Research Supports and Policies in the Campania Region

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Abstract

Recent economic and social changes have affected the level of collaboration between research and industry. The role of Institutions and their decisions can be crucial in stimulating and promoting such relationships. This paper summarizes the presentation that the author made on the main programs and goals that the Regional Government of Campania is trying to achieve for local Universities and Research Centres. Its relevance for the academic world is that a new protocol in the relationship between University and Industry is proposed, which could also become a model to be implemented and improved upon in other countries. The author believes that the achievement of the fixed objectives and the development of similar political programs are key factors for the research of the next years and for the diffusion of composites in construction.

Introduction

In the opening ceremony of the Workshop "Composites in Construction: A Reality", the author communicated a greeting from the President of the Regional Government of Campania, A. Bassolino, to the participants. It was then pointed out that in the present social economic dynamics, improved scientific knowledge and more qualified human resources represent strategic factors, which are extremely important for adequate industrial and social growth. An efficient University-Industry relationship is a key on which to build a new *brain society* (i.e., knowledge-based society).

There are different ways to improve the University-Industry relationship. The three principal possibilities are:

- by education, both with institutional teaching and continuing education programs;
- by research, devoting time and energy to topics that may have industrial applications or that may provide useful industrial applications of present technology.

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- by stronger collaborations, in order to increase industrial innovation and to develop tools that can help managers in the creation and growth of new highly technological companies.

The University, in which there is a significant amount of potentially useful technology and "know-how" that is not commercially utilised, can have a propulsive role in the development of small companies with high added value.

A structured relationship between these two worlds needs to be built that fosters a coordinated and continuous territorial growth.

According to the Organization for Security and Co-operation in Europe (OCSE) analysis, total expenditure for R&D in Italy is only 1.05% of the Gross Domestic Product (GDP), which is far from OCSE average value, but close to the Public expenditure (Figure 1).

98% of our productive system is constituted by Small and Medium Enterprises (SMEs), which usually do not invest enough in R&D.

The aims of European, national and regional programs are to integrate policies, support and investment activities regarding knowledge and technological transfer in order to allow Universities and Research Centres to contribute to local economic and social development.

Also, for the South of Italy, a policy focalised on research will foster the growth competitiveness of SMEs. Research is a key component in achieving these objectives and increasing employment.

The Campania model

To reach these goals, the Regional Government of Campania has instituted a Regional Minister for University, Research, Innovation and New Economy.

The first act realized under this minister has been the definition of a programme integrated with some guidelines and an agenda. As can be seen from this document, available on the regional web site (www.regione.campania.it/ricerca_scientifica), all actions are oriented to reaching the fixed objectives.

Another important aspect of this model is represented by an agreement signed on November 15, 2000, between the Ministry of University, Research and Scientific Development (MURST) and the southern Regions (Basilicata, Calabria, Campania, Puglia, Sardegna and Sicilia) belonging to the so called "Objective 1". This is a special program of funds and incentives that the Central Government issued for regions characterized by economic and employment problems. The agreement was based on the following objectives:

1. Strengthening centre-periphery connections for an integrated and coordinated management of PON (National Operative Program), PNR (National Research Program) and POR (Regional Operative Program) resources.
2. Redefinition of actions for a global development of potential of the South Italy Regions. The agenda and the program of activities include: identification of priority thematic areas, creation of thematic networks of

excellence centres and competence centres, specialization of thematic networks, and identification of coordinating nodes.

From November to the present, much progress has been made in research support, and Regione Campania has worked to realize its Regional Research System (Figure 2), which incorporates new management patterns, based on multidisciplinary cooperation and synergy within the regional, national and international scientific community.

In this system, reinforced support for basic research is forecast (Figure 3). There has been, for the year 2001, the introduction of innovative procedures for projects submitting, technical assistance, and an effective evaluation system based on curricula, international scientific context, relevance for regional economic and social development, and links to other national and international research programs.

This evaluation system, used also for research supported by EU funds, is made by an international peer review team adopting an internationally accepted evaluation method.

To optimise research with EU funds (Figure 4) we have drawn a network system based on competence centres (Figure 5). Centres of Competence are virtual structures that join intellectual, scientific and business resources for the coordination of the Regional Research Plan. They directly involve enterprises in the planning and implementation process and foster the establishment of knowledge-based companies. Each Centre integrates pre-competitive research activities focusing on development and provides high quality training activities in conjunction with other training institutions.

Their requirements are: high scientific competence in business sectors; integration of basic research, pre-competitive research and activities related to partnership research-enterprise; and management by a scientific board supported by an international advisory board.

The sectors in which the Centres are called to conduct strategic projects for the next years are:

- Analysis and monitoring of environmental risks;
- Advanced biology and its applications;
- Preservation, exploitation and improvement of cultural and environmental heritages;
- Agricultural products and food;
- New technologies for manufacturing sectors;
- Information and Communication Technology;
- Transport (by air, by sea, by road).

With the Centre of Competence we intend to reach the following objectives:

- Outcomes from pre-competitive research and patentable research
- Marketing of outcomes; self-financing
- Virtuous circle: Research-Development-Employment

In order to facilitate spin-off and to support a policy oriented to the knowledge transfer, the Region will realize:

- a collection of business concepts, agreement protocols and contracts with national agencies for the development;

- an integrated network of labs and services for enterprises with the creation and/or strengthening of liaison offices between Universities and Public Research Institutions;
- actions oriented to support and promote new technologies for products/processes and aimed at providing both scientific support for research projects and personnel training about new technologies. A Regional Research Observatory will be created to improve the activities of enterprises in high-tech fields.

Conclusions

These policies and activities will contribute to both the future of Campania and a new approach for research by PON, PNR and EU Programs. This South Italy Regions (Objective 1) experiencewill help generating a new model for R&D, based on integrated network systems.

The Regional Government of Campania hopes that this model can be assumedin the future, as an example for the international scientific community.

References

Official website of the Organization for Security and Co-operation in Europe, http://www.osce.org

	Total Expenditure on GDP	Fims'expenses on GDP	Public's expenses on GDP	Researchers per 10,000	% 1993-1999 Requests for Patents
Italy	1,05	0,57	0,48	32,00	25,00
Finland	3,11	2,15	0,96	94,00	446,90
France	2,18	1,35	0,83	60,00	36,10
Germany	2,29	1,55	0,74	60,00	35,90
Japan	3,06	2,18	0,88	96,00	9,60
The Netherlands	2,04	1,11	0,93	50,00	74,30
Spain	0,90	0,47	0,43	37,00	78,40
Sweden	3,70	2,77	0,93	86,00	85,70
United Kingdom	1,83	1,21	0,62	55,00	31,10
U.S.A.	2,84	2,16	0,68	74,00	21,60
OCSE -Total	2,23	1,54	0,69	-	67,40

Figure1. Research and Development (OSCE 2000)

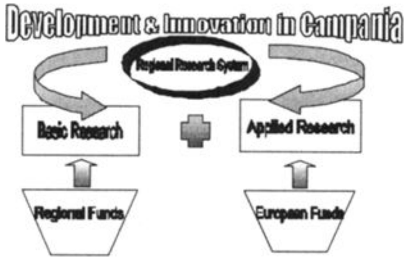

Figure 2. Regional Research System

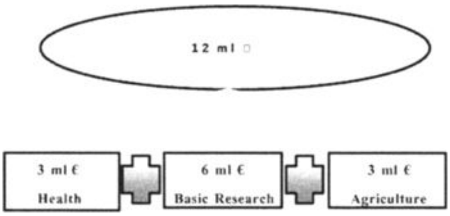

Figure 3. Regional Basic Research 2001 Funds

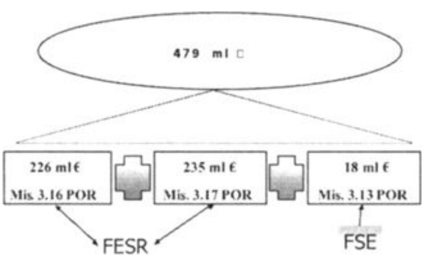

Figure 4. Regional Research Support, EU Funds

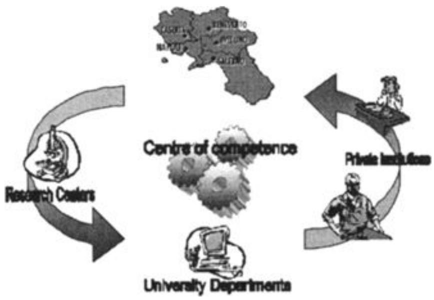

Figure 5. Centre of Competence. Connections

Guides and Specifications for the Use of Composites in Concrete and Masonry Construction in North America

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Abstract

This paper covers the latest developments in the preparation of design guidelines, construction specifications, and inspection and quality control recommendations related to the use of composites in construction. The forms of FRP composites addressed are limited to bars and laminates for reinforcement of concrete and masonry structures (new construction and repair/rehabilitation). FRP bars are being used as the internal reinforcement in concrete members when the conventional steel bars may be undesirable for a host of reasons (e.g., corrosion), and principles for design and construction have been established and proposed to industry by the American Concrete Institute (ACI). Conversely, strengthening of concrete members with externally bonded FRP composites in the form of laminates or near surface mounted (NSM) bars can now be considered an "acceptable practice." Also in this case, the design and construction principles for use in practice are being finalized by ACI. The drivers for FRP strengthening technology are several, but perhaps the most relevant one is the ease of installation. On the wave of historical structures restoration projects conducted in Europe, there is an increasing interest in masonry-type applications even though no institution-sanctioned guidelines are available at present.

Introduction

In this paper, reference is made primarily to two technical documents produced by ACI Committee 440 under the new ACI series of emerging technology. The first one has been recently published (ACI Committee 440 2001) and provides recommendations for design and construction of FRP reinforced concrete (RC) structures. The second one is under development (ACI Committee 440 2001a) and provides guidance for the selection, design, and installation of FRP systems for externally strengthening concrete structures.

It should be noted that only notations critical to the understanding of the paper are defined herein and equations are expressed in US customary units.

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Design and Construction of Concrete Reinforced with FRP Bars

FRP materials are mostly anisotropic, do not exhibit yielding, and for design purpose, are considered elastic until failure. Design procedures should account for a lack of ductility in concrete reinforced with FRP bars. Both strength and working stress design approaches are considered by ACI. In particular, the guide makes reference to provisions as per ACI 318-95 Building Code Requirements for Structural Concrete and Commentary (ACI Committee 318 1995). A FRP RC member is designed based on its required strength and then checked for serviceability and ultimate state criteria (e.g., crack width, deflection, fatigue and creep rupture endurance). In many instances, serviceability criteria may control the design. This ACI document does not address prestressed concrete (PC) applications.

Design Values. The design tensile strength that should be used in all design equations is given in Eq. (1). The design rupture strain should be determined similarly, whereas the design modulus of elasticity is the same as the value reported by the manufacturer.

$$f_{fu} = C_E f^*_{fu} \tag{1}$$

where:

f_{fu} = design tensile strength of FRP, considering reductions for service environment

C_E = environmental reduction factor, given in Table 1 for various fiber types (column Int.) and exposure conditions

f^*_{fu} = guaranteed tensile strength of a FRP bar defined as the mean tensile strength of a sample of test specimens minus three times the standard deviation ($f^*_{fu} = f_{u,ave} - 3\sigma$)

Table 1: C_E factor for various fiber systems and exposure conditions (ACI 440 2001 and 2001a).

Exposure condition	Carbon		Glass		Aramid	
	Int.[a]	Ext.[b]	Int.[a]	Ext.[b]	Int.[a]	Ext.[b]
Interior exposure	1.0	0.95	0.8	0.75	0.9	0.85
Exterior exposure	0.9	0.85	0.7	0.65	0.8	0.75
Aggressive environment	n/s	0.85	n/s	0.50	n/s	0.70

[a] = New construction/internal; [b] = Strengthening/external; n/s = Not specified

Design parameters in compression are not addressed since the use of FRP bars in this instance is discouraged.

Flexure

Behavior and Failure Modes. If FRP reinforcement ruptures, failure of the member is sudden and catastrophic. However, there would be some limited warning of impending failure in the form of extensive cracking and large deflection due to the significant elongation that FRP reinforcement experiences before rupture. The concrete crushing failure mode is marginally more desirable for flexural members reinforced with FRP bars (Nanni 1993). In conclusion, both failure modes (i.e., FRP rupture and concrete crushing) are acceptable in governing the design of flexural members reinforced with FRP bars provided that strength and serviceability criteria are satisfied. To compensate for the lack of ductility, the member should possess a higher reserve of strength. The suggested margin of safety against failure is therefore higher than that used in traditional steel-RC design.

Figure 1 shows a comparison of the theoretical moment-curvature behavior of beam cross-sections designed for the same factored strength, ΦM_n, following the design approach of ACI 318 and ACI 440 (including the recommended strength reduction factors). Three cases are presented in addition to the steel reinforced cross section: two sections reinforced with GFRP bars and one reinforced with CFRP bars. For the section experiencing GFRP bar rupture, the concrete dimensions are larger than for the other beams in order to attain the same design capacity.

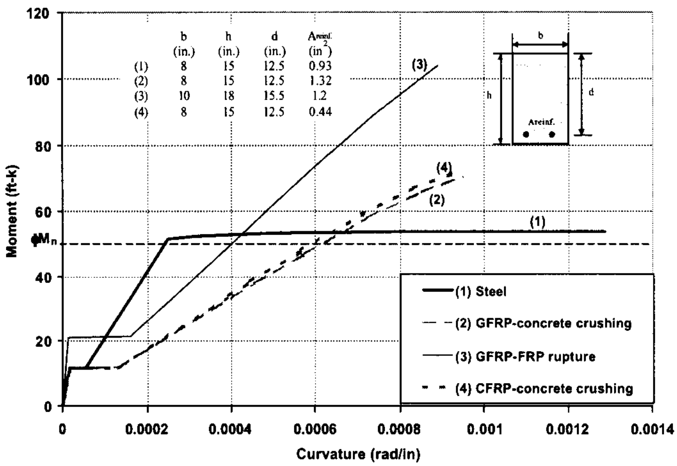

Figure 1. Moment-curvature relationships for RC sections using steel and FRP bars (ACI 440 2001).

<u>Φ factor</u>. Because FRP members do not exhibit ductile behavior, a conservative strength-reduction factor is adopted and set equal to 0.70 rather than 0.90 as per steel RC. Furthermore, because a member that experiences a FRP rupture exhibits less plasticity than one that experiences concrete crushing, a strength-reduction factor of 0.50 is recommended for FRP rupture-controlled failure. While a concrete crushing failure mode can be predicted based on calculations, the member as constructed may not fail accordingly. For example, if the concrete strength is higher than specified, the member can fail due to FRP rupture. For this reason and in order to establish a transition between the two values of Φ, a section controlled by concrete crushing is defined as a section in which the reinforcement ratio is larger or equal to 1.4 times the balanced reinforcement ratio ($\rho_f \geq 1.4\ \rho_{fb}$) and a section controlled by FRP rupture is defined as one in which $\rho_f < \rho_{fb}$.

<u>Minimum reinforcement</u>. If a member is designed to fail by FRP rupture, $\rho_f < \rho_{fb}$, a minimum

amount of reinforcement, $A_{f,min}$, should be provided to prevent failure upon concrete cracking (that is, $\Phi M_n \geq M_{cr}$ where M_{cr} is the cracking moment). The minimum reinforcement area for FRP reinforced members is obtained by multiplying the existing ACI 318 limiting equation for steel by 1.8 (i.e., 1.8 = 0.90/0.50 which is the Φ ratio).

Crack Width. For FRP reinforced members, the crack width, w, can be calculated from the expression shown in ACI 318 with the addition of a corrective coefficient, k_b, for the bond quality. The k_b term is a coefficient which accounts for the degree of bond between the FRP bar and the surrounding concrete. For FRP bars having bond behavior similar to steel bars, k_b is assumed equal to one. Using the test results from Gao et al. (1998), the calculated values of k_b for three types of GFRP bars were found to be 0.71, 1.00, and 1.83. When k_b is not known, a value of 1.2 is suggested for deformed FRP bars.

Creep rupture and fatigue. Values for safe sustained and fatigue stress levels are given in Table 2. These values are based on experimental results with an imposed safety factor of 1/0.60.

Table 2. Creep rupture and fatigue stress limits in FRP reinforcement (ACI 440 2001 and 2001a).

Fiber type	Glass FRP	Aramid FRP	Carbon FRP
Creep rupture stress limit, $F_{f,s}$	$0.20 f_{fu}$	$0.30 f_{fu}$	$0.55 f_{fu}$

Shear

Issues to be addressed when using FRP as shear reinforcement include: relatively low elastic modulus; high tensile strength; no yield point; tensile strength of the bent portion significantly lower than the straight one; and low dowel resistance.

According to ACI 318, the nominal shear strength of a steel RC cross section, V_n, is the sum of the shear resistance provided by concrete, V_c, and the steel shear reinforcement, V_s. Similarly, the concrete shear capacity $V_{c,f}$ of flexural members using FRP as main reinforcement can be derived from V_c multiplied by the ratio between the axial stiffness of the FRP reinforcement ($\tilde{n}_f E_f$) and that of steel reinforcement ($\tilde{n}_s E_s$). For practical design purposes, the value of ρ_s can be taken as $0.5\rho_{s,max}$ or $0.375\rho_b$. Considering a typical steel yield strength of 420 MPa (60 ksi) for flexural reinforcement, the equation for $V_{c,f}$ is that shown in Eq. (2) (noting $V_{c,f}$ cannot be larger than V_c).

$$V_{c,f} = \frac{\rho_f E_f}{90\beta_1 f_c'} V_c \qquad (2)$$

The ACI 318 method used to calculate the shear contribution of steel stirrups, V_s, is applicable when using FRP as shear reinforcement, with the provision that the stress level in the FRP shear reinforcement, f_{fv}, should be limited to control shear crack widths, maintain shear integrity of the concrete, and avoid failure at the bent portion of the FRP stirrup, f_{fb}. Eq. (3) gives the stress level in the FRP shear reinforcement at ultimate for use in design. An expression for f_{fb} is given in ACI 440.1R-01.