097.13 DPWH
05.23.2018

REPUBLIC OF THE PHILIPPINES
DEPARTMENT OF PUBLIC WORKS AND HIGHWAYS
OFFICE OF THE SECRETARY
MANILA

21 MAY 2018

DEPARTMENT ORDER NO. 80 Series of 2018 05.23.18

SUBJECT: Amendment to DPWH Standard Specification for Item 1046 – Masonry Works

In order to ensure uniformity in the application/ adoption of the Pay Items of Work to be used/ adopted by those who are involved in the preparation of the Design Plans and Quantities, Program of Works (POW) and Approved Budget for the Contract (ABC) for Infrastructure Projects Nationwide, and to provide material requirements for Autoclaved Aerated Concrete (AAC), the attached DPWH Standard Specifications for **Item 1046 – Masonry Works** is hereby prescribed, for the guidance and compliance of all concerned.

This specification shall form part of the on-going revision of the DPWH Standard Specifications for Public Works Structures – Buildings, Ports and Harbors, Flood Control and Drainage Structure and Water Supply Systems, Volume III, 1995 Edition.

This Order supersedes *Department Order No. 230, Series of 2016 (DPWH Standard Specification for Item 1046 – Masonry Works)* and shall take effect immediately.

MARK A. VILLAR
Secretary

14.1.2 FET/RGT

Department of Public Works and Highways
Office of the Secretary
WIN8U01609

DPWH STANDARD SPECIFICATION FOR ITEM 1046 – MASONRY WORKS

1046.1 Description

This Item shall consist of furnishing of all necessary materials, tools, equipment and labor necessary to complete the execution of the masonry works using Concrete Hollow Blocks, Louver Blocks and Autoclaved Aerated Concrete (AAC) blocks as shown on the Plans and herein specified.

1046.2 Material Requirements

1046.2.1 Hydraulic Cement

Hydraulic Cement shall conform to the applicable requirements of Subsection 900.2.1, Portland Cement of Item 900, Reinforced Concrete.

1046.2.2 Aggregates

1046.2.2.1 Aggregates for Concrete Hollow Blocks and Louver Blocks

Aggregates shall conform to the applicable requirements of Subsection 900.2.2, Concrete Aggregates of Item 900, Reinforced Concrete.

1046.2.2.2 Aggregates/Pozzolan for Autoclaved Aerated Concrete (AAC) blocks

Aggregates and pozzolan shall conform to the applicable requirements of ASTM C332, Standard Specification for Lightweight Aggregates for Insulating Concrete and ASTM C618, Standard Specification for Coal Fly Ash and Raw or Calcined Natural Pozzolan in Concrete, respectively.

1046.2.3 Water

Water shall conform to the applicable requirements of Subsection 900.2.3, Water of Item 900, Reinforced Concrete.

1046.2.4 Reinforcing Steel

1046.2.4.1 Reinforcing Steel for Concrete Hollow Blocks and Louver Blocks

Reinforcing steel shall conform to the applicable requirements of Item 902, Reinforcing Steel.

1046.2.4.2 Reinforcing Steel for Autoclaved Aerated Concrete (AAC) blocks

Dowels and tie bars shall conform to the applicable requirements of AASHTO M 322M or ASTM A996M, Standard Specification for Rail-Steel and Axle-Steel Deformed Bars for Concrete Reinforcement.

1046.2.5 Mortar for Concrete Hollow Blocks and Louver Blocks

Mortar shall consist of sand, cement and water conforming to the requirements of Item 900, Reinforced Concrete, mixed in the proportion of one (1) part cement to three (3) parts sand by volume, and sufficient water to obtain the required consistency.

1046.2.6 Quicklime for Autoclaved Aerated Concrete (AAC) Blocks

Quicklime shall conform to the applicable requirements of ASTM C5, Standard Specification for Quicklime for Structural Purposes.

1046.2.7 Gypsum for Autoclaved Aerated Concrete (AAC) Blocks

Gypsum shall conform to the applicable requirements of ASTM C22M, Standard Specification for Gypsum.

1046.2.8 Aeration Agent for Autoclaved Aerated Concrete (AAC) Blocks

Aeration agent shall conform to manufacturer's specifications.

1046.2.9 Thin-bed Mortar for Autoclaved Aerated Concrete (AAC) Blocks

Thin-bed mortar shall conform to the applicable requirements of ASTM C1660, Standard Specification for Thin-bed Mortar for Autoclaved Aerated Concrete (AAC) Masonry.

1046.2.10 Backer Rod for Autoclaved Aerated Concrete (AAC) Blocks

Backer rod shall conform to the applicable requirements of ASTM D5249, Standard Specification for Backer Material Use with Cold- and Hot- Applied Joint Sealants in Portland-Cement Concrete and Asphalt Joints.

1046.2.11 Concrete Hollow Blocks and Louver Blocks

Width, height and length of concrete hollow blocks and louver blocks shall be ±3.20 mm from the specified dimension shown on the Plans.

1046.2.11.1 Load-Bearing Concrete Hollow Blocks

Load-bearing concrete hollow blocks shall conform to the physical requirements of the Tables 1046.1 and 1046.2 as prescribed on ASTM C90, Standard Specifications for Load-bearing Concrete Masonry Units.

Table 1046.1 - Thickness of Face Shells and Webs

Nominal Width (W) of Units, mm	Minimum Face Shell Thickness (t_{fs}), mm	Minimum Web Thickness (t_w)	
		Webs, mm	Equivalent Web Thickness, mm/linear m
76.2 and 102	19	19	136
152	25	25	188
203	32	25	188
254 and greater	32	29	209

Table 1046.2 - Strength, Absorption, and Density Classification Requirements

Density Classification	Oven-Dry Density of Concrete, kg/m³	Maximum Water Absorption, kg/m³		Minimum Net Area Compressive Strength, MPa (Psi)	
	Average of 3 Units	Average of 3 Units	Individual Units	Average of 3 Units	Individual Units
Lightweight	Less than 1680	288	320	13.1 (1900)	11.7 (1700)
Medium Weight	1680 to less than 2000	240	272	13.1 (1900)	11.7 (1700)
Normal Weight	2000 or more	208	240	13.1 (1900)	11.7 (1700)

1046.2.11.2 Non-load bearing Concrete Hollow Blocks and Louver Blocks

Non-load bearing concrete hollow blocks shall be clearly marked to prevent their use as load bearing units.

1. **Type I, Moisture-Controlled Units –** Units shall conform to the requirements of Tables 1046.3, 1046.4 and 1046.5.

2. **Type II, Non-Moisture-Controlled Units –** Units designated as Type II shall conform to the requirements of Table 1046.4.

Table 1046.3 - Weight Classification

Weight Classification	Oven-Dry Density of Concrete, kg/m³
Lightweight	Less than 1680
Medium Weight	1680 to less than 2000
Normal Weight	2000 or more

Table 1046.4 - Strength Requirements

	Compressive Strength (average net area, Min.) MPa (Psi)
Average of 3 Units	4.14 (600)
Individual Unit	3.45 (500)

Table 1046.5 - Moisture-Content Requirements for Type I Units

Total Linear Drying Shrinkage, %	Moisture Content, Max., % of Total Absorption (Average of 3 Units)		
	Humidity Conditions at Job Site of Point of Use		
	Humid[A]	Intermediate[B]	Arid[C]
Less than 0.03	45	40	35
0.03 to less than 0.045	40	35	30
0.045 to 0.065, max	35	30	25

Note: [A] Mean annual relative humidity above 75%
[B] Mean annual relative humidity 50 to 75%
[C] Mean annual relative humidity less than 50%

1046.2.12 Autoclaved Aerated Concrete Blocks

Overall unit dimension (width, height or length) of autoclaved aerated concrete blocks shall not exceed three (3) mm from the specified dimension shown on the Plans.

Non-load bearing Autoclaved Aerated Concrete Blocks shall conform to the physical requirements of the following tables as prescribed on ASTM C1693, Standard Specifications for Autoclaved Aerated Concrete (AAC).

Table 1046.6 - Weight Classification

Strength Class	Nominal Dry Bulk Density, kg/m3	Density Limits, kg/m3	
		Lower Limit >	Upper Limit <
AAC-4	500	450	550
	600	550	650
AAC-5	600	550	650
	700	650	750
AAC-6	600	550	650
	700	650	750

Table 1046.7 - Strength Requirements

Strength Class	Minimum Compressive Strength, MPa (Psi)
AAC-4	4.0 (580)
AAC-5	5.0 (725)
AAC-6	6.0 (870)

Table 1046.8 - Average Drying Shrinkage Requirement

Strength Class	Average Drying Shrinkage
AAC-4	≤0.02%
AAC-5	≤0.02%
AAC-6	≤0.02%

1046.2.13 Other Constituents for Concrete Hollow Blocks and Louver Blocks

Air-entraining agents, coloring pigments, integral water repellents, finely ground silica, and other constituents that are previously established as suitable for use in concrete masonry shall conform to applicable ASTM standards.

1046.3 Construction Requirements

1046.3.1 Concrete Hollow Blocks and Louver Blocks

1046.3.1.1 Mixing

Concrete shall be mixed well using the proportion specified by the Engineer. Hand mixing shall be done, using shovels, on a level concrete slab or steel plate. Mix aggregate and cement until

the color is uniform. Spread the mixture out, sprinkle water over the surface and mix. Continue with this process until the right amount of water has been mixed in. Mixture shall be free from impurities such as dirt and grass.

If batch mixer is used, accurate timing and measuring devices shall be observed as per manufacturer's recommendation.

1046.3.1.2 Moulding

Hand operated machines shall be used as manufacturer's recommendation.

The mould of a powered machine should be filled until six (6) to eight (8) cycles of compaction are required to bring the compacting head to its stops.

Demoulding or removal of the mould shall be done carefully so that the fresh blocks are not damaged. Fresh blocks shall be protected from rain with plastic sheets or any suitable covering during the first day and from the drying effects of the sun and wind until curing starts.

1046.3.1.3 Curing

After being removed from the mold, the Concrete Hollow Blocks (CHB) and Louver Blocks shall be covered with a plastic sheet or tarpaulin and kept damp and shaded for at least seven (7) days in order to effectively cure. This can be achieved by continually spraying them with water or keeping them under water in tanks.

1046.3.1.4 Installation

1. All masonry work shall be laid true to line, level, plumb and neat in accordance with the Plans.

2. Units shall be cut accurately to fit all plumbing ducts, opening for electrical works, and all holes shall be neatly patched.

3. No construction support shall be attached to the wall except where specifically permitted by the Engineer.

4. Masonry unit shall be sound, dry, clean and free from cracks when placed in the structure.

5. Proper masonry units shall be used to provide for all window, doors, bond beams, lintels, plasters etc., with a minimum of unit cutting.

6. Where masonry units cutting is necessary, all cuts shall be neat and true to line.

7. Units shall be placed while the mortar is soft and plastic. Any unit disturbed to the extent that the initial bond is broken after initial positioning shall be removed and re-laid in fresh mortar.

8. Mortar should not be spread too far ahead of units, as it will stiffen and loose plasticity, especially in hot weather. Mortar that has stiffened should not be used. ASTM C270, Standard Specification for Mortar for Unit Masonry requires that mortar be used within 2½ hours of initial mixing.

1046.3.1.5 Reinforcement for Concrete Hollow Blocks

Reinforcement shall be done in accordance with the structural Plans as to size, spacing and other requirements of Section 902.3 of Item 902, Reinforcing Steel.

Reinforcement shall be clean and free from loose, rust, scales and any coatings that will reduce bond.

1046.3.1.6 Finish and Appearance

1. All units shall be sound and free of cracks or other defects that interfere with the proper placement of the unit or significantly impair the strength or permanence of the construction. Minor cracks, incidental to the usual method of manufacture or minor chipping resulting from customary methods of handling in shipment and delivery, are not grounds for rejection.

2. Where units are to be used in exposed wall construction, the face or faces that are to be exposed shall not show chips or cracks, not otherwise permitted, or other imperfections when viewed from a distance of not less than 6.1 m under diffused lighting.

    a. Five (5) percent of a shipment containing chips, not larger than 25.4 mm in any dimension, or cracks not wider than 0.5 mm and not longer than 25 percent of the nominal height of the unit, is permitted.

3. The color and texture of units shall be specified by the purchaser. The finished surfaces that will be exposed in place shall conform to an approved sample, consisting of not less than four (4) units, representing the range of texture and color permitted.

4. A shipment shall not contain more than five (5) percent of units, including broken unit that do not meet the requirements of the above provisions.

1046.3.1.7 Sampling and Testing for Concrete Hollow Blocks and Louvers

Method of Sampling for Quality Test shall be as follows:

1. One (1) Quality Test for every 10,000 units or fraction thereof.
2. Six (6) specimens to be submitted for one (1) quality test in which three (3) specimens for Compression Test and the remaining three (3) for Moisture Content and Water Absorption.

Units shall be tested in accordance with ASTM C140, Standard Test Methods for Sampling and Testing Concrete Masonry Units and Related Units and ASTM C426, Standard Test Method for Linear Drying Shrinkage of Concrete Masonry Units.

1046.3.1.8 Storage and Handling of Masonry Works

The blocks shall be stored in such a way as to avoid contact with moisture at site. They shall be stock-piled on planks or other supports free from contact with ground and covered to protect against wetting. The block shall be handled with care and damaged units shall be rejected.

1046.3.2 Autoclaved Aerated Concrete (AAC) blocks

1046.3.2.1 Installation

1. Establish reference lines based on the given Plan.

2. Make layout adjustments or opening rectifications (plumbing ducts or opening for electrical works) before laying masonry units.

3. Masonry unit shall be clean and free from dust or loose particles on it.

4. Floor and wall area shall be moistened prior to laying first layer of masonry unit. Mortar setting with 2:1 sand:cement ratio shall be provided as starter blocks if slab is unleveled beyond two (2) cm.

5. Adhesive shall be mixed using manufacturer's specified proportion of water using a power mixer and a non-absorptive pail or mixing container. Adhesive that has stiffened should not be used. Refer to manufacturer's instructions for the pot life of the adhesive mix.

6. Thin bed adhesive shall be set and screed with notched trowel on the starter blocks to receive initial layer of masonry unit.

7. Laying of masonry unit shall be continued until the lateral layer is complete before moving on to the next layer. Adhesive shall be applied at five (5) mm thick using a notched trowel on the required portions and maintaining three (3) – five (5) mm gap on the wall side surface to allow any wall movement. Alignment and levelness shall be regularly checked using rubber mallet and level bar.

8. Gaps and joints shall be filled with adhesive. Excess adhesive should be spread on the surface or used to fill the gaps.

9. Rebar dowel, 10 mm in diameter, shall be installed spaced at 600 mm on the wall sides and along the affected beam and slab soffit. Dowel should be embedded at least 50 mm into the side and top structures, exposing 100 mm to support lateral movement. No epoxy is needed.

10. Polyethylene backer rod, 20 mm in diameter, shall also be simultaneously installed at the slab or beam soffit.

11. When cutting of masonry unit is necessary, it shall be downsized first before applying the adhesive. Ice or wood saw can be used for this matter.

12. Corner interlocking setup is recommended.

1046.3.2.2 Finish and Appearance

1. All units shall be sound and free of cracks or other defects that interfere with the proper placement of the unit or significantly impair the strength or permanence of the construction. Minor cracks, incidental to the usual method of manufacture or minor chipping resulting from customary methods of handling in shipment and delivery, are not grounds for rejection.

2. Where units are to be used in wall construction, the face or faces that are to be exposed shall not show chips or cracks, not otherwise permitted, or other imperfections when viewed from a distance of not less than 6.1 m under diffused lighting. Five (5) percent of a shipment containing chips and cracks not longer than one-third (1/3) of the dimension where it is found and not wider than five (5) mm is permitted.

3. The color and texture of units shall be specified by the purchaser. The finished surfaces that will be exposed in place shall conform to an approved sample, consisting of not less than four (4) units, representing the range of texture and color permitted.

4. A shipment shall not contain more than five (5) percent of units, including broken unit that do not meet requirements of the above provisions.

1046.3.2.3 Sampling and Testing

Method of Sampling for Quality Test shall be as follows:

1. Two (2) Quality Tests for every 10,000 units or a fraction thereof
2. Three (3) specimens to be submitted for every one (1) quality test namely, Compression Test and Moisture Content & Bulk Density Determination.

Units shall be tested in accordance with ASTM C1693, Standard Specifications for Autoclaved Aerated Concrete (AAC).

1046.3.2.4 Storage and Handling of Masonry Works

The blocks shall be stored in such a way as to avoid contact with moisture at site. They shall be stock-piled on planks or other supports free from contact with ground and covered to protect against wetting. The block shall be handled with care and damaged units shall be rejected.

1046.4 Method of Measurement

The work to be paid for under this Item shall be the number of square meters of masonry units that are satisfactorily accepted and completed.

1046.5 Basis of Payment

The accepted quantity, measured as prescribed in Section 1046.4, Method of Measurement shall be paid for at the Contract Unit Price for Masonry Works which price and payment shall include the cost of furnishing all labor, materials and equipment necessary to complete the work.

Payment shall be made under:

Pay Item Number	Description	Unit of Measurement
1046 (1) a1	CHB Load-Bearing (including Reinforcing Steel), 100 mm	Square Meter
1046 (1) a2	CHB Load Bearing (including Reinforcing Steel), 150 mm	Square Meter

Pay Item Number	Description	Unit of Measurement
1046 (2) a1	CHB Non-Load-Bearing (including Reinforcing Steel), 100 mm	Square Meter
1046 (2) a2	CHB Non-Load Bearing (including Reinforcing Steel), 150 mm	Square Meter
1046 (3)	Louver Block	Square Meter
1046 (4) a1	AAC Non-load Bearing, 100mm	Square Meter
1046 (4) a2	AAC Non-load Bearing, 150mm	Square Meter

References:

1. *American Society for Testing and Materials (ASTM)*
2. *American Association of State Highway and Transportation Officials (AASHTO)*
3. *DPWH Standard Specification for Highways, Bridges and Airports, Vol, II*
4. *Internet: http://www.afrisam.co.za/media/13734/How_to_make_concrete_bricks_and_blocks.pdf*
5. *Internet: National Concrete Masonry Association, www. ncma.org*
6. *Internet: https://www.sheltercluster.org/sites/default/files/docs/Key%20Messages%20CHB%20V1.1.pdf*
7. *Internet: http://photos.state.gov/libraries/manila/681079/aventuradohj/ATTACHMENT%206.pdf*
8. *AAC by LightStrong Product Brochure*