

## CHAIRMAN'S OVERVIEW : JOINTS IN STEEL AND COMPOSITE STRUCTURES

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**ABSTRACT :** The paper gives an overview of the scientific activities of the COST C1 Working Group 2 on "Steel and Composite Joints" (WG2) and of its three sub-groups, respectively on composite joints, column bases and steel joints, since 1992 until the final Liège Conference in 1998. The reader interested in one of the topics or subjects raised in the next paragraphs should find more detailed information in the ten written contributions which follows the present paper in the Proceedings.

It has to be noted that these ones have not been drafted by individuals, but by a group of WG2 members involved in a specific field. As a consequence, the written contributions reflect agreed views of WG2 rather than personal views.

### 1 WORK ORGANISATION WITHIN COST C1 WG2

The Working Group, as a whole, meets two times in a year since 1992. In February 1999, the last meeting, the 12<sup>th</sup> one, will take place in Delft, the Netherlands. All along these 6 years, three main fields of research progressively developed within the working group and, because of the rather high number of participants at each of the main meetings, three corresponding sub-groups were set-up in order to increase the efficiency in the work :

- sub-group on composite joints;
- sub-group on column bases;
- sub-group on steel joints.

This organisation is schematised in Figure 1.

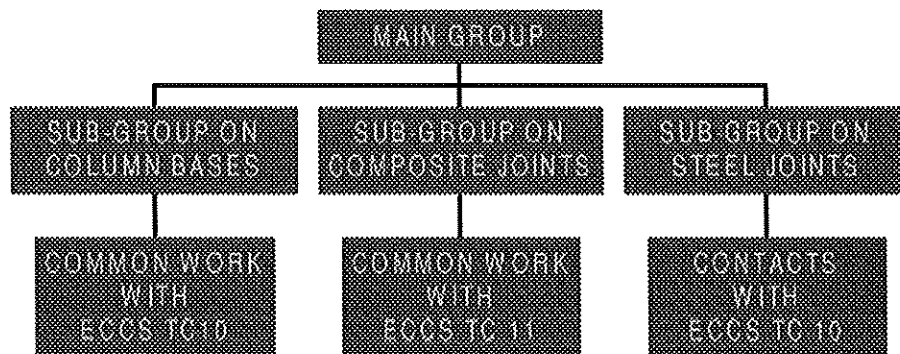


Figure 1 Work organisation

Each of the three working groups developed contacts with other international associations such as the European Convention for Constructional Steelwork (ECCS) and, more particularly, with its Technical Committees 10 and 11, respectively on "Connections" and "Composite Structures". These links will be identified later when describing the activities of the COST C1 WG2 sub-groups.

The names of all those who contributed to these different activities are reported at the end of the present paper. Special thanks have to be addressed to all of them for their continuous involvement in the work during all these years.

Besides the regular meetings of the main groups and of the sub-groups, contacts were also established between the COST members through the so-called short scientific missions which allowed to young researchers to stay and work for a period from few days to one month in a foreign institution.

Several such missions took place within COST C1 WG2; they allowed to strengthen scientific links between the participants, to develop common views, to exchange experiences and sometimes to solve technical disagreements.

## **2 MAIN OUTCOME**

Before describing more precisely the work in each sub-group, the main outcome of the activities of the whole group may be pointed out :

- Involvement of new European countries and institutions in the field of structural joints;
- Exchange of expertise between specialists;
- Confrontation of national practices;
- Agreement on common definitions :
  - design/actual/ultimate resistance;
  - joint/connection;
  - characterisation;
  - idealisation;
  - classification;
  - modelling;
  - ...
- Agreement on a common concept for joint characterisation called "the component method" which is applicable to all steel and composite joints as well as to column bases and which may be extended also to joints made of other materials.
- Clarification of specific items like "modelling".
- Proposal of new concepts, for instance for joint classification.

## **3 SUB-GROUP ON COMPOSITE JOINTS**

The sub-group on composite joints, whose Convenor is Prof. D. Anderson from Warwick University in U.K., is constituted of COST WG2 members and of ECCS TC11 ones. In this group, the component method which has initially been proposed for steel joints has been extended to composite steel-to-concrete joints between composite beams and steel or composite columns.

For the components belonging to the steelwork connections, reference is made to the revised Annex J of Eurocode 3. To develop a composite action in the joints, new components required some investigations in order to develop appropriate analytical tools for the prediction of their mechanical properties. The components to be studied are the slab in tension (reinforcements, connectors, slips, ...) and the concrete in compression at the interface between the column flange and the concrete slab (see Figure 2).

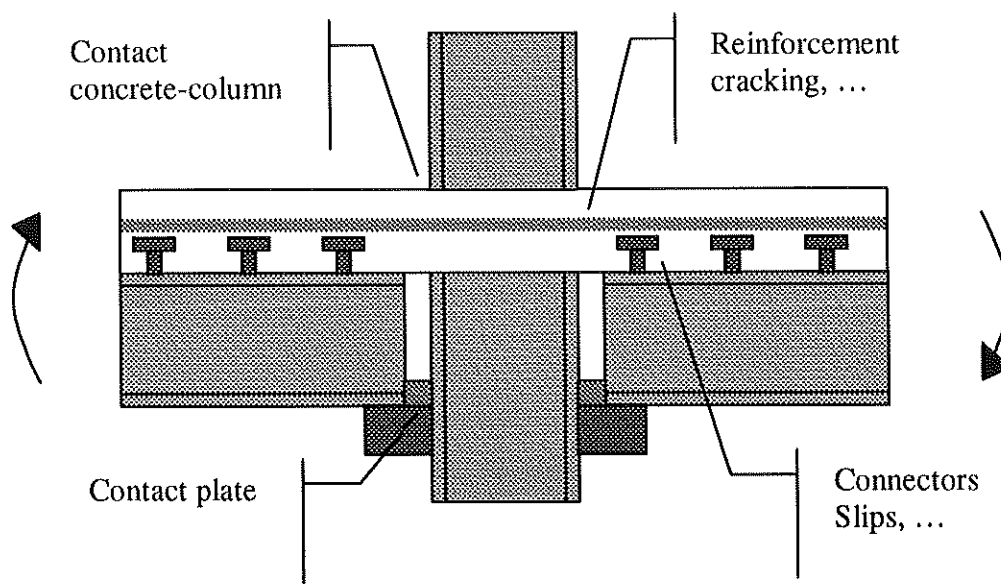


Figure 2 Composite joint with a contact plate connection

Analytical expressions have been suggested to evaluate the properties of these components in terms of stiffness, resistance and deformation capacity. Their validity has been demonstrated by means of extensive comparisons with results of experimental tests in laboratory.

This material has been gathered in a COST technical report containing all the scientific background.

A second action was aimed at drafting parts of a normative document on composite joints and a so-called Annex J of Eurocode 4 on "Joints in Composite Frames" was prepared and sent to the European Normalisation Committee (CEN).

Finally, an ECCS report containing practical guidelines is now in preparation and should be finalised in a very near future.

#### 4 SUB GROUP ON COLUMN BASES

The Convenor of the sub-group on column bases is Fr. F. Wald from Czech University. The members are partly from COST C1 WG2 and ECCS TC10. The activity of the sub-group concentrates on the derivation of design rules and design guidelines for column bases as the one represented in Figure 3.

As for composite joints, the concept of the component method has been followed.

In Figure 3, the main components to be considered are indicated.

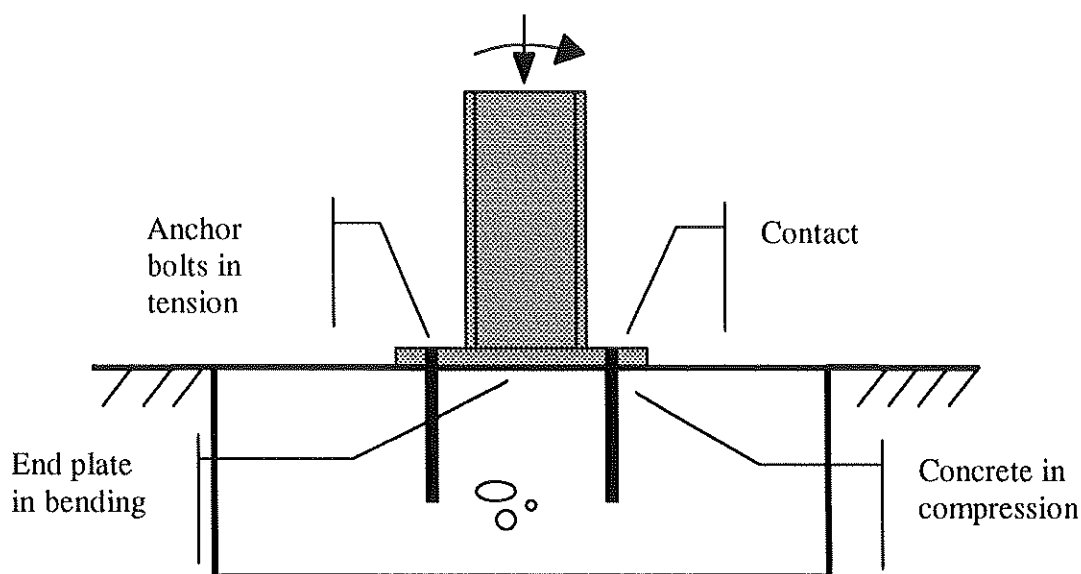


Figure 3 Column base

A working procedure similar to that expressed for composite joints has been adopted in the sub-group, what should lead to the preparation of three separate documents :

- a COST C1 publication covering the scientific works aimed at deriving analytical expressions to evaluate the stiffness, the resistance and the rotation capacity of the column bases;
- a normative document containing appropriate rules for inclusion in Eurocode 3;
- an ECCS report presenting design guidelines for application of the normative documents in an easy and practical way.

The first step (the background COST publication) should be ready at the end of 1998.

## 5 SUB-GROUP ON STEEL JOINTS

The sub-group on steel joint formed at a later stage, i.e. in 1996 and met less times than the two other sub-groups. Most of the discussions on steel joints took place during the meetings of the main working group.

The need for a sub-group appeared as soon as it was decided to prepare a publication summarising all the developments made in this specific field of research.

The main items which will be addressed in the forthcoming publication on steel joints are listed here below :

- Extension of the component method to further steel joint configuration not yet covered by the codes :
  - weak axis joints where the beam is connected to the web of a H or I column section;
  - joints made of tubular columns and I or H beams;
  - joints made of high strength steels up to S460;

- joints between built-up profiles with slender webs and flanges;
- ...
- Clarification about joint modelling and new concepts for joint classification.
- Required and available rotation capacity in view of a plastic frame analysis with plastic hinges in the joints.
- Study of new special connectors like :
  - flow-drill;
  - Huck-Fit bolts;
  - shot nails;
  - ...

## **6 PERSPECTIVES FOR FURTHER DEVELOPMENTS**

A big step forward has been achieved in the field of structural joints in steel and composite steel-concrete buildings through the COST C1 European Action. Basic knowledge and design models have been developed for less traditional steel joints, but also for composite joints and column bases. This material is gathered into COST C1 research reports, either already available or in preparation.

To some extent, rules for normative documents have been derived and validated through comparisons with experimental results.

In the future, efforts should be concentrated on the drafting of documents which would allow the practitioners to profit from the new design concepts for joints in their daily practice and which would highlight how economical benefit on fabrication and erection can be achieved.

From a research point of view, structural aspects linked to the integration of the actual joint behaviour into the frame analysis and design process should be further investigated, especially as far as composite construction is concerned.

### **ANNEX : List of COST C1 WG2 members**

#### **AUSTRIA**

F. Tschammernegg, G. Huber and D. Rubin

#### **BELGIUM**

J.P. Jaspart and D. Vandegans

#### **CZECH REPUBLIC**

F. Wald and Z. Sokol

#### **FINLAND**

T. Leino and J. Kouhi

## FRANCE

J.M. Aribert and A. Lachal  
J.P. Muzeau

## GERMANY

K. Weynand, C. Müller and M. Feldmann  
H.J. Kronenberger and H. Bode  
A. Klinkenberg  
H. Pasternak and R. Kocker  
U. Kuhlmann and F. Kühnemund

## GREECE

C.C. Baniotopoulos, A. Avdelas, E.S. Mystakidis, E. Sakellariadou, O.K. Panagouli  
and C. Bisbos  
G.E. Stavrolakis

## HUNGARY

M. Ivanyi and L. Hegedus

## ITALY

C. Bernuzzi and O. Bursi  
  
E. Cosenza and G. Fabbrocino  
G. De Matteis and A. Mandara

## POLAND

Z. Waszczyszyn, Z. Mendera, A. Razowski and K. Ryz  
S. Dorosz  
A. Kozłowski

## PORTUGAL

F. Gomes, L. Neves and L. Silva

## ROMANIA

M. Georgescu, D. Dubina and D. Grecea

## RUSSIAN FEDERATION

V. Kalenov and A. Pavlov

SLOVENIA

L. Trauner

SPAIN

J. Benito

R. Alvarez Cabal

SWEDEN

B. Edlund

SWITZERLAND

M. Crisinel and M. Kattner

THE NETHERLANDS

M. Steenhuis

A.M. (Nol) Gresnigt

TURKEY

S. Arda

UNITED KINGDOM

D. Anderson

P. A. Kirby and J.B. Davison

Y. Xiao

K. Virdi

B. Bose

C. Jolly