JOINT FREE SLABS - DESIGN & DOCUMENTATION GUIDELINE

1. Determine design loads from experience, from AS1170 and/or from client brief.
2. Decide minimum concrete strength for serviceability and durability - refer AS3600 Table 4.7 but do not over specify.
3. Decide whether thickness will be determined by empirical means or by analysis and design. If by empirical means **go to 4**. If by analysis and design **go to 5**.
4. Adopt slab thickness giving thought to both short term and long term loading - refer also to C&CA Handbook Table 1.14. Do not over specify thickness. **Go to 12.**
5. Determine Modulus of Subgrade Reaction (k value) to be used for analysis. Refer notes on back.
6. Decide on load cases and load case combinations to be used in analysis, and always include self weight.
7. Analyse 1000 wide slab strips with 250 long members and pins at every fourth node using beam on elastic foundation analysis . Ensure spring supports can only act in compression if below or tension if above the slab.
8. Calculate the characteristic flexural tensile strength for the chosen concrete:

$$f'_{cf} = 0.7\sqrt{f'_c}$$

9. Calculate design tensile strength $f_{all} = k_1\ k_2\ f'_{cf}$
10. Calculate actual tensile stress $f_b = M/Z$
11. Check $f_b \leq f_{all}$ Adjust slab thickness and/or concrete strength as necessary.
12. Calculate reinforcement requirement based on 0.17% minimum for slabs with applied floor coverings and 0.20% minimum for slabs without applied finishes. Note that the percentage reinforcement is calculated using the area of concrete above the crack inducers (i.e. 70% of the total cross sectional area) but do not use less that F62 in any slab.
13. Set out crack inducer grid on plan to generally eliminate the need to cut in around the perimeter.
14. Show ground restraints around the full perimeter of each slab pour and at about 14m maximum centres throughout. Position internal ground restraints so that they are straddled by the crack inducer grid to avoid need for additional bar chairs.
15. Call up trimmers as per standard details, but increase at any deep re-entrant corners. Note that 2N12 trimmers are required around the full perimeter of ev ery slab pour, and note that all mesh and bars are to be fully lapped into subsequent pours.
16. Cut and paste standard CAD details and notes.
17. Draw any project specific details as required.
18. If in doubt, ask.

Modulus of Subgrade Reaction (k)

The Modulus of Subgrade Reaction (**k**) is the ratio of the applied pressure to the corresponding settlement, and hence the units are kN/m^3 but when divided by 1,000 **k** is expressed as kPa/mm.

The factors below have an affect on the value of **k**:

1. Nature of the soil - the firmer the soil the higher the value of **k**.
2. Layering of the soil - soft layers below the surface will reduce the equivalent value of **k** that should be used in an analysis if they fall within the sphere of influence of the load. Given that the depth of the sphere of influence increases as the area over which the load is applied increases, the effect of soil layering on the value of **k** should be considered with large area loads.
3. Size and shape of the loaded area - typically the value of **k** published in references is determined by field tests using a 300x300 or 300 diameter plate. Such a **k** value is suitable for use with most post loads and wheel loads, but can give rise to erroneous results when used for large area loads. Designers should bear in mind that the value of **k** is more or less inversely proportional to the width of the loaded area. Refer

also to Fig 6.1 in TR34 Third Edition 2003 for **k** conversion factors relating to a 750 diameter bearing plate.

4. Magnitude of the applied pressure **- k** is not a constant for any particular soil. Although it is expressed as:

   k = q/y
   where **q** = the intensity of soil pressure, and
   y = the average settlement for an increment of pressure

   settlement actually increases at a faster rate than increases in the applied pressure. If possible designers should use a value for **k** that relates to the actual loading intensity that is to be applied to the soil.

Whilst modest errors in the adopted value of **k** will have little effect on the accuracy of the calculated slab thickness (refer Table 6.1 in TR34 Third Edition 2003), engineers should be ever mindful of the above and they should make corrections to suit. It is recommended that engineers should err on the conservative side when it comes to selecting a value for **k**, and if in doubt they should seek expert advice from a geotechnical engineer.

Typical values of k for different soil types (kPa/mm):

Reference - Bowles, Foundation Analysis and Design

Granular Soils	Loose	Medium	Dense
Dry or moist sand	**15**	**40**	**160**
Limiting values	7 - 20	20 - 100	100 - 330
Submerged sand	**10**	**25**	**100**

Cohesive Soils	Stiff	Very stiff	Hard
Precompressed clay	**25**	**50**	**100**
Range of values	16 - 30	30 - 65	65 - 160

Note: The above **k** values are appropriate for a 300x300 bearing plate or a 300 wide strip.
Refer also to Table 6.2 in TR34 Third Edition 2003

For a relationship between **k** and CBR, refer to Fig 2 in the C&CA publication 'Concrete Industrial Floor and Pavement Design' July 1985, or Fig 6.2 in TR34 Third Edition 2003.