# Fundamentals of Road Construction

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# Lecture 2

**The subject of the lecture:**

**Introduction to road design**

**Design is the process of originating and developing a plan for object, requiring research, thought, modelling, iterative adjustment.**

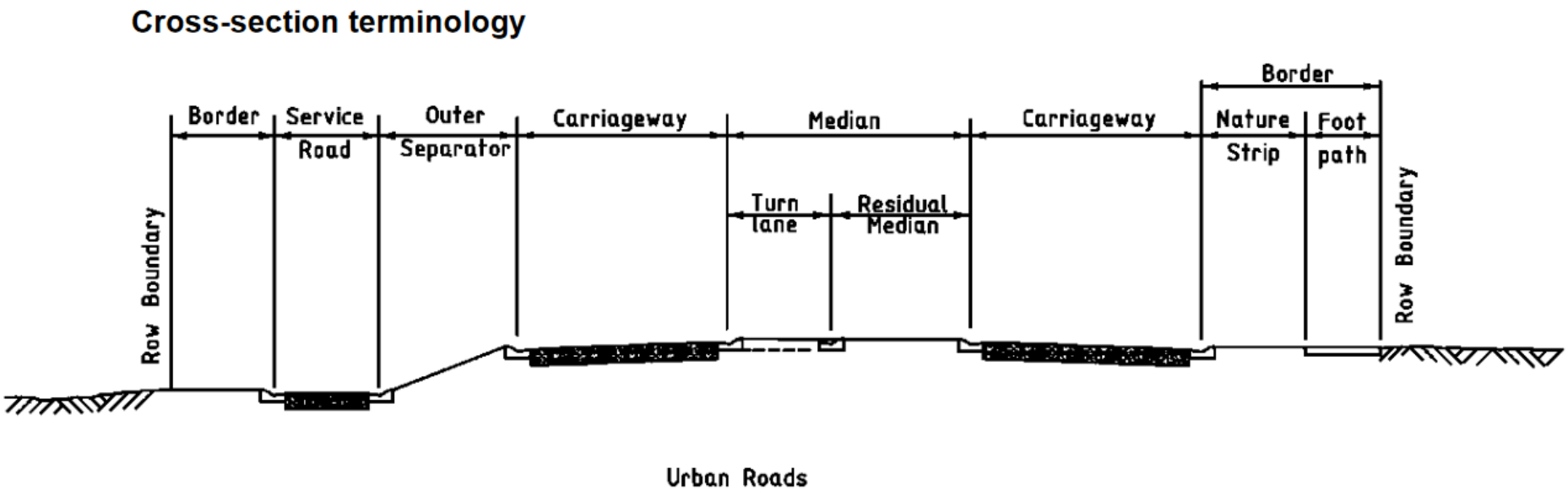
**In road design, the end result of the design process is presented on drawings and in specifications to allow the road to be constructed.**

**Doing a design of road should be achieve a balance between the:**

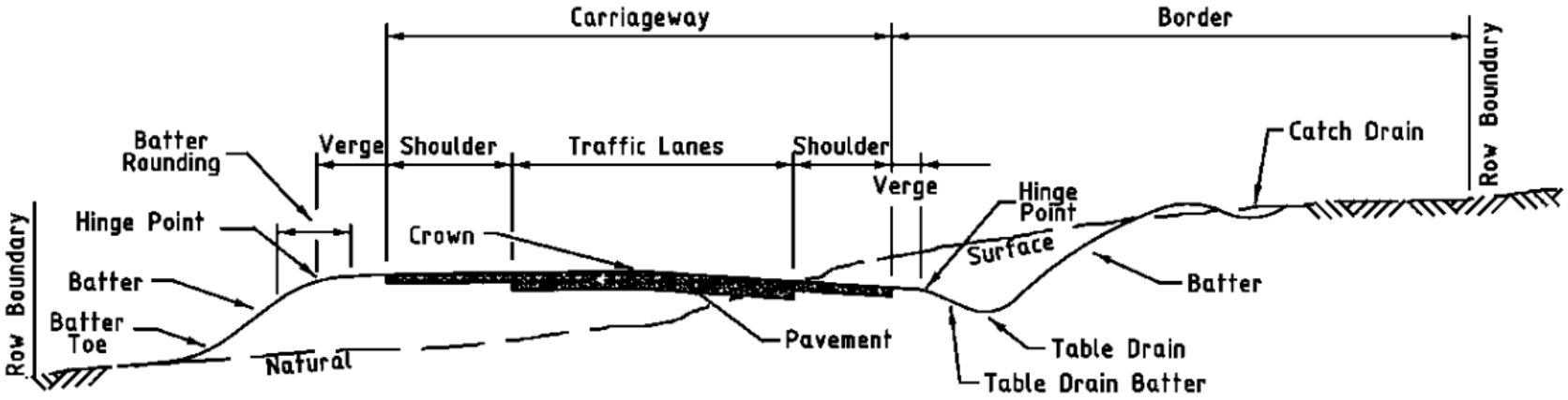
- **operational requirements,**
- **safety,**
- **cost,**
- **social and environmental impacts.**

**The main geometric elements that may impact on efficiency and safety are:**

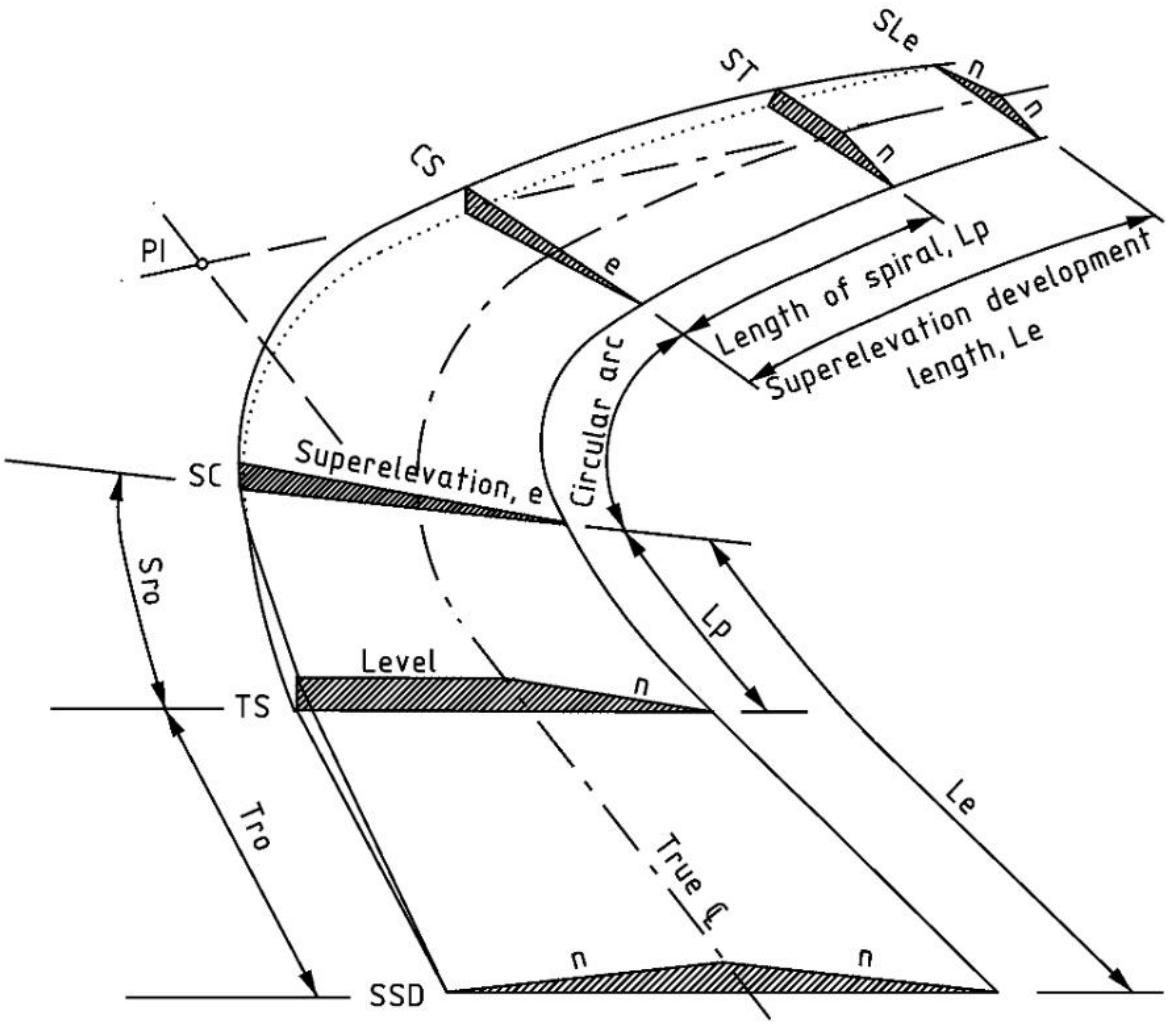
- **cross-section (e.g. widths of lanes, shoulders, medians and verges),**



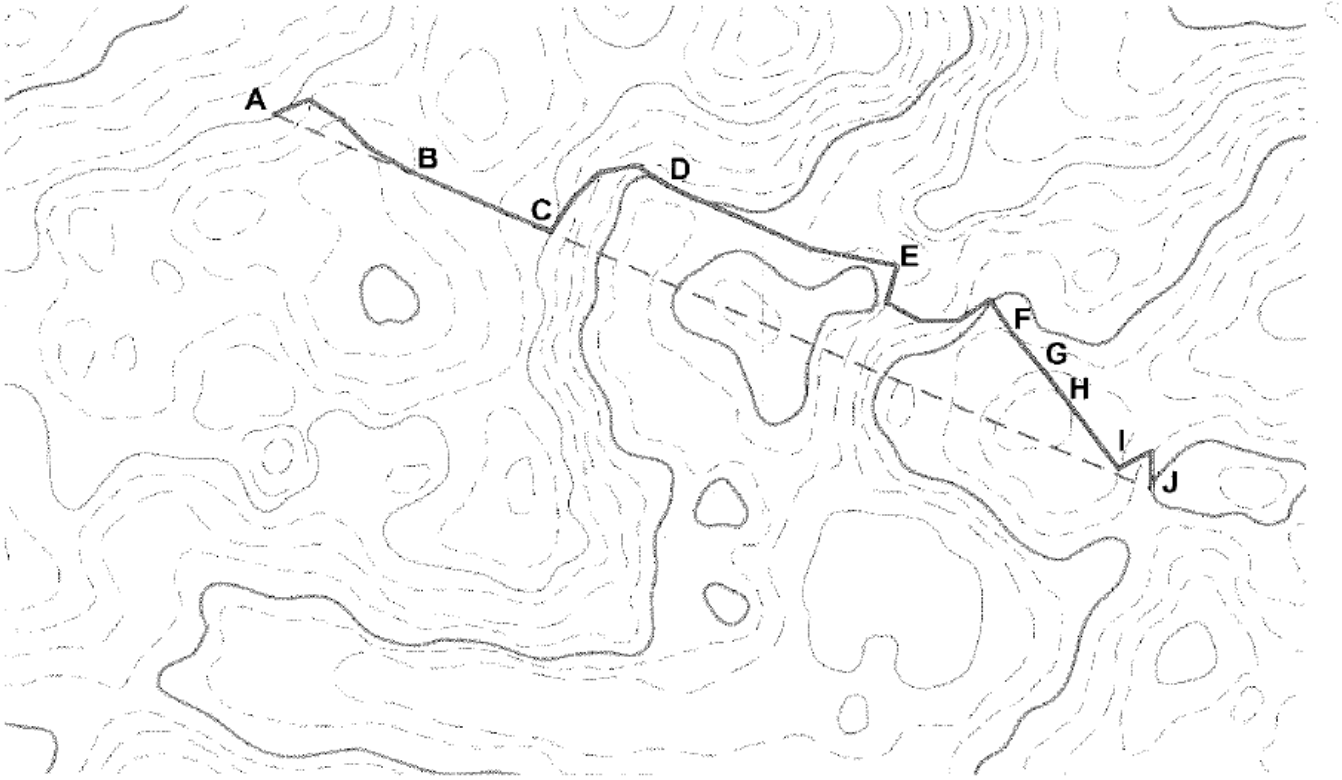
**The number and width of traffic lanes mostly depends on traffic volumes and number of trucks.**



- **horizontal curves,**

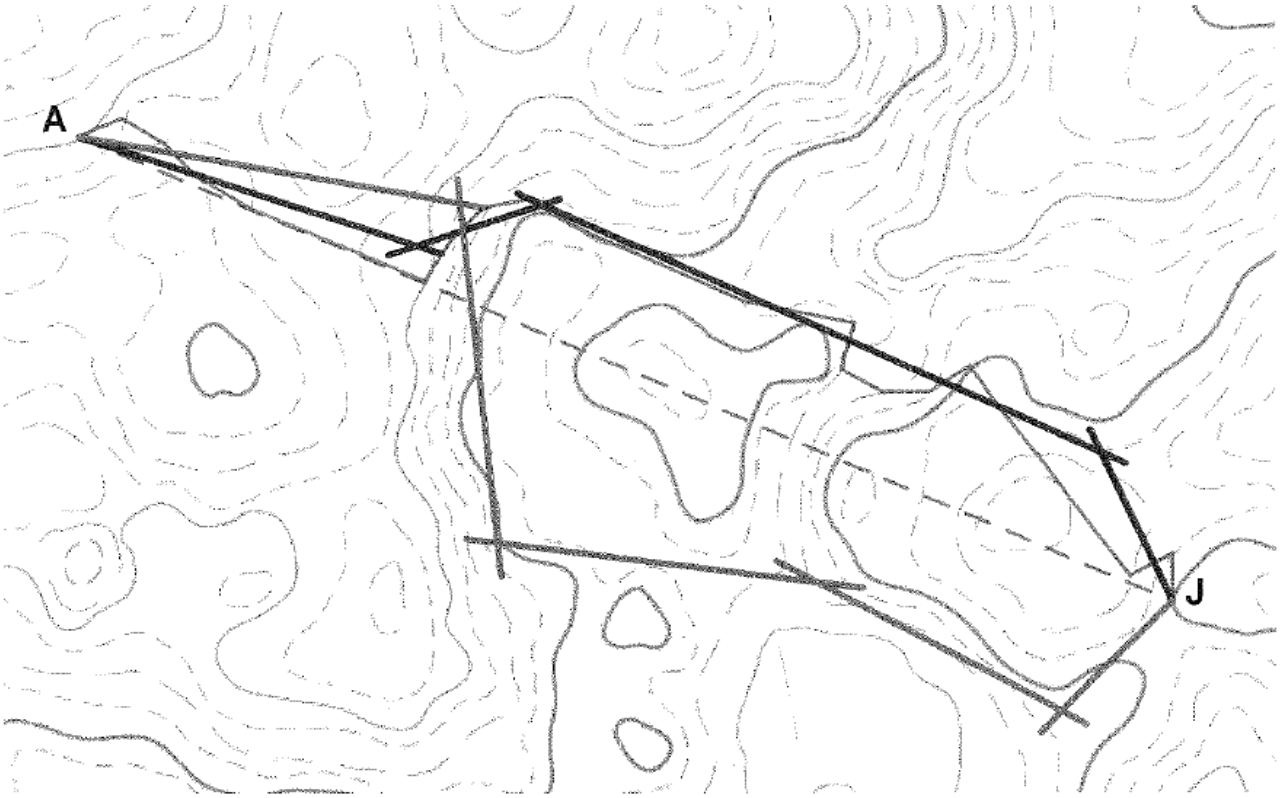


- **vertical curves and gradients,**

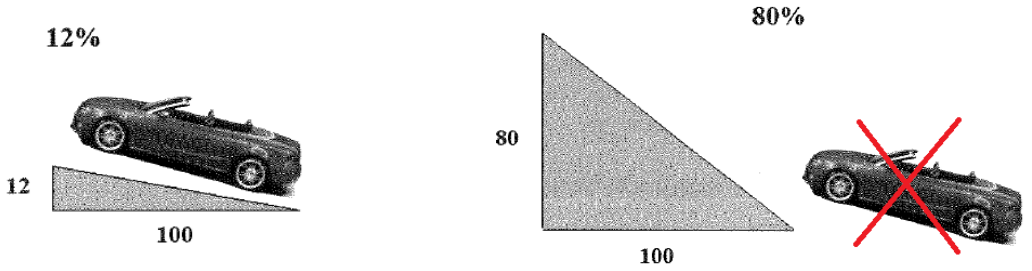



Lines of uniform inclination A – J

*Source:* W.S. Młodożeniec, Budowa dróg – podstawy projektowania, BEL Studio Sp. z o.o., Warszawa, 2011

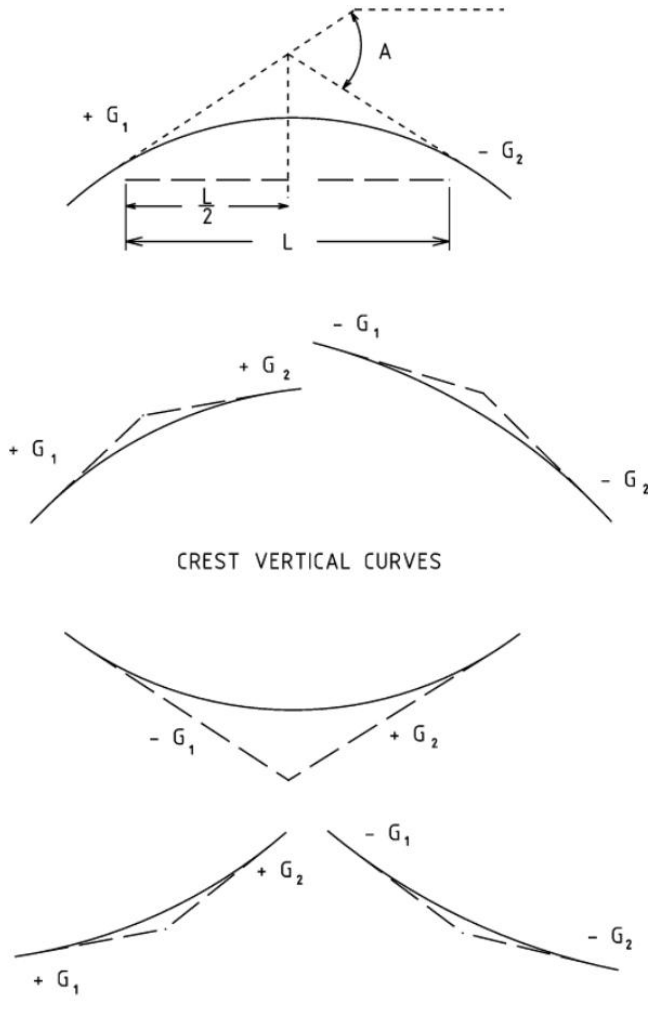



Equalization lines A – J

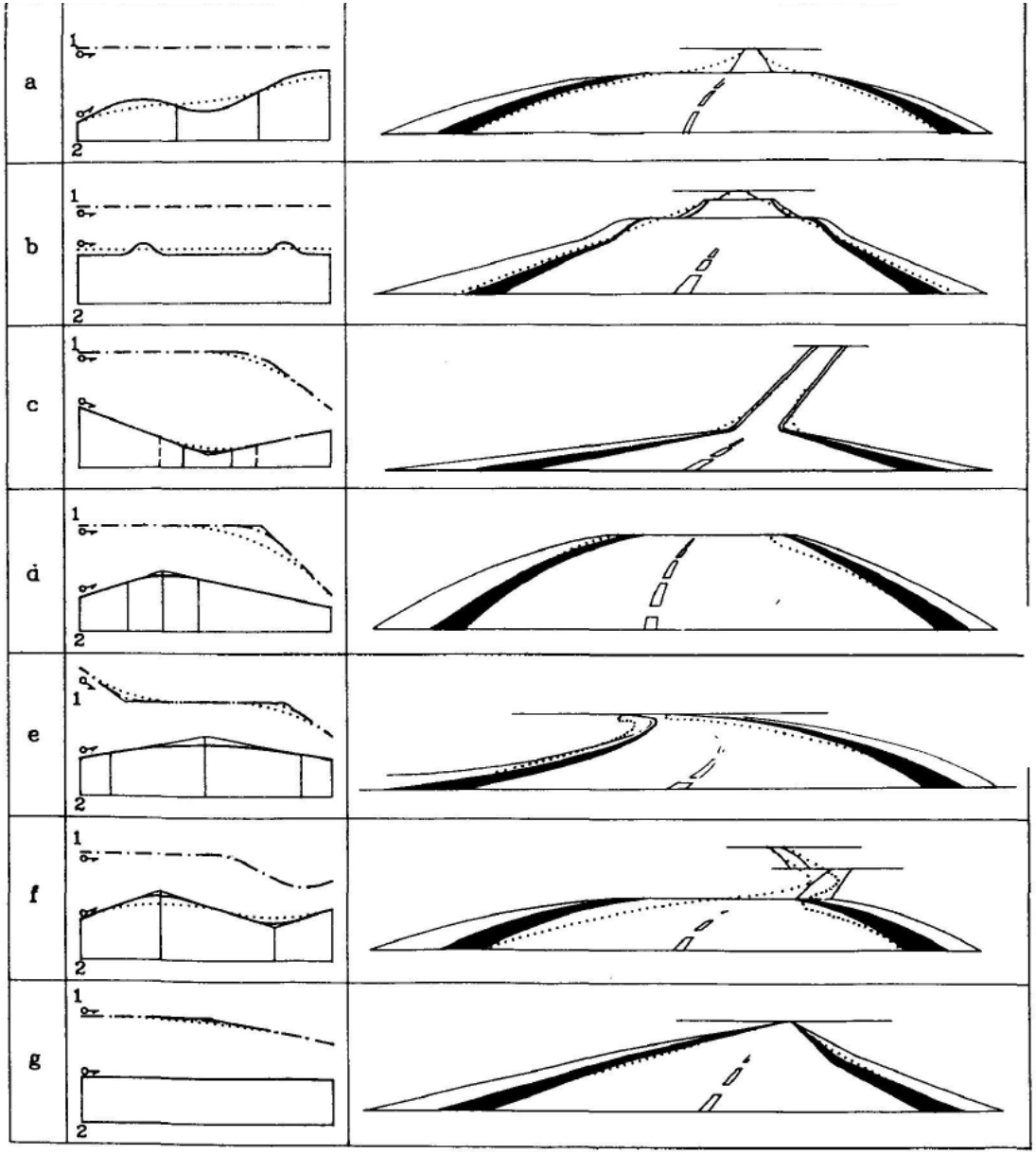


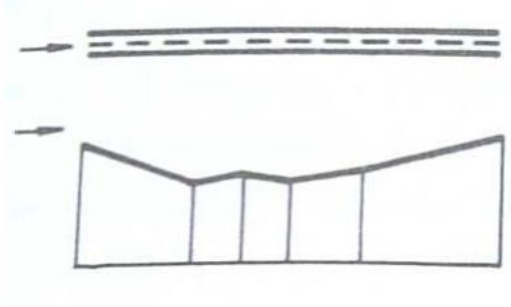

*Source:* W.S. Młodożeniec, Budowa dróg – podstawy projektowania, BEL Studio Sp. z o.o., Warszawa, 2011

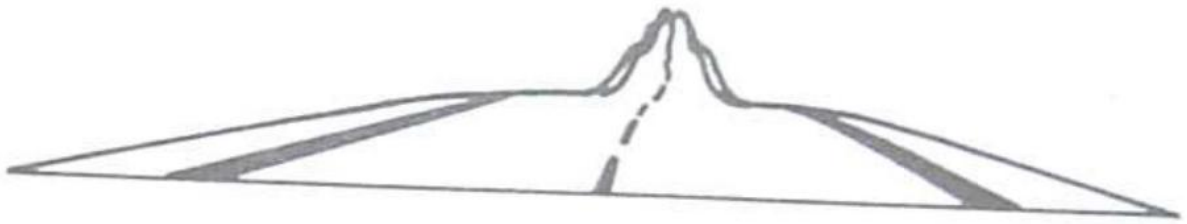
# vertical curves

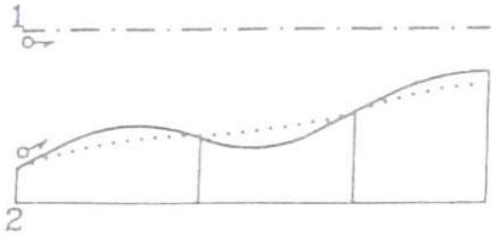


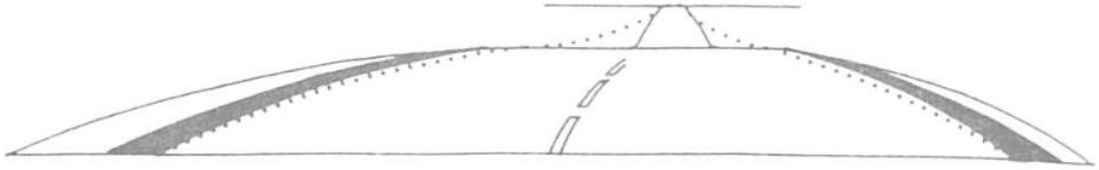
- **coordination of geometric elements**

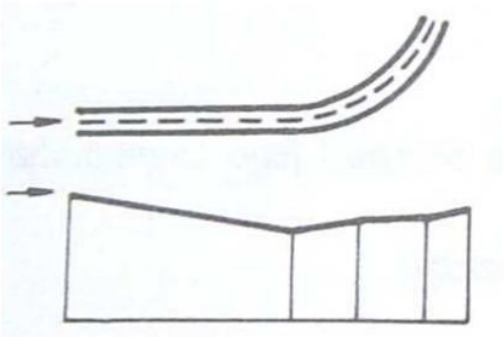




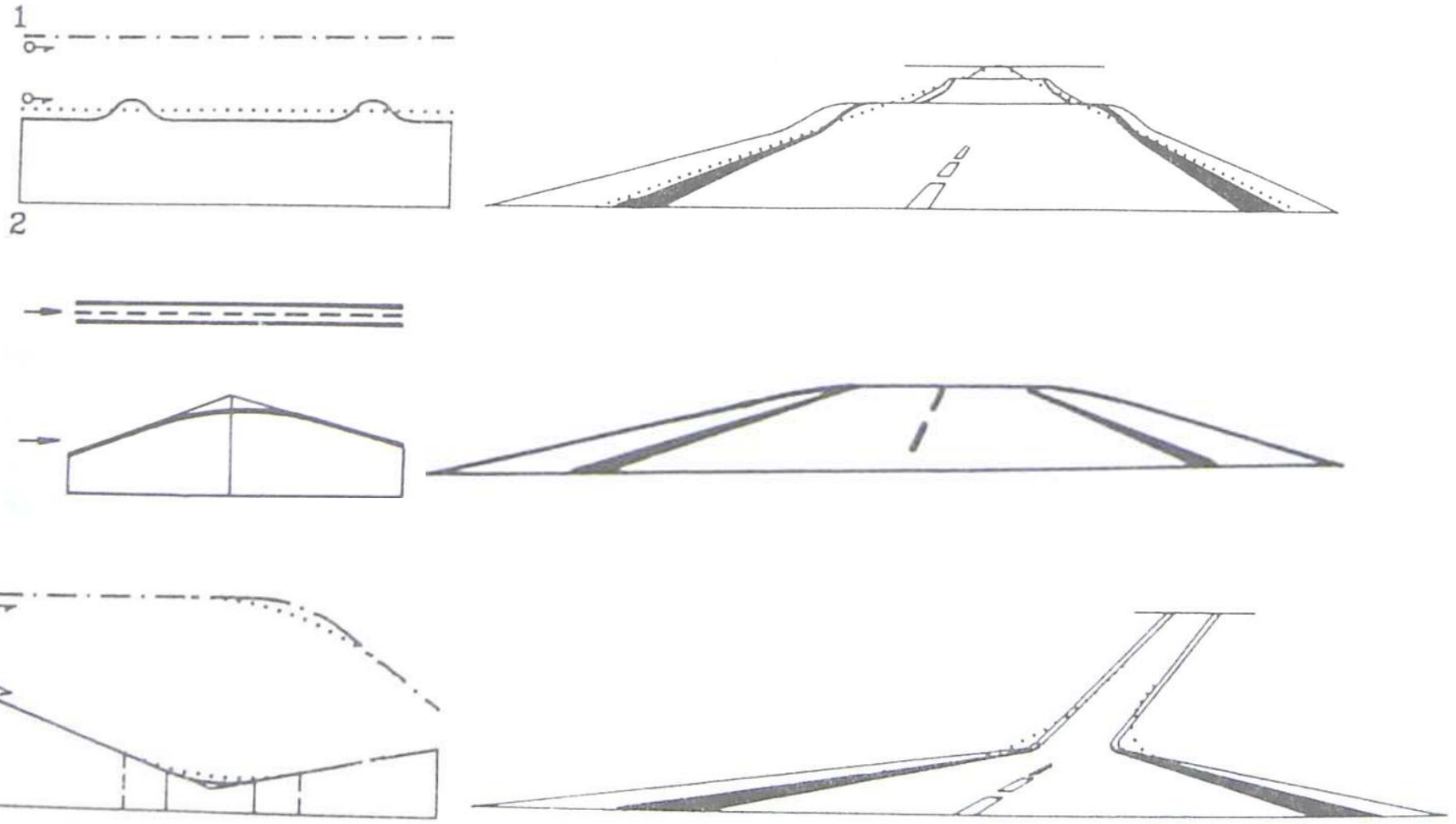




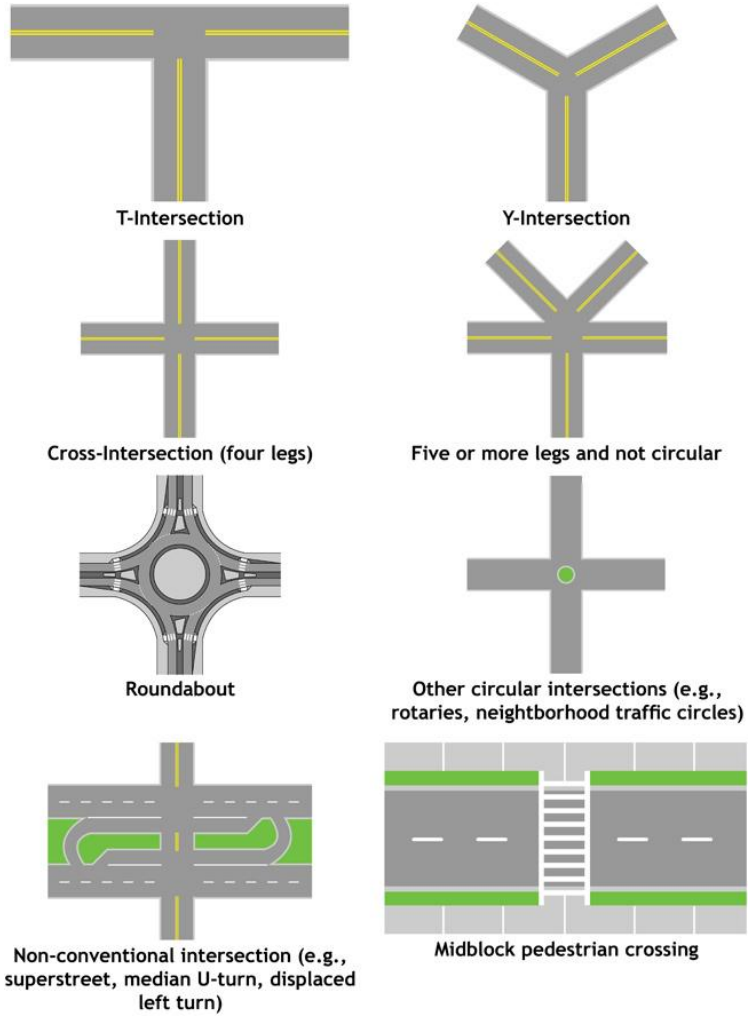


**solutions not recommended**



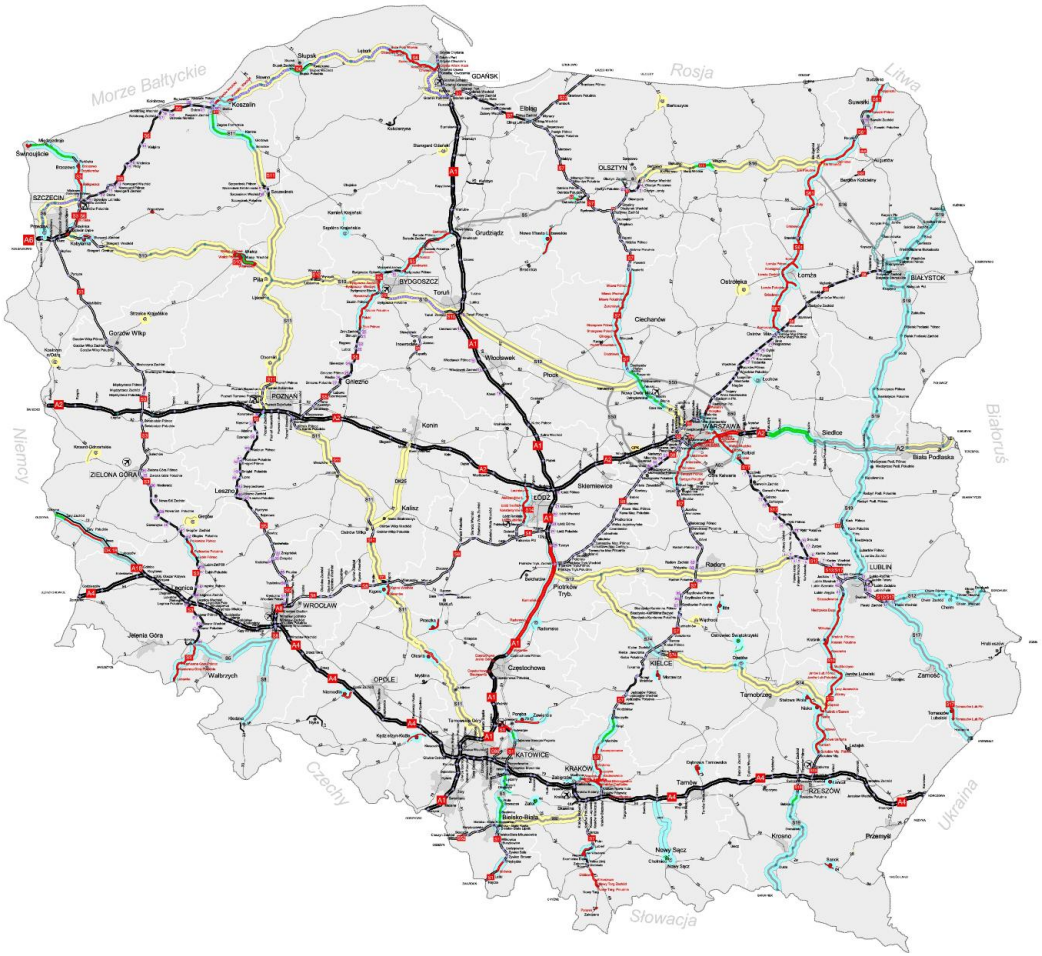

**solutions not recommended**

- **intersections,**




Source: https://safety.fhwa.dot.gov/tools/data_tools/mirereport/images/figure-6.jpg

- **merge areas,**




Source: https://www.paih.gov.pl/poland_in_figures/transport

- **diverge areas.**


Source: https://www.charismaticplanet.com/wp-content/uploads/2017/02/This-wildlife-ecoduct-is-located-over-a-six-lane-highway-in-Singapore-and-is-dotted-with-trees-and-shrubs-750x555.jpg

**Design of road surface construction according to Polish catalogs of typical pavement structures.**

**There are two catalogs - one is for typical constructions of flexible and semi-rigid surfaces, and the other for rigid.**

**The procedure of dimensioning the pavement structure and the layer of improved subsoil using the catalog:**

1) **Adoption of the length of the pavement design period depending on the road class.**
2) **Collection of input data for design concerning the: geotechnical conditions, road traffic load and climatic conditions.**

3) Calculation of "design traffic" and determination of "traffic categories".
4) Determining the soil and water conditions and the subsoil load capacity of the pavement.
5) Selection of a typical solution for the improved subgrade and the lower layers of the road structure depending on the traffic category and the type of materials adopted for each layer.

6) Check the need for a drainage or separation layer.
7) Selection of a typical solution for the upper layers of the road structure depending on the designed material of the main base.
8) Check the need for a anti-frost layer and, if necessary, design this layer.

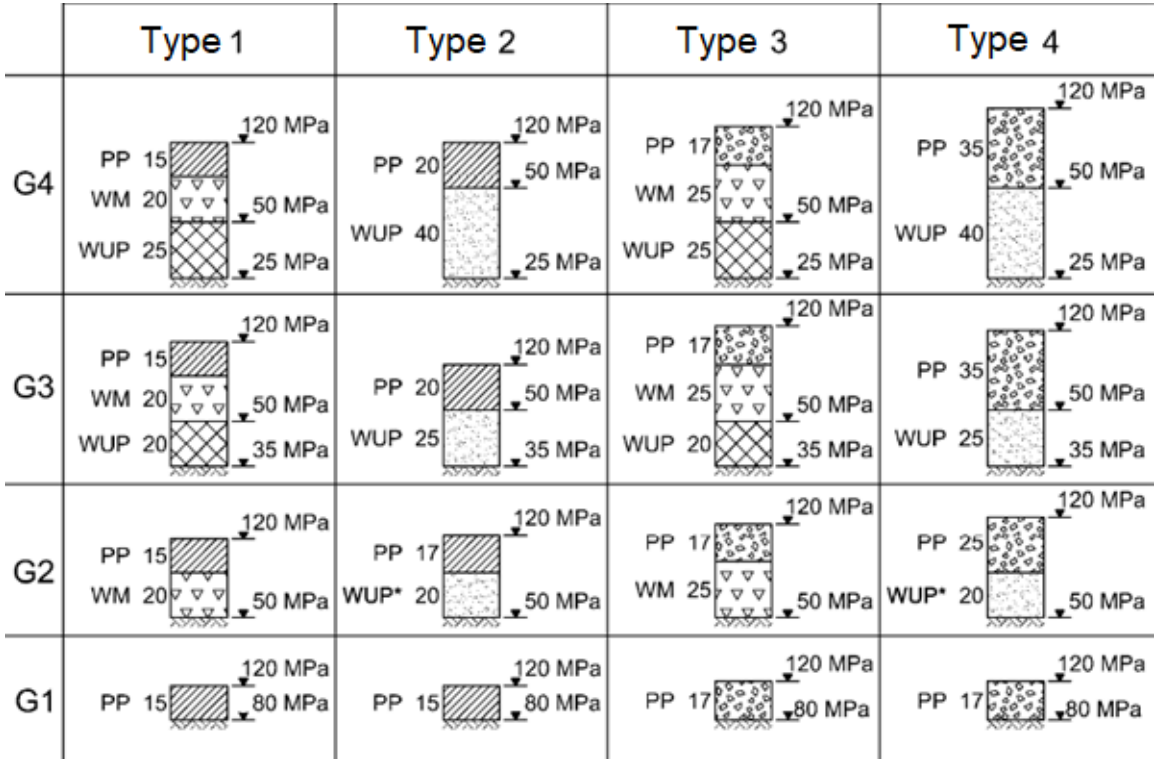
# „Traffic category”

| "Traffic category" | The total number of equivalents of standard axles 100 kN during the entire period design [million axis 100 kN on the "computable's traffic line"] |
|---|---|
| *1* | *2* |
| KR1 | $0{,}03 < N_{100} \leq 0{,}09$ |
| KR2 | $0{,}09 < N_{100} \leq 0{,}50$ |
| KR3 | $0{,}50 < N_{100} \leq 2{,}50$ |
| KR4 | $2{,}50 < N_{100} \leq 7{,}30$ |
| KR5 | $7{,}30 < N_{100} \leq 22{,}00$ |
| KR6 | $22{,}00 < N_{100} \leq 52{,}00$ |
| KR7 | $N_{100} > 52{,}00$ |

# „Group of subgrade load capacity”

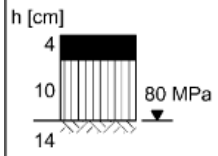
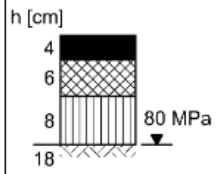
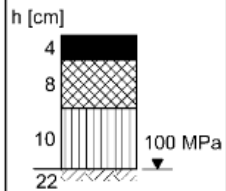
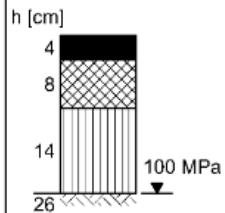
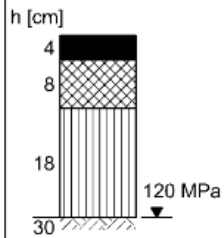
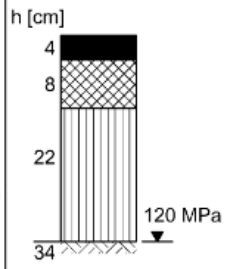
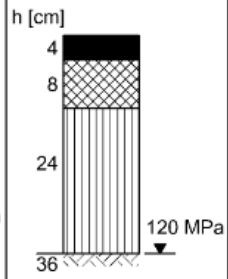
| no. | Type of soil: | "Group of subgrade load capacity" depending on water conditions: | | |
|---|---|---|---|---|
| | | Good | Average | Bad |
| *1* | *2* | *3* | *4* | *5* |
| 1. | Non-frost soil | G1 | G1 | G1 |
| 2. | Dubious soil | G2 | G2 | G3 |
| 3. | Average frost soil | G3 | G4 | G4 |
| 4. | Very frost soil | G4 | G4 | G4 |

# „Typical solution for the improved subgrade and the lower layers ”




- subbase made of a mixture or soil stabilized with a hydraulic binder
- subbase made of an unbound mixture with a CBR ≥ 60%
- anti-frost layer made of an unbound mixture or non-frost soil with a CBR ≥ 35%
- anti-frost layer made of a mixture or soil stabilized with a hydraulic binder
- improvement subgrade made of a soil stabilized with a hydraulic binder or lime
- improvement subgrade made of an unbound mixture or non-frost soil with a CBR ≥ 20%

# „Example of typical solution for the upper layers ”

| KR1 | KR2 | KR3 | KR4 | KR5 | KR6 | KR7 |
|---|---|---|---|---|---|---|
| 0,03 - 0,09 | 0,09 - 0,5 | 0,5 - 2,5 | 2,5 - 7,4 | 7,4 - 22,0 | 22,0 - 52,0 | > 52,0 |
|   |   |   |   |   |   |   |

All layers made of a hot mix-asphalt

# THANK YOU FOR YOUR ATTENTION