# The types and the origin of carbonate karsts in Malaysia and their significance

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Karst (named after a region of the same name in the former Republic of Yugoslavia) refers to a characteristic topographic feature or landscape which can be developed by rocks undergoing dissolution by downward percolating meteoric water (Jakucs, 1977). Many features of karst are also developed by flowing water which had flowed laterally on reaching the water-table which becomes the base-level of erosion for the development of the many karstic features observed in the tropics and elsewhere (Zotl, 1989). Several rock types under such natural "weathering/solution" environment can develop karstic topography. They include limestone, dolomite, gypsum, salt deposits and silica rocks (Jennings, 1971).

However, the most common and the best known are those developed by carbonates [calcite, $CaCO_3$ and dolomite, $(Mg, Ca)CO_3$]. Under tropical humid conditions, calcitic and dolomitic limestones or their metamorphosed equivalents develop tropical karstic features which show spectacular tall steep-sided hills (tower karst or mogote) (Jennings, 1982) and solution features such as karren, dolines, uvalas, poljes and cockpits (locally referred to as wangs).



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**Table 1.** Karstic features and karst types and their potential geotechnical problems and hazards.

**1. KARST TYPE A: ABOVE SURFACE TOWER KARST (MOGOTE) (IPOH AND LANGKAWI)**

| *KARSTIC FEATURES* | *POTENTIAL GEOTECHNICAL PROBLEMS AND HAZARDS* |
|---|---|
| 1. MOGOTE HILLS | A. STEEP VERTICAL FACE |
| 2. CAVES | B. COLLAPSE OF WALL/FACE |
| 3. WANGS (OR COCKPITS) | C. INSTABILITY OF OVERLYING GROUND (SINKHOLE FORMATION) |
| 4. NOTCHES | |
| 5. OVERHANGING CAVES | D. VERY DIFFICULT OR IMPOSSIBLE TO CONSTRUCT UNLESS CUT DOWN TO PLATFORM LEVEL |
| 6. SPLEOTHEMS | |
| 7. KARREN (VARIOUS TYPES) | |

**2. KARSTIC TYPE B: BURIED RELICT/EXHUMED KARST (KINTA AND KLANG VALLEYS)**

| *KARSTIC FEATURES* | *POTENTIAL GEOTECHNICAL PROBLEMS AND HAZARDS* |
|---|---|
| 1. PINNACLES | A. PILE DEFLECTION (DRIVEN PILE) |
| 2. DOLINES AND UVALAS | B. PILE DAMAGE (DRIVEN PILE) |
| 3. CAVITIES | C. UNSTABLE ANCHORAGE (END-BEARING) |
| 4. OVERHANGS | D. MOVEMENTS OF PILE OVER SLABS AND OVERHANGS |
| 5. SLABS | |
| 6. CHANNELS | E. WEATHERED ROCKS AND SOLUTIONS GIVING RISE TO PROBLEMS OF ANCHORING |
| 7. WEATHERED LIMESTONE | F. COLLAPSE OF ROOF OF CAVITIES |
| | H. WITHDRAWAL OF SEDIMENTS (SURFACE INSTABILITY) |

**3. KARSTIC TYPE C: STRATIGRAPHIC KARST (K.L. PAN PACIFIC OR K.L.C.C. TYPE)**

| *KARSTIC FEATURES* | *POTENTIAL GEOTECHNICAL PROBLEMS AND HAZARDS* |
|---|---|
| 1. UNEVEN BEDROCK | A. MAJOR PROBLEM TO SITE TALL HIGH-RISE DUE TO MAJOR OVERHANGS RELATED TO DEEP AND UNEVEN BEDROCK (E.g. K.L.C.C.) |
| 2. LARGE MASS ROCK HEAD | B. OVERLYING WEATHERED SOFT SEDIMENTS |
| 3. MINOR SOLUTION SURFACE. | C. MINOR IRREGULAR SURFACE AT SHALLOW DEPTHS |
| 4. SOLUTION ZONES | D. VERTICAL CLIFFS AND OVERHANGS |
| 5. DEEP CAVITIES AND CAVERNS | E. SOLUTION OF BEDROCK IN PROGRESS |
| | F. ARCHING OF OVERLYING SOFT SEDIMENTS |
| | G. SEDIMENT WITHDRAWAL (SINKHOLES) |

**4. KARSTIC TYPE D: SUBMARINE KARST (OFF THE COAST OF SOUTHEAST ASIA)**

| *KARSTIC FEATURES* | *POTENTIAL GEOTECHNICAL PROBLEMS AND HAZARDS* |
|---|---|
| | — **BURIED PLATFORM TYPE** |
| 1. PLATFORM AND PINNACLED | A. UNSTABLE ANCHORAGE AT SHARP BEDROCK SURFACE |
| 2. PLATFORM WITH SOLUTION CAVITIES | B. WEAK ZONES TRAVERSED BY FAULTS |
| | C. AREAS WITH CAVITIES WHICH ARE INTERCONNECTING (AT SHALLOW TO DEEP LEVELS) |
| | D. SOME SIMILAR PROBLEMS AS FOR SUBSURFACE KARST |

3. MINOR SHARP BEDROCK SURFACE

| | — **BURIED RELICT** |
|---|---|
| 1. MAJOR SHARP SURFACES | A. UNSTABLE ANCHORAGE OVER SHARP BEDROCK SURFACE |
| 2. WEATHERED ZONES | B. WEATHERED AND WEAK ZONES (FAULT-CONTROLLED) |
| 3. CAVITIES AND POTENTIAL | C. POTENTIAL COLLAPSE OF CAVITIES AND CAVERNS CAVERN ROOFS |
| | D. SOME SIMILAR PROBLEMS AS FOR SUBSURFACE KARST |