I. Structural Engineer – a Sense of Achievement

Structural engineers (SEs) deal with the _____[1]and skeletons of buildings, bridges, towers, stadiums, tunnels, and monuments—in short, virtually every aspect of the world's ____[2] environment. SEs work with other engineers as well as urban planners and architects on projects as _____[3] as the Millenium Dome, Channel Tunnel, Hoover Dam, or Sunshine Skyway Bridge. The primary duty of a structural engineer is to ensure ____[4]safety and to serve the client's interests while _____ [5] by the appropriate standards and legal codes. SEs design the _____[6] of a structure that hold its contents—"contents" being people, vehicles, and property. In buildings, SEs design roof _____ [7](beams, rafters, trusses), floor framing (floor decks, joists, beams, _____[8]), curtain walls, lattices, columns, braces, frames, pile foundations, and walls. For bridges, they design the ___[9] surface, girders or stringers, and____[10]. They work with a broad range of materials, including steel, concrete, wood, ____[11], and aluminum. SEs must design structures to resist forces from gravity, earthquakes, high winds, water, _____[12], and explosions. They ____[13] their designs by performing a complex series of calculations and by utilizing computer programs. They then draw their results on a ____[14]of plans, and those drawings are used by contractors to and build the structures in question. The job is challenging but also highly____[15]; one SE notes, "One of the greatest joys is seeing a project ____[16] construction and then walking into or driving on the finished product." Within the field of structural engineering, there are many specialties. SEs may ____[17] to specialize in working with certain types of buildings or bridges, or even certain types that are made of a ____[18] material. One may specialize in ____[19] bridges or even amusement park roller coasters, for example. _____ [20] SEs advice that it is a good idea for engineers to become involved in the design and _____[21] of as many different structure types as possible early in their careers. That way, young SEs may have a broad ___[22] of options open to them later on.

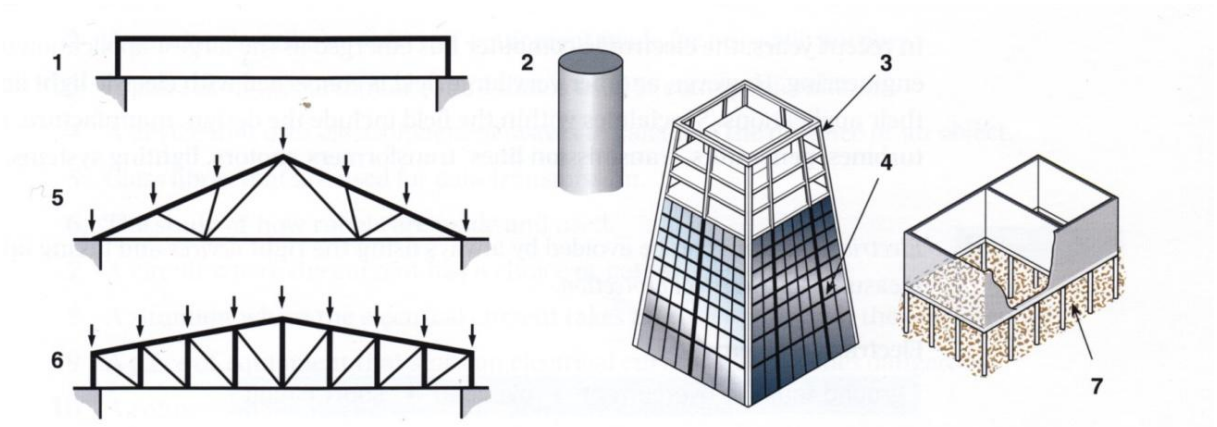
Source: http://en.wikipedia.org/wiki/Institution_of_Structural_Engineers

Language practice

Fill in the missing words:

component	under	public	opt
masonry	analysis	varied	particular
framework	rewarding	long-span	develop
abiding	joists	girders	deck
piers	built	collisions	price
set	framing	range	

Label the following diagrams using words from the text above:



1 _____ 4 _____ 7 _____ foundations

2 _____ 5 roof _____

3 steel _____ 6 lattice _____

Complete the following sentences:

a) A structural engineer has an impact _____

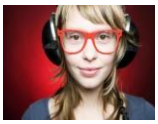
b) A career of a structural engineer ranges from _____

c) A structural engineer develops constructions _____

d) In the structural design an engineer considers _____

Find the opposite meaning:

collapse	
subside	
intact	
currently	
significant	



5. Listen

http://youtu.be/3KVg5kljuU0

Introduction to Structural Engineering and Steel Design

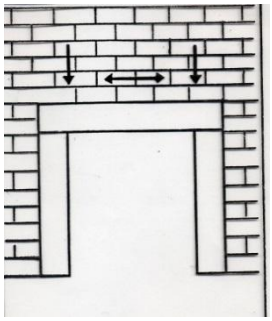


Figure 1.1

Listen and watch the documentary and translate required expressions:

- vijek trajanja
- biti zaslužan za gradnju
- prometni znakovi
- model napravljen pomoću kompjutora
- elementi konstrukcije
- funkcionira na najbolji mogući način
- opterećenje

- krutost
- armirano betonska konstrukcija
- most velikog raspona
- statički proračun
- čvrstoća
- elektrana

II. A Career Ladder of a Structural Engineer

1. A career in structural engineering attracts those who wish to rise to the challenge of a creative profession and the many career challenges that accompany this. A structural engineer will first conceive a structure; considering strength, form and function. Then they will choose appropriate materials – calculating and checking to ensure that the construction will remain safe and serviceable for the length of its intended lifetime.

Figure 2.1

SEs typically hold a college degree in structural engineering, civil engineering with an emphasis on structures, or architectural engineering. Many hold a master's degree, and some have PhDs. Course work typically includes physics, mechanics, blueprint reading, architecture, mathematics, and materials science. A structural engineer must be familiar with all components and methods of construction.

Many states require that structural engineers have at least two years of experience in the construction industry and pass a written test that assesses their analytical skills and their knowledge of stress levels as well as local and federal construction codes. Usually, just prior to or shortly after completing their bachelor's degrees, engineering majors take an exam that, once passed, affords the test taker the designation of engineer-in-training. Early in their

careers, SEs are mentored by senior staff. They then seek to obtain professional licensure; this usually occurs five years after college graduation.

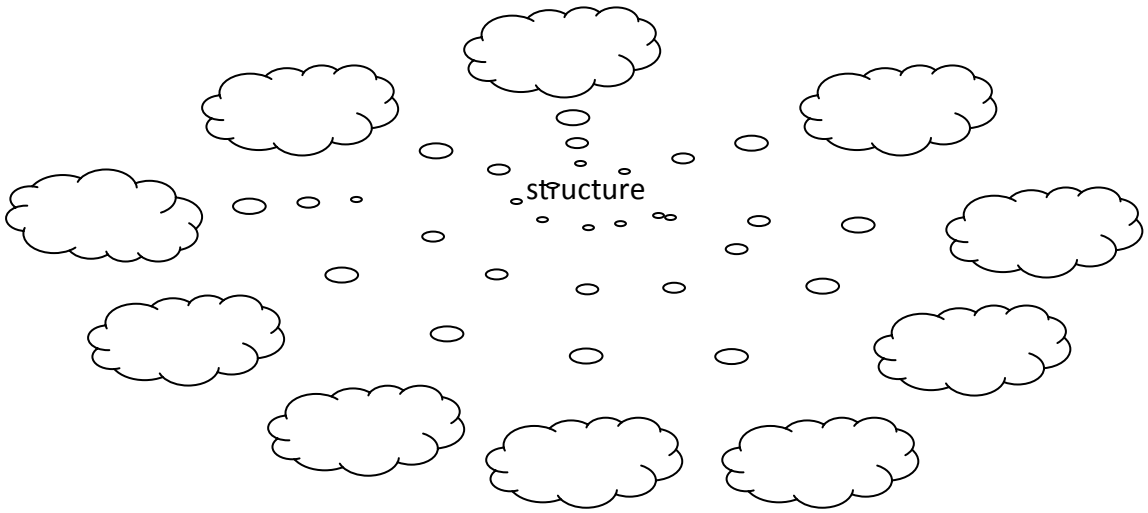
Many structural engineers have a construction background, and they may opt to return to this field and become construction managers, materials purchasers, architectural assistants, and consultants to worksites. SEs possess analytical abilities that make them well-suited to many professions, though.

These engineers must not only be high-class detail-oriented professionals in the field of construction, but also effective team workers with formidable administrative skills, to be able to adapt their experience to company specifics and staff.

Source:http://targetjobs.co.uk/career-sectors/civil-and-structural-engineering/286857-how-do-i-get-a-graduate-job-in-civil-and-structural-engineering

1. Give title to each of the five paragraphs:

Find in the text at least 10 associated words connected with the term STRUCTURE!



3. *Translate:*

naprezanja	nabavljač	poslovni objekt	inženjer početnik	nastajati
rekreativni objekti	čvrstoća	uporaban statičkin proračun	biti upoznat s nečime	raznolika karijera

4. *Listen*

http://www.youtube.com/watch?v=cKBlaBeBaOE

A typical day in the life of a young, female structural engineer.

5. Use the words from above to describe the activities in a typical day of SE.

ići na teren **osjećaj postignuća** **projektirati**

baviti se nečime

III. The Hyatt Regency Walkway Collapse

Figure 3.1

1. Read all the paragraphs bellow and put them into correct order:

a) The hotel included a 40-story guest room tower, a four-story wing containing restaurants and meeting rooms, and a large, open atrium. It contained three suspended walkways at the second-, third-, and fourth-floor level which connected the tower section with the restaurants and meeting rooms. Each walkway was 120 feet long and approximately 8 and ½ feet wide.

b) Instead of using continuous rods, however, the contractor hung the walkways from two separate sets of rods. Each fourth-floor box beam had two holes at each end, one 2 inches from the end and the other 6 inches from the end. The upper hanger rod passed through-the outer hole, while the lower hanger rod, onto which hung the second-floor walkway, passed through the inner hole. A nut-and-washer connection was used on the ends of the rods.

c) The National Bureau of Standards discovered that a significant design change had been made after the completion of the original design drawings, in the way in which the walkways were connected to the hanger rods. The original drawings called for both the fourth- and second-floor walkways to be hung

from the same continuous steel rods. As originally conceived, pairs of single rods about 45 feet long would have been passed through the box beams at the second-floor level. The walkways were to have been supported by a nut-and-washer connection under the box beams at each level.

d) On July 17, 1981, during a weekly tea dance, two suspended walkways in the atrium area of the Hyatt Regency Hotel in Kansas City, Missouri collapsed, killing 114 people and injuring 185. The collapse was one of the most serious structural failures in the history of the United States.

e) In the aftermath of the tragedy, the mayor of Kansas City requested that the National Bureau of Standards conduct an independent investigation to determine the cause of the collapse. There were, of course, other investigations and hearings as well as at least 150 lawsuits seeking total damages of 1.5.billion dollars.

f) Each of the walkways consisted of four spans of about 30 feet. Intermediate supports consisted of three pairs of steel hanger rods. Each walkway was supported from underneath longitudinally by wide flange steel beams and laterally by steel box beams. The box beams were made of pairs of steel channels that were welded together at their open ends. The walkway deck consisted of a formed steel deck overlain by a lightweight concrete slab which acted compositely with the 16-inch deep stringers.

g) An “expert witness" appearing before the Missouri Administrative Hearing Commission stated that the engineer of record usually has to delegate his

duties because there is too much work. "But he cannot delegate his responsibility. . . There has to be a point where the buck stops."

h) The second- and fourth-floor walkways were constructed one above another along the west wall of the atrium. The third-floor level walkway was independently suspended from the atrium roof trusses and was built about 13 feet toward the center of the room. The second-floor walkway was suspended from the roof framing.

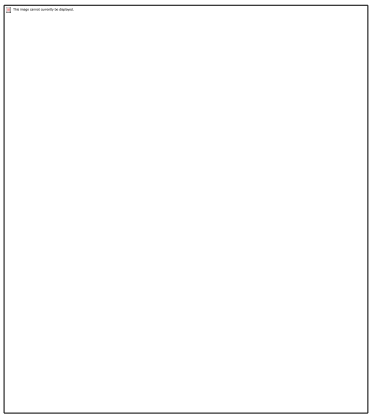


Figure 3.2

i) The effect of this change was to essentially double the load on the box-beam hanger connection at the fourth floor walkway. In fact, it was concluded that the collapse was initiated when the welding of one of the fourth-floor beams split, and the nut-and-washer connection supporting that part of the walkway slipped through the hole. The load of both walkways was then transferred to the remainder of the fourth floor connections, which also failed. The fourth-floor walkway then collapsed onto the one below it, and both walkways crashed onto the lobby floor. It was reported that the failed connection was designed by the project's steel erector and fabricator, a common practice in the construction industry. It was noted, however, that the shop drawings submitted by the fabricator had been signed by the chief structural engineer and the project engineer. Missouri law states that: "Any registered engineer

who affixes his signature and personal seal to any such plans..... shall be personally and professionally responsible therefore." The Board of Architects, professional Engineers, and Land Surveyors voted unanimously to revoke the licenses of these two engineers permanently and to revoke the certificate of authority of their firm. The firms' assets were sold to another civil and structural engineering firm.

Write sentences related to the story of the Hyatt Regency walkways collapse using the following linking words:

- In contrast to
- In short
- In other words
- In conclusion
- All in all
- On the other hand
- To sum up
- Furthermore
- Unlike

Translate:

viseći	sandučasta greda
konstrukcijski promašaj	matica i vijak
krovna rešetka	platforma
raspon (rešetke)	betonska ploča
podupirač	izvođač
Radionički crtež	Provesti istraživanje

Find synonyms:

suspend beam lobby beam rod steel erector

The Board of Architects shop drawing contractor joint

Explain the meaning of the following words:

a) welded connections b) land surveyors c) the welding split

Find the following expressions in the text:

- Napravitipromjene u nacrtu
- Pad je započeokada je zavaren spoj
- Povući dozvolu za rad
- Povućipravo ovlaštenja
- Proizvođač čelika

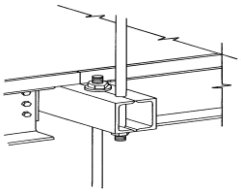


Figure 3.3

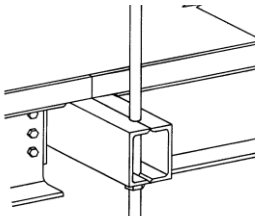


Figure 3.4

7. Translate:

Figure 3.5

Most kod Saltasha nije tako slikovit kao lančani most u Cliftonu, ali je to zapravo mnogo originalnija konstrukcija, pri kojoj su primijenjena sva ona načela građenja, kako pri spuštanju središnjeg nosača, tako pri gradnji potpornog stupa – što će ih inženjeri primjenjivati cijelo stoljeće. Brunel je predak New Yorka, i to je očito. Imamo njegovu fotografiju s cigarom, stojeći pred lancima što su poslužili pri porinuću u more - ili bolje, neuspjelom porinuću – njegova golemog parobroda New Eastern. I premda je great Eastern napokon zaplovio i preplovio Atlantik, odgađanje i nesreće ubrzale su smrt njegova pornalazača. Međutim je i transatlantski brod pridonio novom oblikovanom svijetu 19. Stoljeća i njegovoj arhitekturi.

Source: K. Clark, Civilizacija, Mladost, Zagreb, 1979, p. 324

IV. Architect vs. Civil Engineer?

Figure 4.1

At the heart of the Dome's design process was the creative relationship that evolved between the architects and the engineers. Engineers traditionally viewed as the back-room boys and girls of the design world have never quite shaken off an unjustified reputation for dullness. In the public mind, engineers are perceived as the full stops, the fail-safes, answering a firmly structural "because" to the architect's "Why not". The worst engineering takes such caution to extremes, specifying a structural design that, while safe and workable, overloads creativity with feet of clay.

Figure 4.2

The best engineering, on the other hand, is in itself proudly creative, innovative and forward looking, it is the practical application of the technological cutting edge. In the words of P.

Rice:" The architect's response is primarily creative, whereas the engineer's essentially inventive."

Source: E. Wilhide: The MilleniumDome : The Official Book of the Dome, HarperCollins,1999, p. 29

1. Match the meaning with following terms:

a) Back-room	1. alertness and prudence in a hazardous situation; care; wariness
b) Fail-safe	2. a premise located in the rear, esp. one used only by certain people.
c) Full stop	3. something designed to work or function automatically to prevent breakdown of a mechanism, system, or the like
d) Caution	4. a period indicating the end of a sentence

2. Insert adequate above listed terms:

a) _____ politics

b) A complete halt, as one made by a motor vehicle is also _____.

c) Landslides ahead—proceed with _____.

d) Our structure is guaranteed not to fail – it is _____.

Figure 4.3

3. Give an example of firmly structural „because“to the architect's „why not“!

4. Find in the text words for the following synonyms:

a) overcharge, press, strain

b) practicable, productive, serviceable

c) ongoing, onward, radical, revolutionary

d) advanced, innovative, modern, pioneering,

5. *Translate*

Figure 4.4

Brooklynski most koji su sagradili otac i sin Roebling zapravo je početak cijelog suvremenog New Yorka, herojskog New Yorka. „Goleme skele, okvirna konstrukcija, grede. Lukovi.“ Pjesnik Whalt Whitman je jednako tako, kao i ja, bio oduševljen mostom Firth of Forth, premda je taj most anakronizam, neka vrst prethistorijske nemani brontosaurus tehnologije. U doba njegova dovršenja, 1890, novi su oblici krenuli drugim smjerom, k vitkosti i ekonomičnosti, prema značajkama lančanog mosta. Ovaj most s prošlošću povezuje velika neprekidna tradicija zapadnog duha: matematička tradicija.

Source: K. Clark, Civilizacija, Mladost, Zagreb, 1979, p. 326

V. Weak Points of the House

There's time in every civil engineer's career when he has to prevent old buildings from becoming unsteady. There are many problems with old buildings, and if we take a good look we will see clear evidence of it. The most frequent problem on the external walls is crumbling plaster and rot at windows sill exteriors, but this doesn't put structure out of service. Much bigger issues to solve are dampness on outer and inner basement and foundation walls, rot in floor joists and unsteady balcony condition that can put human life on the line. To sum up, as good engineers we have to be very careful when we determine which weak points and flaws are important for structure's stability.

Indicate weak points of the house:

1._____walls

2. _____ walls

3._____ walls

4. _____joists

5. _____exteriors

6._____windows

7. _____ wallpaper

8. _____ joist floor

9. _____ paint

10. _____condition

11. _____drainage

12. _____facade

13. _____roofing

14. _____roof structure

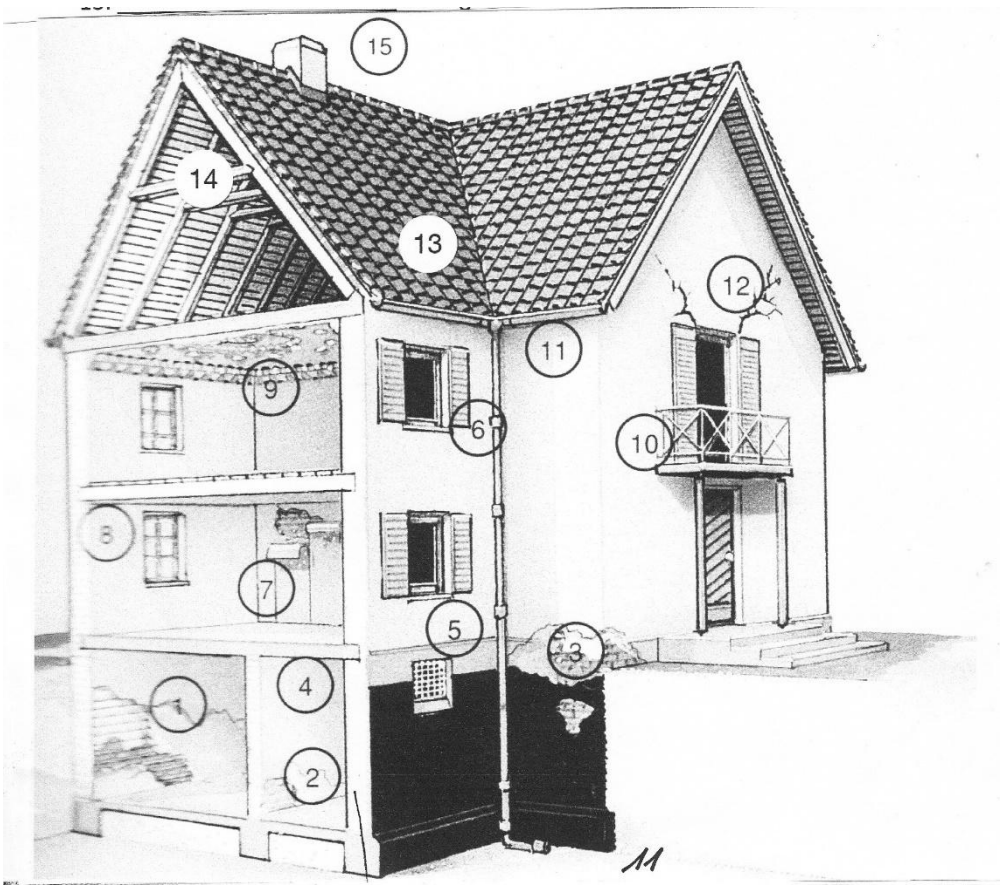


Figure 5.1

Source: T. Schmitz- Günther, Living Spaces, Könemann, Hagen, 1999, p.161

8. Find antonyms

unstable cracking crumbling deteriorating rusting

VI. Timber Structures

1. **Look at the picture of a timber house and match the corresponding terms**

diagonal	siding
brick	cripple wall
wood	foundation
stud	wall
unbraced	blocking
straight	joist &rafter
horizontal	brick chimney
let-in	cripple wall
concrete	sheating
unreinforced	foundation

2. **Fill in the blank spaces with the above matched terms:**

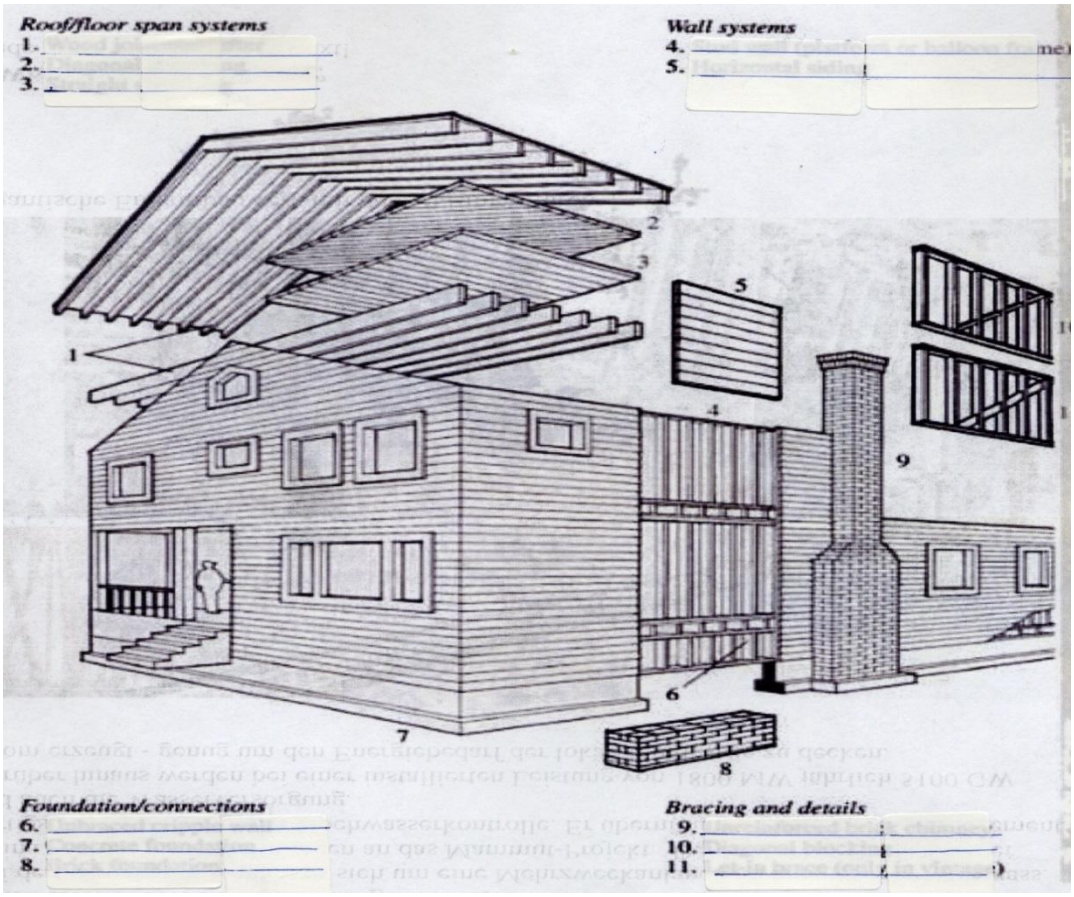


Figure 6.1

Source: T. Schmitz- Günther, Könemann, 1999, p.38

3. *Translate*

Dragi Bill,

Moj suprug i ja kupili smo kuću staru 100 godina i namjeravamo sami poduzeti mnoge potrebne popravke (unutar naših granica!). Nemamo baš puno iskustva i mislim da smo ovdje pretjerali….

Otvorili smo strop naše dnevne sobe da bismo dobili pristup za našeg vodoinstalatera kako bi popravio cijev za tuš (tu nije bila ugrađena stupica). Prijašnji vlasnici su "prepravili" kupaonu i loše su isjekli grednike. Greda ispod zahoda ima preokrenuti V zarez koji ju skoro presijeca, a postoje i druge velike, nepravilne rupe izrezane kako bi kroz njih prolazile cijevi. Prijašnji vlasnici su pokušavali pokrpati gredu sa 2x4's, ali grede ništa zapravo ne podupiru i ne dopiru do zida (kraj grede)Nemamo novaca kako bismo doveli inženjera konstruktora , pa nam je iskusni majstor kazao da "posestrimo" gredu na svakoj strani sa drvenom građom 2x6 & 1/2" vijcima, i zarežemo je tako da sjedi na bazi. Ne razumijem sve posljedice prijenosa opterećenja & postavljanja vijaka –ono što razumijem jest da je to zaista važan popravak s puno težine. Moj suprug radi u tvornici za proizvodnju čelika i može dobiti kutno željezo ili čelik, i probušiti ga za vijke - bila bi nam velika pomoć bilo koja ideja o tome!

Slika 6.2. Oštećeni grednik

hvala,

Jan

Translated from: http://www.yarnharlot.ca/blog/archives/2012/03/29/this_old_house.html

VII. Wembley Stadium

Students are divided into the groups of three and compete to guess required terms.

2. Which words - and all of them are related to the construction of the Wembley stadium - do you associate with given prompts:

	A	B	C	D
1		expertise	skyscraper	
2	basketball			comfortable
3		creativity		
4				damaged
STADIUM				

The construction of one of the most beautiful stadiums in Europe began in October, 2002.The aim of the project was to design and build a state-of-the-art national stadium, unlike any other in the world, which would be the home of English football and would host large events such as Cup Finals, music events and athletics.

Figure 7.1

The old Wembley Stadium was originally constructed as the main attraction of the 1924 British Empire Exhibition.

Famous architect Sir Norman Foster designed the arch and the roof structure. The stadium is designed like a bowl, and its unique features include retractable roof panels and the arch.

The arch itself is not just a cosmetic feature; it supports the north roof and a sizeable area of the south roof. It was designed to give the appearance of solidity without incurring the penalty of high wind loads. The arch has a lattice form consisting of 41 steel rings (diaphragms) connected by spiralling tubular chords and is formed of modules with two tapering end sections. The arch is held in position by a series of forestay and backstay cables tied to the main stadium structure. The leading edge of the north roof is in turn suspended from the arch by the forestay cables. Cables from the arch are arranged in a diagonal pattern to help spread loads to control in-plane bending while also providing out-of-plane restraint to resist buckling. The arch structure is 133m in height, with a span of 315m and is the longest single-span roof structure in the world. The 50,000m² roof is essential to the operation of the stadium as a sporting and concert venue. Weighing some 7,000t, the roof has a number of retractable edge sections that can be manoeuvred to allow direct sunlight to reach all parts of the grass pitch (to allow the pitch to achieve top quality). With its load-bearing capabilities, the arch allowed designers to eliminate the need for columns within the interior, which means that every stadium seat has an unobstructed view of the pitch. The arch fulfils another function aside from supporting the majority of the roof. It also provides a "beacon" for the stadium, illuminating the north-west London sky on match days. The designer's vision for the arch was a tube of light that would hover over the stadium at night creating an iconic statement.

Figure 7.2

Structural engineers worked closely with the steelwork subcontractor to transfer the load, in excess of 1,300t, to the permanent cable net and eyebrow catenary cable. In summer of 2006 the laying of the new Wembley turf was completed. The turf arrived at the stadium in giant rolls and was transported in 25 lorry loads. The fibre sand pitch is made up of an

underlying web of heating and drainage pipes plus lots of crushed stone, gravel, grit, sand and a blend of soil and fibre. To understand the size of the project, the stadium encloses four million cubic metres within the walls and under the roof. The construction required 90,000m³ of concrete, 23,000t of steel and 35 miles of heavy-duty power cable. Four thousand separate piles were used to form the foundations.

Figure 7.3

The stadium roof rises 52m above the pitch and the circumference of the building is 1km. The stadium has the facility to be converted into an athletics venue by virtue of a removable steel and concrete platform. To overcome financial concerns over the new stadium, the parties involved came to an agreement on a fixed-cost contract.

Figure 7.4

Under such an arrangement, the client is protected from exposure to budget over-runs or delays in construction. That risk was borne by the main contractor. When the project first started, it was delayed for two years due to financial and political difficulties before eventually getting underway in late 2002. The stadium was supposed to be completed for the FA Cup Final, but Multiplex was unable to complete the stadium within the scheduled time and had to pay penalties. Multiplex sued the stadium designer Mott MacDonald for

£253m saying that it was denied access to key design information that led to increased steelwork costs.

A few construction problems were highlighted during the project. The first was a problem between Multiplex and the steel contractor Cleveland Bridge.

Cleveland Bridge walked off the job shortly before the arch was raised because they did not believe they would be paid for materials and there were irrevocable difficulties between the two parties. The problems resulted in two high-profile court cases where the two companies sued each other for breach of contract. The second problem involved a temporary roof support rafter, which fell by over half a metre. This resulted in the evacuation of 3,000 construction workers and delayed work, while inspections and reports were carried out. The project began again shortly afterwards.

Later, the third problem came to light. The sewers under the stadium had buckled due to ground movement. Remedial work started later on. The stadium was scheduled to be completed by late summer 2006, however, it was completed in March 2007 moving the scheduled sport events to other stadium.

Source: http://hr.wikipedia.org/wiki/Wembley_Stadium

3. Match the parts of the stadium with the numbers in the Figure 5:

a) broadcasting room b) seeding room, c) corridor d) lobby, e)locker room, f) training room g) room for equipment heating h) room for various installation

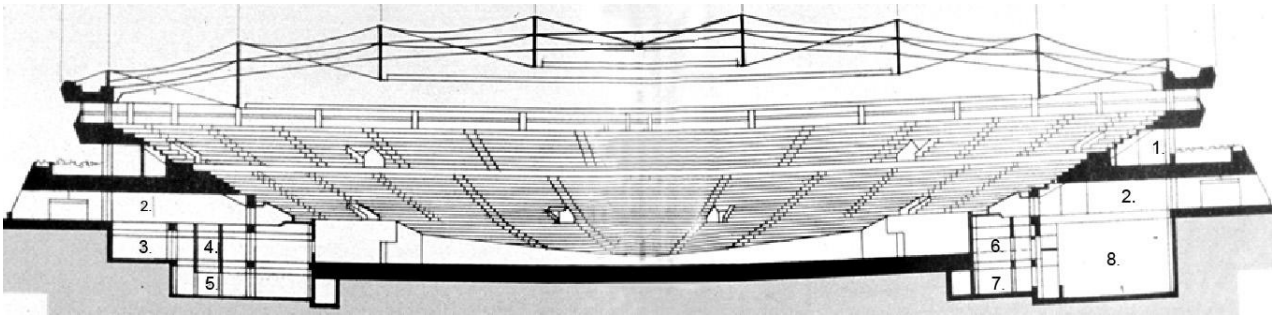


Figure 7.5

1. corridor
2. lobby
3. seeding room
4. broadcasting room
5. room for various installations
6. room for equipment heating
7. locker room
8. training room

4. Match the words from the text with their definitions:

sizeable	distance around a close curve
venue	an arched form above an enclosed space
hover	structural element of architecture that resembles the hollow upper half of a sphere
grit	quite large
circumference	infrastructure that conveys waste
dome	place where is an organized gathering
vault	the process by which an object is suspended by a physical force against gravity, in a stable position without solid physical contact
sewer	coarse-grained siliceous rock usually with sharp grains

5. Explain the following terms:

truss-supported roof _____

tensegrity structure _____

retractable roof panels _____

spiral tubular chords _____

tapering element _____

beacon of the stadium _____

catenary cable _____

blend of soil _____

budget over-run _____

breach of contract _____

6. **Sum up the contents of the text with emphasis on the structural aspects using the following terms:**

state-of-art, lattice form, in-plane bending, buckling, obstructed view, turf, irrevocable difficulties

7. **Sum up the contents of the text focusing on construction management and use the following words: breach of contract, aspects, client, budget over-run, contractor, schedule, penalties**

Listen

Tokyo's Sky City

Figure 7.6

8. **Watch the video „Tokyo's Sky City“ and find expressions for the following terms:**

Stvoriti nove prostore

stanovnici grada

sasvim novi pejzaž

prenatrpanost prostora

luksuzni zeleni prostor

naslagati jedan blok nadrugi

neefikasna gradnja

zglob ne smije popustiti

uobičajena metoda

9. Explain the following terms:

Urban sprawl

Land crunch

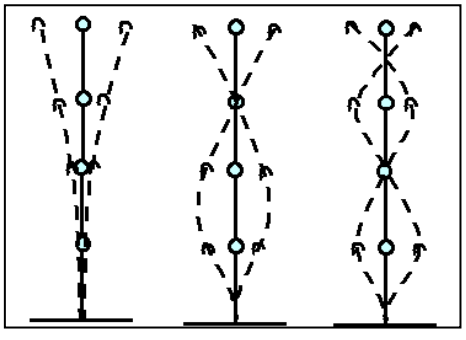
Loose sandy soil

10. Summarize the story upon hearing and watching the documentary

11. Match the pictures with the following terms:

a) Displacement
b) Tuned liquid column damper
c) Base isolation
d) Single degree of freedom system
e) Modal shapes
f) Active mass damper
g) Viscous damping system
h) Tuned mass damper

_____



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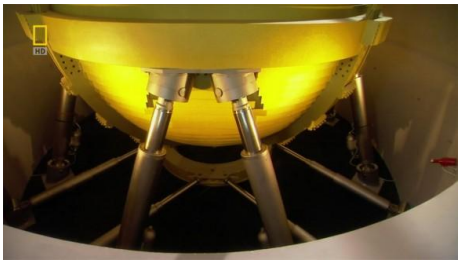

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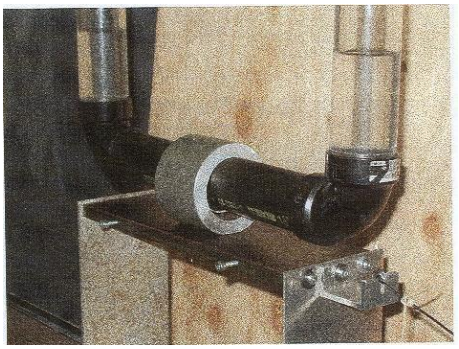

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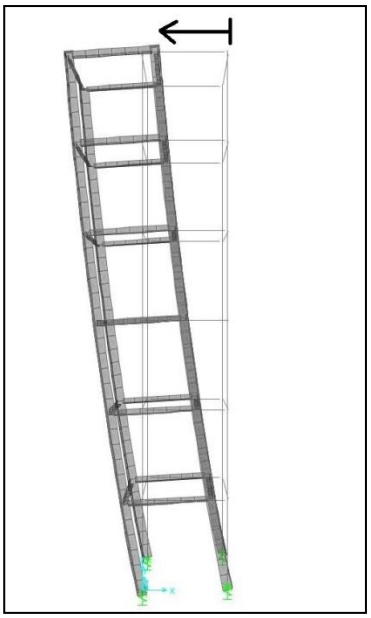

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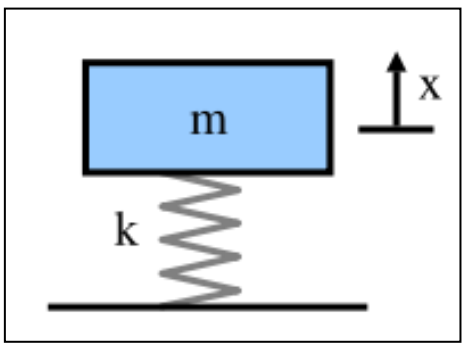

m
x
k

_____

12. Match the corresponding parts of the sentences:

Inside the Taipei 101 skyscraper	Japan shut down all nuclear power plants.
Mistuned damping systems	is the world's largest and heaviest tuned mass damper.
First natural frequency of two degree of freedom system	tuned to the natural frequency of structure.
The frequency of tuned mass damper has to be	damage during earthquake.
After one of the most destructive earthquake in our known history	embedded in cables of a suspension bridge.
Natural frequency of tuned sloshing water damper	has lower value than the second one.
The amount of ground shaking during earthquake can be	grows the impact of the earthquake.
Viscous dampers are often	depends of container geometry.
Flexibility of structure prevents	can't increase motion of some building during earthquake.

VIII. Bridges

Listen

1. **The following video provides basic knowledge about bridge construction. Use it to write a technical report on the construction progress:**
   http://www.youtube.com/watch?v=Rn9RPAOcQ_0

DAMAGES IN ARCH BRIDGES

To be able to know and understand the damages of the arch bridges, it is important to become familiar with its parts.

Almost every stone or masonry arch bridge is composed of the following parts:

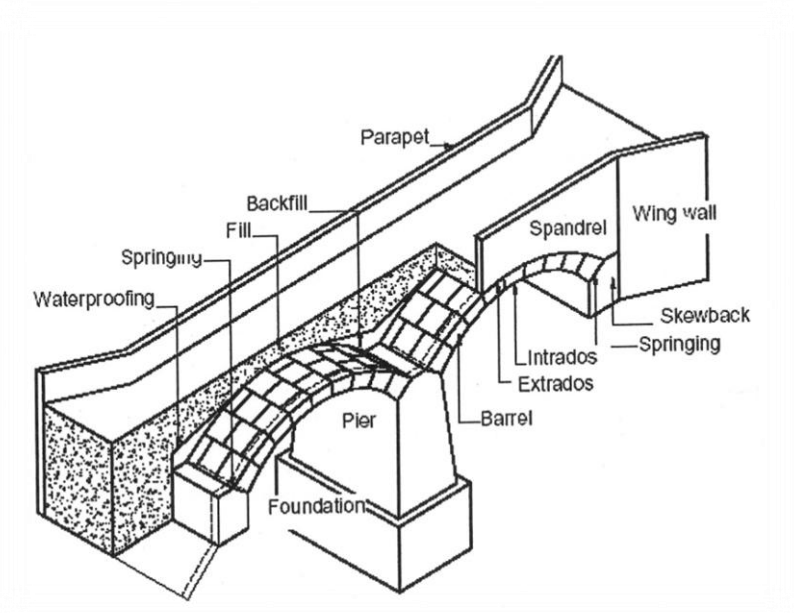


Figure 8.1

Knowledge of the damage that has occurred to an arch bridge is important to all structural engineers, so that they may be able to properly assess the condition of the bridge and undertake its repair.

The occurrence of damages in structures is unavoidable over time, partly due to the action of nature and the aging of the materials and partly due to increased traffic loads.

Defects in arch bridges can be broadly classified into two categories:

1) Foundation Damages

2) Structural Damages

Some of the damages are due to material deterioration, some to soil-foundation dilapidation. Sand extraction on the river shores might lead to the excavation of riverbeds. Damages in wing walls include overturning and bulging and vertical cracking. Superstructure damages result usually from bad resistance performance and are often due to durability issues. Imposed movements are the result of foundation movements in the abutments and piles, and their consequencesmight be, for example, the undermining. In an extreme case of transverse bending coupled with differential settlement, a partial collapse of an arch can occur. The loss or dislocation of pieces is a type of damage that occurs either due to the strength or the durability of the structure, or is due to a combination of both. Another type of failure is stepped cracking, which occurs due to differential settlements in the plane of the wing wall. Damages caused by deficient durability include inapprop inappropriate maintenance and negligence, vegetation growth and blockage of the drainage system.

Problems can also be caused by abutment overturn due to excessive earth pressure. The bulging of spandrels is linked to excessive earth pressure of the fill and the water retained in it. In addition, the horizontal components of live loads must be considered. In extreme cases, the entire spandrel wall can be overturned if destabilizing forces due to clogged fill, surcharge and increased live loads are very large. Transversal cracking is a type of arch mechanism failure. This is the most serious type of damage, and it is visible in the form of transversal cracks in the intrados of the arch barrel. Additional problems can be caused by

plants that grow on bridges, which cause many different disorders. Vegetation growth can lead to the blockage of the drainage system on the bridge deck.

2. Find words in the text above that have the same meaning as the following: ispuna, izbočavanje, ljuštenje žbuke, bačvasti lom, izvijanje, slijeganje, nadlučje, isušivanje, neodržavanje, građevine, nemar u održavanju građevine, manjkav, odvodnja, trošno stanje, iskapanje

3. Match the labels with the corresponding images below:

a) Local action of a current of water on a foundation

b) Relative movement along the longitudinal elevation of a bridge

c) View of concrete arches

d) Presence of plants and disorders caused by them

e) Differential settlement and transversal rotation of the longitudinal axis of a pier base

f) Damages caused due to inward rotation of the abutment

g) Configuration of collapse by sufficient number of hinges

h) Bridge parapet (on the left side the one built in 1926 and on the right the old one)

i) Masonry arch bridge foundation deterioration example: formation of cavities and complete disintegration of the foundation section

j) Overturning and bulging of spandrels

k) Vertical cracking

l) Transversal cracking in the intrados of an arch barrel

m) Cracking in stair pattern on wing walls or on side walls

Figure 8.2

Figure 8.3

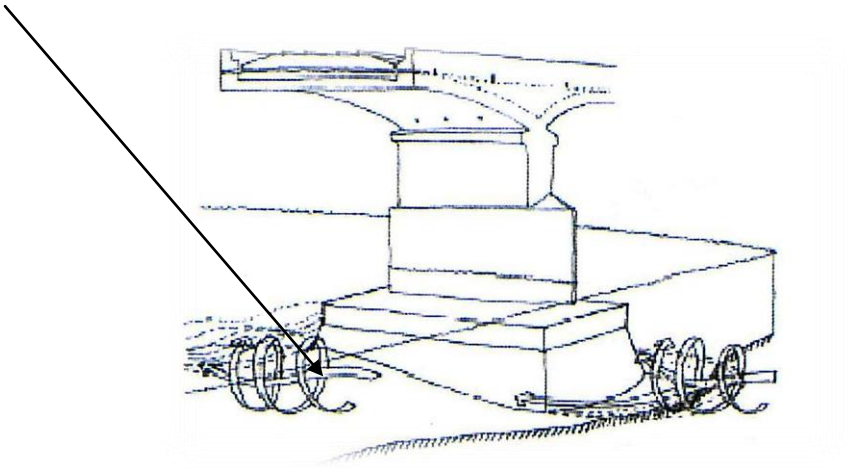


Figure 8.4

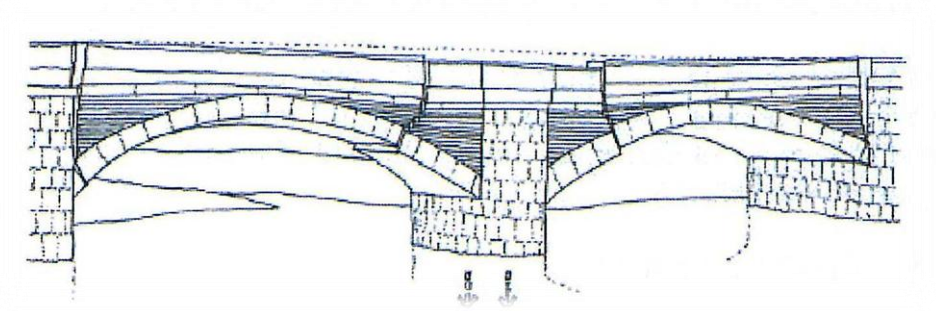


Figure 8.5

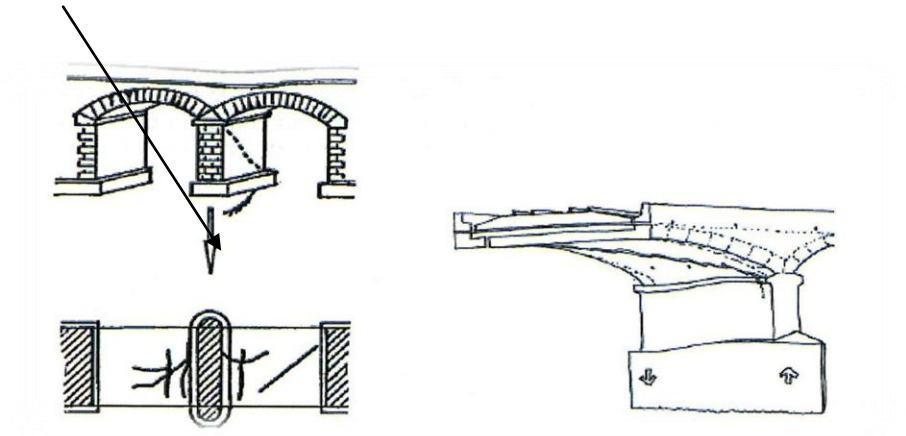


Figure 8.6

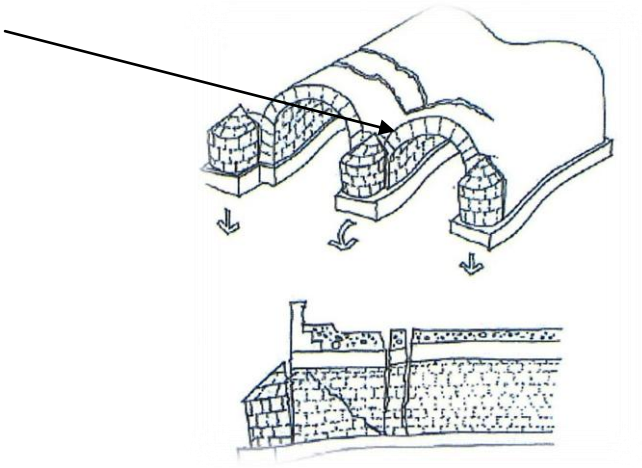


Figure 8.7

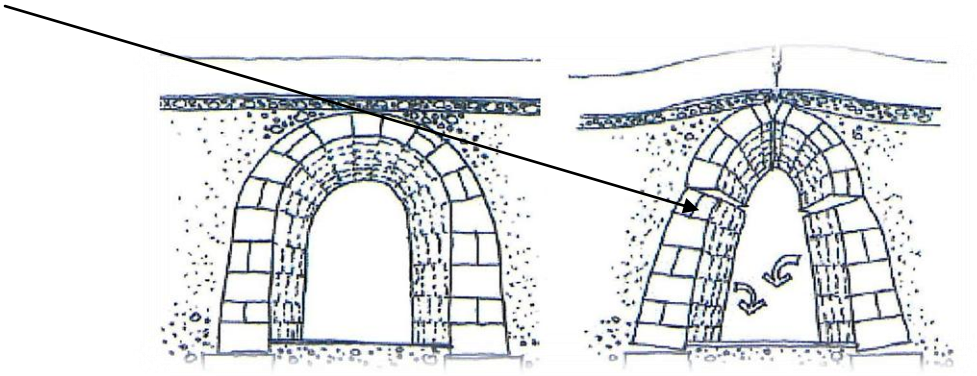


Figure 8.8

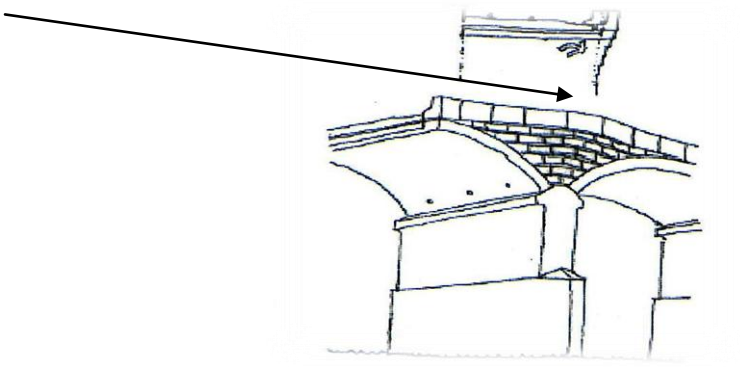


Figure 8.9

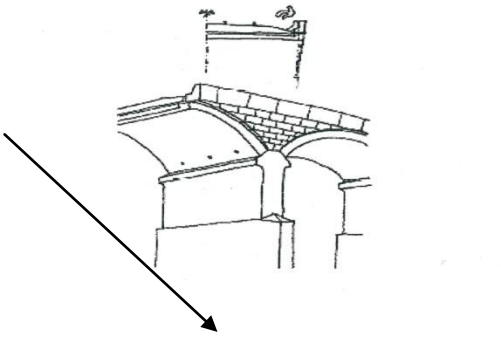


Figure 8.10

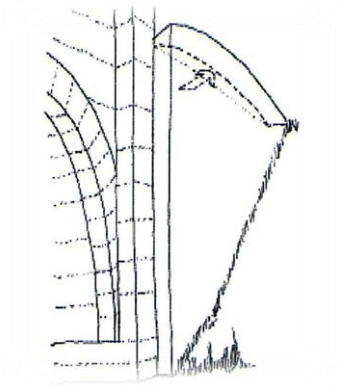


Figure 8.11

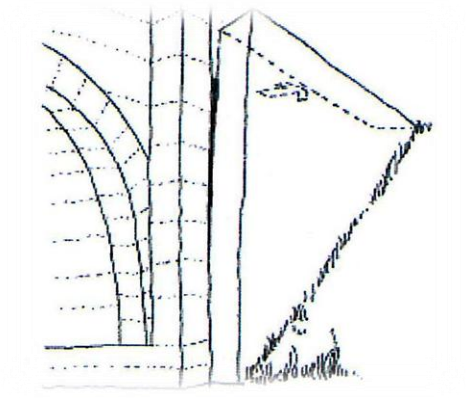


Figure 8.12

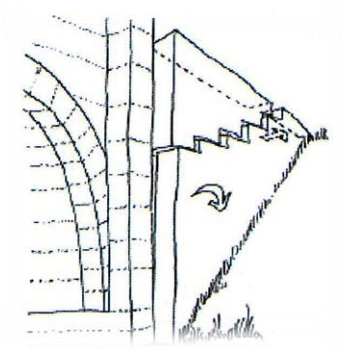


Figure 8.13

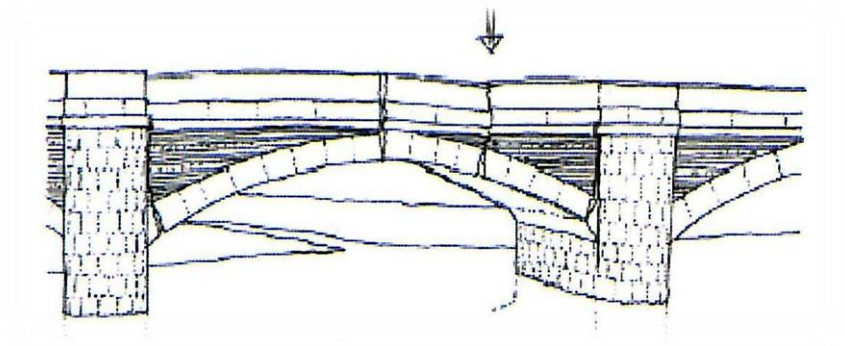


Figure 8.14

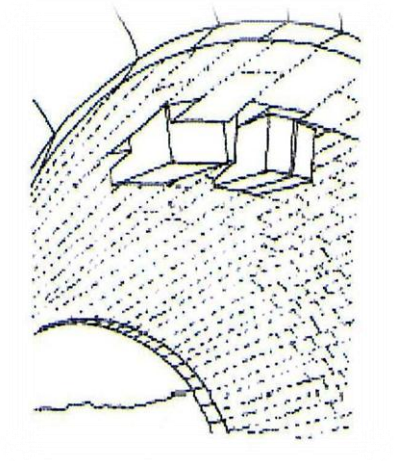


Figure 8.15

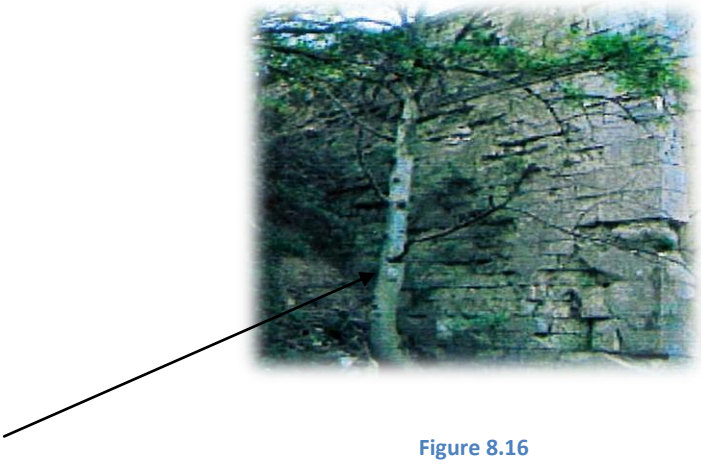


Figure 8.16

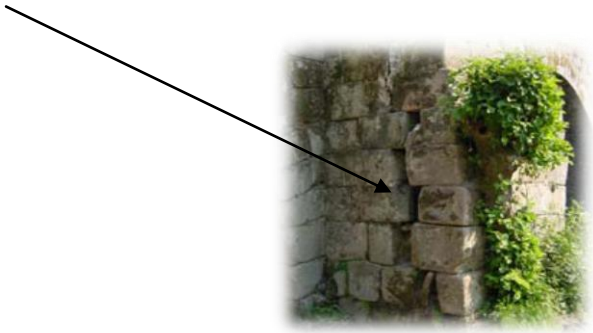


Figure 8.17

Error

1. Correct the report on the „Restoration of masonry arch bridge over Venta River in Kuldiga„

Bridge over Venta River in Kuldiga built in 1874 belongs to the longest clay brick masonry highway bridges in Europe.

The renovation of masonry arch bridge over Venta River in Kuldiga has been a successful project that proves the importance of material and structural resource.

Figure 1

The inspection carried out in 2006 showed several deteriorations in masonry wall and arch structures. They were found in bricks, some stones had crumbled away in piers, cracks in reinforced concrete

Figure 2

Figure 3

Figure 4

Reconstruction design

Figure 5

The surface of brick arches was in good condition, old waterproofing and protection layers where still partly there. Therefore the most necessary tasks were to restore waterproofing (Fig. ____) and fill the arches with draining soil.

Figure 6

After renovation it will be possible to use the bridge over the River Venta for everyday traffic capacity provided by transport rules (Fig.8).

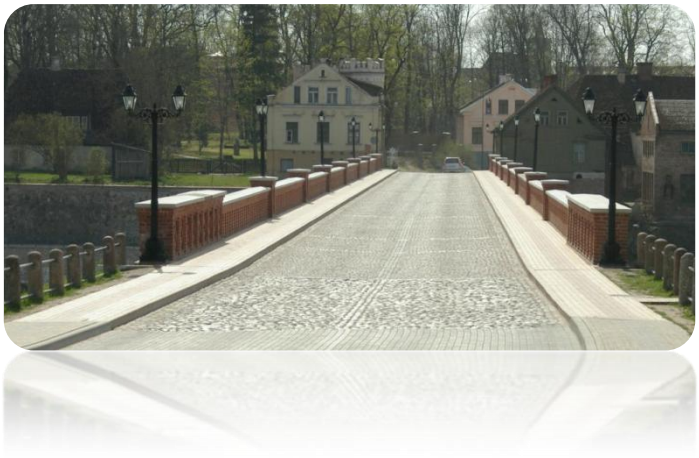


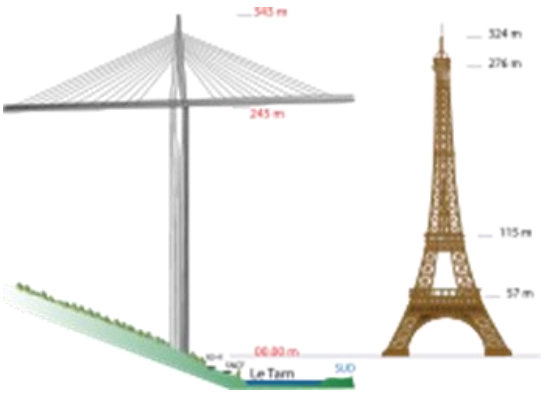
Figure 7

2. Match the labels with corresponding figures:

- New waterproofing
- View of deteriorated arches
- View of the fifth arch in 2006 inspection
- View of reinforced concrete arch
- Bridge parapet (on the left side the one built in 1926 and on the right the old one)
- Bridge deck after renovation
- View of the bridge after renovation

Listen

Europe's Longest Viaduct



1. Watch the video and answer comprehension questions:

1. The Millau Viaduct is located

   a) a)In northern France
   b) In southern France

2. The main reason to build Millau was

   a) to create a detour
   b) to reduce the number of visitors passing through Millau

3. The bridge deck

   a) was constructed on land at the ends of the viaduct and rolled lengthwise from one pylon to the next, with eight temporary towers providing additional support
   b) construction started from the middle of the valley

4. Arguments put forward against the bridge's construction

   a) there is no considerable reduction of the cost of vehicle traffic travelling along this route

b) the project would never break even; toll income would never amortise the initial investment

5. As far as the deck of the bridge is concerned

a) the surface is somewhat flexible to adapt to deformations in the steel deck without crack
b) the surface is completely rigid

6. Imagine you are an engineer taking part in the construction of the Millau Bridge

a) Translate expressions given bellow; use them to retell the history of the Bridge's construction

most se još gradi

autocesta

podignuti dijelove mosta (gornji ustroj)

povezati gradove

blokovini su sastavljeni

guratim masu potiskom

dizalice

sandučasti nosač

potiskivanje

provesti ispitivanje

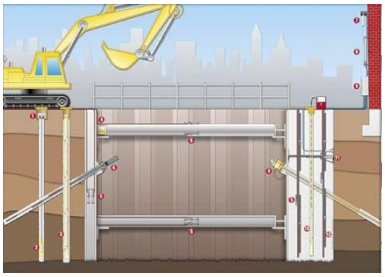
značaj gradnje

oprema

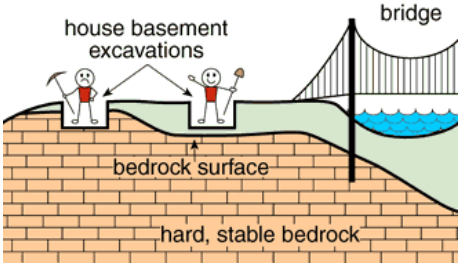
postepeno poravnanje

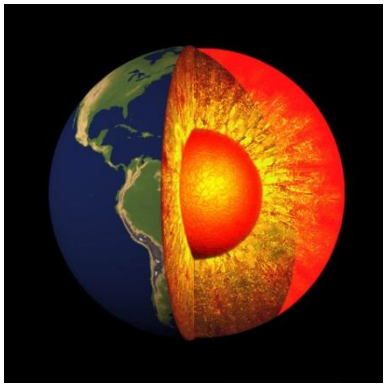
b) Translate the terms a – e and connect the words with the pictures:

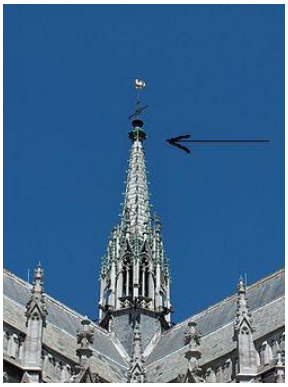
a) obodni zid	b) iskop	c) temeljna stijena	d) most
e) jezgra	f) vrh	g) prigušivač	h)stabilizacijski
sustav	i) betonska ploča	j) kruti spoj	k) bušotina
l) vapnenački kamen			



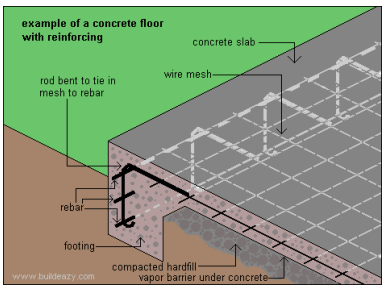

SCIENCEphotoLIBRARY


house basement
excavations
bridge
bedrock surface
hard, stable bedrock

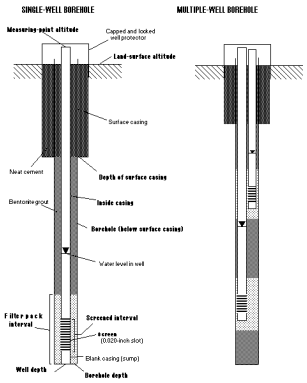


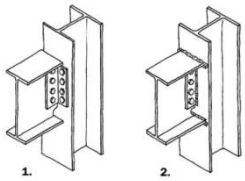


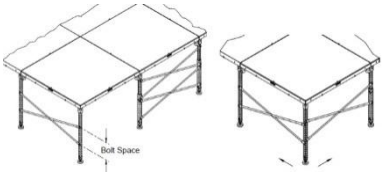

dreamstime.com


example of a concrete floor
with reinforcing
concrete slab
wire mesh
rod bent to tie in
mesh to rebar
rebar
footing
compacted hardfill
vapor barrier under concrete
www.buildeazy.com


© geology.com


SINGLE-WELL BOREHOLE
MULTIPLE-WELL BOREHOLE
Measuring point altitude
Capped and locked well protector
Land-surface altitude
Surface casing
Neat cement
Depth of surface casing
Bentonite grout
Inside casing
Borehole (below surface casing)
Water level in well
Filter pack interval
Screened interval
screen
(0.020-inch slot)
Blank casing (sump)
Well depth
Borehole depth


1.
2.


Bolt Space

IX. The Story of the Dome

Listen

1. Listen to the story about the origins of the Brunelleschi's Dome Santa Maria del Fiore - Act as a consecutive translator from Croatian into English! Consecutive translation is a type of oral translations in which the speaker makes a pause necessary for the interpreter to translate everything he has just said.

Source: Radio Zagreb, Školski program:Veliki graditelji, 25.3.2008.

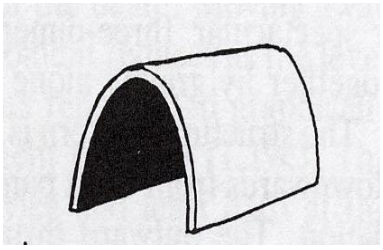
Figure 9.1

2. Listen for the English equivalents of the following expressions, and write them down:

a) Rebrasta kupola
b) Ukrućivanje pomoću zatega
c) Naručitelj gradnje
d) Otkazati ugovor
e) Pomoćne sprave /dizalica
f) Apsida, zašiljen dio
g) Unutarnja oplata

3. Label the drawings with the following words:

SPHERE, VAULT, ANGLE, COLUMN, RECTANGULAR, INCLINED and CURVED:



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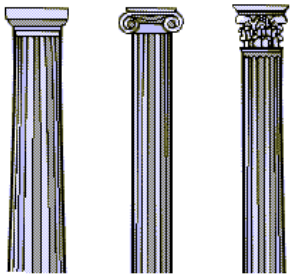

____

_____

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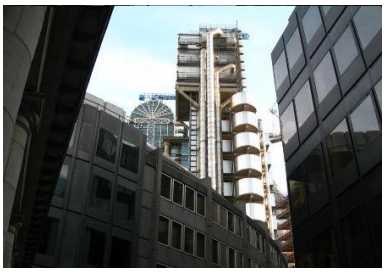
4. Translate

Arhitekt	Richard Rogers
Lokacija	London, England
Vrijeme gradnje	Od 1979. do 1984.
Tip gradevine	Poslovni neboder – sjedište tvrtke Lloyd's
Konstruktivni sistem	Čelični okvir sa ovješenim staklenim pročeljem
Ostalo	Vidljiva nosiva konstrukcija i servisna infrastruktura zgrade, kao temeljni ornament.

_____

_____



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