

MIX DESIGN ENHANCEMENTS

Functional Specification: QESTMix Mix Design Module

The following defines the functionality of the QEST Mix Design module and its integration into the QEST package. In writing this Spectra QEST has taken the perspective of a user of the package and concentrated on the concrete technology aspects. Technical specifications from an IT perspective are provided separately.

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26 October 2005	Lief Martin	1.0	Original Document
11 November 2005	Lief Martin	1.1	Revision of several sections, incl. target gradings / specifications for materials
24 January 2006	Lief Martin	1.2	Revision based on meeting with Readymix. Improved mock-ups, several other changes.

RELATED DOCUMENTATION

Name	Location	Details
R&D Funct Specs QESTMix Design	\\adls0003\Documents\Customer\Active\AUBOR - Boral ACM\42006 R & D\Specifications\ R&D Funct Specs QESTMix Design.doc	Manfred's original specification document. Functionality required for Boral.
D027 Concrete Mix Design Application	\\adls0003\Documents\Customer\Active\AURMX - Readymix Holdings\42003 National System\Specifications\D027 Concrete Mix Design Application.doc	Gary's original specification. Functionality required for Readymix.

TABLE OF CONTENTS

1. Business Requirements	2
1.1 Overview.....	2
1.2 Detailed Requirements	2
2. Functional Requirements	2
2.1 Overview.....	2
2.2 General Changes	2
2.2.1 User rights	2
2.3. Target Gradings for Mix Designs.....	3
2.3.1 New section in tree	3
2.3.2 Management of availability of Target Gradings.....	4
2.3.3 Importing of Specification Limits from QESTLab	4
2.4 Raw Materials	5
2.4.1 All Material Types.....	5
2.4.2 Aggregates and sands.....	5
2.4.3 Additives	9
2.4.4 Admixtures	9
2.4.5 Cementitious Materials.....	9
2.5 Mix Design.....	10
2.5.1 New Mix Design Fields.....	11
2.5.2 Changes to mix material data	12
2.5.3 Mix Details and Additional Properties.....	12

2.5.4 Grading Optimisation Tab	13
2.6 Design Master Report.....	14
2.6.1 Report Layout.....	14
2.7 General Reporting Enhancements	15
2.7.1 Ability to use data-filters with QESTMix reports	15
2.7.2 Interpolation between cement levels for change points.....	15
2.8 Mix Performance Review.....	16
2.8.1 Adjustments to the Create/Update Products function.....	16
2.8.2 Adjustments to Current Products/History Screen	16
2.8.3 Performance review tab.....	17
3. Assumptions and Additional Constraints	19

1. Business Requirements

1.1 Overview

n/a

1.2 Detailed Requirements

n/a

2. Functional Requirements

2.1 Overview

The QEST Mix Design module will be integrated into the QESTMix software and utilises the basic concepts developed in the QEST MixDesigner module. The MixDesigner was a project study carried out in 2002 by Spectra QEST in conjunction with the University of Adelaide and concentrated on finding routines to calculate aggregate proportions based on target gradings with flexible optimisation options.

Access to the QEST Mix Design module and certain specific parts will be made available to the user through licensing files and appropriate security access rights.

The Mix Design Module will be fully integrated with the current QESTMix package and in particular two sections are affected

- Mix Designs and Change Points – new functionality for grading optimisation
- Raw Materials – new functionality for integration with QESTLab data

The existing section for grading envelopes will also be expanded, and will be moved into a new section of the QESTMix tree under a new node, "Target Gradings".

There is also a new type of report for mix design information, and some new functionality for performance review.

2.2 General Changes

2.2.1 User rights

The following user permissions will be required

User right	Description
Design Module	Permission is needed to access any of the additional features described in these specification.
Update Raw Mat.	Access to tools to update QESTMix raw materials
Update Mixes	Access to tools to update Mix design performance data
Save Designs	Ability to save mix designs in section 'Mix Design and Change Points'

Edit Target Gradings	Ability to edit and import target gradings for mix designs / change points
Edit Material Gradings	Ability to edit and import target and actual gradings for materials

Access to certain functions specified required that the license file enables this functionality and the particular user has the appropriate user right.

2.3. Target Gradings for Mix Designs

The existing envelopes functionality in QESTMix is not really sufficient for the functionality required to support the new mix design capabilities. The enhancements basically involve an expansion to QESTMix to allow more control over the use of target gradings/envelopes.

2.3.1 New section in tree

A new node, "Target Gradings" will be added to the QESTMix tree (icons to be finalised). These will contain possible target grading for different mix designs.



Figure 1: QESTMix Tree

Target Gradings are the combination of a target and tolerance lines, and can be associated with mix designs. These will be transferred across to the appropriate product mixes automatically as a part of the create/update process (see section 2.7)

Access to these will be through the new "Edit Target Gradings" user right.

A mock-up of the data entry screen to be used for target gradings is shown below.

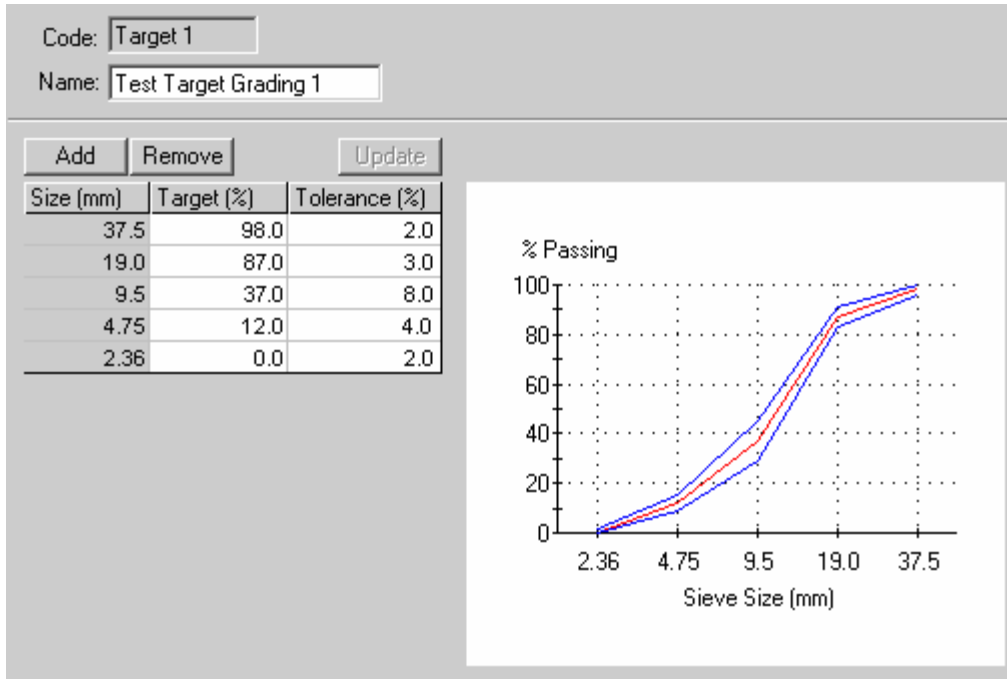


Figure 2: Design Mix Target Grading screen

2.3.2 Management of availability of Target Gradings

Availability of target gradings to regions will be maintained in the same way as the availability of Design Groups and Materials, through the Manage Regions tool.

After a target grading has been mapped to a specific material or mix design, if it is removed from the region (or is not available to another region that contains the plant), it will work in the same way as materials that are not available in a region. This basically means that it will be displayed in grey, but will continue to be available to the specific mix design / material.

Access to this will be through the "Manage Regions" user right.

2.3.3 Importing of Specification Limits from QESTLab

There are two modes in which information may be imported from QESTLab specification limits for target gradings. The first is that the data can be copied across, and made available for adjustment in QESTMix. This would be used when the QESTLab specification is to be used as a basis for the target grading, however, there is a need to change it. The second is that the target grading can be associated with the specification in QESTLab. In this case, the target grading would be locked out for editing, and the ability to synchronise the data from the QESTLab specification would be available – as shown in the screenshot below.

When importing a specification, it will need to be converted to have a target line, and a tolerance. Some QESTLab specifications will not be in this form, and instead may have a minimum and maximum instead. The imported target grading will have a target line that is the centre point of the minimum and maximum lines, and tolerance that is half of the distance between the minimum and maximum lines (at each point).

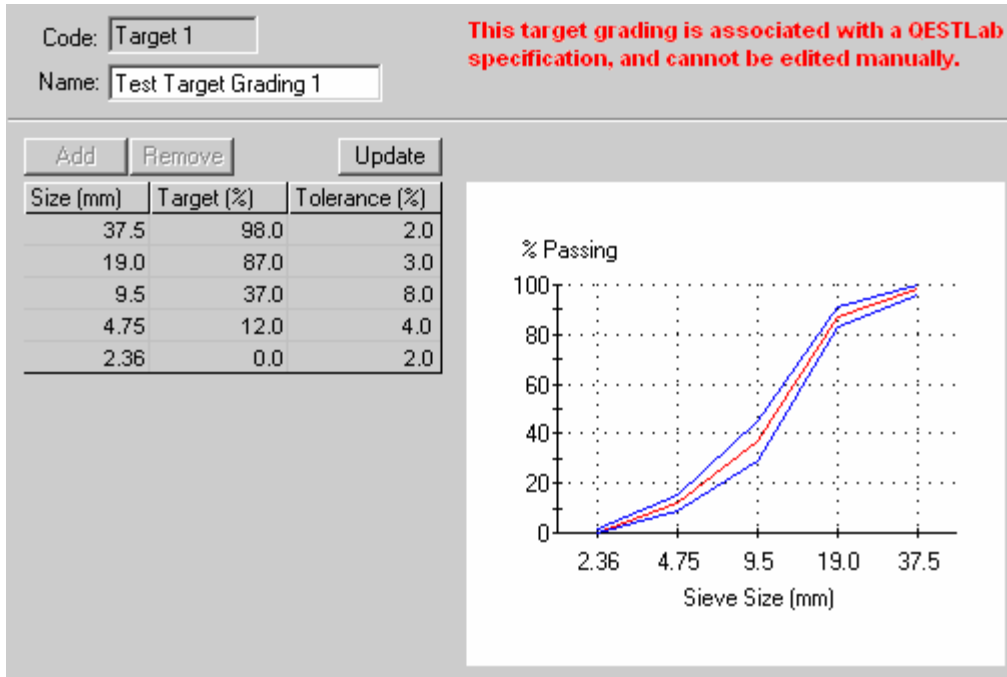


Figure 3: Design Mix Target Grading linked to a QESTLab specification

Note that QESTMix would have its own copy of the data. This means that there is no reliance on a connection to the QESTLab database in order to use the target grading, however it also means that the data can become 'out of sync' if the QESTLab data is updated. A new item will be added to the tools menu "Update Target Gradings from QESTLab" to update the target gradings. In addition, this would be available on a per-target basis from the standard data entry screen.

Access to this function will be through the new "Edit Target Gradings" user right.

2.4 Raw Materials

The raw materials section of QESTMix will be modified as specified below.

2.4.1 All Material Types

The 'Exclude from Batch Card and Export' checkbox will be moved onto the Details tab.

Two new properties will be added to the details tab, 'Source', and 'Compliance Specification'. For more information see specification 42003-1440 Mix Submission (D086). These will be plain text fields, and where possible, will be updated from the QESTLab materials list.

2.4.2 Aggregates and sands

Material gradings will be expanded with two new columns, which relate to the target/tolerance or min/max gradings for the material. For users that also have QESTLab, these can be imported from either the QESTLab materials list, or a selected QESTLab specification, or they can be entered manually. For users without QESTLab, they will need to be entered manually.

Header

Code: **10CRG**
Name:

Details
Properties
Blend
Interface
Used By...

Material Type:

Size (mm):

Moisture (%):

Absorption (%):

SG (kg/m3):

Prod. Cost (\$):

Ex-Bin Cos: (\$):

Cartage Cost - Hide plants without settings.

Code	Name	Cart. Cost	Batch Code	In Stock	Man Batch	Split Mat
2		0.00		No	No	
6		0.00		No	No	

Values

Chart

Manual Edit
 Use QESTLab Material List
 Use QESTLab Specification:

Test Spec

...

Default
Add
Remove
Import/Update

Size (mm)	Target (%)	Tolerance (%)	Actual (%)
37.5	91.0	2.5	91.0
19.0	80.0	15.0	75.7
9.5	59.5	12.0	50.0
4.75	39.7	11.0	25.5
2.36	6.0	3.0	6.0

Figure 4: Material Properties Screen (Aggregate/Sand)

By default, the material will be in the 'manual edit' mode. In this mode, the target and tolerance will be able to be edited, and new sieves will be able to be added and removed.

To import the target and tolerance data from QESTLab, either the "Use QESTLab Material List", or the "Use a QESTLab Specification" needs to be selected.

When the "Use QESTLab Material List" option is selected, the specification will be controlled by the QESTLab material list. The name of the specification will be displayed alongside, but will not be able to be edited (note: if the specification name is too long, a 'tool-tip' will be used to display the full name when the mouse cursor is placed over the text).

When the "Use a QESTLab Specification" option is selected, the name of the specification can be entered directly, or, browsed for if the exact name is not known (via the '...' button).

The 'Browse for specification' button (labelled '...') will bring up a dialog with a tree allowing you to browse for a suitable specification by lab, group and then name (note: this is designed based on specification enhancements that have not yet been released, which allow for lab based specifications, and also allow for specifications to be divided into groups - e.g. "RTA Specifications"). A mock-up of this dialog is shown below. By default (and for all versions of QESTLab that do not support specification grouping), specifications will be listed in the "(global)" lab, under the "(no group)" group.

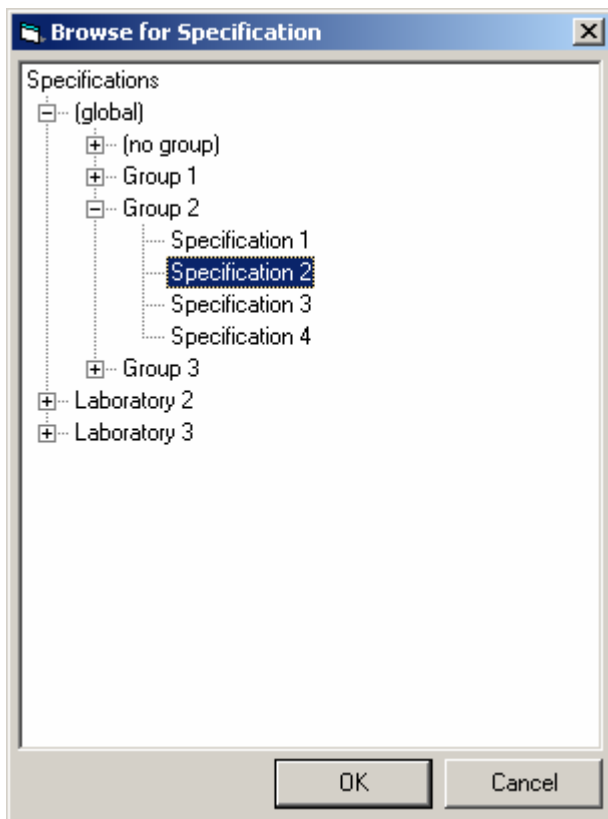


Figure 5: Browse for QESTLab Specification dialog box

Note that when browsing for specifications, there will be no restriction to specifications from specific labs or groups. This means that the list can be fairly large, however, once they have been sorted into appropriate groups in QESTLab, this should not be a major issue.

In both the "Use QESTLab Material List" and "Use a QESTLab Specification" modes, the target and tolerance columns will be locked out. Selecting the "Manual Edit" option will retain the existing data, and allow user editing of the target and tolerance columns. This allows the user to override the data imported from QESTLab if it proves necessary.

If the ActualPass% is outside of the limits specified by the target grading / specification, the value will be shown in red.

The Import/Update button will bring up a dialog allowing both the actual grading, and the target grading to be updated. Default values are shown in the mock-up below. Note that the date range is intended to default to the "last 30 days".

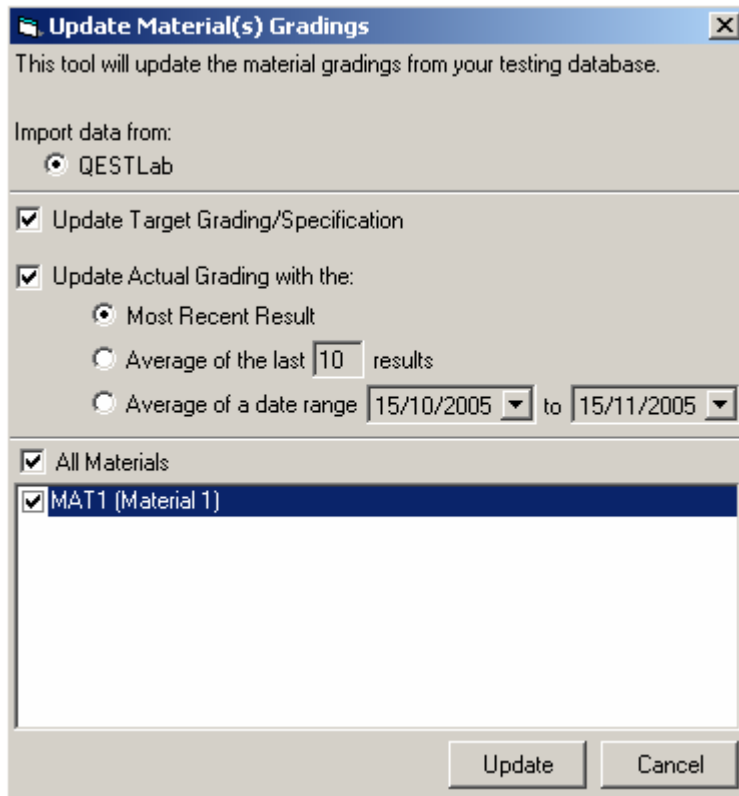


Figure 6: Update Material Properties Dialog Box

A new item will be added to the tools menu that will also trigger the 'Import/Update Material Gradings' dialog. This tool will have the same functionality as described above, but will also allow multiple materials to be updated at once. When using this tool, all materials in the region that are either aggregates or sands will be listed.

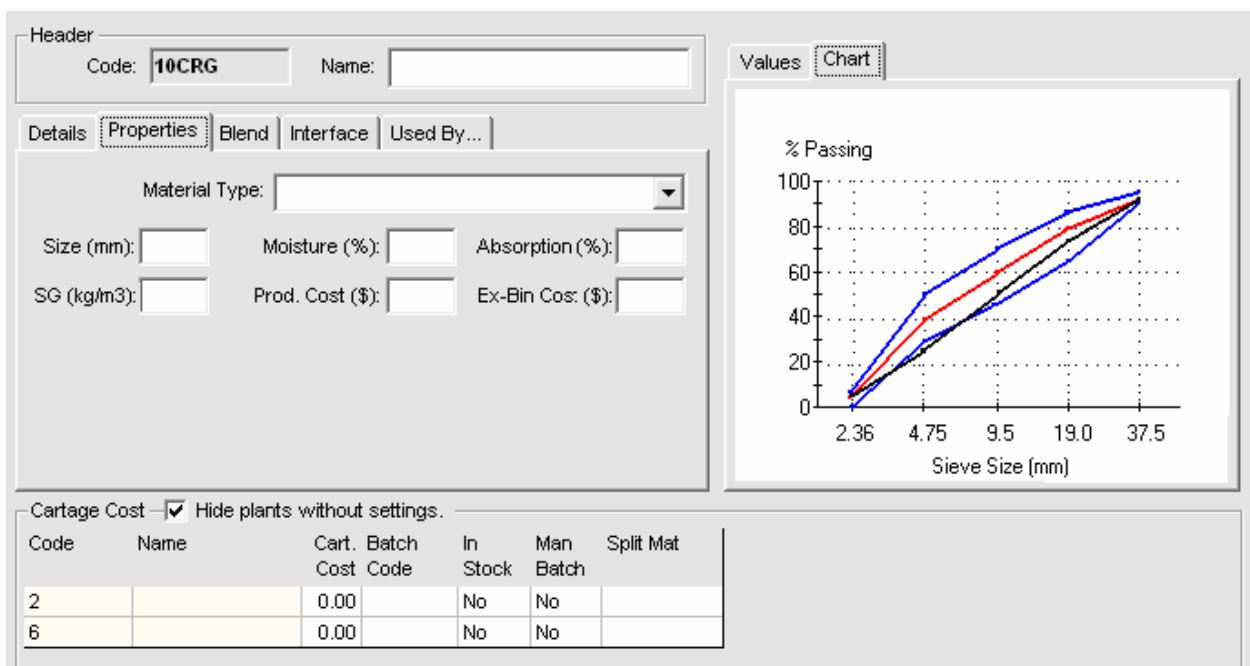


Figure 7: Material Properties Screen (Aggregate/Sand) Chart

The chart tab is also modified to include the target grading. Four grading lines will be shown on the chart, Target (red), Minimum (blue), Maximum (blue) and Actual (black).

2.4.3 Additives

Additives will no longer show the fields for size, moisture or absorption. None of these are applicable to additives.

2.4.4 Admixtures

As is the case for additives, admixtures will no longer show the fields for size, moisture or absorption. None of these are applicable to admixtures.

The data base of QESTMix will be enhanced for admixtures and cementitious materials to include additional fields as specified below.

A new admixture type (g/m³) will be introduced. This needs to be introduced in all parts of QESTMix and the QDI that refer to material types, including all imports and exports (e.g. docket import), material screen, plant material costs, mix material weights.

The existing fields for SG and Moisture content will be enabled. Most admixtures are liquid; however they often contain other materials in addition to water which should not be counted when calculating the total water in the mix.

The following new 'property' fields will be added for admixtures. These are all data entry fields, some of which will be used in calculations on the Mix Design screen.

Caption	FieldName	Format	Data Type
Na ₂ O	Na2O	"0.00"	real (32bit-floating point)
pH	pH	"0.0"	real (32bit-floating point)

The screenshot shows a software interface for entering material properties. At the top, there is a 'Header' section with 'Code: 10CRG' and a 'Name:' field. Below this are tabs for 'Details', 'Properties', 'Blend', 'Interface', and 'Used By...'. The 'Properties' tab is active, showing a 'Material Type:' dropdown menu and several input fields: 'Moisture (%)', 'SG (kg/m3)', 'Prod. Cost (\$)', 'Ex-Bin Cost (\$)', 'pH', and 'Na2O'. At the bottom, there is a 'Cartage Cost' section with a checked checkbox 'Hide plants without settings.' and a table with the following data:

Code	Name	Cart. Batch Cost	In Stock	Man Batch	Split Mat
2		0.00	No	No	
6		0.00	No	No	

Figure 8: Material Properties Screen (Admixture)

The layout of the input textboxes for Admixtures will be as shown above.

2.4.5 Cementitious Materials

The following new 'property' fields will be added for cementitious materials – these will be data entry only fields, but will be available for searching/reporting capabilities.

Caption	FieldName	Format	Data Type
Na ₂ O	Na2O	"0.00"	real (32bit-floating point)
C ₂ S (%)	C2SPercent	"0.00"	real (32bit-floating point)
C ₃ A (%)	C3APercent	"0.00"	real (32bit-floating point)
C ₃ S (%)	C3SPercent	"0.00"	real (32bit-floating point)
Residue (<45µm)	Residue	"0.00"	real (32bit-floating point)
Blain Fineness	BlainFineness	"0.00"	real (32bit-floating point)

Figure 9: Material Properties Screen (Cementitious)

The layout of the input textboxes for Cementitious materials will be as shown above.

2.5 Mix Design

There are several new fields that need to be added to the mix design screen. These new fields have prompted some re-design of the existing layout. Please note that these changes will both Mix Designs and Change Points. In addition, to maintain product consistency, the Current Products and History will be updated so that a similar layout is used (See 2.8.2)

Some key points: All of the entered fields will be located on one tab 'Mix Details'. This set of tabs will also contain a section for the grading optimisations (new), and another for interface fields (existing).

The Properties and Chart sections will be visible regardless of which tab is selected. This allows all of the important information relating to the mix be displayed both while optimising the grading, and also while adjusting factors like water / cement levels. The intention is that the grading chart will resize to take as much room as possible, for example, when the tree is hidden. Note: this new layout will take up almost the whole screen on a 1024x768 display.

The grading optimisation tab will allow for the selection of a target grading, and also make available settings for the automatic proportioning of the aggregates and sands in the mix.

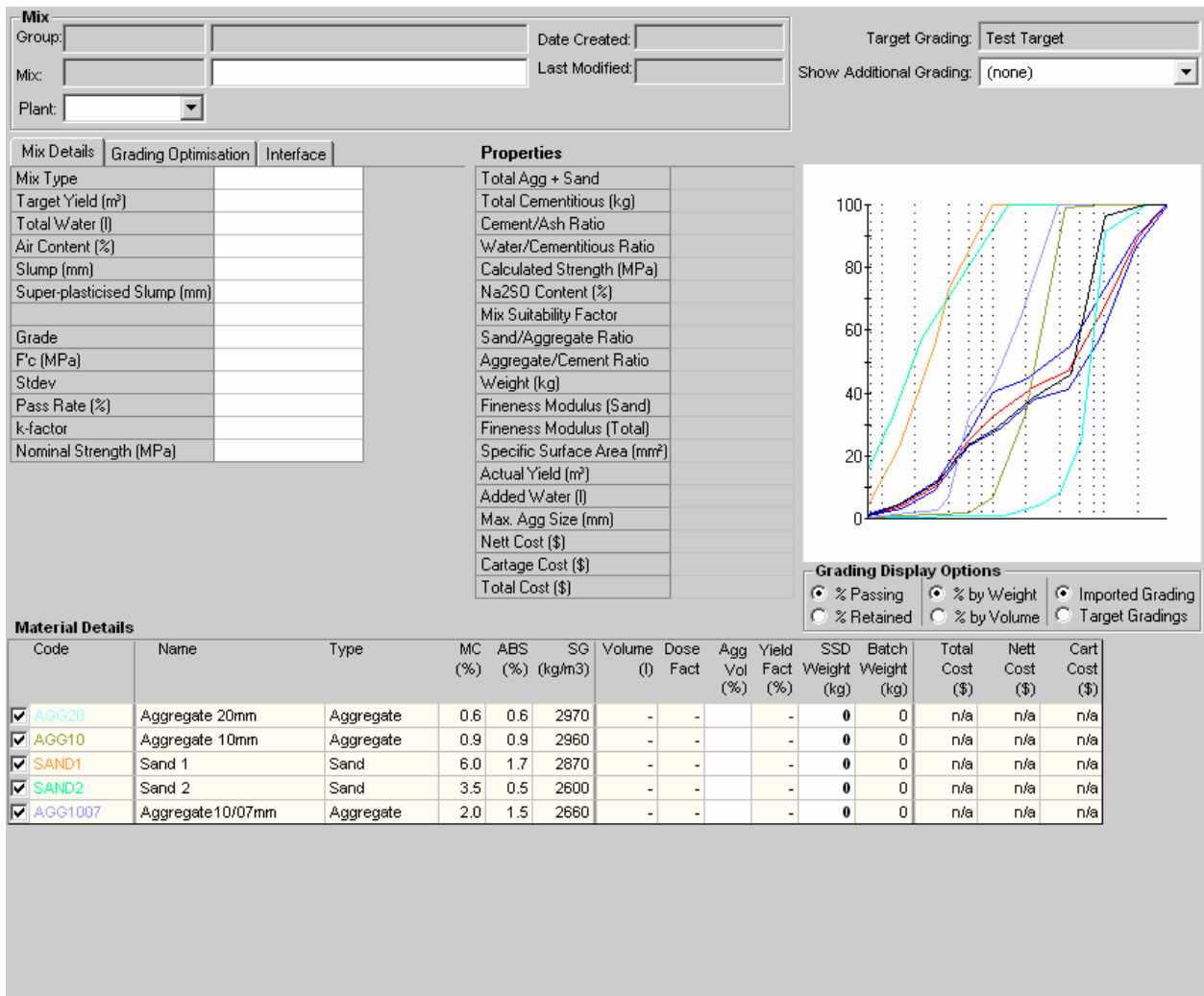


Figure 10: Mix Design Screen (Mix Details tab)

2.5.1 New Mix Design Fields

All of the new fields are calculated fields that are useful when designing the mix. These will be displayed in the properties section of the mix design screen.

A list of the new fields to be added is as follows:

Caption	FieldName	Format	Data Type	Calculation
MSF	MixSuitabilityFactor	0	Real (32bit float)	#
Calc MPa	CalculatedStrength	0.0	Real (32bit float)	#
FM Sand	FinModSand	0.00	Real (32bit float)	=Sum(%Retained on FM Sieves for the sands**)
FM Mix	FinModMix	0.00	Real (32bit float)	=Sum(%Retained on FM Sieves for the mix##)
SSA(m ² /m ³)	SpecificSurfaceArea	0	Real (32bit float)	=Sum((%retained/100) * (3 / sievesize)) ###
Agg/Cem	AggregateCementRatio	0.0	Real (32bit float)	=TotalAgg / TotalEffectiveCementitious
Sand/Agg	SandAggregateRatio	0.0	Real (32bit float)	=TotalSand / TotalAgg
Na ₂ O (%)	Na2O	0.00	Real (32bit float)	####
Paste (l)	PasteVolume	0.0	Real (32bit float)	=TotalCementitious + TotalWater + (AirContent * ActualYield)
Mortar (l)	MortarVolume	0.0	Real (32bit float)	= PasteVolume + TotalSand

MixSuitabilityFactor and CalculatedStrength are custom calculations – this should be defined in a separate module, and be able to be customised for different installations of QESTMix. There are several ways that they could be calculated, and it makes sense to leave this up to the user to a certain extent. Initially the formulas below will be implemented:

$$\text{CalculatedStrength} = (25 * \text{TotalEffectiveCementitious}) / (\text{TotalWater} + (0.4 * (\text{AirContent}\% - 1)) * (\text{SQRT}(\text{TotalEffectiveCementitious}))) - 8$$

$$\text{MixSuitabilityFactor} = \text{SpecificSurfaceArea} + (\text{TotalEffectiveCementitious} * 0.025) - 7.5 + (0.25 * \text{AirContent}\%)$$

Fineness Modulus sieves are a standard set of sieves where the volume doubles on each consecutive sieve. 75.0, 37.5, 19.0, 9.5, 4.75, 2.36, 1.18, 0.600, 0.300 and 0.150 mm. Values can be interpolated where they are unavailable on intermediate sieves (e.g. if the 4.75 sieve was not used for some reason).

SSA is surface area per unit volume, the formula uses the assumption of spherical particles.

Na₂O content needs to be calculated by finding the total Na₂O content in the mix from the cementitious materials and the admixtures. The final result is the percent of the overall mix that is Na₂O (so it will be much less than either the cementitious or admixture Na₂O amounts – it is effectively “diluted” by the sand/aggs and added water). This will be done as a calculation by volume of the total mix (rather than calculating by mass).

2.5.2 Changes to mix material data

The “Yield / Dose Factor” column will be split into two separate columns - Dose Factor, for admixtures and additives, and Agg Vol (%), for aggregates and sands. The Agg Vol (%) column will be used to hold the proportioning information. This is basically the proportion of the total aggregate/sands that will be taken up by the specific aggregate / sand. These should always add up to 100%. The auto-fit functionality will populate this column with the appropriate values to obtain the ‘best fit’ to the target grading.

2.5.3 Mix Details and Additional Properties

Slumps

The existing slump fields will be replaced by more correct names. The existing ‘Initial Slump’ field will be renamed to Slump (this is Design Slump in QESTLab), and the ‘Final Slump’ field will be renamed to ‘Super-plasticised Slump’. This is only applicable when a mix contains a super-plasticiser, however, data entry will be permitted for all mixes. (One reason for this is backwards compatibility – in some cases the final slump may have already been entered, even if the mix does not contain a super-plasticiser).

Nominal Strength

The nominal strength calculation is to assist with the calculation of appropriate cement levels for the mix (i.e. water/cement ratio). It is calculated based on a given standard deviation, the required strength, and the required success rate (or k-factor).

The formula used to calculate the nominal strength is:

$$\text{NominalStrength} = F_c + k_factor * \text{StandardDeviation}$$

The k-factor is a standard statistical function, based on the expected pass rate (entering either of these will calculate the other). One of the common values used is 1.65, which corresponds to a 95% probability of meeting the target.

The calculation will be set up so that any field may be modified, and the remainder will be calculated. Behaviour is as follows:

Changed Field	Result
F _c	Recalculate nominal strength
StDev	Recalculate nominal strength
Expected Pass Rate	Recalculate k-factor and nominal strength
k-factor	Recalculate expected pass rate and nominal strength
Nominal Strength	Recalculate expected pass rate and k-factor

2.5.4 Grading Optimisation Tab

The grading optimisation tab is an expansion of the existing grading tab. It allows the association of a target grading with the design, and provides an interface for the automatic material blending utility.

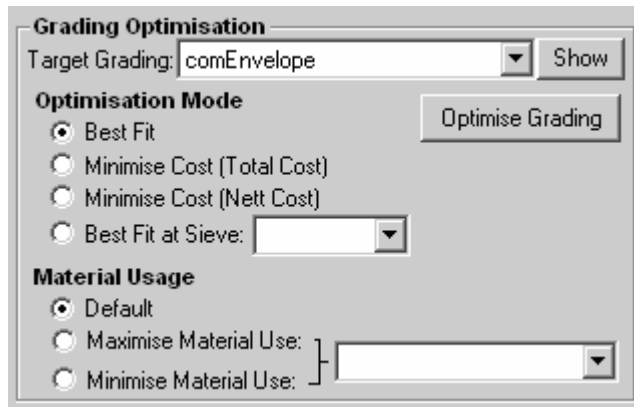


Figure 11: Mix Design Grading Optimisation Tab

Selection of materials for the automatic calculation is done via checkboxes in the materials grid. Materials that have been selected for 'auto-calculation' will have their percentages by volume automatically re-calculated when the "Optimise Grading" button is clicked. After this, whenever the SSD weights of other materials (i.e. cements) are changed, the SSD weights of the aggregates will be re-calculated based on the "Agg Vol (%)" column.

2.5.4.1 Optimisation Parameters

There are several grading optimisation parameters. These operate as follows:

Optimisation Mode:

1. Best Fit – Ignore the cost of the materials, and aim for the best possible fit. This can be used in combination with material usage parameters, which will result in treating all other materials as equal, except for the material to minimise/maximise.
2. Minimise Nett Cost – find the aggregate/sand proportions that will have the lowest nett cost, but will still have a combined grading that fits within the specified envelope.
3. Minimise Total Cost (delivered cost) – as per 2, but for the total/delivered cost
4. Best fit at sieve – Reduces the tolerance to 0 on a specific sieve – this finds the best fit for the specified sieve, which can be useful for gap-graded mixes.

Material Usage Parameters:

1. Default – just use the optimisation mode, try for minimum cost / best fit possible
2. Minimise material (select material from drop down)

3. Maximise material (select material from drop down)

2.5.4.2 Description of the Algorithm Used

The algorithm used will do the following:

1. Find the 'best fit' (ignoring material cost/preference for this step). This will find the proportions of materials that will closest fit the target curve, after taking into account any materials that have been assigned SSD weights explicitly.

2. If the best fit lies within the acceptable limits, we can try to minimise the 'cost', but still keep within the target grading tolerances. There are different ways of 'weighting' the cost calculation. By default, all materials will be treated as having the same cost, however, this can be changed by the 'minimise cost', 'minimise material' and 'maximise material' options.

- minimise material – treat this material as if it were 'very expensive'
- maximise material – treat this material as if it were 'very cheap' (i.e. free)

Basically, the algorithm uses a weighted least squares approach to find the cheapest possible mix within the boundaries – because there is a "hard" limit, we have to use a kind of 'trial and error' approach to minimising the cost.

Once the optimum proportions have been calculated, the %Volume for each material that has been selected for optimisation will be populated. This will also populate the SSD weights. The SSD weights will be adjusted in proportion to the %Volume as the total amount of aggregates/sands is changed (usually by changing the total cementitious / total water properties).

2.5.4.3 Additional Notes

The %Volume can be entered manually (or overridden) for each aggregate/sand, which could leave an overall percentage that doesn't add up to 100%. In this case, the percentages will be highlighted in red. Note that materials that have been selected for auto-grading (via the checkbox) will have their SSD field locked out. Unchecking it will retain the same value in the SSD column, but will adjust the percentages of the other materials to that they add up to the same total as they did previously (hopefully 100%).

Note: Implementation of the core routines will be done by transferring the code that has been written in the existing mix designer module.

2.6 Design Master Report

A new report selection titled 'Design Master' will be added under 'Group' nodes in the QESTMix tree. This report will be available in both the Mix Designs area, and the Change Points area. In addition, it will be available in the reporting section for multiple groups at one time.

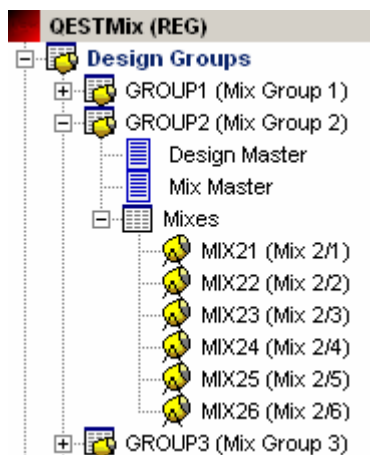


Figure 12: QESTMix Tree showing Design Master Report node

2.6.1 Report Layout

This new report will contain a printable view of the design information, in particular the grading details for the mixes in the group. In terms of functionality, it will be similar to the Mix Master report, which allows for the display of one group per page of the report.

The main difference between this report and the existing report will be the type of data displayed. The new report will include the actual combined grading (in tabular form), and several of the calculated fields. Rather than re-calculating all of these fields each time the report is run, these fields will be stored alongside the design. This will improve performance, particularly when running the report on a large range of mix designs / change points.

Concrete Design Master														Design Details							
Mix Group: GROUP1 (Mix Group 1)														Plants: PLT1 (Plant 1), PLT2 (Plant 2), PLT3 (Plant 3)				as on 22/11/2005 at 13:08			
Mix Code	37.5	26.5	19.0	Cumulative Percent Passing (Sieve Size in mm)							0.6	0.3	0.15	0.075	Fineness Modulus	Specific Surface Area	Air Content (%)	Total Water (l)	Water/Cement Ratio	Calc Strength (MPa)	Mix Suitability Factor
MIX11	100	100	98	87	66	54	36	32	29	23	9	3	1	4.61	28	3.5	140	0.70	26.0	27	
MIX12	100	100	98	87	65	53	35	31	28	22	9	3	1	4.86	27	3.0	150	0.57	32.0	27	
MIX13	100	100	97	86	64	52	34	31	28	21	8	2	1	5.01	27	2.0	160	0.49	40.0	27	
MIX14	100	100	97	86	64	51	33	30	27	21	7	2	1	5.14	26	1.5	170	0.42	50.0	27	
MIX15	100	100	97	85	63	50	32	29	26	20	6	1	1	5.20	25	1.0	180	0.30	65.0	27	

QESTMix by SpectraQEST.com.au

Figure 13: Design Master Report

2.7 General Reporting Enhancements

2.7.1 Ability to use data-filters with QESTMix reports

This is a fairly small change in terms of implementation, but one that will provide enormous benefit to QESTMix users. The existing datafilters in QESTMix will be expanded to support the reports section. As with other areas of QESTMix, there will be default filters for each type of report, which will have the same search criteria as the existing 'search' control.

The layout of the reports screen will be changed slightly. Since there will no longer be a need for the existing search panel (on the left hand side), it makes sense to move the few remaining options for the reports to the top of the reports. These will be placed in the reporting toolbar.

It makes sense to implement this at the same time as implementing a new report as there will be less additional work overall than there would be if it were first implemented using the existing "filters", and then migrated separately.

2.7.2 Interpolation between cement levels for change points

Currently, when designing a mix using change points, the reporting engine is only able to display the actual change points that have been specified. This means that when reviewing the data, the user needs to interpolate between the cement levels in order to determine the actual data that would be used for intermediate cement levels.

A new option for the interpolation of cement levels will be made available in the report toolbar (note that the filtering section on the left hand side is no longer necessary). This will be available for Mix Master and Design Master reports.

When this option is enabled, the user will be able to specify what the difference between consecutive cement levels should be on the report. As an example, setting the value to 10 would mean that a line would be generated on the report for every 10kg of cement.

Change points will be listed in bold on the report so that they can be readily identified. In addition, the Mix Code column will be replaced with "Cement Level", as there is no actual "mix code" associated with the interpolated lines.

Please note: There will be a significant performance hit when this type of report is being run. This is due to limitations of the existing software model, which has not been designed to optimise repeated calculations using the same design group. To get an idea of the expected performance, you can enable the integrity checks option on the design-product relation screen. Performance is expected to be similar to this.

2.8 Mix Performance Review

2.8.1 Adjustments to the Create/Update Products function

There are several new fields for mix designs. These also need to be added to mixes in the current products and history, and will be populated as a part of the Create/Update process.

In addition to the new fields, the target grading will also need to be calculated for the product. Then the product is based on a mix designs, the target grading for the product mix will be identical to that of the mix design, and for change points, it will be interpolated from the two adjacent change points.

2.8.2 Adjustments to Current Products/History Screen

In order to maintain product consistency, the product screen will be updated in a similar way to the mix design screen. A mock-up of the main screen is shown below.

The target grading will be shown in the chart, along with the material and combined gradings. Note that the Grading Optimisation tab will not be required because the material weights cannot be adjusted through the "current product" screen.

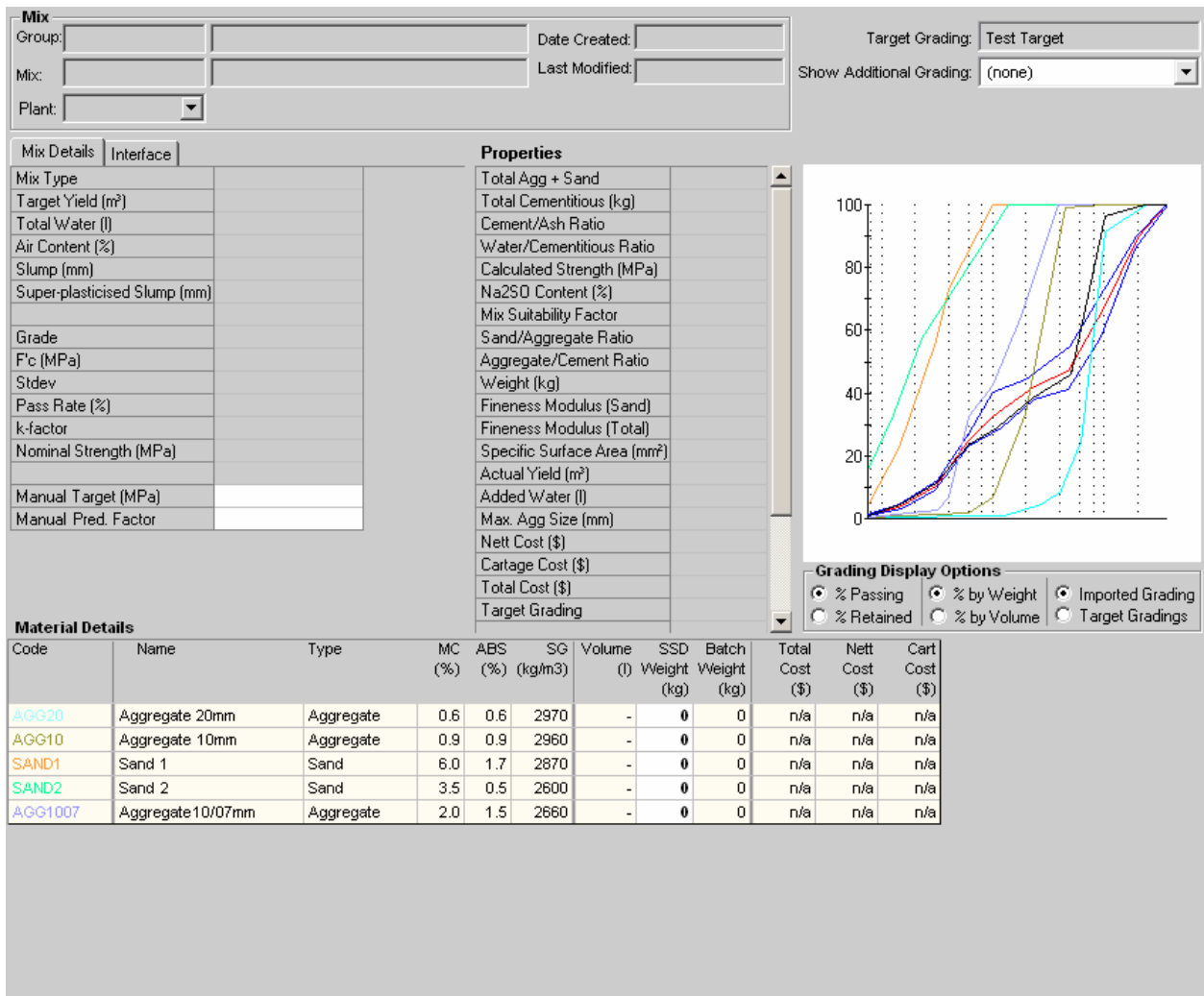


Figure 14: Product Mix screen (Current Products and History)

2.8.3 Performance review tab

To make use of the grading data in performance review, a new chart is required. This chart will display the full grading for each docket, along with the target grading for the product. To make this chart useful, it is important to be able to select specific docket for display, as displaying of all returned records will likely be confusing for the user (due to the number of lines being displayed).

2.8.3.1 Ability to show untested docket

A new option 'Show untested' will be added to return all docket rather than just those that have field-sheets. Currently, the data is based around field-sheets, as it was designed to be used for the strength results. This allows the grading to be looked up even where the concrete was not actually tested. Note that none of these records will have strength data, so they are only useful where the mix details are the important part.

2.8.3.2 Ability to select specific Docket

To facilitate the selection of specific docket/fieldsheets for display, a new column will be added to the left of all existing columns indicating which items have been selected for display on the chart tabs. This will allow the inclusion/exclusion of each row of data on both the existing charts, and the new grading performance tab. By default, all items in the grid will be selected. "Select All" and "Deselect All" buttons will be provided for ease of use.

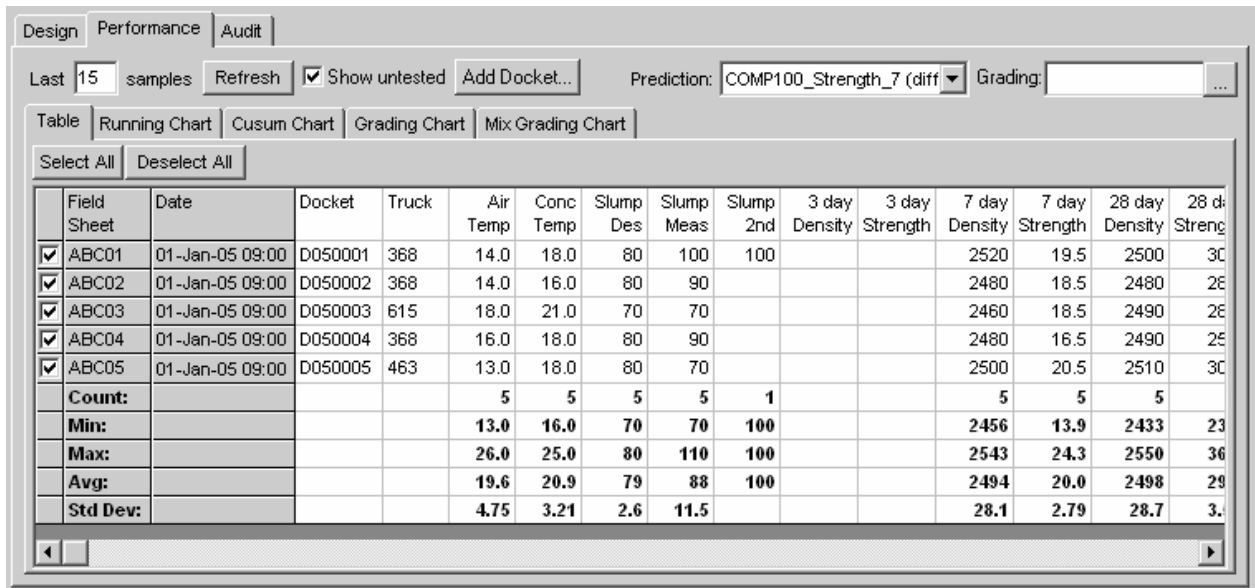


Figure 15: Mix Performance Review tab (Current Products and History)

In addition to this, a new button will be added 'Add Docket...' to lookup specific docket (by docket number). This will be a simple button that will prompt for a docket number, and add it to the bottom of the list of selected docket. Note that the statistics will not be updated to include this docket, however, specific information for the docket will be available. The will be added to the very bottom of the list, below the statistics so that it is clear that they are not included in the stats.

2.8.3.3 Mix Grading Chart

Basically, the new chart displays the grading for each of the fieldsheets that have been selected on the "Table" tab, along with the target grading. The displayed target grading comes from the grading that was stored with the product mix when the "create and update" process was run (i.e. either copied from the mix design, or interpolated from the appropriate change points). Both the target line, and the minimum/maximum lines from the target will be displayed (target line in red, envelope in blue).

The grading data will come from the data calculated during the docket import. This data is available from the QESTLab database, and should be reasonably accurate for the state of the materials at the time the mix was actually produced.

If it is found to be necessary (during testing), a limit may need to be imposed on the number of gradings that can be displayed at one time. This may be needed to reduce the performance hit when the chart is loaded after selecting a large number of gradings (e.g. the 30 most recent samples).

Note: all references to field sheet numbers in all charts will be replaced with the docket number instead (this is not reflected in the mock-up below).

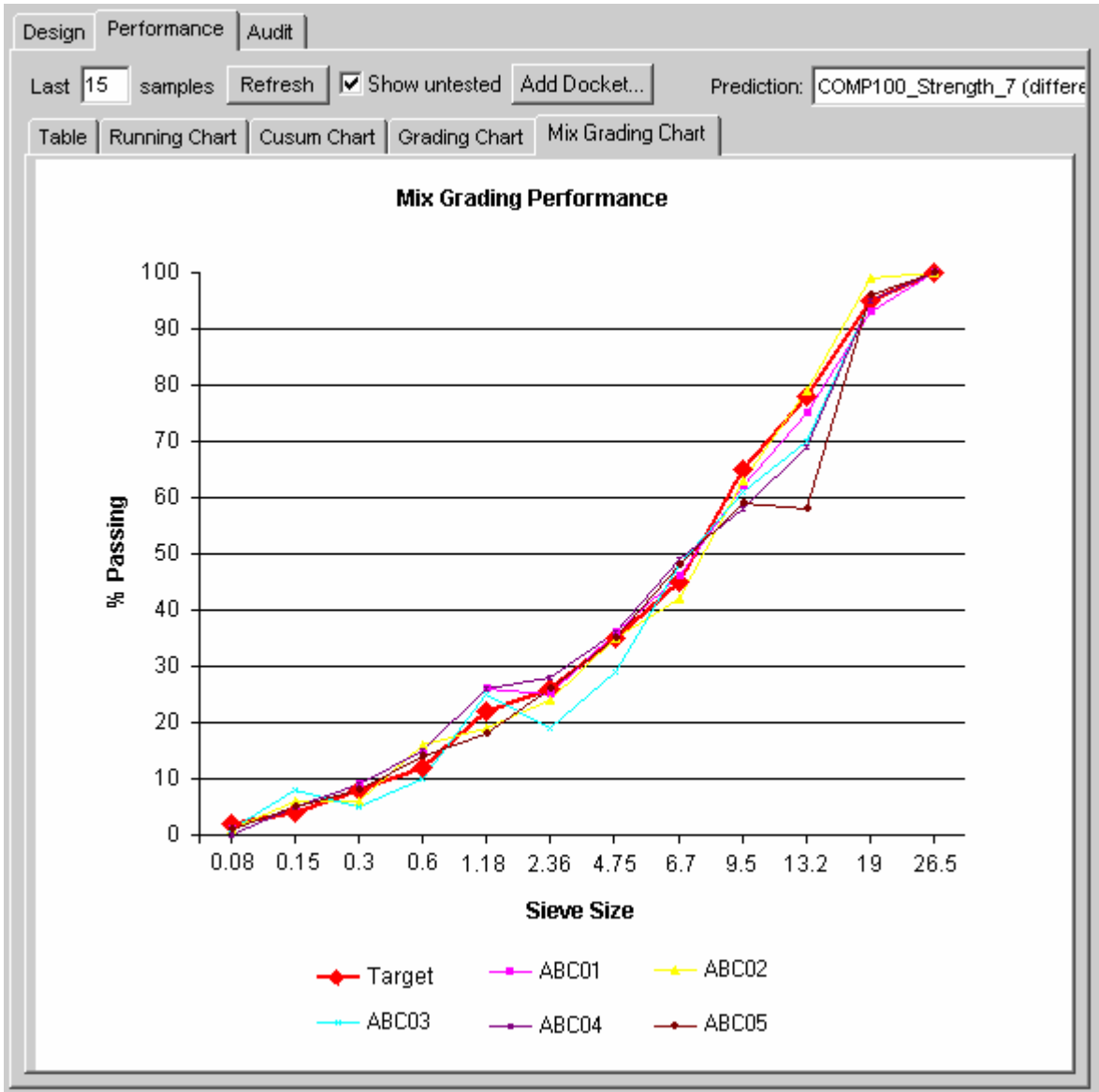


Figure 16: Mix Grading Chart (Current Products and History)

3. Assumptions and Additional Constraints

n/a