

**STRUCTURES DESIGN MANUAL  
FOR HIGHWAYS AND RAILWAYS**

**2013 Edition**

**AMENDMENT NO. 1/2021**

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**Highways Department**

The Government of the Hong Kong  
Special Administrative Region



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**2013 Edition**

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### **INTRODUCTION**

The “Structures Design Manual for Highways and Railways – 2013 Edition” (SDM) published by the Government of the Hong Kong Special Administrative Region sets out standards and provides guidance for the design of highway and railway structures in Hong Kong. In 2021, Highways Department conducted a review on enhancing the requirements for external prestressing.

Following the review, amendments to Section 5.6.3 of the SDM are made.

### **AMENDMENT DETAILS**

The following amendments are made:-

- 1. CONTENTS**  
Page 8 of the SDM is replaced by Replacement Sheet 1.
- 2. CHAPTER 5**  
Page 90A of the SDM is replaced by Replacement Sheets 2 to 4.

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- (6) Provisions shall also be made in the design to facilitate routine inspection and maintenance of the tendons, particularly at the locations of deviators and anchor diaphragms where the tendons/anchors are encased in concrete. In particular, each tendon shall be provided with an identification tag showing the tendon reference number and anchorages shall be fabricated with inspection holes located to permit a probe or inspection by borescope of the upper part of the duct behind the anchor heads. The holes shall also facilitate the post-grouting inspection. Anchorage caps covering the inspection holes shall be designed to be removable as necessary for access to the inspection holes.
- (7) A robust multiple barrier protection system shall be used to protect the external tendons from weathering and corrosion.
- (8) For grouted tendons, consideration should be given to the use of vacuum-assisted grouting for improved quality of grouting especially for long horizontal tendons and for tendons without access/vents at the high points of the tendon profiles.
- (9) Length of tendons shall not exceed 200m, and length between grout injection point and the most distant grout vent/anchor head shall not exceed 100m, unless it can be demonstrated with grouting trials that complete filling of the tendon ducts, with the tendons completely surrounded with grout, can be satisfactorily achieved. Similarly for tendons to be injected with other flexible corrosion-inhibiting products.
- (10) It is preferable to provide remote monitoring and warning system for the detection of tendon/strand/wire breakage. At locations where inspection of tendons is difficult, remote monitoring and warning system shall be provided. The need and details of the provision shall be agreed with the respective maintenance offices during the design stage.
- (11) Detailed method statements describing the procedures and their purposes as well as the quality checking arrangement shall be approved by the Engineer before commencement of the prestressing works.
- (12) To inspect the quality of grouting, hammer sounding or other equivalent inspection methods shall be conducted at all grouted tendons before handing over of the completed structures to the maintenance authority. If suspected voids are detected, further verification by local tendon duct sectioning or borescope inspection through drilled holes shall be carried out.
- (13) The quality of grouting at anchorages and deviators shall also be inspected. Such inspection can be conducted in form of visual inspections of the grouting condition at grout vents. If suspected abnormalities are found, further verification by borescope inspection through grout vents or pre-installed inspection holes shall be carried out.
- (14) The inspection of quality of grouting shall not be conducted by the prestressing works contractor or his agents, and shall be conducted by the site supervisory staff or other independent parties.
- (15) Adequate training shall be provided to all supervisory personnel and workers to ensure their awareness of the purposes of every step and detail of the prestressing works.

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- (16) To facilitate future maintenance, the following records shall also be passed to the respective maintenance authorities upon handing over of completed structures:
- (a) Information of prestressing system and components, such as product names, serial numbers, catalogues, materials, details of corrosion protection system, testing records, as-built dimensions and profiles.
  - (b) Records of grouting operations, including location, date and time, weather conditions, technical personnel supervising or carrying out the grouting operations, prestressing tendon reference numbers, grout mix, admixtures used, grouting equipment, grouting methods and procedures, actual locations of grout vents and taps, grout material test reports, grouting trial reports, air test of grout vents and detailed records of the grouting operation (such as injection pressures, volume of grout used, time and duration of grouting, and details of any interruptions and topping up).
  - (c) Records of tensioning operations, including location of the operations, coil, heat and bundle numbers of strand used, date and time, weather conditions, technical personnel supervising or carrying out tensioning operations, prestressing tendon reference numbers, tensioning apparatus identification, prestressing sequence, measured extensions, amount of draw-in and pressure gauge or load cell reading.
  - (d) Records of duct friction tests.
  - (e) Other particulars, records and reports in relation to prestressing works which are required to be submitted by the contractors under the contract specifications.
  - (f) Records of hammer sounding inspection at tendons, the inspection of grouting condition at anchorages and deviators, and the subsequent remedial and reinstatement works. The inspection records shall be checked and signed by the project office or the resident site staff.
  - (g) Any abnormality observed during prestressing works.
  - (h) Method statements on tendon replacement/removal as mentioned in Clauses 5.6.3(4) and 5.6.3(5).
  - (i) Information on provisions made in the design to facilitate routine inspection and maintenance of tendons as mentioned in Clause 5.6.3(6).
  - (j) Design calculation and computer model.
- (17) Where circumstances justify it, other external prestressing tendon systems comprising of individual strands, each with permanent protective materials and sheathing, such as a monostrand system, may be considered in the design as alternatives to grouted tendons. If an alternative system is considered feasible, project-specific design and maintenance requirements shall be proposed for the agreement by Chief Highway Engineer/Bridges and Structures and the respective maintenance authorities.

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#### **5.6.4 Specialist Prestressing Contractors**

(1) All prestressed concrete works for highway structures shall be carried out by specialist contractors in the Prestressed Concrete Works for Highway Structures Category of the List of Approved Suppliers of Materials and Specialist Contractors for Public Works.

(2) The Prestressed Concrete Works for Highway Structures Category consists of two classes:

Class I - Supply and Installation of Prestressing Systems; and

Class II - Supply of Prestressed Concrete Units.

(3) The supply and installation of on-site prestressing work shall be carried out by a contractor in Class I. Precast prestressed units manufactured off-site shall be supplied by a contractor in Class II.