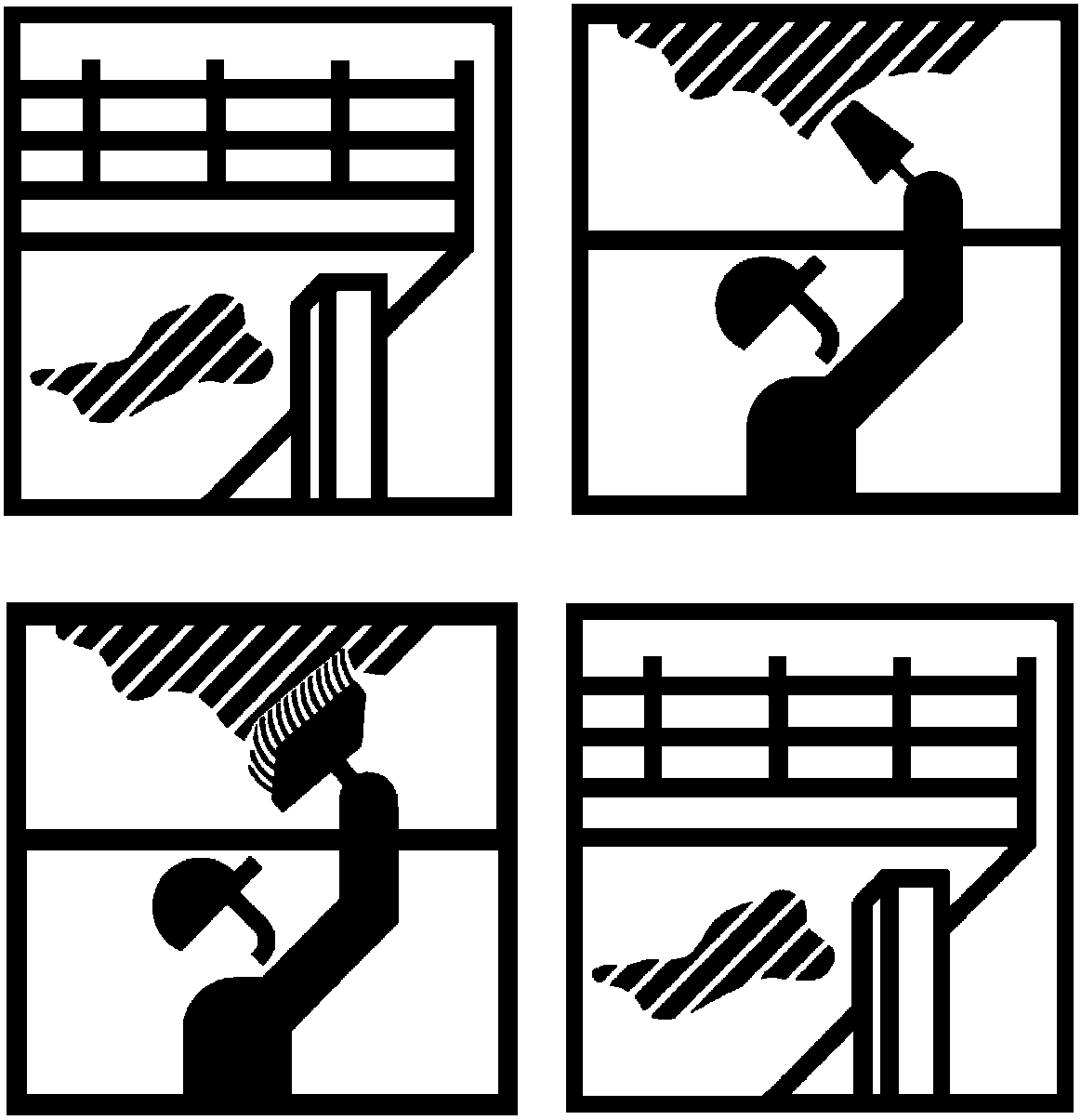
MasterEmaco® P 158

Ready to use SBR based bonding and polymer modifying agent for concrete and mortars



To be read in conjunction with the **MasterEmaco® P 158** technical datasheet

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Concrete repair using MasterEmaco® P 158

Concrete repair and renovation

It is generally accepted that concrete is best repaired with concrete or cement mortar. Only when there are other overriding factors such as structural crack injection or bonding, are resin based materials substituted. To meet this requirement for a cementitious repair system, BASF have developed the following method which incorporates the use of **MasterEmaco® P 158** , as a simple, versatile and cost effective system for the renovation of concrete.

The method is especially suitable where due to logistical or economic considerations, the use of **MasterEmaco** pre-bagged repair products is not appropriate.

SBR based concrete repair method

Most repairs can be executed using the following method, which is based on established good practice and the use of **MasterEmaco® P 158** . This repair method will give durability similar to that of the surrounding concrete fabric.

The method is outlined below:-

1. Diagnosis

i. Ascertain the cause of failure.
Ensure that the new repair is carried out in such a manner that the original cause of failure is eliminated - this will make certain that, in the future, a similar failure does not re-occur in the repair or alongside it.

ii. Determine whether chlorides are present. **MasterEmaco® P 158** repairs are generally recognised as being one of the most effective ways of limiting further problems caused by high percentage of chlorides in concrete.
If chlorides are present, deterioration may occur in adjacent areas, due to chloride action, although at the time of repair no defect is apparent. Protection of adjacent areas helps to limit any further decay.

2. Preparation

i. Carry out preparation of the defective area thoroughly and in accordance with current good practice.

ii. Mechanically clean reinforcing steel to remove all corrosion products. Wash reinforcing steel with clean water (to remove soluble salt contamination) and allow to dry.

3. Priming

i. Brush apply a primer coat of 1½:1 or 2:1 cement/**MasterEmaco® P 158** by volume over freshly cleaned and dry reinforcing steel. Allow primer to dry for 16 to (not exceeding) 36 hours.

ii. Pre-wet the prepared concrete substrate (so that concrete is saturated but surface is free of water).

iii. Re-prime reinforcement and concrete with primer as 3.1 above.

4. Repair

i. Whilst the primer is still wet, carefully apply and compact a mix comprising of 50kg OP cement, 125kg well graded BS 882 C&M (previously Zone 2) sand and 8 litres of **MasterEmaco® P 158** , adding water as required

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to give sufficient workability. Yield is 0.1 cu. metre.

ii. SCREEDS AND REPAIR MORTARS SHALL NOT BE APPLIED TO DRY **MasterEmaco® P 158** PRIMER. APPLY INTO WET OR TACKY PRIMER ONLY.

Comments:

i. 8 litres of **MasterEmaco® P 158** per 50kg of cement is the recommended rate for thin applications, i.e. less than 19mm thick, or when maximum performance is required, i.e. when exposure conditions to water, chemicals or abrasion are severe, when cover to reinforcement is less than desired and/or when sand grading is poor. In less demanding situations, the addition level can be reduced to 5 litres or less per 50kg of cement (provided that a lower performance improvement is acceptable).

iii. On vertical patches, coats can be applied up to 25mm thick, provided slumping does not occur. This depends on the repair size and geometry. On larger flat areas, coats should not exceed 6mm in thickness, though several coats can be applied in quick succession, each coat setting firm before the next is applied (usually between 15-30 minutes, dependent on ambient conditions). Finish off the final surface. Alternatively - scratch the first coat after application, allow to dry overnight and then apply a second coat.

5. Watchpoints:

i. Do not mix more mortar than can be used within 45 minutes.

ii. If shuttering is required, this should be prepared and fitted ahead. The shutter is then removed and **MasterBrace ADH 1414** epoxy bonding agent is applied (instead of **MasterEmaco® P 158** slurry). The shutter is replaced and the repair is completed without delay.

iii. Do not provide less than 10mm absolute minimum thickness of repair mortar over reinforcement.

iv. When repairing heavy duty floors, include granite chippings. Refer to Guidelines and recommendations for floor screeds and toppings.

6. Curing

Moisture cure for 24 hours only and then allow to dry out slowly. All the above work is to comply with the recommendations detailed in the **MasterEmaco® P 158** technical data sheet.

Other forms of repair

Concrete repair may also take the form of protective renders, screeds or toppings all using **MasterEmaco® P 158** modified mixes. Refer to Guidelines and recommendations for Floor Screeds and Toppings. Also concrete may be bonded to concrete using **MasterEmaco® P 158** slurry. As with the SBR Basic Concrete Repair Method, thorough and adequate preparation is essential as described in Guidelines and recommendations for Preparation of Substrates.

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Protection
Consult BASF regarding protection of structures after repair is complete.

Internal waterproof tanking with MasterEmaco® P 158 modified mortars
MasterEmaco® P 158 modified mortar is ideal for waterproofing structures subject to water pressure (pressures up to 20 metre head of water or more can be handled by this method).

The method is often applied to leaking lift pits or wells, basements, inspection pits and other underground structures. It is also used to waterproof liquid storage tanks, bund walls, swimming pools, water towers and sea (or other immersed structures.

Leaking basements and pits
The **MasterEmaco® P 158** internal waterproofing method of internal tanking, used as instructed, will remedy a leaking structure. The walls may be dry or damp, but free of running water. In this case the remedial tanking is relatively straightforward. Alternatively, water may be leaking under pressure, in which case special measures have to be taken.
Although new construction is normally not expected to leak, unfortunately, it often does and similar remedial measures have to be taken. Alternatively, internal tanking with the use of SBR may be the means of waterproofing specified in the initial design of the structure.

Liquid retaining and submerged structures
Internally applied tanking is equally successful in preventing penetration of liquid into the structure and, particularly, in stopping leakage from concrete liquid retaining tanks. When aggressive chemicals are involved, an appropriate protective coating from the **MasterProtect** range may be applied over the system.

Leaking basements and pits
1. **Initial inspection**
   Clear away all water and closely inspect the structure to determine that the existing walls and floors are sound. Any cracks must be static (otherwise watertight movement joints will have to be formed). Any defects must be rectified prior to commencing waterproofing and the substrate must be sound. Check that the structural floor and walls are capable of taking the hydrostatic load that will result once waterproofing is completed (the water level may well rise once leakage is stopped).

2. **Preparation**
   Prepare the surface to be waterproofed. Remove any laitance from the concrete and weak or delaminating brickwork. Brush down and clean off. This preparation is often carried out by use of scabblers or chipping hammers.

3. **Water leakage under pressure**
   If leaking is under pressure, cut into the structure to relieve the pressure at points of severe leakage and pipe water away to a drain or pump. (Pipes are set in and any remaining leaks are plugged using the techniques described overleaf).

4. **Waterproofing**

i. Thoroughly pre-wet any dry surfaces, making sure that they are saturated (but surface free of water).

ii. Mix a **MasterEmaco® P 158** slurry of 1 part **MasterEmaco® P 158** to 1½ to 2 parts of cement by volume. Mix to a smooth, creamy paste.

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iii. Brush apply two full coats of this slurry, to a total thickness of approximately 1mm, allowing the preceding coat to dry (usually overnight) prior to applying the second at right angles to the first.

iv. When the slurry coats have dried, apply a third coat (at right angles to the second) and immediately render or screed onto it.

Apply 13mm screed to horizontal surfaces, or two coats of render on vertical surfaces (to achieve 13mm total thickness), to tank the area completely. When the screed has dried sufficiently to take foot traffic, apply fillets of the same mortar at floor/wall junctions and internal wall angles.

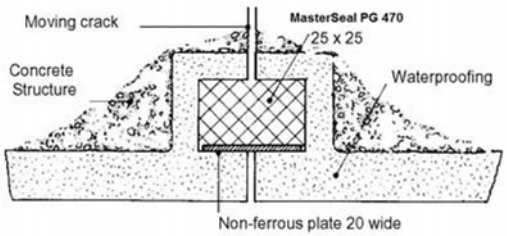
Notes:
Mortar mixes for screeds, renders and fillets are to be 3:1, BS 882 C&M sand (previously Zone 2) OP cement, + 10 litres **MasterEmaco® P 158** per 50kg cement. (For render, BS 1199 Table 1 sand can be used). Add water as required for workability.

For high water pressure, increase **MasterEmaco® P 158** use to 15 litres per 50kg cement. (In this case sand must not be too wet or the desired workability may be unattainable).

5. Movement

Form watertight joints where further movement is expected. Form rebates at joints and waterproof leaving an approximately 25 x 25mm rebate. Apply **MasterSeal PG 470** onto the primed joint and waterproof over, as illustrated.

Typical movement joint



Alternatively, covering the joint with **MasterSeal 930**, joint strip, maybe appropriate. Consult your BASF representative for further advice.

6. **Removal of pressure-relieving pipes:**
When the waterproofing has cured, remove pipes (if placed, plug holes and make good the waterproofing.

Liquid retaining and submerged structures

Similar techniques to those outlined in Sections 1, 2, 4 and 5 above are used to provide a **MasterEmaco® P 158** waterproof lining.

Plugging leaks

Leaks and holes drilled to relieve water pressure are sealed permanently using **MasterSeal 590** applied as recommended. To plug leaks under pressure, chase out the area of the leak until water flow is free; insert a length of plastic hose leading to a suitable drain or pump sump. Seal around the plastic hose using **MasterSeal 590** plugging compound as above: applied with a gloved hand. When set hard, clean the cavity and apply a slurry of 1½ to 2 parts OP Cement to approximately 1 part of **MasterEmaco® P 158** . Repair the hole around the pipe with a **MasterEmaco® P 158** mortar and allow to cure.

When the surrounding **MasterEmaco® P 158** mortar waterproofing is complete, withdraw the pipe and plug the hole with plugging compound as

above, using a gloved thumb to hold it in place until set (approximately 1 minute. Fill the remainder of the hole with mortar and when firm, complete the **MasterEmaco® P 158** waterproofing ensuring that the slurry coats overlap the slurry coats of the surrounding waterproofing.

Similar techniques are used for plugging leaks that do not need to be piped.

Fixing brick slips, tiles, copings, kerbstones etc. using MasterEmaco® P 158 modified mortar is ideal for waterproof and chemical-resistant bonding and bedding of slip bricks, tiles, glass blocks, mosaics, kerbstones and precast units.

Fixing method - brick slips and tiles Prepare the substrate to receive the mortar - see **MasterEmaco® P 158** technical data sheet. It is imperative that a good mechanical key to a sound, strong and stable substrate is achieved when fixing slip bricks and unsupported tiles. The thickness of the mortar bed should normally be 6mm, but in special circumstances this can be increased upto a maximum of 12mm.

1. Thoroughly clean the substrate and saturate with clean water. Remove all free water (leaving surface damp only). Thoroughly dampen the back of the brick or tile to reduce suction.

2. Provide rigid temporary support for any unsupported bottom courses and brace where necessary. Bottom courses should be permanently supported over at least 75%of their length.

3. Apply a **MasterEmaco® P 158** bonding slurry to the back of the tile and to the substrate whilst still damp.

4. Before the bonding slurry starts to dry, butter the back of the tile or brick with mortar to give the desired thickness and firmly press home to ensure complete contact. Strike off surplus mortar. Do not disturb until set. Cure and protect as recommended.

5. Similar mortar may be used for pointing joints - but not until at least 24 hours have elapsed.

Notes:
Adequate slip and compression joints must be provided, together with vertical joints where appropriate at centres not exceeding 4 metres. As a general rule, brick slips should not be less than 20mm or more than 35mm thick. Tiles and concrete claddings should not exceed 35kg/m² maximum weight. Hard, dense and/or smooth materials should have moulded lugs or keys on the back surface.

All the above work is to be carried out as generally recommended in the **MasterEmaco® P 158** technical data sheet and relevant local standards.

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Recommended mix

Rapid hardening Portland cement:	50kg
BS 882 M&F (previously Zone 3 sharp washed sand:	150kg
MasterEmaco® P 158 :	15 litres
Add water as necessary: approx.	3 litres

For thicknesses less than 6mm (for light tiles only, and not less than 4mm, BS 882 F (previously Zone 4 sand can be used. If over 6mm bed is unavoidable (but not more than 12mm, BS 882 C&M /previously Zone 2 sand is recommended. For heavier tiles and slip bricks, applied to a dense background, reduce the sand content to 125kg.

MasterEmaco® P 158 modified mortars are also ideal for bedding kerbstones or precast units following the same principles as outlined above.

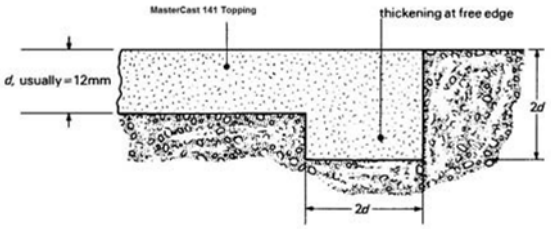
Floor screeds and toppings using MasterEmaco® P 158

Applied to properly prepared sound substrates, suitably designed mixes modified with **MasterEmaco® P 158** produce thin (6mm-25mm) floor toppings which exhibit improved impact and wear resistance together with added resistance to many chemicals. These floors are economical, dustproof and durable.
Similar mixes can be used as unbonded screeds of 35mm- 60mm thick.

Laying of **158** screeds and toppings.

1. Inspect the substrate for defects and where necessary repair with **MasterEmaco® P 158** mortar - refer to Guidelines and recommendations for concrete repair.
2. Thoroughly prepare the substrate. The floor topping is only as good as the substrate onto which it is laid. The substrate must be load-bearing and stable throughout the life of the wearing topping and preparation must be adequate - refer to Guidelines and recommendations for preparation of substrates for further guidance.
   The vast majority of floor failures are due to poor preparation and the need for good preparation cannot be over-stressed.
3. The minimum thickness of **MasterEmaco® P 158** screeds is 6mm. Do not feather edge. Cut rebates for thickening at threshold joints and at free edges. It is recommended that these rebates give double the screed depth and width overall.

Typical edge detail



4. Thoroughly clean off the substrate and saturate with clean water. Remove all free water (leaving the surface damp only).
5. Fix screed battens to level.

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6. Work a **MasterEmaco® P 158** bonding slurry into the floor, using a stiff brush to give a thickness of 1 to 2mm.
   Ensure that coverage is complete and that the slurry is still wet when the flooring is placed onto it. Do not apply slurry too far ahead of the floor laying. Re-apply slurry if the earlier application dries
7. Mix and place the **MasterEmaco® P 158** modified mix in accordance with the technical data sheet recommendations. Finish as the work proceeds - i.e., immediately after placing.

8. Moisture cure for a minimum of 1 day before allowing to dry out slowly. Protect and do not traffic until sufficiently hard.

Mix designs

1. Medium duty floor screeds and toppings

Normal thickness 12mm (min. 6mm, max. 25mm)

Mix by weight:

OP Cement	50kg
Zone 2 sand (BS 882 Grade C&M)	150kg
MasterEmaco® P 158	10 litres
Add water as required approx.	5-7 litres
Yield approx.	0.1m³

Note:
Reduce sand content to 125kg for thicknesses under 10mm.

2. Heavy duty floor topping
Recommended thickness 20- 25mm
Mix by weight:

OP Cement	50kg
Zone 2 sand (BS 882 Grade C&M)	75kg
6mm single size clean granite aggregate	75kg
MasterEmaco® P 158	10 litres
Add water as required approx.	5-7 litres
Yield approx.	0.1m³

3. General notes:

Increase the **MasterEmaco® P 158** content to 15 litres if watertightness or enhanced properties are required. (Do not use wet aggregates or the desired workability may be unattainable).

MasterEmaco® P 158 can also be used to advantage in textured and architectural floor finishes etc., the rate of addition normally being 10 litres per 50kg of cement and the mix design being dependent on aggregates being used and the finish desired.

Preparation of substrates using MasterEmaco® P 158

Preparation of substrates prior to repair

The performance of **MasterEmaco® P 158** repairs, whether patches, renders, screeds, toppings or slurry only, is dependent on the surface to which they are applied being suitable to receive them and so to develop the full potential of the **MasterEmaco® P 158** mixes used. Depending on the nature of the repair, preparation may involve one or more of the following processes:-

1. Removal of defective substrate and exposure of corroded steel.
2. Reduction to accommodate the application.
3. Preparation of the surface - this is necessary in practically every case (unless already clean and suitable).

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1. **Removal of defective substrate and exposure of corroded steel**
   Identify the decayed or damaged area. Mark clearly. Saw cut the perimeter of the area to be treated or cut neatly, keeping the sides of the areas as square as possible. Defective material must be removed carefully using suitable reducing plant, needle guns or sharp tools and chipping hammers. The force applied must not be such as will damage sound material beneath; for this reason jack hammers must never be used.

   If unsound material or corroded reinforcement is found to extend beyond the premarked area, extend the cutting as necessary, treating the edges as above. If corroded, ensure that the back of the reinforcement is exposed to a depth of 20mm. Test the substrate exposed for soundness.

2. **Reduction to accommodate the application**
   Some repairs necessitate reduction of the existing substrate to accommodate the minimum thickness of the application. This is frequently the case, for example, when slabs or pavements are being resurfaced. Reduction can be carried out by planers, by sharp scabblers or by blasting with very high pressure water, grit or sand. As above, care must be taken to remove material from the substrate surface without causing damage to underlying layers below.

   After reduction, the thickness achieved should be as constant as possible - avoid high points and depressions. If a change of thickness is unavoidable, it must be very gradual. However, free edges of floors should have a thickening - refer to the Guidelines and recommendations for preparation of substrates.

   Test the reduced surface for soundness - probe to ensure that there are no soft or weak areas.

3. **Preparation of the substrate surface**
   This applies to untreated surfaces and to treated surfaces (as 1 and 2 above) that are not sufficiently regular and/or not adequately textured. Texturing can be achieved by scabbling or light grit blasting.

   The lightly textured but firm surface must be brushed clean of all loose debris, dust and standing water. An air lance using oil-free compressed air or an industrial vacuum aid thorough cleaning.

The surface must be thoroughly wetted down and kept damp for at least 1 hour; free water is then removed, just prior to application of the **MasterEmaco® P 158** slurry.

Watchpoint

If a surface is contaminated, e.g.: by oil, all the contaminant and any contaminated substrate must be removed prior to preparation of the substrate. Light oil or grease deposits should be removed with a degreasing solution. Heavy oil deposits should be removed by hot compressed air. If purpose designed equipment is not available, a propane gas torch may be used to heat the concrete and dry out the deep seated oil. Care must be taken when using this method to heat the concrete slowly. Keeping the torch trained on one spot to effect a rapid heat build up will cause the concrete to spall violently.

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The need for adequate preparation

There is no substitute for good substrate preparation prior to application of **MasterEmaco® P 158** mixes.
If a reduced standard of substrate preparation is undertaken, the user cannot expect to achieve the full potential of the **MasterEmaco® P 158** repair. Poor substrate preparation can be the cause of future failure of a repair.

Cleaning corroded reinforcement

Reinforcement should have all the corrosion removed by use of powered tools, abrasive blasting, water jetting or wire brushing, as appropriate. For basic repairs, clean the steel removing all corrosion and leaving clean. Where chlorides are present in significant amounts, all rust must be removed by grit blasting. After cleaning reinforcement, it is advisable to finally wash and dry (to remove final traces of soluble salts). If excessive steel has been corroded away and the reduction might impair the strength of the structure, the missing cross-sectional area must be reinstated. This is usually achieved by lapping in or anchoring additional reinforcement. When in doubt, an Engineer's advice must be sought. Critical cross sectional areas are usually those of main bars and shear reinforcement in areas of high shear. A 10% reduction in cross-sectional area is usually accepted as the maximum permissible, but each and every case must be considered on its merits.

Watchpoint

Always ensure that concrete repair extends to the limits of corrosion and for a nominal distance beyond (say 25mm). This may mean cutting beyond the edges of the decayed concrete or behind the reinforcing bars to expose corrosion. Before cutting structural concrete away, consider structural stability.

Temporary structural support and / or removal of load

The structural significance and safety of each repair process should be considered and, if necessary suitable propping must be provided during repair.

Properties of MasterEmaco® P 158 and modified mortar

MasterEmaco® P 158 , styrene butadiene co-polymer latex rubber:

Typical values

pH	10.5
Specific gravity	1.01
Freeze-thaw stability	Withstands at least 5 freeze thaw cycles, but inside storage above 0°C is recommended
Particle size	0.17 micron*
Stabilisation	Non-ionic
Butadiene content	40% by weight of the SBR polymer
Antioxidant	Yes
Bactericide	Yes
Antifoam	Yes
Minimum film forming temperature	Approximately 1°C
Shelf life (interior storage)	Above 2 years, but from above 0°C to 25°C agitate before use after prolonged storage

*A cubic mm of dried film is made up from more than 125,000,000,000 particles

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Tests on performance properties of MasterEmaco® P 158 modified mortars

Mix formulation for test:
All mixes were prepared with 3 parts BS 882 Zone 2 sand and 1 part Ordinary Portland cement. The level of **MasterEmaco® P 158** was varied.

The minimum quantity of water was used to achieve a reasonable consistency in accordance with normal good working practice. Typically water:cement ratio was 0.5 for unmodified mortar, 0.28-0.34 for modified mortars.

Unless stated otherwise, results were obtained after ageing specimens for 28 days. Curing conditions were:

1 day wet, 27 dry for ”DRY” and normally 1 wet, 20 dry, 7 wet for ”WET” (abbreviated on next page to 1W27D, 1W20D7W).

Test methods

Air content
BS 4551: 13:2 or 13:3.

Compression tests
BS1881: Part 116: (Curing condition modified as above).

Flexural strength
BS 4551: (Curing condition modified as above.

Tensile strength
BS 6319 Part 7 but at pulling rate 1.5mm/min. (Curing condition modified as above.

Adhesion method 1
A half dumb-bell of steel or cured mortar was placed in a tensile mould as above, primed and the test mortar compacted against it. Pulling rate: 1.5mm/min.

Adhesion method 2
Slant Shear BS 6319 Part 4.

Water vapour permeability
BS 4016/BS 3177 11mm thick test pieces.

Water penetration
30 metres per head of water was applied to one face of a mortar disc 85mm diameter, 15mm thick. The volume of water passed in a given time was then measured.

Comment:
Test results are tabulated overleaf. These results illustrate that the incorporation of **MasterEmaco® P 158** in cement mortar significantly improves adhesion, tensile and flexural strengths, both at normal working temperatures and under extreme conditions of use. Very good resistance to a wide range of chemicals is also demonstrated. It is apparent that **MasterEmaco® P 158** enables highly water resistant mortars to be designed with low w:c ratios and low water penetration characteristics.

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Test results MasterEmaco® P 158 modified mortars

MasterEmaco® P 158 ltr/50kg cement			0	10	12.5	15	20
			Values in N/mm²				
Adhesion to concrete:	1W27D	DRY	0.07	2.0	-	2.1	3.4
Test method 1	1W20D7W	WET	0.3	1.0	-	0.9	1.4
	1W20D63W	WET	0	1.4	-	1.8	2.1
Adhesion to steel:		DRY	0	2.0	-	-	1.6
		WET	0	-	-	-	1.3
Slant shear adhesion (mortar/SBR mortar using 141 bonding slurry) Test method 2:			-	31	-	-	-
Tensile Strength:		DRY	3.0	-	-	-	4.3
		WET	1.8	-	-	-	3.9
Compressive Strength:		DRY	56.0	50	-	-	-
Flexural Strength:		DRY	7.1	-	13.2	-	10.6
		WET	5.8	-	-	-	9.6
Effect of chemicals on Flexural Strength after 6 months immersion:							
Untreated		DRY	7.2	-	13.2	-	-
10% Potassium Hydroxide		DRY	6.1	-	12.3	-	-
10% Magnesium Sulphate		DRY	4.3	-	13.3	-	-
5% Lactic Acid		DRY	5.9	-	8.0	-	-
10% Sucrose		DRY	5.9	-	9.2	-	-
5% Hydrochloric Acid		DRY	0	-	2.2	-	-
20% Ammonium Nitrate		DRY	2.6	-	4.8	-	-
Petroleum Spirit		DRY	7.7	-	7.5	-	-
Effect of extremes of temperature Flexural Strength:							
Untreated			7.1	-	-	-	10.6
After 60 freeze/thaw cycles in 10% brine at -18°C			0	-	-	-	10.4
After 1 year at 70°C			5.2	-	-	-	14.3
Adhesion to concrete:							
Untreated			0.1	-	-	-	3.4
After 6 months at 70°C			0	-	-	-	2.6
			Co-efficient x 10^6				
Thermal expansion (linear):	- 20°C to + 20°C		12.7	-	-	12.8	-
	+ 20°C to + 60°C		12.8	-	-	12.9	-

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Shrinkage during drying:						
w/c ratio		0.40	0.34	-	0.34	0.30
% shrinkage		0.07	0.02	-	0.01	0.01
				g / m² / 24 hrs		
Water vapour permeability:		46.9	38.1	-	3.9	1.9
Water penetration:				**kg / m² / 24 hrs**		
with **MasterEmaco® P 158** in mortar		100	35	-	0	0
with **MasterCast 141** / cement sealing coats on unmodified mortars		0	-	-	-	-

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