Subsidence Advisory NSW

Mine subsidence design structural engineer certification form – Attachment F

Structural Engineer	
Date of determination	
TBA Number	
Certification to meet condition No.	

Description of structure

1. **Brief description**, (e.g. house, units, commercial structure, extension of existing structure, etc).

2. **Description of site**, (e.g. natural slope, depth and type of fill materials (if any)), depth to rock (if known).

3. **Footing Type(s)**, (e.g. slab on ground, strip footing, piers, mixed-footing, etc).

4. **Foundation bearing material**, (e.g. sandstone, weathered rock, fill, mixed (i.e. cut-fill), etc.) bearing capacity, (if known).

5. **Plan footprint dimensions**

6. **No. of storeys and height**, (single / split level)

7. Construction type (framing system, cladding, articulation, roof cladding)

- Timber and steel framed structures with flexible external linings (timber, weatherboard, metal sheet etc.) are flexible and can accommodate greater differential mine subsidence movements than structures with rigid materials such as masonry walls.
- Additional subsidence mitigation measures are, therefore, expected to be included in the design of structures with rigid materials.
- In the case of larger, reinforced concrete framed structures, flexibility can be introduced by inclusion of construction and articulation joints between rigid elements.

8. Basements / integral retaining structures

Subsidence design requirements

9. Vertical subsidence (mm)

Note: Vertical displacement does not, by itself, result in damage. If provided as a condition of approval consideration should be given to the proposed development height above the flood level.

10. Tilt (mm/m)

Note: If not accommodated by design, tilt may result in issues with roof gutter, wet area drainage and gravity pipework.

Serviceability | *Safety*

11. Radius of Curvature (km)

Note: Curvature is the second derivative of subsidence, or the rate of change of tilt. Curvature is usually inverted and expressed as the Radius of Curvature. The design must account for both hogging or sagging of the ground, and curvature can be oriented in multiple directions.

Serviceability | *Safety*

12. Strain (mm/m)

Note: The subsidence design requirements for strain refer to normal strain, which is the differential horizontal movement of the ground. The design must account for both tensile strains (expressed as positive) and compressive strains (expressed as negative) and strains can be oriented in multiple directions.

Serviceability | *Safety*

Certification to Australian Standards

13. **Have the structure(s) been designed in accordance with current, relevant and applicable Australian Standards, the National Construction Code and good engineering practice?**

☐ Yes ☐ No ☐ N/A

- Specific focus on AS1684, AS2870- 2011, AS3600, AS3700, AS4773 where applicable.

Comments:

Comparison to development guidelines

14. **Describe what elements of the design do not comply with Subsidence Advisory's Surface Development Guideline assigned to the property, and therefore require a Merit Assessment.**

Response:

Subsidence mitigation measures for tilt

15. **Have the gradients on wet area floors, roof gutters, gravity pipework been increased to ensure that they remain serviceable if the gradients are reduced by the tilt specified in the subsidence design requirements?**

Serviceability ☐ Yes ☐ No ☐ N/A **Safety** ☐ Yes ☐ No ☐ N/A

Comments: (describe reason for not applying if No or N/A is selected)

16. **Has the house been designed to be readily relevelled if required?** (this question applies where tilts specified in the subsidence design requirements are greater than 4mm/m)

Serviceability ☐ Yes ☐ No ☐ N/A **Safety** ☐ Yes ☐ No ☐ N/A

Comments: (describe reason for not applying if No or N/A is selected)

17. **Have the walls, cavity and brick veneer wall ties and roof-framing been designed for the impact of tilt?**

Serviceability ☐ Yes ☐ No ☐ N/A **Safety** ☐ Yes ☐ No ☐ N/A

Comments: (describe reason for not applying if No or N/A is selected)

18. **Are there any other subsidence mitigation measures for tilt in design?**

Serviceability ☐ Yes ☐ No ☐ N/A **Safety** ☐ Yes ☐ No ☐ N/A

- The above questions refer to design techniques that are commonly used in the design of subsidence mitigation measures.
- Subsidence Advisory is, however, open to alternative or additional design ideas.

Comments:

Subsidence mitigation measures for curvature (hogging and sagging) and strain (tensile and compressive)

Note: The structure(s) must be designed for the combination of curvature and strain, including hogging curvature plus tensile strain and sagging curvature plus compressive strain, or other combinations, as required.

19. **Are the base(s) of ground slabs formed on one level plane, with sand bedding and plastic membranes beneath (if applicable)?**

Serviceability ☐ Yes ☐ No ☐ N/A **Safety** ☐ Yes ☐ No ☐ N/A

- The base of slab(s) are preferred to be on one level plane.
- In-ground step beams / drop edge slabs are discouraged as they anchor the structure to the ground at these locations and, therefore, more readily transfer ground strains into the structure at concentrated location(s). Structures with these features are also very difficult to relevel.
- Sand bedding and plastic membranes provide a slip plane between the ground and the underside of ground slabs. They also provide a buffer between the ground and the slab.

Comments: (describe reason for not applying if No or N/A is selected)

20. Is there separation between in-ground footings (e.g. piers, ground beams, etc,) and superstructure (if applicable)?

Serviceability ☐ Yes ☐ No ☐ N/A **Safety** ☐ Yes ☐ No ☐ N/A

- This design feature is preferred to minimise transfer of mining-induced ground strains into superstructure and facilitate relevelling of structure if required.
- Ties between in-ground footings and superstructure are discouraged as it is difficult to relevel structures if the footings are tied.
- For steel and concrete framed structures, it is not recommended to tie ground slabs to the superstructure, or pour ground slabs over column baseplates.

Comments: (describe reason for not applying if No or N/A is selected)

21. Are the retaining walls / basements structurally isolated from superstructure?

Serviceability ☐ Yes ☐ No ☐ N/A **Safety** ☐ Yes ☐ No ☐ N/A

- Difficult to repair / relevel sub-floor areas and superstructure when they are tied together.
- Founding level of footings are encouraged to be beyond the angle of influence of base of retaining wall from a safety and serviceability point of view.

Comments: (describe reason for not applying if No or N/A is selected)

22. Are there construction joints and/or articulation joints at the cut/fill interfaces or changes in foundation materials (if applicable)?

Serviceability ☐ Yes ☐ No ☐ N/A **Safety** ☐ Yes ☐ No ☐ N/A

- Mine subsidence impacts are commonly observed to structures, pavements and pipework at cut-fill interfaces or changes in foundation materials.
- Articulation is recommended at the cut- fill interfaces or changes in foundation materials where possible.

Comments: (describe reason for not applying if No or N/A is selected)

23. Is the development proposed to be constructed above an infilled water course or dam?

☐ Yes ☐ No ☐ N/A

- Constructing houses directly above infilled creeks or near the bases of natural creeks is strongly discouraged as they are more likely to experience elevated compressive strains (valley closure) and increased hogging curvature (upsidence). Valley closure and upsidence movements are consistently observed when mining is conducting beneath valleys.
- Additional subsidence mitigation measures are, therefore, expected to be included in the design of structures that are located directly above infilled creeks or dams.
- The applicant may be requested to seek specialist advice on potential mine subsidence movements if seeking to build structures above buried creeks.

Comments:

24. For excavations, are compressible fillers documented between footings / walls and excavated rock faces and other natural materials to reduce transfer of ground strains into structure?

Serviceability ☐ Yes ☐ No ☐ N/A **Safety** ☐ Yes ☐ No ☐ N/A

Comments: (describe reason for not applying if No or N/A is selected)

25. Are there any other subsidence mitigation measures included in the design of foundations and sub-floor areas?

Serviceability ☐ Yes ☐ No ☐ N/A **Safety** ☐ Yes ☐ No ☐ N/A

- The above questions refer to design techniques that are commonly used in the design of subsidence mitigation measures.
- Subsidence Advisory is, however, open to suitable alternative or additional design ideas.

Comments: (describe reason for not applying if No or N/A is selected)

26. Are there construction or articulation joints in the floor slabs and walls and at the interfaces between other rigid elements?

Serviceability ☐ Yes ☐ No ☐ N/A **Safety** ☐ Yes ☐ No ☐ N/A

- Construction joints are required where there are changes in footing or foundation types
- Construction joints are required where extensions are proposed to adjoin the existing structures.
- Articulation joints are required where there are changes in construction type, including number of levels, changes in floor level, etc.

Comments: (describe reason for not applying if No or N/A is selected)

27. Is the damp proof course designed to be level between each of the construction joints (if applicable)?

☐ Yes ☐ No ☐ N/A

- Masonry walls are commonly observed to slip on the damp proof course in response to normal and shear strains, particularly when they are founded on strip footings.
- Stepped damp proof courses can result in cracking at the step changes.
- For structures on sloping ground, these can usually be resolved by introducing a construction joint at the step change.

Comments: (describe reason for not applying if No or N/A is selected)

28. Does the design include architectural relief at the damp proof course (if applicable)?

☐ Yes ☐ No ☐ N/A

- If masonry walls experience slippage on the damp proof course due to differential mine subsidence movements, the impact is very noticeable if the walls were designed to be continuous and planar across the damp proof course. In these instances, the common method of repair is to replace the affected wall. This is not only an expensive repair but also a substantial inconvenience for the owner.
- An architectural relief is encouraged at the damp proof course, particularly for structures on strip footings. Examples include an expressed brick / corbel or a shadowline at the damp proof course, a movement joint in the render, or a separate external finish between the masonry walls above and below the damp proof course. Alternatively, the external panel could be designed to be removeable.

Comments: (describe reason for not applying if No or N/A is selected)

29. Are there articulation joints at window and door openings? Do the windows extend up to the eaves? Alternatively, are there flexible panels above windows and doors?

☐ Yes ☐ No ☐ N/A

- Articulation joints are required in masonry walls at window and door openings.
- Windows are commonly extended up the eaves.
- Flexible panels can be included above windows and doors.

Comments: (describe reason for not applying if No or N/A is selected)

30. Are there articulation joints specified in the architectural finishes to reflect construction joints in the structure?

☐ Yes ☐ No ☐ N/A

- Rigid architectural finishes such as floor and wall tiles and timber flooring are required to have articulation joints specified at the construction joints in the structure.
- Articulation or other architectural relief is encouraged for flexible linings (flexible sealants at cornices, shadowlines in set ceilings, construction joints aligned with internal walls)

Comments: (describe reason for not applying if No or N/A is selected)

31. Are there flexible sealants at tile wall and floor junctions?

☐ Yes ☐ No ☐ N/A

- It is good practice to include flexible sealants at tile wall and floor junctions, regardless of mitigating against differential mine subsidence movements.
- Flexible tile adhesives are also recommended between tiles and FC sheeting and concrete slabs to reduce the potential for cracking across joints in the sheeting and reflected slab cracking.

Comments: (describe reason for not applying if No or N/A is selected)

32. Are there flexible joints or separation between external pavements and the building structure(s)?

☐ Yes ☐ No ☐ N/A

- External pavements commonly move differentially to the building structure(s). They can move away in some places and push into the structure(s) in other places, damaging the building structure(s).
- Flexible joints are required where external pavements are designed to adjoin the building structure (e.g. driveway slab next to built-in garage).

Comments: (describe reason for not applying if No or N/A is selected)

33. Is there articulation and sand bedding below in-ground pipework?

☐ Yes ☐ No ☐ N/A

- Differential mine subsidence typically occurs between pipework and building structures. Impacts are commonly experienced at the interface between the structure and the ground.
- Flexible joints in pipes shall be designed in accordance with AS2870- 2011 to minimum H2 site classification specifications to accommodate curvature in any plane, coupled with tensile or compressive strain.
- Branches, bends and valve stems shall be protected by flexible wrapping or shrouds to prevent shearing of the pipes as ground movement occurs. Flexible joints shall be provided where pipes are connected to chambers or gullies.
- The bases of downpipes could be designed without physical connections to in-ground drains.
- Holes in the structure for pipework should be over-sized to accommodate differential movements.

Comments: (describe reason for not applying if No or N/A is selected)

34. Are there any other subsidence mitigation measures that are included in the design of superstructure?

Serviceability ☐ Yes ☐ No ☐ N/A **Safety** ☐ Yes ☐ No ☐ N/A

- The above questions refer to design techniques that are commonly used in the design of subsidence mitigation measures.
- Subsidence Advisory is, however, open to suitable alternative or additional design ideas.

Comments:

Designing for greater than anticipated subsidence

35. Has the structure been designed so that it remains safe, serviceable and readily repairable if it experiences greater than anticipated differential subsidence movements?

☐ Yes ☐ No ☐ N/A

- Consider scenarios where the structure experiences twice the subsidence design parameters (tilt, curvature and strain), or as a minimum, subsidence design parameters as specified in Surface Development Guideline 4.
- Consider ground strains and curvature concentrating across a point or line.
- Subsidence Advisory is not requiring the structure to be designed to withstand greater than anticipated subsidence effects, but is seeking evidence of ductility and redundancy in the design so that it is likely to remain safe, serviceable and readily repairable if it experiences greater than anticipated subsidence movements.
- A higher level of protection is required for critical public and private infrastructure, where it is not possible to relocate occupants. These structures should be designed such that they remain safe, serviceable and repairable if they experience greater than anticipated subsidence movements. For these cases, the applicant may be requested to seek specialist advice on potential mine subsidence movements and how the structure(s) can be designed to meet these criteria.

36. How would the structure be repaired if it experiences greater than anticipated differential subsidence movements?

☐ Yes ☐ No ☐ N/A

- In-ground pipework is recommended to be placed around the perimeter of houses that are constructed on ground slabs to facilitate repairs if the pipework is damaged.
- Some of the earlier questions in this form (e.g. designs at the damp proof course, pouring ground slabs over baseplates) are relevant when answering this question.
- A higher level of protection is required for critical public and private infrastructure. These structures should be designed such that repairs can be carried out with minimum impact to the use of the structure(s). For these cases, the applicant may be requested to seek specialist advice on potential mine subsidence movements and how the structure(s) can be designed to meet these criteria.

Comments:

Limitations

37. Please note any limitations attached to the design

38. Tabulate the design drawings relating to this document

39. I confirm that the design drawing referenced above and submitted to Subsidence Advisory NSW will result in the improvement meeting the following performance criteria if it experiences differential subsidence movements as outlined in the subsidence design parameters specified in this document.

Serviceable ☐ Yes ☐ No ☐ N/A

- Improvement shall be designed to be safe, serviceable and readily repairable in accordance with the definitions contained in Subsidence Advisory's Merit Assessment Policy.
- Improvement shall be designed for full utilization and continuous serviceability whilst mine subsidence repairs are being carried out.

Safe ☐ Yes ☐ No ☐ N/A

- The improvement shall remain structurally sound.
- The improvement shall remain accessible and safe.
- The improvement shall be repairable (cost of repair less than cost of demolition and replacement).

Repairable ☐ Yes ☐ No ☐ N/A

- Designed for ease of repair if subject to mine subsidence ground movements.
- Sacrificial elements shall be identified on drawings.
- Method for identification of damaged areas and repair clearly articulated in design drawings.
- The cost of repair shall be less than 10% of the cost of replacement.

Structural Engineer

Date