MANUAL ON WATERPROOFING OF GFRG /RAPIDWALL BUILDINGS

Second Edition

September 2018

Structural Engineering Division
Department of Civil Engineering
IIT Madras

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

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Prepared by

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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

The support of Rapid Building Systems Pty Ltd Australia, RBS India Pvt Ltd, Rashtriya Chemicals and Fertilizers (RCF) Mumbai, FACT-RCF Building Products Ltd (FRBL) Cochin – Govt of India Public undertaking, Zydex Industries, is gratefully acknowledged.

Rs. 200/-

FOREWORD

Glass Fibre Reinforced Gypsum (GFRG) Panel Building 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 this 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 building system, it is essential that suitable manuals may be developed which will help the construction agencies to make use of the technology. In the process, BMTPC has published Design manual & Construction manual for GFRG panel system prepared by IIT Madras. Recently, CPWD has also included the GFRG panel system in its DSR 2016 through Correction Slip No. 13 vide DG/DSR/25 dated 13.8.2018 as items no. from 26.51 to 26.61 of Sub Head 26 (New Technologies & Materials). Also, Ministry of Housing & Urban Affairs has issued an OM dated 20.03.2018 instructing use of GFRG panel building system as one of the technologies in the projects by CPWD, DDA & NBCC.

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. BMTPC published first edition of water proofing manual earlier which was prepared by IIT Madras, however, a need was felt to update the publication with more alternative waterproofing solutions. Accordingly, IIT Madras prepared this latest publication which is being published by BMTPC and can be readily used by construction agencies while implementing the technology in the field.

The water proofing solution provided in the earlier publication was based on indigenously produced nano technology by Zydex Industries which is tailor mode 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. Further, the polyurethane water proofing products developed by Alchimica are found to be suitable for waterproofing and added in this edition. 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. Devdas Menon of IIT Madras who has been putting R&D efforts to make the GFRG panel system as viable alternate system for housing.

Dr. Shailesh Kr.Agrawal
Executive Director
BMTPC

REVISION

An acrylic co-polymer waterproofing product developed by Zydex industries was found to be effective for use as damp proof course in GFRG building construction. This product is also suitable for use for the waterproofing of wet areas, and as special additives / adhesive for fixing glazed tiles on GFRG walls. A ready-to-apply acrylic joint sealant was also developed by Zydex for sealing the joints encountered in GFRG buildings. Furthermore, the polyurethane waterproofing products developed by Alchimica are also found to be suitable for waterproofing of GFRG buildings, including waterproofing of the terrace. These products were tested at IIT Madras and are found to be compatible with both GFRG and concrete. In this regard, the manual of 'Waterproofing of GFRG / Rapidwall Buildings' was revised to incorporate the additions and to make the waterproofing foolproof and effective.

PREFACE

Water-proofing is important in buildings in order to prevent ingress of moisture, causing possible dampness, discolouration 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.

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Waterproofing Solution for GFRG / Rapidwall Buildings

1. Introduction

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

GFRG / Rapidwall building, with large building panels for walls and floor / roof slabs in combination with RC, requires waterproofing treatment to be carried out at the time of erection of panels and prior to pouring of concrete, as part of construction. As done in conventional construction certain treatment are to be done post- constrction of structure as part of final finishing of building.

This booklet lists products and their application procedures for waterproofing of buildings, constructed using 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 rovings and special additives. The main raw material is hemi-hydrate Gypsum Beta Plaster ($CaSO_4$.½ H_2O) produced by reprocessing of industrial by-product gypsum (available in India) The panel is manufactured to a 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. Detail regarding the (structural design and construction) use of GFRG panels in building conctruction are given in the GFRG/Rapidwall structural design manual and GFRG/Rapid wall construction manual.

To enhance surface hardness and water repellent quality, the panels require special primer that will impregnate or penetrate into its outer surface. 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 nano-technology based polymer products to address various issues related to water proofing enable long term protectio against severe weather conditions viz. rain and also prevent material deterioration (including corrosion of reinforcement) in coastal regions.

1.1 Waterproofing Solutions for GFRG / Rapidwall Buildings in India

Although waterproofing agents are incorporated in the manufacturing process and water absorption tests conducted on GFRG / Rapidwall panels have revealed that the panels absorb less than 2% of water after 24 hours immersion in water, 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 the surface hardness and water repellent quality, the panel requires special primer to be applied on the exposed wall surfaces. This will also act as a base primer coat, enhancing the bonding properties, for finishing coat using water or oil based paints, acrylic paints, distemper or cement paints. If the mandatory primer is not applied to the panels (on both the sides) the painting will peel-off and will affet the durability of GFRG buildning.

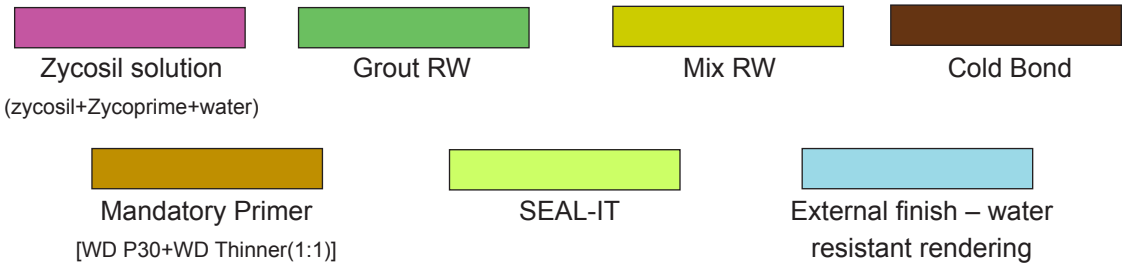
Water proofing treatment of both Zydex based products and Alchimica based products are detailed here under.

1.2 Water Proofing Treatment using Zydex products:

S.No.	Product	Description	Features / Benefits	Application Areas
1	ZYCOSIL Penetrative Waterproofing	Colour: Pale yellow Form: Liquid Density (g/ml) (at 25 °C): 0.91+/- 0.02, Water soluble, forming water clear solution.	Zycosil+ nanotechnology is chemically reactive, water soluble, breathable UV and heat stable. It penetrates upto 2 mm in concrete pores / cementitious surfaces and forms Si-O-Si Siloxane bond by Nano siliconization of surfaces.	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 as base coat of damp proof course.
2	Zycoprime Acrylic Bonding Agent	Colour: Milky Density:1.03+/- 0.02	Zycoprime is acrylic co-polymer emulsion for bonding of cement mix to Zycosil+ / ZMB60 surfaces. It gives excellent bonding of reinforced membrane to screed plaster.	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 as base coat of damp proof course.
3	**COLD BOND** (i) As adhesive/ additives (without adding water for glazed wall tiles fixing)	Acrylic co-polymer nano-technology product liquid translucent or colourless. Water resistant string bonding with flexible polymeric membrane.	Very superior water proofing product compatible for concrete and GFRG/Rapidwall panel. Sticking strongly with old concrete or with new concrete/any cementitious surfaces.	For fixing glazed tile/marble/ granite slab on vertical wall in bath/toilet or in living hall etc.(without adding water) Apply as damp proof course (adding water at 1:1) on RC plinth beams or floor or roof slab or in wet areas as per instructions.
	(ii) As damp proof course Coldbond (at 1:1 mixed with water)	Flash point: 95 degree celcius	Easy dispersible in water. Self-life of product is 48 months. Self mixing with water at 1:1 ratio by applying cold bond by using spray / brush	It can be used as part of damp proof course waterproofing treatment of bath or toilet rooms or wet areas as per the details of the process of water proofing treatment

S.No.	Product	Description	Features / Benefits	Application Areas
4.	Elastobar™ EB50 - Barrier for Microcracks & Cracks **EB 50** To prepare (i)RW Grout (ii)Mix RW (iii)Patching compound (iv)Water resistant rendering compound / mix as given in the formulation table	Colour : Milk Form: Liquid Density:1.06+/- 0.02	In the original waterproofing solution, this product was named WD 60. 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 preparing water resistant patching / Rendering compound or mix.	Elastobar EB50 product can be used to make suitable filling / sealant compound. Grout RW is for sealing cracks / small joints. 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. Patching compound is for patch up dent or repairing work Rendering compound is for rendering external or internal wall/ ceiling
5.	**WD P30** (For preparing mandatory primer by mixing with WD thinner at 1:1)	Colour : Translucent Form: Liquid Density: 1.01	Nano penetrating polymeric primer for improved abrasion resistance and improved bonding to GFRG / Rapidwall panel Over this special primer, all types of paint can be applied.	WD P30 is primer specially developed to apply on external and internal GFRG / RW surfaces and ceiling by mixing with WD thinner. A coat of this primer is to be applied before painting.
6.	**WD Thinner** (WD P30 and WD thinner to be mixed at 1:1 ratio to make primer)	Colour : Transparent Form: Liquid	(WD P30 is to be mixed with WD Thinner at ratio 1:1 to make special primer to penetrate into the panel surface without adding water)	Primer will penetrate into the skin (flange) of GFRG / Rapidwall panel by 0.3 to 0.4mm and will become part of the material itself. Primer also provides bonding to paints.
7	**'SEAL IT'** **(Joint sealant)**	Acrylic joint sealant: Colour: Transcelucent colourless Specific gravity: 1.6 to 1.7 Solid content: 87±1% Packing:600g and 1.2 kg Self life : 1 year	18 rmt per pack of 1.2kg (9m / 600 gram pack) for 5mm wide gap with 10mm deep. ie, 15Rm / Kg SEAL-IT	**Drying time**: Touch dry: 4-6 hours Complete drying: 7 days Apply with a spatula/ hand wearing rubber gloves, push it hard into the joint gap/cracks as deep as possible.

1.3 Formulation for Preparation / mixing of compounds: (Colour code)



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.

S. No.	Material	Description / Mixing Preparation	Coverage (Approximate)	Drying time under sun light
1	**Zycosil solution: [**Zycosil+water(1:20)]+ Zycoprime 2ltr mixed in this ratio used as water proofing compound.	Zycosil+ = 1 Ltr Water = 20 Ltrs Zycoprime+ = 2 Ltrs **Total = 23 Ltrs**	30-40m^2/ 23 litre of zycosil solution	12 – 24 hrs
2(i)	**Grout RW** (to be used for filling gaps, joints and patch work) **Paste form in white colour** **In slurry form**	(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** When required in slurry or grout form, add 0.1 to 0.5Ltr of water as per requirement to the above formulation	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)	2 times water spray in an interval of 24 hrs
2(ii) 2(iii) 2(iv)	**Grout RW** (to be used for filling gaps, joints and patch work) **Paste form in grey colour** **In slurry form**	(ii) **Formulation with grey cement** Elastobar EB50=1.0 kg Grey cement =1.25 kg 100 mesh silica=1.25 kg (sieved fine sand) Water =0.5 litre **Total = 4 kg/ltr** (Use 10kg elastobar 12.5kg grey cement 12.5kg 100 mesh sand 4-5 litres water to make 40 litre thick slurry to apply brush or roller) When required in slurry or grout form add 0.1 to 0.5Ltr water as per requirement to the above formulation	2.8 kg or 0.09 cft volume can fill approximately 38 running meters of vertical RW joint (gap to joint < 0.5 mm). Use 8.9 kg Elastobar EB50 to make 1.0 cft or 31.1 litres of Grout RW (sealant compound) For application in horizontal conctrete surface and vertical wall upto 300mm in bath / toilet room on part of waterproofing treatment for 1sqm area mix of 1.6kg.	2 times water spray in an interval of 24 hrs

S. No.	Material	Description / Mixing Preparation	Coverage (Approximate)	Drying time under sun light
3	**Mix RW** (will be used as a coving on of the junction of horizontal and vertical surfaces) **In paste form**	Elastobar = 1.0 – 2.0 kg (avg 1.5 kg) Cement = 10 kg Sand = 30 kg Water = 8 kg / Litre **Total = 49 kg /0.75cft** (Adjust water as required to make paste form) When Mix RW is to be made in paste form, use sieved fine sand (using 100 mesh)	With 1.0 – 2.0 kg Elastobar, 0.75 cft or 0.0212 m^3 Mix RW (or 0.75 cft / 0.0212 m^3 Coving) can be made.	4 days of curing with water by spraying 2 times a day
4	**a) Cold Bond** an adhesive/ additives for fixing glazed tile on vertical wall panel	Nano-technology acrylic product Liquid : Translucent/colourless	Using as adhesive/ additives for fixing glazed tiles on vertical wall panel. Pure without adding water. 2sq.m on both wall panel and rear side of tile. Wall panel alone 4sq,m. Rear side of tile done 40 Nos of (full drying time 7 days) tiles of 1' x 1'	Initial drying time 15-30 minutes (diluting with water at 1:1 for tiles < 300 × 300mm. coverage will be double the area of above)
	b) As damp proof course	To apply on top of RC plinth beam floor slab,cut-out opening of windows/ventilator external door opening treatment of 174/184mm band around on each floor slab including roof slab 6 sq.m per 2 litre(cold bond solution at 1:1 and added with water) @ 360 g per sq.m by spraying	(i) 40 Rmt @ 0.15m wide (ii)30 Rmt @ 0.2m wide (top of RC plinth beam) (iii)35 Rmt @ 0.174m wide (for band treatment) (iv) 32 rmt @ 0.184 m wide (for band treatment) (v) 48 Rmt @ 0.124m(parapet wall top) and cut-out opening of window/ventilators.	15-30 minuntes
5	**Primer:** **WD P30** (1 kg WD-P30 + 1 kg WD Thinner) on external & internal wall and ceiling panel surface.	WD P30 = 1.0 kg/ltr WD Thinner = 1.0 kg/ltr **Total = 2.0 kg**/ltr Nano penetrating polymeric primer for external & internal wall surface & ceiling panel surface.	40-50 m^2 / 2 kg/litre (1 kg / litre WD P30 & 1 Kg / litre WD thinner) single coat or (per litre primer to cover 20 – 2.5 sqm)	24 hrs
6	**SEAL IT**	Ready to apply acrylic joint sealant Specific gravity 1.6 to 1.7 Solid content 87% ± 1% Apply with a spatula / gloves. insert into the joint/gap/crack as deep as possible. Self life: 1 year	sealant in 1.2kg pack/ 600 gm pack Coverage: For 18 rmt a pack of 1.2kg (or 9Rm / 600grm) required to seal 5mm wide joint with 10mm deep (15Rm / Kg)	Touch dry: 4 to 6 hrs Complete dry: 7 days

S. No.	Material	Description / Mixing Preparation	Coverage (Approximate)	Drying time under sun light
7	**Elastobar EB50**	(i) EB50 1 kg +10 kg of FRBL/RCF wall plaster (ii) EB50 2 kg + 20kg of FRBL/RCF wall palster (iii) EB50 1.5 kg + 15 kg of FRBL/RCF wall plaster Rendering compound	For 1mm thickness coverage area of 1sq.m For coverage of 2mm thickness of 1 sq.m area For 1.5mm thick coverage area of 1sq.m It can also be used for patch up works	Touch dry: 4 to 6 hrs Complete dry: 3 days

2. Guidlines for calculating / estimating quantities of various waterproofing products/chemicals

Chemicals for waterproofing treatment of GFRG / Rapidwall buildings are not ready for direct application. For example, Zycosil solution is to be mixed with water at 1:20 and add 2 litre Zycoprime mixed / stirred well to make 23 litre Zycosil solution.

Similarly, Grout RW and Mix RW, rendering compound / patching compound are compounds made at the construction site using Elastobar EB50 which is a polymer product. For Mix RW 1-2 kg / mix is recommended. For better workability and stretchability 2 kg per mix is recommended. But, for quantity calculation purpose average 1.5 kg/ mix is advised.

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

1. Zycosil+: 1litre / 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.

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

3 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)

4 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 (1 cft (0.0283 cum) wet Grout RW may weighs about 50Kg)

(ii) For Mix RW : 1.5 Kg/mix of 49 kg for coving of lintel- sunshade, encasing / packing of piping work etc, if 500 Kg Mix RW to be made require 500 / 49×1.5=16 Kg Elastobar EB50. (1 cft wet Mix RW may weighs about 35 Kg)

(iii) For preparing water resistant rendering compound mix Elastobar at 1:10 (1 kg Elastobar at 10kg) gypsum based wall plaster (FRBL/RCF) or Birla / JK wall putty. An average 1.5 – 2mm thickness would require 2kg compound.

(iv) For application of Grout RW in thick slurry form on horizontal surface its 1.6kg mix prepared (o.4kg Elastobar 0.5kg grey cemnt, 0.5kg seived silica and 0.25 litre water) can cover 1 sqm area.

5 Cold Bond:

(a) To use as adhesive/additives for glazed tile fixing on vertical wall panel without diluting one Kg will cover 4 sq.m (1 sqm on panel surface of 1 sqm on rear side of tiles

(b) To apply damp proof course 1 kg will cover 6 sqm by mixing at 1:1 with water.

6. SEAL-IT : 15Rm per Kg for 5mm wide 10 -15mm wide deep joint.

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

Product	Unit	Coverage	Remarks
Zycosil(1 lit), 2 lit Zycoprime and 20 lit water to make 23 lit solution	1 Lit	40 sqm	Mixed with water to make Zycosil+ solution
WD P30	1 kg	40–45 Sq.m (20–22.5 Sqm / lit)	Mixed 1:1 to make primer 2 kg/ litre (without water) for external
WD Thinner	1 kg		
Elastobar EB50 For Grout RW composition	1 kg	For mix of 4 kg	To make Grout RW (compound / composition) as specified
Elastobar EB50 For Mix RW composition (Coving)	1.5 kg	For mix of 49 kg	To make Mix RW as specified. For more flexible composition/compound, increase the dosage of Elastobar EB50 to 2 Kg / mix
Cold bond (i) To use as tile fixing adhesive/ additives (ii) To use as damp proof course course.	1 lit	to use as adhesive 4 sq.m(2+2) to use as damp proof course 6 sq.m/lit	Without adding water (By adding water at 1:1) (i) 40Rmt @ 0.15m wide (ii) 30Rmt @ 0.2m wide (iii) 35 Rmt @ 0.174m wide (iv) 32 Rmt @ 0.184m wide (v) 48Rmt @ 0.124m wide
SEAL IT Acrylic Joint sealant		For sealing both vertical and horizontal joint between GFRG wall panel and conc. (also between wall panel & window,ventilator/door frame) 15Rm/kg	Touch dry: 4 to 6 hrs Complete dry 6 days

3. Mandatory treatment for the construction joints and areas of GFRG buildings

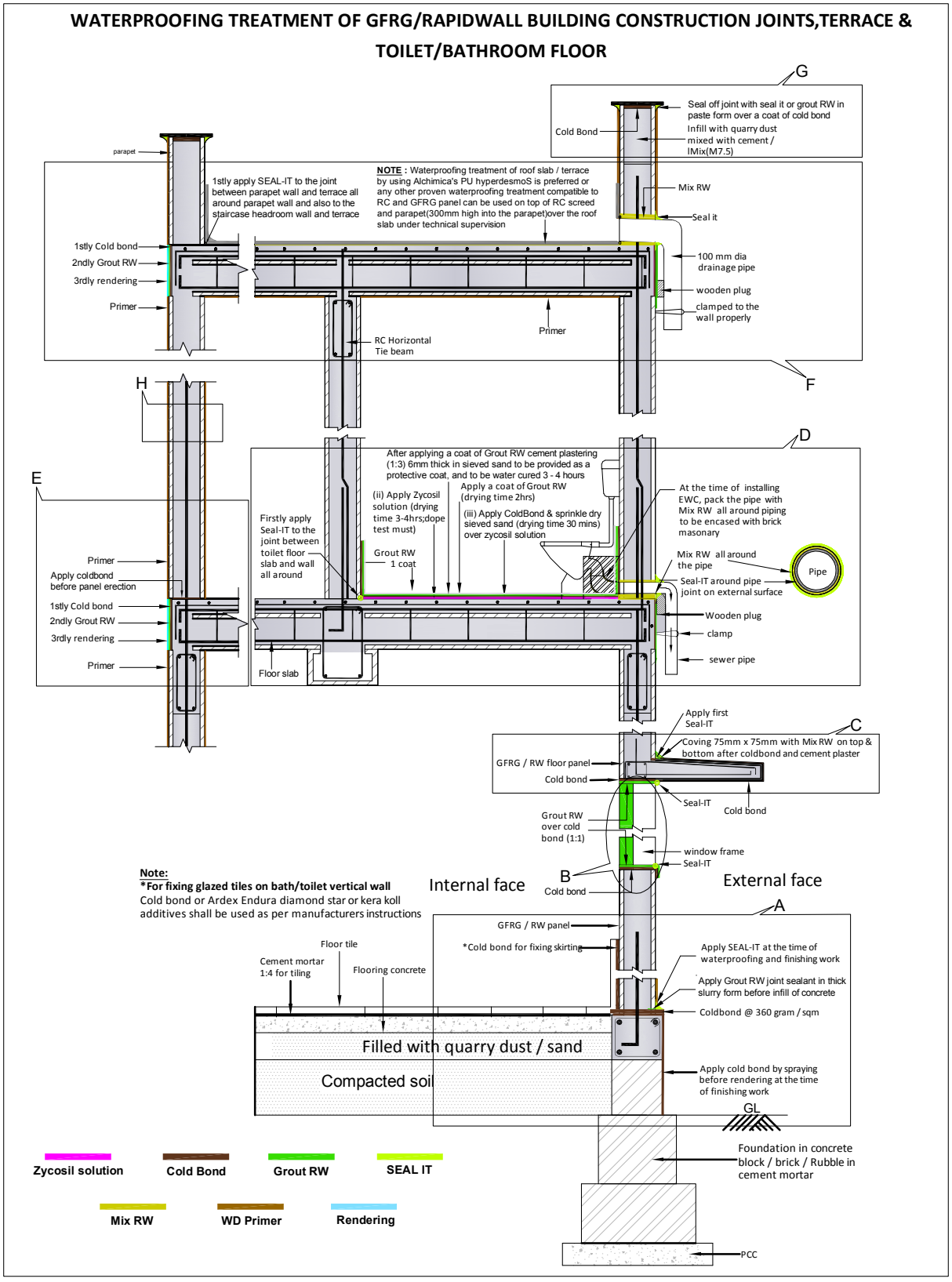
3.1 Following construction joints and areas shall be treated mandatroy:

1. Basement above ground level / plinth or basement 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 75mm x 75 mm coving with Mix RW
6. Cut-out open of windows/ventilators/external door.
7. Intermediate joints between floor slab/ roof slab and outer walls including exposed external side of RC slab
8. Bath / toilet floor including 300 mm high vertical walls, along with treatment of floor slab.
9. Joints between roof slab and parapet wall
10. Joint between roof slab and parapet walls of stair case head room / lift well head room
11. Staircase top slab and its parapet wall
12. 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.
13. Parapet wall and top coping with cement plaster / Mix RW.
14. 174 / 184 mm wide band all around at every floor / roof slab (exposed RC-floor/Roof slab)

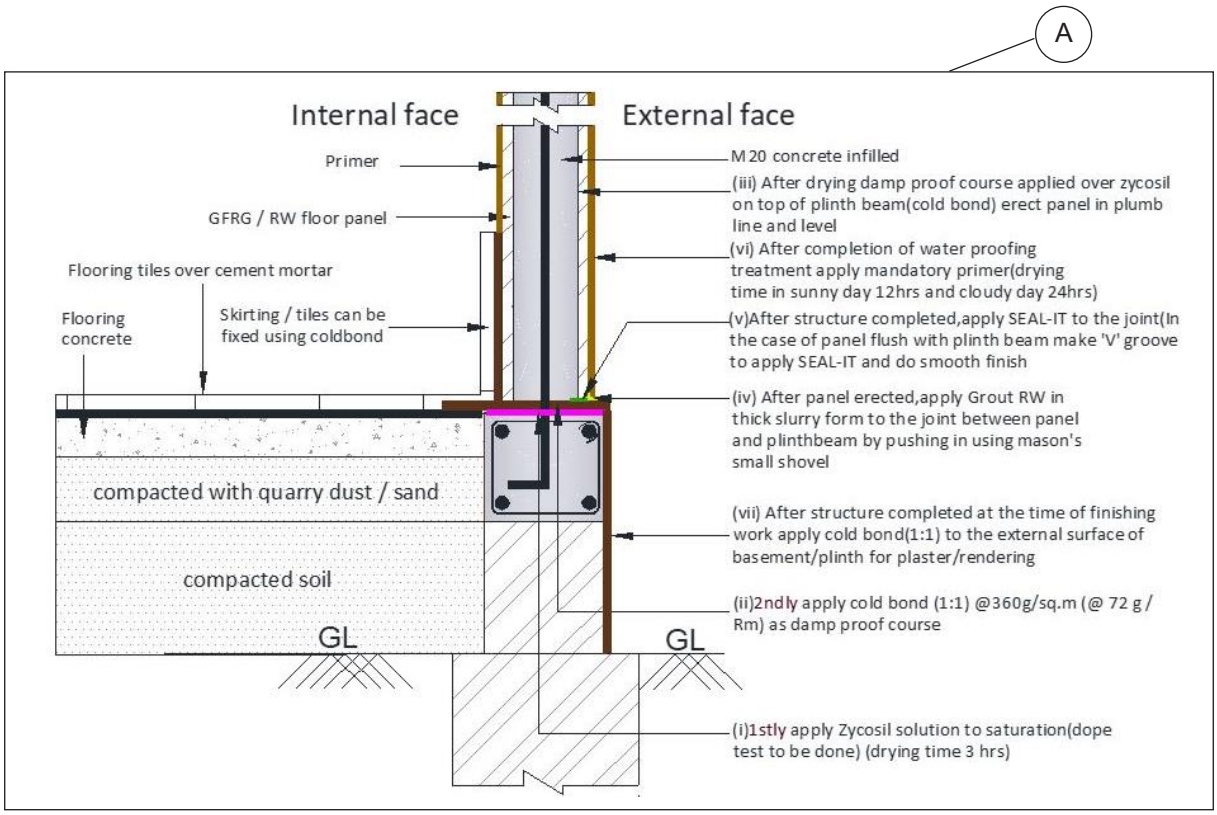
3.2 Application of Primer:

1. It is mandatory to apply primer with WD P30 mixed with WD thinner (1:1) for external & internal surface & ceiling for applying paint. (Drying time 12 hrs on sunny day and 24 hrs on cloudy day)
2. Rendering / thin layer of plastering (1 -2 mm / average 1.5mm thickness @ 1.5Kg / sqm) of external wall using gypsum based FRBL/RCF Plaster / JK wall putty / Birla wall putty mixed with Elastobar 1:10 to make it water resistant by trained & skilled putty applicators for fine and smooth finish. (Drying time 12 -24 hrs)
3. Painting
4. Interior finishing of vertical wall corners / ceiling and wall corners using wall Plaster (FRBL / RCF) or Birla / JK wall putty mixed with Elastobar at 1:10, painting team after applying primer.

4 Waterproofing of GFRG / Rapidwall Buildings:



4.1 Details of joint treatment of RC plinth beam and wall joint at 'A':



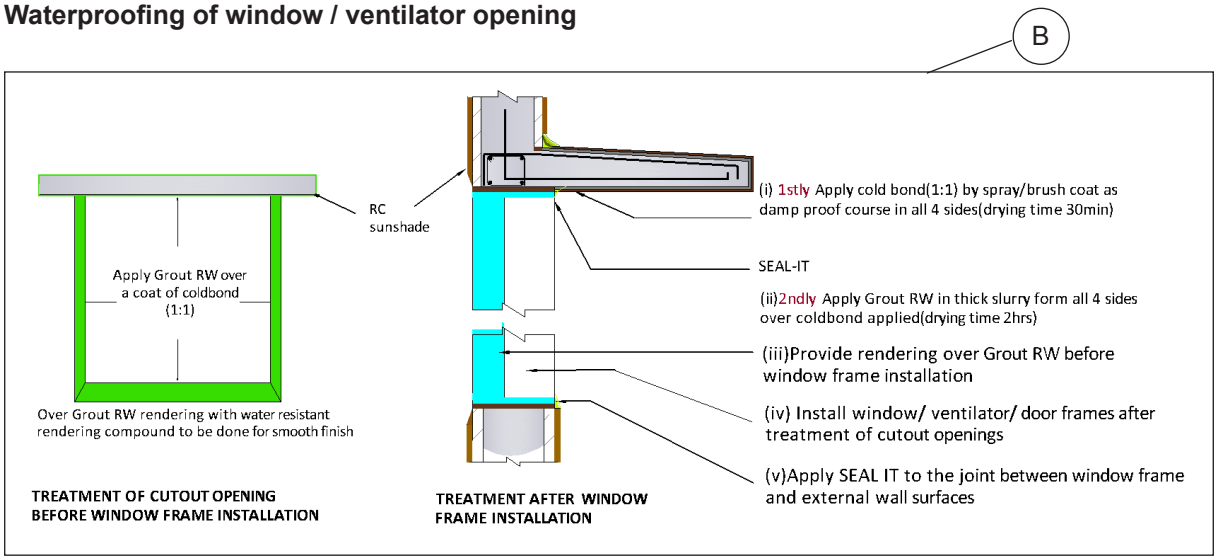
(Fig – 1)

Note:

If rendering to be done before painting, for superior finishing rendering to be done using gypsum wall plaster (FRBL/RCF) or JK / Birla wall putty mixed with Elastobar EB50 @ (10:1) to make water resistant rendering mix for external wall surface, toilet / bathroom walls etc.

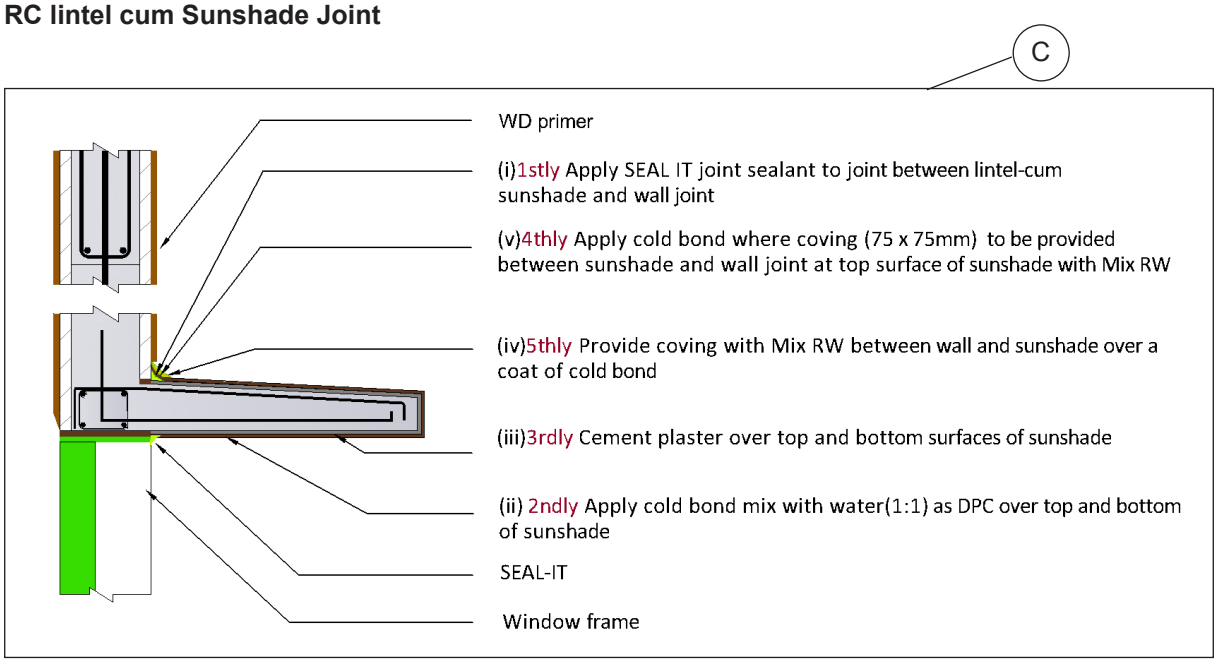
4.2 Details of Treatment of Windows/ventilator opening and RC lintel cum Sunshade Joint at 'B' and 'C'

Waterproofing of window / ventilator opening



(Fig – 2)

RC lintel cum Sunshade Joint

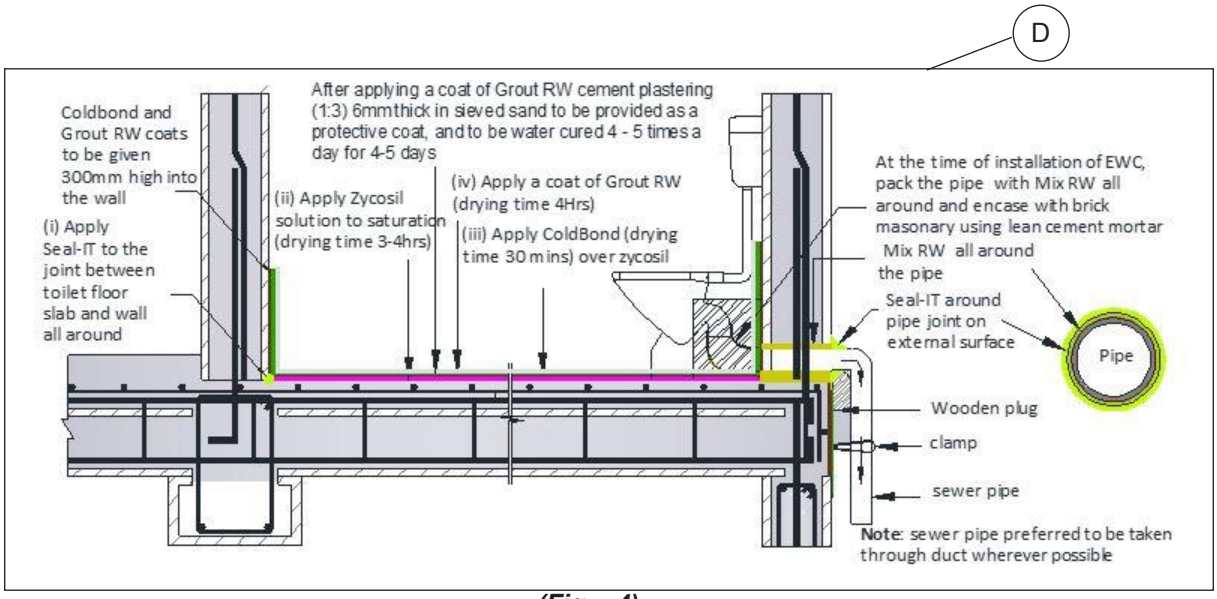


(Fig – 3)

4.3 Water Proofing treatment of bath room / toilet / wet area at 'D':

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

1. Provide water supply / sanitary pipe conncetions and waste water pipe connections cutting through slab and wall panel and treat cut out on wall around this pipe bend etc with SEAL-IT(water closet, wash basin, bathing tub, shower, washing machine etc to be fixed only after completing the waterproofing treatment and curing of protective layer of 6mm thick cement plaster for 4-5 days.
2. Firstly apply 'SEAL-IT' joint sealant to the joint between walls and floor slab.
3. Clear off all the dirt and debris. Apply zycosil solution to saturation and carryout drops test. If drop test failed re –apply zycosil solution to saturation (drying time 3-4 hrs). Zycosil solution should not be applied to GFRG wall panel.
4. After drying of Zycosil solution (3-4hrs) apply by spraying or brush coldbond(1:1) at 360 grams/ sqm. Apply 300mm up into wall around also.
5. After drying coldbond apply thick slurry of Grout RW (using grey cement, sieved sand and elastobar formulation with required water to make it thick slurry) apply 1 coat (1.6 kg mix/sqm) including 300mm up into the wall all around by using brush (over coldbond already applied). Drying time 4-6 hrs.
6. Next day provide cement plaster 1:3 (seived sand), 6mm thick as a protective layer. After 12 hrs of cement plastering, water cure for 4 -5 times a day for 4 -5 days.
7. After curing of protective layer of cement plaster for 4-5 days, ready for fixing sanitary items like closet with P / S trap, wash basin, water supply line and waste water outlets etc. Provide pipe joints packing to make it leaf proof (before carrying on laying of flooring tiles, by filling up with broken brick and base cement mortar for laying flooring tiles, also fixing vertical wall glazed tile using prescribed special additive / adhesive like cold bond as per separate iems of work).



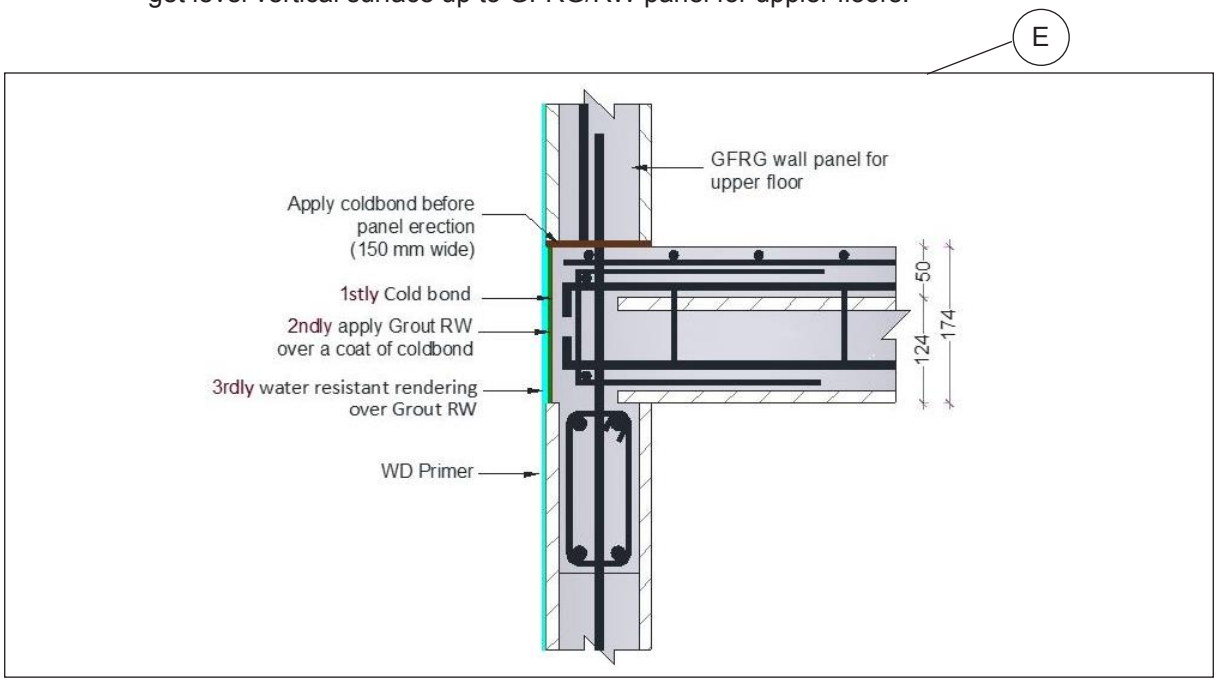
(Fig – 4)

Note:

1. If drop test on Zycosil solution applied is failed re-apply zycosil solution to saturation.
2. EWC (European water closet) and other toilet and bathroom fillings to be installed only after completing water proofing treatment.
3. For Pipe connection pipe bends to be installed before water proofing and joint to be treated as illustrated.

4.4 Treatment of 174 / 184mm wide band all around exposed in RC floor/roof slab at 'E':

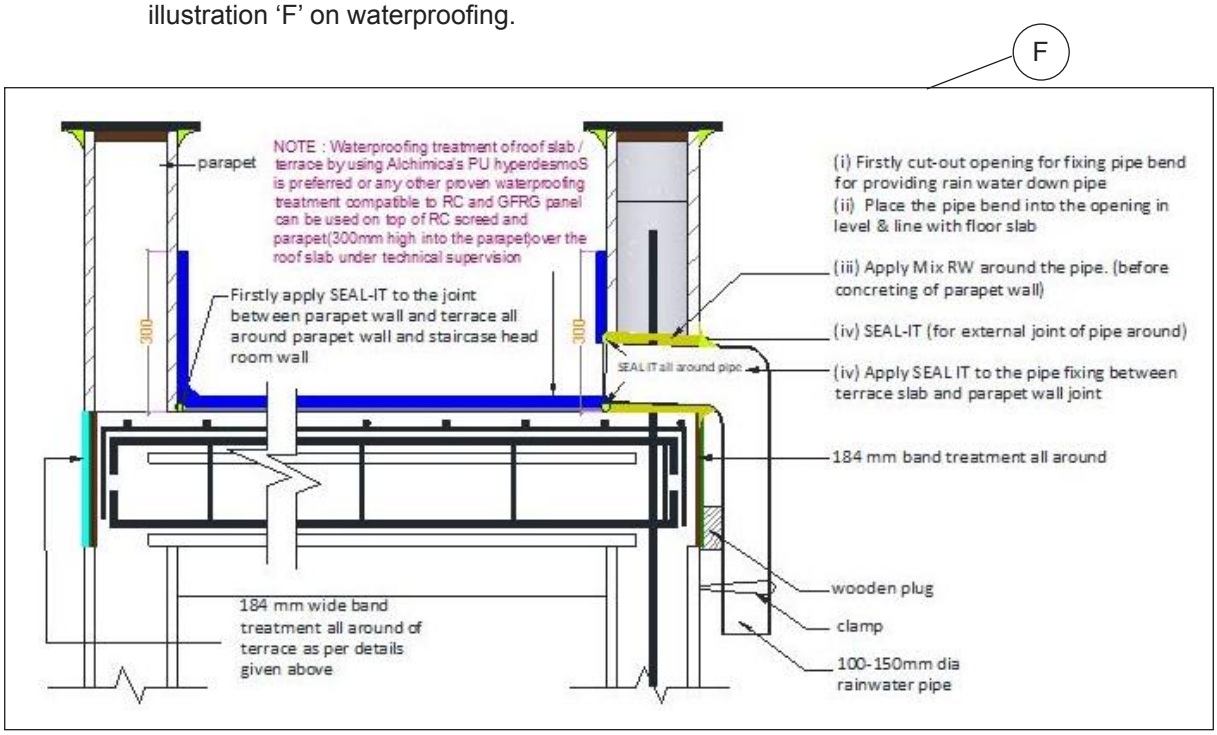
- External face of RC concealed beam and screed at external sides is to be provided with 6mm groove. This groove is to be treated wih cold bond by spraying, and then apply a coat of Grout RW in paster form or thick slurry form using white cement route.
- After applying Grout RW, and 3 hrs of drying, 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 uppler floors.



(Fig – 5

4.5 Protocol for Waterproofing treatment of terrace slab at 'F':

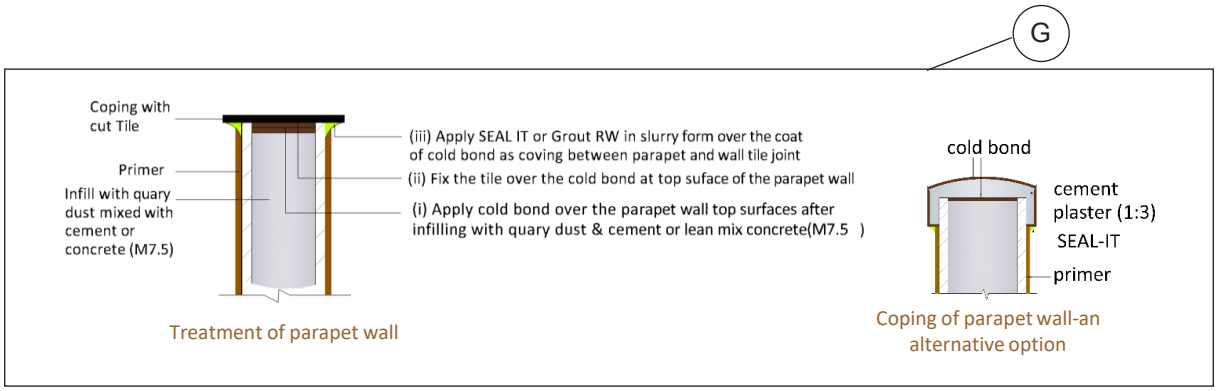
- Provide rain water down drainage PVC pipe connection (100mm or 150mm by properly embedding the pipe mouth suitably) to drain rain water at required locations cutting through the parapet wall and seal off the joint of pipe connetions to make it leaf proof. Clean the roof slab of any debris, loose cement mortat or concreteand debris and laitance.
- Firstly apply SEAL IT, acrylic joint sealant to the horizontal joint between parapet wall/ wall of staircase head room/ lift well head room wall and the terrace slab. Also to apply SEAL IT to the vertical joints of parapet wall and other walls on terrace floor. (drying time 6 hrs for touch set and full drying 7 days)
- Waterproofing treatment of Roof / terrace slab by using Alchimica PU HyperdesmoS product over base coat of aqua smart or any other approved or proven waterproofing technique to be provided to give fool proof water proofing. The same to be applied to 300mm hih into parapet wall and all other walls in terrace floor like staircase / lift head room etc. See the illustration 'F' on waterproofing.



(Fig – 6)

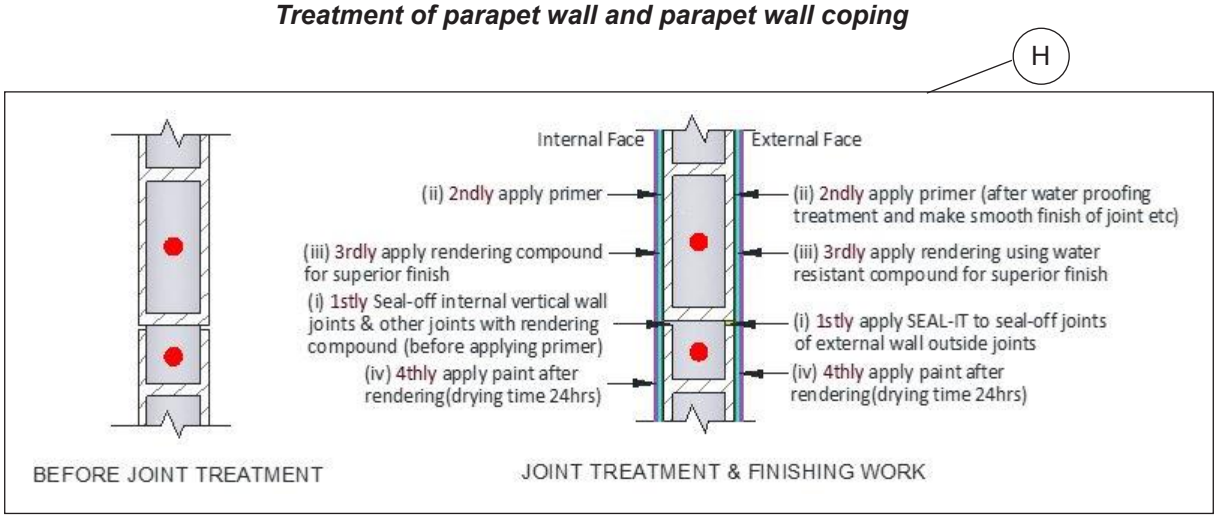
4.6 Fill in of empty cavities with treated soil & capping of Parapet top at 'G' and 'H'

- Empty cavities of parapet RW, wall can be in filled with locally available soil, treat 100mm top compacted soil to be treated with diluted zycosil + (1: 200) solution.
- Fill top 25mm to 50mm thickness with Mix RW with proper slope and smooth out top surface with cement. (forparapet wall)
- Apply diluted Zycosil+ (1 : 20) mixed with 2 litre Zycoprime+ by spray on the 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.



(Fig – 7)

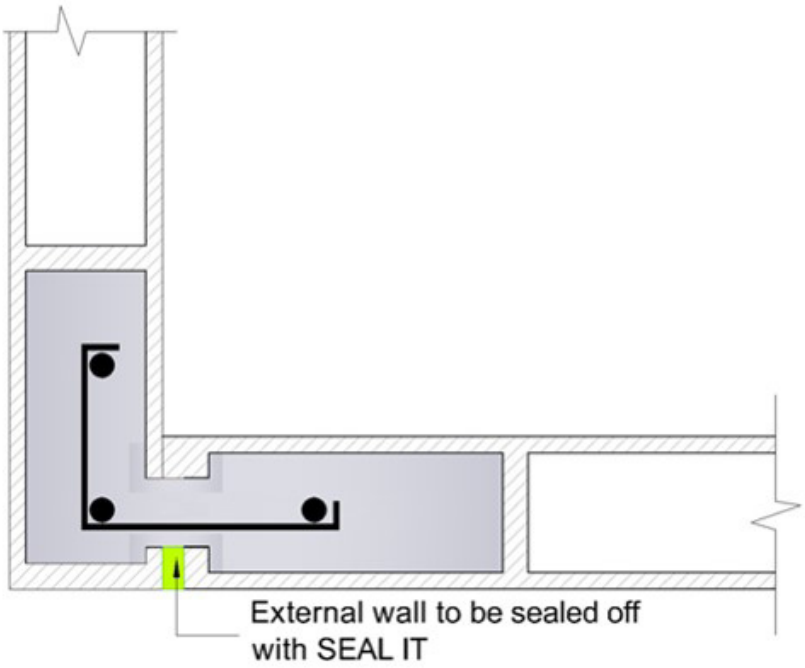
Treatment of parapet wall and parapet wall coping



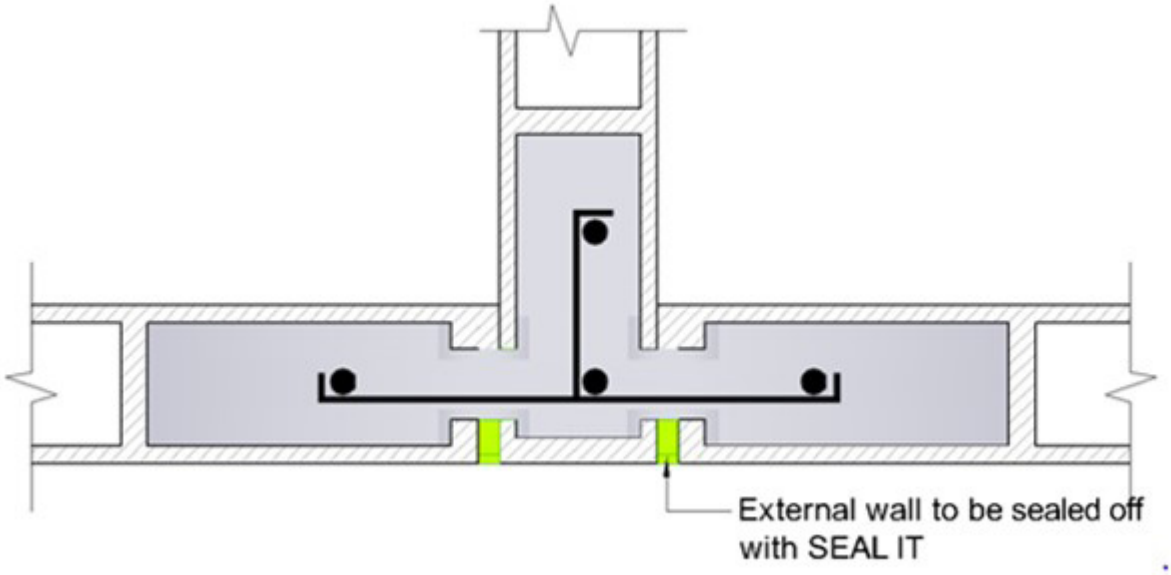
(Fig –8)

Wall joints of external walls, bath / toilet wall

4.7 Waterproofing treatment of vertical wall joints (external walls)

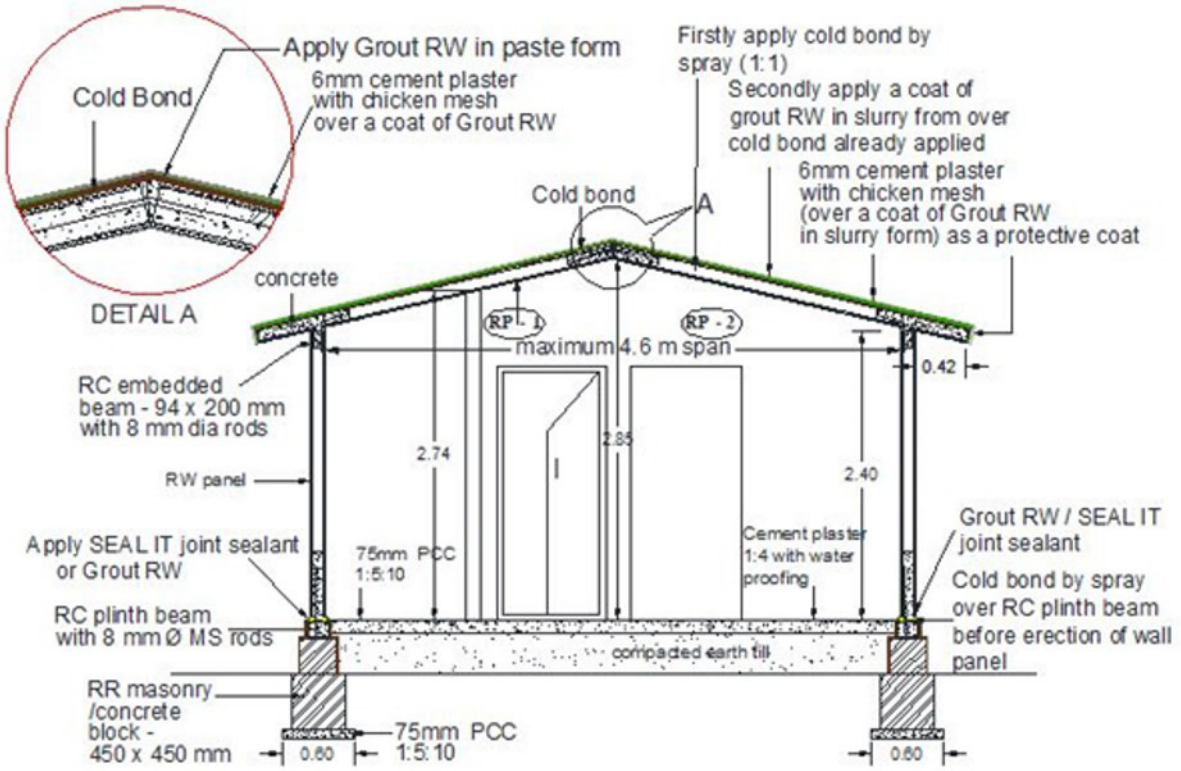


(Fig –9)



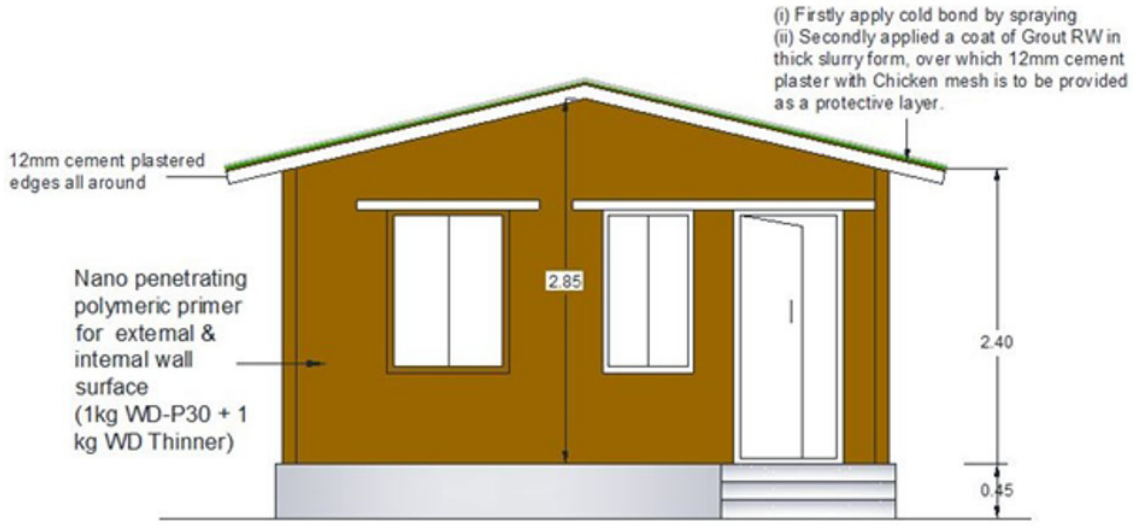
(Fig –10)

4.8 Cost effective waterproofing solution for GFRG / Rapidwall houses with sloped roof for Urban & Rural poor / Low income groups at affordable cost



SECTIONAL VIEW

(Fig –11)



(Fig –12)

Note-1:

Water proofing applicator or 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 / 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.

Note-2:

Finishing coat of paints on Rapidwall buildings

A. Painting over special primer (WD-P30 – External Primer) or Rendering to be provided over primer coat for superior finishing. To get superior / best finishing, it is necessary to smooth the joint area / bend area its with wooden grinder machine using sandy disc, before primer applied and rendered. Before painting primer of respective paint can also applied as per manufactures instructions But WD primer is mandatory over panel surface.

1. Emulsion paint (external / internal)
2. Arcylic paint (external / internal)
3. Cement paint – water based (external)
4. Distemper (internal)

5 Specifications of Items of work using Zydex products:

1. Application of Zycosil+ Solution (1 litre of Zycosil+ & 20 litres of water stirred first & 2 litre of Zycoprime+ added to it and stirred (total 22 litres)) by spraying using suitable sprayer. 22 litres of solution will cover 40 sqm. to saturation (by drop test) 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. On top of RC plinth beams walls/ parapet walls, spray Cold Bond to 300mm wide.

2. Application of damp prooof course on the top of RC plinth beams in GF: Application of Cold Bond diluted by adding water at 1:1 over already applied coat of Zycosil+ & Zycoprime+ solution on the top of all RC plinth beams (200mm wide) spraying using metal bottle sprayer @ 360grams per sqm as damp proof course(drying time 30minutes). After this erection or installation of GFRG / Rapidwall over RC plinth beams in GF can be started. In the case of all upper floors damp proof course apply Cold Bond over 150mm wide floor slab for all the external walls, bath / toilet / wet areas (drying time 30 minutes) before erection of wall panel.

3. Apply Grout RW (grey cement route) in thick slurry form or in paste form into the external wall side joint between wall and RC plinth beam before the first pour of concrete. After wall panel is erected and kept in rigid position by providing proper later prop in line, plumb and level before infill or first pour of concrete, Grout RW to be applied by publishing in, into the gap between panel and RC beam using masons small shoel and thumb (use rubber glovse).

4 (a): Application of damp proof course on vertical concrete & walll panel cut surface (124mm wide) like cut out opening of window/ ventilator, external dooor opening by applying by spraying Cold Bond diluted by adding water at 1:1 (drying time 15-30 minutes). Over Cold Bond sprayed applying Grout RW in thick slurry form by brush.

4 (b): Application of damp proof course or water prooofing treatment on vertical surface of concrete & wall panel cut surface like external side of RC floor slab/ roof slab 174/ 184 band around by applying spraying Cold Bond diluted by adding water 1:1 (drying time 15-30 minutes). Over Cold Bond sprayed applying Grout RW in thick slurry form by brush (drying time 3 hrs).

4 (c): Over the Grout RW coating Rendering to be provided to fill up the remaining gap (out of 6mm grove). It is necessary to level the surface between upper wall panel and lower floor wall panel and 174mm / 184mm band around by grinding with wood grinder with sandy disc before making rendering of external wall surface. Cost of this rendering also to be paid separately.

4 (d): Application of damp proof course or water proofing treatment on the top of parapet wall on terrace. Apply by spraying cold bond (1:1) on top of in concrete or lean concrete or quarry dust and cement mixed in fill. If the parapet top is to be capped wth concrete or cement mortar, after capping it suitably apply a coat of cold bond diluted (1:1). If the parapet top is to be capping with glazed tile suitably cut place over the cold bond sprayed and provide SEAL IT acrylic joint sealant on both sides of joint between tile and parapet wall. In such cases cost of SEAL IT application cost to paid separately.

5. Application of SEAL IT, acrylic joint sealant to seal off both horizontal or vertical joints like joint between the wall RC plinth beam / floor slab, terrace slab and parapet wall, toilet / bath

rooms or wet areas and parapet wall, Joint between wall and RC lintel cum sunshade and the wall panel external walls and vertical joints of wall to wall on external side, parapet wall / staircase head room and lift well head room walls in terrace floor.

SEAL IT to be pushed into the joint by thumb (wearing rubber glove is a must for applicators). Where gap of joint is too samll, V grove to be formed with sufficient depth and wide enough to apply the joint sealant properly (After applying primer / water proofing treatment, joint sealant surface to be smooth finished by grinding with wood grinder using sandy disc before rendering)

After installation of external door frame(including door frames of toilet/bath) window/ventilator, vertical joints (of external side) between door frame, window & ventilator frames (on all four sides) of outer walls SEAL IT joint sealant to be applied. Before primer applied and rendered.

6. Treatment of RC lintel cum sunshade: After applying the joint sealant to the joint between wall and RC lintel cum sunshade as per item under 4 above, provide 12mm thick cement plaster 1:4 to top and bottom and sides of sunshade as a protective coat., it is necessary to spray Cold Bond (1:1) on top and bottom and sides including 75mm into wall also. There after provide 75x75mm coving with Mix RW between wall and sunshade.

7. Water proofing tretment of bath/ toilet / wet areas:
Provide the sanitary connections / system and water supply and waste water pipe connections cutting through floor slab and wall panel (to fix later water closet, wash basin, bathing tub, shower, washing machine etc after completing the waterproofing treatment). Seal off the joint between pipe and floor slab, wall and pipe and pack up the pipe around also.
Firstly Apply SEAL IT joint sealant between wall and floor slab all around (cost not included and hence to be paid separately). After drying (3 hrs) apply Zycosil solution to saturation. Carry out Drop test to make sure that Zycosil application is perfectly saturated. If not re-apply Zycosil solution (drying time 3 hrs). Apply by spraying Cold Bond at 360grams/ sqm. Spray 300mm up into wall around also (drying time 30 minutes). After drying apply thick slurry of Grout RW (using grey cement, sieved sand and Elastobar formulation with required water to make it thick slurry) brush application 1 coat. Apply the same 300mm up into the wall all around. After drying Grout RW, provide 6mm thickness 1:3 cement plaster in sieved sand as protective coat. Then water by sprinkling water for 4 - 5 times a day for 4 – 5 days. After proper curing of cement plaster ready for fixing sanitary items like closet with P / S trap etc, wash basin, water supply line and waste water outlets etc. Provide pipe joints packing tec to make it leaf proof (before carrying on laying of flooring tiles, by filling up with broken brick and base cement mortat for laying flooring tiles. For vertical wall glazed tile fixing apply prescribed special additive/ adhesive Cold Bond as per separate items of work).

8. Water proofing treatment of roof slab / open terrace:
Water proofing treatment of roof slab / terrace by using Alchimica's PU hyperdesmoS is preffered or any other proven and approved waterproofing treatment compatible to RC and GFRG panel can be used on top of RC screed and parapet (300mm high into the parapet) over the roof slab under technical supervision.

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, after spraying cold bond made to give perfect grip over.

10. Application of Nano penetrating polymeric primer (before rendering /thin plastering of internals & external walls, including wall corners, joints between ceiling & walls, whereever fine finish is required) using Wd P30 & 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 internal & external surfaces, before rendering (after 12 hrs of drying) if rendering is included for superior finishing.

11. Rendering/ plastering with a thin layer (1.5 to 2 mm) thickness with an average of gypsum based wall plaster (FRBL/RCF) or Birla / JK wall putty mixed with Elastobar(1:10) 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).

12. Waterproofing treatment of affordable GFRG housing with carpet area upto 30 sqm having sloped roof using GFRG panel: after clearing the roof surface spray cold bond @ 360 grams per sqm. Over this apply a thick slurry brush coat of Grout RW. After 3 hrs drying sprinkle water 2 times a day for 2 days.

6. Waterproofing Treatment of GFRG Buildings Using Alchimica Polyurethane Products

GFRG building system comprises both gypsum based GFRG (Glass Fibre Reinforced Gypsum) / Rapidwall and conventional RC (reinforced concrete), both of which co-axial as composite structural materials in the building. Water proofing treatment of the construction joints of GFRG buildings invloving two different building materials has been a major challenge, as most of the existing water proofing chemicals available world over are developed for conventional building materials like concrete/ cementitious only.

The waterproofing treatment of above includes above the ground level structures of GFRG building system including treatment of wall panel joints, joint between RC plinth beams and wall panels, wet room areas, Joint between parapet wall and terrace slab, waterproofing of terrace slab / roof, RC lintel cum sunshades, joint between window / door/ventilator frame and wall.

One of the challenges of water proofing of the construction joints of GFRG building is that the water proofing treatment need to be compatible to both materials like concrete, gypsum in the structures.

Alchimica's polyurethane technology is time tested building chemicals used in construction industry for waterproofing solutions in both conventional concrete and gypsum based building materials is now available in the Indian market.

Specially formulated PU products developed by Alchimica have been used on gypsum buildings in Greece and other European countries. Their Coatings and sealants are compatible for both concrete and GFRG (gypsum based).

Alchimica Products used for GFRG buildings and its colour codes

1. **AQUASMART DUR CONCENTRATE:** Components A, B and C mixed in 4:4:1 proportion (by weight) to form a concentrated compound; used as DPC (damp proof course) & base coat for joint sealant application, over concrete surface.

COLOUR CODE	(brown)

NOTE - **HYPERSEAL OMEGA 50 & 125 FAB**: This is a special reinforcement fab; used at joints like window & door openings, through cut-outs on panels, panel to concrete joints, etc. 50 and 125 refers to the width of the tape (fab).

COLOUR CODE	(white)

2. **HYPERSEAL EXPERT** – A special PU + hybrid technology joint sealant formulated to withstand high temperature and humidity; used as joint sealant for panel to panel joints, panel to concrete and metal joints.

COLOUR CODE	(red)

3. **MICROSEALER 50:** PU based product used as base coat or as first coat over concrete surface before applying **HYPERDESMO CLASSIC**; used in open area of terrace, sunshades etc.

COLOUR CODE	(yellow)

4. **HYPERDESMO S:** PU based liquid waterproofing coating (involving special formulations) having substantial elastic property; used in toilets / bath rooms, side surfaces of cut-outs, etc. Colours available are black / grey / white / teja.

COLOUR CODE	(blue)

5. **HYPERDESMO CLASSIC:** PU based exposable waterproofing coating having a minimum elongation of 300%; used for exposable surfaces like terrace / roof slab, sunshade, balconies etc.

COLOUR CODE	(purple)

6. **AQUASMART DUR PRIMER:** Components A, B, C and water mixed in 8:8:1:2 proportion (by weight) to form compound mix in paintable consistency; recommended primer for GFRG / Rapidwall panels (internal and external wall surfaces and ceiling).

COLOUR CODE	(green)

NOTE - Rendering if required, can be done for smooth finished surface of wall panel, using Rapid gypsum plaster mixed with suitable additives. This additive should be a water resistant one when used for rendering of external wall, bath / toilet etc.; but for internal walls and ceilings, this need not have to be water resistant. Suitable additives required for the rendering compound that are compatible with Rapid gypsum plaster need to be proposed by Alchimica.

COLOUR CODE	(orange)

Methodology of waterproofing using Alchimica PU products

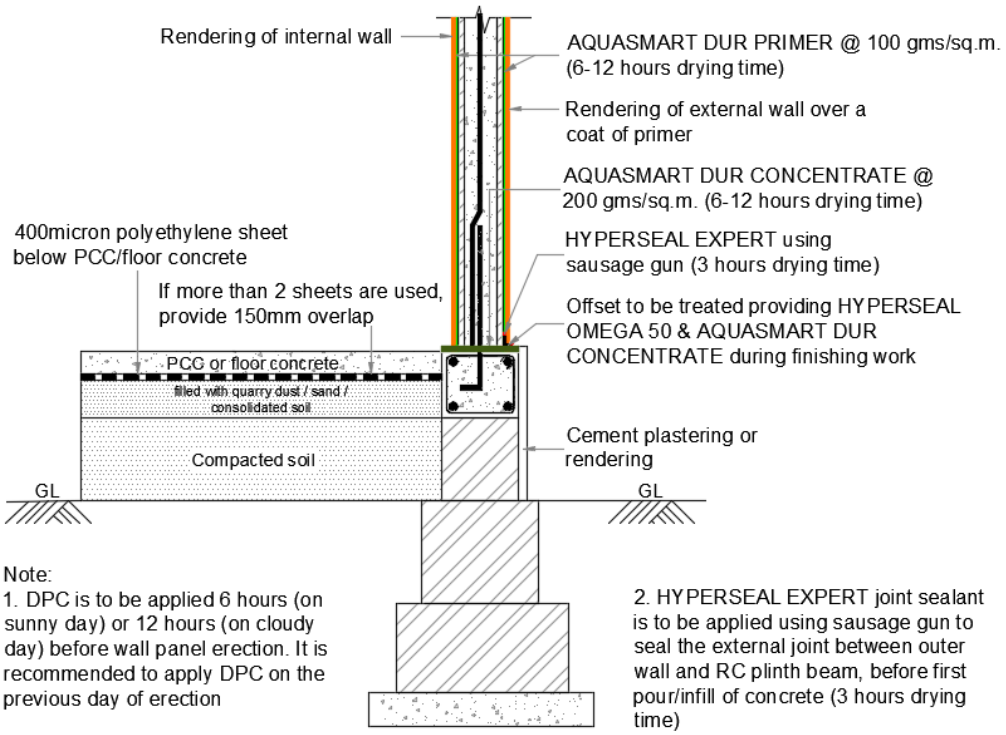
Waterproofing using Alchimica PU products should be done only by accredited applicators of Alchimica India, or applicators and supervisors of construction companies / builders trained and accredited by Alchimica India. The different waterproofing products that need to be used at various locations, where waterproofing is required, is explained below in detail.

1) Damp proof course (DPC) for protection of RC plinth beam top in ground floor (GF) – 200mm wide

AQUASMART DUR CONCENTRATE: The components A, B and C mixed in the ratio 4:4:1 by weight is to be applied at a dosage of 200 gms/rmt (for a single coat application using spatula) or 100 gms/rmt (for each coat of application using brush – 2 coats are required). Mixing is to be done at site with a slow speed stirrer (300 rotations per minute (rpm)) to get uniform mix, after which the mix is to be consumed within 45 minutes (summer) to 60 minutes (winter).

Method of application:

AQUASMART DUR CONCENTRATE is to be used for the damp proof coating of top of RC plinth beam at a dosage of 200 gms/rmt to a width of 200mm. The application can be done either by spray or squeeze or by using spatula or by using special short bristle (Alchimica brush). This is to be done only 2 - 3 days prior to the installation / erection of wall panel or at least 6 -12 hours (minimum drying time of the DPC coat) before the erection of panel. The specified drying time of 6 -12 hours means



Figure–1: Foundation, basement and plinth beam with starter bars and GFRG panels in position, flooring and joint between GFRG panel and RC plinth beam)

that the drying time required is only 6 hours, if the application is done on a sunny day, and 12 hours, if done on a cloudy day. Wherever the drying time is specified like-wise in this manual, it has to be interpreted as specified here. This should also be applied on floor slabs for the upper floors before the erection of external wall, bathroom, staircase / lift head room and parapet walls (150mm wide). **Note:** For ground floor, before laying the PCC (plain cement concrete) floor, as part of the water proofing treatment, it is recommended to provide a layer of polyethylene sheet (400 microns thk.), spread over the top of filled up and consolidated earth / sand / quarry dust filling, or just below the concrete floor, before casting of the floor. PCC is to be done with 40mm aggregate to prevent rising of dampness from ground. When two or more sheets are laid within a room space in between the RC plinth beams, a minimum overlapping of 150mm is to be provided. Refer Figure 1 for more details.

2) Treatment of construction joints

HYPERSEAL EXPERT should be applied for sealing joints over a base coat of **AQUASMART DUR CONCENTRATE**. This treatment can be used to seal the joints between external walls & RC plinth beam in GF, floor slab in upper floors; that between roof slab & staircase / lift head room walls, parapet walls in terrace; that between bath / toilet walls and floors; vertical joints of the outer side of external walls, outer and inner sides of vertical joints of parapet walls, inner vertical joints of bath / toilet walls; joint between wall panel & RC lintel cum sunshade; joint between wall and window / door / ventilator frame around all the 4 sides - top, bottom and 2 vertical sides, on outer & inner sides and on top and bottom joint of 174 / 184 mm band around. In short, the construction joint treatment is to be done for the joints like, horizontal joints between concrete and panel, external vertical panel to panel wall joints of outer / external walls, panel to concrete and metal surfaces (joint between window frame and wall) and RC lintel cum sunshade joints.

AQUASMART DUR CONCENTRATE is intended for use as a base coat for concrete surfaces only. **HYPERSEAL EXPERT** can directly be used without the need for a base coat on the construction joints, where concrete is not present. On concrete surfaces, **AQUASMART DUR CONCENTRATE** provides bonding to **HYPERSEAL EXPERT**.

Method of application:

After the wall panels are erected in position over the RC plinth beams and fixed rigidly by providing lateral props (after checking the level and plumb of the panel), the joint between the RC plinth beam and external side of the wall panel is to be sealed-off with **HYPERSEAL EXPERT** (PU sealant) using sausage gun, in order to prevent rain water from getting inside through the external joint between RC plinth beam and wall panel. This is also done to prevent the escape of slurry from concrete during the first pour of concrete (up to 300mm depth). This requires a drying time of 3 hours. It is to be noted that **HYPERSEAL EXPERT** should be applied only over a base coat of **AQUASMART DUR CONCENTRATE** (dosage of 100 gms/rmt, with a drying time of 6 - 12 hours). This is also illustrated in Figure 1. Coverage of **HYPERSEAL EXPERT** sealant per 600 cc (720 grams) sausage in running meters (rmt) is given in Table 1.

Table 1 ***HYPERSEAL EXPERT*** *sealant coverage*

Depth considered	Width of gap		
	< 5 mm	5 mm	10 mm
< 5 mm	30 rmt		
5 mm		24 rmt	12 rmt

If there is an offset between the plinth beam and the wall panel on the external side, then **HYPERSEAL OMEGA 50 FAB** strip is to be provided through-out the edge, finished with **AQUASMART DUR CONCENTRATE.** This is to be done only as part of the finishing work. The top of this treated offset can also be rendered while rendering the external sides of wall surfaces and basement footing (above GL) during finishing of the building (refer Figure 1).

All the internal vertical wall joints, except inner joints of bathroom / toilet need to be sealed-off only with rendering mix and fine finished, before **AQUASMART DUR PRIMER** is applied to the walls and ceilings followed by rendering / painting.

Note: While concrete is infilled inside the cavities or when the RC horizontal tie beam on the top of the wall panel is concreted, the vertical joints between the panels may also get filled with cement slurry. So when the external vertical joints on external side are treated, the joints need to be cleaned to a minimum depth of 5mm and sealed-off properly with **HYPERSEAL EXPERT** with a base coat of **AQUASMART DUR CONCENTRATE.** A drying time of 6 - 12hours is recommended for the base coat.

3) Treatment of cut-outs / door / window openings

All the through and through cut-open areas of external walls and bath/toilet walls for piping works (before pipe / pipe bends are placed in position); the areas around door / window / ventilator openings (before the installation of the frames) are to be properly treated.

Method of application:

The side surfaces (of 124mm width) of cut-outs of GFRG panel (exposed / wet area surface) is to be treated with a coat of **HYPERDESMO S** (dosage of 200 gms/rmt, with a drying time of 24 – 48 hours) over a base coat of **AQUASMART DUR CONCENTRATE** (dosage of 200 gms/rmt, with a drying time of 6 – 12 hours) at the junction between the door / window / ventilator frame and wall panel (which will cover both the panel and concrete). The entire width of wall is to be reinforced with a layer of **HYPERSEAL OMEGA** 125 (125 mm width), between the base and the first coats. If the cut-outs are treated and finished properly as stated above, there is no need for rendering. Refer Figure 2 for details.

4) Treatment of periphery of doors, windows and ventilator frames

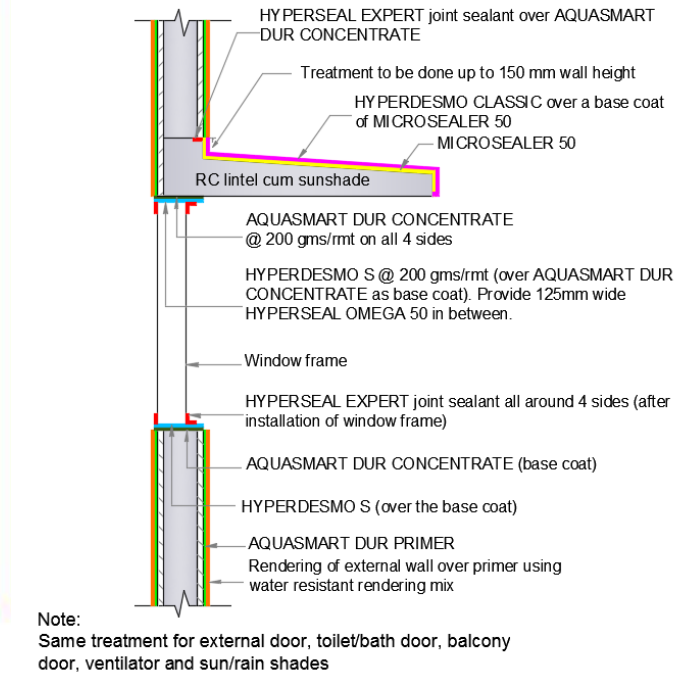
HYPERSEAL EXPERT sealant is to be applied on the joints between the door / window / ventilator frame and concrete / GFRG panel surfaces, the inside of which is already treated with **HYPERDESMO S** encasing **HYPERSEAL OMEGA 125 FAB**. (Refer Figure 2).

Method of application:

After installation of door / window / ventilator frames using 100 to 150 mm long suitable steel coach screws of required numbers driven to the concrete, the joint between the frame and wall is to be sealed-off all around the outer and inner sides with **HYPERSEAL EXPERT** (follow Table 1 for dosage, drying time of 3 hours) of 5 – 10 mm width in order to seal the gap and make it water tight. Tooling is recommended to be done immediately after the application of sealant to form the coving. (Refer Figure 2)

5) Treatment of RC lintel cum sunshades

After the completion of construction of RC lintel cum sunshade as per recommended procedure for GFRG building construction, the joint between the concrete and the cut GFRG panel should be treated



Figure–2: Treatment of RC lintel cum sunshade joint

with **HYPERSEAL EXPERT** joint sealant (follow Table 1 for dosage, drying time of 3 hours) as per the procedure stated for the joint treatment of periphery of doors, windows and ventilator frames.

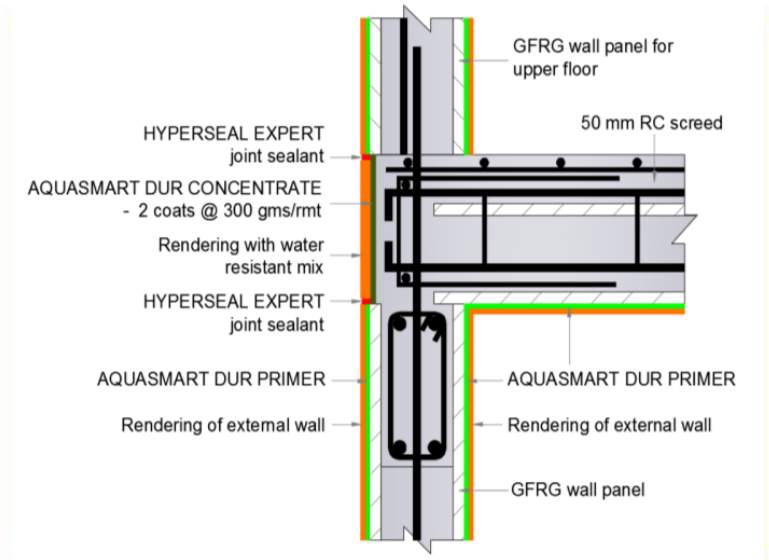
The top (with necessary slope to drain-off water) and side surfaces of the sunshade is to be cement plastered for smooth finish. (Refer Figure 2)

Over the plastered top and side surfaces, as a further protection, two coats of **HYPERDESMO CLASSIC** can be applied at a dosage of 1.5 kg/sq.m., allowing a drying time of 12 - 24 hours between the successive coats and after the final coat, over a base coat of **MICRO SEALER 50** (dosage - 100 gms/ sq.m., drying time – 6 hours). Application of **HYPERDESMO CLASSIC** for sunshade is to be treated like terrace waterproofing treatment. It is to be noted that the recommended coating on the sunshades have to be further taken on to the vertical wall up to 150mm height to cover the exposed RC lintel.

6) Treatment of 174/184 mm wide band (exposed area of floor / roof slab) all around

The band portion is the exposed external side of RC floor / roof slab which needs treatment. The 174/184mm wide band is to be water proofed after cleaning up the dust, dirt, etc., with two coats of **AQUASMART DUR CONCENTRATE** at a dosage of 200 gms/rmt for the first coat and 100 gms/rmt for the second. Application can be done with roller / brush. The drying time required is 6-12 hours in between each coat, and after the final coat. The band treatment should be done only on the eve of rendering after the primer application; or 2-3 days before rendering only, this treatment must be done. Refer Figure 3 for more details.

It is also necessary to provide **HYPERSEAL EXPERT** (dosage and drying time as already discussed) joint sealant on the top & bottom joints of the band all around after rendering. In order to do this, while rendering, insert a thread to make a small grove of size 3-4mm by pulling out the thread later. (Refer Figure 3).



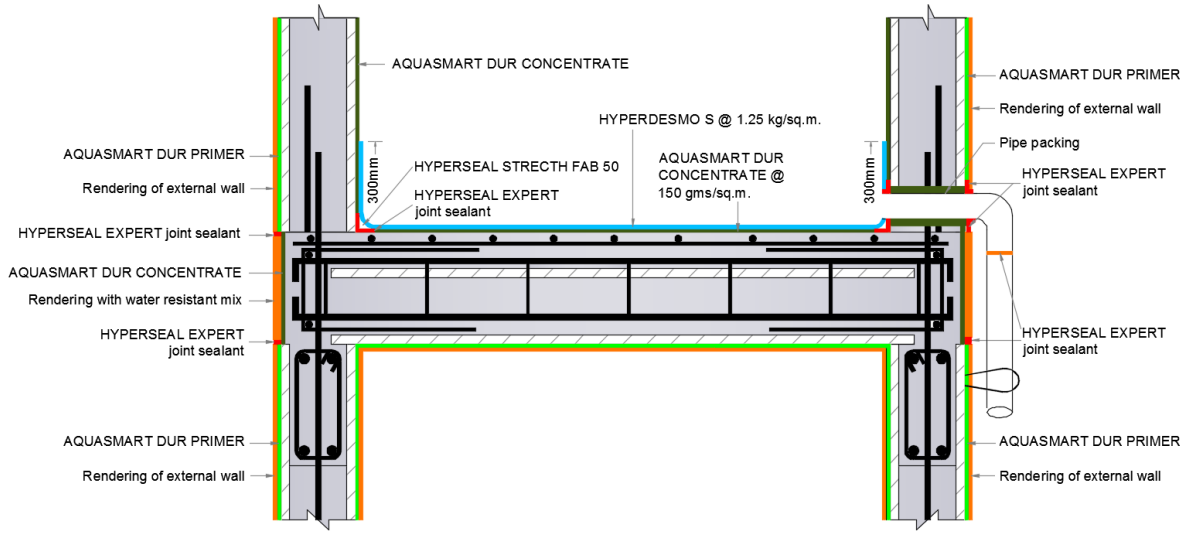
Figure–3: Treatment of exposed slab

7) Waterproofing treatment of bath / toilet floor (except GF) & open balconies

Before waterproofing the bath / toilet floor, make sure that the joint between the GFRG panel and floor slab, all pipe joints, WC connections, waste water and water supply pipes are sealed properly, as was already discussed.

Method of application:

The concrete floor surface is to be cleaned first and then apply a base coat of **AQUASMART DUR CONCENTRATE** at a dosage of 150 gms/sq.m. and allow it to dry for 6 - 12 hours. A strip of **HYPERSEAL OMEGA 50** (50 mm wide) is to be applied at the junction of wall and slab as reinforcement. Over this base coat, apply **HYPERDESMO S** using roller or brush at a dosage of 1.25 kg/sq.m., and allow it to dry for 24 - 48 hours. The base coat and the over coat should also cover 300 mm (along the height) on to the wall. Now provide 15 mm thick cement plaster (1:3) as a protective layer over the **HYPERDESMO S** coating. This can be the base for providing flooring tiles. The floor tiling joints have to be properly filled up with suitable tile joint product. Refer Figure 4 for more details.



Figure–4

8) Fixing of glazed tiles on wall panel in bath / toilets

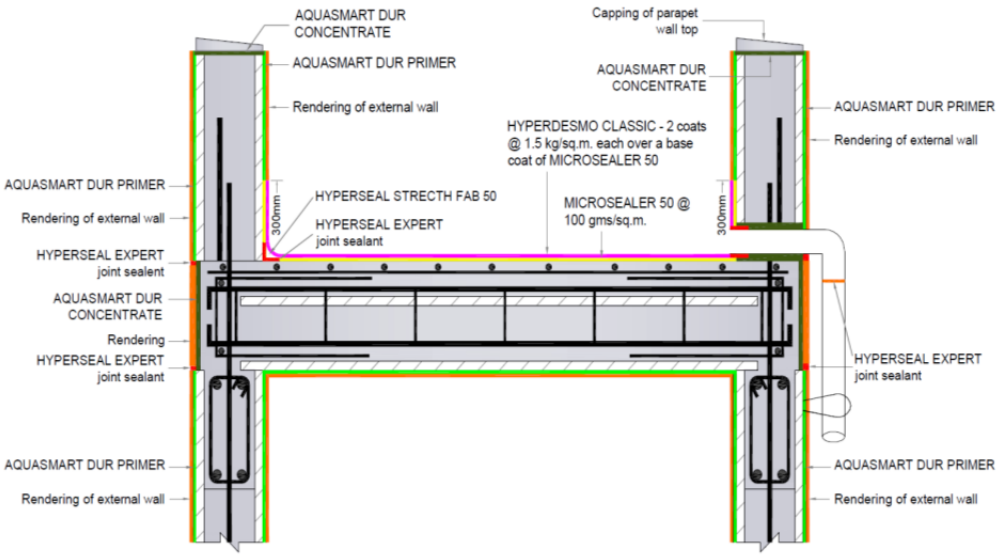
Primer need not have to be applied on the wall surfaces where glazed tiles or marble or granite need to be fixed. Special additives approved by specialised suppliers like Kerakoll or Ardex Endura (with their primer and additives) can directly be used on the walls for fixing of tiles, by following their methodology and using the right application tools. Refer Figure 4.

9) Waterproofing treatment of terrace/ roof slab and staircase / lift well head room slab

Clean the terrace slab by clearing dust and debris and complete the sealing of joints between the terrace slab & parapet wall panel as well as staircase / lift well head room wall panels, using **HYPSERSEAL EXPERT**, the procedure of which has already been explained.

Method of application:

Apply a base (first) coat of **MICRO SEALER 50** over the concrete surface at a dosage of 100 gms/ sq.m. and allow it to dry for 6 hours. Following this, apply **HYPERDESMO CLASSIC** as second coat at a dosage of 1.5kg/sq.m., and allow this to dry for 12 -24 hours. After the second coat gets dried, 50mm wide **HYPERSEAL OMEGA 50** fab can be provided all along the joint between parapet wall and roof slab in order to reinforce the particular joint part. Similar to second coat, apply third coat using **HYPERDESMO CLASSIC**, which also require a drying time of 12 -24 hours. It is to be noted that the whole treatment procedure needs to be done on to 300mm height of parapet wall also. The application can be by brush / spray / roller technique. Refer Figure 5 for more details.



Figure–5

Optional protective layer for terrace / roof slab in the interest of Architects / Construction Engineers / Builders:

Two days after the above treatment, provide 20 to 30mm thick granolithic flooring (with fine finish) on the top of the slab using cement, sand and coarse aggregate (6mm and below metal) in the mix ratio of 1:1:2.

10) Treatment of parapet wall top

Apply **AQUASMART DUR CONCENTRATE** on top of the concrete filled parapet wall at a dosage of 150 gms/sq.m. After allowing this to dry for 6 - 12 hours, suitable coping can be provided as per the architect's or designer's plan, the top of which can be capped with tile or marble pieces, as the case may be, to prevent ingress of water into the parapet wall. Refer Figure 5 for details.

11) AQUASMART DUR PRIMER for external and internal panel surfaces

AQUASAMRT DUR PRIMER is a solvent free primer which is to be applied on the internal and external surfaces of the GFRG wall panels and ceiling of GFRG slab (under-side of GFRG floor / roof slab) in order to improve the bonding strength and abrasion resistance of the panels. The components A, B, C and water mixed in the ratio of 8:8:1:2 by weight is to be applied in a dosage of 100 gms/rmt, allowing it to dry for 6 – 12 hours. Mixing is to be done at the site with a slow speed stirrer (300 rpm) to get uniform mix. After mixing the compound, it should be consumed within 45 minutes (summer) to 60 minutes (winter) depending upon the weather condition. The left-over mix cannot be stored for further application beyond 1 hour. It can be applied using brush / roller / spray gun on then GFRG panel surfaces. During rainy or windy period, it is better not to apply the primer. Primer should be applied only after completion of all the waterproofing works. It is recommended to apply the primer only on the eve of rendering work; or if rendering is not to be done, priming can be done 5-6 days before the commencement of painting work.

Immediately after mixing of the components, the mix will appear to be milky, while after the application, it will become transparent and will turn into a lightly yellowish colour within 3 to 4 hours. This will help a lot in distinguishing primed and un-primed wall at site. If the building is not to be painted, water based colour pigment can be mixed with the primer to provide any desired colour finish. For affordable mass housing, rendering or painting need not have to be done, instead **AQUASMART DUR PRIMER** mixed with a desired colour will give the final finish.

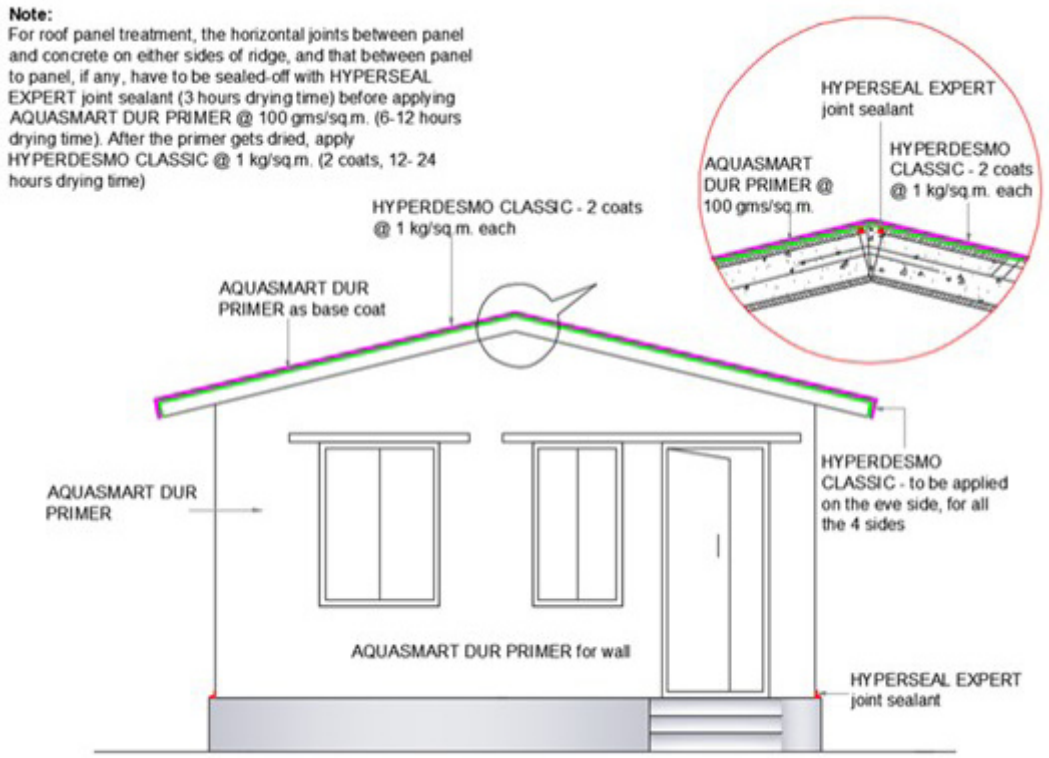
Rendering of the wall panel surfaces (external and bath / toilet walls) with a water–resistant rendering compound:

There is a need for a water-resistant rendering compound for rendering (thin layer of plaster of thickness - 1 to1.5 mm) of the GFRG panel surfaces in order to also have smooth finish of external wall surfaces and bath / toilet walls. One of the ideal products identified is Rapid gypsum plaster which is a gypsum based wall plaster, manufactured by FRBL Kochi and RCF Mumbai. But this require a suitable waterproofing chemical / product in order to mix with the gypsum plaster and to prepare the water resistant rendering mix, which should also has bonding with the panel surface and with the paint. If this rendering compound is not water resistant, rain can peel-off or erode the rendering.

Rapidwall gypsum plaster is being tested at Alchimica's lab in Greece in order to develop a suitable product to be mixed with the Rapidwall gypsum plaster to prepare a water resistant rendering compound & also a patching compound; or to develop a suitable single component ready to apply product, for applying a very thin layer of coating on the wall surface which has proper bonding and gives a smooth finish (0.5 to 1mm thick) to have very fine finish of the building and to apply paint over the top.

12) Water proofing treatment for roof panel of houses for the urban / rural poor with pitched roofing panel

Centrally sponsored housing (with Government subsidy) for rural poor under the Indira Awas Yojana (IAY) now subsumed with Pradhan Mantri Awas Yojana (Gramin) scheme having 20 sq.m. plinth area is the smallest housing unit which can be built for the rural poor in India. But for urban India, the housing unit size required is upto 30 sq.m. carpet area. The use of GFRG panel for pitched roofing is illustrated in the 'GFRG Structural Design Manual' issued by BMTPC, Ministry of Housing & Urban Affairs, Govt. of India, where the panel is used for roofing without the concealed RC beams and RC screed.



Figure–6: Waterproofing of GFRG house with sloped roof for rural / urban poor

Method of application:

After laying the roof panel in position, completing the tie down system and infill of concrete inside the wall cavities, ridge top and eve side, the joints at either sides of the ridge joint (joint between roof panel and RC concrete at ridge) need to be sealed off with **HYPERSEAL EXPERT** before the application of primer leaving a drying time of 3 hours. If roofing panel has joints, such joints also have to be sealed-off with **HYPERSEAL EXPERT**.

It is recommended to have a brush coat of **AQUASMART DUR PRIMER** at a dosage of 100 gms/sq.m. on the top and eve sides of the panel (exposed side of sloped roof slab), allowing this to dry for 6 - 12 hours, over which two coats of **HYPERDESMO CLASSIC** is to be applied (also covering the eave side) at a dosage of 500 gms/sq.m each, with a drying time of 12 – 24 hours between the successive coats and after the final coat. The application can be done using a roller / brush.

Under joints of roofing panel (inside the house) is to be sealed-off with rendering compound and then smooth-finished, before applying the primer.

7. Specification of items of waterproofing works for GFRG / Rapidwall buildings with Alchimica Polyurethane (PU) based products

1. Damp proof course (DPC) for protection of RC plinth beam top in GF:

Providing DPC with **AQUASMART DUR CONCENTRATE** (supplied in components A, B & C), mixed in 4:4:1 ratio (by weight) at site with a slow speed stirrer (300 rpm) to form homogenous mix, is applied @ 200 gms/rmt. This mixed compound is applied on the top of network of RC plinth beams (200mm wide) at the GF level using a short bristle special brush (available with manufacturer) / sprayer / spatula depending up on the site requirements. The dry concrete surface is wetted with water before application of DPC. Pot life of the mixed compound is between 45 to 60 minutes, depending upon the weather condition. The same type of treatment is also carried out for floor slab in the upper floors before the erection of external wall, bathroom, staircase / lift head room and parapet walls (150mm wide).

Drying time: 6 – 12 hours - In summer season or on days of warm weather, a minimum 6 hours drying time is provided and during monsoon season or in a cloudy day, a minimum 12 hours drying time is provided, for curing of this compound. Wherever the drying time is specified like-wise in this manual, it has to be interpreted as specified here. Erection of GFRG panel starts only after the DPC layer is completely cured. It is recommended to apply the DPC on the previous day, allowing it to cure over-night.

Unit of measurement: Running meters (rmt)

Note:

Providing 400micron polyethylene sheet (with overlap of 150 mm, when using more than 1 sheet) through-out the entire area on top of filled-up and consolidated earth / soil and below the PCC / floor concrete in GF to prevent rising dampness to GF floor will very useful.

2. Treatment of all cut-outs / window / door openings

Providing waterproofing treatment for the cut-outs made in GFRG panels for door / window / ventilator openings with a coating of **HYPERDESMO S** @ 200 gms/rmt over a base coat of **AQUASMART DUR CONCENTRATE** @200 gms/rmt. A layer of **HYPEROMEGA 125 FAB** of 125 mm width is sandwiched between the two coats.

Drying time: 6 – 12 hours for complete drying of **AQUASMART DUR CONCENTRATE;** 24 – 48 hours for curing of **HYPERDESMO S** before installation of door / window / ventilator frames.

Unit of measurement: Running meters (rmt)

3. Treatment of construction joints

Joints around window and door frames:
Providing joint treatment with **HYPERSEAL EXPERT** using sausage gun around door / window / ventilator frames. After completing the installation of frames in position, the junction between the frame and sub-surface is sealed with **HYPERSEAL EXPERT**. After application of PU joint sealant, tooling is

recommended for proper finishing.

Joint between GFRG panel and plinth beam:
The junction between the GFRG panel (around the periphery of the building) bottom and plinth beam top is treated (only external sides) with a pencil of **HYPERSEAL EXPERT PU** sealant of required size as per the site condition. Application of this sealant is done before the first pour of concrete into the cavities, allowing it to cure completely. In the event, if concrete is poured before application of PU sealant, then the set cement slurry is scraped and proper groove of 5 x 5 mm is formed, cleared and before application of PU sealant (but over a base coat of **AQUASMART DUR CONCENTRATE**) and allowed to cure.

Joint between GFRG panel and lintel cum sunshade:
Joint between the GFRG panel and lintel cum sunshade is grooved to a depth of 5 × 5mm, cleaned, and filled with **HYPERSEAL EXPERT**, over. a base coat of **AQUASMART DUR CONCENTRATE**.

Joint between wall panel and floor slab inside the toilet / bathroom:
The junction between the GFRG panel and floor slab is cleaned, applied with a pencil of **HYPERSEAL EXPERT PU** sealant, over a base coat of **AQUASMART DUR CONCENTRATE**. Size of this PU sealant depends upon the site condition.

Joint between GFRG panel and roof slab (parapet):
Internal junction between the GFRG panel and roof slab is treated with pencil of **HYPERSEAL EXPERT** PU sealant on the internal side of the parapet wall.

Drying time: 3 - 6 hours

Unit of measurement: running meters (rmt), also depends on the size of PU sealant

4. Water proofing treatment of bath / toilet floor and open balconies

Providing waterproofing treatment of wet areas (toilets & bathrooms) and balconies located in the upper floors (other than ground floor) of GFRG buildings with **HYPERDESMO S** @ 1.25 kg/sq.m. over a base coat of **AQUASMART DUR CONCENTRATE** @ 150 gms/sq.m. This treatment is extended 150mm high onto the walls around.

HYPERDESMO S treatment is carried out on the floor slab surface after sealing the joints between the panel and floor slab. Also, after completion of all plumping works and WC, PU sealant is provided at all the identified weak spots.

Drying time: 6 - 12 hours for **AQUASMART DUR CONCENTRATE**; 24 –48 hours (due to closed space) for **HYPERDESMO S**
Unit of measurement: square meters (sq.m.)

5. Pipe Packing

Pipe packing materials are provide with micro–concrete to fill the openings around the pipes in the GFRG panel and the edges are sealed with **HYPERSEAL EXPERT PU** sealant.

Unit of measurement: running meters (rmt)

6. Treatment of band (exposed area of slab) around the building

Providing waterproofing treatment of 174/184 mm wide band of the exposed floor/ roof slab, all around the building. Supply and application of two coats of **AQUASMART DUR CONCENTRATE** @ 300 gms/ rmt (200gms/rmt for the first coat and 100 gms/rmt for the second coat) of using spatula or special Alchimica brush, after sealing of joints with **HYPERSEAL EXPERT** (10 x 5mm) between the GFRG panel and concrete on top and on bottom.

Drying time: As mentioned earlier

Unit of measurement: Running meters (rmt)

7. Waterproofing treatment of terrace / roof slab and staircase / lift well head room slab

Providing waterproofing treatment on the terrace /roof slab after sealing the roof slab - staircase headroom / lift headroom / parapet wall joints with joint sealant. Procedure followed and billed as per the item 3 mentioned above.

After curing of joint sealant, providing terrace waterproofing with two coats of **HYPERDESMO CLASSIC** @ 1.5 kg/sq.m. over a base coat of **MICROSEALER 50** @ 100 gms/sq.m. **HYPERDESMO CLASSIC** is applied with spatula / sprayer / special Alchimica brush. This roof treatment is extended 300mm high onto the parapet walls and staircase head room / liftwell head room walls.

Drying time: 6 hours for MICROSEALER; 12 – 24 hours for HYPERDESMO CLASSIC

Unit of measurement: square meters (sq.m.)

8. Priming of external and internal panel surfaces

Providing external wall primer coating on the GFRG panel with **AQUASAMRT DUR PRIMER** (supplied in components A, B & C), mixed (with water) in 8:8:1:2 ratio (by weight) at site with a slow speed stirrer (300 rpm) to form homogenous mix, is applied @ 100 gms/sq.m. It is applied using brush / roller / spray gun on the GFRG panel surfaces. Pot life of mixed primer is 1 hour after mixing.

Drying time: 6 - 12 hours. Rendering / final painting is done after the primer coat is completely dried. Once the primer is dried, it turns light yellowish in colour within few days.

Unit of measurement: square meters (sq.m.)

9. Waterproofing treatment of roof panel of houses of the urban / rural poor with pitched roofing panel

Providing roof waterproofing for the pitched roof of GFRG houses (for rural / urban poor) by applying two coats of ***HYPERDESMO CLASSIC*** @ 500 gms/sq.m. each, over a base coat of A**QUASMART DUR PRIMER** @ 100 gms/sq.m.

Roof panel joints and concrete to panel joints are filled with **HYPERSEAL EXPERT** and are allowed to dry completely before application of **AQUASMART DUR PRIMER** and **HYPERDESMO CLASSIC**. The water proofing treatment is provided to the eaves sides (for all the four sides).

Drying time: 6 - 12 hours for **HYPERSEAL EXPERT** and **AQUASMART DUR PRIMER**; 12 - 24 hours for **HYPERDESMO CLASSIC**.

Unit of measurement: square meters (sq.m.)

About BMTPC

The Building Materials & Technology Promotion Council (BMTPC) under the aegis of the Ministry of Housing & Urban Affairs 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.

The information contained in this document is endorsed by Rapid Building Systems Pty.Ltd., Australia as an effective waterproofing system for buildings constructed using Rapidwall in India and SW Asia subject absolutely to the use of recommended quantities detailed and their appropriate application by skilled and trained applicators approved by Zydex and Alchimica.

Products, quantities and their application may change from time to time and it is the responsibility of the applicator to ensure they have the latest information available prior to application from www.zydexindustries.com and www.alchimica.com.