耐震標章特別監督人訓練課程

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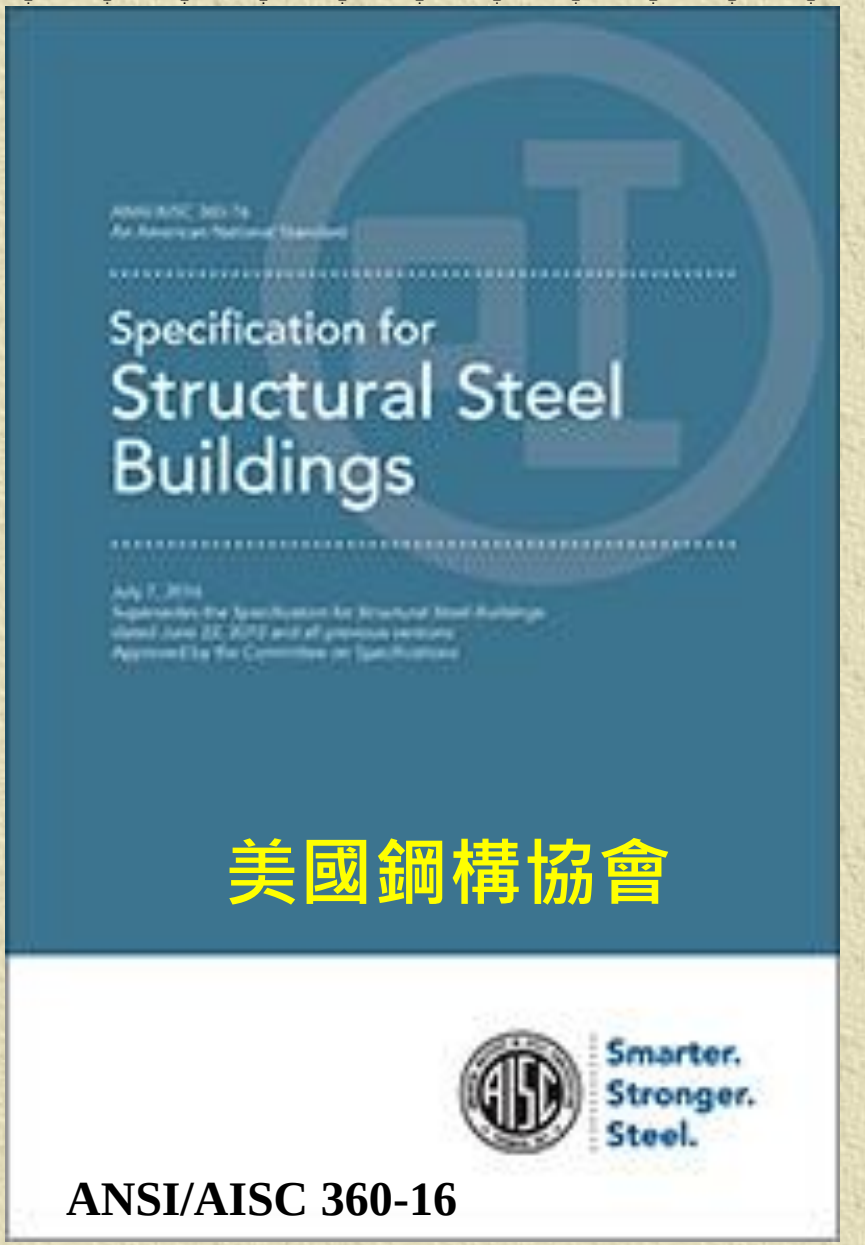
理成營造
理成建設
英業達理念
創新 品質 盡心 力行

以NDT角度看建築設計

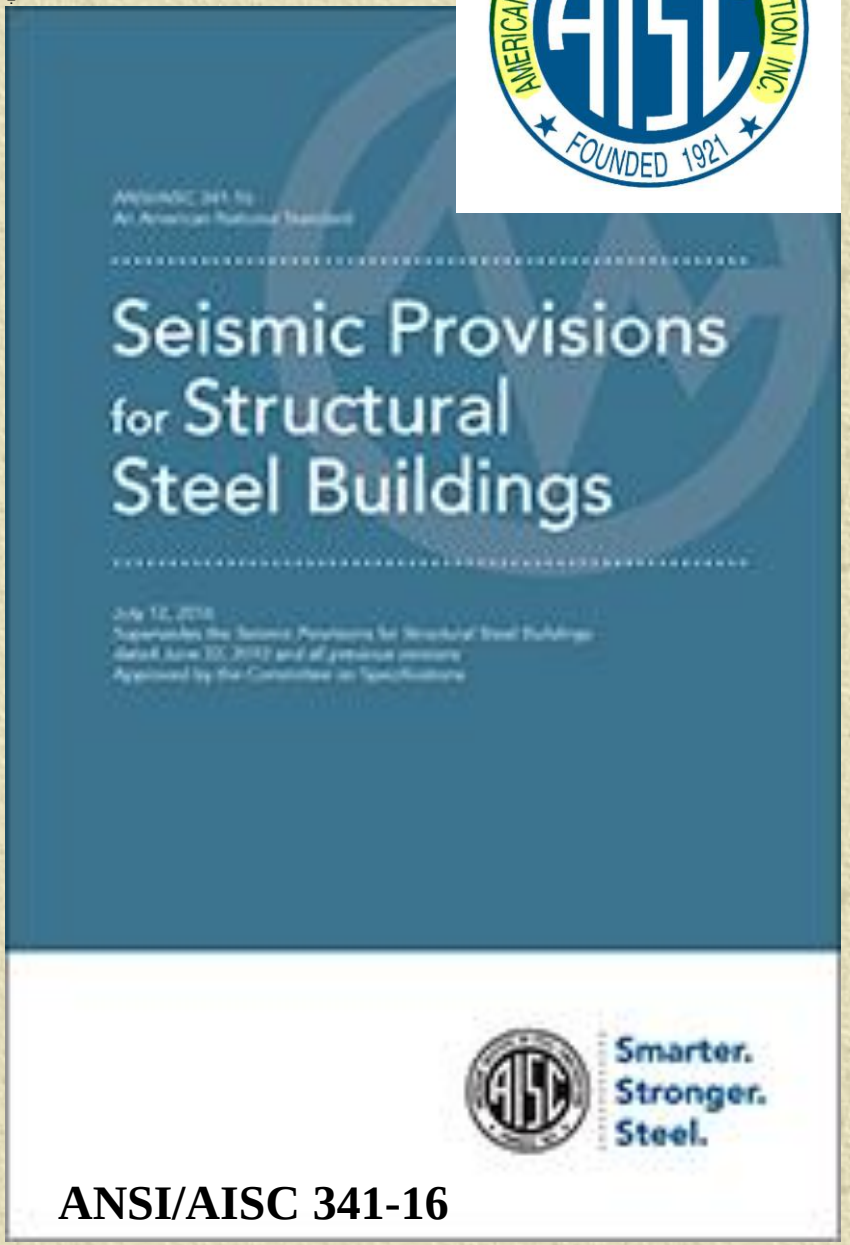
美國鋼構協會 AISC
美國銲接協會 AWS

耐震標章特別監督人訓練課程



美國鋼構協會

ANSI/AISC 360-16



ANSI/AISC 341-16

AWS D1.1/D1.1M：2020

AWS D1.8/D1.8M：2021

B

以NDT角度看建築設計

銲道組立設計探討
最少熔填量
最小入熱量

耐震標章特別

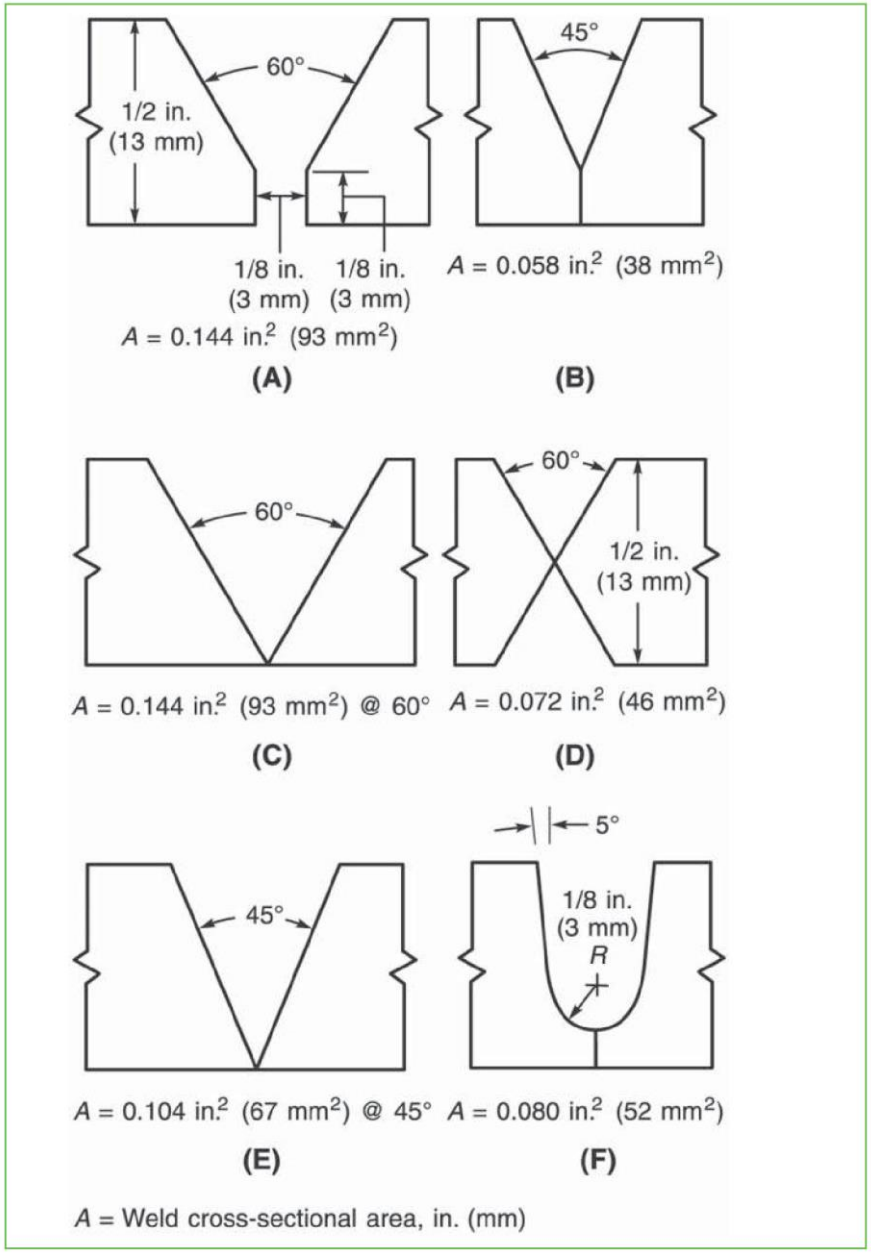


Fig. 1 — Effects of minor changes in joint design on weld cross-sectional area: A — Typical high-volume weld joint; B — reduced weld volume by eliminating the root opening; C — another high-volume weld joint; D — double-sided joint for reduced volume; E — reduced weld volume by decreasing the included angle; F — U-groove for reduced weld metal volume.

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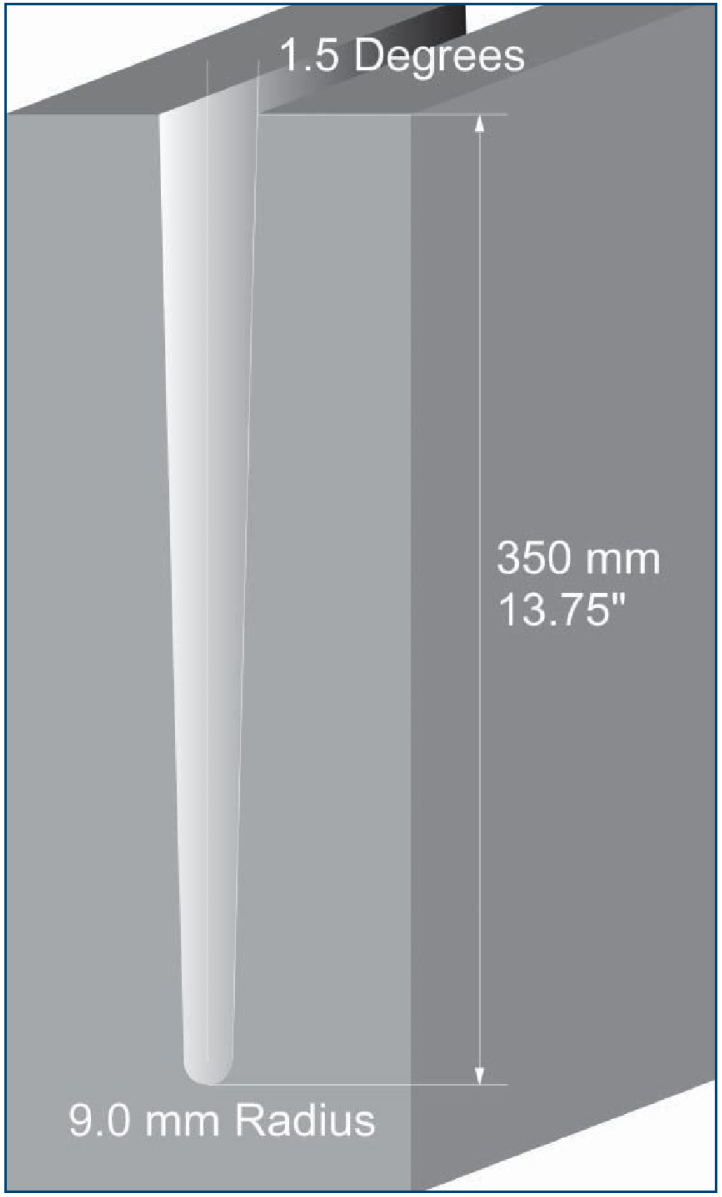

Fig. 1 — Typical narrow groove profile (top left) and cross section of a weld.

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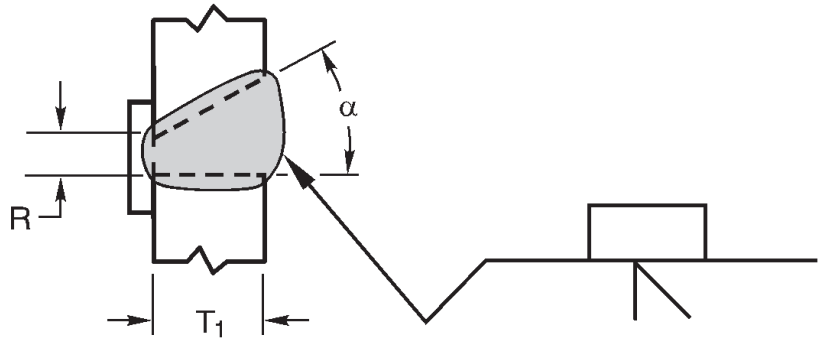
建築鋼構常用銲道組立

Single-bevel-groove weld (4)
Butt joint (B)



Tolerances	
As Detailed (see 5.4.1.1)	As Fit-Up (see 5.4.1.8)
R = +2, −0	+6, −2
α = +10°, −0°	+10°, −5°

Welding Process	Joint Designation	Base Metal Thickness (U = unlimited)		Groove Preparation		Allowed Welding Positions	Gas Shielding for FCAW	Notes
		T_1	T_2	Root Opening	Groove Angle			
SMAW	B-U4a	U	—	R = 6	α = 45°	All	—	c, e, j
				R = 10	α = 30°	All	—	c, e, j
GMAW FCAW	B-U4a-GF	U	—	R – 5	α = 30°	All	Required	a, c, j
				R = 6	α = 45°	All	Not req.	a, c, j
				R = 10	α = 30°	F, H	Not req.	a, c, j
SAW	B-U4a-S	U	—	R = 10	α = 30°	F	—	c, j
				R = 6	α = 45°			

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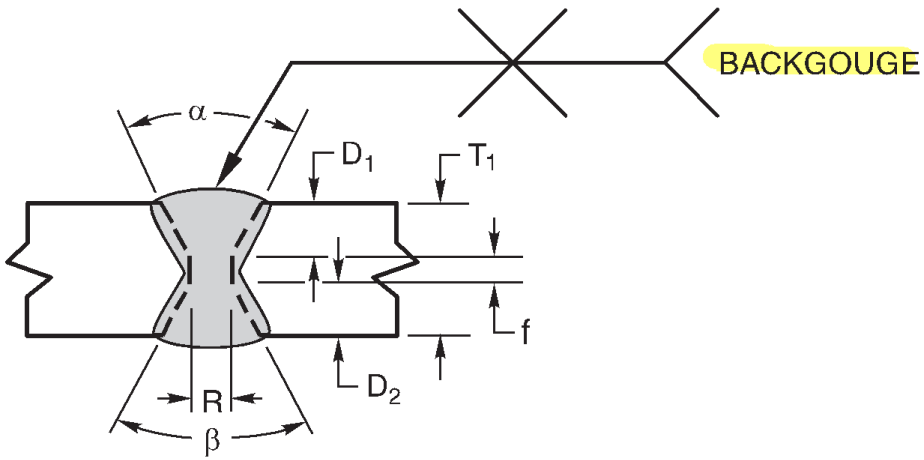
Double-V-groove weld (3)
Butt joint (B)



For B-U3c-S only		
T_1		D_1
Over	to	35
50	60	
60	80	45
80	90	55
90	100	60
100	120	70
120	140	80
140	160	95
For $T_1 > 160$ or $T_1 \leq 50$ $D_1 = 2/3(T_1 - 6)$		

壓力容器與鍋爐常用銲道組立

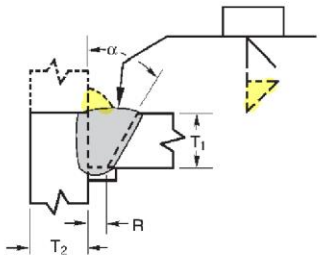
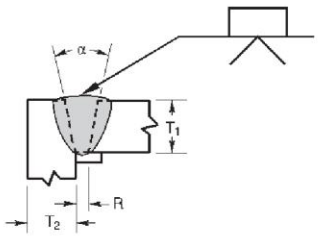
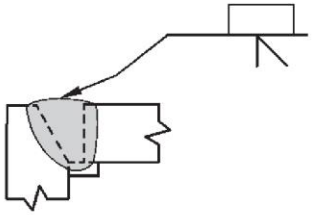
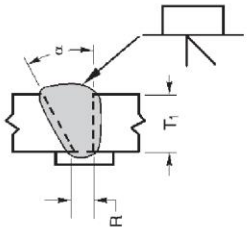
Welding Process	Joint Designation	Base Metal Thickness (U – unlimited)		Groove Preparation			Allowed Welding Positions	Gas Shielding for FCAW	Notes
				Root Opening Root Face Groove Angle	Tolerances				
		T_1	T_2		As Detailed (see 5.4.1.1)	As Fit-Up (see 5.4.1.8)			
SMAW	B-U3b	U	—	R = 0 to 3 f = 0 to 3 α = β = 60°	+2, −0 +2, −0 +10°, −0°	+2, −3 Not limited +10°, −5°	All	—	d, e, h, j
GMAW FCAW	B-U3-GF						All	Not required	a, d, h, j
SAW	B-U3c-S	U	—	R = 0 f = 6 min. α = β = 60°	+2, −0 +6, −0 +10°, −0°	+2, −0 +6, −0 +10°, −5°	F	—	d, h, j
				To find D_1 see table above: $D_2 = T_1 - (D_1 + f)$					

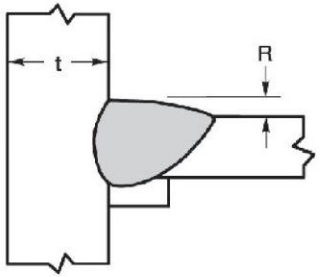
DANGER
RADIOACTIVE MATERIAL
USA/0025/IROA TYPE B

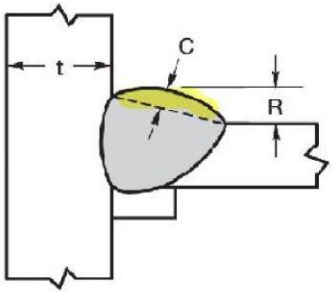
耐震標章

建築鋼構較常用開槽全滲透銲道 (Dimensions in Millimeters)

AWS D1.1/D1.1M：2020-Figure 5.1-Prequalified CJP Groove Welded Joint Details (see 5.4.1)

			
Single-bevel-groove weld (4) T-joint (T) Corner joint (C)	Single-V-groove weld (2) Corner joint (C)	Single-bevel-groove weld (4) Corner joint (C)	Double-bevel-groove weld (5) T-joint (T) Corner joint (C)
單邊斜開槽銲道 柱柱、柱樑接頭 內隔板、加勁板 SAW 銲接開槽	角接單邊雙開槽 SAW 銲接開槽	角接單邊斜開槽 SAW 銲接開槽	對接 單邊斜開槽銲道 GMAW FCAW





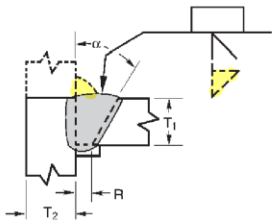
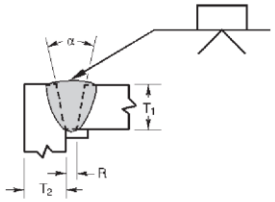
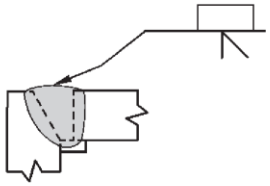
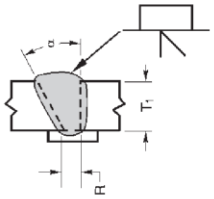
AWS D1.1/D1.1M:2020-Figure 7.4 (d) Groove Weld Profiles in T-Joints

靜態荷重結構對接(若寬度或厚度不同)、角接和 T-接開槽全滲透銲道(CJP)和部份滲透銲道(PJP)表面，可多銲腳長≦8 mm 之補強填角銲道，以使銲道表面平順與減少應力集中。且應平緩延伸至母材表面。

AWS D1.1/D1.1M:2020-4.7.5 Butt, Corner and T-Joint Surface Contouring. Fillet welds may be applied over CJP and PJP groove welds in butt joints joining parts of unequal width or thickness, corner and T-joints for the purpose of contouring weld face or to reduce stress concentrations. When such surface contouring fillet welds are used in statically loaded applications, the size need not be more then 5/16 in. [8 mm] . The fillet-like reinforcement on the surface of T and corner joint groove welds that naturally occurs shall not be cause for rejection nor need it be removed provided it does not interfere with other elements of the construction. No minimum contour radius need be provided.

AWS D1.1/D1.1M:2020-7.23.3 Groove Welds. Groove weld reinforcement shall comply with Tables 7.8 and 7.9 and with the provisions below. Welds shall have a gradual transition to the plane of the base metal surfaces.

耐震標章特別監督人訓練課程

建築鋼構較常用開槽全滲透銲道 (Dimensions in Millimeters) AWS D1.1/D1.1M：2020-Figure 5.1-Prequalified CJP Groove Welded Joint Details (see 5.4.1)			
			
Single-bevel-groove weld (4) T-joint (T) Corner joint (C)	Single-V-groove weld (2) Corner joint (C)	Single-bevel-groove weld (4) Corner joint (C)	Double-bevel-groove weld (5) T-joint (T) Corner joint (C)
單邊斜開槽銲道 柱柱、柱樑接頭 內隔板、加勁板 SAW 銲接開槽	角接單邊雙開槽 SAW 銲接開槽	角接單邊斜開槽 SAW 銲接開槽	對接 單邊斜開槽銲道 GMAW FCAW

開槽全滲透銲道，執行超音波檢測-UT

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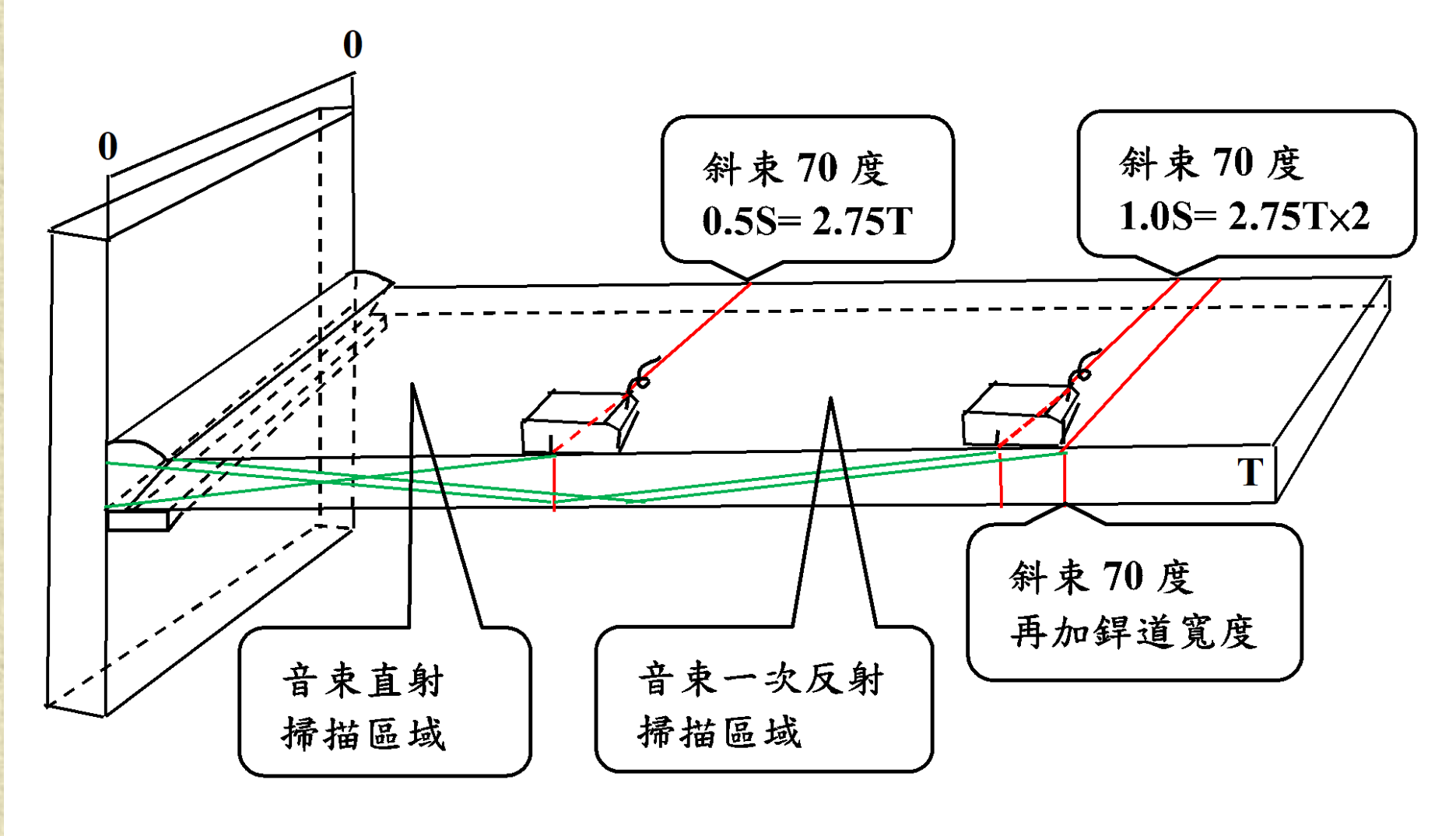

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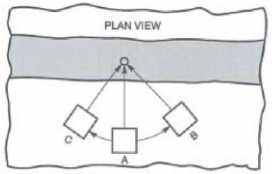
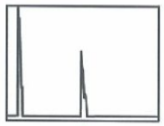
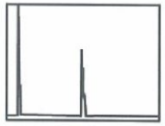
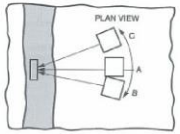
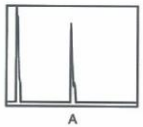
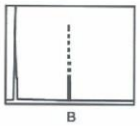
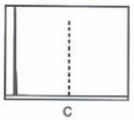
(1) 球型狀瑕疵 (獨立氣孔、分散型氣孔與非線狀夾渣)：

Spherical- Individual pores and widely spaced porosity, nonelongated slag

			
球型狀瑕疵 上視圖	A 點 瑕疵最高回波處	探頭以瑕疵為圓心 往右弧移至 B 點 B 點波高與位置 略同 A 點	探頭以瑕疵為圓心 往左弧移至 C 點 C 點波高與位置 略同 A 點

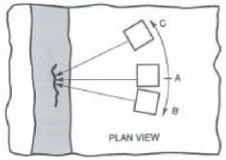
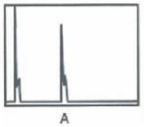
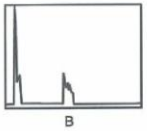
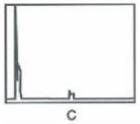
(2) 圓柱狀瑕疵 (線狀夾渣、線狀排列氣孔與長形空洞)：

Cylindrical- elongated slag, aligned pores of porosity, hollow beads

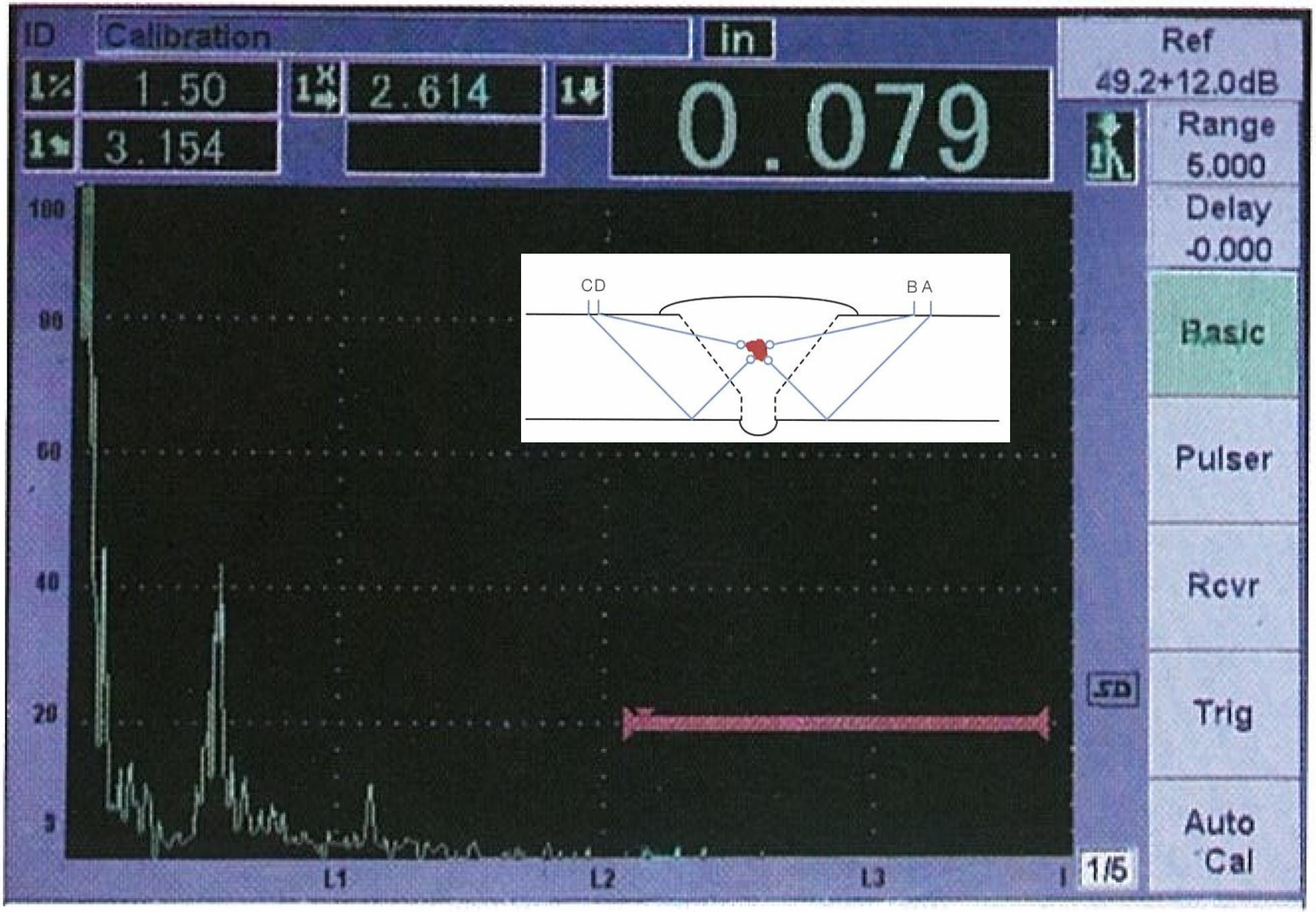
			
圓柱狀瑕疵 上視圖	A 點 瑕疵最高回波處	探頭以瑕疵為圓心 往右弧移至 B 點 B 點波高降低 位置略同 A 點	探頭以瑕疵為圓心 往左多弧移至 C 點 C 點波高較 B 點更低 位置略同 A 點

(3) 平面狀瑕疵 (熔合不良、滲透不足與裂縫)：

Planar- imcomplete fusion, inadequate joint penetration, cracks

			
平面狀瑕疵 上視圖	A 點 瑕疵最高回波處	探頭以瑕疵為圓心 往右弧移至 B 點 B 點波高降低 位置略同 A 點	探頭以瑕疵為圓心 往左多弧移至 C 點 C 點波高較 B 點更低 位置略同 A 點

中 CND 檢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Calibration
in
1.50
2.614
0.079
3.154
Ref
49.2+12.0dB
Range
5.000
Delay
0.000
Basic
Pulser
Rcvr
Trig
Auto
Cal
100
80
60
40
20
0
L1
L2
L3
1/5
CD
B A

耐震標章特別監督人訓練課程

第三者獨立公正檢測單位之UT檢測頻率-
公共工程施工規範、業主、建築師-建築設計圖面內有規定、結構技師-鋼構設計圖面內有規定

公共工程-1050429-建築工程施工綱要規範-第05122章-TPC0.2-1020813-鋼構造

(2)超音波檢測（UT，Ultrasonic test）

除契約或設計圖另有規定者外，對於開槽全滲透銲道之抽樣比例依表 2.3 之規定，惟工地銲接之開槽全滲透銲道部分應 100%檢測。

表 2.3 超音波檢測抽樣比例

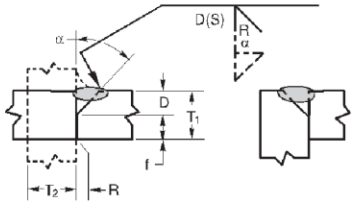
構　　件	受　力　種　類	銲接方式	抽樣比率
柱、樑 柱與樑之接頭	張　力　接　頭	橫　向	50 %
		縱　向	25 %
	壓　力　接　頭	橫　向	20 %
		縱　向	10 %
其　他	張　力　接　頭	橫　向	20 %
		縱　向	10 %
	壓　力　接　頭	橫　向	10 %
		縱　向	5 %

耐震標

建築鋼構較常用部份滲透銲道 (Dimensions in Millimeters)

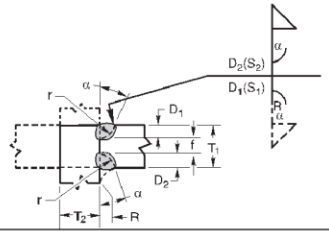
AWS D1.1/D1.1M：2020-Figure 5.2-Prequalified PJP Groove Welded Joint Details (see 5.4.2)

開槽銲道單邊無鋼背襯施銲和雙邊施銲，且都無背鏟銲補，則視為部份滲透銲道。



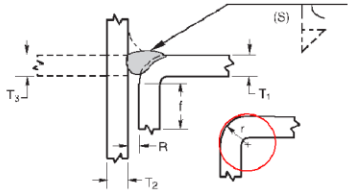
Single-bevel-groove weld (4)
Butt joint (B)
T-joint (T)
Corner joint (C)

單邊斜開槽銲道



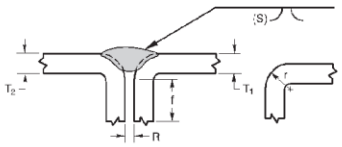
Double-J-groove weld (9)
Butt joint (B)
T-joint (T)
Corner joint (C)

鋼筋續接器銲道



Flare-bevel-groove weld (10)
Butt joint (B)
T-joint (T)
Corner joint (C)

鋼筋搭鋼板銲道



Flare-V-groove weld (11)
Butt joint (B)

R:外側板半徑

Radius of outside surface

鋼筋搭鋼筋銲道

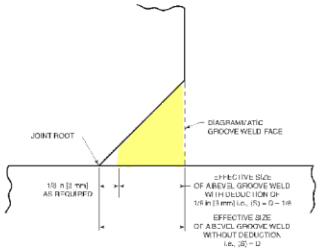


Figure 4.2—Unreinforced Bevel Groove Weld (see 4.4.2.7)

圖 4.2 Unreinforing Bevel-Groove Weld

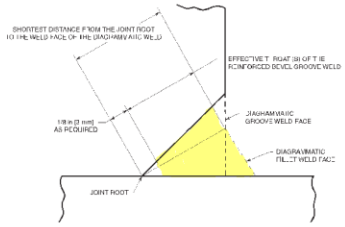


Figure 4.3—Bevel Groove Weld with Reinforcing Fillet Weld (see 4.4.2.7)

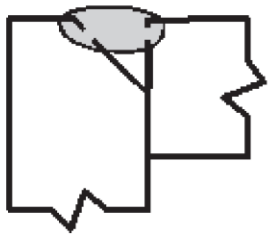
圖 4.3 Bevel-Groove with Reinforing Fillet Weld

銲接方法	有效尺寸 Flare-Bevel
SAW FCAW-S	5/16 R
GMAW FCAW-G	5/8 R
SAW	5/16 R

Table 4.1-Effective Size of Flare-Bevle-Groove

銲接方法	有效尺寸 Flare-V
SAW FCAW-S	5/8 R
GMAW FCAW-G	3/4 R
SAW	1/2 R

Table 4.1 Effective Size of Flare-V-Groove



Unreinforing Bevel-Groove Weld

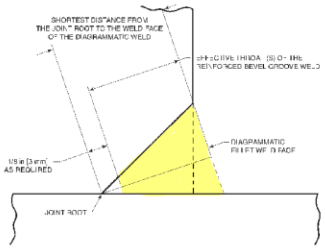


Figure 4.4—Bevel Groove Weld with Reinforcing Fillet Weld (see 4.4.2.7)

圖 4.4 Bevel-Groove with Reinforing Fillet Weld

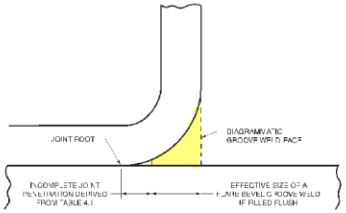


Figure 4.5—Unreinforced Flare Bevel Groove Weld (see 4.4.2.7)

圖 4.5

Flare-Bevel-Groove

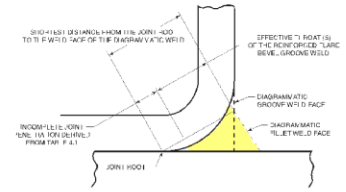


Figure 4.6—Flare Bevel Groove Weld with Reinforcing Fillet Weld (see 4.4.2.7)

圖 4.6

Flare-Bevel-Groove with Reinforcing Fillet Weld

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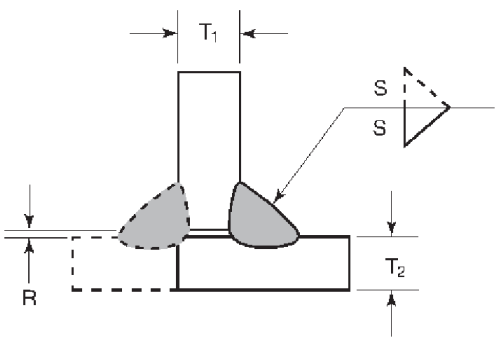
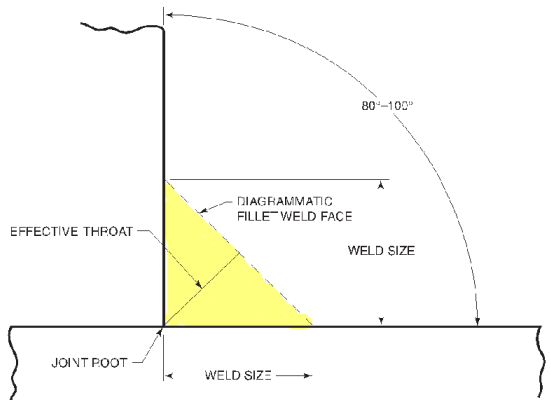
預檢定合格之 T 接填角銲道 (Dimensions in Millimeters)-圖 5.3

AWS D1.1/D1.1M：2020-Figure 5.3-Prequalified Fillet Weld Joint Details (see 5.4.3)



Fillet weld (12)
T-joint (T)
Corner joint (C)
Lap joint (L)



填角銲道尺寸 Weld Size

Figure 4.1—Fillet Weld (see 4.4.2.6)

鋼板厚度, T Base Metal Thickness	最小尺寸(腳長) S, Minimum Size of Fillet Weld
T≦6	S≧3 mm 動態荷重- S≧5
6＜T≦12	S≧5 mm
12＜T≦20	S≧6 mm
20≦T	S≧8 mm

AWS D1.1/D1.1M：2020-Table 7.7-Minimum Fillet Weld Sizes (see 7.13)
Note c: Minimum size for cyclically loaded structures shall be 3/16 in [5 mm]

(1) 填角銲道最小尺寸必須能夠傳遞負載荷重且不可小於表 7.7 內之規定，僅開槽銲道表面之填角銲道補強除外或是設計圖面另標註有填角銲道較大尺寸。

(2) 填角銲道 T 接，兩鋼板垂直度誤差≦±10°。

AWS D1.1/D1.1M：2020-4.4.2.8 Minimum Size. The minimum size fillet weld shall not be smaller than the size required to trasmit the applied load nor that provided in 7.13.

AWS D1.1/D1.1M：2020-7.13 Minimum Fillet Weld Sizes. The minimu fillet weld size, except for fillet welds use to reinforcement groove welds, shall be as shown in Table 7.7. The minimum fillet weld size shall apply in all cases, unless the design drawings specify welds of a larger size.

AWS D1.1/D1.1M：2020-Figure 5.3-Note d: Perpendicularity of the members shall be within ±10°

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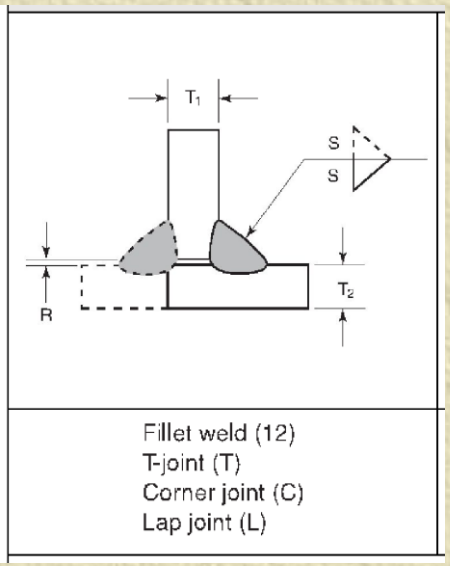
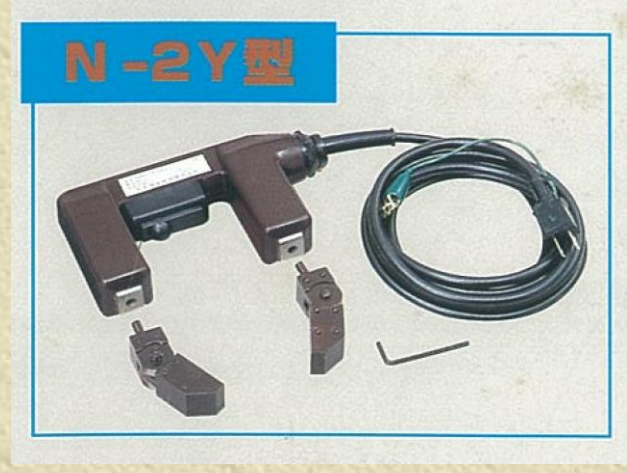
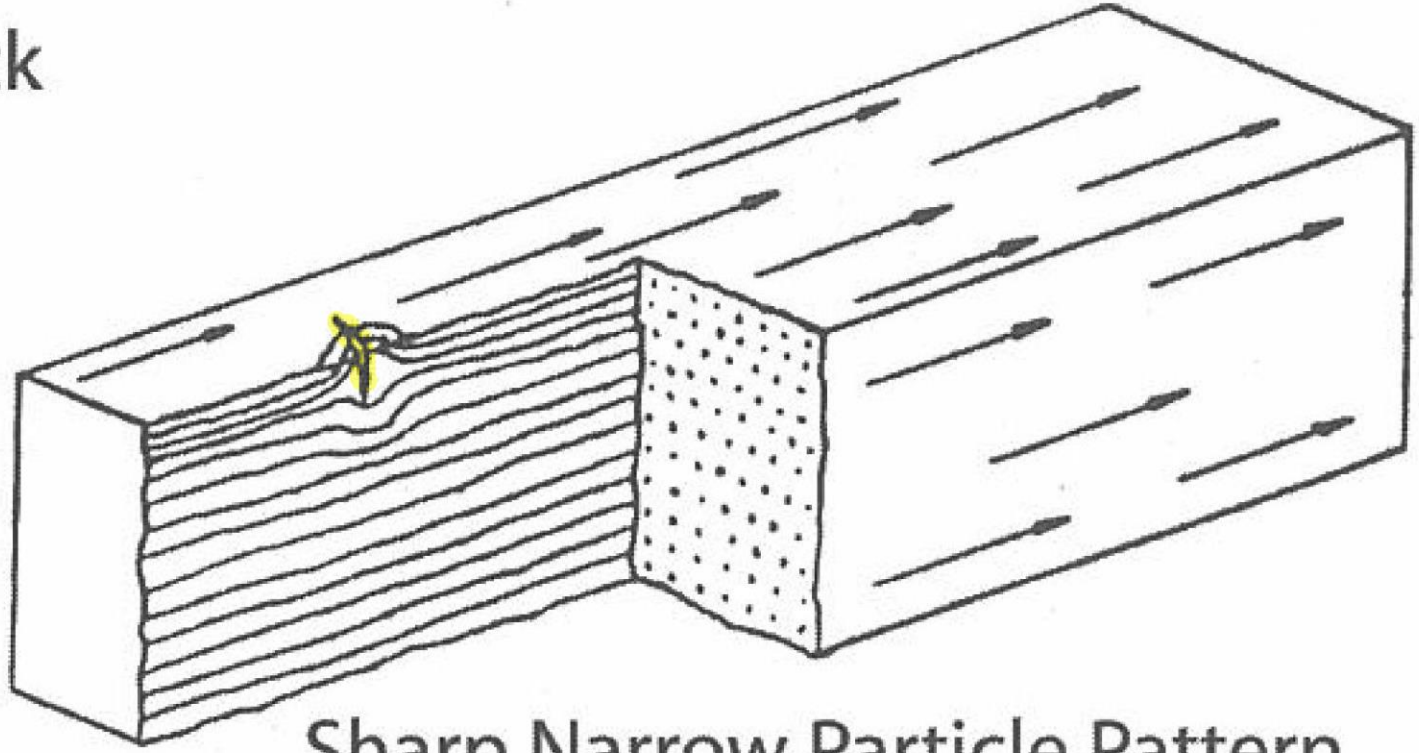


填角銲道，執行乾式色比磁粒檢測-MT



開口至表面裂痕

Surface Crack



(a)

Sharp Narrow Particle Pattern

Stronger Magnetic Leakage

開口至表面裂痕磁漏強力吸附磁粒聚集，形成清晰明顯線條顯示。

ASNT-Nondestructive Evaluation-Magnetic Particle-Figure 4.12

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第三者獨立公正檢測單位之MT檢測頻率-
公共工程施工規範、業主、建築師-建築設計圖面內有規定、結構技師-鋼構設計圖面內有規定

公共工程-1050429-建築工程施工綱要規範-
第05122章-TPC0.2-1020813-鋼構造

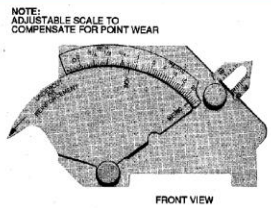
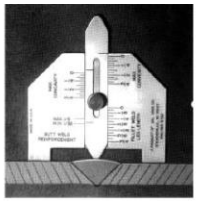
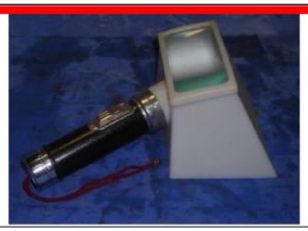
(4)磁粒檢測（MT，Magnetic particle test）

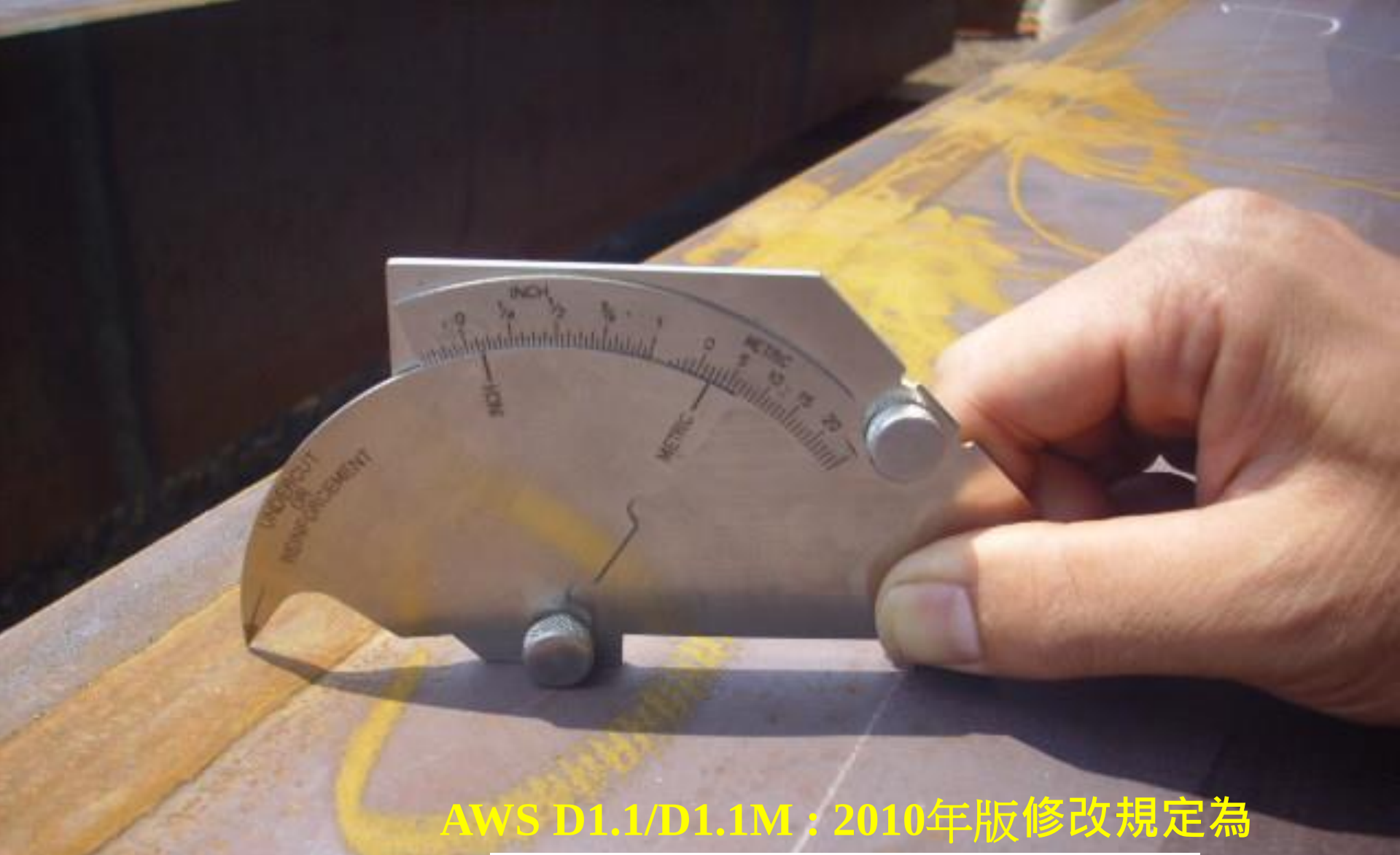
除契約或設計圖另有規定者外，任何銲道之抽樣比例依表 2.5 之規定。

表 2.5 磁粒檢測抽樣比例

構件	受力種類	抽樣比率
主要構件	張力接頭	20 %
	壓力接頭	10 %
其他	—	5 %

耐震

台灣製鋼直尺 Ruler	台灣製短捲尺 Try-Lock Tapes	台灣製長捲尺 Line Tape	數位式游標卡尺 Mitutoyo-CD-6CS 型 Digital caliper
			
美國 GAL AWS INSPECTORS TOOL KIT	美國 AWS 銲道規 BRIDGE CAM GAUGE	美國 AWS 銲道規 BRIDGE CAM GAUGE	填角銲道量規 Fillet Weld Gauge
			
美國銲道規 Butt and Fillet Type Weld Gauge	燈光放大鏡 M-50 型 Magnifier	目視反射鏡 Inspection Mirror	硬式 50cm 長反射鏡 Inspection mirror
台灣 POLICE 聚光手電筒 Flashlight	Luxsit 5LC 型頭罩燈 Headlamp	數位相機 Digital camera	美國黑白光照度計 Spectroline DSE-100X 型 Radiometer/Photometer



AWS D1.1/D1.1M：2010年版修改規定為

鋼板厚度(T) mm Thickness of thicker plate	銲冠容許高度(R) mm Reinforcement
T ≦ 25	3
25 ＜ T ≦ 50	5
50 ＜ T	6

填角銲道腳長量測

填角銲道喉深量測

以NDT角度看建築設計

起熄弧板移除探討

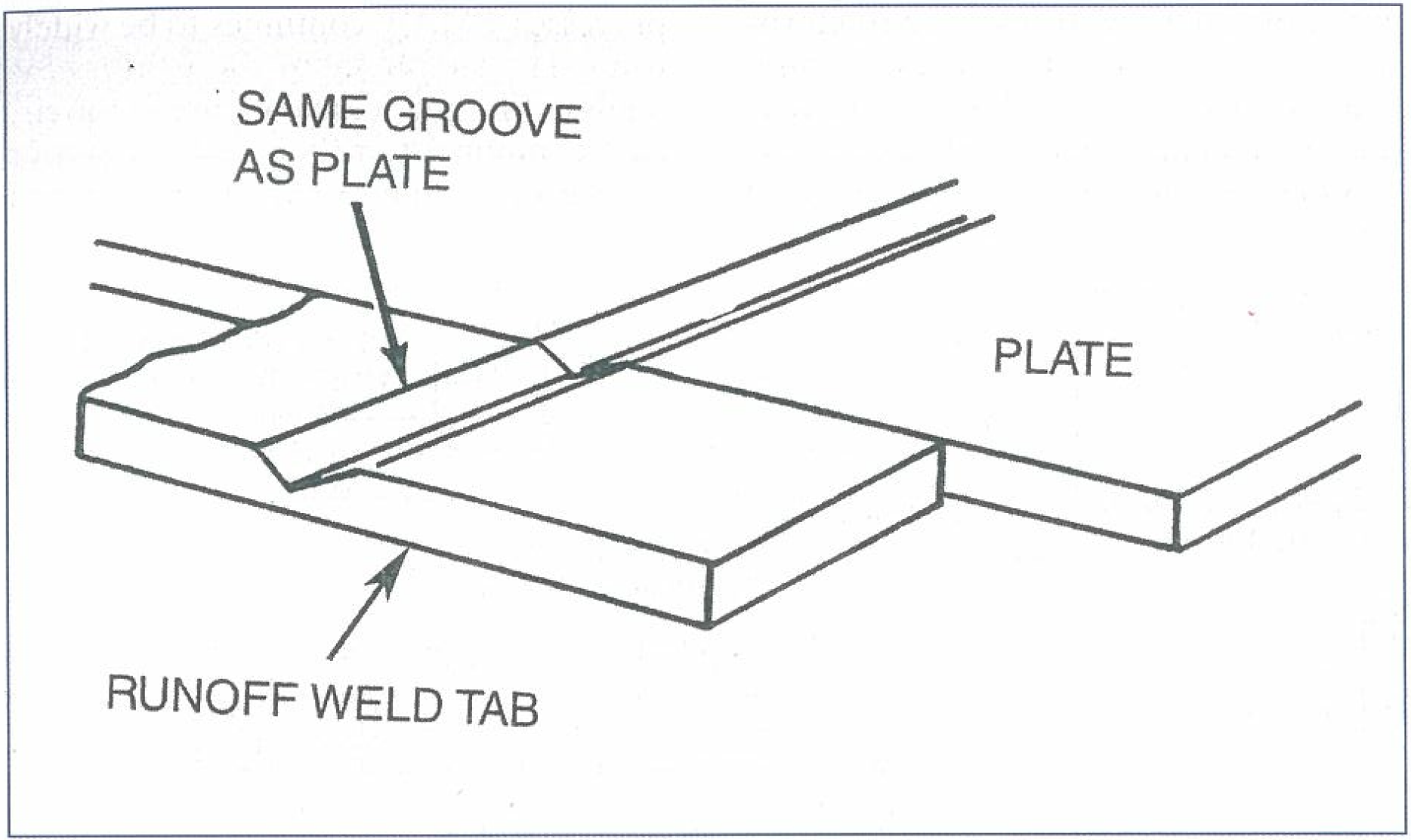


Fig. 2 — Runoff weld tab at the end of a joint.

鋼構-T Joint-Weld Tabs保留探討

AWS D1.1/D1.1M : 2006 Structural Welding Code –
2.7.3 Weld Tab Removal.
5.31.2 Removal of Weld Tabs for Statically Loaded Nontubular Structures.
2.16.5 Transversely Loaded Butt Joints.
建築鋼構-靜態結構之 T Joint 和 Corner Joint 起弧板（Weld Tabs）並未規定強制移除.

移除起弧板（Weld Tabs）會延伸出以下風險：

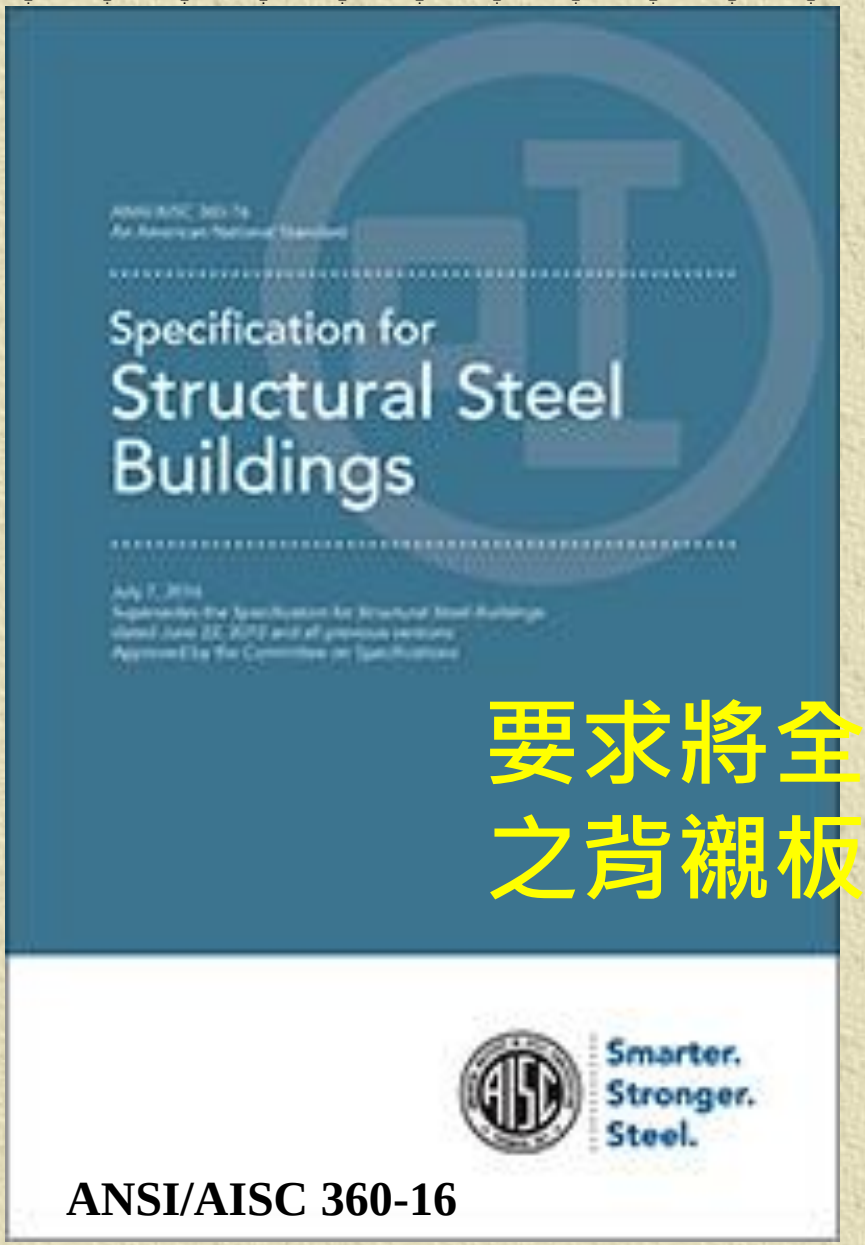
(1) 即然要將起弧板銲接完成後移除, 乾脆銲接前就省略組立起弧板, 如此則易造成上述之兩側銲道邊緣未填滿、柱鋼板面有弧擊痕跡和銲疤遺留在有效銲道內.
(2) 起弧板移除, 採用 oxyfuel gas cutting 或 gouging, 則極易傷及柱鋼板面, 且若未研磨則殘留之刻痕(Notch), 受劇大之拉扯力, 將易成為邊緣起裂點, 更容易撕開銲道.
(3) 起弧板移除後研磨, 由上述常發現研磨面有裂紋顯示, 若受劇大之拉扯力, 將易成為邊緣起裂點, 更容易撕開銲道.

雖說 FEMA-353 於2000年建議將起弧板移除, 但是否有考量到以上風險？
AWS D1.1/D1.1M : 2006年版仍未規定將建築鋼構-靜態結構之 T Joint 和 Corner Joint 起弧板強制移除.

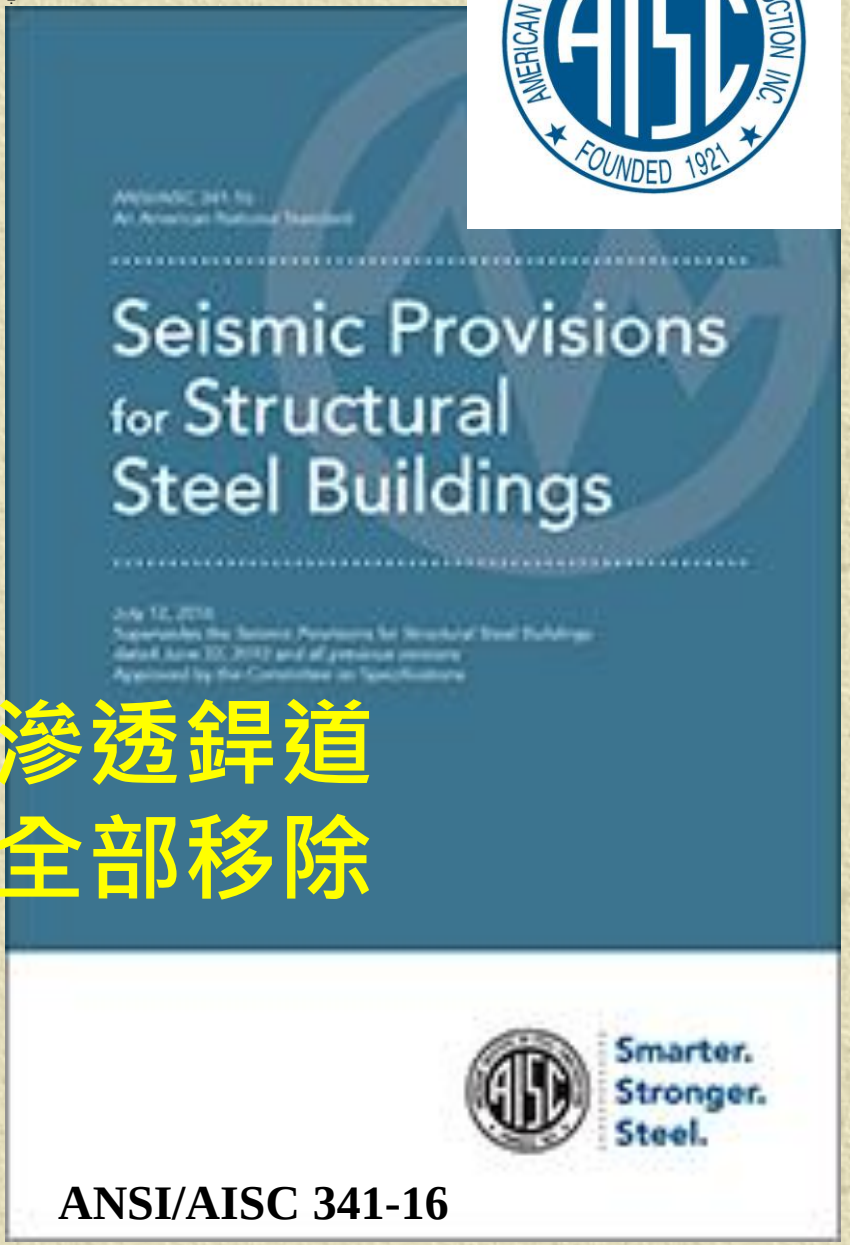
以NDT角度看建築設計

背襯板移除探討

耐震標章特別監督人訓練課程



ANSI/AISC 360-16

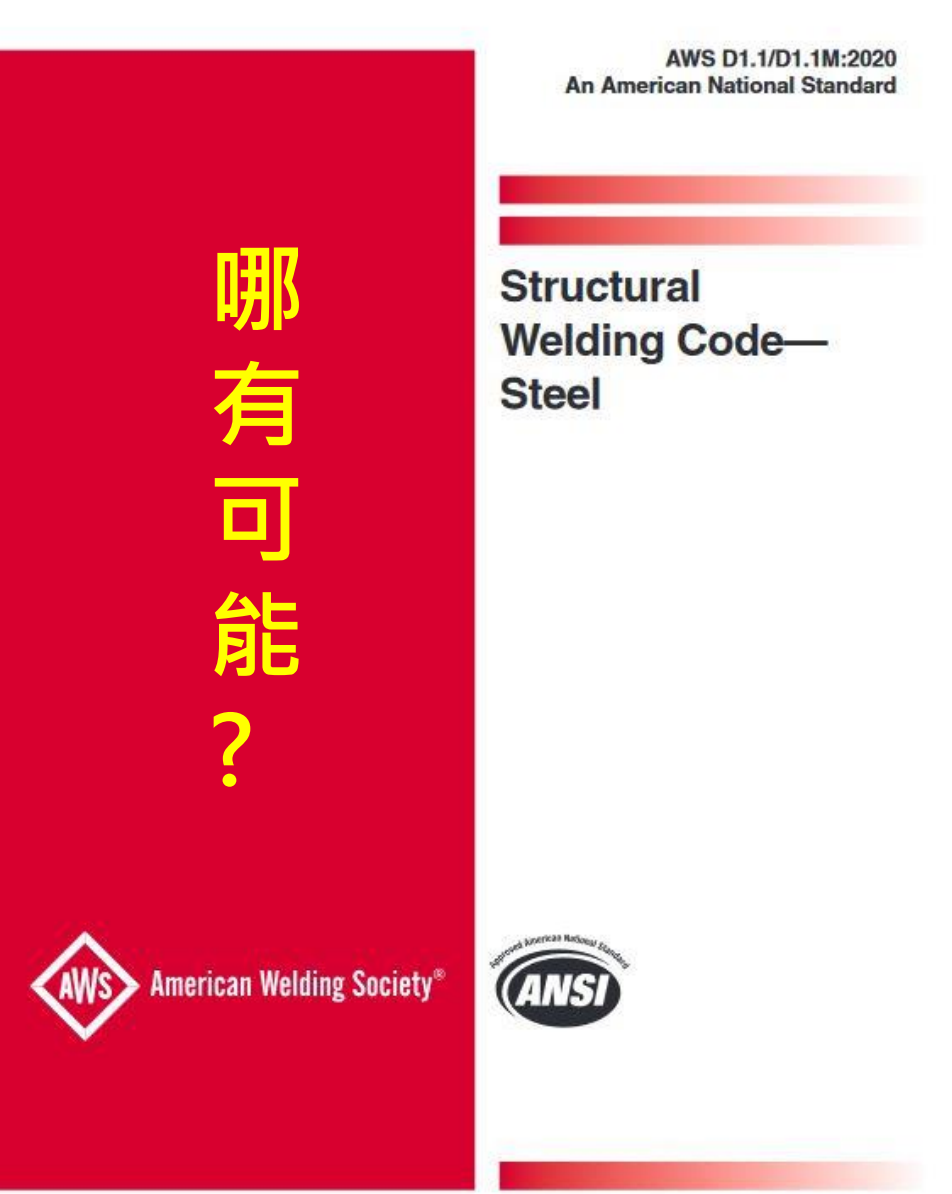


ANSI/AISC 341-16

要求將全滲透銲道
之背襯板全部移除

AWS D1.1/D1.1M：2020　　AWS D1.8/D1.8M：2021

哪有可能？

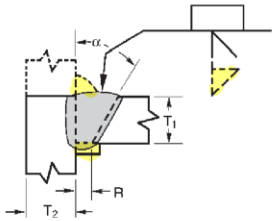
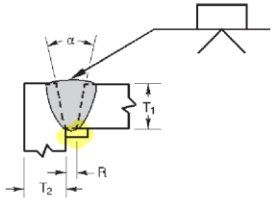
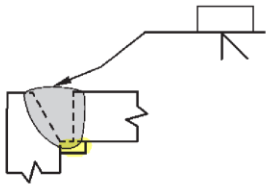
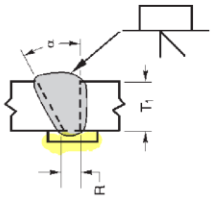


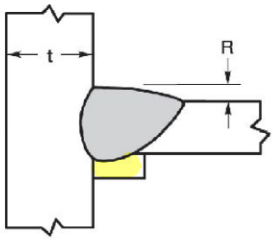
耐震標章特別監督人訓練課程

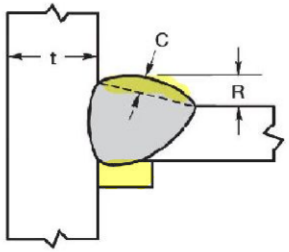
全滲透銲道 (Complete Joint Penetration)

建築鋼構較常用開槽全滲透銲道 (Dimensions in Millimeters)

AWS D1.1/D1.1M：2020-Figure 5.1-Prequalified CJP Groove Welded Joint Details (see 5.4.1)

			
Single-bevel-groove weld (4) T-joint (T) Corner joint (C)	Single-V-groove weld (2) Corner joint (C)	Single-bevel-groove weld (4) Corner joint (C)	Double-bevel-groove weld (5) T-joint (T) Corner joint (C)
單邊斜開槽銲道 柱柱、柱樑接頭 內隔板、加勁板 SAW 銲接開槽	角接單邊雙開槽 SAW 銲接開槽	角接單邊斜開槽 SAW 銲接開槽	對接 單邊斜開槽銲道 GMAW FCAW





AWS D1.1/D1.1M:2020-Figure 7.4 (d) Groove Weld Profiles in T-Joints

靜態荷重結構對接(若寬度或厚度不同)、角接和 T-接開槽全滲透銲道(CJP)和部份滲透銲道(PJP)表面，可多銲腳長≦8 mm 之補強填角銲道，以使銲道表面平順與減少應力集中。且應平緩延伸至母材表面。

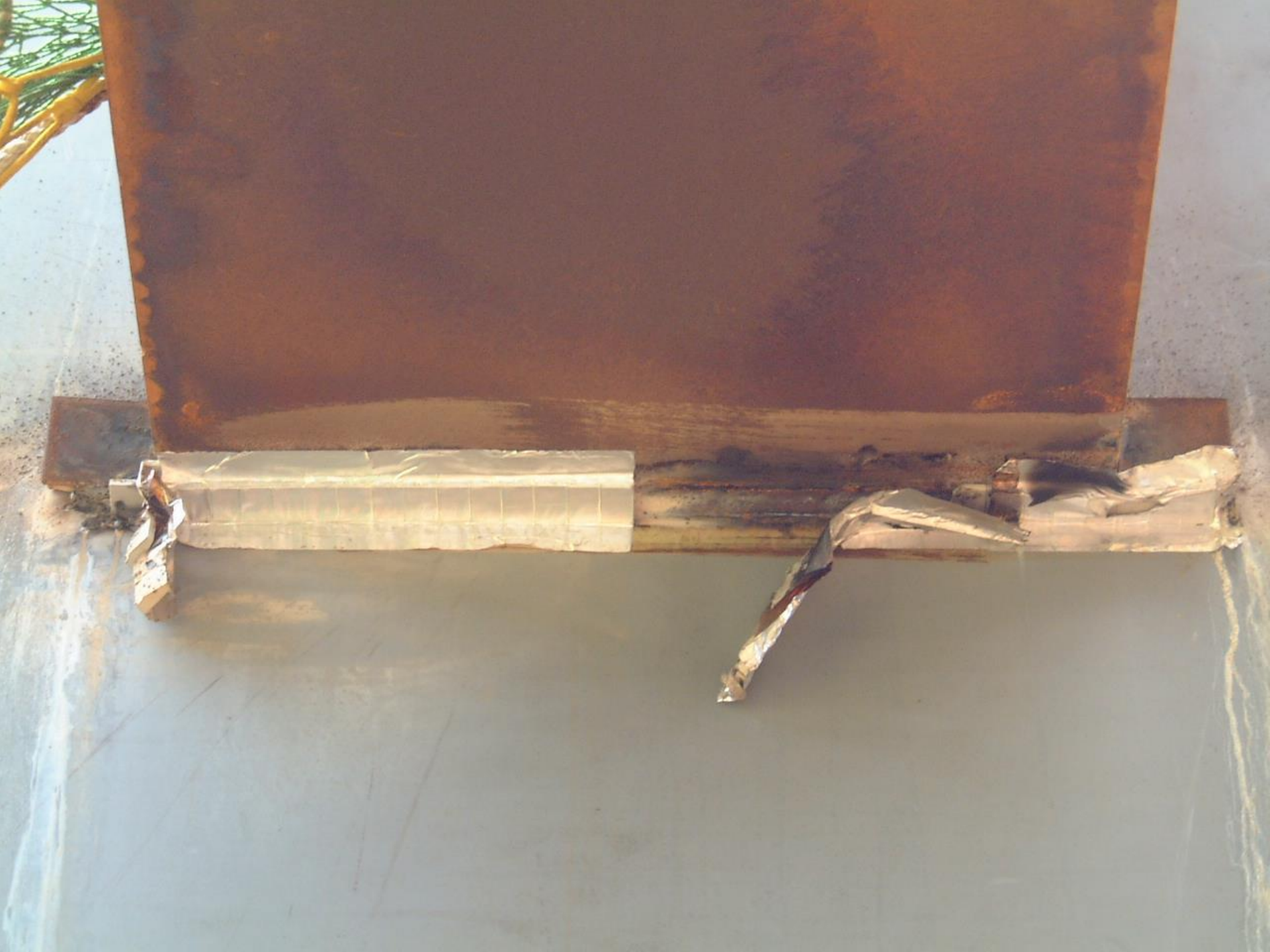
AWS D1.1/D1.1M:2020-4.7.5 Butt, Corner and T-Joint Surface Contouring. Fillet welds may be applied over CJP and PJP groove welds in butt joints joining parts of unequal width or thickness, corner and T-joints for the purpose of contouring weld face or to reduce stress concentrations. When such surface contouring fillet welds are used in statically loaded applications, the size need not be more then 5/16 in. [8 mm] . The fillet-like reinforcement on the surface of T and corner joint groove welds that naturally occurs shall not be cause for rejection nor need it be removed provided it does not interfere with other elements of the construction. No minimum contour radius need be provided.

AWS D1.1/D1.1M:2020-7.23.3 Groove Welds. Groove weld reinforcement shall comply with Tables 7.8 and 7.9 and with the provisions below. Welds shall have a gradual transition to the plane of the base metal surfaces.

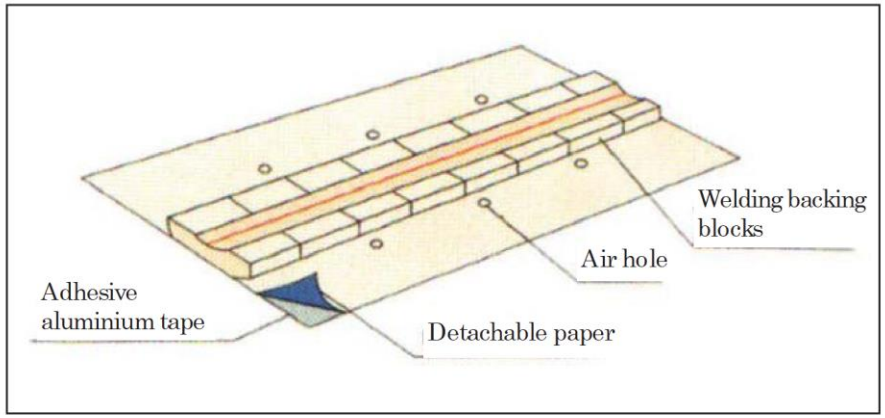
以NDT角度看建築設計

陶瓷背襯取代鋼背襯探討

總包
熊谷組
華熊榮工
大友爲JV
台北金融大樓公司



橋樑鋼構全滲透銲道使用之陶瓷背襯



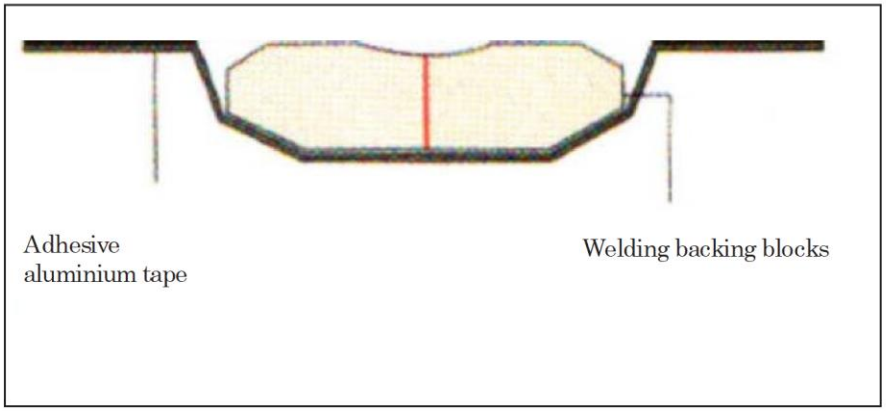


Fig. 5 — Ceramic backing type.

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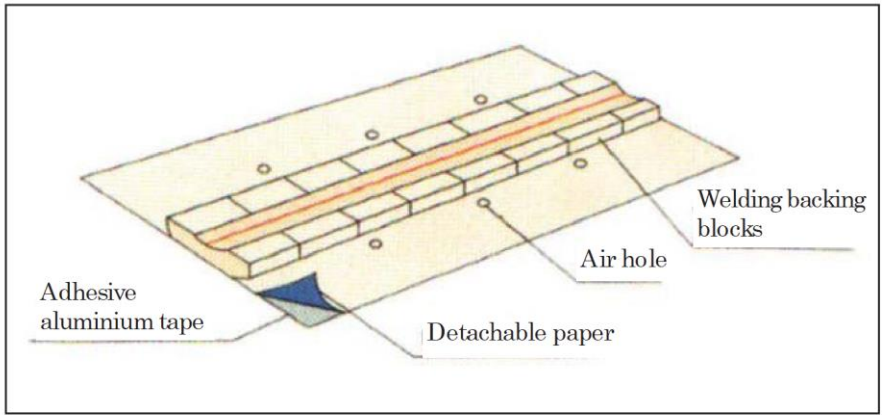


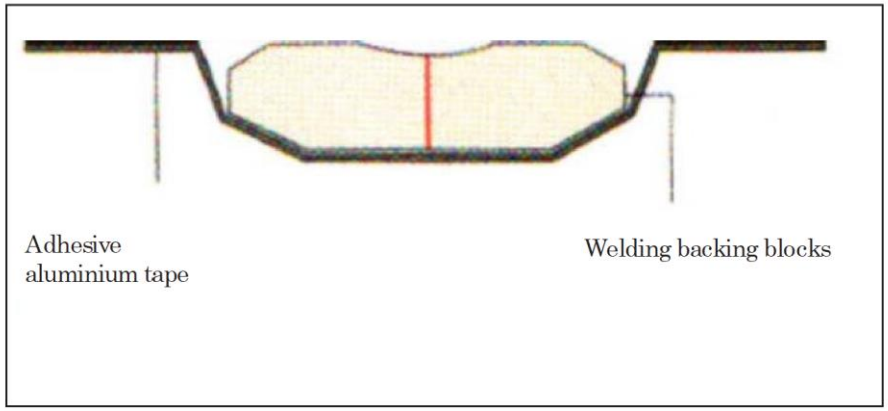


Fig. 5 — Ceramic backing type.

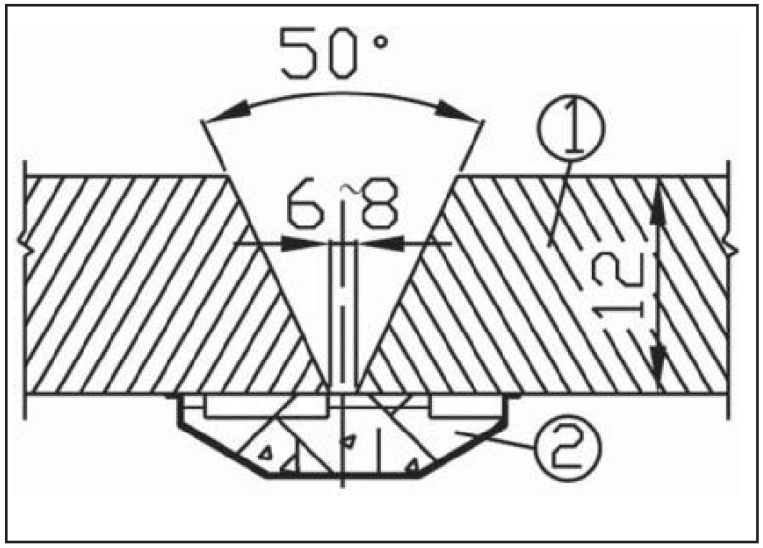
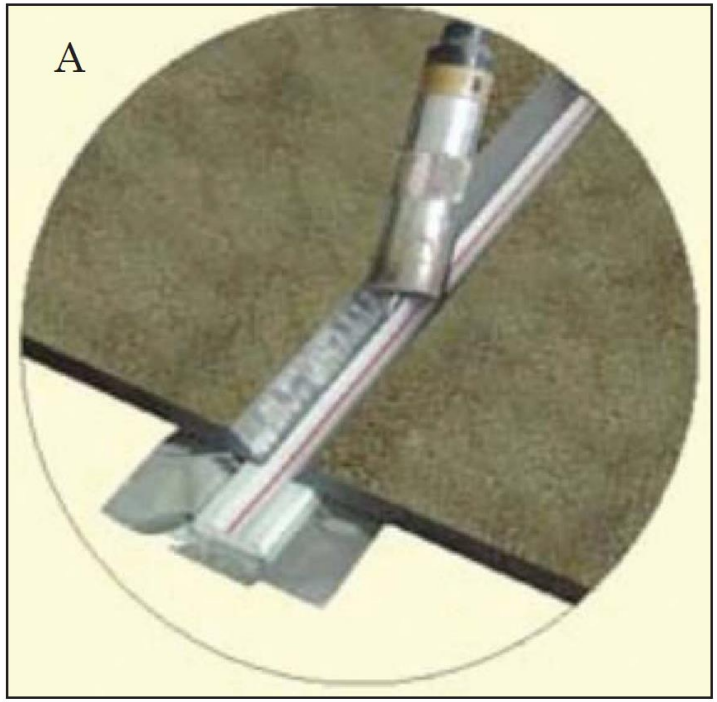


Fig. 3 — Test plate assembly. 1 — Test plate; 2 — ceramic backing.



中正橋陶瓷背襯拆除後之全滲透銲道根部表面現況

中正橋陶瓷背襯拆除後之全滲透銲道根部表面現況

以NDT角度看建築設計

銅背襯取代鋼背襯探討

伸鼎

A490
A490

以NDT角度看建築設計

鋼背襯

陶瓷背襯

銅背襯

目前妥協方案探討

陳
実仁
GAPY

以NDT角度看建築設計

SAW替代之銲道組立探討

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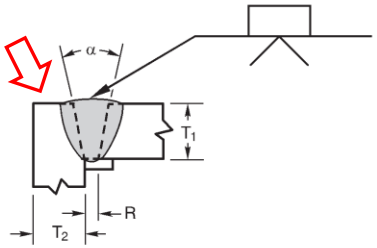
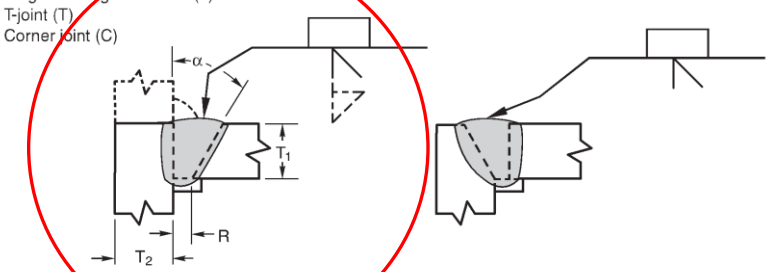
Single-V-groove weld (2)
Corner joint (C)



Tolerances	
As Detailed (see 5.4.1.1)	As Fit-Up (see 5.4.1.8)
R = +2, −0	+6, −2
α = +10°, −0°	+10°, −5°

Welding Process	Joint Designation	Base Metal Thickness (U = unlimited)		Groove Preparation		Allowed Welding Positions	Gas Shielding for FCAW	Notes
		T_1	T_2	Root Opening	Groove Angle			
SMAW	C-U2a	U	U	R = 6	α = 45°	All	—	e, o
				R = 10	α = 30°	F, V, OH	—	e, o
				R = 12	α = 20°	F, V, OH	—	e, o
GMAW FCAW	C-U2a-GF	U	U	R = 5	α = 30°	F, V, OH	Required	a
				R = 10	α = 30°	F, V, OH	Not req.	a, o
				R = 6	α = 45°	F, V, OH	Not req.	a, o
SAW	C-L2a-S	50 max.	U	R = 6	α = 30°	F	—	o
SAW	C-U2-S	U	U	R = 16	α = 20°	F	—	o

Single-bevel-groove weld (4)
T-joint (T)
Corner joint (C)



Tolerances	
As Detailed (see 5.4.1.1)	As Fit-Up (see 5.4.1.8)
R = +2, −0	+6, −2
α = +10°, −0°	+10°, −5°

Welding Process	Joint Designation	Base Metal Thickness (U = unlimited)		Groove Preparation		Allowed Welding Positions	Gas Shielding for FCAW	Notes
		T_1	T_2	Root Opening	Groove Angle			
SMAW	TC-U4a	U	U	R = 6	α = 45°	All	—	e, g, k, o
				R = 10	α = 30°	F, V, OH	—	e, g, k, o
GMAW FCAW	TC-U4a-GF	U	U	R = 5	α = 30°	All	Required	a, g, k, o
				R = 10	α = 30°	F	Not req.	a, g, k, o
				R = 6	α = 45°	All	Not req.	a, g, k, o
SAW	TC-U4a-S	U	U	R = 10	α = 30°	F	—	g, k, o
				R = 6	α = 45°			

C-5.4.1.6 and C-5.4.2.5 Corner Joint Preparation. The code allows an alternative option for preparation of th groove in one or both members for all bevel- and J-groove welds in corner joints as shown in Figure C-5.2. This provisio was prompted by lamellar tearing considerations allowing all or part of the preparation in the vertical member of the join Such groove preparation reduces the residual tensile stresses, arising from shrinkage of welds on cooling, that act in th through-thickness direction in a single vertical plane, as shown in prequalified corner joints diagrammed in Figures 5. 5.2, and 5.4. Therefore, the probability of lamellar tearing can be reduced for these joints by the groove preparatio now allowed by the code. However, some unprepared thickness, "a," as shown in Figure C-5.2, should be maintained t prevent melting of the top part of the vertical plate. This may easily be done by preparing the groove in both member (angle β).

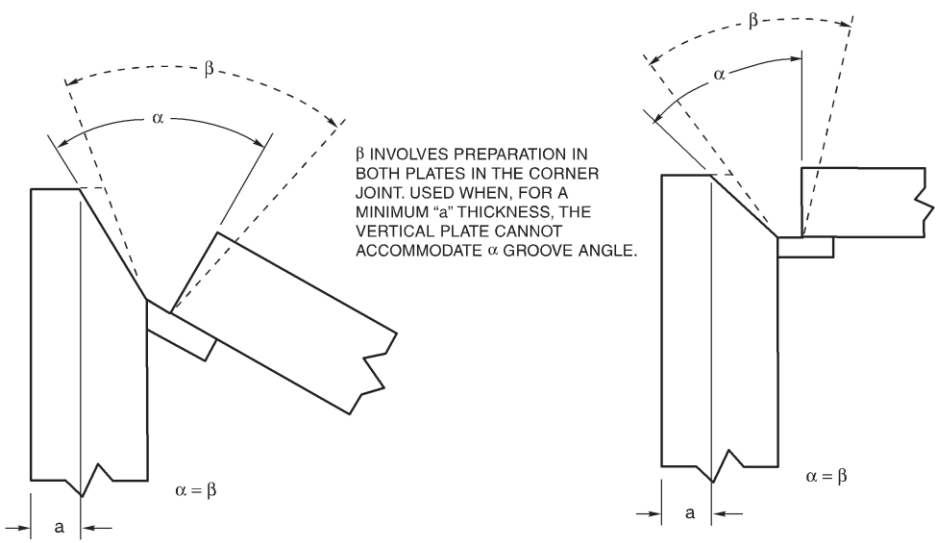
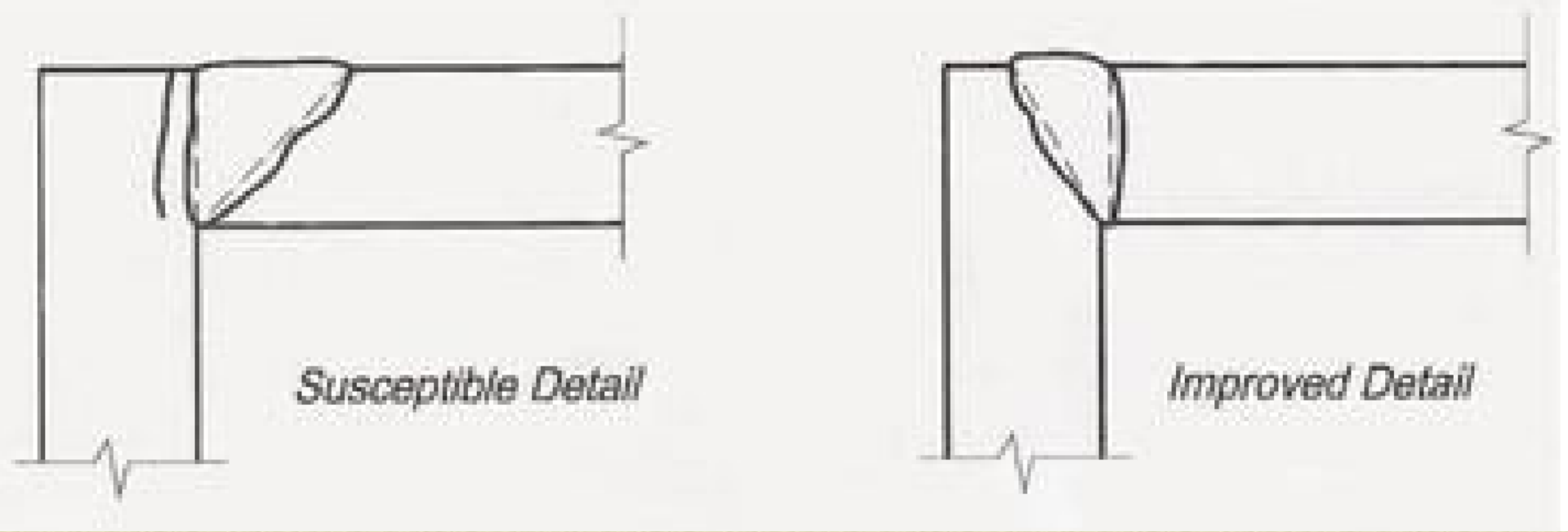


Figure C-5.2—Details of Alternative Groove Preparations for Prequalified Corner Joints (see C-5.4.1.6 and C-5.4.2.5)



層裂(Lamellar Tearing)預防，改變銲道開槽組立方式
Lamellar Tearing and Failures Cases-Seth M. Moyer, BAE/MAE, The Pennsylvania State University, 2012

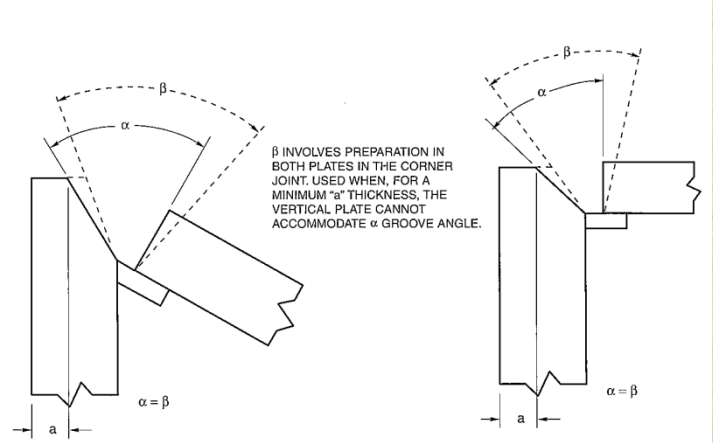


Figure C-3.3—Details of Alternative Groove Preparations for Prequalified Corner Joints (see C-3.11.2)

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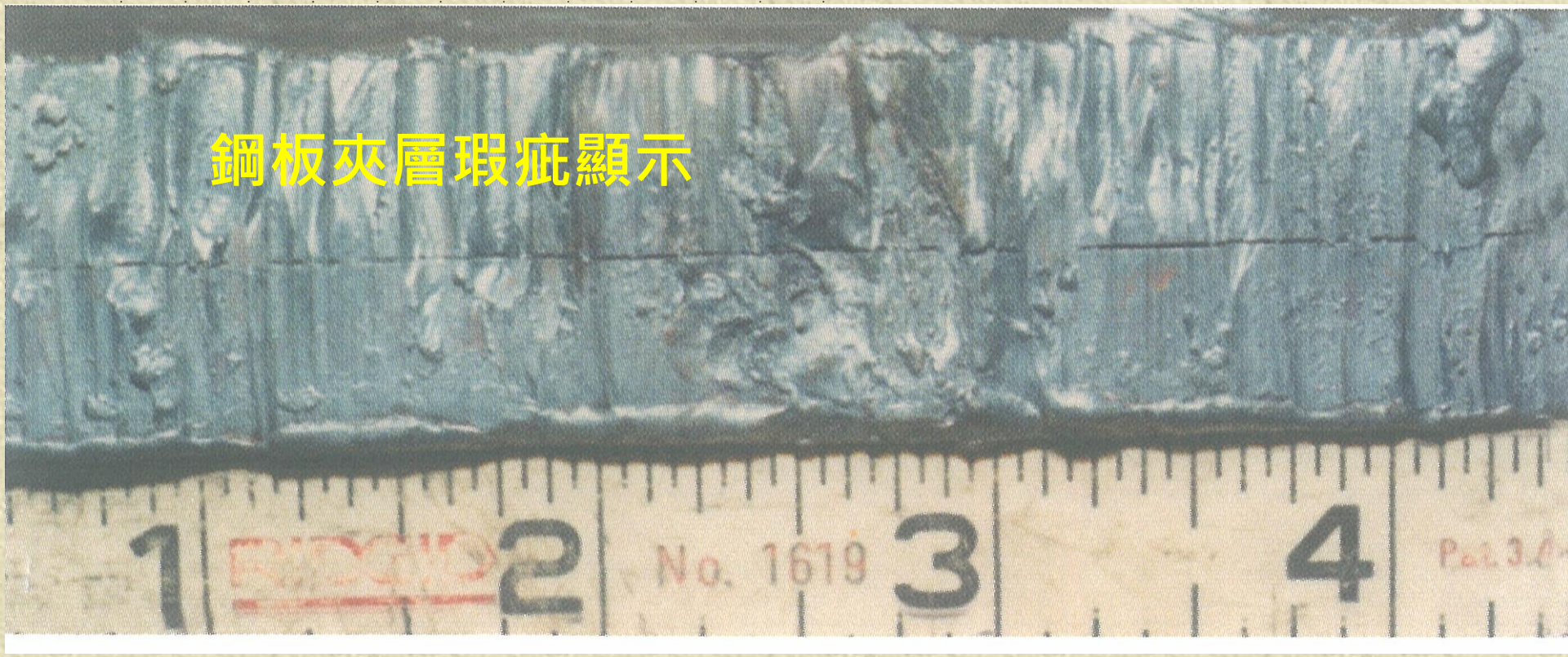
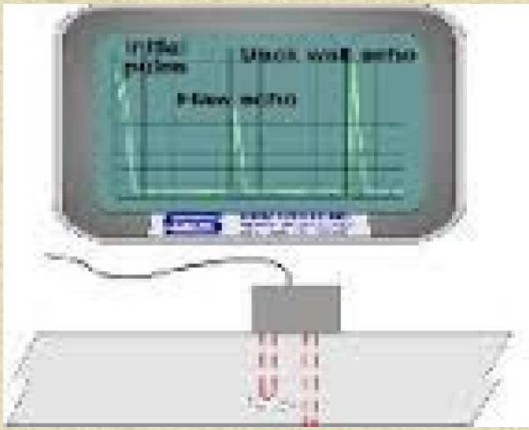
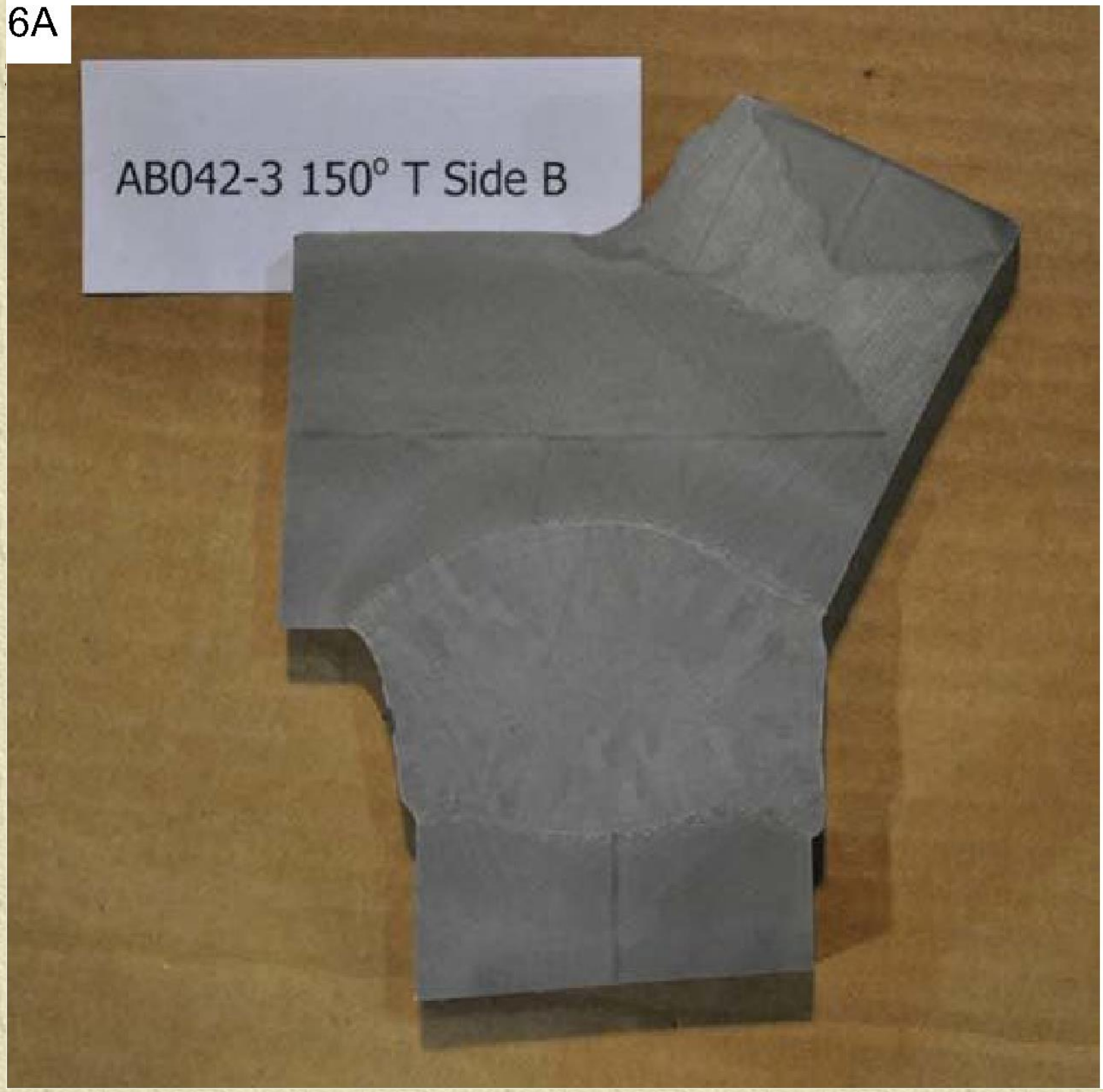




耐震



以NDT角度看建築設計

銲接程序書WPS-PQR
銲接技術人員WQR
檢定探討

American Welding Society®

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Wei-Han Chen

has complied with the requirements of AWS QC1,
Standard for AWS Certification of Welding Inspectors

14102381
CERTIFICATE NUMBER

Oct/01/2023
EXPIRATION DATE

AMERICAN WELDING SOCIETY
INCORPORATED
1932
NEW YORK

AWS PRESIDENT

AWS QUALIFICATION & CERTIFICATION
COMMITTEE CHAIR

Wei-Han Chen
CWI 14102381
QC1 EXP. 10/1/2023

耐震標章

TWS

Taiwan Welding Society

台灣銲接協會銲接檢驗師證書

銲協證字(10)TW004 號
有效期限：2025 年 5 月

依台灣銲接協會銲接檢驗師資格檢定及授證辦法

授　予

簡 志 桐 先生 **銲接檢驗師資格**

典　試　古錦松

理事長　林秋豐

中　華　民　國　一　一　一　年　一　月　廿　七　日

Taiwan Welding Society

Certifies that Welding Inspector

Jyh-Torng Jean

has complied with the requirements of TWS Regulations for Qualification and Certification of Welding Inspectors.

Certificate NO. **(10)TW004**

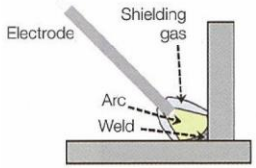
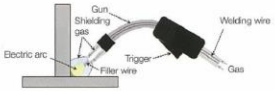
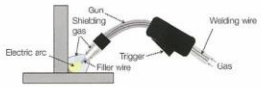
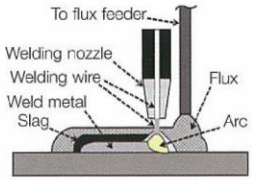
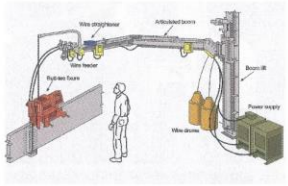
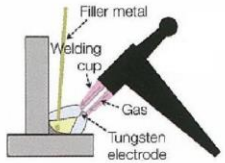
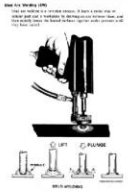
Expires date **May, 2025**

Chairman Q&C Li-Son Ku

President TWS Chu-Feng Lin

耐震標章

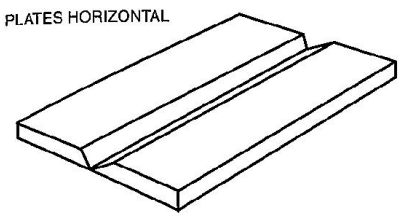
銲接方法

手銲 SMAW- Shielded Metal Arc Welding			
遮護氣體電弧銲接 半自動銲接 (MIG, CO_2) GMAW-Gas Metal Arc Welding			
包藥銲線電弧銲接 半自動銲接 FCAW-Flux Cored Arc Welding			
潛弧銲接 SAW-Submerged Arc Welding			
電熱熔渣銲接 ESW-the Electroslag Welding 或電熱氣體銲接 EGW-the Electrogas Welding			
氬銲 TIG 銲接 GTAW-Gas Tungsten Arc Welding			
植釘銲接 SW-Stud Welding			

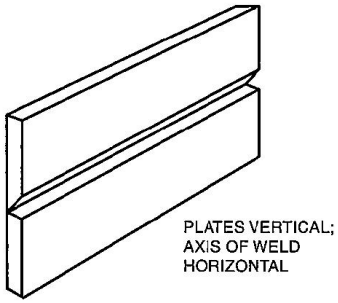
耐震標章特別監督人訓練課程

平板檢定試片開槽銲道銲接姿勢

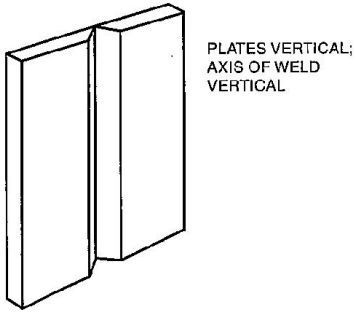
AWS D1.1/D1.1M：2020-Figure 6.3-Position of Test Plates for Groove Welds (see 6.3.4)



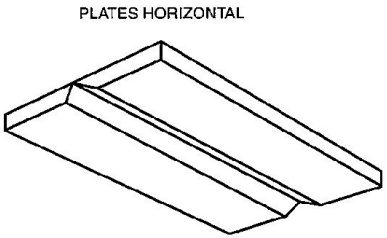
(A) FLAT WELDING TEST POSITION 1G



(B) HORIZONTAL WELDING TEST POSITION 2G



(C) VERTICAL WELDING TEST POSITION 3G



(D) OVERHEAD WELDING TEST POSITION 4G

平銲-1G	橫銲-2G	立銲-3G	仰銲-4G

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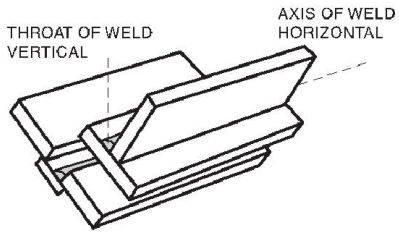
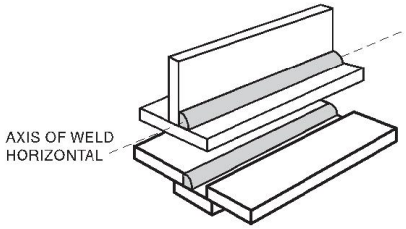
平板檢定試片填角銲道銲接姿勢

AWS D1.1/D1.1M:2010-Figure 4.5-Position of Test Plates for Fillet Welds

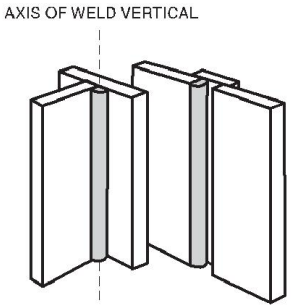


(A) FLAT WELDING TEST POSITION 1F

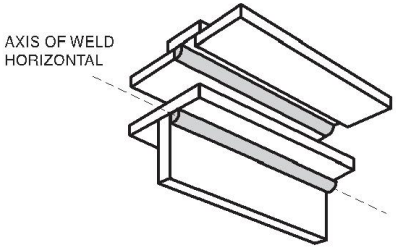


Note: One plate must be horizontal.

(B) HORIZONTAL WELDING TEST POSITION 2F



(C) VERTICAL WELDING TEST POSITION 3F

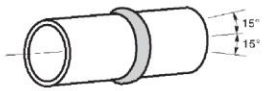
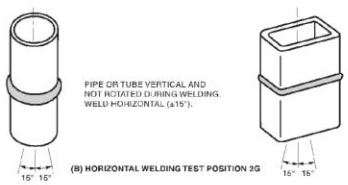
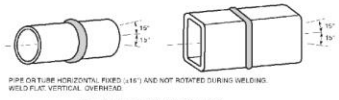
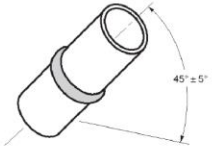
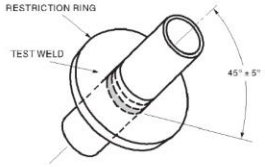


Note: One plate must be horizontal.

(D) OVERHEAD WELDING TEST POSITION 4F

非管狀結構平銲-1F	非管狀結構橫銲-2F	非管狀結構立銲-3F	非管狀結構仰銲-4F

耐震標章

管狀結構開槽銲道銲接姿勢 AWS D1.1/D1.1M：2020-Figure 10.12-Position of Test Pipe or Tubing for Groove Welds (see 10.11.1)		
 PIPE HORIZONTAL AND ROTATED. WELD FLAT (±15°). DEPOSIT FILLER METAL AT OR NEAR THE TOP. (A) FLAT WELDING TEST POSITION 1G ROTATED	 (B) HORIZONTAL WELDING TEST POSITION 2G	(1) 圓管(外直徑＜600 mm)開槽銲道，無 3G，4G (2) 圓管(外直徑≧600 mm)開槽銲道圓弧弧度變化較緩，以平板 1G，2G，3G，4G 檢定銲接姿勢。
空白(Blank)		AWS D1.1/D1.1M:2020-Table 6.1 WPS Qualification-Production Welding Positions Qualified by Plate, Pipe, and Box Tube Tests (see 6.4)-[a] Qualifies for circumferential welds in pipes equal to or greater than 24 in [600 mm] nominal outer diameter.
空白(Blank)		AWS D1.1/D1.1M:2020-6.4 Production Welding Positions Qualified. The production welding positions qualified by a plate test shall conform to the requirements of Clause 6 and Table 6.1. The production welding positions qualified by a tubular test shall conform to the requirements of Clause10 and Table 10.8.
管狀結構平置旋轉 平銲-1G	管狀結構立置固定 橫銲-2G	無立銲-3G、仰銲-4G
 PIPE OR TUBE HORIZONTAL FIXED (±15°) AND NOT ROTATED DURING WELDING. WELD FLAT, VERTICAL, OVERHEAD. (C) MULTIPLE WELDING TEST POSITION 5G	 PIPE INCLINATION FIXED (45° ± 5°) AND NOT ROTATED DURING WELDING. (D) MULTIPLE WELDING TEST POSITION 6G	 (E) MULTIPLE WELDING TEST POSITION 6GR WITH RESTRICTION RING (T-, Y-, OR K-CONNECTIONS)
管狀結構平置固定 全姿勢-5G	管狀結構斜置固定 全姿勢-6G	管狀結構斜置固定+約束環 全姿勢-6GR

WPS

5. Prequalification of WPSs

6. Qualification

中國非破壞檢驗有限公司
CHINA NON-DESTRUCTIVE INSPECTION CO., LTD.

鋼結構(碳鋼)銲接程序書 WPS檢定記錄表 (WQ-T11DP-1050901)
WPS Procedure Qualification Record for Steel Welding

中 CND 檢

編號： -0501-PQR-1001
頁次：第 4 頁，共 6 頁

銲接程序 WELDING PROCEDURE SPECIFICATION (WPS)

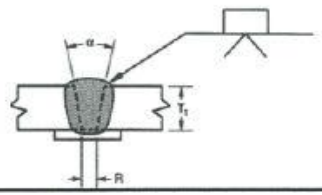
公司名稱 Co.	TUNG KANG STEEL STRUCTURE CORP.			銲接方式 WELDING	FCAW
制訂者 Formulated by	H.P. YU	日期	2013.01.30	銲接區分 Using	銲接 For Welding √ 修補 For Repairing √
授證者 Authorized by	T.C.CHEN	日期	2013.01.30	型式 Type	手動式 Manual — 半自動 √
輔助 PQR 文號 Supporting PQR	SM570-No.11	校訂 Rev.	1		機械式 Machine — 全自動 Automatic —

接頭設計 JOINT DESIGN USED		**銲接位置 POSITION**	
型式	Single-V-groove weld, Butt-joint	開槽位置 Position of Groove	3G 填角銲 —
單邊銲 Single Weld	√ 雙邊銲 Double Weld —	立銲前進方式 Vertical Progression	
背襯板	是 Yes √ 否 No —	由下而上 Up	√ 由上而下 Down —
背襯板材料 Backing	SM490A	**電流性質 ELECTRICAL CHARACTERISTICS**	
開槽間隙 R Root Opening	6 mm 開槽根部尺寸 f Root Face Dimension	轉換型式 Transfer	短弧 Short-Circuiting —
開槽角度 α Groove Angle	45° 半徑 r Radius (J-U)	球狀 Globular	√ 噴銲 Spray —
背創 Back Gouging	是 — 否No √ 方法 —	電流 Current	交流 AC — 直流正極 DCEP √
母材 BASE METALS			脈衝式 Pulsed — 直流負極 DCEN —
材料規格 Material Spec.	SM570M		其他 Other —
型式或等級 Type or	-A;B;C HW	**銲接技術 TECHNIQUE**	
厚度 Thickness		直線或擺動 Stringer or Weave	Stringer / Weave Bead
開槽	Unlimited 填角 Fillet —	單層銲或多層銲 Multi-pass or Single Pass (per side)	Multiple
直徑	—	電極數 Number of Electrodes	Single
銲材 FILLER METALS		電極間隔 Electrode Spacing 縱向	—
規格 AWS	A5.29	橫向 Lateral	—
等級 AWS	E81T1-Ni1C	角度 Angle	—
被覆材料 SHIELDING		噴嘴距離 Contact Tube to Work	—
銲粉 Flux	—	敲擊 Peening	None
銲條-銲粉(等級) Electrode-Flux (Class)	—	層間清理 Interpass Cleaning	Air Chipping / Grind / Wire Brush
氣體 Gas	CO_2	**銲機種類 WELDING MACHINE**	Lincoln DC-600、 LN-7
成份	99.8% 流量 Flow Rate 20~25 L/Min	**銲接程序編號 Identification No.**	TKSS-WPS- B-U2a-F -3G
氣體出口口徑 Gas Cup Diameter	ϕ 23 mm		

預熱/層間溫度(最小) Preheat/Interpass Temp.(Min.)	3～20	10℃	**銲後熱處理 POSTWELD HEAT TREATMENT** Temp.	N/A
	>20～38	65℃	Time	N/A
	>38mm	110℃		

銲接程序 WELDING PROCEDURE

層次 Pass or Weld Layer(s)	銲材 Filler Metals 直徑 Diameter (mm)	電流 Current (A) 型式或電極 Type & Polarity	安培或送線速度 Amps or Wire Feed Speed	電壓 Volts (V)	行走速度 Travel Speed (mm / min)	接合型式 Joint Details
1～n	1.2	DCEP	130~220	25~34	80～130	B-U2a-GF
1～n	1.4	DCEP	150~230	24~26	90～140	



中國非破壞檢驗有限公司
CHINA NON-DESTRUCTIVE INSPECTION CO., LTD.

鋼結構(碳鋼)銲接程序書 WPS檢定記錄表 (WQ-T11DP-1050901)
WPS Procedure Qualification Record for Steel Welding

中 CND 檢

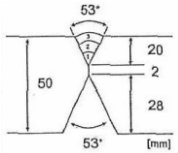
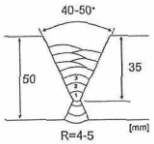
編號： -0501-PQR-1001
頁次：第 2 頁，共 6 頁

姓名：王建國 (Name)	人員識別編號：CND-W001 (Identification No.)	檢定日期：104/02/09 (Qualification Date)

銲接程序書編號：CND-WPS-101 版次：00版 核定日期：MARCH 01, 2013
(Welding Procedure Specification No., Rev, Date)

銲接參數 (Variables)	檢定數據 (Qualification Values)
銲接方法 (Process)	鋼結構銲接 (Structural Welding)：■SMAW, □GMAW, □GMAW-S, □FCAW-G, □FCAW-S, □SAW, □ESW, □EGW, □GTAW
電極/電流 / 極性 (Electrode/Current/Polarity)	■單極 Single Electrode, □多極 Multiple Electrode, ■交流電 AC, □直流電正極 DCEP, □ 直流電負極 DCEN, □ 脈波 Pulsed
銲接姿勢 /前進方向 (Position /Weld Progression)	□平銲 Flat, □橫銲 Horizontal, ■立銲上 Vertical Up, □立銲下 Vertical Down □仰銲 Overhead, □縱向 Stringers, ■擺動 Weave,
銲道組立 (Test Assembly)	■開槽銲道 Groove, 開槽角度 Groove Angle: 35˚, 根部間距 Root Opening：6 mm □填角銲道 Fillet, □直接對接 Direct butt, □間接對接 Indirect Butt, □T 接 T-Joint
背襯/背鏟 (Backing/Backgouging)	■背襯型式 Backing Material：ASTM A 131A, □無背襯 No Backing □背鏟方法 Backgouging Method：
母材規格 (Material/Spec.)	■母材規格 Spec.：ASTM A572 Gr.50, 厚度 Thickness：25 mm, □管件直徑 Pipe Diameter：10 in. , □鋼筋號數 Bar Size, in：10
銲材規格 (Filler Metal)	銲材製造廠商型號尺寸：天泰型號 , Φ 4 mm AWS 規格 Spec. NO., Class, F-No.：A5.5 -E7016 -F4
遮護氣體/銲藥型式 (Gas/Flux Type)	□氣體成份 Composition：100% CO_2, 氣體流量 Flow Rate：45CFH , 氣杯尺寸 Gas Cup Size：#4, □銲藥 Flux Type：860-F7A2-EM12K
預熱與層間溫度 (Preheat/Interpass)	預熱與層間溫度 Preheat/Interpass Temperature (Min)：最低 75˚ 層間溫度 Interpass Temperature (Max)：最高 350?

銲接程序 (Welding Procedure)

銲道層數 Weld Layer	銲接方法 Process	銲材 Filler Metals 規格 Class	銲材 Filler Metals 直徑 Diam.	電流 Current 電流極性 Type/ Polarity	電流 Current 安培/送線速度 Amps/Wire Feed Speed	電壓 Volts	銲接速度 Travel Speed	銲道組立 Joint Details
1 1-6	SMAW-G	EM12K	4 mm	DC+	45 ipm 550 Amps ±10%	28V ±7%	16 imp ±15%	
2 1-6	SMAW-G	EM12K	4 mm	DC+	45 ipm 550 Amps ±10%	28V ±7%	16 imp ±15%	

中國非破壞檢驗有限公司
CHINA NON-DESTRUCTIVE INSPECTION CO., LTD.

鋼結構(碳鋼)銲接程序書 WPS檢定記錄表 (WQ-T11DP-1050901)
WPS Procedure Qualification Record for Steel Welding

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銲道外觀目視檢測結果 (Weld Appearance Visual Test Results)	
Test-1, Test-2 ■合格 (Pass)	□不合格 (Fail)

射線檢測結果 (Radiographic Test Results)

底片編號 (Film Identification NO.)	結果 (Result)	底片編號 (Film Identification NO.)	結果 (Result)
N/A		N/A	

判讀者 (Interpreted by)：簡志桐 報告編號 (Test No.)：CND-0201-RT-1001
檢測單位 (Organization)：中國非破壞檢驗有限公司 日期 (Date)：104/02/09

超音波檢測結果 (Ultrasonic Test Results)

銲道編號 (Weld Identification NO.)	結果 (Result)	銲道編號 (Weld Identification NO.)	結果 (Result)
銲道試片 (Test Piece)-1	合格 (Pass)	銲道試片 (Test Piece)-2	不合格 (Fail)

判讀者 (Interpreted by)：簡志桐 報告編號 (Test No.)：CND-0201-UT-1001
檢測單位 (Organization)：中國非破壞檢驗有限公司 日期 (Date)：104/02/09

試驗結果 (Test Result)

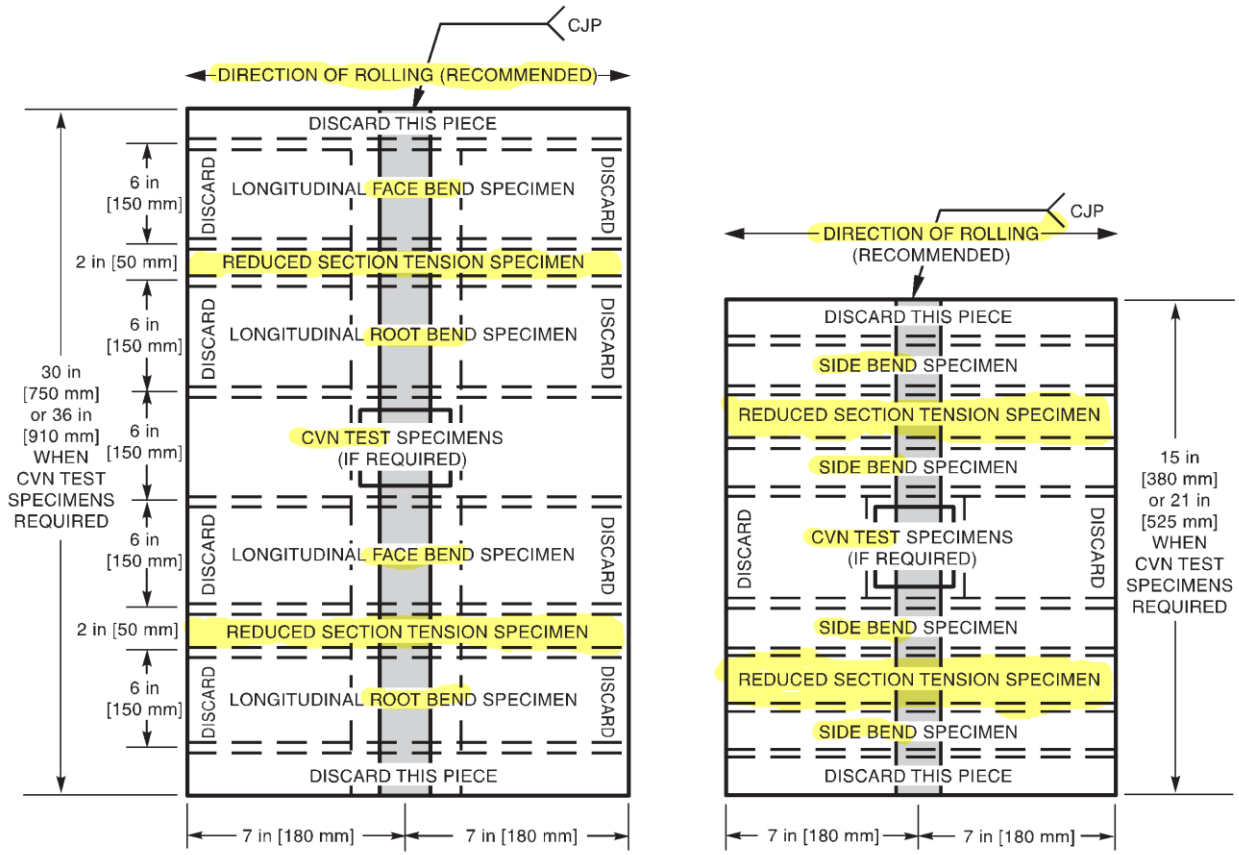
試驗方法 (Type)	結果 (Result)	試驗方法 (Type)	結果 (Result)
縮斷面拉伸試驗 -1	合格 (Pass)	側彎 (Side Bend Test)-1	合格 (Pass)
(Reduced Section Tension Test)		側彎 (Side Bend Test)-2	合格 (Pass)
縮斷面拉伸試驗 -2	合格 (Pass)	側彎 (Side Bend Test)-3	合格 (Pass)
(Reduced Section Tension Test)		側彎 (Side Bend Test)-4	合格 (Pass)

試驗者 (Inspection by)：XXX 報告編號 (Test No.)：_XXXX
試驗單位 (Organization)：台灣檢驗科技股份有限公司 日期 (Date)：104/02/09

茲證明本記錄之內容均屬正確，銲道之銲接前準備、銲接過程及試驗檢測，均符合美國 AWS D1.1-2015 規範第四章或美國 AWS D1.4-2011 規範第六章之規定。
We, the undersigned, certify that the statements in this record are correct and that the test welds were prepared, welded, and tested in conformance with the requirements of Clause 4 of AWS D1.1/D1.1M-2010, Structural Welding Code-Steel or Clause 6 of AWS D1.4/D1.4M-2011, Structural Welding Code-Reinforcing Steel.

製造者或承包商 (Manufacturer or Contractor)：中國鋼結構股份有限公司
核准者 (Authorized by)：中國非破壞檢驗有限公司 簡志桐 日期 (Date)：104/02/09

PQR



(1) LONGITUDINAL BEND SPECIMENS **(2) TRANSVERSE BEND SPECIMENS**

Notes:
1. The groove configuration shown is for illustration only. The groove shape tested shall conform to the production groove shape that is being qualified.
2. When CVN tests are required, the specimens shall be removed from their locations, as shown in Figure 6.28.
3. All dimensions are minimum.

Figure 6.6—Location of Test Specimens on Welded Test Plate Over 3/8 in [10 mm] Thick—WPS Qualification (see 6.10)

WPS 檢定試片

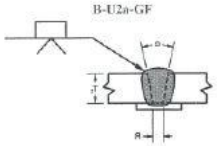
中國非破壞檢驗有限公司 CHINA NON-DESTRUCTIVE INSPECTION CO., LTD. XXXXXX 新建工程鋼結構(碳鋼) 銲接技術人員資格檢定記錄表 (WQ-T11DW-1090701) Welder, Welding Operator, or Tack Welder Qualification Test Record	中 CND 檢 編號:XX-0801-WQR-2001 頁次：第 4 頁，共 7 頁

使用之銲接程序(WPS)-SMAW-3G

銲接程序	WELDING PROCEDURE SPECIFICATION (WPS)						
公司名稱 Co. Name	TUNG KANG STEEL STRUCTURE CORP.			銲接方式 WELDING	SMAW		
製訂者 Formulated by	J.Y. WU	日期 Date	2017.08.07	銲接	銲接 For Welding	√	修補 For Repairing √
授權者 Authorized by	H.P. YU	日期 Date	2017.08.07	型式 Type	手動式 Manual	√	半自動 –
認可規範 Prequalified by	Prequalified	校訂 Rev.	0		機械式 Machine	–	全自動 Automatic –
接頭設計 JOINT DESIGN USED				銲接狀態 POSITION			
型式 Type	Single-V-groove weld, Butt-joint			開槽情況 Position of	3G	角銲 Fillet	–
單邊焊 Single Weld	√	雙邊焊 Double Weld	–	立銲前進方式 VERTICAL PROGRESSION			
背襯 Backing	是 Yes √	否 No	–	由下	–	由上到下 Down	–
背襯材料 Backing Material	SN490B, A572GR50			電流性質 ELECTRICAL CHARACTERISTICS			
開槽間隙 Root Opening	6 mm	開槽根部尺寸 Root Face Dimension	–	銲接型式 Transfer Mode	短路 short-circuiting		–
開槽角度 Groove Angle	45°	半徑 Radius (J-U)	–	球狀	√	噴銲 Spray	–
背刨 Back Gouging	是 –	否 No √	方法 –	電流 Current	交流 AC √	直流正極 DCEP	–
					直流負極 DCEN –	脈沖式 Pulsed	–
					其他 Other	–	
母材 BASE METALS				銲接技術 TECHNIQUE			
材料規格 Material Spec	CNS 13812, ASTM			直線或擺動 Stringer or	Stringer / Weave Bead		
型式或等級 Type or Grade	SN490B/C/YC, A572GR50,			單層銲或多層銲 Multi-pass or Single Pass (per side)	Multiple		
厚度 Thickness				電極數 Number of	Single		
開槽 Groove	Unlimited	填角 Fillet	–	電極 Electrode	縱向 Longitudinal		–
直徑(管) Diameter(Pipe)	–			間隙	橫向 Lateral		–
銲材 FILLER METALS					區向 Angle		–
規格 AWS Specification	A5.1			槍嘴距離 Contact Tube to			–
分級 AWS Classification	E7016			敲擊 Peening			–
被覆材料 SHIELDING				層間清理 Inter pass	Air Chipping / Grind / Wire Brush		
銲劑 Flux	–			銲機種類 WELD MACHINE	Manual (TC-600)		
銲條銲劑配合(分級) Electrode-Flux (Class)	–			銲接程序編號 PROCEDUCE NO.	TKSS-WPS- B-U2a-3GF		
氣體 Gas	–						
成份 Composition	99.8%	流量 Flow Rate	–				
氣體出口口徑 Gas Cup Diameter	–						
預熱/層間溫度(最小) Preheat/Interpass Temp.(Min.)	3～20	0℃		銲後熱處理 POST WELD	Temp.	N/A	
	>20～38	10℃			Time	N/A	
	>38～65	65℃					
	>65 mm	110℃					

銲接程序 WELDING PROCEDURE

層次 Pass or Weld Layer(s)	銲材 Consumable 直徑 Diameter (mm)	電流 Current (A) 型式或電極 Type & Polarity	安培或送線速度 Amps or Wire Feed Speed	電壓 Volts (V)	行走速度 Travel Speed (mm / min)	接合型式 Joint Details
1～n	4.0	AC	150～180	_	150～	B-U2a-GF
1～n	5.0	AC	200～240	_	150～	



中國非破壞檢驗有限公司 CHINA NON-DESTRUCTIVE INSPECTION CO., LTD. XXXXXX 新建工程鋼結構(碳鋼) 銲接技術人員資格檢定記錄表 (WQ-T11DW-1090701) Welder, Welding Operator, or Tack Welder Qualification Test Record	中 CND 檢 編號:XX-0801-WQR-2001 頁次：第 3 頁，共 7 頁

姓名：吳主恩 (Name)	檢定證號：XXXXXX-02-FCAW-3G01 (Identification No.)	檢定日期：APR 10, 2019 (Qualification Date)
銲接程序書編號：TKSS-WPS-B-U2a-F-3G 版次：1 版 核定日期：AUG, 2017 (Welding Procedure Specification No., Rev, Date)		
銲接參數 (Variables)	實際數據 (Actual Values)	檢定範圍 (Qualification Range)
銲接方法 (Process)	☐SMAW, ☐GMAW, ☐GMAW-S, ☐GTAW, ■FCAW-G, ☐FCAW-S, ☐SAW, ☐ESW, ☐EGW	FCAW
電流 / 極性 (Current/Polarity)	☐交流電 AC ■直流電正極 DCEP, ☐ 直流電負極 DCEN	DCEP
銲接姿勢 /前進方向 (Position /Weld Progression)	☐平銲 Flat, ☐橫銲 Horizontal, ☐仰銲 Overhead ■立銲上 Vertical Up, ☐立銲下 Vertical Down	1G,2G,3G 1F,2F,3F
銲道組立 (Test Assembly)	■開槽銲道 Groove, ☐填角銲道 Fillet ☐Direct butt, ☐ Indirect Butt, ☐T-Joint	開槽銲道 Groove
背襯 (Backing)	■有背襯 Backing, Yes ☐無背襯 Backing, No	有背襯 Backing, Yes
母材規格 (Material/Spec.)	■母材規格(Spec.)：SN490B ■厚度 Thickness： 25 mm, ☐鋼筋號數 Bar Size：10	Group I 及 Group II 3 mm ≦母材厚度
銲材規格 (Filler Metal)	首銳 SFC-71/ϕ1.2mm Spec. NO., Class, F-No.	A5.20 E71T-1C
遮護氣體/ 銲藥型式 (Gas/Flux Type)	■遮護氣體 Shielding Gas：100% CO_2 ☐銲藥型式 Flux Type：	CO_2
其他 (Other)		

銲道外觀目視檢測 (Visual Weld Appearance)			
■合格 (Pass)		☐不合格 (Fail)	
試驗結果 (Test Result)			
試驗方法 (Type)	結果 (Result)	試驗方法 (Type)	結果 (Result)
側彎 (Guided Bend Test)-1	N/A	側彎 (Guided Bend Test)-2	N/A
試驗者 (Inspection by)：N/A		報告編號 (Test No.)：N/A	
試驗單位 (Organization)： N/A		日期 (Date)：N/A	

射線檢測結果 (Radiographic Test Results)			
底片編號 (Film Identification NO.)	結果 (Result)	底片編號 (Film Identification NO.)	結果 (Result)
No.SN490B-FCAW-3G-1	合格	N/A	N/A
判讀者 (Interpreted by)：李春生		報告編號 (Test No.)：KN-19-00575	
檢測單位 (Organization)：台灣檢驗科技股份有限公司		日期 (Date)：Apr.18,2019	

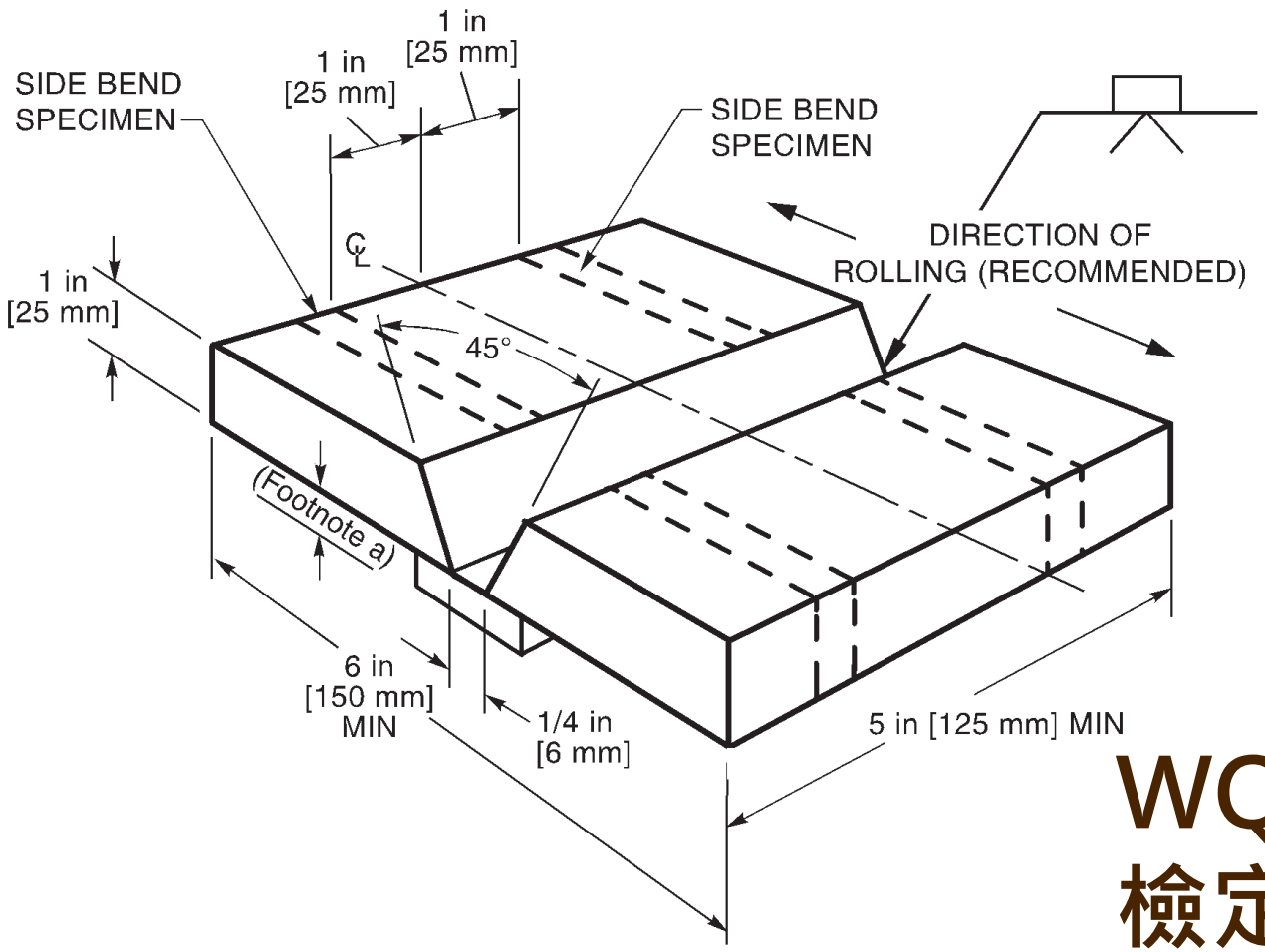
茲證明本記錄之內容均屬正確，銲道之銲接前準備、銲接過程及試驗檢測，均符合美國 AWS D1.1/D1.1M：2020 規範或美國 AWS D1.4/D1.4M：2018 規範之規定。

We, the undersigned, certify that the statements in this record are correct and that the test welds were prepared, welded, and tested in conformance with the requirements of AWS D1.1/D1.1M-2020, Structural Welding Code-Steel or AWS D1.4/D1.4M：2018, Structural Welding Code-Reinforcing Steel.

WQR

製造者或承包商 (Manufacturer or Contractor)：XXXXXX

核准者 (Authorized by)：中國非破壞檢驗有限公司 簡暐恩 日期 (Date)：Apr 19, 2019



WQ
檢定試片

[a] The backing thickness shall be 1/4 in [6 mm] min. to 3/8 in [10 mm] max.; backing width shall be 3 in [75 mm] min. when not removed for RT, otherwise 1 in [25 mm] min.

Note: When RT is used, no tack welds shall be in test area.

Figure 6.16—Test Plate for Unlimited Thickness—Welder Qualification and Fillet Weld Consumable Verification Tests (see 6.13.3.2 and 6.21.1)

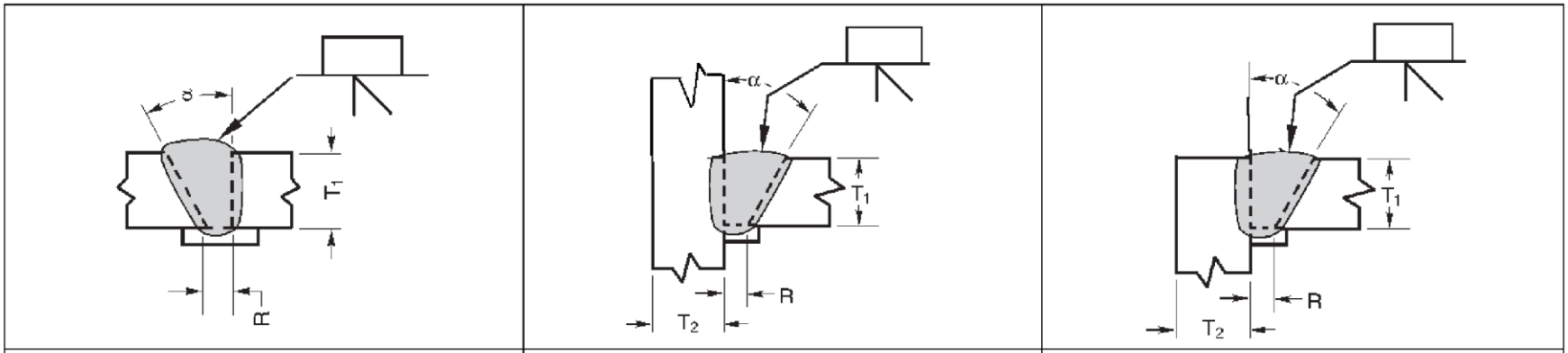
9. WPS 檢定試片準備 PREPARE WPS QUALIFICATION TEST PLATE OF

(1) 鋼構製造廠商或合約承攬廠商，負責依據檢定合格之[銲接程序書檢定記錄表(PQR)]內必要參數，擬定文件化之[銲接程序書(WPS)]，作為銲接技術人員執行銲接作業之依據。

(2) 銲接程序書(WPS)檢定，平板 WPS 檢定試片厚度≧25 mm，即可普遍反映銲道和熱影響區之化性(Chemical Property)、入熱量、和預熱之影響，若檢定合格即可允許現場銲接任何厚度。雖然鋼板軋延方向，可能造成銲道物性(Mechanical Property)劇烈變化，如縱向軋延之抗拉強度和衝擊值，就較橫向軋延高，除非鋼板有執行縱橫雙向軋延。而彎曲試驗也是類似結果，所以有些衝擊試驗，須將軋延方向紀錄於報告內。

(3) 非管狀結構，對接開槽銲道之銲接程序書(WPS)檢定，平板對接 WPS 檢定試片之全滲透銲道組立，可選用圖 6.5~6.7 內之 WPS 檢定試片。

(4) 非管狀結構，T 接和角接銲道之銲接程序書(WPS)檢定，仍選用平板對接 WPS 檢定試片，且如 T 接和角接現場開槽之銲道組立，但開槽深度可不超過 25 mm。



對接開槽全滲透銲道	T 接開槽全滲透銲道	角接開槽全滲透銲道

(5) 銲接程序書(WPS)檢定，WPS 檢定試片銲道須執行目視檢測、NDT 檢測、面彎、根彎和側彎、縮斷面抗拉試驗、全銲道抗拉試驗和巨觀試驗等。

(6) 銲接方法混用：若銲接方法之必要參數符合各銲接程序書(WPS)之要求，則預檢定和已檢定合格銲接程序書(WPS)內之銲接方法可混用，無需再執行各銲接方法混用之銲接程序書(WPS)檢定合格。

(2) If adequate material from the original welded test coupon does not exist, a new test coupon shall be prepared following the original PQR as closely as practicable. The new welded test coupon need only be of sufficient length to provide the required two test specimens. If the new test specimens pass, the essential and supplementary essential variables shall be documented on the PQR.

For material over 1-1/2 in [38 mm] thick when multiple test specimens are required to represent the complete thickness, failure of a test specimen representing a portion of the thickness shall require testing of all test specimens representing the complete thickness from two additional locations in the test coupon.

6.11 CJP Groove Welds

See Table 6.2(1) for the requirements for qualifying a WPS of a CJP weld on nontubular connections. See Figures 6.5–6.7 for the appropriate test plate.

6.11.1.1 Corner or T-Joints. Test specimens for groove welds in corner or T-joints shall be butt joints having the same groove configuration as the corner or T-joint to be used on construction, except the depth of groove need not exceed 1 in [25 mm].

耐震標章特別監督人訓練課程

10. 銲接技術人員檢定試片準備 PREPARE WELDING PERSONNEL QUALIFICATION TEST PLATE

(1) 銲接技術人員(銲接技術員、銲接操作員和固定銲接技術員)資格檢定作業，僅確認有能力可銲出良好的銲道品質，是具備最基本且可接受之銲接技藝。而實際現場之銲接作業，仍須依據銲接程序書(WPS)施銲。

(2) 銲接技術人員(銲接技術員、銲接操作員和固定銲接技術員)，必須遵循預檢定或檢定合格銲接程序書內必要參數之限制，執行資格檢定作業。而銲接技術人員資格檢定記錄表(WQR)，必須列出所用之必要參數，作為文件紀錄證明。

(3) 銲接技術人員(銲接技術員、銲接操作員和固定銲接技術員)，被雇用為此規範之銲接作業前，必須以所使用銲接方法 SMAW、SAW、GMAW、GTAW、FCAW、ESW 或 EGW，先經過銲接技術人員資格檢定合格。

(4) 銲接技術人員-全滲透銲道(CJP)資格檢定合格，即可執行該銲接方法和銲接姿勢所允許現場銲接姿勢之部份滲透銲道(PJP)、填角銲道(Fillet)和圓槽銲/長槽銲之銲接作業。

AWS D1.1/D1.1M:2020-6.16 General.
The performance qualification tests required by this code are specifically devised tests to determine a welder's, welding operators, or tack welder's ability to produce sound welds. The qualificaiton tests are not intended to be used as guides for welding or tack welding during actual construction. The latter shall be performed in conformance with a WPS.

以NDT角度看建築設計

MT檢測： 乾式或濕式
PT檢測：色比溶劑移除式
三種檢測方法
何者較適用鋼構銲道探討

G5. Method

The continuous method, using an AC or DC electromagnetic yoke (double-leg or single-leg configuration) with dry, white-light-visible magnetic particles, shall be used.

G6. Yoke

The yoke shall be of the articulating-leg type. A single-leg yoke may be used in areas of tight access. Fixed-leg yokes are not permitted. AC yokes shall have a lifting force of at least 10 lbs [4.5 kg] and DC yokes shall have a minimum lifting force of at least 40 lbs [18 kg] when the legs are spaced at the maximum inspection distance.

G7. Magnetization

A magnetizing current at 50 Hz to 60 Hz AC or DC electromagnetization shall be used for detection of surface-breaking discontinuities.

G8. Particles

The magnetic particles shall be dry, finely divided high-permeability ferromagnetic material with low retentivity and a suitable size range. Their color shall provide high contrast to the background on which applied. Particles shall be free from rust, fillers, or other material that could interfere with their use. Magnetic particle materials shall be used only once. Particle application and removal equipment (powder bulbs, aerosol sprays) shall be such that fine indications are not removed by excessive force.

E709 – 15

15. Application of Dry and Wet Magnetic Particles

15.1 Dry Magnetic Particles:

15.1.1 Magnetic Fields for Dry Particles—Dry magnetic powders are generally applied with the continuous magnetizing techniques. When utilizing AC, the current must be on before application of the dry powder and remain on through the examination phase. With Half-wave rectified AC or yoke DC magnetization, a current duration of at least ½ s should be used. The current duration should be short enough to prevent any damage from overheating or from other causes. It should be noted that AC and half-wave rectified DC impart better particle mobility to the powder than DC or full-wave rectified AC. Dry magnetic powders are widely used for magnetic particle examination of large parts as well as on localized areas such as welds. Dry magnetic particles are widely used for oil field applications and are frequently used in conjunction with capacitor discharge style equipment and the residual method.

8/17/18
MT
C.K

50
40
30
20
10

油漆膜厚在50 μm以內，規範允許執行磁粒檢測。

1/2 mm 1 2 3 4 5 mm 6
INCHES 32 1 2 64

738

X50

8/17/18
MT
C.K

50
40
30
20
10

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以NDT角度看建築設計

規範是最低要求探討
Minimum Requirement