STAIRCASES

INESE DINDONE KTH ARCHITECTURE

SEMINAR COURSE: **UNIVERSAL ARCHITECTURE IN THE DESIGNER' S EYE**, 2014 AUTUMN

INTRODUCTION

The simplest and earliest type of staircases were developed in Africa, a climbing pole ladder. This was made out of a tree trunk, in which steps were carved. The reason for inventing stairs is mainly functionally motivated: lifting the building just a few meters above the ground helped to protect the habitat from the dangers at the ground level, animals, flooding or other people. When this defensive function occurred, then the ladders were removed. This was also a sign of no one being at home. The uplifted position also helped to ventilate the habitat after rainfalls (*John Templer, 1992*)

After some time, people started to realize that climbing up to rungs was difficult, and, staircases were invented. In this case, nature supplied some exemplary models, like natural stair like formations in cliffs or hillsides. These stairways allowed for carrying heavier loads. The tread was comparatively smaller than the riser, however, over time, this relationship changed. A broader tread and a lower riser allowed for a more comfortable and slower gait (*John Templer, 1992*).

During the Middle Ages, the function of staircases was closely associated with defensive purposes. The staircases were often made out of wood, and sometimes covered by a wooden roof construction. In case of an attack, these stairwells were torched in order to stop the invading enemy (*John Templer,1992*).

After the Middle Ages, staircases gained a new interest, not only as a functional element, but as embellishing architectural elements. The use of the staircases shifted, and stairways became associated with power and status (*John Templer, 1992*). Large spanning staircases with a curved or incurved body, indoors or outdoors, became a design feature in architecture. A well-executed staircase was the pride of architects. Staircases became the most significant spatial element in the inside space, as well as an exterior motif (*John Templer, 1992*). In combination with expensive garments and female fashion, the stair halls became an important space for showing off status and wealth (*John Templer,1992*).

Hence, staircases has gone from being a mere adjustment of the terrain due to transportation motives into becoming an important architectural feature. Living without difference in levels has become unimaginable, however, various accidents and injuries can be associated with staircases. The development of new designs for staircases have imposed new demands on safety precautions concerning the proportion between the tread and the riser, height of bannister and railings (*John Templer,1992*).

The classical theorem appropriately designed staircases was introduced during renaissance era I.E. **2XRISER+TREAD=600-650 MM**

The evolution of the staircases has developed more than just being a movement of transportation. Life without level differences is unimaginable, especially nowadays.

Our daily life is full of unexpected events; every day when we step out of the door, we put our lives at risk. In the US, some 12,000 people die every year due to fall injuries (*John Templer, 1992*). Most of the times, simple missteps are the reason. Staircase-related accidents are more frequent in Japan, the Netherlands and the UK than traffic accidents (*John Templer, 1992*). These numbers give some inkling about how problematic stairs might be.

Age might be a factor in staircase-related accidents, since the sense of balance can be troubled due to high age (*John Templer, 1992*). People aged 65 years and above have a higher risk of falls in staircases than younger persons (*John Templer, 1992*). In addition, inappropriate shoe ware and over-thinking personal capacities are other reasons behind fall injuries.

AIMS AND PURPOSES

I decided to compare staircases in capitals in three countries and their measurements. They are Stockholm, Copenhagen and Riga. I decided to include Copenhagen in my research since we also study Building Regulation of Denmark in this seminar course. Reason for including Riga was simply to see if there is any difference between Nordic countries and Latvia which has different history and development. I choose most frequently used stairs in my daily routine, my friend who lives in Copenhagen and my sister who lives in Riga.

This paper explores contemporary design of staircases in three cities, Copenhagen in Denmark, Stockholm in Sweden and Riga in Latvia. It is a comparative study on the persistence of the classical theorem in the Nordic countries for designing appropriate staircases.

Northern new mexico bandelier Ladder **(internet)**[1]

African tribal ladder **(internet)**[2]

Imperial stair at Wurzburg palace, Gemany **(internet)**[3]

Palace of the Arches, Brasilia, by Oscar Niemeyer **(internet)**[4]

1 (internet)[1] https://www.google.se/search?q=northern-new-mexico-bandelier-ladder&biw=1366&bih=624&source=lnms&tbm=isch&sa=X&ei=bj12VPy7KcfRyg033lDYBg&ved=0CAYQ_AUoAQ#tbm=isch&q=northern+new+mexico+bandelier+ladder&facrc=_&imgdii=_&imgrc=i6LkNOEVnz8QvM%253A%3BtX_epohe66MJJM%3Bhttp%253A%252F%252Fimage.trucktrend.com%252Ff%252Ffeatures%252Ftravel%252F163_1012_northern_new_mexico_trucks%252F28833926%252Fnorthern-new-mexico-bandalier-ladder.jpg%3Bhttp%253A%252F%252Fwww.trucktrend.com%252Ffeatures%252Ftravel%252F163_1012_northern_new_mexico_trucks%252Fphoto_09.html%3B750%3B1049

2 (internet)[2] https://www.google.se/search?q=northern-new-mexico-bandelier-ladder&biw=1366&bih=624&source=lnms&tbm=isch&sa=X&ei=bj12VPy7KcfRyg033lDYBg&ved=0CAYQ_AUoAQ#tbm=isch&q=west+africa+tribal+eye+gallery+ledders&facrc=_&imgdii=_&imgrc=RigYO4dCFmTONM%253A%3BmCKfNCmu3bvyAM%3Bhttp%253A%252F%252Fancientpoint.com%252Fimgs%252Fa%252Ff%252Fq%252Fv%252Fa%252Fafrican_tribal_dogon_ladder_______mali__west_africa___________tribal_eye_gallery_________1_thumb2_lgw.jpg%3Bhttp%253A%252F%252Fancientpoint.com%252Fcategory%252F235-antiques_ethnographic_african_other_%252Fpage_9.html%3B320%3B590

3 (internet)[3] https://www.google.se/search?q=northern-new-mexico-bandelier-ladder&biw=1366&bih=624&source=lnms&tbm=isch&sa=X&ei=bj12VPy7KcfRyg033lDYBg&ved=0CAYQ_AUoAQ#tbm=isch&q=Imperial+stair+at+Wurzburg+palace,+Germany&spell=1&facrc=_&imgdii=_&imgrc=WEISP7COrotVeM%253A%3BwWdu6cgkiOPuSM%3Bhttp%253A%252F%252Fwww.wga.hu%252Fart%252Ft%252Ftiepolo%252Fgianbatt%252F5wurzbur%252F2stair2.jpg%3Bhttp%253A%252F%252Fwww.skyscrapercity.com%252Fshowthread.php%253Ft%253D584411%2526page%253D203%3B900%3B1142

4 (internet)[4] https://www.google.se/search?q=northern-new-mexico-bandelier-ladder&biw=1366&bih=624&source=lnms&tbm=isch&sa=X&ei=bj12VPy7KcfRyg033lDYBg&ved=0CAYQ_AUoAQ#tbm=isch&q=Palace+of+the+Arches%2C+Brasilia%2C+by+Oscar+Niemeyer&facrc=_&imgdii=_&imgrc=cV9UcTzCDjMW3M%253A%3BFhmTpGDjst5WgM%3Bhttp%253A%252F%252Fmedia-cache-ak0.pinimg.com%252F236x%252F1c%252F4d%252Fbb%252F1c4dbb4e641ecfd5e20f36a726a14107.jpg%3Bhttp%253A%252F%252Fwww.pinterest.com%252Fandrebateira%252Foscar-niemeyer%252F%3B236%3B352

THEORY

"The worst thing that can happen to the stair is the wrong proportion"

(John Templer, 1992, „ Study of hazards, falls, and safer design." , Aalto 1975)

Similar to athletes who try to develop better running techniques, architects are trying to discover the ultimate formula for designing appropriate staircases.

In order to understand the correlation between riser and tread, we have to investigate human gait. We have to take in consideration different: body proportion, dominant leg, and choice of shoe ware.

When descending a staircase, we use the tip toe of the lead foot to find the tread. Then, the ball of the foot is slowly lowered to touch the tread, and then the heal. At the same time, the weight of the body in transferred to this foot, so that we can balance our body while the second foot realizes the same maneuver. When ascending a staircase, we also use the lead foot. The most serious accidents occurs when this intrinsic operation fails in any way (*John Templer, 1992*).

Studies of hazads, falls and safer design, (book)[5]

Studies of hazads, falls and safer design, (book)[6]

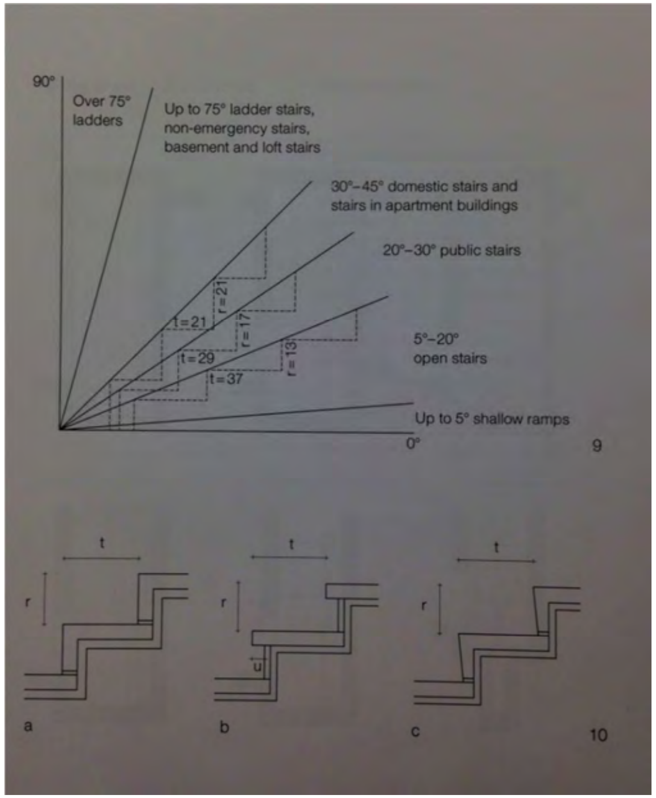
5 BOOK [5] John Templer, 1992, „ Study of hazards, falls, and safer design." Page 10

6 BOOK [6] John Templer, 1992, „ Study of hazards, falls, and safer design." Page 14

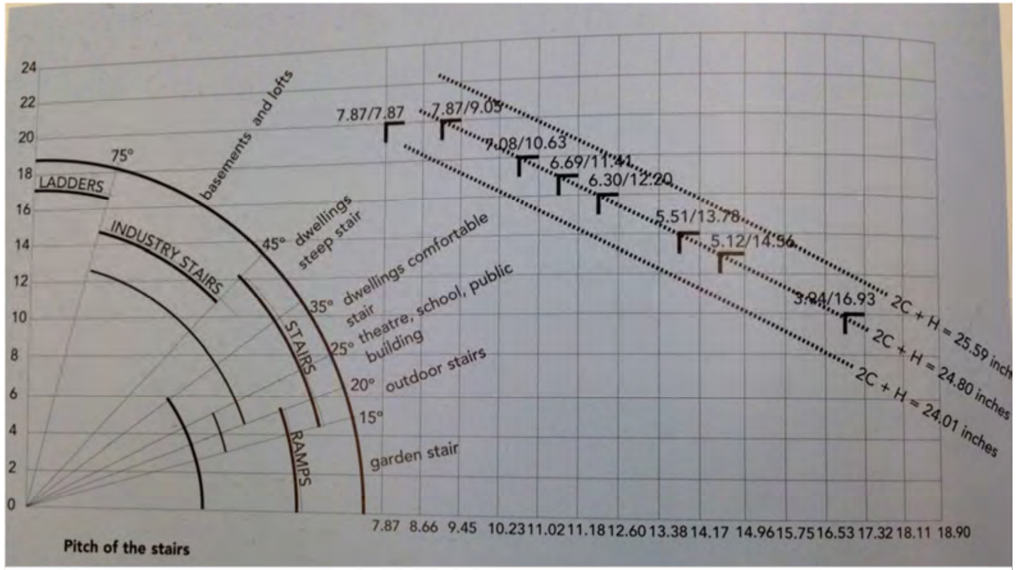
The ultimate proportion between riser and tread has caused several arguments over the centuries. The classical stair formula that we use nowadays on rise and run states that:

2rise+going= 600-650 mm

Riser heights that are more than 18.6cm and going that are less than 27.9-36.6 cm are not recommended. (*John Templer, 1992*).



Carles Broto "New staircases" (book)[7]

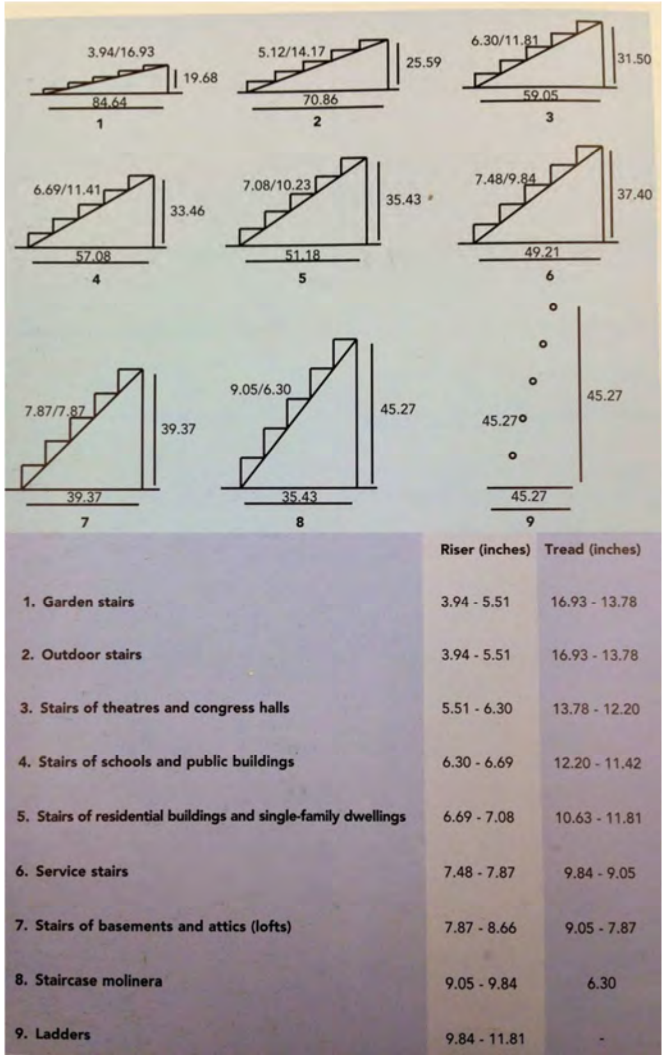


Carles Broto "New staircases" (book)[8]

This diagram shows the most convenient angle for stairs depending on stair function. Also illustrates variety of overhang steps. Depending on stair function it also can differ.

7 BOOK Carles Broto, 2011, "New staircases"

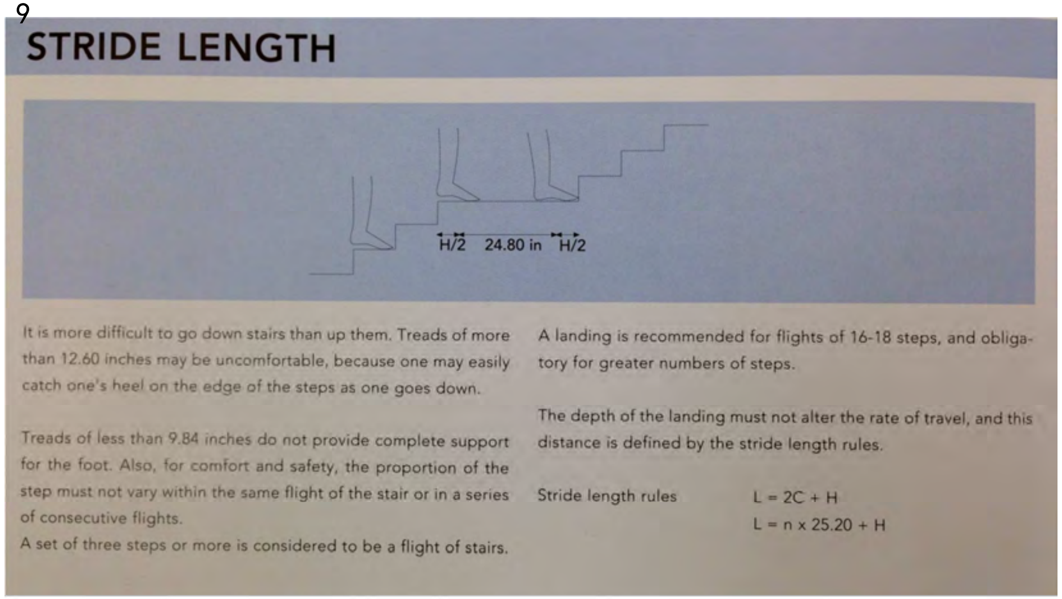
8 BOOK Carles Broto, 2011, "New staircases"



	Riser (inches)	Tread (inches)
1. Garden stairs	3.94 - 5.51	16.93 - 13.78
2. Outdoor stairs	3.94 - 5.51	16.93 - 13.78
3. Stairs of theatres and congress halls	5.51 - 6.30	13.78 - 12.20
4. Stairs of schools and public buildings	6.30 - 6.69	12.20 - 11.42
5. Stairs of residential buildings and single-family dwellings	6.69 - 7.08	10.63 - 11.81
6. Service stairs	7.48 - 7.87	9.84 - 9.05
7. Stairs of basements and attics (lofts)	7.87 - 8.66	9.05 - 7.87
8. Staircase molinera	9.05 - 9.84	6.30
9. Ladders	9.84 - 11.81	-

Carles Broto "New staircases" (book)[9]

9



STRIDE LENGTH

It is more difficult to go down stairs than up them. Treads of more than 12.60 inches may be uncomfortable, because one may easily catch one's heel on the edge of the steps as one goes down.

Treads of less than 9.84 inches do not provide complete support for the foot. Also, for comfort and safety, the proportion of the step must not vary within the same flight of the stair or in a series of consecutive flights.

A set of three steps or more is considered to be a flight of stairs.

A landing is recommended for flights of 16-18 steps, and obligatory for greater numbers of steps.

The depth of the landing must not alter the rate of travel, and this distance is defined by the stride length rules.

Stride length rules $L = 2C + H$

$L = n \times 25.20 + H$

Carles Broto "New staircases" (book)[10]

Health-related research states that climbing staircases is very healthy especially for people who suffer from heart conditions, cardio-vascular diseases or lung conditions. (Cardiovascular disease) Climbing at least 20 steps per week can lower 20% risk of stroke. Prevents muscle-mass loss and It also applies for people who want to lose some weight. It' s easier to claim downstairs then upstairs since we use different muscles and also have to consider gravity, therefore claiming downstairs are not considered as efficient then claiming upstairs.

9 BOOK Carles Broto, 2011, "New staircases"

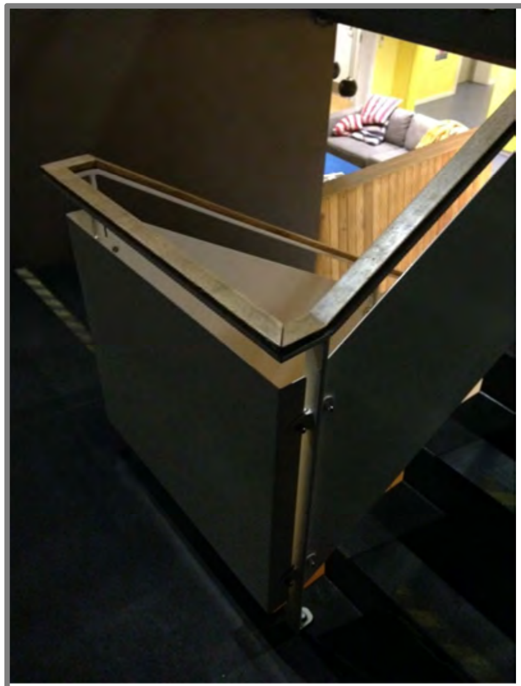
10 BOOK Carles Broto, 2011, "New staircases"

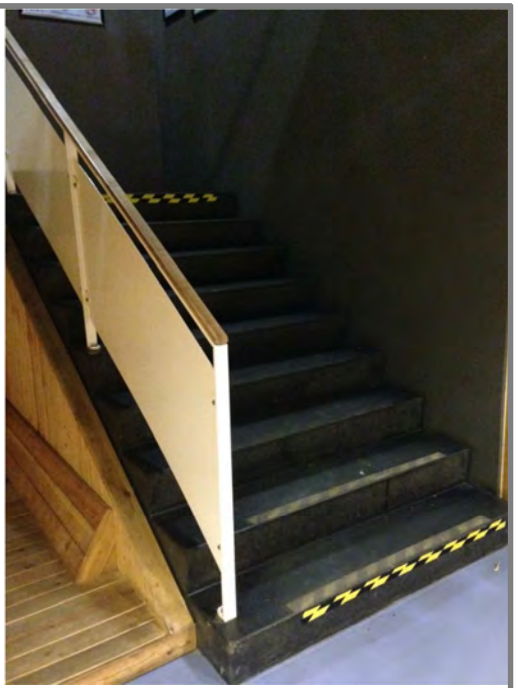
REASERCH

This formula : 2rise+going= 600-650 mm has been used in all three countries.(Sweden, Denmark, Latvia) In this report I analyze how often we follow strict rules and actually use this formula while designing the stairs?

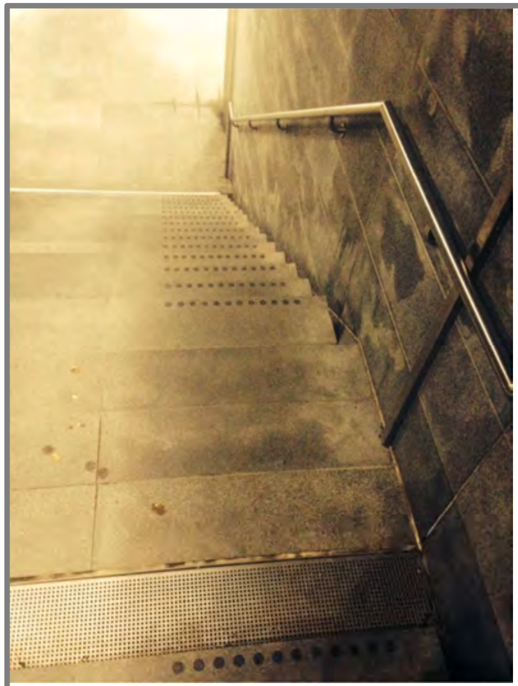
Analyzing staircase formula in three different countries, whereas analyzing three different people's daily life routine. Starting from the point when we leave the house, heading public transport till the point we enter the university or in my friend's and sisters case their office. I also included some areas of public space (Copenhagen and Stockholm) to see the difference and compare public and domestic buildings.

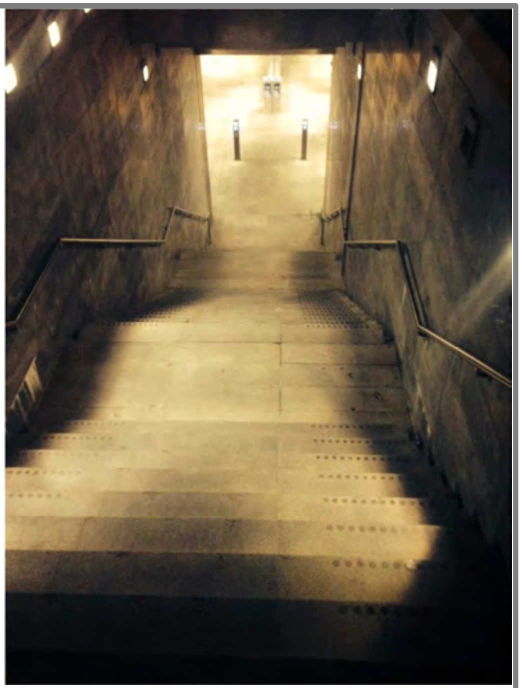
Staircases in **Copenhagen**


Kulturhuset Islands Brygge, CPH, (Broka, 2014)[11]


Kulturhuset Islands Brygge, CPH, (Broka, 2014)[12]

STAIR WIDH	**1480 MM**
RISER	**170 MM**
TREAD	**290 MM**


Metro station Islands Brygge, CPH, (Broka, 2014)[13]


Metro station Islands Brygge, CPH, (Broka, 2014)[14]

STAIR WIDH	**2800 MM**
RISER	**160 MM**
TREAD	**280 MM**

Staircases in **Copenhagen**

Residental building Islands Brygge, CPH, (Broka, 2014)[15]

Residental building Islands Brygge, CPH, (Broka, 2014)[16]

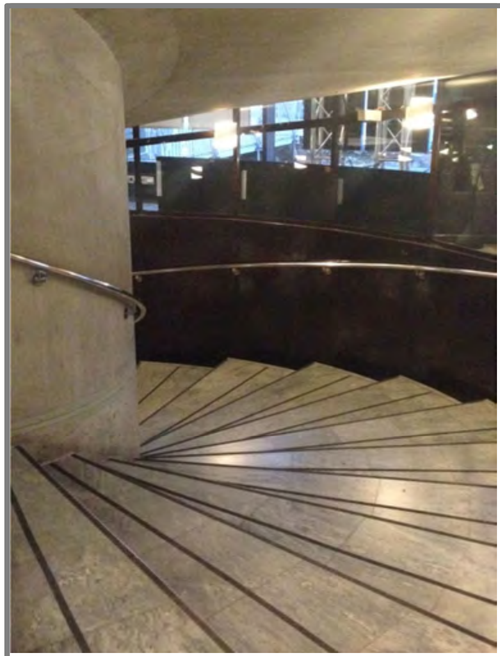
STAIR WIDH	**1000 MM**
RISER	**170 MM**
TREAD	**270 MM**

Office building, Frederiksberg Alle 15, CPH, (Broka, 2014)[17]

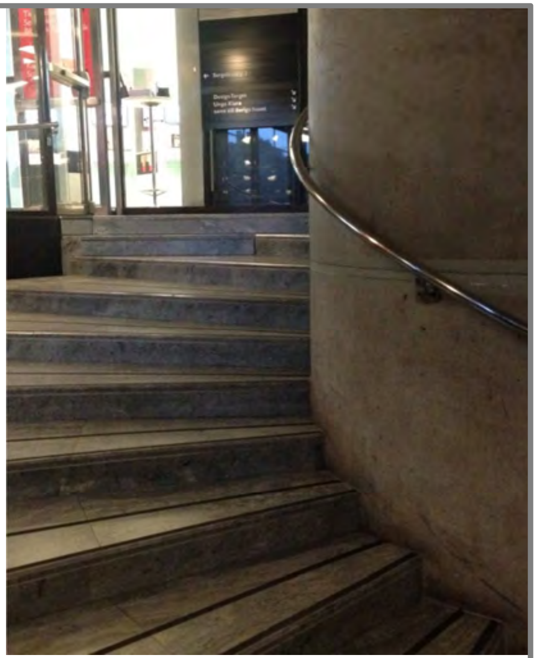
Office building, Frederiksberg Alle 15, CPH, (Broka, 2014)[18]

STAIR WIDH	**1890 MM**
RISER	**175 MM**
TREAD	**280 MM**

Staircases in **Stockholm**



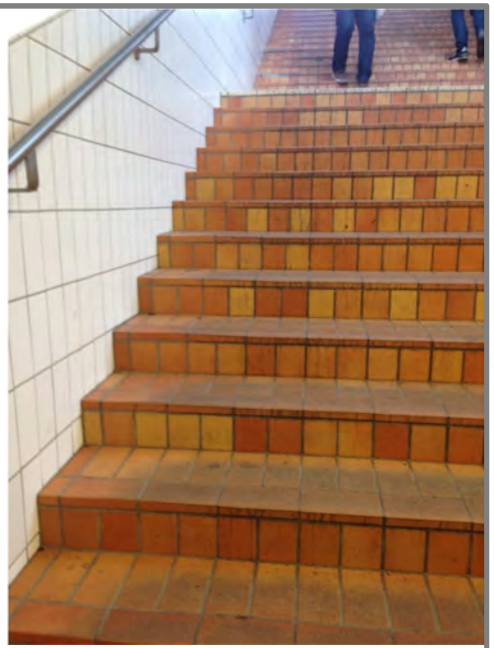
Kulturhuset Stockholm T-centrale, (Dindone, 2014)[19]



Kulturhuset Stockholm T-centrale, (Dindone, 2014)[20]

STAIR WIDH	**2300 MM**
RISER	**150 MM**
TREAD	**220-1000 MM**

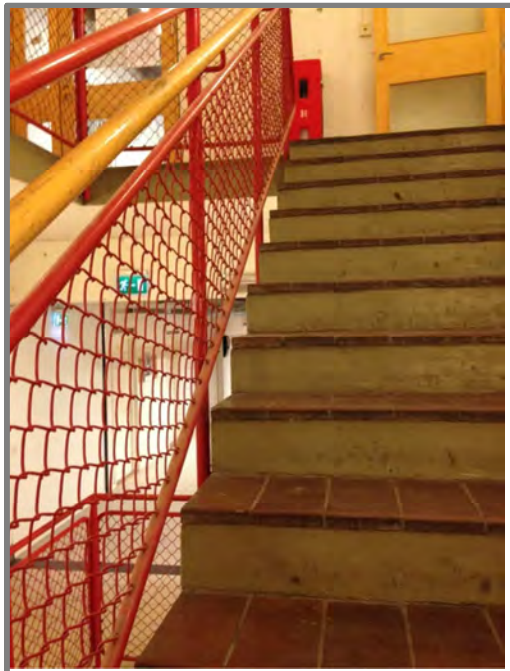
Metro station Stockholm Östra, (Dindone, 2014)[21]



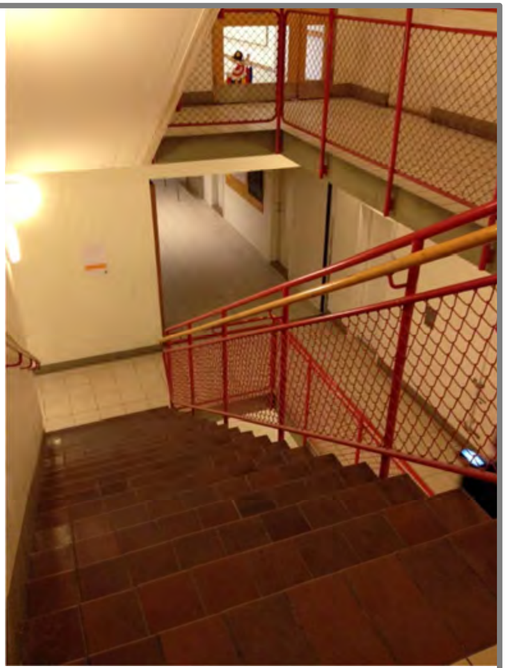
Metro station Stockholm Östra ostra, (Dindone, 2014)[22]

STAIR WIDH	**2800 MM**
RISER	**145 MM**
TREAD	**300 MM**

Staircases in **Stockholm**

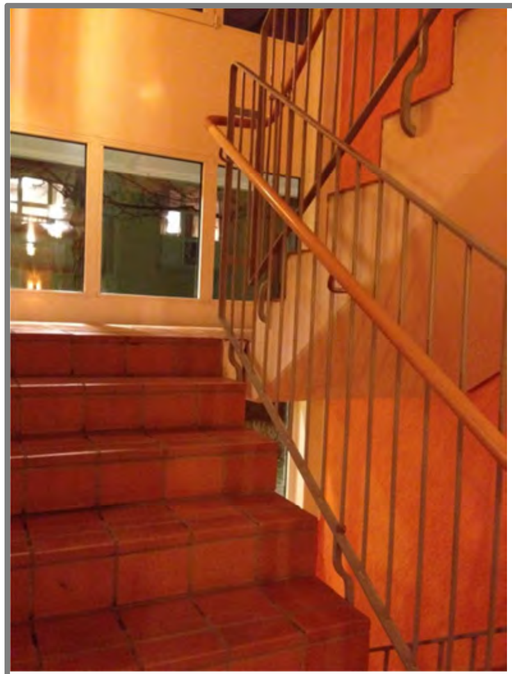


KTH architecture, Stochkolm, (Dindone, 2014)[23]

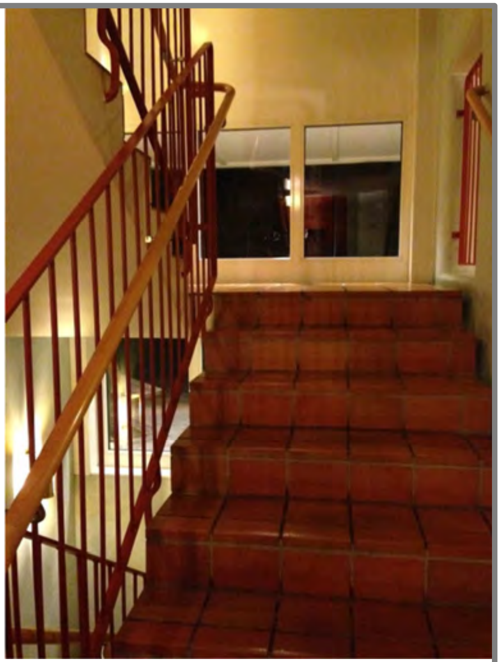


KTH architecture, Stochkolm, (Dindone, 2014)[24]

STAIR WIDH	**1000 MM**
RISER	**170 MM**
TREAD	**270 MM**



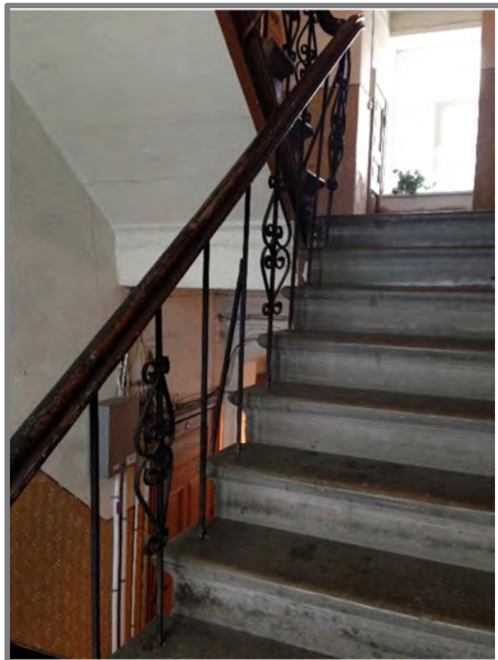
Residental building Djursholms center, Stockholm, (Dindone, 2014)[25]



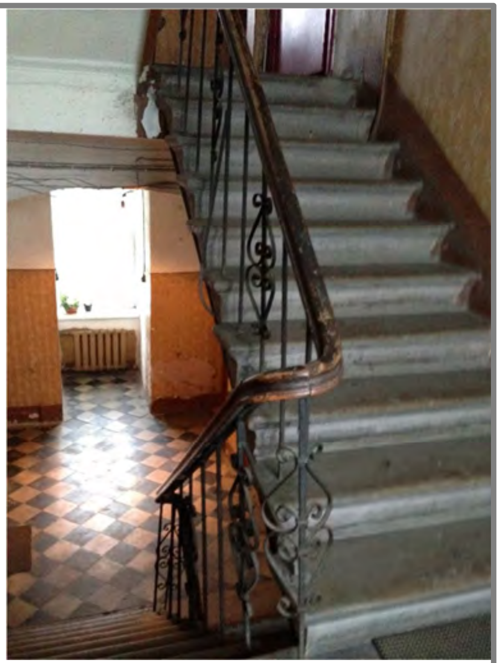
Residental building Djursholms center, Stockholm, (Dindone, 2014)[24]

STAIR WIDH	**1400 MM**
RISER	**170 MM**
TREAD	**280 MM**

Staircases in **Riga**



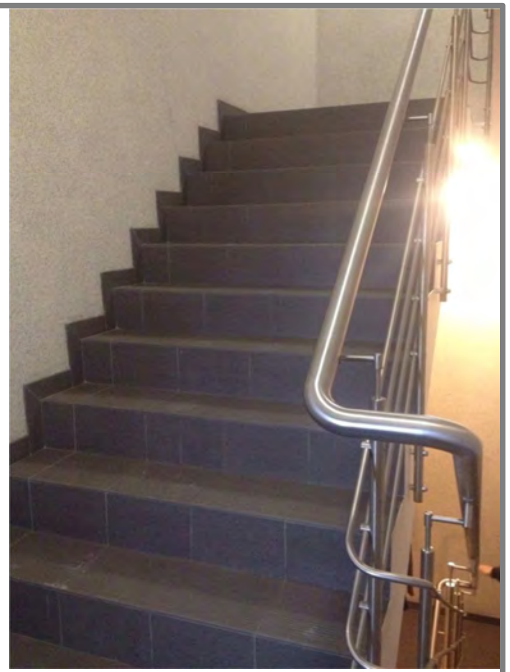
Dzirnavu iela 115, Riga, (Dindone, 2014)[27]



Dzirnavu iela 115, Riga, (Dindone, 2014)[28]

STAIR WIDH	**1180 MM**
RISER	**180 MM**
TREAD	**280 MM**

Lielirbes iela 17, Riga (Dindone, 2014)[29]



Lielirbes iela 17, Riga (Dindone, 2014)[30]

STAIR WIDH	**1200 MM**
RISER	**190 MM**
TREAD	**260 MM**

CONCLUSION

In this study, no major differences in the design of staircases could not be detected in the three Nordic capitals. In all countries, the riser height and the tread width were consistent with the classical stair formula. Given the fact, the undertaken research included architecture from various time periods, no difference could be detected that would suggest that the stair formula is being abandoned by contemporary architects. In fact, the different numbers for riser and tread in Denmark, Sweden and Latvia are almost identical.

At my sisters office (Lielirbes iela 17, Riga) staircase riser is higher and thread a bit narrow than normally assumed, however it does not change the overall calculation of the formula in this study.

Based on this random study of stairs in three capitals, we can conclude that the classical stair formula 2xriser+tread=600-650 mm will persist living.

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(internet) 2 https://www.google.se/search?q=northern-new-mexico-bandelier-ladder&biw=1366&bih=624&source=lnms&tbm=isch&sa=X&ei=bj12VPy7KcfRyg033lDYBg&ved=0CAYQ_AUoAQ#tbm=isch&q=west+africa+tribal+eye+gallery+ledders&facrc=_&imgdii=_&imgrc=RigYO4dCFmTONM%253A%3BmCKfNCmu3bvyAM%3Bhttp%253A%252F%252Fancientpoint.com%252Fimgs%252Fa%252Ff%252Fq%252Fv%252Fa%252Fafrican_tribal_dogon_ladder_______mali__west_africa___________tribal_eye_gallery_________1_thumb2_lgw.jpg%3Bhttp%253A%252F%252Fancientpoint.com%252Fcategory%252F235-antiques_ethnographic_african_other_%252Fpage_9.html%3B320%3B590

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Book 5 Book, John Templer, 1992, „Study of hazards, falls, and safer design.” page 10

Book 6 Book John Templer, 1992, „Study of hazards, falls, and safer design.” page 1**Error! Bookmark not defined.**

Book 7 Book Carles Broto , 2011," New staircases" Carles Broto

Book 8 Book Carles Broto , 2011," New staircases" Carles Broto

Book 9 Book Carles Broto , 2011," New staircases" Carles Broto

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