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**LONG-TERM SETTLEMENT OF THE
NATIONAL MUSEUM, OTTAWA, CANADA**

BY

M. BOZOUK

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Long-term Settlement of the National Museum, Ottawa, Canada

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The settlement record of a point on the National Museum building in Ottawa for the period 1951 to 1974 is given. It shows that the average rate of settlement for this period was about 0.003 ft (0.9 mm) per year. Total settlement of the point since the structure was completed in 1910 is estimated to be 0.27 ft (82 mm).

Les observations de tassement d'un repère sur le bâtiment du Musée National à Ottawa sont données pour la période de 1951 à 1974. Elles indiquent que la vitesse moyenne de tassement durant cette période est de 0.003 pied (0.9 mm) par an. Le tassement total du repère, depuis l'achèvement de la structure en 1910, est estimé à 0.27 pied (82 mm).

The National Museum, also known as the Victoria Museum, was completed in 1910. It is a four-storey structure about 400 ft (122 m) long, 150 ft (46 m) wide, with heavy sandstone bearing walls supported on spread footings and two basement and footing levels (Fig. 1).

The building was erected on a thick deposit of compressible marine clay typical of the clays found in the Ottawa area (Eden and Crawford 1957). The soil profile (Fig. 2) consists of fill and sand to a depth of 9 ft (2.7 m), underlain by stiff fissured clay extending to a depth of 18 ft (5.5 m). From this depth to 50 ft (15 m) the soils are highly plastic grey clays and very sensitive silty clays overconsolidated by about 0.8 t.s.f. (85.8 kN/m²) and having water contents generally exceeding the liquid limits.

These formations rest upon a very sensitive sandy clay and grey silty clay underlain by glacial till at 122 ft (37 m) and bedrock at 132 ft (40 m).

Crawford (1953) reported that the foundation pressures under the footings supporting the bearing walls varied from 1.45 t.s.f. (155.6 kN/m²) at the east and west entrances to 4.04 t.s.f. (433.5 kN/m²) below the north tower at the time the structure was completed. Estimated vertical settlements at these locations were 0.20 ft (61 mm) and 1.58 ft (481 mm) respectively, occurring between 1910 and 1951.

The change in elevation of a point located at the stone steps at the east entrance of the building has been measured periodically since 1951. A record of the measured settlements is

FIG. 1. Outline of National Museum, Ottawa (after Crawford 1953).

FIG. 2. Variation of water content, Atterberg limits, shear strength, and preconsolidation load with depth (after Eden and Crawford 1957).

FIG. 3. Settlement of point at the east entrance of National Museum, Ottawa.

given in Fig. 3. The earliest surveys were carried out with an engineer's level, using a point on a nearby building as a benchmark, but these surveys were not sufficiently accurate, as shown by the scatter of points in Fig. 3. Subsequent surveys were performed with an engineer's precise level referenced to a deep benchmark similar to that described by Bozozuk *et al.* (1962). These observations showed that the east entrance, which applied a foundation pressure of 1.45 t.s.f. (155.6 kN/m²) to the soil, settled at a constant rate of about 0.003 ft (0.9 mm) per year. The total settlement of

the entrance since the building was erected in 1910 has amounted to approximately 0.27 ft (82 mm).

These settlements are attributed to secondary compression of the subsoil because the settlement record is linear with log of time as shown on Fig. 3. If regional subsidence resulting from the gradual reduction of pore water pressure in the marine clay with time had been the principal cause of settlement, the settlement-time record would have been quite different from that shown on the figure.

This settlement record cannot be applied to

the whole building. The heavier sections have probably settled more than the lightly loaded east entrance since 1951. It is unfortunate that level surveys have not been carried out on the heavier parts of the structure.

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