Foundation Sliding Checks

Slippery surfaces subvert structural stability

Sliding stability is nothing too fancy. But the new feature in VisualFoundation 4.0 will help you with a lot of bookkeeping--that tedious aspect of your business that makes you feel more like an accountant than an engineer: VisualFoundation 4.0 now offers lateral sliding checks in the plane of the mat footing!

You apply the sliding forces as loads. These may be applied at columns and walls in any service load case.

You also specify the lateral passive soil pressure. We'll use this pressure to calculate a "sum total" of resistance against sliding in each direction using the projected width of the footing and the average thickness.

We'll throw in a resisting friction force automatically calculated based on the weight of the footing and the applied vertical loads well, semi-automatically, you must provide us with a friction coefficient.

Sliding Stability

Load Combination	Equation	Sliding Force	Resisting Friction	Resisting Passive	Safety Factor
16-9	D + L	31.9 K	51.9 K	0.135 K	1.63
16-11Lr	D + 0.75L	34.4 K	51.9 K	0.135 K	1.51
16-3Lr+L	1.20D + 0.50L	45.3 K	62.3 K	0.135 K	1.38
16-13W+Lr s+Y	D + 0.75L + 0.75W+Y	34.4 K	47.4 K	0.135 K	1.38

With this addition, VisualFoundation will now complete the foundation stability calculations including uplift and overturning, freeing you to work on more complicated issues.

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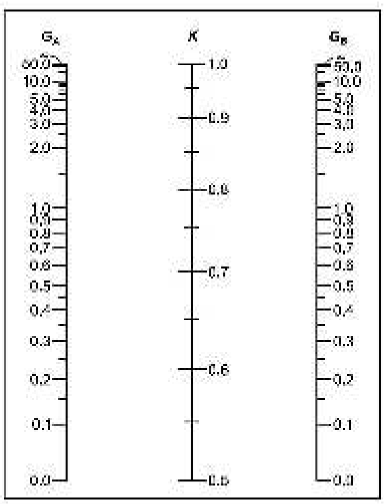
K-Factors in VisualAnalysis

A Glimpse Into Software Development

VisualAnalysis is a technological acheivement that is both easy to use and incredibly sophisticated. The tool consists of nearly 200,000 lines of code created by some talented engineers/developers over the last 20 years. The work that goes on behind the scenes may be under-appreciated by those who see its simplicity and use it to solve their everyday problems--taking for granted the deep knowledge and creativity embedded into the system.



Take K-Factors, for example, those innocuous fudge-factors used to simplify the design of steel columns while accounting for complex buckling behavior. For many years engineers calculated K-Factors using a nomograph in the steel manual--or just used an idealized approximation. Over the years, we have implemented code to calculate those K factors automatically in VisualAnalysis using that nomograph in programming code very much like you would by hand. However, with the release of VisualAnalysis 9.0 as we worked on an extensive validation project whereby we tried to systematically and automatically double-check the calculations that

VisualAnalysis performs, we revisited this seemingly "trivial" sort of calculation. What we found was that we could do a much better job of incorporating the latest changes and research to implement much more accurate K factors.

The art and the science of K Factor calculations depends upon a very large number of factors that go into your finite element model including the member sizes, orientations, geometry, and end-releases. The specifications make certain assumptions about differences between beams, columns, braces, moment frames or braced frames that may not be "obvious" to a chunk of computer code that doesn't have an engineer's brain--just some logic about which axis is vertical, or similar "clues" you have provided in setting up your model.

$$\frac{G_A G_B}{4}(\pi/K)^2 + \left(\frac{G_A + G_B}{2}\right)\left(1 - \frac{\pi/K}{\tan(\pi/K)}\right) + \frac{2\tan(\pi/2K)}{(\pi/K)} - 1 = 0$$

After taking all these factors into account and performing the necessary coordinate transformations, we must then calculate the "G" stiffnessess for the various members that participate in another member's K factor and perform a numerical, iterative solution of the equations--like the one above that lies behind the nomograph. We must also handle the special cases to avoid division by zero or other numerical overflow and round-off issues. (These calculations alone occupy some 500 lines of programming logic that have been debugged and validated with many test cases!) Here is a sampling of that code to calculate G stiffnesses at member ends:

```
double CalculateMemberGFactor( const CMember& m, int end, ETCoordinate dir ) {
    double G = 50.0;
    const CNode* endNode = m.node( end );
    ETDirection memLocalRotation = GetMemberLocalRotationFor( m, dir );
    if( m.isReleased( end, memLocalRotation ) ) {
        return G;
    }
    if( isMemberRotationSupportedAtThisNode( m, *endNode, dir ) ) {
        G = 1.0;
    }
    else {
        CLine3D line_m;
        m.line3D( line_m );
        double EI_L_Columns = 0.0;
        double EI_L_Beams = 0.0;
        int nMembersAtEnd = theModel.elementsAt( endNode );
        for( int mae = 1; mae <= nMembersAtEnd; ++mae ) {
            const CElement* pE = theModel.elementAt( endNode, mae );
            if( pE && (pE->type() == MEMBER_ELEMENT) ) {
                const CMember* pM = (const CMember*)pE;
                CLine3D line_pM;
                pM->line3D( line_pM );
                bool isCollinear = line_m.is_parallel( line_pM );
                double braceEffectOnG =
                    CalculateBraceEffectOnG( m, *pM, *endNode, dir );
                if( isCollinear == true ) {
                    EI_L_Columns = EI_L_Columns + braceEffectOnG;
                }
                else {
                    EI_L_Beams = EI_L_Beams + braceEffectOnG;
                }
            }
        }
        if( !zero(EI_L_Beams) ) {
            G = EI_L_Columns/EI_L_Beams;
        }
    }
    return G;
}
```

Of course, we still do not get it 100% correct in every situation and therefore we allow you to override K factors--at least in the 'advanced' level of VisualAnalysis.

There is also a change coming in VisualAnalysis 10.0 (this fall) to allow you to specify K factors even when you are performing an AISC Direct Analysis design where K=1 is the norm, because there are situations where this is not 100% correct--such as with bracing members.

This ongoing development work is the result of a great partnership between talented designers "in the field" using VisualAnalysis as a tool and the well-educated engineers at IES who are constantly striving to make VisualAnalysis smarter, faster, and more reliable than anything we have used before. You may not see all the complexity in these intricate cycles of technology, but now you can have some appreciation for the work.

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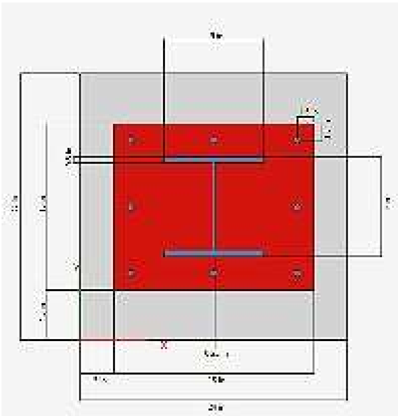
Sneak Peak: VA 10

Introducing Connection Design

There is a lot of development work going on at IES this summer as we work to bring you VisualAnalysis 10.0 and beyond. The software world is a rapidly changing landscape and IES engineers are working hard to bring both practical upgrades to you in a timely manner as well as to build a platform that will help meet your needs over the next ten years. A lot of our efforts are going into the creation of modular, flexible components that can be used within VisualAnalysis in an integrated way so that your workflow through a structural project is as streamlined and as efficient as possible. We also want tools that can be leveraged **à la carte** as you have specific needs or tasks to accomplish.



Conection design is a new area for IES tools, though we have had some minor features like a base plate design tool for a long time. The art of connection design for steel buildings has long been one of our aspirations and we are getting close to releasing to you tools that perform this complex and critical task in either a stand-alone or a holistic fashion.

Our first efforts will be with a brand new implementation of Base Plate Design as well as a beam shear-tab Connection Design tool. Both will integrate directly with VisualAnalysis to allow you to take member properties and forces directly into the connection design process.

We are excited about this venture and look forward to hearing more about your needs in this aspect of engineering. If you have suggestions or experiences with other connection-design tools that you would like to share with us, please drop us a line. When our new tools arrive in beta-test form later this year, please take a moment to evaluate them and help us fine tune them to make your job easier.

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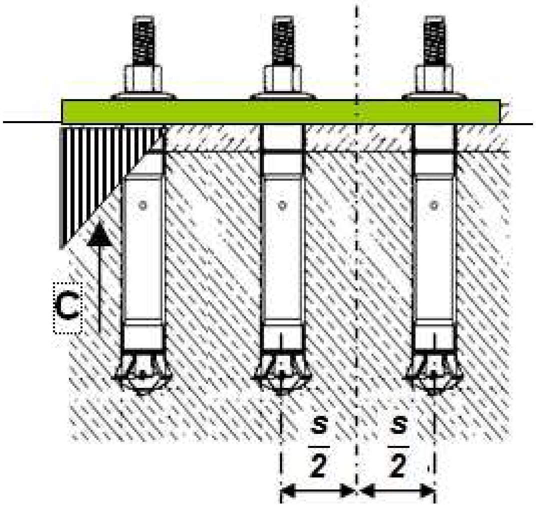
Anchor Bolt WebApp?

Free Online Utility is AWOL!

For the last couple years we've offered a free online web app to "test the waters" with regard to online software for structural engineering. We did not get a lot of feedback on this tool, but it did seem somewhat popular. Unfortunately there were some technology issues due to web browser differences and requirements.



We removed this application from the web site in June also because it had become obsolete with code changes since its original publication.

IES is working on newer technologies and striving for the highest quatlity code we can deliver and we hope eventually to revive the application. The forthcoming Base Plate Design tool, for example, will be peforming anchorage calculations in an improved an up-to-code fashion.

If you have comments or suggestions regarding web-applications, structural engineering utility needs or desires, please let us know -- we are always striving to meet **your needs** with regard to structural software.

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QuickRWall 3.0 Released

Improvements for Retaining Wall Design

Retaining wall design is a specialized task that does not lend itself to a generalized finite element analysis. IES offers the QuickRWall product to help you get this job done in a minimum amount of time and with a high degree of accuracy. QuickRWall has been leading the industry since 2003 when it pioneered the concept of "Transparent Reporting" that allows you (and any plan checker) to see exactly what calculations were made during the design process.

IES is now excited to introduce version 3.0, with some long awaited features and improvements that will make this tool even more useful, especially if you are working with AASHTO requirements.

Key New Features:

- Updated to IBC 2009, ACI 318-08, MSJC 08
- Lateral deflection calculation
- Transfer forces across stem joints
- AASHTO load combinations
- more...

Download a free trial, or purchase your upgrade today at www.iesweb.com.

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