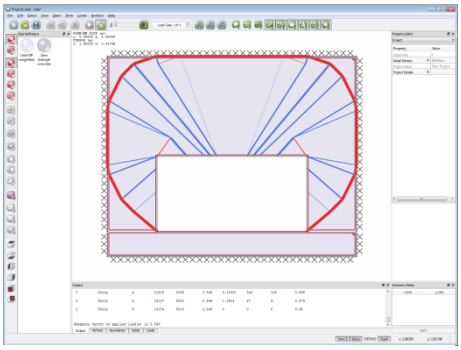
limitstate slab

automated yield-line analysis software

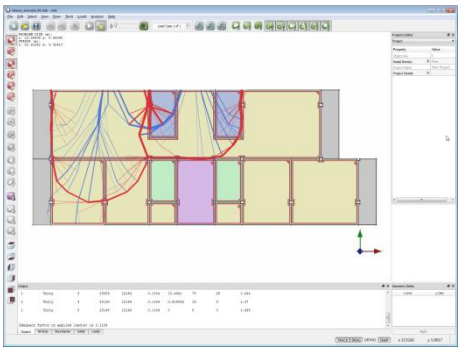


Yield-line theory and optimization technology are combined to allow rapid identification of the critical failure mechanism and associated margin of safety

A breakthrough in reinforced concrete slab analysis

LimitState:SLAB systematically automates the yield-line method for reinforced concrete slabs. This allows the software to identify reserves of strength in slabs that other methods may miss. LimitState:SLAB is fast, easy to use and can be applied to complex slab geometries. The software can be used in the assessment of existing structures or in the design of new ones.

'Yield-line analysis leads to least cost, least weight, best value solutions – and great opportunities' *



Complex slab models can be set up and analysed quickly and easily via the intuitive user interface

Find the critical failure mechanism for any slab geometry

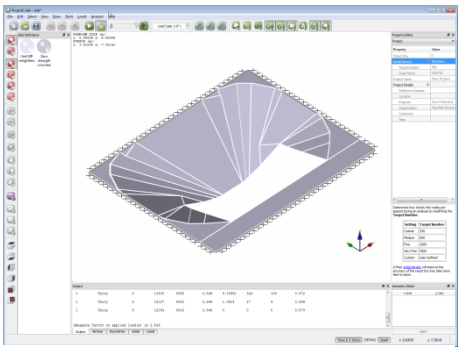
For the first time, the full power of the yield-line method is available to engineers. The method will often demonstrate that a reinforced concrete slab is significantly stronger than other methods suggest. This is beneficial both for the analysis of existing slabs and for the design of new ones.

Until now, a yield-line analysis had to be done by hand, or via software which selects a yield-line failure mechanism from a small library of predefined patterns. In contrast LimitState:SLAB systematically pinpoints the critical failure mechanism from vast numbers of alternatives, for any slab geometry. Engineers can now leverage the power of the yield-method in a way that was previously impossible.

Find hidden reserves of strength in existing slabs

For projects which involve refurbishment or re-use of existing slabs, LimitState:SLAB will often find that these have hidden reserves of strength. This can mean that costly upgrading work is not required, potentially saving the client significant sums.

Slab problems are quick to set up and solve in the software. A slab geometry can be defined by importing from a CAD file, or by drawing it on the screen. It is then easy to edit the model geometry, and to specify loading, material properties and boundary conditions.



Animated output enables a deeper understanding of slab behaviour at the point of failure to be gained

Since LimitState:SLAB uses rigorous mathematical optimization to automatically consider vast numbers of failure modes, there is no longer a concern that the critical failure mode has been missed. This has always been a concern with hand-based yield-line analysis. The critical failure mode can also be animated, aiding interpretation.

Use the yield-line method to design more economic slabs

'Yield Line design is quick and easy to apply. It may be used on all types of slabs and loading configurations' *

Around 60% of the structural cost of a typical new building is accounted for by the floor. LimitState:SLAB can help engineers to design slabs that are thinner, and contain less reinforcement than conventional approaches. The reinforcement can also be regularly arranged, so that it is easier to detail and easier to fix, and hence less costly to construct. In contrast, use of elastic analysis (e.g. elastic FEA) tends to lead to significantly more costly designs.

limitstate

analysis & design software for engineers

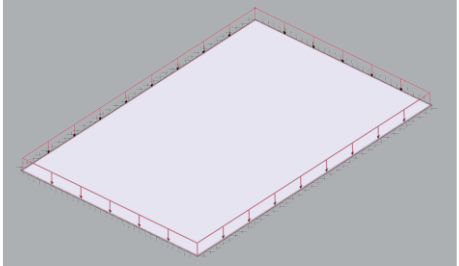
* Kennedy and Goodchild (2004) *Practical Yield Line Design*, The Concrete Centre. Camberley.

How it works

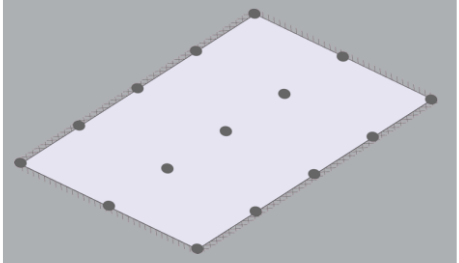
The software uses Discontinuity Layout Optimization (DLO) to find the critical yield-line pattern.

Steps:

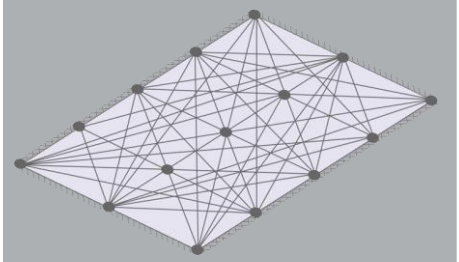
1. The user specifies the slab geometry, loading and support conditions:



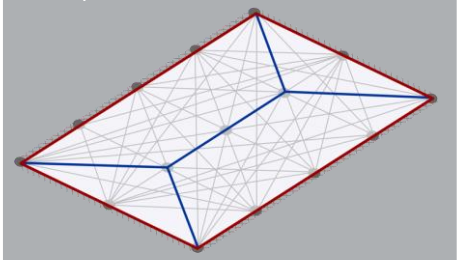
2. Nodes are distributed across the slab area:



3. Potential yield-lines (or 'discontinuities') connect the nodes:



4. Optimization is used to find the layout of discontinuities defining the critical yield-line pattern:



Use of larger numbers of nodes allows increasingly accurate solutions to be found.

State of the art technology

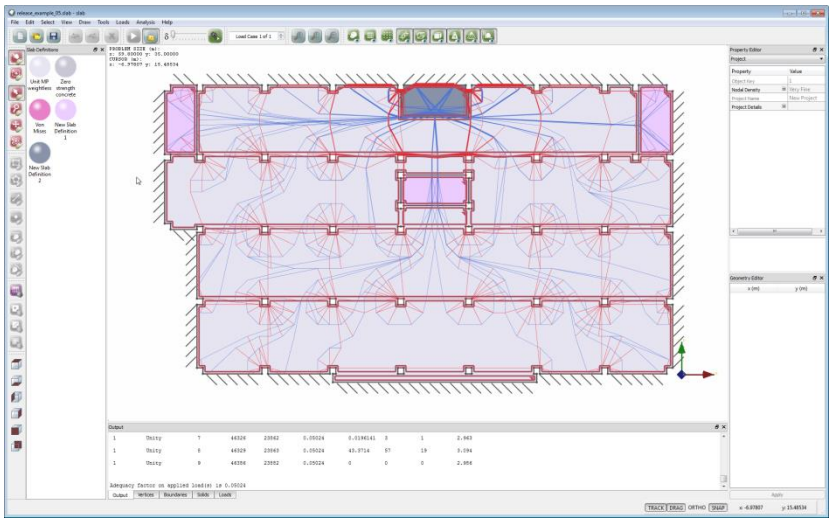
It has long been known that the yield-line method is a powerful tool when a realistic estimate of the capacity of a reinforced concrete slab is required. However, carrying out a yield-line analysis by hand is slow. The breakthrough, and the key technological innovation in LimitState:SLAB, is to automate the yield-line analysis process, through the use of Discontinuity Layout Optimization (DLO).

DLO is a plastic limit analysis procedure, underpinned by rigorous theory published in the *Proceedings of the Royal Society*, and already applied to other engineering applications. LimitState:SLAB uses DLO to identify the critical yield-line pattern from vast numbers of alternatives, and also allows the critical failure mechanism to be animated to aid interpretation.

All of this is done automatically, in seconds or minutes. This means that engineers no longer need to spend time guessing the likely critical failure mode, and then performing manual calculations.

LimitState:SLAB key benefits

- Quick and easy to set up and solve slab problems.
- Identifies the critical failure mechanism, whatever the problem geometry, without the need to resort to pre-defined mechanisms.
- More realistic assessment of slab flexural strength than traditional elastic analysis methods.
- When applied to existing slabs, will often reveal additional reserves of strength.
- When applied in design, will often lead to very economic slab designs, with low amounts of reinforcement.
- Fully interactive modelling environment so that slab models can be easily modified and 'what if' scenarios explored.
- Failure mechanism can be animated, making it easier to understand the predicted mode of response.



www.limitstate.com/slab

LimitState:SLAB is fully supported by an expert team

Need technical advice? Need help with your model? Our support team is on hand to offer expert advice on any aspect of the software.

Learn more about LimitState:SLAB and try it for yourself

Visit www.limitstate.com/slab to find out how you can obtain your copy of the latest version of LimitState:SLAB and then try it for free.

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