

## FIELD CODING PROCEDURES

The City of Greater Sudbury Construction Surveyors' create CAD drawings using AutoCAD Civil3D 2023, the CGS Template, CGS Master Field Code Library, Linework Code Sets and the Figure Prefix Database. Knowing how each part plays a role in developing the finished product that meets our standards is imperative. A laminated copy of the most recent field code library should be attached to each data collector. All codes are in alphabetical order.

Codes are a combination of letters/symbols, from the CGS Master Field Code Library. Linework Code Sets are commands that AutoCAD uses to begin and end lines, curves, etc. **All codes and linework code sets are case sensitive and must be in BLOCK CAPITALS. See 10-4 CODING EXAMPLE DIAGRAMS in the manual to refer to while reading the following coding procedures.**

**Coding for a single shot:** Codes that are used for single shots and not used to draw a line, have a ~!~ after each code. The tilde (~) represents a space and the exclamation point (!) is a 'Code Set' that tells Civil3D **not** to draw a line. An example is GRASS~!~ or GRVL~!~.

**Coding for single shots with added text:** You can add a description at the end of any code to describe something about the shot. For example: BLG~ 2355 BARRYDOWNE, SIB~!~ BENT SOUTH, VB~!~ (asset ID) or DTREE2~!~ 0.5; the number included in the code, (2), represents the radius of the drip edge, the number after the code, (0.5), represents the diameter of the tree trunk. Use DTREE for deciduous trees, trees that lose their leaves annually. Use CTREE for coniferous trees, trees that retain their needles. When tying in a building, the building number and street name are only put on the **first shot** and the remaining shots would be coded as BLG~. Be sure to leave a space after the last tilde (~) before typing in a description.

When coding to draw a line in CAD, you must always take the next shot on the line ahead of the previous shot taken on that same line. A good analogy for this is like 'connect the dots'.

**Coding for drawing a line:** An example for a line would be EP~ which is used to draw a line along edge of pavement. When you want the line to end, add the Linework Code Set, an exclamation point, to the code of the last shot. For example: 'EP~!~. A tilde must be present before and after the exclamation point so there is no interference with any other line used for EP.

**Coding for connecting the last shot to the first shot in a line:** An example for this would be when tying in a flowerbed of any shape, except a circle. The coding would be BED~ on the first shot and all subsequent shots along the edge of the flowerbed. On the last shot use the

Linework Code Set + to join the last shot back to the first shot on the line in order to close the shape, for example, BED~+~.

**Coding for circular objects:** An example for this would be when tying in a round flowerbed. The coding would be BED~BC~ on the first shot only where BC~ tells CAD to begin the curve on the flowerbed line. The remaining shots on the circle would be coded as BED~. The last shot on the circle would be a few centimeters away from the first shot and coded as BED~!~EC~, “!” tells CAD to end the line and EC tells CAD to end the curve at that shot.

**Coding to close a square or rectangle:** An example of this would be when tying in a building. The first shot on the building must be coded BLG~ 2355 BARRYDOWNE, leave a space after the tilde then enter the building number and the street name. The second code would be BLG~ and the third code BLG~RT~5.125~+~ if the direction from the third shot to the next corner is to the right. If the direction from the third shot to the next corner is to the left, then the code would have a negative number, for example, BLG~RT~-5.125~+~. The number at the end of the code represents the length of the building that CAD is closing.

**Coding for points on a curve:** An example of this would be for a curve along edge of pavement, curb, boulevard and a sidewalk as it transitions from one street to another. Where the edge of pavement meets the curb, only shoot the edge of pavement to draw one line, coded EP~, do not shoot the curb at this point. Where the top of curb meets the boulevard, only shoot the top of curb to draw one line, coded CURB~, do not shoot the edge of boulevard at this point. When the boulevard meets the sidewalk for example, only shoot the boulevard to draw one line, coded BLVD~, do not shoot the sidewalk at this point or there would be too many lines to close together on the drawing. Shoot the back of the sidewalk to draw one line for the sidewalk, coded SW~. The shot where the curve starts would be coded as EP~BC~ and CURB~BC~ and BLVD~BC~ and SW~BC~, this starts the arc in the curve on each line. Each shot along each curved line would then be coded as EP~ and CURB~ and BLVD~ and SW~. In order to draw a smooth curved line, shots along the curve should be relatively close, (2 m), and the shots on EP, CURB, BLVD and SW **should be at the same intervals along the curve**. The last shot on the end of the curve would be coded as EP~EC~ and CURB~EC~ and BLVD~EC~ and SW~EC~ which ends the arc on the curved lines. When these lines end they would be coded as EP~!~ and CURB~!~ and BLVD~!~ and SW~!~.

**Coding for shooting multiple lines:** Always start at one end of the job and work towards the other end. **The structure that you are standing on is the predominant figure and will be the first code in the string of codes.**

Standing on a storm manhole and moving to a manhole catch-basin would be coded, STMH~!~MHCB~ (asset ID). Be sure to use asset ID of dominating structure - the one you are standing on.

On the next structure (MHCB), code as MHCB~ (asset ID), do not end the line because the next structure is also a MHCB. Leave a space after the Tilde and add the predominant figure (asset ID).

Standing on the next structure, a MHCB, from that point draw three lines to three other structures that join to this point. Code as MHCB~!~STMH~STMH1~CB~ (asset ID). This ends the MHCB line and starts three other separate lines. Since there are two storm manholes in different directions from this point, use STMH~STMH1~. Leave a space after the last Tilde and add the predominant figure (asset ID). The predominant figure is always the first structure named. In this case, it is MHCB (asset ID).

Move to the CB next and code as CB~!~ (A). This ends the CB line. Leave a space after the Tilde and add the (asset ID) in brackets. Designate a letter to any structure that you cannot find in Geocortex/Field Maps app. This letter designation must match with the corresponding structure in the Survey123 app data, which generates sub-surface asset invert elevations.

Next move to STMH (asset ID) and code as STMH1~!~ (asset ID). This ends that line and describes the number of the predominant figure as an (asset ID).

Next move to STMH (asset ID) and code as STMH~!~DCB~ (asset ID). This ends the STMH line and starts a new line from this point to the double catchbasin. Leave a space after the Tilde and add predominant figure (asset ID).

Next move to the double catchbasin and code as DCB~!~ (B). This ends the line at the DCB and after the Tilde leave a space and add the predominant figure (asset ID).

## HOW TO TIE-IN DETAIL IN THE FIELD

Tie-in all roadwork, hydro poles and municipal signs together in the first sweep. Tie in all the other detail, except for structures, after the roadwork is complete. Perform inverts before horizontal tie-ins to ensure lines are correct in order for them to join each structure in the system. Proper coding creates lines in AutoCAD. Start at either the South end or the West end of the job and tie-in points where the line changes direction and at each 15m station. Shots are taken on centerline CL~, edge of pavement EP~, top of curb at back CURB~, edge of asphalt boulevard where it meets the sidewalk ABLVD~ and back of sidewalk CSW~. Move ahead 15m and work your way backwards on the same profile, CSW~, ABLVD~, CURB~, EP~ and CL~.

Continue this until each line ends. On curved lines such as curb returns, take shots closer together at the same intervals for each profile line so the lines in the drawing appear smooth.

**When shooting the center of objects**, they require either a two (2) point distance offset or a distance/angle offset to reflect the center of the object accurately. Below are brief descriptions on how to tie-in field data. All measurement descriptions are to be in millimeters, except for the dripline radius of trees which are to the closest meter.

## **MUNICIPAL SERVICES**

- Center of Manholes – Sanitary and Storm
- Center of Catchbasins
- Center of Double Catchbasins and Double Manhole Catchbasins. Shoot center of pavement between the two covers.
- Center of Ditch Inlet Catchbasins and Birdcage Catchbasins for an accurate horizontal location with an additional shot on the frame where the water flows into the structure for a more accurate vertical elevation. Change the elevation of the original center of structure shot to reflect the elevation where the water flows into the structure. Delete the frame shot afterwards.
- Center of Valve Chambers, Swab Launch Stations and Valve Boxes, Blow-off Valves
- Center at back of Hydrants and center of Hydrant Valve Boxes
- Center of Service Boxes
- Center of Water Wells (non municipal) and water monitoring wells

## **STORM SEWER DETAIL**

- When approaching a culvert, end the ditch line just before the culvert, DIT~!~, then tie-in the invert of the culvert, CULV~ 450 CSP INV, then tie-in the other end of the culvert and end the line, CULV~!~ 450 CSP INV. Start a new line to continue the centerline of ditch, DIT~.
- Shoot the top of the culverts at each end and add the pipe diameter to the rover pole height in order to keep the rover level and the horizontal position more accurate. Use an even 2m for a rover pole height so it is easy to add the diameter to it and reduces risk of error. If culverts are buried deep then the top of the culvert can be shot and coded as CULV~ 450 CONC TOP. It is often hard to determine the size and type of pipes.
- All culverts tied-in at the invert of the pipe, include size, pipe type and invert or top.

- Tie-in box culverts by taking one shot on top of each of the four (4) corners and code the shots as CULV~ TOP OF BOX. Also, take one shot at each end in the center at the invert; include size, type and inv, for example, CULV~ 1200 X 1500 CONC INV. Take a shot in creek bed just outside of the invert of the culvert.
- Sub-drains tied-in at the invert of the pipe, include size, type, inv or top
- Outline the top of Storm Headwalls, bottom of ditch will reflect the elevation at bottom of the headwall.
- Centerline of Swales and outline Spillways, also profile their centerline.

## **UTILITIES**

- Center of Bell Poles and Hydro Poles (Please note what is on the pole after leaving a space after the Tilde, for example, HPOLE~!~ LS 3TRANS, LS for Lamp Standard and 3TRANS for three (3) Transformers)
- Draw a line from pole to pole in the CAD drawing for all utility and/or anchor wires that cross above the roadway. Do NOT tie-in service wires that cross above the road.
- Center of Anchor Poles
- Guy Wires where they anchor to the ground (join guys wires to the pole with a line)
- Center of all Manholes – Gas, Hydro, Bell and Fiberoptics, etc.
- Center of Electrical Handholes and Junction Boxes
- Center of all Pedestals
- Center of Gas Regulators
- Center of Gas Valves
- Center of all Lamp Standards
- Hydro Transformers – Outline concrete pad, '232.CONC', take one shot on center of Transformer using an offset shot.

## **TRAFFIC CONTROL**

- Center of Traffic Junction Boxes and Traffic Handholes
- Center of Bollards
- Center of Signs – if sign has two posts, shoot both and draw a line between the two
- Center of Traffic Light Standards and Walk Light Standards
- Center of Traffic Controller – outline the concrete pad and one shot on center of controller box
- Railway Tracks -- shoot top of both rails, for example, RWY~ and RWY1~

- Railway Junction Box - outline concrete pad if it sits on one then use a two point offset shot to tie-in center of box
- Center of Railway Signal Pole and Wigwag Arm Base

## VEGETATION

- Center of a Tree trunk - for a line of trees that are the same or of similar size and type and are spaced evenly, draw a line between the first and last tree, no need to tie-in every tree. Coding for a tree is distinguished between a Coniferous (Evergreen) or a Deciduous (sheds leaves annually) and by the radius of the drip line. For example, DTREE2~!~ 0.1 or CTREE2~!~ 0.1, the 2 being the radius of the dripline and after the tilde leave a space then enter 0.1, the diameter of the tree trunk at the ground. This will scale the drip line of the tree in the CAD drawing.
- Centerline of a Hedge drawing a line, HED~ and HED~!~
- Center of a Shrub/Bush, SHRUB~!~
- Center of a Stump
- Edge of Flower Beds – take a few shots inside the bed **without** a Line Joiner for elevation.
- Edge of a Planter Box
- Edge of a Bush Line

## DETAIL WITHIN RIGHT-OF-WAY AND PRIVATE PROPERTY

Most Codes for road detail in the Field Code Library are Line Joiners used to draw lines in the CAD drawing.

- Edge of Pavement, Shoulders, Curbs, Boulevards, Sidewalks, Trails, Driveways and Parking Lots.
- Top and Bottom of Slopes/Break Lines using a Line Joiner.
- Portable Curb shot on top at center, begin and end each individual curb, for example, CURB~ for the first shot and CURB~!~ for the second/last shot.
- Cable Guide Rails start and end where the anchor cable goes into the ground and shoot both the first and last wood post, take the rest of the shots at 15m intervals.
- Steel Beam Guide Rails start and end where the end of the metal beam is and shoot both the first and last metal post, take the rest of the shots at 15m intervals.
- Rock Outcrops are outlined using Earth to Rock Code, ERK~ all the way around top, bottom and sides. A line is drawn for the rock face from one end to the other using RK~

and individual cross sections/profiles are shot at 7.5m station intervals and at any break lines. **Follow Health and Safety Procedures for Working at Heights (travel restraint).**

- Edge of driveways – use the Code that specifies the construction material.
- Edges of retaining walls using the code that specifies the construction material. For retaining walls under 100 mm in width, the center line of the wall can be tied-in when stating the width of the wall and that center line was tied-in, for example, WRET~ 100 CL.

All retaining walls 150 mm and up, outline the top of the entire wall.

- Edge of sidewalks on Municipal property and walkways on private property.
- Edge of parking lots

## BUILDINGS

Tie-in buildings with a minimum of three (3) shots per building required. You may also tie-in every jog around the entire building. On the first shot, provide a description of the municipal address, for example, BLG~ 2355 BARRYDOWNE. If using a GPS, use a 2-point offset for each corner while particular attention to recording an accurate elevation on the ground at the corner of the building.

Square or rectangular shaped buildings are visible as a closed shape on the CAD drawing. Depending on the direction from the third shot to the next corner of the building determines what coding sequence is used. If the direction is to the right then use BLG~RT~5.125~+~, 5.125 is the length of the wall on the opposite side of the building. If the direction is to the left, use a negative sign in front of the distance, for example, BLG~RT~-5.125~+~

- Outline Buildings with a minimum of three (3) shots per building, add the building number and street name to the description of the first shot only, for example, BLG~ 2355 BARRYDOWNE
- Take three shots on detached garages and close the object on the main CAD drawing if they are square or rectangular.
- Tie-in attached garages and carports with the main building. If shooting the main building first and then moving on to the garage, end the line for the main building and continue with a line for the garage, for example, BLG~!~GAR~.
- Outline Portable Carports and Sheds closing the line on the last shot as described above for square or rectangular buildings.
- Outline Bus Shelters and outline the concrete pad that it sits on as well.

## MISCELLANEOUS

- Centerline of all Fences and change Code to gate when appropriate, for example, FEN~!~GATE~ for the first shot on the gate then to GATE~!~FEN~ for the other end of the gate then back to FEN~ to continue to the end of the fence then code FEN~!~.
- Edge of all Walkways using a line joiner
- Outline all Boxes: Garbage, Donation, Sandbox, and Mailboxes, except for private Mailboxes, where only one shot is required.
- Center of all Handrails using a Line Joiner
- Outline all Steps and Landings. When shooting the landing, take the first shot where the building meets the landing. Code the shot, LAND~. The second shot would be taken at the corner, also coded, LAND~. Move forward on the landing where the stringer for the stairs is located and double code that shot LAND~STEP~. Your next shot would be taken at the top outside corner of the bottom step, it will be coded STEP~. Next, take a shot at the other side of the last step, STEP~, then to the top of the landing in line with the steps, STEP~!~LAND~, then to the next corner of the landing, LAND~ then to the landing at the building, LAND~!~.
- Outline Bleachers and Back Stops
- Center of Posts and Boreholes

## WATERWAYS

**Follow Fall Arrest, Travel Restraint Procedures, SOP for Surveying Bridges, Large Culverts and Rock Cuts and SOP for Working Over or Near Open Water, when working close to watercourses.**

- Edges and centerline of all waterways drawing a line, if you can do so safely.
- Edge of Swamps drawing a line
- Outline Bridges and Bridge Abutments on both sides
- Outline Rip Rap – take a few shots on the Rip Rap without a Line Joiner for elevation.

## AS-BUILT CODES

The as-built codes at the end of the code sheet for the data collector are generally used for sub-surface detail that has recently been installed during a construction project and would be coded as single shots, for example, SBEND~!~. When tying in structures, it is necessary to use the proper line-work to join the lines in the drawing.