Close Out Report

On works completed aboard the

MTR2

For Mermaid Drilling

By

Chemco Specialty Coatings

Contractor and Supplier:

Refurbishment of Upper Accomadation Deck

Using Sandwich Laminating System

To Recover Deck

Work Completed January - April 2013

Report by

Bill Bradnick

Technical Director

CHEMCO SPECIALITY COATINGS (SEA) PTE LTD ★ CHEMCO

Mermaid Drilling Limited
MTR-2
IMO # 7533408
Gross Tonnage 7989

ANTHONY YEO
SENIOR PROJECT MANAGER
KEPPEL SHIPYARD (C&L)

BUREAU VERITAS - SURVEYOR IN SINGAPORE - INTERNATIONAL REGISTER - PARIS 1828

Report on Refurbishment of Accomadation Deck

Aboard the MTR2

Chemco Specialty Coatings Pte Ltd.

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Sunday, 7 April, 2013

Mr Robby Wilhelm

Rig Manager MTR-2 LTD

55 Gul Road

Singapore

Dear Sir,

RE: Final Report on recent activities aboard the MTR2.

Involves; - Strengthening, Waterproofing and Corrosion Protection of Upper Accomadation Deck External Surface. Use of Chemco International Materials and a Specialised Lamination Process known as a *"Sandwich Construction"* combining Steel Plate and Polymer Materials .

Executive Summary:

During January 2013 Chemco Specialty Coatings were contacted to investigate the problem that existed on the Accomadation Deck where serious corrosion pitting had placed the deck at risk and the Survey Team issued a directive to Management to replace the steel deck in total to rectify metal loss.

This directive to replace the deck caused serious implications for the management and crew due the dislocation and physical disruption so caused. Major Cost implications were involved with the "Hot Work" and further destruction of current infrastructure internally to carry out the work complicated the repair further.

Chemco Specialty Coatings put forward their unique Laminating system as one that would not require any hot work, and simultaneously Strengthen, Water Proof and Provide Corrosion Protection for the foreseeable future.

The system has been applied to a large surface area including the incorporation of 2mm thick steel plate (providing for the metal loss due to corrosion) anchored into position followed up by a dual layer laminating system providing a synergistic fully bonded repair medium recovering the strength to acceptable levels without any hot work or serious disruption to normal activities whilst in the shipyard.

This report details the repair via actual photographs and discussion of each stage of the work so that there is a permanent record of the work for all who were present and those in the future that may be interested as to the course of action taken.

The work has been a complete success and has met the goals of the concept and original intention. A much larger surface area than what was originally intended has been treated with 85 no. 2.4 by 1.2 meter plates bonded directly to the deck and laminated in.

Detailed Discussion of Work:

The Technical Proposal that was produced by Chemco Specialty Coatings (see Appendix #1) was the basis for the work and indeed this was followed with some physical variations on the theme as a result of the actual conditions encountered on site. The intention and the result have provided a very similar product with an increase in the strength of the restoration as a result of the process differential. Please read the Appendix #1 to gain the full understanding of the original concept.

The concept calls for:

- Surface Preparation.
- Priming the Surface
- Filling of depressions
- Using physical Anchors to ensure the adhesion of the deep fills, over 5mm thickness
- Applying steel plate to the filled area where the plate was deemed necessary by the survey team.
- This plate “glued” down to 100% of the surface area.
- Lamination technique which includes the addition of Selected Chopped Strand Mat to provide the physical strength bonding the entire structure into a monolithic repair medium that uses the synergistic strength of both the glass and the steel, which combines to replace the strength of the metal lost due to pitting and general surface loss by corrosion. The complete Water Proofing of the entire area was also accomplished with this plan.
- Please refer to the Drawing in Appendix Two.

Actual Work as Built:

There was a change of work method that in itself was minor but allowed the work to continue, it is felt actually that as a result of the change there has been an improvement in the strength accomplished. The original concept was followed but due to some physical conditions on site after the start of the work it became apparent that some modification would be necessary.

The anchoring was accomplished using the HILTI gun to quickly install pins that were used as the primary anchor.

During testing of the application before the work on plate separate to that of the MTR2 we arrived at a suitable impingement so that the anchor was protruding into the filler mass that was going to applied thus gaining grip internally and externally.

On site the steel deck was thinner than expected and we could not alter the compressed gas settings or the length of the nail that matched the circumstances.

It was decided to drive the pins through the entire fabrication thus directly securing the 2mm plate to the deck through the fill which was placed on the wet deck surface.

The force applied drove the pin entirely through the 2mm plate with sufficient impingement in the substrate to the extent that even with a lever it was impossible to remove. The plates when combined with the anchors securing them in this way and the very high adhesion of the RA500M filler used, is a very permanent repair. The application of the lamination system also has an important part to play in the securing of the entire system both to the deck and the bonded plates

Thus, the description of the system as a “Sandwich Construction” remains true. The polymer is sandwiched between the steel plating and the deck, and the Laminate is in turn also bonded 100% to the surface of the plate which creates a new material, both steel and plastic at the same time. This new material is monolithic, bonded and will move and weave with the substrate and the general structure without losing any of the bond strength and at the same time, providing the continuous water proofing that is desired.

The finished laminate was top coated with one more coat of RA500M to fully seal the deck and make some cosmetic aesthetic appeal.

The heavily corroded coving was rebuilt using this system and other outer deck area was also coated as part of this process.

Conclusion:

- The work has been completed in the intended manner; the actual works deviated in a small way from the original plan. This deviation had two benefits.
- The plate itself was physically anchored to the deck not just the fill.
- The resultant anchoring also reduced the fill allowing the plate to follow more the original profile saving filling material.

- There are some areas where water ponding will be possible, but this will have no effect on the coating/laminating system, it is totally waterproof and suitable for a tank lining as fully submerged!
- This repair is a long term repair that will see the life of the MTR2 out in our opinion.
- This repair has passed a Vacuum Test as conducted by Mr. Clive Fok, Marine Surveyor Bureau Veritas Marine (Singapore) Pte Ltd.

Warranty:

A five year rollover warranty is offered with the work, pursuant to an inspection and touch up if required the warranty is available for a second period of 5 years thus giving ten years coverage!

Photographic Records:

All the photos and video taken during the work are attached in the DVD ROM provided. Much of the work has been recorded in video format and interested parties are encouraged to view the various stages of work in living colour and full action replay!

Chemco Specialty Coatings recommends the report, the concluded work and its further specification elsewhere.

Yours Truly,

Bill Bradnick.

Technical Director

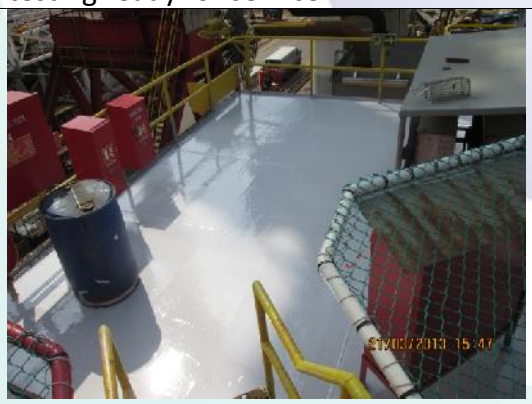
Photo Report:

	
Pic 1: Surface Before the treatment after the high pressure water blast as carried out by the shipyard.	Pic 2: As per previous pic, surface oxidization had reached critical levels over two week period must be removed.
	
Pic 3: Air Powered Twist knot wire brushes were used to remove the build-up of oxidisation that had occurred.	Pic 4:Heavy Oxidisation being removed by Power Wire Brush ready to prime after washing

	
Pic 5: Washing the deck after the Power wire brushing was complete	Pic 6:After wash surface ready to prime with Chemco RS 500P
	
Pic:7: Surface pitting severe in several places.	Pic8: Surface looks like the moon it is so pitted.
	
Pic 9: Priming of surface in progress.	Pic 10: Primed surface with transport system on view. Provided mobility in tight area.

	
Pic 11:Plates bought on to site they have been blasted on the side facing the deck, for maximum adhesion	Pic 12: First step in preparation for the plate apply a bed of wet material suitably prepared, the men call this “mud”
	
Pic 13:Notched trowel used to spread the mud evenly.	Pic 14:The entire surface has the mud applied, the plate is applied whilst the mud is still wet forming 100% glue line
	
Ic 14: Plate ready for laying down onto bed whilst it is wet,	Pic 15: Gunning the first plate down using the Hilti Compressed Air Gun model GX120.

	
Pic 16: Plates layed to over 80% of the surface area.	Pic 17: Plates layed over wide area not the glue line between plates ensuring full bonding even on the edge.
	
Pic 18: The First Laminating Cloth laid out	Pic 19: Laminating completed in every second strip to give access whilst the application is on-going.
	
Pic 20: Laminating in action, shipyard assistance present.	Pic 21: Completed surface ready for next process.

	
Pic:23 Completed work after top coat just prior to Vacuum test	Pic 24:Vacuum Test in action with BV inspector present….passed the test!
	
Pic 25: Finished Work Completed after testing ready for service	Pic 26: Finished Work Completed after testing ready for service.
	
Pic 27: Several other external areas were completed to finish off entire deck	Pic 28: The Chemco team leave the site, job complete…well done!

Sunday, 13 January, 2013

Mr Robby Wilhelm

Rig Manager MTR-2 LTD

55 Gul Road

Singapore

RE: Technical Proposal to refurbish and re-strengthen top deck of Accomadation Block aboard the MTR 2.

After the visit to the MTR 2 in the presence of the Owners Rep, Mr David Jones, the Captain of the Vessel and Bureau VERITAS Inspector Mr Clive Fok, we have been able to formulate the following repair recommendations based on the Chemco International range of Products and world recognized laminating techniques incorporating High Strength Composite materials up to and including steel plate.

The site is presented as an aged but well preserved steel deck that forms the roof of the Accomadation block underneath and somewhat protected by the Helideck. It appears in recent history some protective coatings work has been done to eliminate the corrosion that at one time has seemingly ravaged in various ways the deck leaving behind surfaces that differ. Concern has expressed by the stakeholders around the areas of persistent pitting as result of local corrosion cell activity resulting in pitting in localised areas of perhaps 3-4 m2 each which in turn, in total, affects only 10% (approximately) of the entire deck surface area. It would appear as an average that some of the deepest pits are deeper than 50% of the original plate thickness estimated at 6 mm thick. These local areas of pitting are well spaced and not connected to each other which mean that the structural integrity of the damaged areas can be improved by building off the sound areas surrounding the zones deemed to be affected structurally by the incidence of corrosion pitting.

We observed areas of water pooling which over time may have been one of the primary causes of the corrosion and in general may have to be corrected by filling these areas to achieve a suitable surface for rebuilding with the laminate system.

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The Chemco Coating Technology:

Our coatings, RS 500P and RA 500M are 100% Volume solids high strength Epoxy Resin materials which are essentially used in the Marine and Offshore Industries as extreme anti-corrosion coatings due to their unique ability to be used in challenging situations, for example on wet and rusty surfaces, which has opened many new possibilities dealing with corrosion in unconventional ways.

In this case we are proposing to use these materials both as an anti-corrosion system *and* as building blocks to form a high strength composite layering system that incorporates the RA 500M resin as a component of a composite sandwich laminar Glass Fibre/Steel Plate repair system. The advantage of the resin system is that it converts from *a liquid to a solid,* 100% without any shrinkage. The resulting cured material has mechanical properties which when combined with the Glass Fibre Laminating materials and the incorporated steel plate combine to form a monolithic medium working synergistically with each individual element incorporated. This system provides a repair membrane that is both mechanically anchored and bonded to the deck, supported by the surrounding sound material providing new strength and replacing that which is lost by a safe margin.

Corrosion generally is eliminated now and will be in the future by virtue of the density of the system, the resin itself is filled with Glass Flake providing an impermeable waterproof barrier. The steel plate used in the Composite Sandwich is internalised and will never be exposed to corrosion forces as it is totally encapsulated.

Methodology:

Surface Preparation:

Prior to any washing/surface preparation an inspection will be carried out to identify any penetrations; those found will be plugged with fast setting epoxy to waterproof the area prior to washing.

Due to the existing coating being sound and in good condition and only very localised corrosion present it does not appear necessary to remove the existing coatings. We will wash the entire surface with a power wash say 3000 psi to remove loose dirt and coatings so that an effective inspection/survey can take place.

Areas to be treated with the Sandwich construction will be marked out. Where necessary, areas that has to be made level by filling the zones that are depressed and the cause of the water

ponding situation. String lines will be used to identify the exact area to be filled and the volume estimated.

Anchors will be screwed into the deck surface at 200mm centres with the top of the anchor kept below the string line so that the fill material encompasses the anchor.

Using suitable fillers (resin and selected light weight aggregates) depending on the depth of fill will be applied in 25 mm thick layers to bring surface back to line of surrounding deck plate. After curing a light grind will take place to remove any high spots after checking levels.

Sandwich Construction Application:

The Sandwich Construction will be applied in a "wet on wet" fashion so that the entire Composite cures together and is monolithic and within the same curing cycle.

After local hand preparation methods such as "bristle blaster" power wire brush or even hand wire brush techniques, Apply RS 500 P @ 100- 200 microns DFT to any areas exposed to substrate.

After primer has cured enough (less than 30 mins) Apply bedding coat of RA 500M and laminate in one layer of recommended Chopped Strand Mat 250gm/m2 using the special spiked rollers to ensure total wetting out of the matting. Prepare steel plate separately (just after purchase) and apply further bedding coat to both surfaces, invert plate and exclude all material excess by rolling the plate with weighted roller. As coating is curing apply further coating to topside of plate and continue will application of Chopped Strand Mat ensuring overlap with sound substrate. Ensure use of spiked rollers to ensure total take up of resin materials. Allow to cure.

Apply one more layer of 250gsm Mat again overlapping entire repair zone. This is the finish of the Sandwich construction; after curing (12 hours) finishing and levelling coats will be applied later in the process.

Areas affected by pitting that is superficial in small and local areas will be trowelled level and using the same process as above without the steel plate using three layers of the Laminate. When all levelling and repairs are finished one final layer of laminate will be applied to the entire deck area to be finished in colour of Choice. (White recommended).

RE: Conclusions.

We believe that this repair is possible and will be effective in strengthening the roof, rebuilding lost material creating a viable alternative to steel replacement with all the difficulties and hazards that will be created in carrying out that hot work.

The affected areas are very local, and separated by other areas of strong and original thickness plate. This means that the pitted areas can be bridged out by a repair that is fully bonded and inclusive of steel plate that is half of the original thickness.

Because of the variances in local application, the thickness that is applied and the variances in Laminates used it is not possible without finite element analysis to predict the actual strength of the individual repair. However the strength of various laminates is well known based on resin types used and thickness required for various applications. This information is available publically from many of the large chemical houses such as Dow and can be accessed to gauge the strength of the repair.

Our experience in testing shows that the laminate (in this case Sandwich Construction) operates synergistically with the substrate that actually forms one new Monolithic Element that works together with the substrate, anchored and bonded, providing recovered acceptable strength well into the foreseeable future.

The pull off strength of the resin from the substrate is very high having attained 2600psi and averaged 2400psi in practice. Our resin materials start off life similar in type to those used as glue such as the well-known Araldite.

Based on our IMO approvals we must provide a warranty for FIVE YEARS on this repair which will take it to the next class inspection for further evaluation.

We look forwards to further discussion, various approval documentation and technical data is attached for your perusal.

Yours Truly,

BILL Bradnick.

Technical Director.

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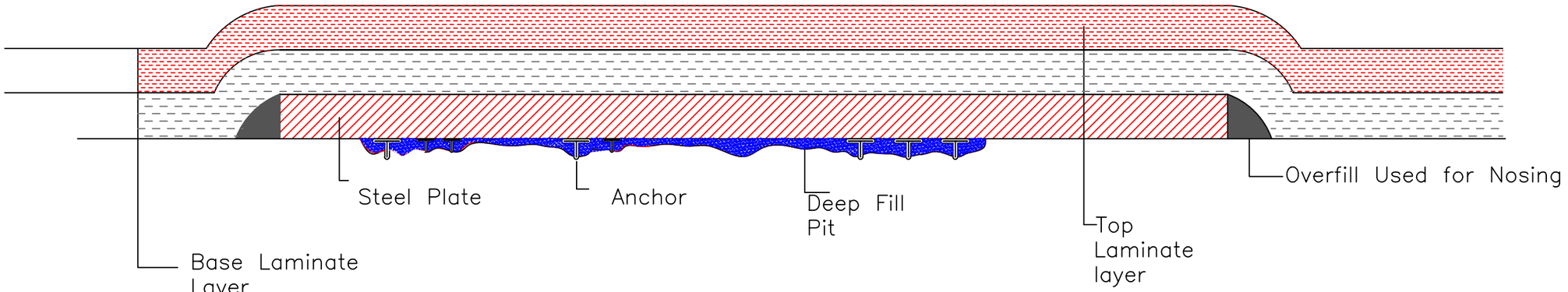
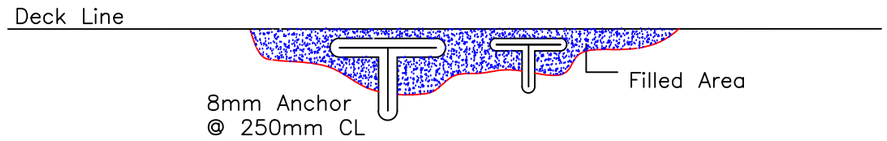
CSC LAMINATE DETAIL

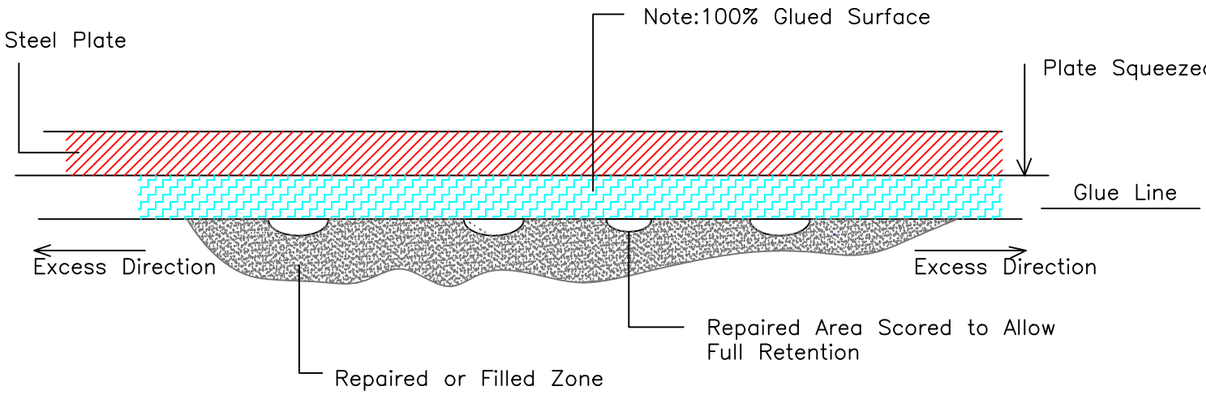
MERMAID DRILLING MTR–II



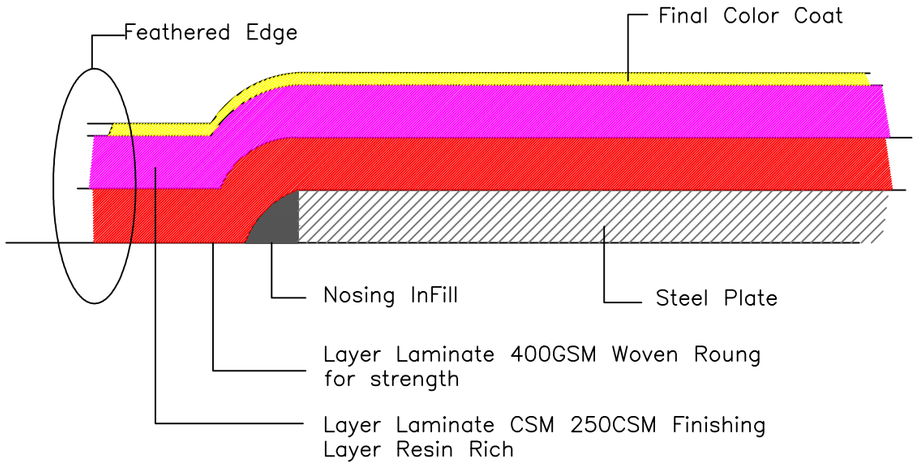
ANCHOR DETAIL



GLUE LINE DETAIL

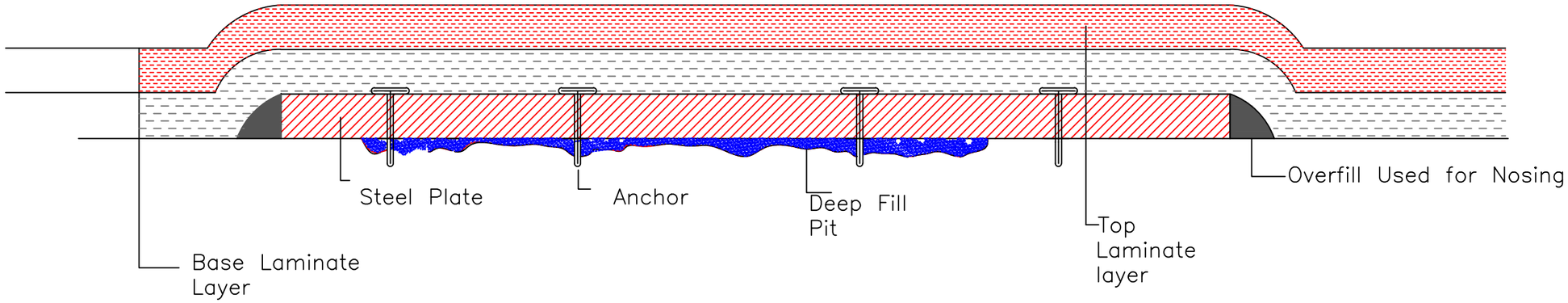


LAMINATE DETAIL



Chemco Specialty Coating Laminate Detail

MERMAID DRILLING MTR–II



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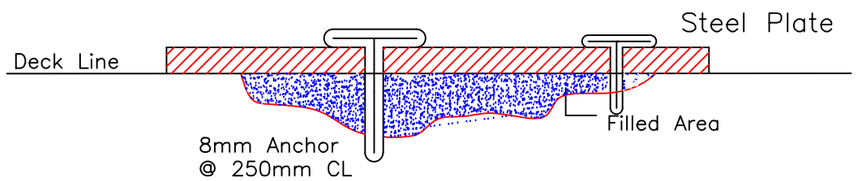

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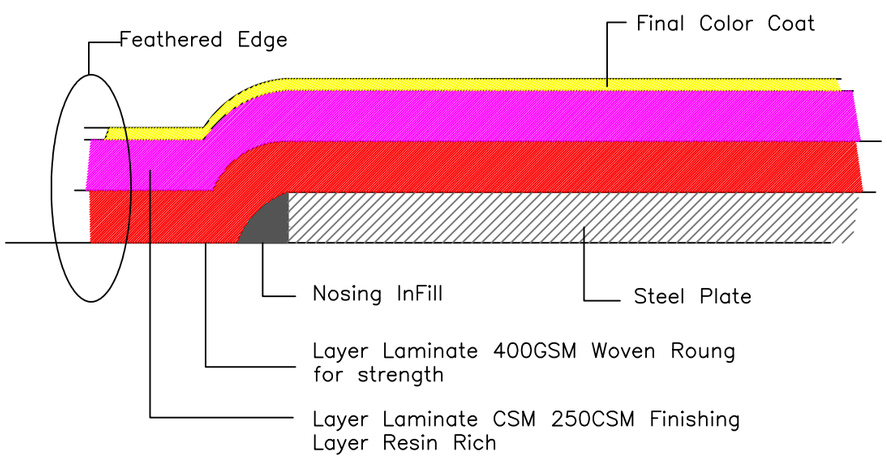

AS BUILT DRAWING
APRIL 2013

MTK - L

ACCOMMODATION TOP PLATING

D: 04/01/13

FWD