MANUAL ON WATERPROOFING OF GFRG / RAPIDWALL BUILDINGS

Structural Engineering Division
Department of Civil Engineering
IIT Madras

Building Materials & Technology Promotion Council
Ministry of Housing & Urban Poverty Alleviation
Government of India

Glass Fibre Reinforced Gypsum (GFRG) Panel Building System – A New Solution for Rapid and Affordable Mass Housing
Manual on Waterproofing of GFRG /RAPIDWALL Buildings

Prepared by

Structural Engineering Division
Department of Civil Engineering
IIT Madras

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Disclaimer

The information presented in this Manual is supplied in good faith and is based entirely on the test data and design guidelines furnished for GFRG building panel. BMTPC, New Delhi or Indian Institute of Technology Madras is not responsible for incorrectness, if any, in such data furnished for GFRG building panels.

Acknowledgment

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FOREWORD

Glass Fibre Reinforced Gypsum (GFRG) Panel System is an alternate construction system and has potential to be a viable solution for affordable mass housing. BMTPC along with IIT Madras has been promoting the technology for affordable housing projects. In this endeavour the GFRG panel system has been studied and evaluated by IIT Madras and certified by BMTPC through Performance Appraisal Certification Scheme (PAC No.1009-S/2012). In order to mainstream GFRG technology, it is essential that suitable manuals may be created which will help the construction agencies to make use of the technology. In the process, BMTPC has published Design Manual for GFRG panel system which was prepared by IIT Madras.

Being gypsum based product, there are lot of queries regarding water proofing treatment of the panel system despite of the fact that GFRG panels absorb less than 2 percent of water after immersing in water for 24 hours. Further, GFRG building with large building panels for walling and floor/roof require water proofing treatment to be carried out at the time of construction and prior to pouring of concrete, as part of construction. Therefore, it was felt apt that a publication on water proofing solution for GFRG construction may be brought out. IIT Madras has come out with this publication being published by BMTPC which can be readily used by construction agencies while implementing the technology in the field.

The water proofing solution provided in the publication is based on indigenously produced nano technology by Zydex Industries which is tailor made for GFRG buildings in consultation with IIT Madras. The solution proves to be a viable proposition for effective water proofing of GFRG buildings, however, the application need to be done under strict supervision of trained and skilled manpower. Various materials and applications mentioned in the document have been developed and recommended by IIT Madras after extensive R&D and testing. Products from any other industry may also be used after establishing their efficacy on the GFRG panel system through testing. The publication has been produced by Prof. Meher Prasad and Prof. Devedas Menon of IIT Madras who has been putting R&D efforts to make the GFRG panel system as a viable alternate system for housing.

Dr. Shailesh Kr.Agrawal
Executive Director
BMTPC
PREFACE

Water-proofing is important in buildings in order to prevent ingress of moisture, causing possible dampness, discoloration and deterioration in the long term, if left unattended. The use of large Glass Fibre Reinforced Gypsum (GFRG) panels significantly reduces the number of joints encountered in conventional masonry walls, but these too need waterproofing for complete protection against water ingress. In particular, waterproofing is required at joints located at the junctions of plinth beams and walls, walls and slabs, joints between walls and openings for door and window frames, at lintels and sunshades, on terraces and wet areas (such as toilets). Indeed, it is desirable to provide a waterproofing coating at all joint locations.

There are various options for waterproofing, and new generation materials are emerging, through innovative research efforts, in order to provide hydrophobic action. These are found to be more effective than conventional cementitious waterproofing chemicals for GFRG wall panels. The solution also needs to be cost effective in the context of affordable mass housing. This is possible through indigenous production, avoiding the importing of products that are presently available, but are expensive.

From the experience gained over the past few years, using indigenously produced nanotechnology and polymer based products and waterproofing methods, it now seems to be a viable proposition to provide effective waterproofing for GFRG buildings. This, however, needs to be done by fully trained and skilled persons/applicators, to provide for a guaranteed solution.

This manual gives details of such a waterproofing solution specially suited for GFRG buildings. It is also suggested that regular maintenance shall be carried out, to ensure that the walls and slabs remain waterproof during the life of the building.

Dr Meher Prasad
Dr Devdas Menon

Professors, Structural Engineering Division
Department of Civil Engineering
IIT Madras
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1. Introduction

Waterproofing chemicals and their application practices are very important in building construction industry. The objective is to prevent water leakages / seepage and avoid consequent problems. Conventional construction, using traditional building materials and construction practices, involves waterproofing treatment to be provided simultaneously with the construction of building structure, while certain treatments are to be done as part of the finishing work of building construction.

GFRG / Rapidwall building, with large building panels for walling and floor / roof slab in combination with RC, requires waterproofing treatment to be carried out at the time of erection of the panels and prior to pouring of concrete, as part of the construction. However, certain waterproofing treatment is to be carried out, post-construction of structure, as finishing work.

This manual lists products and their application procedures for waterproofing of buildings, constructed utilizing GFRG / Rapidwall panels produced in India using Rapidwall technologies of Australia.

GFRG / Rapidwall is an energy efficient, eco-friendly large load bearing building panel manufactured with high quality Gypsum Beta Plaster, reinforced by micro strand glass fibre roving and special additives. The main raw material is hemi-hydrate Gypsum Beta Plaster (CaSO4.½ H2O) produced by reprocessed industrial by-product gypsum available in India by low energy consuming Rapid Flow (fluidized) calcining technology. The panel is manufactured in standard size of 12 m length, 3 m height and 124 mm thickness with modular cavities of 230 mm × 94 mm along the full height. The panel can be cut to required wall sizes and can be used as external or internal load bearing walls with RC infill in the required cavities or non-load bearing partition walls with or without infill. Design details are given in the Structural Design Manual.

To enhance abrasion resistance and water repellent quality, the panels require special primer that will impregnate or penetrate into the outer surface of the panel. This will also act as a base primer coat with good bonding property to apply finishing coat of water based paints, acrylic paints, distemper or cement paints.

Zydex Industries have developed new nano-technology and polymer based products to address various waterproofing and long-term protection of GFRG / Rapidwall buildings against heavy rain with heavy winds during severe monsoon seasons in India, particularly in coastal regions and elsewhere.
1.1 Waterproofing Solutions for GFRG / Rapidwall Buildings

Although waterproofing agents are incorporated in the manufacturing process and water absorption tests conducted on GFRG / Rapidwall panels have found that the panels absorbed less than 2% water after immersing in water for 24 hours, construction with the panels still requires waterproofing to be carried out, both at the time of erection of the panels and finishing work.

To enhance abrasion resistance and water repellent quality, the panel requires special primer to impregnate or penetrate into the outer surface of the panel. This will also act as a base primer coat, with excellent bonding properties, prior to applying finishing coat with water or oil based paints, acrylic paints, distemper or cement paints. If the primer is not applied to the panels (on both the sides) in the factory before despatch, it is mandatory that such primer shall be applied at the construction site.

Listed below are the products and application procedures for the waterproofing of buildings constructed with GFRG / Rapidwall panels in India.

1.2 Waterproofing (nano-technology & polymer) and special primer products developed in India

In India, GFRG / Rapidwall buildings combine both panels and concrete as cast in-situ cavity infill and construction of joints of structural components. As the properties of the GFRG panels and concrete can vary, different waterproofing treatments are required. However, nano-technology based products have been developed that are suitable for the waterproofing of these buildings.
### 1.2.1 Products:

<table>
<thead>
<tr>
<th>Sr. No.</th>
<th>Product</th>
<th>Description</th>
<th>Features / Benefits</th>
<th>Application Areas</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td><strong>ZYCOSIL</strong></td>
<td>Colour: Pale yellow</td>
<td>Zycosil+ nanotechnology is chemically reactive, water soluble, breathable UV and heat stable. It penetrates up to 2 mm in concrete pores / cementitious surfaces and forms Si-O-Si Siloxane bond by Nano siliconization of surfaces.</td>
<td>Zycosil+ solution (1 : 20 water) mixed with 2 litre of Zycoprime+ (1 : 20 : 2) (Total 23 litres) can be applied on all cementitious surfaces / concrete / RC part of GFRG / Rapidwall building construction, to make construction joint (comprises of concrete / RC &amp; GFRG / Rapidwall) waterproof.</td>
</tr>
<tr>
<td></td>
<td></td>
<td>Form: Liquid</td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td></td>
<td>Density (g/ml) (at 25°C): 0.91 +/- 0.02.</td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td></td>
<td>Water soluble; forming water clear solution.</td>
<td></td>
<td></td>
</tr>
<tr>
<td>2</td>
<td><strong>Zycoprime+</strong></td>
<td>Colour: Milky</td>
<td>Zycoprime is acrylic copolymer emulsion for bonding of cement mix to Zycosil+/ZMB60 surfaces. It gives excellent bonding of reinforced membrane to screed plaster.</td>
<td></td>
</tr>
<tr>
<td></td>
<td></td>
<td>Density (g/ml): 1.03 +/- 0.02</td>
<td></td>
<td></td>
</tr>
<tr>
<td>3</td>
<td><strong>ZMB60</strong></td>
<td>Colour: Black</td>
<td>ZMB60 is a liquid product which forms in-situ, seamless modified bitumen membrane (without fillers). ZMB60 chemically bonds to Zycosil+ treated cementitious / concrete surfaces gives protection against leakage or seepage due to future micro crack formation in the slab due to expansion - contraction.</td>
<td>ZMB60 mixed with ZMB Thinner solution is to be applied as a protective layer over Zycosil+ &amp; Zycoprime+ solution on Terrace / roof slab / car porch top.</td>
</tr>
<tr>
<td></td>
<td></td>
<td>Form: Water based Liquid</td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td></td>
<td>Density (g/ml): 1.01 +/- 0.02</td>
<td></td>
<td></td>
</tr>
<tr>
<td>4</td>
<td><strong>ZMB Nano Thinner</strong></td>
<td>Colour: Pale yellow</td>
<td>Reduces viscosity of water based cationic bitumen emulsion, allowing to work at room temperature. (100% pinhole free surface)</td>
<td>Prepare ZMB Thinner solution by adding 1 litre ZMB Thinner in 20 litre of water and 1 litre of Zycoprime+.</td>
</tr>
<tr>
<td></td>
<td></td>
<td>Form: Liquid</td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td></td>
<td>Density (g/ml) (at 25°C): 0.85 +/- 0.01.</td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td></td>
<td>Water soluble Formin clea solution.</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Sr. No.</td>
<td>Product</td>
<td>Description</td>
<td>Features / Benefits</td>
<td>Application Areas</td>
</tr>
<tr>
<td>--------</td>
<td>---------------</td>
<td>--------------------------------------</td>
<td>--------------------------------------------------------------------------------------</td>
<td>-----------------------------------------------------------------------------------</td>
</tr>
<tr>
<td>5</td>
<td>Elastobar</td>
<td>Colour: Milk</td>
<td>In the original waterproofing solution, this product was named WD 60.</td>
<td>Elastobar EB50 product can be used to make suitable filling / sealant compound.</td>
</tr>
<tr>
<td></td>
<td></td>
<td>Form: Liquid</td>
<td>The purpose of this polymer product is to make Grout RW and Mix RW compound (polymer rich flexible filling material) at GFRG / RW construction site for the filling of joints and cracks associated with concrete and GFRG / Rapidwall panel. It gives better bonding to treated surface and panel. Also for making rendering compound/mix for rendering of external and internal wall surfaces.</td>
<td>Grout RW is for sealing cracks / small joints.</td>
</tr>
<tr>
<td></td>
<td></td>
<td>Density (g/ml): 1.06 +/- 0.02</td>
<td></td>
<td>If GFRG / RW panel has got some damage / dent / crack etc during handling of panel / erection of panel / construction and needs repair or rectification this compound can be used. Mix RW is for coving and infilling and packing of piping. External and internal wall surfaces.</td>
</tr>
<tr>
<td>6</td>
<td>WD P30</td>
<td>Colour: Translucent</td>
<td>Nano penetrating polymeric primer for improved abrasion resistance and improved bonding to GFRG / Rapidwall panel only GFRG / Rapidwall building. Over this special primer, all types of paint can be applied. (WD P30 is to be mixed with WD Thinner in to ratio 1:1 to make special primer to penetrate into the panel surface.)</td>
<td>WD P30 is primer specially developed to apply to external and internal GFRG / RW wall surfaces and ceiling by mixing with WD thinner. A coat of this primer is to be applied as a base primer coat before painting.</td>
</tr>
<tr>
<td>7</td>
<td>WD Thinner</td>
<td>Colour: Transparent</td>
<td></td>
<td>Primer will penetrate into the skin (flange) of GFRG / Rapidwall panel by 0.3 to 0.4 mm and will become part of the material itself. Primer also provides bonding to paints.</td>
</tr>
</tbody>
</table>
1.2.2 Preparation / mixing of compounds:

**Colour code**
- Zycosil solution
- Grout RW
- Mix RW
- ZMB solution
- WD primer
- Zycoprine solution
- Rendering

With the above products, the following mixes will be prepared and recommended to be used during waterproofing application of houses built with Rapidwall panels in combination with infill of concrete / RC.

<table>
<thead>
<tr>
<th>Sr. No.</th>
<th>Material</th>
<th>Description</th>
<th>Coverage (Approximate)</th>
<th>Drying time under sun light</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>Diluted Zycosil+ (1:20) + 2 litres Zycopprime+ Water-proofing in spray form</td>
<td>Zycosil+ = 1 Ltr Water = 20 Ltrs Zycopprime+ = 2 Ltrs Total = 23 Ltrs</td>
<td>30-40 m²/23 litre of diluted Zycosil+ and Zycopprime+ (surface to be saturated)</td>
<td>3 – 4 hrs</td>
</tr>
<tr>
<td>2(i)</td>
<td>Grout RW (to be used for filling gaps, joints and patch work) Paste form in white colour</td>
<td>(i) To make paste form in white colour: Elastobar EB50=1.0 kg / Ltr White cement =1.5 kg 100 mesh silica=1.0 kg (sieved fine sand) Total =3.5 kg</td>
<td>3.5 kg or 0.13 cft volume can fill approximately 48 running meter of vertical RW joint (5mm width of joint). Use 8.9 kg Elastobar EB50 to make 1.0 cft or 31.1 Ltr Grout RW (sealant compound)</td>
<td>2 times water spray in an interval of 24 hrs</td>
</tr>
<tr>
<td>2(ii)</td>
<td>Grout RW (to be used for filling gaps, joints and patch work) Paste form in gray colour</td>
<td>(ii) Formulation with gray cement Elastobar EB50=0.8 kg / Ltr Gray cement =1.0 kg 100 mesh silica=1.0 kg (sieved fine sand) Total = 2.8 kg</td>
<td>2.8 kg or 0.09 cft volume can fill approximately 38 running meters of vertical RW joint (gap to joint &lt; 0.5 mm). Use 8.9 kg Elastobar EB50 to make 1.0 cft or 31.1 litres of Grout RW (sealant compound)</td>
<td>2 times water spray in an interval of 24 hrs</td>
</tr>
<tr>
<td>Sr. No.</td>
<td>Material</td>
<td>Description</td>
<td>Coverage (Approximate)</td>
<td>Drying time under sun light</td>
</tr>
<tr>
<td>---------</td>
<td>----------</td>
<td>-------------</td>
<td>------------------------</td>
<td>-----------------------------</td>
</tr>
<tr>
<td>3</td>
<td>Mix RW (will be used as a coving on of the junction of horizontal and vertical surfaces)</td>
<td>Elastobar = 1.0 – 2.0 kg Cement = 10 kg Sand = 30 kg Water = 8 kg / Litre Total = 49 kg or 0.75 cft (Adjust water as required to make paste or slurry form) When Mix RW is to be made in paste form, use sieved fine sand (using 100 mesh)</td>
<td>With 1.0 – 2.0 kg Elastobar, 0.75 cft or 0.0212 m³ Mix RW (or 0.75 cft / 0.0212 m³) Coving) can be made.</td>
<td>4 days, two times water spray</td>
</tr>
<tr>
<td>4</td>
<td>ZMB 60 + ZMB Thinner solution (ZMB Thinner + Water + Zycoprime+)</td>
<td>ZMB 60 = 100 Kg ZMB Thinner = 1 Ltr Water = 20 litres Zycoprime+ = 1 Ltr = ZMB Solution (122 litres) Forms in-situ seamless bitumen membrane</td>
<td>Total solution is 122 litre. Dosage is 0.8 to 1 litre per m² (in 5 thin coats)</td>
<td>3 hrs</td>
</tr>
<tr>
<td>5</td>
<td>Primer: WD P30 (1 kg WD-P30 + 1 kg WD Thinner) on external &amp; internal surfaces</td>
<td>WD P30 = 1.0 kg/litre WD Thinner = 1.0 kg/litre Total = 2.0 kg/litre Nano penetrating polymeric primer for external &amp; internal wall surface of GFRG / Rapid-wall building</td>
<td>40-50 m² / 2 kg/litre (1 kg / litre WD P30 &amp; 1 Kg / litre WD thinner) single coat</td>
<td>24 hrs (12 hrs under sun rays)</td>
</tr>
<tr>
<td></td>
<td>Rendering compound/Mix</td>
<td>For 1mm thickness: 1 kg Elastobar EB50 and 10 kg RCF/FRBL wall plaster or JK/Birla wall putty. For 2mm thickness: 2 kg Elastobar EB50 and 20 kg RCF/FRBL wall plaster or JK/Birla wall putty</td>
<td>1 sq.m.</td>
<td>-</td>
</tr>
</tbody>
</table>

2. **Waterproofing & Primer Maintenance Works**

2.1 Waterproofing membrane shall withstand surface temperature up to 700°C and performance life cycle of 20-25 years.

2.2 Waterproofing work Maintenance:

1) In case of leakage or seepage from roof terrace, open balconies, roof top of carport / car porches etc, it is recommended to clean up / scrub topmost screed and apply fresh coat of Zycoprime+ over which, bitumen based ZMB solution is to be applied.

2) In the case of leakage or seepage from indoor wet areas like bathrooms, toilet etc it is recommended to check inlet / outlet and tiles joints. Open the joints and clean
up the surface. Once it get dried, perform the same process of waterproofing as per
sunken waterproofing instruction in manual and seal the tile joints.

2.3 Primer:
WD primer (WD P30 & WD thinner in 1:1 ratio, no water to be added) will be impregnated into the
panel skin. It penetrates by 0.3 - 0.4 mm into the skin of panel and will become part of the panel.
There is no need for reapplying WD primer for repainting but if the surface is abraded by 0.2 to 0.3
mm, then apply fresh primer coat to seal the porosity and apply the paint after 24 hrs of drying.

3. Guidelines for calculating / estimating quantities of various
waterproofing products/chemicals

Chemicals for waterproofing treatment of GFRG / Rapidwall buildings are not ready for direct
application. They have to be mixed at construction site at the time of application. For example,
Zycosil+ is to be mixed with water and Zycoprime+ shall be added to it and mixed / stirred well to
make Zycosil+ solution.

Similarly, Grout RW and Mix RW are compounds made at the construction site using Elastobar
EB50 (formerly called WD 60) which is a polymer product. For Mix RW 1-2 kg / mix is recom-
mended. For better workability and stretchability 2 kg per mix is recommended. But, for quantity
calculation purpose average 1.5 kg / mix is advised.

Following guidelines may be useful for calculating quantities of various items required for water
proofing application:

1) Zycosil+: 1 litre / 40 sqm area of application: Foundation & basement including RC plinth
beam, coat over PCC in GF flooring, sides of door openings (124 mm wide), 4 sides of
window / ventilator opening (124 mm wide), 200 mm wide over floor slab for erection of
wall panel in upper floors. One coat as part of waterproofing treatment of bath / toilet room
including 300 mm wall height on all sides. For soil waterproofing, apply Zycosil+ (1 : 200)
@ 3 litre solution per sqm over consolidated soil in basement,

Note: Zycosil solution should be used within 8 hours since mixing. If the solution is not used within
8 hrs, it should be discarded

i) Zycosil+ for external & internal vertical wall, corner joints of outer walls and bath/
toilet or wet areas by injection using special syringe): 7.5 % of above quantity should
be added extra

2) Zycoprime+: 1 litre / 20 sqm area of application with Zycosil+ solution
2a) Zycoprime+ with ZMB solution (application on terrace, bath room floor etc): 1 litre
/122 sqm
2b) Zycoprime+ for external & internal vertical wall corner joints of outer walls and bath
/toilet or wet areas ( by injection using special syringe ): 10 % of above qty to be
added extra

3) ZMB 60: 1 Kg / 1.25 sqm area of application (bath / toilet floor). For RC plinth beams – 200
mm wide & upper floor slabs 150 mm wide for all the walls @ 250 gram / sqm or 1 Kg / 5
sqm, 3 hrs drying time.
4) ZMB Thinner : 1 Litre / 122 sqm area of application

5. Primer : 1 Kg / 22.5 sqm wall / ceiling area for application of primer (1 kg WD P30 to be mixed with 1 kg WD thinner to make 2 kg primer)

6. 1 Litre / 1 Kg primer / 22.5 sqm wall / ceiling area for application of primer (both 1 Litre WD 30 & 1 Litre WD Thinner (2 litres) can cover 45 sqm)

7. Elastobar EB 50:-
   i) For Grout RW : 1 Kg per mix of 4 Kg for sealing small cracks, joints, sealing off/infilling of joints between RC plinth beam and wall (both inside and outside of external walls, bath / toilet walls, vertical wall corner joints, joints between ceiling and wall, joints between door / window frames and wall, over a coat of Zycosil+ solution. Eg: For making 100 kg compound, 25 litres Elastobar EB50 is required (I cft (0.0283 cum) wet Grout RW may weights about 50Kg).

   ii) For Mix RW : 1.5 Kg/mix of 49 kg for coving of lintel- sunshade, encasing / packing

**Items required for waterproofing application: Table for calculating quantities of waterproofing chemicals:**

<table>
<thead>
<tr>
<th>Product</th>
<th>Unit</th>
<th>Coverage</th>
<th>Remarks</th>
</tr>
</thead>
<tbody>
<tr>
<td>Zycosil+</td>
<td>1 Litre</td>
<td>40 sqm</td>
<td>Mixed with water to make Zycosil+ solution</td>
</tr>
<tr>
<td>Zycoprime+ (for mixing &amp; apply with Zycosil+ solution)</td>
<td>1 Litre</td>
<td>20 sqm</td>
<td>Mixed as specified to make ZMB60 solution for wet floor treatment</td>
</tr>
<tr>
<td>ZMB60</td>
<td>1 kg</td>
<td>0.8 – 1 sqm</td>
<td>For treatment of bath / toilet floor &amp; RC plinth beams and upper floor slab for erection of panel @ 200 / 150 mm wide.</td>
</tr>
<tr>
<td>ZMB Nano Thinner</td>
<td>1 Litre</td>
<td>125 sqm</td>
<td>For treatment of roof / toilet floor &amp; RC plinth beams and upper floor slab for erection of panel @ 200 / 150 mm wide.</td>
</tr>
<tr>
<td>Zycoprime+ (for mixing with ZMB Thinner)</td>
<td>1 litre</td>
<td>122 sqm</td>
<td>Mixed as specified to make ZMB60 solution for wet floor treatment</td>
</tr>
<tr>
<td>WD P30</td>
<td>1 kg/litre</td>
<td>Mixed together to make primer</td>
<td>Mixed 1:1 to make primer 2 kg/litre (without water) for external and internal walls &amp; ceiling. Coverage 40sqm per 2kg / litre primer i.e. 20sqm per 1kg / litre primer</td>
</tr>
<tr>
<td>WD Thinner</td>
<td>1 kg/litre</td>
<td>Mixed together to make primer</td>
<td>Mixed 1:1 to make primer 2 kg/litre (without water) for external and internal walls &amp; ceiling. Coverage 40sqm per 2kg / litre primer i.e. 20sqm per 1kg / litre primer</td>
</tr>
<tr>
<td>Elastobar EB50 For Grout RW composition (joints)</td>
<td>1 kg</td>
<td>For mix of 4 kg</td>
<td>To make Grout RW (compound / composition) as specified</td>
</tr>
<tr>
<td>Elastobar EB50 For Mix RW composition (Coving)</td>
<td>1.5 kg</td>
<td>For mix of 49 kg</td>
<td>To make Mix RW as specified. For more flexible composition / compound, increase the dosage of Elastobar EB50 to 2 kg / mix unit</td>
</tr>
<tr>
<td>Elastobar EB50 for making rendering compound / mix</td>
<td>1 kg for 1mm thickness 2 kg for 2mm thickness</td>
<td>1 sq m</td>
<td>To make mix, Elastobar EB50 to be mixed with RCF/FRBL wall plaster or JK/Birla wall putty in 1:10 ratio.</td>
</tr>
</tbody>
</table>
4. Mandatory treatment for the construction joints and areas of GFRG buildings

4.1 Following construction joints and areas shall be treated mandatory:

1) Basement above ground level / plinth to prevent ingress of water / dampness to superstructure

2) Joint between RC plinth beam and GFRG / Rapidwall erected in position

3) External & internal vertical wall joints of outer walls, all the vertical walls of bath / toilets / wet areas / open to sky ducts etc.

4) External & internal vertical joints between wall and windows / ventilators / external doors

5) Joints between outer wall and RC lintel / lintel cum sunshades including

6) 75 mm x 75 mm coving with Mix RW

7) Top surface of embedded RC horizontal tie beams over outer walls, bath/toilets / wet areas / ducts open to sky

8) Joints between intermediary floor slab / roof slab and outer walls including exposed external side of RC slab

9) Bath / toilet floor including 300 mm high vertical walls

10) Joints between roof slab and parapet wall

11) Joint between roof slab and walls of stair case head room / lift well head room

12) Staircase top slab and its parapet wall

13) Encasing / packing of pipe joints of water supply, sanitary, drainage including bell mouth of drainage outlet pipe in terrace, wherever pipes passing through GFRG wall panel / floor or roof slab.

14) Parapet wall and top coping with cement plaster / Mix RW

4.2 Application of Primer:

1) It is mandatory to apply primer with WD P30 mixed with WD thinner (1:1) for external & internal surface & ceiling for applying paint.

2) Rendering / thin layer of plastering (1 - 3 mm or average 2mm thickness @ 2 Kg / sqm ) of external wall using gypsum based Rapid Plaster / JK wall putty / Birla wall putty mixed with Elastobar 1:10 to make it water resistant by trained & skilled PoP plasterers for fine and smooth finish

3) Painting

4) Interior finishing of vertical wall corners / ceiling and wall corners using PoP / Rapid Plas- ter or putty by PoP plasters / painting team after applying primer.
5. Water Proofing Treatment of Glance:

Zycosil solution
Zycosil+, water, Zycoprim+ at (1 : 20 : 2)

Grout RW
(i) in slurry form
(ii) in paste form (to be in white colour, use white cement and if to be in grey colour, use grey cement)

Mix RW
For packing of pipe joint and coving of RC lintel cum sunshade and wall, parapet wall and RC roof slab

ZMB solution
ZMB60 + ZMB Thinner + water + Zycoprim+

Elastobar
To prepare: (i) Grout RW, (ii) Mix RW and (iii) for mixing with wall plaster / Birla or JK wall putty in 1:10, for rendering of external surface to make the water resistant

WD Primer
WD-P30 mixed with WD Thinner (1:1) for external wall, ceiling

Zycoprim solution
Rendering / thin (1-2mm) layer of plastering mixed with Elastobar (10:1)

GFRG / Rapidwall Buildings at a Glance:

List of joints and areas that require water proofing treatment:

1. Top & sides of RC plinth beams before erection of wall panels
2. Horizontal joints between RC plinth beams & external walls and walls of bath / toilet rooms
3. Horizontal joint between floor slab and external walls, bath / toilet walls in all the floors including parapet wall, staircase head room & lift well head room in stair case in terrace floor
4. Lintel cum sunshade of external walls
5. Joints between window frame and walls
6. Vertical wall joints of external walls, bath / toilet walls in all the floors
7. Exposed RC floor / roof slab on all floors including roof slab (external sides)
8. Waterproofing treatment of bath / toilet floor
9. Application of primer (WD P30 mixed in WD thinner at 1:1) to external & internal wall surface and ceiling floor.
Waterproofing of GFRG / Rapidwall buildings

After drying for minimum 2 to 4 hrs Zycosil solution drop test to be done to check whether it is saturated water droplets will not absorb it, or else repeat application of Zycosil solution to get cementitious surface saturated.
6. **Use of alternative products for waterproofing of GFRG building:**

Glass Fiber Reinforced Gypsum (GFRG) / Rapidwall Panel is unlike other cement based building panels. GFRG wall panel surface is smooth and does not require cement plaster. GFRG panel is also water resistant with less than 5% water absorption when immersed in water for 24 Hrs. The surface does not have bonding to receive commonly used paint primer and finishing coat of painting. If paint primer and paint is applied, it will peel off.

GFRG panel requires specially developed suitable primer which will penetrate into the skin of panel and become part of the material itself and create bonding for painting and also enhance the abrasion resistance of the panel. WDP30 mixed with WD Thinner in 1:1 ratio is a special primer for GFRG panel with excellent result on pull out tests, abrasion resistance test and also proven that panel become repellant to water. It is anti fungal and provides freshness to the building forever. So when similar product is developed by other companies and proven through similar tests, it can also be adopted for application.

Similarly, to provide water proofing treatment to various construction joints like RC plinth beams and wall panel joints, vertical wall corner joints like “L”, “T” joints, “+” four way wall joints and horizontal wall joints, joints between intermediary floor slab / roof slab & wall joints, Joints between RC lintel cum sunshade and wall, joints between parapet wall and roof slab etc involve cement concrete / RC and GFRG wall panel. Also joints between piping and wall panel, the sealant or sealant compound has to be effectively bonded / gripped with both the cementitious material and gypsum based GFRG panel and serve as an effective sealant and water proving treatment to prevent ingress of water.

Specially made sealant compounds such as Grout RW & Mix RW made of Elastobar and other materials for the treatment of construction joints in GFRG buildings are found to be effective for GFRG construction joints. When similar product / sealant is developed by other companies and proven to be effective, they may also be adopted for application.

With regard to water proofing over roof / terrace slab, any proven technique can be adopted on top of the RC screed over the GFRG building roof slab.

7. **Pictorial Description of Water Proofing Treatment**

Fig.1 to 30 describes the specific treatment of joints and elements at different stages of construction of GFRG/Rapidwall buildings.
### 7.1 Waterproofing treatment before erection of wall panel

First a coat of Zycosi solution to be applied on top and sides of RC plinth beam (drying time 3-4 hrs). After drying, apply a coat (200mm wide) of ZMB solution, before 3 hrs of erection of wall panel, at the interface.

After wall panel is placed in correct position during erection, seal off joint (both outside and inside) with Grout RW in paste form by pushing using small shovel first.

Later, after construction of structure is completed, seal off with Grout RW in paste form and smooth finish.

The above waterproofing treatment is to be done for all the walls in GF.

For upper floors, this is required only for external walls, both / toilet walls. Also for parapet wall, stair case head room & lift well head room in ten storey floor.

<table>
<thead>
<tr>
<th>ZMB solution</th>
<th>Zycosi solution</th>
</tr>
</thead>
<tbody>
<tr>
<td>After wall panel placed in correct position during erection, seal off joint (both outside and inside) with Grout RW in slurry form by pushing using small shovel first.</td>
<td></td>
</tr>
<tr>
<td>(after construction of structure completed, seal off with Grout RW in paste form and smooth finish).</td>
<td></td>
</tr>
</tbody>
</table>

Zycosi solution

Zycosi+ (1 : 20) mixed with 2 litre Zyroprime+ (1 : 20 : 2)

(Fig - 1)
7.2 Waterproofing treatment after erection of structure

Treatment of vertical wall joints:
- Affix 50mm wide fibre tape to cover complete height of wall joint of each floor. Inject zycosil solution using large syringe from top till joint is filled up and over flowed (also parapet wall vertical joint)
- Seal off / push in grout RW (after removing fibre tape after 3 hrs of injecting zycosil solution and fine finish) & apply primer
- Primer 12 hrs drying under sun rays, provide rendering

Zycosil solution applied on 3 sides of basement footing including RC plinth beams top & sides
Zycosil+ (1 : 20) mixed with 2 litre Zycopgne+ (1 : 20 : 2)

(Fig - 2)
7.3 Waterproofing treatment of 174mm height / wide (6mm deep) groove all around the building, lintel cum sunshade and window sides

- Apply zycofill solution by spraying or brush coat over coping of parapet wall.
- Exposed RC roof slab.

Coping of parapet wall

Parapet wall

- Treatment of all around 174mm height / wide (6mm deep) groove all around the building:
- Exposed RC floor slab on all floors including roof slab after removing side shuttering and cleaning the groove (174mm wide), firstly apply zycofill solution by spraying to saturation (drop test mandatory to check for saturation).
- If water absorb, re-do spraying of zycofill solution till get saturated.
Waterproofing treatment of 174mm height / wide (6mm deep) groove all around the building, lintel cum sunshade and window sides

- Treatment of all around 174mm height / wide (6mm deep) groove all around the building:
  Exposed RC floor slab on all floors including roof slab after removing side shuttering and clearing the groove (174mm wide); firstly apply zycox solution by spraying to saturation (drop test mandatory to check for saturation).
  If water absorb, re-do spraying of zycox solution till get saturated.

- Treatment of RC lintel cum sunshade:
  After the application of zycox solution (~4 hrs drying time), seal off joint between RC lintel cum sunshade and wall on all sides, top and bottom sides with Grout RW.

(Fig - 4)
7.4 Waterproofing of basement footing above GL including RC plinth beam (Fig - 5a & 5b)

Waterproofing of foundation above GL and on top and sides of RC plinth beam, and providing a coat of ZMB solution over RC plinth beam (3 hrs drying) before erection of panel is necessary.

1. Apply Zycosil solution by spray technique, saturating all sides of the foundation, brick walls / concrete block masonry above ground level, RC plinth beam etc. (fig - 5a)

2. Apply ZMB solution (100 Kg ZMB 60 + 20 litre water + 1 litre ZMB Thinner + 1 litre Zycoprine+ = 122 Kg @ 250 gram / sqm or 1 Kg / 4 sqm) over all RC plinth beams, 200 mm wide before 3 hrs of erection of wall panel. (fig - 5b)

3. For erection of wall panels on upper floors, apply first a coat of zycosil solution, over which ZMB solution as described above is to be applied, 150 mm wide for all the walls over floor slabs, including roof slabs for erection of parapet wall (3 hrs drying time).

Note:

In construction site, wherever chances for rising of ground water level is high and the area is prone to or suspected of sulphate or chloride attack due to salinity etc, the waterproofing treatment of foundation below the ground level (GL) is to be done. The foundation below GL is to be treated with Zycosil solution by spraying, to prevent any chance of sulphate, chloride attack on wall above GL due to ingress of water from below.
7.5 Joint between wall panel & RC plinth beam:

After erection of wall panels and at the time of treatment of joints, first pack up the flowable Grout RW into the side joints on both faces between wall panel & RC plinth beam. Ensure that no gap / joint is left unfilled / unpacked on both the faces. Then do finishing by 25 mm x 25 mm coving (if there is offset for plinth) with Grout RW at external and internal side joint of GFRG / Rapidwall and RC plinth beam.

![Diagram of joint between wall panel & RC plinth beam]

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Foundation, basement & plinth beam with starter bars for erection of RW panel, flooring and joint between RW panel & RC plinth beam

Waterproofing treatment for RC raft foundation and basement (including RC plinth beam)

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(Fig - 5b)

(Fig - 6)
Note:
(i) After sealing off with Grout RW provide 12 mm thick cement plaster 1:4 on top, bottom and sides of sunshade & cure for a day
(ii) Apply a coat of zycosil solution to saturation level & allow to dry
(iii) Provide 75 mm x 75 mm coving with Mix RW on top
(iv) Apply primer before rendering

7.6 RCC Lintel cum Sunshade Joint

Firstly spray Zycosil+ solution into the joint
Secondly seal off with Grout RW including 25x25mm coving
Thirdly cement plaster 1:4 on all sides of RC sunshade
Fourthly zycosil solution on top of cement plaster
Fifthly 75x75mm Mix RW coving

Apply primer to wall surface
(WD - P30 mixed with WD thinner 1:1)

After 12 hrs of primer drying render / apply thin layer of plastering (1-2mm thickness) using gypsum based wall plaster or Birla / JK wall putty

Treatement of RCC lintel cum sunshade joint experienced POP plasterers for quality superior finish

(Fig - 7)
Fig. 8 Waterproofing of window / ventilator opening
After drying Grout RW (3-4 hrs) render/thin layer of (1-2mm) wall plaster or Brita/JK wall putty mixed with Elastobac (16:1)

(Fig - 8d)

Infill/ seal off joint with Grout RW (after application of zyrosil 3 & zycoprime + solution) by pushing in to the joint all around the sunshade with 20 mm x 20 mm coving.

(Fig - 8e)

After installation of window/ventilator frame (also external door): Seal off joint between wall and window frame by pushing in with Grout RW in paste form (white)

provide 76x75mm coving between RC lintel and sun shade with Mv RW

(Fig - 8f)

When rendering to the wall surface applied, sealing joint also to be covered with rendering.
7.7 Method of clamping system to pour concrete

"L" wall joint

(Tie / clamp system with suitable angle iron / flat with nuts and bolts to hold panel joints firmly (inserting a pvc pipe inside) to pour concrete. Remove the clamps after initial set of concrete (1-2 hrs))

"T" joint
(external face)

Horizontal joint

(Fig - 9)

"+" Four way wall joint

(Tie / clamp system with suitable angle iron / flat with nuts and bolts to hold panel joints firmly (inserting a pvc pipe inside) to pour concrete. Remove the clamps after initial set of concrete (1-2 hrs))
Various types of wall corner joints

"L" angle wall corner joint

"T" angle joint

Horizontal joint

"T" joint

"T" joint with two open end panel (external face)

(external face)

"T" joint with one open end panel

"+" Four way wall joint

(Fig - 10)
7.8 Waterproofing treatment of vertical wall joints (external walls) (Figs. - 11a, 11b, 12a - 12f)

Infill the cavities of joints with RC / concrete as per requirement.

- Seal the RW joints with fibre tape temporarily.
- Inject diluted zycosil+ (1 : 20) mixed with 2 litre zycoprime+ using 50 ml syringe till the gap and concrete infill would be completely saturated and waterproofed.
- Remove the tape. Seal and finish the joints with Grout RW paste with fine / smooth finish.

(Fig - 11a)

(Fig - 11b)
7.9 Waterproofing of vertical joints of external & internal wall

(Fig - 12a)

(Fig - 12b)
Waterproofing of vertical joints of external & internal wall

(Fig - 12c)

Apply zycosil solution by industrial syringe on external & internal wall joints

25 / 50 mm fibre tape or suitable paper tape pasted temporarily

zycosil solution applied to external & internal vertical wall joints

(Fig - 12d)

external wall

zycosil solution applied to external & internal vertical wall joints

25 / 50 mm fibre tape or suitable paper tape pasted temporarily

external wall
Waterproofing of vertical joints of external & internal wall

After pasting fibre tape for inside wall corner & outside joints, temporarily inject zycoprine \(^{+}\) from the top till saturation (fibre tape to be removed 1 hr after injecting zycopril solution).

(Fig - 12e)

- Fiber tape pasted temporarily is removed after 1 hr
- Infill / seal off vertical waterproofed joint with Grount RW by pushing into the joints (both external & internal joints)
- Apply fine finish for primer application

(Fig - 12f)

After pasting fibre tape for inside wall corner & outside joints, temporarily inject zycopril solution from the top till saturation (fibre tape to be removed 1 hr after injecting zycopril solution).
7.10 Horizontal slab & vertical wall (External face) (Fig - 13a & 13b)

- External face of RC concealed beam and screed at external sides is to be provided with 6 mm groove. This groove is to be treated with zycosil solution by spraying, and then apply a coat of Grout RW.
- Apply ZMB solution [100 Kg ZMB 60 + (1 litre ZMB Thinner + 20 litre water + 1 litre Zycoprime*) = 122 Kg] @ 250 gram / sqm or 1 Kg / 4 sqm over 150 mm of floor slab, 3 hrs before the erection of wall panel.
- After the above treatment, apply Grout RW. After 3 hrs of drying, plaster remaining groove with Elastobar mixed (10:1) wall plaster/ Birla / JK wall putty along with rendering of the external wall surface to get level vertical surface up to GFRG/RW panel for upper floors. The erection of wall panel for upper floor is as given below:
ZMB solution @ 250 gm / sqm (3 hrs drying time)

Zy cosmosil solution

50 mm RC screed

6 mm Ø stirrups

embedded RC concealed beam

MS rods

GFRG / RW floor panel

40 mm bearing

Zy cosmosil + (1 : 20) mixed with 2 litre Zycopride

apply Grout RW

primer

rendering

(Fig - 13b)

Treatment of exposed slab & vertical wall (External face)
7.11 Floor slab concrete outer edge to be with 6mm recess / groove for waterproofing treatment (174 x 6 mm through out external face) (Fig - 14a & 14b)

Type - 1 method of joint (with slab exposed)

- side shuttering using steel sheet or plywood fixed with 6 mm plywood 174 mm high / wide to get 6 mm groove
- 6mm thick plywood to create 6mm groove on concreting of floor/roof slab at external wall side

(Fig - 14a)

- ZMB solution @ 250 gm / sqm (3 hrs drying time)
- firstly Zycosal solution
- secondly, apply Grout RW (2mm thickness) over zycosal solution
- thirdly, infill balance groove with wall putty mixed with elastobart
- fourthly, nano penetrating polymeric WD primer
- fiifthly, rendering to get fine external finish, after applying a coat of WD primer

(Fig - 14b)

- Connection between slab & wall at external side

- Grout RW
- ZMB solution @ 250 gm / sqm (3 hrs drying time)
- Zycosal+ (1 : 20) mixed with 2 litre Zycoprime+
- 50 mm RC screed
- embedded RC concealed beam in floor slab @ 0.75 m c/c
- embedded RC horizontal tie beam 94 x 200 mm below floor slab
- GFRG wall panel for upper floor
- 10 gauge weld mesh a 100 x 100 mm c/c
- special 'C' anchorage (1m long) @ 0.75m c/c between vertical rebars and concealed beam
- 50 mm RC screed
- embedded RC concealed beam in floor slab @ 0.75 m c/c
- 40 mm bearing into wall
- embedded RC horizontal tie beam 94 x 200 mm below floor slab
- GFRG wall panel
7.12 Connection between slab & wall at external side (Fig- 15a &15b)

Type - 2 method of joint (with slab unexposed)

- Grout RW
- ZMB solution @ 250 gm / sqm (3 hrs drying time)
- Zycosil+ (1 : 20) mixed with 2 litre Zycoprimex
- 50 mm RC screed
- embedded RC concealed beam in floor slab @ 0.75 m c/c
- inner flange of external wall panel cut and removed 174mm
- embedded RC horizontal tie beam 94 x 200 mm below floor slab
- GFRG wall panel for upper floor
- 10 gauge weld mesh at 100 x 100 mm c/c
- special 'C' anchorage (1m long) @ 0.75m c/c between vertical rebars and concealed beam
- 50 mm RC screed
- embedded RC concealed beam in floor slab @ 0.75 m c/c
- 40 mm bearing into wall
- embedded RC horizontal tie beam 94 x 200 mm below floor slab
- GFRG wall panel
- vertical rebar

(Fig - 15a)

(Fig - 15b)

nano penetrating polymeric WD primer
rendering to get fine external finish, after applying a coat of WD primer
7.13 Erection of Wall panel for upper floors (Fig - 16)

- Apply diluted Zycosil+ (1 : 20) mixed with 2 litre Zycoprime+ on top side of RC screed above the horizontal tie-beam. Apply the solution by spray in an area, 250 mm wide throughout the length of external walls, and walls of bath or toilet or wet areas.

- Apply ZMB 60 mixed with ZMB Thinner solution [100 Kg ZMB 60 + (1 litre ZMB Thinner + 20 litre water + 1 litre Zycoprime+)] = 122 Kg] @ 250 gram / sqm or 1 Kg / 4 sqm, 150 mm of floor slab, 3 hrs before erection of wall panel.

- For external wall horizontal joints between wall panel and floor slab on both sides have to be packed with Grout RW into the joint (slurry or paste form as per requirement) without leaving any gap and ensuring smooth finish.

- For all upper floors, before the erection of wall panels for external wall / bath room, toilets, wet areas the above process is to be repeated.

- This is most critical area for waterproofing.

**Erection of Wall panel for upper floors:**

*Note: If thin layer of rendering to be done, it has to be done after applying primer.*
7.14 Fill-in of empty cavities with treated soil & capping of Parapet top (Fig - 17)

- Empty cavities of parapet RW wall can be in filled with locally available soil and treat 100 mm top compacted soil to be treated with diluted Zycosil+ (1 : 200) solution.
- Fill top 25mm to 50 mm thickness with Mix RW with proper slope and smooth out top surface with cement. (for parapet wall)
- Apply diluted Zycosil+ (1 : 20) mixed with 2 litre Zycoprime+ by spray on the top finished layer.
- Apply Grout RW at the horizontal and vertical joint.
- Do coping with Mix RW and cure it.
- Apply diluted Zycosil+ (1 : 20) mixed with 2 litre Zycoprime+ by spray on top covered / capped portion.
After 3 to 4 hrs Zycosil+ solution, drop test to be done to check whether the solution got saturated (water drop stays still if saturated) if water gets absorbed, repeat the application of zycosil solution to get the cementitious surface saturated.

Waterproofing treatment of roof slab/terrace by any proven technique can be adopted on top of RC screed over the GFRG building roof slab.

Note: In the case of terrace slab with slope when drop test done, if water gets absorbed that area is to be bonded with cement-sand mortar and apply zycosil solution by spraying/flooding (impounding) into 5mm to 10mm depth.

(Fig - 18)
7.15 Gradient / slope of GFRG - RC roof slab

Waterproofing treatment of roof slab / terrace by any proven technique can be adopted on top of RC screed over the GFRG building roof slab.

Zyconsil+ (1 : 20) mixed with 2 litre Zycoprime+ to get fine external finish, after applying a coat of special primer (WD-P30 primer mixed with WD thinner 1:1) a thin layer of J.K wall putty / Birla wall putty can be rendered (very thin layer of plastering) by PoP plasterer (mason)

Note:
Height difference of external & internal wall (external & external walls) minimum 75mm for gradient / slope for easy flow of rain water in roof slab. Hence top most floor wall panel cutting drawing to be prepared accordingly.

So the architectural / building design / planning has to be taken care of it. this has to be indicated in the sectional plan

(Fig - 19)
Waterproofing treatment of roof slab / terrace by any proven technique can be adopted on top of RC screed over the GFRG building roof slab.

Firstly, Zycosil+ (1 : 20) mixed with 2 litre Zycoprim+ solution applied

Secondly, apply Grout RW (2mm thickness) over zycosil solution

Thirdly, infill balance groove with wall putty mixed with elastobar

Fourthly, nano penetrating polymeric primer WD-P30 & WD Thinner 1:1 including wall panel external surface

Fifthly, to get fine external finish, after applying a coat of special primer (WD-P30 primer mixed with WD thinner (1:1) a thin layer of J.K wall putty / Birla wall putty can be rendered (very thin layer of plastering) by PoP plasterer (mason)

Roof terrace slab without parapet wall

(Fig - 20)

Waterproofing treatment of roof slab / terrace by any proven technique can be adopted on top of RC screed over the GFRG building roof slab.

Grout RW

Nano penetrating polymeric primer for external & internal surface WD-P30 (1 kg WD-P30 + 1 kg WD Thinner)

Roof terrace slab without parapet wall

(Fig - 21)
7.16 Infilling of empty cavities of wall panel with dry soil mixed with weedicide. It can also be infilled with quarry dust / dry sand up to window height or full height cavity filling and waterproofing (Fig. 22)

- Unfilled cavity of wall panel can be infilled with locally available soil to 2.10 m high / window or door height or full wall height as per requirement and allow to dry. Soil will provide more thermal cooling.
- Apply diluted Zycosil+ (1 : 200) @ 3 L/m² (15 cavities per litre) and do complete drying.
- Lay 50 mm thick concrete on treated soil
- Apply diluted Zycosil+ (1 : 20) mixed with 2 litre Zycoprime+ by spray on concrete top surface

Infilled with locally available crushed earth / soil mixed with weedicide (as per manufacturer’s instruction)

OR

quarry dust & 5% cement mix dry & infill as per instruction in different stages and pour just enough water to make it damp enough to become cake form

(Fig - 22)

For single storey low cost housing
7.17 Flooring bath room / toilet / wet area (Fig - 23a, 23b, 24a, 24b, 25a, 25b & 26)

For cement flooring and wall surface: (for sunken floor / same floor level bath or toilet)

- Apply diluted Zycosil+ (1:20) mixed with 2 litre Zycoprim+ flooded way by spray technique on cement floor and vertical walls by roller brush and allow to dry. Check the waterproofing by drop of water.

- Brush apply diluted ZMB 60 mixed with ZMB Thinner solution (0.4 litre per sq m) as per given in table

<table>
<thead>
<tr>
<th>Coat</th>
<th>Mixing ratio</th>
<th>Dosage</th>
<th>Drying time</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>ZMB 60 in ml</td>
<td>ZMB thinner solution (1:20:1) in ml</td>
<td></td>
</tr>
<tr>
<td>1st Coat</td>
<td>100</td>
<td>22</td>
<td>200</td>
</tr>
<tr>
<td>2nd Coat</td>
<td>100</td>
<td>22</td>
<td>200</td>
</tr>
</tbody>
</table>

- Spray sand (30 mesh) above for tack free bitumen surface and roll it using hand rollers.

- Spray Zycoprim+ (1:10) 0.2 - 0.25 litre per sq m on the sanded waterproofed membrane for superior bonding to plaster or cement screed.

- Apply Grout RW on edges where RW is cut for water outlet piping work etc.

- After laying piping / sanitary pipes, WC etc in position fill up (for Sunken floor) with brick jelly, sand and lime mix to required thickness and gradient / slope to outlet. Outlet pipe through the wall like other pipes packed / encased with Mix RW.

- Provide cement mortar (1:3) plastering 12 mm - 15 mm thickness over lime mix, for laying suitable bath / toilet floor tiling.

- Floor tile joints to be applied with diluted Zycosil+ (1:20) mixed with 2 litre Zycoprim+ solution and when dried tile joints are sealed off with Grout RW.
Zycosil+ (1 : 20) mixed with 2 litre Zycoprim+  

ZMB 60 mixed with ZMB Thinner solution  
Fine sand 30 mesh  
Zycoprim+ (1:10) tile additives for tiling* 
glazed tile for vertical wall  
Grout RW  

Flooring tiles over base plaster (1 : 3)  
special tile additives for glazed wall tiling*  

Grout RW  
Pipe joint encased / packed with Mix RW  

ZMB solution  
GFRG / RW panel  
Pipe all around th Gap with Mix RW and dc final smooth finishing with Mix RW.  

Zycosil solution  
Grout RW  
Storm water drain pipe  
RC tie beam  
375x124mm  
Wooder plug  

Clamped to the wall properly  

After drying for minimum 3 to 4 hrs zycosil solution drop test to be done to check whether saturated (water drop stay still if saturated)  
If water get absorbed repeat application of zycosil solution to get cementitious surface saturated  

Sunken floor for toilet / bathroom  
with 200mm level difference  
(Fig - 23a)  

Then, the gap around services is to be sealed off by pushing Grout RW for inside & outside and fine finished before applying primer  

First, the gap between the cut openings around pipe/services and wall is to be encased / packed with Mix RW  

(Fig - 23b)  

Note:  
For laying floor tiles of bath / toilet cement , sand mortar 1:3 mix with 10-12mm thickness to be used, so that bath / toilet finished floor level to be 12-15mm lesser than the adjuvant room / hall floor level.  
For floor tiling of adjuvant room / hall cement mortar 1:5 mix 20-25mm thickness to be provided  

* For fixing wall tiles, special additives (like, Ardex Endura's dimond star white adhesive) have to be used, for effective bonding of tiles to GFRG/Rapidwall panels  

Waterproofing of piping
Note - 1:

RC screed concreting of toilet / bath room floor area to be 20 mm lower than the adjoining floor level with slope 1 in 10 outward to outlet pipe.

* For fixing wall tiles, special adectives (like, Ardex Endura's dimond star white adhesive) have to be used, for effective bonding of tiles to GFRG/Rapid-wall panels.
Note:

For laying floor tiles of bath / toilet cement, sand mortar 1:3 mix with 10-12mm thickness to be used, so that bath / toilet finished floor level to be 12-15mm lesser than the adjacent room / hall floor level.

For floor tiling of adjacent room / hall cement mortar 1:5 mix 20-25mm thickness to be provided.

* For fixing wall tiles, special additives (like, Ardex Endura’s diamond star white adhesive) have to be used, for effective bonding of tiles to GFRG/Rapidwall panels.
Intermediary floor slab / roof slab in RC

Waterproofing treatment to Lift well / stair well with RC beam to adjust the height difference

Waterproofing treatment of walling and RC concrete floor slab (Internal & external walls)
(Fig - 28)

GFRG/ Rapid wall building Applying primer for external surface

Whenever wall panel is cut for providing Window AC, proper water proofing treatment is to be provided all around the AC frame to prevent ingress of water.

Patch work:
For patch work, use grout RW to fill up / plaster / repair damage or dent caused during erection or handling of panel, to level or smoothen the GFRG / Rapidwall surface. For external side, wall putty / wall plaster mixed in the ratio 10:1 (10kg putty / wall plaster and 1 part elastobar) is to be used for thin layer of plastering.
7.18 Cost effective waterproofing solution for GFRG/Rapidwall houses with sloped roof for Urban & Rural poor / Low income groups at affordable cost

**SECTIONAL VIEW**
(Fig - 29)

- Apply a coat of zycosil solution (1 : 20 : 2)
- ZMB mixed with ZMB Thinner solution
- 12mm cement plaster over a coat of Grout RW
- ZMB 60 mixed with ZMB Thinner solution
- Grout RW
- Cement plaster 1:4 with water proofing
- Contracted earth fill
- RR masonry / concrete block - 450 x 450 mm
- 75mm PCC 1:5:10
- 76mm PCC 1:5:10
- 0.60
- 0.60
- 2.74
- 2.85
- 2.40
- maximum 4.6 m span

- 12mm cement plastered edges all around
- GFRG / RW roof panel applied with coat of Grout RW in slurry form, over which 12mm cement plaster with Chicken mesh is applied
- Nano penetrating polymeric primer for external & internal surface
- WD-P30 (1 kg
- WD-P30 + 1 kg
- WD Thinner)

**FRONT ELEVATION**
(Fig - 30)
Notes:

1. Skilled workers experienced in water proofing treatment can carry out the same in GFRG / Rapidwall buildings, under the guidance and supervision of site construction Civil Engineer & Civil Engineering construction supervisors. One or two experienced skilled workers on the above teamed up with GFRG / Rapidwall construction crew, will be the best to carry out concurrent treatment at the time of erection of panels and infill of concrete. Application of primer and finishing paint is to be done strictly after carrying out filling up and sealing of all joints etc as part of waterproofing treatment.

2. Finishing coat of paints on Rapidwall buildings

Painting over special primer (WD-P30 - External Primer)

1. Emulsion paint (external / internal)
2. Acrylic paint (external / internal)
3. Cement paint - water based (external)
4. Distemper (internal)
Details of waterproofing treatment for different locations

ZMB 60 mixed with ZMB Thinner solution @ 250 gm / sq m (3 hrs drying time)

Firstly spraying of zycosal solution
Secondly apply thick coat of Grout RW in paste form
Thirdly WD-P30 mixed with WD Thinner (1:1)
Fourthly rendering

6mm groove
primer WD-P30 mixed with WD Thinner (1:1) for ceiling.
rendering if required for 'B' side

Fig. A1 Details of treatment of 6mm groove all around building at floor slab level
Details of treatment of band all around
(if architectural design envisage projection/ band at every floor or roof level)

Firstly primer WD-P30 mixed with WD Thinner (1:1).
Secondly rendering
Before erection of wall panel on upper floors, apply a coat of zycosil+ solution and then ZMB60 solution
Grout RW

Firstly spraying of zycosil solution
Secondly apply thick coat of Grout RW in paste form
Thirdly rendering

primer WD-P30 mixed with WD Thinner (1:1) for ceiling.
rendering if required for 'B' side

Fig. A2 Treatment at floor slab level
All the pipe joints to be properly packed with Mix RW and sealed off with Grout RW to prevent ingress of water / leakages.

All the horizontal joints between RC plinth beam and wall, intermediary floor slab and roof slab & parapet wall, vertical wall joints, RC lintel cum sunshade etc., to be treated and sealed off. Sunshade pipe joints to be properly packed on all around the joint with Mix RW and sealed off properly.

All the pipe joint inside the wall cavities and embedded in concrete to be properly packed with Mix RW and sealed off with Grout RW to prevent ingress of water / leakages.

GI water supply pipe line taken through the cavities of panel to be fixed properly to the panel with wooden plug properly fixed on every floor wall to take care of water hammering.

After construction of structure completed, seal off with Grout RW in paste form and smooth finish.

Fig. A3 Waterproofing treatment of pipe joints
Waterproofing treatment of parapet wall & terrace slab

(Fig - A4a)

(Fig - A4b)

![Diagram showing waterproofing treatment of parapet wall & terrace slab]

**Fig. A4 Treatment at terrace floor**
Waterproofing treatment of parapet wall & terrace slab

application of zycosil solution over parapet wall coping

parapet wall  sealing of joint with Grout RW

sealing off joint before parapet wall and roof slab by pushing in Grout RW in slurry form first and later sealing off with coving using Grout RW 25x25mm in paste form all around

(Fig - A4c)

application of primer WD-P30 mixed with WD Thinner 1:1 inside of panel

Terrace to be treated with approved type waterproofing treatment after seal off joint with Grout RW

(Fig - A4d)

Fig. A4 Treatment of parapet wall and terrace slab
Waterproofing treatment of terrace slab

Waterproofing treatment of roof slab / terrace by any proven and approved technique to be adopted for waterproofing treatment of terrace slab

(Fig - A4e)

Rendering / thin layer (1-2mm) plastering of inner surface of parapet wall for superior finish

coving 150x150 Mix RW all around the parapet wall / lift well head room wall and staircase head room after completing terrace slab waterproofing treatment

Waterproofing treatment of roof slab / terrace by any proven and approved technique to be adopted for waterproofing treatment of terrace slab

(Fig - A4f)

*Fig.A4 Treatment at terrace floor*
External wall surface:
After all horizontal, vertical joints, and grooves / band, sunshades, window frames, pipe, parapet wall joints treatment etc. completed, apply WD primer.

Internal wall surface:
Same way after completion of treatment of internal vertical wall joints of external wall, bath / toilet wall joints WD primer and also for ceiling.

Fig. A5 Application (spraying) of primer
After drying of primer 12-24 hrs (12 hrs under sun rays) External wall surface complete (including groove band all around) to be rendered with thin layer of plastering (1-2mm thickness) using gypsum based wall plaster or Brite JK wall putty mixed with Elastoser (10:1) by trained and experienced POP plasterers for quality superior finish before painting.

Fig. A6 Rendering / thin layer (1-2mm) plastering of external surface for superior finish
After 3 to 4 hrs zycosil+ solution, drop test to be done to check whether the solution got saturated (water drop stays still if saturated). If water gets absorbed, repeat the application of zycosil solution to get the cementitious surface saturated.

**Fig. A7 Treatment of footing**

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**Note:**

In construction site, wherever chances for rising of ground water level is high and the area is prone to or suspected of sulphate or chloride attack due to salinity etc, the waterproofing treatment of foundation below the ground level (GL) is to be done. The foundation below GL is to be treated with Zycosil solution by spraying, to prevent any chance of sulphate, chloride attack on wall above GL due to ingress of water from below.
For internal walls:

(i) sealing of inside vertical wall corner joints of external walls zycosil solution to be injected after fixing 50mm fibre tapes. Remove tape after 3-4 hrs

(ii) Seal of above joints with Grout RW in paste form (white) and smooth finish

(iii) Same treatment for vertical wall corner joints of bath / toilet / wet area

(iv) For other internal walls, vertical wall corner joints to be smooth finished with Gypsum based wall plaster or Birla / JK wall putty mixed with Elastobar (10:1)

(v) If any joints of ceiling to be smooth finished as given in (iv)

(vi) on completion of above items apply, WD-P30 mixed with WD Thinner (1:1)

For superior finish of internal walls:

(a) ‘A’ side will be smooth, however if any dent etc. require rendering with thin layer plastering using wall plaster / Birla or JK wall putty

(b) ‘B’ rough side for quality or superior finish rendering (thin layer plastering) 1-2mm
ANNEXURE - II

Waterproofing of GFRG / Rapidwall Structures (including foundation) - Items of work specification:

1. Application of Zycosil+ Solution (1 litre of Zycosil+ & 20 litres of water stirred first & 2 litre of Zycoprine+ added to it and stirred (total 23 litres)) by spraying using suitable sprayer. 23 litres of solution will cover 40 Esq. to saturation (by testing as per RILEM) with 12 – 24 hrs drying time by trained applicator / skilled person who has the experience in mixing or preparation of waterproofing chemicals / products and waterproofing treatment of GFRG / Rapidwall buildings.
   (i) Over foundation masonry footing top at ground level (GL)
   (ii) Over basement footing above GL (before casting of RC plinth beam)
   (iii) Internal and external vertical sides of foundation & basement footing over cement plastered surface
   (iv) Top (200 mm wide) and 2 sides of network of RC plinth beams in GF. In the case of upper floors, 150 mm wide over floor slab on all floors and roof slab of external walls, toilet / bathroom / wet areas (before erection of wall panel / parapet walls)
   (v) All sides of door opening, vertical sides of window and ventilator opening in all floors
   (vi) Apply a coat of Zycosil+ & Zycoprine+ solution on top and sides of RC sunshade (after cement plastering of the surface including coving).
   (vii) Apply a coat of Zycosil+ & Zycoprine+ solution over embedded horizontal RC tie beam on all external sides and bath / toilet / wet areas (Rate Rs..... per sqm).

2. Application of ZMB 60 solution (100 Kg ZMB 60, 1 litre ZMB Nano Thinner, 20 litres of water & 1 litre of Zycoprive+ = 122 litres / Kg) over already applied coat of Zycosil+ & Zycoprine+ solution on the top of all the RC plinth beams (200 mm wide) by brush / spray coat (brush stroke horizontal and across - 3 hrs drying time) before erection of GFRG / Rapidwall over RC plinth beams in GF. In the case of all upper floors including, repeat on 150 mm wide on floor slab for all the external walls, bath / toilet / wet areas (3 hrs drying time) before erection of wall panel. (Rate Rs..... per R.M)

3. In-filling / sealing of joints with Grout RW sealant, between the RC plinth beam / floor slab and the wall panel on outer and inner sides of external walls (including parapet wall / staircase head room walls), and also at the toilet / bathroom / wet areas on all floor slabs, after the erection of GFRG panel. The sealant Grout RW compound in paste form has to be pushed using suitable tool like thin hand shovel to fill up the voids / gap / joint before the infill of concrete in the panel cavities. (Rate Rs..... per R.M)

4. Do- vertical joints (of external side and internal side) between door frame, window & ventilator frames (on all four sides) of outer walls over the Zycosil+ & Zycoprine+ solution, already applied (before the installation of door / window / ventilator frames in position). (Rate Rs..... per R.M)

5. In-filling / sealing of joint between RC lintel cum sunshade and wall (on external side) in all floors by pushing in Grout RW in paste form and coving 20 mm x 20 mm after applying a coat of Zycosil+ & Zycoprine+ solution before cement plastering of top, bottom and sides of RC sunshade. (Rate Rs..... per R.M)
6. Waterproofing treatment of bath / toilet / wet areas: After cleaning up the floor area and removing all dirt, flood diluted Zycosil+ solution (1:20) mixed with 1 litre of Zycoprime+ over the entire area. Apply two coats of ZMB 60 solution (as per GRFG waterproofing manual) up to 150 mm height all around the walls. Sprinkle meshed sand over the above coating, then spray 0.2 – 0.25 litre per sqm. of Zycoprime+ (1:10) on the sanded waterproofed membrane for superior bonding to plaster or cement screed. Apply Grout RW on the edges where the panel is cut for water outlet, piping work etc. All the pipe joints have to be encased with Mix RW. After laying of piping / sanitary pipes, WC etc in position, fill up (for sunken floor) with brick jelly, sand and lime mix to required thickness and gradient/ slope to outlet. Provide cement mortar (1:3) plastering, 12-15 mm thick over lime mix, for laying suitable bath / toilet floor tiling. Floor tile joints are to be applied with Zycosil+ & Zycoprime+ solution and when dried, tile joints are to be sealed off with Grout RW. (Rate Rs.... per sqm)

7. Treatment of external wall and floor slab joints: As illustrated in the GFRG water proofing manual, 6 mm grove is to be provided through side shuttering work when floor slab or roof slab is concreted. This 174 mm wide, 6 mm grove is for providing water proofing and smooth finish by rendering. Apply first Zycosil+ & Zycoprime+ solution after cleaning the exposed 174 mm wide portion of exterior side of floor slab and apply a coat of Mix RW or Grout RW sealant compound in paste form to 2 to 3 mm thickness. When rendering / applying thin layer of plaster of 1 to 2 mm thickness on external wall, with JK Wall Putty / Birla Wall putty / Wall Plaster mixed with Elastobar in 1 : 10 ratio to give smooth fine even finish, this 174 mm wide grove all around the external wall surface is also to be plastered. (Rate Rs......per R.M)

8. Application of Zycosil+ (1 litre : 20 Litres of water) &2 litre Zycoprime+ solution at inner and outer wall corner joints of external walls by temporarily pasting (to be removed 3 hrs after application) 50mm fiber tape for full height of internal wall joints and 25 mm tape for outer / external joints to full height, from RC plinth beam to bottom of horizontal RC embedded beam (before casting of embedded beam) by injecting from top using a special syringe as per the instructions. Complete work in GF and all upper floor wall corner joints (inner & outer wall corner joints of external walls). (Rate Rs...... per R.M)

9. Water proofing / encasing / packing around the pipes (bath, toilet, water supply, rain water pipes from terrace etc): The pipes are usually laid through walls by cut opening of wall panels. The gap between the pipes and wall panels has to be sealed off with Mix RW compound made at site using Elastobar EB50 and other materials as specified in the manual. Then, apply Grout RW on inner and outer surface of external walls to get fine finish. (Rate Rs..... per R.M)

10. Application of Nano penetrating polymeric primer (before rendering / thin plastering of internal & external walls, including wall corners, joints between ceiling & walls, wherever fine finish is required) using WDP30 & WD Thinner (1:1, no water to be added), suitable for GFRG / Rapidwall for external and internal walls and ceiling (under side of floor / roof slab) including parapet wall surfaces, before applying finishing coat of paint. (Rate Rs.... per sqm)

11. Rendering / plastering with a thin layer (1 to 2 mm thickness) of Birla wall putty / JK wall putty / Rapid Wall Plaster mixed with Elastobar in 1:10 ratio (rendering compound/mix), on external wall surface to give a fine smooth finish. Rendering to be carried out (whether external / internal wall) only after applying primer coat with WD P30 mixed WD P thinner (1:1). (Rate Rs.... per sqm)
About BMTPC

The Building Materials & Technology Promotion Council (BMTPC) under the aegis of the Ministry of Housing & Urban Poverty Alleviation strives to propagate cost effective, energy efficient, eco-friendly and disaster resistant construction technologies for field level applications. Over the years, BMTPC has successfully transferred many alternate building materials & construction systems, developed standards & specifications and brought out meaningful publications, brochures, guidelines for better advocacy and outreach. However, in the recent years in the backdrop of acute housing shortage, it has been realised that potential emerging technologies for social mass housing is the need of the hour and therefore, BMTPC is making concerted efforts so as to identify, study and propagate new technologies. In the process, BMTPC has successfully identified number of technologies and the same are being studied for implementation in Indian conditions through Performance Appraisal Certification Scheme (PACS) being operated by BMTPC. These emerging technologies are being studied so as to bring speed, quality, economy and safety against natural hazards over the conventional way of construction. With fast depleting natural resources; need for environment protection to protect greenhouse effect; need for bringing more speed, durability and quality in construction; it is prudent to bring alternate technologies from within and outside the country.

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