

Numerical Analysis of Reinforced Masonry Shear Walls Using the Nonlinear Truss  
Approach

Scott A. Williams

Thesis submitted to the faculty of the Virginia Polytechnic Institute and State University  
in partial fulfillment of the requirements for the degree of

Master of Science

In

Civil Engineering

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## Virginia Tech ETD Fair Use Analysis Results

*This is not a replacement for professional legal advice but an effort to assist you in making a sound decision.*

Name: Scott Williams

Description of item under review for fair use: (Figure 2.1 Fiber model. Source: A Fiber Beam-Column Element For Seismic Response Analysis of Reinforced Concrete Structures, December 1991)

Report generated on: 01-23-2014 at : 22:34:23

### **Based on the information you provided:**

#### **Factor 1**

Your consideration of the purpose and character of your use of the copyright work weighs: *in favor of fair use*

#### **Factor 2**

Your consideration of the nature of the copyrighted work you used weighs: *in favor of fair use*

#### **Factor 3**

Your consideration of the amount and substantiality of your use of the copyrighted work weighs: *in favor of fair use*

#### **Factor 4**

Your consideration of the effect or potential effect on the market after your use of the copyrighted work weighs: *in favor of fair use*

**Based on the information you provided, your use of the copyrighted work weighs: *in favor of fair use***



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## Virginia Tech ETD Fair Use Analysis Results

*This is not a replacement for professional legal advice but an effort to assist you in making a sound decision.*

Name: Scott Williams

Description of item under review for fair use: (Figure 2.2: Fiber section with shear spring model. Source: Trial Application: Reinforced Masonry Shear Wall Structures. In Evaluation of the FEMA P-695 Methodology for Quantification of Building Seismic Performance Factors, 2010)

Report generated on: 01-23-2014 at : 22:38:51

### **Based on the information you provided:**

#### **Factor 1**

Your consideration of the purpose and character of your use of the copyright work weighs: *in favor of fair use*

#### **Factor 2**

Your consideration of the nature of the copyrighted work you used weighs: *in favor of fair use*

#### **Factor 3**

Your consideration of the amount and substantiality of your use of the copyrighted work weighs: *in favor of fair use*

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## Virginia Tech ETD Fair Use Analysis Results

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Name: Scott Williams

Description of item under review for fair use: (Figure 2.4. Truss model with single cell per story without tension diagonal.  
Source: Hysterical Behavior of Reinforced Concrete Structural Walls, 1979)

Report generated on: 01-23-2014 at : 22:43:05

### **Based on the information you provided:**

#### **Factor 1**

Your consideration of the purpose and character of your use of the copyright work weighs: *in favor of fair use*

#### **Factor 2**

Your consideration of the nature of the copyrighted work you used weighs: *in favor of fair use*

#### **Factor 3**

Your consideration of the amount and substantiality of your use of the copyrighted work weighs: *in favor of fair use*

#### **Factor 4**

Your consideration of the effect or potential effect on the market after your use of the copyrighted work weighs: *in favor of fair use*

**Based on the information you provided, your use of the copyrighted work weighs: *in favor of fair use***



**Draft 09/01/2009**

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## Virginia Tech ETD Fair Use Analysis Results

*This is not a replacement for professional legal advice but an effort to assist you in making a sound decision.*

Name: Scott Williams

Description of item under review for fair use: (Figure 2.5: Truss model with multi cell truss configuration. Source: A New Modelling Strategy for the Behaviour of Shear Walls under Dynamic Loading, 2002)

Report generated on: 01-23-2014 at : 22:44:22

### **Based on the information you provided:**

#### **Factor 1**

Your consideration of the purpose and character of your use of the copyright work weighs: *in favor of fair use*

#### **Factor 2**

Your consideration of the nature of the copyrighted work you used weighs: *in favor of fair use*

#### **Factor 3**

Your consideration of the amount and substantiality of your use of the copyrighted work weighs: *in favor of fair use*

#### **Factor 4**

Your consideration of the effect or potential effect on the market after your use of the copyrighted work weighs: *in favor of fair use*

**Based on the information you provided, your use of the copyrighted work weighs: *in favor of fair use***



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## Virginia Tech ETD Fair Use Analysis Results

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Name: Scott Williams

Description of item under review for fair use: (Figure 2.6. Modified compression field theory factor. Source: Nonlinear Cyclic Truss Model for Reinforced Concrete Walls, 2012)

Report generated on: 01-23-2014 at : 22:46:47

### **Based on the information you provided:**

#### **Factor 1**

Your consideration of the purpose and character of your use of the copyright work weighs: *in favor of fair use*

#### **Factor 2**

Your consideration of the nature of the copyrighted work you used weighs: *in favor of fair use*

#### **Factor 3**

Your consideration of the amount and substantiality of your use of the copyrighted work weighs: *in favor of fair use*

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## Virginia Tech ETD Fair Use Analysis Results

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Name: Scott Williams

Description of item under review for fair use: (Figure 2.7. Three vertical line element model. Source: Analysis of the Full-Scale Seven-Story Reinforced Concrete Test Structure, 1983)

Report generated on: 01-23-2014 at : 22:48:04

### **Based on the information you provided:**

#### **Factor 1**

Your consideration of the purpose and character of your use of the copyright work weighs: *in favor of fair use*

#### **Factor 2**

Your consideration of the nature of the copyrighted work you used weighs: *in favor of fair use*

#### **Factor 3**

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Name: Scott Williams

Description of item under review for fair use: (Figure 2.8. TVLEM with nonlinear springs at the base. Source: Modeling of Reinforced Concrete Structural Walls, 1999)

Report generated on: 01-23-2014 at : 22:49:21

### **Based on the information you provided:**

#### **Factor 1**

Your consideration of the purpose and character of your use of the copyright work weighs: *in favor of fair use*

#### **Factor 2**

Your consideration of the nature of the copyrighted work you used weighs: *in favor of fair use*

#### **Factor 3**

Your consideration of the amount and substantiality of your use of the copyrighted work weighs: *in favor of fair use*

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## Virginia Tech ETD Fair Use Analysis Results

*This is not a replacement for professional legal advice but an effort to assist you in making a sound decision.*

Name: Scott Williams

Description of item under review for fair use: (Figure 2.9: Multiple vertical line element model with individual shear springs at each vertical element. Source: Experimental Study on Seismic Restoring Performance of Reinforced Concrete Shear Walls, 2004)

Report generated on: 01-23-2014 at : 22:50:34

### **Based on the information you provided:**

#### **Factor 1**

Your consideration of the purpose and character of your use of the copyright work weighs: *in favor of fair use*

#### **Factor 2**

Your consideration of the nature of the copyrighted work you used weighs: *in favor of fair use*

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Name: Scott Williams

Description of item under review for fair use: (Figure 3.3. Diagonal truss element effective width. Source: Nonlinear Cyclic Truss Model for Reinforced Concrete Walls, 2012)

Report generated on: 01-23-2014 at : 22:52:01

### **Based on the information you provided:**

#### **Factor 1**

Your consideration of the purpose and character of your use of the copyright work weighs: *in favor of fair use*

#### **Factor 2**

Your consideration of the nature of the copyrighted work you used weighs: *in favor of fair use*

#### **Factor 3**

Your consideration of the amount and substantiality of your use of the copyrighted work weighs: *in favor of fair use*

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## Virginia Tech ETD Fair Use Analysis Results

*This is not a replacement for professional legal advice but an effort to assist you in making a sound decision.*

Name: Scott Williams

Description of item under review for fair use: (Figure 4.1. Experimentally applied displacement history . Source: Response of Sing-Story Reinforced Masonry Shear Walls to In-Plane Lateral Loads, 1991)

Report generated on: 01-23-2014 at : 22:53:51

### **Based on the information you provided:**

#### **Factor 1**

Your consideration of the purpose and character of your use of the copyright work weighs: *in favor of fair use*

#### **Factor 2**

Your consideration of the nature of the copyrighted work you used weighs: *in favor of fair use*

#### **Factor 3**

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## Virginia Tech ETD Fair Use Analysis Results

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Name: Scott Williams

Description of item under review for fair use: (Figure 4.2. Isolated single story wall experimental configuration. Source: Response of Sing-Story Reinforced Masonry Shear Walls to In-Plane Lateral Loads, 1991)

Report generated on: 01-23-2014 at : 22:54:46

### **Based on the information you provided:**

#### **Factor 1**

Your consideration of the purpose and character of your use of the copyright work weighs: *in favor of fair use*

#### **Factor 2**

Your consideration of the nature of the copyrighted work you used weighs: *in favor of fair use*

#### **Factor 3**

Your consideration of the amount and substantiality of your use of the copyrighted work weighs: *in favor of fair use*

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## Virginia Tech ETD Fair Use Analysis Results

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Name: Scott Williams

Description of item under review for fair use: (Figure 4.6: Experimentally observed damage pattern of the shear-dominated wall. Source: Response of Sing-Story Reinforced Masonry Shear Walls to In-Plane Lateral Loads, 1991)

Report generated on: 01-23-2014 at : 22:55:32

### **Based on the information you provided:**

#### **Factor 1**

Your consideration of the purpose and character of your use of the copyright work weighs: *in favor of fair use*

#### **Factor 2**

Your consideration of the nature of the copyrighted work you used weighs: *in favor of fair use*

#### **Factor 3**

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## Virginia Tech ETD Fair Use Analysis Results

*This is not a replacement for professional legal advice but an effort to assist you in making a sound decision.*

Name: Scott Williams

Description of item under review for fair use: (Figure 4.10. Experimentally observed damage pattern of the sliding-dominated wall. Source: Response of Sing-Story Reinforced Masonry Shear Walls to In-Plane Lateral Loads, 1991)

Report generated on: 01-23-2014 at : 22:56:12

### **Based on the information you provided:**

#### **Factor 1**

Your consideration of the purpose and character of your use of the copyright work weighs: *in favor of fair use*

#### **Factor 2**

Your consideration of the nature of the copyrighted work you used weighs: *in favor of fair use*

#### **Factor 3**

Your consideration of the amount and substantiality of your use of the copyrighted work weighs: *in favor of fair use*

#### **Factor 4**

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Name: Scott Williams

Description of item under review for fair use: (Figure 5.1. Two story structure plan view. Source: Personal Communication with Mavros, 2013)

Report generated on: 01-23-2014 at : 22:57:56

### **Based on the information you provided:**

#### **Factor 1**

Your consideration of the purpose and character of your use of the copyright work weighs: *in favor of fair use*

#### **Factor 2**

Your consideration of the nature of the copyrighted work you used weighs: *in favor of fair use*

#### **Factor 3**

Your consideration of the amount and substantiality of your use of the copyrighted work weighs: *in favor of fair use*

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## Virginia Tech ETD Fair Use Analysis Results

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Name: Scott Williams

Description of item under review for fair use: (Figure 5.2 Elevation view of web walls. Source: Personal Communication with Mavros, 2013)

Report generated on: 01-23-2014 at : 22:58:57

### **Based on the information you provided:**

#### **Factor 1**

Your consideration of the purpose and character of your use of the copyright work weighs: *in favor of fair use*

#### **Factor 2**

Your consideration of the nature of the copyrighted work you used weighs: *in favor of fair use*

#### **Factor 3**

Your consideration of the amount and substantiality of your use of the copyrighted work weighs: *in favor of fair use*

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## Virginia Tech ETD Fair Use Analysis Results

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Name: Scott Williams

Description of item under review for fair use: (Figure 5.3. Elevation view of one set of flange walls. Source: Personal Communication with Mavros, 2013)

Report generated on: 01-23-2014 at : 22:59:33

### **Based on the information you provided:**

#### **Factor 1**

Your consideration of the purpose and character of your use of the copyright work weighs: *in favor of fair use*

#### **Factor 2**

Your consideration of the nature of the copyrighted work you used weighs: *in favor of fair use*

#### **Factor 3**

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Name: Scott Williams

Description of item under review for fair use: (Figure 5.4. Reinforcement detail for web walls. Source: Personal Communication with Mavros, 2013)

Report generated on: 01-23-2014 at : 23:00:09

### **Based on the information you provided:**

#### **Factor 1**

Your consideration of the purpose and character of your use of the copyright work weighs: *in favor of fair use*

#### **Factor 2**

Your consideration of the nature of the copyrighted work you used weighs: *in favor of fair use*

#### **Factor 3**

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## Virginia Tech ETD Fair Use Analysis Results

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Name: Scott Williams

Description of item under review for fair use: (Figure 5.5. Reinforcement detail for one set of flange walls. Source: Personal Communication with Mavros, 2013)

Report generated on: 01-23-2014 at : 23:00:51

### **Based on the information you provided:**

#### **Factor 1**

Your consideration of the purpose and character of your use of the copyright work weighs: *in favor of fair use*

#### **Factor 2**

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## Virginia Tech ETD Fair Use Analysis Results

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Name: Scott Williams

Description of item under review for fair use: (Figure 5.7. Photograph of experimental wall after completion of tests. Source: Personal Communication with Mavros, 2013)

Report generated on: 01-23-2014 at : 23:03:44

### **Based on the information you provided:**

#### **Factor 1**

Your consideration of the purpose and character of your use of the copyright work weighs: *in favor of fair use*

#### **Factor 2**

Your consideration of the nature of the copyrighted work you used weighs: *in favor of fair use*

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Name: Scott Williams

Description of item under review for fair use: (Figure 6.1. Plan view of the one story masonry shear wall archetype. Source: Evaluation of the FEMA P-695 Methodology for Quantification of Building Seismic Performance Factors, 2010)

Report generated on: 01-23-2014 at : 23:09:14

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Name: Scott Williams

Description of item under review for fair use: (Figure 6.6. Plan view of 2 story masonry shear wall archetype . Source: Evaluation of the FEMA P-695 Methodology for Quantification of Building Seismic Performance Factors, 2010)

Report generated on: 01-23-2014 at : 23:10:14

### **Based on the information you provided:**

#### **Factor 1**

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