GAMMON INDIA LIMITED

Presentation by

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ON

27-09-11
CONTROLLING REINFORCEMENT ACTIVITIES

• The cost of Reinforcement in Reinforced concrete structures will contribute 15% to 25% of cost of contract value of a project.

• Hence there is a need to control on all activities related to Reinforcement steel

• The activities to be controlled are planning, indenting, ordering, procurement, inventory management, storage, utilization, measurement, reconciliation etc.
CONTROLLING REINFORCEMENT ACTIVITIES

• Nominate an experienced Sr. Engineer at site.

• Depute the assistants to assist him as per the quantum of work.
CONTROLLING REINFORCEMENT ACTIVITIES

PLANNING:

• Study the contract documents and technical specifications

• Find the provisions regarding mode of measurement in item rate contract.

• Check the items payable including reinforcement.

• Check whether laps, spacers and chairs are payable or inclusive.

• Arrange the required relevant codes, standards and other related documents at site for reference and study.

• Study the tender drawings without fail.
CONTROLLING REINFORCEMENT ACTIVITIES

PLANNING:

• Calculate quantity as per the preliminary drawings, Dia wise and grade wise.

• Prepare the month wise procurement schedule as per the construction schedule.

• Prepare procurement schedule of binding along with reinforcement schedule.

• Plan for cover blocks and splices (if required) in advance to get required strength of cover blocks casted at site.
CONTROLLING REINFORCEMENT ACTIVITIES

PLANNING:

• Obtain Dia wise and grade wise quantities from designer for lump sum contract if drawings were not available at initial stages of project for planning procurement.

• Allow an inventory of 45 days while planning procurement or depending upon the availability.

• Indent only 90% of quantities of total requirement till you have all approved drawings to avoid variations due to design/drawing revisions.

• Cover block – with grade in excess of 5N/mm²
CONTROLLING REINFORCEMENT ACTIVITIES

INFRASTRUCTURE:

- Locate the reinforcement yard at suitable location keeping logistics in view.

- Provide centralized reinforcement yard.

- Provide separate yard for storage and for cutting/bending.

- Provide separate yard for scrap storage.

- Fence all yards.
CONTROLLING REINFORCEMENT ACTIVITIES

• Keep only one entry and exit with security in each yard.

• Plan the internal roads in the yard with proper drainage facility.

• Plan and Locate cutting and bending machine suitably.

• Maintain documents either in soft/hard from for entry and exit of vehicle with registration number of vehicles.

• Install electronic weigh bridge of required capacity inside the yard.
CONTROLLING REINFORCEMENT ACTIVITIES

PLACING ORDER:

• Indent for quarterly requirement 30 days in advance apart from total requirement in phase.

• Specify supply lengths Dia wise along with quantity.

• Specify the rolling margin and straight length bars and avoid U-bars procurement.

• Insist for traceable manufacturers test certificate with each lot.
CONTROLLING REINFORCEMENT ACTIVITIES

• Check the purchase order before releasing to the vendor with the indent raised at site to avoid mismatch with indented quantity, type/size and other requirements.

• Before releasing of PO check the stock at site to avoid excess inventory of reinforcement at the site either in the from of cut/bend/protruding steel/usable scrap, etc.

• In metros check for availability of ready made cut and bent steel suppliers and amend the PO accordingly.
CONTROLLING REINFORCEMENT ACTIVITIES

RECEIPT AT SITE:
• Declare receiving time as Day time only.
• Inspect carefully for defects like excessive corrosion, scaling, pitting etc. before accepting the consignment.
• Check type and grade of reinforcement steel.
• Correlate the material, invoice and the MTC before accepting/ even taking weighment.
• Accept only after weighing and check physically verifying weight on weigh bridge.
• Where weigh bridges are not installed, inform the transporter to stop the vehicles at nearest weigh bridge to site to avoid redirecting truck from site to weigh bridge.
CONTROLLING REINFORCEMENT ACTIVITIES

• Keep an escort from weigh bridge to site yard after weighing and for weighing of tare weight of vehicle.

• Take random samples to establish actual unit weight and rolling margin supplier wise and diameter wise for each lot.

• Put tags/identification boards with diameter, weight, batch etc.

• Unload the reinforcement carefully by mechanical means or manually to avoid deformation of bars.
Check for TMT Bar

Chemical Composition

<table>
<thead>
<tr>
<th>C%</th>
<th>Si%</th>
<th>Mn%</th>
<th>P%</th>
<th>S%</th>
<th>Ni%</th>
<th>Cu%</th>
<th>Cr%</th>
<th>Mo%</th>
<th>Al%</th>
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<tbody>
<tr>
<td>0.172</td>
<td>0.20</td>
<td>0.80</td>
<td>0.017</td>
<td>0.025</td>
<td>0.10</td>
<td>0.25</td>
<td>0.16</td>
<td>0.01</td>
<td>0.010</td>
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</tbody>
</table>

TEMPERED MARTENSITE SURFACE

PERRITE/PERLITE CORE

Hardness vs. radius on treated rebars
Confirmation test of TMT Bar (ETCH TEST)
<table>
<thead>
<tr>
<th>S.NO.</th>
<th>DESCRIPTION</th>
<th>FREQUENCY</th>
<th>REFERENCE DOCUMENT</th>
<th>ACCEPTANCE DOCUMENT</th>
<th>ACCEPTANCE VALUE</th>
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</thead>
<tbody>
<tr>
<td>1</td>
<td>Chemical Properties</td>
<td>One sample per Heat No.</td>
<td>IS : 1786</td>
<td>Tech. Spec. of Contract</td>
<td>Max</td>
</tr>
<tr>
<td></td>
<td>a) % CARBON</td>
<td></td>
<td></td>
<td></td>
<td>0.30%</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td>0.02%</td>
</tr>
<tr>
<td></td>
<td>b) % SULPHUR</td>
<td></td>
<td></td>
<td></td>
<td>0.06%</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td>0.01%</td>
</tr>
<tr>
<td></td>
<td>c) % PHOSPHORUS</td>
<td></td>
<td></td>
<td></td>
<td>0.06%</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td>0.01%</td>
</tr>
<tr>
<td></td>
<td>d) % SULPHUR &amp; PHOSPHORUS</td>
<td></td>
<td></td>
<td></td>
<td>0.11%</td>
</tr>
<tr>
<td></td>
<td>e) CARBON EQ</td>
<td></td>
<td></td>
<td></td>
<td>0.42%</td>
</tr>
<tr>
<td>2</td>
<td>Physical Properties</td>
<td>One sample per 500 MT</td>
<td>IS:1786</td>
<td>Tech. Spec. of Contract</td>
<td>Min 415 N/mm²</td>
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<td></td>
<td>a) Yield Strength</td>
<td></td>
<td></td>
<td></td>
<td>Min 485 N/mm²</td>
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<tr>
<td></td>
<td>b) Ultimate Tensile</td>
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<td></td>
<td></td>
<td>14.50%</td>
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<tr>
<td></td>
<td>Strength</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td>c) Elongation</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td>d) Bend Test</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td>e) Rebend Test</td>
<td>One Sample per Heat No.</td>
<td>IS :1786</td>
<td>Tech. Spec. of Contract</td>
<td>No cracks to be seen on visual inspection after bending and Rebending</td>
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</tbody>
</table>
# Record for Rolling Margin

<table>
<thead>
<tr>
<th>Invoice No. &amp; Cast No.</th>
<th>Dia in mm</th>
<th>Weight in kg</th>
<th>Required Mass per metre run</th>
<th>Actual Mass obtained in Kg per metre run</th>
<th>Tolerances</th>
<th>Variation</th>
</tr>
</thead>
<tbody>
<tr>
<td>SRMB/TM/103/05-06</td>
<td>16.00</td>
<td>0.78</td>
<td>1.580</td>
<td>1.544</td>
<td>± 5</td>
<td>-6.00</td>
</tr>
<tr>
<td>SRMB/TM/105/05-06</td>
<td>12.00</td>
<td>0.44</td>
<td>0.888</td>
<td>0.872</td>
<td>± 5</td>
<td>-6.00</td>
</tr>
<tr>
<td>05/AHM/68</td>
<td>10.00</td>
<td>0.32</td>
<td>0.617</td>
<td>0.623</td>
<td>± 7</td>
<td>-8.00</td>
</tr>
<tr>
<td>L-006645-2</td>
<td>36.00</td>
<td>4.09</td>
<td>7.990</td>
<td>8.091</td>
<td>± 3</td>
<td>-4.00</td>
</tr>
<tr>
<td>RU/TMT/2005/08/469</td>
<td>36.00</td>
<td>3.99</td>
<td>7.990</td>
<td>7.956</td>
<td>± 3</td>
<td>-4.00</td>
</tr>
</tbody>
</table>
REBEND TEST

Stage 1

Stage 2

Stage 3

REBEND TO INCLUDED ANGLE OF 157.5°

BEND TO INCLUDED ANGLE OF 135°

NOMINAL DIA OF SPECIMEN = φ

NOTE — φ Represents the nominal size in mm of the test piece.

FIG. 2 REBEND TEST
BEND TEST AS PER IS 1786 - 2008

• The test piece, when cold, shall be doubled over the mandrel by continuous pressure until the sides are parallel.

• The specimen shall be considered to have passed the test if there is no rupture or cracks on bent portion.
BEND TEST (IS -1599)

Test specimen bar

Mandrel

Rupture or crack zone
COMMON CHECKS

• Mandrel / bar bending machine ( for 16 ø & above )
  Mandrel of proper diameter is to be used for maintaining the radius of bend. If mandrel made tight the bar may show cracks at the bend due to less radius of bend.

• Mark on rebars / Grade
  Check the grade of steel and trade mark/name of the manufacturer.
COMMON CHECKS

• Check coupler welded or threaded is as per drawing, For bars in tension max 20% of steel area staggered 600mm c/c minimum.

• Check lap welding Min length 12d with gap or space, welded with recommended electrode by (checking carbon content of rebar matching electrode.)
CONTROLLING REINFORCEMENT ACTIVITIES

STORAGE AND ISSUE:

• Stock reinforcement on elevated pedestals of minimum 150 mm above ground level cover with PVC sheets

• Issue reinforcement on FIRST-IN-FIRST-OUT BASIS to minimize oxidation loss.

• Keep record of all steel issued from storage yard to cutting and bending yard.

• In case of theft lodge FIR and register claim with insurance company
REINFORCEMENT STEEL STOCK YARD
BAD HANDLING OF R/F
BAD HANDLING OF R/F
REINFORCEMENT YARD IN BAD SHAPE
CONTROLLING REINFORCEMENT ACTIVITIES

PREPERATION OF BBS AND RECORD OF CONSUMPTION:

• Prepare bar bending schedule from approved, latest revised drawings and check for error/inconsistencies and take approval from consultant/client.
• Plan and check for fix ability and sequence of fixing.
• Plan intelligent cutting from full length bars by preparing cutting length.
• Cutting length shall be worked out after considering bend effect.
• Check the bent shapes for dimensional accuracy against full scale template and get approval from client.
• Keep painted specimen bars for comparison with production.
• Use cut pieces for ancillary works and record consumption.
HANDLING OF REINFORCEMENT:

• Avoid re bend, reshape and straighten bent bars
• If bending and re bending are unavoidable, ensure bending radius is not less than 4D AND 6D respectively for MS and Tor bars.
• After complete fabrication bundle them with identification tags.
• Use tractor trailer for internal shifting of reinforcement in the project area.
• Avoid manual shifting as for as possible.
• Shift only the required qty of cut and bent bars to nearest location where bars are to be fixed.
THREADED END COVERED WITH PLASTIC CAPS
CONTROLLING REINFORCEMENT ACTIVITIES

FIXING OF REINFORCEMENT:

- Draw the lay out as per the drawing on PCC, Shuttering, on vertical bars etc.

- Stagger laps and avoid excessive laps.

- Use mechanical splices for higher diameter.

- Insist for open stirrups and links in case of complex structures.

- Provide minimum number of laps by using full length bars wherever possible.

- Use pre-fabricated cages wherever possible. Provide adequate bracing, spacers and sufficient lifting points to avoid deformation of cage.
CONTROLLING REINFORCEMENT ACTIVITIES

FIXING OF REINFORCEMENT:

• Avoid substitution of bars, if unavoidable check for over consumption.

• Do not use tack weld at cross points.

• Avoid excessive chairs. Arrive at optimum spacing of chairs by trials.

• Use cut pieces/welded scraps for chairs. Avoid using full length bars for making chairs.

• Use spider beam to lift heavy cages.
CONTROLLING REINFORCEMENT ACTIVITIES

FIXING OF REINFORCEMENT:

• Check spacing's, number of bars, location of bars etc. before start of concrete.

• Fix the bars accurately with specified cover of size and grade.

• Plan best fixing sequence to achieve accuracy and to accommodate form work, void formers, starter bars etc.

• Ensure inspection of reinforcement fixing intermittently to avoid redoing.

• Avoid large time gap between the concrete pours to prevent deterioration of projected reinforcement.

• Record deviations /extra bars provided as per instruction of consultant / client.
Arrangement of concrete pipeline
REINFORCEMENT THEFT BY CUTTING FROM STRUCTURES
PROPER ACCESS MUST BE MADE FOR FIXING LOCATION
NO COVER AT THIS SIDE
ROCK PIECE PROVIDED AS COVER
MORE COVER AT ONE SIDE AND LESS OTHER SIDE
MORE COVER AT ONE SIDE AND LESS OTHER SIDE
MORE LENGTH OF BINDING WIRE LEADS TO CORROSION AND COST
Heavy embedded parts in TG Deck
Congested reinforcement
SCALING DUE TO CORROSION
VARIOUS SIZES OF MANDRELS ON BENDING MACHINE
COMMON CHECKS

• Clear cover : Measured from nearest surface of main reinforcement and concrete surface.

• Nominal cover : Cover considered for design purpose which includes stirrups and links.

• Check Nominal cover as per drawing tolerance 0 to +10 mm for nominal cover only.

• Check Size and spacing of links and stirrups as per drawing.
Nominal Cover

Clear cover

Main Reinforcement

Stirrups / Links

No tolerance for Clear cover

Tolerance 0 to +10 mm for Nominal cover
COMMON CHECKS

• Check that rebar diameter, numbers, shape and spacing is as per drawing and changes if made are approved by RCC consultant.

Slab tolerance in spacing of reinforcement

± 10 mm for slabs upto 200mm thick

± 15 mm for slabs more than 200mm thick

• Double binding not specified in IS.
CORRECT SPACING OF SLAB REINFORCEMENT
BINDING OF STEEL WITH BINDING WIRE

For Piling reinforcement use galvanized or PVC coated binding wires

- Single
- Saddle
- Figure 8
Lap length in columns with 1:6 max slope at splice point.
COLUMNS REINFORCEMENT

- Check that column bars laps staggered (min 50 %) and Clear distance between two laps c/c 1.3 Ld
SLOPE AT LAP NOT 1 : 6
## MECHANICAL SPLICING SPECIFICATIONS

<table>
<thead>
<tr>
<th>COUPLER DIMENSIONS</th>
<th>BAR SIZE</th>
</tr>
</thead>
<tbody>
<tr>
<td>Length A</td>
<td>16 52</td>
</tr>
<tr>
<td>Diameter G</td>
<td>16 25</td>
</tr>
<tr>
<td>Weight Kg</td>
<td>16 0.13</td>
</tr>
<tr>
<td>No. of Rebar Thread</td>
<td>10-12</td>
</tr>
</tbody>
</table>

[Image of mechanical splicing coupler]

[Image of mechanical splicing coupler with threads]
LAP SPLICES VS MECHANICAL COUPLERS

Lap splices double the number of bars leading to rebar congestion which can restrict the flow of larger aggregates.

Mechanical couplers reduce rebar congestion and improves concrete consolidation.
LAP SPLICES VS MECHANICAL SPLICES

LAP SPLICES
Additional rebar in the lap zone

MECHANICAL SPLICES
Ideal balance of steel and concrete
Extensive usage of couplers in critical structure
Extensive usage of couplers for critical structure
Bar Break Guarantee Test for Coupler Joint
Acceptance Criteria:
The following shall constitute the acceptance standard of spliced joint:
• The tensile strength of the spliced joint shall be more than Rebars of Fe 415.
• The spliced Bartech coupler joint should not fail in tension test at coupler location.
• Check at site:
  • Thread dimension check with GO and NOGO gauges
  • Tensile strength check one sample per 1000 joints
FIG. A-11 LAP JOINT

FIG. A-12 LAP JOINT
Butt Welding of Reinforcement

- Butt weld cut pieces of reinforcement steel beyond economical break even length by cutting ‘V’ groove and welding by qualified welder, especially for 20mm dia and above.
- Test welded joint to make sure that joint is stronger than parent bar, irrespective whether such testing is insisted by clients or not.
- Use butt weld bars not more than 20% in a given cross section.
Cross Section of Butt Weld sample for welder qualification
FOOTING REINFORCEMENT

• Check Foundation rebars have 90° bend upwards at foundation ends as per drawing.

• Check that at bottom, column bars bent min 300 mm or 24 d whichever is more or as per drawing.

• Check column Main Bars in plumb, tied by stirrups inside footing @ 8 ø, 300 c/c (Minimum 3 Nos) or as per drawing.
TYPICAL FOOTING DETAILS

Use 8Ø 300mm links Min 3 Nos Or as specified.

50 mm cover

75 mm

Ldt

Ldc

G L

Depth of foundation >500 mm

75 mm

300mm or 24 D which is greater

50 mm cover

Ldt

Ldc

Depth of foundation >500 mm

75 mm

300mm or 24 D which is greater
FOOTING REINFORCEMENT

- Check for any plinth beam/dowels passing through footing
COLUMN REINFORCEMENT

• Check column Bars Joggle, ( max shape 1:6 )

• Column offset $\leq 75$mm ( 1 or 2 sides ), main bars offset bent. If cranking not within beam, provide 3 Nos ties c/c 8 dia ( 2 extra + 1 regular ) at crank point.
Fixing ties to be removed before erecting cage above

Splicing when lower bar cranked into a position inside the upper bars when relative displacement of column faces is less than 75mm
Fixing ties to be removed before erecting cage above

≤ 75 mm

Slop 1: 6 max

Extra ties at the point of bend

Splice with lower bars cranked into position inside upper bars (Intermediate Floors)
Slop 1: 6 max

Fixing ties to be removed before erecting cage above

Splice when Upper bar cranked into a position inside the lower bars
Fixing ties to be removed before erecting cage above

Stirrups in beam column junction

Slop 1: 6 max

Splicing when lower bar cranked into a position inside the upper bars with steping of columns from one side.
Fixing ties to be removed before erecting cage above

> 75 mm

Column Starter

Splicing at the floor level when the relative displacement of column faces is more than 75 mm
COLUMN REINFORCEMENT

- Check that dowels (2Ld) for bars requiring change in diameter for next floor.
COLUMN REINFORCEMENT

- Check that column offset > 75mm (1 or 2 sides) bars in columns (not extending) stopped at floor (inverted L) and dowels provided.
At Roof Level
Column Bar inside Slab

7.14B TERMINATION OF COLUMN BARS INSIDE A SLAB
LEG LENGTH OF STIRRUP LESS THAN 8D
LOOSE COLUMN LINKS
BEAM REBARS NOT THROUGH THE COLUMN
COLUMN REINFORCEMENT

- Local bend in column bars provided at column.
- Sudden bend in column bars.
COLUMNS REINFORCEMENT

- Check column bars projecting min 50 (Ld) above slab or as per drawing with minimum 2/3 fixing ties/ temporary stirrups before casting of slab. Ties removed for erecting next stage.
• Check spacing of stirrups, diameter, shape is as per drawing (end anchorage 8d for 90° and 6d for 135°) for heavy columns fabricated in parts, extra 12 Ø open ties at double spacing.
END ANCHORAGE 8 Ø FOR 90 º BEND IN STIRRUPS
END ANCHORAGE 6 Ø FOR 135 ° BEND IN STIRRUPS

By bending ring into 135° net saving per ring is 16 d
SLAB / BEAM REINFORCEMENT

- Check lap length of steel in beams / slab is 30 d or as per drawing.

Two rebars with different diameters. Provide lap with respect to smaller diameter.
Fig. 7.13 Beam-Column Intersection

- **Primary Beam**
- **Secondary Beam**
- **Column Bars Straight Through Junction**
- **Top Bars, Primary Beam Bars Placed Above Secondary Beam**
- **Bottom Bars Stop Short of Column Face**
- **Bottom Support Bars**
- **Stirrup Hanger Bars Stop Short of Column Face**
Stirrups in beam column junction

Slope 1:6 (max)
SLAB / BEAM REINFORCEMENT

• Check that beam bars are modified for electric down take conduits with adequate cover to the conduits.

• Between two electrical conduits 25mm gap shall be given.
ELECTRIC CONDUITS INCORRECTLY PLACED
SLAB / BEAM REINFORCEMENT

• Check that sunk toilet, beam with down takes modified (suspended / taken below if required.

Beam damaged for making holes for drainage lines
SLAB / BEAM REINFORCEMENT

• Check position of lap in continuous beams bottom bars over intermediate support, top bars extreme middle third or as per drawing.
POSITION OF LAPS IN CONTINUOUS BEAM

Top reinforcement lap at extreme middle third

Bottom reinforcement lap at center of intermediate support
SLAB / BEAM REINFORCEMENT

- Main steel of secondary beams is resting on the main bars of primary beams.
SLAB / BEAM REINFORCEMENT

• Check that main beam bars are passing through column main bars or as per drawing.

At least one bar of main beam reinforcement shall go through column
SLAB / BEAM REINFORCEMENT

• Check that minimum horizontal spacing between the bars max of:

1) Max diameter of bar

2) 5 mm more than the max size of aggregates.
SLAB / BEAM REINFORCEMENT

• Check that minimum vertical spacing (Pin Bars) for two or more rows of bars in line is maximum of:
  1) Maximum diameter of bar
  2) 15 mm
  3) 0.67 x max size of aggregates
SLAB / BEAM REINFORCEMENT

• Check spacing of stirrups, diameter, shape is as per drawing (end anchorage 8d for 90° bend and 6d for 135° bend)
CHAIRS FOR SLABS

• Chairs shall be designed to take manual and mechanical loads during slab casting. Chair is meant to maintain spacing between two meshes of slab top and bottom.

• Chair shall not be touching to shuttering or sheathing.
WRONG PRACTICE FOR PLACING CHAIRS ON SHUTTERING
EXTRA REINFORCEMENT IN RECTANGULAR OPENINGS

ADDITIONAL REINFORCING BARS
EXTRA REINFORCEMENT IN CIRCULAR OPENINGS

ADDITIONAL REINFORCING BARS
VERTICAL SECTIONS OF THE WALLS

- Wall Thickness $\leq 170$ mm
- Wall $>170$ mm BUT $\leq 220$ mm & walls $> 220$ mm with vertical reinforcement greater than nominal
- WALLS of thk $> 220$ mm with nominal reinforcement

- Horizontal bars tied to vertical reinforcement
- Clips connecting the two layers of vertical reinforcement
- Clips connecting the two layers of Horizontal reinforcement
COMMON STEEL DETAILING ERRORS
CANTILEVER BEAM DETAILING

INCORRECT

CLOSE STIRRUPS

CORRECT

Ld/2

Ld

Ldt

Ldt/2

Ld/2
NON PRISMATIC BEAM DETAILING

INCORRECT

CLOSE STIRRUPS

CORRECT

Ld/2

Ld

Ld/2

Ldt/2

Ldt
Details of Main & Secondary beams

Secondary beam

Main beam

INCORRECT

Secondary beam

Close rings

1.5d

1.5d

Hanger bars

Main beam

CORRECT
CONTINUOUS BEAM DETAILING

INCORRECT

CORRECT
CANTILEVER BEAM PROJECTING FROM COLUMN

INcorrect

Not less than 0.5Ast

Not less than greater of 0.5 L or Ld 50mm

Correct

0.25Ast

Ld/3

Ld
CANTILEVER BEAM WITH POINT LOAD

INCORRECT

CORRECT

Shear rein.

Ld

Extra ties

d

Ld

2/3d
TERMINATION OF COLUMN BARS INSIDE BEAM

INCORRECT

CORRECT
Good Detailing Practices
Reconciliation of Steel

Steel being the high value item of the project it needs to be reconciled monthly by considering the following factors.

- Scrap measurement
- Billable quantity
- Stock of cut & bent steel in yard
- Transfer to other sites
- Consumption against ancillary works
- Stock available in Stock yard
- Invisible wastages
- Steel saved from cutting and bending allowances.
- Theft documents, if any.
Safety Measures by hazard identification

Safety measures for the following hazards to be taken care on priority

• Cut / Crush injury
• Toppling of crane
• Failure of wire rope
• Hit by truck / trailer
• Poor lighting
• Improper earthing of machines
• Fall of material / person
• Over speed of vehicle
• Hit by projected rods
• Fall of person due to poor house keeping
THANK YOU