Pop-up physics

Saturday, November 23, 1996

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The accompanying experimental folding experiment devised in 1815 may be duplicated in the school physics lab. Pop-up structures are found in many places and are caused by regional stress release which occurs naturally or during quarrying an excavation.

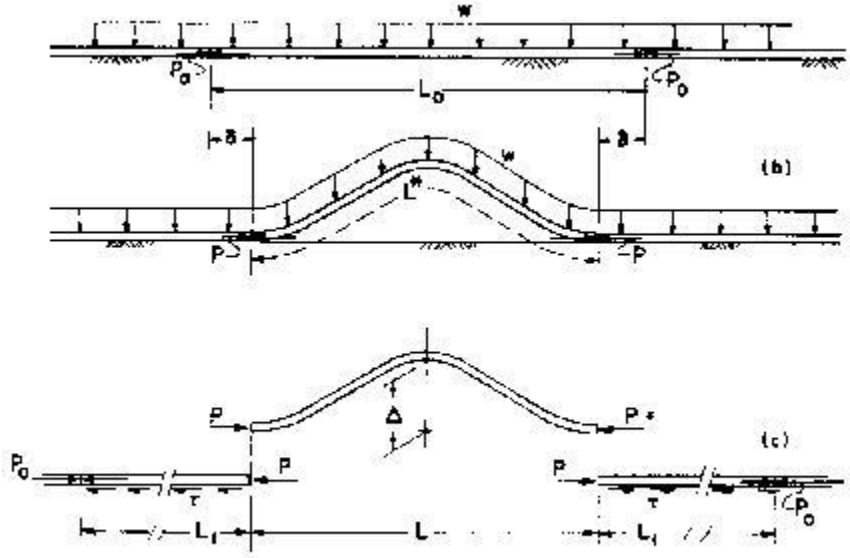

Figure 1 - Forces involved in pop-up formation

If regional stress effects are not taken into account when engineering projects are undertaken costly mistakes can be made. In the Toronto area when tunnels and other excavations are made they must be left open for a while so that the rocks can move and redistribute the regional horizontal stress. Excess rock is then taken off and the work is completed. If concrete foundations or tunnels are lined before stress release takes place major structural damage results.

At the Wiarton quarries of Arriscraft, diamond saw blades were jamming in the cut as they extracted large blocks of dolostone. Dr. Maurice Dusseault of the University of Waterloo Earth Sciences Department studied the problem and the simple solution was to cut the rock at right angles to the regional stress. Rock from this quarry must also be allowed to rest for a few months before being made into architectural stone work. If this is not done stone produced will not be accurately cut. Problems of this type occurred when the rush was on to build the Canadian Embassy in Washington.

At the hydroelectric power generating stations at Niagara Falls the results of regional stress may be seen in some vertical cylindrical excavations where were originally round and are now oval.

Occasionally pop-ups occur in the quarries, such as Marmoraton Mine near Madoc, Ontario, and stress relief fracturing can be catastrophic when they create underground mining "rockbursts."

Pop-ups are discussed in a timely article in the November December issue of Canadian Geographic Magazine. Pop-up ridges have been known for many years around southern Ontario. More interest was shown in these structures when an aircraft performing at the Canadian National Exhibition crashed into the Toronto Harbour area two years ago. When using sonar to locate remains of the aircraft pop-up ridges were found on the floor of Lake Ontario.

Try experimenting with different materials instead of the cloth in the 1815 example cited. Rubber matting, with thin flexible steel between the layers, or old file cards stacked vertically between rubber matting and the steel. Vary the weight and other physical parameters, thin cloth layers may produce complex folding as in the original experiment. Layers of clay and sand will also produce different structures.

Figure 2 - An angular fold in Oakville, ON.

References

Elizabeth Shilts, 1996, On Shakey Ground, *Canadian Geographic Magazine,* issue 6,

P.F. Karrow, 1990. Rock Popups in Southern Ontario, *Wat on Earth*, Vol. 3 No. 2, pp. 26-27.