

Prestressed Ground Anchors in Building Works

The use of permanent prestressed ground anchors in a project imposes a long-term monitoring commitment on the maintenance parties which usually involves appreciable recurrent cost and, should deficiencies be revealed, remedial works may be difficult and expensive. The past records show that compliance with this criterion by the owners is not practically viable. For these reasons, Buildings Department takes the view that the permanent ground anchors requiring long term monitoring are short-lived temporary building works and the Building Authority has the power to refuse to accept such temporary building works for incorporation into a permanent building under the Buildings Ordinance.

2. In the exceptional circumstances where permanent prestressed ground anchors are considered acceptable, their provision and installation in building works should be in accordance with the requirements and procedures given in Appendix A.



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In the exceptional circumstances where permanent prestressed ground anchors are considered acceptable, their provision and installation in building works should be in accordance with the requirements given in the Model Specification for Prestressed Ground Anchors (GEOSPEC 1). In conjunction with the publication of GEOSPEC 1, a Prior Approval System for Permanent Prestressed Ground Anchors (PASA), operated by the Geotechnical Engineering Office came into effect. The PASA confers a level of acceptance on proprietary ground anchor systems (Approved Anchor Systems) and on different types of ground anchors (Approved Anchor Types) within each Approved Anchor System. The object of the PASA is to ensure consistent and satisfactory standards in the provision of ground anchors and to save time for designers, contractors, suppliers and approving authorities in avoiding repetitive checking of the design of components and assembly details. The PASA therefore simplifies the processing of submissions for building works incorporating ground anchors. It must however be pointed out that the PASA does not remove any of the responsibilities of the authorized persons (AP) and registered structural engineers (RSE) under the Buildings Ordinance. Submissions including anchor systems not under the PASA may still be made in the usual way. Further details of the PASA, and definition of terms, are given in GEOSPEC 1.

2. A list of the current Approved Anchor Systems and Approved Anchor Types is available free from the Geotechnical Information Unit of the Civil Engineering Library. Copies may also be obtained by writing to the Technical Secretary of the Geotechnical Engineering Office, Civil Engineering Department.

3. Approved Anchor Types in the Prior Approval list when supplied and installed in compliance with the relevant Prior Approval Documents are considered technically acceptable to the Building Authority. Where permanent prestressed ground anchors under the PASA are to be used in a private project, the RSE would normally be required to provide the following information in relation to the anchors in the submission for approval :

- (a) a plan showing the location, inclination and length of the anchors required;
- (b) the Anchor Class (as defined in GEOSPEC 1), design working load and design free anchor length of each anchor together with supporting justification including geotechnical information and design calculations;
- (c) which anchors are to be subjected to Suitability Tests and Extended Acceptance Tests;
- (d) the compressive movement which must be allowed for between the anchor pad and the fixed length during stressing;
- (e) details of the anchor pad provision; and

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- (f) arrangements for long-term monitoring, including the schedule for future monitoring, provision of access and the agreement of the relevant maintenance party that it is willing to undertake the required long-term monitoring and maintenance.

4. In addition, the RSE will be required to submit plans and sections of the proposed anchored structure showing site boundaries and geotechnical information together with his own anchor design calculations. The RSE will also be required to furnish with the submission, plans of all adjacent buried and surface public utility services and adjacent buried and surface structures and to demonstrate that anchors will not cause damages. Plans and design calculations relating to other works not related to anchors should be submitted in the usual manner.

5. Prior to consent application for works in relation to the anchors, the RSE should submit additional plans for approval, giving the name of the Approved Anchor System and the Approved Anchor Types adopted, the specification of any materials which may need to be replaced, the schedule and procedures for future monitoring and guidelines on the interpretation of future monitoring results; the name and experience of the anchor installation contractor to be employed should also be submitted. The installation contractor must be suitably experienced in the installation of the adopted Approved Anchor System and should therefore be selected from the list of Nominated Anchor Contractors as specified in the Prior Approval Documents for the Approved Anchor System. Conditions and requirements under Buildings Ordinance section 17(1) may be imposed for such standards of workmanship and qualified supervision as appropriate, and consent to the anchoring works may be refused if any of the above information is not provided to the satisfaction of the Building Authority or is in conflict with the requirements of the PASA.

6. For the purpose of checking on site the adequacy of the ground anchors, RSEs are advised to maintain a certified true copy of the full set of the Prior Approval Documents on site prior to commencement of the approved anchor works. The RSE shall ensure that the provision, installation, testing and monitoring of the anchors is in accordance with the Prior Approval Documents.

7. After installation of any anchor system, the RSE should submit to the Buildings Department (BD) an 'as built' location drawing showing the full length and details of each anchor installed together with the following information, which may have been shown in the approved plans or required as conditions to consent :

- (a) the name of the Approved Anchor System and Approved Anchor Type;
- (b) the specification for any materials which may need to be replaced;
- (c) the design load of each anchor;
- (d) a summarized 'as built' record of total length, bond length, free length, angle of inclination, descriptions of all strata encountered in drilling, quantity of grout injected and pressures, used for each anchor;

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- (e) the dates of all stages of installation, testings and monitoring;
- (f) all anchor stressing records and test records including those for trial anchors, Suitability Tests, Acceptance and/or Extended Acceptance Tests;
- (g) a record of the monitoring results taken to date;
- (h) the schedule and procedures for future monitoring; and
- (i) guidelines on the interpretation of future monitoring results.

8. Monitoring of prestressed ground anchors is essential throughout their service life to ensure their continued satisfactory performance. The requirements for monitoring are given in GEOSPEC 1. It is therefore essential that the parties responsible for subsequent maintenance are consulted and their agreement obtained before prestressed ground anchors are adopted and that they are provided with complete 'as built' details.

9. In accordance with GEOSPEC 1, testing of existing grease in the anchor heads is to be undertaken during anchor monitoring, in addition to the normal anchor inspections and residual load measurement. During the past few years, the Geotechnical Engineering Office (GEO) has received some queries on the method of determination of the chloride, nitrate and sulphide ion contents in the grease. The GEO has issued Corrigendum 1/98 (May) and Corrigendum 2/98 (September) to clarify the method of extraction of water-soluble ions and of the method of calculation of the soluble ion contents. These corrigenda are attached to the Appendix and AP/RSEs are requested to take these into account when undertaking work in the monitoring of prestressed ground anchors.

10. In the past, submissions have sometimes proposed the provision of ground anchors extending outside the site boundary into public or private streets, government land or adjacent private land. Ground anchors can give rise to unacceptable consequences such as the obstruction of new works or new public utility services, and, in addition, their existence could inhibit the development of land. Furthermore, an undesirable situation could result should damage to property or public utility services be caused during installation. Therefore only in exceptional circumstances will approval be given to submissions of any new development incorporating ground anchors outside the site boundary.

11. If it is intended to extend the ground anchors outside the site boundary into government land, application to the Land Authority (Lands Department) for permission should be made at the early stages of design. Where it is intended to extend the anchors into adjacent private land, the specified Form BA5 for the site formation works should include the lot number of the adjacent private land, to indicate the acquiescence of the adjoining owner.

This revision January 1999 (Para. 9 added & paras. 10 & 11 re-numbered)

**MODEL SPECIFICATION
FOR PRESTRESSED GROUND ANCHORS (GEOSPEC 1)**

1989 Edition (Hong Kong Government)

CORRIGENDUM No. 1/98 (May)

Table 1
Properties of Grease
(Page 75)

Replace Note 3(a) with the following :

“(a) Weigh, accurate to 0.001g, about 5g of grease into a separating funnel, add 70ml of hexane and shake the mixture until the grease is completely dissolved.”

Add Note 3(g) at the end of the table :

“(g) For the purpose of calculating the chloride, nitrate and sulphide ion contents, the concentration should be determined as parts per million by mass of the final aqueous extract.”

- Notes :**
- (1) Note 3(a) is amended to specify the use of hexane as the organic solvent. This revision is to enable more effective separation of the organic solvent from the aqueous extract in the extraction process during the grease testing.
 - (2) Note 3(g) is added to clarify for users the intended calculation method for chloride, nitrate and sulphide ion contents.

**MODEL SPECIFICATION
FOR PRESTRESSED GROUND ANCHORS (GEOSPEC 1)**

1989 Edition (Hong Kong Government)

CORRIGENDUM No. 2/98 (September)

Table 1
Properties of Grease
(Page 75)

Replace 3(a), 3(d) and 3(f) with the following :

“(a) Weigh, accurate to 0.001g, $5g \pm 0.05g$ of grease into a separating funnel, add 70ml of hexane and shake the mixture until the grease is completely dissolved.”

“(d) Add, to the second separating funnel containing the combined water extract, about 20 - 30 ml of hexane, gently swirl the mixture and again allow for complete separation of the 2 layers.”

“(f) Carry out a blank determination, following the same procedures, with the same amount of reagents, as the sample determination. Subtract the corresponding blank value, if any, from each of the water-soluble ion determinations to obtain the corrected values of these ion determinations.”

- Notes :**
- (1) Note 3(a) is amended to prescribe the acceptable tolerance in the weighing of the grease sample.
 - (2) Note 3(d) is amended to using hexane as the organic solvent consequent to revising Note 3(a) in Corrigendum No. 1/98 (May).
 - (3) Regarding Note 3(f), it is necessary and common practice to conduct a corresponding blank determination to obtain a “real” value of the target analysis determination.
 - (4) Regarding Note 3(g) in Corrigendum No. 1/98 (May), the term “mass of the final aqueous extract” shall be interpreted as the mass of deionized water used for the extraction of water-soluble ions in the grease sample. The mass or the volume of organic solvent (hexane) for dissolving the grease sample shall not be included in the calculation of water-soluble ion contents.