Fundamentals of Road Construction

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Lecture 1

The subject of the lecture :

- **organizational matters,**
- **general characteristics of road surfaces.**

Organizational matters

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The requirement*) for passing the *FoRC* lectures is: obtaining a positive grade in the single-choice written test conducted at the last lecture in the semester or during the retake period during the summer examination session.

*) conditions for passing lecture in accordance with the regulations of full-time and part-time first and second cycle studies approved by the Academic Senate of the Poznan University of Technology by Resolution No. 154/2016-2020 of April 24th, 2019.

Single-choice written test (1 correct answer of 4):

- **16 questions,**
- **time: 16 minutes.**

Grading scale:

15, 16 points – 5,0

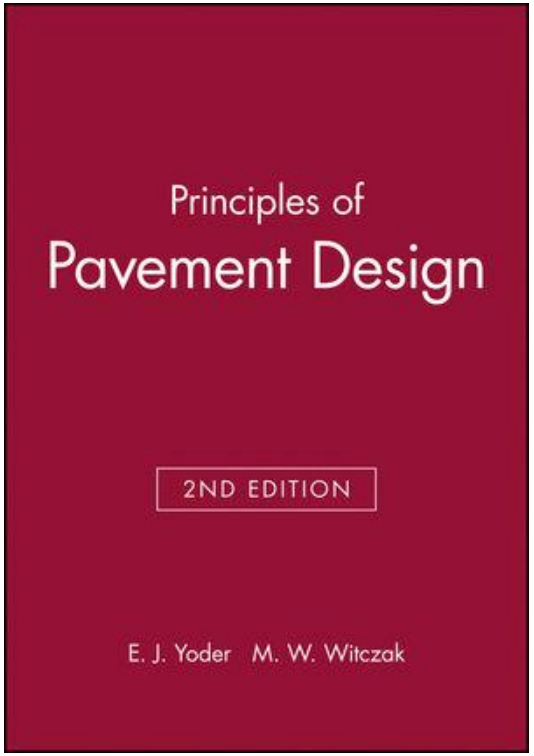
13, 14 points – 4,5

12 points – 4,0

10, 11 points – 3,5

8, 9 points – 3,0

ADDITIONAL LITERATURE



E. J. Yoder, M. W. Witczak, *Principles of Pavement Design*, John Wiley & Sons, 2008

LECTURES SUBJECTS

Lecture 1 - General characteristics of road surfaces

Lecture 2 - Introduction to road design

Lecture 3 - Horizontal alignment

Lecture 4 - Vertical alignment

Lecture 5 - Design of horizontal and vertical curves

Lecture 6 - Others road elements

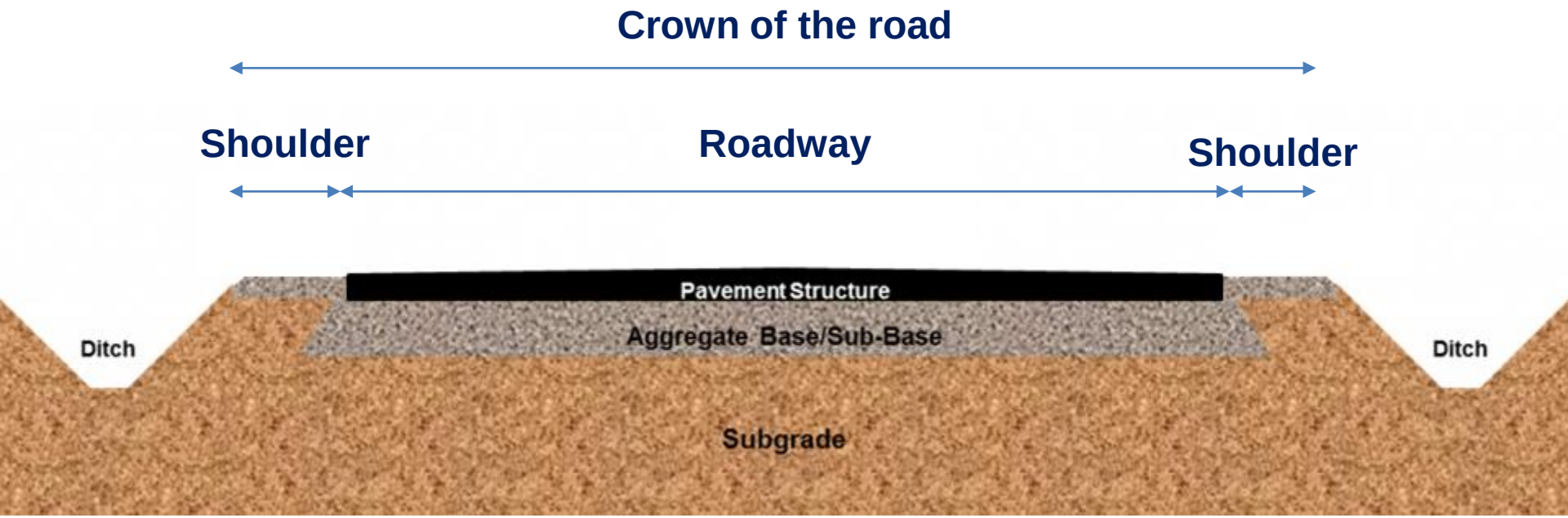
Lecture 7 - Final test

General characteristics of road surfaces (pavements)

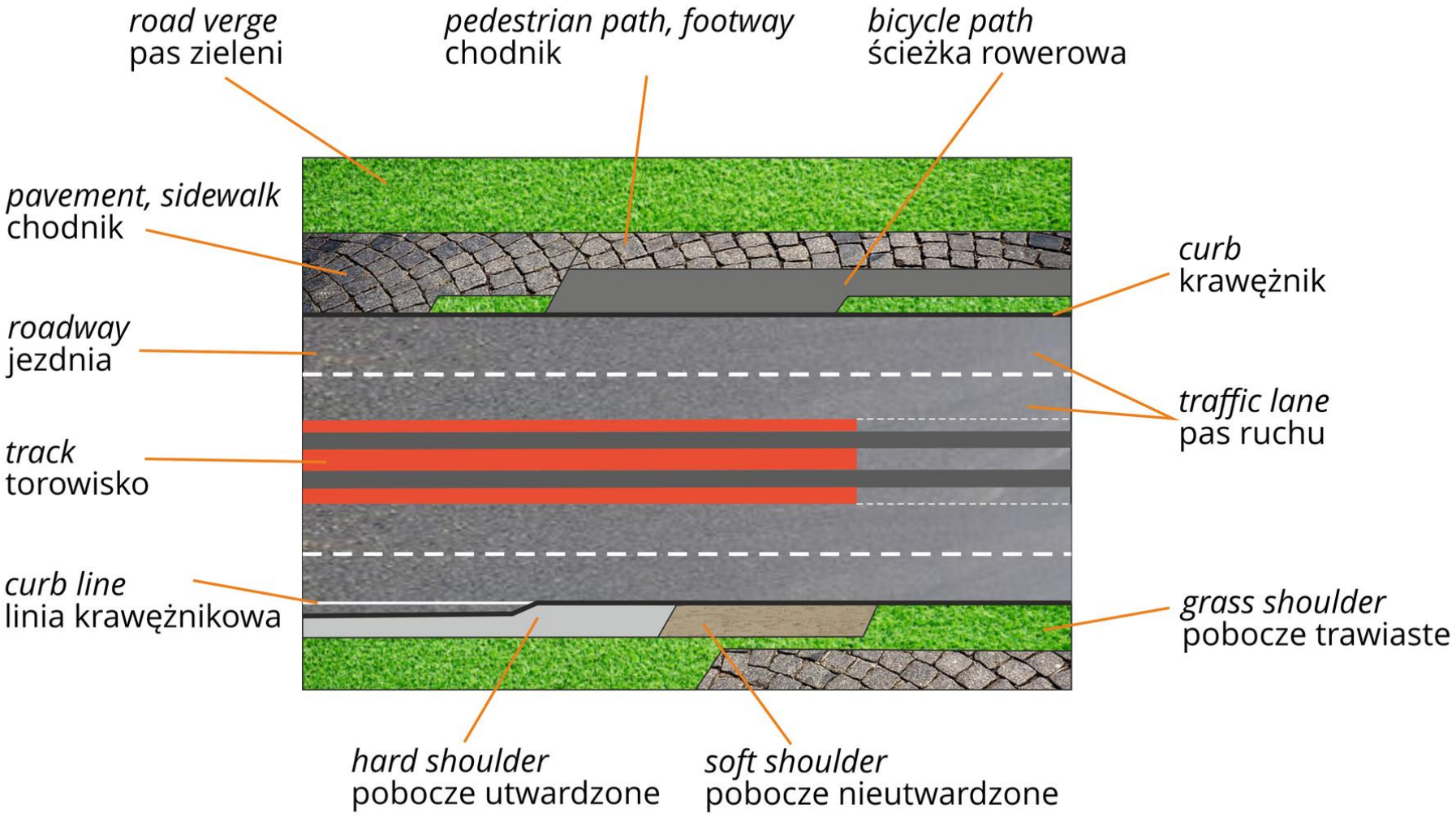
Road is a linear construction connecting specific places in the area, intended for the traffic and standstill of vehicles and pedestrians.

General definition :

road is a separate strip of area consisting of a roadway, shoulder, sidewalk, bicycle path, tram tracks, road engineering structures, devices and installations located in this strip.



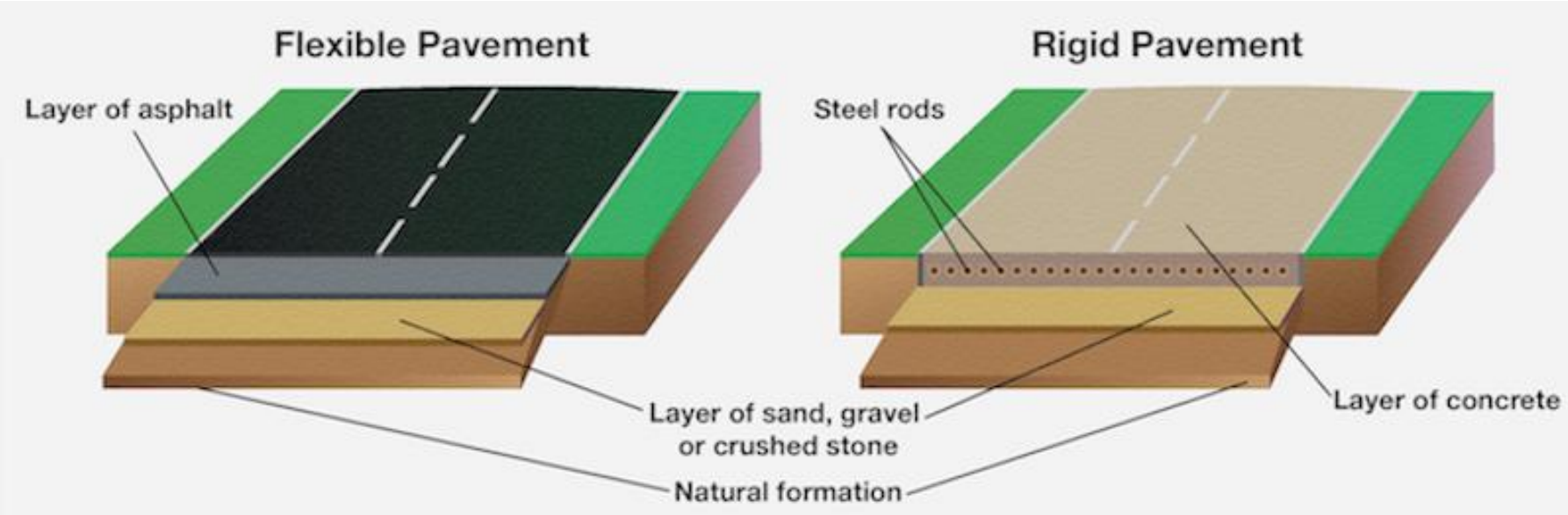
Source: https://vaasphalt.org/wp-content/uploads/2013/03/drainagetable3-1024x267.png



Source: https://epodreczniki.pl/a/construction-of-road-pavements/Djah4Wa1c

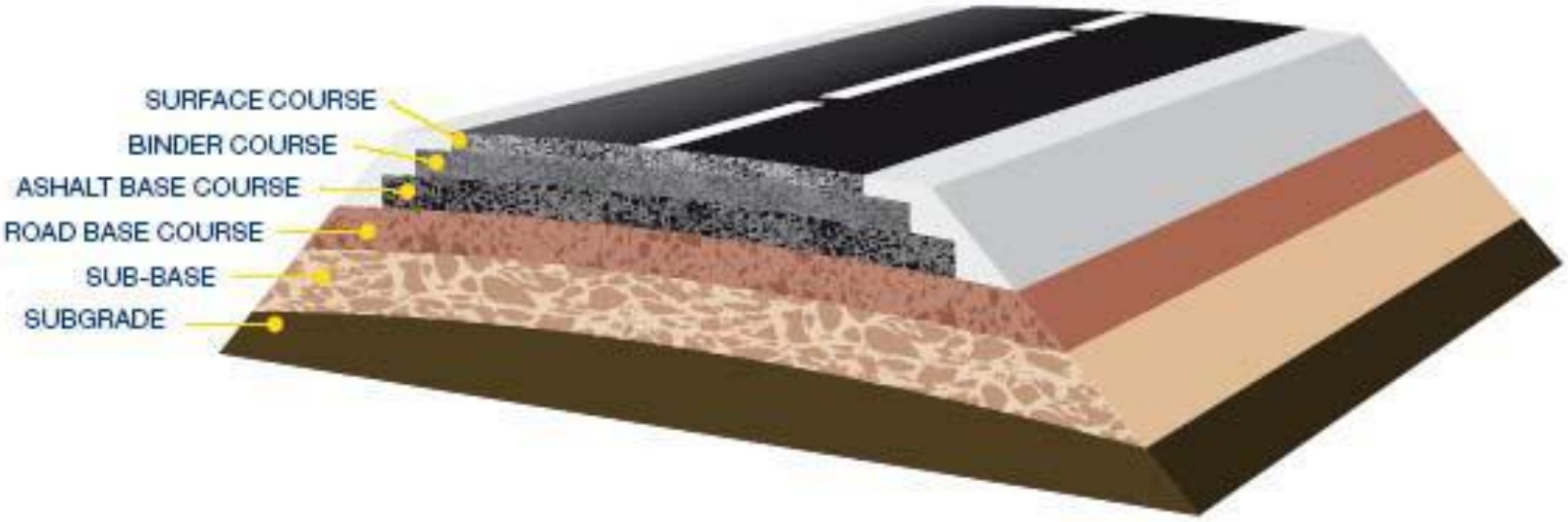
Types of road surface structures:

- flexible,
- semi-rigid,
- rigid.



Source: http://www.yahara.com/wp-content/uploads/2014/05/road-construction1.png

Layers of flexible and semi-rigid pavement



Source: https://pbs.twimg.com/media/CHjhaP6UkAANg1b.jpg

Layers of flexible and semi-rigid pavement

wearing course	surface course
binder course	
base course	additionally can have the leveling or reinforcing layer
subbase course	consists from the anti-frost layer, drainage layer or separation layer
improvement subgrade	depending on the bearing capacity and soil and water conditions
subgrade	

- **Wearing course** - the top layer of the pavement, subject to the direct influence of vehicle traffic and weather conditions. Made of hot mix asphalt.
- **Binder course** - the layer between the wearing course and the base course, ensuring a better distribution of stresses in the pavement and their transfer to the subgrade. Made of hot mix asphalt.

Source: http://katywroclawskie.pl/sites/default/files/attachment/dscf6372.jpg

Source: http://www.dw755ostrowiec-ozarow-etap3a.pl/wp-content/uploads/2015/12/DSC_0113.jpg

- **Base course - the lower layer of the pavement used to transfer traffic loads onto the subgrade, may consist of the only base course or base and subbase course. It can be made of hot mix-asphalt, lean concrete, aggregate or soil stabilized mechanically or using hydraulic binders.**

Base course - it is the upper part of the base layer that acts as a load-bearing structure, it may also consist of a **reinforcing layer** or a **leveling layer.**

- **Reinforcing layer** - layer is used to strengthen the existing construction or when the road construction is design for very heavy traffic.

- **Leveling layer** – is a layer used to compensate for the unevenness of the sub base or the profile of the existing road surface.

Subbase - it is the lower part of the base layer, which, apart from load-bearing functions, also protects the surface against water, frost, prevention a subgrade particle migration into the subbase. It may have a **anti-frost layer, drainage layer** or **separation layer.**

- **Anti-frost layer** – is a layer (usually made of aggregate) whose main task is to protect the road surface against the effects of frost.

- **Drainage layer** – is a layer (usually made of aggregate) that serves to drain water outside the road surface.

- **Separation layer** – is the layer (usually made of geotextile) used to limitations the migration a small particle of subgrade to layers above.

Materials used in base layers:

- hot mix-asphalt,
- mechanically stabilized crushed aggregate,
- aggregate or soil stabilized by hydraulic binders,
- geotextiles.

Hot mix asphalt (HMA) - consists of asphalt binder, fine and coarse aggregate and filler.

hot mix-asphalt

Source: http://www.obwodnica-belchatowa.pl/sierpien2015/naziemne/04.jpg

Aggregate mechanical stabilization –
technology of compacting the aggregate using static and vibrating rollers while maintaining optimal humidity in order to obtain the maximum load-bearing capacity of layer.

Road construction when base is made from aggregate mechanical stabilization is name the flexible pavement.

mechanically stabilized crushed aggregate

Source: http://s17-pulawy.pl/foto/zdjecia/listopad2016/P_11.jpg

Aggregate or soil stabilized with a hydraulic binder –
a mixture in which the binding takes place and hardening
as a result of hydraulic reactions.
The mix can be performed in-situ or in a stationary mixing plant.
As hydraulic binders are used cement, fly ash, lime,
trademark hydraulic road binders.

Road construction when base is made
from aggregate or soil chemical stabilization
is name the semi-rigid pavement.

In the case of surfaces where the base course is made of a material exposed to shrinkage (eg. hydraulic binders) must be used above base courses sliding layer made by an aggregate or geotextile .

aggregate stabilized
by hydraulic binders (cement)

Source: http://s7jedrzejow-granica.pl/public/files/galeria/galeria/199/594900__warstwa_mrozoochronna.jpg

geotextiles

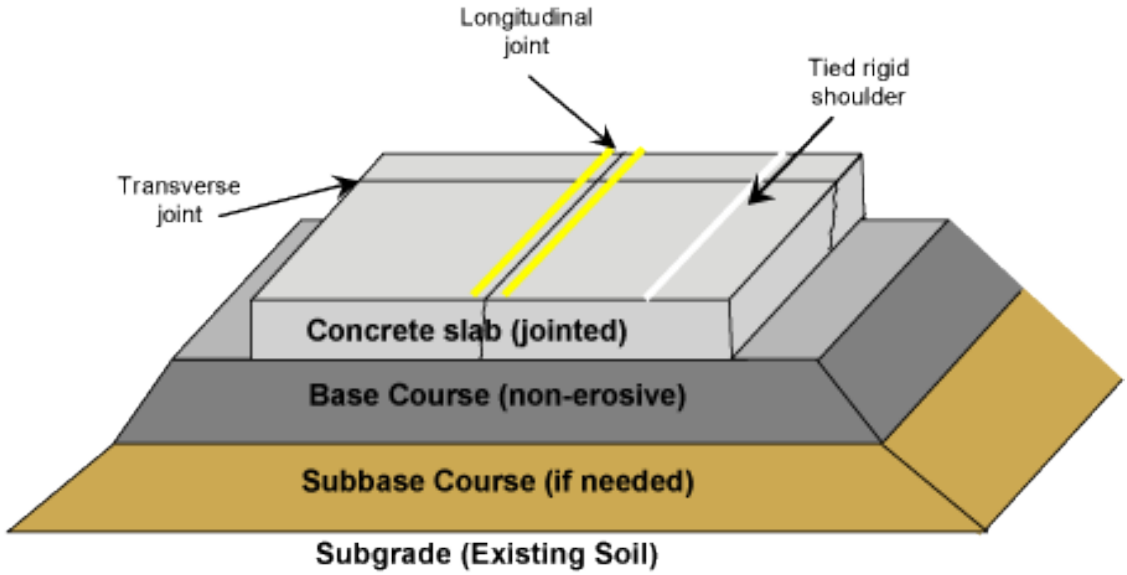
Source: http://www.tegola.pl/resources/aimg_d/29_2_zdjecie0203.jpg

- **Improved subgrade - is the top layer of the subgrade, lying directly under the road surface, improved (mechanically or with hydraulic binders) in order to enable the taking over of construction traffic and the proper execution of the road surface - fulfill requirement specified for load-bearing of subgrade.**

Source: http://inzynieria.weebly.com/uploads/4/7/9/8/4798975/gruntomieszarka.jpg

Source: http://www.zbm.home.pl/s7/podc2/files/Roboty%20Drogowe%20-%20Ulepszone%20podloze%20stabilizowane%20cementem,%20km%2036_700,%2009.08.2016.JPG

Construction of rigid pavement



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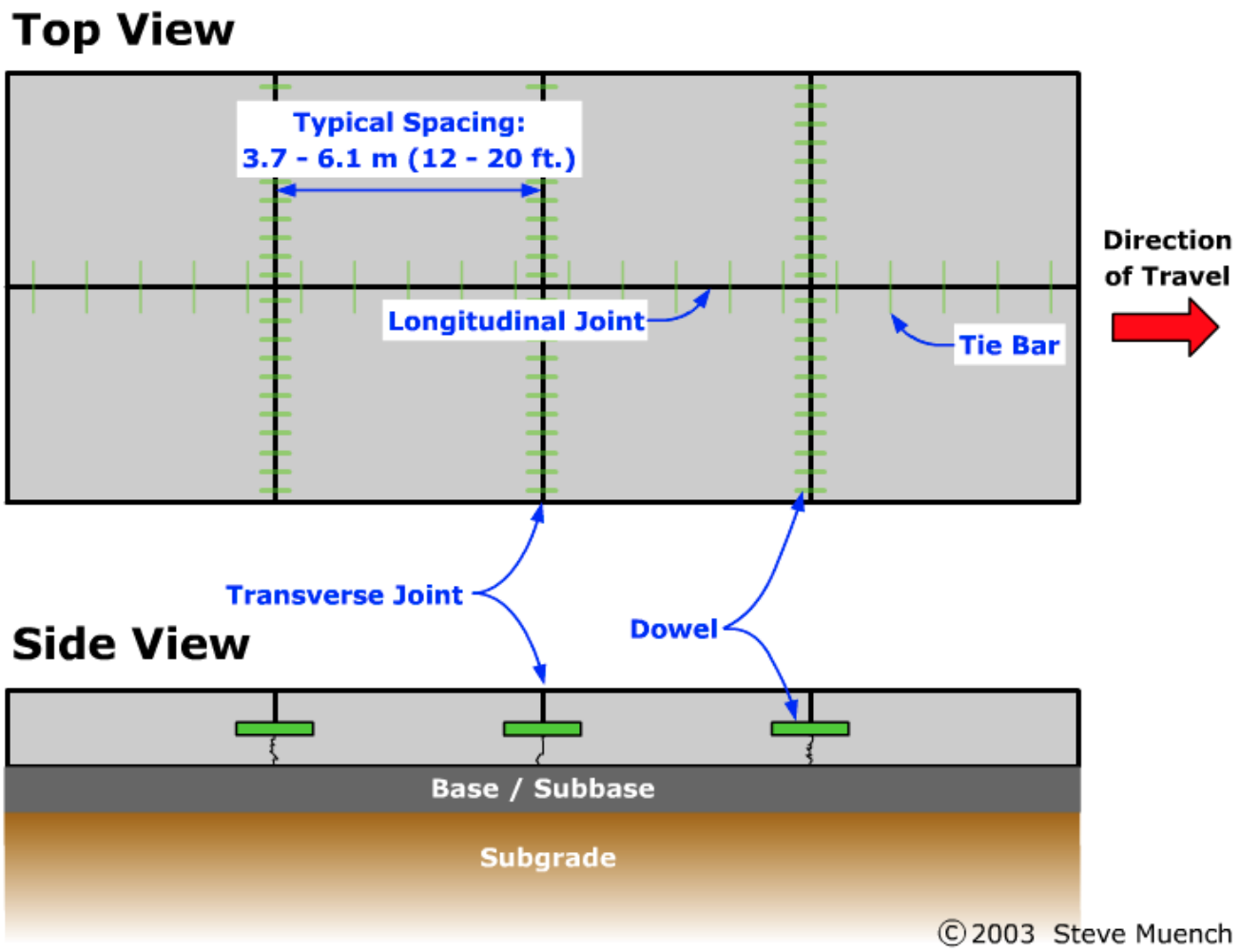
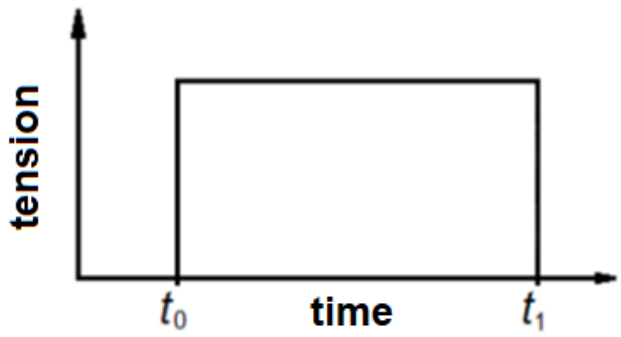
In the case of rigid (concrete) pavements in order to limit cracks related to temperature changes, joints (full and apparent) are used which are filled with rubber inserts or grouting masses. Additionally anchors and dowels are used to limit the movement of the slabs.

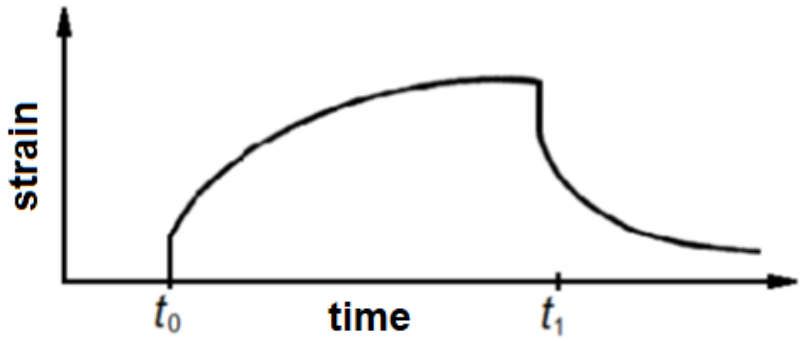


Source: https://pavementinteractive.org/wp-content/uploads/2018/04/Screen-Shot-2018-04-10-at-9.41.26-AM.png

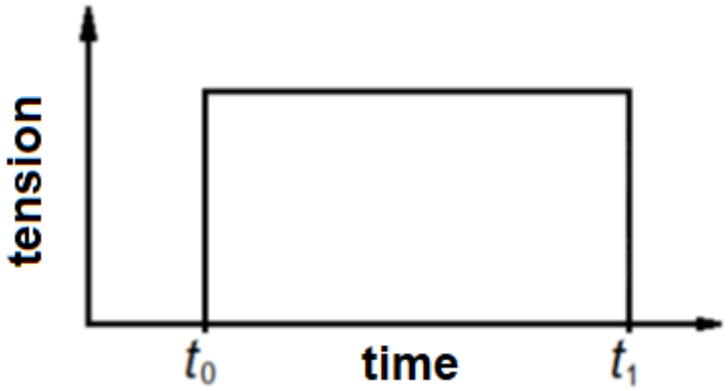
Source: http://cdn15.muratorplus.smcloud.net/t/image/thumbnails/79302/droga_z_nawierzchnia_betonowa_800x0_rozmiar-niestandardowy.jpg

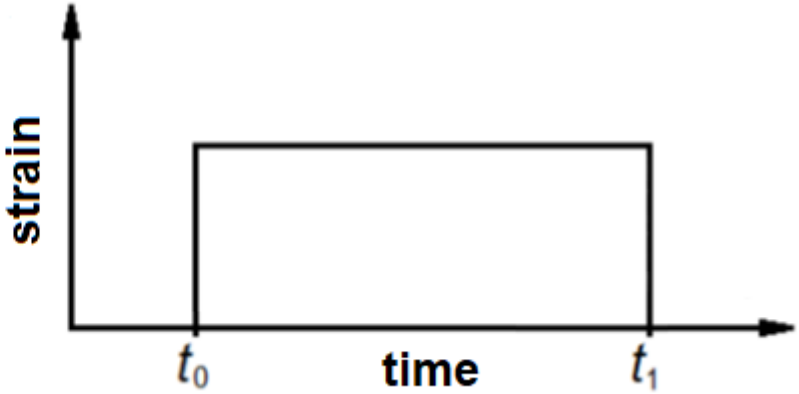
The difference in strain of road structures





flexible pavement

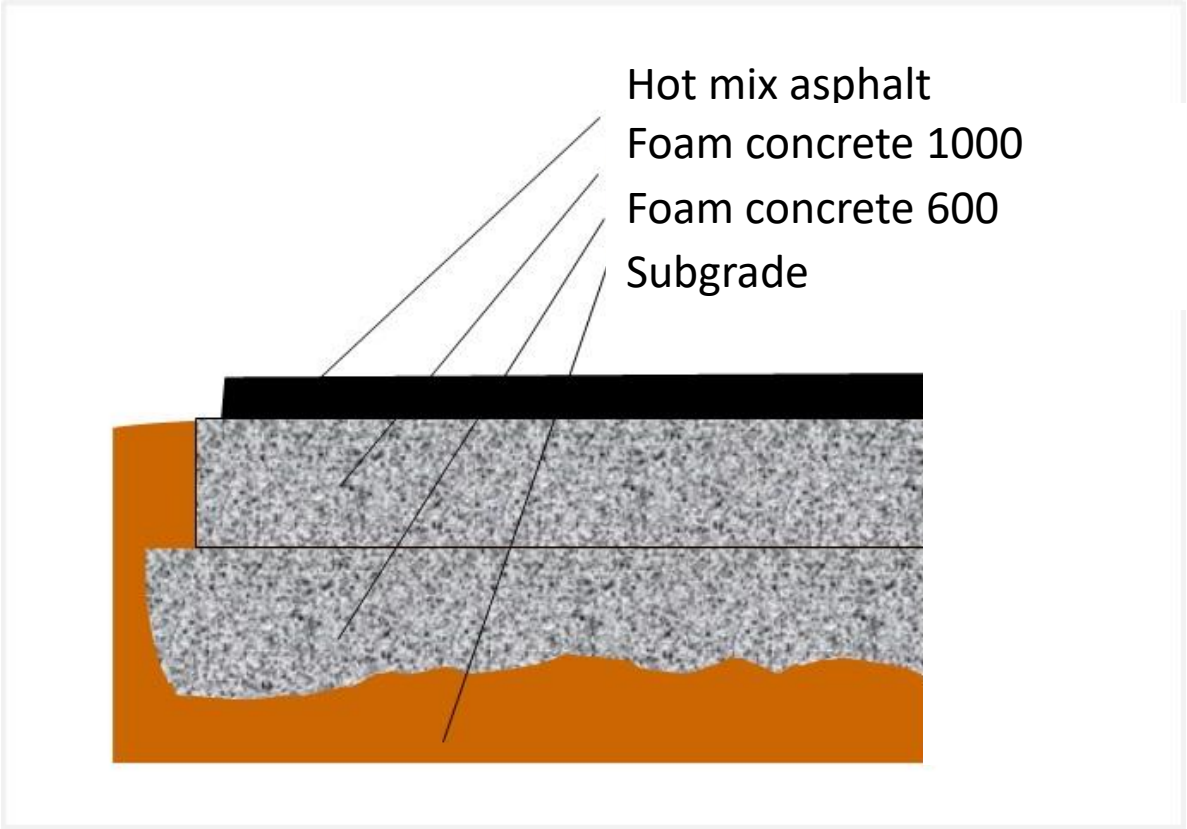




rigid pavement

alternative technologies - expanded clay, foam concrete

expanded clay



Roads can be make from soil or can have a hard surface.

First type of road are a dirt roads. It made form native soil in two variants:

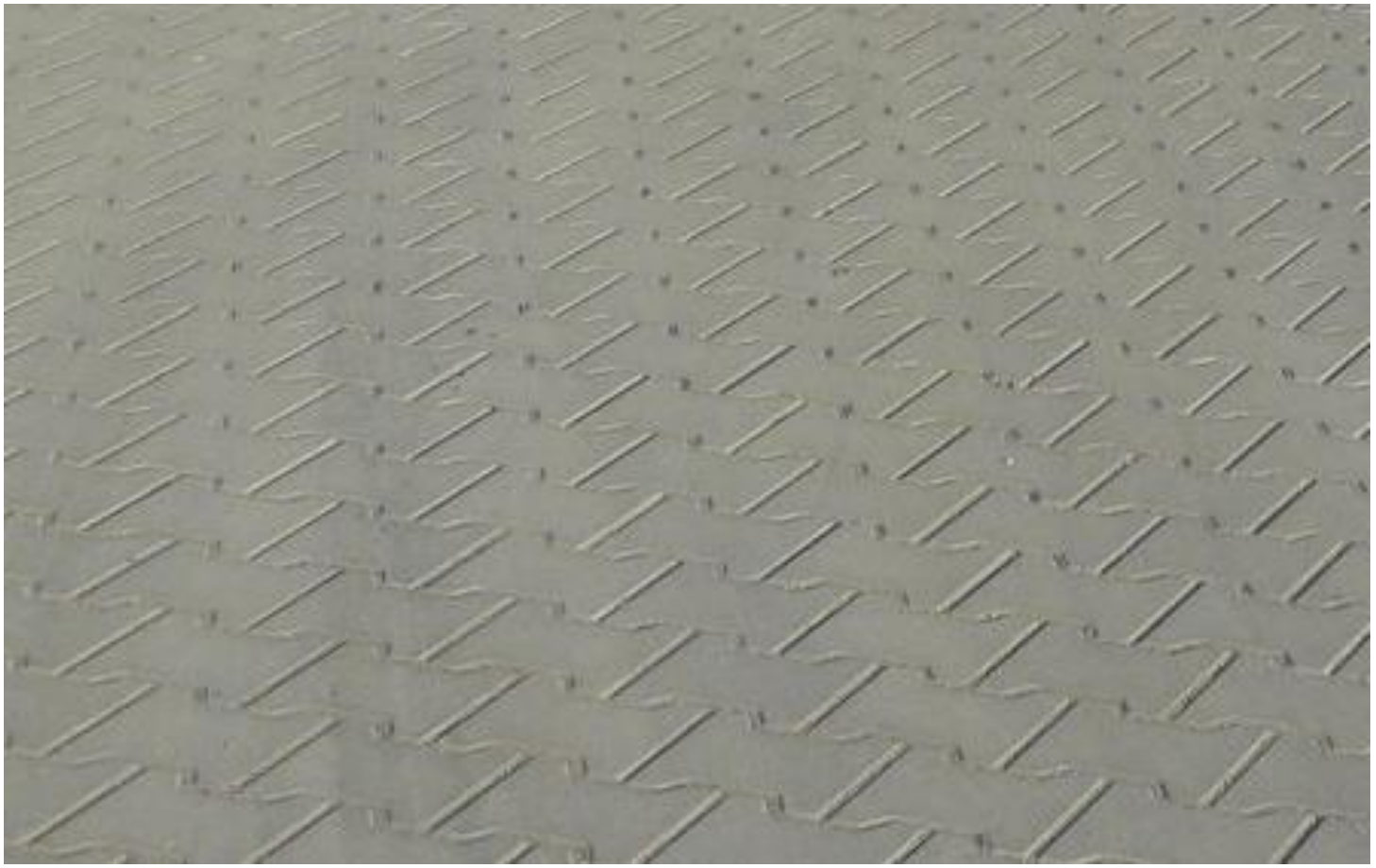
- **unpaved,**
- **mechanical or chemical improved.**

Road with a hard surface has two variants:

- **not improved - make from crushed stones, cobbles.**
- **improved – make from hot mix-asphalt, concrete, setts.**

hot mix-asphalt road surface

concrete road surface



concrete setts road surface

setts road surface

cobbles road surface

crushed stone road surface

concrete slab road

THANK YOU FOR YOUR ATTENTION