REACTIVE SOILS CAN BE VICIOUS

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ABSTRACT

When we talk about reactive soils, we don't mean reactive soils as in radio–active soils from a nuclear test site or a toxic waste dump.

While that type of soil may be detrimental or even deadly to health the effect of the reactive soils discussed here can be destructive to buildings and the underground pipes and fittings used to service these buildings, be they large commercial buildings or domestic houses, herein we will only discuss the latter.

1.0 INTRODUCTION

From the outset, Martin (Marty) Bennett, a Master Plumber and Drainage Contractor with the full support and assistance of his wife Jenny, founded Storm Plastics in 1989. It was in response to the urgent need to overcome what was and still is, a very serious problem for all drainage systems constructed in areas of reactive soils.

Of particular concern was how the outcome of soil movement impacted on young couples, first home buyers who had committed their savings and ongoing income towards owning their own home only to be suddenly confronted with damage beyond their monetary means within a short time of moving into their new house.

2.0 WHAT IS REACTIVE SOIL?

Reactive soil can be quickly described as any soil that will expand or contract with a variation of moisture content but the study and understanding of Reactive Soils can be very technical. No doubt we have seen cracks appear in the ground when the soil is very dry, sometimes only small cracks barely visible, others where one can put your finger in. There have been reports where cattle have to be moved off properties because cracks are such that the animals risk broken legs from stepping into these cracks as they move about to feed.

When the rains come the water washes dead grass, dust and small twigs down the cracks, the moisture enters the soil and it reacts and expands back to its normal state but now it has additional mass and may take on an undulated state. With the increased requirement of land for housing, some of these areas are becoming domestic blocks. However it is not only new blocks from new land releases, many blocks built on over the decades have the same reactive soil characteristics. This reactive soil process of drying out and shrinking; getting wet and expanding has been going on for centuries.

Possibly due to the recent prolonged and severe drought some buildings may have been affected that have never suffered sufficiently in the past to be damaged by the effect of reactive soil. The outcome of such events frequently causes damage to drainage systems and building structures. Broken pipework, cracked walls and concrete floors are typical of the damage caused.

Expanding soil has a slow, silent and enormous power called heave, similar to a wave action in slow motion. In many cases the damage is so severe that major repairs or even total demolition and reconstruction is required. This is well recorded throughout the nation by Insurers, Engineers and Builders alike.

Most soils are affected by water, clay soils and black soils react physically. As we read above, they expand and contract with changes in moisture content but trying to maintain absolute stability of the moisture in the soil around a building is rarely achievable however much can be done to control it and minimise its affects.

Firstly, we must know what type of soil with which we are dealing. By taking samples of the soil on the proposed building site either by core sample or by drilling with an auger and forwarding those samples to a qualified and competent Geotechnical Engineer who has the ability to assess the potential for any soil to react to variations in moisture content in accordance with the Australian Standard AS/NZS2870-1996. Results from site testing are collated and transformed into easily identifiable Site Classifications.

3.0 REACTIVE SOIL SITE CLASSIFICATIONS IN BRIEF.

Table 1: ***Description of soil classifications and their characteristics***

Soil Class	Characteristics
Class- A	Little or no ground movement (Non Reactive).
Class- S	Slightly reactive
Class- M	Moderately reactive. Extending to: Class M-D. (D meaning deep seasonal moisture variations)
Class- H	Highly reactive. Extending to: Class H-D
Class- E	Extremely reactive. Extending to: Class E-D
Class- P	Applies to Problem sites eg. Filled soil, potential to collapse and abnormal moisture conditions caused by the drying effect of trees. Special provisions apply

The movement of the above classifications expand and contract at various amounts in accordance with the moisture content. For example, from a dry to a saturated state Class M may move 40mm, Class H, 70mm and Class E can move in excess of 70mm, but over 250mm has been recorded on some projects.

Just to make it more difficult, these soils that react at different rates of expansion and contraction can at times be found on the same block of land and if a "cut and fill" is required to level the site the various soils left as the cut section remain static but the spoil moved to become the "fill section" can be all mixed together. This really creates a problem for the designers.

For allotments containing reactive soils classified as H, E, H-D or E-D it is a mandatory requirement for compliance with AS/NZS2870-1996, Section 5, Clause 5.5.4 (a), that pipes through external footings *shall* be lagged and (b), Connection of stormwater drains and waste drains *shall* include flexible connections and in 6.6 (f), Joints in plumbing pipes within 3m of the house under construction *shall* be articulated to accommodate ground movement without leakage. The word shall doesn't mean '*maybe*' or '*I'll think about it'* it means **SHALL**.

AS/NZS3500.2.2003 3.8.2 (C) (I) also calls for Flexible Joints.

There have been many cases where these instructions were not adhered to, even though they were included in the designers detail but the Flexible Drainage System was not employed in a reactive soils site, only to find that over a short space of time, the rigid PVC-U drainage system had been comprised by soil movement and water leaked out of the pipes, wet the surrounding soils, created heave and damaged the structure. A very costly experience which could have and should have been avoided had the correct procedures been employed.

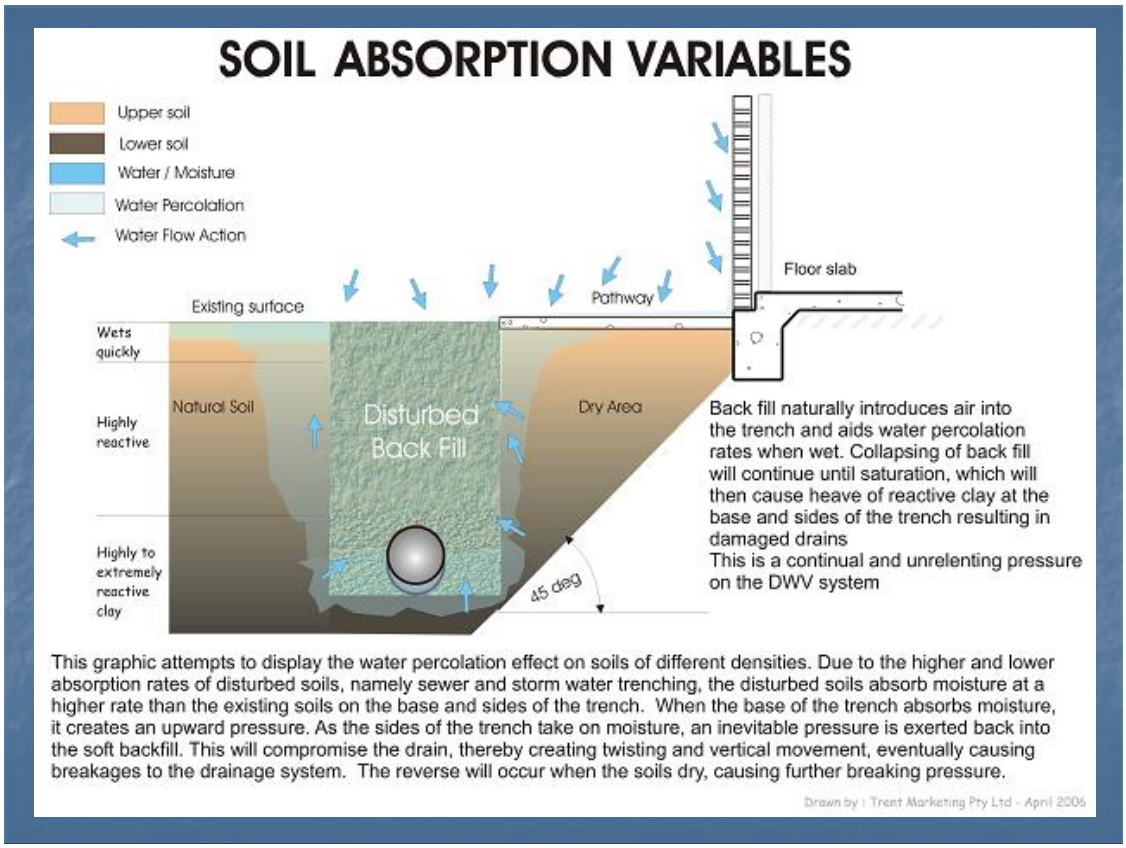

Figure 1: ***Soil absorption variables***

Excess moisture content in one concentrated area can cause excessive heave and destroy concrete slabs, brickwork and internal walls as shown in an artist's detail and the photos below.

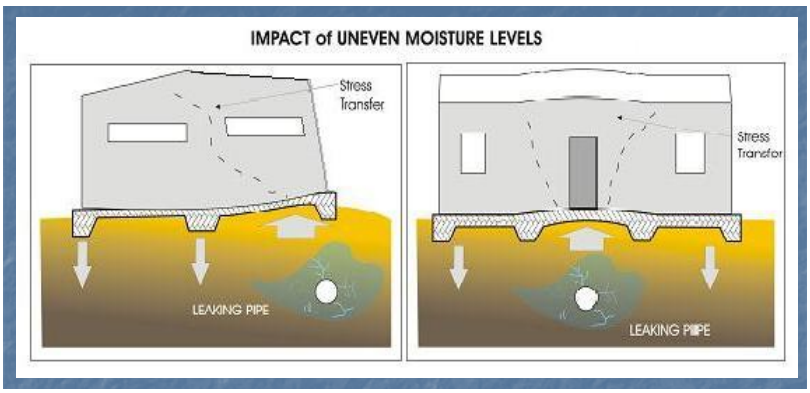

Figure 2: ***Impact of uneven soil moisture levels***

Figure 3: ***Actual damage to buildings caused by reactive soils***

4.0 FLEXIBLE DRAINAGE SYSTEMS

In response to the various issues listed above, Marty Bennett invented the Storm Plastics Expanda Joint in Adelaide in 1989. Since then he has incorporated a Swivel Joint to complete the "Storm Plastics Flexible Drainage System."

On the website www.stormplastics.com.au information can be found on all the products and drawings are available to download, some in CAD form, showing the Manufacturer's Guidelines on the installation of the "Storm Plastics Flexible Drainage System." Without any flexibility, **disaster;** but with a correctly designed and installed Storm Plastics Flexible Drainage System all ground movement can be accommodated.

It is recommended these PVC-U products be installed by a qualified and licensed Plumber conversant with the type of soils to be found on the jobsite and in compliance with the Manufacturer's Guidelines and the relevant Australian/NZ Standards.

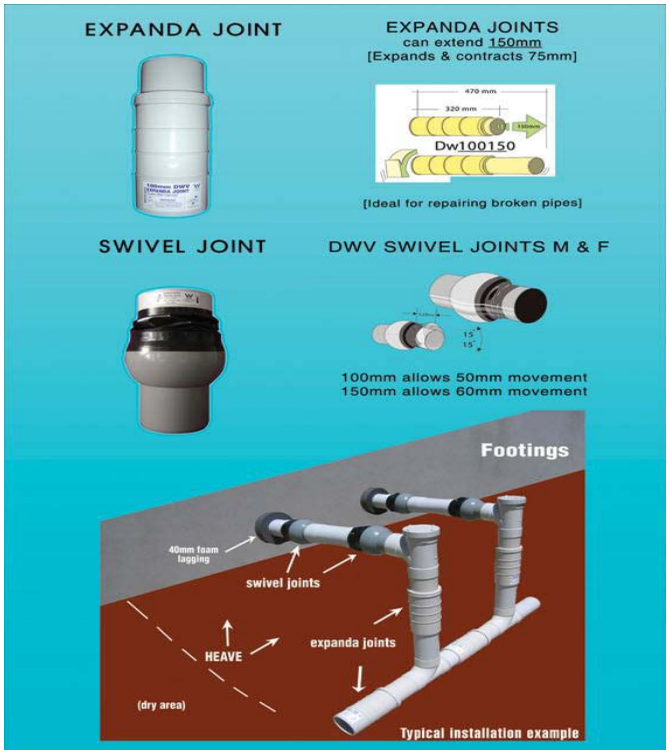

Figure 4: ***Some of Storm Plastics range of flexible joints***

5.0 SUMMARY

With today's advanced technologies, the understanding of how, when soils move, they do so simultaneously in a horizontal and vertical plane similar to a wave action in slow motion and how Storm Plastics Flexible Drainage Systems compensate for that movement, Hydraulic and Soil Engineers are now able to predict and design with greater certainty drainage systems that respond more harmoniously with the natural movements within reactive soils.

Relieving the stresses generated by the expansion and contraction motions, the wave action, through reactive soils is a major step towards alleviating the incidence of damage to underground PVC-U pipework systems.

To ensure Storm Plastics keep abreast with the latest events and to maintain a Reactive Soils training presence in the Plumbing and Drainage Industry they maintain membership with the following Associations;

AHSCA Association of Hydraulic Services Consultants of Australia (Queensland Chapter),
FFS Foundation and Footings Society,
MPMSAA Master Plumbers and Mechanical Services Association of Australia,
IPIQ Institute of Plumbing Inspectors Queensland Inc.,
QMBA Queensland Master Builders' Association,
WIOA Water Industry Engineers and Operators' Association of Australia,
HIA Housing Industry Association,
MPAT Master Plumbers' Association of Tasmania.
PIA Plumbing Industry Association of South Australia.

In conjunction with and also independent of the above Associations, Storm Plastics conduct various training seminars throughout Australia and New Zealand on the devastating effects of Reactive Soils and how Storm Plastics Flexible Drainage Systems can alleviate most of the associated problems of soil movement.

Sodic soils are also a serious problem but that is a story on its own for another time.

6.0 ACKNOWLEDGEMENTS

Graphic blocks above photos of damaged walls, Trent Marketing.

7.0 REFERENCES

AS/NZS 2870-1996 and AS/NZS3500.2.2003

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