One Stop Solution for Bridge and Civil Structures





單跨預鑄合成斷面預力梁橋

台灣邁達斯 技術部製作 www.midasuser.com.tw

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概要

此為單跨 36m 長的預鑄合成斷面預力梁橋分析例題。與車行方向垂直的剖面 如下圖所示,為六根間隔 2.75m 的預鑄預力梁組成,預力梁與 20cm 厚現場澆灌 的混凝土橋面版形成合成斷面,橋面版上施加靜載重、活載重與衝擊載重。本例將 1.5cm 厚的磨耗層視為 20cm 橋面版的一部分,另有 5cm 厚的磨耗層載重將額外 考量。

橋梁尺寸



材料

混凝土	- 橋面版(Deck)與橫樑(Cro	oss Beams)
•	CNS(RC) C280	,
	Modulus of elasticity	÷ 2.6956 x 10 ⁵ kgf/cm ²
	Poisson's ratio	: 0.2
	Density	:2.4 tonf/m ³
	Concrete strength (28-day)	÷ 280 kgf/cm ²
	Deck total thickness	: 20 cm
	Deck structural thickness	:18.5 cm
	Cross beam depth	:18.5 cm (與橋面版厚度同)
	Interior cross beam width	:3m(鄰接橫樑中心到中心的距離)
	End cross beam width	: 1.5 m
混凝土	- – 預鑄樑(Precast Beams)	
	CNS(RC) C420	
	Modulus of elasticity	: 3.4366 x 10 ⁵ kgf/cm ²
	Poisson's ratio	: 0.2
	Density	:2.4 tonf/m ³
	Concrete strength (28-day)	÷ 420 kgf/cm ²
鋼材 -	· 預力鋼腱(Prestress Tendor	ns)
	12.7mmΦ7線絞索,高拉力	力低鬆弛鋼絞索
	Modulus of elasticity	:1.95 x 10 ⁶ kgf/cm ²
	Ultimate strength	:190.0 kgf/mm ² 極限抗拉強度
	Yield strength	:160.0 kgf/mm ² 降伏強度
載重		
靜載重	-	
	橋面版	
	Exterior PC Beam	(0.2m) (2.275m) (2.4 tonf/m ³) = 1.092 tonf/n
	Interior PC Beam	(0.2m) (2.75m) (2.4 tonf/m ³) = 1.32 tonf/m
	Haunch above beam	n : (0.015m) (1m) (2.4 tonf/m ³) = 0.036 tonf/m
	護欄	
	(2 barriers)(0.45 tonf	f/m) / (6 beams) = 0.15
	新增磨耗層	
	(0.05m)(2.4 tonf/m ³)) (14.6m) / (6 beams) = 0.292 tonf/m , use 0.3
預力		
	初始應力 = 146.0 kgf/mm ² ((75% of ultimate strength)

初始應力 = 146.0 kgf/mm² (75% of ultimate strength) 因彈性縮短的瞬時損失= 8.9 % (13 kg/mm²) 假設應力 = 133.0 kgf/mm²

車輛載重 (Taiwan) HS 20-44

開啟檔案與偏好設定



Tools > **Unit System** Length>**cm** ; Force (Mass)>**kgf** Temperature > **Celsius** ↓



圖 3 開新檔案與單位設定

材料與斷面性質

在此章節將定義模型中須使用到的材料與斷面性質。

材料性質

定義以下材料: Deck; Precast Beams; Tendons; Cross Beams.

Properties > [] Material Properties J Properties 對話框 > Material 表單 > Add Name>Deck Type of Design>Concrete Standard>None Modulus of Elasticity>269560 Poisson's Ratio>0.2 Thermal Coefficient>1.1 e-005 1/[C] Weight Density>0 J Apply

Note:

本例將橋面版視為梁載重施加,故此處橋面版單位重輸入為零,不要在施工 階段生成合成斷面後就自動計算橋面版自重。

	Civil 2016 - [E:\05_Training\PSC Single Span_2016] - [MIDAS/Civil]	- 0 %
View Structure Node/Element Properties Boundary Load Analy	vsis Results PSC Pushover Design Rating Query Tools	🛱 Help 🗸 – 🖉 🗵
Asterial Comp. Strength Strength Strength Strength Strength Strength Streng	ness Tapered Section for Thickness Moment Characteristic Association Property	
re Manu re Manu Table Works Group. Report Table Works Group. Report Table Porties Table Por	Central Material ID I Name Dedi Elstricty Data Type of Posign Concrete Type of Naterial Post optic Orthotropic Stel Modular of Electory : 0.000000000 kg/fcm*2	
Close	Prosents Rate : 0 Thermal Coefficient : 0.0000e+000 L/[C] Weight Density : 0 kg/(cm ^3) □ Use Mass Density: 289560 kg/(cm ^3) Modula of Elestoty : 289560 kg/(cm ^3) Prosents Rate : 0.2 Thermal Coefficient : 1.1e+005 L/[C] Weight Density : 0 kg/(cm ^3) □ Use Mass Density: 0 kg/(cm ^3)	
	Plasticity Data Plasticity Data Plastic Material Name NCNE Thermal Transfer Secific Heat Specific Heat : Heat Conduction : Damping Ratio : OK Cancel	۵ ۲ ۵ ۵ ۲
For Help, press F1	anet U:0.0.0 G:0.0.0 ket ∨ cm.	

圖 4 設定材料對話框

Name> Precast Beams

Type of Design>Concrete Standard>None Modulus of Elasticity>343660 Poisson's Ratio> 0.2 Thermal Coefficient>1.1 e-005 1/[C] Weight Density> 0.0024 kgf/cm³ (i.e., 2.4 tonf/m³) <u>A</u>pply

Name> Tendon Type of Design>User Defined Standard>None Modulus of Elasticity>1.95e+006 Poisson's Ratio> 0.3 Weight Density> 0.0024 kgf/cm³ (i.e., 2.4 tonf/m³) ↓ Apply

Note:

在此範例中係將鋼腱的單位重與混凝土的單位重設定為相同,目的是讓使用 者易於與其他不考慮鋼腱單位重的模型作比較。

Name> Cross Beams Type of Design>Concrete Standard>None Modulus of Elasticity>269560 Poisson's Ratio>0.2 Thermal Coefficient>1.1 e-005 1/[C] Weight Density>0 ↓ 0K

Note:

為施加車輛載重而虛設 cross beams,故 cross beams 單位重設為0。

<u>C</u>lose

時間依存材料性質

Properties >	Time Dependent	Material > Creep	/ Shrinkage	┛
--------------	----------------	------------------	-------------	---

Time Dependent Material (Creep / Shrinkage) 對話框 > _____Add Name>CEB-FIP

Code>CEB-FIP(1990)

Compressive strength of concrete at the age of 28 days>**420** Relative Humidity of ambient environment (40–99)>**70** % Notational size of member>**25** cm (此為臨時設定值,此值將於後續步驟讓程 式自動計算與替換) Type of cement>**Normal or rapid hardening cement (N, R)** J Age of concrete at the beginning of shrinkage>**3** day

Show Result	(圖 6)
<u>C</u> lose	(, ,
OK	
<u>C</u> lose	

ne:	CEB-FIP	Code :	CEB-FIP(19	90)		
EB-FI	P(1990)					
Chara at the	cteristic compressive streng age of 28 days (fck) :	th of concrete	4	20	kgf/cm^2	
Relati	ve Humidity of ambient envi	ronment (40 - 99) :	7) 🗘	%	
Notion	nal size of member :		25		cm	
h =	2 * Ac / u (Ac : Section Are	a, u : Perimeter in contact v	with atmosphe	re)		
Type	ofcement					
C	Rapid hardening high stre	ngth cement (RS)				
	Normal or rapid hardening	cement (N, R)				
C) Slowly hardening cement ((SL)				
Age o	f concrete at the beginning	of shrinkage :	3	•	day	

圖 5 設定乾縮潛變對話框



圖 6 乾縮係數圖

Properties > Time Dependent Material > Comp. Strength 4

Time Dependent Material (Comp. Strength) 對話框 > Add Name>C420 Type>Code Development of Strength>Code>CEB-FIP(1990) Concrete Compressive Strength at 28 Days>420 Cement Type(s)> N, R: 0.25 Redraw Graph

OK	
<u>C</u> lose	

lame		Scale Factor	Graph Options	
C420		1.0	X-axis log scale	Y-axis log scale
ype				
۲	Code O User	500		
evelopmer	nt of Strength	450		
Code :	CEB-FIP(1990) ~	350		
	$f(t)=(f_{ck}+\Delta f)\times exp(s\times [1-(28/t_{eq})^{0.5}])$	300		
Mean comp at the age	pressive strength of concrete	250		
420	kgf/cm^2	200		
Cement Ty	/pe(s)	150		
N, R	: 0.25 🗸	50-		
		0 2 4	Time (day)	20 22 29 26 28 30
-	Dathew Crack			OK Canad

圖 7 設定抗壓強度對話框

Properties > Time Dependent Material > Material Link ,

Time Dependent Material Type>Creep/Shrinkage>**CEB-FIP** Time Dependent Material Type>Comp. Strength>**C420** Select Material to Assign>Materials>**2:Precast Beams**

Add / Modify

Time Dependent Material Link
Creep/Shrinkage CEB-FIP
Comp. Strength C420 💌
Select Material to Assign
Materials Selected Materials
1:Deck 2:Precast Beams 3:Tendon 4:Cross Beams
Operation Delete
No Mat Creep/ Comp 2 Preca CEB-FIP C420
✓ ✓ ✓ ✓ ✓ ✓ ✓ ✓ ✓ ✓ ✓ ✓ ✓ ✓ ✓ ✓ ✓ ✓ ✓

圖 8 時間依存材料連結對話框

斷面性質

定義以下斷面:Interior Precast Beams、Exterior Precast Beams、 End Cross Beams、Interior Cross Beams

內側與外側的預鑄梁彼此間的有效橋面版寬度不同。 內側與端部橫梁的寬度不同。

Properties > I Section Properties ↓ Properties 對話框 > Section 表單 > Add 選擇 Composite 表單 Section ID > 1 Name>Interior Precast Beams Section Type>Composite-I Slab>Bc>275 cm Slab>tc>18.5 cm Slab>Hh>1.5 cm

比對 **PSC Viewer** 的斷面示意圖, 輸入 Interior PC Beams 對應的點位 尺寸(J1, JL1...JL4, JR1...JR4)。

Girder>**J1**, **JL1** (on) Girder>**Symmetry** (on)

下拉 Girder 視窗並輸入 表 1 的斷面幾何資料:

H1	180
HL1	10
HL2	10
HL2-1	5
HL3	132
HL4	12
HL5	16
BL1	7.5
BL2	50
BL2-1	37.5
BL4	32.5

表 1 Interior Precast Beams 斷面幾何資料

)B/User Value SRC Com	bined PSC	Tapere	Compos	site s	teel Girde
Section ID 1	Name []	nterior Prec	ast Beams	1	
	Section Type	com	posite-I		
Bc	Slab Width	0			cm
i te	Girder : Num	0 2	CTC	0	cm
Line Line Line Line Line Line Line Line	Slab				
	Bc	275		cm	
	tc	18.5		cm	
	Hh	1.5		cm	
	Girder				
	HI 3		132 000	cm	-
	HI 4		12 000	cm	
	HL5	-	16.000	cm	_
	BL1		7.500	cm	
·> v	BL2	-	50.000	cm	
	BL2-1		37.500	cm	
	BL4		32.500	cm	
	-				
	Material	Select Mate	rial from D	B	
Display Centroid	Ead/Esb	1.2749	Dod/D	sb	0
	Pgd	0.2	Psb		0.2
O FEM O Equation	Tgd/Tsb	0			
	Multiple	Modulus of	Elasticity		
	Es/Ec (Cre	ep)	C)	
Offset : Center-Center	Es/Ec (Shri	nkage)	C)	
Change Offset	Conside	r Shear Def	formation.		
	Conside	r Warping B	ffect(7th	DOF)	

圖 9 斷面資料對話框

Note:

Egd/Esb 代表梁(girder)與橋面板(slab)的彈性模數比, Egd/Esb = 343660/ 269560 = 1.2749.

Dgd/Dsb 代表梁(girder)與橋面板(slab)的單位密度比,在此處設定為 0 代表 想將橋面版重視為梁荷重,不要自動計算橋面版自重。

Properties 對話框 > Section 表單 > ID 1 (Interior Precast Beams) <u>Copy</u> ID 2 (Interior Precast Beams) <u>Modify...</u> Name>Exterior Precast Beams Slab > Bc > 227.5 cm (此為兩斷面唯一的不同). OK

Properties 對話框 > Section 表單 >Add DB/User 表單	
Name> End Cross Beams 選 User	
Select Solid Rectangle (H> 18.5 cm B> 150 cm OK	•)
Properties 對話框>Section 表單>Add DB/User 表單	
Name>Interior Cross Beams 選 User	
Select Solid Rectangle ()
B> 300 cm OK <u>C</u> lose	

Note:

Cross Beams 的深度取為橋面板厚度,寬度則取為 Cross Beams 間的中心距。

結構模型

Tools > **Unit System** Length>m ; Force (Mass)>**tonf** ↓

Top View

Node/Element > Nodes > Coordinates (x,y,z)>0,0,0 Copy>Number of Times>5 Copy>Distances (dx,dy,dz)>0,2.75,0 m Apply Close

Node Element Boundary Mass Load
Create Nodes 💌
Start Node Number : 79
Coordinates (x,y,z)
0, 0, 0 m
Сору
Number of Times : 5
Distances (dx,dy,dz) :
0, 2.75, 0 m
Merge Duplicate Nodes
✓ Intersect Frame Elements
Apply Close

圖 10 建立節點對話框

預鑄梁

Auto Fitting
Node Number

Node/Element > Elements > I Extrude ↓ Select Window > Nodes 1, 6 Extrude Type>Node→ Line Element Element Attribute>Element Type>Beam Material>2: Precast Beams Section>2: Exterior Precast Beams Generation Type>Translate Translation>dx,dy,dz>3, 0, 0 m Number of Times>12 Apply

Node Element Boundary Mass Load
Extrude Elements
EStart Number
Node Number : 179
Element Number : 73
Extrude Type
Node -> Line Element
Source 🔽 Remove 🗖 Move
Reverse I-J
Element Attribute
Element Type: Beam
2 2: Precast Beams
Section :
2 2: Exterior Precast B 💌
Beta Angle : 0 T [Deg]
- Conception Turns
Translate C Rotate C Project
Translation
Equal Distance
C Unequal Distance
4.4.4. 200
ax,ay,az: 13, 0, 0 m
Number of Times : 12 🐳
Merging Tolerance
Apply Close
圖 11 擠出元素對話框

Select Window Sales 2to5 Extrude Type>Node→ Line Element Element Attribute>Element Type>Beam Material>2: Precast Beams Section>1: Interior Precast Beams Generation Type>Translate Translation>dx,dy,dz>3, 0, 0 m Number of Times>12

橫梁

Select Window S>Nodes 1, 29

Extrude Type>Node→ Line Element Element Attribute>Element Type>Beam Material>4: Cross Beams Section>3: End Cross Beams Generation Type>Translate Translation>dx,dy,dz>0, 2.75, 0 m Number of Times>5

Select Window S>Nodes 7to27by2

Extrude Type>Node-> Line Element Element Attribute>Element Type>Beam Material>4: Cross Beams Section>4: Interior Cross Beams Generation Type>Translate Translation>dx,dy,dz>0, 2.75, 0 m Number of Times>5

<u>C</u>lose

打開 🌺 Element Number 桿件編號以檢視模型幾何關係、節點編號與桿件編號,重新編號後關閉之。

Y向桿件重新編碼

<u>A</u>pply

free Me	nu				4 3
Node	Element	Boundar	y M	ass Lo	ad
Renun	bering			•	^
_ ⊟st	art Numbe	er ———			
Node	Number	: 7	9		
Elem	ent Numbe	er: 1	38		
C	umbering 1 Node Node & Ele	larget © E ement	leme	nt	
Sele	ction Type All	⊙ By S	ielecti	ion	
New	Start Num	ber Eleme	nt [73	
Ren	umbering (Options -			
Sor	ting Coord	linates —			1
Ca	rtesian Co	ordinate		•	
Sor	ting Prefe	rence			
	Order	Glob	al Ax	is	
	1 ST	Z		-	
	2 ND	Y		•	
	3 RD	X		-	
	[Apply] [⊆lose	

圖 12 桿件重新編號對話框



圖 13 Y 向桿件新編號

修改時間依存材料特性值

此功能用於將修正已建立桿件的乾縮潛變形狀參數。

Properties > Time Dependent Material > Time Dependent Material > Time Dependent Material > Time Dependent A

Select	: All
Element [Dependent Material>Notational Size of Member
Select Au	to Calculate
<u>A</u> pply	
<u>C</u> lose	

hange Ele	ment Depe	ndent M	ateri 🔻
	lumber —		
Node Nur	ober i	79	
	iller :	100	
Element	Jumber :	J138	
Option -			
• Add/	Replace	0	Delete
Flomont	Dependent	Makavial	
Liement	Jependenc	material	
Notatio	hal Size of I	Member	
C Inpu	it 🖲 Ai	uto Calcu	late
h:)		m
Code	CEP ET	0	-
code.	JCED-FI	٢	
The for	ula is	h = 2* A	c/u
		u = Lo +	a*Li
		a: 0.5	_
	Ac	oply	Close
			_

圖 14 修改構件之時間依存材料特性值

邊界條件

Boundaries > Select Window Solution > Node 1 Options > Add Support Type (Local Direction) > D-ALL ▲pply

Supports Boundary Group Name Default Options Add Replace Delete Support Type (Local Direction)	Node Element Boundary Mass Load
Boundary Group Name Default Options Add Replace Delete Support Type (Local Direction)	Supports 💌
Options \bigcirc Add Replace Delete Support Type (Local Direction) Image: Construction of the second s	Boundary Group Name
Options © Add © Replace © Delete Support Type (Local Direction)	Default
Support Type (Local Direction)	Options
$ \begin{array}{c c} Z \\ Ry Dy Y \\ Rz Dx \\ Dz V \\ V \\ Dz V \\ V Dy V Dz V \\ R-ALL \\ Rx Ry Rz $	Support Type (Local Direction)
D-ALL Dx V Dy V Dz V R-ALL Rx Ry Rz	Rz Dz X
R-ALL Rx Ry Rz	D-ALL Dx V Dy V Dz V
	R-ALL
	KX KY KZ
<u>Apply</u> <u>Close</u>	<u>Apply</u> <u>Close</u>

圖 15 支承設定對話框

Select Window Solution >Node 29

Support Type (Local Direction)> **Dy**, **Dz**

Select Window S>Nodes 2to6 Support Type (Local Direction)> Dx, Dz

Select Window S >Nodes 30, 75to78 Support Type (Local Direction)> Dz Apply Close



圖 16 模型邊界條件

載重資料

接下來將定義以下載重資料:載重群組、靜載重、預力鋼腱、車輛載重。

載重群組

執行施工階段分析前,必須先定義結構群組、邊界群組、載重群組。在此定義的載重群組名稱是為了方便將各載重群組化。

Structure > Group > B/L/T > Define Load Group

Select New			
Name> PC & C/B	Define Load Grou	dr dr	×
Add	Name :	Prestress	
Name> Deck	Suffix :		
Add		r (Example 13567 to 2	0 by 2)
Name> Barrier			
Add	Deck		
Name> Wearing surface	Wearing surface		Delete
Add	Prestress		Delete Inv
Name> Prestress			
Add			⊆lose
Close			

圖 17 設定載重群組名稱

靜載重

Load > Static Loads > IC Static Load Cases 4 Name>Deck Type>Dead Load of Component and Attachments (DC) Add Name>Wearing surface Type>Dead Load of Wearing Surfaces and Utilities (DW) Add Name>Barrier Type> Dead Load of Wearing Surfaces and Utilities (DW) Add Name>PC & C/B Type> Dead Load of Component and Attachments (DC) Add Name>Prestress Type>Prestress (PS) Add Close

Name	:	Prestress			Add	
Case	: [All Load Cas	e	•	Modify	
Туре	: 1	Prestress (P	5)	•	Delete	
Description	n: [
No		Name	Туре	De	scription	ł
	1 De	ck	Dead Load of Component an			
1	2 We	earing surf	Dead Load of Wearing Surfa			
3	3 Bai	rrier	Dead Load of Component an			
4	4 PC	& C/B	Dead Load of Component an			
• •	5 Pre	estress	Prestress (PS)			

圖 18 設定靜載重名稱對話框



Load > Beam Loads > <u>□</u> Element Beam Loads ↓ Load Case Name>Deck Load Group Name>Deck Direction>Global Z Projection>No Value>Relative w>-1.356 tonf/m (1.32 deck + 0.036 haunch)



圖 20 於 Model View 顯示梁荷重

Ҡ Select Ide	ntity-Elements
Select Identi	ty 對話框>Select Type>Section
"2: Exterior	Precast Beams"
Replace	
Close	

Load Case Name>**Deck** Load Group Name>**Deck** w>-1.128 tonf/m (1.092 deck + 0.036 haunch)

Select Identity-Elements Select Identity 對話框>Select Type>Section "1: Interior Precast Beams" Add "2: Exterior Precast Beams" Add Close

Load Case Name>Wearing surface Load Group Name>Wearing surface w>-0.3 tonf/m

Select Previous
Load Case Name> Barrier
Load Group Name> Barrier
w>-0.15 tonf/m
Apply
Close

Load > Static Loads> ^(W) Self Weight Load Case Name> PC & C/B Load Group Name> PC & C/B Self Weight Factor>Z>-1

Close



圖 21 設定自動計算材料自重對話框

預力鋼腱





圖 23 鋼腱縱向標準配置



Tools > **Unit System** Length>**mm**; Force (Mass)>**kgf ا**

Add/Modify Tendon Property		×		
Tendon Type				
Tendon Name	ТН			
Tendon Type	Internal(Pre-Tension)	•		
Material 3	3: Tendon	•		
Total Tendon Area	1381.94 mm	r^2 🛄 🔨		
Strand Diameter	41.94687934 mm			
Relaxation Coefficient	Magura 💌 45	5 💌		
Ultimate Strength	190 kqf	/mm^2		
Yield Strength	160 kqf	/mm^2		
Curvature Friction Factor	0			
Wobble Friction Factor	0 1/n	nm		
External Cable Moment Magnifier	0 kqf	/mm^2	Tendon Area	
Anchorage Slip(Draw in)	Bond Type			
Begin : 0 mm	Bonded		Strand Diameter	: 12.7mm(0.5") 💌
End : 0 mm	C Unbonded		Number of Strands	: 14
OK	Cancel	Apply		OK Cancel

圖 25 設定鋼腱性質對話框

Add Tendon Property 對話框> 🫄 Tendon Name>TS Tendon Type>Internal (Pre-Tension) Material>3: Tendon 按 ... 輔助計算 Total Tendon Area Tendon Area 對話框> Strand Diameter>12.7mm (0.5") Number of Strands>34 0K Select Relaxation Coefficient Relaxation Coefficient>Magura>45 Ultimate Strength>**190** kg/mm² Yield Strength>**160** kg/mm² OK <u>C</u>lose 闢閉顯示 🔊 Node Number 開啟顯示 🚨 Element Number Top View Select Identity-Elements Select Identity 對話框>Select Type>Section 選 "1: Interior Precast Beams" 選 "2: Exterior Precast Beams" Add Close 🔼 Activate

	x(mm)	y(mm)	z(mm)	fix	Ry[deg]	Rz[deg]
1	0.0000	0.0000	1620.0	Г	0.00	0.00
2	14800.	0.0000	380.00	~	0.00	0.00
3	21500.	0.0000	380.00	~	0.00	0.00
4	36300.	0.0000	1620.0	Г	0.00	0.00
5				Г		

圖 26 鋼腱 TH 的局部座標資料

Profile Insertion Point>-150, 0, -1312 mm x-Axis Direction>X

Note:

插入點為鋼腱在整體座標系(GCS)的參考點,即便一根預鑄梁並非僅為一個單元所組成,但只需要設置一個鋼腱座標(Profile)即可模擬鋼腱位置。

依圖 24 所示,外側梁與內側梁的鋼腱插入點都設於梁底部,但插入點的高程 (Z-軸)並不相同,這是因為其各自之混凝土版的有效寬度不同,導致中性軸至 梁單元底部的距離不同。

Tendor	Name :	TH1		Group	p: Ter	ndon 1	~
Tendor	Property		тн			~	
Assigne	ed Elements		1to23by2	8			
Inpu	t Type	-		Straight	Length	ofTendo	n
02.	D	() 3-D		Begin :	0		mr
● Sp	pline	Round		End :	0		m
Турі	cal Tendon		N	o. of Te	ndons :	1	
Lead L	ength			_	_		_
User	defined Ler	ngth	✓ Begin	: 0	End	1: 0	_
Profile			0			<u> </u>	
Refer	ence Axis		 Straig 	ht () Curve	OE	eme
Y	2207.69					-	
	-	-				-	-
	2792.31	5000	150	000	2500	0	35
				_			_
Z	2207.69				_	-	-
	2792.31	_					_
	0	5000	150	000	2500	0	35
	x(mm)	v(mm)	z(mm)	fix F	Rvídeal	Rzíde	al
	0 0000	0 0000	1620.0		0.00	0.0	00
2	14800.	0.0000	380.00		0.00	0.0	00
3	21500.	0.0000	380.00	1	0.00	0.0	00
4	36300.	0.0000	1620.0	Г	0.00	0.0	00
5							
Point	of Sym.:	○ First	Last	Ma	ke Symm	etric Ter	ndor
Profile	e Insertion F	Point :	-150,0,-	1312		mm	
x Axis	Direction	:	Θx	OY	Vect	or	
			0,0	<u> </u>		0000	
v Anie	Dot And				Denis	- time	
X AXIS	Rot. Angle		· · · · ·	deg]	Proje	cuon	
Grad.	Rot. Angle	:	Y V	0	-	[deg]	
			OK	0	Cancel		App



Tendon Profile 對話框> 選 TH2
Copy / Move
Mode > Copy
Equal Distance > dx, dy, dz : 0 ,2750, 0 mm0K
選 TH2-Copy
Modify
Tendon Name> 修改為 TH3
Group>修改為 lendon3
OK
以同樣的方法,建立鋼腱 TH4 與 TH5,個別將其設定為鋼腱群組 Tendon4 與 Tendon5
Tendon Profile 對竏柾>躍 TH5
Copy / Move
Mode > Copy
Equal Distance > dx, dy, dz : 0 ,2750, 0 mm
選 TH5-Copy
Modify
Tendon Name> 修改為 TH6
Group> 修改為 Tendon6
Assigned Elements > 2to24by2
Profile Insertion Point>修改為 -150, 13750, -1312 mm
- OK
Tendon Profile 對話框> Add
Tendon Name>TS1
Group>Tendon7
Tendon Property> TS
滑鼠移到 Assigned Elements 欄位
Select Window M > Elements Tto23by2
Curve Type> Spline
Profile>Reference Axis>Straight
在 Profile 輸入以下鋼腱局部座標點資料:

	x(mm)	y(mm)	z(mm)	fix	Ry[deg]	Rz[deg]
1	0.0000	0.0000	100.00	Г	0.00	0.00
2	36300.	0.0000	100.00	Г	0.00	0.00
3						

圖 28 鋼腱 TS 的局部座標資料

٩	Add/M	lodify Ten	don Pro	file					×
	Tendor	Name :	TS1		Gro	oup : Te	ndon7	~	
	Tendor	Property	:	TS			~		
	Assigne	ed Elements		1to23by2					
	Inpu	t Type	0		Straig	ht Length	ofTend	on	
	02	D e Type	• 3-D		Begin	n: 0		mm	1
	● Sp	oline	Round	1 I I I	End :	0		mm	n l
C	Typic	cal Tendon		N	o, of '	Tendons :	1		-
	User	defined Ler	ngth	✓ Begin	: 0) En	d: 0		mm
	Profile		-		_				
	Refer	ence Axis	:	 Straig 	ght	OCurve	OE	emer	nt
		2207.69-	-		_			_	
	1	-	_	-				-	
	-	2792.31	5000	15	000	250	00	35	
									x
	Z	2207.69							
		2792.31						_	
		0	5000	15	000	250	00	35	x ⁰
		x(mm)	y(mm)	z(mm)	fix	Ry[deal	Rzíde	g]	^
	1	0.0000	0.0000	100.00	F	0.00	0.0	00	
	2	36300.	0.0000	100.00	Г	0.00	0.0	00	
	3				Г				
	x Axis x Axis	Direction		: • x 0, 0	OY deal	⊖ Vect	tor mm ection		
	Grad.	Rot. Angle	: [Y V	0		[deg]		
	250	2		OK		Cancel		Appl	y
	20	,v	_						
	啚	29 1	設定	鋼腱	TH	位置	1對	話	框
rofile Insertion Po -Axis Direction> X 0K	int>	-150	, 0, -	1312	! m	ım			
endon Profile 對	話杠	≦>選′	TS1						
lode > Copv									
augl Distance > d	v ~	- h	· ^	2750				1)K
دريانة بريانة بريانة (۲. ۲. ۲. ۲. ۲. ۲. ۲. ۲. ۲. ۲. ۲. ۲. ۲. ۲	х, О	iy, uz	. U ,	2150	, U			~	
Modify									
endon Name>修改	欠為	TS2							

Group> 修改為 Tendon8 Assigned Elements> 25to69by4

Profile Insertion Point>修改為 -150, 2750, -1358 mm

OK

Tendon Profile 對話框>選 TS2
Copy / Move
Mode > Copy
Equal Distance > dx, dy, dz : 0 ,2750, 0 mmOK
選 TS2-Copy
Modify
Tendon Name> 修改為 TS3
Group> 修改為 Tendon9
Assigned Elements> 26to70by4
以同樣的方法,建立鋼腱 TS4 與 TS5,個別將其設定為鋼腱群組 Tendon10
與 Tendon11
Tendon Profile 對話框>選 TS5 Copy / Move
Equal Distance > dx, dy, dz : $0,2750, 0 \text{ mm}$
迭 135-COpy Modifie
Tendon Name> 修改為 TS6
Group>修改為 Tendon12
Assigned Elements> 2024092 Profile Insertion Point>修改為 -150, 13750, -1312
在 Model View 中香看鋼腱位置是否正確
□ Iso View
到工作數 Tree Menu: Works 選單
Prestressing Tendon> Tendon Profile
Right- mouse and select Display
設定鋼腱所施拉的預力量
Load > Temp./Prestress > restress Loads> 😁 Tendon Prestress Loads 斗
Load Case Name>Prestress
Load Group Name>Prestress
Select rendon for Loading>rendon>選所有鋼腱 (1H1~1H6, 1S1~1S6) Selected

Stress Value>**Stress** 1st Jacking>**Begin** Begin>**133** kgf/mm² End>**0**

1133	
<u>C</u> lose	

Node Element Boundary Mass Load
Tendon Prestress Loads
- Load Care Name
Prestress
Load Group Name
Prestress
Select Tendon for Loading
Tendon Selected
Name Name
TH1 TH2
TH3
- Stress Value
Stress C Force
1st Jacking : Begin 💌
Begin : 133 kqf/mm^2
End : 0 kqf/mm^2
Grouting : after 0 🛨 Stage
Tendon Type Load C 🔺
TS6 Stress Prestress
TS4 Stress Prestress
TS3 Stress Prestress
Add Modify Delete
Close
圖 30 設定鋼腱預力對話相

車輛載重

Tree Menu > Group 表單 > **錚 Structure Group** 右鍵選單點 **New...** Name>**Cross Beam** Add

Define Structure (Group	
Name :	Cross Beam	
Suffix :		
	(Example 1 3 5 6 7 to	20 by 2)
↓A ↓A ↑	4	Add
Cross Beam		Modify
		Delete
		Delete In
		Close

圖 31 設定結構群組對話框

Select Intersect → > Elements 73to137 選取所有 Cross Beam 從 Tree Menu 拖拉 "Cross Beam" 至 Model View 中完成群組指派。



圖 32 設定結構群組"Cross Beam"

Note:

為增加車輛載重分析的正確性,橫梁的數量也需要隨之增加,可於橫向虛設許多根等間距且單位重為0的橫梁"Cross Beams",這些橫梁的深度與寬度相當於橋面版厚與橫梁間的中心距。

Tools > Unit System

Length>m; Force (Mass)>tonf ↓

開啟顯示 N Node Number

關閉顯示 🚢 Element Number

Load > Moving Load > ♣ Moving Load Code ↓ Select Moving Load Code 對話框>Moving Load Code>Taiwan



圖 33 車道線與車道梁偏心距示意圖

Load > Moving Load > ■ Traffic Line Lanes J Traffic Line Lanes 對話框> Add Lane Name>Lane 1 Eccentricity>-1.375 m Vehicular Load Distribution>Cross Beam Cross Beam Group>Cross Beam Moving Direction>Both Selection by>2 points 點擊第一個輸入座標點的欄位 Model View > 模型視窗中點擊 Nodes 1 與 29 Lane 資料自動寫入下方表格中

	Define Design Traffic Line Lane
	Lane Name : Lane1
	Traffic Lane Properties
	Start End a : Eccentricity
	Eccentricity : -1.375 m
	Wheel Spacing: 0.0 m
	Impact Factor : 0.0
	- Vebicular Load Distribution
	C Lane Element C Cross Beam
	Cross Beam Group
	Cross Beam1
	Skew
	Start 0 🛨 End 0 🛨 [deq]
	Moving Direction
	C Forward C Backward 📀 Both
	Selection by
	36, 0, 0 m
	Operations Add Insert Delete
	No Elem Eccen. (m) Impact Factor Span 1 1 -1.375 0 □ 2 3 -1.375 0 □ 3 5 -1.375 0 □ 4 7 -1.325 0 □
	圖 34 定義車道線
Traffic Line Lanes 對	話框> <u>A</u> dd
Lane Name>Lane 2	
Eccentricity>-5.025 m	
Vehicular Load Distribu	ution> Cross Beam
Cross Beam Group>CI	ross Beam
Moving Direction>Both	1
Selection by>2 points	
點擊第一個輸入座標點	的欄位

Lane 資料自動寫入下方表格中

Model View > 模型視窗中點擊 Nodes 1 與 29

OK

 Traffic Line Lanes 對話框>
 Add

 Lane Name>Lane 3
 Eccentricity>-8.675 m

 Vehicular Load Distribution>Cross Beam

 Cross Beam Group>Cross Beam

 Moving Direction>Both

 Selection by>2 points

 點擊第一個輸入座標點的欄位

 Model View > 模型視窗中點擊 Nodes 1 與 29

 Lane 資料自動寫入下方表格中

 OK

 Traffic Line Lanes 對話框>

 Add

 Lane Name>Lane 4

 Eccentricity>-12.325 m

 Vehicular Load Distribution>Cross Beam

Cross Beam Group>**Cross Beam** Moving Direction>**Both** Selection by>**2 points** 點擊第一個輸入座標點的欄位 **Model View** > 模型視窗中點擊 Nodes 1 與 29

Lane 資料自動寫入下方表格中



GWYGIT					
/ehicular Load Proj	perties				
Vehicular Load Na	me:	H520-	44(MS18	3)	
Vebicular Load Tv	ne :	HS20-	44(MS18	3)	
		,	,		
	D.	P2		P3	
	11				
	•	↓ 		- ↓	
	↓ D1	↓ × < Da	2∽D3	→	
	↓ ←D1	↓ > < D2	2∽D3	→	
No Load/ton	D1	→l≺ D2	2∽D3	→ →	tonf/m
No Load(toni 1 3.6709	↓ D1 () Spacin 8	→ < D2 ng(m) 4.25	2∽D3		tonf/m
No Load(ton) 1 3.6709 2 14.683	↓ D1 () Spacin 8 9	→ < D2 ng(m) 4.25 4.25 0.15	≥∽D3 W Ps		tonf/m
No Load(ton) 1 3.6709 2 14.683 3 14.683	↓ D1 () Spacii 8 9 9	→ I < D2 ng(m) 4.25 4.25 9.15	2∽D3 W Ps Pm		tonf/m tonf tonf
No Load(ton) 1 3.6709 2 14.683 3 14.683	↓ D1 () Spacia 8 9 9 9	↓ → < D2 D2 02 02 02 02 02 02 02 02 02 0	W Ps Pm dW1		tonf/m tonf tonf tonf tonf/m
No Load(ton) 1 3.6709 2 14.683 3 14.683	↓ D1 () Spacia 8 9 9 9	→ ← D2 D2 4.25 4.25 9.15	2 ~ D3 W Ps Pm dW1 dD1		tonf/m tonf tonf tonf m
No Load(ton) 1 3.6709 2 14.683 3 14.683	↓ D1 () Spacia 8 9 9	↓ → ← D2 D2 4.25 4.25 9.15	W Ps Pm dW1 dW2	→ 0 0 0 0	tonf/m tonf tonf tonf/m tonf/m
No Load(ton) 1 3.6709 2 14.683 3 14.683	↓ D1 () Spacia 8 9 9	→ I ← D2 ng(m) 4.25 4.25 9.15	2 ~ D3 W Ps Pm dW1 dD1 dW2 dD2	→ 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0	tonf/m tonf tonf tonf tonf/m m tonf/m

圖 35 設定標準車載重

Vehicles 對話框>	<u>A</u> dd Standard	
Standard Name> 1	Taiwan	
Vehicular Load Na	me> HS-20-44 (N	IS18)
Vehicular Load Ty	pe> HS-20-44 (M	S18)
OK		
<u>C</u> lose		

Load > Moving Load > **b** Moving Load Cases Moving Load Cases 對話框> <u>Add</u> Load Case Name>MLC

Multiple Presence Factor	
Num of Loaded Lanes	Scale Factor
1	1.2
2	1
3	0.85
> 3	0.85

圖 36 輸入多車道折減係數

Sub-Load Cases>Loading Effect>Independent

Add Sub-Load Case 對話框>Vehicle Class>VL: HS-20-44 (MS18) Scale Factor>1 Min. Number of Loaded Lanes>1 Max. Number of Loaded Lanes>4 Assignment Lanes>List of Lanes> Lane 1, Lane 2, Lane 3, Lane 4 選所有車道 OK

Define Moving Load Case	×	1
Load Case Name :	ILC	
Description :		
🔲 Load Case for Permit Ve	ehicle	
Multiple Presence Factor		
Num of Loaded Lanes	Scale Factor	
1	1.2	
2	1	Sub - Load Case
3	0.85	- Load Case Data
> 3	0.85	Vehicle Class : VI:HS-20-44(MS18)
		Scale Sector 1
-Sub-Load Cases		Min. Number of Loaded Lanes :
Loading Effect		Max. Number of Loaded Lanes 4
C Combined	Independent	- Assignment Lanes
Vakiela elasa 🛛 🖉	anda Lanast	List of Lanes Selected Lanes
VL:HS-20-44(MS18) 1	Lane1	Lane1
VL:HS20-44(MS18) 1	Lane1	Lane2
		L-> Lane4
		<
Add Modify	y Delete	
	el <u>A</u> pply	<u>QK</u> <u>Cancel</u>
	圖 37	定義車輛載重狀況

施工階段資料

此範例以3個施工階段模擬橋梁的構築順序,下表為施工階段的細節:

	~~ ~ ~ ~	他工作权
階段	天	說明
Stage 1 (30 天)	1	放置預鑄梁與橫梁並施拉預力
	21	澆鑄橋面版
Stage 2 (30 天)	1	版+梁的合成斷面效應
	1	安裝護欄
	6	鋪設磨耗層
Stage 3 (10000 天)	-	-

表2 施工階段

Note:

在 Stage 1 的第一天時,設置預鑄構件的初始材龄 (主梁 precast beams & 横梁 cross beams) 為7天。

群組

Tree Menu > Group 表單 > **झ Structure Group** 右鍵選單點 **New...**

Na	me	e>/	4 11
	A	dd	
	<u>C</u> I	ose	
-			

Select All

從 Tree Menu 拖拉 "All" 群組至 Model View 中進行指派。

Tree Menu > Group 表單 > ๋ Boundary Group
右鍵選單點 New
Name> Supports
Add
<u>C</u> lose
Select All
從 Tree Menu 拖拉 "Supports" 至 Model View 中
勾選 Boundary Type 對話框> Support
OK



設定施工階段

Load>Construction Stage > Hi Define Construction Stage

Construction Stage 對話框> Stage>Name>Stage Stage>Suffix>1to3 Save Result>Stage, Addition	Generat	s (on)				
Stage Name Stage Suffix Ito3 Duration 0	1					
Additional Steps	Construct	ion Stage				×
(Example: 1, 3, 7, 14) <u>Modify</u> <u>Clear</u>	Name	Duration	Date	Step	Result	Add
Step Day	Stage1	0	0	0	Stage,	Insert Prev
Auto deneration	Stage3	ō	ō	ō	Stage,	Insert Next
Step Number : 10						Generate
						Modify/Show
Save Result Save Result Stage Additional Steps						Delete
OK Cancel Apply						

圖 39 設定施工階段

Construction Stage 對話框> 選 Stage 1 按 Stage>Stage 1 Name>Stage 1 Duration>30 day(s) Additional Steps>Day>21 按 Additional Steps Add 加八 Element 表單 Group List>All Activation>Age>7 day(s) 按 Activation 功能區內 Add 加八

Boundary 表單 Group List>Supports Support/Spring Position>Deformed 按 Activation 功能區內 ______ 加入 Load 表單 Group List>PC & C/B Active Day > **First** day (s) <u>A</u>dd 加入 按 Activation 功能區內 Group List>**Prestress** Active Day > **First** day (s) <u>A</u>dd 按 Activation 功能區內 加入 Group List>**Deck** Active Day>**21** day(s) <u>A</u>dd 按 Activation 功能區內 加入 0K

結構群組、邊界群組、載重群組建立後,會一直於後續施工階段保持作用的 狀態,直到被撤除 (Deactivation)為止。

Modify/Show Construction Stage 對話框> 選 Stage 2 按 Stage>Stage 2 Name>Stage 2 Duration >30 day(s) Additional Steps>Day>6 按 Additional Steps ____Add 加入 Load 表單 Group List>Barrier Active Day > **First** day (s) <u>A</u>dd 按 Activation 功能區內 加入 Group List> Wearing Surface Active Day>6 day(s) 按 Activation 功能區內 <u>A</u>dd 加入 0K Modify/Show Construction Stage 對話框>選 Stage 3 按 Stage>Stage 3 Name>Stage 3 Duration>10000 day(s) 0K <u>C</u>lose

loge			Additional Steps	
Stage :	Stage1	× •	Day : 21	Add Delete
Name :	Stage 1		(Example: 1, 3, 7, 14)	Modify Clear
Duration :	30	day(s)		Step Day
			Auto Generation	1 21
ave Result	D. D		Step Number : 0	1
	⊠ Stage ⊠	Additional Steps		
	Current Stage	Information	Generate Steps	
,				
ement Bour	ndary Load			
Group List		Activation	Deactivation	
Barrier Wearing St	rtico			
wearing ac	a race	Active Day : 21	day(s) Inactive Day :	First \vee day(s)
		Group List	Group List	
		Name Da	y Name	Day
		PC & C/B First	st	
		Prestress First	st	
		Deck 21		
		Add Modify	Delete Add I	Modify Delete
		Add Modify	Delete Add I	Modify Delete

圖 40 定義施工階段 1

tage			Addition	al Steps		
Stage :	Stage2	~	Day:	6	Add	Delete
Name :	Stage2		(Exam	ple: 1, 3, 7, 14)	Modify	Clear
Duration :	30		day(s)	Generation	Step	Day
ave Result					1	D
	Stage	Additional Steps	Step N	lumber : 0 🖶		
				Generate Steps		
	Current	Stage Information				
lement Bour	ndary Load					
Group List		Activation		Deactivation		
PC & C/B Deck Prestress		Active Day Group List	: 6 ~ day(s) Inactive Day : Group List	First ∨	day(s)
		Name Barrier Wearing	Day First Surf 6	Name	Day	
		Add	Modify Delete	Add M	lodify De	elete

圖 41 定義施工階段 2

Load > Construction Stage > \square Composite Section for CS \downarrow

Composite Section for Construction Stage 對話框> Add Active Stage>Stage 1 Section>1: Interior Precast Beams Composite Type>Normal

Construction Sequence>Part>1: Material Type>**Material** Material>**2:Precast** Composite Stage>**Active Stage** Age>**7**

Construction Sequence>Part>2: Material Type>**Material** Material>1:Deck Composite Stage>**Stage 2** Age>**10**

Acuve	Stage	Stage 1		~					
Sec	tion	1	1: In	terior Precas $ \smallsetminus $			2]
Compos	ite Type	Normal		~					
Section	туре	Comp	posite						
Section	Shape	CPCI	t				1		
							\supset \bigcirc		
Elemer Construct	nt List tion Sequence	25to72							
Elemer Construct	ion Sequence Material Type	25to72	erial	Composite Stage	Age	h	v/s	Stiff.	Stiff. Scale
Elemer Construct Part	ion Sequence Material Type Material	25to72 Mat	erial	Composite Stage Active Stag	Age 7	h 0.1568	v/s 0	Stiff.	Stiff. Scale

圖 42 設定內側預鑄梁與橋面版於施工階段的合成階段

Composite Section for Construction Stage 對話框> Add Active Stage>Stage 1 Section>2: Exterior Precast Beams Composite Type>Normal

Construction Sequence>Part>1: Material Type>**Material** Material>**2:Precast Beams** Composite Stage>**Active Stage** Age>**7**

Construction Sequence>Part>2: Material Type>**Material** Material>1:Deck Composite Stage>**Stage 2** Age>**10**

OK <u>C</u>lose

Acuve	Stage	Stage1	~					
Sec	tion	2 2	Exterior Precas 🗸			2		
Compos	te Type	Normal	~					
Section	Туре	Compos	te		<u> </u>			
Castier	Shane	CPCT				1		
Secuor	i on upe							
Elemer	it List	lito24			C			
Elemer onstruct	it List ion Sequence Material Type	lito24	al Composite Stage	Age	h	v/s	Stiff.	Stiff. Scale
Elemer onstruct Part	it List ion Sequence Material Material	lito24	al Composite Stage Active Stag	Age 7	h 0.1568	v/s	Stiff.	Stiff. Scale

圖 43 設定外側預鑄梁與橋面版於施工階段的合成階段

預設已勾選

加

設定施工階段分析控制項:

Analysis > Construction Stage Analysis Control

Final Stage>Last Stage

0K

Analysis Option>Include Time Dependent Effect (on)

Time Dependent Effect Control

Time Dependent Effect>Creep & Shrinkage (on) Type>Creep & Shrinkage Auto Time Step Generation for Large Time Gap (on) Tendon Tension Loss Effect (Creep & Shrinkage) (on) Variation of Comp. Strength (on) Tendon Tension Loss (Elastic Shortening) (on)

Load Cases to be Distinguished from Dead Load for CS Output: Load Case>Wearing Surface Add Load Case>Barrier Add

Beam Section Property Changes>Change with Tendon

Frame Output>Calculate Output of Each part of Composite Section (on)

Save Output of Current Stage (Beam/Truss) (on)

nal Stage		Cable-Preter	nsion Force Control			
Last Stage Other Stage	Stage1	 Internal 	Force O Exte	rnal Force	() Add	Replace
Restart Construction Stage Analysis	Select Stages for Restart	Initial Force	Control t Final Stage Membe	er Forces to Initia	I Forces for Post	tC.S.
Tadysis Option	plinear Applyric Control			- beam		
Independent Stage	Accumulative Stage	Change C	Cable Element to Eq itial Member Force to	uivalent Truss El o C.S.	ement for PostC	S
Include Equilibrium Element Nodal Force	es	Initial Displace	cement for C.S.			
Include P-Delta Effect Only	P-Delta Analysis Control	Initial Tar	ngent Displacement	for Erected Stru	ctures	
🛛 Indude Time Dependent Effect	Time Dependent Effect Control			Group	Cross Beam	
ad Cases to be Distinguished from Dead Loa	d for C.S. Output	Lack-o	f-Fit Force Control		Cross Beam	~
No Load Case Name Type 1 Erection Load 1 DW V	Case 1 Cas Add Nearing surf Barr	Consider	mber Displacement Stress Decrease at Interpolation	to C.S. (if Define Lead Length Zor Constant : S	ed) ne by Post-tensi Stress *	on
¢	>	Beam Section	n Property Changes ant	s	n Tendon	
		Frame Outpu	ut e Concurrent Forces e Output of Each Pa -Constrained Forces	s of Frame art of Composite : s & Stresses	Section	
		Save Output	ut of Current Stage	(Beam/Truss)		
	ļĻ	Remove	Construction Stage	Analysis Control	Data	
				-	011	
		_		L	UK	Cance
Pependent Effect Creep & Shrinkage Type ○ Creep ○ Shrinkage Creep Convergence for Creep Iteration Number of Iterations: 5 ○ Only User's Creep Coefficient □ Internal Time Step for Creep : ☑ Auto Time Step Generation for Large T : Time Gap T > 10 T > 1000 T > 10000	 Creep & Shrinkage Tolerance : 0.01 2 0 T > 100 5 0 7 0 7 0 7 0 10 0 	Define Load (Load Assig Loac Li Ded PC 8 Pres	e Erection Load Case Name Type for C.S. gnment Load Cases d Case ist of Load Case k & C/B stress	Erection Load 1 Dead Load of V	L Vearing Surfaces Selected Load (/earing surface arrier	X and Utiliti V Case
Tendon Tension Loss Effect (Creep & : Consider Re-Bar Confinement Effect Variation of Comp. Strength	Shrinkage) odulus to Post C.S				OK	Cancel
Apply Time Dependent Effect Elastic Ma	tening)					

圖 44 施工階段分析控制資料

執行分析

Analysis > 🖾 Perform Analysis

查看結果

載重組合

切換到 Post Construction Stage PostCS I

Results > 懂 Combinations 🗸

Load Combinations 對話框>General 表單> ____Auto Generation...

Option>Add Add Envelope (on) Code Selection>Concrete Design Code>AASHTO-LRFD02 Manipulation of Construction Stage Load Case>CS Only

Load Modifier>1

Load Factors for Permanent Loads (Yp): Component and Attachments>Load Factor>**Both** Wearing Surfaces and Utilities>Load Factor>**Both**

Condition for Temperature, Creep, Shrinkage Factor>Deformation Check

OK

Note:

勿選"ST+CS" (Static Load + Construction Stage)選項,避免輸出混淆的結果。 "Bridge Deck"與"PC & C/B"已經定義為"Dead Load of Components and Attachments (DC)"與"Construction Stage (CS) Loads",同樣的,"Wearing Surface"與"Barrier"已經定義為"Dead Load of Wearing Surface and Utilities (DW)"與"Erection Loads (EL)"(參考 Static Load Cases 與圖 44),若選擇選 "ST+CS",則這些靜載重會重覆出現於輸出結果。

Option Add O Rep	place		Add En	velope	
Code Selection					
⊖ Steel	ete (○ Ste	el Compos	ite
Design Code :	A	ASHTO	-LRFD02	~	
Manipulation of Const	ruction	Stage	Load Case		
O ST Only (O CS (Only	0	ST+CS	
ST : Static Load Case	C	S : Co	nstruction	Stage	
Will Execute Constru	ction S	tage A	nalvsis		
Consider Losses fo	or Pres	tress L	oad Cases		
Transfer Stage :	1				
Service Load Stage :	1			Define Fa	actor
			-		
Load Modifier :			1		
Load Factors for Perm	anent	Loads	(Yp)		
Type of Loa	ad		Lo	ad Factor	
			Max	Min	Bot
Component and Attack	nments		01.25	0.90	۲
Downdrag			1.80	0.45	0
Wearing Surfaces and	Utilitie	S	0 1.50	0.65	۲
Horizontal Earth Press	ure				
Active			0 1.50	0.90	
O At-Rest			1.35	0.90	
Vertical Earth Pressure					
Overall Stability					
Retaining Walls, Ab	utmen	ts	1.30	0.90	
Rigid Buried Structu	ire		1.35	0.90	
Rigid Frames			1.95	0.90	
Metal Box Culverts	ctures	(Non	1.50	0.90	
Flexible Metal Box (Culvert	s	1.50	0.90	
Earth Surcharge			1.50	0.75	0
			4		
load Factor for Settlen	nent:		1		
Structural Plate Box	Struct	ures(M	etal Box C Shrinkace	ulverts) Factor	
Deformation Cher	k	accp,		Effects	
Terroringuon Chec	A	(All Oule	a chects	

圖 45 依規範進行載重組合設定

		Name		Type	Description ^		LoadCase	Factor	
	1	al CB1	Activ	bhA	Strength-I:1 75M[1]+1 25(cD)+1	T	MLC(MV)	1 7500	- 1
<u> </u>	2	gLOB1	Activ	Add	Strength-I:1 75M[1]+1 25(cD)+0	H	Dead Load	1 2500	
	3	dLCB3	Activ	Add	Strength-I:175M[1]+0.90(cD)+1		Erection I	1 5000	
	4	al CB4	Activ	Add	Strength-I:1 75M[1]+0 90(cD)+0		Tendon Se	1 0000	
-	5	dl CB5	Activ	Add	Strength-II:1 35M[1]+1 25(cD)+		Creen Sec	1 2000	
	6	d CB6	Activ	Add	Strength-II:1 35M[1]+1 25(cD)+		Shrinkage	1 2000	
	7	aLCB7	Activ	Add	Strength-II:1.35M[1]+0.90(cD)+	*	Chining		
	8	al CB8	Activ	Add	Strength-II:1.35M[1]+0.90(cD)+				
	9	aLCB9	Activ	Add	Strength-IV:1.50(cD)+1.50(cEL				
	10	aLCB10	Activ	Add	Strength-IV:1.50(cD)+0.65(cEL				
	11	aLCB11	Activ	Add	Strength-IV:0.90(cD)+1.50(cEL				
	12	aLCB12	Activ	Add	Strength-IV:0.90(cD)+0.65(cEL				
	13	aLCB13	Activ	Add	Service-I:1.00M[1]+1.00(cD)+1.				
	14	gLCB14	Activ	Add	Service-II:1.30M[1]+1.00(cD)+1.				
	15	gLCB15	Activ	Add	Service-III:0.80M[1]+1.00(cD)+1				
	16	gLCB16	Activ	Add	Service-IV:1.00(cD)+1.00(cEL1)				
	17	gLCB17	Activ	Add	Fatigue:0.75M[1]				
	18	RC ENV	Activ	Envelope	Concrete Strength Envelope				
	19	RC ENV	Activ	Envelope	Concrete Serviceability Envelop				
*									
					~				
4					>				



	Name	Active	Type	Description ^		LoadCase	Factor	
1	aLCB1	Activ	Add	Strength-I:1.75M[1]+1.25(cD)+1	•	gLCB1(CB)	1.0000	
2	aLCB2	Activ	Add	Strength-I:1.75M[1]+1.25(cD)+0		gLCB2(CB)	1.0000	
3	gLCB3	Activ	Add	Strength-I:1.75M[1]+0.90(cD)+1		gLCB3(CB)	1.0000	
4	gLCB4	Activ	Add	Strength-I:1.75M[1]+0.90(cD)+0		gLCB4(CB)	1.0000	
5	gLCB5	Activ	Add	Strength-II:1.35M[1]+1.25(cD)+		gLCB5(CB)	1.0000	
6	gLCB6	Activ	Add	Strength-II:1.35M[1]+1.25(cD)+		gLCB6(CB)	1.0000	
7	gLCB7	Activ	Add	Strength-II:1.35M[1]+0.90(cD)+		gLCB7(CB)	1.0000	
8	gLCB8	Activ	Add	Strength-II:1.35M[1]+0.90(cD)+		gLCB8(CB)	1.0000	
9	gLCB9	Activ	Add	Strength-IV:1.50(cD)+1.50(cEL		gLCB9(CB)	1.0000	
10	gLCB10	Activ	Add	Strength-IV:1.50(cD)+0.65(cEL		gLCB10(C	1.0000	
11	gLCB11	Activ	Add	Strength-IV:0.90(cD)+1.50(cEL		gLCB11(C	1.0000	
12	gLCB12	Activ	Add	Strength-IV:0.90(cD)+0.65(cEL		gLCB12(C	1.0000	
13	gLCB13	Activ	Add	Service-I:1.00M[1]+1.00(cD)+1.	*			
14	gLCB14	Activ	Add	Service-II:1.30M[1]+1.00(cD)+1.				
15	gLCB15	Activ	Add	Service-III:0.80M[1]+1.00(cD)+1				
16	gLCB16	Activ	Add	Service-IV:1.00(cD)+1.00(cEL1)				
17	gLCB17	Activ	Add	Fatigue:0.75M[1]				
18	RC ENV	Activ	Envelope	Concrete Strength Envelope				
19	RC ENV	Activ	Envelope	Concrete Serviceability Envelop				
F]			~				
				,	1			

圖 47 定義包絡載重組合

Spread Sheet Form

依表 3 改變 gLCB13、gLCB14、gLCB15 與 gLCB16(Service I, II and III, respectively)載重組合係數。

使用 AASHTO-LRFD02 必須建立合乎該規範的載重組合

表3中無描述的載重係數為0,該格可留白

<u>C</u>lose

Load Comb.	MLC	Dead Load	Erection Load	Tendon Primary	Tendon Secondary	Creep Primary	Creep Secondary	Shrinkage Primary	Shrinkage Secondary
gLCB1	1.75	1.25	1.50		1.00		1.20		1.20
gLCB2	1.75	1.25	0.65		1.00		1.20		1.20
gLCB3	1.75	0.90	1.50		1.00		1.20		1.20
gLCB4	1.75	0.90	0.65		1.00		1.20		1.20
gLCB5	1.35	1.25	1.50		1.00		1.20		1.20
gLCB6	1.35	1.25	0.65		1.00		1.20		1.20
gLCB7	1.35	0.90	1.50		1.00		1.20		1.20
gLCB8	1.35	0.90	0.65		1.00		1.20		1.20
gLCB9		1.25	1.50		1.00		1.20		1.20
gLCB10		1.25	0.65		1.00		1.20		1.20
gLCB11		0.90	1.50		1.00		1.20		1.20
gLCB12		0.90	0.65		1.00		1.20		1.20
gLCB13	1.00	1.00	1.00	1.00		1.20		1.20	
gLCB14	1.30	1.00	1.00	1.00		1.20		1.20	
gLCB15	0.80	1.00	1.00	1.00		1.20		1.20	
gLCB16		1.00	1.00	1.00		1.20		1.20	
aLCB17	0.75								

表3 施工階段結果的載重組合

預力損失圖

於此範例中, TH 字首的鋼腱為曲線鋼腱, TS 字首的鋼腱為直線鋼腱, 可用 Animate 功能查看特定鋼腱於所有階段的鋼腱損失圖。

Results>Tendon Loss Graph J



鋼腱"TH1"於 Stage 1 的圖會自動顯示

Tendon>**TH2** Stage>**Stage 1** Step>**Last Step**



圖 48 鋼腱 TH2 的預力損失圖

Tendon> TS2 Stage>Stage 1 Step>Last Step Animate





<u>C</u>lose

預拉力損失表

到 Tree Menu 選 Table 表單 Result Tables > Tendon > 🖊 Tendon Loss 🗸

Tendon Group > Tendon 1 Stage > Stage 1 Apply

	Elem	Part	Stress (After Immediate Loss) : A (tonf/m^2)	Elastic Deform. Loss : B (tonf/m^2)	Stress(Elastic Loss)/ Stress(Immedia te Loss)	Creep/Shrinkage Loss (tonf/m^2)	Relaxation Loss (tonf/m^2)	Stress(After All Loss)/ Stress(After Immediate Loss)	Effective Num.
	The Loss	of tendon	group [Tendon1] at the	stage of [Stage1]					
	Tendon G	roup	Tendon1	Stage	Stage1	Apply			
•	1	1	129758.3068	-216.7358	0.9983	-3498.1611	-2104.1443	0.9552	1.0000
	1	J	128369.9815	-1268.5310	0.9901	-4892.2151	-1953.7863	0.9368	1.0000
	3	1	128369.9815	-1292.0953	0.9899	-4891.6329	-1953.0313	0.9366	1.0000
	3	J	126145.4993	-630.6784	0.9950	-5810.1484	-1817.0591	0.9345	1.0000
	5	1	126145.4993	-653.5878	0.9948	-5808.9613	-1816.2909	0.9344	1.0000
	5	J	123266.8782	1218.2124	1.0099	-6411.6257	-1685.4882	0.9442	1.0000
	7	1	123266.8782	1203.9485	1.0098	-6410.4247	-1684.9738	0.9441	1.0000
	7	J	120153.5398	3586.4016	1.0298	-6843.0707	-1561.2190	0.9599	1.0000
	9	L.	120153.5398	3581.1743	1.0298	-6842.0844	-1560.9695	0.9599	1.0000
	9	J	118324.4134	5109.9636	1.0432	-7008.0600	-1495.1732	0.9713	1.0000
	11	T.	118324.4134	5110.5161	1.0432	-7007.7547	-1495.1148	0.9713	1.0000
	11	J	118324.4134	5229.2745	1.0442	-6934.0669	-1499.9763	0.9729	1.0000
	13	1	118324.4134	5234.6826	1.0442	-6934.3414	-1500.0776	0.9730	1.0000
	13	J	118324.4134	5116.7497	1.0432	-7008.2755	-1495.2296	0.9714	1.0000
	15	1	118324.4134	5127.4347	1.0433	-7009.2121	-1495.4973	0.9715	1.0000
	15	J	120153.5398	3602.6350	1.0300	-6843.3179	-1561.3727	0.9600	1.0000
	17	1	120153.5398	3623.2398	1.0302	-6845.2787	-1561.9084	0.9602	1.0000
	17	J	123266.8782	1252.4347	1.0102	-6412.5755	-1685.9034	0.9445	1.0000
	19	1	123266.8782	1291.8773	1.0105	-6415.9145	-1686.8854	0.9447	1.0000
	19	J	126145.4993	-560.5131	0.9956	-5813.5862	-1818.0974	0.9351	1.0000
	21	1	126145.4993	-495.9637	0.9961	-5820.3572	-1819.6308	0.9355	1.0000
	21	J	128369.9815	-1128.3855	0.9912	-4903.8480	-1956.2374	0.9378	1.0000
	23	1	128369.9815	-1039.6631	0.9919	-4919.8013	-1958.1665	0.9383	1.0000
	23	J	129758.3068	57.3961	1.0004	-3531.6518	-2109.5716	0.9570	1.0000

 Tendon Loss (Stress) Tendon Loss (Force) < 圖 50 鋼腱預應力損失

Elem	Part	Force (After Immediate Loss) : A (tonf)	Elastic Deform. Loss : B (tonf)	Force(Elastic Loss)/ Force(Immediat e Loss)	Creep/Shrinkage Loss (tonf)	Relaxation Loss (tonf)	Force(After All Loss)/ Force(After Immediate Loss)	Effective Num
The Loss	of tendon	group [Tendon1] at the	stage of [Stage1]					
Tendon Gr	roup	Tendon1	Stage	Stage1	Apply			
1	L	179.3182	-0.2995	0.9983	-4.8342	-2.9078	0.9552	1.00
1	J	177.3996	-1.7530	0.9901	-6.7607	-2.7000	0.9368	1.00
3	1	177.3996	-1.7856	0.9899	-6.7599	-2.6990	0.9366	1.00
3	J	174.3255	-0.8716	0.9950	-8.0293	-2.5111	0.9345	1.00
5	1	174.3255	-0.9032	0.9948	-8.0276	-2.5100	0.9344	1.00
5	J	170.3474	1.6835	1.0099	-8.8605	-2.3292	0.9442	1.00
7	1	170.3474	1.6638	1.0098	-8.8588	-2.3285	0.9441	1.00
7	J	166.0450	4.9562	1.0298	-9.4567	-2.1575	0.9599	1.00
9	1	166.0450	4.9490	1.0298	-9.4554	-2.1572	0.9599	1.00
9	J	163.5172	7.0617	1.0432	-9.6847	-2.0662	0.9713	1.0
11	1	163.5172	7.0624	1.0432	-9.6843	-2.0662	0.9713	1.0
11	J	163.5172	7.2265	1.0442	-9.5825	-2.0729	0.9729	1.0
13	1	163.5172	7.2340	1.0442	-9.5828	-2.0730	0.9730	1.0
13	J	163.5172	7.0710	1.0432	-9.6850	-2.0663	0.9714	1.0
15	1	163.5172	7.0858	1.0433	-9.6863	-2.0667	0.9715	1.0
15	J	166.0450	4.9786	1.0300	-9.4571	-2.1577	0.9600	1.0
17	1	166.0450	5.0071	1.0302	-9.4598	-2.1585	0.9602	1.0
17	J	170.3474	1.7308	1.0102	-8.8618	-2.3298	0.9445	1.0
19	1	170.3474	1.7853	1.0105	-8.8664	-2.3312	0.9447	1.0
19	J	174.3255	-0.77*6	0.9956	-8.0340	-2.5125	0.9351	1.0
21	1	174.3255	-0.6854	0.9961	-8.0434	-2.5146	0.9355	1.0
21	J	177.3996	-1.5594	0.9912	-6.7768	-2.7034	0.9378	1.0
23	1	177.3996	-1.4368	0.9919	-6.7989	-2.7061	0.9383	1.0
23	J	179.3182	0.0793	1.0004	-4.8805	-2.9153	0.9570	1.0

鋼腱伸長量

Tools > **Unit System** Length>**cm**; Force (Mass)>**tonf** ,

到 Tree Menu 選 **Table** 表單

Result Tables > Tendon > **I Tendon Elongation**

				Tendon El	ongation	Element El	ongation	Summa	ation
	Tendon Name	Stage	Step	Begin (cm)	End (cm)	Begin (cm)	End (cm)	Begin (cm)	End (cm)
•	TH1	Stage1	001(first	12.3138	12.3138	0.2171	0.2171	12.5309	12.5309
	TH2	Stage1	001(first	12.3138	12.3138	0.2171	0.2171	12.5309	12.5309
	TH3	Stage1	001(first	12.3138	12.3138	0.2171	0.2171	12.5309	12.5309
1	TH4	Stage1	001(first	12.3138	12.3138	0.2171	0.2171	12.5309	12.5309
3	TH5	Stage1	001(first	12.3138	12.3138	0.2171	0.2171	12.5309	12.5309
3	TH6	Stage1	001(first	12.3138	12.3138	0.2171	0.2171	12.5309	12.5309
3	TS1	Stage1	001(first	12.2769	12.2769	0.5274	0.5274	12.8043	12.8043
3	TS2	Stage1	001(first	12.2769	12.2769	0.5274	0.5274	12.8043	12.8043
	TS3	Stage1	001(first	12.2769	12.2769	0.5274	0.5274	12.8043	12.8043
	TS4	Stage1	001(first	12.2769	12.2769	0.5274	0.5274	12.8043	12.8043
3	TS5	Stage1	001(first	12.2769	12.2769	0.5274	0.5274	12.8043	12.8043
	TS6	Stage1	001(first	12.2769	12.2769	0.5274	0.5274	12.8043	12.8043

圖 52 鋼腱伸長量

影響線

返回 Model View □ Initial View 圓 Iso View

Tools > **Unit System** Length>**m**; Force (Mass)> **tonf ا**

Results > Moving Load >Influence Lines > Results > Moving Load >Influence Lines > Results > Beam Forces/Moments J Line/Surface Lanes>LANE all Key Element>13 Scale Factor>1 Parts>j Components>My Type of Display>Legend (on)

梁單元 13 端點(My)彎矩影響線圖顯示如圖 53,此位置恰對應其中一內側梁的跨距中央處。



圖 53 影響線圖

車輛載重追蹤器

Results> Moving Load > Moving Tracer> **Beam Forces/Moments**

Moving Load Cases>**MVmax: MLC** Key Element>**13** Scale Factor>**1** Parts>**j** Components>**My** Type of Display>**Contour** (on) ; **Legend** (on) ; **Applied Loads** (on) Apply



造成梁單元 13 端點(My)彎矩最大值的車輛活載重位置顯示如圖 54。

圖 54 Moving Load Tracer

施工階段預力梁應力

Model View > 施工階段工具列 > Stage 1 ▼

Result>Result Tables>Composite Section for C.S.> **呈 Beam Stress** J Records Activation 對話框: Loadcase/Combination>Summation(CS) Stage/Step>Stage 1:0003(last) (on); Stage 2:0003(last) (on)

Part Number>Part j

OK

ode or Element	Loadcase/Combination	Stage/Step	Part Numbe
All None Inverse Pre	Dead Load(CS) Erection Load 1(CS) Tendon Primary(CS) Creep Primary(CS) Creep Formatry(CS)	Stage 1:001(first) Stage 1:002(user 1) Stage 2:003(last) Stage 2:001(first) Stage 2:002(user 1)	Part 1/4 Part 1/4 Part 2/4 Part 3/4 ✓Part j
Gement Type V Add TRUSS Delete PLANE STRESS	Creep secondary(CS) Shrinkage Primary(CS) Shrinkage Secondary(CS) Summation(CS)	Stage32005(ast) Stage3:001(first) Stage3:002(last) Min/Max:max Min/Max:min	
LATE Replace LANE STRAIN XISYMMETRIC V Intersec	t		

圖 55 設定輸出資料對話框

設定輸出施工階段1與施工階段2時,桿件1至72的J端軸力、彎矩與組合應力結果。

	Elem	Load	Stage	Step	Section Part	Part	Axial (tonf/m ²)	Bend(+y) (tonf/m^2)	Bend(-y) (tonf/m ²)	Bend(+z) (tonf/m^2)	Bend(-z) (tonf/m^2)	Cb(min/max) (tonf/m^2)	Cb1(-y+z) (tonf/m^2)	Cb2(+y+z) (tonf/m^2)	
		Summati	Stage1	003(last)	1	J	-1055.41	-13.15	13.15	432.38	-421.02	-1484.98	-609.88	-636.18	
	1	Summati	Stage1	003(last)	2	J	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	
	1	Summati	Stage2	003(last)	1	J	-978.55	-11.40	11.40	452.50	-440.89	-1426.85	-514.65	-537.44	
	1	Summati	Stage2	003(last)	2	J	-63.65	-0.07	0.07	6.02	-6.02	-69.74	-57.56	-57.71	
	2	Summati	Stage1	003(last)	1	J	-1055.35	12.99	-12.99	432.44	-421.07	-1484.87	-635.91	-609.93	
	2	Summati	Stage1	003(last)	2	J	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	
	2	Summati	Stage2	003(last)	1	J	-978.85	11.29	-11.29	452.61	-440.99	-1427.18	-537.54	-514.96	
	2	Summati	Stage2	003(last)	2	J	-64.05	0.38	-0.38	6.02	-6.02	-70.44	-58.41	-57.65	
	3	Summati	Stage1	003(last)	1	J	-1057.63	-17.76	17.76	244.11	-232.92	-1302.09	-795.75	-831.28	
	3	Summati	Stage1	003(last)	2	J	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	
	3	Summati	Stage2	003(last)	1	J	-957.10	-16.07	16.07	254.08	-242.73	-1210.28	-686.95	-719.10	
	3	Summati	Stage2	003(last)	2	J	-96.60	-0.09	0.09	0.66	-0.66	-97.36	-95.85	-96.04	
	4	Summati	Stage1	003(last)	1	J	-1057.57	17.59	-17.59	244.16	-232.98	-1301.99	-831.00	-795.81	Г
	4	Summati	Stage1	003(last)	2	J	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	Г
	4	Summati	Stage2	003(last)	1	J	-957.36	15.92	-15.92	254.17	-242.82	-1210.53	-719.11	-687.28	П
	4	Summati	Stage2	003(last)	2	J	-96.95	0.23	-0.23	0.66	-0.66	-97.84	-96.53	-96.06	Г
	5	Summati	Stage1	003(last)	1	J	-1059.14	-14.42	14.42	115.90	-105.85	-1174.37	-928.82	-957.67	Г
	5	Summati	Stage1	003(last)	2	J	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	Г
	5	Summati	Stage2	003(last)	1	J	-940.89	-13.54	13.54	117.18	-107.17	-1056.86	-810.17	-837.24	Г
	5	Summati	Stage2	003(last)	2	J	-121.76	0.18	-0.18	-3.33	3.33	-125.28	-125.28	-124.91	Г
	6	Summati	Stage1	003(last)	1	J	-1059.09	14.26	-14.26	115.95	-105.90	-1174.26	-957.40	-928.89	Г
	6	Summati	Stage1	003(last)	2	J	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	Г
	6	Summati	Stage2	003(last)	1	J	-941.11	13.38	-13.38	117.26	-107.25	-1057.06	-837.23	-810.48	П
	6	Summati	Stage2	003(last)	2	J	-122.07	-0.07	0.07	-3.33	3.33	-125.47	-125.34	-125.47	Г
	7	Summati	Stage1	003(last)	1	J	-1059.04	-11.42	11.42	45.01	-35.79	-1102.24	-1002.61	-1025.44	Г
	7	Summati	Stage1	003(last)	2	J	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	f
	7	Summati	Stage2	003(last)	1	J	-929.14	-10.94	10.94	38.65	-29.74	-965.99	-879.55	-901.43	٢
	7	Summati	Stage2	003(last)	2	J	-138.69	0.49	-0.49	-5.96	5.96	-145.14	-145.14	-144.17	Г
	8	Summati	Stage1	003(last)	1	J	-1058.99	11.25	-11.25	45.06	-35.83	-1102.13	-1025.19	-1002.68	Г
Þ	\Beam	Stress	1						<						>

圖 56 梁於施工階段的應力值

預力梁彎矩圖

□ Top View
 開啟顯示
 ▲ Element Number
 Select Window Solution
 > Elements 25to69by4
 ○ Activate
 ○ Front View

Model View

Results > Forces > J Beam Diagrams J Load Cases/Combinations>CS: Summation Step > Last Step Components>My Display Options>5 Points (on) ; Solid Fill (on) Type of Display>Contour (on) ; Legend (on) Apply

顯示施工階段1,所有施工階段載重作用下,內側主梁的彎矩圖。



圖 57 主梁於施工階段 1 的彎矩圖

開啟視窗下方 Status Bar 狀態列上的 🐮 Active Fix

施工階段工具列 > Post Construction Stage (PostCS).

Load Cases/Combinations> CBall: RC ENV_STR Components>My

顯示完工階段,內側主梁的彎矩包絡圖。



圖 58 主梁於完工階段的彎矩包絡圖

預力梁剪力圖

Load Cases/Combinations> CBall: RC ENV_STR Components>Fz

144.5
Close

顯示完工階段,內側主梁的剪力包絡圖。



圖 59 主梁於完工階段的剪力包絡圖

反力

Results>Result Tables > **⊊ Reaction ↓** Records Activation 對話框> Loadcase Combination>gLCB1(CB:max)

Node or E	lement			Loadcase/Combination	
All	None	Inverse	Prev	Deck(ST)	
lode	~ 1to7	78		Barrier(ST)	
Select T	/ne			PC & C/B(ST) Prestress(ST)	
Element	Туре	~	Add	MLC(MV:all) MLC(MV:max)	
TRUSS		^	Delete	MLC(MV:min) gLCB1(CB:all)	
PLANE S	TRESS			gLCB1(CB:max)	
PLATE PLANE S	TRAIN		Replace	gLCB2(CB:all) gLCB2(CB:max)	
AXISYM	METRIC	~	Intersect	gLCB2(CB:min) gLCB3(CB:all)	

圖 60 設定輸出資料對話框

Node	Load	FX (tonf)	FY (tonf)	FZ (tonf)	MX (tonf*m)	MY (tonf*m)	MZ (tonf*m)
1	gLCB1(m	-35.103931	0.569277	94.619327	0.000000	0.000000	0.0000
2	gLCB1(m	22.544699	0.000000	112.825424	0.000000	0.000000	0.0000
3	gLCB1(m	18.663174	0.000000	113.930523	0.000000	0.000000	0.0000
4	gLCB1(m	19.035862	0.000000	113.983548	0.000000	0.000000	0.0000
5	gLCB1(m	23.904161	0.000000	113.017900	0.000000	0.000000	0.0000
6	gLCB1(m	-32.837370	0.000000	93.611126	0.000000	0.000000	0.0000
29	gLCB1(m	0.000000	1.830174	94.676792	0.000000	0.000000	0.0000
30	gLCB1(m	0.000000	0.000000	93.670761	0.000000	0.000000	0.0000
75	gLCB1(m	0.000000	0.000000	112.779080	0.000000	0.000000	0.0000
76	gLCB1(m	0.000000	0.000000	113.916212	0.000000	0.000000	0.000
77	gLCB1(m	0.000000	0.000000	113.970234	0.000000	0.000000	0.0000
78	gLCB1(m	0.000000	0.000000	112.973199	0.000000	0.000000	0.0000
		SUI	MMATION OF REA	CTION FORCES PR	RINTOUT		
	Load	FX (tonf)	FY (tonf)	FZ (tonf)			
	gLCB1(m	N/A	N/A	N/A			

圖 61 完工階段,載重組合 LCB1 作用下,各支承點的最大反力