B1. Conceptual and Preliminary Design

This part of the text takes the input information from the previous section and uses this to devise alternative framing systems, that could be used to satisfy the needs of the client and the various other constraints relevant to the project. The section also introduces an air conditioning ducting layout typical of what is likely to be required for the project. This stage of design is relatively non quantitative and may be described as being involved with the "art" of design. This section presents:

- Two fundamentally different conceptual floor framing systems
- Several fundamentally different ways in which horizontal wind loads may be carried to ground
- Preliminary slab design, to determine the maximum unpropped span of the chosen Bondek decking system. This is necessary to allow beam centre line dimensions to be added to the conceptual floor framing systems
- A decision relating to the choice of floor framing and "shear core" systems to be adopted for the project
- A cartoon style representation of the proposed construction sequence for the project that is necessary to understand the use of "erection columns" and the loads for which they must be designed
- Preliminary sizing of steel beams
- Analysis to determine plenum height to accommodate air conditioning ducting and thus allow the total height of the building to be determined
- Preliminary sizing of the columns and core walls

If you are familiar with the design of reinforced concrete multistorey buildings then there may be little new for you in this section except with regard to development of the floor framing system. Some "old fashioned" applications of composite slab systems for low rise applications, involved slab spans of around 5 metres requiring the use of 1 or more rows of props to assist the decking in carrying the load of the wet concrete. Such systems still have their place, but for multistorey buildings, one of the big advantages of composite construction, is the elimination of props. The general objectives in arriving at an economical floor framing system are as follows:

- The number of beams should be minimised, recognising that crane time required to lift each beam into position will represent a dominant time and cost factor for the project

- Minimising the number of beams means maximising the unpropped span of the floor slab. Appendix I illustrates a number of different decking profiles with maximum spans varying from 2 to 6 metres. Around 3 metres span for the slab, appears to represent a "sweet spot" for multistorey construction. To achieve the required 120 min FRL, a minimum slab depth of 120 is required. This same slab depth is about the minimum required to achieve satisfactory stiffness over a 3000 slab span. If a slab span of say 2 metres is used then the slab depth will still have to be 120 to satisfy the FRL requirement – but the 120 will represent more than enough for stiffness. With contemporary long spanning decking systems, unpropped slab spans up around 5 or 6 metres may be appropriate particularly in medium rise applications. Generally they will involve thicker, heavier slabs and heavier loaded, deeper beams, resulting in increased column and footing loads and floor to floor heights, all of which are increasingly disadvantageous as the number of floors increases.

- The system should minimise the clashes between the air conditioning ducts and the floor beams

- All of the standard objectives relating to repetition and simplicity and buildability of detailing. All beam to beam and beam to column connections are likely to be "pinned" connections using either a web side plate or a flexible end plate connection type.

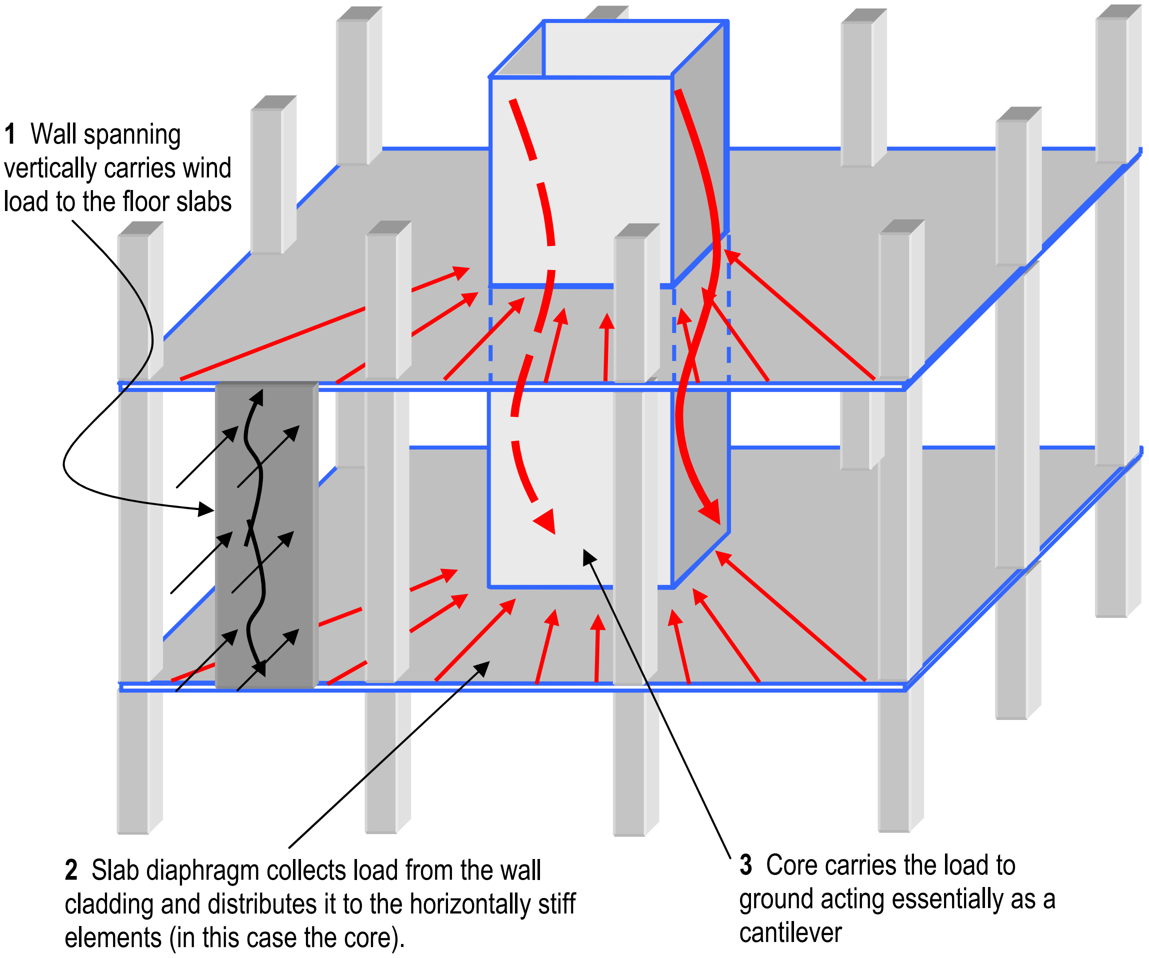
- Secondary beams should be smaller than supporting primary beams to avoid detailing and erection problems

The following alternative floor framing systems anticipate a slab span of around 3 metres but at this conceptual development stage, the focus is on identifying fundamentally different systems rather than considering the details of a particular beam and column layout.

of the columns at each floor level until such time as the concrete is in place.

B1.3 Framing system for horizontal loading – initial distribution of load

The following figure represents the initial distribution of horizontal wind loading from the wall cladding through to, in this case, the shear core. This first stage of distribution of horizontal load is generally applicable to all overall systems for taking horizontal loads to the ground.



General schematic representation of distribution of horizontal wind loading.

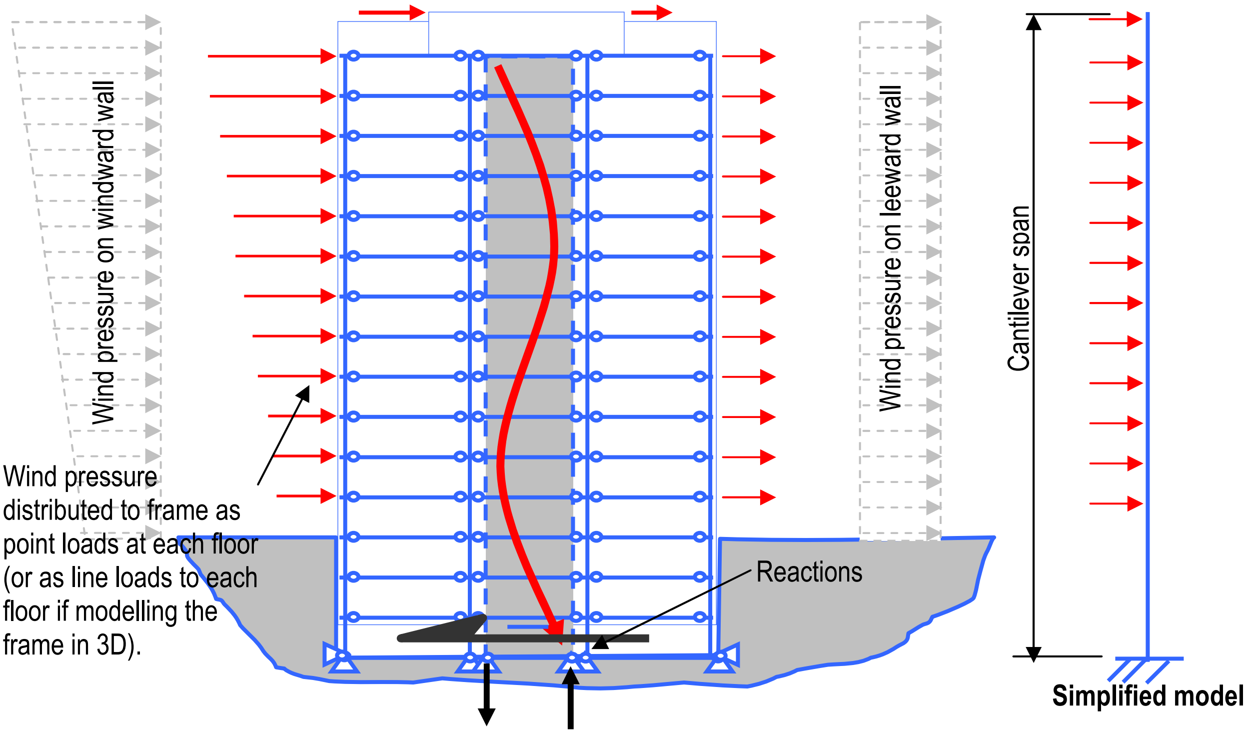
The load path as illustrated above is as follows:

- Curtain walling spans vertically between the floor slabs
- Floors slabs act as diaphragms to distribute the horizontal load to those parts of the structure with significant horizontal stiffness. As illustrated it is assumed that only the central core has significant horizontal stiffness.
- The horizontally stiff elements (in this case the core) carry the horizontal load to ground.

The following pages illustrate 6 different overall systems that may be used to carry horizontal loads to ground in multistorey construction. Those with experience in multistorey construction will recognise that at least in the Australian context, some form of “shear core” system will be the obvious choice for a 12 storey building. The alternative systems are presented to illustrate with minimal discussion, the different systems that may be applicable for taller buildings.

B1.4 Alternatives for overall distribution of horizontal load to ground

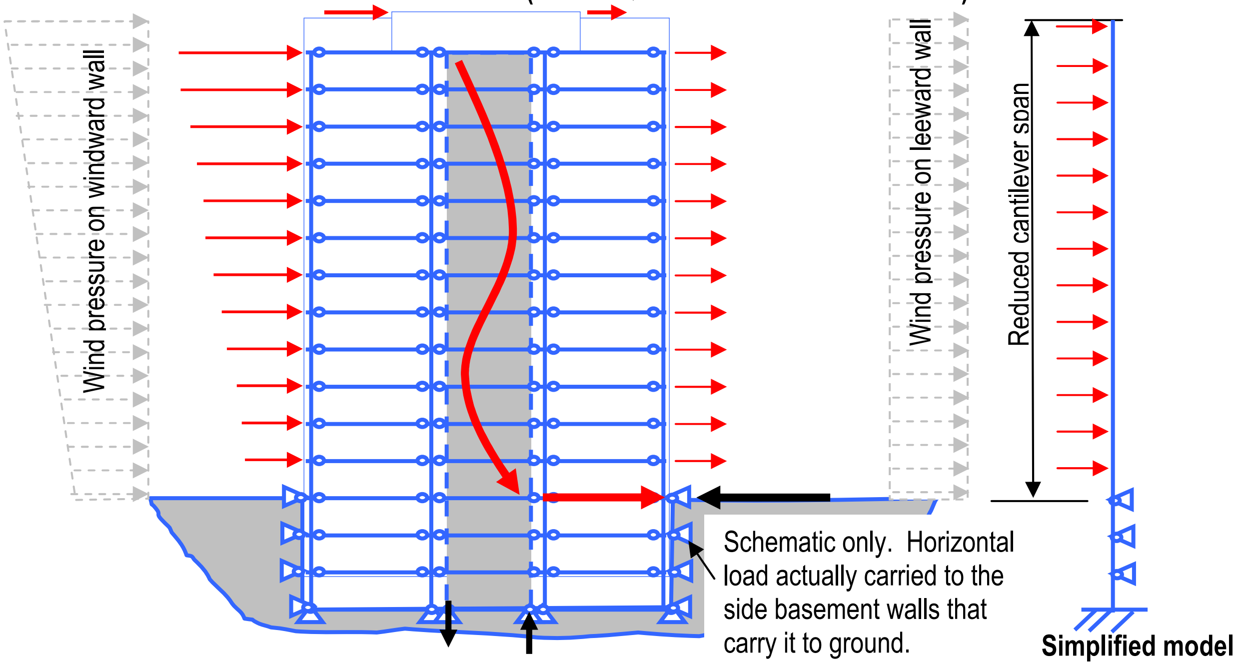
Alternative 1 – shear core alone



Characteristics

- All beam to column (and beam to core) connections are economical pinned connections
- Entire horizontal load is carried by the shear core as a cantilever beam of relatively small width
- High vertical and horizontal reactions at the base of the shear core

Alternative 2 – modified shear core alone (SUBSEQUENTLY ADOPTED SYSTEM)



Characteristics

- All beam to column (and beam to core) connections are economical pinned connections
- Entire horizontal load is carried by the shear core as a cantilever beam of relatively small width
- Reduced vertical reactions at the base of the shear core
- High horizontal loads in floor diaphragm at ground floor level and high horizontal loading to basement walls
  - Significantly reduced cantilever core span with distribution of horizontal load to basement walls

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