FHWA GEC-12 - Design and Construction of Driven Pile Foundations

Tuesday October 18th  1:00 – 1:50 pm

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GRL Engineers, Inc.
Cleveland, OH
216-831-6131
GEC-12 Design and Construction of Driven Pile Foundations
Available Now!

GEC-12 Design and Construction of Driven Pile Foundations

**Contractor:**

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**Industry Review:**
TRB, State Agencies, ASCE Geo Institute, DFI, PDCA
GEC-12 Design and Construction of Driven Pile Foundations

Abutment 1  Predominantly Sand Profile
Center Pier  Mixed Profile
Scour
Abutment 2  Cohesive Profile
Rock
What’s in Volume I?

Chapter 1  Driven Pile Foundation Manual
Chapter 2  Overview of Pile Design and Construction
Chapter 3  Considerations in Foundation Selection
Chapter 4  Site Characterization
Chapter 5  Geomaterial Design Parameters and Geotechnical Reports
Chapter 6  Pile Types for Further Evaluation
Chapter 7  Geotechnical Aspects and Limit State Design
Chapter 8  Structural Aspects and Limit State Design
# Chapter 1 – Driven Pile Foundation Manual

<table>
<thead>
<tr>
<th>Section</th>
<th>Title</th>
</tr>
</thead>
<tbody>
<tr>
<td>1.1</td>
<td>INTRODUCTION</td>
</tr>
<tr>
<td>1.2</td>
<td>PURPOSE OF THE MANUAL</td>
</tr>
<tr>
<td>1.3</td>
<td>SCOPE OF MANUAL</td>
</tr>
<tr>
<td>1.4</td>
<td>HISTORY OF DRIVEN PILE FOUNDATIONS</td>
</tr>
<tr>
<td>1.5</td>
<td>INFORMATION SOURCES</td>
</tr>
</tbody>
</table>
Chapter 2 – Overview of Pile Foundation Design and Construction

2.1 INTRODUCTION
2.2 LIMIT STATES
2.3 LOADS, LOAD COMBINATIONS, AND LOAD FACTORS
2.4 NOMINAL AND FACTORED RESISTANCE
2.5 STRENGTH LIMIT STATES
2.6 SERVICE LIMIT STATES
2.7 EXTREME EVENT LIMIT STATES
2.8 CONSTRUCTION OF PILE FOUNDATIONS
2.9 FOUNDATION SPECIALIST INVOLVEMENT
2.10 THE DRIVEN PILE DESIGN AND CONSTRUCTION PROCESS
2.11 COMMUNICATION

6 Page Flow Chart with 32 steps
Chapter 3 – Considerations in Foundation Selection

3.1 FOUNDATION DESIGN APPROACH

3.2 FOUNDATION ALTERNATIVES
   3.2.1 Shallow Foundations  See GEC-6
   3.2.2 Shallow Foundations with Ground Improvement
   3.2.3 Deep Foundations
      3.2.3.1 Driven Piles
      3.2.3.2 Drilled Shafts  See GEC-10
      3.2.3.3 Micropiles
      3.2.3.4 Continuous Flight Auger (CFA) Piles  See GEC-8

3.3 ESTABLISHMENT OF A NEED FOR A DEEP FOUNDATION

3.4 ECONOMIC ASPECTS OF FOUNDATION SELECTION
   3.4.1 Foundation Support Cost
   3.4.1.1 Cost Optimization Example
# Chapter 3 – Considerations in Foundation Selection

## 3.5 OTHER CONSIDERATIONS

### 3.5.1 Constructability
### 3.5.2 Consideration of Pile Driving Noise
### 3.5.5 Durability Considerations

## 3.6 UNANTICIPATED OCCURRENCES

### 3.6.1 Fill Stockpile
### 3.6.2 Adjacent Construction
Chapter 3 – Considerations in Foundation Selection
Chapter 4 – Site Characterization

4.1 INTRODUCTION

4.2 SITE CHARACTERIZATION PROGRAM
4.2.1 Data Collection
4.2.2 Field Reconnaissance Survey
4.2.3 Detailed Field Exploration
  4.2.3.1 Geophysical Surveys
  4.2.3.2 Depth, Spacing, and Frequency of Boring & In-Situ Tests
  4.2.3.3 Soil Boring Methods
  4.2.3.4 Soil Sampling Methods
  4.2.3.5 Rock Exploration Methods (Coring / Drilling)
  4.2.3.6 Groundwater
4.2.4 Information Required for Construction

Old pile manual Chapters 4, 5, 6, and 13 condensed into Chapters 4 and 5.
For more detail consult GEC-5
# Chapter 5 – Geomaterial Design Parameters and Geotechnical Reports

## 5.1 In-Situ Soil Testing

- **5.1.1 Standard Penetration Test**
- **5.1.2 Cone Penetration Test**
- **5.1.3 Vane Shear Test**
- **5.1.4 Other In-Situ Tests**
  - **5.1.4.1 Dilatometer Test**
  - **5.1.4.2 Pressuremeter Tests**
  - **5.1.4.3 Dynamic Cone**

## 5.2 Soil Parameters

- **5.2.1 Soil Classification and Index Properties**
- **5.2.2 In-Situ Stress**
- **5.2.3 Shear Strength**
  - **5.2.3.1 Laboratory Tests for Soil Shear Strength**
    - **5.2.3.1.1 Direct Shear**
    - **5.2.3.1.2 Unconfined Compression**
    - **5.2.3.1.3 Triaxial Compression Test**
  - **5.2.3.2 Effective Stress Friction Angle Correlations, Cohesionless Soils**
  - **5.2.3.3 Fully Drained Shear Strength of Fine-Grained Cohesive Soils**
  - **5.2.3.4 Undrained Shear Strength of Fine-Grained Cohesive Soils**
Chapter 5 – Geomaterial Design Parameters and Geotechnical Reports

5.2.4 Deformation
  5.2.4.1 Elastic Deformation
  5.2.4.2 Primary Consolidation Settlement

5.2.5 Electro Chemical Properties

5.3 ROCK PARAMETERS
  5.3.1 Rock Index Properties and Classification
  5.3.2 Rock Mass Shear Strength
  5.3.3 Rock Mass Deformation

5.4 CONSIDERATIONS FOR PILE DRIVABILITY

5.5 SELECTION OF PARAMETERS FOR DESIGN AND CONSTRUCTION
  5.5.1 Soil Parameters
  5.5.2 Rock Parameters
  5.5.3 Site Variability

5.6 GEOTECHNICAL REPORTING
  5.6.1 Geotechnical Data Reports
  5.6.2 Geotechnical Foundation Design Reports
  5.6.3 Geotechnical Baseline Reports
Chapter 6 – Pile Types for Further Evaluation

6.1 OVERVIEW OF TYPICAL PILE TYPES
6.2 TIMBER PILES
6.3 STEEL H-PILES
6.4 STEEL PIPE PILES
   6.4.1 Closed End Steel Pipe
   6.4.2 Open End Steel Pipe
6.5 MONOTUBE PILES
6.6 TAPER TUBE PILES
6.7 SPIN FIN PILES
6.8 PRESTRESSED CONCRETE PILES
   6.9.1 Spun-Cast Cylinder Piles
   6.9.2 Bed-Cast Cylinder Piles
   6.9.3 Industrial Concrete Products (ICP) Piles
6.9 CONCRETE CYLINDER PILES
6.10 COMPOSITE PILES
   6.10.1 Precast Concrete - Steel H-pile Composite Piles
   6.10.2 Steel Pipe - H-pile Composite Piles
   6.10.3 Corrugated Shell - Timber Composite Piles
   6.10.4 Corrugated Shell - Pipe Composite Piles

Availability of Higher Strength Materials
6.11 PILE TYPES INFREQUENTLY USED ON TRANSPORTATION PROJECTS
   6.11.1 Fundex Piles
   6.11.2 Tubex Piles
   6.11.3 Pressure Injected Footings (PIF)
   6.11.4 Mandrel Driven Piles
   6.11.5 Reinforced Concrete Piles

6.12 DESIGN CONSIDERATIONS IN AGGRESSIVE SUBSURFACE ENVIRONMENTS
   6.12.1 Corrosion of Steel Piles
      6.12.1.1 Corrosion in Non-Marine Environments
      6.12.1.2 Corrosion in Marine Environments
   6.12.2 Sulfate and Chloride Attack on Concrete Piles
   6.12.3 Bacteria, Fungi, Insect, and Marine Borer Attacks on Timber Piles
   6.12.4 Design Options for Piles Subject to Degradation or Abrasion

6.13 SELECTION OF PILE TYPE AND SIZE FOR FURTHER EVALUATION

6.14 HISTORICAL PRICE INFORMATION
   6.14.1 California
   6.14.2 Florida
   6.14.3 Indiana
   6.14.4 Maryland
   6.14.5 North Carolina
   6.14.6 Pennsylvania
   6.14.7 Texas
Chapter 7 – Geotechnical Aspects and Limit States

7.1 INTRODUCTION
7.1.1 Static Analysis Methods in Limit State Design
7.1.2 Events During and After Pile Driving
   7.1.2.1 Cohesionless Soils
   7.1.2.2 Cohesive Soils
   7.1.2.3 Additional Soil Resistance Considerations
7.1.3 Load Transfer
7.1.4 Effective Stress
7.1.5 Resistance Factors
7.1.6 Interdiscipline Communication and Coordination
7.2 STRENGTH LIMIT STATES

7.2.1 Determination of Nominal Resistance for Single Piles

7.2.1.1 General

7.2.1.2 Static Analysis Overview

7.2.1.3 Nominal Resistance of Single Piles in Soils

7.2.1.3.1 Nordlund Method – Cohesionless Soils

7.2.1.3.2 α-Method - Cohesive Soils

7.2.1.3.3 API RP2A Method – Mixed Soil Profiles

7.2.1.3.4 Effective Stress β-Method – Mixed Soil Profiles

7.2.1.3.5 Brown Method – Mixed Soil Profiles – SPT Data

7.2.1.3.6 Eslami and Fellenius Method – CPT Data

7.2.1.3.7 Nottingham and Schmertmann Method – CPT Data

7.2.1.4 Nominal Resistance of Single Piles to Rock

7.2.1.4.1 Piles Driven into Soft and Weak Rock

7.2.1.4.2 Piles Driven to Hard Rock

7.2.1.5 Software for Single Pile Nominal Resistance Computations

7.2.2 Resistance of Pile Groups in Axial Compression

7.2.2.1 Pile Groups in Cohesionless Soils

7.2.2.2 Pile Groups in Cohesive Soils

7.2.2.3 Block Failure of Pile Groups
Design Chart for Nominal and Factored Resistance in Axial Compression
Design Chart for Nominal and Factored Resistance in Axial Tension

18 inch O.D. Closed End Pipe Pile

- $R_n$ - Total Resistance
- $R_s$ - Shaft Resistance
- $R_r = \phi_{up} R_s = 0.60 R_s$ (SLT)
- $R_r = \phi_{up} R_s = 0.50 R_s$ (DLT)
- $R_r = \phi_{up} R_s = 0.25$ to $0.35 R_s$ (Stat)

- Soft Clay $S_u = 0.25$ ksf
- Medium Sand $N'_{60} = 12, \phi' = 37^\circ$
- Stiff Clay $S_u = 1.50$ ksf
- Dense Sand $N'_{60} = 32, \phi' = 41^\circ$
Chapter 7 – Geotechnical Aspects and Limit States

7.2.3 Design for Axial Tension Resistance
  7.2.3.1 Axial Tension Resistance of Single Piles
  7.2.3.2 Axial Tension Resistance of Pile Groups
  7.2.3.2.1 Axial Tension Resistance of Groups in Cohesionless Soils
  7.2.3.2.2 Axial Tension Resistance of Groups in Cohesive Soils

7.2.4 Nominal Axial Resistance Changes after Pile Driving
  7.2.4.1 Relaxation
  7.2.4.2 Soil Setup
    7.2.4.2.1 Estimation of Pore Pressures During Driving
  7.2.4.3 Implementation of Time Effects During Construction

7.2.5 Nominal Lateral Resistance

7.2.6 Pile Length Estimates for Contract Documents

7.2.7 Groundwater Effects and Buoyancy

7.2.8 Site Dewatering
  7.2.8.1 Artesian Conditions

7.2.9 Scour

7.2.10 Downdrag
Chapter 7 – Geotechnical Aspects and Limit States

7.3 SERVICE LIMIT STATES

7.3.1 Tolerable Vertical Deformations and Angular Distortion
    7.3.1.1 Load Factor for Vertical Deformations

7.3.2 S-0 Concept for Vertical Deformations

7.3.3 Construction Point Concept

7.3.4 Recommended Procedure for Vertical Deformation Analysis

7.3.5 Pile Group Settlement
    7.3.5.1 Elastic Compression of Piles
    7.3.5.2 Group Settlement in Cohesionless Soils
        7.3.5.2.1 Method Based on SPT Test Data
        7.3.5.2.2 Method Based on CPT Test Data
    7.3.5.3 Group Settlement in Cohesive Soils
    7.3.5.4 Time Rate of Settlement in Cohesive Soils
    7.3.5.5 Group Settlement in Layered Soils
    7.3.5.6 Group Settlement Using the Janbu Tangent Modulus Approach
    7.3.5.7 Group Settlement Using the Neutral Plane Method

Moulton (1985)
Procedure for Vertical Deformation Analysis Based on Construction Point Concept

(a) Wearing surface Superstructure Substructure Deep Foundation

Legend:

<table>
<thead>
<tr>
<th>W</th>
<th>Load after foundation construction</th>
</tr>
</thead>
<tbody>
<tr>
<td>X</td>
<td>Load after pier column and wall placement</td>
</tr>
<tr>
<td>Y</td>
<td>Load after superstructure construction</td>
</tr>
<tr>
<td>Z</td>
<td>Load after wearing surface construction</td>
</tr>
<tr>
<td>S</td>
<td>Service load (service limit state)</td>
</tr>
<tr>
<td>F</td>
<td>Factored load (strength limit state)</td>
</tr>
</tbody>
</table>

(b) Load

During construction
Long-term settlement (if applicable)

Vertical Deformation

<table>
<thead>
<tr>
<th>S_W</th>
<th>Settlement under load W</th>
</tr>
</thead>
<tbody>
<tr>
<td>S_X</td>
<td>Settlement under load X</td>
</tr>
<tr>
<td>S_Y</td>
<td>Settlement under load Y</td>
</tr>
<tr>
<td>S_Z</td>
<td>Settlement under load Z</td>
</tr>
</tbody>
</table>
Settlement Profile with Angular Distortion from Construction Point Concept

Legend:
- Calculated settlement profile (refer to Figure 7-38).
- Hypothetical settlement profile assumed for computation of maximum angular distortion, based on $S = 0$ concept.
- Range of relevant angular distortions using construction point concept.
Chapter 7 – Geotechnical Aspects and Limit States

7.3.6 Settlement Due to Downdrag
   7.3.6.1 Recommended Approach for Downdrag
   7.3.6.2 Methods for Reducing Downdrag and Drag Force

7.3.7 Horizontal Pile Foundation Deflection
   7.3.7.1 Pile Head Fixity
   7.3.7.2 Lateral Design Methods
   7.3.7.3 p-y Method
   7.3.7.4 Strain Wedge Method
   7.3.7.5 Single Piles
   7.3.7.6 Pile Groups
      7.3.7.6.1 Lateral Resistance Increases Through Ground Improvement

7.3.8 Lateral Squeeze of Foundation Soil and Solutions

7.3.9 Overall Stability
Calculated Load Versus Depth in 12.75 Inch O.D. Concrete Filled Pipe Pile

Data Courtesy of MnDOT and MnDOT Geotechnical Manual
Illustration of Neutral Plane and Resulting Pile Forces

Axial Load and Resistance Plot with Neutral Plane Location Based on Mobilized Toe Resistance

Chapter 7 – Geotechnical Aspects and Limit States

7.4 EXTREME EVENT LIMIT STATES
   7.4.1 Extreme Event Scour During Check Flood
   7.4.2 Seismic and Seismic Induced Downdrag
      7.4.2.1 AASHTO Recommendations for Equivalent Static Seismic Force
      7.4.2.2 Liquefaction
   7.4.3 Ice and Collisions
      7.4.3.1 Ice Loads
      7.4.3.2 Vehicle Collision
      7.4.3.3 Vessel Collision
   7.4.4 Combined Extreme Events

7.5 DETERMINATION OF MINIMUM PILE PENETRATION

7.6 DETERMINATION OF Rndr TO ESTABLISH CONTRACT DRIVING CRITERIA

7.7 DRIVABILITY ANALYSIS
   7.7.1 Factors Affecting Drivability
   7.7.2 Methods for Determining Pile Drivability
   7.7.3 Drivability versus Pile Type

7.8 CONSIDERATIONS FOR BATTER PILE DESIGN AND CONSTRUCTION

7.9 CORROSION AND DETERIORATION
Preliminary Drivability Assessment of Candidate Pile Types

- Nominal Driving Resistance (kips)
- Blow Count (bl/ft)
- Compression Stress (ksi)

Graphs showing penetration depth vs. driving factors for different pile types:
- HP 10x42
- HP 12x53
- HP 12x74
- HP 14x89
- HP 14x117

Note: Not Recommended

Graph indicates which pile types are not recommended based on the specified criteria.
Drivability Assessment of HP 14x89 Based on Hammer Size

Nominal Driving Resistance (kips)

Blow Count (bl/ft)

Compression Stress (ksi)

Penetration Depth (ft)

Hammer Models:
- D 30-52
- D 36-52
- D 46-52

200 kips
17 ft

Not Recommended
# Chapter 7 – Geotechnical Aspects and Limit States

## 7.10 ADDITIONAL DESIGN AND CONSTRUCTION CONSIDERATIONS

<table>
<thead>
<tr>
<th>Section</th>
<th>Description</th>
</tr>
</thead>
<tbody>
<tr>
<td>7.10.1</td>
<td>Minimum Pile Spacing, Clearance, and Cap Embedment</td>
</tr>
<tr>
<td>7.10.1.1</td>
<td>Special Considerations for Large Pile Sizes</td>
</tr>
<tr>
<td>7.10.2</td>
<td>Identification of High Rebound Soils</td>
</tr>
<tr>
<td>7.10.3</td>
<td>Soil and Pile Heave</td>
</tr>
<tr>
<td>7.10.4</td>
<td>Piles Driven Through Embankment Fills</td>
</tr>
<tr>
<td>7.10.5</td>
<td>Effect of Predrilling, Jetting and Vibratory Installation on Nom. Resistance</td>
</tr>
<tr>
<td>7.10.6</td>
<td>Densification Effects on Nominal Resistance and Installation Conditions</td>
</tr>
<tr>
<td>7.10.7</td>
<td>Plugging of Open Pile Sections</td>
</tr>
</tbody>
</table>
Chapter 8 – Structural Aspects and Limit States

8.1 INTRODUCTION

8.2 BASIC STRUCTURAL PROPERTIES OF DRIVEN PILES
   8.2.1 Material Properties
   8.2.2 Pile Section Definitions
   8.2.3 Effective Length and Buckling

8.3 STRUCTURAL CONSIDERATIONS AND RESISTANCE FACTORS
   8.3.1 Depth to Fixity
   8.3.2 Limiting Slenderness Ratio
   8.3.3 Resistance Factors

8.4 TIMBER PILES
   8.4.1 Driving Stresses
   8.4.2 Structural Resistance
      8.4.2.1 Axial Compression Parallel to Grain
      8.4.2.2 Flexure
      8.4.2.3 Combined Flexure and Axial Compression

8.5 STEEL PILES
   8.5.1 Driving Stresses
   8.5.2 Structural Resistance
      8.5.2.1 Axial Compression
      8.5.2.2 Flexure
Chapter 8 – Structural Aspects and Limit States

8.5.2.3 Combined Axial Compression and Flexure
8.5.2.4 Shear
8.5.3 Example Calculations for H Pile Structural Resistance.

8.6 CONCRETE PILES
8.6.1 Driving Stresses
8.6.2 Structural Resistance
8.6.2.1 Axial Compression
8.6.2.2 Biaxial Flexure

8.7 COMPOSITE PILES
8.7.1 Driving Stress
8.7.2 Structural Resistance
8.7.2.1 Axial Compression

8.8 LAYOUT OF PILE GROUPS

8.9 PRELIMINARY DESIGN OF PILE BENT AND GROUP CAPS
8.9.1 Cap Considerations for Large Pile Sizes
What’s in Volume II?

Chapter 9  Static Load Testing
Chapter 10 Dynamic Testing and Signal Matching Analysis
Chapter 11 Rapid Load Testing
Chapter 12 Wave Equation Analysis
Chapter 13 Dynamic Formulas
Chapter 14 Contract Documents
Chapter 15 Pile Driving Equipment
Chapter 16 Pile Accessories
Chapter 17 Driving Criteria
Chapter 18 Construction Monitoring of Pile Installation
Chapter 9 – Static Load Testing

9.1 GENERAL
9.1.1 Reasons and Prerequisites for a Static Load Test Program
9.1.2 Developing a Static Load Test Program
9.1.3 When and Where to Load Test
9.1.4 Effective Use of Load Test Information
   9.1.4.1 Design Stage
   9.1.4.2 Construction Stage
   9.1.4.3 Load Test Databases
9.1.5 Resistance Factors for Static Load Testing

9.2 AXIAL COMPRESSION LOAD TEST
9.2.1 Compression Load Test Equipment
9.2.2 Recommended Axial Compression Test Loading Method
9.2.3 Presentation and Interpretation of Axial Compression Test Results
9.2.4 Limitations of Axial Compression Tests

9.3 TENSION LOAD TEST
9.3.1 Tension Load Test Equipment
9.3.2 Tension Test Loading Methods
9.3.3 Presentation and Interpretation of Tension Test Results
Chapter 9 – Static Load Testing

9.4 LATERAL LOAD TEST
9.4.1 Lateral Load Test Equipment
9.4.2 Lateral Test Loading Methods
9.4.3 Presentation and Interpretation of Lateral Test Results

9.5 LOAD TRANSFER EVALUATIONS
9.5.1 Use of Telltales
9.5.2 Use of Strain Gages
9.5.3 Determination of Residual Load

9.6 PRACTICAL ISSUES AND CONSIDERATIONS

9.7 ADVANTAGES, DISADVANTAGES, AND LIMITATIONS
Static Load Testing

Calculated Axial Compression Load in Pile (tons)

- $16.3 \text{ tons} / [12.3 \text{ ft} (3.67 \text{ ft})] = 0.36 \text{ tsf}$
Chapter 10 – Dynamic Testing and Signal Matching Analysis

10.1 BACKGROUND

10.2 APPLICATIONS FOR DYNAMIC TESTING METHODS
   10.2.1 Nominal Resistance
   10.2.2 Hammer and Driving System Performance
   10.2.3 Driving Stresses and Pile Integrity

10.3 RESISTANCE FACTORS FOR DYNAMIC TESTING

10.4 DYNAMIC TESTING

10.5 BASIC WAVE MECHANICS

10.6 DYNAMIC TESTING METHODOLOGY
   10.6.1 Nominal Resistance Determination by Case Method
   10.6.2 Soil Resistance Distributions
   10.6.3 Energy Transfer
   10.6.4 Driving Stresses
   10.6.5 Pile Integrity
   10.6.6 Signal Matching
Dynamic Load Test Systems

Pile Driving Analyzer unit

Embedded Data Collector

EDC unit
# Chapter 10 – Dynamic Testing and Signal Matching Analysis

## 10.7 Considerations in Test Specification and Implementation

## 10.8 Presentation and Interpretation of Dynamic Test Results
- 10.8.1 Field Results
- 10.8.2 Evaluation of Hammer and Drive System Performance
- 10.8.3 Test Record Illustrating Problematic Hammer Performance
- 10.8.4 Test Record Illustrating Pile Damage
- 10.8.5 Test Records Illustrating Soil Setup
- 10.8.6 Test Records Illustrating Relaxation
- 10.8.7 Reporting of Dynamic Test Results

## 10.9 Case History

## 10.10 Advantages, Disadvantages, and Limitations

## 10.11 Practical Issues and Considerations
Chapter 11 – Rapid Load Testing

11.1 REQUIREMENTS FOR RAPID LOAD TESTS

11.2 BACKGROUND ON RAPID LOAD TEST METHODS
   11.2.1 Combustion Gas and Reaction Mass Apparatus (Statnamic)
   11.2.2 Cushioned Drop Weight Systems

11.3 RAPID LOAD TEST APPLICATIONS

11.4 RAPID LOAD TEST INTERPRETATION METHODS
   11.4.1 Unloading Point Method (UPM)
   11.4.2 Modified Unloading Point Method (MUP)
   11.4.3 Segmental Unloading Point Method (SUP)
   11.4.4 Fully Mobilized UPM
   11.4.5 Sheffield Method for Cohesive Soils
   11.4.6 Loading Rate Reduction Factors
   11.4.7 Resistance Factors (None currently in AASHTO)

11.5 LATERAL LOADING APPLICATION

11.6 CASE HISTORY

11.7 ADVANTAGES, DISADVANTAGES, AND LIMITATIONS

11.8 PRACTICAL ISSUES AND CONSIDERATIONS
Rapid Load Test Systems

- 9000 kip Statnamic gravel
- 790 kip Fundex device
- 1600 kip Apple RLT
- 1000 kip Statnamic hydraulic
Chapter 12 – Wave Equation Analysis

12.1 WAVE EQUATION ANALYSIS INTRODUCTION

12.2 WAVE PROPAGATION

12.3 WAVE EQUATION METHODOLOGY

12.4 WAVE EQUATION APPLICATIONS

12.5 WAVE EQUATION EXAMPLES
   12.5.1 Example 1 – General Bearing Graph
   12.5.2 Example 2 – Constant Capacity / Variable Stroke Option
   12.5.3 Example 3 – Drivability Studies
   12.5.4 Example 4 – Tension and Compression Stress Control
   12.5.5 Example 5 – Use of Soil Setup
   12.5.6 Example 6 – Driving System Characteristics
   12.5.7 Example 7 – Assessment of Pile Damage
   12.5.8 Example 8 – Selection of Wall Thickness
   12.5.9 Example 9 – Evaluation of Vibratory Driving
Chapter 12 – Wave Equation Analysis

12.6 ANALYSIS DECISIONS FOR WAVE EQUATION MODELING
   12.6.1 Selecting the Proper Approach
   12.6.2 External Combustion Hammer Consideration
   12.6.3 Diesel Hammer Considerations
   12.6.4 Vibratory Hammer Considerations
   12.6.5 Batter Pile Considerations
   12.6.6 Hammer and Pile Cushion Considerations
   12.6.7 Selection of Soil and Rock Parameters
   12.6.8 Pile Modeling Considerations
   12.6.9 Comparison with Dynamic Measurements

12.7 WAVE EQUATION ANALYSIS INPUT
   12.7.1 Other Analysis Options

12.8 WAVE EQUATION ANALYSIS OUTPUT AND INTERPRETATION

12.9 PLOTTING OF WAVE EQUATION RESULTS

12.10 SUGGESTIONS FOR PROBLEM SOLVING

12.11 ADVANTAGES, DISADVANTAGES, AND LIMITATIONS

12.12 PRACTICAL ISSUES AND CONSIDERATIONS
Chapter 13 – Dynamic Formulas

13.1 BACKGROUND
   13.1.1 Historical Accuracy of Dynamic Formulas
   13.1.2 Basic Limitations with Dynamic Formulas

13.2 RESISTANCE FACTORS FOR DYNAMIC FORMULAS

13.3 DYNAMIC FORMULAS
   13.3.1 FHWA Modified Gates Formula
   13.3.2 AASHTO Modified Engineering News Formula
   13.3.3 Other Dynamic Formulas
      13.3.3.1 Washington State DOT Pile Driving Formula
      13.3.3.2 Minnesota Pile Formula 2012 (MPF12)

13.4 DYNAMIC FORMULA CASE HISTORY

13.5 ADVANTAGES, DISADVANTAGES, AND LIMITATIONS

13.6 PRACTICAL ISSUES AND CONSIDERATIONS
# Chapter 14 – Contract Documents

<table>
<thead>
<tr>
<th>Section</th>
<th>Description</th>
</tr>
</thead>
<tbody>
<tr>
<td>14.1</td>
<td>OVERVIEW OF PLAN AND SPECIFICATION REQUIREMENTS</td>
</tr>
<tr>
<td>14.2</td>
<td>GENERIC DRIVEN PILE SPECIFICATION</td>
</tr>
<tr>
<td>14.2.1</td>
<td>SECTION X.01 DESCRIPTION</td>
</tr>
<tr>
<td>14.2.2</td>
<td>SECTION X.02 SUBMITTALS AND APPROVALS</td>
</tr>
<tr>
<td>14.2.3</td>
<td>SECTION X.03 MATERIALS</td>
</tr>
<tr>
<td>14.2.4</td>
<td>SECTION X.04 DRIVING EQUIPMENT AND APPURTEANCES</td>
</tr>
<tr>
<td>14.2.5</td>
<td>SECTION X.05 DETERMINATION OF NOMINAL RESISTANCE</td>
</tr>
<tr>
<td>14.2.6</td>
<td>SECTION X.06 PREPARATION AND DRIVING</td>
</tr>
<tr>
<td>14.2.7</td>
<td>SECTION X.07 METHOD OF MEASUREMENT</td>
</tr>
<tr>
<td>14.2.8</td>
<td>SECTION X.08 BASIS OF PAYMENT</td>
</tr>
</tbody>
</table>
Chapter 15 – Pile Driving Equipment

15.1 CRANES

15.2 DEDICATED AND UNIVERSAL RIGS

15.3 LEADS

15.4 TEMPLATES

15.5 HELMETS

15.6 HAMMER CUSHIONS

15.7 PILE CUSHIONS

15.8 HAMMERS
   15.8.1 Hammer Energy Concepts
Dedicated Pile Driving Rig

Universal Rig Equipped For Pile Driving
Chapter 15 – Pile Driving Equipment

15.9 DROP HAMMERS
15.10 SINGLE ACTING AIR/STEAM HAMMERS
15.11 DOUBLE ACTING AIR/STEAM HAMMERS
15.12 DIFFERENTIAL ACTING AIR/STEAM HAMMERS
15.13 SINGLE ACTING (OPEN END) DIESEL HAMMERS
15.14 DOUBLE ACTING (CLOSED END) DIESEL HAMMERS
15.15 SINGLE ACTING HYDRAULIC HAMMERS
15.16 DOUBLE ACTING HYDRAULIC HAMMERS
15.17 VIBRATORY HAMMERS
15.18 RESONANT HAMMERS
15.19 IMPACT HAMMER SIZE SELECTION
15.20 HAMMER KINETIC ENERGY MONITORING
15.21 NOISE SUPPRESSION EQUIPMENT
15.22 UNDERWATER NOISE SUPPRESSION EQUIPMENT
15.23 FOLLOWERS
15.24 JETTING
15.25 PREDRILLING
15.26 SPUDDING
15.27 EQUIPMENT SUBMITTALS
Chapter 16 – Pile Accessories

16.1 TIMBER PILES
   16.1.1 Pile Toe Attachments
   16.1.2 Attachments at Pile Head
   16.1.3 Splices

16.2 STEEL H-PILES
   16.2.1 Pile Toe Attachments
   16.2.2 Splices

16.3 STEEL PIPE PILES
   16.3.1 Pile Toe Attachments
   16.3.2 Splices
   16.3.3 Constrictor Plates

16.4 PRECAST CONCRETE PILES
   16.4.1 Pile Toe Attachment
   16.4.2 Splices

Constrictor Plate in LDOEP
Chapter 16 – Pile Accessories

16.5 WELDED SPLICES AND TOE ATTACHMENTS
  16.5.1 Welding Surface Preparation
  16.5.2 Temperature Requirements During Welding and Splicing
  16.5.3 Welding Pile Toe Accessories
  16.5.4 Welded Splice Checklist
      16.5.4.1 Preparation
      16.5.4.2 During Welding
      16.5.4.3 Final Weld Inspection
Chapter 17 – Driving Criteria

17.1 DEVELOPMENT OF THE PILE DRIVING CRITERIA

17.2 PRACTICAL AND ABSOLUTE REFUSAL

17.3 PRACTICAL ISSUES AND CONSIDERATIONS

17.4 EXAMPLES FOR establishing driving criteria
   17.4.1 Driving Criterion – Example 1
   17.4.2 Driving Criterion – Example 2

Practical Refusal = 10 blows / inch for a maximum of 3 consecutive inches

Absolute Refusal = 20 blows / inch for a 1 inch, 5 / ¼ inch, or 10 / ½ inch
Chapter 18 – Construction Monitoring of Pile Installation

18.1 MONITORING NEEDS BASED ON THE PROJECT DELIVERY METHOD

18.2 ITEMS TO BE MONITORED

18.3 REVIEW OF PROJECT PLANS AND SPECIFICATIONS

18.4 INSPECTORS TOOLS

18.5 INSPECTION OF PILES PRIOR TO AND DURING INSTALLATION
   18.5.1 Timber Piles
   18.5.2 Precast Concrete Piles
   18.5.3 Steel H-Piles
   18.5.4 Steel Pipe Piles

18.6 INSPECTION OF DRIVING EQUIPMENT
**Chapter 18 – Construction Monitoring of Pile Installation**

<table>
<thead>
<tr>
<th>Section</th>
<th>Description</th>
</tr>
</thead>
<tbody>
<tr>
<td>18.7</td>
<td>INSPECTION OF DRIVING EQUIPMENT DURING INSTALLATION</td>
</tr>
<tr>
<td>18.7.1</td>
<td>Drop Hammers</td>
</tr>
<tr>
<td>18.7.2</td>
<td>Single Acting Air/Steam Hammers</td>
</tr>
<tr>
<td>18.7.3</td>
<td>Double Acting or Differential Air/Steam Hammers</td>
</tr>
<tr>
<td>18.7.4</td>
<td>Single Acting Diesel Hammers</td>
</tr>
<tr>
<td>18.7.5</td>
<td>Double Acting Diesel Hammers</td>
</tr>
<tr>
<td>18.7.6</td>
<td>Single Acting Hydraulic Hammers</td>
</tr>
<tr>
<td>18.7.7</td>
<td>Double Acting Hydraulic Hammers</td>
</tr>
<tr>
<td>18.7.8</td>
<td>Resonant Hammers</td>
</tr>
<tr>
<td>18.7.9</td>
<td>Vibratory Hammers</td>
</tr>
<tr>
<td>18.8</td>
<td>INSPECTION OF TEST OR INDICATOR PILES</td>
</tr>
<tr>
<td>18.9</td>
<td>INSPECTION OF PRODUCTION PILES</td>
</tr>
<tr>
<td>18.10</td>
<td>DRIVING RECORDS AND REPORTS</td>
</tr>
<tr>
<td>18.11</td>
<td>SAFETY</td>
</tr>
</tbody>
</table>
Thank You!

Any Questions???