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Chapter 2

Time-dependent behaviour of concrete

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This chapter provides an introduction to the constitutive models commonly specified in design guidelines to describe the time-dependent behaviour of concrete and that can be used for the time-dependent analysis of composite structures. These formulations range from the simplest algebraic methods, such as the Effective Modulus Method that is widely recommended in design guidelines, to more sophisticated approaches that can account for creep and shrinkage effects in advanced modelling. The last part of the chapter provides a brief overview of multi-physics modelling that could be useful in predicting the concrete time-dependent response for composite construction.

2.1 Introduction

The time-dependent behaviour of composite steel-concrete structures is characterised by creep and shrinkage effects in the concrete components. This chapter provides an overview of, and an introduction to, the available constitutive models that range from the algebraic formulations, commonly recommended for routine design in the European, and Australian and New Zealand composite guidelines (EN 1994-1-1 [1], EN 1994-2 [2], AS/NZS 2327 [3], AS/NZS 5100.6 [4]), to more sophisticated constitutive representations suitable for advanced analysis. An introduction to multi-physics modelling is provided at the end of the chapter to highlight its advantages in predicting the long-term response of concrete. The purpose of this chapter is to present the theoretical background and design models that will be used in the following chapters when considering the time-dependent behaviour of composite structures.

The mathematical representations and derivations will be kept to a minimum. Further details on concrete time effects can be found in specialised textbooks, e.g. [5], [6] and [7], or in the references cited thereinafter.