A New Model Customization Concept for the PMIS

What's different? What's new?

Under an ongoing TxDOT research project, recommendations have been made to make the distress prediction models in the PMIS both *more accessible* to users in the districts and *customizable* in the event that a better one is available.

The Customization Concept in a Nutshell

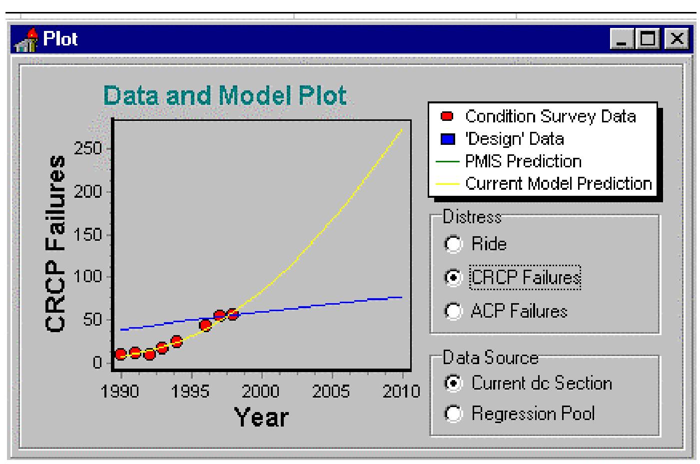
The current PMIS makes distress predictions based on a set of very general models as a function only of the pavement type, and sometimes traffic, climate and subgrade. These are intended for planning purposes and were certainly not intended for detailed use. However, with a move towards better integration between network wide planning and detailed project selection, it was found that these general predictions were a major limiting factor. The network and project level predictions seldom agreed!

Consequently, it was proposed that the solution to this problem was to allow users to update the PMIS predictions whenever 'they knew better'. A fundamental change is thus proposed whereby a separate prediction curve is stored for each distress on *every* PMIS data collection section. The predictions are initially stored as points in the condition history table of the database and these are converted to a sigmoidal model using built-in regression tools. This seemingly simple paradigm shift opens up a world of possibilities.

The Possibilities are Endless

• Improving the General Models

Improving the general default models requires more data. This has always been hard to collect for every single section out there. But what if we had extra data for just some of the sections; say because I knew the course aggregate type and age of all my CRCP or wanted to use data from the CTR Rigid Pavement Database? In this case it would be possible to use this expanded dataset which, unlike the PMIS database, includes age, aggregate type and detailed crack spacing data, to generate improved predictions with more accurate models.



• Importing Externally Produced Models

Our FPS design predictions recommend a 50mm overlay in 12 years and the PMIS recommends a seal at 8 and 14 years.

What's the problem? The first reason might be that the decision criteria are different, but it is often the case that the prediction of roughness in the two cases may also have been different.

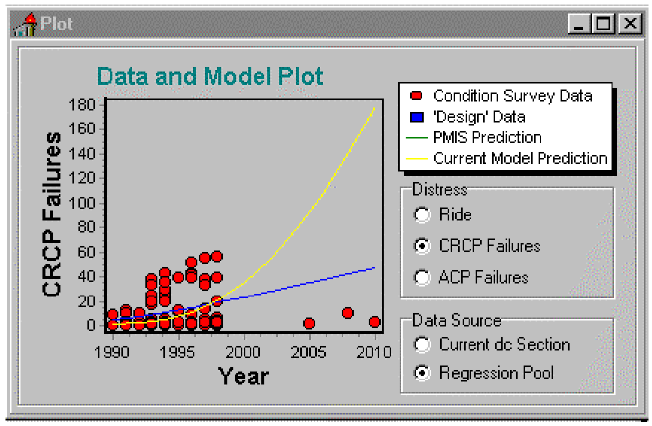
Which is right? Probably the FPS because more detailed information was used. The PMIS prediction was for the *average* similar section and everyone knows that a section is not often exactly average.

What to do? Well previously we were stuck with the original PMIS prediction in the knowledge that it was fine for planning purposes but possibly of little use for specific project selection. However, with customizable prediction curves and assuming the two roughness measures were approximately equivalent, it would be possible to actually import the design FPS roughness prediction curve into the PMIS.

• Create Your Own Regression from the PMIS Condition Surveys

An extremely valuable source of data is the PMIS condition survey database. With the introduction of customizable models it would then become possible to run a regression on that data *from that particular section* and use this to update the prediction curve.

The feasibility of regression on PMIS data also opens up many possibilities. It would also be possible, for instance, for a user to



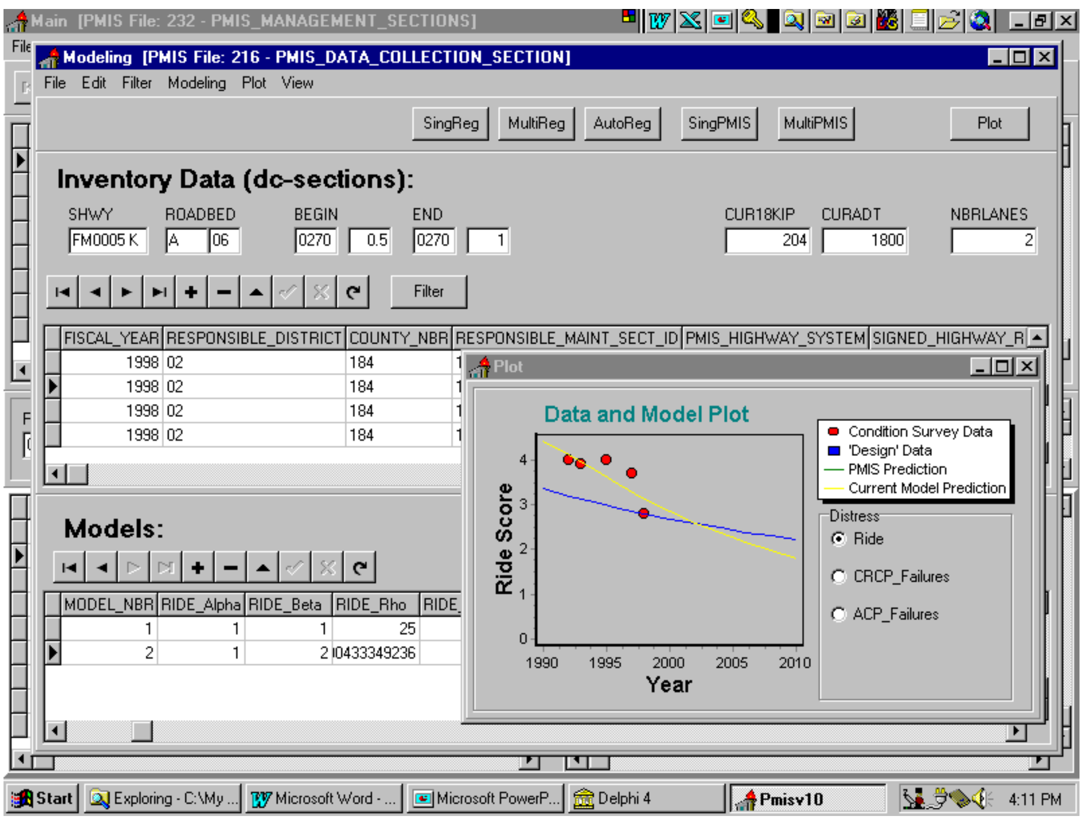
quickly gather the PMIS data for a number of similar sections, perhaps based on age, traffic, location and type, run a regression on *this* data, and apply the resulting model to all the sections.

• Use Multiple Models

While only one model would be considered current, it would also be possible to store other models for reference purposes. For instance, if a new design had been carried out for a particular section, the design prediction curve could be stored as the best available prediction. Some years down the line after a number of PMIS condition surveys had been carried out, a regression curve could be generated on this data and this 'actual' curve compared with the original design. By appending new models to the database and not necessarily overwriting old ones, considerable research comparing initial predictions with actual performance could be carried out.

Demonstration Computer Program

To demonstrate the model customization concept, a pilot computer program has been developed. The program allows users to connect to the actual PMIS database and thereafter use the flexible filtering capabilities to generate any number of interesting models by regression of existing PMIS condition data. It also allows users to input their own data points from whatever external source they choose, and perform regressions in exactly the same way to generate models of their own.



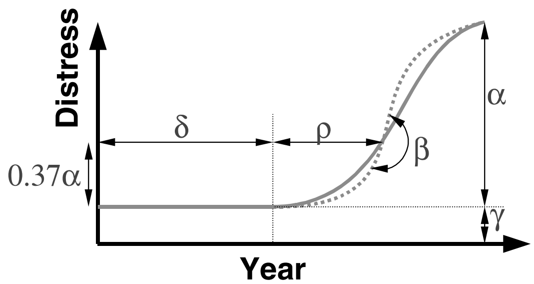
The Technical Details:

The Curve Shape.

One of the implications of this change is that the models become highly specific to each section. Predicted values become dependent on actual conditions at the site, not upon some generic "default" conditions *assumed* to fit all highways.

This is accomplished by using modified sigmoidal (S-shaped) curves. The curves use a total of five shape coefficients, α, β, ρ, δ, and γ.

Together these effectively fix the shape and position of the curve. The



curve is as shown in the illustration where:

α is the maximum level of distress. As an example, for alligator cracking, this would be 100 percent.

β is an internally fixed quantity which depends on the form of the fatigue function.

ρ controls the horizontal position of the inflection point. This is used to define how quickly the distress develops once started. The smaller the value, the steeper the curve.

δ is a horizontal shift factor controlling the age at which the first sign of distress appears. For example, on a thin overlay, shallow rutting might not appear until year 3.

γ is a vertical shift factor giving the initial level of the "distress" if this is non-zero. For instance there will always be an average crack spacing, even in a new CRCP.

To store a particular model for a section, it is only necessary to store the location information along with these coefficients and the distress to which they refer.

The Database Structure

The PMIS database currently holds a number of tables. To accommodate the individual section models it is proposed to add a new 'models' table to the existing inventory and condition history tables.

Flexibility for the Future

One thing that is always known with certainty is that things will change. The proposed customization concept can handle this. For instance, if new design methods are introduced with the future AASHTO 2002 guide, these can be 'incorporated' by simply generating predictions for a number of years in the future as before, and thereafter converting this prediction set to a sigmoidal model attached to that particular section or sections.

Indeed, because the models are now effectively detached from the PMIS and only the resulting prediction curves for each section are stored, the original models can be changed and improved at will without affecting the PMIS. This means that if new models for spalled cracks becomes available for CRCP but which require specific construction information, these can be incorporated immediately into the PMIS for planning and selection purposes for all sections where that data is available. It is no longer necessary to have 'all the data for every section'.

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