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Insurance Exposure related to Road Construction

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Purpose of Roads

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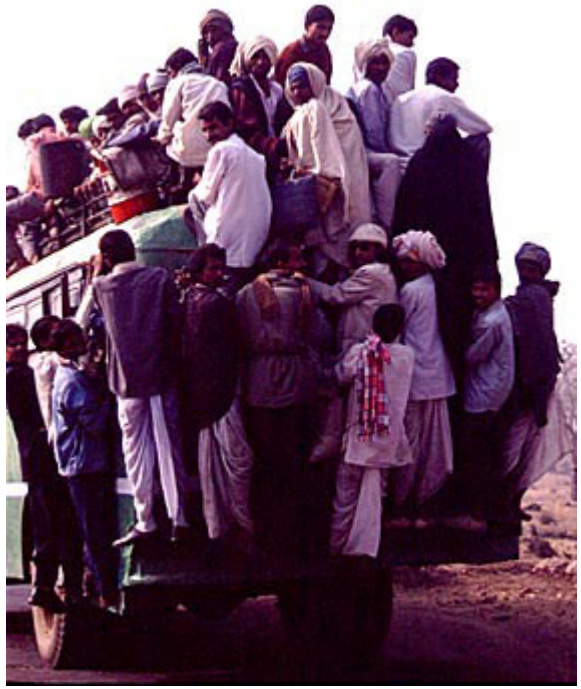
Transportation of Goods

..and People



Type of Roads 1/2

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Dependent on traffic load

..and required comfort

Type of Roads 2/2

As well as different design speeds…

Goal of Presentation

The goal of the paper “Engineering Insurance Exposure related to the Construction of Roads” is to help the Underwriter understand road construction, to build up awareness of the wide variety of perils road construction is exposed to, to help in performance of professional risk analysis and underwriting, and to draw the reader’s attention to possible loss scenarios.

In this presentation we would like to give you an understanding of the main outcomes of the paper:

- Understanding of technical, organisational and economical aspects of road construction
- Main exposures with possible loss scenarios
- Underwriting considerations and potential mitigation actions

Agenda

- Design of a Road (Parameters, etc.)
- Road Structure (subsoil, layers)
- Cuts and Slopes
- Drainage Systems
- Structures (Over- and Underpasses)

- Technical Aspects
- Main Exposures
- Loss Scenarios
- Risk Management
- Underwriting Considerations

- Site Organisation
- Project Costs
- Overview of Exposures
- Probable Maximum Loss Considerations
- Discussion

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Determining Factors

Climate and natural perils

International and local standards

Geology/Soil Conditions

Expected traffic load

Maximum speed

Topography

Existing/Third Party Property

Local Regulations and Laws

Design Elements

Road body (subsoil and layers)

Vertical and horizontal alignment

Required structures (bridges, tunnels)

Road width /number of lanes

Design of Roads

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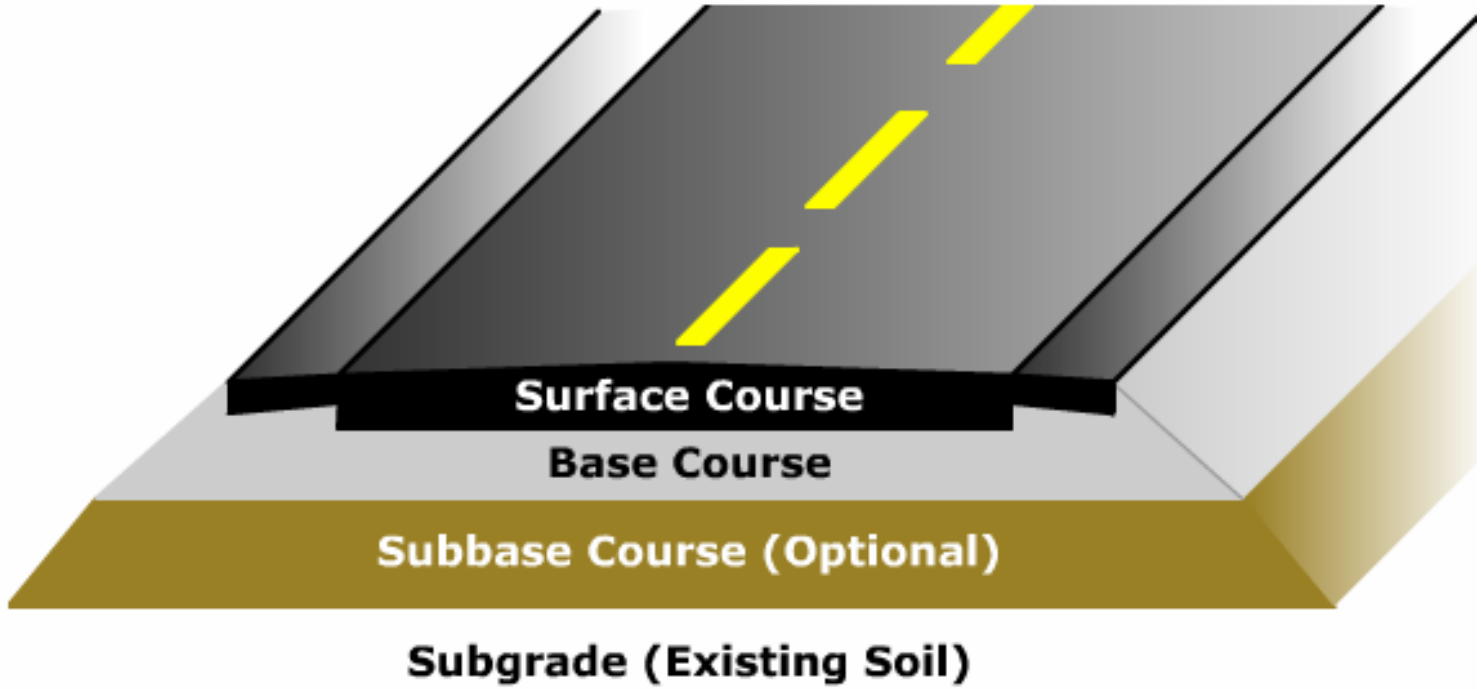
Main exposures	Underwriting considerations
The design parameters are not accurately defined (e.g. geology)	The amount and extent of surveys to gather data needs to be in line with the complexity of the project and should be carried out by technical specialists (e.g. a geologist) who are familiar with the local conditions.
The design parameters are not considered correctly in the design	Engineers and other specialists involved have to be familiar with the local particularities and should have experience with similar projects in the same location. In some cases, it might proove useful to have the design checked by an independent engineer.

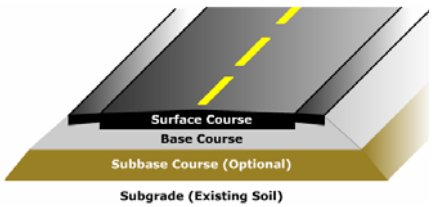
Road Structure

A road body is built up of several layers of different materials which fulfill various functions



Wearing course (surface)

- Impervious to the ingress of water
- Comfort and durability
- Made of asphalt



Base course (binder) and Road base

- Load bearing and spreading layers
- Usually around 100mm thick
- Made of bituminous material

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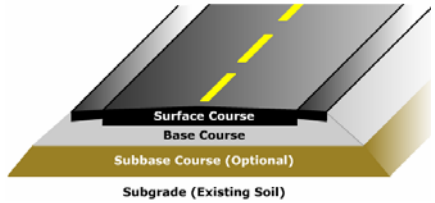
Sub-Base



- Load spreading layer
- Often used as a drainage layer
- Made of graded granular material
- Thickness dependent on traffic load and quality of subsoil (20-40cm)
- Often used during construction to temporarily carry heavy site equipment

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Subgrade (existing subsoil)

- Layer of naturally occurring material the road is built upon
- The strength of the subgrade is an important factor, influencing the thickness of the road pavement design and is commonly measured using the California Bearing Ratio (CBR) test

- Sometimes the soil conditions have to be improved e.g. through soil replacement, by embankments, sand-drains, adding lime or various other methods.

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Main exposures (1/2)

Rain, flood and inundation

Underwriting considerations

- Availability of meteorological and hydrological data incl. nearby water bodies
- Applied return period for the design of flood protection measures (MR endt. 110)
- Time schedule (seasonal aspects)
- Limitation of unprotected work sections (MR end. 106)

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Main exposures (2/2)

Faulty material/workmanship

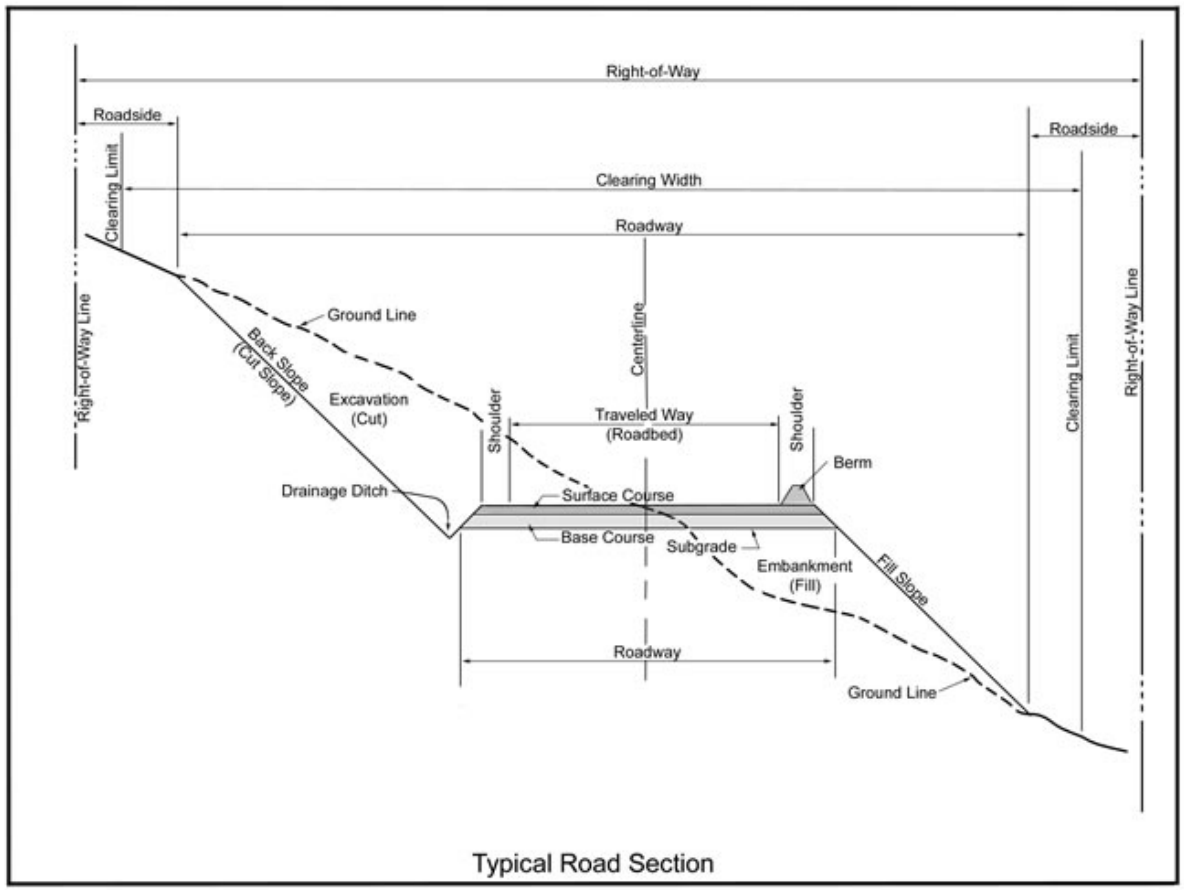
In the majority of the cases, the consequences (deformations or even collapse of road structure) show only at a later stage, i.e. after some months of operation under traffic loads (e.g. during the maintenance period)

Underwriting considerations

- A quality assurance programme for suppliers and on the site needs to be in place for testing of the materials (grading, strength) as well as for workmanship (e.g. compacting). The design specifications/tolerances must be met.
- Experienced and qualified parties
- Phased handover
- Definition of faulty part: All layers as a whole are seen as one entity of the works

Cuts and Slopes

Often the road route is obliged to traverse more or less mountainous or hilly regions where ‘cut’ and ‘fill’ forms a major part of the contract works.

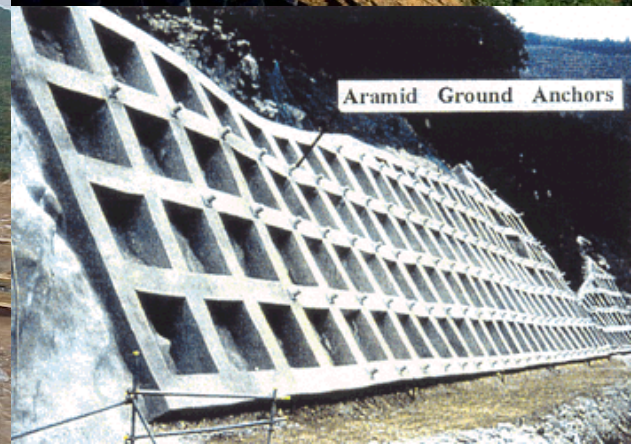


Typical Road Section

Cuts and Slopes

The design of the slopes is based on the geological data gathered from the survey and has to take into account temporary stages as well as the final protection. Depending on the slope angle and geology, various slope protection measures can be applied, for example:

- Gabion walls
- Geo web
- Shotcrete
- Ground anchors
- Retaining walls



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Main exposures (1/2)

Faulty design

Underwriting considerations

- Experienced engineer and contractor
- Check adequacy of geological surveys to define design parameters
- Identify critical construction phases
- Adequate slope angles and slope protection measures
- Adequate drainage
- Continuous monitoring of movements and deformations if required before start of construction works
- Consider TPL exposure due to potential landslides

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Main exposures (2/2)

Natural Catastrophe

Underwriting considerations

- Availability of meteorological and hydrological data
- Check earthquake exposure
- Drainage system (also temporary) has to be able to cope with specified amount of rain (e.g. 25 years return period, MR endt. 110)
- Sufficient slope protection against surface erosion
- Consider seasonal aspects in the construction programme
- Removal of debris from Landslides clause (MR endt. 111)

Drainage System

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Ground Drainage

- Maintain stability of subsoil, slopes and road structure
- Examples: Seepage drainage pipe, pumps, open channels, wells

Surface drainage

- Carry a maximum flow of water resulting from rain (design return period!)
- Collect debris and dangerous fluids after accidents
- Pipes, ducts and sewers close to surface

Temporary Drainage

Same as above but lower design return periods due to costs.

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Main exposures

Faulty design

Rain, flood and inundation

Underwriting considerations

- Definition of design parameters based on availabe data from surveys and investigations. Design return period has to be sufficient (eg. 100 years for final system, 25 years for temporary system. (MR endt. 110)
- Open trenches and the laid pipes are exposed to flood. Therefore the trenches have to be backfilled and the length of open trenches limited (MR endt. 117)
- Contractors often try to save costs on temporary drainage

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Overpass

Underpass

In order to avoid interference with existing roads, railways or pedestrian ways, under- and or overpasses are often built.

Normally these are simple structures with short spans. The foundations have to be adapted to the local geological conditions.

Project Organisation

- Main types of work: Earth movement (incl. cuttings and embankments), road structure, drainage, structures (over-/underpasses, culverts), infrastructure (lighting, signalisation, buildings)
- Linear construction site: The teams, doing different types of work, “follow“ each other along the route of the road under construction in a coordinated fashion
- In order to speed up the works, the contractors starts at several locations at the same time
- Reuse of excavated material (quality check!)
- Higher complexity for roads in urban areas (access, limited space, TPL exposure)

Project Costs

The average total construction costs vary between USD 250,000 and USD 750,000 per lane and kilometre (excluding land acquisition costs).

This estimate applies for roads in average geological and topographical conditions and excludes costs for large structures like tunnels and bridges. The level of construction cost is also highly dependent on the cost level in different countries.

Where tunnels and bridges form a major part of a road project, the average costs per kilometre can be much higher.

Overview of Exposures 1/3

- Natural catastrophes with water damage as the main theme to be considered
- Experience and track record of contractor and other involved parties
- Faulty design, material and workmanship
- Geology / hydrology and soil conditions
- Topographical Exposures (landscape, surrounding area)

Overview of Exposures 2/3

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Third party liability

Camps and stores

Overview of Exposures 3/3

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Contractors plant and equipment

Other environmental impacts

Probable Maximum Loss Considerations

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In General

Due to the linear nature of roads, the concentration of values is generally low. Therefore a total loss is highly unlikely.

High severity/low probability

Depending on the topography and the numbers of structures a severe earthquake can cause large damage to the insured property

Medium sized, high frequency losses

As a result of flood, inundation, landslide and faulty design, material and workmanship which, during the full construction period, can add up to high total amount.

Acknowledgments

Workgroup

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Thank You

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