CHAPTER 2. ANALYSIS AND DESIGN OF ONE-WAY RIBBED SLABS

2.1. INTRODUCTION

One-way slabs transmit their load mainly in one direction (i.e., the direction. of span). A 1m strip is taken in the direction of span and treated similar to continuous beams.

Elastic analysis such as slope-deflection, moment distribution and matrix method or plastic analysis or approximate method such as the use of moment coefficient or such methods as portal or cantilever can be used.

2.2. ANALYSIS AND DESIGN OF ONE-WAY SLABS

Long-span floors for relatively light live loads can be constructed as a series of closely spaced, cast-in-place T-beams (or joists or ribs) with a cross section as shown in Figure 2-1figure 2.4-1. The joists span one way between beams. Most often, removable metal forms referred to as fillers or pans are used to form the joists. Occasionally, joist floors are built by using clay-tile fillers, which serve as forms for the concrete in the ribs that are left in place to serve as the celling.

Figure 2-1 – Ribbed slab layout

Ribbed slabs are more economical than solid slabs for long spans with relatively light loads. They may be constructed in a variety of ways as discussed above. Two principal methods of construction are:

1. Ribbed slabs without permanent blocks,
2. Ribbed slabs with permanent hollow or solid blocks.

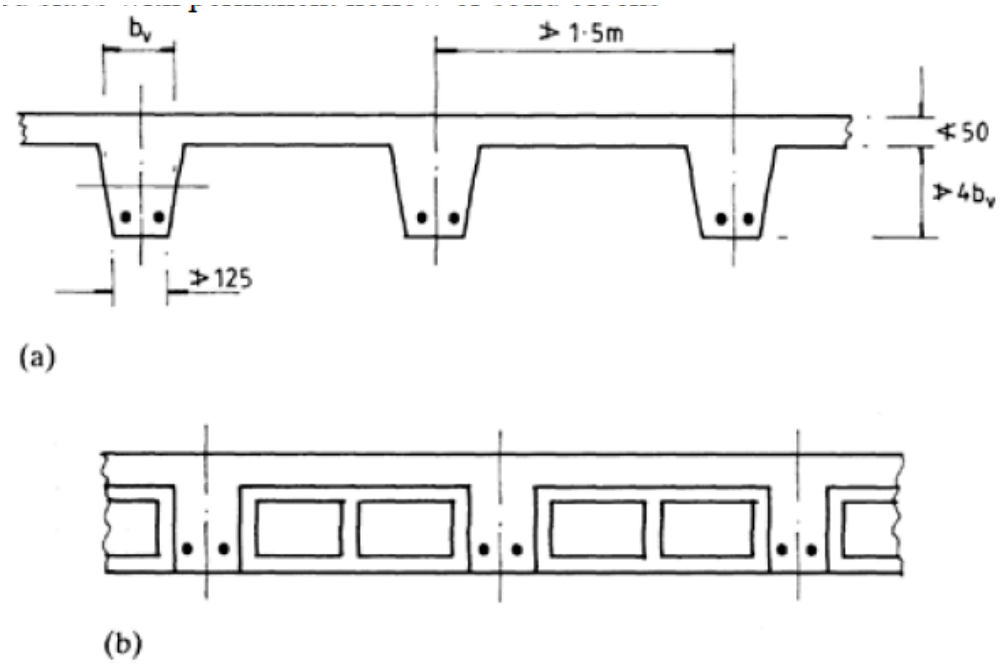

Figure 2-2 (a) Ribbed slab; (b) ribbed slab with hollow blocks

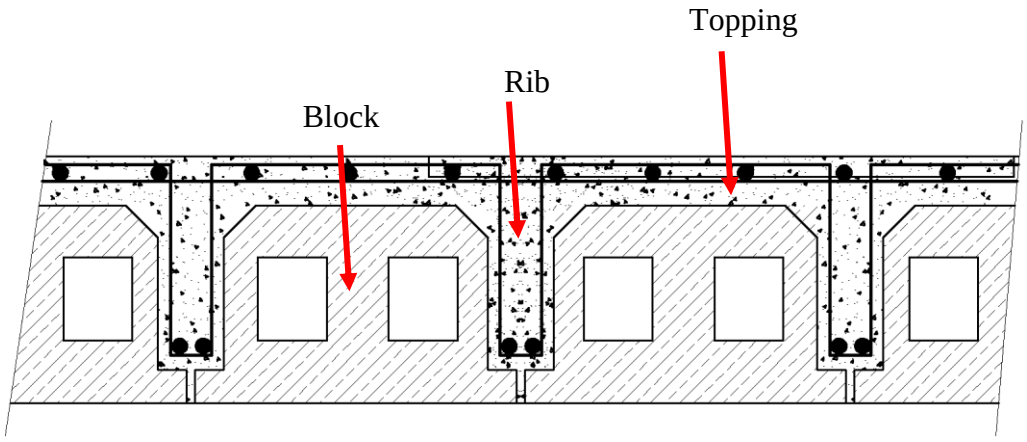

Figure 2-3 Typical ribbed slab cross-section

2.3. GENERAL REQUIREMENTS:

The topping or concrete floor panels between ribs may or may not be considered to contribute to the strength of the slab. The design of slabs with topping taken into account is discussed as follows.

2.3.1. RIBBED SLAB PROPORTIONS

According to section 5.3.1 of EBCS EN 2004:2014 , ribbed or waffle slabs need not be treated as discrete elements for the purpose of analysis, provided that the flange or structural topping and transverse ribs have sufficient torsional stiffness. This may be assumed provided that the flange

or structural topping and transverse ribs have sufficient torsional stiffness. This may be assumed provided that:

1. The centers of ribs does not exceed 1.5 m;
2. The depth of the rib below the flange does not exceed 4 times its width
3. The depth of the flange is at least 1/10 of the clear distance between ribs or 50mm, whichever is the greater
4. Transverse ribs are provided at a clear spacing not exceeding 10 times the overall depth of the slab.

Note: The minimum flange thickness of 50 mm may be reduced to 40 mm where permanent blocks are incorporated between the ribs. This exception applies for slabs with clay blocks only.

2.4. PROCEDURE FOR DESIGN OF RIBBED SLABS

1. **Shear forces and moments (Analysis):** Shear forces and moments for continuous ribbed slabs can be obtained by elastic analysis with due consideration to live load variation.
2. **Design for moment and moment reinforcement:** The mid-span section is designed as a T-beam with flange width equal to the distance between ribs (the effective flange width should be calculated and checked if it is less that the center to center distance between the ribs). The support section is designed as a rectangular beam. The slab may be made solid near the support to increase shear resistance. Moment reinforcement consisting of one or more bars is provided in the top and bottom of the ribs. If appropriate, bars can be curtailed in a similar way to bars in solid slabs
3. **Shear resistance and shear reinforcement:** The shear verification is carried out for the critical section of the rib with the same procedure as in a rectangular beam section. Shear verification should also be carried out for the section between the flange and the rib according to EBCS EN 2004:2014 Section 6.2.4.
4. **Reinforcement in the topping:** Mesh reinforcement with a cross-sectional area of not less than 0.12% of the area of the topping in each direction should be provided. The spacing of wires should not exceed one-half the center-to-center distance of the ribs. The mesh is placed in the center of the topping and requirements of cover in the code should be satisfied.
   If the ribs are widely spaced the topping may need to be designed for moment and shear as a continuous one-way slab between ribs.