



TRINITY COLLEGE DUBLIN

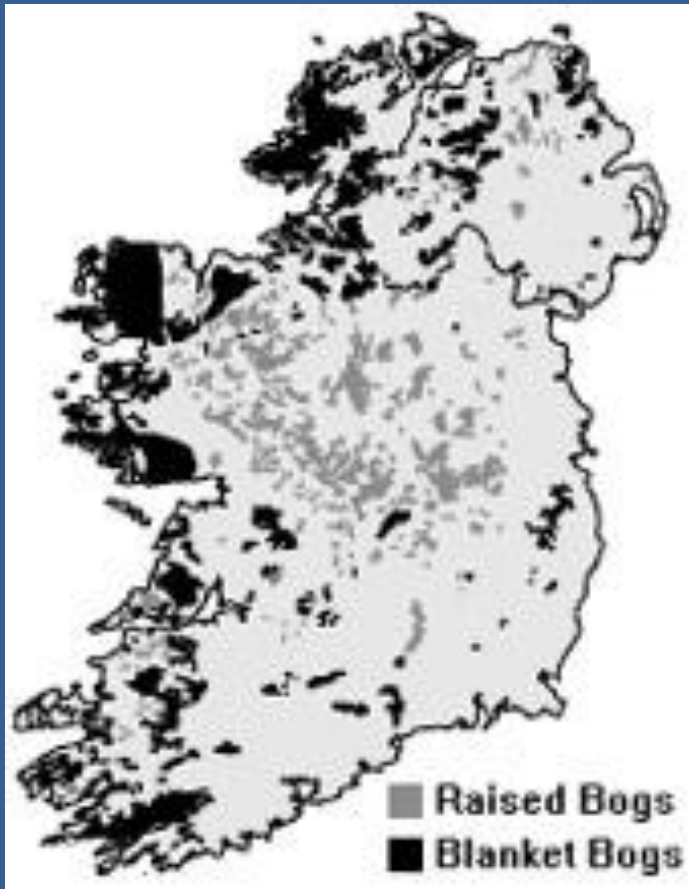
***RAMPART ROADS IN THE PEAT LANDS OF  
IRELAND: GENESIS, DEVELOPMENT AND  
CURRENT PERFORMANCE***

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# INTRODUCTION

# PEAT IN IRELAND



Peatlands distribution in Ireland  
(Bord na Móna, 2001).

- “17.2% of the land surface of Ireland is covered with peat” (Hobbs, 1986).
- Much of the primary and secondary road system is founded in this highly compressible and low strength material

# **RAMPART ROADS: HISTORICAL BACKGROUND**

- Peat harvesting for fuel in the vicinity of the bog roads has been a common practice in Ireland and has led to the creation of elevated roads, referred to as rampart roads.
- References in the Old Irish law texts trace peat harvesting back to the seventh and eighth centuries (Feehan & O'Donovan, 1996).



Rampart road on the R400 regional road, between Rhode and the N6, County Offaly, Ireland.



Peat harvesting site  
next to the R400.



Peat briquettes drying

# GENESIS OF THE RAMPART ROADS



# GENESIS OF THE RAMPART ROADS

It was in the eighteenth century that the network of bog roads in Ireland began to be properly developed by landowners and the Grand Jurys in order to gain commercial and military access to the remote rural areas.

# GENESIS OF THE RAMPART ROADS

- The improved roads across the peat lands provided better access and made peat harvesting easier.
- The rapid cut away of the peat material in the vicinity of the roadsides resulted in an elevated road surface that in some cases was many meters above the surrounding ground.

# GENESIS OF THE RAMPART ROADS

- These elevated bog roads are referred to as rampart roads.
- Leebody (1911) reported rampart roads of between 1.5 and 9.0 m in height.



Rampart road on the N62 national secondary road, between Cloghan and Birr, County Offaly, Ireland.

# GENESIS OF THE RAMPART ROADS

- Rampart roads often undergo considerable distortion due to the low shear strength and high compressibility of the peat foundation, which may pose a significant safety hazard.



Extreme undulations on  
N62 rampart road,  
County Offaly, Ireland.

# PREVIOUS WORKS

- Cuddy (1988) reported that the cost of maintaining a bog road at a similar performance level to that of a road constructed on a firm ground foundation was about ten times higher.

# PREVIOUS WORKS

*Hanrahan (1953 & 1954):*

Presented research studies on bog roads, most of which were rampart roads. Nearly all sites exhibited some of the following features:

- Transverse or diagonal surface undulations.
- Cracking or depressions due to poor drainage.



# PREVIOUS WORKS

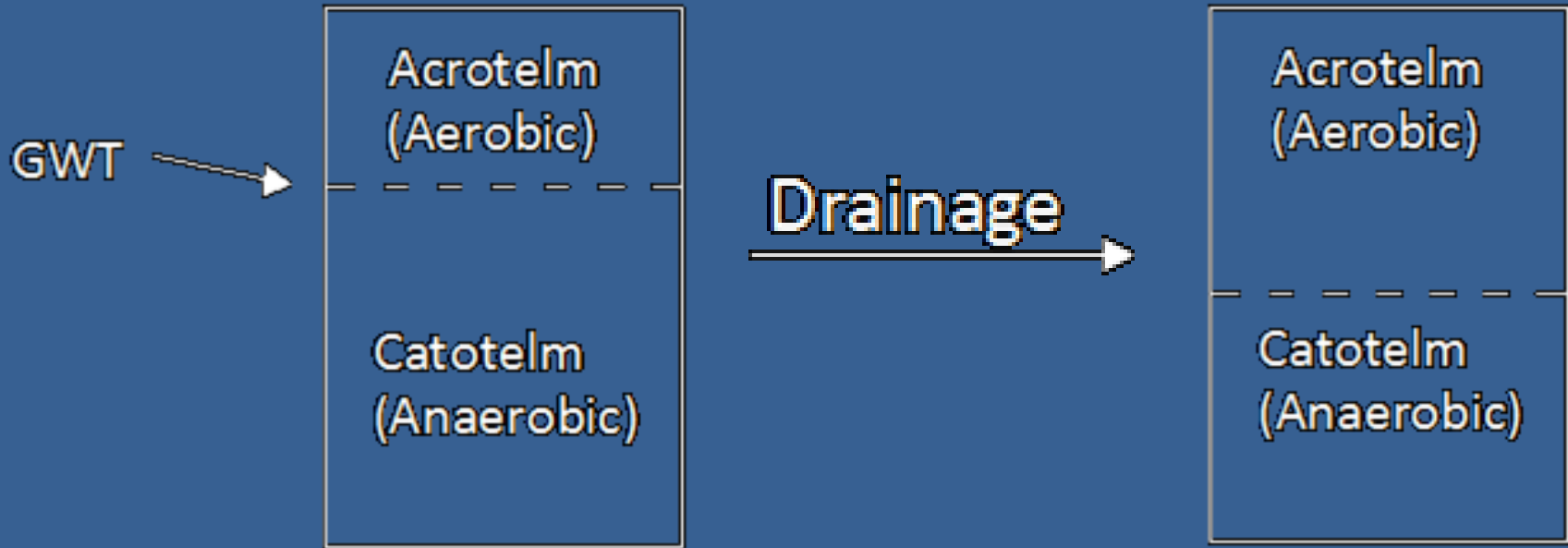
- Lack of maintenance.
- Thin road structure.
- Large vegetation, which increased the loads and rate of consolidation near the roadsides.
- Humps and depressions at side road junctions.
- In some cases, failure due to the low quality of the construction materials.

# **GEO TECHNICAL PROPERTIES AND DRAINAGE EFFECT**

# PEAT GEOTECHNICAL PROPERTIES

Land drainage for peat harvesting significantly alters the geotechnical properties of the peat, inducing distortion and potentially instability in the rampart.

# PEAT GEOTECHNICAL PROPERTIES



Regain oxygen and become repopulated with aerobic micro-flora, speeding up the decay process and inducing several changes:

# PEAT GEOTECHNICAL PROPERTIES

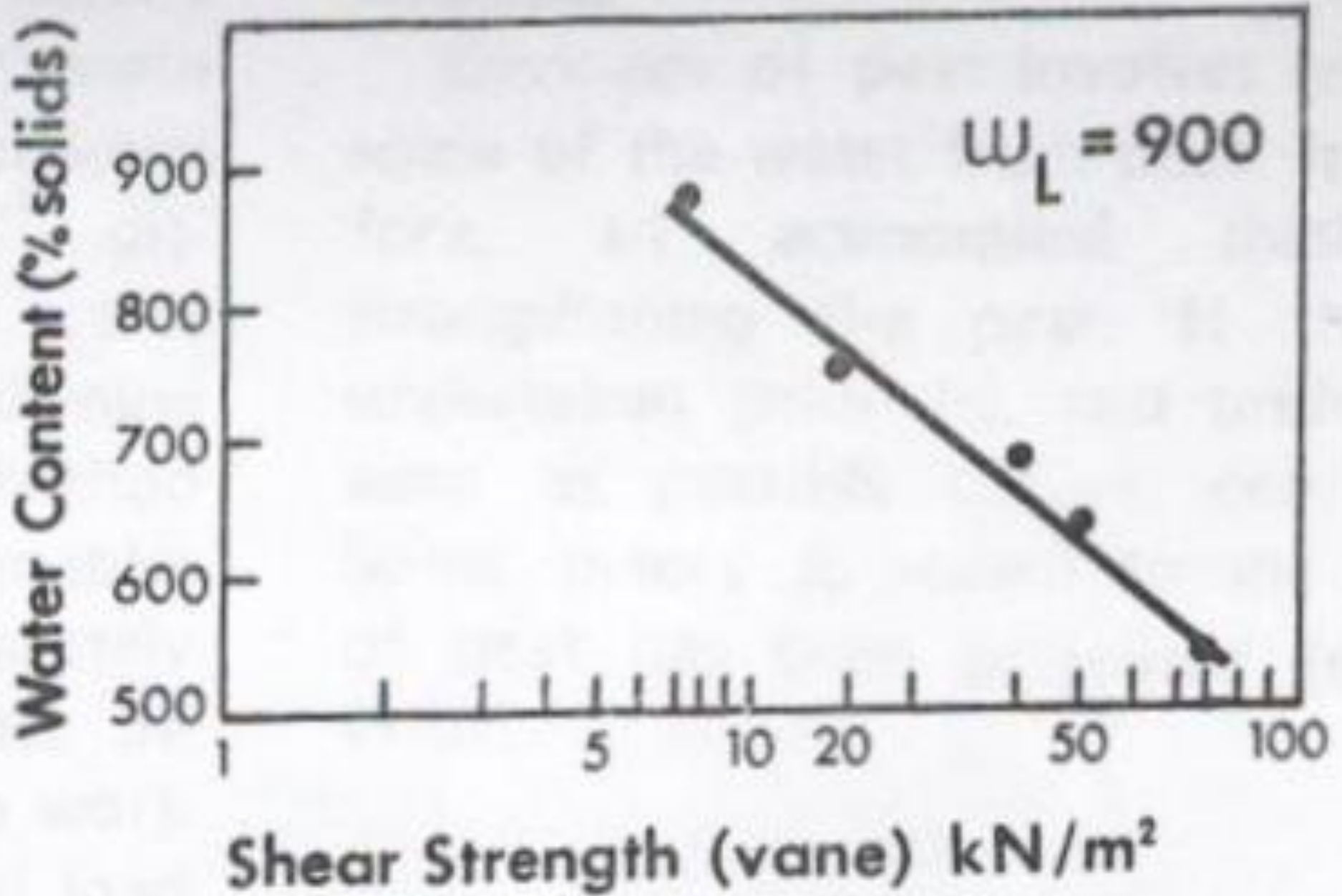
- The level of humification increases as the decay rate increases.
- Volumetric shrinkage occurs due to air drying of the peat.
- The void ratio, water content and permeability values decrease while the unit weight, effective stress and shear strength values increase.

# PEAT GEOTECHNICAL PROPERTIES

The peat that remains submerged is subjected to an increased state of effective stress that results in subsidence and may potentially lead to shear failure.

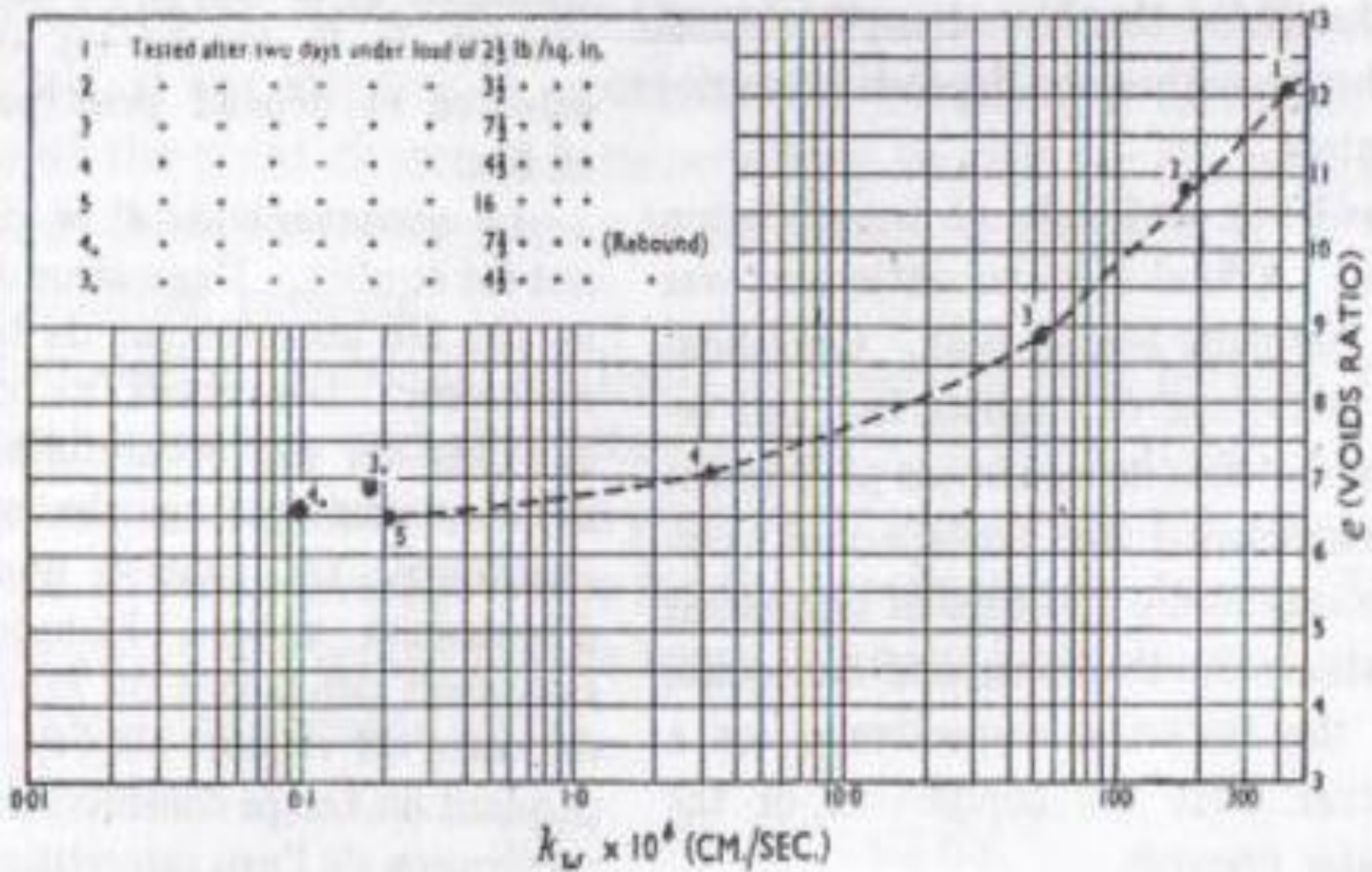
# PEAT GEOTECHNICAL PROPERTIES

	$\omega_{\text{mean}}$ (%)	$e_o$	$\sigma'_p$ (mean) (kPa)	Reference
Clara bog: No significant peat harvesting	1400	16 – 32	3	O'Loughlin, 2001
Raheenmore bog: No significant peat harvesting	1200	18	5	Hebib & Farrell, 2003
Ballydermot bog: Over 50 years of peat harvesting	850	12	15	Hebib & Farrell, 2003



Shear Strength/water content relationship (Hanrahan, 1976)





Permeability/voids ratio relationship (Hanrahan, 1954)

# PEAT GEOTECHNICAL PROPERTIES

- Horizontal-to-vertical coefficient of permeability ratios in the range of 1.7 to 7.5(Hobbs, 1986).
- However, this ratio can be increased up to 300 after vertical loading due to horizontal alignment of the constituent fibres (Cuddy, 1988).

# IMPROVEMENT METHODS

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Maintenance technique	National roads	Regional roads	Local roads
Overlay existing pavement with hot-mix bituminous material or crushed stone.	First option	First option	First option
Reinforce the pavement incorporating geosynthetic with bituminous overlay.	Second option	Second option	Not used
Replace peat using granular fill.	Third option	Not used	Not used

# IMPROVEMENT METHODS

*Crushed stone and bituminous overlay:*

- Overlaying the existing pavement with crushed stone, hot-mixed or cold-mixed or bituminous materials are the most popular maintenance techniques.

# IMPROVEMENT METHODS

The main disadvantage of overlaying the existing pavement is the increase in weight applied to the compressible bog foundation so that the technique really only provides a temporary improvement.

# IMPROVEMENT METHODS

Bituminous materials are stronger and structurally more efficient than crushed stone overlays and can be applied at about half the depth to achieve a similar structural contribution, applying less weight to the bog foundation and most likely causing less settlement (Davitt et al., 2000).

# IMPROVEMENT METHODS

*Geosynthetic combined with unbound or bituminous overlay:*

- In Ireland, geosynthetic reinforcement of the pavement has proven to be successful and cost efficient giving longer life spans compared to crushed stone and bituminous overlays.



# IMPROVEMENT METHODS

The technique has succeeded in maintaining lightly trafficked roads over bog land for more than ten years whereas crushed stone or bituminous overlays have had to be reapplied at intervals of between three and four years (Davitt et al., 2000).

**CONCLUSIONS**

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- Rampart roads, a particular feature of bog roads in Ireland, pose a significant safety hazard to road users.
- Drainage and peat harvesting have lead to changes in the geotechnical properties of the bog foundation inducing distortion and instability of the rampart roads.

# CONCLUSIONS

- The existing rampart road network has to be improved and widened in accordance with the present traffic demand and economical growth.
- An extensive research program on the current performance and geotechnical properties of rampart roads must be conducted. No large scale research on the subject has been undertaken since Hanrahan (1953 & 1954).

# CONCLUSIONS

- In particular, the effectiveness of the maintenance, improvement and construction methods used for bog and rampart roads have to be assessed.

# ACKNOWLEDGEMENTS



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