CURVED STAIR & RAIL MEASURING

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Curved Stair & Rail Measuring

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METALfab Convention-Indianapolis, IN

March 13-16, 2019
Topics for Discussion

- Measuring Devices
- Safety Requirements
- Properties of a Circle
- Types of Radius Stairs
- Basic Radius Stair Layout
- Measuring Scenarios
Measuring Devices

- Rotating Laser
- Laser Light
- Laser Target
- Marker (Sharpie)
- Blum Bob
- String Line
- Square
- Tape Measure
- Level
- Securing Tape
- Layout Paper
- Compass
- Paper & Clipboard
- Pen/Pencil
Rotating Laser and Measuring Stick
Laser Light
Used for shooting elevation
Laser Target & Marker
Blum Bob

Used for transferring work point/radius to the floor below
String Line
Used for setting control lines
Square

Used to transfer lines and get more accurate dimensions
Level
Paper, Clipboard, Compass, Pen & Pencil
Safety Requirements

- Safety Vest
- Hard Hat
- Safety Glasses
- Steel Toe Boots
- Harness and Ropes
Safety Vest, Hard Hat, Glasses and Steel Toe Boots
Safety Harness and Ropes
Properties of a Circle

- **Center** - A point inside a circle. All points on a circle are equidistant (same distance) from the center point.

- **Radius** - The radius is the distance from the center to any point on the circle. It is half the diameter.

- **Diameter** - The distance across the circle. The length of any chord passing through the center. It is twice the radius.

- **Circumference** - The circumference is the distance around a circle.

- **Chord** – A line segment linking any two points on a circle.

- **Sub cord** – The distance from mid-point of the cord perpendicular to the mid-point of the arc length

- **Tangent** – A line passing a circle and touching it at just one point
Types of Radius Stairs and Ramps

- **Circular or Helical** – Having a shape of a spiral or coil; a turning section of an entire staircase around an open atrium, turning wall, column or newel post

- **Winders** – A stairway used to make an “L” shape turn, made with “pie” shaped or wedge cut treads

- **Ellipse** - Ellipse stairs will have multiple radiiuses, “An elliptical staircase will go from a tight radius to a gentle radius to a tight radius again"

- **Spiral** – A stairway having a closed circular form in its plan view with uniform section shaped treads attached to and radiating from a minimum-diameter supporting column

- **Serpentine** – Ramp and/or rail that makes or follows a winding course
Circular or Helical Stair
Winder Stair
Elliptical Stair
Serpentine Ramp
Story Pole

• Use a straight board to make the story pole
• Set the board in the opening
• Use a level to make sure the board is perfectly plumb
• Mark the upper floor surface on the story pole
• Measure from this mark to the bottom of the pole to determine the total rise
• Divide the total rise by the number of tread you desire
• Mark the treads on the story pole.
Basic Radius Stair Layout
STAIR ELEVATION VALUES

BENCH MARK (B.M.) = FINISH FLOOR (F.F.)
HEIGHT OF INSTRUMENT (H.I.) #1 =
HEIGHT OF INSTRUMENT (H.I.) #1 =

1 =
2 =
3 =
4 =
5 =
6 =
7 =
8 =
9 =
10 =

HEIGHT OF INSTRUMENT (H.I.) #2 (FROM #10) =
HEIGHT OF INSTRUMENT (H.I.) #2 =

11 =
12 =

13 FINISH FLOOR (FF)=
14 FINISH FLOOR (FF)=

8TH FLOOR

7TH FLOOR
STAIR PLAN VIEW RADIUS LAYOUT

WP1
7TH FLOOR

WP2

WP3 LANDING

WP4
8TH FLOOR

CONTROL LINE

3'-0" OFFSET LINE

3'-0"

CONTROL LINE

CONTROL LINE

CONTROL LINE

1 =
2 =
3 =
4 =
5 =
6 =
7 =
A =
B =
C =
D =
E =
F =
Scenarios

• Skeleton Frame and Template
• Measuring Radius Balcony
• Measuring Radius Stair
• Measuring Radius Stair & Rail
• Measuring Radius Stair for Soffit Panels
• Measuring Serpentine Ramp
Skeleton Frame and Template
Skeleton Frame & Template

- Review drawings
- Determine material required
- Cut material to manageable sizes (10’-0” lengths)
- Determine tools required
- Pre-roll material and cut post in shop
- In the field take preliminary measurements
- Mount post in correct location
- Attach top and bottom member
Skeleton Frame & Template

- Brace rail with low cost material
- Cut frame or template to manageable size (10’-0” length)
- Once frame is complete then infill can be added in shop
- Use template to fabricate rail in shop
Existing Conditions
Existing Conditions
Finished Rail Built From Skeleton Frame
Finished Rail Built From Skeleton Frame
## Skeleton Frame and Template

<table>
<thead>
<tr>
<th>Pros</th>
<th>Cons</th>
</tr>
</thead>
<tbody>
<tr>
<td>• Peace of mind rail will fit</td>
<td>• More man hours in the field</td>
</tr>
<tr>
<td>• Less work in the shop</td>
<td>• Additional material for bracing</td>
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</tbody>
</table>
Existing Condition at Bottom of Stair
Existing Condition
Existing Condition
Existing Condition
Existing Condition
Skeleton Template at Shop
Skeleton Template at Shop
Skeleton Template at Shop
Finished Interior Rail From Skeleton Template
Finished Interior Rail
From Skeleton Template
Radius Balcony
Measuring Radius Balcony

- Review drawings
- Determine measuring tools required
- As built existing conditions of balcony
- Locate column lines and/or set control lines
- Locate main work points
  - Center line of stair
  - Upper & Lower work points
  - Edge of concrete
- Tie main work point back to column/control lines in two directions
Measuring Radius Balcony

- Shoot elevations at the top and bottom floor
- Shoot elevation around opening of balcony
- Tie elevation shots back to building bench mark
- Transfer radius of floor opening to floor below
- Determine your main cord and sub cord
Existing Radius Balcony Conditions
As Built Work Points
Radius Stair
Rail for Existing Stair

• Review drawings

• Determine measuring tools required

• As built existing conditions of stair

• Locate column lines and/or set control lines

• Locate main work points
  ▪ Center line of stair
  ▪ Upper & Lower work points

• Tie main work point back to column/control lines in two directions
Rail for Existing Stair

- Determine bench mark in building
- Shoot elevations at the top, landing and bottom of stair
- Tie elevation shots back to building bench mark
- Transfer radius of stair to floor below
- Determine your main cord and sub cord
- Determine floor build ups if required
Existing Condition at WP1
Existing Condition at WP2 & WP3
Existing Condition at WP4
Existing Conditions at Balcony
As Built Work Points
Elevation Shots and Main WP

#1: Approx. Elevation

Total BU = 530'-0" from FL.
#1 = 330'-0"
#2 = 543'-11/16 ( Ook Up 1"
#3 = 543'-1/16 ( Ook Up 1"
#4 = 543'-10/16 ( Ook Up 1"
#5 = 543'-1/16 ( Ook Up 1"
#6 = 543'-1/16 ( Ook Up 1"
#7 = 543'-1/16 Hi Point
#8 = 543'-1/16 Hi Point
#9 = 543'-11/16 ( Ook Up 1"
#10 = 543'-1/16 ( Ook Up 1"

Note: All measurements are approximate.
Installation of Lower Rail
Installation of Upper Rail
Installation of Balcony Rail
Finished Rail
Finished Rail
Finished Balcony Rail
Radius Stair and Rail
Radius Stair and Rail

- Review drawings
- Determine measuring tools required
- As built existing conditions of stair and rail
- Set control lines
- Locate main work points
  - Center line of stair
  - Upper & Lower work points
- Tie main work points back to control lines in two directions
- Define bench mark in building
Radius Stair and Rail

• Shoot elevations at the top, landing and bottom of stair
• Tie elevation shots back to building bench mark
• Transfer radius of stair to floor below
• Determine your main cord and sub cord
• Determine floor build ups if required
Layout of Existing Stair
Cleaned Up Layout of Existing Stair
Layout of Existing Concrete Slab Below Existing Stair
Layout of Existing Concrete Slab Below Existing Stair
Cleaned Up Layout of Existing Concrete Slab Below Existing Stair
Tape Layout Line on Finished Floor
Locating Existing WP1 at Inside Stringer
Locating Existing WP1 at outside Stringer
Transferring Wall to Floor Below
Existing Conditions
at Top Transition
Existing Conditions at Top Transition

02/28/2004
Existing Condition at Balcony Rail
Tying 3\textsuperscript{rd} Floor to 2\textsuperscript{nd} Floor
Reveals in Wall and Angle of Wall at Balcony Rail
Radius Stair for Soffit Panels
Radius Stair for Soffit Panels

- Walk the site to determine the best way to achieve objectives
  - Note what needs to be done
  - Note what could be done easily
  - Note what obstacles stood in the way
- Lay paper on floor and tape it down
- Use laser to locate work points on outside radius
- Use laser to locate work points on inside radius
- Tape walls on inside radius to ensure work point alignment and use laser to double-check work points
Radius Stair for Soffit Panels

- Determined mid-point of sections – in this case the break in glass
- Located mid-point on inside & outside radii using laser
- Drew lines at work points for cord, sub cord, etc.
- Split upper & lower sections in half to give two equal sections for upper & two for lower
- Drew lines between top & bottom work points for cord, sub cord, etc.
- Measured distances along work lines to determine widths between inside & outside radii
Customer Expectations

1" from ISR of glass
2" from wood wall
1/2" from bot of hor
1/2" from wood panel top
1/8" from wall panes
Field Dimensions of Existing Conditions

A Out To B Out
Arc = 55 1/8
Core = 55
Sub C = 1 1/16

B Out To C Out
Arc = 55 1/8
Core = 55 1/4
Sub C = 1 1/16

C Out To C In
Arc = 110 3/8
Core = 109 3/16 +
Sub C = 7

A Out To C In
109 13/16
C Out To A In
112 5/16
Field Dimensions of Existing Conditions

Diagram showing dimensions and calculations for various points and distances.
Existing Conditions
Existing Conditions
Existing Conditions
Layout on Floor Below
Layout on Floor Below
Layout on Floor Below
Existing Conditions
Existing Conditions
Serpentine Ramp
Serpentine Ramp

- Walk the site to determine best way to achieve objectives

- Note:
  - what needs to be done
  - what can be done easily
  - any obstacles

- Locate benchmarks and finished floor marks

- Locate control lines in two directions
Serpentine Ramp

- Begin measuring by establishing all work points.
- After all work points are established, tie to column lines and/or control lines or both (if possible).
- Measure from work point to work point (wp1 to wp2, wp2 to wp3 and continue the process to the last work point and if possible from last work point back to wp1).
Serpentine Ramp

- When measuring curve of the ramps, tie the work points together by measuring the follow:

  1. Curve length: taken by pulling tape measure to outer-face of curve

  2. Cord dimensions: measuring straight across from work point to work point

  3. Sub cord dimensions: taken by pulling a straight line from "x" work point to "x" work point and then measuring from the center of that straight line to curved face

Note: Cord dimension should be much greater than the sub-cord dimension.
Serpentine Ramp

For Existing Ramps with Many Work Points and Landings

• When measuring an existing ramp with many work points and many landings (level areas), always check if slope is continuous all the way from one landing to another.

• To ensure that the correct slope is acquired, set a level line above ramp surface (usually a level line) and measure from that line down to ramp surface (about every 5‘) all the way down between landings.
Existing Conditions
Plan View Field Dimensions of Existing Conditions
Elevation Shots of Existing Conditions
Plan View Field Dimensions of Existing Conditions
Elevation Shots of Existing Conditions
Finished Serpentine Ramp
Finished Serpentine Ramp
Finished Serpentine Ramp
THANK YOU FOR ATTENDING

Please make sure to complete your session survey.