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

0927, 13 DPWH
12-12-2005

DEC 09 2005

DEPARTMENT ORDER)
NO. 96)
Series of 2005 12-17-05)

SUBJECT: Use of Geoset as Stabilizer to Lahar Materials

In line with the continuing efforts to upgrade the construction technology thru the adoption of successful research studies, this Department has approved the use of Cement-based Solidifying Agent (Geoset) as Stabilizer to Volcanic Sand/Lahar Materials, to improve the strength properties of lahar materials subject to its specifications, hereto attached. A Certificate of Conditional Approval had been issued by this Department, accrediting the use of Geoset in DPWH projects from April 2004 until April 2009.

This order takes effect immediately.

HERMOGENES E. EBDANE, JR.
Acting Secretary

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DEPARTMENT ORDER
NO. 96
SERIES OF 2005

ANNEX "A"

SPECIFICATION OF LAHAR STABILIZED WITH GEOSET AS ROAD FOUNDATION MATERIALS

1.1 Description

This item shall consists of furnishing, placing and compacting lahar stabilized with GEOSET on an embankment or on a prepared base / subbase in accordance with this specification and the lines, grades, thickness and typical cross-sections shown on the Plans, or as established by the Engineer.

1.2 Materials Requirements

1.2.1 Composition and Quality of Lahar Stabilized with GEOSET

1.2.1.1 Lahar

Untreated lahar shall conform to the grading requirements of Table 1.

Table 1 – Grading of Untreated Lahar

Sieve Analysis	Specification % Passing
Sieve Size, mm	
19.0	100
12.5	-
9.5	95 - 100
4.75	85 - 90
2.36	-
1.18	45 – 80
0.60	-
0.30	30 - 35
0.15	15 – 20
0.075	0 – 15

1.2.1.2 Stabilized Lahar

The stabilized lahar shall be composed of volcanic sand at its saturated surface dry condition, solidifying agent GEOSET and water in proper proportions. The bearing strength value of in-placed lahar treated with GEOSET shall not be less than the conventional base, which is 80%.

1.2.2 Stabilizing Agent

GEOSET is a cement-based solidifying agent that can be used as stabilizer to improve the strength properties of lahar materials.

Properties of GEOSET

Physical

Density	- ≥ 2.90	g/cm³
Fineness	- ≥ 2,700	cm²/g

Chemical

Loss on Ignition	- ≤ 5.0	
Insolubility	- ≤ 3.0	
SiO_2	- 18.0 - 22.0	
Al_2O_3	- 3.0 - 6.0	
Fe_2O_3	- 2.0 - 4.0	
CaO	- 50.0 - 65.0	
MgO	- ≤ 5.0	
SO_3	- 3.5 - 9.5	

1.2.3 Water

It shall conform to the requirements of Item 714, Water.

1.2.4 Proportioning of Mixture

The amount of GEOSET to be added to the untreated lahar shall be more than 2% and the optimum mixing ratio should be determined in the laboratory and approved by the Engineer based on the type of soils and required strength.

By adding the adequate amount of GEOSET to lahar materials according to its properties, an increased compressive strength and California Bearing Ratio (CBR) values can be achieved.

1.3 Construction Requirements

1.3.1 Preparation of Roadway

1.3.1.1 Embankment

It shall conform to the requirements of Item 104, Embankment.

1.3.1.2 Base / Subbase

The existing surface shall be graded and finished as provided under Item 105, Subgrade Preparation, before placing lahar stabilized with GEOSET.

1.3.2 Placing

Lahar stabilized with GEOSET shall be placed at a uniform mixture on an embankment or on a prepared subgrade in a quantity, which will provide the required compacted thickness. When more than one layer is required, each layer shall be shaped and compacted before the succeeding layer is placed.

The placing of material shall begin at the point designated by the Engineer. Placing shall be from vehicles especially equipped to distribute the material in a continuous uniform layer or windrow. The layer or windrow shall be of such size that when spread and compacted the finished layer shall be in reasonably close conformity to the nominal thickness shown on the Plans.

When hauling is done over previously placed material, hauling equipment shall be dispersed uniformly over the entire surface of the previously constructed layer, to minimize rutting or uneven compaction.

1.3.3 Spreading and Compacting

When uniformly mixed, the mixture shall be spread to the plan thickness, for compaction.

Where the required thickness is 150 mm or less, the material may be spread and compacted in one layer. Where the required thickness is more than 150 mm, the lahar stabilized with GEOSET shall be spread and compacted in two or more layers of approximately equal thickness, and the maximum compacted thickness of any layer shall not exceed 150 mm. All subsequent layers shall be spread and compacted in a similar manner.

The moisture content of treated lahar shall, if necessary, be adjusted prior to compaction by watering with approved sprinklers mounted on trucks or by drying out, as required in order to obtain the required compaction.

Immediately following final spreading and smoothening, each layer shall be compacted to the full width by means of approved compaction equipment. Rolling shall progress gradually from the sides to the center, parallel to the centerline of the road and shall continue until the whole surface has been rolled. Any irregularities or depressions that develop shall be corrected by loosening the material at these places and adding or removing material until surface is smooth and uniform. Along curbs, headers, and walls, and at all places not accessible

to the roller, the treated lahar shall be compacted thoroughly with approved tampers or compactors.

If the layer of treated lahar, or part thereof, does not conform to the required finish, the Contractor shall, at his own expense, make the necessary corrections.

Compaction of each layer shall continue until a field density of at least 100 percent of the maximum dry density determined in accordance with AASHTO T 180, Method D has been achieved. In-place density determination shall be made in accordance with AASHTO T 191.

The compacted lahar treated with GEOSET shall be continuously cured and covered by tarpaulins prior to surfacing of either asphalt or concrete pavement.

1.3.4 Trial Sections

Before lahar stabilized with GEOSET is laid, the Contractor shall spread and compact trial sections as directed by the Engineer. The purpose of the trial sections is to check the suitability of the materials and the efficiency of the equipment and construction method, which is proposed to be used by the Contractor. Therefore, the Contractor must use the same material, equipment and procedures that he proposes to use for the main work. One trial section of about 500 m^2 shall be made for every type of material and/or construction equipment/procedure proposed for use.

After final compaction of each trial section, the Contractor shall carry out such field density tests and other tests required as directed by the Engineer.

If a trial section shows that the proposed materials, equipment or procedures in the Engineer's opinion are not suitable for base, the material shall be removed at the Contractor's expense, and a new trial section shall be constructed.

If the basic conditions regarding the type of material or procedure change during the execution of the work, new trial sections shall be constructed.

1.3.5 Tolerances

Lahar stabilized with GEOSET shall be laid to the designed level and transverse slopes shown on the Plans. The allowable tolerances shall be in accordance with following:

Permitted variation from design THICKNESS OF LAYER	± 10 mm
Permitted variation from design LEVEL OF SURFACE	+ 5 mm -10 mm
Permitted SURFACE IRREGULARITY Measured by 3-m straight-edge	5 mm
Permitted variation from design CROSSFALL OR CAMBER	± 0.2%
Permitted variation from design . LONGITUDINAL GRADE over 25 m in length	± 0.1%

1.4 Method of Measurement

Lahar treated by GEOSET will be measured separately in cubic metre (m^3) and the actual weight of GEOSET used, respectively. No allowance shall be given for materials placed outside the design limits shown on the cross-sections. Trial sections shall not be measured separately but shall be included in the quantity of lahar and GEOSET used.

1.5 Basis of Payment

The accepted quantities, measured as prescribed in Section 1.4, shall be paid for at the contract unit price for the quantity of GEOSET used and lahar delivered and which price and payment shall be full compensation for furnishing and placing all materials, including all labor, equipment, tools and incidentals necessary to complete the work prescribed in this Item.

Payment will be made under:

Payment Item Number	Description	Unit of Measurement
1	Lahar	Cubic metre
2	GEOSET	Kilogram/Tonne

Department of Public Works and Highways

CERTIFICATE OF CONDITIONAL APPROVAL

Product Accreditation

This is to certify that

GEOSET

which is supplied by

Kawasho Corporation
20th Floor Metrobank Plaza
Sen. Gil J. Puyat Ave., Extension
Makati City

is duly accredited for use in DPWH projects as stabilizer to Volcanic Sand/Lahar, subject to its specifications (hereto attached) pursuant to the provisions of DPWH Department Order No. 189, series of 2002.

This Accreditation shall remain in force until expiry date printed below, subject to compliance with the requirements of the aforementioned Department Order.

Conditional Approval No.	:	003
Date Issued	:	April 2004
Expiry Date	:	April 2009

FLORANTE SORIQUEZ
Acting Secretary