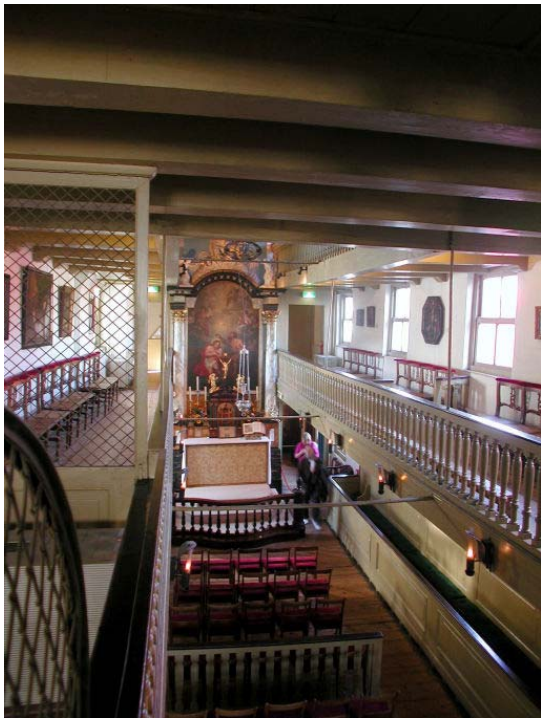
CONSTRUCTIEBUREAU DE PROUW BV
BUILDING CONSTRUCTION CONSULTANTS

Order P4084

Ons Lieve Heer Op Solder [Our Lord in the Attic] Oudezijds Voorburgwal 40 in Amsterdam

FOURTH AND FIFTH STORY FLOORING



PRINCIPAL
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Bunnik, March 27, 2007

Introduction

This report was occasioned by an onsite inspection performed by Mr. R. Danen of the Constructiebureau De Prouw BV, in the middle of February 2007. The purpose was to determine the allowed loads for the building's fourth and fifth floors.
To this end, the dimensions of the existing wooden joists were measured.

Building Code

The Building Code stipulates the requirements for construction safety. In practice this means that strength is the only concern. Structural deflection is not taken into consideration.

NEN6702 – Loads and deformation

This standard is the basis for the builder to calculate the structures and their components. In addition to structural strength requirements, this standard also includes requirements for structural rigidity (deflection).

The following requirements are taken into consideration regarding deflection for wooden floors.

$U_{elastic}$ = time-independent portion of deflection, permanent + variable loading.
U_{creep} = time-dependent portion of deflection, permanent + 60% of the instantaneous variable loading.
$U_{permanent}$ = deflection compared to the permanent loading.
$U_{variable}$ = deflection compared to variable loading (persons, equipment, etc.).

$U_{total} = U_{elastic} + U_{creep}$ < 0.004 x span length
$U_{additional} = U_{total} - U_{permanent}$ < 0.003 x span length

Variable loading specifications

NEN6702 has the following requirements for buildings where large numbers of people may gather, or where a portion of the building is intended for visitors.
Variable loading $P_{rep} = 5.00\ kN/m^2$
Instantaneous factor $\Psi = 0.25$

Another approach would be to allow access to groups of no more than 15 people. In our assessment, this would allow the following loading:
Variable loading $P_{rep} = 3.00\ kN/m^2$
Instantaneous factor $\Psi = 0.5$

By comparison, loading for an office would be: $P_{rep} = 2.50\ kN/m^2$

Existing suspension of the gallery edge beams

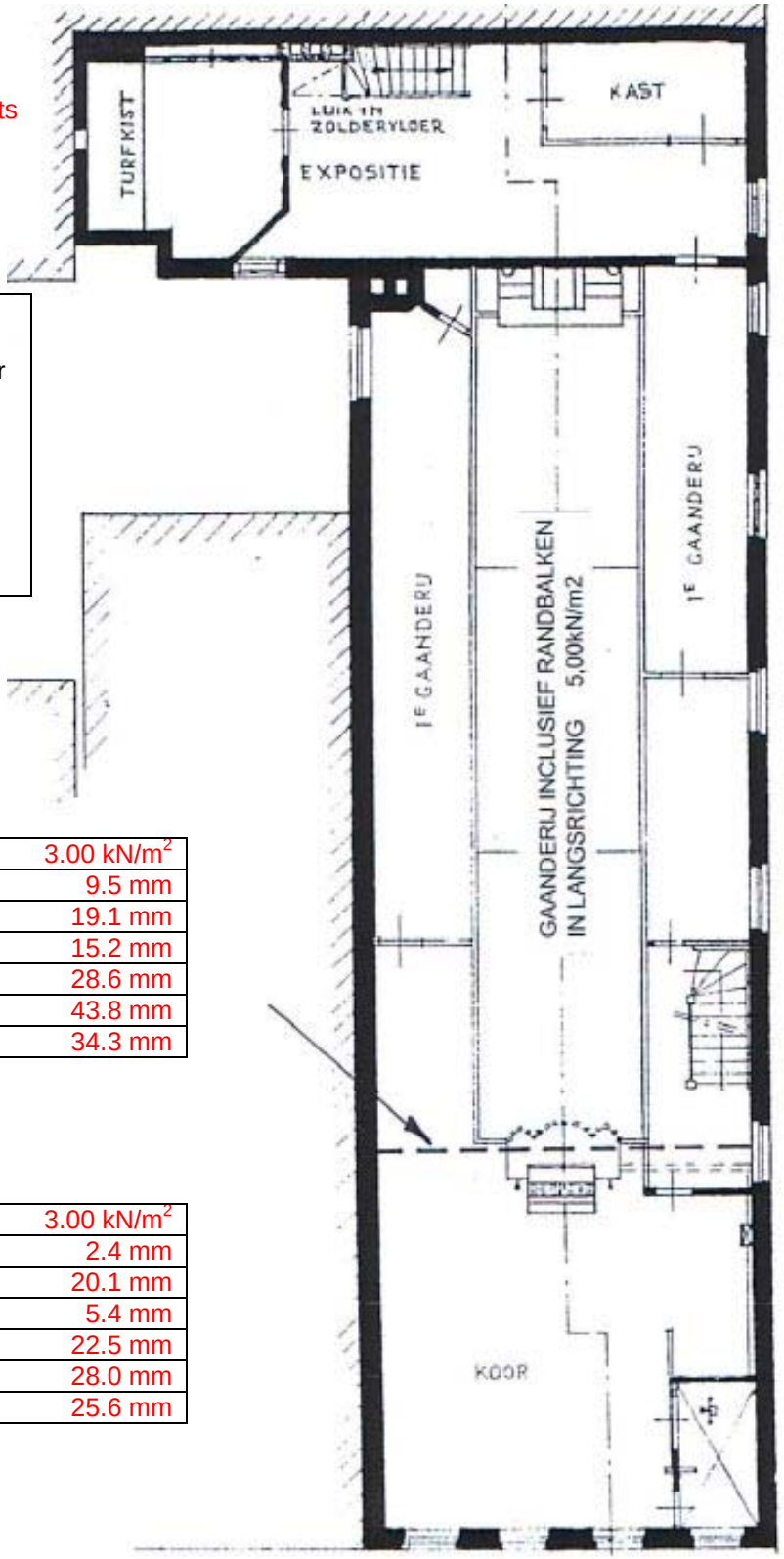
When the atrium was created in the fourth and fifth floors, the edge beams were suspended by tie bars from the joists of the attic floor. The original joist is maximally loaded by the roof and the attic, and cannot bear further loading; nor are the other joists capable of carrying an additional load.
In the past, however, the structure proved sufficient for a slight load on the flooring of the galleries.

If no measures are taken to increase the load capacity of the tension rods, only very slight loading will be allowed for the galleries, and very few people will be allowed per gallery.
Potential measures to increase the loading capacity where the tension rods are located:

- install steel joists between the existing wooden ones and couple the tension rods to the steel joists;
- install columns where the tension rods are located down to an angle-steel cross-beam.

Throughout the remainder of the report (drawings), the point of departure is that measures will be taken to add rigid supports to the wooden structure alongside the tension rods, which would determine the loading capacity of the wooden structure.

Allowed loading per NEN6702
Allowed loading per strength requirements



[Key:
turfkist = peat chest
luik in zoldervloer = trap door in attic floor
expositie = exhibit
kast = cupboard
gaanderij = gallery
inclusief = inclusive
randbalken = edge beams
langsrichting = longitudinal
koor = choir]

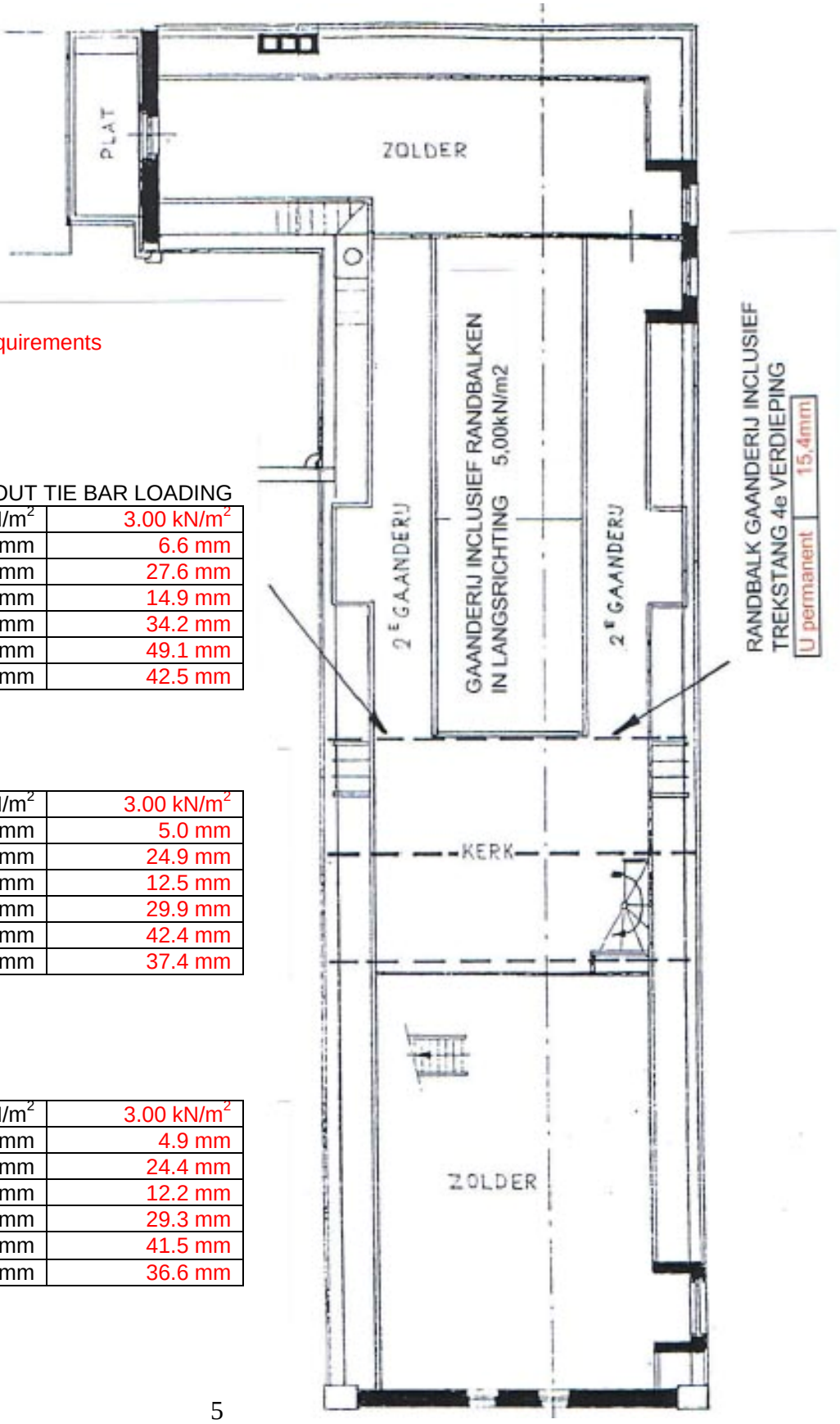
GALLERY EDGE BEAM

	1.00 kN/m^2	3.00 kN/m^2
U permanent	9.5 mm	9.5 mm
U variable	6.4 mm	19.1 mm
U creep	11.4 mm	15.2 mm
U elastic	15.9 mm	28.6 mm
U total	27.3 mm	43.8 mm
U additional	17.8 mm	34.3 mm

CHOIR

	1.35 kN/m^2	3.00 kN/m^2
U permanent	2.4 mm	2.4 mm
U variable	12.7 mm	20.1 mm
U creep	6.2 mm	5.4 mm
U elastic	15.1 mm	22.5 mm
U total	21.4 mm	28.0 mm
U additional	19.0 mm	25.6 mm

[Key:
plat = plan
zolder = attic
gaanderij = gallery
inclusief = inclusive
randbalken = edge beams
langsrichting = longitudinal
kerk = church
trekstang = tension bar]



Allowed loading per NEN6702
Allowed loading per strength requirements

GALLERY EDGE BEAM WITHOUT TIE BAR LOADING

	1.00 kN/m^2	3.00 kN/m^2
U permanent	6.6 mm	6.6 mm
U variable	9.2 mm	27.6 mm
U creep	9.4 mm	14.9 mm
U elastic	15.8 mm	34.2 mm
U total	25.2 mm	49.1 mm
U additional	18.6 mm	42.5 mm

JOISTS BY THE STAIRWELL

	1.40 kN/m^2	3.00 kN/m^2
U permanent	5.0 mm	5.0 mm
U variable	11.8 mm	24.9 mm
U creep	8.5 mm	12.5 mm
U elastic	16.8 mm	29.9 mm
U total	25.3 mm	42.4 mm
U additional	20.3 mm	37.4 mm

ATTIC

	1.35 kN/m^2	3.00 kN/m^2
U permanent	4.9 mm	4.9 mm
U variable	11.0 mm	24.4 mm
U creep	8.2 mm	12.2 mm
U elastic	15.9 mm	29.3 mm
U total	24.0 mm	41.5 mm
U additional	19.1 mm	36.6 mm

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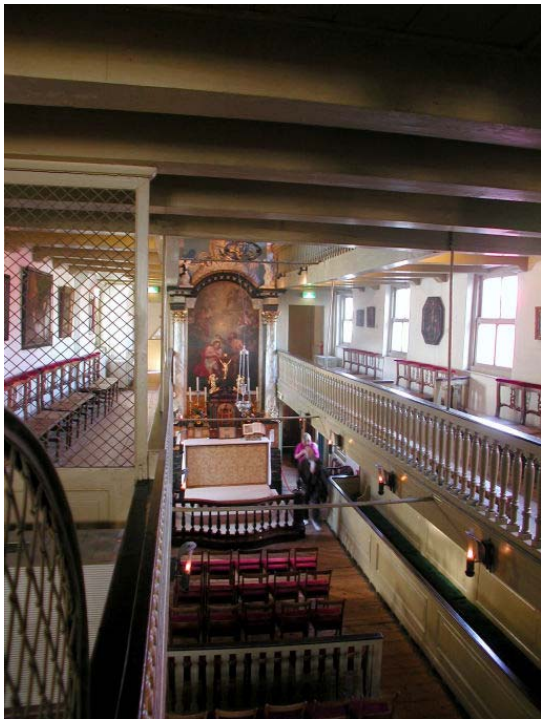

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Bunnik, June 8, 2007

Building Code

The Building Code stipulates the requirements for construction safety. In practice this means that strength is the only concern. Structural deflection is not taken into consideration. If a building is only checked for strength and deflection is left out of consideration, this can lead to building damage, such as, for example, cracks in the masonry which may not have a direct effect on the load bearing capacity of the masonry.

NEN6702 – Loads and deformation

This standard is the basis for the builder to calculate the structures and their components. In addition to structural strength requirements, this standard also includes requirements for structural rigidity (deflection).

The following requirements are taken into consideration regarding deflection for wooden floors.

$U_{elastic}$ = time-independent portion of deflection, permanent + variable loading.
U_{creep} = time-dependent portion of deflection, permanent + 60% of the instantaneous variable loading.
$U_{permanent}$ = deflection compared to the permanent loading.
$U_{variable}$ = deflection compared to variable loading (persons, equipment, etc.).

$U_{total} = U_{elastic} + U_{creep}$ < 0.004 x span length
$U_{additional} = U_{total} - U_{permanent}$ < 0.003 x span length

For wood structures, the total deflection (final deflection) consists of a combination of elastic deflection plus deflection caused by creep.

Elastic deflection is the deflection resulting from the weight of the construction itself and the deflection resulting from load changes (persons, equipment, etc.). This elastic deflection is the time-independent portion of the total load.

Creep means the increase in deformation over time while the loading remains unchanged; it is the time-dependent portion of the deflection. Creep is the consequence of the permanent loading plus 60% of the variable instantaneous load. The instantaneous load is the value for the probable variable load at any arbitrary point in time. The (NEN6702) regulations stipulate the values of the instantaneous load factor along with the variable load for different functional usage.

Creep originates from loading which is assumed to be present at all times, namely:
- permanent load (own weight);
- 60% of the instantaneous variable loading, the portion of the variable load.

Existing suspension of the edge beams of the gallery

When the atrium was created in the fourth and fifth floors, the edge beams were suspended by tie bars from the joists of the attic floor. The original joist is maximally loaded by the roof and the attic, and cannot bear further loading; nor are the other joists capable of carrying an additional load.
In the past, however, the existing structure proved sufficient for current usage, and a slight load on the floor of the galleries.

But if we consider the current situation mathematically, the structure is not adequate for current use. Mathematically, we consider the entire construction as a plurality of separate components which are monitored separately.

The relatively short wooden joists of the galleries will in practice absorb a portion of the loading from the tension rods. If the wooden joists have been fully encased by masonry, after a slight rotation they will become “spring-loaded.”
This “spring-loading” means that the joisting will absorb more than half of the loading of the span.

If no measures are taken to increase the load capacity of the tension rods, only a very slight loading will be allowed for the galleries, and very few people will be allowed per gallery.
Potential measures to increase the loading capacity where the tension rods are located:

- install steel joists between the existing wooden ones and couple the tension rods to the steel joists;
- install columns where the tension rods are located down to an angle-steel cross-beam.