ADDENDUM TECHNICAL REPORT

Crawford Reference: SU1903936

59 Pearson Park
Hull
HU5 2TQ

Prepared for

AXA Commercial - London Property Team

SUBSIDENCE CLAIM

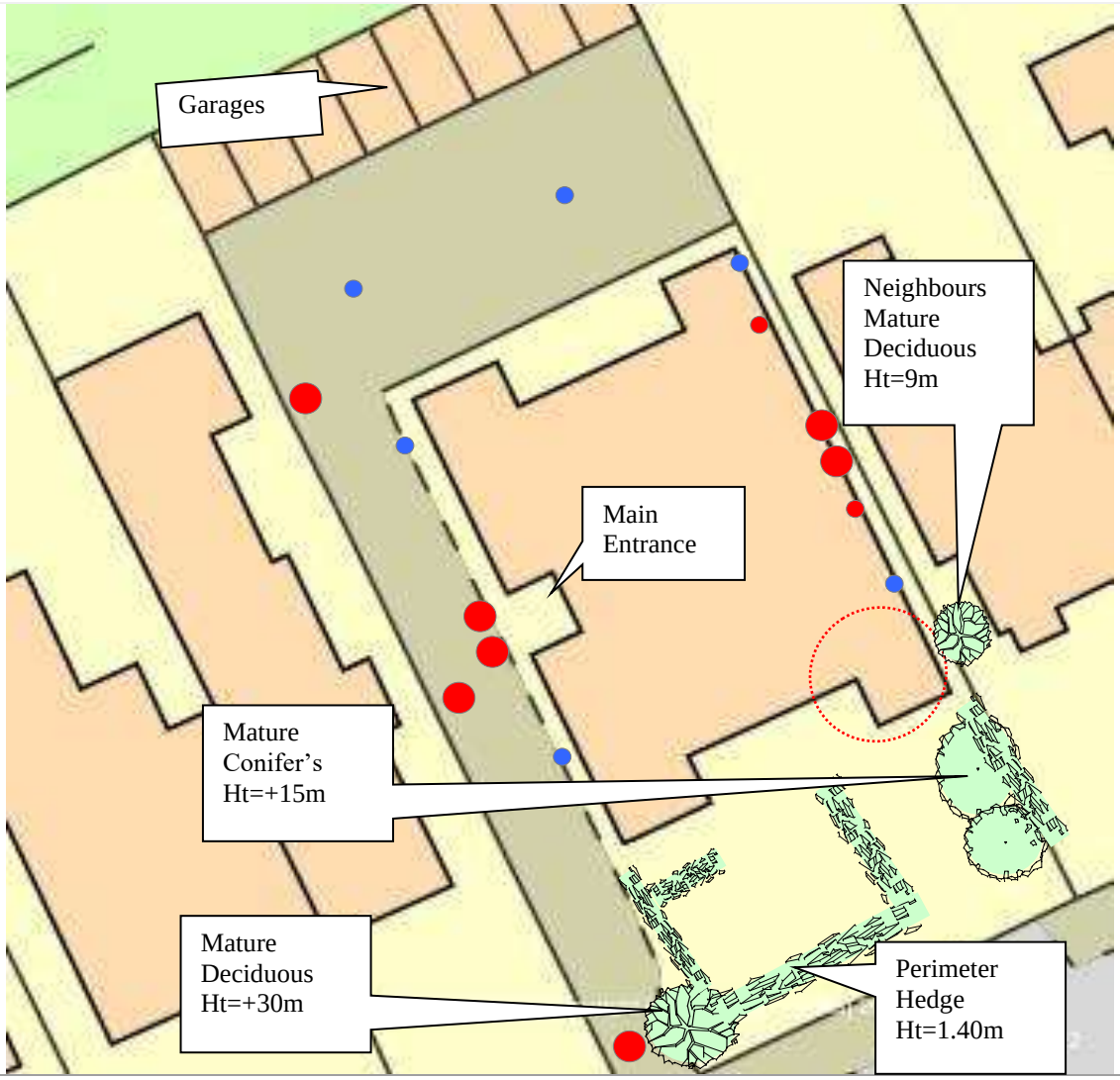
DATE 7 March 2021

Crawford and Company
Cartwright House,
Tottle Road,
Riverside Business Park,
Nottingham, NG2 1RT
Tel: 0115 943 8266

Crawford

Site Plan	This plan is Not to Scale

This plan is diagrammatic only and has been prepared to illustrate the general position of the property and its relationship to nearby trees etc. The boundaries are not accurate, and do not infer or confer any rights of ownership or right of way. Position of utilities is only indicative and contractors must satisfy themselves regarding actual location before commencing works.



Key:

	Tree: Deciduous		Tree: Conifer		Shrub
	Hedge		Area of Damage		Bore Hole
	Trial Hole		Trial & Bore Hole		Level Monitoring
	Rain Water Manhole		Rain Water Gulley		Rain Water Pipe
	Waste Water Manhole		Waste Water Gulley		Toilet Pipe
	Rain Water Drain		Waste Water Drain		Electricity Cable

INTRODUCTION

We have been asked by AXA Commercial - London Property Team to comment on movement that has taken place to the above property. We are required to briefly describe the damage, establish a likely cause and list any remedial measures that may be needed.

Our report should not be used in the same way as a pre-purchase survey. It has been prepared specifically in connection with the present insurance claim and should not be relied on as a statement of structural adequacy. It does not deal with the general condition of the building, decorations, timber rot or infestation etc.

The report is made on behalf of Crawford & Company and by receiving the report and acting on it, the client - or any third party relying on it - accepts that no individual is personally liable in contract, tort or breach of Statutory duty. Where works address repairs **that are not covered** by the insurance policy we recommend that you seek professional advice on the repair methodology and whether the works will involve the Construction (Design & Management) Regulations 2015. Compliance with these Regulations is compulsory; failure to do so may result in prosecution. We have not taken account of the regulations and you must take appropriate advice.

We have not commented on any part of the building that is covered or inaccessible.

TECHNICAL CIRCUMSTANCES

The claim was notified to Insurers on the basis of tenants/landlords notifying Managing Agents of visible internal cracks to the front right of the apartment block.

PROPERTY

Three storey multi-occupied Apartment Block of traditional construction with brick walls surmounted by a hipped, tiled roof.

HISTORY & TIMESCALE

Site investigations are being organised and we have appointed Arboricultural consultants to provide recommendations on the extent of tree works, which can be undertaken.

Date of Construction ..... Circa 1970
Damage First Noticed ..... August 2019

TOPOGRAPHY

The property occupies a reasonably level site with no unusual or adverse topographic features.

GEOLOGY

Reference to the 1:625,000 scale British Geological Survey Map (solid edition) OS Tile number TASW suggests the underlying geology to be Chalk.

Chalk[1] is a white, fine grained, powdery, limestone formed of calcium carbonate, containing small amounts of silt and mud but predominantly microscopic organic remains and shell debris. It is a marine deposit and effervesces strongly when in contact with cold, dilute hydrochloric acid. It is finer grained than limestones.

High porosity (>40%) and variable permeability. Often associated with aquifers.

The superficial deposits are thought to be Silts.
Silts occur as glacial, alluvial or windblown deposits. They are water bearing and soft in consistency, and therefore amongst the most troublesome soils in excavation work since they are vulnerable to slumping and 'boiling'.

They can also suffer from frost heave[2]. In the south-east of England they are known as Brickearth, which are generally firm to stiff, where they are less troublesome.

They do not suffer volumetric changes in the presence of vegetation in the way of clay soils, but can be a problem where there are leaking drains, water services or fluctuations in the water table, when consolidation settlement can occur.

They can also suffer localised erosion and softening in the presence of water.

Geology. Reproduced with consent of The British Geological Survey at Keyworth.
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[1] BS 5930 (1981) *"Code of Practice for Site Investigation"*

[2] Tomlinson M.J. (1991) *"Foundation Design & Construction"* LONGMAN SCIENTIFIC

VEGETATION

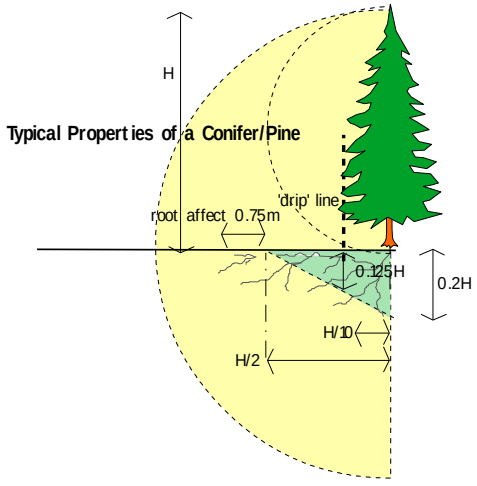
There are several trees and shrubs nearby, some with roots that may extend beneath the house foundations. The following are of particular interest:-

Type	Height	Distance	Ownership
Conifers	12 m	3 m	Owners
Conifers	16 m	6 m	Owners
Shrubs	1 m	3 m	Owners
Deciduous	30m	15m	Owners
Deciduous	9 m	3 m	Neighbour

See sketch.

Tree roots can be troublesome in cohesive (clay) soils because they can induce volumetric change. They are rarely troublesome in non-cohesive soils (sands and gravels etc.) other than when they enter drains, in which case blockages can ensue.

Conifers ~ The term is usually used to refer to cypresses and close relatives, but in the broader sense includes any trees that bear cones and nearly all of them have simple needle or scale like leaves, sometimes arranged into fronds as in the cypresses.



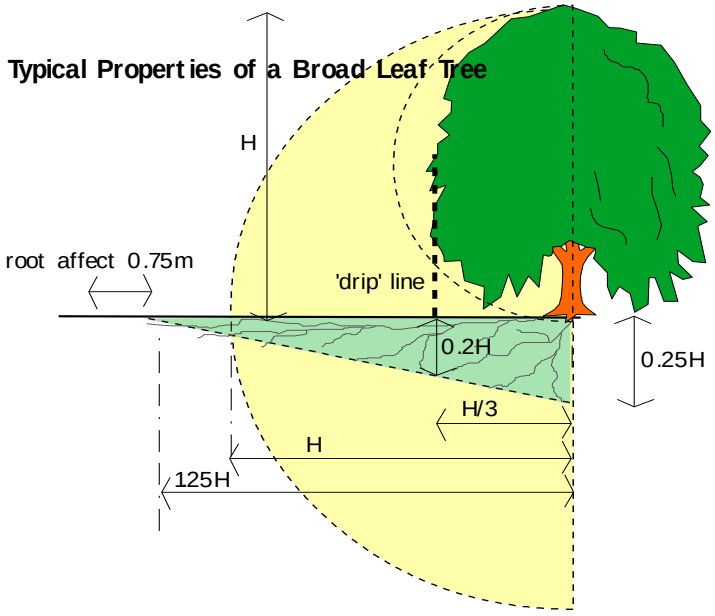
Typical tree proportions showing the root zone. This is a conservative estimate, as the zone can equal the height of the tree.

Generally they have less invasive roots and lower water demands than broadleaved species, but cypresses are often associated with subsidence as they are very fast growing, popular hedge plants that are frequently planted near houses.

Shrubs. Sometimes even small shrubs can cause localised subsidence damage. In the Kew Garden Survey data was collected between 1979 - 86 to record the number of roots of each species received for identification. Of the 1009 roots identified, 367 (36%) belonged to the family *Rosoideae* or Rose. Next came the family *Oleaceae* (Forsythia, Jasmin, Privet and Lilac) with 354 (35%) enquiries.

Berberis, Viburnum, Hedera (ivy), *Hydrangea and Pyracanthus* are also regularly associated with foundation movement, the latter having surprisingly large roots on occasions.

Broadleaf trees typically have wider spreading roots and higher water demands than coniferous species and many are better adapted to growing on heavy clay soils. Some are capable of sprouting from cut stumps or bare wood and most will tolerate pruning better than conifers.



Typical proportions of a broadleaf tree. Note the potential root zone. It must be noted that every tree is different, and the root zone will vary with soil type, health of the tree and climatic conditions.

However heavy pruning of any tree should be avoided if possible, as it stimulates the formation of dense masses of weakly attached new branches which can become dangerous if not re-cut periodically to keep their weight down.

OBSERVATIONS

The main area of damage affects the front right hand side of the block. This entails two properties identified as Flat 4 (ground floor) and Flat 10 (first & second floor).

The following is an abbreviated description. Photographs accompanying this report illustrate the nature and extent of the problem.

INTERNAL

Stepped diagonal cracks sited either side of windows up to 15mm wide.
Vertical tapering cracks to masonry walls up to 15mm wide.

Flat 4 – Vertical Crack in Lounge

Flat 10 – Diagonal Crack to Lounge

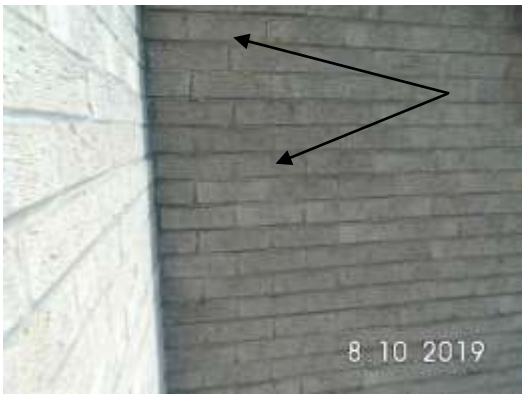
Flat 4:

- Main damage affects the lounge walls and ceiling; with cracks up to 15mm wide.
- There is a minor crack to the bedroom wall; mirroring that of the lounge.

Flat 10:

- Main damage affects the lounge window wall; with visible daylight to the window frame. The uPVC door to balcony area is out of alignment with variable sized cracking.
- The master bedroom above the lounge shows hairline cracking around the window head.

EXTERNAL



Flat 4 – Side Wall Stepped Cracking

Flat 10 – Stepped Cracking

Front and RHS Gable Elevations:
Stepped diagonal cracks above and below windows up to 20mm wide.
Stepped diagonal cracks to external masonry up to 20mm wide.

CATEGORY

In structural terms the damage falls into Category 4 of Table 1, Building Research Establishment[3] Digest 251, which describes it as “severe”.

Category 0	"negligible"	< 0.1mm
Category 1	"very slight"	0.1 - 1mm
Category 2	"slight"	>1 but < 5mm
Category 3	"moderate"	>5 but < 15mm
Category 4	**"severe"**	**>15 but < 25mm**
Category 5	"very severe"	>25 mm

Extract from Table 1, B.R.E. Digest 251
Classification of damage based on crack widths.

[3] Building Research Establishment, Garston, Watford. Tel: 01923.674040

DISCUSSION

The pattern and nature of the cracks is indicative of an episode of subsidence. The cause of movement appears to be clay shrinkage.

The timing of the event, the presence of shrinkable clay beneath the foundations and the proximity of vegetation where there is damage indicates the shrinkage to be root induced. This is a commonly encountered problem and probably accounts for around 70% of subsidence claims notified to insurers.

Fortunately, the cause of the problem (dehydration) is reversible. Clay soils will re-hydrate in the winter months, causing the clays to swell and the cracks to close. Provided the cause of movement is dealt with (in this case, vegetation) there should not be a recurrence of movement.

Investigations Undertaken

Trial pit and borehole investigations were undertaken to the front right gable corner and to the left of the protruding balcony area. A CCTV survey of the drainage system in the area of damage was undertaken.

Observations from Site Investigations

Trial Pit/Borehole 1:

- The foundations of the apartment block are 500mm deep; with a 300mm projection.
- The foundations bear onto an initial strata of moist, very stiff brown, sandy, fine to medium, gravelly, silty clay; to a depth of 1.50m below ground level. At 1.50 below ground level, strata is found to be moist, stiff, brown silty clay. Strata at 2.50 to termination depth of 3.0m below ground is damp, stiff brown, sandy, fine to medium, gravelly, silty clay.
- The soils are determined as being of high to very high plasticity.
- *Roots* - were recovered from beneath the foundations of the property which were identified as the species ***ACER*** (Maples, Sycamores).

Trial Pit/Borehole 2:

- The foundations of the apartment block are 500mm deep; with a 300mm projection.
- The foundations bear onto an initial strata of moist, very stiff brown, silty clay; to a depth of 2.50m below ground level. Strata at 2.50 to termination depth of 3.0m below ground is damp, stiff brown, sandy, silty clay.
- The soils are determined as being of high to very high plasticity.
- *Roots* - were recovered from beneath the foundations of the property which were identified as 0.50m deep, examined root: a conifer, could well be the family ***CUPRESSACEAE*** (Cypresses ('macrocarpa', 'Leylandii' etc.), Thuja (Western Red Cedar), Junipers). At 1.0m deep, examined root: again, could be the family ***CUPRESSACEAE*** (as listed above). Less than 0.2mm in diameter. At 1.5m deep, examined root: similar in many ways to the family ***SALICACEAE*** (Salix (Willows) and Populus (Poplars)).

CCTV survey of drainage:

- This revealed the drains to be in a serviceable condition and are not a factor in the damage.

Conclusions of Site Investigations

The results of the site investigations confirm that the cause of subsidence is root-induced clay shrinkage. The clay is plastic and thus will shrink and swell with changes in moisture content. Roots have extracted moisture below the depth of the footings, thus causing differential foundation movement to occur.

Arborist Report:

Site investigations and soil test results have confirmed a plastic clay subsoil susceptible to undergoing volumetric change in relation to changes in soil moisture. A comparison between moisture content and the plastic limits suggests moisture depletion at the time of sampling in TP/BH1 & 2 at depths beyond normal ambient soil drying processes such as evaporation indicative of the soil drying effects of vegetation.

Roots were observed to a depth of 500mm below ground level (bgl) in TP/BH1 and recovered samples have been positively identified (using anatomical analysis) as ***Acer*** (Maple), the origin of which will be T4 (Sycamore – Maple).

Roots were observed to a depth of 1,000 and 1,500mm bgl in TP/BH2 and recovered samples have been positively identified as ***Cupressaceae*** (Cypress) and ***Salicaceae*** (Willow family), the origin of which will be T2 (Cypress) and T3 (Weeping Willow) respectively, confirming the influence of T2, T3 and T4 on the soils below the foundations.

Irrespective of the identification of recovered root samples, the roots of S1 are also likely to be present below foundation level in proximity to the area of movement/damage and influencing soil moisture and volumes.

Based on the Technical Reports currently available, engineering opinion and our own site assessment we conclude the damage is consistent with shrinkage of the clay subsoil related to moisture abstraction by vegetation. Having considered the information currently available, it is our opinion that T2, T3, T4 and S1 are the principal cause of or are materially contributing to the current subsidence damage.

Level Monitoring:

- Initial set-up and first readings recorded February 2020
- Latest readings recorded February 2021
- Readings have demonstrated movement throughout the seasons consistent with changes in weather – IE, shrinkage in warm seasons and expansion during wet seasons.

Conclusions of Arborist Report

- Conditions necessary for clay shrinkage subsidence to occur related to moisture abstraction by vegetation have been confirmed by site investigations and the testing of soil and root samples. Engineering opinion is that the damage is related to clay shrinkage subsidence.
- There is significant vegetation present with the potential to influence soil moisture and volumes below foundation level.
- Roots have been observed underside of foundations and identified samples correspond to vegetation identified on site.

Recommendations
*Please refer to the attached Arborist Report for location and annotation of trees/vegetation that have been implicated.

If an arboricultural solution is to be implemented to mitigate the influence of the implicated trees/vegetation we recommend that ***T2, T3, T4 and S1*** are removed.

Other vegetation recorded presents a potential future risk to building stability and management is therefore recommended.

Consideration has been given to pruning alone as a means of mitigating the vegetative influence, however in this case, this is not considered to offer a viable long-term solution due to the proximity of the responsible vegetation.

Projected costings for required/recommended structural repairs:

- If mitigation is achieved and the TPO Application is agreed, we envisage repairs to be circa ***£18,000***

- If mitigation is unsuccessful and the TPO Application is declined, we envisage repairs to be circa ***£80,000***

The basis of increased costs of repair incorporate substructure stabilisation by way of underpinning and/or root barriers to protect the property against the remaining trees/vegetation deemed to be causing nuisance.

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