B4. Indicative Construction Sequence and Stages

B4.1 The importance of construction stages in composite design

In many forms of construction it is sufficient to consider the strength, stability and serviceability of a structure only in its final completed form. The documentation of most engineering designs contains a clause to the effect "the builder shall be responsible for the safety and stability of the works during the course of construction". This clause means that the builder should provide any formwork and or temporary propping and falsework that is required to ensure that the structure does not fall down during construction while the engineer's responsibility starts once the building is completed. There have been recent changes to the laws in this regard and the split of responsibility is never as black and white as this – but the general principal remains for many types of construction.

With composite construction, the builder remains responsible for many issues during the course of construction – but the engineer cannot pass on all responsibility for safety and stability during construction. A major advantage of composite flooring systems is that at least potentially, no formwork and no propping is required. But the engineer must think through the proposed construction sequence and carry out necessary design checks at all critical stages through the construction sequence, to ensure that overloading or instability will not develop.

This section presents in graphical style a typical construction sequence for this sort of building. In the detailed design stage, calculations are presented that confirm the safety of the structure during the various stages.

It is critical to get a clear picture of the three principal stages during construction at which the designer must confirm design adequacy of the proposed floor framing arrangement and sizes. These critical stages are as follows:

- When the steel beams have been lifted into place and support the steel decking but are not yet fixed to that decking so that they are unrestrained against beam buckling over a long effective length.

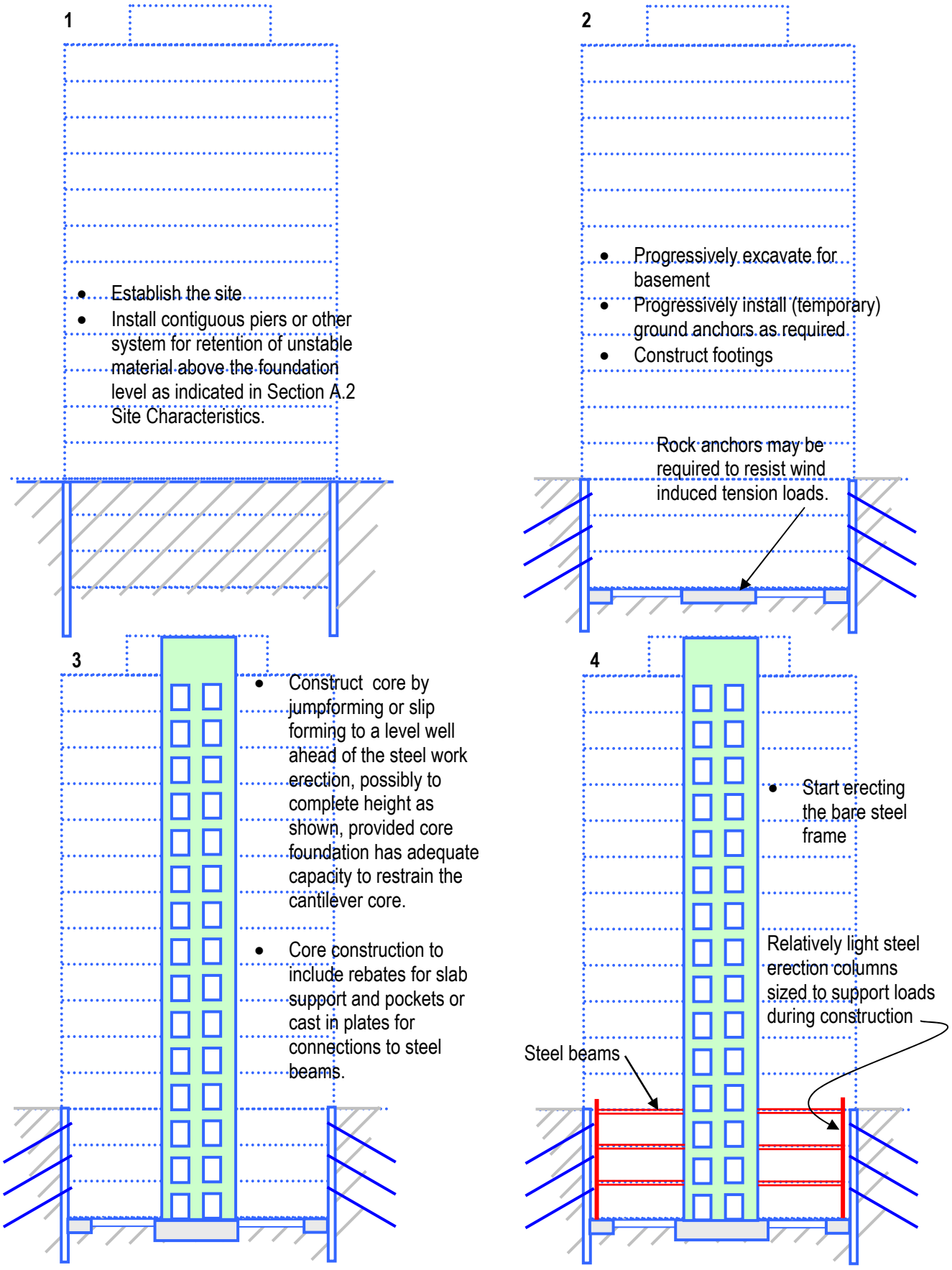
- At the concrete pour stage. At this stage the Bondek has to support the wet concrete and construction loads without any assistance from composite action. This is the stage that determines the maximum unpropped slab span. The beams at this stage should be secured to the decking and thus are restrained against buckling but have to support a considerable load without the assistance of a cured concrete slab to act as a composite top compression flange.

- During occupancy when the building is completed. It is not until the floor is completed and cured that composite action develops to assist in supporting the full and final design loads.

With the proposed construction sequence, steel 'erection columns' are used. As illustrated on following pages these allow construction to proceed at a fast rate – but they are not designed to support the full final weight of the building. This is carried by the steel columns acting together with reinforced concrete columns poured around the erection columns. Thus the engineer needs to ensure that the erection columns are strong enough to support the maximum load that they will carry during construction – while the final RC columns will carry the final completed building loads. This also provides essential fire resistance. (Normally, the concrete columns will be poured prior to pouring the next floor above, so that the erection columns will support only the erected steelwork plus one concreted floor; only in rare instances will the concreting of the columns be delayed as illustrated on following pages.

The indicative construction sequence shows the steel frame being completed well ahead of the concreting of the floors. This system allows for maximum flexibility in scheduling the construction and was popular in the past to minimise floor to floor construction times. It potentially gives rise to high erection column loads prior to their concrete encasement. Because of increased safety requirements it is now more common (at least in Australia) to allow the steel frame to proceed only one or two levels ahead of concreting.

B4.1 Indicative construction sequence and construction stages



AUSTRALIAN STEEL INSTITUTE
(ABN)/ACN (94) 000 973 839

Composite Design Example for Multistorey Steel Framed Buildings

Published by: AUSTRALIAN STEEL INSTITUTE

FIRST EDITION 2007 (LIMIT STATES)

National Library of Australia Cataloguing-in-Publication entry:
Durack, J.A. (Connell Wagner)
Kilmister, M. (Connell Wagner)
Composite Design Example for Multistorey Steel Framed Buildings

1st ed.
Bibliography.
ISBN 978-1-921476-02-0

1. Steel, Structural—Standards - Australia.
2. Steel, Structural—Specifications - Australia.
3. Composite, (Engineering)—Design and construction.
I. Connell Wagner
II. Australian Steel Institute.
III. Title

Table of contents