Structural Welding Requirements and the Building Code

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OBJECTIVES

- CSA and CWB history
- Building code welding requirements
  - Section 4
  - Section 9
- CWB certification
- Welding faults
- Common questions
- Q & A

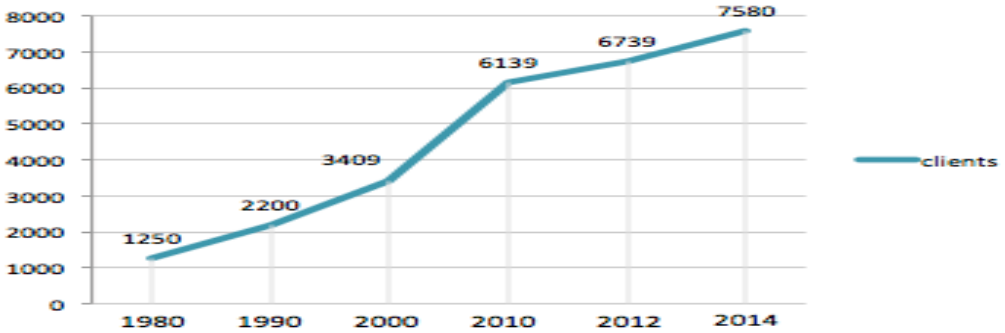
CSA and CWB history

CSA and CWB history

- Created by CSA in 1947, the CWB provided, and continues to provide, stability in an industry where local, regional and industry rules made the safe and constant use of welding difficult
- Under the Canadian Standards Association, the CWB administered the CSA company certification and welder qualification scheme across Canada as part of the National Building Code
- In the early 1990's The CWB was spun off as a not-for-profit company: the CWB Group
- Since that time the recognition and demand for welding certification in Canada has grown steadily

CSA and CWB history

- Created Administrator of CSA and other standards
- A third-party certification and auditing service provider
- A Standards Council of Canada (SCC) accredited certification body
- A private independent not-for-profit corporation
- Funded solely by industry from fees charged



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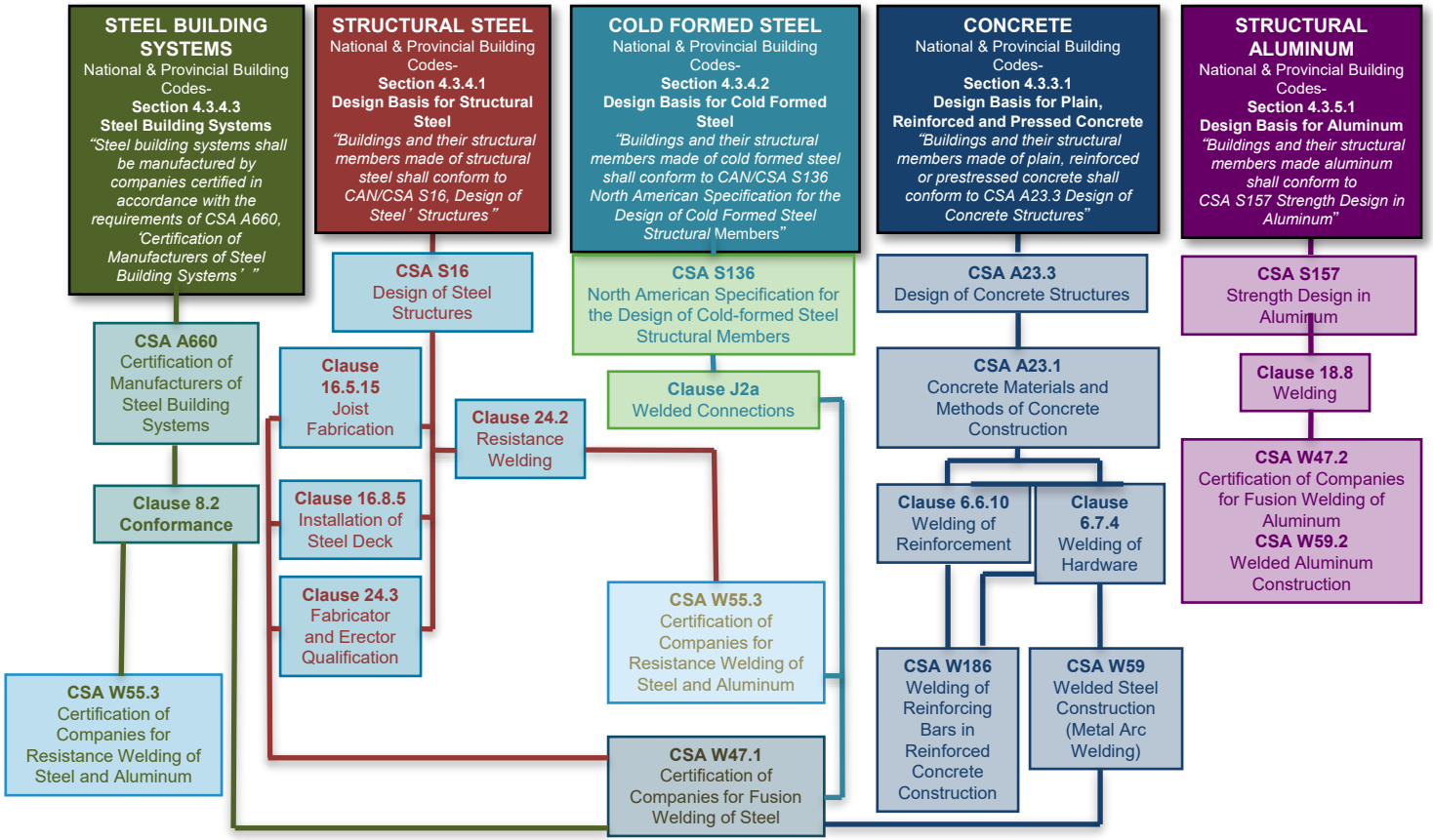
Building code welding requirements

Certification References



Structural references

Section 9.4. Structural Requirements
9.4.1. Structural Design Requirements and Application Limitations
9.4.1.1. General
(See Note A-9.4.1.1. and Article 2.2.7.6. of Division C.)
1) Subject to the application limitations defined elsewhere in this Part, structural members and their connections shall

a) conform to requirements provided elsewhere in this Part,

b) be designed according to good engineering practice such as that provided in the CWC, "Engineering Guide for Wood Frame Construction," or

c) be designed according to Part 4 using the loads and deflection and vibration limits specified in

i) Part 9, or

ii) Part 4.

Structural references

CAN/CSA Standard S16 "Limit States Design of Steel Structures"

- *Welding Requirements*
- Fabricator shall be a CSA W47.1 certified company in Division 1 or 2
- Fabricator may sublet to a Division 3 company (assist in fabrication or erection)
  - But…Division 3 companies can't take on work directly
- Joint design and quality requirements must meet CSA W59

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CWB welding certification

CWB welding certification

- There are 4 key elements to a fabricator certification program:
  1. Qualified welder(s)
  2. Qualified welding procedures
  3. Qualified welding supervisor(s)
  4. Qualified welding engineer(s)
  5. Qualified management system

In practical terms, this means that a **welding fabricator must have**:

- **Competent individuals** making the welds, who are…
  - Following **proven and documented "recipes",** in a shop…
    - **Overseen by competent "bosses**".

When all three are in place, high quality welds will result!

- Certification ensures these key elements are in place and working

CWB welding certification

- Fabricators can be certified to 1 of 3 “divisions”.

	Division 3	Division 2	Division 1
Qualified Welders	Yes	Yes	Yes
Qualified Welding Supervisor(s)	Yes	Yes	Yes
Qualified Welding Engineer(s)	No	Yes – Retained	Yes - Employed
Accepted Welding Procedures	Yes	Yes	Yes

CWB welding certification

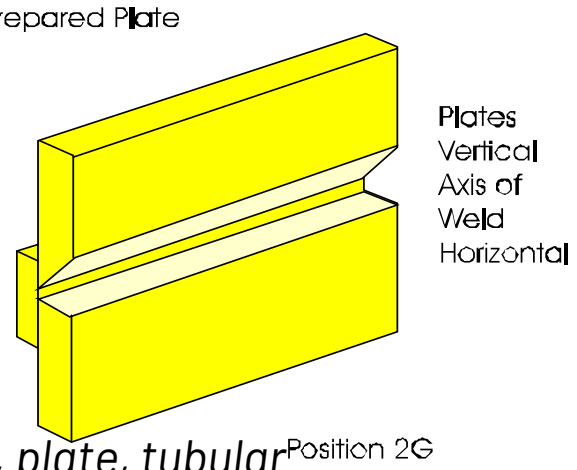
- Fabricators must define the “scope” of their certification
  - Like any quality system, the work that falls within the control of the system must be clear to both the employees of the organization, the independent certification body and the customers
- This is done through a statement on a Fabricator’s certificate and made available to the public
- Examples:
  - *“Fabrication of structural steel”*
  - *“Erection of structural and miscellaneous structural steel.”*
  - *“Repair and maintenance of cranes and crane runways.”*

#1 Qualified welders

- Must pass a practical test
  - For joint, positions and processes used
  - Witnessed by the CWB
- Issued a Welder Card, or “Ticket”
  - Valid for the certified company named on the ticket
  - Tickets transferable between certified companies
- Use of Ticket
  - Valid only while employed by a CSA W47.1 company
  - Normally, valid only for 2 years

#1 Qualified welders

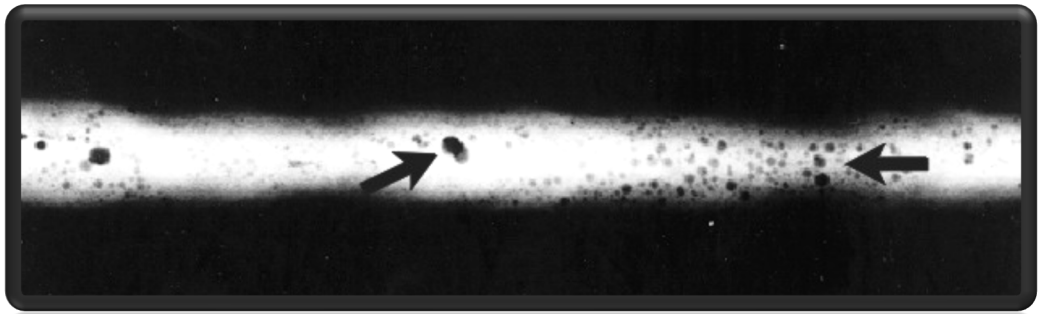
- Welders are tested for specific:
  - Welding processes
    - *SMAW, FCAW, GMAW*
  - Electrode type
    - *Steel, low-alloy, stainless, aluminum*
  - Welding position
    - *Flat, horizontal, vertical, overhead*
  - Welding joints / types
    - *Fillets, grooves, backing/no backing, plate, tubular*



#1 Qualified welders

Welders tests are evaluated by either:

1. Destructive tests
   - Bends, fracture, macro-etch
2. Non-destructive tests
   - Radiography



#1 Qualified welders

#2 Qualified Welding Supervisor(s)

- Employ at least one Welding Supervisor
- Must demonstrate:
  - Minimum education/knowledge
    - Drawings, welding symbols, knowledge of weld faults, quality control, inspection methods and the company's welding procedures & equipment
    - Welding codes and standards
    - Examinations are required, administered by CWB
  - Minimum experience
    - 5 years of welding-related experience pertinent to the company's type of operations
- Key roles:
  - To ensure that welders are qualified
  - To ensure that welding procedures in place and followed
  - To ensure visual weld quality requirements

#3 Qualified Welding Engineer(s)

- Employ/Retain at least one Welding Engineer (Div 1 or 2 only)
- Must demonstrate:
  - Minimum education/knowledge
    - Steel / aluminum, welding fundamentals, welding metallurgy, and welding procedures and practice.
    - Welding codes and standards
    - Examinations are required, administered by CWB
  - Minimum experience
    - 5 years of welding-related experience
- Key roles:
  - Development of new welding procedures
  - Documentation related to welding procedures
  - Periodic review of overall welding operations

#4 Qualified Welding Procedures

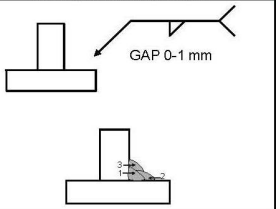
WELDING PROCEDURE DATA SHEET

WPDS NO.: GMAW-2F
DATE: 5/27/2008 Rev.: 0

Company Name: Canadian Welding Bureau
Address: 7250 West Credit Avenue, Mississauga, ON L5N 5N1
Ref. Standards: CSA W47.1/ W59
Ref. WPS: GMAW-1

Welding Processes:	1	GMAW	Pulsed: ☐ Yes ☑ No	2	Pulsed: ☐ Yes ☐ No
Shielding Gas Type:		90%Ar/ 10% CO2		
Positions:		Horizontal		
Process Mode:		☐ Manual ☑ Semi-Auto ☐ Machine ☐ Auto		
Joint Type:		☐ Butt ☑ Tee ☐ Corner ☐ Lap ☐ Edge		
Penetration:		☐ Complete ☐ Partial ETT= ☑ Fillet		
Backing:		Material: N/A Thickness:		
Backgouging:		☐ Yes Method: ☑ No Depth:		
Electrode Extension:		20 mm		
Nozzle Diameter(s):		16 mm		
Flux Classification:		N/A		
Tungsten Electrode:		Type: N/A Dia.:		
Cleaning Procedures:		Wire brush, clean between passes		
CSA W186 Rebar Splice Type:		☐ Direct Splice ☐ Indirect Splice ☐ Lap Splice ☐ Rebar to Structural Member Only		

Joint Configuration & Pass/Layer Sequence



Identification of Base Material (for CSA W186 indicate carbon equivalent, max. phosphorus & sulphur content)

Part	Specification & Grade	Thickness or Dia.	Special Requirements
I	ASTM A36, A516 Gr. 70 G40.21Gr. 300W, 350 W	6-10 mm	N/A
II	ASTM A36, A516 Gr. 70 G40.21Gr. 300W, 350 W	6-10 mm	N/A

Identification of Filler Material

Process	Trade Name	Classification	Group	Filler Treatment
GMAW	N/A	E G 49 A 3 C G6 (ER49S-6)	N/A	Cl. 5.2.4.5, CSA W59

SAMPLE

Welding Parameters

Thickness ( )	Weld Size/ ETT	Layer	Pass Number	Welding Process	Dia. ( )	Wire Feed Speed (m/min)	Current A	Volt V	Current Polarity	Welding Speed (mm/min)	Burn-Off Rate ( )	Gas Flow Rate (l/min	Heat Input ( )
	6	1	1	GMAW	1.2	10.0	260	28	DC+	400-500		20	
	8	1	1	GMAW	1.2	10.0	260	28	DC+	300-400		20	
	10	1	1	GMAW	1.2	10.0	260	28	DC+	400-500		20	
		2	2-3	GMAW	1.2	10.0	260	28	DC+	400-500		20	

Heat treatment :

Preheat min: 10° C
Interpasstemp.max.: 250° C
Interpasstemp.min.: 10° C
In accordance with Table 5-3, CSA Standard W59

CWB Acceptance

Company Authorization

To be signed by the engineer or supervisor before submission to the CWB

Date: 5/27/2008

#5 Elementary Quality Requirements

- Each organization must have a system that provides control over the following requirements for:
  - Review of welding-related requirements and technical review
  - Equipment maintenance
  - Inspection and Testing
  - Non-conformance and corrective actions
  - Identification and traceability
  - Quality records

The CWB audits each company every 6 months

- To maintain certification, companies must:
  - Qualify new & check test existing welders every 2 years
  - Submit new or revised welding procedures, as required
  - Continually verify visual acceptance of welded product(s)
  - Ensure any CWB "scope" work subcontracted to a CWB
  - certified company

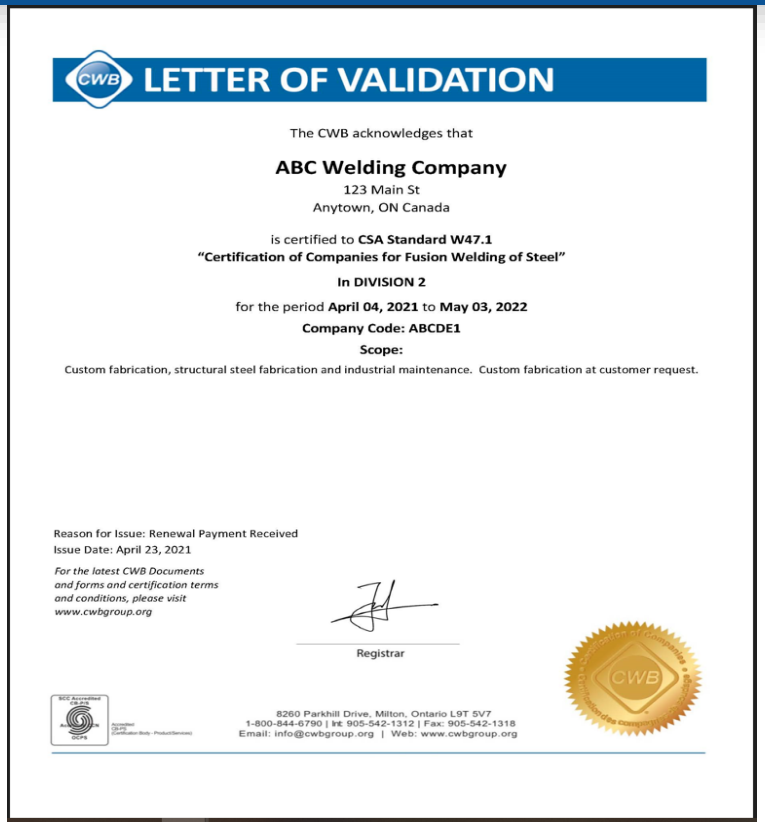
How can I verify CWB certification

- Verify company status on CWB website
  - **www.cwbgroup.org**

- Ask fabricator for current ***Letter of Validation***
  - Annual letter given to certified clients
  - Verify dates
  - Verify scope of operations.

- Call the CWB
  - 1-800-844-6790

How can I verify CWB certification



LETTER OF VALIDATION

The CWB acknowledges that

ABC Welding Company
123 Main St
Anytown, ON Canada

is certified to **CSA Standard W47.1**
"Certification of Companies for Fusion Welding of Steel"

In DIVISION 2

for the period **April 04, 2021** to **May 03, 2022**

Company Code: ABCDE1

Scope:

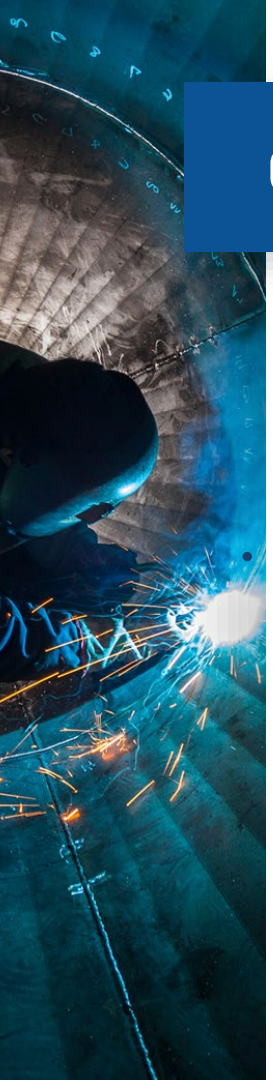
Custom fabrication, structural steel fabrication and industrial maintenance. Custom fabrication at customer request.

Reason for Issue: Renewal Payment Received
Issue Date: April 23, 2021

For the latest CWB Documents and forms and certification terms and conditions, please visit www.cwbgroup.org

Registrar

8260 Parkhill Drive, Milton, Ontario L9T 5V7
1-800-844-6790 | Int. 905-542-1312 | Fax: 905-542-1318
Email: info@cwbgroup.org | Web: www.cwbgroup.org



CSA A660 Steel Building Systems

4.3.4.3. Steel Building Systems

(1) Steel building systems shall be manufactured by companies certified in accordance with the requirements of CSA A660, "Certification of Manufacturers of Steel Building Systems"

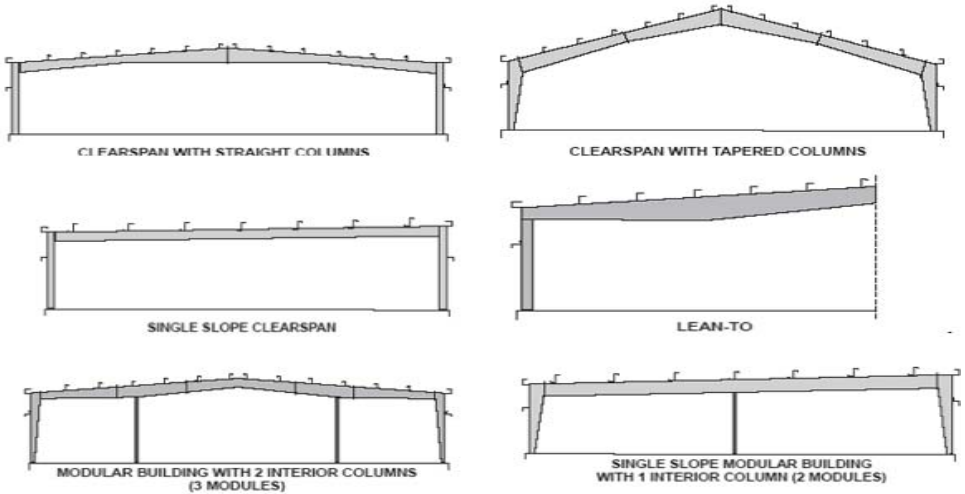
Quality management system that involves:

- Detailed audit of the manufacturer's design systems to ensure compliance to Canadian standards
- Thorough review of the manufacturer's fabrication from raw material to finished product
- Similar to the more common ISO 9001 certification but much more detailed and specific to steel building manufacture

CSA A660 Steel Building Systems

What is a steel building system?

- "an integrated assembly of manufactured ***steel*** primary structural components, secondary structural components of ***any material***, and cladding of ***any material***, specifically designed by the manufacturer to support and transfer loads and provide a complete or partial building shell."



CSA A660 Steel Building Systems

Examples of A660 applications :

- Traditional Pre-engineering Buildings
- Fabric Covered Buildings
- Mini Storage Building

CSA A660 Steel Building Systems

 Certification of manufacturers of steel building systems

Certificate of design and manufacturing conformance

This Certificate is to affirm that all components of the steel building system described below, to be supplied by the named manufacturer certified in accordance with CSA A660, have been or will be designed and fabricated in accordance with the following Standards to carry the loads and load combinations specified.

1. DESCRIPTION

Manufacturer's name and address _____
Manufacturer's Certificate No. under CSA A660 _____
Customer order number _____
Building type and size _____
Intended use and occupancy _____
Importance category [*NBC*, Sentence 4.1.2.1.(3)] _____
Site location _____
Applicable building code _____
Builder's name and address _____
Owner's name and address _____

2. DESIGN STANDARDS **Engineer's initials***

National Building Code of Canada, 2005, Part 4: *Structural Design* _____
CSA S16-09, *Design of steel structures*
CSA S136-07, *North American specification for the design of cold-formed steel structural members*
Other (specify) _____ dated _____

3. MANUFACTURING STANDARDS _____

(a) Fabrication has been or will be in accordance with CSA S16 and CSA S136, as applicable.
(b) Welding has been or will be performed in accordance with CSA W59 and CSA S136, as applicable.
(c) The manufacturer has been certified in accordance with CSA W47.1, for Division 1 or 2, and/or CSA W55.3, if applicable.
(d) Welders have been qualified in accordance with CSA W47.1.

4. PURLIN STABILITY _____

Purlin braces are provided in accordance with CSA S136, Clause D3 and Appendix B, Clause D3.2.3. In particular, for a standing seam roof supported on movable clips, braces providing lateral support to both top and bottom purlin flanges have been or will be provided. The number of rows is determined by analysis but in no case is it less than 1 for spans up to 7 m inclusive or less than 2 for spans greater than 7 m.

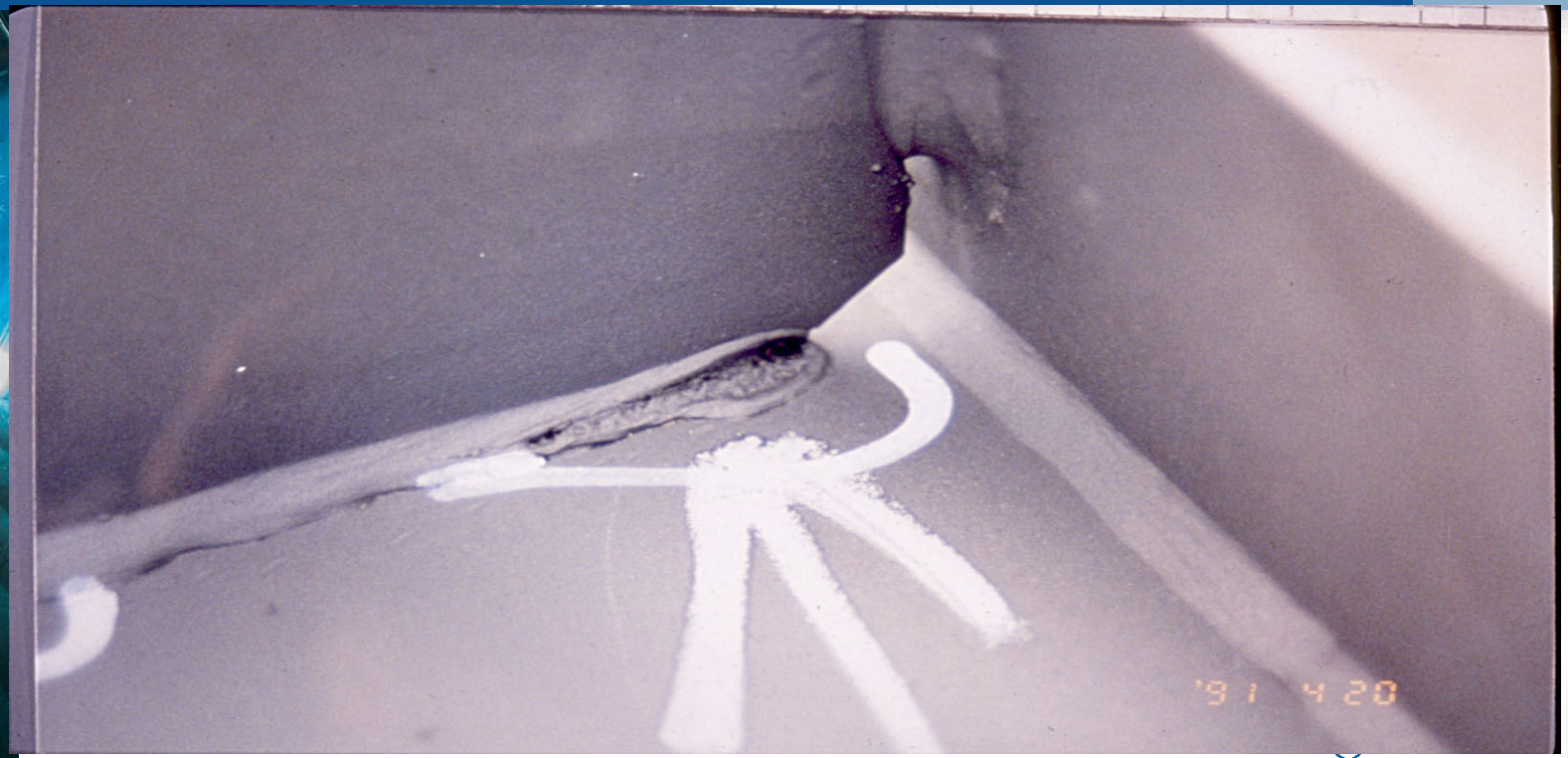
- All buildings must be supplied with a "*Certificate of Design and Manufacturing Conformity*"
- Many permit sets of drawings include the certificate

What about Other National Standards / Equivalency?

- There are no domestic or international equivalents to CWB certification requirements for structural steel or pre-engineered buildings.
- Other national systems, such as that of the American Welding Society (AWS) do not include key concepts such as independent and on-going verification and welding supervisors / engineers
- Not sure? Call the CWB

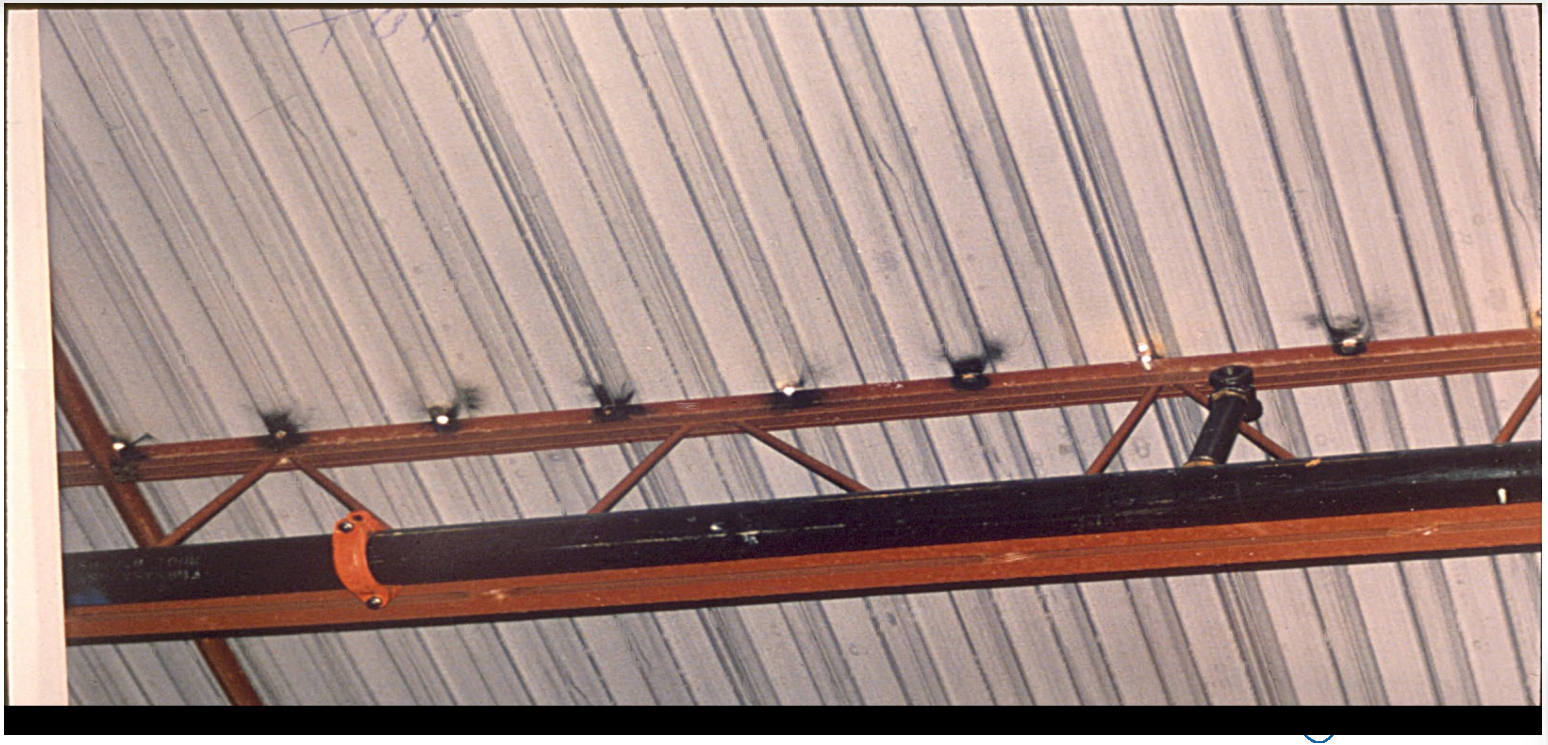
Welding faults

Welding faults



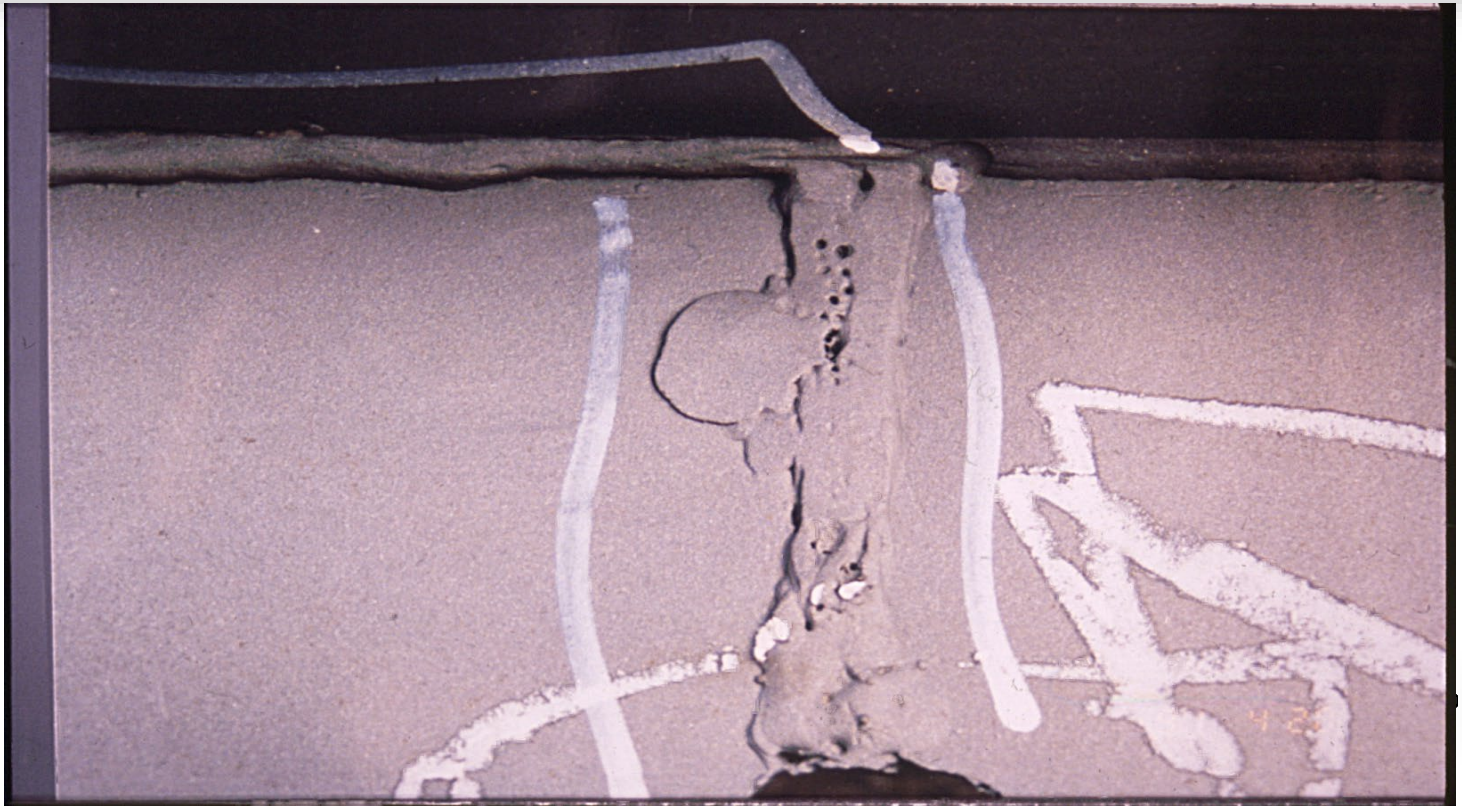
Weld crater

Welding faults



Damaged joist / deck

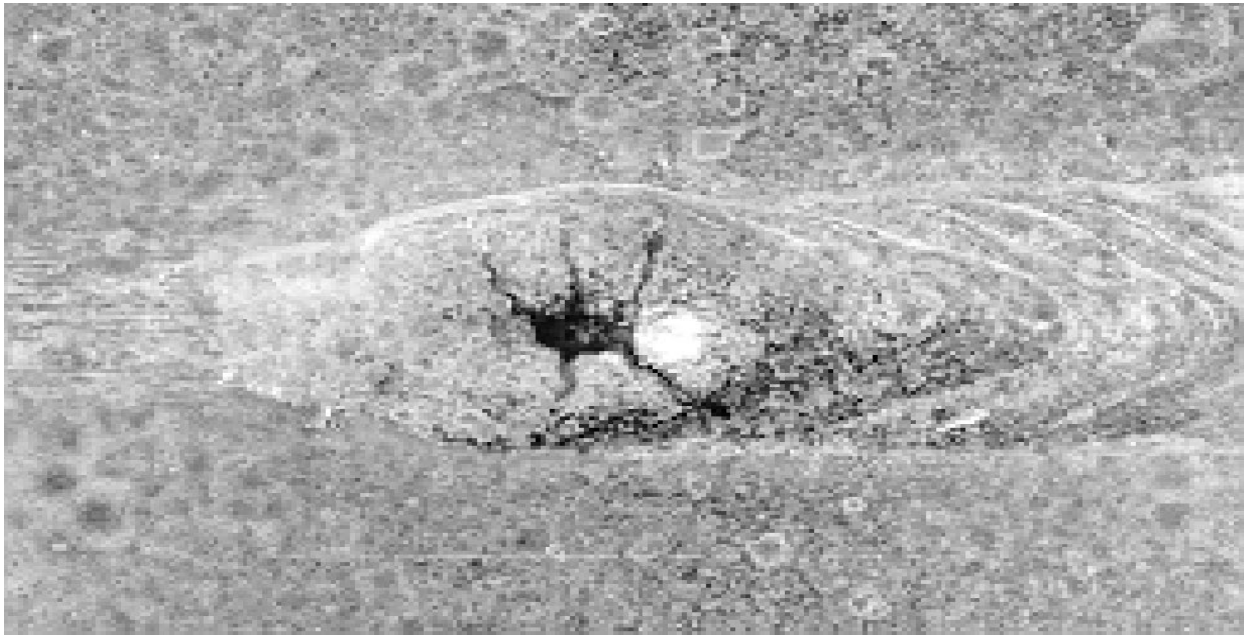
Welding faults



Welding faults

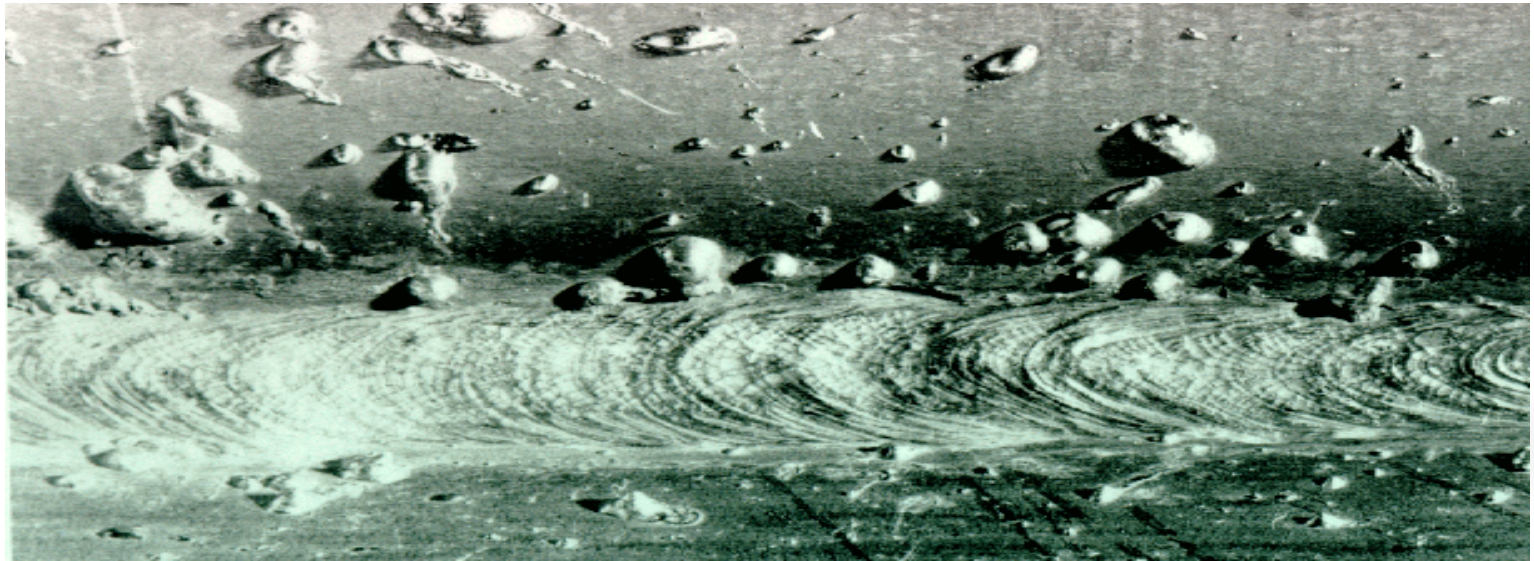
Source of Cracking

Crater Cracks are Characterized by Star-Shaped Patterns



Welding faults

- Excessive spatter - Unacceptable visually
- Caused By:
  - Incorrect Welding Parameters
  - Foreign Material on/in Weld Joint



Q & A

ASK A QUESTION

THANKS!

Any questions?

CWB Group Office of Public Safety

- www.cwbgroup.org
- PublicSafety@cwbgroup.org
- 1-800-844-6790 x717