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Autor: Sanpaolesi, Luca / Gulvanessian, Haig

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EC 1: Snow Loads

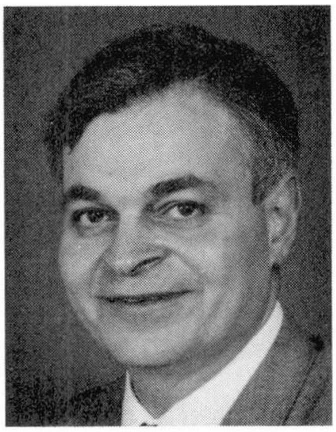
EC 1: Charges dues à la neige

EC 1: Schneelasten

Luca SANPAOLESI
Professor
University of Pisa
Pisa, Italy

Luca Sanpaolesi born in Florence, Italy, in 1927, graduated in Civil Engineering at the Technical University of Pisa. At present he is Professor of Structural Engineering at the Pisa University and is involved in the studies of Eurocode EC 1.

Haig GULVANESSIAN
Civil Eng.
Build. Res. Establ.
Garston, UK



Haig Gulvanessian, born 1941, is a graduate of the Universities of London and Wales. Before being appointed to his present post he was at the Departments of Transport and Environment UK where he was concerned with the design of bridges, elevated roadways, and buildings.

SUMMARY

This paper describes the background against which Eurocode 1: Part 2.5: Snow Loads is being drafted. It identifies some of the problems in achieving a fully harmonised code and provides some proposals to overcome them. It discusses topics for future developments of the code.

RESUME

Cet article décrit l'esprit dans lequel l'Eurocode 1: partie 2.5 «Snow Loads» a été écrit. Il souligne les difficultés à réaliser un code adapté harmonieusement aux besoins de tous les pays et présente quelques suggestions pour remédier au problème. L'article aborde aussi les développements futurs du code.

ZUSAMMENFASSUNG

Der Beitrag beschreibt die Grundlagen, auf denen der Entwurf zu Eurocode 1, Teil 2.5 über Schneelasten beruht. Er streicht einige Probleme heraus, die sich aus der angestrebten Harmonisierung ergeben und zeigt mögliche Lösungen auf. Themen der zukünftigen Entwicklung werden diskutiert.

SUMMARY

This paper describes the background against which Eurocode 1: Part 2.5: Snow Loads is being drafted. It identifies some of the problems in achieving a fully harmonised code and provides some proposals to overcome them. It discusses topics for future developments of the code.

INTRODUCTION

Most of the Member States of the European Commission and EFTA have code clauses covering snow loads. The task of drafting the part of Eurocode 1 dealing with snow loads has been one of attempting to produce a code that in the first instance gives approximately the same values for a particular region as is given by the National Code covering the region. The Code being drafted, is capable of being developed as new meteorological data for the various CEN countries becomes available. In addition to taking account of the National Codes, the European Snow Code closely follows the International Standard on Snow Loads ISO 4355: 1981[1]

The Project Team drafting the code are - Professor L Sanpaolesi (Convenor)(Italy), the Technical Secretary of CEN/TC250/SC1 Mr H Gulvanessian (UK), Mr M Gränzer (Germany), Mr J Raoul (France), Mr R Sandvik (Norway) and Mr U Stiefel, (Switzerland).

SCOPE AND FIELD OF APPLICATION

Scope

The Code will provide guidance for the calculation of snow loads on roofs which occur in calm air or windy conditions; for the calculation of loads imposed by snow sliding down a pitched roof to a fence or other obstruction, and for loads due to snow overhanging the cantilevered edge of a roof.

The code will be applicable for use in all CEN Member States but will exclude regions where snow is present all the year and for sites at altitudes higher than 1500 metres above mean sea level.

Further limitations of the Code are that it does not provide guidance for:

- Impact snow loads resulting from snow sliding off or falling from a higher roof;
- Loads which could occur if snow and ice block gutters;
- the additional wind loads which could result from changes in shape or size of the building structure due to the presence of snow or the accretion of ice;
- ice loading (which will be covered elsewhere in Eurocode 1); and
- lateral loading due to snow (eg. lateral loads exerted by drifts).

Field of Application

The code applies to:

(a) new buildings and new structures; and

(b) significant alterations to existing buildings and existing structures;

designed in accordance with Eurocodes 2 to 9.

FORMAT OF CODE CONSIDERING CLIMATIC VARIATION

Both the initial deposition and any subsequent movement of snow on a roof are affected by the presence of wind. However, there is little data on the combined action of wind and snow to allow a direct statistical treatment. In design this is normally overcome by considering one or more critical design situations. These are usually snow deposited when no wind is blowing and snow deposited when the wind speed is sufficient to cause drifting, but without quantifying the precise wind speed. Due to the climatic variability across Europe the Eurocode provides different rules for the 'single snow event' concept and the 'multiple snow event' concept.

Single snow events occur in regions where the snow that falls is considered to be associated with single weather systems of about 3 to 4 days and where between one weather system and the next there is a reasonable expectation that the snow deposited on roofs will thaw. This requires the consideration of either uniform load or a drift load as the two are not expected to occur together.

Multiple snow events occur where snow is more persistent and where for example snow falling in calm conditions may be followed by further snow, carried by another weather system driven by wind and there may be several repetitions of these events before there is significant thawing. In these cases the accumulations are combined in a single load case.

The Eurocode does not actually call these concepts single and multiple events; but provides rules for such eventualities and it is the responsibility of the National Competent Authority to specify which should be used for a particular region.

SNOW LOAD ON THE GROUND

Characteristic value of snow load on the ground

The snow load on the ground is that assumed to occur in perfectly calm conditions. It is usually determined from records of snow load or snow depth measured in well sheltered areas. (ISO 4355 recommends in a deciduous forest). The characteristic value for the snow load on the ground is defined in the Eurocode as the value with an annual probability of being exceeded of 0.02. The variation of this snow load with geographical location will be given in map form.

Snow Maps

It is highly likely that the initial version of the Eurocode will rely on present National Data extracted almost directly from National Snow Loading Codes. The data will be adjusted to standardize on a definition of ground snow related to a return period of 50 years.

The reference altitudes for ground snow load vary in the codes of the CEN Member States. Standardization on this point is difficult as it would require extrapolation from the most reliable sources of information.

Two attempts have been made by members of the CEN Project Team for this Part of Eurocode 1 to establish a single European harmonised snow map to be included in the final version of the Eurocode.

The first (Gränzer)[2], considered all the available basic meteorological data for European Commission countries. This will not be completed in time because

- of the difficulty of establishing a common statistical relation between snow load and altitude;
- there is at present insufficient consistent data for many of the countries; and
- of the difficulty of extending the methodology to the EFTA countries within the time scales in the programme of work to produce the Eurocode.

The second (Sanpaolesi/del Corso)[3], defines six climatic regions, each being divided into snow load zones based on current National Code values of ground snow load correlated to a common return period and reference altitude. This should be looked upon as an interim solution and not a final harmonised map and it offers a compromise solution to the cross-frontier problem.

The investigation into producing a harmonised snow map of Europe will continue and be introduced in future developments of the code as this is an essential objective for the harmonisation process.

METHOD OF ASSESSMENT OF SNOW LOAD ON THE ROOF

Basis of Assessment

As most of the 18 CEN Member States approved ISO 4355: 1981 during voting with ISO and several of the National Codes are based on the same, the format of the Eurocode was based on that adopted in the ISO standard. By this it is meant that the snow load on the roof is derived by multiplying the snow load on the ground (S_o) by snow load shape coefficients (μ). The Eurocode contains sufficient data to allow the determination of both S_o and shape coefficients μ. In addition the Eurocode makes provision for further modification of the roof snow load by the introduction of a thermal coefficient factor for heat loss through the roof and an exposure coefficient factor to allow for abnormal exposure to the elements. These coefficients are taken from the proposed amendment of ISO 4355 (ISO DP4355 (1992))[4].

The Eurocode recommends that the snow roof load is treated as a variable action of medium term duration unless otherwise defined for particular regions in Annex A of the Code "Characteristic values of snow load on the ground".

Snow Load Shape Coefficients

Several different snow load shape coefficients must be considered for every design. These relate to different climatic conditions before, during and after the snow fall.

The Eurocode in the first instance will provide shape coefficients for monopitch, duo-pitched and multi-pitched roofs and coefficients for drifting at abrupt changes in roof height and at obstructions to roofs.

In general three primary loading situations can be identified and are accounted for in the coefficients provided in the code.

a) that resulting from a uniformly distributed layer of snow over the complete roof, likely to occur when snow falls with little wind (balanced load part);

b) that resulting from either an initially unbalanced distribution, local drifting at obstructions or a redistribution of snow which affects the load distribution on the complete roof, eg. snow transported from the windward slope of a pitched roof to the leeward slope (unbalanced load part due to drifting);

c) that resulting from a redistribution of snow from an upper part of the building (unbalanced load part due to sliding).

In the clauses from which the snow load shape coefficients are calculated, the limiting values applying to the 'single snow event' are based on the current UK code[5]. The limiting values for the multiple snow event are based on ISO 4355:1981.

FUTURE DEVELOPMENT

The draft being developed at the present time will be presented in a 'final' form to CEN/TC250/SC1 for submission for voting as a prENV by 31 January 1993.

After this the development of the code must continue to cover the requirements of the designers and to present them with information based on the latest results of research. It is possible these later versions will be based upon the latest ISO 4355. (ISO DP4355 (1992)).

Two particular areas needing development to ensure a fully harmonised code are the reappraisal of the ground snow loads and hence the production of a coordinated European Map and the reconsideration of the roof snow load shape coeffients and the duration with reference to Serviceability Limit States.

CONCLUSIONS

This paper has described the basis of Eurocode 1: Part 2.5: Snow Loads, the first steps to produce a fully harmonised European Snow Code. It describes difficulties in producing a fully harmonised code at this stage and provides items for future research from which a fully harmonised code will be completed.

REFERENCES

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