



# **Kodak's Flat Top Dots**

## **THE EFFECT OF FLEXO DOT SHAPE ON PLATE STRESS AND WEAR**

By Dr. John Anderson and Emma Schlotthauer  
JULY 2010

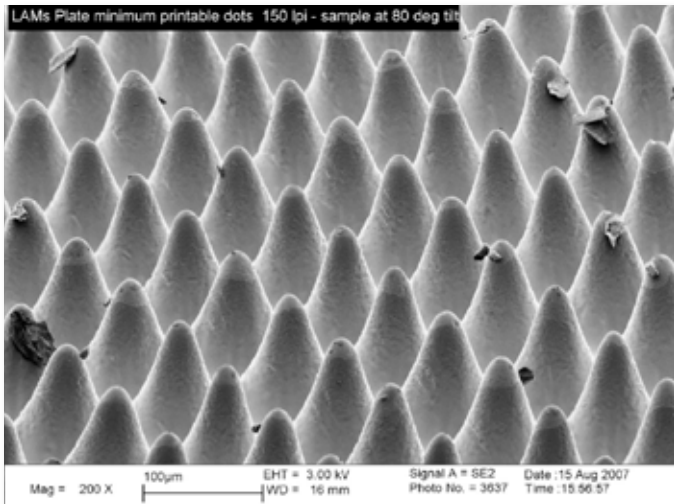


**Kodak**

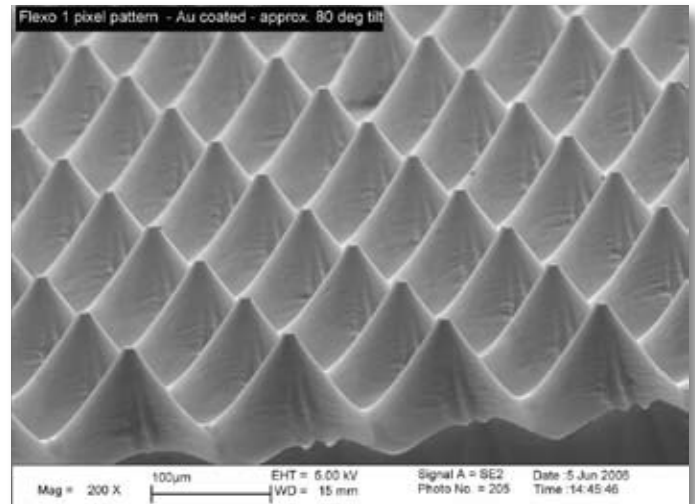
## Background

Over the years the flexographic printing industry has used several dot shapes and structures, with varying resultant effects on plate life and consistency. It is generally accepted that the flat top dot structure of analogue or conventional flexo dots enables considerably longer plate life (often 2 to 5 times) compared in like-for-like tests to the rounded dots utilised by traditional digital plates.

The introduction of **Kodak Flexcel NX** Digital Flexographic Plates with Kodak's flat top dot structure also shows analogue-type improvements in plate life over traditional digital plates.



*Rounded traditional digital dots*



*Flat top dots*

## But why?

Kodak personnel are often asked why the flat top dot structure is better for plate life. Intuitively the answers seem obvious, but we chose to commission an engineering study to find an independent, science-based answer.

## Seeking the scientific answer

The Welsh Centre for Printing and Coating (WCPC) at Swansea University (SU) is a world-recognised centre of expertise in computer simulations of engineering problems. The technique first developed at SU, and used globally today, is Finite Element Analysis (FEA), which breaks down complex structures and situations into a mesh of smaller elements to allow application of engineering equations to calculate stresses. It is a standard analysis method for analysis of potential structures for buildings, airplanes, cars, etc.

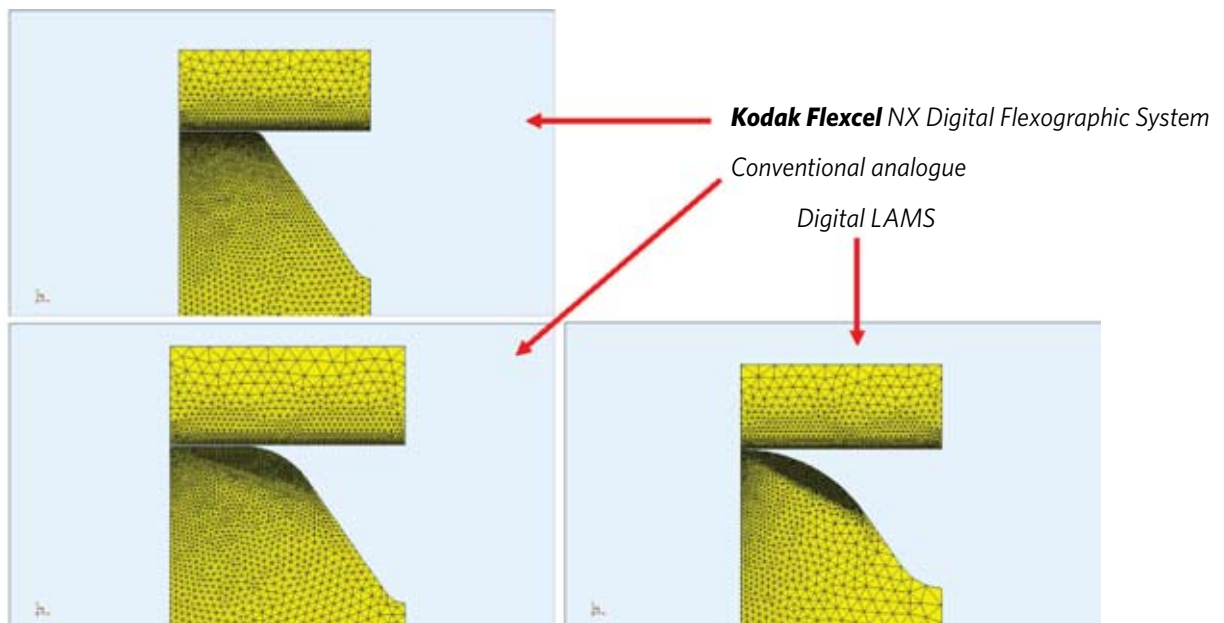
The staff at the WCPC, under the guidance of Prof. Tim Claypole MBE and Prof. David Gethin, carried out a series of FEA studies using a commercially available package developed at SU, to study the stresses generated with static conditions at a series of applied deflections and conditions. They used generic dot profiles to represent analogue, traditional digital, and **Kodak Flexcel NX** Digital Flexographic Plates. The tests assume the same materials and load conditions to provide a like-for-like set of results based on dot shape alone.

## Reading the results

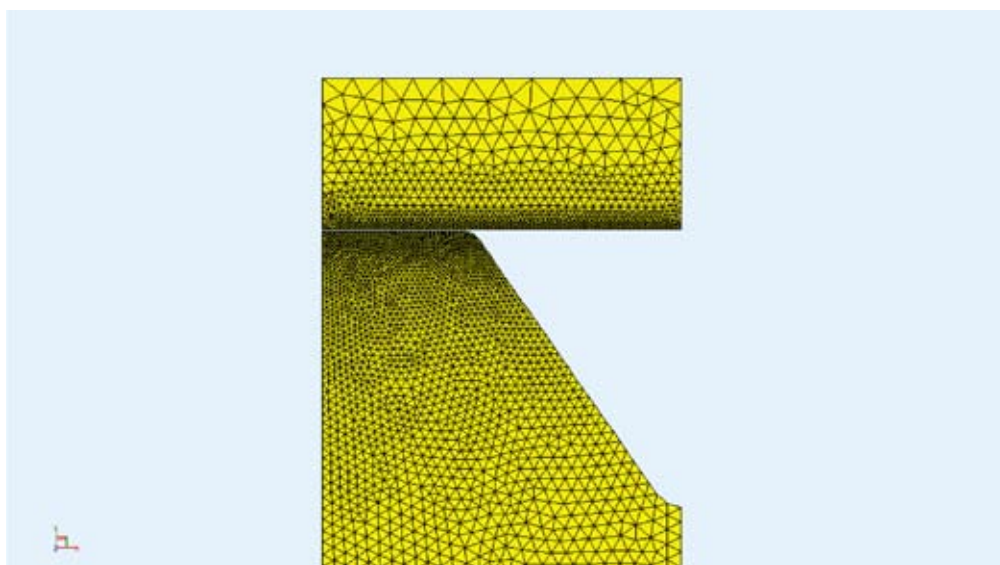
Reading the results is very simple. The blue colours indicate low stresses and probable low wear rates: the brighter the colour higher up the scale, the higher the stress and the faster the probable wear.

For the base case WCPC was instructed to use standard photopolymer properties based on data from their flexo material research that started in 1998, and to use dot profiles based on their scientific non-contact measurements.

The images below show the standard profiles considered. The lower part of each image represents the dot, and the upper part represents the impression surface. All sets of images in this report are arranged in the same configuration, with the **Flexcel** NX Plate samples to the upper left and the traditional digital LAMS samples to the lower right.



The following figure shows the **Flexcel** NX Plate profile in more detail. Note that the mesh is not evenly applied, at the contact point the mesh is very fine, whereas away from this the mesh is more coarse. This is deliberate and is a standard method to increase the accuracy of the models, allowing the equations greater accuracy.



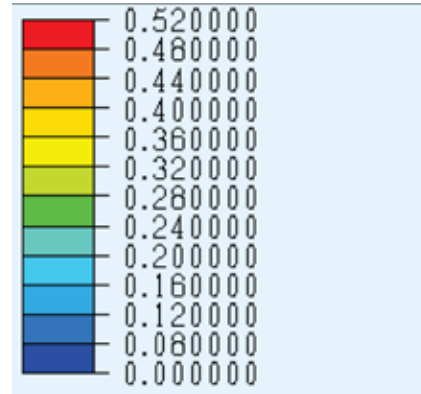
**Kodak Flexcel** NX Digital Flexographic System

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## Fixing the Scale

To help make the reading of the results as transparent as possible, WCPC were instructed to use the same scale for the stresses on all of the results. This means that the blue, yellow, or red colours represent the same stress levels on ALL of the figures allowing instant reading and simple comparison.

As the colour moves from blue to green to yellow, then to orange and red, the stresses get higher.



## Loading Conditions

The model then considers the deflection of the tip of the dot at two pre-set distances, to mimic the dots under two levels of impression setting. The distances used were 3 thousandths of an inch or 75 microns, and 5 thousandths of an inch or 125 microns.

## Interpretation

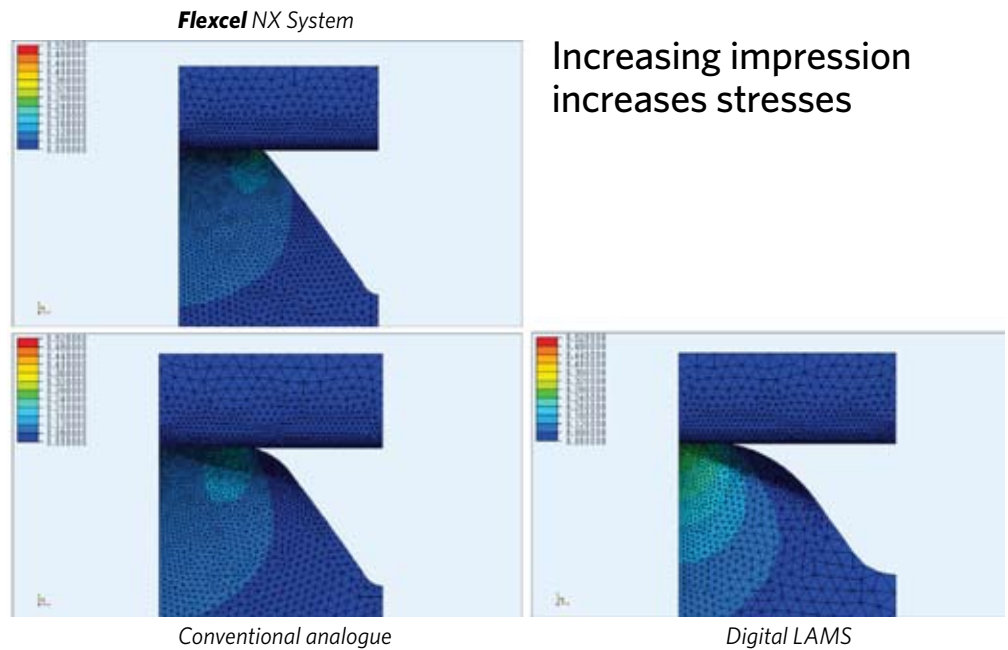
The author, Dr John Anderson, a 9-year, 3-degree graduate of SU, has been carrying out and reviewing FEA results since 1992, with extensive application throughout his time in Swansea. What follows is Dr Anderson's analysis of the results, based on the data supplied by WCPC. The basic premise is that plate areas that undergo the highest stress levels lead to the greatest amount of plate wear. The largest areas of higher stresses indicate the fastest probable wear conditions.

## The Results

### 1. Flat tops reduce stress and wear

The first case applies the two standard loading conditions to a 30% dot at 150 lpi.

30% Halftone, 150 lpi,  
3 thou (75  $\mu\text{m}$ )  
engagement

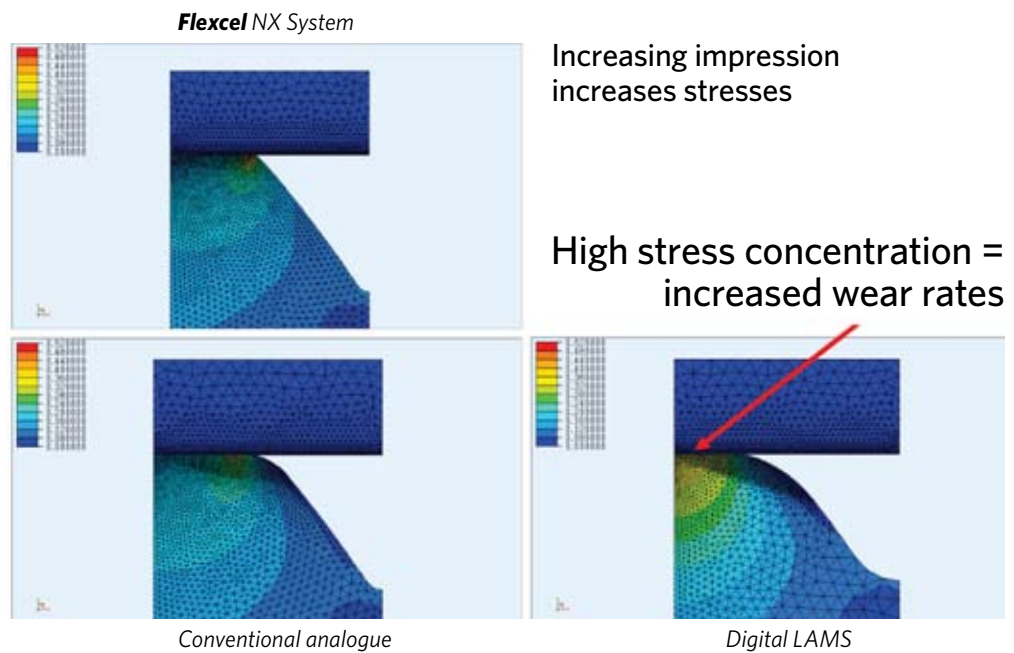


The results show that the peak stress on the **Flexcel NX** Plate is a small point where it transitions rapidly from no load to fully loaded. This is a very small area and should not cause significant wear stresses.

Comparing the profiles of the dots, it is clear that the Traditional Digital LAMS dots show very significant stresses over a large area, especially at the tip or contact point. This would be expected to cause much faster rates of wear than either the **Flexcel NX** Plate or conventional analogue dot structures.

It is clear from the image that the flat top dot structures distribute the loading more evenly, reducing the stresses, and the potential for wear.

30% Halftone, 150 lpi,  
5 thou (125  $\mu\text{m}$ )  
engagement



Increasing the engagement to the higher setting shows that the overall stresses experienced increase in all three cases, but again the two flat top dot structures on the left have much smaller increases, and are devoid of large and significant stress concentration throughout the whole contact region.

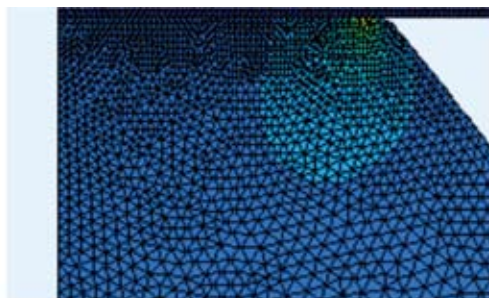
The models have therefore verified a few key points, even with just these two loading cases:

- **Dot shape has a significant effect on the stress profile.**
- **Stress level increases as the engagement (impression) increases.**
- **The flat top dot structures distribute or share the loading better to achieve lower stresses.**
- **The rounded shape of the traditional digital LAMS dot, results in the highest stress concentrations, suggesting the highest wear rates.**
- **The stresses are focused in the contact zone.**

Several of these findings are intuitive, and the results of the tests appear to be logical. The following figures show these two conditions in more detail.

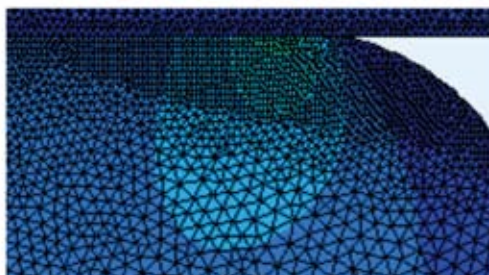
30% Halftone, 150 lpi,  
3 thou (75  $\mu\text{m}$ )  
engagement

**Flexcel NX System**

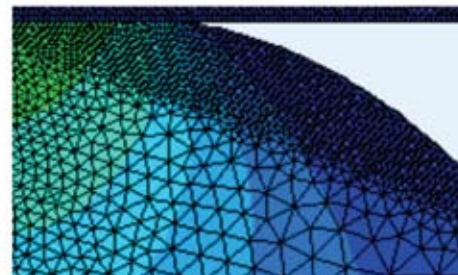


Increasing impression  
increases stresses

Stress profiles are VERY  
dot shape-dependent



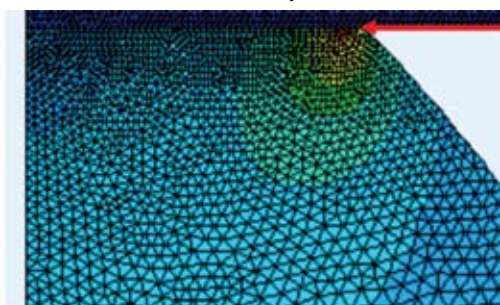
*Conventional analogue*



*Digital LAMS*

30% Halftone, 150 lpi,  
5 thou (125  $\mu\text{m}$ )  
engagement

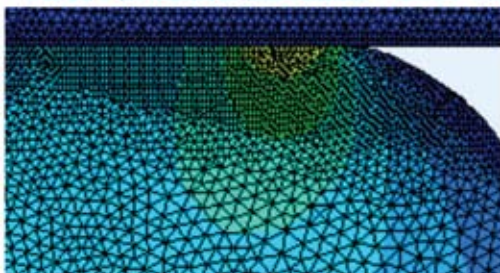
**Flexcel NX System**



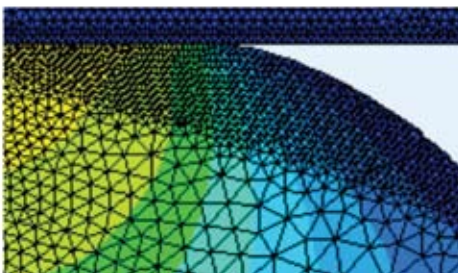
Highest peak stress,  
fast dissipation

Increasing impression increases  
stresses

Stress profiles are VERY  
dot shape-dependent



*Conventional analogue*



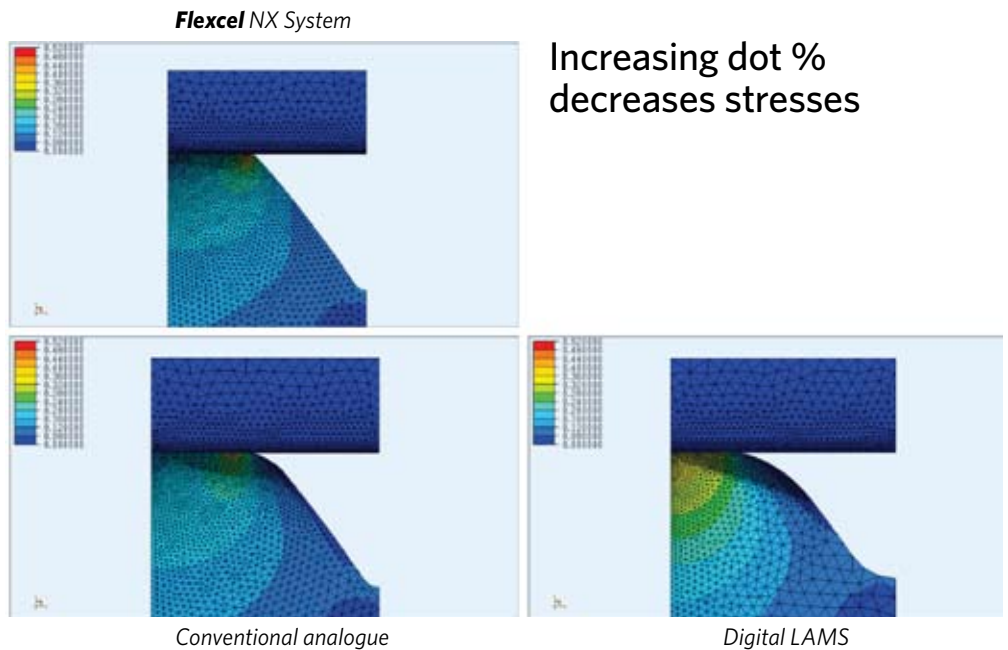
*Digital LAMS*

The results explain some common dot growth issues that occur at the start of production with traditional LAMS dots, and the common practice of cutting the minimum dots off at higher dot sizes or dot % to increase plate life.

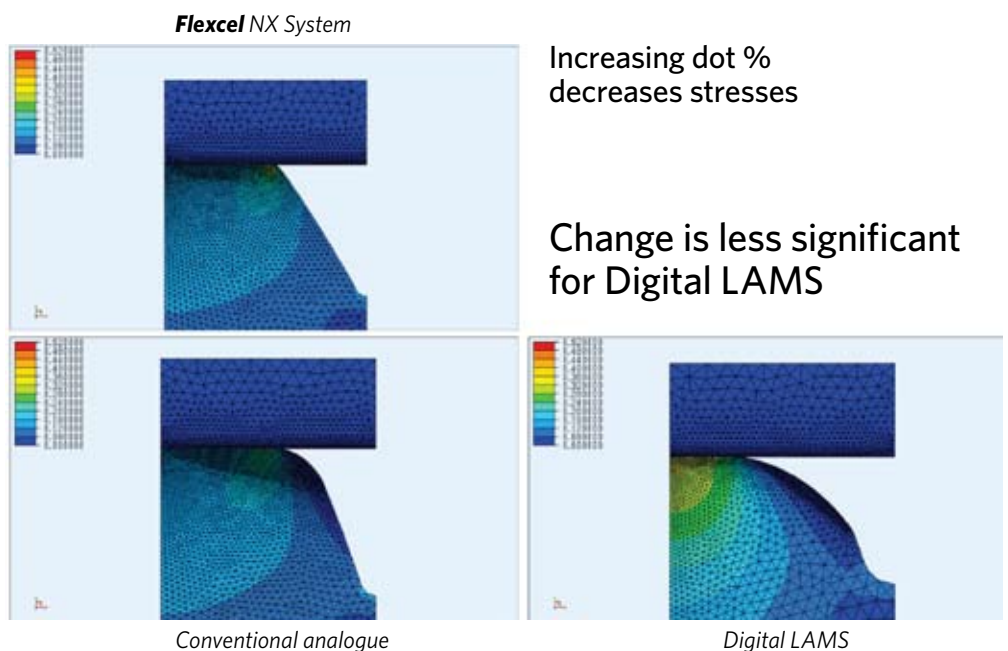
## 2. Flat tops still win out as dot size increases

This next example considers a 30% and 50% dot under the same loading conditions.

30% Halftone, 150 lpi,  
5 thou (125  $\mu\text{m}$ )  
engagement



50% Halftone, 150 lpi,  
5 thou (125  $\mu\text{m}$ )  
engagement



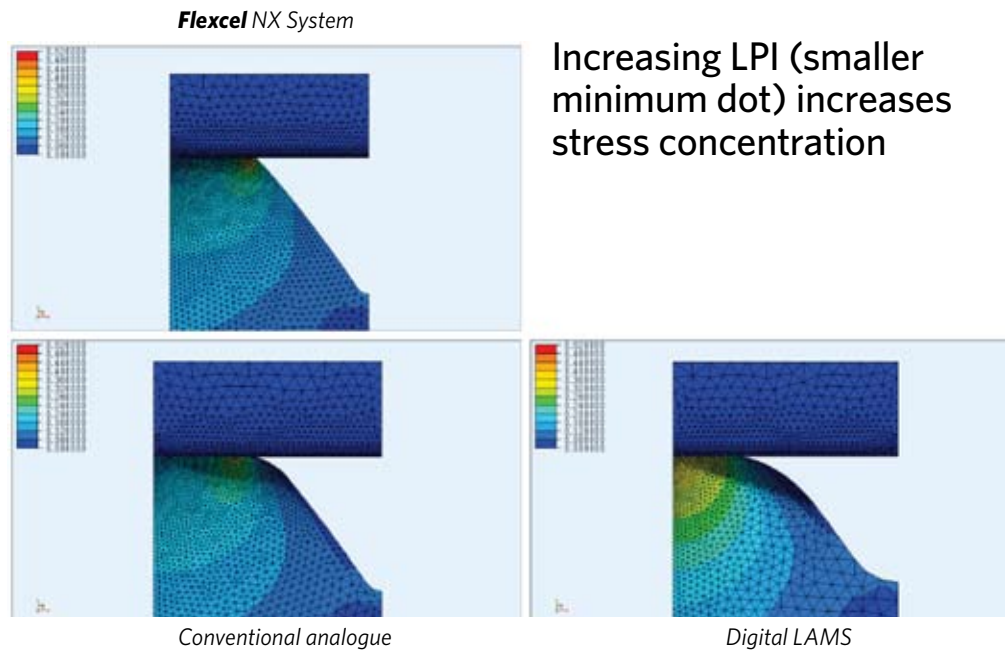
The results, as expected, show that as the dot gets bigger the stresses experienced decrease. What is interesting is the fact that the decrease with the analogue and the **Flexcel NX Plate** dots is much more significant than that for the traditional digital LAMS dot. These models verify:

- Dot size affects stress concentrations.
- Stress levels decrease less for rounded dots.

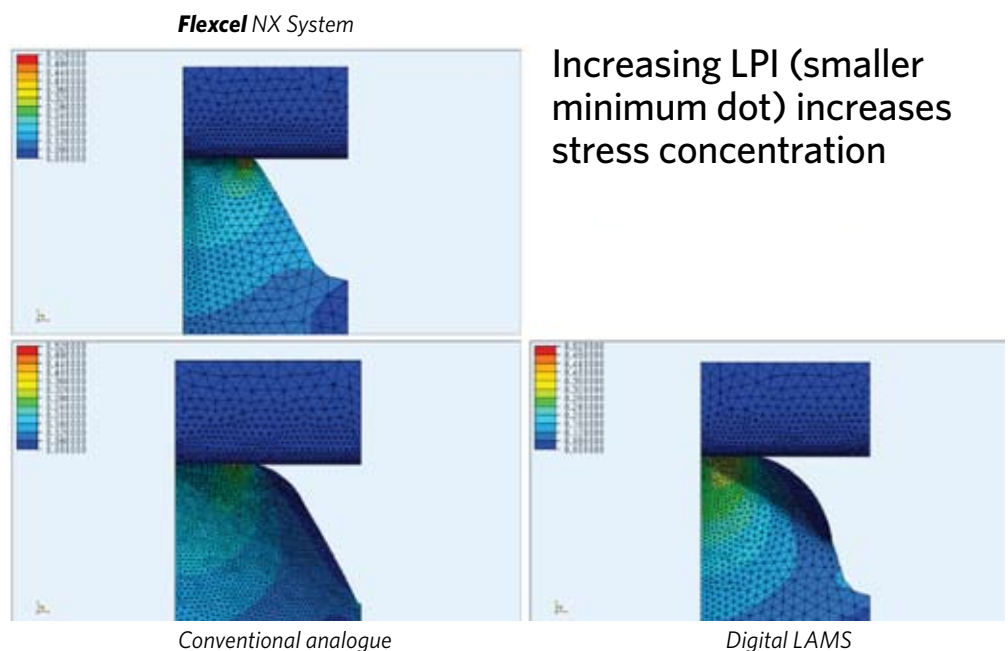
### 3. The effect of resolution on plate wear

The final case considers what happens as resolution increases, and whether there is a trade off between resolution and potential plate life. In the following two examples, the line screen increases from 150 lpi to 200 lpi.

30% Halftone, 150 lpi,  
5 thou (125  $\mu\text{m}$ )  
engagement



50% Halftone, 200 lpi,  
5 thou (125  $\mu\text{m}$ )  
engagement



The results show that the stresses increase, but do not change a great deal. However they are more concentrated than before, and indicate that increasing resolution can potentially negatively affect plate life. These models verify that:

- **Smaller dots further concentrate the stress and potential wear rates.**

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## Conclusions

The graphical nature of the stress profile plots means that the figures included in this white paper are relatively easy to read, and demonstrate clear findings that the stresses and the significant concentration of stresses around the tip of the rounded dot of traditional digital LAMS plates, will cause a significantly increased likelihood of accelerated wear.

The flat top dot structure of analogue or conventional dots, along with those of **Flexcel** NX Plates, distributes the stresses more effectively and evenly, reducing the stress concentration and the likelihood of plate wear.

Additional feedback gathered from printers has clearly confirmed that flat top dot structures have a positive impact on plate life. Printers are reporting plate life of 2-5 times longer with flat top dot structures, with the differences often higher when more abrasive substrates are used. This provides additional evidence that flat top dot structures are superior for on-press impression and plate life performance.

## Key Learnings

- Dot shape has a significant effect on the impression stress profile.
- Stress level increases as the engagement (impression) increases.
- Flat top dot structures distribute or share the loading better to achieve lower stresses.
- As dot size increases, stress levels decrease.
- Stress levels decrease less for rounded dots than for flat top dots.
- Dot size affects stress concentrations.
- Stress levels decrease less for rounded dots.
- Smaller dots further concentrate the stress and potential wear rates.



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