

Meeting the Steel Standards:

Challenges for Safer Construction in Myanmar

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Myanmar Steel Industry Association (MSIA)

29h July2025

Agenda

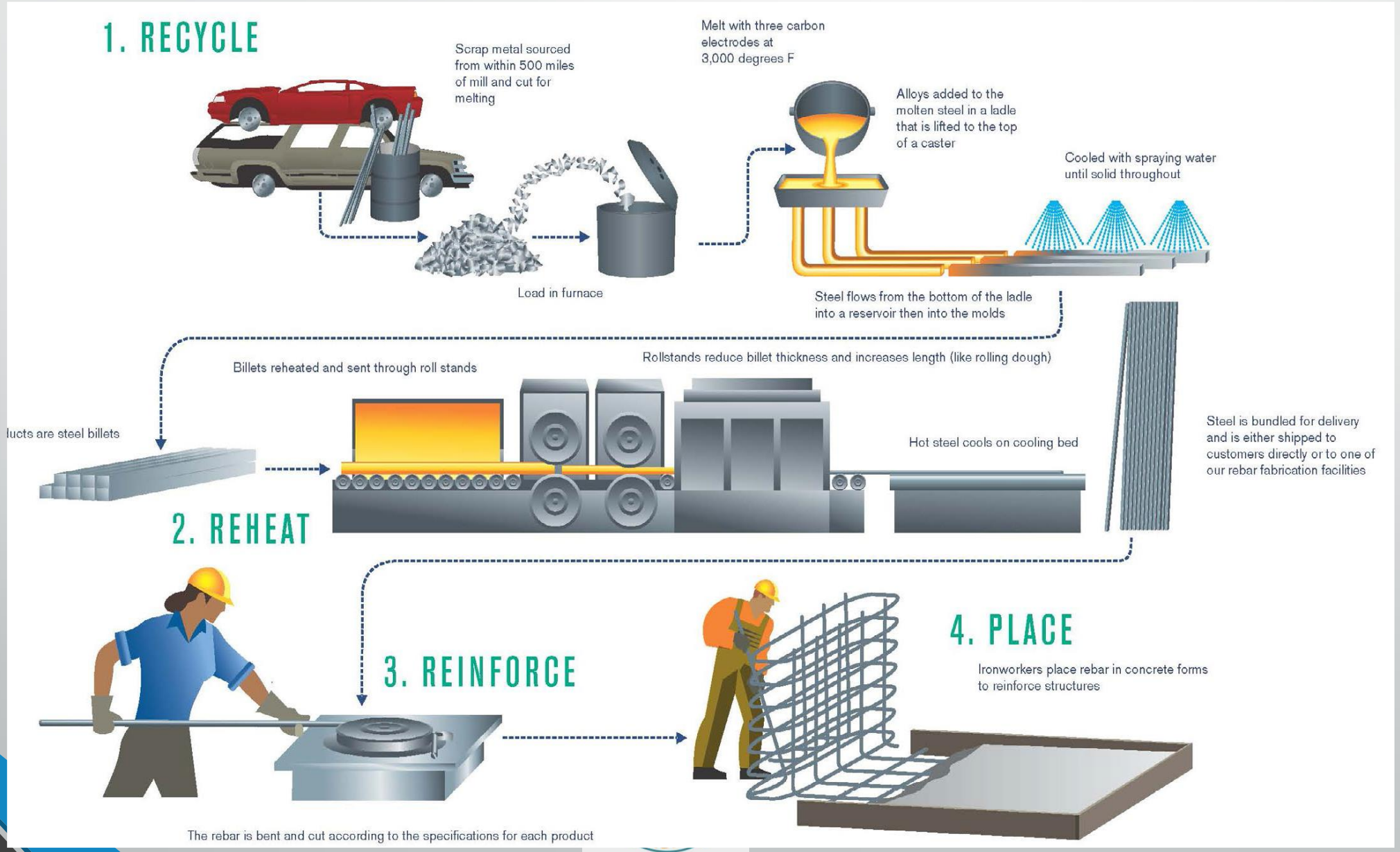
- The Urgency
- The Rebar Supply Chain
- Basics of ASTM Rebar Standards
- **The Challenges**
- **The Solutions**
- Blockchain Technology for Rebar Quality Control

The Urgency – Why Action is Needed Now

- **March 28, 2025, M 7.7 Earthquake:** Many buildings collapsed due to **poor-quality construction materials including rebars**.
- **Current Rebar Market:**
  - Imported rebars ***(variable quality, some substandard)***
  - Locally produced rebars (***outdated induction furnaces, untested scrap materials and quality control***)
- **Risk:** Continued use of substandard rebars = More **deadly collapses** in future quakes.

Value for Money vs. Money for Value

REBAR Supply Chain



Basics of ASTM Rebar Standards

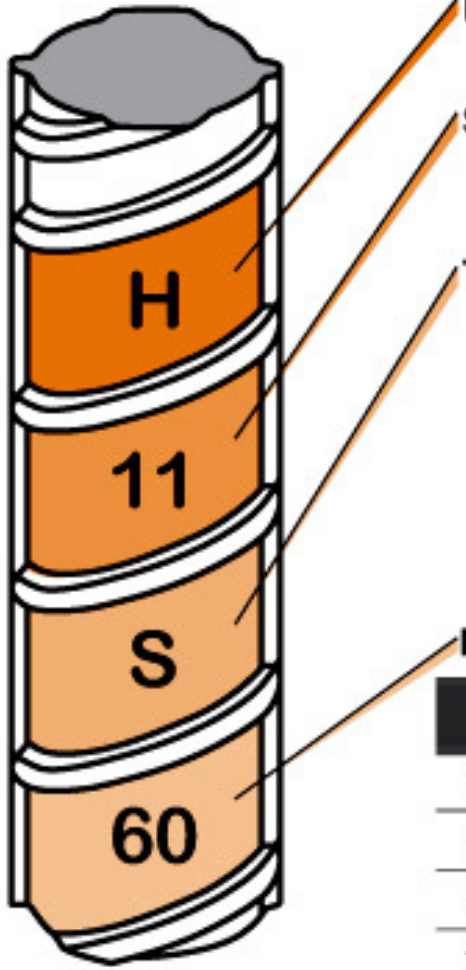
- **ASTM A615/A615M** – *Standard Specification for Deformed and Plain Carbon-Steel Bars for Concrete Reinforcement*
  - **Requirements:**
    - **Tensile Test** (ASTM A370) – Determines yield strength, tensile strength, elongation.
    - **Bend Test** (ASTM A370) – Checks ductility by bending rebar around a mandrel.
    - **Rebar Markings & Dimensions** – Verification of deformations (spacing, height).
    - **Chemical Analysis** (ASTM A751) – Checks carbon, phosphorus, sulfur, and other elements.

Associated Testing Standards:

- **ASTM A370** – *Standard Test Methods and Definitions for Mechanical Testing of Steel Products*
  - Covers tensile testing, bend tests, hardness tests, and Charpy impact tests.
- **ASTM E8/E8M** – *Standard Test Methods for Tension Testing of Metallic Materials*
  - Used for tensile testing (yield strength, elongation, etc.).
- **ASTM A751** – *Standard Test Methods, Practices, and Terminology for Chemical Analysis of Steel Products*
  - Determines chemical composition (carbon, manganese, sulfur, phosphorus, etc.).

Additional Quality Control Tests:

- **Dimensional Checks** – Confirming rib height, spacing, and bar diameter.
- **Weight Verification** – Ensuring mass per unit length complies with standards.
- **Metallographic Examination** (if required) – Microstructure analysis (ASTM E3, E112).



Point of Origin
Letter(s) or symbol(s) of producing mill

Size Designation
3, 4, 5, 6, 7, 8, 9, 10, 11, 14, 18
[10, 13, 16, 19, 22, 25, 29, 32, 36, 42, 57]

Type of Steel
S = Carbon-Steel (A615/A615M)
W = Low-Alloy Steel (A706/A706M)
SS = Stainless-Steel (A955/A955M)
R = Rail-Steel (A996/A996M)
I = Rail-Steel (A996/A996M)
A = Axle-Steel (A996/A996M)
CS = Low-Carbon Chromium (A1035/A1035M)

Minimum Yield Designation (Grade Mark or Grade Line)

Inch-Pound Markings		Metric Markings	
60	Grade 60*	4	Grade 420*
75	Grade 75**	5	Grade 520**
80	Grade 80***	6	Grade 550***
100	Grade 100***	6	Grade 690***
120	Grade 120****	8	Grade 830****
None	Grade 40 or 50	None	Grade 280 or 350

*Or 1 Grade Line / **Or 2 Grade Lines / ***Or 3 Grade Lines / ****Or 4 Grade Lines

For stainless-steel (ASTM A955/A955M) reinforcing bars:
"•" for Grade 60 [420], "••" for Grade 75 [520]

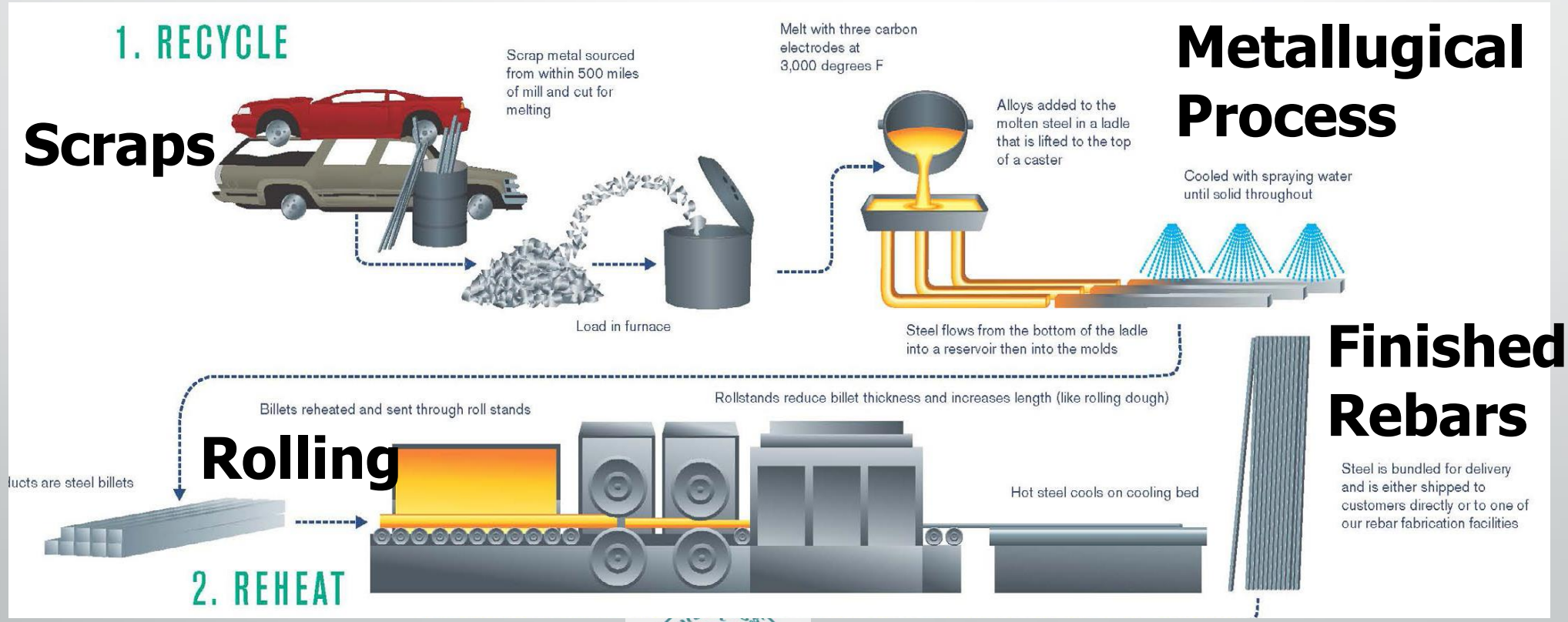
Proper labeling /Marking ensures

- ***traceability,***
- ***quality control, and***
- ***compliance*** with structural safety standards.

The Challenges for Domestic Rebars

Unsorted scraps ??

Induction Furnace???



Scraps

Metallugical Process

Rolling

Finished Rebars

Temperature Control ???

Testing / Marking???

The Challenges for Domestic Rebars

- **Induction Furnaces (IF):**
  - Designed for scrap melting, not precise steel chemistry control without secondary metallurgy process.
  - High impurities (S, P, Cu) → ***weak, brittle rebars***.
- **Lack of Testing & Quality Control:**
  - No proper chemical analysis, mechanical testing, or certification.
- **Cost of Upgrading to MFIF (Medium Frequency IF) or EAF (Electric Arc Furnace):**

The Challenges for Domestic Rebars

- **Dimensional Accuracy**
  - Considerably smaller dia. And a lot more than ASTM A 615 allowance.
- **Weight Accuracy**
  - Considerably lighter weight. And a lot more than ASTM A 615 allowance.
- **Fail at Bend Test**





The Challenges for Imported Rebars

- **No Mill Test Certificate (MTC) or fake certificates**
- **Dimensional and Accuracy**
  - Not within the ASTM A 615 allowance.
- **Weight Accuracy**
  - Not within the ASTM A 615 allowance.
- **Fail at Bend Test**
  - **Brittleness, High Carbon Equivalent Ratio (CE Ratio)**

Manufacturer / Fabricante / Herstellerwerk	Type of document / Tipo de documento / Art der Prüfbescheinigung	Document number / N° de certificado / Bescheinigungsnr. 08/03/2018
outokumpu	**INSPECTION CERTIFICATE** CERTIFICADO DE INSPECCION ABNAHMEPRÜFZEUGNIS according to / de acuerdo con / nach EN 10204-3.1	**0000363415 /** Page / Pagina / Seite: **1 / 2**

1 Steel Drive; P.O. Box 13000; Calvert, AL 36513-1300

Customer/Ship to / Cliente / Besteller/Empfänger

Customer's order number / N° de [illegible] / Kundenbestellnr.: H20383

Manufacturer's works order no. / N° de Pedido Manufactura / Werksauftragsnr.: 901245326 / 001

Delivery note no. / N° de Entrega / Lieferanzeige Nr.: 85560926 / 010

Product / Producto / Erzeugnis: COIL/BOBINA/BAND

Terms of delivery / Condiciones de entrega / Lieferbedingungen:
ASTM A240/A240M-17, ASME SA-240 Sec. II part A Ed.2017
ASTM A480/A480M-17, ASME SA-480 Sec. II part A Ed.2017
ASTM A666-15
SAE AMS 5516 P
SAE AMS 5513 J

Steel grade and quality / Acero / Stahlsorte und Gütegruppe: TYPE 304/302

Customer's material no./ N° de material del cliente/ Kundenmaterial-Nr.	Product dimensions (Thickness / Width / Length) / Dimensiones (Espesor / Ancho / Largo) / Maße des Erzeugnisses (Dicke / Breite / Länge)	Sweetmaking procedure/ Proceso de manufact./ Herstellart	Finish/ Acabado/ Ausführung
	1.58 mm x 1,219.20 mm 0.0620 inch x 48.0000 inch	AOD	Mc / 2B

Packing-No./ N° de Empaque/ Paket-Nr.	No.of pieces/ Pieces/ Stückzahl	Actual weight/ Peso actual/ Ist-Gewicht	Actual length/ Longitud actual/ Ist-Länge	Coil-No./ Bobina No./ Band-Nr.	Heat No./ Colada/ Schmelze	Sample Id. N° de muestra/ Proben-Id.	Sample Id. N° de muestra/ Proben-Id.
3127311	1	12,280 lb / 5,570 kg	1,194 ft / 364 m	829796	521957	1000566855	1000566856
3127336	1	12,390 lb / 5,620 kg	1,194 ft / 364 m	829796	521957	1000566855	1000566856
3127345	1	12,390 lb / 5,620 kg	1,194 ft / 364 m	829796	521957	1000566855	1000566856
Sum / Suma / Summe	3	37,060 lb / 16,810 kg					

Heat / Colada / Schmelze	Country of Melt / País de colada / Erschmelzungsland	Chemical composition / Composición Química/ Chemische Zusammensetzung Chemical analysis per ASTM A751-14a									
		% C	% Si	% Mn	% P	% S	% Cr	% Mo	% Ni	% N	% Cu
521957	USA	0.026	0.33	1.34	0.031	0.0010	18.18	0.30	8.04	0.062	0.41

Sample Position/ Localiz.de la muestra/ Probenlage: TRANSVERSE Mechanical testing per ASTM A370-17

Inspection lot/ Lote de inspección/ Prüflos	YS0.2% PSI / MPa	TS PSI / MPa	EL A2" %	HRB		
1000566855	40,464 / 279	88,324 / 609	57.3	80		
1000566856	40,029 / 276	88,760 / 612	54.7	80		

Resistant to intergranular corrosion / Resistente contra corrosiónintergranular / Beständig geg. interkrist. Korrosion: ASTM A 262-15, PRACTICE E - Sample Acceptable

Dimensions-surface / Dimensiones-Superficie / Maße-Oberfläche: OK

Test of identity (spectrum analysis) / Control de identidad (análisis espectográfico) / Verwechslungsprüfung (Spektralanalyse): OK

Heat Treat: Solution anneal 1900°F/1040°C Min, Air and water quench

Bending test O.K.

No welding or weld repairs were performed on this material

DFARS 225.872-1 Compliant

No intentional additions of Mercury compounds were made or used

Free of radioactive contamination

EU RoHS Directive 2011/65/EU Compliant

Originator of the document / Originador del documento / Aussteller der Bescheinigung

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An ISO 17025: 2005 accredited lab
EU PED 2014/68/EU, Anex I, 4.3 certified

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Name of expert / Nombre del experto / Name des Sachverständigen

Date of issue and validation / Fecha de emisión y validación / Datum Ausstellung / Bestätigung

08/03/2018

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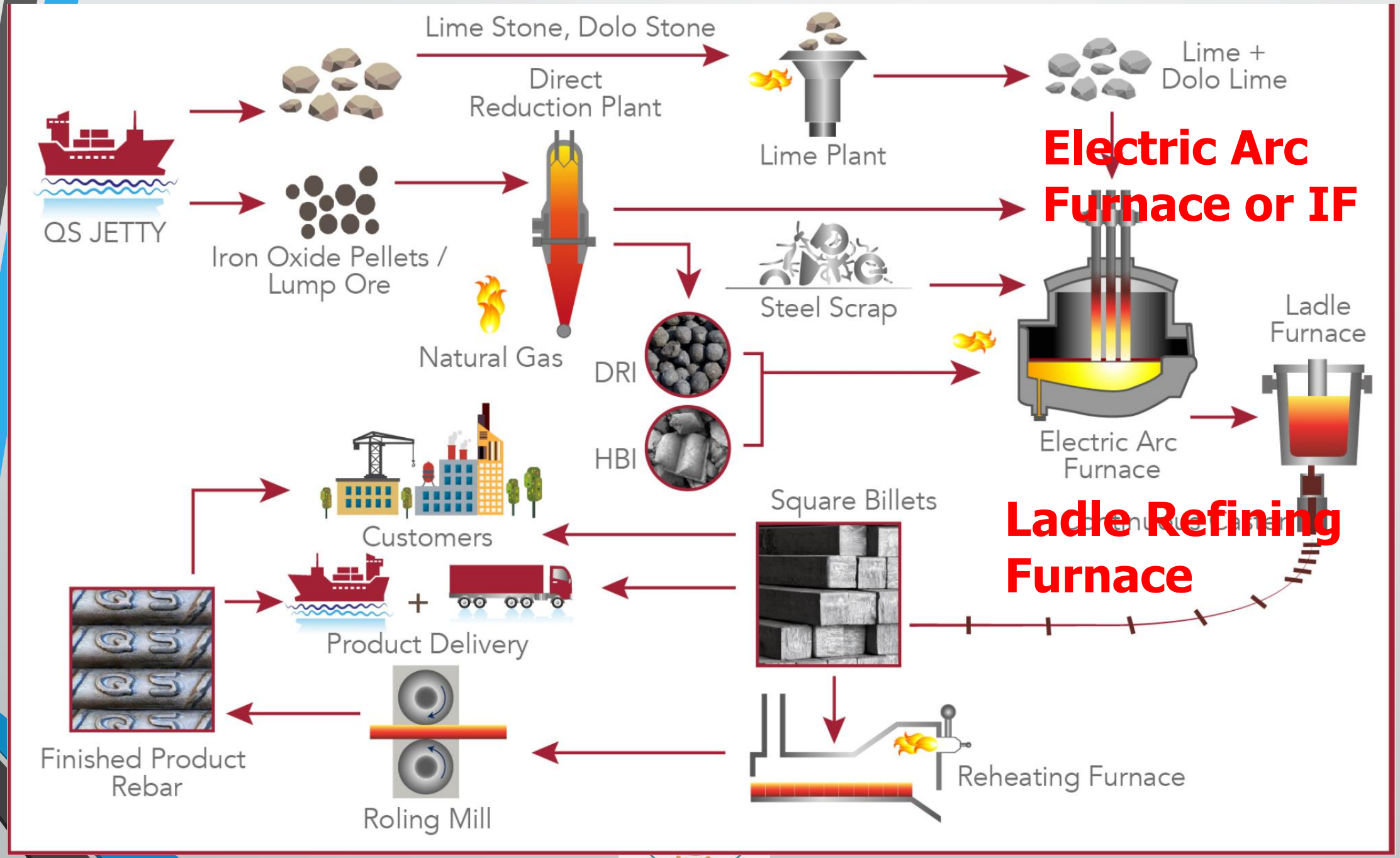
Solutions – Affordable Phased Improvements

- **Short-Term :**

- ☑ **Strict Scrap Selection & Pre-Treatment**
  - avoid contaminated scrap (e.g., coated, galvanized, mixed metals).
  - Use spectrometers for **real-time chemistry checks**.
- ☑ **Basic Process Upgrades**
  - **Ladle refining** (to reduce impurities).
  - **Continuous casting** (better microstructure than ingot casting).
- ☑ ***Mandatory Testing & Certification***
  - Enforce **ASTM A615 testing** (tensile strength, bend tests, chemical analysis).
  - Third-party **quality certification** for all rebars (local & imported).


Lime Stone, Dolo Stone
Direct
Reduction Plant
Lime Plant
Lime +
Dolo Lime
Electric Arc
Furnace or IF
QS JETTY
Iron Oxide Pellets /
Lump Ore
Natural Gas
Steel Scrap
DRI
HBI
Ladle
Furnace
Electric Arc
Furnace
Customers
Square Billets
Ladle Refining
Furnace
Product Delivery
Finished Product
Rebar
Roling Mill
Reheating Furnace

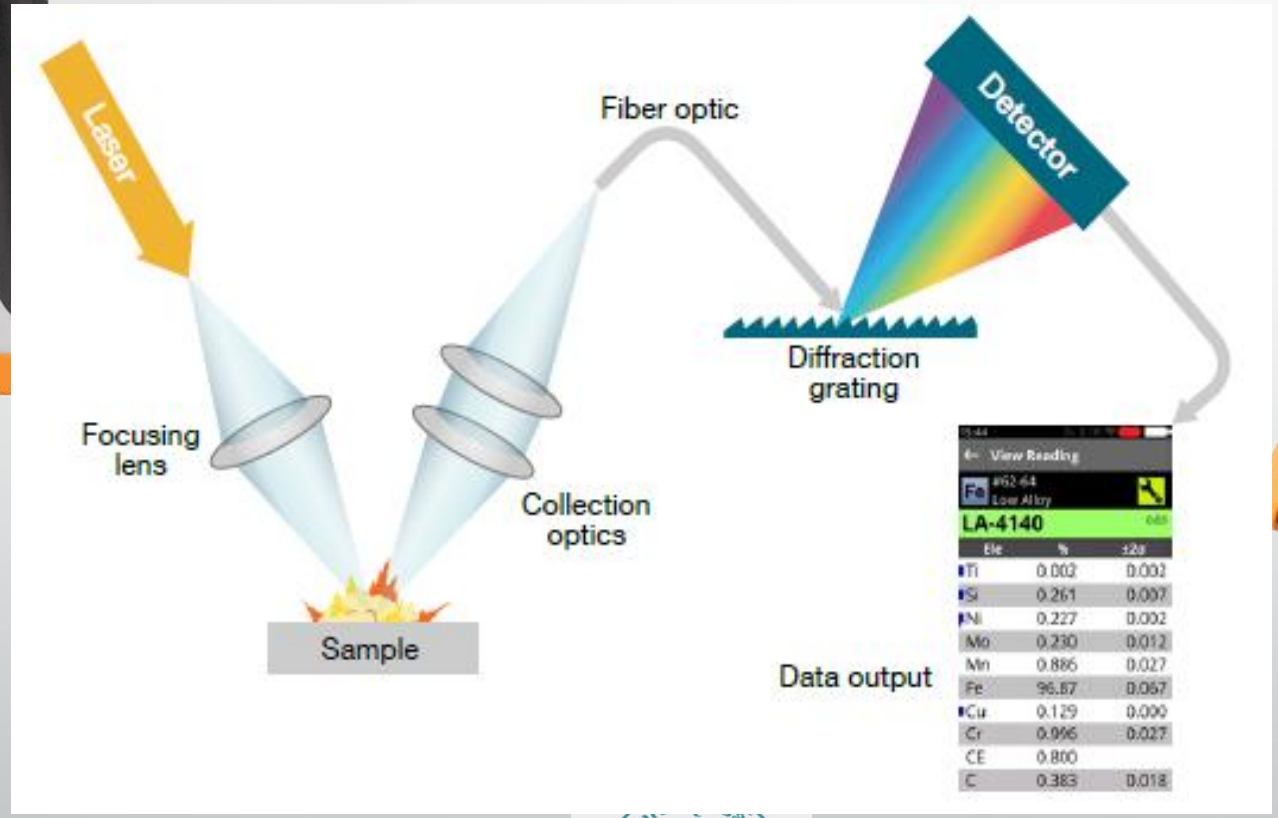
Solutions – Affordable Phased Improvements

Mid-Term : Strengthening the Supply Chain

- **1. Incentivize Mill Upgrades**
  - Tax breaks for mills adopting **better refining & testing**.
  - Low-interest loans for **EAF transition** in the future.
- **2. Control on Substandard Imports**
  - **Strict checks** with portable **XRF or LIBS analyzers** (detect weak rebars) and **Leeb** Hardness Tester.
  - **Tighter control** on fake-certified rebars.
- **3. Local Testing Labs , Accredited National Lab & Training**
  - **Testing centers** in key steel hubs.
  - Training for **mill operators & inspectors** on ASTM standards.



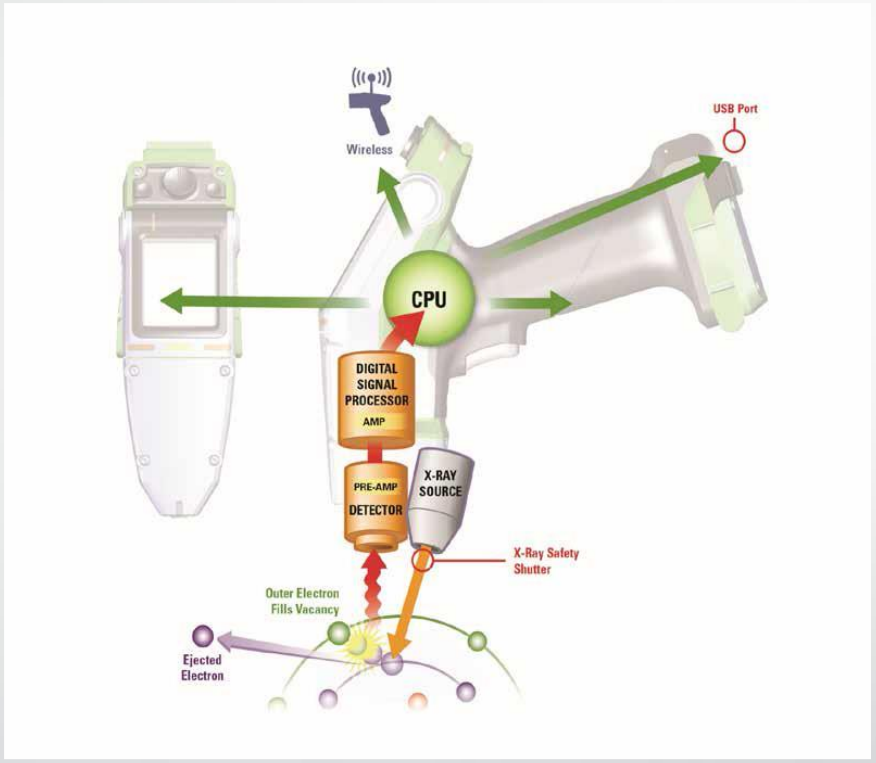
Handheld LIBS (Laser Induced Breakdown Spectroscopy) ***Analyzers***

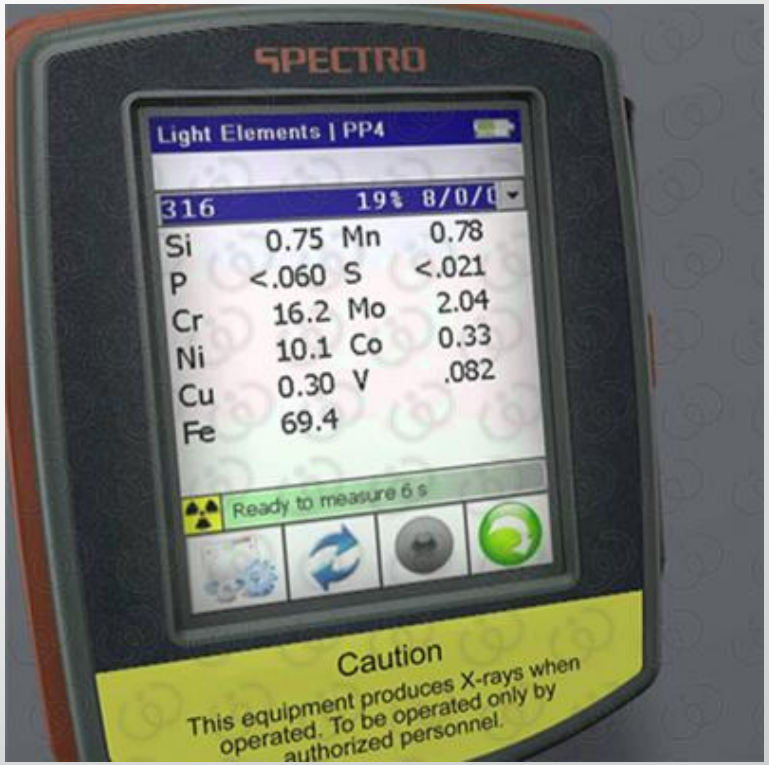




XRF (X-ray Fluorescence)







Element Range	LIBS	XRF
Light Elements (Z < 11)	Better detection (e.g., Li, Be, B, C, N, O, F, Na)	Poor/No detection (XRF struggles with elements below Mg (Z=12))
Mid-Heavy Elements (Z = 11-20)	Good (Mg, Al, Si, P, S, K, Ca)	Good (Mg to Ca) but may have lower sensitivity for lighter ones
Transition Metals (Z = 21-30)	Excellent (Ti, V, Cr, Mn, Fe, Co, Ni, Cu, Zn)	Excellent
Heavy Metals (Z > 30)	Good (As, Pb, Hg, U, etc.)	Better sensitivity and detection limits (especially for trace heavy metals)
Rare Earth Elements (REEs)	Possible but with lower sensitivity	Possible but depends on instrument energy range

Portable Leeb Hardness Tester And OES

Hardness to Tensile Strength Estimation





OES for Chemical Composition Test

Solutions – Affordable Phased Improvements

Long-Term : Sustainable Steel Industry

- **Goal:**
  - Full compliance with **ASTM A615/ ASTM A706**
  - Gradual shift to modern **EAF** where feasible.
  - **Recycling partnerships** for clean scrap supply.
- **National rebar quality database** (traceability)
  - ***Rebar QA Dashboard***

CARES

UKAS PRODUCT CERTIFICATION 0002

911002

Validate with the CARES Cloud App

CARES product certification (UK Certification Authority for Reinforcing Steels)





Call to Action – What Needs to Happen Now?

- **Government:**
  - Enforce **mandatory testing** for all rebars (local & imported).
  - Support mills with **scrap regulations & incentives**.
- **Mill Owners:**
  - Invest in **basic refining & testing** now. Plan for **EAF transition** within the next 5 years or so.
- **Construction Sector:**
  - Demand **certified rebars only** – refuse substandard materials.

The cost of inaction? Measured in graves.

Blockchain Technology for Rebar Quality Control

1. Immutable Mill Test Reports (MTRs or MTC)

- **ASEAN Example:** Vietnam's *SteelChain* Platform (2022)
- **How it Works:**
  - Each rebar batch generates a digital MTR with:
    - Chemical composition (XRF/OES data), Mechanical test results, Production timestamps
  - Data is hashed onto a ***Hyperledger Fabric*** blockchain
  - QR codes on rebars link to permanent records
- **Impact in Vietnam:**
  - Reduced fake certificates by **92%** in 18 months
  - **Customs clearance time dropped from 3 days → 2 hours**

Blockchain Technology for Rebar Quality Control

2. Cross-Border Certification Sharing

- **ASEAN Steel Quality Network (2024 Proposal)**
- **Features:**
  - Malaysia's SIRIM, Thailand's TISI, and Vietnam's VSA **share test data**
  - **Zero-Knowledge Proofs** protect commercial secrets while verifying compliance
  - Myanmar customs can instantly verify Indonesian SNI certificates

Potential Savings:

Duplicate testing costs across ASEAN

Blockchain Technology for Rebar Quality Control

3.Vietnam – Digital Quality Tracking for Rebar (2023)

- **Company/Project:** Hoa Phat Group (Vietnam's largest rebar producer)

- **Solution:**
- Implemented **blockchain-based traceability** for rebar quality assurance.
- Each batch of rebar is assigned a ***unique QR code*** containing mill test certificates (MTCs), chemical composition, and mechanical properties.
- Contractors and regulators can scan QR codes to verify authenticity, reducing counterfeit rebar in the market.

  Outcome:
- Improved trust among buyers in **high-rise projects** in Ho Chi Minh City and Hanoi.

  Reduced non-compliant rebar in the supply chain.

Blockchain Technology for Rebar Quality Control

4. Indonesia: 3D Scanning for Rebar Compliance

- **Company/Project:** PT Krakatau Steel (State-Owned Steel Producer)

- **Solution:**
- **Laser 3D scanning** to check rebar dimensions (rib height, spacing) against **SNI (Indonesian National Standard)**.
- Automated sorting systems to segregate non-compliant rebars.

- **Outcome:**
- Reduced construction delays in **Jakarta's toll road projects** due to rebar rejection.



Blockchain Technology for Rebar Quality Control

5. Japan: *Smart Rebar Certification (JIS Compliance)*

- **Company/Project:** Nippon Steel (Japan)

Solution:

- **RFID tagging** for rebar bundles, storing JIS (Japanese Industrial Standard) certification data.

Outcome:

- Zero recall incidents in **Tokyo's earthquake-resistant infrastructure projects**.
- **100% compliance** with Japan's strict seismic construction codes.

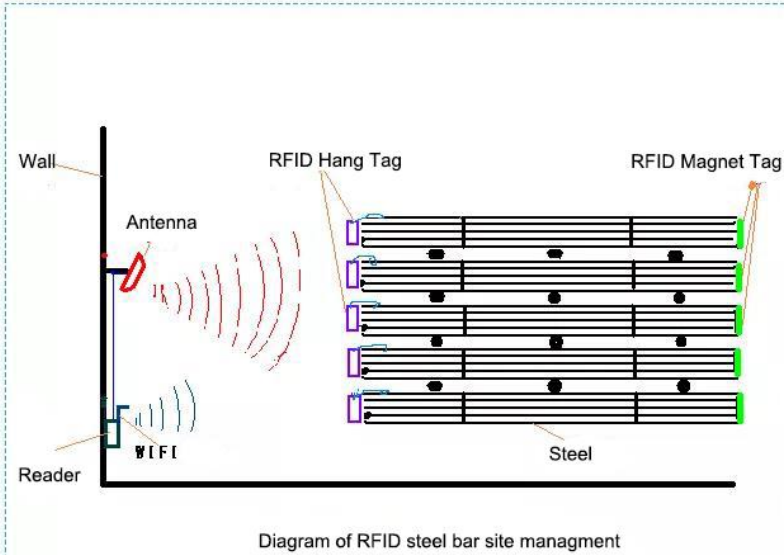
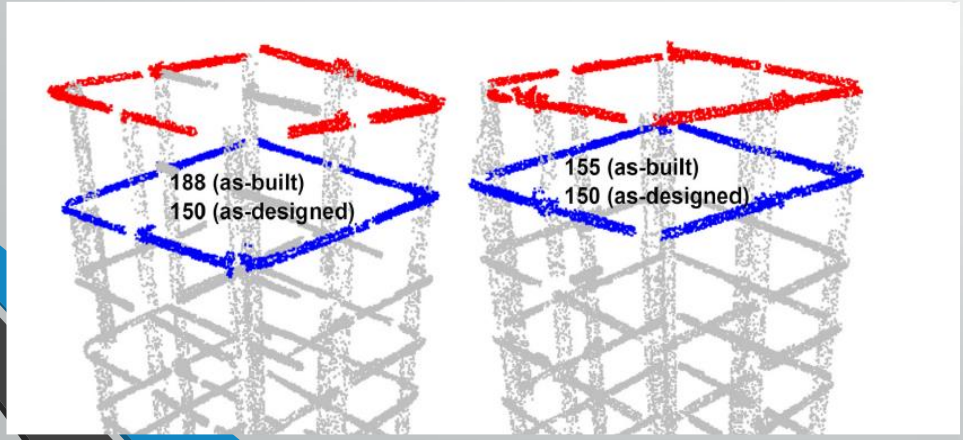
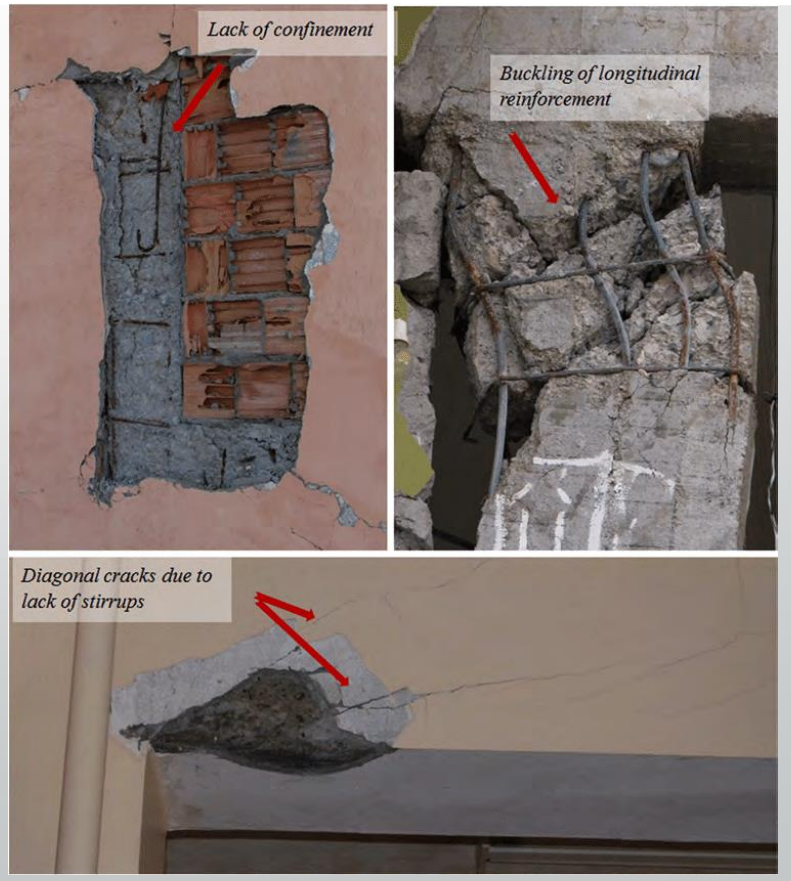


Diagram of RFID steel bar site managment



- **ACI 318, IS 13920, Eurocode 8**
- ***Bend Testing***
- ***Seismic Detailing***
- ***Confinement Detailing etc…***





Thank You

- ***"The choice, thus, is clear: quality reinforcement isn't a mere construction detail; it's the frontline defence against disaster."***

Stay safe, Myanmar!