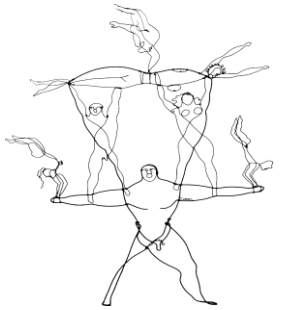
Light up!
Pro Holz Student Trophy

Abteilung Tragwerkslehre

Univ.Prof. Dipl.-Ing. Peter BAUER
Associate Prof. Dipl.-Ing. Dr.techn. Alireza FADAI; Univ.Ass. Dr.techn. Felipe RIOLA PARADA

pro:Holz
STUDENT Trophy



TU WIEN
ITI - Department of
Structural Design and
Timber Engineering

Pilgrims in Vatican

Oilplatform in storm

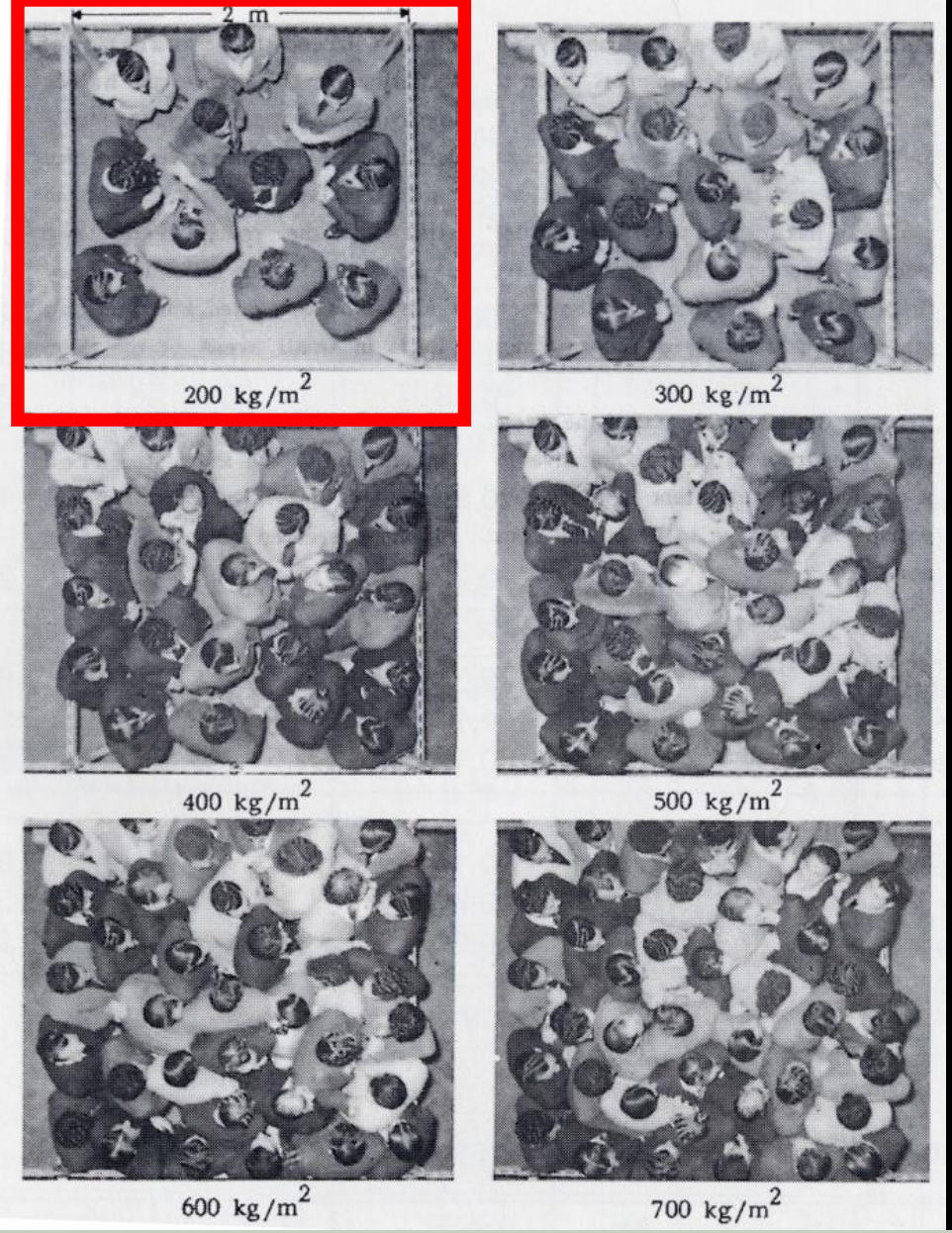
Train accident in Montparnasse 1895

Snowstorm in the Alps

pro:Holz
STUDENT Trophy

Action forces

Light up!
Vertical extensions with wood



Picture taken from: Der Ingenieurbau, Tragwerkszuverlässigkeit , Einwirkungen

Wind

$\rho_{Air} \sim 1.20$ kg/m3
at 20°C on sea-level

The acting wind-force depends therefore on the velocity of the air(molecules) in the moment they hit a body (negative acceleration). It also depends on the form of the body.

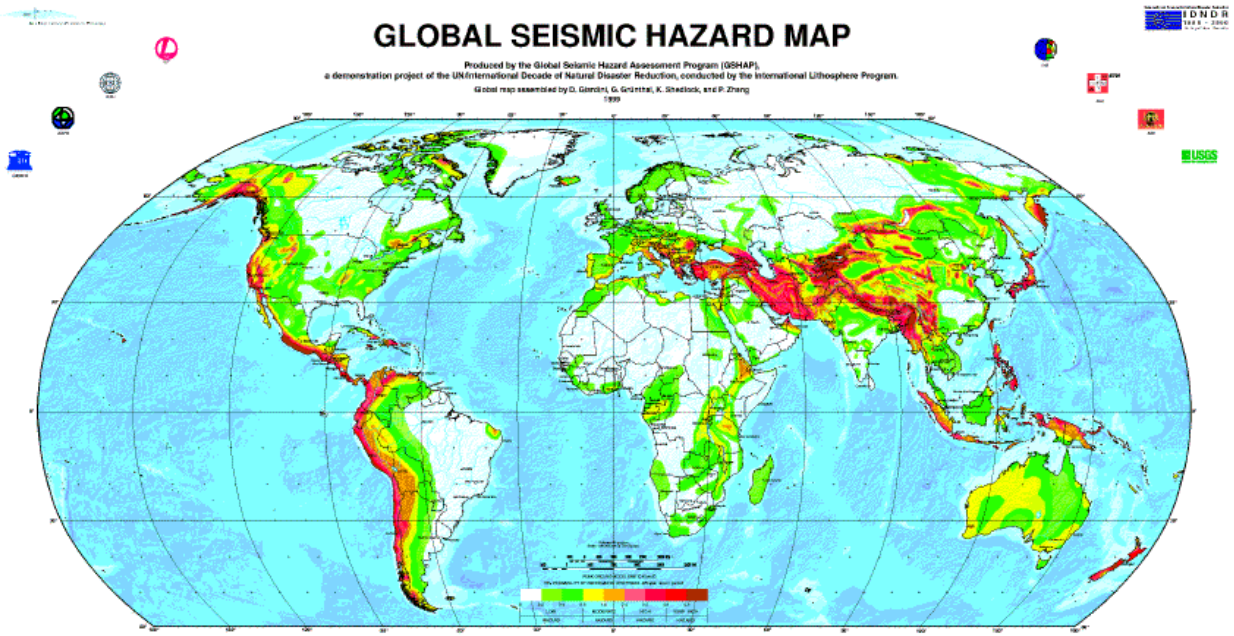
Wind load

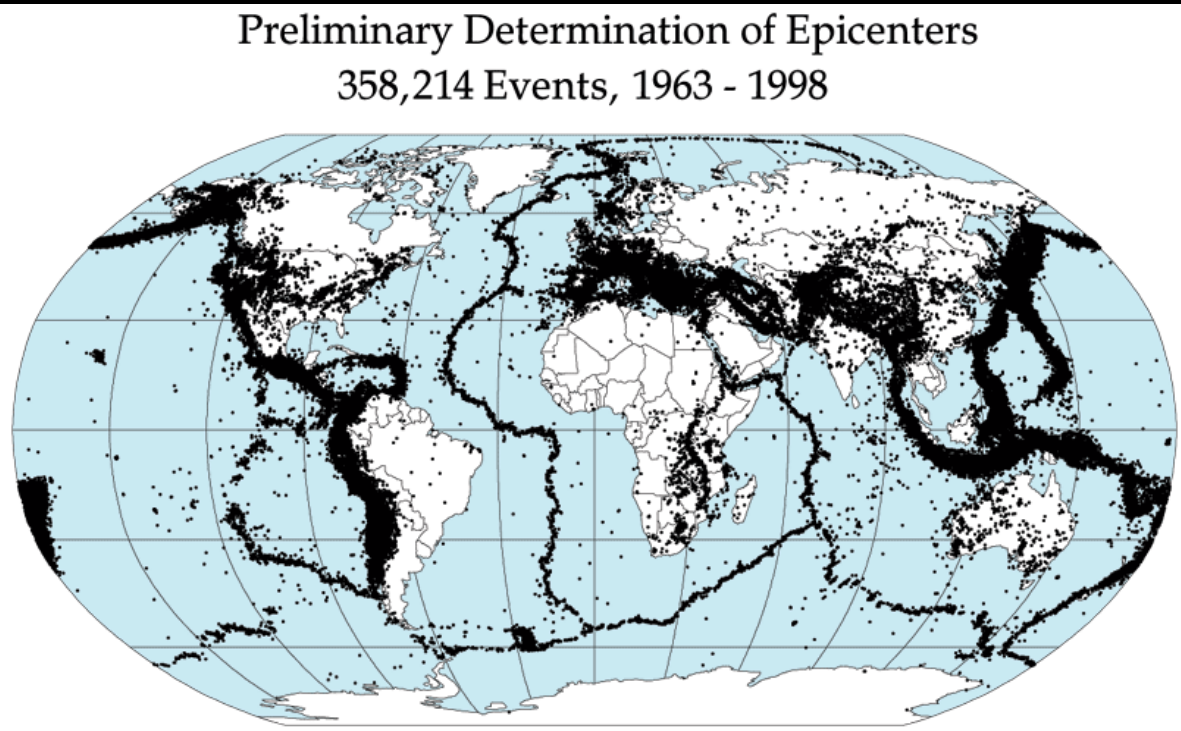
$w_{Vienna} \sim 0.70 \ldots 1.0$ kN/m2

Snow load

$s \sim \mu s_K$

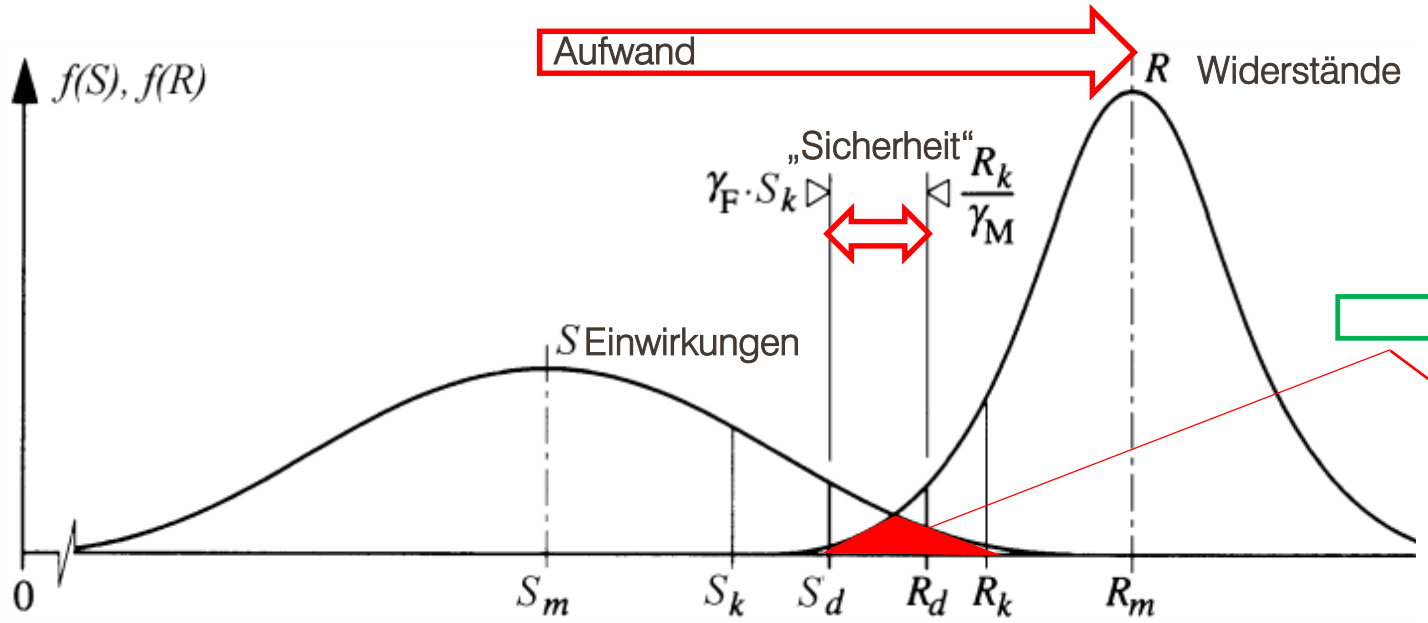
$s_{Vienna} \sim 1.0$ kN/m2

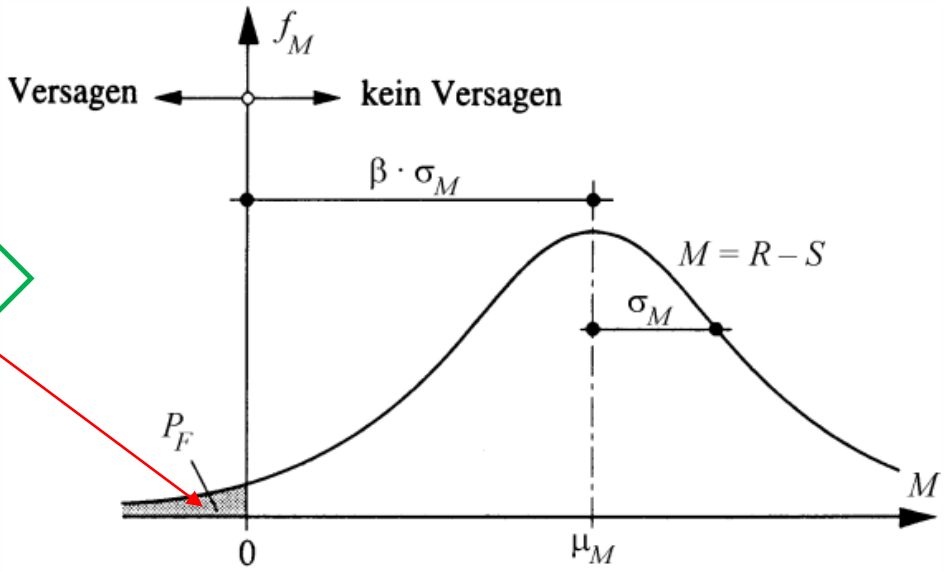


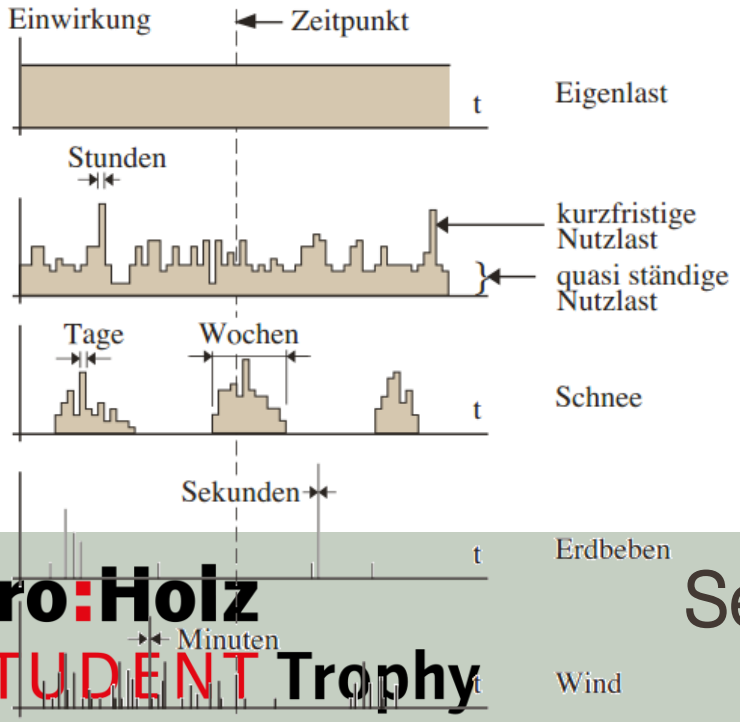


Peak ground acceleration

$a_{gr,Vienna}$ = 0.8 m/sec2 x 1.2 = 0.96 m/sec2 (for soil class B)







$$P_f = P(R \leq S) = P(R - S \leq 0) = \int_{-\infty}^{\infty} F_R(x) f_s(x) dx$$

Semi-probabilistic safety concept

pro:Holz STUDENT Trophy

Light up! Vertical extensions with wood

Table B1 - Definition of consequences classes

Consequences Class	Description	Examples of buildings and civil engineering works
CC3	**High** consequence for loss of human life, *or* economic, social or environmental consequences **very great**	Grandstands, public buildings where consequences of failure are high (e.g. a concert hall)
CC2	**Medium** consequence for loss of human life, economic, social or environmental consequences **considerable**	Residential and office buildings, public buildings where consequences of failure are medium (e.g. an office building)
CC1	**Low** consequence for loss of human life, *and* economic, social or environmental consequences **small or negligible**	Agricultural buildings where people do not normally enter (e.g. storage buildings), greenhouses

Mittlere Todesfallwahrscheinlichkeit pro Jahr und pro 100'000 Personen	
Altersabhängige Sterblichkeit	
110	25 jähriger Mensch
100	35 jähriger Mensch
300	45 jähriger Mensch
800	55 jähriger Mensch
2'000	65 jähriger Mensch
5'000	75 jähriger Mensch
Zusätzliche arbeitsbedingte Sterblichkeit	
100	Holzfällerarbeit
90	Forstarbeit
50	Bauarbeiter
15	Chemische Industrie
10	Maschinenindustrie
5	Büroarbeit
Zusätzliche Sterblichkeit aus Lebensstil	
400	Rauchen, 20 Zig./Tag
300	Trinken, 1 Flasche/Tag
150	Motorradfahren
20	Autofahren (20-24 jährig)
10	Fussgänger
10	Haushalt
10	Autofahren 10,000 km/Jahr
5	Bergwandern
3	Autobahn 10,000 km/Jahr
1	Flugzeugunglück (pro Flug)
1	Zugfahren 10,000 km/Jahr
0,5	Brand in Gebäude
0,1	Blitzschlag

CC1- $1*10^{-5}$

CC2- $1*10^{-6}$

CC3- $1*10^{-7}$

Tabelle 2: Beispiele von Todesfallwahrscheinlichkeiten (Schneider, 1996)

Earth quake and individual risk

Required reliability:

Assumed:
50 Person-equivalents in existing building
15 Person-equivalents in extension

$P_{f,extension}$ =
(50* 10^{-5} +15* 10^{-6})/(50+15)= $7.92*10^{-6}$

Leads to: α_{soll}= 0.30

Required factor of horizontal improvement

v~ 0.30/0.25= 1.20

Note: 2.35 Persons/flat

aus der SIA entnommen:

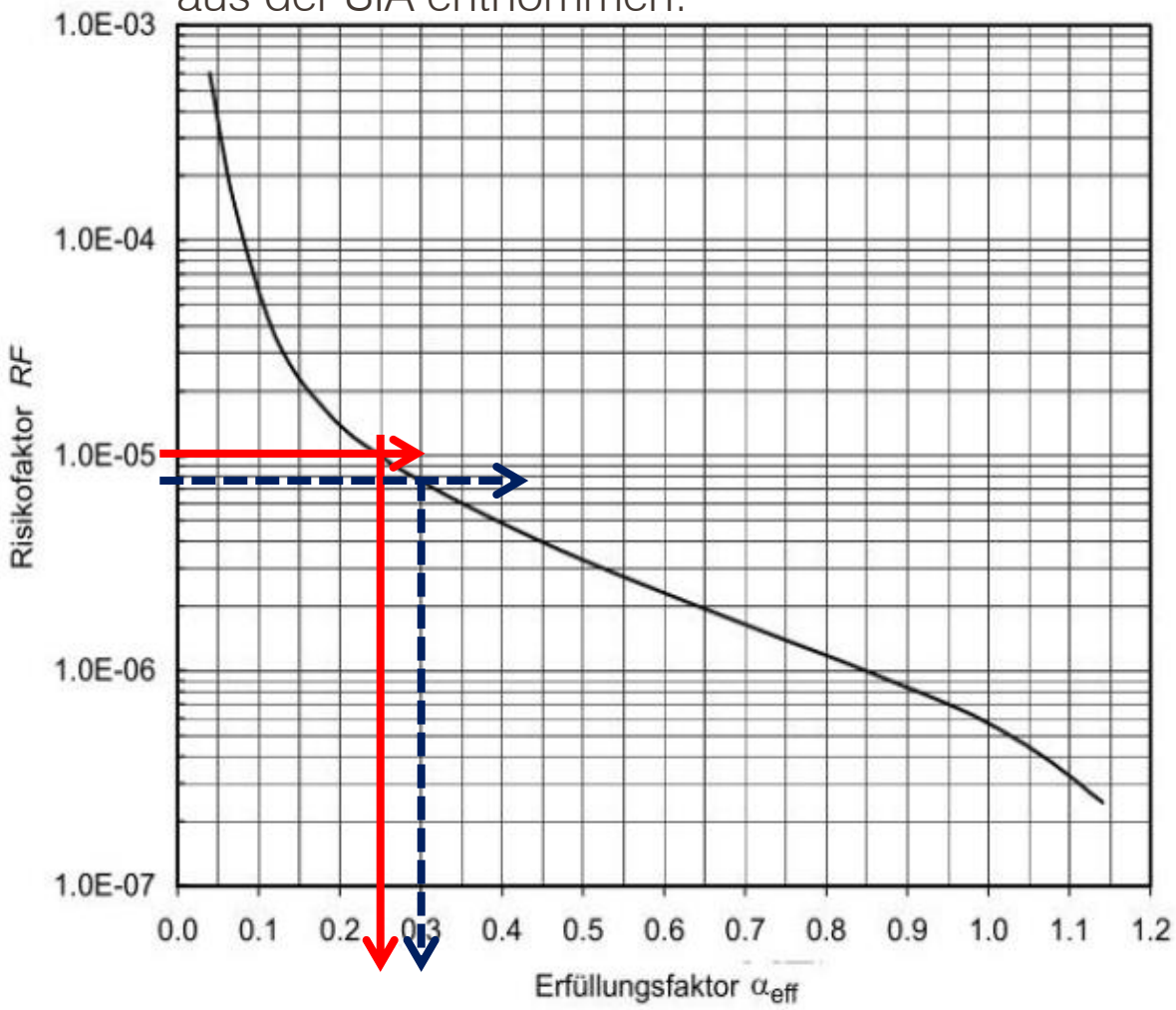
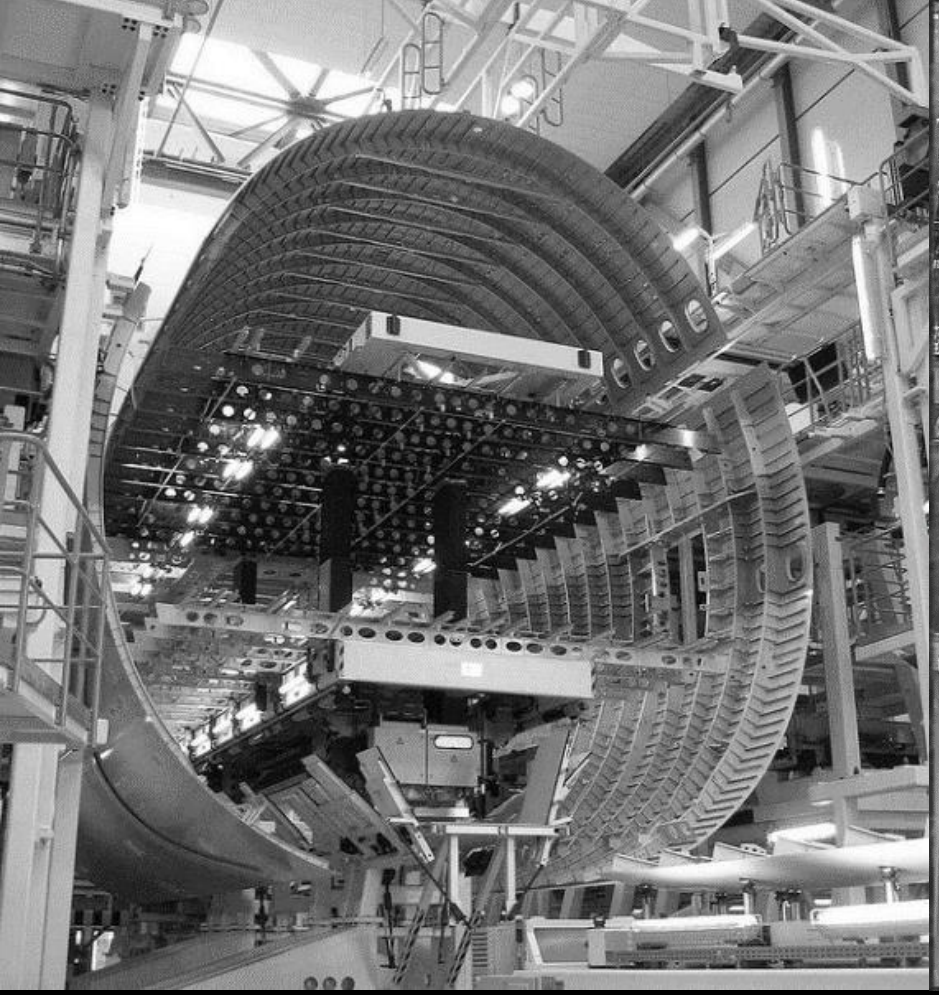


Abb. 5: Risikofaktor-Erfüllungsfaktor-Beziehung

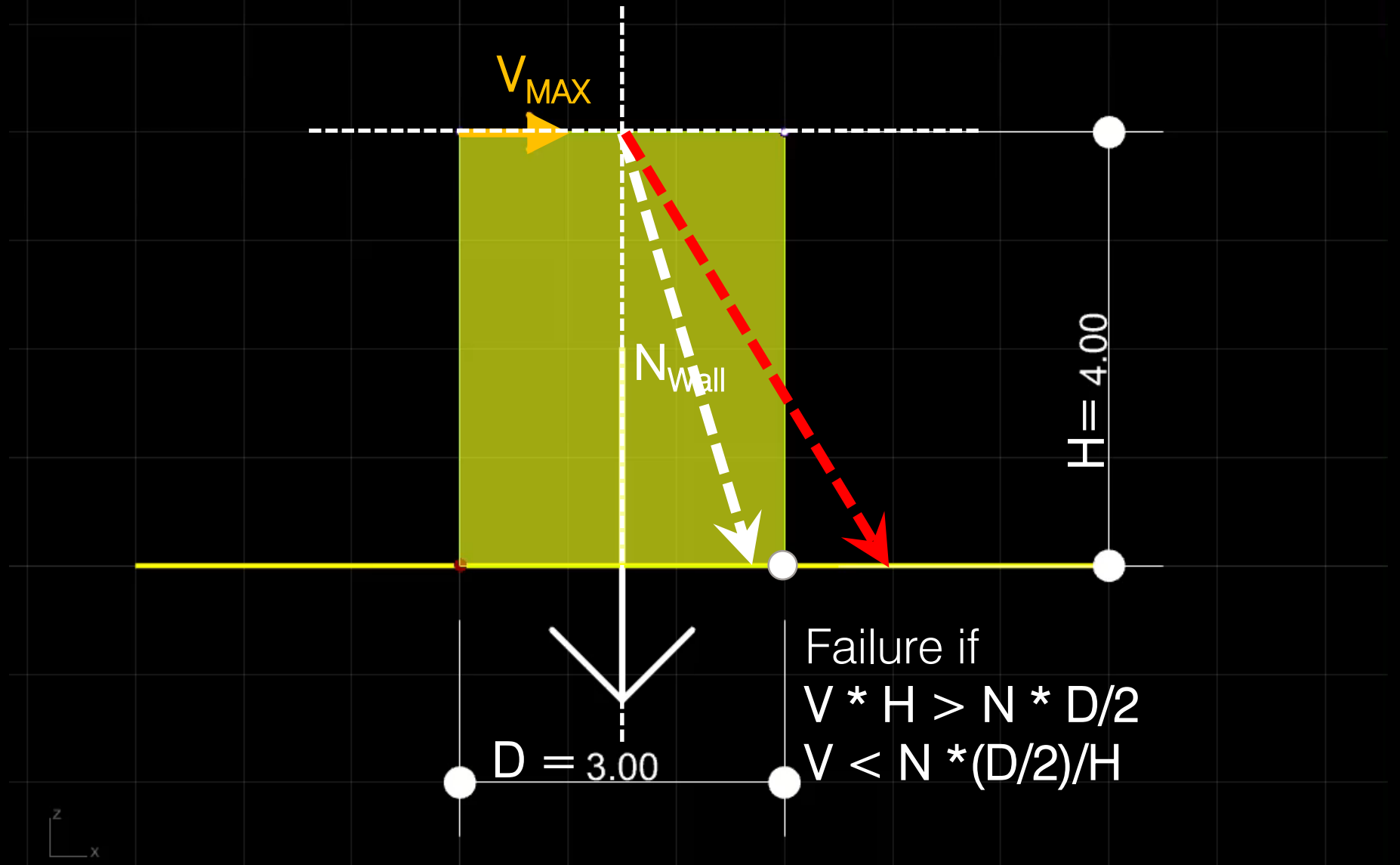


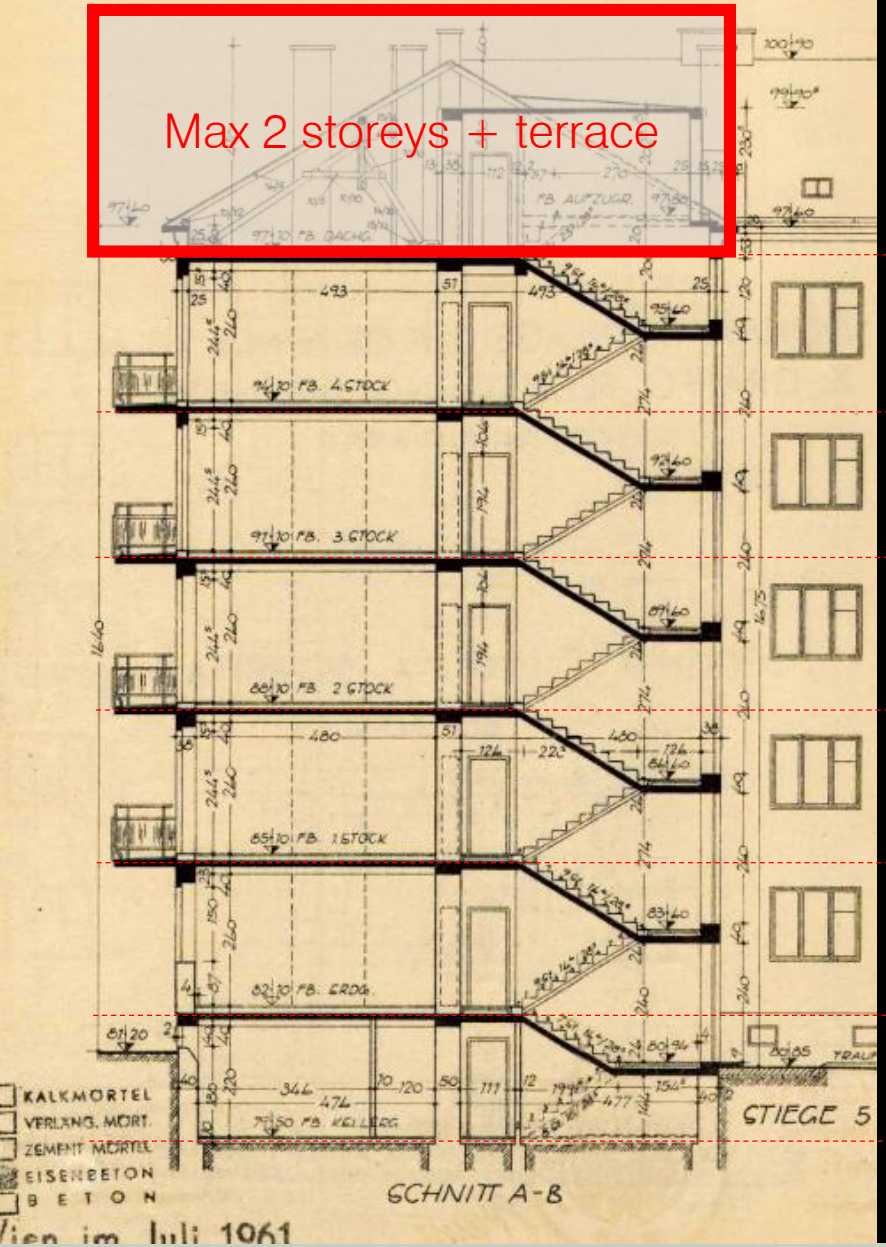
Balance individual and public risk

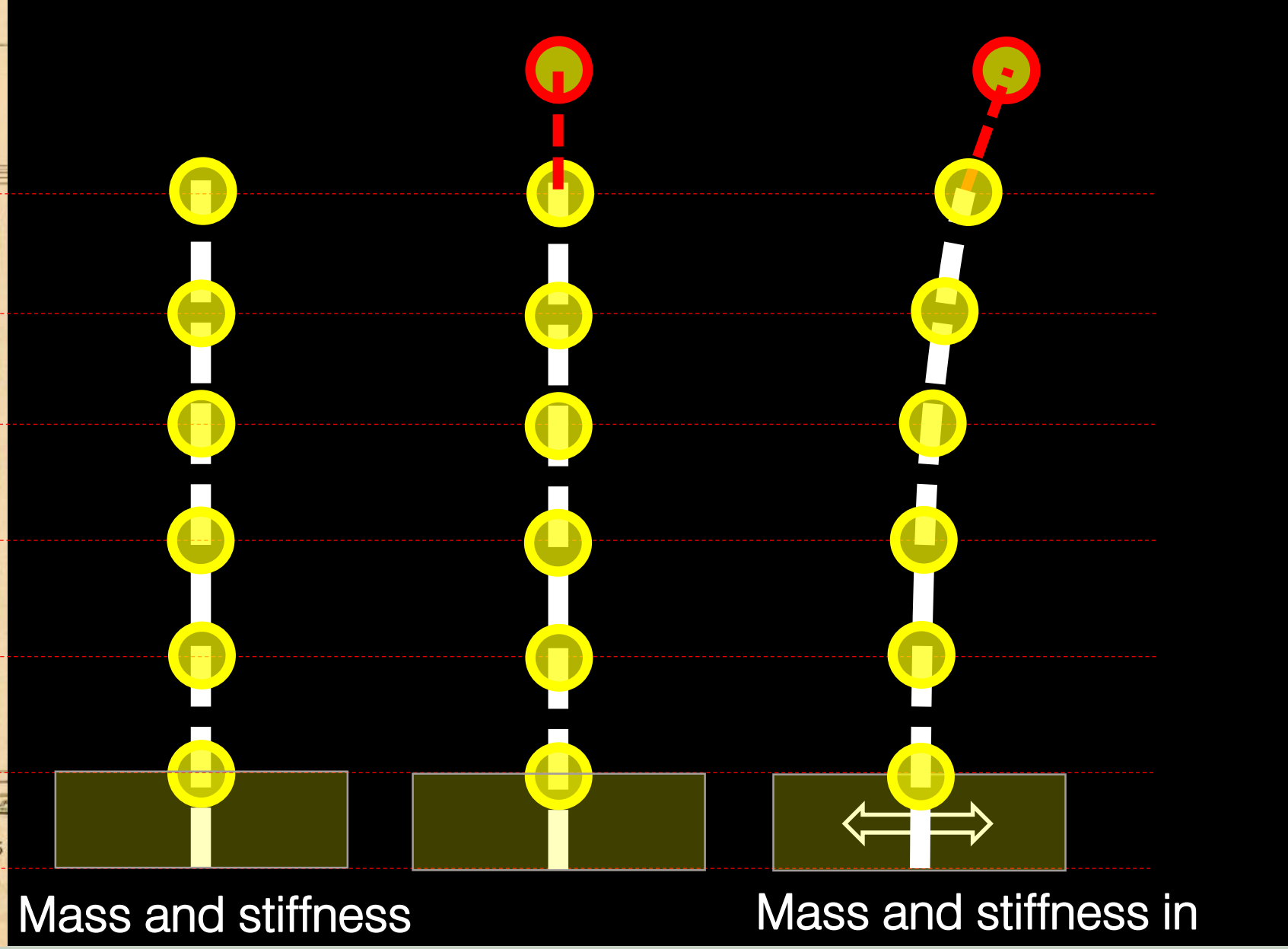
Retrofitting of existing buildings in case of increasing number of individuals

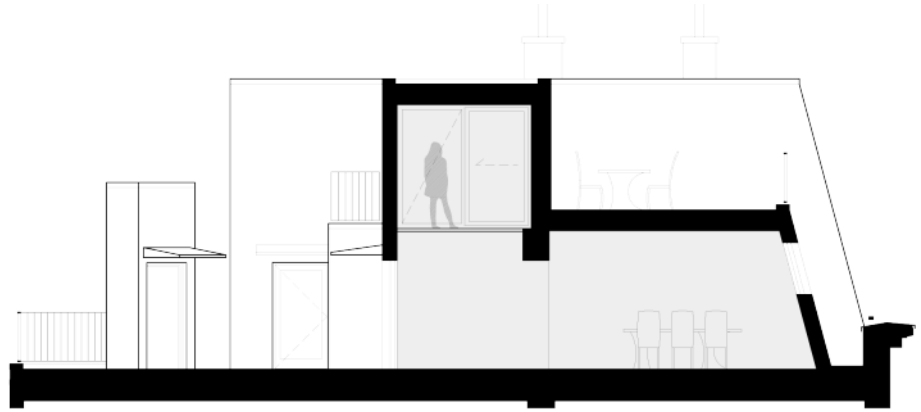
No restrictions in case of adding supplements like balconies, terraces,…

11

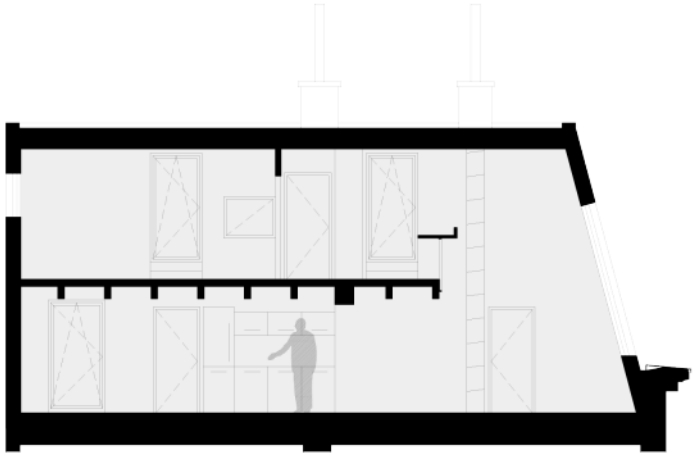

V_{MAX}
N_{Wall}
H = 4.00
D = 3.00
Failure if
V * H > N * D/2
V < N *(D/2)/H


Max 2 storeys + terrace
KALKMORTEL
VERLANG. MÖRT.
ZEMENT MÖRTEL
EISENBETON
B E T O N
STIEGE 5
SCHNITT A-B


Mass and stiffness
Mass and stiffness in motion

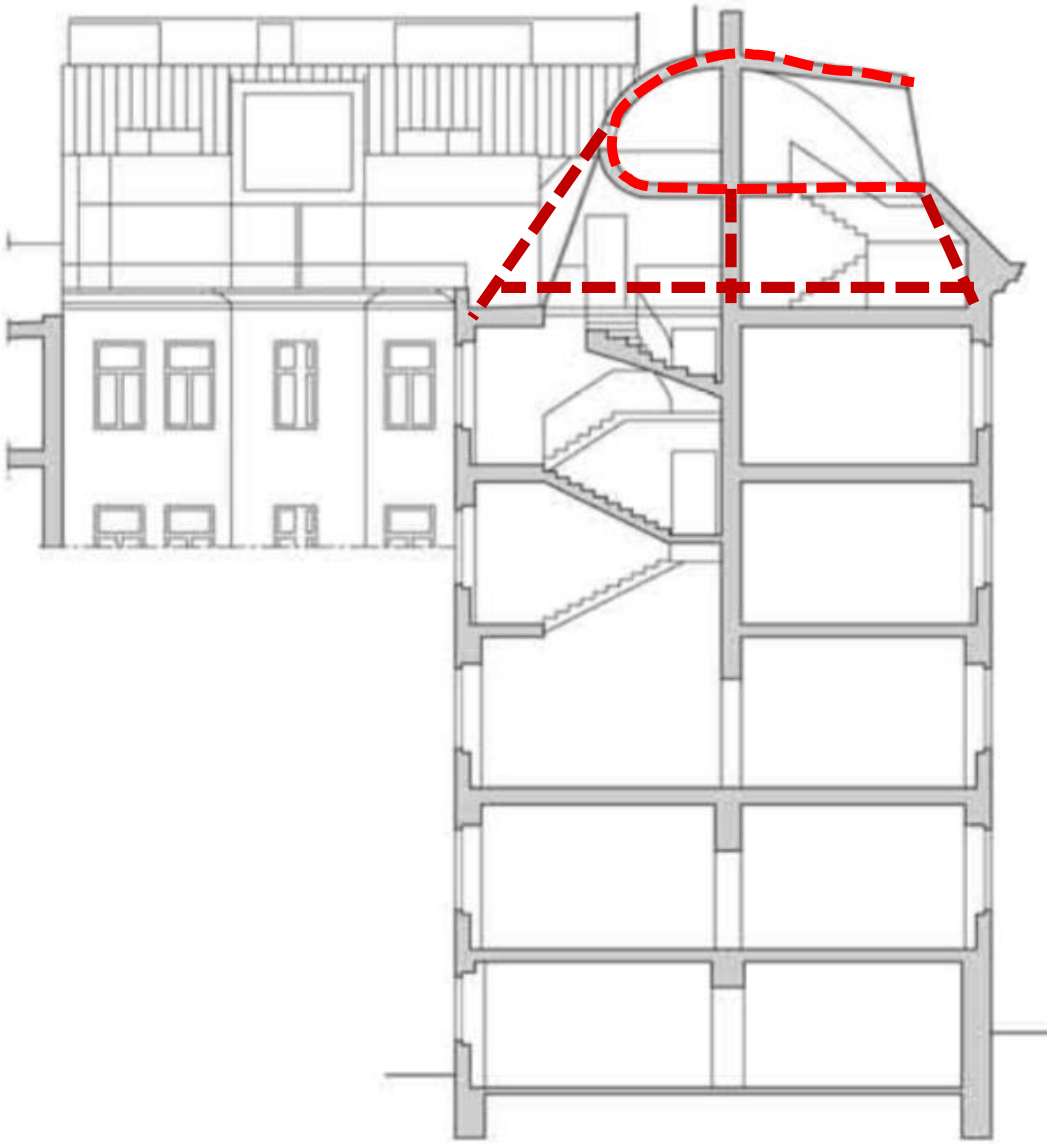


SCHNITT EE – 1:100



GRUNDRISS 1.DACHGESCHOSS – 1:200

SMEG

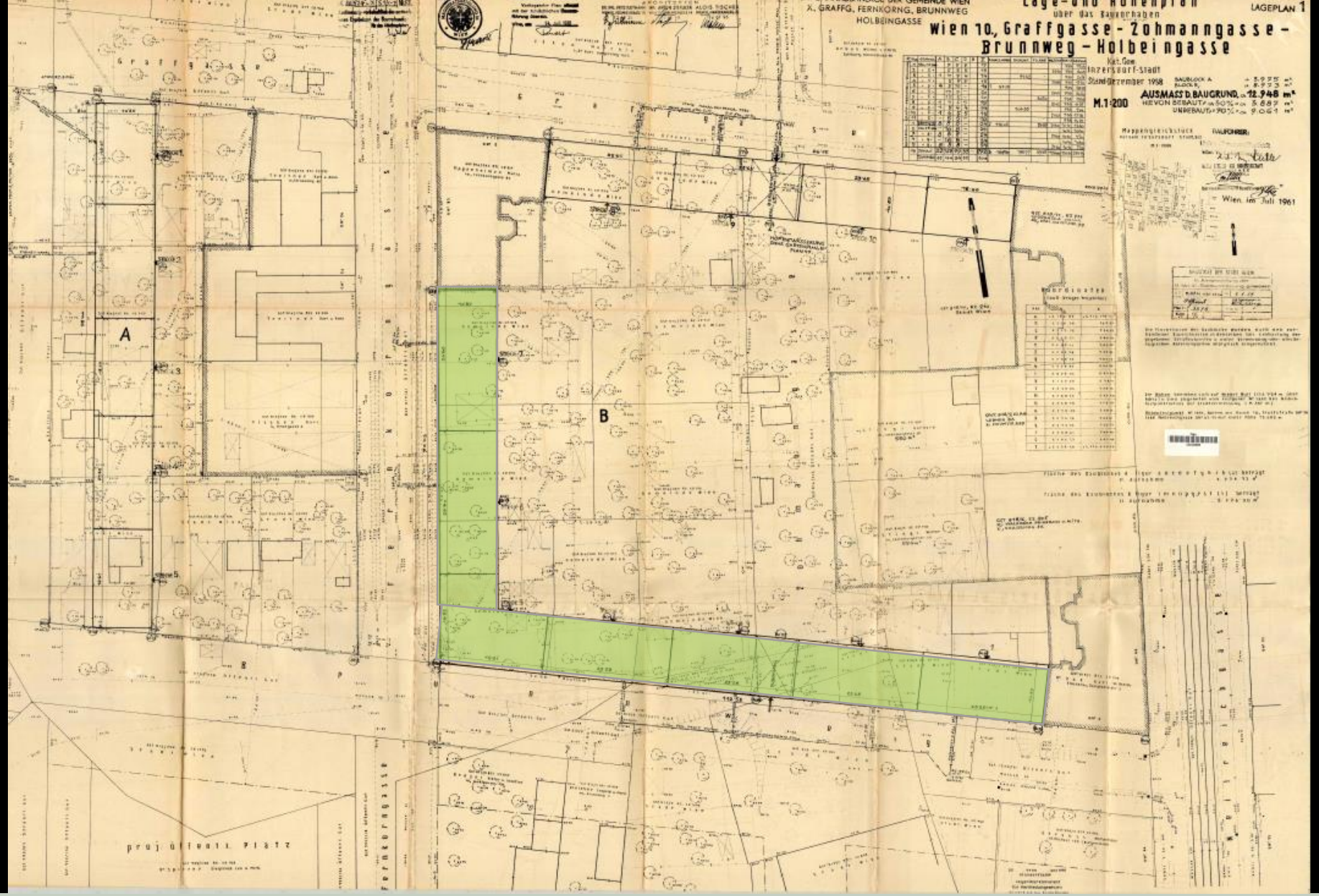


RaU Architekten– Penthouse WEG

pro:Holz
STUDENT Trophy

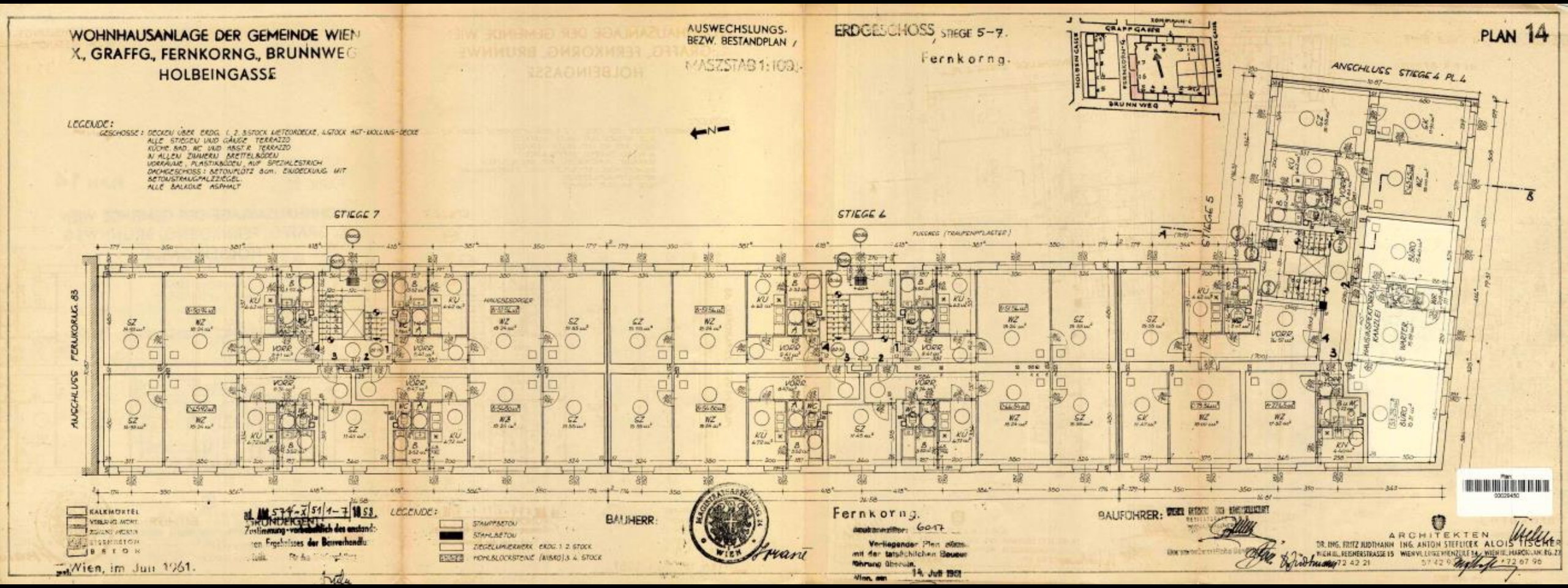
RaU Architekten– Penthouse WEG

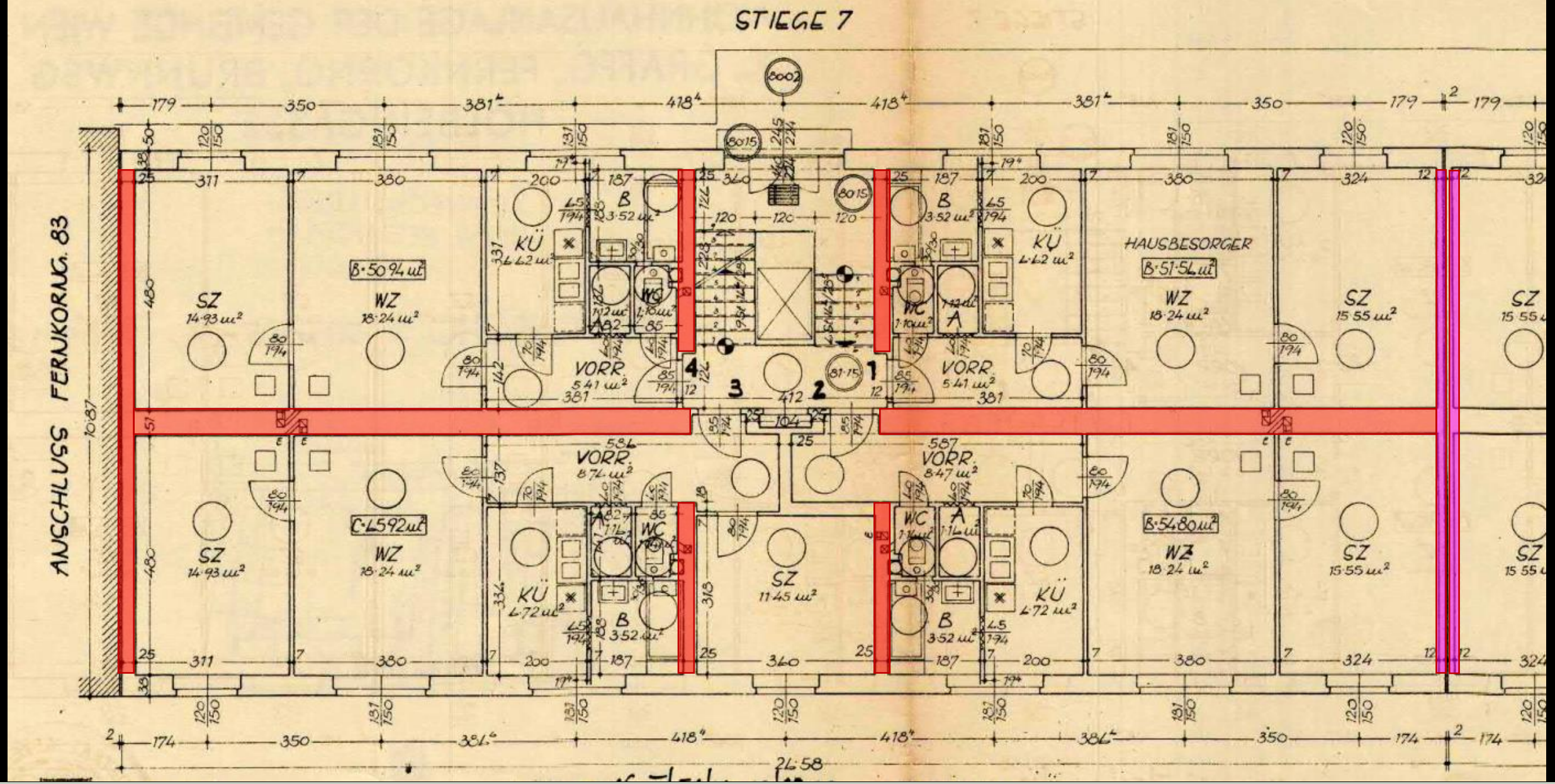
Light up!
Vertical extensions with wood


Wien 10., Graffgasse - Zohmanngasse - Brunnweg - Holbeingasse
LAGEPLAN 1
M.1:200
A
B

2D

Search Google Maps
See travel times, traffic and nearby places
Map
Transit
Click on stations for more information

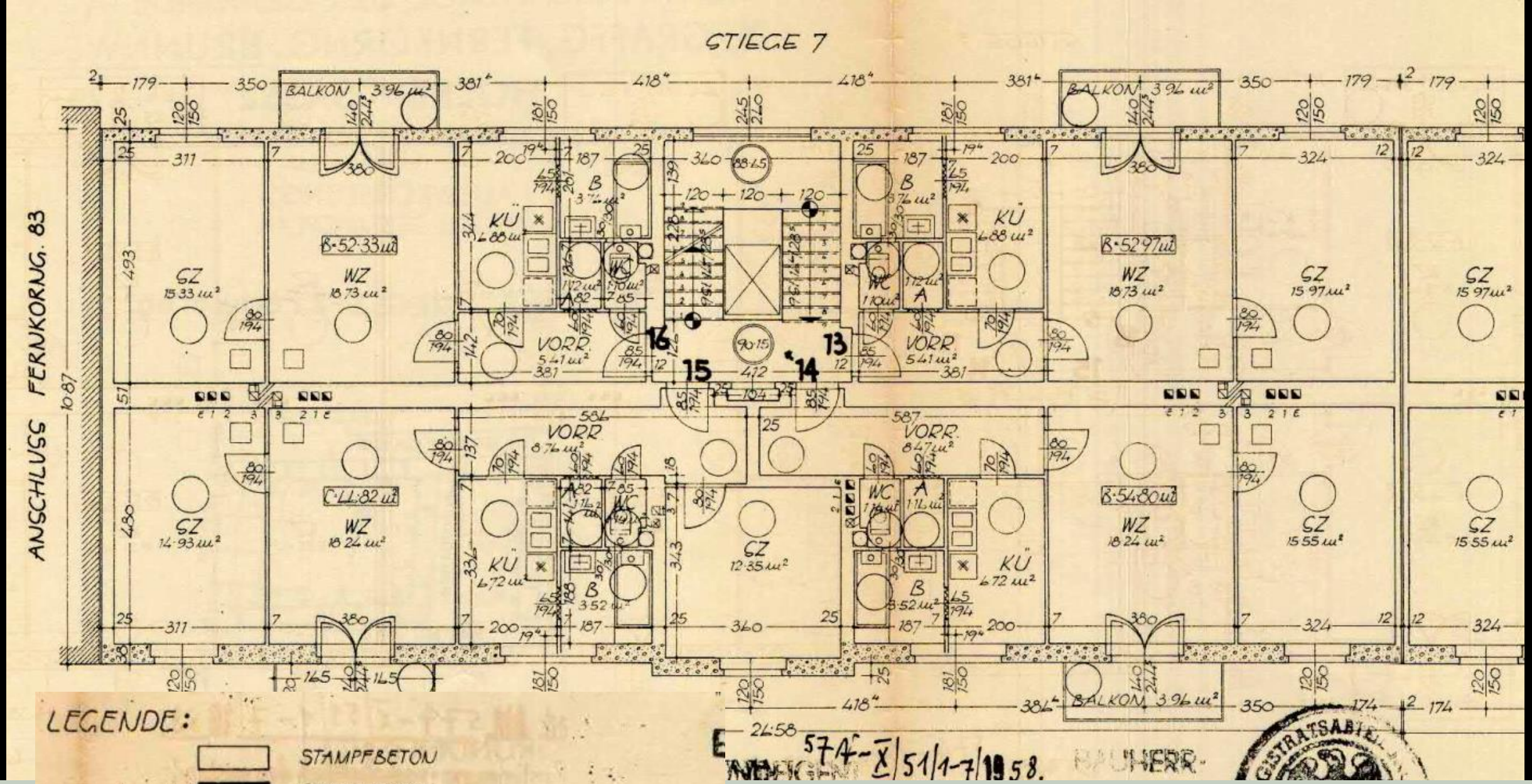

WOHNHAUSANLAGE DER GEMEINDE WIEN
X., GRAFFG., FERNKORNG., BRUNNWEG
HOLBEINGASSE
AUSWECHSLUNGS-
BEZW. BESTANDPLAN /
MASZSTAB 1:100
ERDGESCHOSS, STIEGE 5-7.
Fernkorng.
PLAN 14
LEGENDE:
GESCHOSSE: DECKEN ÜBER ERDG. 1. 2. 3.STOCK MIETEORDECKE, 4.STOCK AGT-MOLLINS-DECKE
ALLE STIEGEN UND GÄNGE TERRAZZO
KÜCHE, BAD, WC UND MAST.R TERRAZZO
IN ALLEN ZIMMERN BRETTELBÖDEN
VORRÄUME, PLASTIKBÖDEN AUF SPEZIALESTRICH
DACHGESCHOSS: BETONPLATTE 8cm. EINDECKUNG MIT
BETONSTRANGFALZZIEGEL.
ALLE BALKONE ASPHALT
STIEGE 7
STIEGE 4
STIEGE 5
ANSCHLUSS STIEGE 4 PL 4
ANSCHLUSS FERNKORNG. 83
GRAFFGASSE
HOLBEINGASSE
FERNKORNGASSE
BRUNNWEG
N
KALKMÖRTEL
ZEMENTMÖRTEL
ZEMENTMÖRTEL
EISENBETON
BETON
LEGENDE:
STAMPFBETON
STAHLBETON
ZIEGELMAUERWERK ERDG. 1. 2. STOCK
HOHLBLOCKSTEINE (BIBRO) 3. 4. STOCK
BAUHERR:
Fernkorng.
BAUFÜHRER:
ARCHITEKTEN
DR. ING. FRITZ JUDTMANN
ING. ANTON STEFLICEK ALOIS TISCHER
Wien, im Juni 1961.



pro:Holz
STUDENT Trophy

Ground floor

Light up!
Vertical extensions with wood



3. Floor

Light up!
Vertical extensions with wood

MAUERWERK :
KELLER = STAMPFBETON, ZIEGELMWK. I. ZEM. M.
ERDG., 1., 2. STOCK = ZIEGELMWK.
3 + 4. STOCK = VIBROSTEINE
DACHG. = ZIEGEL, VIBRO-AUFM.

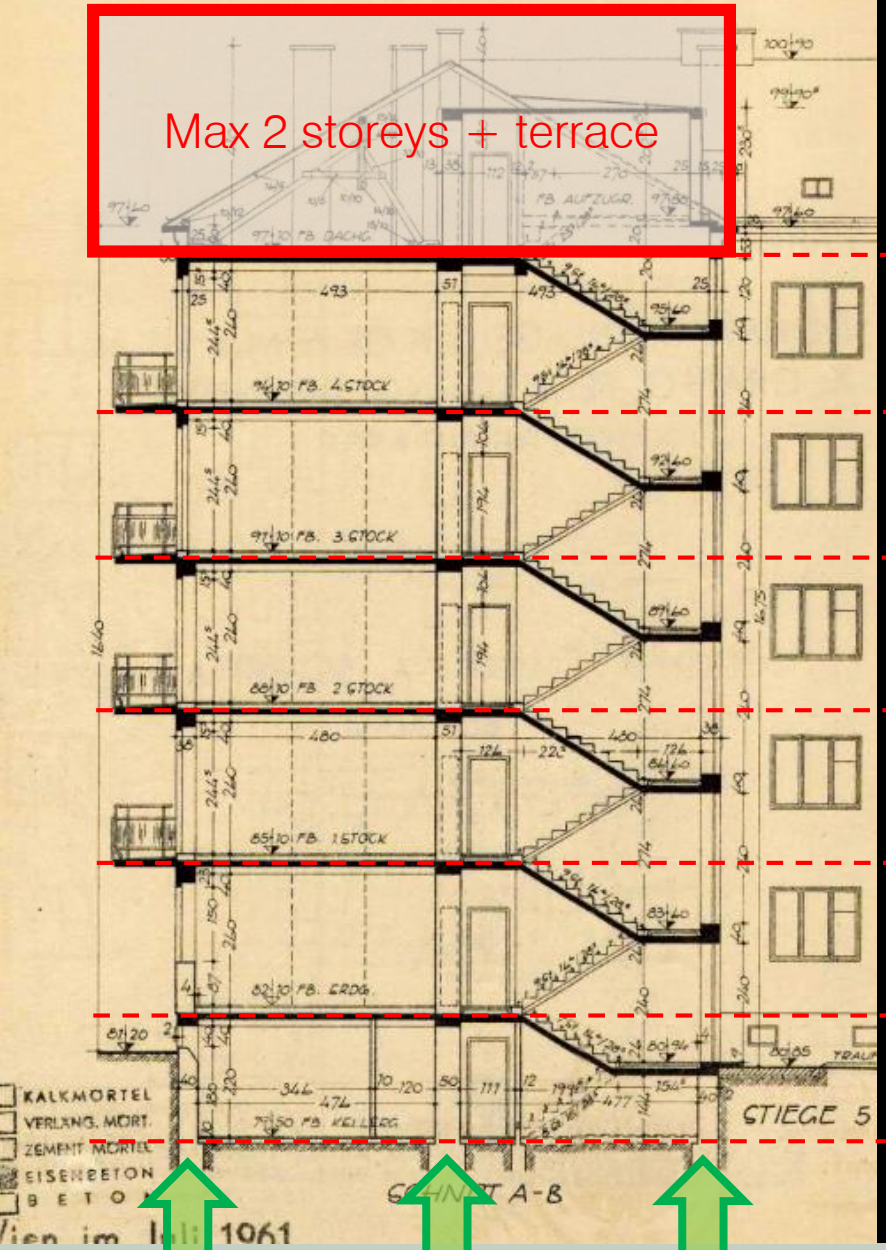
DECKENKONSTRUKTION:
KELLER + 4. STOCKDECKE = ASTMOLIN -
ÜBER ERDG., 1., 2., 3. STOCK = "METEOR"-DECKE

DACHEINDECKUNG:
ROTE BETONSTRANGFALZZIEGEL

FUSSBÖDEN :
KELLER = BETON
WASCHKÜCHE + BALKONE = ASPHALT
DACHBODEN = BETONFLÖTZ
STIEGENPODESTE, VORR. Z. WASCHK. } = TERRAZZO
KÜ, KN, B, A, WC
WZ, SZ, SK = BRETTELBÖDEN
VORRÄUME = PLASTIK

HAUSKANAL = GLASIERTE STEINZEUGROHRE
HOFKANAL = BETONROHRE
ABFALLSTRÄNGE = ETERNITROHRE

Vertical loads



Floor above last storey: Load bearing?

Floor-survey?

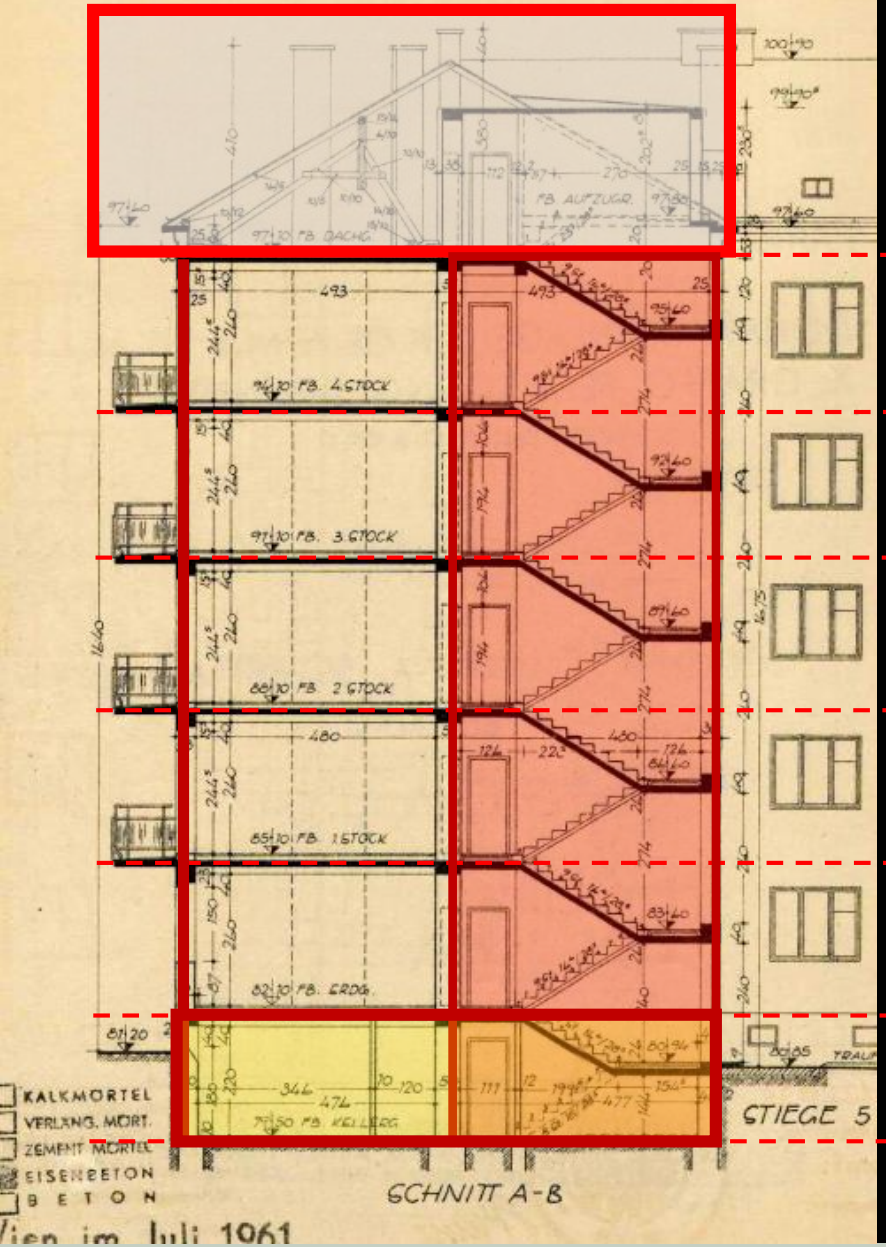
Ground floor masonry stress:

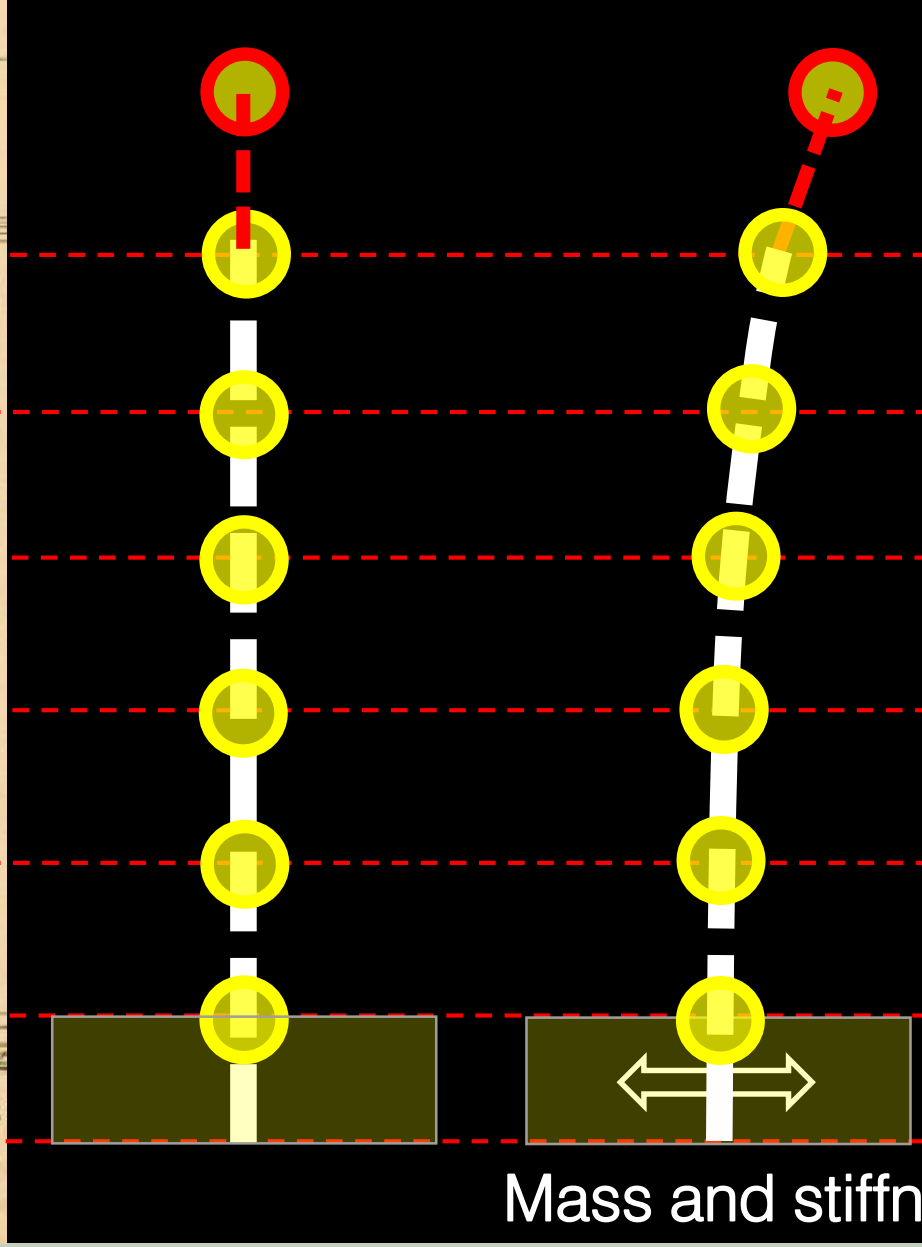
$\sigma_{Ed} \sim 0.85\ N/mm^2 < 1.5\ N/mm^2 = f_{Rd}$

Masonry-survey?

Foundation: Maybe not sufficient?

Foundation-survey?





Horizontal loads

Calculation of required lateral enforcement:

Individual risk existing building:
4 apartements x 5 floors x 2.35 = 47 individuals

Individual risk refurbished and extended building:

47 + 2…6 *2.35 = 47 + 5…15 = 52…62 individuals

Mass and stiffness in motion

Earth quake and individual risk

Required reliability:

$P_{f,extension}$ =
$(50* 10^{-5} + 15* 10^{-6})/(50+15) = 7.92*10^{-6}$

Leads to: $\alpha_{soll} = 0.30$

Required factor of horizontal improvement

v~ 0.30/0.25 = 1.20

aus der SIA entnommen:

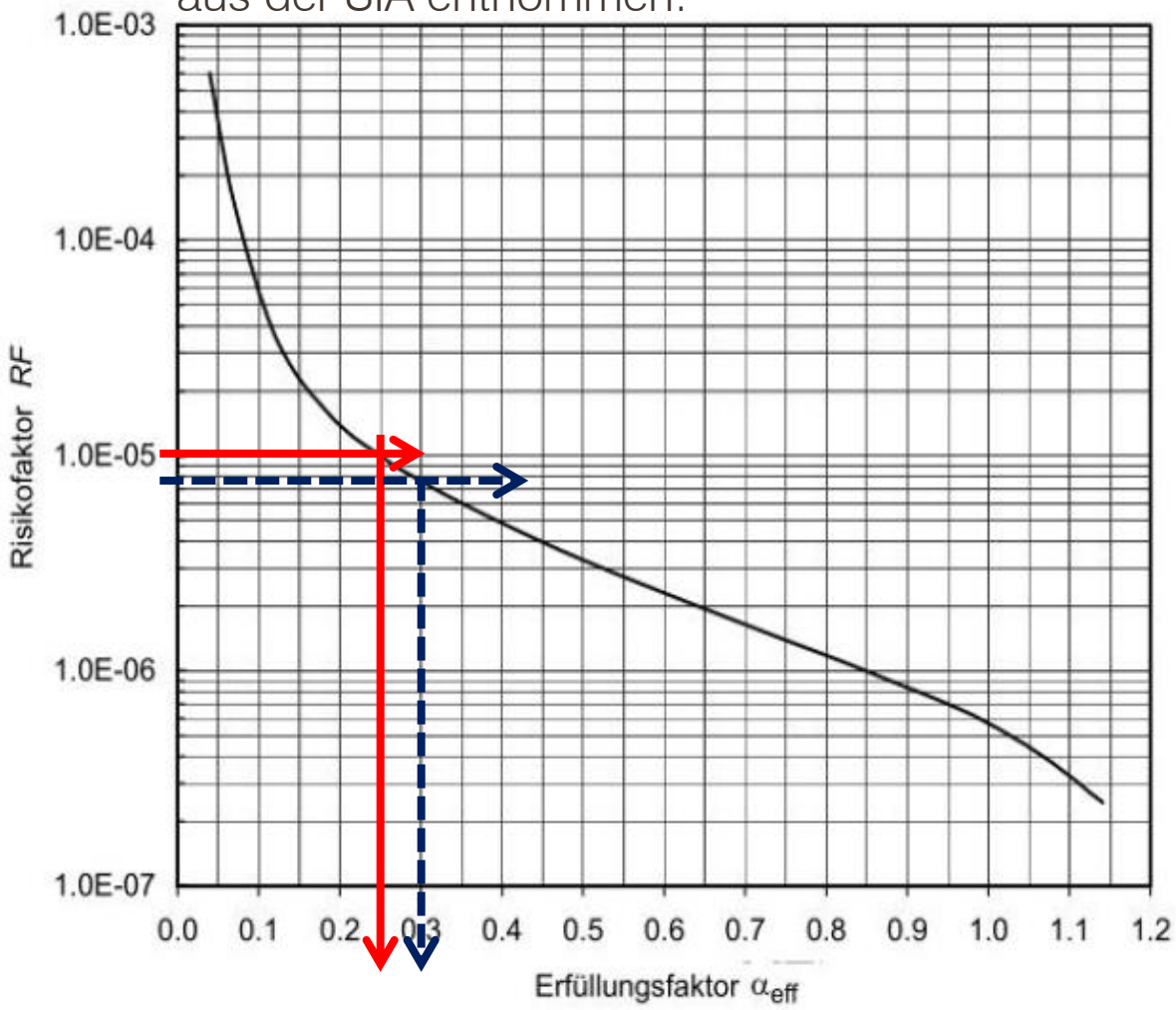
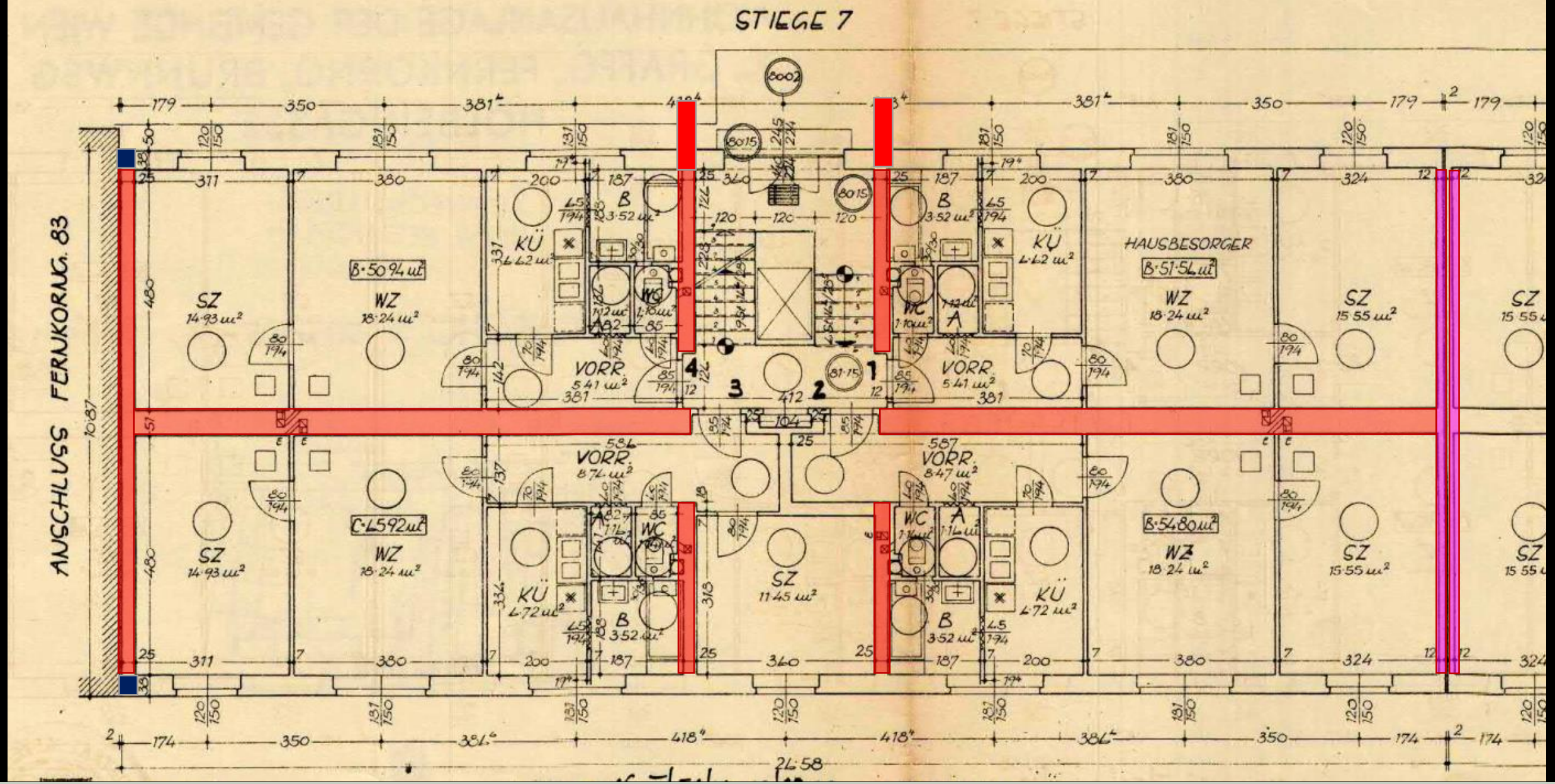


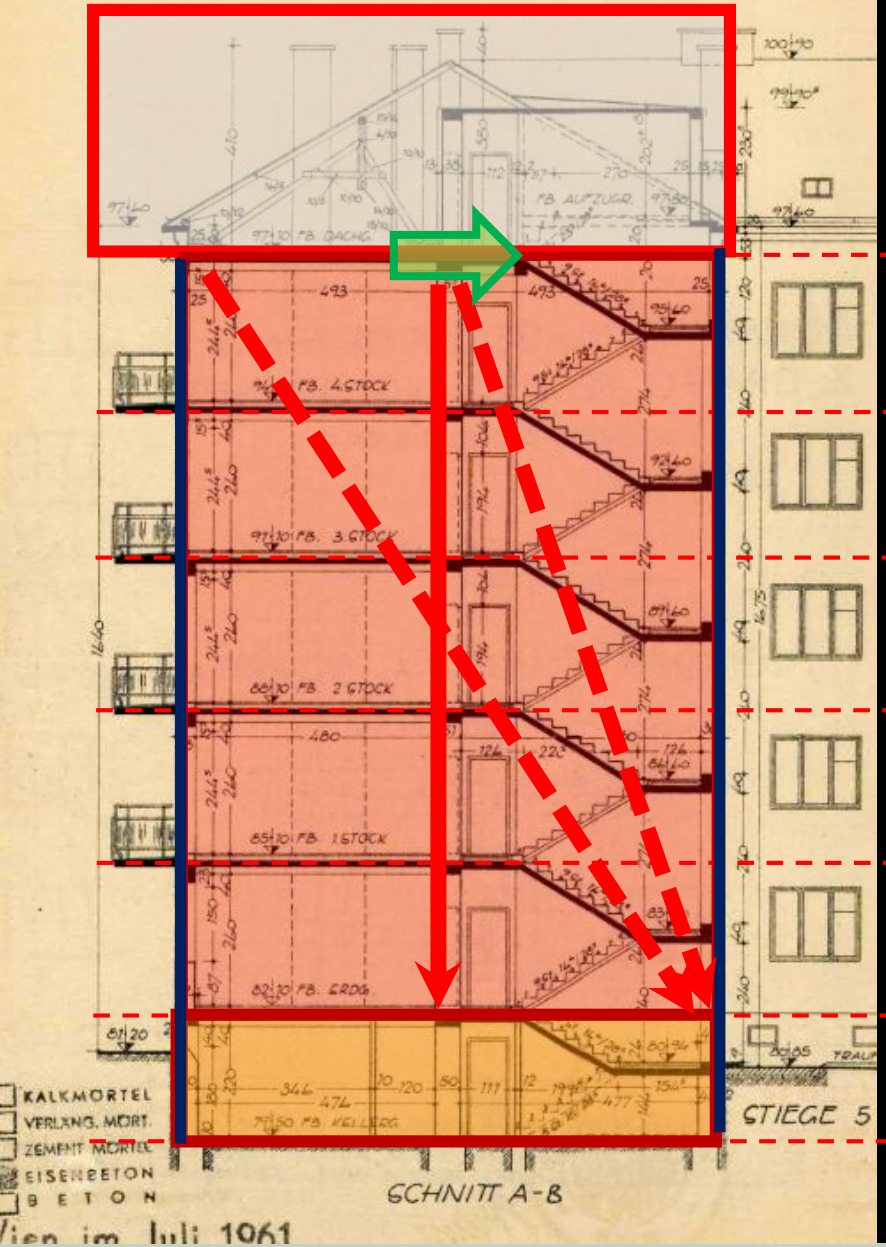
Abb. 5: Risikofaktor-Erfüllungsfaktor-Beziehung

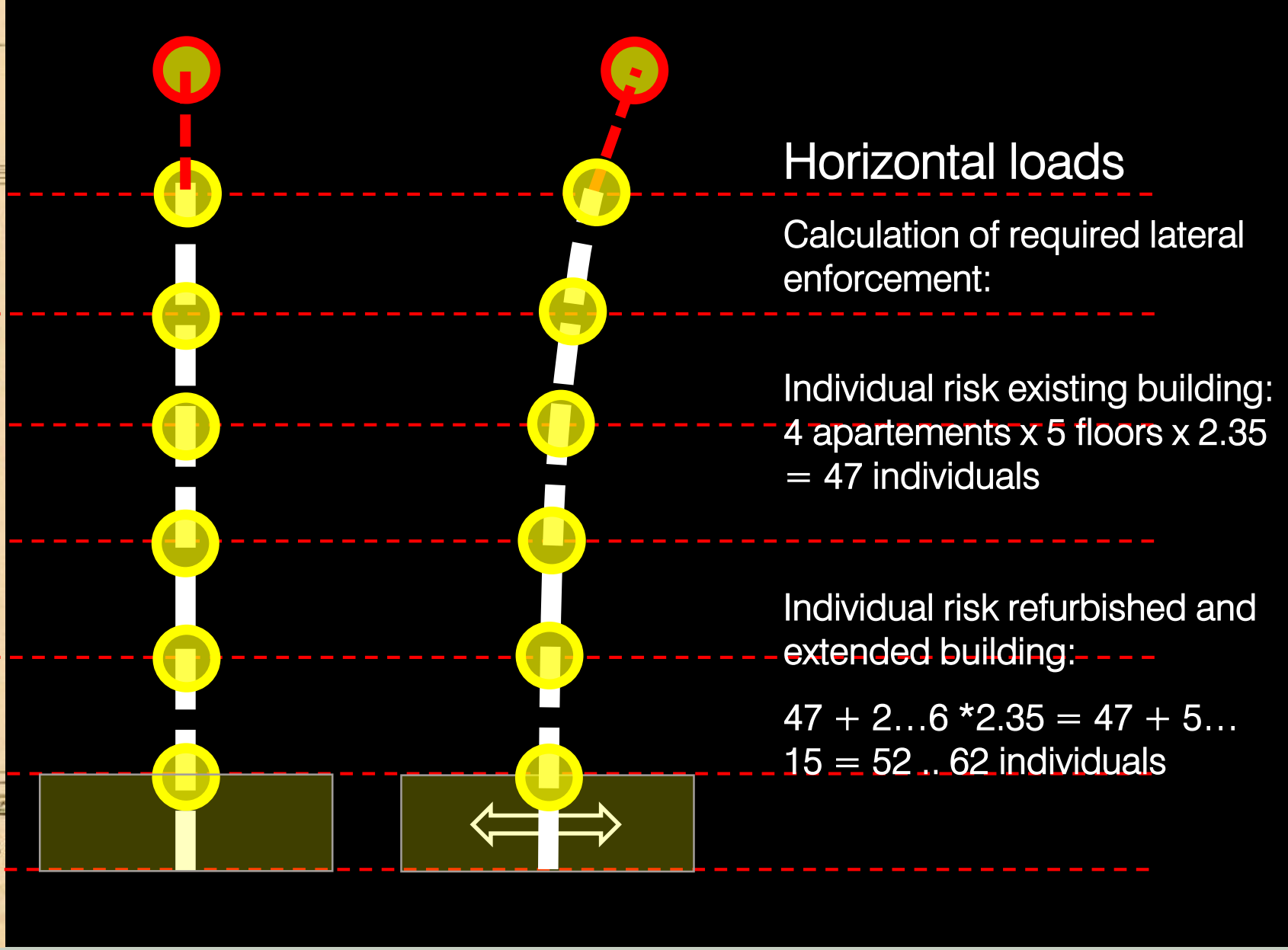


pro:Holz
STUDENT Trophy

Ground-floor

Light up!
Vertical extensions with wood





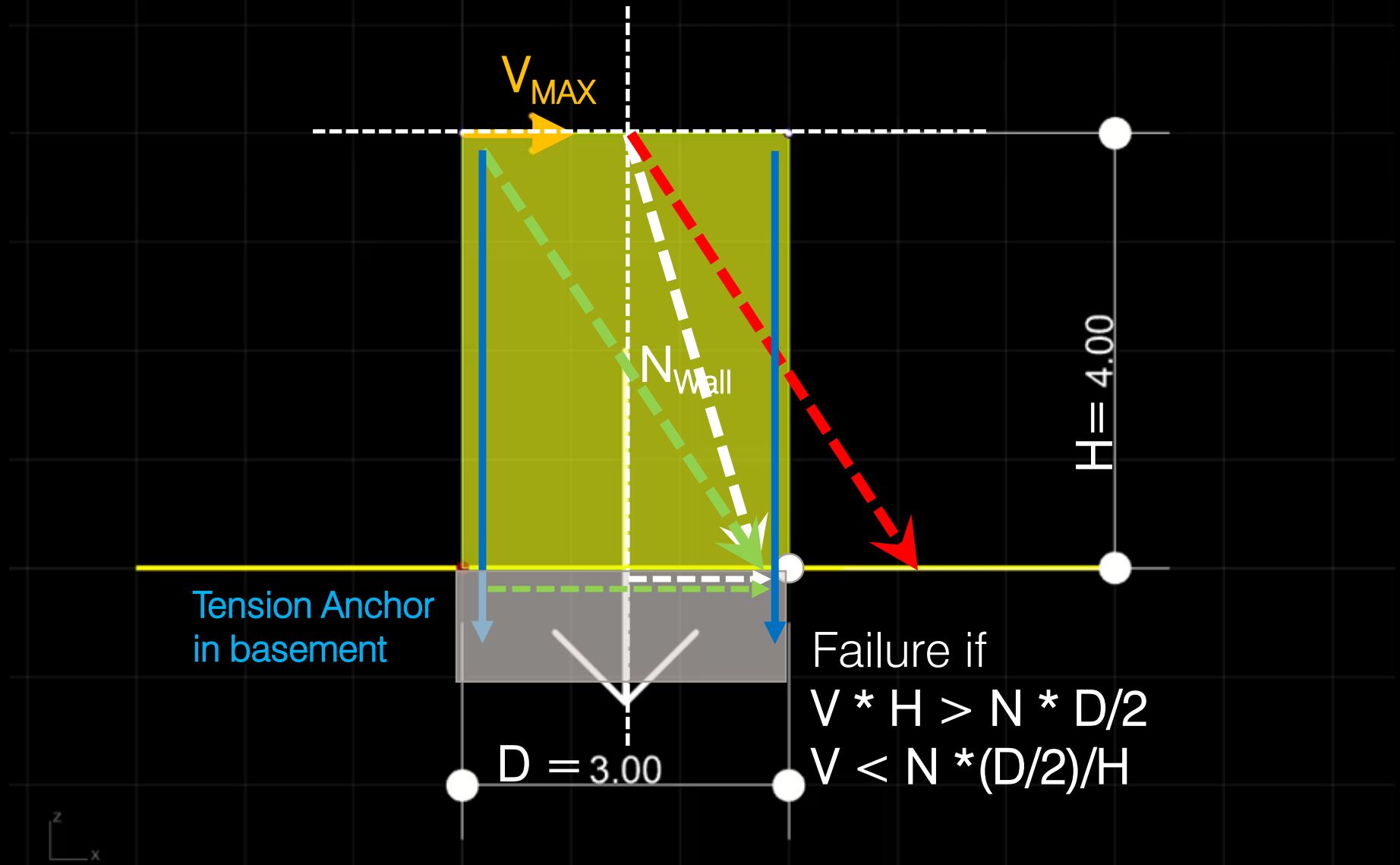
Horizontal loads

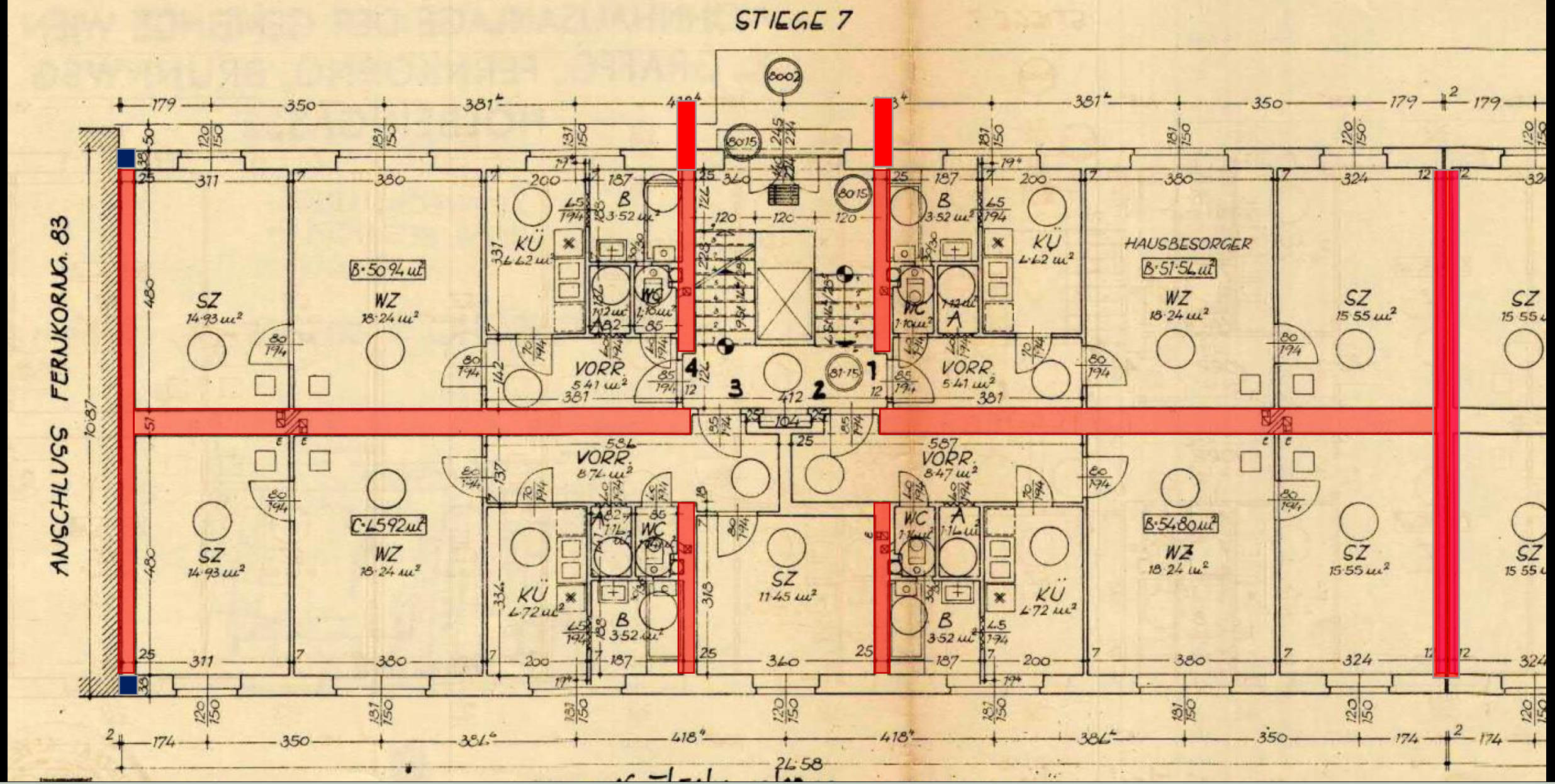
Calculation of required lateral enforcement:

Individual risk existing building:
4 apartements x 5 floors x 2.35 = 47 individuals

Individual risk refurbished and extended building:

47 + 2…6 *2.35 = 47 + 5… 15 = 52 .. 62 individuals

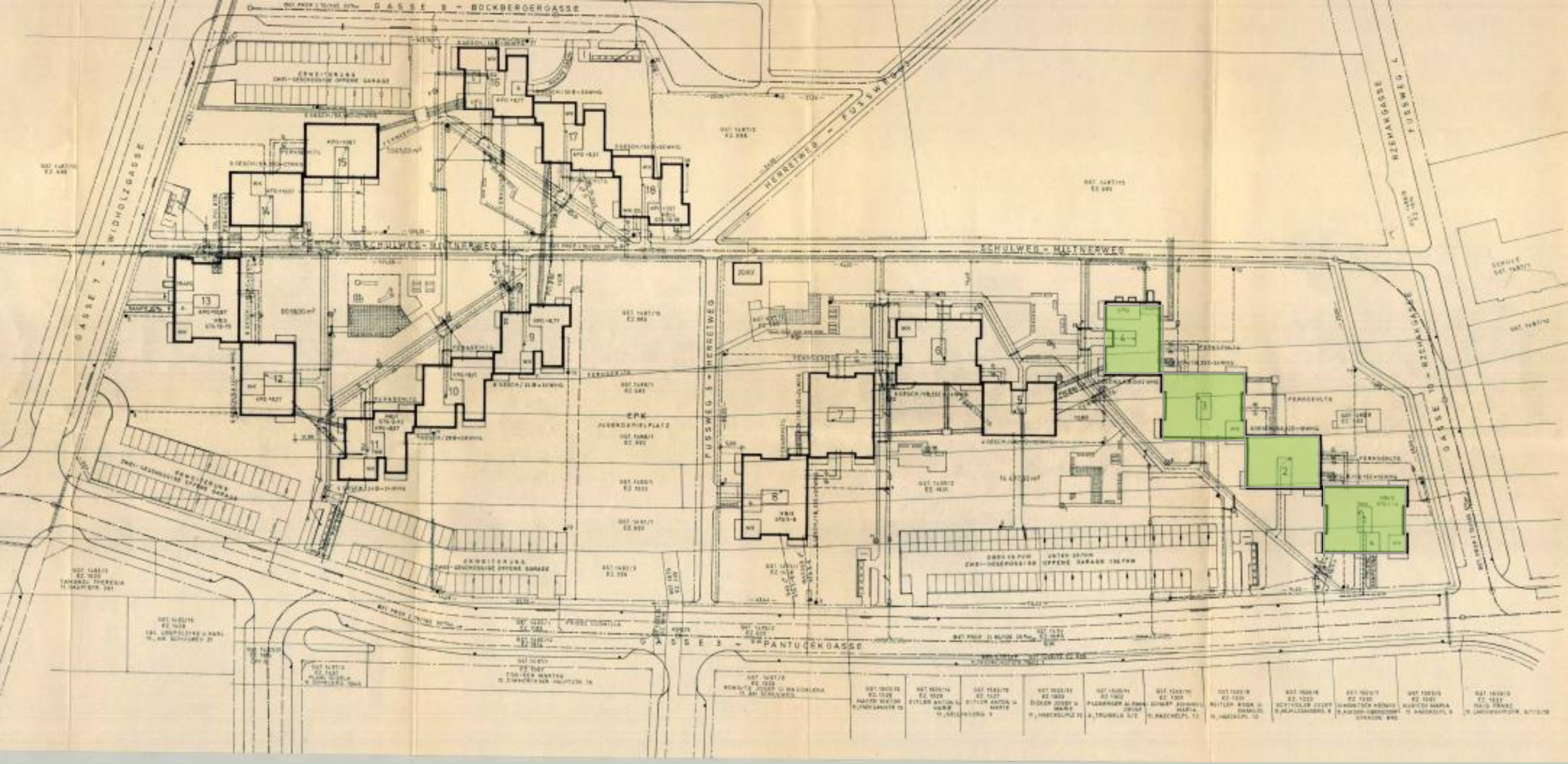

V_{MAX}
N_{Wall}
H = 4.00
Tension Anchor
in basement
D = 3.00
Failure if
V * H > N * D/2
V < N *(D/2)/H



pro:Holz
STUDENT Trophy

Ground floor

Light up!
Vertical extensions with wood



pro:Holz
STUDENT Trophy

Wohnhausanlage Pantucekgasse 33
Stiege 1 bis 4

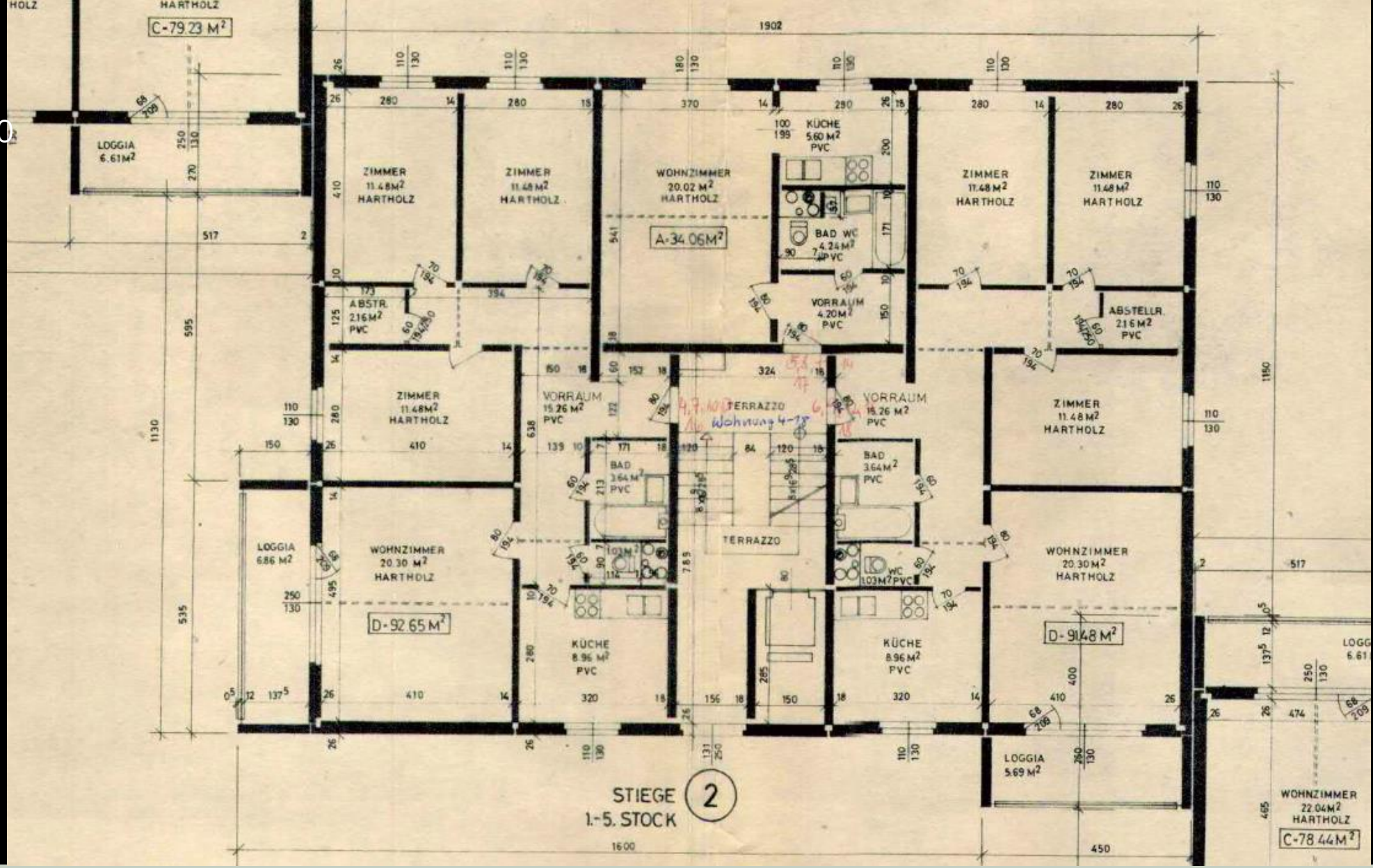
Light up!
Vertical extensions with wood

Storey-height:
16 rises of 16.9 cm = 270 cm

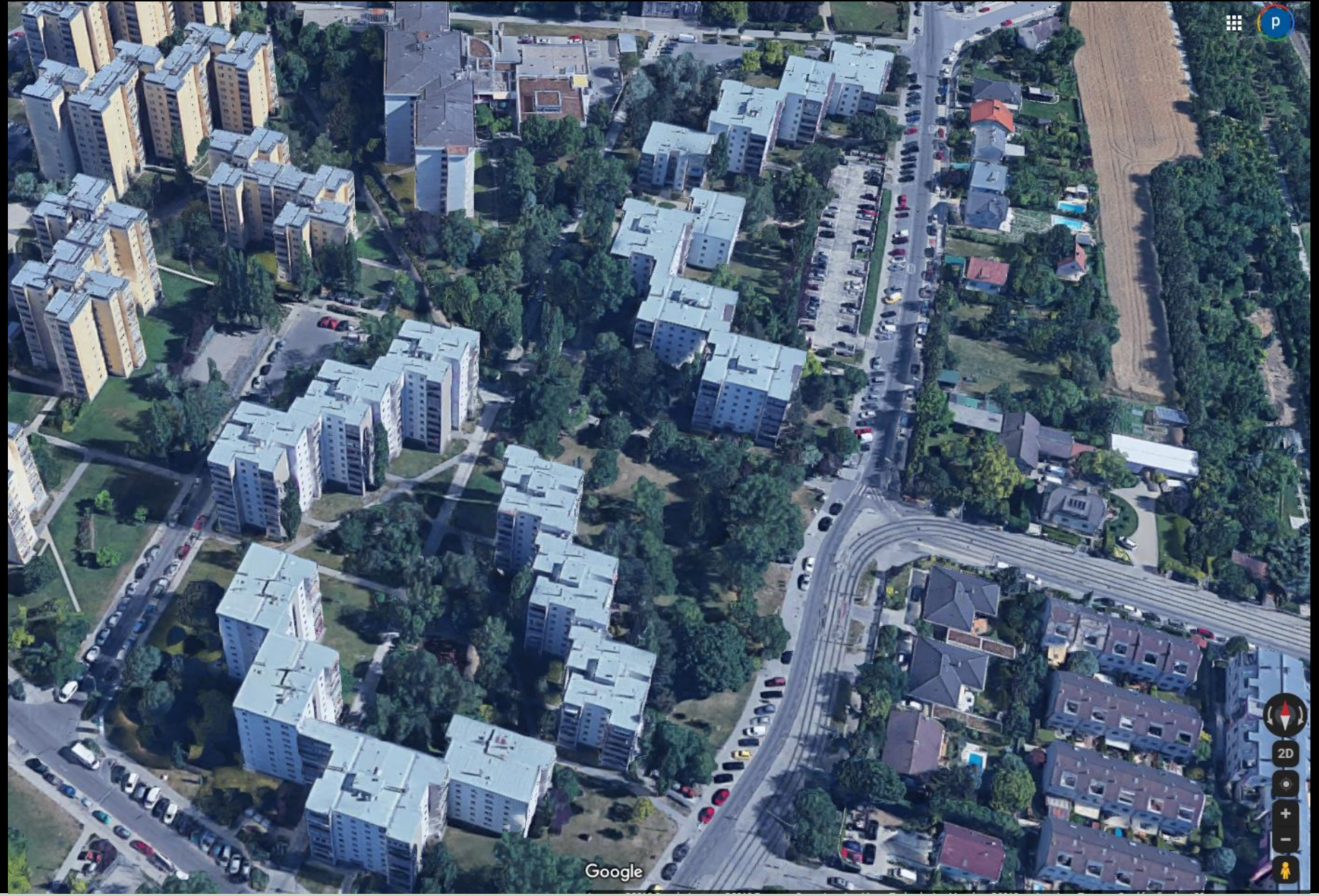
Slabs
Concrete ~ 18..20 cm
circumference support?

Walls
Concrete, prefebracated

Basement
Existing, mezzanine



Ground floor


Google
2D

Vertical loads

Floor above last storey: Load bearing?
Floor-survey?

Ground floor wall stress:
Sufficient

Foundation: Maybe not sufficient?
Foundation-survey?

Horizontal loads

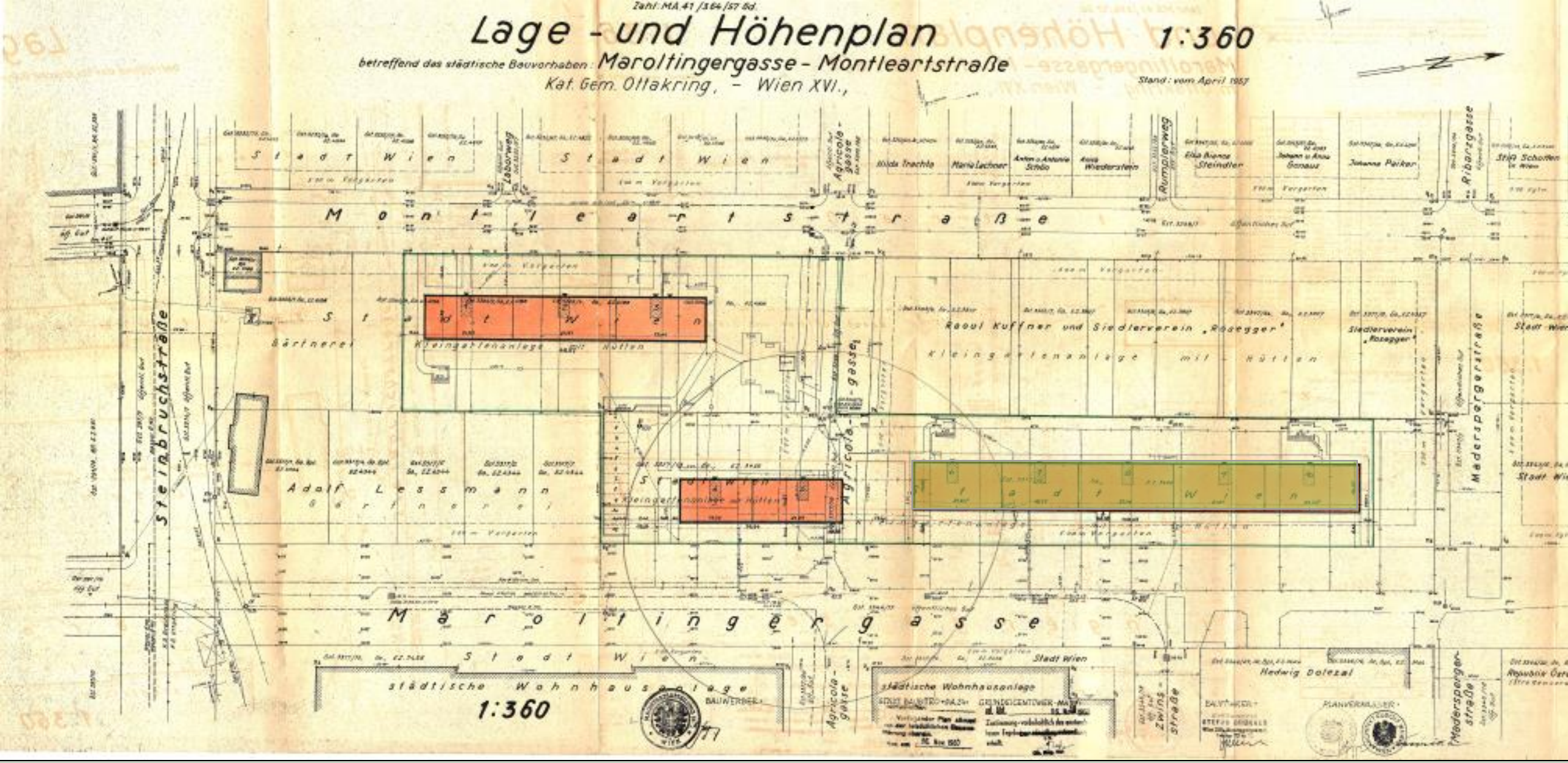
Calculation of required lateral enforcement:

Individual risk existing building:
3 apartements x 5…8 floors x 2.35 = 36…57 Individuals

Individual risk refurbished and extended building:

36..57 + 2…6 *2.35 = 36…57 + 5… 15 = 41 .. 72 Individuals

Concrete walls usually sufficient!

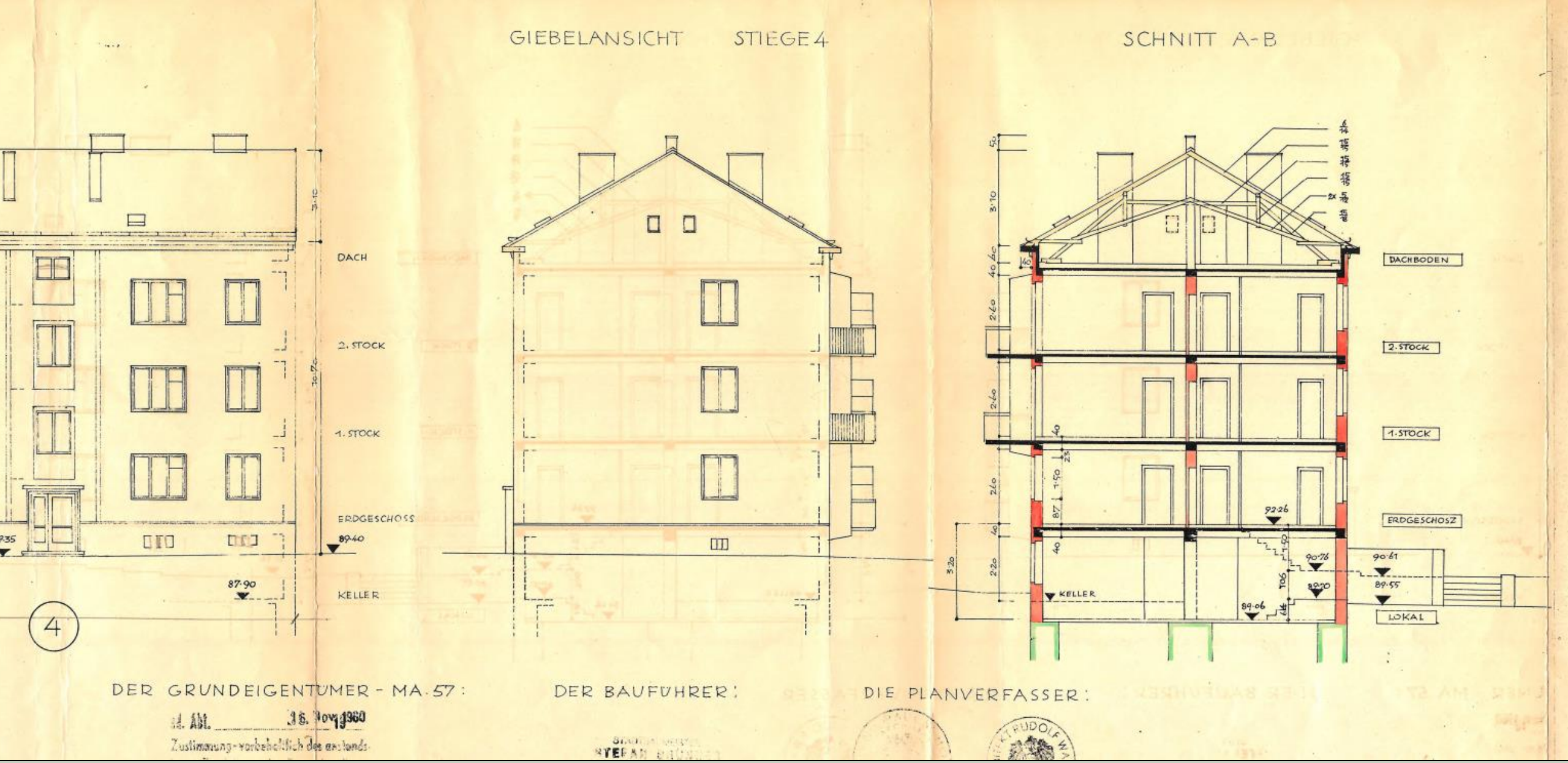


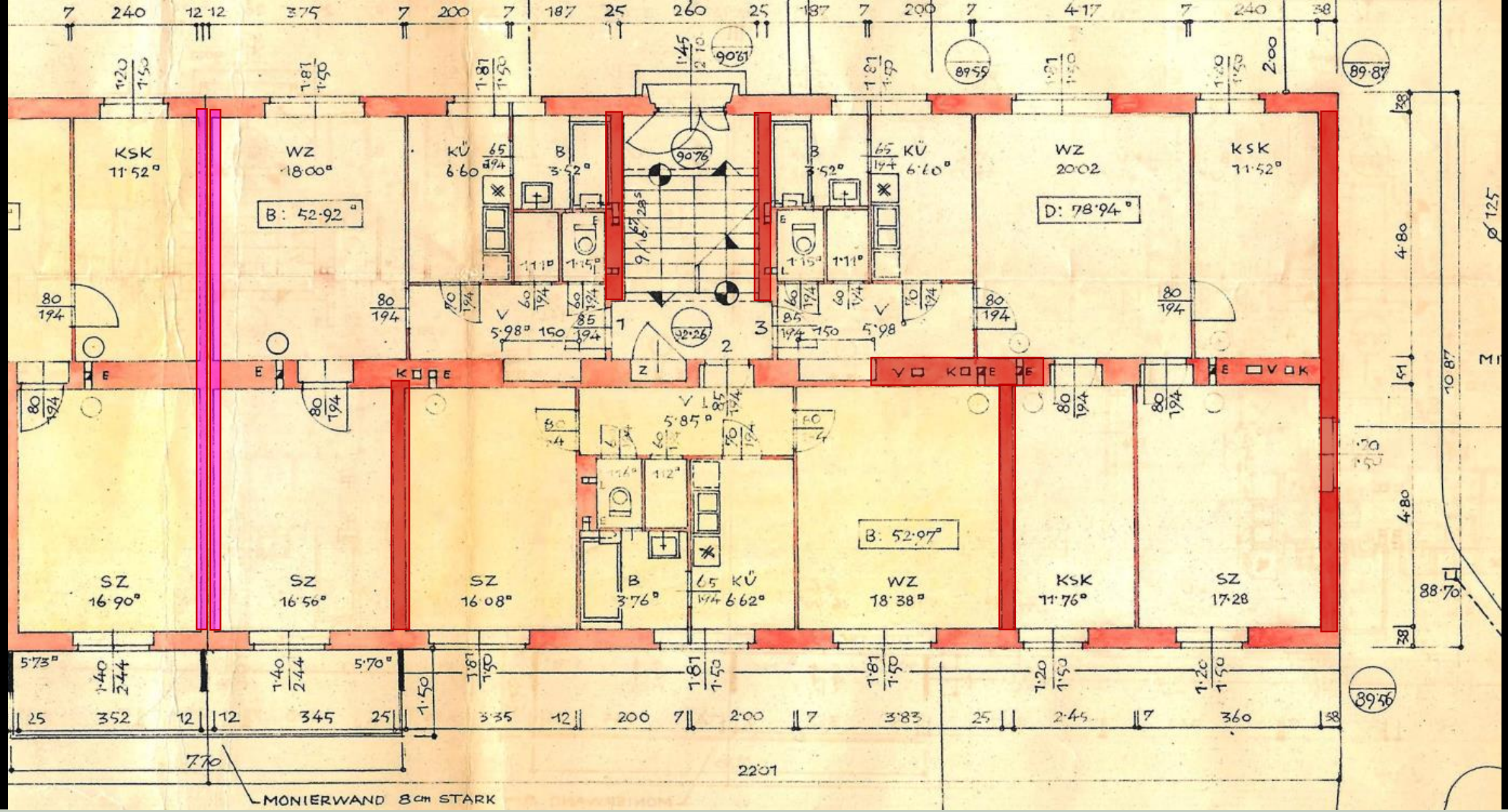
pro:Holz
STUDENT Trophy

Wohnhausanlage Maroltingergasse 19-25
Stiege 6 bis 10

Light up!
Vertical extensions with wood

Google
2D

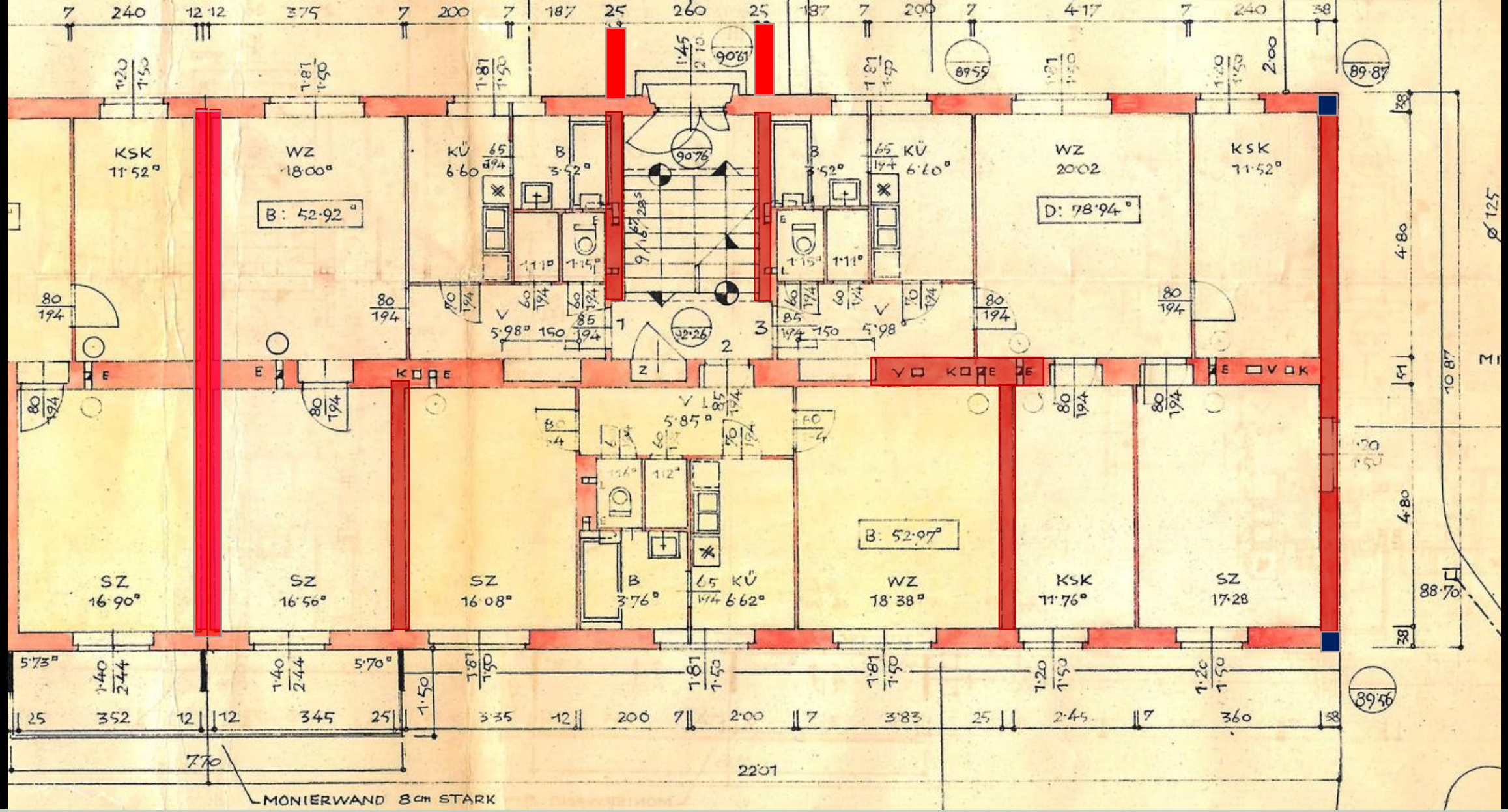

GIEBELANSICHT STIEGE 4
SCHNITT A-B
DACH
2. STOCK
1. STOCK
ERDGESCHOSS
KELLER
DACHBODEN
2. STOCK
1. STOCK
ERDGESCHOSZ
KELLER
LOKAL
DER GRUNDEIGENTÜMER - MA. 57:
DER BAUFÜHRER:
DIE PLANVERFASSER:
Zustimmung - vorbehaltlich des anstands



pro:Holz
STUDENT Trophy

Ground floor

Light up!
Vertical extensions with wood


KSK
11·52°
WZ
18·00°
B: 52·92°
KÜ
6·60
B
3·52°
WZ
20·02
D: 78·94°
KSK
11·52°
SZ
16·90°
SZ
16·56°
SZ
16·08°
B
3·76°
KÜ
6·62°
B: 52·97°
WZ
18·38°
KSK
11·76°
SZ
17·28
MONIERWAND 8cm STARK

Vertical loads

Floor above last storey: Load bearing?
Floor-survey?

Ground floor masonry stress:
$\sigma_{Ed} \sim 0.85$ N/mm2 < 1.5 N/mm2 $= f_{Rd}$
Masonry-survey?

Foundation: Maybe not sufficient?
Foundation-survey?

Horizontal loads

Calculation of required lateral enforcement:

Individual risk existing building:
4 apartements x 3 loors x 2.35 = 29 Individuals

Individual risk refurbished and extended building:

29+ 2…6 *2.35 = 29 + 5… 15 = 34 .. 44 Individuals

Required factor of horizontal improvement

v~ 0.30..0.35/0.25= 1.20..1.40

Thank you for your attention