Draft #1 – July 15, 2008

A) PURPOSE

The following Column Casting Procedure shall be adhered to ensuring quality product with consistency in process. These procedures are specific to Column Casting production and the principles entailed in our Standard Casting Procedure – Winnipeg shall be observed in all aspects not specifically covered herein.

B) RESPONSIBILITY

The Production Foreman in conjunction with Charge Hands and Lead Hands are responsible for ensuring compliance with and/or enforcement of this procedure.

C) PROCEDURE

It shall be understood that casting of Columns is not finished until the bed is covered with poly tarp and all clean up has been fully completed. Failure to do so may result in work performance related disciplinary action should anyone from the casting and/or stripping crew leave prior to all daily tasks being accomplished.

It shall also be understood that everyone involved in the casting process is not limited solely to their main job task and wherever possible may be required to help others complete their job tasks to ensure the daily cast is completed in as safe and timely a fashion as possible. Failure to do so may result in work performance related disciplinary action.

1. STRIPPING

a) Quality Control Technician shall perform a compression test break to verify the form cast concrete has reached stripping strength as per drawing specification or Engineering. Compression test requirement, break numbers and corresponding times shall be recorded on the white board in designated common area for easy and full reference.

b) Curing temperature records shall be reviewed to determine that proper and even curing temperatures were used, (any discrepancies shall be reported to Engineering for evaluation).

c) Steam supply shall be switched off and insulated tarps used to encapsulate form shall be removed and neatly folded setting aside so as to avoid trip hazard.

d) Charge Hand, Lead Hand or personnel designate shall walk both sides of the form assuring all bolts used to hold JVI's, M-Iron, tilt shore inserts, bulkheads, block outs,

Burke pocket formers, etc. and any top bracing, side bracing, wedges, jigs, etc. have been removed from the form.

e) Casting crew shall open sides of form after verifying all securing mechanisms as described in #1, d) have been removed. The form shall be opened by removing of clamps (one side at a time) after verifying all securing mechanisms as described in #1, d) have been removed. Block out formers shall be removed carefully to avoid damaging block out forms. All form material shall be stored in close proximity to form bed and placed in a neat and orderly fashion so as to avoid trip hazards, avoid potential damage situations and to facilitate ease of install upon form cleaning being completed.

f) If applicable, casting crew shall clean out any concrete seepage from Burke lifters ensuring the Burke lifting device is can lock safely into place without undue delay by crane operators.

g) Strip product with either tandem overhead cranes (product length and lifting hook placement determinant) or single crane and strong back application. Crane operator shall be responsible for ensuring proper strong back and lifting mechanisms utilized as per product stripping requirement.

h) Once product has been stripped from bed, casting crew shall clean tilt shore pockets, remove pocket formers (if applicable), etc. All edges of the product shall be finished with finishing stone prior to leaving plant.

i) Production Foreman in conjunction with production team members as designated shall mark the product on both ends using a paint marker in an appropriate location identifying the piece mark #, casting date, applicable weight and any other markings as per drawing specification.

j) QC technician shall perform a post-pour check on the product after product stripped from the form and prior to leaving plant unless otherwise authorized by Production Foreman. Any discrepancies shall immediately be brought to the Production Foreman's attention for corrective action so that the issue is not repeated in subsequent pours.

k) Production Foreman shall perform post-pour inspections after final finishing processes (sand blasting, retarded finish washing, etc. if applicable) immediately upon completion of said process for acceptance. Should any repairs be needed these shall be addressed immediately so that repairs are completed prior to pieces being yarded in final storage placement unless otherwise directed. Production Foreman shall review all finished product prior to green tag designation.

l) All cast in place hardware faces shall be cleaned of concrete. All nail or sharp projectiles shall be removed immediately upon stripping. Pockets, tilt shore inserts, threaded inserts, Styrofoam block outs, etc. shall be cleaned prior to product leaving the plant. Both these processes may be completed in yard providing Production Foreman has set forth this condition.

m) Crane operators shall ensure product is properly placed on dunnage as per drawing specification.

n) Should product require additional in-plant curing as per contractual specifications, Production Foreman will provide action plan for in-plant storage.

o) Should product require remedial work, it shall be left out of the form in the plant for such repairs only yarded when the repair has been completed unless otherwise designated by Production Foreman.

2. PREPARING FORM FOR CASTING

a) Forms shall be cleaned with rubble removed via wheelbarrow or mobile debris cart.

b) Once form has been fully cleaned, a thin layer of Renocast form oil shall be applied to the entire form including bulkheads, edge rails, and block out formers (if applicable) observing procedures for M-Iron/inserts, etc. as described herein e) and f). Form shall be mopped to evenly distribute and to remove excess form oil. Dirty or contaminated mop heads shall be replaced as needed to ensure a clean underside of final product. Additional attention shall be taken when mopping the underside of the form ledges, pocket formers, etc. to ensure full coverage of all form surfaces.

c) Form walls shall be assembled, straightened using a string line, squared and braced to create the appropriate form for the piece to be produced. Appropriate wedges are to be in place at 24" (610mm) intervals between the base of the form wall and the kick plate. Additionally, appropriate bracing shall be set in place at 24" (610mm) intervals or as otherwise required.

d) Bulkheads shall be set in proper location ensuring accurate and square positioning. Bulkheads shall be set against back stops to ensure length and square integrity.

e) Bearing plates (if required) shall be set in forms (if not attached to cage during assembly) and secured to bulkhead via bolt connection. **The positioning of these bearing plates is critical and they must be secured to bulkhead to remain in position during casting.**

f) Any hardware that is to be cast face down in the form shall be placed in the form and fastened at the appropriate location/position using 2-way tape prior to oiling. The use of nails on the form face/base is to be avoided whenever possible to prevent damage to the forms.

g) The remainder of the form including the base, walls, top of walls, corbels, etc. shall then be oiled and mopped, using clean mops and/or rags as warranted ensuring uniform application of applicable form oil. Oil pooling of any kind must be eliminated since excessive oil causes unsightly bug holes and staining. Care must also be taken not to contaminate hardware that may already be in the form. If hardware has been contaminated clean all surfaces with appropriate degreasing cleaner.

h) All jigs, clamps, various lumber, etc. used in the casting process shall also be oiled and/or greased as the case may be to ensure easy removal and cleaning after casting. Any concrete residue shall be removed either by steel wool or scraper. Hammers are not to be used to remove concrete from the form due to damage potential.

i) The reinforcement cage(s) shall be placed inside form(s) on 1-1/4" bolster chair assemblies (or as otherwise specified by drawing specifications) placed along the bottom of the form. Reinforcement cage shall be lifted with the aid of a strong back to ensure safety, cage integrity in transport and placement.

j) If unable to secure in e) and f), JVI's, M-Iron, tilt shore inserts, block outs, Burke lifters, etc. shall be placed in designated location as per drawing specification and as per previously marked out position. Ensure appropriate pocket formers are in place and if ramset pin assemblies or bolt holes are required for securing said items into place, they are pre-drilled to corresponding locations. The form oil in the placement area shall be removed with degreasing agent and cleaned thoroughly. Two-sided tape shall be applied to the underside of the JVI/M-Iron/Tilt shore insert and the JVI/M-Iron/Tilt shore insert shall be set in place. Care shall be taken during the balance of the set up process to not damage or knock the JVI/M-Iron/Tilt shore insert out of position. After the JVI/M-Iron/Tilt shore insert has been secured into position, form oil shall be applied with a rag to any area of the form where form oil was removed for JVI/M-Iron/Tilt shore insert placement.

k) Corbel forms shall be set in proper location ensuring accurate and square positioning. Corbel forms shall be set against stops to ensure length and square integrity. Corbels will in all likelihood run on angled skews on the form and great care shall be taken to ensure the correct angled measurements are adhered to for the entire corbel placement.

l) Once all mechanical attachments are properly secured to side walls of forms, the casting crew shall visually inspect the form to ensure all tools, debris, wood, etc. have been removed from the forms interior and exterior. Great care shall also be taken to ensure the mechanical attachments are not hindered by the reinforcement cage upon final placement (minor adjustments may need to be made to ensure mechanical attachments clear the cage).

m) Should knife connections be required, it is imperative the knife connection device is install straight and true and remains as such throughout the entire set up and casting process. Any misalignment may lead to rejected columns and/or costly remedial work.

n) Should PVC pipe sleeves/galvanized corroduct be required for erection hardware attachment purposes, it is imperative these PVC pipes/corroducts are secured in place on the corresponding pucks/holding device and that any top mounted bracing and puck devices are properly secured to keep the PVC pipe/corroduct in place, level and straight during the casting process.

o) Should grout tubes be required, it is imperative the grout tubes are long enough to have enough flex room allowing for free movement of grout during erection connection. Great care shall be taken to ensure grout tubes are not positioned in such a manner as to create grout flow issues when the column is in the upright erection position (grout tubes do not bend into upwards position as gravity flow grouting will be unsuccessful). The grout tubes shall be secured in place via jig assembly and properly affixed to the galvanized piping with duct tape ensuring no concrete seepage can penetrate the grout tubes or galvanized piping.

p) Should erection connection hardware be required, ensure all projection outside of form is as per drawing specification and great care shall be taken to ensure the correct measurements are adhered to for the entire hardware bar placement. Threaded connection material outside the form shall be lightly greased ensuring threads are free from concrete build up post casting. For connection hardware through block outs, etc. incorporating nut assemblies, the nut assemblies shall be tightened into place prior to casting and lightly greased for easy removal of any concrete spillage during casting.

q) Lift hooks/aircraft cable as per drawing specification (if applicable) shall be inserted through reinforcement cage and secured with strand tails (strand and cable application only) splayed out providing maximum resistance when lifting. Each strand shall be tightly secured with tie wire in a minimum two places per strand tail either to the stressed strand or reinforcement cage.

r) Rebar reinforcement as per drawing specification shall be inserted through all tilt shore inserts, M-Iron (if applicable), Burke's and any other mechanical connection device and securely tied into place on the reinforcement cage. The reinforcement cage may need to be chaired away from all interior surfaces as per drawing specification using the appropriate sized chair.

s) Corbel placing shall be rechecked for positioning once all sides have been closed.

t) Bulkheads shall be rechecked for positioning once all sides have been closed. Manual turnbuckles or come along devices shall be used to ensure bulkheads stay in position during casting.

u) All cross bracing shall be installed, tightened and clamped into position to ensure the top of the form opening is as per drawing specifications.

v) Once production has ensured the form is correctly assembled, the Production Foreman along with personnel from Quality Control shall perform a pre-pour inspection.

w) Only once the Production Foreman and QC are satisfied the form set up is correct is it appropriate to proceed with casting.

x) Production Foreman, Charge Hand or Lead Hand shall notify batch plant that concrete is required in approximately 15 minutes. The form oiled concrete delivery bucket shall be placed under mixer chute.

3. CONCRETE CASTING AND BEAM FINISHING

a) Prior to complete form set up, Production Foreman, Charge Hand or Lead Hand shall perform an inspection of the vibrator(s), screeds, broom, concrete buckets, etc. to ensure all is in proper working order.

b) Casting crew shall ensure all hand tools, vibrators, electrical cords, etc. are in place prior to concrete arriving at form. Casting crew shall use any wait time prior to concrete arrival at form to begin Off Line Process or cleaning of the casting area.

c) Concrete shall be ordered from the batch plant specifying Work Order #, Mix # and Quantity. Ideally the amount ordered as per drawing specification shall be cut back by a least 0.5 meters allowing for more accurate quantity ordering required to fill the form. By adhering to the preceding, we can verify the correct amount of concrete is batched avoiding extra or waste concrete that is very costly not only to produce but to dispose of after the fact. The wait time for the top up concrete shall be utilized for cleaning the form/plant, finishing what has already been poured, prepping the following day's materials, etc.

d) Batcher and/or QC Technicians shall perform slump and air tests for acceptance as per product/project design specifications prior to placement in the form for the first batch of that mix design for the day. If concrete is within design specifications pouring shall proceed with QC Technicians conducting test procedures according to ACI standards.

e) QC Technician shall perform the required concrete testing procedures including but not limited to; slump, air content, temperature, and making of compression specimens. Concrete testing procedures shall be carried out in accordance with CSA A23.2 Methods of Test for Concrete. For concrete products where heating is necessary, QC shall attach data logger information capture device into concrete compression specimen(s) and concrete product. Prior to concrete being cast into the form, QC shall attach any data log wiring in the proper position. If production requires wire movement or should the data wire become dislodged at any time during the casting of concrete, production shall place wire back in its original position or notify QC immediately so they may replace wiring. QC Technician shall take concrete samples at approximately the half way point and from one of the last 2 buckets of concrete to be cast.

f) After QC Technician has made the concrete compression specimens, they shall place them near the casting form for the applicable product but in such a manner as to not be in the way of the casting procedure or where they can be disturbed. Once the cast product has been prepped for covering, great care shall be taken in placing the test cylinders in such a manner as to replicate actual product curing conditions keeping cylinders away from direct contact with cold air drafts, over-exposure to heating lines/sources, isolated tarp draping, etc. **Ideally, all test cylinders shall be placed**

on an elevated grill stand in such a manner as to allow free air movement around the cylinders for optimum curing conditions keeping in mind the preceding criteria in e) and f).

g) Concrete cast into forms with corbels shall be placed in two layers (without corbels in one layer). The first layer shall be poured for the entire length and width of the form to the height of the form wall taking care not to disturb any hardware and in such a manner as to not cause the reinforcement cage to move in any direction. The concrete shall be poured from the bucket as close to the form as possible in a slow measured manner and hoed/raked into place prior to vibrating. Concrete vibration shall be completed with whip vibrator as follows.

i) For whip vibrator application, the initial cast layer shall be whip vibrated (7 foot whip length with 1-¾" vibrating head) once the bottom layer has been filled completely past any pocket formers by approximately 2-3". Should multiple buckets of concrete be required for a single form cast, all new placement of concrete shall always be placed on top of previously placed concrete. Whips shall be inserted at intervals not exceeding 8" along the length and width of the form ensuring whips are inserted to the full depth of the form but avoiding contact with any part of the form itself and ensuring whips are inserted in an angular fashion to eliminate air pockets entrapped on the underside of the pocket formers or block outs. For the column interior, whip shall be inserted to the full depth of the form and slowly retrieved to provide maximum concrete consolidation slowly retrieved to provide maximum concrete consolidation. Vibrating too close to the form face may result in undesired whip marks (exposed final finish applications) which may result in rejection of the product for cosmetic reasons. The amount of time of vibration per whip insertion/extraction will be dependent upon concrete conditions (i.e. wet, dry). Be mindful that the purpose of vibration is to consolidate concrete removing entrapped air voids throughout the depth of the concrete form. Large air bubbles escaping from the surface should be seen as the whip vibrator is being pulled to the top of the form. Extra vibrating attention shall be applied to areas where there is an abundance of cast in place hardware, strand, connections, etc. as it is imperative concrete is vibrated to all voids in these types of areas in the form.

ii) Once initial layer past block out formers has been vibrated, the second pouring sequence shall commence. Concrete shall be placed in the balance of the form taking care not to disturb any hardware and in such a manner as to not cause the reinforcing bar or hardware to move in any direction. The concrete shall be poured from the bucket as close to the form as possible, in a slow measured manner and hoed/raked into place prior to vibrating. Should multiple buckets of concrete be required for a single Beam form cast, all new placement of concrete shall always be placed on top of previously placed concrete.

iii) The final cast layer shall be whip vibrated (7 foot whip length with 1-¾" vibrating head) once the bottom layer has been filled completely. Whips shall be inserted at

intervals not exceeding 8" along the length and width of the beam form. Whip shall be inserted to the full depth of the form and slowly retrieved to provide maximum concrete consolidation. The amount of time of vibration per whip insertion/extraction will be dependent upon concrete conditions (i.e. wet, dry). Be mindful that the purpose of vibration is to consolidate concrete removing entrapped air voids throughout the depth of the concrete form. Large air bubbles escaping from the surface should be seen as the whip vibrator is being pulled to the top of the leg form.

iv) If a top corbel application is required, concrete shall be poured into the corbel in such a manner as to fill the corbel form to capacity for the length of the corbel. The corbel shall be whip vibrated (7 foot whip length with **1" vibrating head**) once the bottom layer has been filled completely. Whips shall be inserted at intervals not exceeding 8" along the length and width of the corbel. Whip shall be inserted to the full depth of the corbel plus an additional 12" and slowly retrieved to provide maximum concrete consolidation. The amount of time of vibration per whip insertion/extraction will be dependent upon concrete conditions (i.e. wet, dry). Be mindful that the purpose of vibration is to consolidate concrete removing entrapped air voids throughout the depth of the concrete form. Large air bubbles escaping from the surface should be seen as the whip vibrator is being pulled to the top of the leg form.

v) Once the entire corbel has been vibrated, the concrete that has dropped from the corbel bottom shall be cut from the bottom level and placed back into the corbel. The corbel shall then be re-vibrated as outlined in iii) but only through to the depth plus 6" of the initial layer of concrete in the corbel.

vi) The process as outlined in v) shall be repeated until the corbel is full of concrete.

h) Extra caution shall be taken when dealing with steam lines, coils, and heat source elements running adjacent to concrete walls during the entire casting process. At all times do not step or stand on, throw around, throw concrete or refuse on top of lines as they are easily damaged and expensive to replace/repair. Additionally, damaged or clogged lines do not distribute heat efficiently creating adverse curing conditions. All damage must be reported to a Production Foremen, Charge Hand or Maintenance for immediate repair.

i) Once the form has been filled with concrete and vibration has occurred, the top of the fresh concrete shall then be struck off at least once to ensure uniform height.

j) Concrete shall be finished as per drawing specification. Attention shall be paid to areas around block outs, PVC pipe inserts, protruding hardware, etc. to ensure these surfaces are properly finished.

k) Finishers shall place lightly greased metal lifting hook pocket formers into place pressing into concrete until top of former is level with Beam concrete (if required).

Finishers shall magnesium float area around pocket former and remove excess concrete from interior of former.

l) Once the concrete has set for approximately 30-45 minutes (variables may be ambient and/or concrete temperature, slump, etc. and attention should be paid to concrete set up 15 minutes after magnesium float finish), the lifting hook pocket formers (if applicable) shall be removed and all excess concrete under the hook shall be cut out and concrete pocket edges and bottom of pockets smoothed out to create a clean crisp grout pocket once the field has burned the cable hook out.

m) Should top corbels be utilized, once the concrete has set for approximately 30-45 minutes (variables may be ambient and/or concrete temperature, slump, etc. and attention should be paid to concrete set up 15 minutes after magnesium float finish), the top corbel formers shall be removed carefully ***IF*** the concrete is set enough to hold the form of the concrete corbel without slumping. Great care shall be taken to finish the sides of the corbel and the corbel to column connection area to emulate the final finish of the balance of the exposed concrete as per drawing specification.

n) Once the concrete has been properly finished, the area around the form and all tools, jigs, vibrators, etc. shall be cleaned and put away in designated locations.

o) Steam coils, steam lines and/or heat sources shall be located adjacent to the forms in such a manner as to provide appropriate curing heat to the form cast concrete. Ideally, steam lines when practicable shall be placed under any form wall bracing (metal turnbuckle bracing in particular) so as to counteract any adverse enveloping created by errant tarp/poly placement. Steam coils/lines shall be cleaned immediately of any fresh concrete or debris inadvertently placed upon them during the casting process.

p) Tarp/Poly support hoops shall be put in place, compression test specimens shall be placed in designated curing area (criteria set forth in f)) and the form cast concrete shall then be covered tightly with appropriate tarp or poly to create a curing bubble free of cold drafts that will adversely affect curing after initial concrete set up time (1-2 hours) has occurred.

q) Ensure steam is turned on at the appropriate time (1-2 hours after initial set), steam lines are free from obstruction (bleeding lines if required) and the actual steam line is fully within the tarp/poly envelope and not cordoned/isolated off by covering on any side of the steam line or heating source.

4. OFF LINE PROCESS

a) Verify all M-Iron, tilt shore inserts, PVC/galvanized metal piping and miscellaneous hardware is in place for the following day's cast. Should any material be missing or not as per drawing specification, it is imperative the Production Foreman is notified

immediately so remedial action can be taken to ensure all materials are in place prior to the following day's casting process.

b) Ensure all tools are in clean and proper working order and stored where they are supposed to be. Should any tools be missing it is imperative the Production Foreman is notified immediately so remedial action can be taken to ensure all tools are in place prior to the following day's casting process.