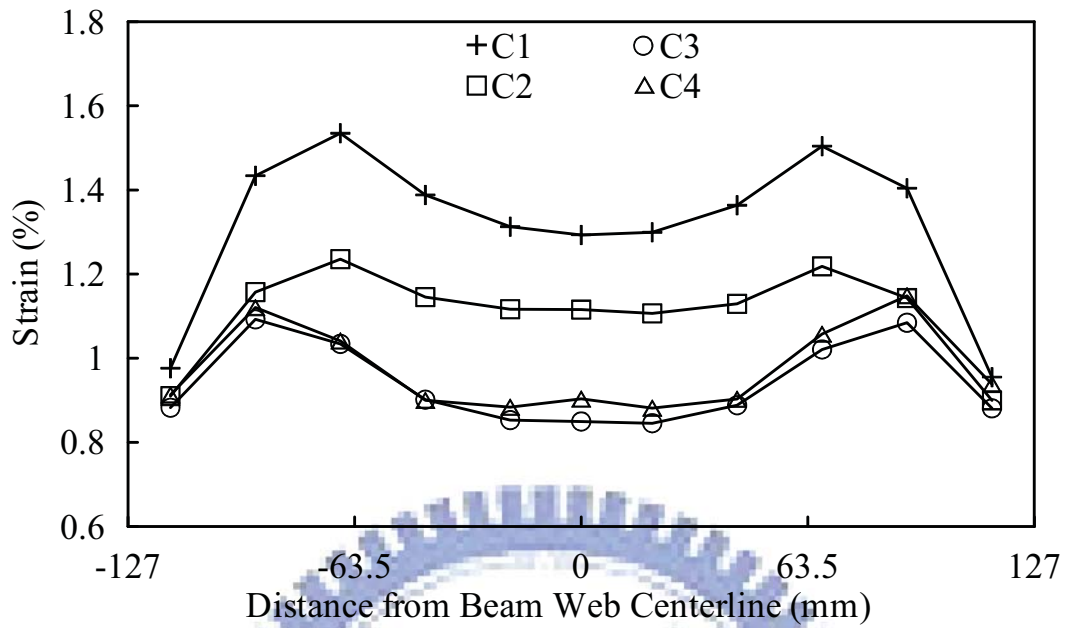


圖 5.79 FDWS 加勁板柱參數對於 Line A 處之應變關係圖 (4% Drift)

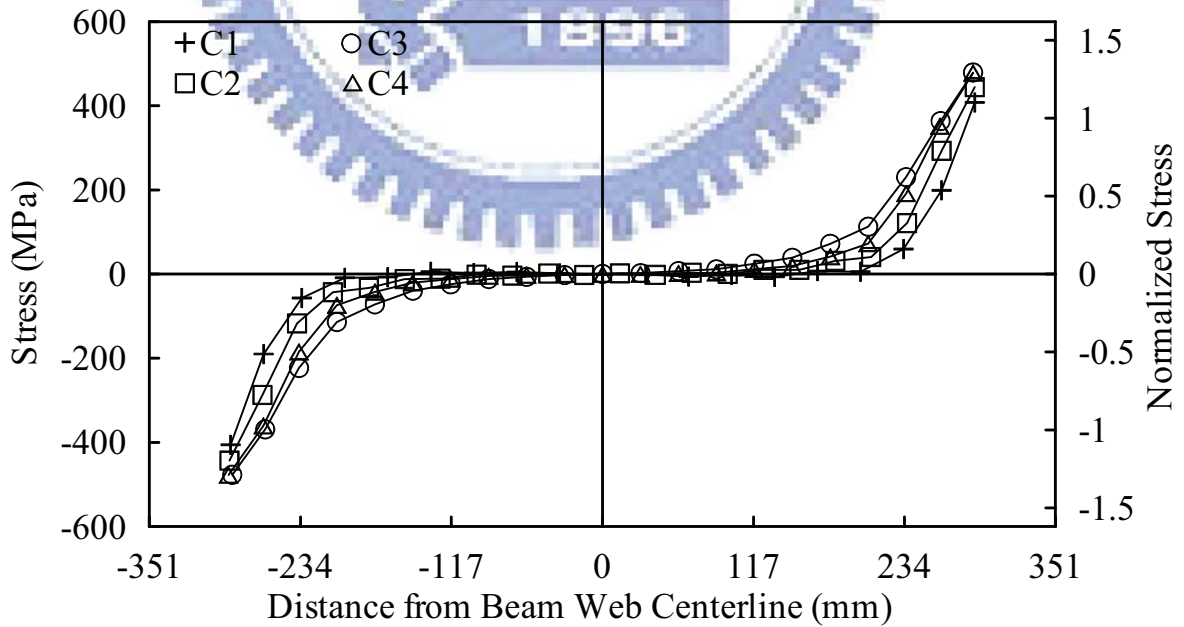


圖 5.80 FDWS 加勁板柱參數對於加勁板之應力關係圖 (4% Drift)

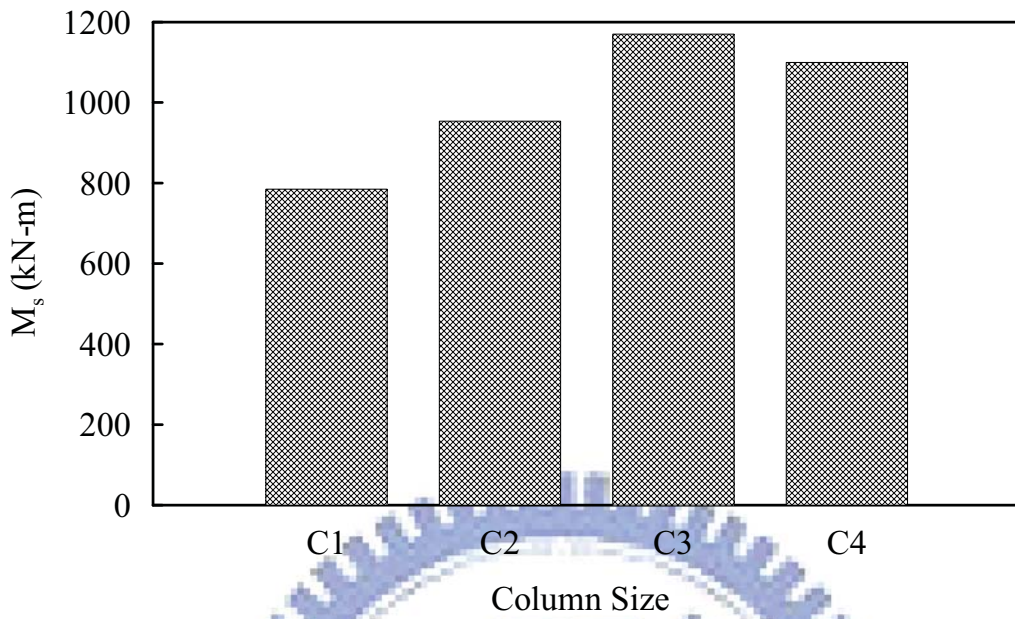


圖 5. 81 FDWS 加勁板柱參數對於加勁板之彎矩貢獻量比較圖 (4% Drift)

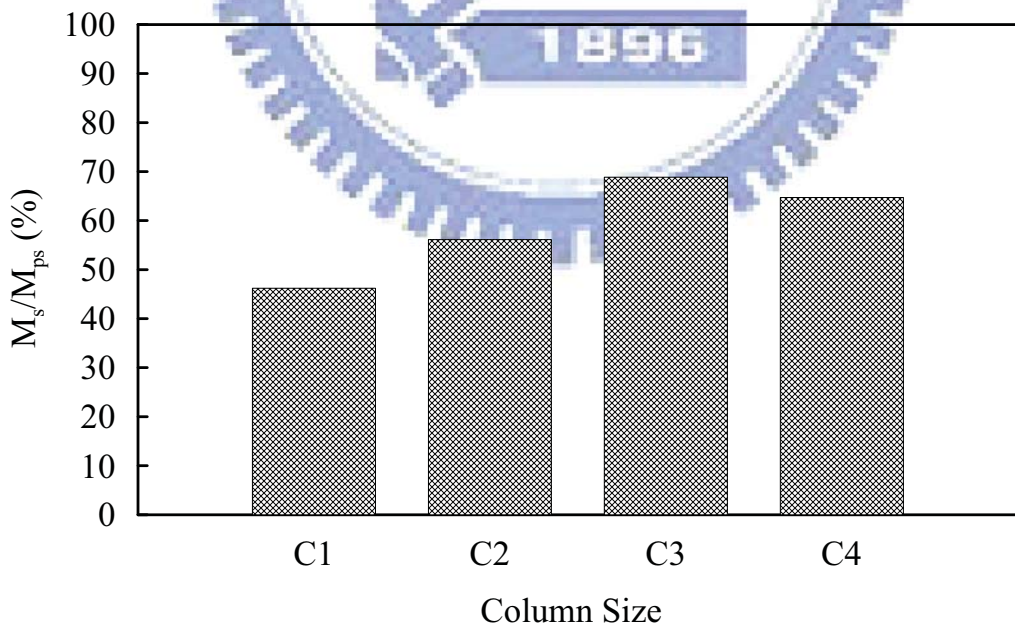


圖 5. 82 FDWS 加勁板柱參數對於提供之塑性彎矩 M_{ps} 比例圖 (4% Drift)

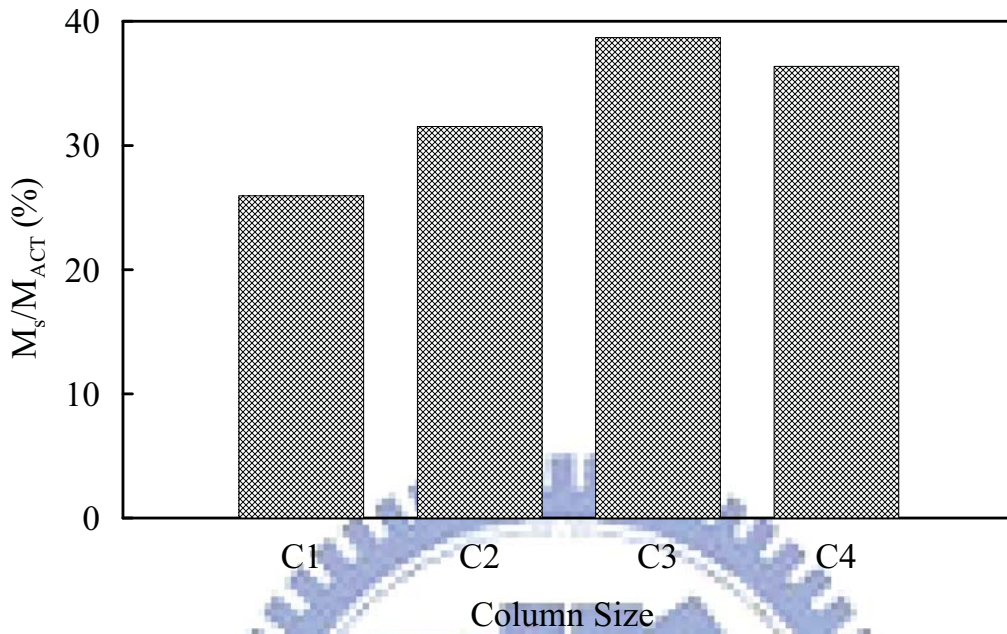


圖 5.83 FDWS 加勁板柱參數於加勁板提供彎矩佔整體彎矩比例 (4% Drift)

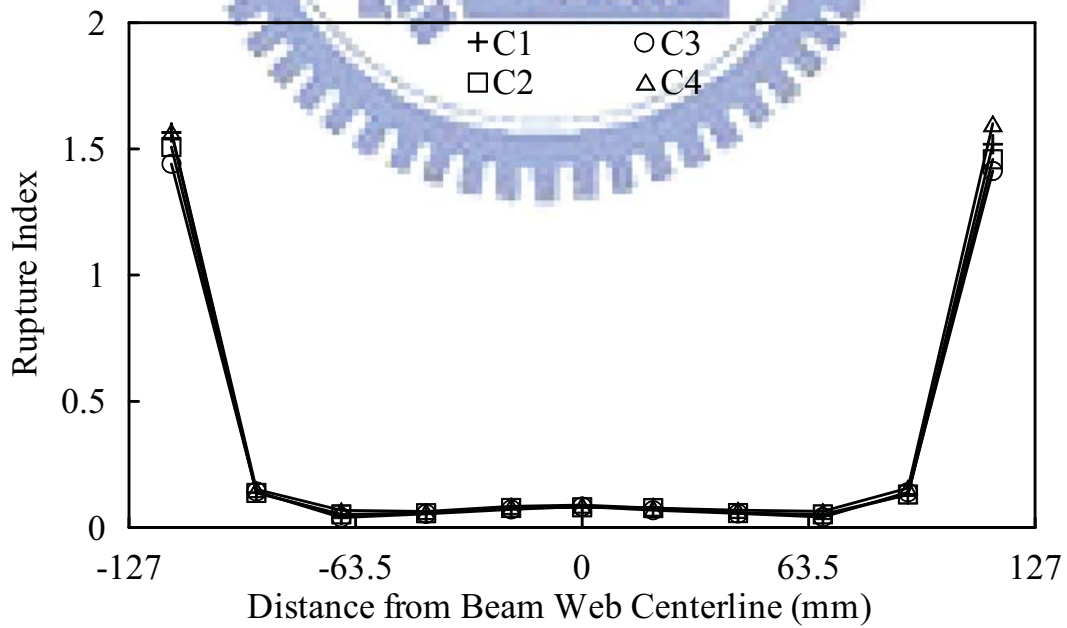


圖 5.84 FDWS 加勁板柱參數對於 Line B 處之破裂參數 RI 關係圖(4% Drift)



照片 3.1 試體 UR 試驗前全景



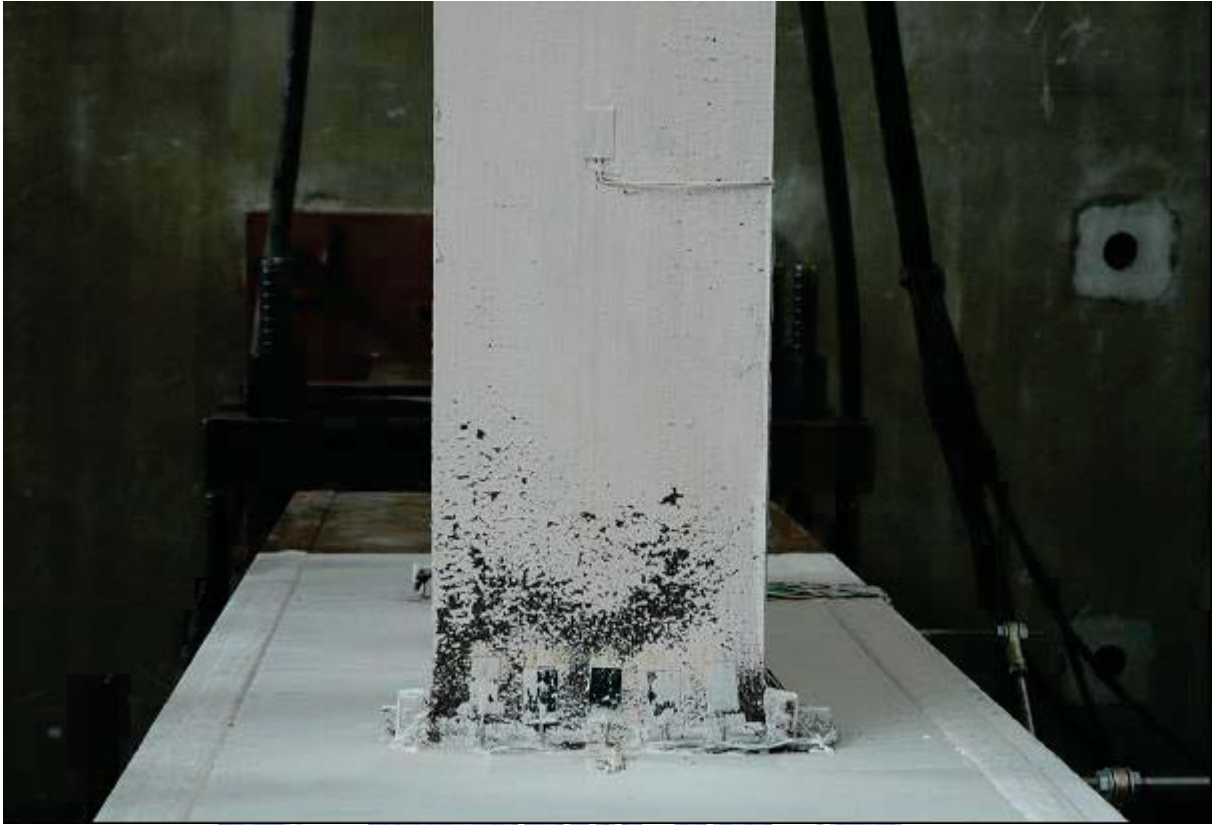
照片 3.2 試體 UR 上翼板降伏 ($\theta = -1.5\%$ 弧度)



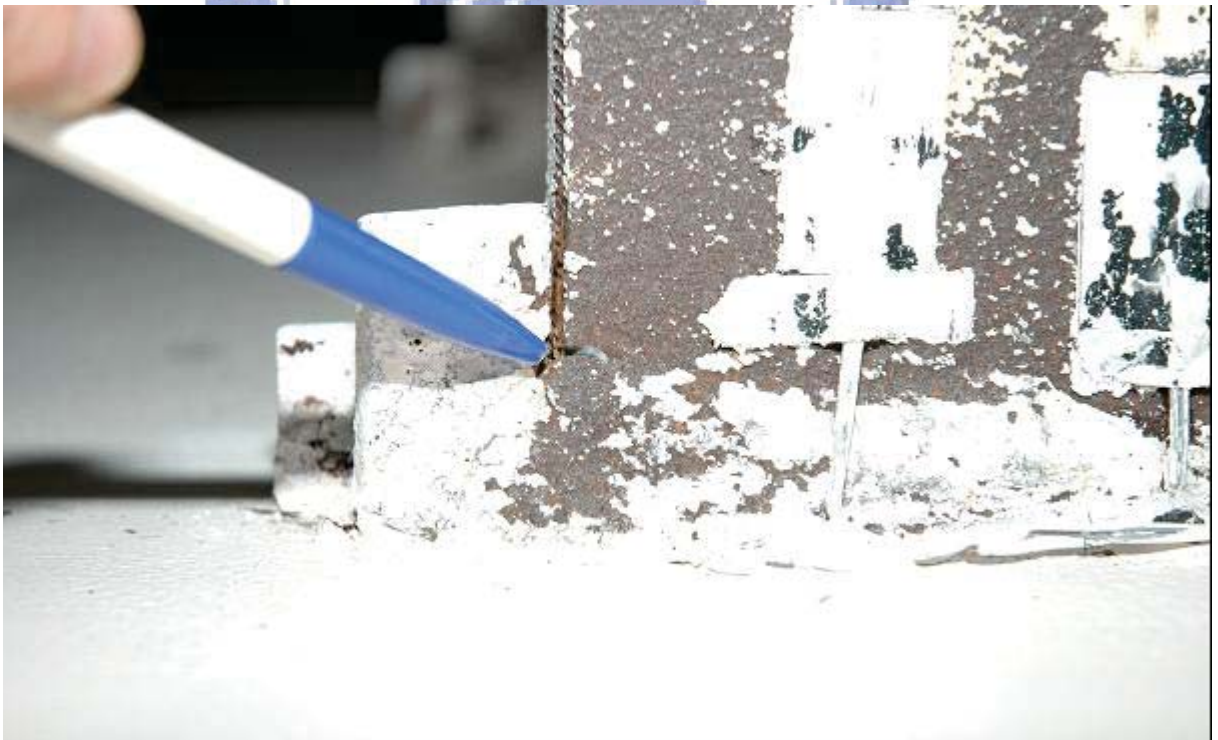
照片 3.3 試體 UR 梁腹板扇形開口處降伏 ($\theta = -1.5\%$ 弧度)



照片 3.4 試體 UR 剪力板降伏 ($\theta = 1.5\%$ 弧度結束)



照片 3.5 試體 UR 梁上翼板降伏 ($\theta = +2.0\%$ 弧度)



照片 3.6 試體 UR 梁上翼板焊道端部裂縫 ($\theta = -3.0\%$ 弧度第一圈)



照片 3.7 試體 UR 剪力板焊道端部裂縫 ($\theta = -3.0\%$ 弧度第一圈)



照片 3.8 試體 UR 側撐中心至柱面產生側向扭轉 ($\theta = +3.0\%$ 弧度第一圈)



照片 3.9 試體 UR 梁上翼板扇形開口產生裂縫 ($\theta = -3.0\%$ 弧度第二圈)



照片 3.10 試體 UR 梁上翼板開裂 ($\theta = -4.0\%$ 弧度第一圈)



照片 3.11 試體 UR 剪力板焊道端部裂縫 ($\theta = -4.0\%$ 弧度第一圈)



照片 3.12 試體 UR 梁下翼板降伏 ($\theta = 4.0\%$ 弧度第一圈結束)



照片 3.13 試體 UR 最大位移角之全景 ($\theta = +4.0\%$ 弧度)



照片 3.14 試體 IFS1 試驗前全景



照片 3.15 試體 IFS1 上翼板降伏 ($\theta = -1.5\%$ 弧度)



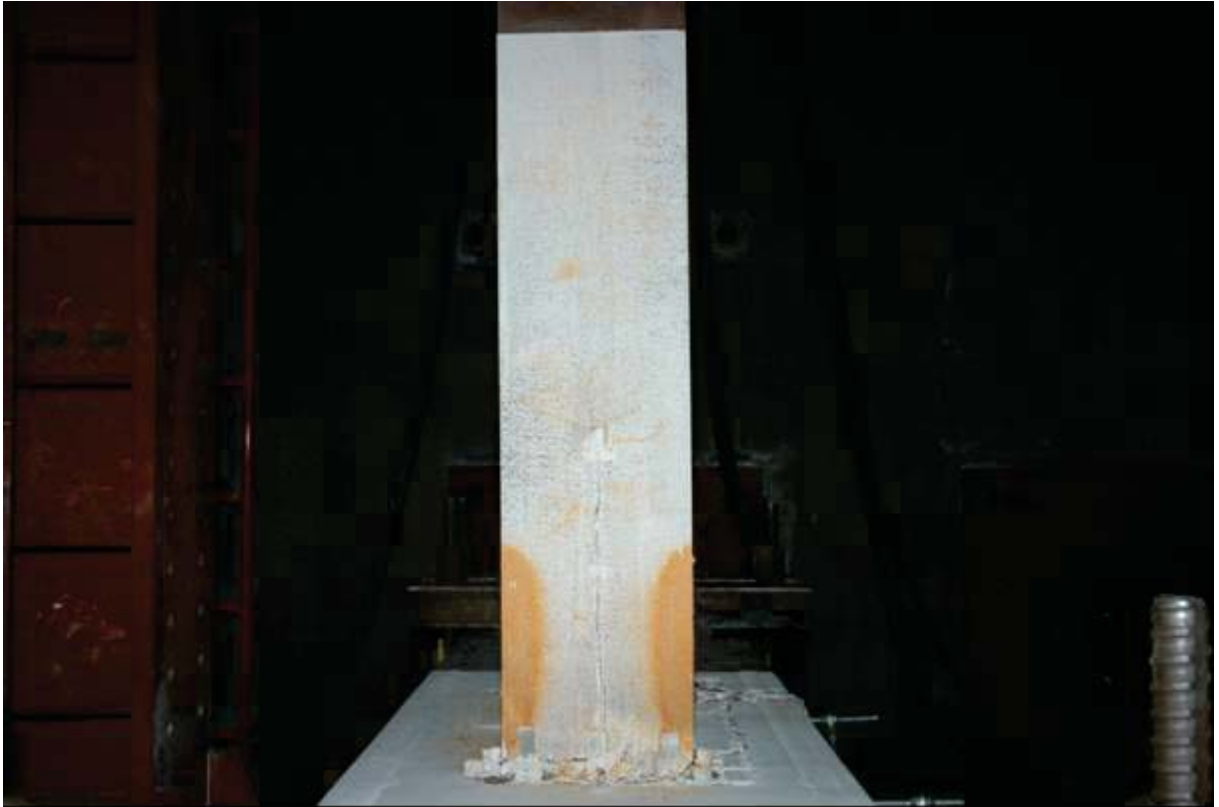
照片 3.16 試體 IFS1 下翼板降伏 ($\theta = -1.5\%$ 弧度)



照片 3.17 試體 IFS1 上翼板角落鐵銹剝落 ($\theta = -2.0\%$ 弧度)



照片 3.18 試體 IFS1 上翼板左側之裂痕 ($\theta = -2.0\%$ 弧度)



照片 3.19 試體 IFS1 上翼板之降伏範圍 ($\theta = +2.0\%$ 弧度)



照片 3.20 試體 IFS1 上翼板焊道之裂痕 ($\theta = -3.0\%$ 弧度)



照片 3.21 試體 IFS1 加勁板與柱接之焊道裂縫 ($\theta = +3.0\%$ 弧度)



照片 3.22 試體 IFS1 梁上翼板焊道破壞 ($\theta = -3.0\%$ 弧度第二圈)



照片 3.23 試體 IFS1 梁下翼板降伏情形 ($\theta = +4.8\%$ 弧度)



照片 3.24 試體 IFS1 實驗後全景 ($\theta = +4.8\%$ 弧度)



照片 3.25 試體 IFS2 試驗前全景



照片 3.26 試體 IFS2 上翼板降伏 ($\theta = -1.0\%$ 弧度)



照片 3.27 試體 IFS2 下翼板降伏 ($\theta = +2.0\%$ 弧度)



照片 3.28 試體 IFS2 下翼板內側降伏 ($\theta = +2.0\%$ 弧度)



照片 3.29 試體 IFS2 梁柱接頭焊接處梁翼出現降伏 ($\theta = +2.0\%$ 弧度)



照片 3.30 試體 IFS2 由柱面起算 470 mm 降伏擴大 ($\theta = -3.0\%$ 弧度)



照片 3.31 試體 IFS2 梁下翼板焊道沿柱面將柱表面拉起 ($\theta = +3.0\%$ 弧度)



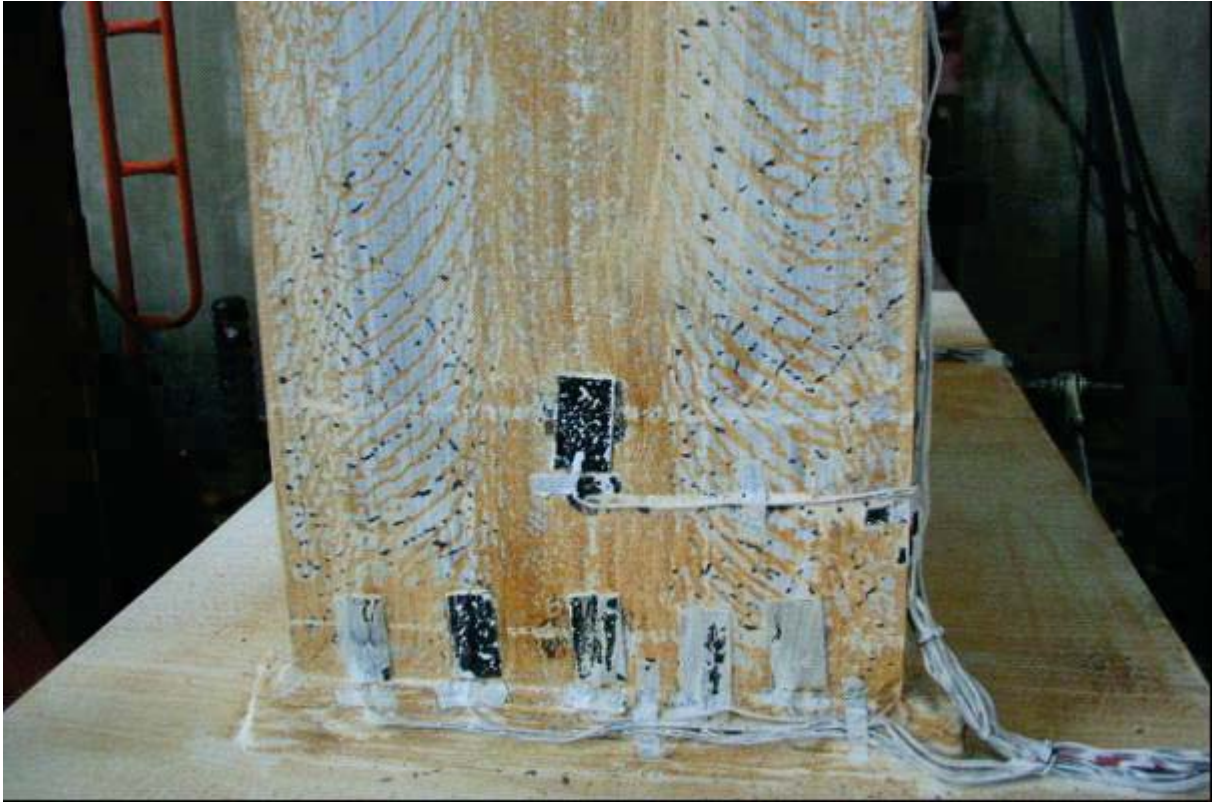
照片 3.32 試體 IFS2 梁上翼焊道無出現降伏現象 ($\theta = -4.8\%$ 弧度)



照片 3.33 試體 IFS2 最大位移角之全景。(θ = -4.8% 弧度)



照片 3.34 試體 IFS3 試驗前全景



照片 3.35 試體 IFS3 上翼板降伏 ($\theta = -0.75\%$ 弧度)



照片 3.36 試體 IFS3 梁上下翼板及腹板大範圍降伏 ($\theta = 2.0\%$ 弧度結束)



照片 3.37 試體 IFS3 梁下翼加勁板降伏 ($\theta = -3.0\%$ 弧度)



照片 3.38 試體 IFS3 梁下翼板於加勁板端部降伏 ($\theta = +3.0\%$ 弧度)



照片 3.39 試體 IFS3 梁上翼背墊板延柱面拉起 ($\theta = -4.0\%$ 弧度)



照片 3.40 試體 IFS3 最大位移角之全景。($\theta = +5.0\%$ 弧度)



照片 3.41 試體 IFS4 試驗前全景



照片 3.42 試體 IFS4 上翼板降伏 ($\theta=0.75\%$ 弧度結束)



照片 3.43 試體 IFS4 下翼板降伏 ($\theta=0.75\%$ 弧度結束)



照片 3.44 試體 IFS4 上翼腹板於加勁板端部降伏 ($\theta=1.0\%$ 弧度結束)



照片 3.45 試體 IFS4 梁腹板降伏範圍增加 ($\theta=1.5\%$ 弧度結束)



照片 3.46 試體 IFS4 加勁板與梁翼板接合之焊道降伏 ($\theta=3.0\%$ 弧度結束)



照片 3.47 試體 IFS4 梁上翼板之降伏情形 ($\theta=4.0\%$ 弧度結束)



照片 3.48 試體 IFS4 梁下翼板之降伏情形 ($\theta=4.0\%$ 弧度結束)



照片 3.49 試體 IFS4 梁腹板及加勁板降伏情形 ($\theta=4.0\%$ 弧度結束)



照片 3.50 試體 IFS4 下翼加勁板與梁接之焊道端部開裂 ($\theta=-4.4\%$ 弧度)



照片 3.51 試體 IFS4 加勁板與柱接之焊道端部上方降伏 ($\theta = -4.4\%$ 弧度)



照片 3.52 試體 IFS4 梁上翼之腹板挫屈向外凸 14 mm ($\theta = 4.4\%$ 弧度結束)



照片 3.53 試體 IFS4 梁下翼之腹板挫屈向內凹 7 mm ($\theta=4.4\%$ 弧度結束)



照片 3.54 試體 IFS4 最大位移角之全景 ($\theta=-4.4\%$ 弧度)



照片 3.55 試體 IFS4 第二次試驗前加勁板與梁接合之裂縫修補



照片 3.56 試體 IFS4 第二次試驗前全景



照片 3.57 試體 IFS4 上翼板整體挫屈之情形 ($\theta=3.0\%$ 弧度結束)



照片 3.58 試體 IFS4 下翼板焊道上方母材出現裂痕 ($\theta=3.0\%$ 弧度結束)



照片 3.59 試體 IFS4 第二次試驗結束前全景 ($\theta = +4.4\%$ 弧度)



照片 3.60 試體 IFS5 試驗前全景



照片 3.61 試體 IFS5 上翼板降伏 ($\theta=0.5\%$ 弧度結束)



照片 3.62 試體 IFS5 下翼板降伏 ($\theta=0.5\%$ 弧度結束)



照片 3. 63 試體 IFS5 上翼板降伏 ($\theta=1.0\%$ 弧度結束)



照片 3. 64 試體 IFS5 下翼板降伏 ($\theta=1.0\%$ 弧度結束)



照片 3.65 試體 IFS5 梁腹板於加勁板端部降伏 ($\theta=1.5\%$ 弧度結束)



照片 3.66 試體 IFS5 梁上翼板之降伏情形 (位移角 $\theta=4.0\%$ 弧度結束)



照片 3.67 試體 IFS5 梁下翼板之降伏情形 (位移角 $\theta=4.0\%$ 弧度結束)



照片 3.68 試體 IFS5 梁腹板之降伏情形 (位移角 $\theta=4.0\%$ 弧度結束)



照片 3.69 試體 IFS5 梁下翼板挫屈 8 mm (位移角 $\theta = -4.7\%$ 弧度)



照片 3.70 試體 IFS5 梁下翼腹板挫屈 18 mm (位移角 $\theta = -4.7\%$ 弧度)



照片 3.71 試體 IFS5 梁上翼腹板挫屈 11 mm (位移角 $\theta = +4.7\%$ 弧度)



照片 3.72 試體 IFS5 最大位移角之全景 (位移角 $\theta = +4.7\%$ 弧度)



照片 3.73 試體 IFS5 梁下翼之腹板挫屈 11 mm (位移角 $\theta = -1.0\%$ 弧度)



照片 3.74 試體 IFS5 梁下翼之腹板挫屈 12 mm (位移角 $\theta = +1.0\%$ 弧度)



照片 3.75 試體 IFS5 梁下翼板挫屈 6 mm (位移角 $\theta = -1.5\%$ 弧度)



照片 3.76 試體 IFS5 梁上翼板挫屈 8 mm (位移角 $\theta = +1.5\%$ 弧度)



照片 3.77 試體 IFS5 梁上翼焊道上方母材裂痕 (位移角 $\theta=2.0\%$ 弧度結束)



照片 3.78 試體 IFS5 下翼加勁板上方母材裂痕 (位移角 $\theta=2.0\%$ 弧度結束)



照片 3.79 試體 IFS5 下翼加勁板上方母材裂痕（位移角 $\theta = +3.6\%$ 弧度）



照片 3.80 試體 IFS5 梁上翼焊道上方母材裂痕（位移角 $\theta = 3.6\%$ 弧度結束）



照片 3.81 試體 IFS5 第二次試驗最大位移角全景 (位移角 $\theta = +3.6\%$ 弧度)



照片 3.82 試體 IFS5 第二次試驗上翼板之挫屈情形



照片 3.83 試體 IFS5 第二次試驗下翼板之挫屈情形





照片 4.1 試體 FDWS1 試驗前全景



照片 4.2 試體 FDWS1 上翼板降伏 ($\theta=1.0\%$ 弧度結束)



照片 4.3 試體 FDWS1 下翼板降伏 ($\theta=1.0\%$ 弧度結束)



照片 4.4 試體 FDWS1 上翼板降伏擴大 ($\theta=-2.0\%$ 弧度)



照片 4.5 試體 FDWS1 下翼板降伏擴大 ($\theta = +2.0\%$ 弧度)



照片 4.6 試體 FDWS1 下翼板局部挫屈 ($\theta = -3.0\%$ 弧度)



照片 4.7 試體 FDWS1 上翼板局部挫屈擴大 ($\theta = +3.0\%$ 弧度)



照片 4.8 試體 FDWS1 梁腹板挫屈幅度達 25 mm ($\theta = +3.0\%$ 弧度)



照片 4.9 試體 FDWS1 梁下翼板嚴重挫屈 ($\theta = -4.0\%$ 弧度)



照片 4.10 試體 FDWS1 梁上翼板嚴重挫屈 ($\theta = +4.0\%$ 弧度)



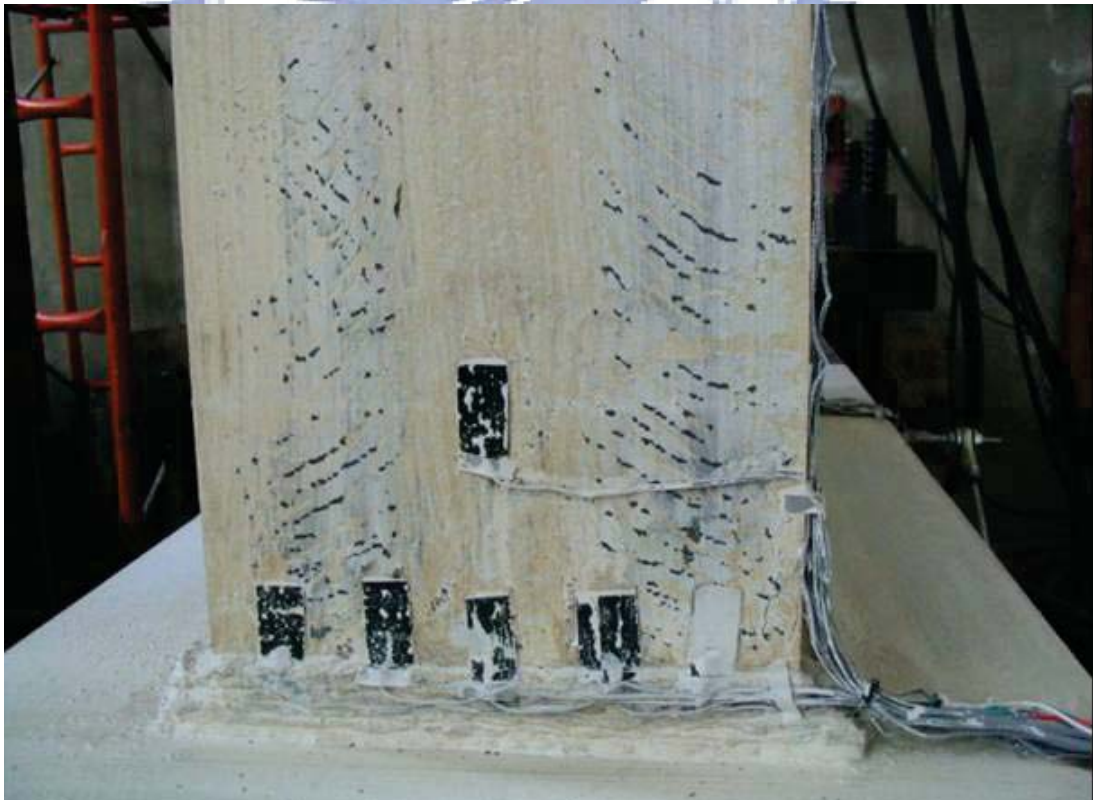
照片 4.11 試體 FDWS1 梁上翼板挫屈幅度達 105 mm ($\theta = +4.7\%$ 弧度)



照片 4.12 試體 FDWS1 最大位移角之全景 ($\theta = +4.7\%$ 弧度)



照片 4.13 試體 FDWS2 試驗前全景



照片 4.14 試體 FDWS2 梁上翼板降伏 ($\theta=0.75\%$ 弧度結束)



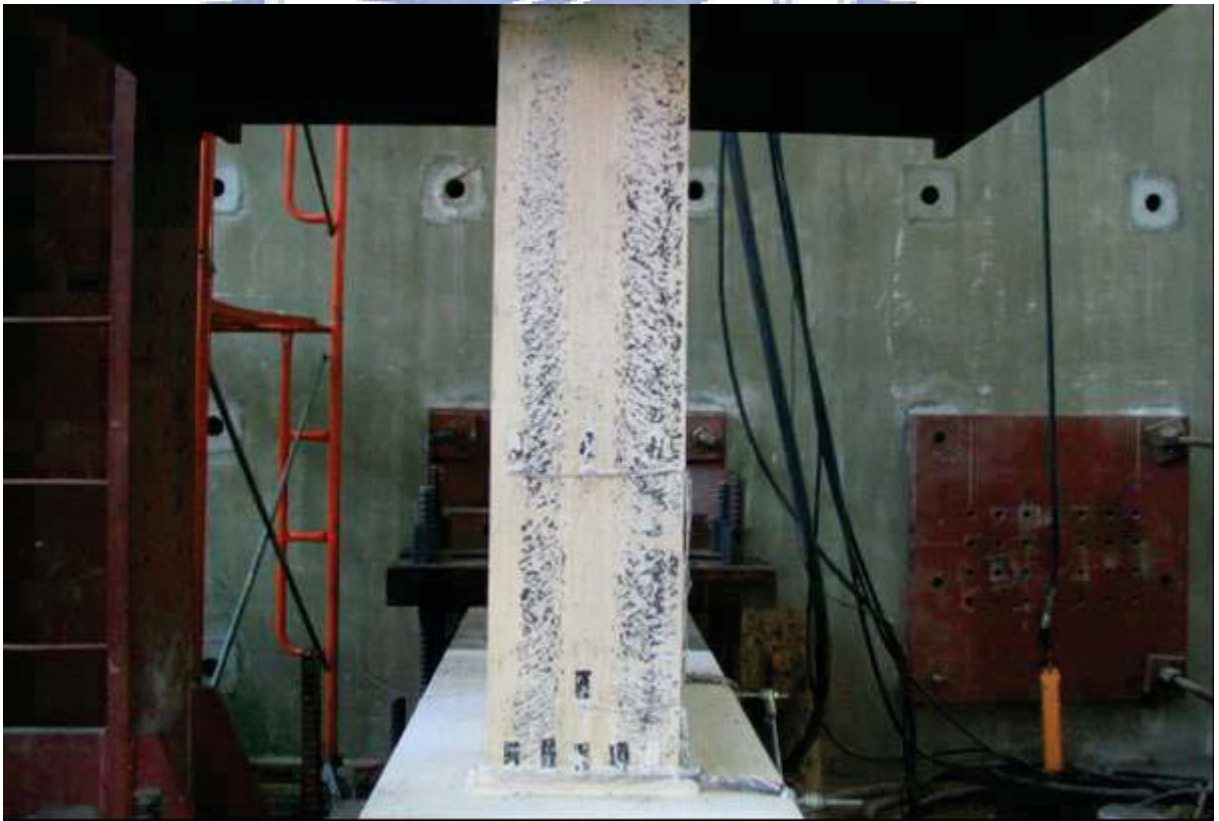
照片 4.15 試體 FDWS2 梁下翼板降伏 ($\theta=0.75\%$ 弧度結束)



照片 4.16 試體 FDWS2 梁腹板降伏擴大之情形 ($\theta=1.0\%$ 弧度結束)



照片 4.17 試體 FDWS2 梁翼板之側面出現塊狀降伏 ($\theta=1.5\%$ 弧度結束)



照片 4.18 試體 FDWS2 梁上翼板降伏擴大之情形 ($\theta=2.0\%$ 弧度結束)



照片 4.19 試體 FDWS2 梁下翼板降伏擴大之情形 ($\theta=2.0\%$ 弧度結束)



照片 4.20 試體 FDWS2 梁腹板降伏擴大之情形 ($\theta=2.0\%$ 弧度結束)



照片 4.21 試體 FDWS2 加勁板降伏範圍擴大之情形 ($\theta=3.0\%$ 弧度結束)



照片 4.22 試體 FDWS2 梁下翼板距柱面 500 mm 處挫屈 ($\theta=-4.4\%$ 弧度)



照片 4.23 試體 FDWS2 梁腹板距柱面 600 mm 處挫屈 ($\theta = -4.4\%$ 弧度)



照片 4.24 試體 FDWS2 梁腹板距柱面 600 mm 處挫屈 ($\theta = +4.4\%$ 弧度)



照片 4.25 試體 FDWS2 上翼梁柱接頭焊道上方母材裂痕及加勁板降伏情形

($\theta=4.4\%$ 弧度結束)



照片 4.26 試體 FDWS2 下翼梁柱接頭焊道上方母材裂痕及加勁板降伏情形

($\theta=4.4\%$ 弧度結束)



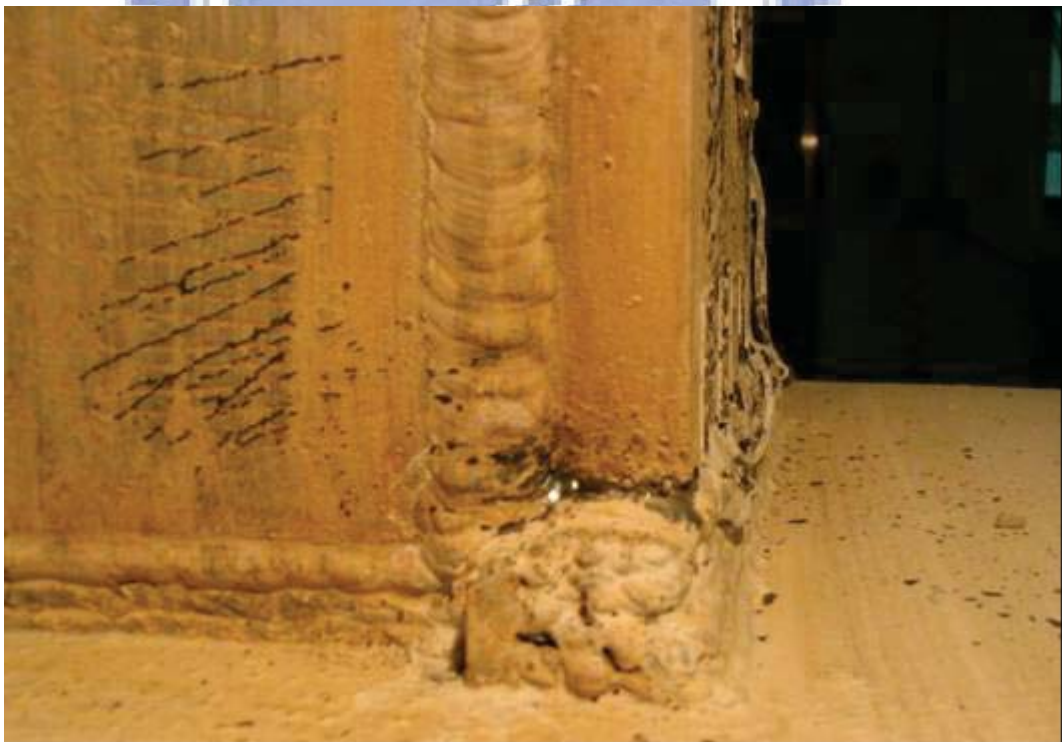
照片 4.27 試體 FDWS2 最大位移角之全景 ($\theta = +4.4\%$ 弧度)



照片 4.28 試體 FDWS2 第二次試驗前之全景



照片 4.29 試體 FDWS2 下翼板於加勁板端部出現裂痕 ($\theta=1.0\%$ 弧度結束)



照片 4.30 試體 FDWS2 上翼梁柱接頭焊道上方母材裂痕

($\theta=3.0\%$ 弧度結束)



照片 4.31 試體 FDWS2 下翼板於加勁板端部出現裂痕 ($\theta=4.0\%$ 弧度結束)



照片 4.32 試體 FDWS2 第二次試驗最大位移角全景

(位移角 $\theta=+4.0\%$ 弧度)



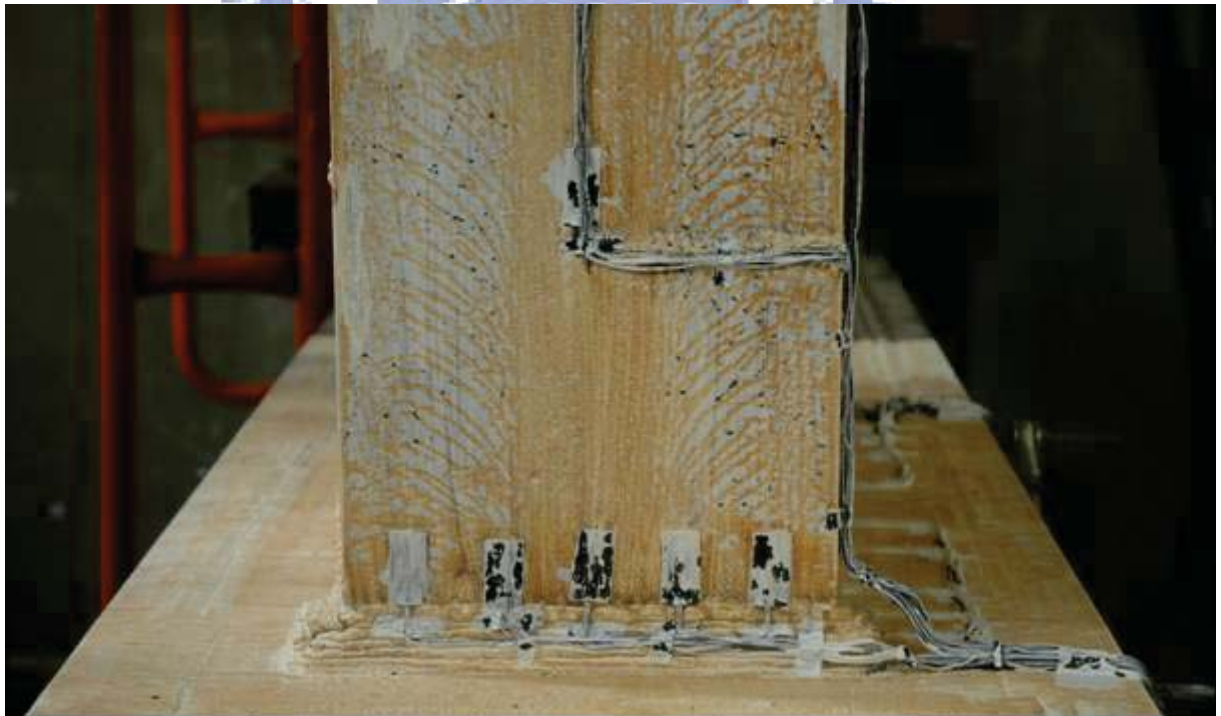
照片 4.33 試體 FDWS2 第二次試驗梁翼板最終之挫屈情形



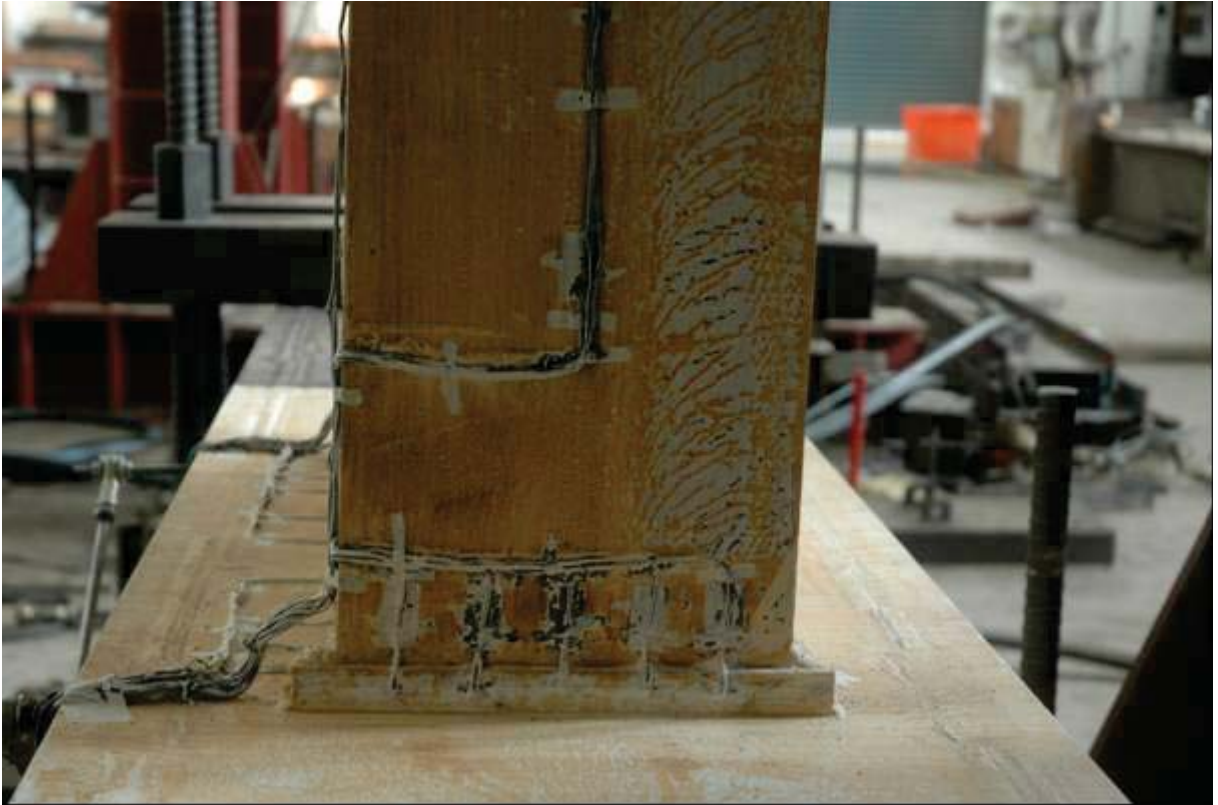
照片 4.34 試體 FDWS2 第二次試驗梁腹板最終之挫屈情形



照片 4.35 試體 FDWS3 試驗前之全景



照片 4.36 試體 FDWS3 梁上翼板之降伏情形 ($\theta=0.5\%$ 弧度結束)



照片 4.37 試體 FDWS3 梁下翼板之降伏情形 ($\theta=0.5\%$ 弧度結束)



照片 4.38 試體 FDWS3 梁下翼板內側之降伏情形 ($\theta=1.0\%$ 弧度結束)



照片 4.39 試體 FDWS3 梁上翼板之降伏情形 ($\theta=1.5\%$ 弧度結束)



照片 4.40 試體 FDWS3 梁下翼板之降伏情形 ($\theta=1.5\%$ 弧度結束)



照片 4.41 試體 FDWS3 梁腹板之降伏情形 ($\theta=1.5\%$ 弧度結束)



照片 4.42 試體 FDWS3 加勁板降伏情形 ($\theta=3.0\%$ 弧度結束)



照片 4.43 試體 FDWS3 加勁板與梁接之焊道端部裂痕 ($\theta=4.0\%$ 弧度結束)



照片 4.44 試體 FDWS3 梁上翼板之降伏情形 ($\theta=4.0\%$ 弧度結束)



照片 4.45 試體 FDWS3 梁下翼板之降伏情形 ($\theta=4.0\%$ 弧度結束)



照片 4.46 試體 FDWS3 梁腹板之降伏情形 ($\theta=4.0\%$ 弧度結束)



照片 4.47 試體 FDWS3 靠近梁下翼之腹板挫屈 5 mm ($\theta = -4.8\%$ 弧度)



照片 4.48 試體 FDWS3 梁上翼板挫屈 4 mm ($\theta = 4.8\%$ 弧度結束)



照片 4.49 試體 FDWS3 梁上翼板側向扭轉 9 mm ($\theta=4.8\%$ 弧度結束)



照片 4.50 試體 FDWS3 加勁板之降伏範圍擴大情形 ($\theta=4.8\%$ 弧度結束)



照片 4.51 試體 FDWS3 加勁板與梁接之焊道端部裂痕 ($\theta=4.8\%$ 弧度結束)



照片 4.52 試體 FDWS3 最大位移角之全景 ($\theta=+4.8\%$ 弧度)



照片 4.53 試體 FDWS3 上翼梁柱接頭焊道上方母材裂痕 ($\theta = -1.0\%$ 弧度)



照片 4.54 試體 FDWS3 梁上翼板於加勁板端部挫屈 ($\theta = +1.0\%$ 弧度)



照片 4.55 試體 FDWS3 下翼梁柱接頭焊道上方母材裂痕 ($\theta = +1.0\%$ 弧度)



照片 4.56 試體 FDWS3 上翼梁柱接頭焊道上方母材裂痕 ($\theta = -3.0\%$ 弧度)



照片 4.57 試體 FDWS3 梁上翼板於加勁板端部挫屈 ($\theta=3.0\%$ 弧度結束)



照片 4.58 試體 FDWS3 上翼於加勁板端部之焊道裂縫 ($\theta=3.0\%$ 弧度結束)



照片 4.59 試體 FDWS3 上翼板於加勁板端部挫屈擴大($\theta=3.77\%$ 弧度結束)



照片 4.60 試體 FDWS3 上翼於加勁板端部之焊道裂縫($\theta=3.77\%$ 弧度結束)



照片 4.61 試體 FDWS3 靠近梁上翼之腹板挫屈 ($\theta=3.77\%$ 弧度結束)



照片 4.62 試體 FDWS3 梁出現側向扭轉的情形 ($\theta=3.77\%$ 弧度結束)



照片 4.63 試體 FDWS3 第二次試驗結束前最大位移角之全景

($\theta = +3.77\%$ 弧度)

附錄 A IFS 加勁板設計例

設計步驟 (參照圖 2.1)

Step1: 計算塑角處之極限彎矩強度 M_{PH} , 如(2.1)式所示, 其中 β 值使用 1.36。

Step2: 初步假設一加勁板長度 L_s , 求柱面彎矩需求 M_{dem} , 如(2.4)式所示。

Step3: 求加勁板之深度 d_s 及厚度 t_s , 如(2.8)式所示, 其中 α 值使用 1.05。

Step4: 檢核 Step2 中所假設之加勁板長度 L_s , 如(2.9)式所示。

Design Example

Beam: H702×254×16×28 use A36 $\sigma_{yn}=1.5 \times 248.4$ MPa

Column: □550×550×35×35 use A572 Gr.50 $\sigma_{yn}=1.1 \times 345$ MPa

L_b : 3600 mm

Step1: 計算塑角處之極限彎矩強度 M_{PH}

$$M_{PH} = \beta \cdot M_{pb} = \beta \cdot R_y \cdot Z_b \cdot \sigma_{yn} = 1.36 \times 1.5 \times 6462752 \times 248.4 = 3274.91 \text{ kN-m}$$

Step2: 初步假設一加勁板長度 L_s , 求柱面彎矩需求 M_{dem}

L_s 假設為 300 mm

$$M_{dem} = \frac{L_b}{L_b - \left(L_s + \frac{d_b}{4} \right)} \cdot M_{PH} = \frac{3600}{3600 - \left(300 + \frac{702}{4} \right)} \times 3274.91 = 3773.30 \text{ kN-m}$$

Step3: 求加勁板之深度 d_s 及厚度 t_s

加勁板採用 A572 Gr.50 之材料

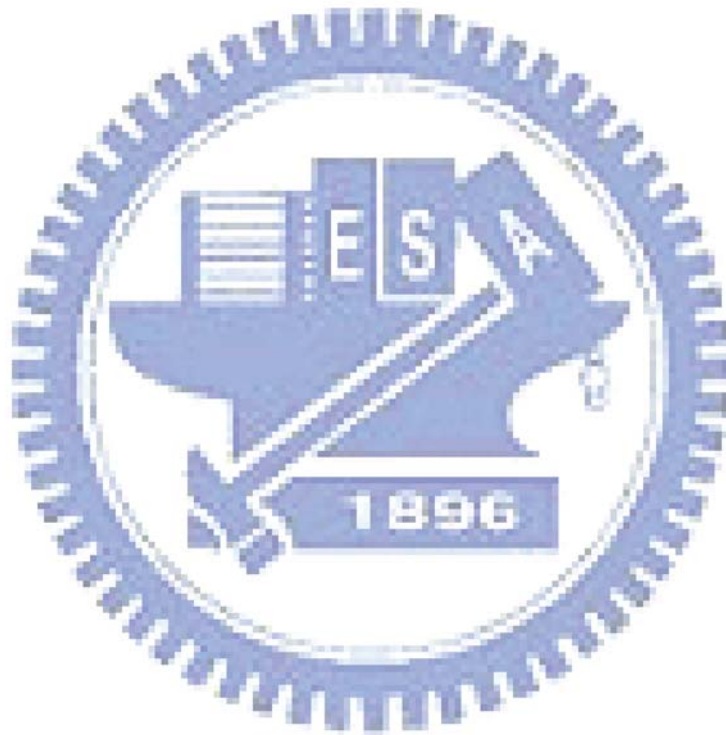
$$d_s \cdot t_s = \frac{\alpha \cdot M_{dem} - M_{pb}}{2 \cdot \left(2 \cdot \sqrt{\frac{1}{2}} - 1\right) \cdot (d_b - 2t_f) \cdot \sigma_{ys}} = \frac{1.05 \times 3773.3 \times 10^6 - 2408.02 \times 10^6}{2 \cdot \left(2 \cdot \sqrt{\frac{1}{2}} - 1\right) \cdot (702 - 2 \times 28) \times 1.1 \times 345}$$

$$= 7651.33 \text{ mm}^2$$

令 $d_s=308 \text{ mm}$ ，得 $t_s=24.85 \text{ mm}$ ，則 t_s use 26 mm 。

Step4：檢核 Step2 中所假設之加勁板長度 L_s

$$L_s \geq 0.77d_s \Rightarrow 300 \geq 0.77 \times 308 \Rightarrow 300 \geq 237.16 \text{ ok}$$



附錄 B FDWS 加勁板設計例

設計步驟 (參照圖 2.5)

Step1: 計算塑角處之極限彎矩強度 M_{PH} , 如(2.1)式所示, 其中 β 值使用 1.44。

Step2: 初步假設一加勁板長度 L_s , 求柱面彎矩需求 M_{dem} , 如(2.4)式所示。

Step3: 求加勁板之厚度 t_s , 如(2.41)式所示, 其中 α 值使用 1.10。

Step4: 檢核 Step2 中所假設之加勁板長度 L_s , 如(2.42)式所示。

Design Example

Beam: H702×254×16×28 use A36 $\sigma_{yn}=1.5 \times 248.4$ MPa

Column: □550×550×35×35 use A572 Gr.50 $\sigma_{yn}=1.1 \times 345$ MPa

L_b : 3600 mm

Step1: 計算塑角處之極限彎矩強度 M_{PH}

$$M_{PH} = \beta \cdot M_{pb} = \beta \cdot R_y \cdot Z_b \cdot \sigma_{yn} = 1.44 \times 1.5 \times 6462752 \times 248.4 = 3467.55 \text{ kN-m}$$

Step2: 初步假設一加勁板長度 L_s , 求柱面彎矩需求 M_{dem}

L_s 假設為 300 mm

$$M_{dem} = \frac{L_b}{L_b - \left(L_s + \frac{d_b}{4} \right)} \cdot M_{PH} = \frac{3600}{3600 - \left(300 + \frac{702}{4} \right)} \times 3467.55 = 3995.26 \text{ kN-m}$$

Step3: 求加勁板之深度 d_s 及厚度 t_s

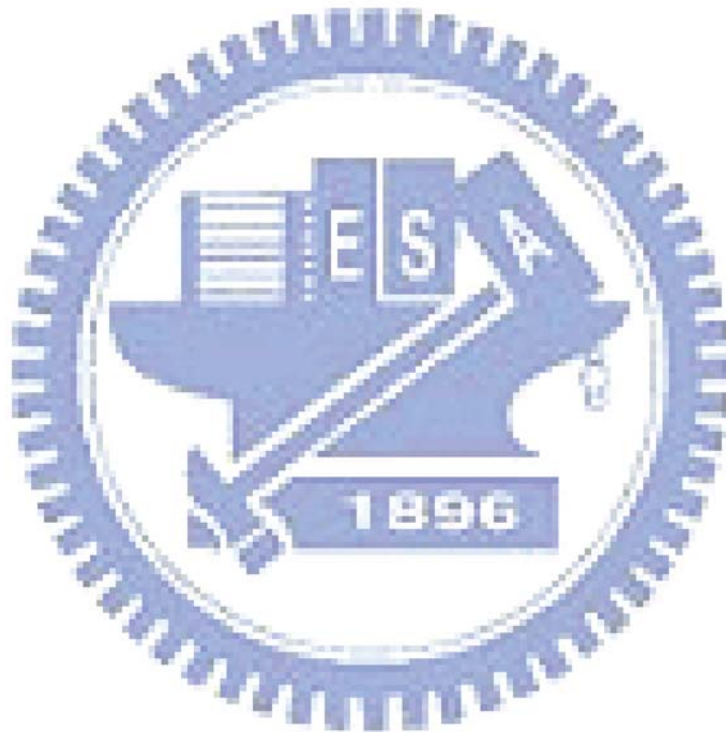
加勁板採用 A572 Gr.50 之材料

$$t_s = \frac{\alpha \cdot M_{dem} - M_{pb}}{\frac{1}{2}(d_b - 2 \cdot t_f)^2 \cdot \sigma_{ys}} = \frac{1.1 \times 3995.26 \times 10^6 - 2408.02 \times 10^6}{\frac{1}{2}(702 - 2 \times 28)^2 \times 1.1 \times 345} = 25.09 \text{ mm}^2$$

則 t_s use 26 mm。

Step4：檢核 Step2 中所假設之加勁板長度 L_s

$$L_s \geq 0.46(d_b - 2 \cdot t_f) \Rightarrow 300 \geq 0.46 \cdot (702 - 2 \times 28) \Rightarrow 300 \geq 297.16 \text{ ok}$$



附件 A

Goodweld CORPORATION
中鋼焊材廠股份有限公司

台南縣永康工業區環山路99號
 99, HUAN KUNG ROAD, TAINAN, TAIWAN, R.O.C.

MATERIAL TEST REPORT
材料檢-測試報告

Customer 客戶名稱		Lot No. 批號	6390
Product 品名	S-6	Mfg. Date 製造日期	07/04/2006
Dimension 尺寸	1.2 mm	Date of Issue 發行日期	08/31/2006
Specification & Classification 適用規範及種類	AWS A5.18 ER70S-6	Certificate No. 證明書編號	0639085

項目	Tensile Test of Deposited Metal 熔金拉力試驗			Impact Test of Deposited Metal 熔金衝擊試驗	Welding Condition 銲接條件				
	Yield Point 屈服點 N/mm ²	Tensile Strength 抗拉強度 N/mm ²	Elongation 延伸率 %		Test Temp. 試驗溫度 ℃	Absorbed Energy(Ave) 均吸收能量	Type of Current 電流種類	Amperage 銲接電流	Arc Voltage 銲接電壓
Specification 標準	400 min.	480 min.	22 min.	-20	27 min.	N/R	N/R	N/R	CO ₂
Test Result 測試值	469	563	29.6	-29	100.8	DC(+)	280A	28V	CO ₂
項目	Bending Test(180°) 彎曲試驗		Soundness Test 射線檢測	Hardness Test 硬度試驗(HRC)	Moisture 含水量(%)	Filler Metal Test 角銲試驗	Postweld Heat Treatment 銲後熱處理		
	Face 面彎	Root 背彎							
Specification 標準	N/R	N/R	GRADE 1	N/R	N/R	N/R	N/R		
Test Result 測試值			GRADE 1						

Chemical Composition by Weight(%)
化學成份

Elements 成份元素	C	Mn	Si	Cr	Ni	Mo	V	Cu	P	S	Al	Ti
Specification 標準	0.06-0.15	1.40-1.80	0.80-1.15	0.15 max.	0.15 max.	0.15 max.	0.03 max.	0.50 max.	0.025 max.	0.035 max.	N/R	N/R
Solid wire 固態材/實心線	0.06	1.48	0.90	0.02	0.01	0.02	0.01	0.01	0.018	0.007		

Core Wire Heat No. : VBE299
心線爐號

Remarks
備註



Above data contained herein were obtained from samples considered to be representative of the products in the subject shipment and are believed to be reliable. All operations performed comply with the material specification.
 以上抽樣所得測試數據，代表本批出貨品質正確無誤，所有測試過程均符合材料規格。

Jack Wu
QUALITY ASSURANCE