

# Fundamentals of Road Construction

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# Lecture 1

**The subject of the lecture :**

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

# Organizational matters

Uczelnia zintegrowana na przyszłość  
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## Duty hours for students:

- **Wednesday<sup>\*)</sup> from 11.00 AM to 11.45 AM  
in K4 (hall A4)**
- **Thursday<sup>\*)</sup> from 11.15 AM to 12.00 AM  
in K4 (hall A4)**

**\*) during the period of classes**

The requirement<sup>\*)</sup> 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.

<sup>\*)</sup> 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 24<sup>th</sup>, 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**

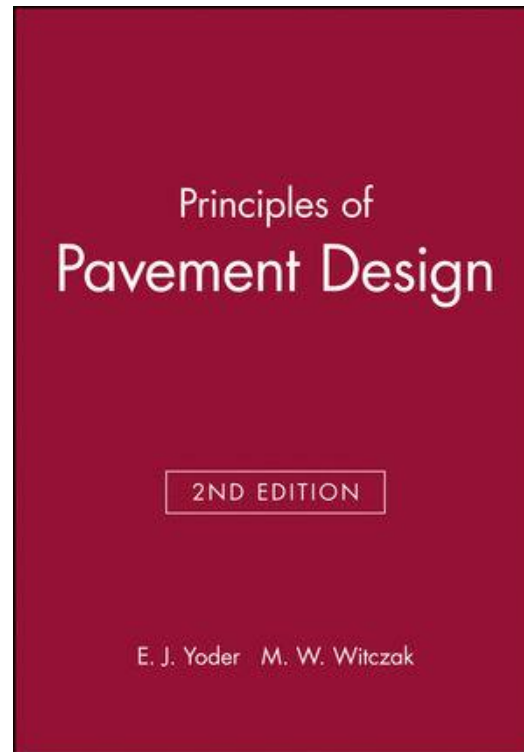
**12 points – 4,0**

**10, 11 points – 3,5**

**8, 9 points – 3,0**



# LITERATURE



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



# DZIENNIK USTAW RZECZYPOSPOLITEJ POLSKIEJ

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Warszawa, dnia 20 lipca 2022 r.

Poz. 1518

## ROZPORZĄDZENIE MINISTRA INFRASTRUKTURY<sup>1)</sup>

z dnia 24 czerwca 2022 r.

w sprawie przepisów techniczno-budowlanych dotyczących dróg publicznych<sup>2), 3)</sup>

Na podstawie art. 7 ust. 2 pkt 2 i ust. 3 pkt 2 ustawy z dnia 7 lipca 1994 r. – Prawo budowlane (Dz. U. z 2021 r. poz. 2351 oraz z 2022 r. poz. 88) zarządza się co następuje:

Journal of Laws of 2022, item 1518

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# 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)

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**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.







**Crown of the road**

**Shoulder**

**Roadway**

**Shoulder**

**Pavement Structure**

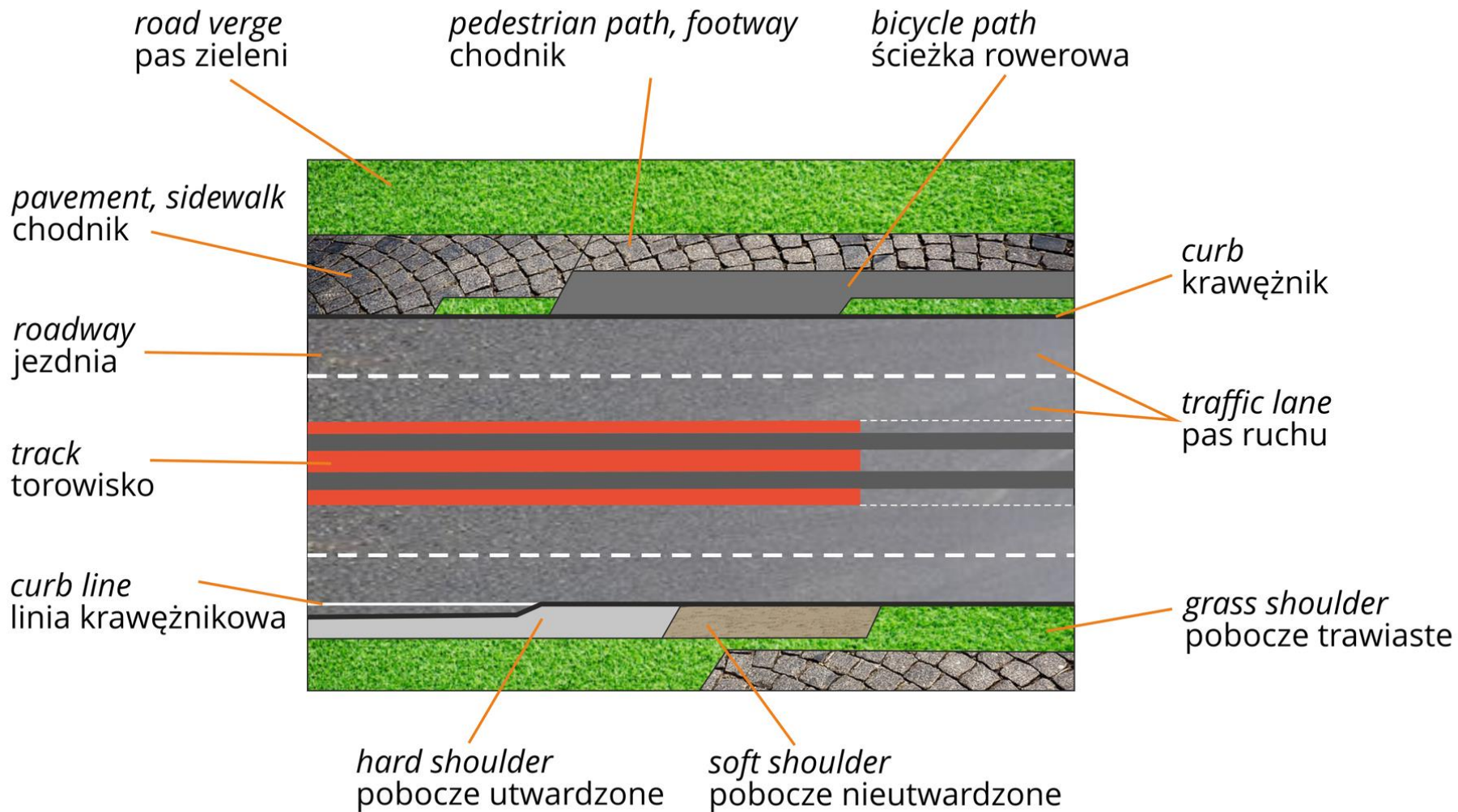
**Aggregate Base/Sub-Base**

**Subgrade**

**Ditch**

**Ditch**

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

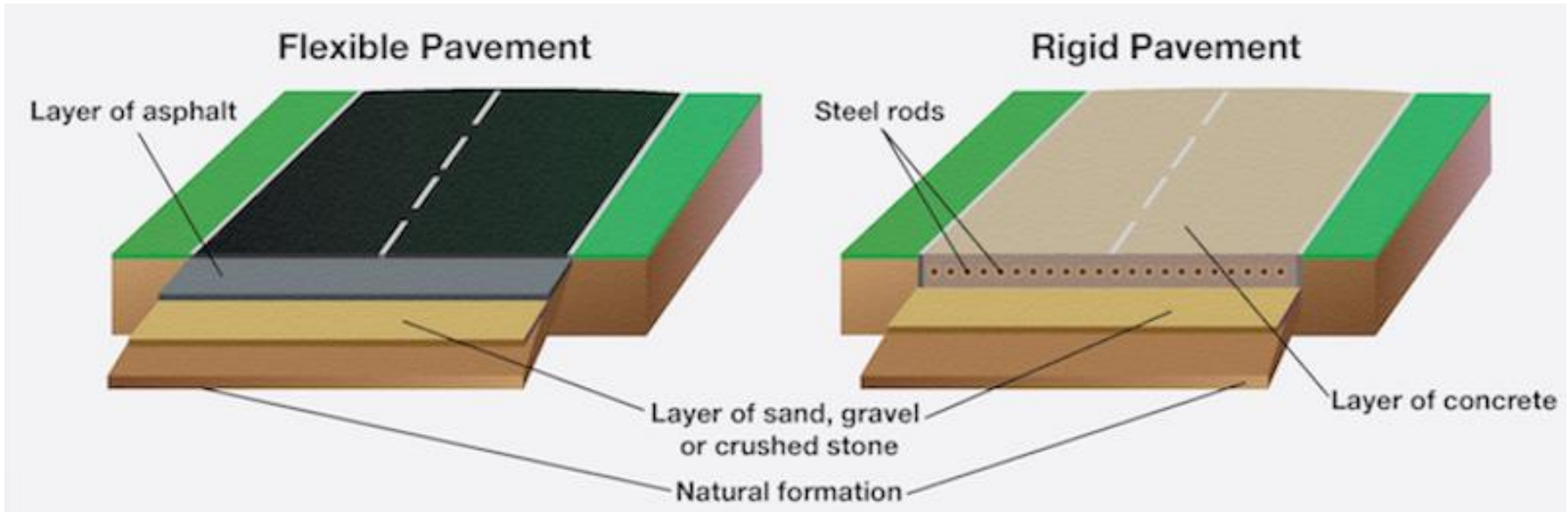


Source: <https://epodreczniki.pl/a/construction-of-road-pavements/Djah4Wa1c>



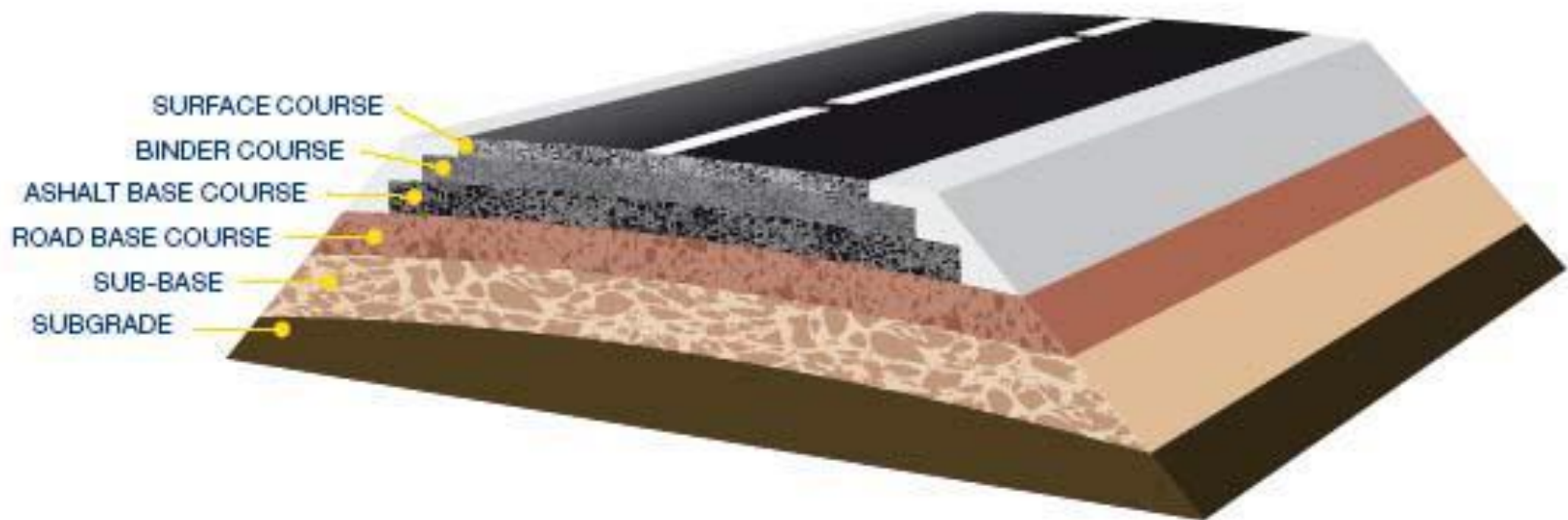
## Types of road surface structures:

- 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

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

- **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>

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Source: [http://www.dw755ostrowiec-ozarow-etap3a.pl/wp-content/uploads/2015/12/DSC\\_0113.jpg](http://www.dw755ostrowiec-ozarow-etap3a.pl/wp-content/uploads/2015/12/DSC_0113.jpg)

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- **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 limit the migration of small particles 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>

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**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](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://s7jdrzejow-granica.pl/public/files/galeria/galeria/199/594900\\_\\_warstwa\\_mrozoochronna.jpg](http://s7jdrzejow-granica.pl/public/files/galeria/galeria/199/594900__warstwa_mrozoochronna.jpg)

## geotextiles



Source: [http://www.tegola.pl/resources/aimg\\_d/29\\_2\\_zdjecie0203.jpg](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>

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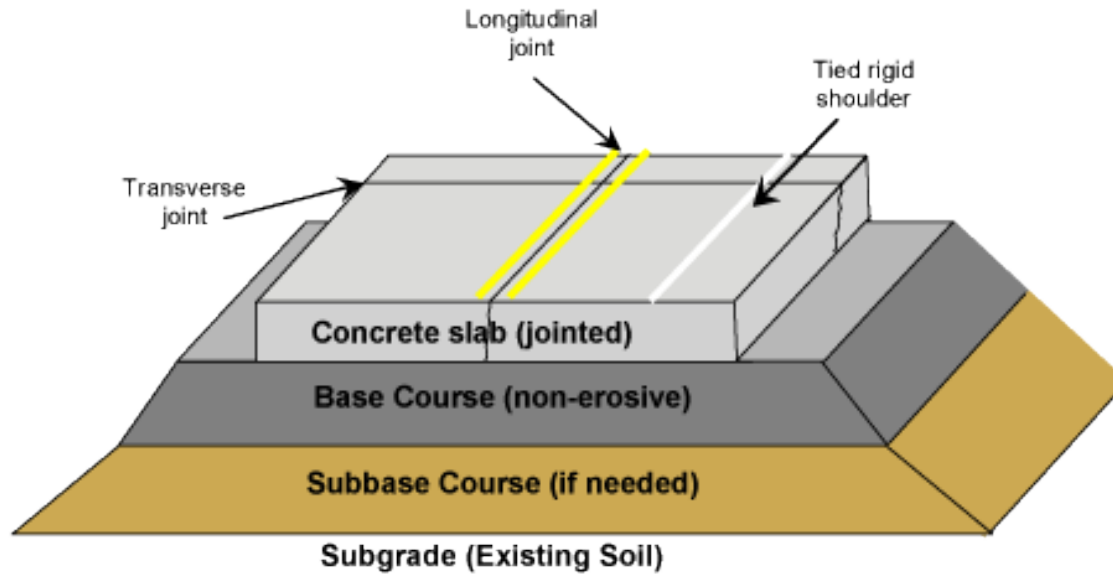
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Source: [http://www.zbm.home.pl/s7/podc2/files/Roboty%20Drogowe%20-%20Ulepszone%20podloze%20stabilizowane%20cementem,%20km%2036\\_700,%2009.08.2016.JPG](http://www.zbm.home.pl/s7/podc2/files/Roboty%20Drogowe%20-%20Ulepszone%20podloze%20stabilizowane%20cementem,%20km%2036_700,%2009.08.2016.JPG)



# Construction of rigid pavement

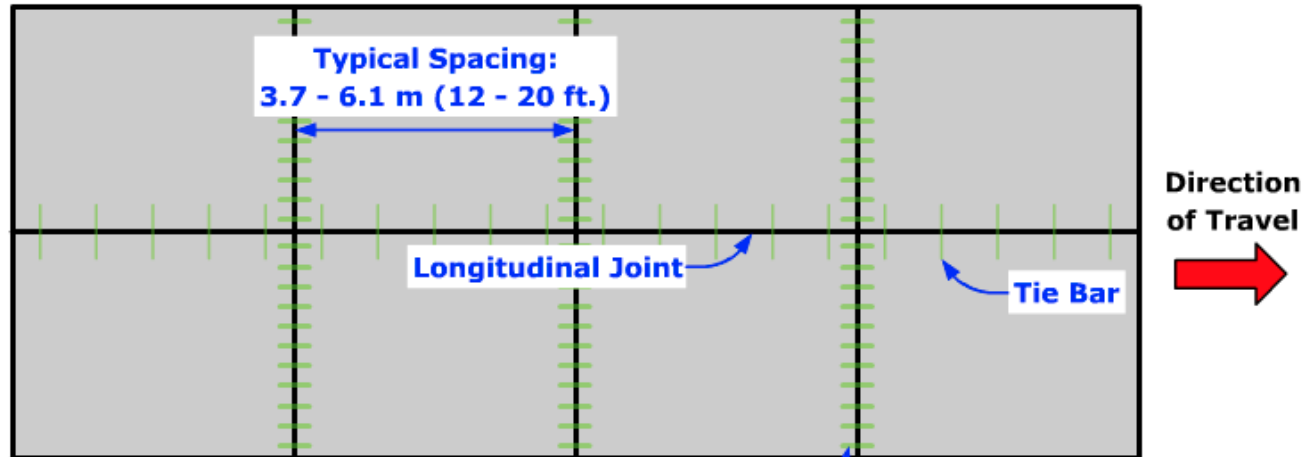


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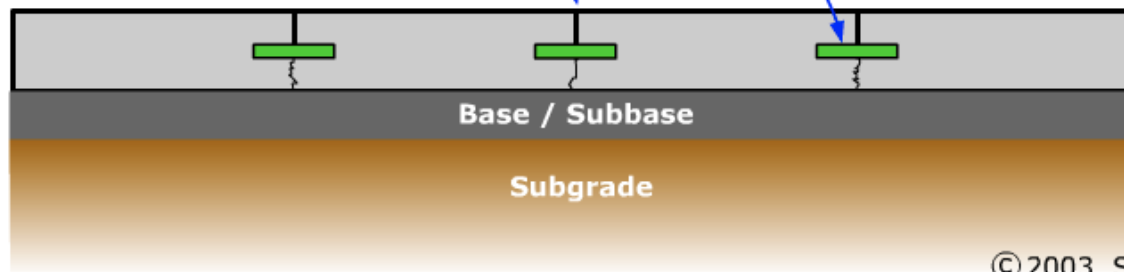
In the case of rigid (concrete) pavements in order to limit cracks related to temperature changes, joints (full and apparent) are used which are filled with rubber inserts or grouting masses. Additionally anchors and dowels are used to limit the movement of the slabs.



## Top View



## Side View



© 2003 Steve Muench

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

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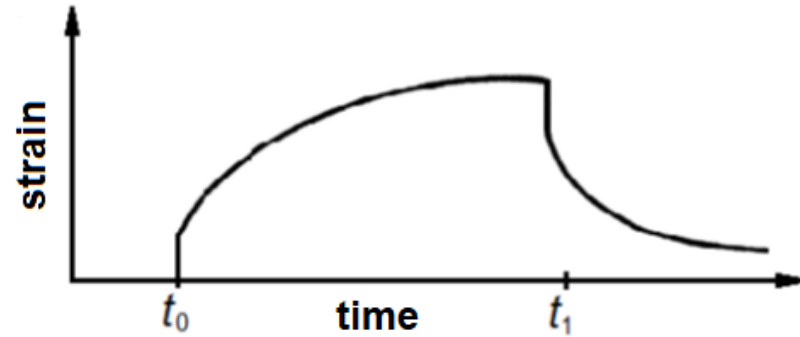
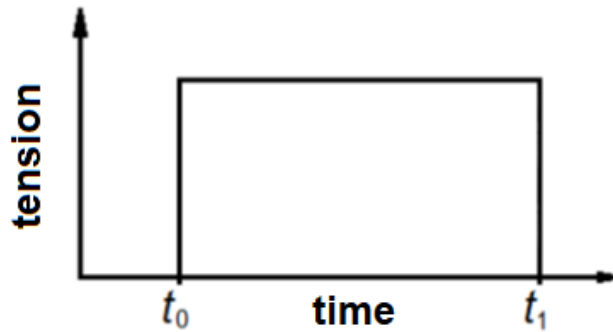


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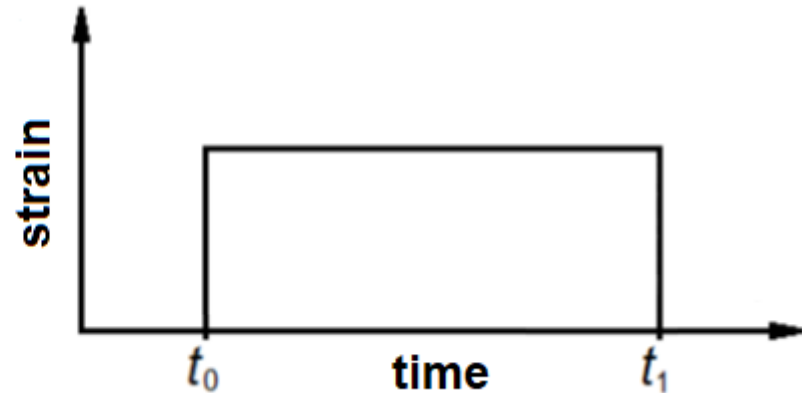
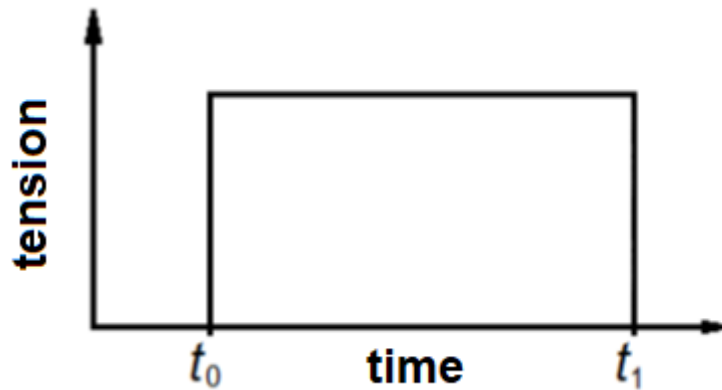


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## The difference in strain of road structures

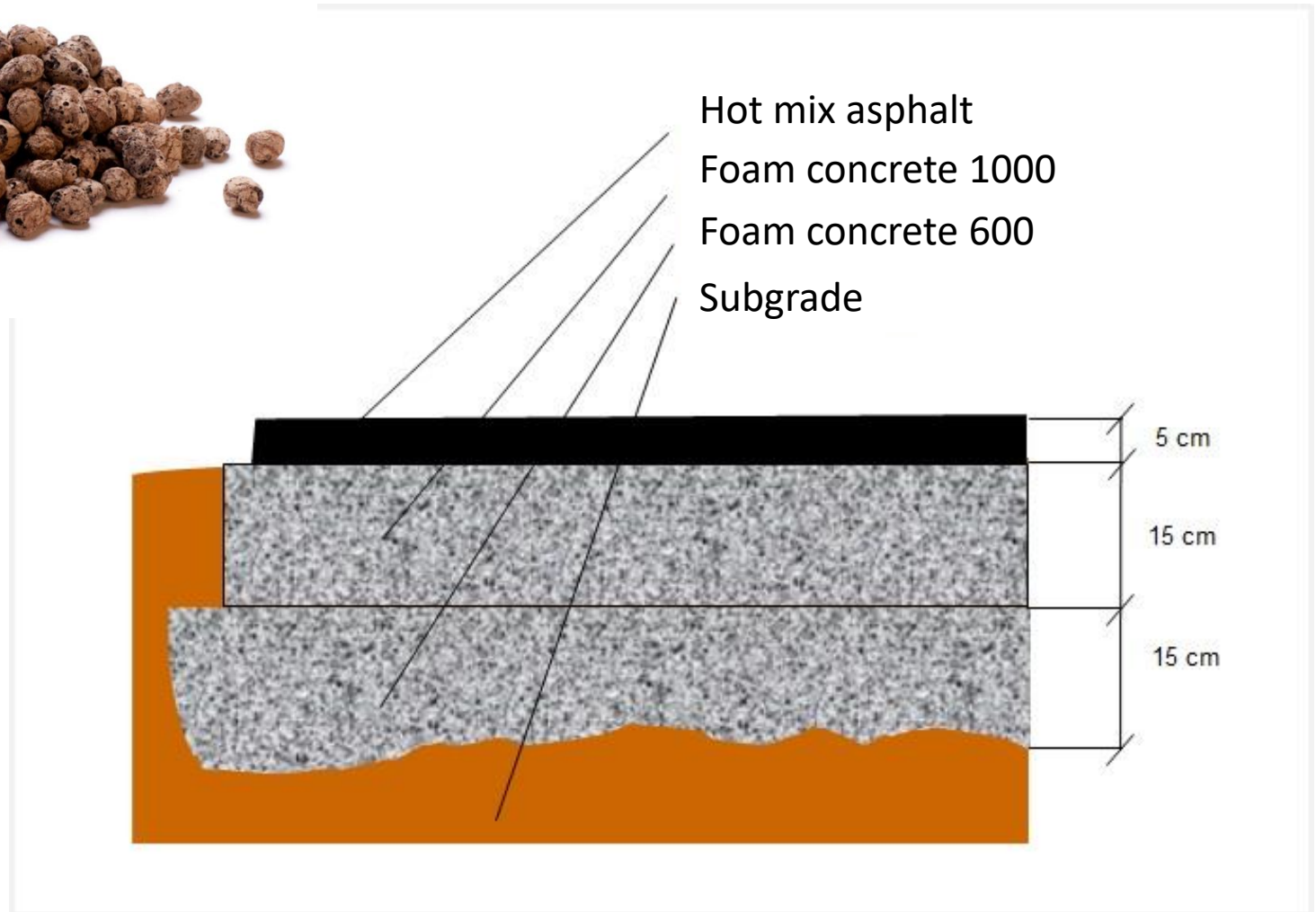


flexible pavement



rigid pavement

alternative => expanded clay



**Roads can be made from soil or can have a hard surface.**

**First type of road are dirt roads. It made from 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

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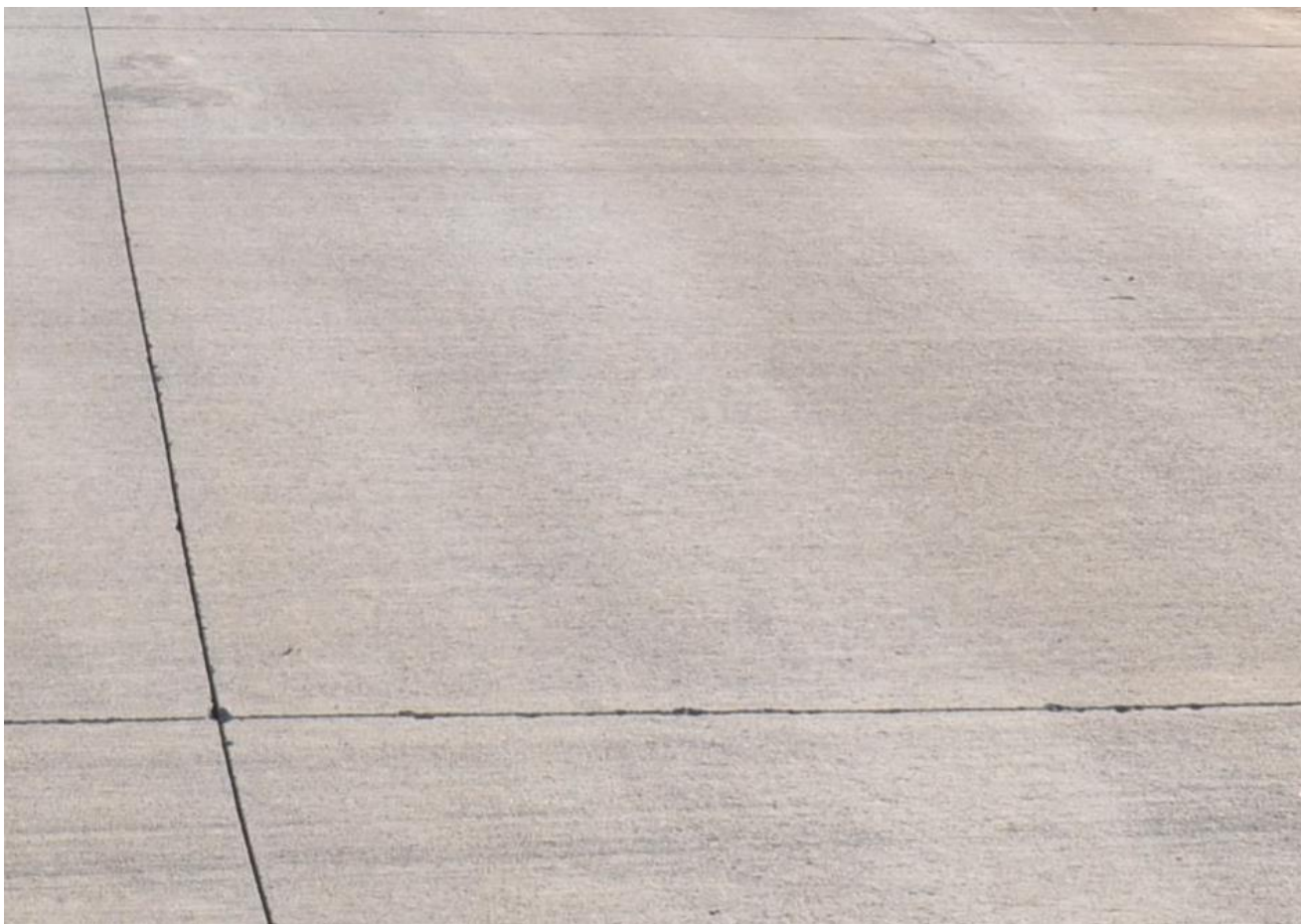


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concrete road surface

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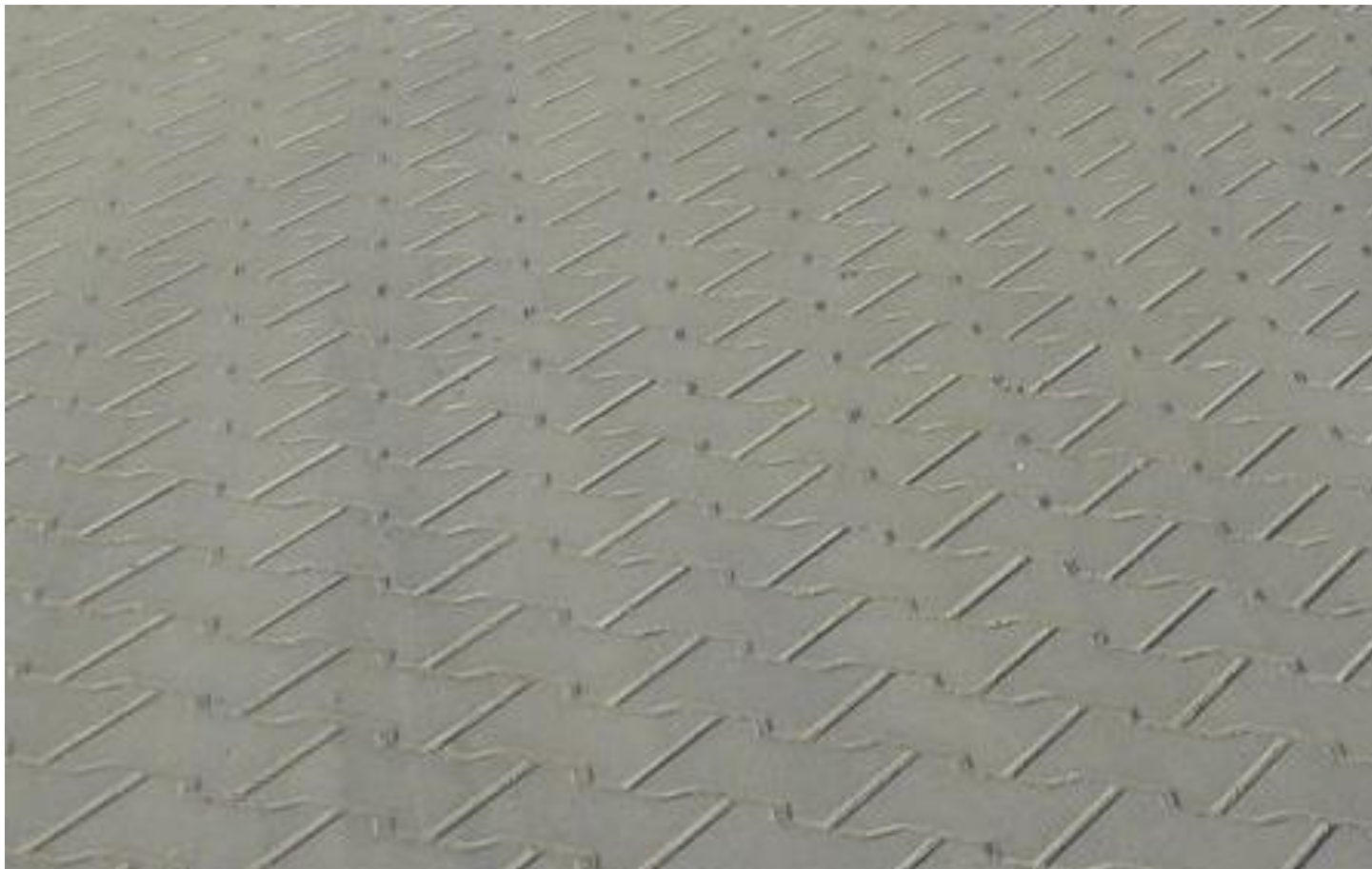
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**concrete setts road surface**

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setts road surface

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**cobbles road surface**

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crushed stone road surface

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concrete slab road

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