

**CRITICAL HEIGHT AND SURFACE DEFORMATION OF COLUMN-SUPPORTED
EMBANKMENTS**

Michael P. McGuire

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

Doctor of Philosophy
In
Civil Engineering

George M Filz (Chair)
Thomas L. Brandon
Russell A. Green
James R. Martin
Raymond H. Plaut

November 1, 2011
Blacksburg, VA

Keywords:
Critical height
Column-supported embankment
Geosynthetic reinforcement
Settlement

Permissions and Fair Use

Figure 1.9 (Used with permission)

Filz, G. M., and Smith, M. E. (2006). "Design of Bridging Layers in Geosynthetic-Reinforced, Column-Supported Embankments." Virginia Transportation Research Council, Charlottesville, Virginia, 46p.

Figure 2.13 (Fair use)

Fadl, M. O. (1981). "The behavior of plate anchors in sand." PhD, University of Glasgow, Glasgow.

Figure 3.15, Figure 3.16 (Used with permission)

Alshibli, K. A., Batiste, S. N., and Sture, S. (2003). "Strain localization in sand: plane strain versus triaxial compression." *Journal of Geotechnical and Geoenvironmental Engineering*, 129(6), 483-494.

Figure 7.9 (Used with permission)

Sloan, J. A. (2011). "Column-supported embankments: Full-scale tests and design recommendations." PhD Dissertation, Virginia Polytechnic Institute and State University, Blacksburg.

Appendix A (Used with permission)

McGuire, M. P., and Filz, G. M. (2008). "Quantitative comparison of theories for geosynthetic reinforcement of column-supported embankments." *GeoAmericas 2008, First Pan American American Geosynthetics Conference and Exhibition*, Cancun, Mexico, 1303-1312.

Appendix B (Used with permission)

McGuire, M. P., Filz, G. M., and Almeida, M. S. S. (2009). "Load-displacement compatibility analysis of a low-height column-supported embankment." *International Foundation Congress and Equipment Expo*, Orlando, Florida.

Appendix C (Used with permission)

McGuire, M. P., and Filz, G. M. (2010). "Incorporation of slack and creep in the British Standard code of practice for calculating tension and deflection of geosynthetic reinforcement used in

column-supported embankments." *9th International Conference on Geosynthetics*, Guaruja, Brazil.

Appendix D Figures D.1 through D.5 (Fair use)

Chen, Y. M., Cao, W. P., and Chen, R. P. (2008). "An experimental investigation of soil arching within basal reinforced and unreinforced piled embankments." *Geotextiles and Geomembranes*, 26, 164-174.

Appendix E Figures E.3 through E.7, E.9, E.10 through E.16, E.25 through E.28 (Fair use)

Demerdash, M. A. (1996). "An experimental study of piled embankments incorporating geosynthetic basal reinforcement." Doctoral Dissertation, University of Newcastle-Upon-Tyne, Department of Civil Engineering.

Appendix F Figures F.1 and F.2 (Fair use)

Ellis, E. A., and Aslam, R. (2009). "Arching in piled embankments: comparison of centrifuge tests and predictive methods - part 2 of 2." *Ground Engineering*, 42(7), 28-31.

Appendix G Figure G.1 (Used with permission)

Han, J., and Gabr, M. A. (2002). "Numerical analysis of geosynthetic-reinforced and pile-supported earth platforms over soft soil." *Journal of Geotechnical and Geoenvironmental Engineering*, 128(1), 44-53.

Appendix H Figures H.1 through H.3 (Used with permission)

Jenck, O., Dias, D., and Kastner, R. (2007). "Two-dimensional physical and numerical modeling of a pile-supported earth platform over soft soil." *ASCE Journal of Geotechnical and Geoenvironmental Engineering*, 133(3), 295- 305.

Appendix I Figure I.1 (Fair Use)

Ting, W. H., Chan, S. F., and Ooi, T. A. (1994). "Design methodology and experiences with pile supported embankments." *Development in Geotechnical Engineering*, Balkema, Rotterdam, 419-432.



Michael McGuire <michael.p.mcguire@gmail.com>

Copyright Request Related to VTRC 06-CR12

3 messages

Winter, Kenneth A. <Ken.Winter@vdot.virginia.gov>

Thu, Nov 10, 2011 at 10:36 AM

To: "Filz, George M." <filz@vt.edu>

Cc: michael.p.mcguire@gmail.com, "O'Leary, Amy A." <Amy.OLeary@vdot.virginia.gov>, "Hoppe, Edward J." <Edward.Hoppe@vdot.virginia.gov>

Mr. Filz-

Thanks for speaking on the phone with me this morning.

To recap our conversation, yesterday I spoke with Mike McGuire, a PhD student at Virginia Tech, and a colleague of yours.

Mike is putting the final touches on his dissertation and is required to get the appropriate permissions for content in the dissertations that came from other published documents.

Mike has requested permission to use a figure from a report you authored under contract with the Commonwealth in his dissertation. To fulfill the requirements for his dissertation on time he noted that he needs this permission granted no later than next Tuesday.

His request was to reproduce Fig 8 on page 19 of the following VTRC report: Filz, G. M., and Smith, M. E. (2006). "Design of Bridging Layers in Geosynthetic-Reinforced, Column-Supported Embankments." Virginia Transportation Research Council, Charlottesville, Virginia, 46p. See: http://www.virginiadot.org/vtrc/main/online_reports/pdf/06-cr12.pdf

I forwarded his request on to Dr. Amy O'Leary for advice and she advised me that typically the permission would be granted by VDOT's policy office, but that the person who normally grants permissions is no longer with VDOT.

In the interest of expediency, Amy has advised me that you are authorized to grant permission for this specific use. Ed Hoppe, who was involved in this research as the project manager, concurs.

Permission is extended, however, with these two conditions:

1. The figure used should include all the proper attribution to the original source.

2. This permission only applies to Mr. McGuire's dissertation. It does not extend to any other works, including derivative works such as journal articles, books, or Web sites.

If these terms make sense and you are willing to grant the this specific use please respond to this e-mail.

Thank you.

Ken

Ken Winter, MLIS
Director of Library and Information Services
VDOT Research Library
530 Edgemont Road, Charlottesville VA 22903
Ph: [434-962-8979](tel:434-962-8979) | E-mail: Ken.Winter@VDOT.virginia.gov
Library Web Page (VDOT Only)

George Filz <filz@vt.edu>

Thu, Nov 10, 2011 at 11:00 AM

To: "Winter, Kenneth A." <Ken.Winter@vdot.virginia.gov>

Cc: michael.p.mcguire@gmail.com, "O'Leary, Amy A." <Amy.OLeary@vdot.virginia.gov>, "Hoppe, Edward J." <Edward.Hoppe@vdot.virginia.gov>

Ken,

Thanks for addressing this so quickly. I agree to grant permission for use of the figure as described in your email message.

Best regards,

George

At 10:36 AM 11/10/2011 -0500, Winter, Kenneth A. wrote:

Mr. Filz-

Thanks for speaking on the phone with me this morning.

To recap our conversation, yesterday I spoke with Mike McGuire, a PhD student at Virginia Tech, and a colleague of yours.

Mike is putting the final touches on his dissertation and is required to get the appropriate permissions for content in the dissertations that came from other published documents.

Mike has requested permission to use a figure from a report you authored under contract with the Commonwealth in his dissertation. To fulfill the requirements for his dissertation on time he noted that he needs this permission granted no later than next Tuesday.

His request was to reproduce Fig 8 on page 19 of the following VTRC report: Filz, G. M., and Smith, M. E. (2006). "Design of Bridging Layers in Geosynthetic-Reinforced, Column-Supported Embankments." Virginia Transportation Research Council, Charlottesville, Virginia, 46p. See: http://www.virginiadot.org/vtrc/main/online_reports/pdf/06-cr12.pdf

I forwarded his request on to Dr. Amy O Leary for advice and she advised me that typically the permission would be granted by VDOT's policy office, but that the person who normally grants permissions is no longer with VDOT.

In the interest of expediency, Amy has advised me that you are authorized to grant permission for this specific use. Ed Hoppe, who was involved in this research as the project manager, concurs.

Permission is extended, however, with these two conditions:

1. The figure used should include all the proper attribution to the original source.
2. This permission only applies to Mr. McGuire's dissertation. It does not extend to any other works, including derivative works such as journal articles, books, or Web sites.

If these terms make sense and you are willing to grant the this specific use please respond to this e-mail.

Thank you.

Ken

Ken Winter, MLIS
Director of Library and Information Services
VDOT Research Library
530 Edgemont Road, Charlottesville VA 22903
Ph: [434-962-8979](tel:434-962-8979) | E-mail: Ken.Winter@VDOT.virginia.gov
Library Web Page (VDOT Only)

George Filz, Ph.D., P.E.
Charles E. Via Professor, Assistant Department Head

Civil & Environmental Engineering Department
Director of the Center for Geotechnical Practice and Research
Virginia Tech
Blacksburg, VA 24061
Ph: [540-231-7151](tel:540-231-7151)
Mobile: [540-558-8651](tel:540-558-8651)

Michael McGuire <michael.p.mcguire@gmail.com>
To: "Winter, Kenneth A." <Ken.Winter@vdot.virginia.gov>

Thu, Nov 10, 2011 at 3:16 PM

Ken:

Thanks for handling this so quickly.

-Mike

On Thu, Nov 10, 2011 at 10:36 AM, Winter, Kenneth A. <Ken.Winter@vdot.virginia.gov> wrote:

Mr. Filz-

Thanks for speaking on the phone with me this morning.

To recap our conversation, yesterday I spoke with Mike McGuire, a PhD student at Virginia Tech, and a colleague of yours.

Mike is putting the final touches on his dissertation and is required to get the appropriate permissions for content in the dissertations that came from other published documents.

Mike has requested permission to use a figure from a report you authored under contract with the Commonwealth in his dissertation. To fulfill the requirements for his dissertation on time he noted that he needs this permission granted no later than next Tuesday.

His request was to reproduce Fig 8 on page 19 of the following VTRC report: Filz, G. M., and Smith, M. E. (2006). "Design of Bridging Layers in Geosynthetic-Reinforced, Column-Supported Embankments." Virginia Transportation Research Council, Charlottesville, Virginia, 46p. See: http://www.virginiadot.org/vtrc/main/online_reports/pdf/06-cr12.pdf

I forwarded his request on to Dr. Amy O'Leary for advice and she advised me that typically the permission would be granted by VDOT's policy office, but that the person who normally grants permissions is no longer with VDOT.

In the interest of expediency, Amy has advised me that you are authorized to grant permission for this specific use. Ed Hoppe, who was involved in this research as the project manager, concurs.

Permission is extended, however, with these two conditions:

1. The figure used should include all the proper attribution to the original source.
2. This permission only applies to Mr. McGuire's dissertation. It does not extend to any other works, including derivative works such as journal articles, books, or Web sites.

If these terms make sense and you are willing to grant the this specific use please respond to this e-mail.

Thank you.

Ken

Ken Winter, MLIS
Director of Library and Information Services
VDOT Research Library
530 Edgemont Road, Charlottesville VA 22903
Ph: [434-962-8979](tel:434-962-8979) | E-mail: Ken.Winter@VDOT.virginia.gov
Library Web Page (VDOT Only)

Draft 09/01/2009

(Questions? Concerns? Contact Gail McMillan, Director of the Digital Library and Archives at Virginia Tech's University Libraries: gailmac@vt.edu)

(Please ensure that Javascript is enabled on your browser before using this tool.)

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: Michael McGuire

Description of item under review for fair use: Figure 2.13 Source: Fadl, M. O. (1981). "The behavior of plate anchors in sand." PhD, University of Glasgow, Glasgow.

Report generated on: 11-10-2011 at : 10:57:43

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*





RightsLink®

Home

Create
Account

Help



Title: Strain Localization in Sand: Plane Strain versus Triaxial Compression

Author: Khalid A. Alshibli; Susan N. Batiste; Stein Sture

Publication: Journal of Geotechnical and Geoenvironmental Engineering

Publisher: American Society of Civil Engineers

Date: 2003-06-00

Copyright © 2003, ASCE. All rights reserved.

User ID

Password

 Enable Auto Login

LOGIN

[Forgot Password/User ID?](#)

If you're a copyright.com user, you can login to Rightslink using your copyright.com credentials. **Already a Rightslink user or want to learn more?**

Permissions Request

This reuse request is free of charge. ASCE does not require a license for this reuse. Please print this page for your records.

Type of use: Dissertation/Thesis

Portion: figures/tables/illustrations

Format: electronic

Use of this content will make up more than 25% of the new work: no

Author of this ASCE work or ASCE will publish the new work: no

BACK

CLOSE WINDOW

Copyright © 2011 [Copyright Clearance Center, Inc.](#) All Rights Reserved. [Privacy statement.](#)
Comments? We would like to hear from you. E-mail us at customercare@copyright.com



Michael McGuire <michael.p.mcguire@gmail.com>

Request for permission

2 messages

Michael McGuire <michael.p.mcguire@gmail.com>

Wed, Nov 9, 2011 at 3:31 PM

To: Joel Sloan <sloanja@vt.edu>

Joel:

In my dissertation I reuse one of your figures (Fig 6.57, page 143). Can you send me an email granting me permission? I need to include the letter when I turn in my ETD on Tuesday.

Hope all is going well for you and your family.

-Mike

Joel Sloan <sloanja@vt.edu>

Thu, Nov 10, 2011 at 7:44 AM

To: Michael McGuire <michael.p.mcguire@gmail.com>

Mike,

Feel free to use Fig 6.57 from my dissertation. I can send you the excel file or perhaps a jpeg of the plot if you'd like something with higher resolution.

Things are going well here although I definitely miss Nancy and Hailey. Hope Tish and the girls are doing well.

Joel

From: Michael McGuire [mailto:michael.p.mcguire@gmail.com]

Sent: Thursday, November 10, 2011 5:31 AM

To: Joel Sloan

Subject: Request for permission

Joel:

In my dissertation I reuse one of your figures (Fig 6.57, page 143). Can you send me an email granting me permission? I need to include the letter when I turn in my ETD on Tuesday.

11/10/11

Gmail - Request for permission

Hope all is going well for you and your family.

-Mike

Copyright Release for Academic Use of a Paper presented at an IGS Conference

Given to:

Michael P. McGuire, Ph.D., P.E.
Research Associate
Civil and Environmental Engineering
120 E Patton Hall
Virginia Tech
Blacksburg, Virginia 24061

For use of the paper:

Quantitative comparison of theories for geosynthetic reinforcement of column-supported embankments

Presented at:

GeoAmericas 2008, First Pan American Geosynthetics Conference and Exhibition, Cancun, Mexico,
1303-1312. McGuire, M. P., and Filz, G. M. (2008) and published in the corresponding proceedings

IGS gives its permission for the paper to be used as an addendum to Mr. McGuire's graduate dissertation.

Elizabeth J Peggs



IGS Secretary



RightsLink®

Home

Create
Account

Help



Conference Proceeding: Contemporary Topics in Ground Modification, Problem Soils, and Geo-Support (GSP 187)

Conference Proceeding Paper: Load-Displacement Compatibility Analysis of a Low-Height Column-Supported Embankment

Author: Michael P. McGuire; George M. Filz; Marcio S. S. Almeida

Publisher: American Society of Civil Engineers

Date: 2009

Copyright © 2009, ASCE. All rights reserved.

User ID

Password

 Enable Auto Login

LOGIN

[Forgot Password/User ID?](#)

If you're a copyright.com user, you can login to Rightslink using your copyright.com credentials. **Already a Rightslink user** or want to [learn more?](#)

Permissions Request

As an ASCE author, you are permitted to reuse you own content for another ASCE or non-ASCE publication.

Please add the full credit line "With permission from ASCE" to your source citation. Please print this page for your records.

Type of use: Dissertation/Thesis

Portion: full article

Format: electronic

Use of this content will make up more than 25% of the new work: no

Author of this ASCE work or ASCE will publish the new work: yes

BACK

CLOSE WINDOW

Copyright © 2011 [Copyright Clearance Center, Inc.](#) All Rights Reserved. [Privacy statement](#).
Comments? We would like to hear from you. E-mail us at customercare@copyright.com

Copyright Release for Academic Use of a Paper presented at an IGS Conference

Given to:

Michael P. McGuire, Ph.D., P.E.
Research Associate
Civil and Environmental Engineering
120 E Patton Hall
Virginia Tech
Blacksburg, Virginia 24061

For use of the paper:

Incorporation of slack and creep in the British Standard code of practice for calculating tension and deflection of geosynthetic reinforcement used in column-supported embankments.

Presented at:

9th International Conference on Geosynthetics, Guaruja, Brazil (2010) and in the corresponding proceedings.

IGS gives its permission for the paper to be used as an addendum to Mr. McGuire's graduate dissertation.

Elizabeth J Peggs



IGS Secretary
10 November 2011

Draft 09/01/2009

(Questions? Concerns? Contact Gail McMillan, Director of the Digital Library and Archives at Virginia Tech's University Libraries: gailmac@vt.edu)

(Please ensure that Javascript is enabled on your browser before using this tool.)

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: Michael McGuire

Description of item under review for fair use: Appendix D Figures D.1 through D.5 Source: Chen, Y. M., Cao, W. P., and Chen, R. P. (2008). "An experimental investigation of soil arching within basal reinforced and unreinforced piled embankments." Geotextiles and Geomembranes, 26, 164-174.

Report generated on: 11-10-2011 at : 11:02:45

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

(Questions? Concerns? Contact Gail McMillan, Director of the Digital Library and Archives at Virginia Tech's University Libraries: gailmac@vt.edu)

(Please ensure that Javascript is enabled on your browser before using this tool.)

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: Michael McGuire

Description of item under review for fair use: Appendix E Figures E.3 through E.7, E.9, E.10 through E.16, E.25 through E.28 Source: Demerdash, M. A. (1996). "An experimental study of piled embankments incorporating geosynthetic basal reinforcement." Doctoral Dissertation, University of Newcastle-Upon-Tyne, Department of Civil Engineering.

Report generated on: 11-10-2011 at : 11:00:23

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





RightsLink®

Home

Create
Account

Help



Title: Numerical Analysis of Geosynthetic-Reinforced and Pile-Supported Earth Platforms over Soft Soil

Author: J. Han; M. A. Gabr

Publication: Journal of Geotechnical and Geoenvironmental Engineering

Publisher: American Society of Civil Engineers

Date: 2002-01-00

Copyright © 2001, ASCE. All rights reserved.

User ID

Password

Enable Auto Login

LOGIN

[Forgot Password/User ID?](#)

If you're a copyright.com user, you can login to Rightslink using your copyright.com credentials. **Already a Rightslink user** or want to [learn more?](#)

Permissions Request

This reuse request is free of charge. ASCE does not require a license for this reuse. Please print this page for your records.

Type of use: Dissertation/Thesis

Portion: figures/tables/illustrations

Format: electronic

Use of this content will make up more than 25% of the new work: no

Author of this ASCE work or ASCE will publish the new work: no

BACK

CLOSE WINDOW

Copyright © 2011 [Copyright Clearance Center, Inc.](#) All Rights Reserved. [Privacy statement.](#)
Comments? We would like to hear from you. E-mail us at customercare@copyright.com



RightsLink®

Home

Create
Account

Help



Title: Two-Dimensional Physical and Numerical Modeling of a Pile-Supported Earth Platform over Soft Soil

Author: Orienne Jenck; Daniel Dias; Richard Kastner

Publication: Journal of Geotechnical and Geoenvironmental Engineering

Publisher: American Society of Civil Engineers

Date: 2007-03-00

Copyright © 2007, ASCE. All rights reserved.

User ID

Password

 Enable Auto Login

LOGIN

[Forgot Password/User ID?](#)

If you're a copyright.com user, you can login to Rightslink using your copyright.com credentials. **Already a Rightslink user or want to learn more?**

Permissions Request

This reuse request is free of charge. ASCE does not require a license for this reuse. Please print this page for your records.

Type of use: Dissertation/Thesis

Portion: figures/tables/illustrations

Format: electronic

Use of this content will make up more than 25% of the new work: no

Author of this ASCE work or ASCE will publish the new work: no

BACK

CLOSE WINDOW

Copyright © 2011 [Copyright Clearance Center, Inc.](#) All Rights Reserved. [Privacy statement.](#)
Comments? We would like to hear from you. E-mail us at customercare@copyright.com

Draft 09/01/2009

(Questions? Concerns? Contact Gail McMillan, Director of the Digital Library and Archives at Virginia Tech's University Libraries: gailmac@vt.edu)

(Please ensure that Javascript is enabled on your browser before using this tool.)

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: Michael McGuire

Description of item under review for fair use: Appendix I Figure I.1 Source: Ting, W. H., Chan, S. F., and Ooi, T. A. (1994). "Design methodology and experiences with pile supported embankments." Development in Geotechnical Engineering, Balkema, Rotterdam, 419-432.

Report generated on: 11-10-2011 at : 10:59:28

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*

