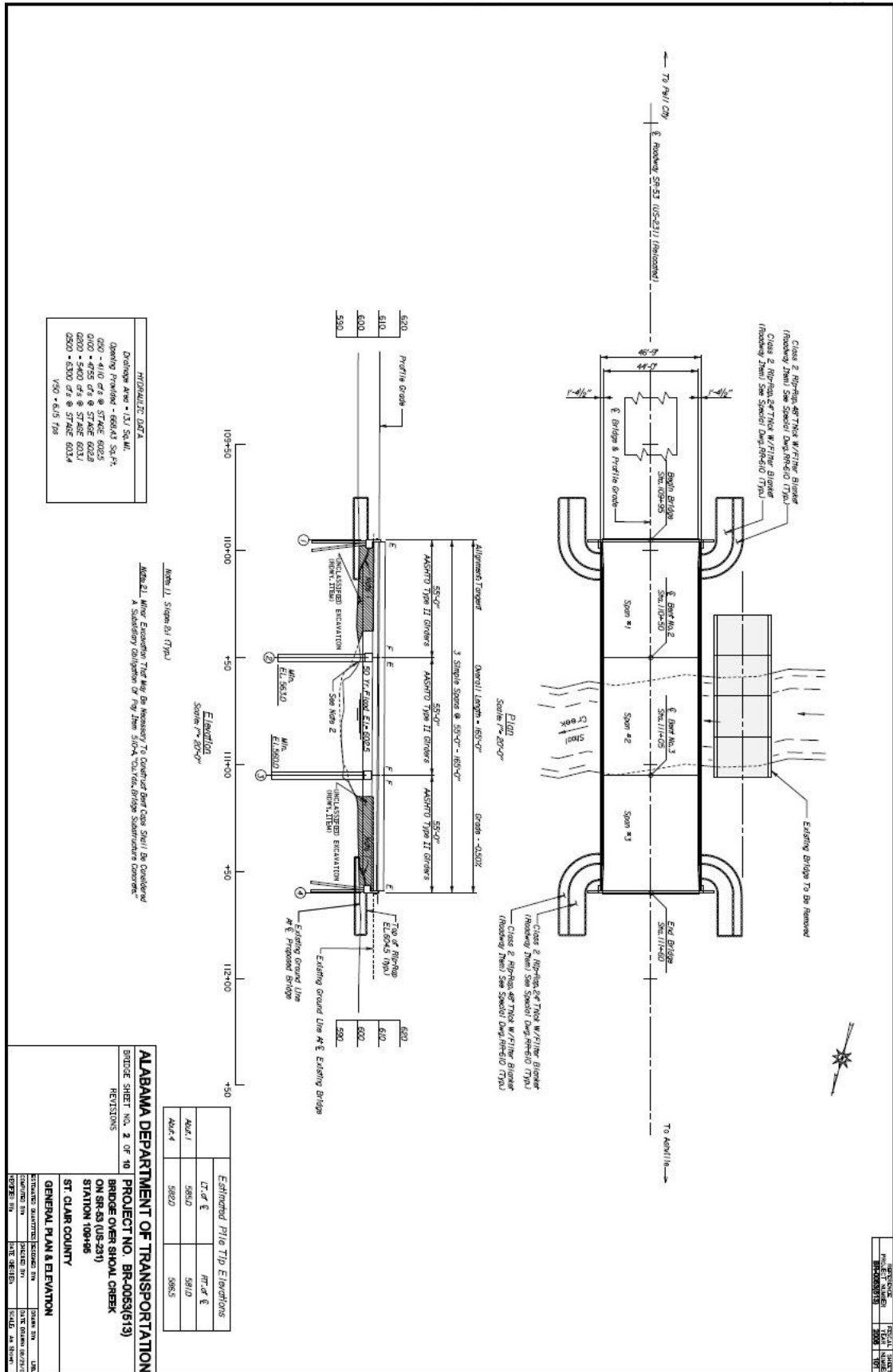
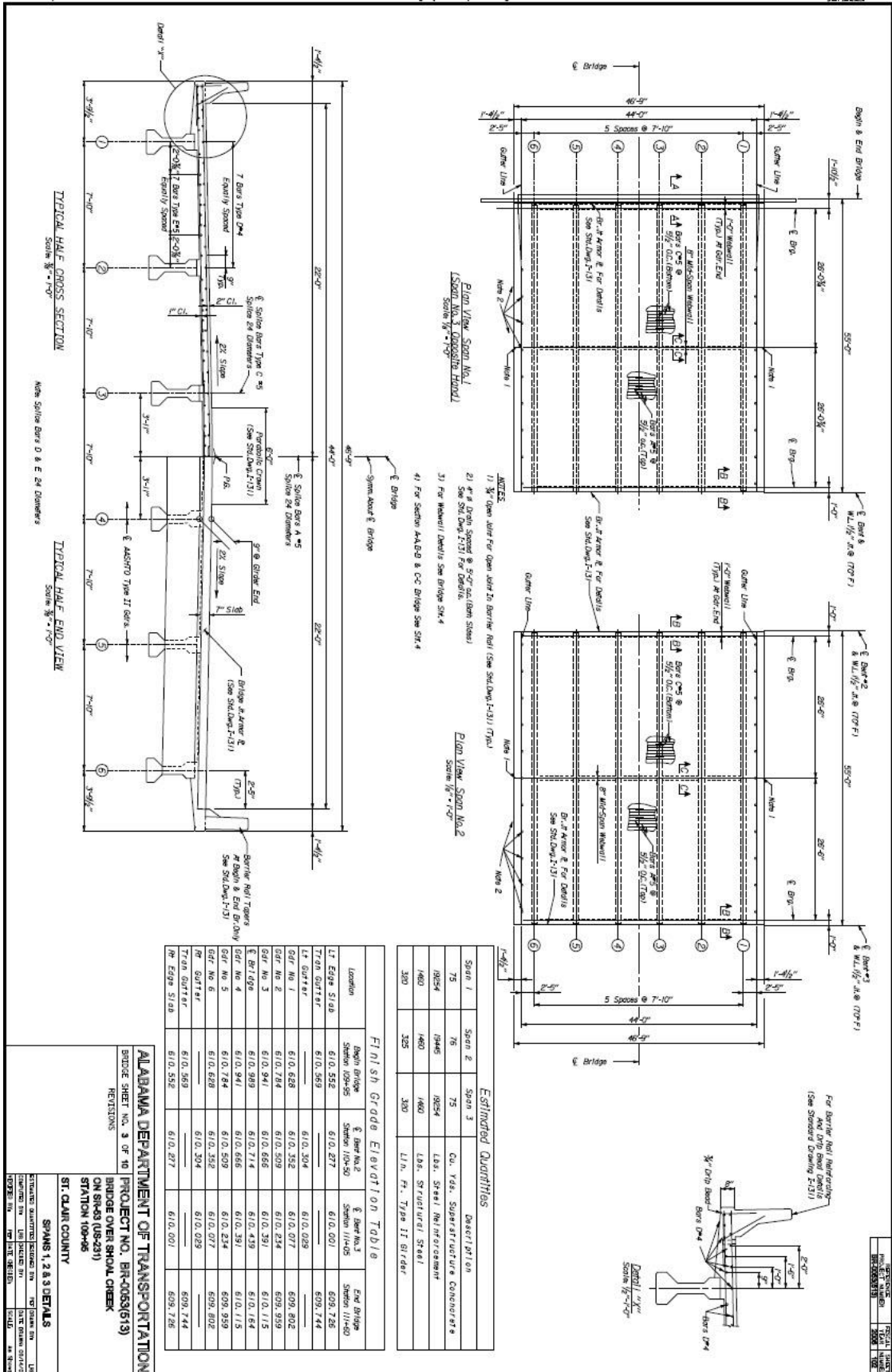

AASHTOWare BrDR 7.5.0
Substructure Tutorial
Frame Pier Drilled Shaft Example

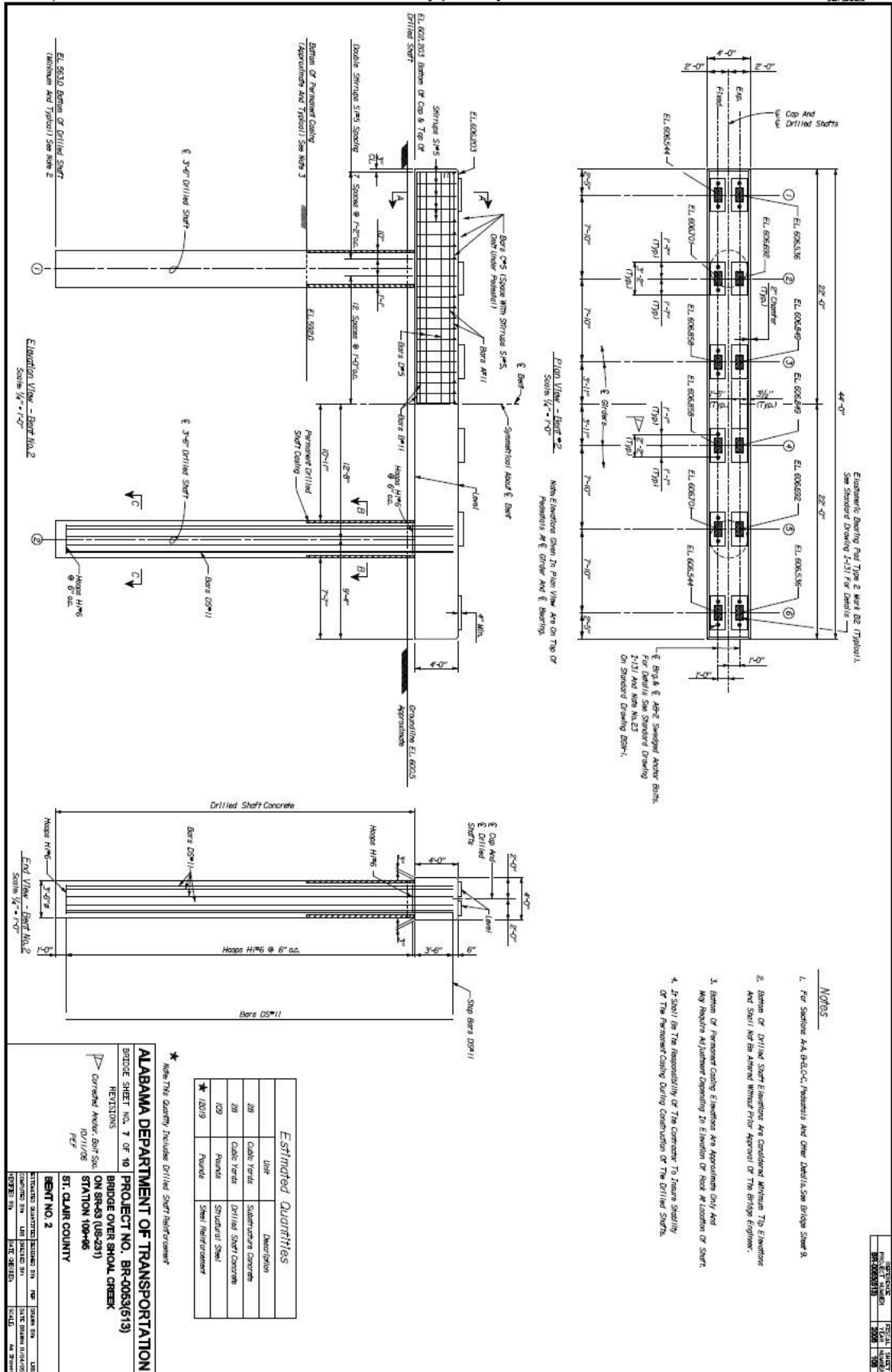
Frame Drilled Shaft Example



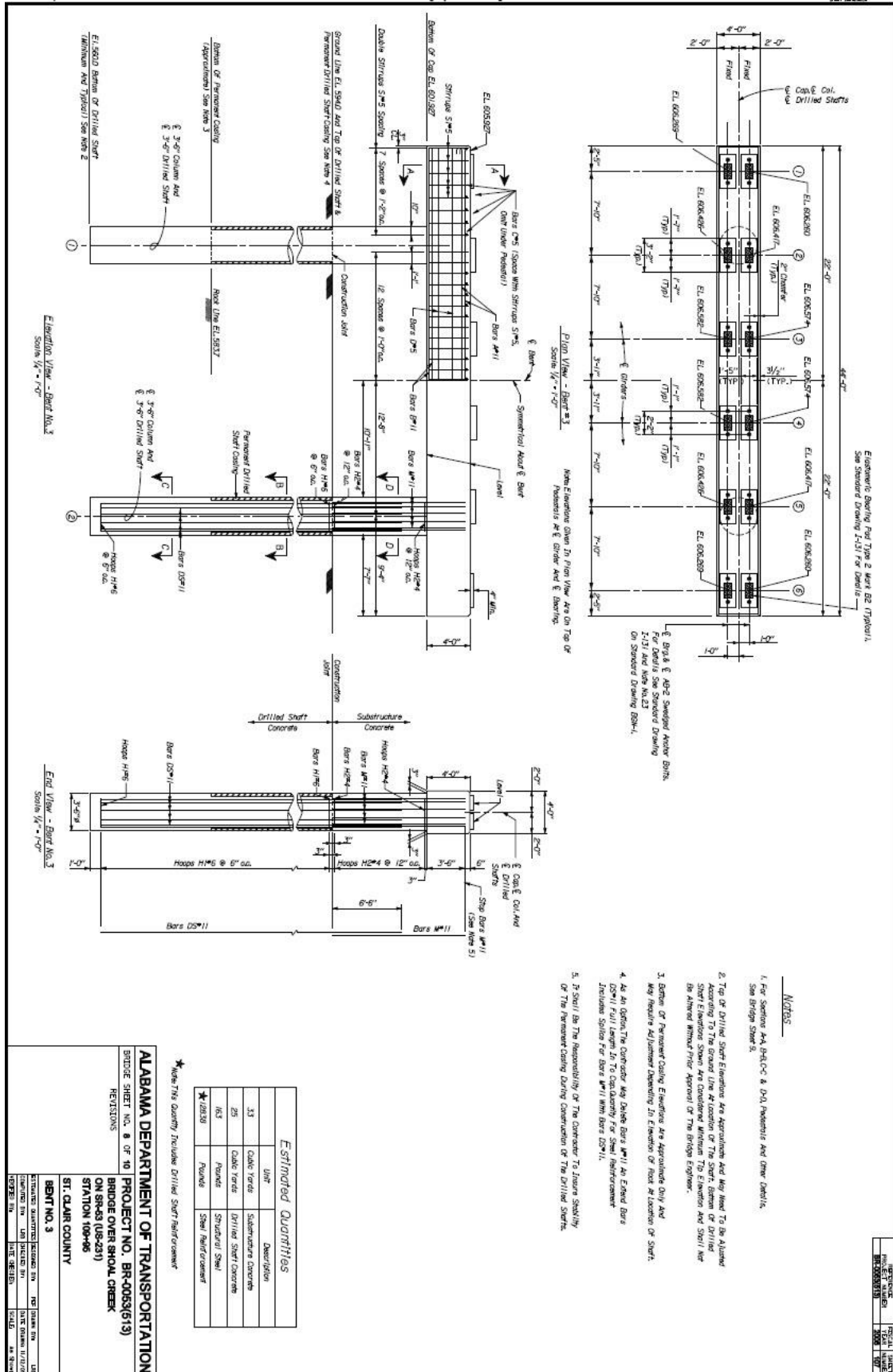
Frame Drilled Shaft Example



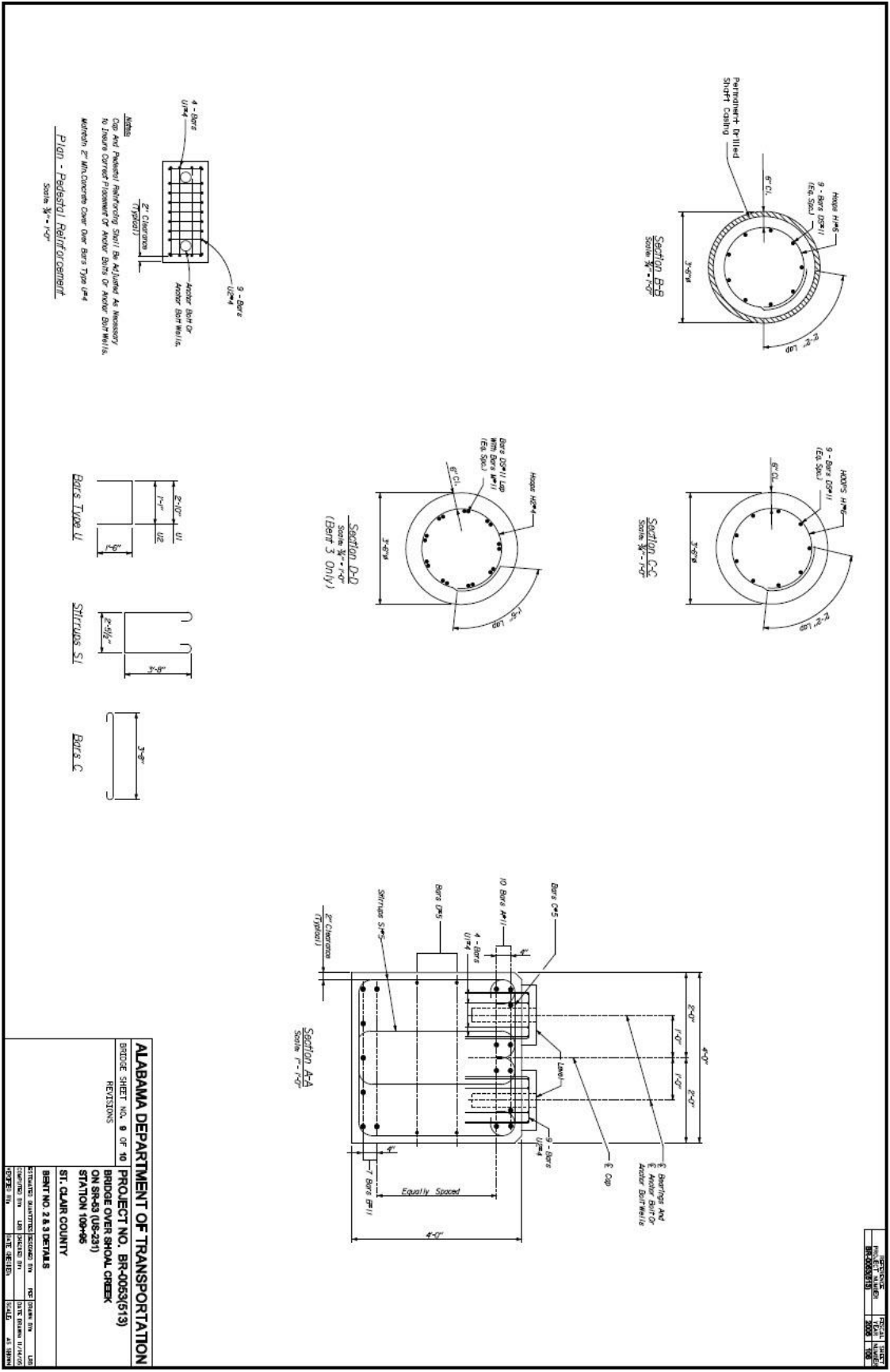
Frame Drilled Shaft Example



Frame Drilled Shaft Example



Frame Drilled Shaft Example



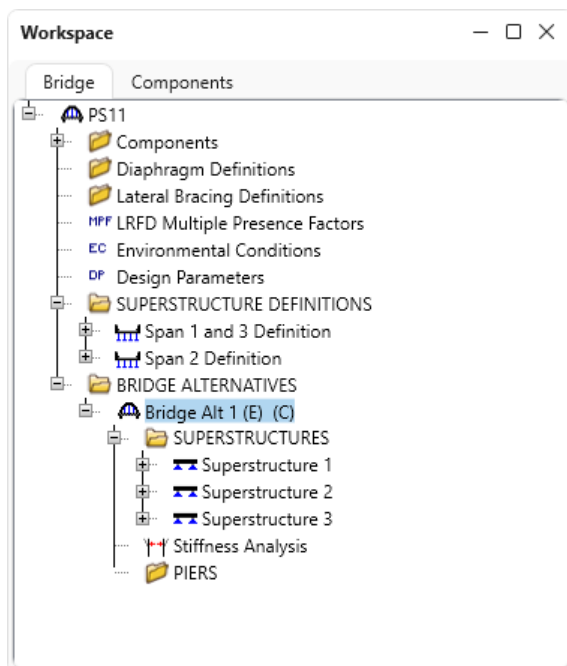
Frame Drilled Shaft Example

This example describes the entry of piers for a 3 simple span superstructure previously entered into BrDR as part of the Alabama BrD superstructure training session – **PS11 – Bridge Over Shoal Creek**. This example is part of the design portion of the training where users attempt to enter data on their own instead of following screen by screen captures. As such, this example does not describe data entry for each window. Instead, it shows only certain windows and describes important modeling concepts on these windows.

Locating Substructure Units

Open the bridge workspace for the **PS11 – Bridge Over Shoal Creek** tutorial and open the **Bridge Alternative** window shown below.

The partially expanded **Bridge Workspace** tree is shown below.



Frame Drilled Shaft Example

Bridge Alternative

The reference line length is the length between the abutment bearings. The starting station is abutment 1 CL Brg station.

Bridge Alternative

Alternative name: Bridge Alt 1

Description: Substructures

Description:

Horizontal curvature

Reference line length: 161.25 ft

Start bearing End bearing

Starting station: 10996.88 ft

Bearing: N 90^ 0' 0.00" E

Global positioning

Distance: 0 ft

Offset: 0 ft

Elevation: ft

Bridge alignment

Curved

Tangent, curved, tangent

Tangent, curved

Curved, tangent

Start tangent length: ft

Curve length: ft

Radius: ft

Direction: Left

End tangent length: ft

Superstructure wizard...

Culvert wizard...

OK Apply Cancel

Frame Drilled Shaft Example

Navigate to the **Substructures** tab. The substructure locations are defined as follows:

The screenshot shows the 'Bridge Alternative' dialog box with the 'Substructures' tab selected. The 'Alternative name' is 'Bridge Alt 1'. The 'Substructures' tab contains a table with the following data:

Substructure unit name	Station (ft)	Offset (ft)	Unit type
Abutment 1	10996.875	0	Abutment
Pier 1	11050	0	Pier
> Pier 2	11105	0	Pier
Abutment 2	11158.125	0	Abutment

Below the table are buttons for 'New', 'Duplicate', and 'Delete'. At the bottom of the dialog are 'OK', 'Apply', and 'Cancel' buttons.

Superstructure

The individual **Superstructure** windows are shown below.

The screenshot shows the 'Superstructure' dialog box. The 'Superstructure name' is 'Superstructure 1'. The 'Description' tab is selected, showing a large text area for the description. Below the description is a 'Reference line' section with the following fields:

- Distance: 0 ft
- Offset: 0 ft
- Angle: 0 Degrees
- Starting station: 10996.88 ft

At the bottom right of the dialog are 'OK', 'Apply', and 'Cancel' buttons.

Frame Drilled Shaft Example

Superstructure

Superstructure name:

Description Alternatives Vehicle path Engine Substructures

Description:

Reference line

Distance: ft

Offset: ft

Angle: Degrees

Starting station: ft

OK Apply Cancel

Superstructure

Superstructure name:

Description Alternatives Vehicle path Engine Substructures

Description:

Reference line

Distance: ft

Offset: ft

Angle: Degrees

Starting station: ft

OK Apply Cancel

Frame Drilled Shaft Example

Relative Stiffness Analysis

Revise the bearing types as follows.

Relative Stiffness Analysis - Bridge Alt 1

Bridge alternative name: Bridge Alt 1

Bearing data | Bearing data (cont'd) | Relative stiffness

Substructure unit data:

Unit type	Substructure unit name	Station (ft)	Offset (ft)	Current alternative	Geometry defined
> Abutment	Abutment 1	10996.875	0		<input type="checkbox"/>
Pier	Pier 1	11050	0		<input type="checkbox"/>
Pier	Pier 2	11105	0		<input type="checkbox"/>
Abutment	Abutment 2	11158.125	0		<input type="checkbox"/>

Bearing types:

Support line	Substructure unit name	Longitudinal movement type	Number of bearings	Bearing type
Support Line 1	Abutment 1	Expansion	6	Elastomeric
Support Line 2	Pier 1	Fixed	6	Elastomeric
Support Line 3	Pier 1	Expansion	6	Elastomeric
> Support Line 4	Pier 2	Fixed	6	Elastomeric
Support Line 5	Pier 2	Fixed	6	Elastomeric
Support Line 6	Abutment 2	Expansion	6	Elastomeric

OK Apply Cancel

Frame Drilled Shaft Example

Since this bridge alternative contains multiple superstructures, the length of superstructure to load for each pier must be specified. Here both the fixed and expansion bearings are assumed to carry the longitudinal forces.

Relative Stiffness Analysis - Bridge Alt 1

Bridge alternative name: Bridge Alt 1

Bearing data Bearing data (cont'd) **Relative stiffness**

Longitudinal force distribution

- Longitudinal forces, except friction, carried only by fixed bearings
- Longitudinal forces carried by both fixed and expansion bearings
 - Simplified method of distribution
 - Refined method of distribution considering relative stiffness
- User specify superstructure length for each load and each pier
 - Specify length unit
 - Specify length percentage

Bridge alternative contains multiple superstructures. You must specify the lengths yourself.

Compute superstructure length to apply to each pier...

	Substructure unit name	Superstructure length to apply to unit (ft)	Superstructure length to apply to unit (%)	
	Abutment 1		25	▲
	Pier 1		25	
	Pier 2		25	
>	Abutment 2		25	

OK Apply Cancel

Frame Drilled Shaft Example

Bent #3 Description

Cap Reinforcement

The cap reinforcement is entered as follows.

Cap Reinforcement - Pier 2 - Bent #2

Flexural Shear

Longitudinal skin
 Bar size: 5 Bar spacing: 11.11 in Bar material: Grade 60 Stirrup clear cover: 2 in

Primary flexural
 Reinforcement input method
 Simplified Advanced Reinforcement follows cap profile

Set	Measure from cap	Vertical distance (in)	Bar size	Number	Material	Start distance (ft)	Straight length (ft)	End distance (ft)	Hook at start	Hook at end	Developed at start	Developed at end
1	Top	3.33	11	6	Grade 60	0.25	43.5	43.75	<input checked="" type="checkbox"/>	<input checked="" type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
2	Top	7.33	11	4	Grade 60	0.25	43.5	43.75	<input checked="" type="checkbox"/>	<input checked="" type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
3	Bottom	7.33	11	2	Grade 60	0.25	43.5	43.75	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
4	Bottom	3.33	11	5	Grade 60	0.25	43.5	43.75	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>

New Duplicate Delete

OK Apply Cancel

Cap Reinforcement - Pier 2 - Bent #2

Flexural Shear

Bar size	Number of legs	Material	Measure from	Direction	Start distance (ft)	Number of spaces	Spacing (in)	Length (ft)	End distance (ft)
5	4	Grade 60	Left Edge of Cap	Right	0.25	1	0	0	0.25
5	4	Grade 60	Left Edge of Cap	Right	0.25	7	14	8.166667	8.416667
5	4	Grade 60	Left Edge of Cap	Right	8.417	1	19	1.5833333	10.003333
5	4	Grade 60	Left Edge of Cap	Right	10	24	12	24	34
5	4	Grade 60	Left Edge of Cap	Right	34	1	19	1.5833333	35.583333
5	4	Grade 60	Left Edge of Cap	Right	35.583	7	14	8.166667	43.749667

Dup & Mirror New Duplicate Delete

OK Apply Cancel

Frame Drilled Shaft Example

Column Geometry

The column geometry is defined as follows. Enter the concrete column diameter as 3.5' and neglect the steel casing.

Segment	Segment vary	Cross-section type	Location	Elevation (ft)	Dimension (ft)					
					D1	D2	D3	D4	D5	D6
1	None	Round	Top	601.927	3.5					
>			Bottom	560	3.5					

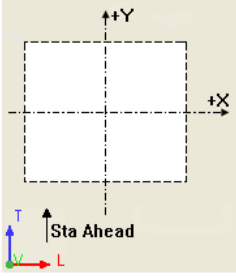
Column Reinforcement

Frame Drilled Shaft Example

Column Reinforcement - - Pier 2 - Bent #2

Name: DS11

Bundle bars



Bar	Bar size	Material	X (in)	Y (in)
1	11	Grade 60	13.545	0
2	11	Grade 60	10.376072	-8.7065582
3	11	Grade 60	2.3520646	-13.339221
4	11	Grade 60	-6.7725	-11.7303141
5	11	Grade 60	-12.7281365	-4.6326628
6	11	Grade 60	-12.7281365	4.6326628
7	11	Grade 60	-6.7725	11.7303141
8	11	Grade 60	2.3520646	13.339221
> 9	11	Grade 60	10.376072	8.7065582

Generate pattern

New Duplicate Delete

OK Apply Cancel

Developed at start is checked to assume actual length of drilled shaft below point of fixity provides enough length for bars to be developed.

Column Reinforcement - Column1 - Pier 2 - Bent #2

Flexural Shear

Set	Start distance (ft)	Straight length (ft)	End distance (ft)	Pattern	Hook at start	Hook at end	Developed at start	Developed at end	Follows profile
> 1	0	13.073	13.073	DS11	<input type="checkbox"/>	<input type="checkbox"/>	<input checked="" type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>

New Duplicate Delete

OK Apply Cancel

Frame Drilled Shaft Example

Column Reinforcement - Column1 - Pier 2 - Bent #2

Flexural **Shear**

Shear reinforcement type

Ties Spirals Spirals designed as ties

	Bar size	Trans. number of legs	Long. number of legs	Material	Start distance (ft)	Number of spaces	Spacing (in)	Length (ft)	End distance (ft)
>	6	2	2	Epoxied	0	1	0	0	0
	6	2	2	Epoxied	0	20	6	10	10

New Duplicate Delete

OK Apply Cancel